MARCH 10, 1981

WHAT REAGAN'S BUDGET CUTS MEAN TO ELECTRONICS SUPPLIERS/104

Software automates scope's operation/181

Message system runs on most computers/167

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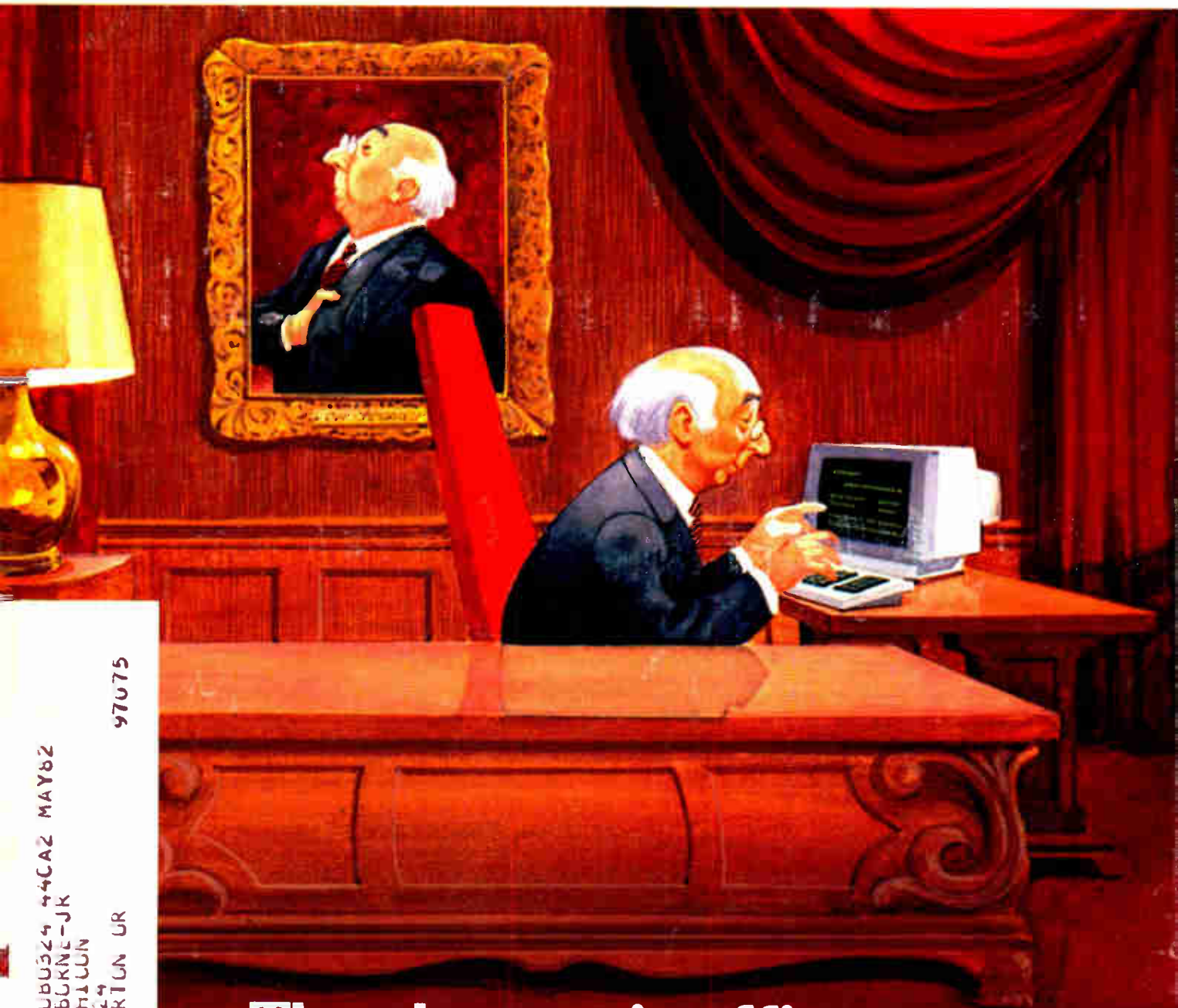
Electronics



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MAKING IT TO THE TOP

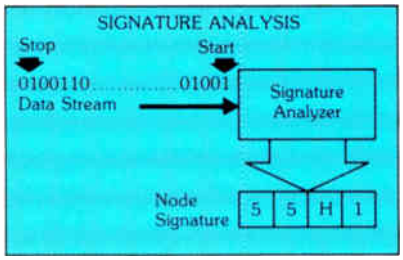
7. Circuit Board Testing Update/No. 7 in a series from Hewlett-Packard.

SIGNATURE ANALYSIS: A NEW AND EFFECTIVE METHOD OF TESTING MICROPROCESSOR-BASED BOARDS AT SPEED

If you're producing microprocessor-based products, you've probably found that board level testing is no trivial problem. That's because the complexity of the microprocessor (MPU) has introduced a number of new testing problems, especially when the boards must be tested at operating speeds.

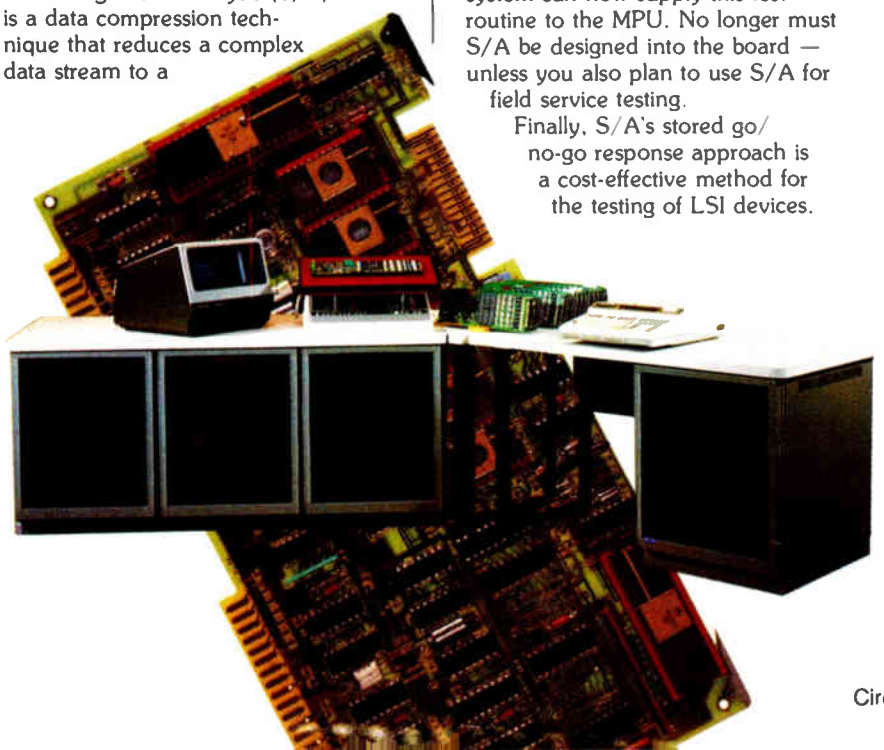
What are the new testing problems?
At-speed testing of dynamic devices creates five major problems: 1) Synchronizing most test systems with the MPU's fast on-board clock isn't possible; 2) The MPU's bi-directional bus makes fault isolation difficult; 3) Existing test systems often aren't fast enough to test today's dynamic memory devices thoroughly; 4) Most test systems cannot exercise the MPU's software — a must, and 5) Functional test development costs are increasing with device complexity. To solve these problems, Hewlett-Packard created new testing techniques.

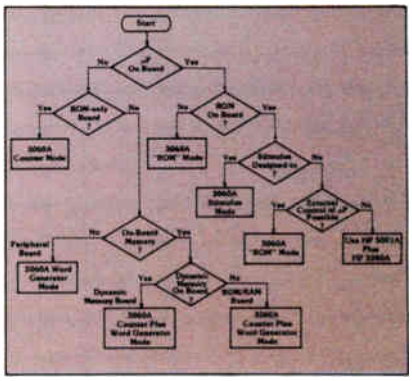
How HP developed Signature Analysis.
In 1977, as a means of reducing field service costs, HP developed a new method of testing dynamic devices. Called Signature Analysis (S/A) it is a data compression technique that reduces a complex data stream to a series of unique four-digit hexadecimal signatures. Under test, the signature of each circuit node is compared to a stored value, making it easy to locate faulty nodes.



Solving the five major problems.
Signature Analysis has made MPU board testing manageable by solving the testing problems outlined above. First, S/A can be synchronized with the MPU's on-board clock at rates up to 10 MHz. Second, interacting with the board under test, S/A can verify the data stream from a specific device on bi-directional buses. Third, the S/A technique is fast. It can locate speed-related faults in dynamic devices. Fourth, with S/A, the board under test is stimulated with a software test routine executed by the on-board MPU. With HP's 3060A, the test system can now supply this test routine to the MPU. No longer must S/A be designed into the board — unless you also plan to use S/A for field service testing.

Finally, S/A's stored go/no-go response approach is a cost-effective method for the testing of LSI devices.





You can put this new tool to work for you now.
Signature Analysis is part of the High Speed Digital Functional Test option to the proven HP 3060A Board Test System. This option is priced at $12,000* and can be added to 3060A's currently in service. The technique is complemented by the 3060A's programmable drivers, in-circuit program generator, and bed-of-nails visibility for automatic backtracing. Note, in the flow chart above, how the 3060A with this option provides flexibility in the selection of dynamic stimulus for board test applications.

For additional information.
To receive complete details on the HP 3060A Board Test System and the High Speed Digital Functional Test option, write: Hewlett-Packard, 1507 Page Mill Road, Palo Alto, CA 94304. Or call the HP regional office nearest you: East (201) 264-5000, West (213) 970-7500, Midwest (312) 255-9800, South (404) 955-1500, Canada (416) 678-9430.

*Domestic U.S.A. price only.

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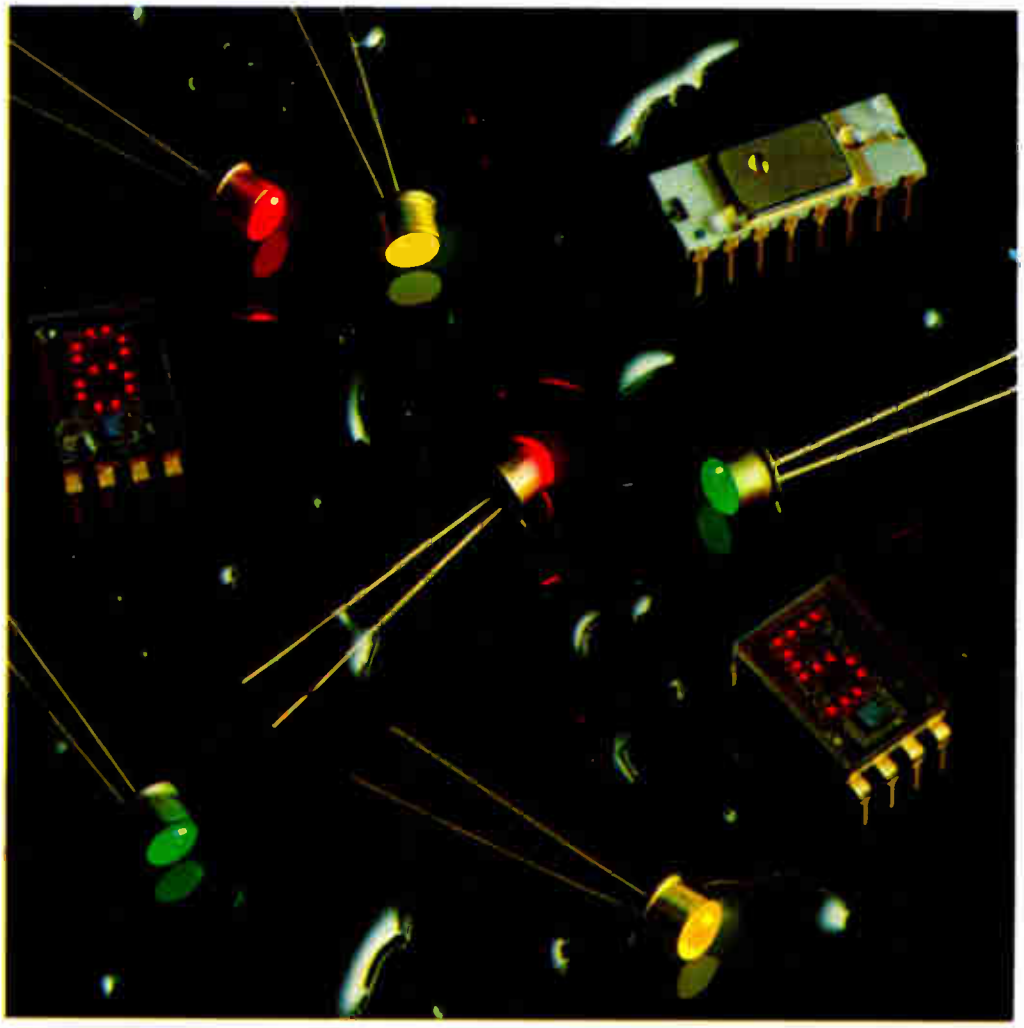

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Electronics
The International Magazine of Electronic Technology
Vol. 5, No. 54 • March 10, 1981

Electronics

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Highlights

Cover: Furnishing the office with the latest electronic systems, 157

Electronic systems are surging into business offices—from the secretary's to the boss's. Carrying them along are software-oriented architectures and the latest techniques of computer science. Tied together by local networks, the work stations of these new systems are capable of handling a veritable wealth of tasks beyond mere word processing. This special report surveys the field, examining the systems from the outside and the inside.

The cover illustration is by Bob Clarke.

Japanese move ahead with C-MOS, 97

Complementary-MOS will soon be the primary semiconductor technology, and several Japanese firms are out in front with C-MOS processing—those are two major points that emerged at last month's International Solid State Circuits Conference. Participants at the conference generally agreed that most MOS chips will be cast in C-MOS. Meanwhile, as evidence of their lead, Japanese companies are designing with 2-micrometer rules, whereas U. S. C-MOS houses are just now getting down to 3-μm features. Another indication of the state of affairs is the fact that some U. S. companies have not yet moved from metal to polysilicon gates.

Software delivers the mail, and then some, 167

The first computer-based message system that can run on almost any computer or terminal, a software application package called InfoMail aims at existing installations. Much more than an electronic mail system, such a system also performs word processing and data-base management, so that it can actually help compose and store messages.

Speech chip likes to play, 177

A toy maker and a company specializing in speech synthesis joined forces early in the game to design a synthetic speech chip that relies on linear predictive coding. Multiplexing a 2-pole filter to emulate a 12-pole one saves chip real estate, keeping the cost down.

Software approach revolutionizes oscilloscope, 181

Software designers have made a significant inroad into oscilloscope measurement systems with a unit whose single rotary knob controls all variable functions. The system software manages practically all of the scope's functions digitally, requiring it to adopt a computer architecture.

And in the next issue . . .

A preview of Electro/81 . . . a new operating system for 16-bit microprocessors . . . IEEE-488 bus standards . . . a small, adaptable controller module for 5¼-inch Winchester disk drives.

March 10, 1981 Volume 54, Number 5
105,156 copies of this issue printed

Electronics (ISSN 0013-5070) Published every other Tuesday except the issue of Monday, Nov. 30, by McGraw-Hill, Inc. Founder: James H. McGraw 1860-1948. Publication office 1221 Avenue of the Americas, N.Y., N.Y. 10020, second class postage paid at New York, N.Y., and additional mailing offices.

Executive, editorial, circulation and advertising addresses: Electronics, McGraw-Hill Building, 1221 Avenue of the Americas, New York, N.Y. 10020. Telephone (212) 997-1221. Teletype 12-7960 TWX 710-581-4879. Cable address: MCGRAWHILL NEWYORK.

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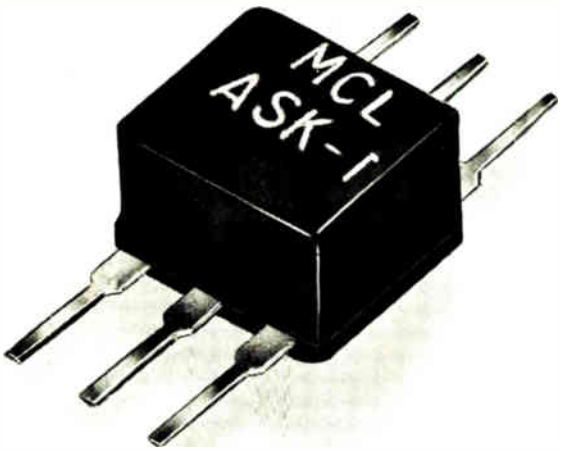

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Publisher's letter

Office automation means much more than machines designed to aid the typist. It involves the entire office from top-level executives to middle managers to clerical workers. Even the engineering department is getting in on the act.

The key to automating the office is sharing information via terminals dotted throughout the organization, and a number of technologies have made it possible. These technologies are described in the special report (p. 157) written by computers and peripherals editor Tom Manuel.

Network technology, one of the topics covered, includes existing two-wire telephone lines and broad-bandwidth distributed control networks based on coaxial cable or fiber optics. In fact, something of a controversy over which is the better hookup has developed as described in the People story (p. 14) about Dean F. Scheff, chairman of CPT Corp., Eden Prairie, Minn.

"My view," Tom observes, "is that both will have a place in future systems. There will be companies that want to use existing wire. But new buildings may contain communications spinal columns for handling video, data, and telephone using fiber optics. The distribution network will be planned as part of the building."

Perhaps more important for the realization of the integrated office is the software technology used in multitasking and distributed operating systems. Now available are the programming languages and development tools that support a wide variety of application software.

It's all coming together rapidly, Tom points out, and a number of major companies, as well as a few startups, around the world are lining up to participate in this potentially large market. As an example of the changes in store, Tom describes the powerful personal terminals being designed for use by executives. Combining a cathode-ray tube, keyboard, telephone dial, and handset, such a desktop unit will be capable of handling electronic mail, data retrieval, and information processing, not to mention phone calls. A number of these machines are in the offing.

Mergers and acquisitions of electronics companies have been regular occurrences going back to the go-go days of the 1960s. The reasons vary—diversification, upward and downward integration, or acquisition of an important technology.

The recent moves by giants in the energy field toward firms with complementary-MOS and double-diffused MOS capabilities appear to fall into the latter category. A story outlining the ins and outs of these firms appears on page 93.

"When you have both General Electric Co. and rival Westinghouse Electric Corp. making similar moves at the same time, you have to take note," comments San Francisco regional bureau manager Bruce LeBoss, who wrote the story. Bruce sees these maneuvers as a means of exploiting the C-MOS and D-MOS power FET technologies in energy-related systems.

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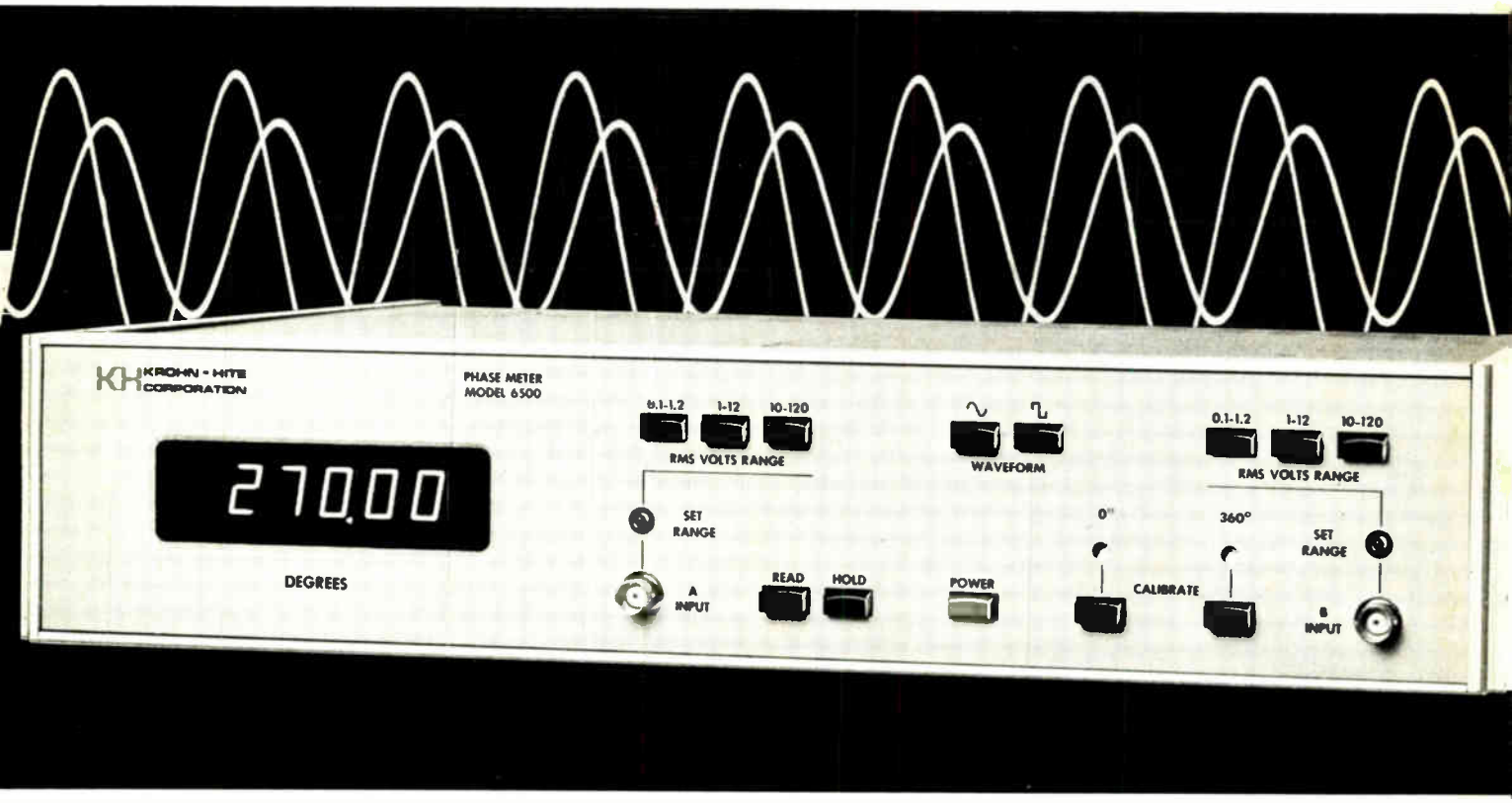

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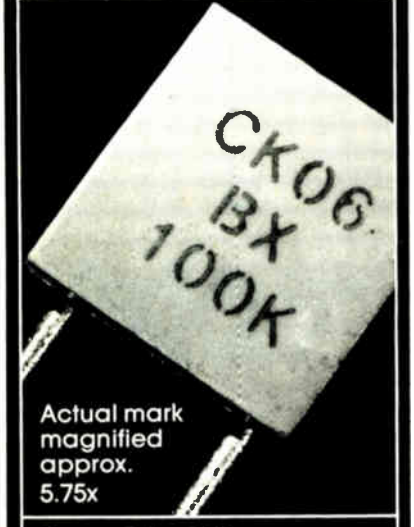

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Readers' comments

GaAs SAW technology reviewed

To the Editor: I wish to correct an inaccuracy and some misleading background information contained in "SAW, semiconductor technologies combine on zinc oxide layer" [Nov. 20, 1980, p. 74]. That article described some very good work at Britain's Standard Telecommunications Laboratories Ltd. on the development of surface-acoustic-wave (SAW) signal-processing components using zinc oxide thin films deposited on gallium arsenide substrates. As mentioned, the STL work was reported at the Institute of Electrical and Electronics Engineers' Ultrasonics Symposium held in Boston, Nov. 5–7. But the reader is led to two incorrect conclusions: first, that GaAs is not a natural piezoelectric material; and second, that the STL work represents the initial development of GaAs-based SAW signal-processing technology.

GaAs is indeed a piezoelectric material, with a SAW piezoelectric coupling coefficient only about 35% lower than that of ST-cut quartz, a common SAW substrate. This and other properties of surface waves on GaAs and on zinc oxide/GaAs were reviewed in the invited paper I presented. I also reviewed prior GaAs SAW convolver development and described several new results obtained at United Technologies under two Government-sponsored programs, which included the development of GaAs SAW resonator filters, phase shifters, and a programmable-correlation matched filter. The SAW resonator filters on GaAs exhibited two-port insertion loss as low as 5 decibels and a Q as high as 11,000 at 180 megahertz. The SAW correlator consisted of 32 programmable field-effect-transistor mixer taps integrated in the SAW propagation path to process arbitrary phase-shift-keyed signals at 10-MHz chip rates. Correlator dynamic range greater than 65 dB and tap power dissipation near 1 milliwatt were demonstrated.

These devices have used the inherent piezoelectric coupling of the GaAs material itself and did not require zinc oxide films either for the transducers or for the acousto-electric SAW-semiconductor interaction. Even though the GaAs substrate has semiconducting properties, the interdigital transducers can be fabricated in the usual way except that the transducer metalization must form a Schottky barrier contact with the GaAs. When reverse-biased, the transducers operate effectively as if the substrate were insulating, because of the depletion of charge carriers beneath the electrodes. Zinc oxide films have also been used to increase the transducer bandwidth, though they have been found to be unnecessary within the convolver or correlator interaction regions.

The initial work on GaAs and zinc oxide/GaAs SAW signal processors was performed at Stanford University and continued at UTRC. By using n-type semiconducting layers on semi-insulating GaAs substrates, it is possible to integrate the various SAW components and other electronic circuits on the same substrate using compatible metal-semiconductor FET processing techniques.

GaAs SAW technology is therefore not entirely new, as the article would imply, although the recent developments in GaAs material quality, SAW device performance, and integrated-circuit technology have most certainly given it a rebirth.

T. W. Grudkowski
Manager, Electronics Research
United Technologies Corp.
Research Center
East Hartford, Conn.

Corrections

In "Reed-coil relay is behind flexible fault detection" (Feb. 24, p. 134), the last component in the shunt referred to in paragraphs 2 and 3 as a zener diode, D_1, is a silicon controlled rectifier.

In "Redesign drops cost of minifloppy to $85" (Jan. 13, p. 40), the average access time of the Micro Peripheral model 61 minifloppy disk drive is given as 5 to 8 milliseconds; rather, the drives have a 5-to-8-ms average track-to-track access time. Our thanks to Jim Schimpf of the New York University Medical Center, New York, for pointing this out.

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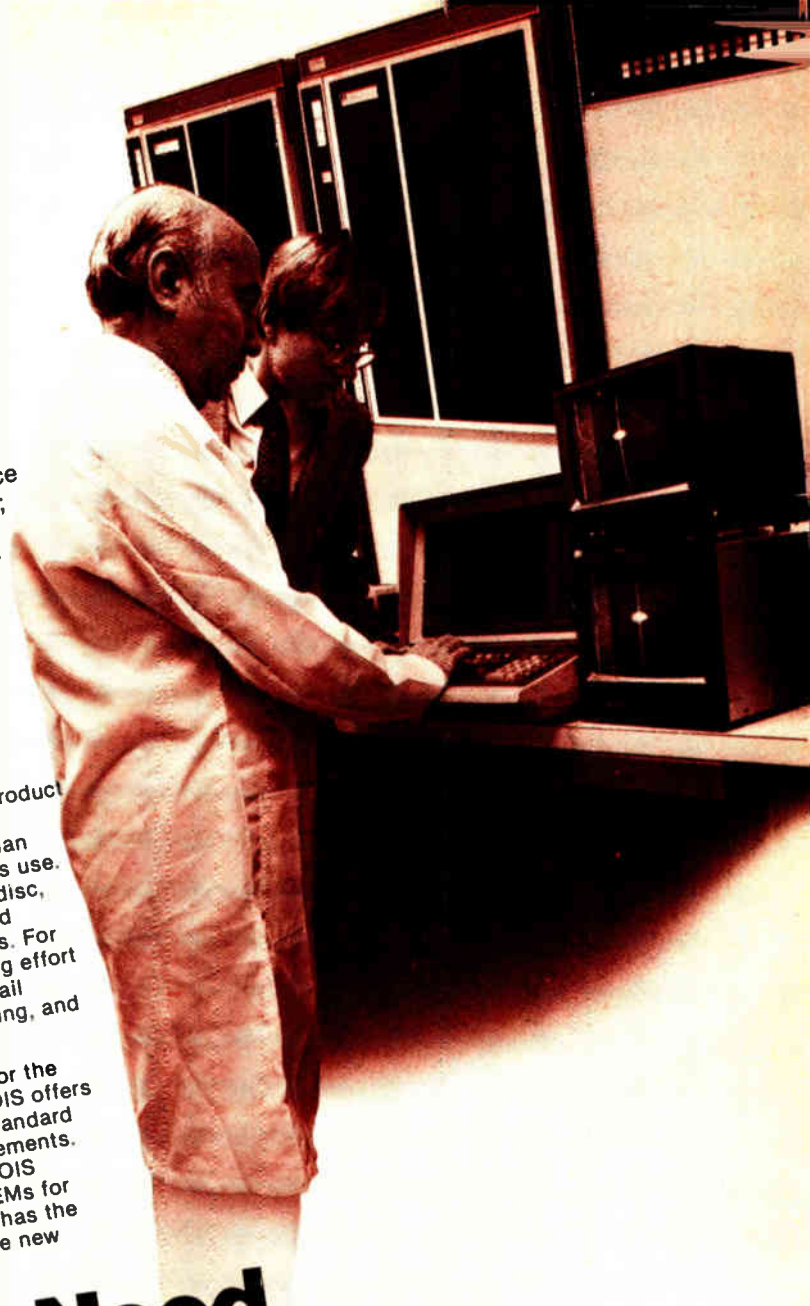

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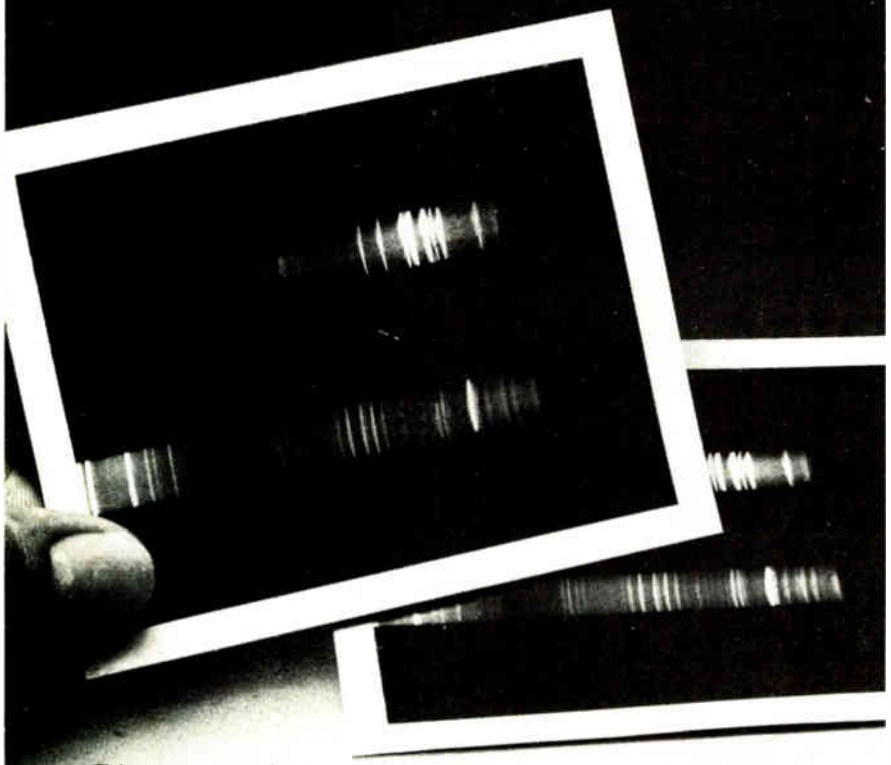

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News update

■ It's beginning to look as if the $12 million that Siemens AG invested for its Sipmos power transistors announced early last year will pay off. Sales figures are hard to come by, but there are several other indications that the West German firm is having success with its new power devices that can be driven directly by microcomputers and other large-scale integrated circuits.

One indication is that the company has stopped all Sipmos advertising because it cannot keep up with demand. In fact, it is preparing to expand its Munich production facilities and is setting up Sipmos production lines in Malaysia and Mexico.

Generally, the market pool for MOS power transistors is far greater than the capacity producers around the world can muster for such devices, says Alfred Prommer, vice president in charge of discrete semiconductors in the Siemens Components group. So company executives see no reason to back away from their 1980 prediction for worldwide annual sales of $300 million worth of MOS power transistors by 1985.

Interest. Siemens believes it is in a strong position to cash in on that market with its Sipmos technology [*Electronics*, March 13, 1980, p. 92]. Its design philosophy of double implantation and a vertical architecture is being emulated by a number of U. S. and European firms on MOS power device approaches, declares Peter Tillmanns, sales manager for commodity power semiconductors.

Siemens expects to be issuing licenses to several semiconductor firms in Europe and the U. S. A prime attraction is Sipmos's combination of high-voltage ratings with low operating inputs and low forward resistances.

At present, the principal applications for Sipmos transistors are in switched power supplies, motor drives, and dc-dc converters for communication systems. "Automobile makers around the world are showing a keen interest in Sipmos," Tillmanns declares, where the devices could serve in control subsystems and for signal processing in multiplexed cable systems. **-John Gosch**

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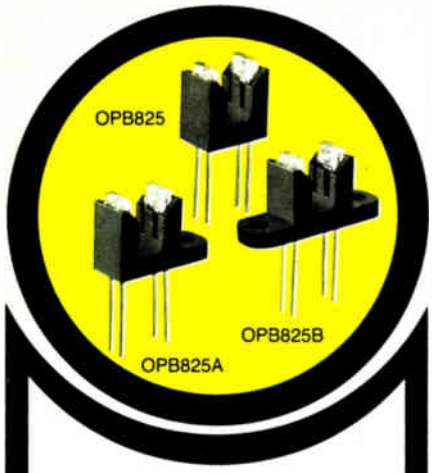

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People

New wiring for offices unneeded, says CPT's Scheff

Though the office automation industry these days is buzzing with talk of local networking schemes such as Xerox Corp.'s Ethernet (see p. 157), Dean F. Scheff is skeptical. "I still think that probably 90% of all applications can be handled very nicely through the wire that's already embedded in a facility," says the 49-year-old cofounder and chairman of CPT Corp., the Eden Prairie, Minn., supplier of stand-alone word-processing systems.

Scheff's opinion is that existing telephone lines will be enough for most jobs, supplanting the need for "some special piece of cable that you're going to put in a building." From his perspective atop the fast-growing firm, which has boosted sales more than fivefold since 1976 to about $60 million last year, Scheff can see fast digital switches on the horizon. By mid-decade, these will have invaded the office, offering speeds of 500,000 bits per second or more using phone lines, he predicts. And that, he says, will be sufficient for interoffice communication in a typical setting.

Except for applications requiring lots of data to be communicated quickly—such as mainframes talking to each other—it will not be cost-effective to string networking cable throughout a large office complex or multistory building, Scheff believes. "If I'm in the World Trade Center or some other huge facility and you ask me to rewire the whole thing just so I can use my Xerox Ethernet, my theory is that you're crazy. It's going to cost me as much to do that as it took to put up the original building," he maintains.

Although he is not an engineer, the outspoken Scheff has been around the office market for a number of years. He received electronics training in the Air Force, then obtained a bachelor of arts degree in economics from the University of Minnesota in 1957, following that with graduate work in industrial relations. Scheff made his living primarily in business machine sales, including a seven-year stint as an automatic typewriter dealer, prior to CPT's founding in 1971.

Despite his doubts that full-blown local nets are the wave of the future in office automation, Scheff says CPT will hedge its bets. "We're working with Intel right now on this Ethernet thing," he says, adding that CPT will be prepared to make its machines compatible with whatever network scheme or schemes eventually do become standard.

Goldman sees reorganization as Motorola's ticket to Japan

The recent reorganization of Motorola Inc.'s microprocessor group may well provide a vehicle for entry into and accelerated growth in the booming Japanese automotive market, says Murray A. Goldman, head of the firm's microprocessor operation in Austin, Texas.

"We want to take it to Japan," states Goldman, 43, who recently was named vice president by Motorola. Creation of three separate profit centers was announced last month to highlight and define Motorola's microprocessor goals—including what it sees as a lucrative worldwide auto market. The operation has been split into automotive; mid-range, encom-

Broadening. Goldman says Motorola's microprocessor group has a global outlook.

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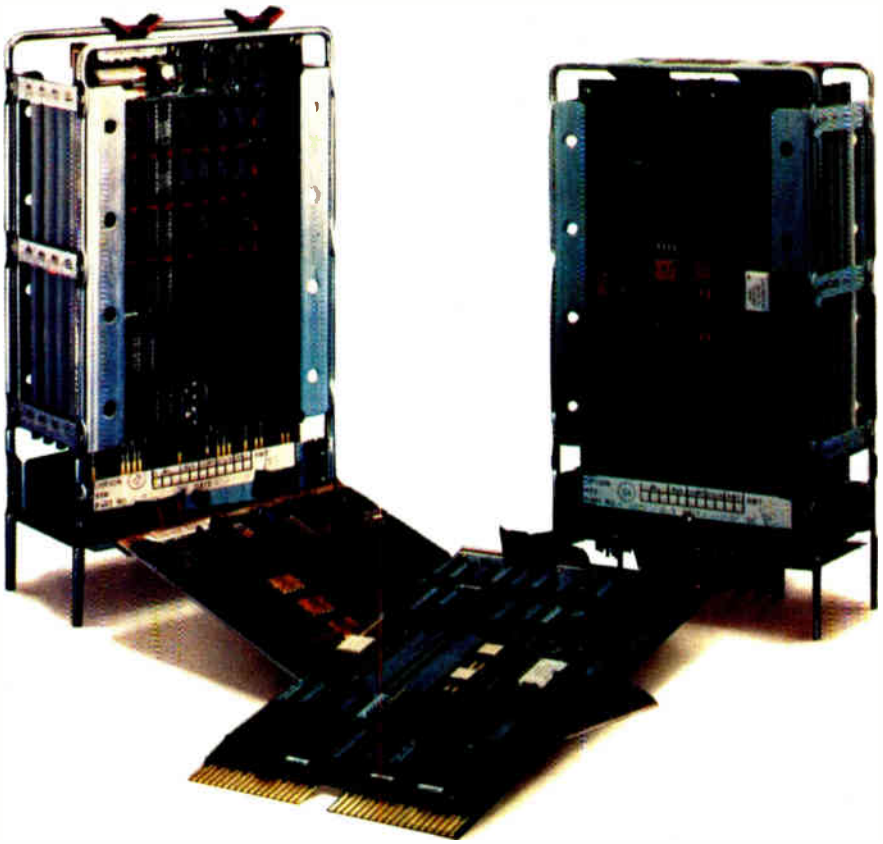

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But to capture a major portion of Japan's auto business, Motorola must face the nation's powerful integrated-circuit makers on their own soil. "In 1976, we [Motorola's operation] were worried about survival. Later on, in the 1979–80 time frame, we were thinking about our major competitor," Goldman explains. "And in 1981, we're really thinking in terms of Japan and the whole world."

"We feel that we have the possibility of overtaking Intel Corp.—which to us is like an IBM—and we are really looking a little past that at Japan," he adds. He goes on to say that "there's a lot of activity with parts like the 6801 in Japan, a lot of activity."

As an established leader in microprocessor sales to the domestic auto industry, Motorola is now more susceptible to car sales slumps than in years past, admits Goldman, who has been with Motorola since 1969. So expansion of applications beyond engine control is also a key for continued growth. The former professor of electrical engineering at New York University estimates that new U.S. models soon will contain as many as eight microprocessors. "The point is that there are a lot of applications that haven't even been thought of yet and a lot that already have been planned," he states.

Creation of the three profit centers will let the operation concentrate on three separate fronts in the entire microprocessor market, Goldman says. For the past year be has been working with top management to bring about the reorganization. "We are getting so many products that we really wanted to focus more highly on our major business sections," he explains.

In fact, business has been growing so much that the microprocessor operation is a prime candidate for relocation in a new South Austin plant site. Officials at the present Motorola complex on the east side of the city in central Texas expect construction to begin within a year on the second site. □

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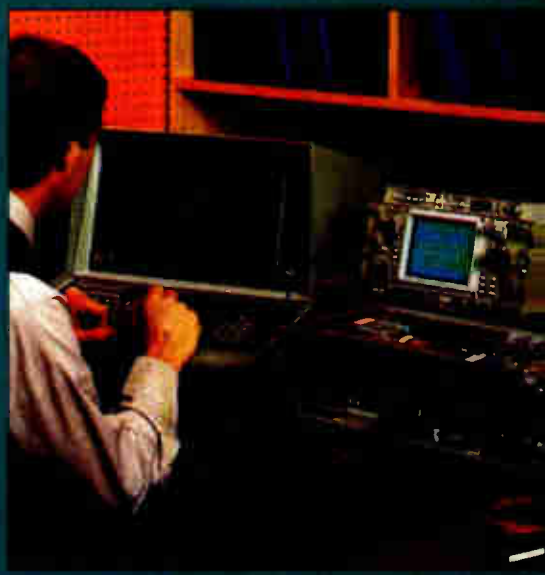

(above left) The Tektronix 468 portable digital storage oscilloscope becomes part of a powerful processing system when interfaced to the Tektronix 4052 Computer/Controller for analysis and processing.

(above right) Users can link the Tektronix 492P Spectrum Analyzer with the 4052 to compare accumulated displays over successive sweeps. Right at hand are high-speed analysis, plus permanent records via the Tektronix hard copiers.

(far right) The Tektronix 7854 Oscilloscope interfaces with the 4052 to apply high-speed floating point calculations and simultaneous display of high-resolution graphics and tabular data to the most complex analytical problems.

(below left) To state-of-the-art Tektronix GPIB waveform measurement instruments, you can add the analytical capabilities of the 19-inch 4054 computer/controller for problems requiring both speed and large data display; the fast 4052 for computationally intensive applications; or the economical, general-purpose 4051.

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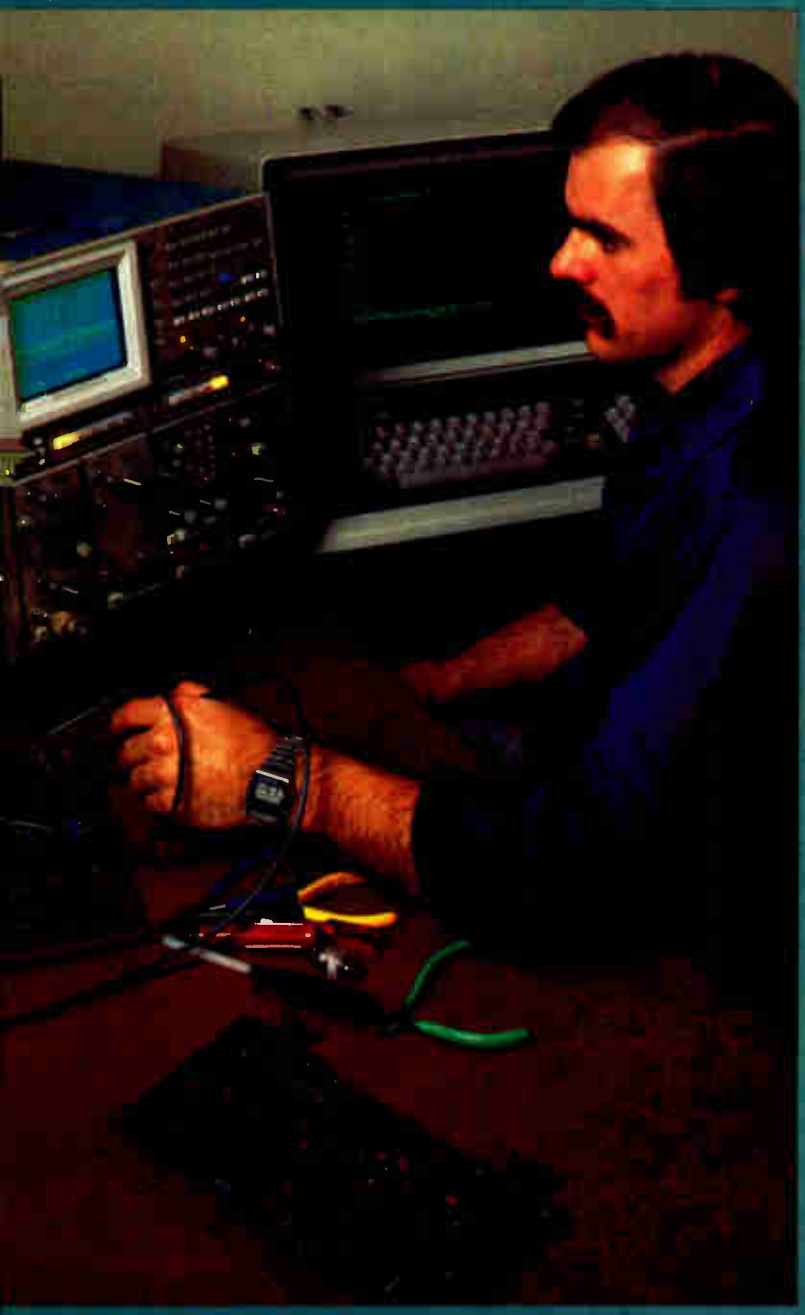

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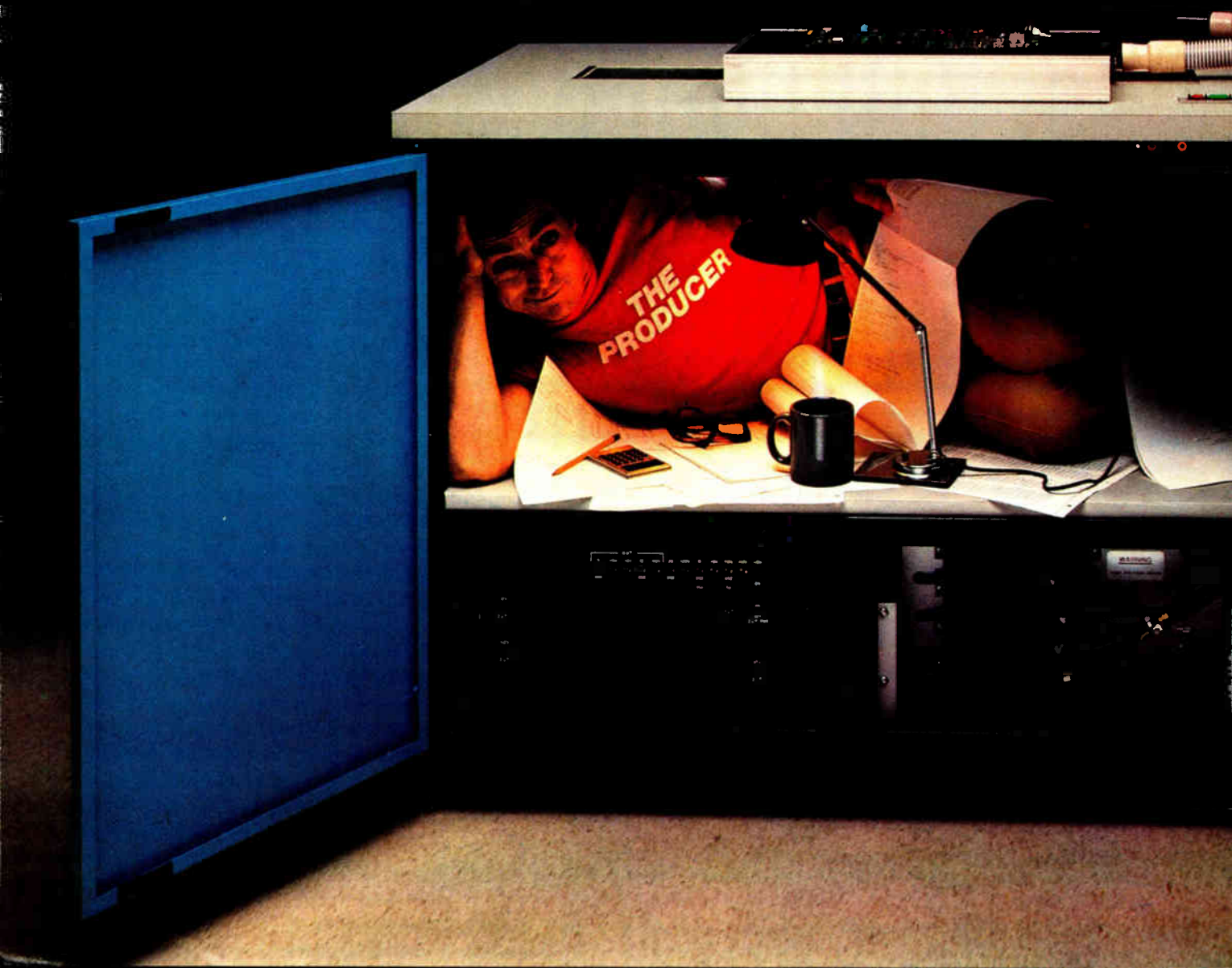

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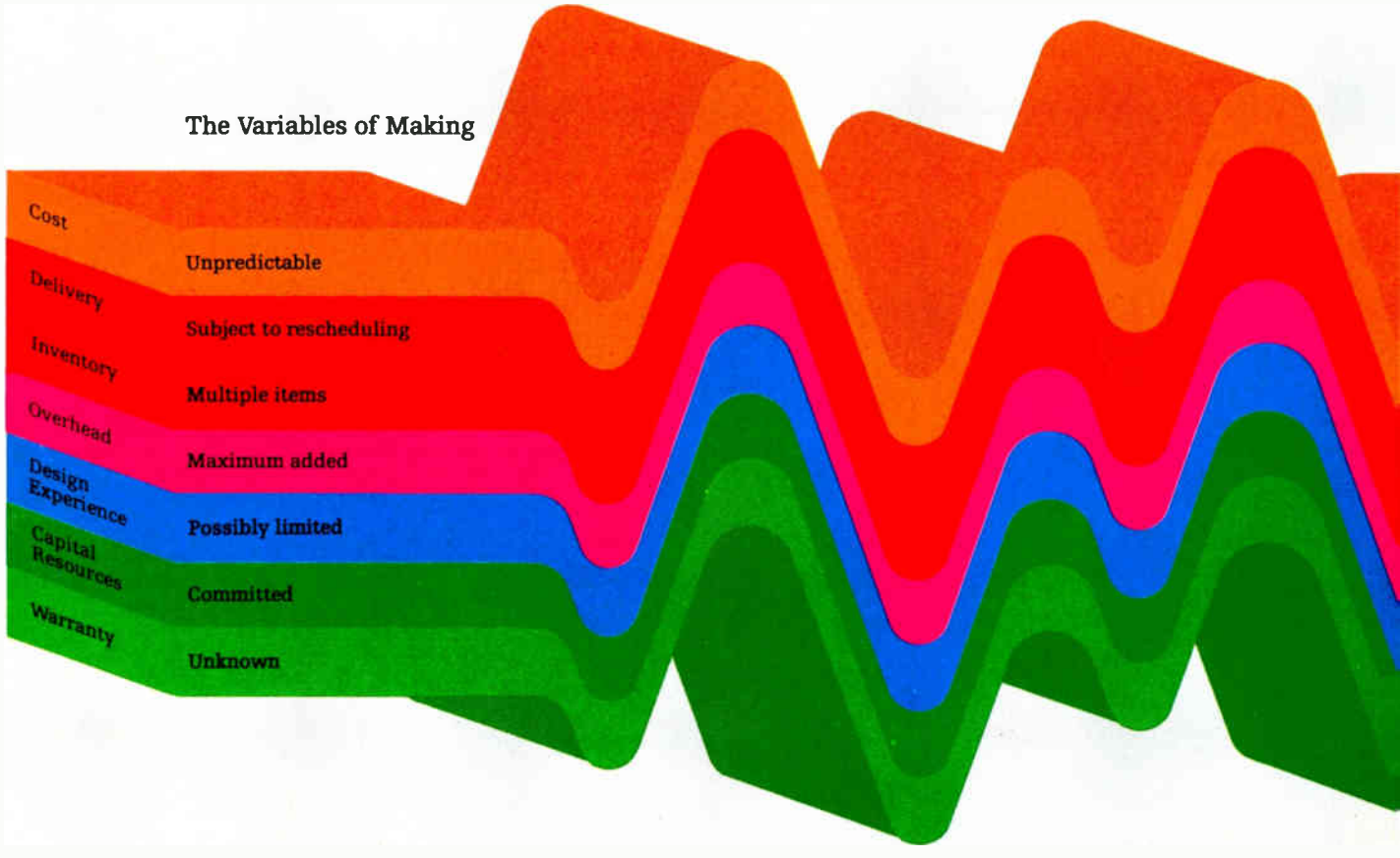

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Budget cuts and science and technology

That cry of pain you hear arises from the nation's science and technology establishment. It is the reaction to deep cuts that have been requested by President Reagan in Federal spending on pure and applied science as well as technological programs. The anguish is compounded by the seeming insensitivity of the new Administration toward the wants, needs, and feelings of the nation's scientists and engineers, as well as apparent determination to ignore what they have traditionally received.

Let us place the matter in perspective. The President is determined to put the national economy in order—to spur what he calls an economic recovery—and science and technology are easy targets. The average citizen, told that colleges and universities will not receive Federal funds with which to purchase equipment for their engineering schools, would probably just shrug and turn on the television set—which would not be there, incidentally, if colleges and universities had always been forced to get along with old and outmoded tools for their fledgling engineers.

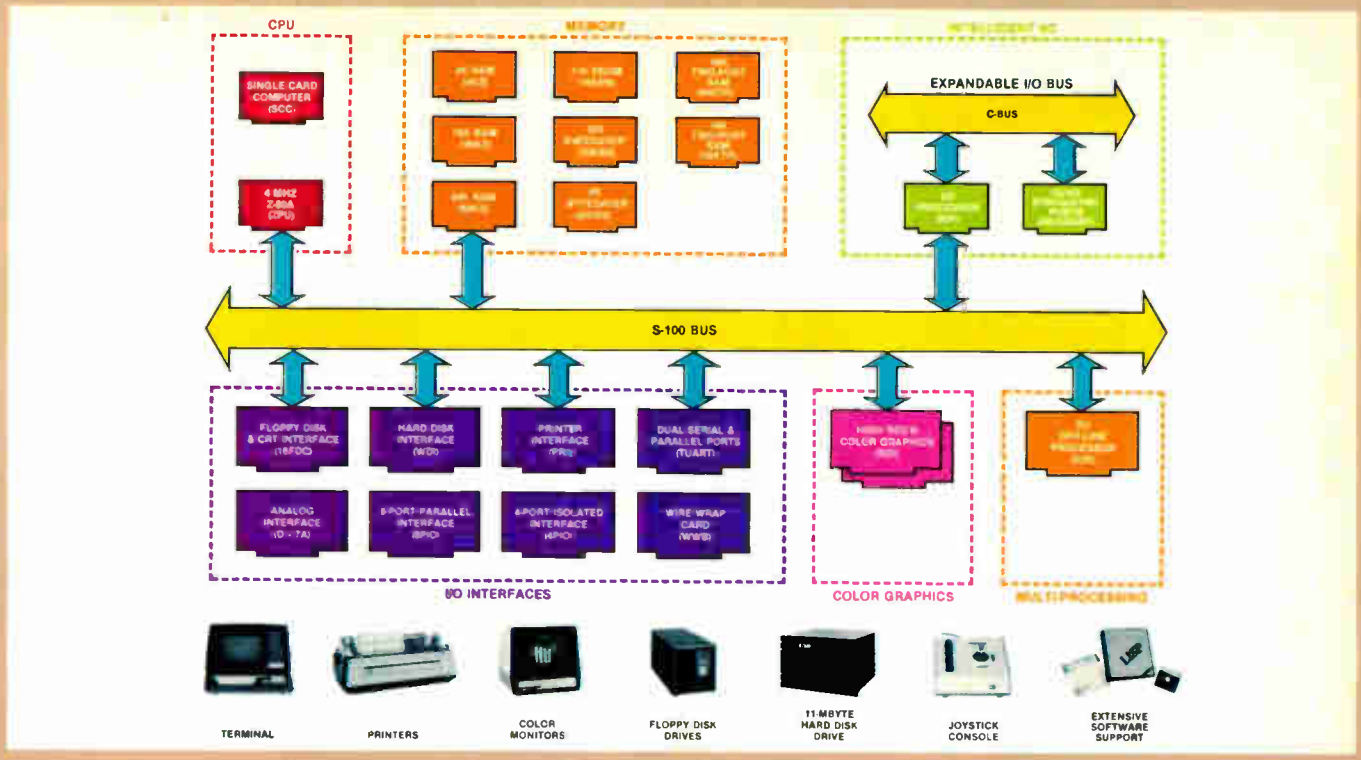
Furthermore, the reasoning of the Reaganites is defective because their outlook is myopic. Technology, at least, is a practical, results-oriented discipline: its end is to create things that enhance the quality of life by their usefulness. What's more, it has been demonstrated beyond refutation that advances in technology create jobs, and one of the Administration's charters is to reduce unemployment.

Thus far, then, the signals have been all bad. But the Federal government works in strange and wondrous ways. Under America's unique system of checks and balances, presidential programs are challenged, changed, and reshaped at the congressional level. Reagan's cuts are not carved in granite. It is highly unlikely that he will get everything that he has asked for, even though there will certainly be deep gouges in the budget submitted by the outgoing Carter Administration.

Where Reagan could signal the science community that he is not totally insensitive to its existence is in his own executive branch. For the new President has not as yet named a science adviser, and some Washington insiders say that there are indications that he may disband the White House Office of Science and Technology Policy. If that is the case, the President is making a grave error, one that the businessmen in his Administration should be able to point out and help him correct.

As for the science adviser's job, the name most widely rumored for the post is that of Simon Ramo, at present vice chairman of TRW Inc. in Cleveland. Though he has said that he asked that his name be excluded from any list of candidates, he has not said flatly that he would turn down the job. That's good, because Ramo is uniquely qualified by his expertise in technology, industrial management, and the practical politics of science in Washington. He has been chief scientist for the U. S. intercontinental guided missile program and won a 1979 National Medal of Science. He spent two years on the White House Energy Research and Development Committee on Science and Foreign Affairs and was chairman of the President's Committee on Science and Technology in 1976–77. Thus the man is eminently qualified to be the science adviser.

If the White House intends to show that it is eliminating "unnecessary" jobs—after all, each agency already has its own science chief—axing the top science post will be counterproductive. Science and technology, which have contributed so much to the preeminence of the U. S., need and deserve a spokesman at the elbow of the President.



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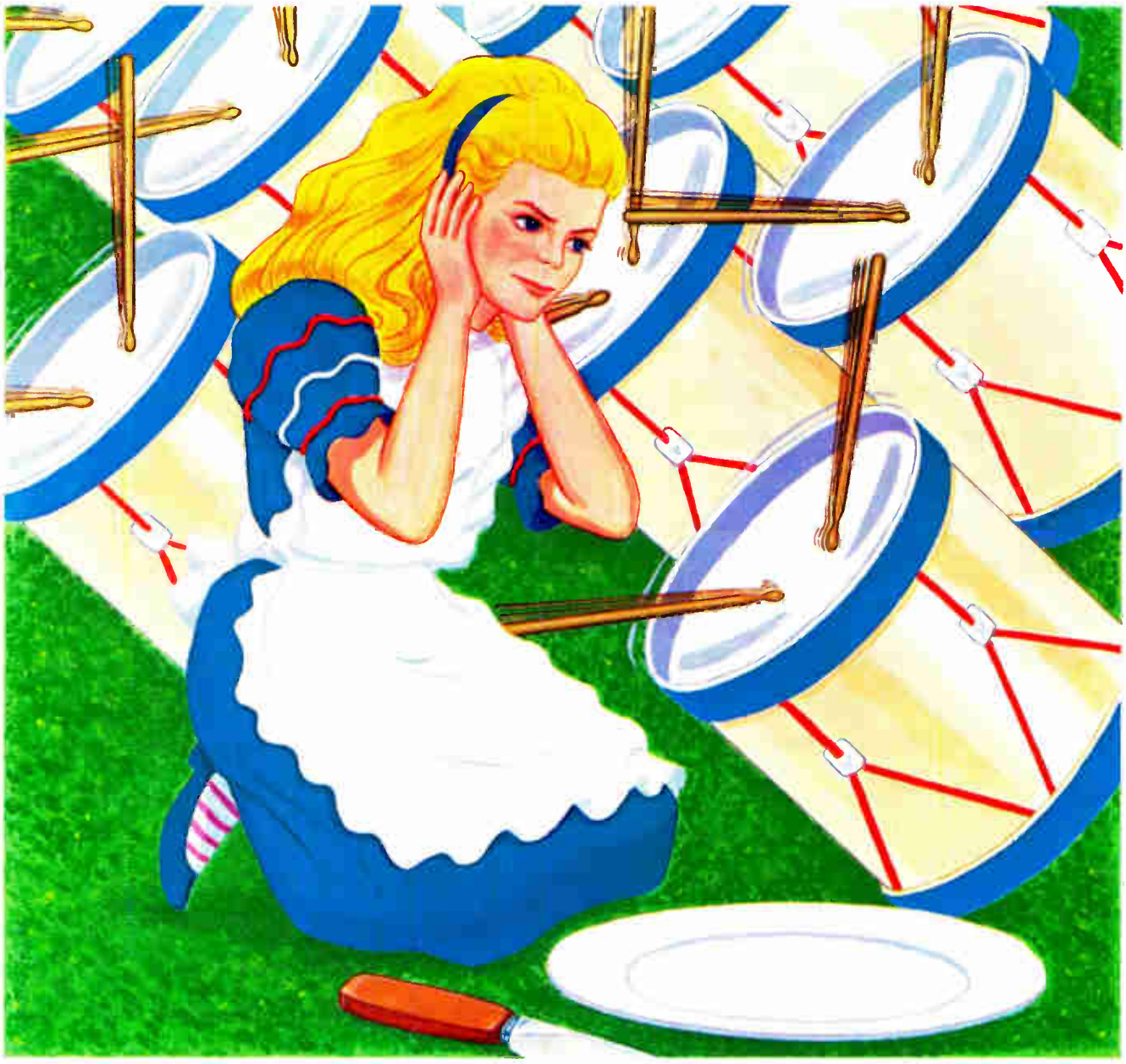

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Alice was very sensitive to noise, so much that she might have been an instrumentation designer. She found irritating noises everywhere in Lewis Carroll's Looking Glass World, from the daisies in the Garden of Live Flowers who shouted at her in shrill voices to the tree that barked "Bough-wough!" at her. Worst of all was the banging of the drums that ended the plumcake war between the Lion and the Unicorn.

"She dropped to her knees, and put her hands

over her ears, vainly trying to shut out the dreadful uproar. 'If *that* doesn't drum them out of town', she thought, 'nothing ever will!'"

For years, designers of monolithic analog circuits have tried to shut out noise for their high-speed instrumentation customers. But noise suppression eluded them, despite the fact that they had managed to suppress most other sources of error.

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We recognize that noise is a fierce competitor and cannot be totally eliminated. The solution is in what you do with it. Two distinct regions of noise can be defined in a typical op amp—the flat or white noise band, which is important in audio applications, and the low-frequency (below 50Hz) range, which is important in precision instrumentation—such as chart recorders. In designing the OP-27/37, PMI managed to optimize both regions with only $3nV/\sqrt{Hz}$ white noise and a very low 1/f corner at 2.7Hz.

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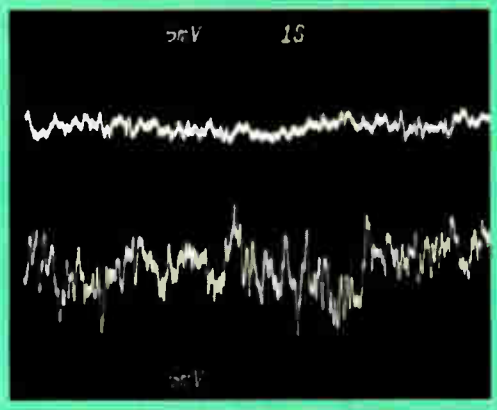

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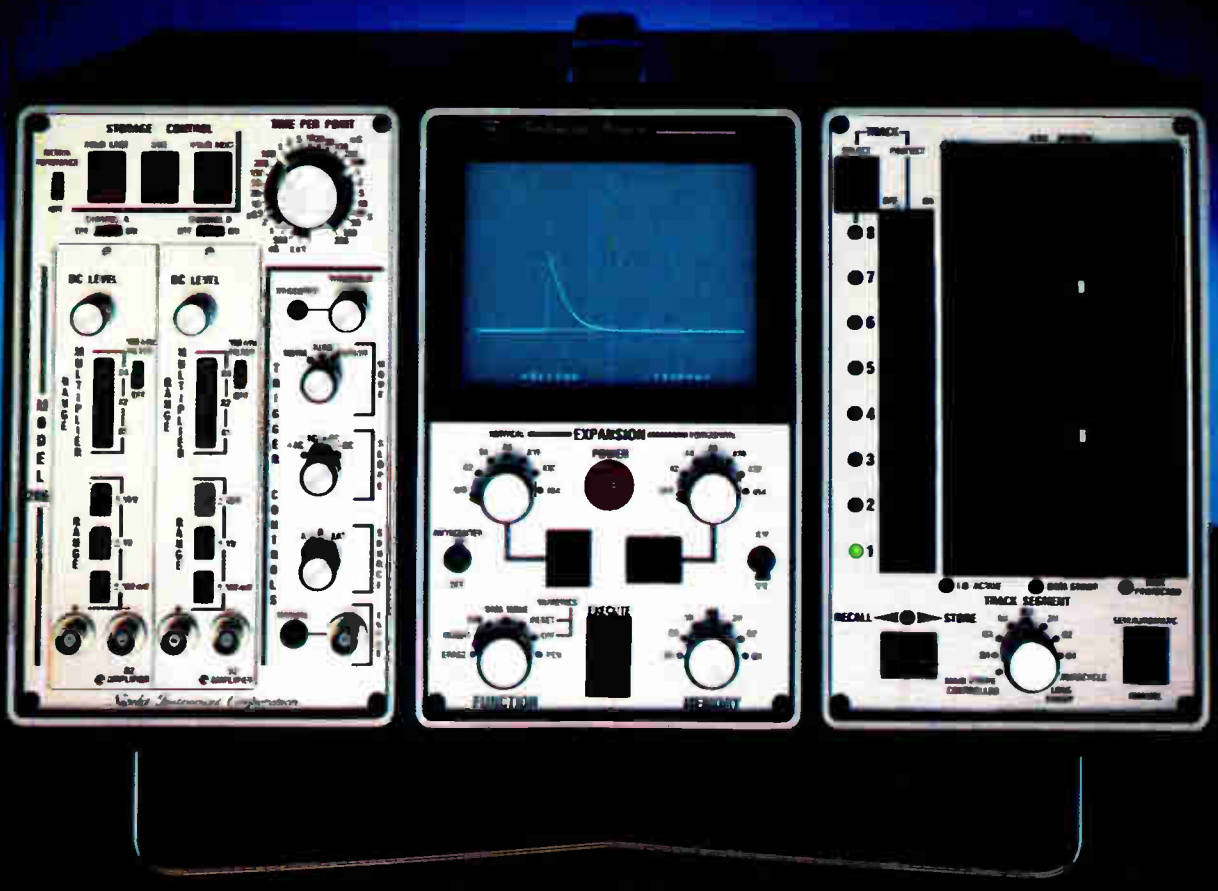

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Electronics newsletter

New HP 3000 model to sport twin ALUs

Look for Hewlett-Packard Co. to introduce a new member of the HP 3000 series within the next month or so. Model 55, internally code-named Gemini, will have a little more than twice the performance of HP's new series 3000 model 44 [*Electronics*, Nov. 6, 1980, p. 33] and will cost about 50% more, or approximately $150,000. It has a machine cycle time of about 70 ns, and **it uses emitter-coupled logic instead of the Schottky TTL used in previous HP 3000 family members.** The duality implied in its code name refers to the internal architecture of the system, two tightly coupled 16-bit ECL processors. They form a dual arithmetic and logic unit. Running under the MPE-IV operating system, the model 55 has each processor performing 16-bit instructions while it maintains a 32-bit data bus and a 32-bit address bus. It has eight disk controllers capable of addressing up to 16 gigabytes of disk memory and uses 64-K random-access memories to pack 1 megabyte of main storage onto a single board. It accesses RAM asynchronously, using 19 clock cycles for an assortive cache memory, which then feeds back eight successive 16-bit words to the central processing unit.

Network links multivendor devices on factory floor

Industrial control could get a big push toward full factory automation from Modway, by Gould Inc.'s Modicon division, a peer-to-peer local-area network and communication system. Unlike earlier industrial networks, Modway supports multivendor data equipment, from data converters and microprocessors to robots and computer-aided design and manufacturing systems. **User-programmable smart interfaces act as protocol translators and grant system access to machines on a priority basis called token passing.** Accommodating up to 250 devices on a cable system or as many as 10,000 on an active cable TV system, the network transmits data at 1,544 Mb/s between nodes up to 5,000 m apart. It will also link to other networks like Ethernet, says Modicon, which unveils Modway at this week's Programmable Controllers Conference in Dearborn, Mich. The Andover, Mass.–based division will sell Modway for $1,000 to $5,000.

Speech system talks for 200-300 s

A board-level speech synthesis system that will provide 200 to 300 seconds of synthesized male or female speech in any language is about to be unveiled by Telesensory Speech Systems of Palo Alto, Calif. Based on Intel's 8085A 8-bit microprocessor, the Speech 1000, as it is called, **features 458 K of on-board read-only memory, programmable speech control and audio gain, and three input/output ports**—Intel's Multibus, an RS-232-C serial interface, and an 8-bit parallel interface with an additional 3-bit control. Having a typical data rate of 2,200 b/s, the system, which uses linear predictive coding, will sell for about $1,200 in single quantities and less than $950 each in lots of 100; vocabulary generation and linear predictive analysis services will be available.

Westinghouse develops new power-device isolation scheme

In an effort to remain cost-effective in low-voltage, low-current applications, Westinghouse Electric Corp.'s Youngwood, Pa., Semiconductor division has developed a more flexible method of processing power rectifiers and thyristors. Instead of etching the edge of a silicon pellet mounted on a molybdenum substrate to form a mesa structure, Westinghouse etches grooves around active regions on both sides of the pellet and fills them with silk-screened glass. **Not only does that eliminate the wet chemistry**

associated with the spin etching, but furthermore the new devices can be mounted on a beryllium substrate, which is electrically cold. Thus, more than one device can be mounted onto a common heat sink without worrying about electrical conduction or shock hazard; indeed, the packaging idea has been approved by Underwriters Laboratories. The idea might also make economical plastic packages more practical. The devices do not have to be round, so that Westinghouse might even laser-scribe power functions—transistor-diode combinations—from a single wafer. But for now, the division is going after motor control and other markets with discrete chips.

National expands in DEC-compatible field

The Memory Systems group of National Semiconductor Corp., Santa Clara, Calif., has announced a bulk memory based on 16-K random-access memories that achieves high reliability through self-diagnosis and repair. Emulating Digital Equipment Corp.'s RS04 fixed-head disk subsystem, **National's Nuram substitutes spares for failing components without interrupting operation.** Access time of the memory, whose capacity is up to 8 megabytes, is 2 μs, and the transfer rate is 500 kilobytes per second. Also announced was a DEC-compatible input/output controller, called Mexacon, that handles three types of device—disk, tape, or a Pertec interface—simultaneously. Its design is based on a new 40-bit microcoded bit-slice processor, called the Transfer Processing Unit, geared for fast data transfers.

Power FET offered at bipolar prices

Its new high-voltage vertical double-diffused MOS power FET may not boast any performance advantages over competitive devices, but Semi Processes Inc. of Santa Clara, Calif., is **perhaps the first semiconductor manufacturer to provide high-voltage performance by a field-effect transistor at bipolar prices.** The SD 500 will be available later this month at a "nonnegotiable, take-it-or-leave-it" price of $2.75 each in 10,000-piece quantities, or $4 each in 100-piece lots. Housed in a hermetically sealed TO-3 package, the 400-V, 3-Ω FET is designed as a direct replacement for bipolar power devices in 200-W, 200-kHz off-line switching power supplies and in power-amplification applications.

Rolm to unveil 32-bit system, first drive

Ever since the introduction of Data General Corp.'s 32-bit MV-8000 computer system [*Electronics*, April 24, 1980, p. 33], the military has been awaiting a ruggedized version of the system. This week, after some slippage, Rolm Corp. of Santa Clara, Calif., will unveil not only the ruggedized 32-bit system, **but also two more 16-bit systems, as well as its first venture into the manufacture of disk drives.** The 32-bit system is the model MSE 800, which will be priced at about $500,000 and have first deliveries in December. The two 16-bit systems, the MSE 14 and MSE 25, are ruggedized versions of Data General's S140 and S250 systems, respectively. With 128-K bytes of random-access memory and without Rolm's new disk drive, they will cost about $55,000 and $80,000, respectively. Rolm's drive, the model 4050, uses 8-in. Winchester technology. It will supply 35.6 megabytes of capacity and add about $50,000 to the cost of the systems.

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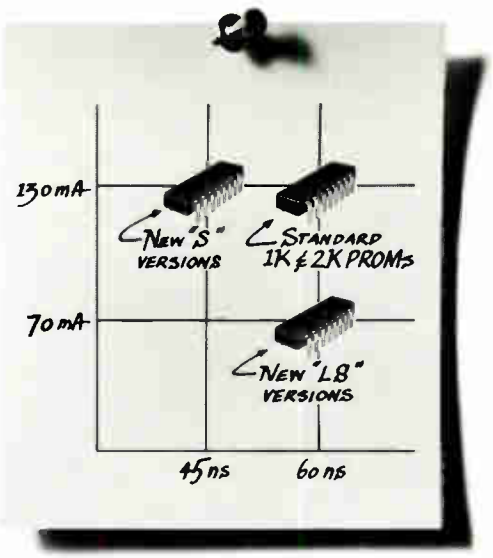

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Circle 38 on reader service card

Denser processors from various makers show similarities

by R. Colin Johnson, Microsystems & Software Editor

Much the same selection of architectural features made possible with extra devices appears in each processor

As VLSI **microprocessor** technology pushes on to the 32-bit level, the new parts are beginning to add architectural features made possible by the extra on-chip devices. What's more, these new very large-scale integrated circuits are in remarkable agreement as to which features to add.

As the table shows, microprogramming and a pipelined instruction-execution sequence are features that began showing up at the 16-bit level; newer ones include on-chip multipliers, barrel shifters, and self-testing. Of course, much of the inspiration for these comes from mainframe computers, whose abilities are increasingly shared by the new microprocessors.

ISSCC. The trend was apparent at the recent International Solid State Circuits Conference in New York [*Electronics*, Feb. 24, p. 138], where designers discussed the 32-bit Bell Laboratories Bell MAC/32, Hewlett-Packard Co.'s new chip set, and the Intel Corp. iAPX 432. Many of the same features show up on the newest 16-bit processors, such as the Toshiba Corp. 88000 discussed at ISSCC and the Texas Instruments Inc. 99000. Complementary-MOS technology was a hot ISSCC topic, with Japanese researchers especially showing strong advances (p. 97).

Toshiba's new proprietary C-MOS part stores its microprogram externally, whereas other 16- and 32-bit machines use on-chip read-only memories. Microprogramming is a favorite design tack in the era of VLSI circuits: in fact, every IC maker except Zilog switched to it for 16-bit microprocessors.

In contrast to hardwired execution units, microprogramming offers flexibility and easy upgrading because changes are a matter of a new lithography mask for the ROM rather than redesigning the random logic of the hardwired approach. For example, additional instructions are quickly realized: Motorola Corp. has already added some to its 68000.

Pipelined architecture that squeezes every ounce of performance out of the short-channel VLSI technologies cannot help but be popular. Instruction prefetching is the most common first stage of a pipeline, as it is in the new 99000, a software-compatible update of TI's pioneering 16-bit 9900. Several of the 32-bit machines add more stages, multiplying the throughput of the instruction stream by the number of stages.

More stages. For instance, HP's 32-bit microprocessor takes three cycles of 55 nanoseconds each to execute most instructions, but since the fetch, decode, and execute stages work simultaneously, the effective throughput is one instruction per cycle. The processor is part of a mul-

MICROPROCESSOR ARCHITECTURAL FEATURES

		Microprogrammed	Pipelined	Multiplier	Barrel shifter	Self-testing	Register based	Memory based
32-bit	Bell MAC/32	●	●		●		●	
	HP 32-bit	●	●	●	●	●	●	
	Intel iAPX-432	●	●		●	●		●
16-bit	Toshiba 88000	●	●	●	●		●	
	TI 99000	●	●			●		●
	Intel 8086	●	●	●			●	
	Motorola 68000	●					●	
	National 16000	●	●				●	
	Zilog Z8000		●				●	

tichip set [*Electronics*, Feb. 10, p. 39]; at ISSCC, its designers discussed a clock driver IC addition to the five already disclosed.

Since there are transistors by the hundreds of thousands on the new VLSI chips (450,000 on HP's, for example), specialized hardware execution units on chips are economically realizable. The 32-bit parts all have barrel shifters that can shift any number of bits in a single clock cycle, and HP adds a multiplier.

Specialized registers for floating-point calculations and virtual memory support also appear at the 32-bit level and on the newer 16-bit units like the Philips proprietary two-chip set [*Electronics*, Feb. 24, p. 50]. The floating-point calculations use the standard Institute of Electrical and Electronics Engineers format, a notable sign of compatibility in this era of intense competition.

An emerging industrywide philosophy delegates responsibility for memory management to the IC maker rather than the system designer. In any system, then, the software supporting the memory management scheme can safely assume set locations for the special registers and standard formats for the protocols handling large memory spaces.

Self-testing. Another bonus of having room to spare on chip is the ability to store self-testing routines in the microprogram ROM. In this way, a processor can test itself each time it is powered up or reset or even as it is executing an instruction.

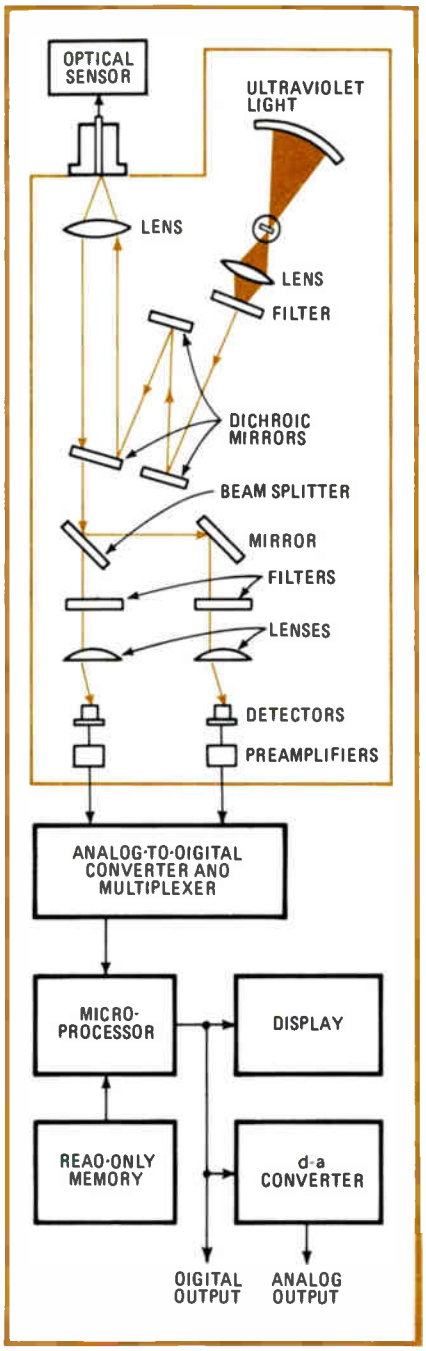
Making a strong break from the register-based architectures of other 16- and 32-bit machines, the 432 joins the 99000 in using memory-based operands. Locating the operands in off-chip random-access memory decreases the software overhead of swapping the register set every time a new task is serviced in a multiuser environment—at the expense of added processing time.

TI is continuing the use of memory-based operands from the 9900, which was the first microprocessor to adopt this route. Yet, with the 99000, it has brought on chip a high-speed RAM of 16 16-bit locations to serve as a special register set.

Instruments

Phosphor glow checks ICs for heat

A newly invented temperature measurement technique that is totally optical in nature promises to make possible the exploration of sections of bare integrated circuits, determining the same sorts of temperature anomalies previously probed at the board level. Using fiber-optic probes a mere 0.7 millimeter in diameter in the first implementation, the technique should also open up new applications in IC design and semiconductor fabrication and in nonelectronic areas like medicine.



Its inventors, engineers Kenneth Wickersheim and Ronald Alves, have dubbed the technique "fluoroptic thermometry" because it depends on the fluorescence of certain rare-earth phosphors in the tip of the fiber-optic probe. They will be marketing an instrument based on the technique through their newly formed Luxtron Corp. of Mountain View, Calif.

Because the system is totally optical, the temperature measurements are unaffected by electromagnetic fields and radio-frequency or microwave sources—nor does the instrument interfere with any of these sources. In addition, the probes are thermally nonconductive and the optical fibers are inert to most chemical reactions.

System setup. The technique measures the ratio of the frequencies of the spectral lines resulting from the fluorescence of two phosphors on the probe's tip. As the figure shows, an ultraviolet light source provides an excitation beam to the probe tip, and the resulting spectral emissions vary according to the temperature of the point being probed.

The phosphors' spectral responses to the temperature go back through the probe to the instrument. They are split and passed to microprocessor-based processing, control, calibration, and display circuitry.

The phosphor tip has a small thermal inertia and allows a measurement settling time of 1 second or less. Luxtron's initial offering, the

Hair-fine measurements. By exciting two phosphors on the tip of a fiber-optic probe 0.7 millimeter in diameter, a new instrument can measure the ratio of the frequencies of the spectral lines resulting from the phosphors' fluorescence, which varies according to temperature.

$5,100 model 1000A, can measure from −50° to +200°C to accuracies of within 0.1°C.

For optimum performance, the probe lengths are kept to 2 meters, but 100-m-long probes may be used, though with degraded performance. The inventors contend that these lengths could be increased if a suitable illumination source like a visible-blue-light LED is used.

Varied uses. Another semiconductor application could include use inside rf plasma etching equipment, because the probes do not melt the photoresist on the surface of a wafer. They also could be put into a transformer: "For the first time we will be able to sense a problem inside a transformer and shut it down before the transformer itself is lost," says Wickersheim.

As useful as this type of thermometer may become in electronics, its applications in other areas may be even more important. The inventors believe their patents are the key to a new hyperthermia technique in cancer therapy. The technique can also be used in a microwave oven, in the processing of plywood, and in electronic-countermeasure warfare equipment. **-Martin Marshall**

Business systems

TI, Northern Telecom offer desktop units

Desktop terminals for executives are popping up all over as the integrated office of the future moves ever nearer. Companies like Xerox, Datapoint, and Northern Telecom already have introduced systems to support such equipment (p. 157), and now Texas Instruments Inc. is introducing a product line, as is Nixdorf AG.

Such units will offer limited word- and data-processing capabilities because they are intended primarily for information retrieval and electronic message services. To judge from early indications, it is likely they will vary considerably in communications capabilities that they offer.

Tiny terminals. Northern Telecom plans to test a prototype desktop terminal plus telephone (top), and TI is set to offer its series 10 that works through a telephone or directly with a computer for $995. Both units are aimed at users who need information retrieval more than data entry.

TI is naming its initial product the series 10: a 12½-inch-high, 9½-pound terminal with a swiveling 5½-in. cathode-ray-tube display (see lower photograph). Using what it calls "existing TI terminal technology," the company has come up with a list price of $995.

The unit incorporates three TMS1000 4-bit microprocessors, one controlling the simple 53-key typewriterlike keyboard, one for the video display, and the third for the internal modulator-demodulator, which is the first modem TI has built.

Plug-in. The operator plugs his desk telephone into the series 10 and then plugs the terminal into the wall jack. Then he can call up a host computer or a commercial data base. An optional command module, based on read-only memory, can contain the log-on sequence as well as the data-protection features and will enter them automatically.

The model 10 also has an RS-232-C port for direct connection to a computer; moreover, through the phone network, it can be used for interoffice communications. As an option, TI will offer a $995 receive-only thermal printer.

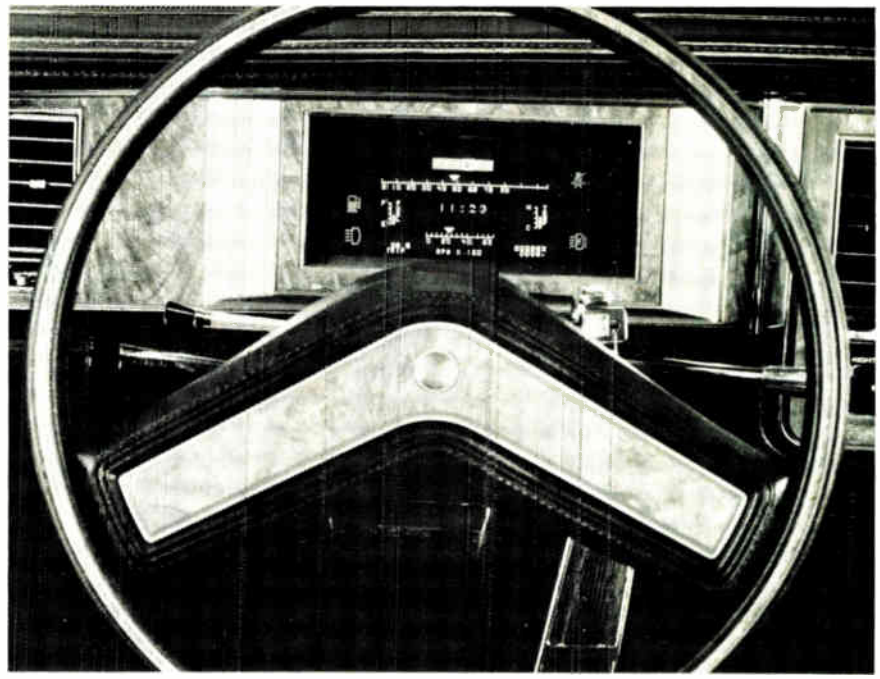
Prototypes of a similar piece of equipment from Northern Telecom Inc. are going into field trials this spring. The Displayphone (upper photograph) incorporates a telephone and keypad, a display, a slide-out keyboard, and a modem.

Like the series 10, it is intended primarily for information retrieval,

but it can handle voice and data transmission simultaneously. The keypad does include five software-configurable keys, and the unit has a personal phone directory and an automatic dialing feature. It was developed by Bell-Northern Research Ltd. of Canada, and Northern Telecom has been willing to talk about it (p. 164) but has only just decided to show it.

In West Germany, computer maker Nixdorf is unveiling a desktop unit that combines a terminal, a telephone, and a teletypewriter (see p. 80). Although considerably more versatile than the series 10, it will be considerably more expensive, with a base price of around $2,500.

At stake is a market projected to grow from nothing in 1980 to more than a million units a year by the end of the decade, with total annual consumption above $2.5 billion, says International Resource Development Inc. In a new report on this market, the Norwalk, Conn., market research firm also predicts that Xerox Corp. will introduce a product this spring. **-J. Robert Lineback**



Inner tube. The CRT, with virtually unlimited capacity for display variation, is Zenith's bid to the auto makers for mid-1980. Color is achieved with filter overlays.

Automotive

New displays intrigue car makers

With the market for automotive displays pegged at $493 million for 1984, proponents of competing display technologies are vying for the attention of the world's auto makers. And the automobile companies, already well along the road to replacing electromechanical gauges, are watching them.

This interest was evident from the numerous papers presented at last month's 75th annual Society of Automotive Engineers conference in Detroit. In fact, an array of papers on the automotive applications of electronic displays and information systems were presented in sessions spread over two and a half days. Engine controls, sensors, and actuators also were session topics.

Along with variations and refinements on the usual approaches such as liquid-crystal, gas-discharge, and electroluminescence, two new techniques were proposed—a vehicular cathode-ray-tube display from Zenith Radio Corp and an electrolytic liquid display from Jaeger SA, a French company.

The auto makers were clear, however, that, for now, vacuum fluorescence is the preferred—though not exclusive—choice. "Whatever comes in will have to replace vacuum fluorescence," comments Laurence A. Lopez, Ford Motor Co.'s engineering manager of electronic instrumentation and features.

And, says Chrysler Corp.'s chief engineer for feature products Bernard F. Heinrich, "the general impression is that the vacuum fluorescent display is still the most viable" when its cost, visibility, ruggedness, and appearance are weighed against those of other techniques.

However, Zenith is taking a radical direction with its CRT display. "What you basically have is a computer display in the car," explains Leonard Dietch, vice president of research and development for the Glenview, Ill., company's picture tube and components operation.

The advantage of using the raster-scanning display, he goes on, is the ability to change the displayed image (see photograph) quickly and easily with software. With other display techniques, the image is silk-screened on, as with the liquid-crystal display, or physically constructed with conductive material such as the vacuum fluorescent display, and it is therefore permanent.

The higher cost of the car CRT is more than offset by the number of standard instruments it replaces, including the gas gauge and speedometer as well as the new trip display appearing on higher-priced autos. In addition, the variable display avoids the distracting clutter of indicators, which Zenith claims can overwhelm the driver.

Contenders. It features a new high-intensity gun for a monochrome display: anode voltage is 12 kilovolts. The 3-by-5-inch faceplate packs 140 lines of resolution. The result of over two years of development and talks with the auto makers, the tube is targeted for the mid-80s generation of cars. According to Lopez of Ford Motors, the CRT is "very expensive but within the realm" of possibility. Observes

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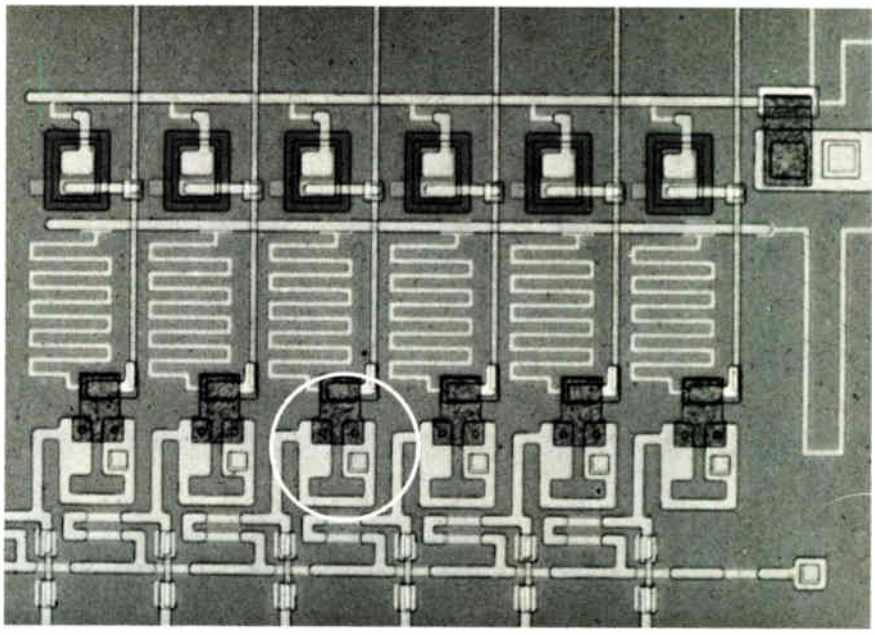
Chrysler's Heinrich, "they've got a fascinating idea that's caught a lot of people's attention."

Another new entry besides Zenith was made by France's Jaeger, located in Levallois, which officially introduced its electrolytic liquid display [*Electronics*, Jan 27, p. 82]. The electrolytic display uses the dispersion of light caused when a thin silver film is deposited on a clear electrode under the influence of an electric current.

Reversing the current removes the deposited film and erases the display, which otherwise retains its image for several minutes without power. It takes 100 to 200 milliseconds to write and 5% to 10% longer than that to erase. The manufacturer claims that the cell is easier and less expensive to manufacture than liquid crystal. In addition, it promises 10,000 hours of operating time at −40°C to +80°C. **-Gil Bassak**



Cool chip. In this NBS a-d converter, each superconducting quantum interference device (circled), containing two Josephson junctions, produces a bit at rates of up to 2 GHz.

Instruments

Josephson IC speeds a-d conversion

Dual-slope and flash-conversion techniques for precision digital instrumentation may well be supplanted by methods based on Josephson junction technology. Such supercooled circuitry can switch at picosecond speeds, so it can measure ultrahigh frequency directly.

Working toward that goal, researchers at the National Bureau of Standards have constructed a Josephson-based 6-bit analog-to-digital converter capable of taking 2 billion samples a second [*Electronics*, Jan. 27, p. 33]. "It is a major step in demonstrating the feasibility of a new generation of measurement instruments based on supercooled integrated circuits," an NBS spokesman says.

As the photograph shows, the NBS chip has six conversion units, each based on a two-junction Josephson element. The conversion technique is based on the ability of this element, called a superconducting quantum interference device, or Squid, to switch states each time the magnetic flux in the area between the junctions reaches the critical level of half a flux quantum. "There's nothing in semiconductor technology like it," maintains Clark Hamilton, the project leader at the Boulder, Colo., facility.

The signal to be measured is injected into the groundplane of the IC. The output of each conversion unit changes periodically with the magnitude of the magnetic field, going from 0 to 2 millivolts at one field strength, 2 mV to 0 at the next, and so on. Using Josephson conversion units with different field-strength sensitivities, the converter is able to produce a binary result in parallel, much like a flash converter.

But flash converters have not reached the speed of the 2-gigahertz NBS converter; Analog Devices claims to make the fastest commercial 6-bit flash unit with a 100-megahertz conversion rate. Moreover, flash converters typically use 2^N conversion elements per N bits.

In contrast, the Josephson-based converter needs only N elements, and since each conversion unit is only 1 square mil, the whole converter can fit in about 15,000 mil^2. "In volume, a chip with the converter alone would cost about 10 cents," Hamilton surmises.

The converter's output has been directly measured at up to 20 million samples per second and found to produce a monotonic staircase. Above that frequency, however, sampling techniques were used because there was no way to capture the converted data in real time.

Memory. To store the data for processing, Hamilton suggests that a shift-register version of the Josephson junction memory that IBM Corp. is building could be put on the chip with the converter. "There's enough space to put probably 500 to 1,000 samples on the same chip," he says.

At IBM's Yorktown Heights, N. Y., research facility, Wilhelm Anacker, head of the Josephson project, points out that, though the memory is fast enough to store the signal, "there may be practical problems with trying to put memories we develop on chips they have developed." Incompatible lithography techniques and process tolerances may prove to be stumbling blocks.

Then, too, the NBS is still working to overcome difficulties in getting the room-temperature signal to the supercooled chip. "Because of a problem with crosstalk in connections to the chip, it is not possible to

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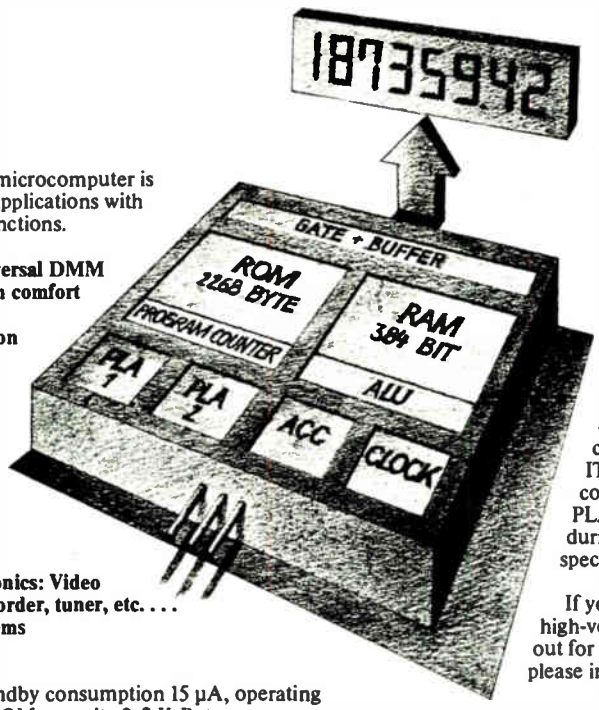

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know what the signal is that is arriving at the chip at ultrahigh frequencies," Hamilton readily admits. He believes that the transmission problem should be overcome in the not-too-distant future.

However, keeping the chips cool in a practical instrument would not be a problem, owing to the work of another NBS researcher, James Zimmerman. He has already constructed a refrigerator that takes up only 1 cubic foot and can keep the chip at 4 K using only 100 watts.

"Anyone using the machine doesn't have to know that there's something inside working at 4 K," Hamilton says. "The operator just turns it on and waits 5 minutes, as with the old vacuum-tube instruments." **-Richard W. Comerford**

Packaging

Ceramic surrounds ICs on tape carriers

Hermetic sealing of integrated circuits mounted on tape carriers is on the way. Working under a Navy contract, Dynacraft Inc. is developing a production-line method of sealing ceramic packages to the tape carrying the ICs.

The still experimental technique is intended for chips used in microcircuit packages, but the Santa Clara, Calif., company foresees commercial applications, notably with very large-scale ICs. The advantage there is not so much the hermetic sealing, but density—the resulting package has leads on 20-mil centers, common in military hybrids using chips on tapes but much denser than the 40-mil-and-up lead centers on packages in commercial use today.

Naval view. "We'll wind up with a very high-density microminiaturized package, a tremendous reduction in failures, and a hermetically sealed package that can be automated using commercially available gang-bonding systems," says Richard Gamble, program manager at the Naval Ocean Systems Center in San Diego. Gamble heads a group specializing in the development of manufacturing technology for implementation by various naval operations and was chairman of a Nepcon West session last month at which the technique was discussed.

The typical military hybrid is sealed at the board level to ensure reliability. Hermetic sealing at the chip level will give another level of protection, and it should also increase yield because the ceramic package will protect the chip during hybrid assembly.

In the Dynacraft technique, the chips are conventionally gang-bonded to the tape, and then ceramic packages are gang-bonded around the ICs. The prime inhibitor of the development has been the bonding of ceramic and film, says Carmen Burns, general manager of the Dynatape division of Dynacraft.

Solder is out because it would act as a conductor between the copper leads screened onto the tape. Direct glass bonding is unsatisfactory because it will not adhere to copper.

Dynacraft's solution is to remove that portion of each copper lead that would intersect the package halves' perimeters—the ceramic at those points is metalized to restore the conducting paths and the two ends of each lead are bonded to the points where they touch the perimeters. Then, just as in many standard bonding techniques, a low-temperature sealing glass is applied around the perimeter of each half of the package, including where the copper would have run.

Burns reports that the chips will likely be bonded to a three-layer tape, which facilitates testing and burning in before the ICs are removed. These dividends add to the savings inherent in the use of tape automated bonding—reduced labor costs and fewer failures because there is less handling.

For the VLSI era, tape automated bonding is being eyed as a serious packaging contender [*Electronics*, Dec. 18, p. 100]. Burns points out that a gang-bonded ceramic or plastic encapsulation for an IC on a tape carrier can replace a leadless chip-carrier or a dual in-line package.

Since the tape's copper pattern is on 20-mil lead centers, use with LSI circuits can increase board densities about five times over the present generation of chip-carriers. Because they have 50-mil centers, the chip-carriers are receiving considerable

Military money can aid a rising technology

Booming in the 1960s and downplayed in the '70s, will military electronics contracts regain their allure in the 1980s? One company that sought military support is Dynacraft Inc., asking development aid for the technique of hermetically sealing chips in tape carriers. The wholly owned subsidiary of National Semiconductor Corp. went after naval backing for its project because it felt the time is not ripe for commercial support.

Dynacraft sees the attention of chip makers focused on leadless chip-carriers as a means of packaging the input/output–intensive parts likely to dominate in the very large-scale integration arena. But it thinks its encapsulation technique can rival chip-carriers, and the Navy money gives the opportunity to get up to speed, says Dynatape's general manager Carmen Burns. A viable commercial technology will derive from the military work—just as did so many solid state developments in the 1960s, the company reasons.

Additionally, Dynacraft can maintain proprietary commercial information even though all military aspects will be disclosed at the required end-of-contract demonstration. But as electronics firms discovered two decades ago, "it's tough dealing with the Government," Burns says. The mass of paperwork and the uncertainty of year-at-a-time contracts with the military compare unfavorably with the stability of the commercial market and the potential for bigger sales. In fact, prime contractors for new military systems are reporting difficulty in finding electronics manufacturers who want to bid on subsystems—and the recent recession-inspired downturn in sales marks no resurgence of interest in the military market, they say. **-Terry Costlow**

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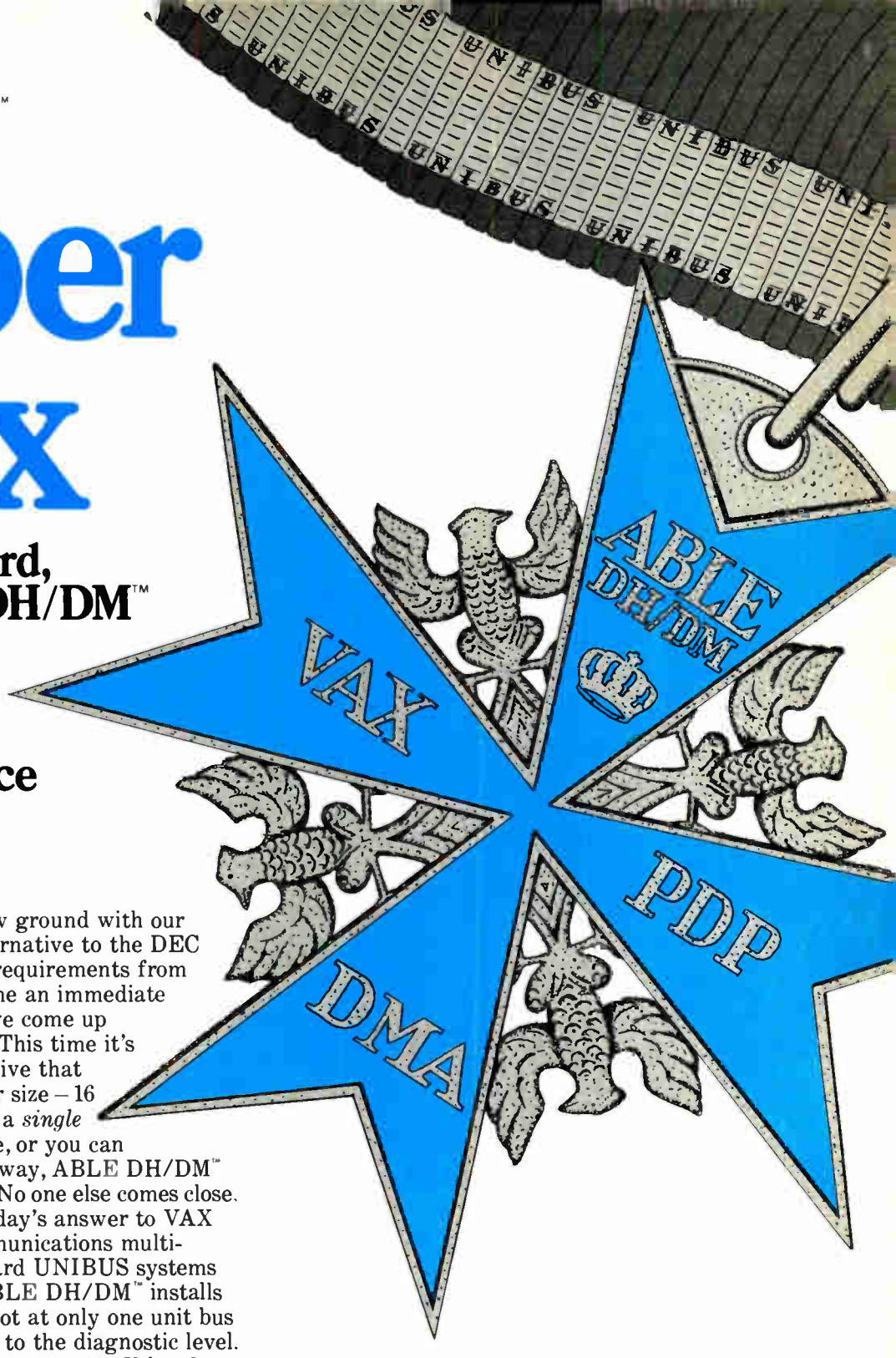

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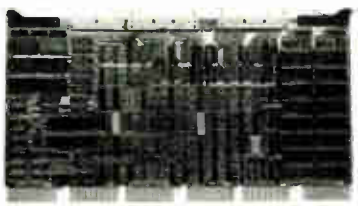

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attention as replacements for DIPs, which have 100-mil centers.

Dynacraft is just starting work on a one-year contract with the Navy, in which it is to produce three chip types in quantities of 200 each. Then a still unselected military systems contractor will use the chip in hybrids for a working system, says the Naval Ocean Systems Center's Gamble. **-Terry Costlow**

Test equipment

Stimulus test mimics processor statically

What amounts to a freeze-frame technique for recreating the different states of a microprocessor-based system could speed system troubleshooting by allowing thorough point-by-point test of the circuitry outside the central processing unit. By mimicking the microprocessor's behavior, it permits hardware debugging independent of software activity.

Called static stimulus testing, the new technique "makes hardware testing easier by transforming many complex dynamic problems into simpler static ones," claims James W. Coffron, developer of the concept and a member of the technical staff at Hewlett-Packard Co.'s Integrated Circuit Processing Laboratory. Since HP has no plans to market testers using the technique, he has helped form a manufacturer, Creative Microprocessor Systems Inc. of Los Gatos, Calif., to offer test modules for systems based on popular 8-bit processors (see photograph).

The technique, Coffron says, is based on the premise that a digital system's hardware alternates between two essentially static states: 1s and 0s. A working system "is really a collection of static events performed at a very rapid rate by the microprocessor," he says.

Although device characteristics and reactive circuit elements impose an upper frequency limit, he continues, "they don't usually impose a similar lower limit—unless dynamic memories are involved." Thus it is possible to represent a 1 by a certain voltage level on an address or data line, leave it there, "and it will still be there with its information intact when called upon."

To accomplish this, the engineer replaces the microprocessor in the system under test with one of Creative Microprocessor's modules, "putting the operator in command of the logic level of each processor pin," Coffron says.

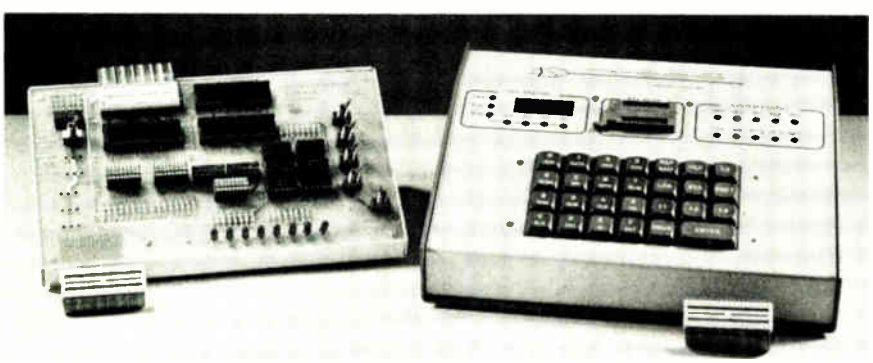
Now the operator can set addresses, data, and control bus logic just as the processor does, "but at one's own pace," he adds. As much time as needed may be devoted to voltage checks on buses and chip pins all along a given logic path, using such inexpensive instruments as a dc voltmeter or logic probe.

"In the past, we would have had to use a fairly complex system, such as an in-circuit emulator or simulator or built-in signature analysis, to find these kinds of troubles," says John Crane, a project leader in the HP lab in Palo Alto, Calif. "You could pay from $10,000 to $30,000 for an ICE or simulator, and then you'd still have to develop the software for it."

Robert Schuchard, an HP design engineer, says the stimulus tester "is really an important tool when the system is down and the microprocessor in it isn't executing any instructions meaningfully. Other debug tools can't be used if the processor isn't functioning."

Checkouts. "All the system hardware can be systematically exercised and checked, except the clocks and microprocessor," Coffron notes. If the system checks out in a static stimulus test, "the probability is high that its dynamic performance will be satisfactory also," he says.

Creative Microprocessor Systems will be selling a static stimulus module for $195, with which the operator sets up each address and data line. For $1,995, it will offer automated units, in which the operator need only key in the instruction to be run and the internal microprocessor configures the lines. The testers will work with the 8080 and 8085, the 6800, and the Z80. **-Bruce LeBoss**



Cousins. Two units reproduce microprocessor activity state-by-state for system tests: one (left) requires manual setting of address and data lines; the other is automated.

Fiber optics

Lightwave data links may start booming

Growing product portfolios and sweeping price slashes suggest that fiber-optic data links are poised for a long-awaited takeoff. What has been holding them back, agree both suppliers and potential users, is the lack of enough proven receivers and transmitters for short-range systems, along with prices too high for volume customers to commit themselves fully to lightwave transmission.

At the same time, telecommunications equipment suppliers have been busy developing their own parts, mainly for long-line telephone links. Now makers of equipment like computers and process-control gear are looking to such suppliers as Hewlett-Packard, Motorola, Spectronics, and TRW Optron to promote general-pur-

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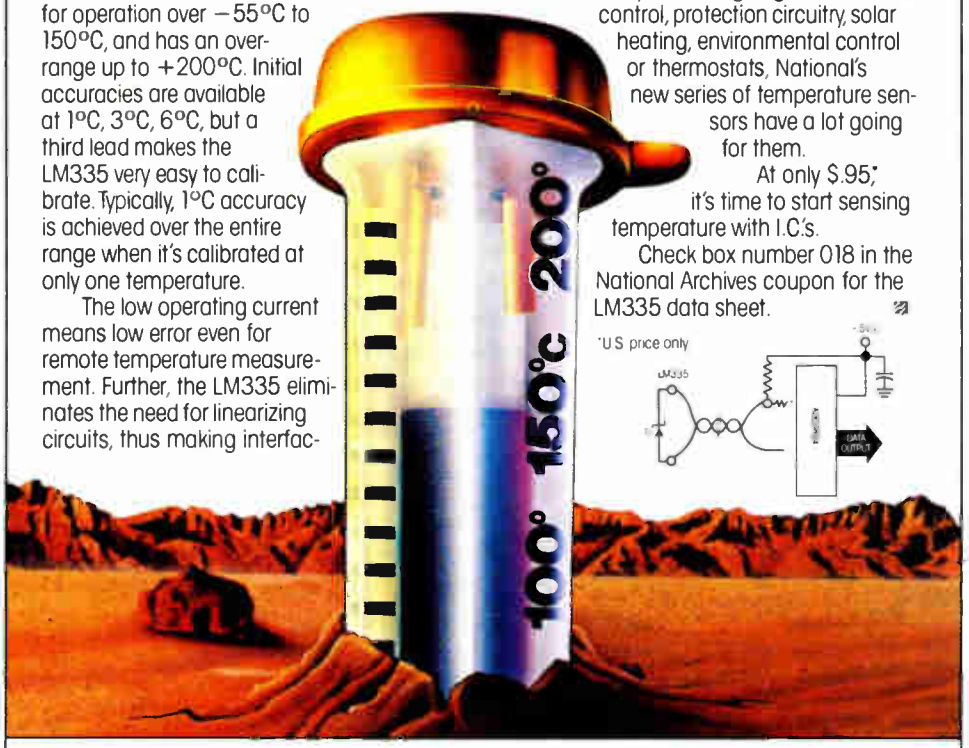

Field-programmable PALs™ save space, time and money.

National now offers a family of Programmable Array Logic devices designed to replace standard TTL logic. A single PAL can replace from 4 to 10 SSI/MSI packages. And PAL devices are fully field-programmable to provide the utmost in design flexibility and efficiency.

PAL's basic logic implementation is the familiar AND-OR array, where the AND array is programmable and the OR array is fixed.

PAL's standard AND-OR logic and flexible I/O programming provides hitherto unknown design and production efficiency. Because logic modifications can be made more quickly and easily with PAL than with discrete random logic.

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For a copy of the PAL brochure check box number 025 in the National Archives coupon.

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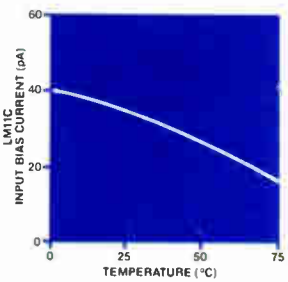
The plastic LM11. The light version of a heavyweight idea.



Introducing the new commercial temp LM11CN and LM11CLN in 8-pin mini-DIPs.

National's LM11 precision DC amplifier, designed by Bob Widlar, represents the most significant advance in bipolar op amp design in a decade. And until now it's only been available in metal cans.

But now the Practical Wizards are offering two commercial temperature models in plastic 8-pin mini-DIPs.

As a pin-compatible replacement, the plastic LM11 op amp makes an ideal upgrade for LM108A applications.

An order of magnitude better than FETs. The LM11 reduces DC error terms significantly enough that the op amp is no longer the limiting factor in most practical designs.

Further, its offset voltage, drift and long-term stability are an order of magnitude better than FETs.

And what's more, they're available off-the-shelf at all National distributors.* For a sample, simply contact the nearest NSC sales office.

Check box number 034 on this issue's National Archives coupon for a complete data sheet and the following technical papers:

- "Working with high impedance op amps"
- "Applying a new precision op amp"
- "Reducing DC errors in op amps"

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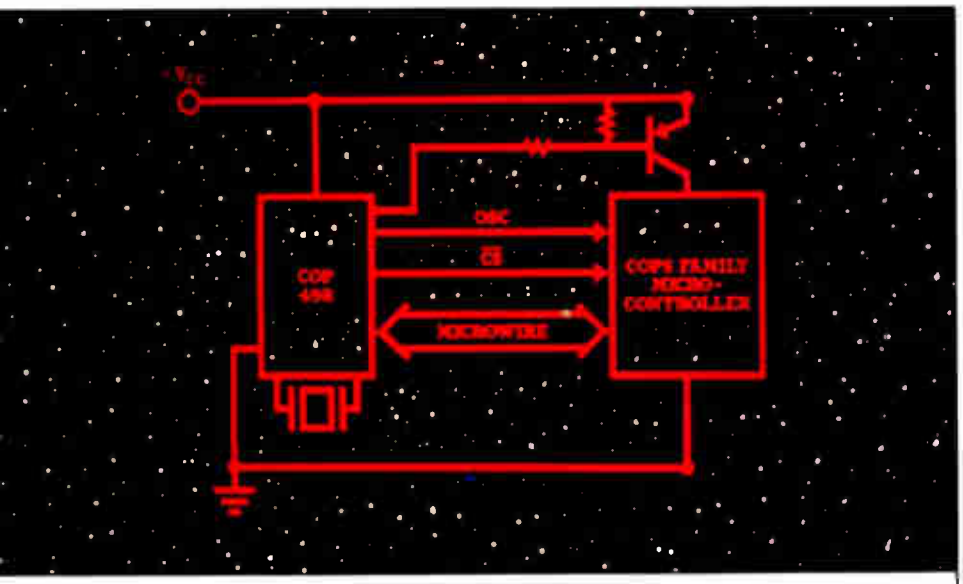
The RAT™ Chip—CMOS power at NMOS cost.



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The new low-cost COPS™ Family RAM/Timer chip trims an NMOS processor's power consumption down to nearly CMOS levels.

National's COPS Family of microcontrollers welcomes a powerful new peripheral member: the COP498 RAM/Timer.

In addition to its 64 x 4 RAM, the 14-pin CMOS RAT Chip carries a crystal-based timer. When used with any of the COPS microcontrollers (or any National μP), it allows the processor to go to sleep (power off) and wake up (power on) under software control.

As an extra measure of design versatility, the engineer can choose between a 2.097152MHz or a 32.768KHz timer. In operation, the processor can specify either a 6ms, 1Hz or 16Hz wake-up signal from the RAT Chip. An external override capability allows for immediate processor wake-up whenever necessary.

The RAT Chip thereby reduces an NMOS processor's overall power consumption to nearly CMOS levels, yet it costs significantly less than CMOS components.

The distribution of intelligence. The COPS Family represents a unique approach to microcontroller applications.

Every COPS device – processors and peripherals alike – has enough intelligence designed into it to execute its own instruction set. By distributing the processing workload to each device on the MICROWIRE,™ every COPS system is optimized for efficiency.

The benefits of this family approach are felt throughout the development phase as well. The entire family is supported by a single development system (the COP400-PDS). The high-efficiency COPS instruction set consists of simple task-oriented instructions that not only take up less memory space, they also accomplish each task in less time than other single-chip microcontrollers.

So it's easy to see why the COPS Family provides the lowest cost solution to application problems. For complete information on the COP498 RAT Chip and the entire COPS Family, enter number 044 on this issue's National Archives coupon.

National takes the RAM market head on.

Only National has the technical expertise and manufacturing muscle to produce the industry's most popular high performance RAMs.

It takes a great deal of manufacturing and technical know-how to satisfy the ever-increasing demand for static and dynamic RAMs. And National Semiconductor has a lot of both.

In fact, National offers the most popular line of high performance MOS RAMs in the business.

Having just stepped up their production capacity even further, National is able to ship more parts in one month than most suppliers can ship in six. At volumes like these, you can be sure that their prices are competitive.

Vastly superior test facilities. Between the production and shipment of each RAM order come National's high-caliber test procedures.

In addition to their use of conventional component level electrical testing from wafers to tested packages, many dynamic RAM customers request National's unique MST™ (Memory Systems Test) program.*

MST eliminates or greatly reduces your own requirements for internal testing. So your incoming test, board test, and system rework costs are substantially reduced. Because MST parts have already been debugged in a 9 megabyte memory system.

The future looks even brighter. In the months to come, National's MOS RAM product line will grow even broader. They will soon add new low-power XMOS™ static RAMs and new dynamic RAMs incorporating their exclusive polysilicon capacitors.

The new dynamic RAMs will feature (among other things) improved refresh characteristics and a high immunity to soft errors.

To find out just how competitive National really is, contact your local distributor or NSC sales rep or enter number 043 on this issue's coupon.

MST and XMOS are trademarks of National Semiconductor Corporation

*Pat. Pending

Between their technical expertise, their high volume production capacity and their high-quality RAMs, it's easy to see that the Practical Wizards are taking the RAM market head on.

RAM SUMMARY TABLE

STATIC RAMs

Part Number	T_{AA} (ns)	Organization
MM2114	150-450	1K x 4
MM5257	250-450	4K x 1
NMC2114A†	120-250	1K x 4
NMC5257A†	120-250	4K x 1
NMC2141	120-250	4K x 1
NMC2142†	120-250	1K x 4
NMC2147	45- 70	4K x 1
NMC2147H†	35	4K x 1
NMC2148	55- 70	1K x 4

DYNAMIC RAMs

Part Number	T_{AA} (ns)	Organization
MM5280	200-270	4K x 1
MM5298	150-250	8K x 1
MM5290	120-250	16K x 1
NMC5295†	80-150	16K x 1
NMC4164††	120-250	64K x 1

†Production in 2-4 months
††Production in 4-6 months

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Universal PLLs simplify AM/FM design.

By combining ECL and I²L technologies, National designed the first single-chip AM/FM Phase-Locked Loops that did not require external prescalers.

National's DS8906 and DS8907 universal Phase-Locked Loops were the first to offer extremely low-noise operation with single-chip versatility.

Thanks to their simple serial data interface, these highly sensitive PLLs operate effectively with the COPS™ Family (or a wide range of other) microcontrollers. This universal approach makes the DS8906/07s ideal for any digital AM/FM radio design.

No prescalers required. The DS8906 and DS8907 were the first PLL frequency synthesizers to accept 120MHz directly. By reducing these functions to a single 20-pin chip, National can offer the double advantage of small size plus high performance and versatility.

In addition to their AM and FM frequency references (500Hz and 12.5kHz, respectively for the DS8906; 10kHz and 25kHz, respectively for the DS8907), both PLLs feature a 50Hz "time of day" reference for digital clock radio designs. All generated from an on-board 4MHz crystal controlled oscillator.

High volume production. National Semiconductor, a long-time leader in bipolar ECL/I²L technology, has their distributors well-stocked with both the DS8906 and DS8907 Phase-Locked Loops. And due to their current high volume production, these versatile PLLs are very competitively priced.

For complete information on National's low-noise Phase-Locked Loops, check box number 047 on this issue's National Archives coupon.

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What's new from the National Archives?

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018 ☐ LM135/LM235/LM335/ Data Sheet

025 ☐ PAL Brochure

034 ☐ LM11 Data Sheet and Application Information

036 ☐ Optoelectronics Handbook ($3.00)

037 ☐ STARPLEX™ and ISE™ Information

043 ☐ Memory Data Book ($3.00)

044 ☐ 1980 MOS Data Book ($4.00)

047 ☐ DS9806/07 Data Sheets

052 ☐ Free Data Update Subscription

053 ☐ 1980 Linear Data Book ($9.00)

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pose fiber-optic links.

Already, HP's Optoelectronics division reports fast acceptance of its recently introduced $55 5-meter, 10-megabit/second complete link [*Electronics*, Nov. 20, p. 153]. And Motorola Semiconductor Group's High Frequency Optical Electronics division is expanding its line of receivers and transmitters. What's more, both firms have jumped onto the price-cutting bandwagon.

There is activity in other segments of the fiber-optic data-link market as well. For example, specialized components for special-purpose data links are burgeoning [*Electronics*, Jan. 27, p. 149].

New parts. In the general-purpose area, Motorola will unveil five new components at the early-April Electro show, the first of many set for introduction this year. Prominent among the five are two monolithic receivers. One converts optical inputs into TTL-compatible 10-Mb/s outputs, into emitter-coupled-logic–compatible 20-Mb/s outputs, or into 10-megahertz outputs for any analog system. The other, simpler part provides data rates of up to 500 kilobits/s. Both will sell for less than $10 each in volume.

On the pricing front, HP has dropped the price of its 100-m transmitter by 33% to $150 and of its 1-kilometer transmitter by 35% to $225, with receiver prices dropping accordingly. Further, the $55 data-link price should drop with bigger volume, predicts Gary LaBelle, marketing manager for the Palo Alto, Calif., division.

Motorola's cuts go even deeper, between 30% and 60% on 36 components, taking effect April 8. The parts are various transmitters, receivers, and integrated receiver preamplifiers in an array of packages.

The price reductions mean that system designers can put together fiber-optic networks at costs approaching those of hardwired versions, argues Jim Herman, fiber optics marketing manager for the Phoenix, Ariz., division. For example, combining a 900-nanometer emitter and corresponding detector capable of handling data rates as

News briefs

Laser target simulator goes into production

First production units of a simulated laser target for use with the airborne Pave Penny target identification system are off the production line at Martin Marietta Aerospace's Orlando, Fla., division. Used in training, the 45-pound target system is set up on a tripod and produces a laser signal that does not pose the hazards to eyes and skin of the real Pave Penny system, which acquires a target illuminated by a laser. The simulator relies on a 1.06-micrometer, 50-millijoule (average) neodymium–yttrium-aluminum-garnet laser whose pulsed output is diffused by a piece of sand-blasted acrylic. Some 64 systems will go to the Aeronautical Systems division, Wright-Patterson Air Force Base, Ohio, under a $4 million contract.

IC makers to get radiation-hardening expertise

Radiation-hardening technology developed by Sandia National Laboratories in recent years for U. S. defense and space programs now will help commercial semiconductor manufacturers. Sandia has established a center for radiation-hardened microelectronics that will transfer design and processing capabilities to private industry. The major direction of the Albuquerque, N. M., center will be in complementary-MOS and metal-nitride-oxide-semiconductor circuitry for nonvolatile memory. A lesser effort will go into n-channel and bipolar work. Any production at the center will be for emergency needs of defense, energy, and space programs. A 5,500-square-foot laboratory houses processing for 4-inch wafers, 24 diffusion furnaces, and other equipment under computer control.

Mainframe market to stay healthy for IBM and its followers

The market for IBM computers and their plug-compatible competitors will continue to grow attractively, says Creative Strategies International. In a just-published report, the San Jose, Calif., research firm predicts that the total worldwide market for mainframes running IBM software and costing $100,000 and up will be $46 billion for 1980–85, with the plug-compatible makers expected to obtain $2.8 billion of that. In addition, the report estimates, $30 billion worth of the peripherals will be bought.

Mostek's Prothro gains chairman title

United Technologies Corp. has completed the transferal of leadership at its Mostek Corp. subsidiary to Charles V. Prothro. The 38-year-old Mostek president has been named chairman of the Carrollton, Texas, firm. The appointment comes two months after the sudden departure of L. J. Sevin, Mostek's founder and only chairman until his resignation [*Electronics*, Jan. 27, p. 53]. Immediately after the move, Prothro was named chief executive officer in addition to his duties as president and chief operating officer.

Fifth company plans to make 6800

Motorola is inking another second-source agreement for its MC68000 microprocessor. Signetics Corp., the Sunnyvale, Calif., affiliate of Philips, plans to produce the 16-bit processor, as well as designing and making data-communications peripheral chips. Previous 6800 second-source agreements include Rockwell in the U. S., Hitachi in Japan, and EFCIS, the MOS house owned by Thomson-CSF and the French atomic energy agency.

TRW-Fujitsu's first computer bows

The multitasking, multiterminal market is the target of TRW-Fujitsu Co.'s first computer product, a system that can be operated in configurations varying from a stand-alone setup to 80-station networks. The TFC 8500 family consists of Fujitsu's V-830, introduced in 1979, and the higher-performance V-850 introduced last July: till now both were available only in Japan. The recently formed Los Angeles joint venture of TRW Inc. and Fujitsu Ltd. [*Electronics*, Sept. 25, 1980, p. 102] wrote programs and assembled operating software packages for the American versions.

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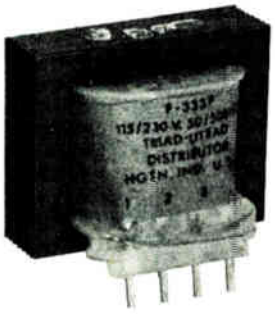

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high as 20 Mb/s for distances up to 1 km costs about $22 for both components in under-25-unit quantities, he claims.

Not to be outdone, Spectronics says it is planning to announce "significant price reductions" during Electro, but declines to give details. In mid-1981, the Richardson, Texas, division of Honeywell Inc. also plans to introduce a new set of transmitter and receiver circuits for 45-Mb/s, 2-km networks.

Bucking the trend, TRW Optron is not slating price reductions on its present product line. Instead, the Carrollton, Texas, division of TRW Inc. is planning performance upgrades while holding prices level. It will introduce two new monolithic receivers, the first in May with upper limits of 10-Mb/s transmissions and 100-m distance.

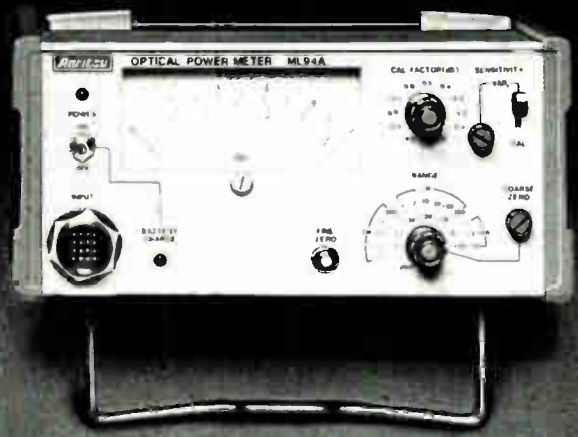
Users. From the user's point of view, such quickening product and price-cut developments indicate that fiber-optic data links have arrived. "I have no doubt about it," says R. Kirk Moulton, principal engineer in the Technology Applications group of Sperry Univac, Blue Bell, Pa.

A key problem has been the lack of choice: systems houses want multiple sources, and only now are suppliers beginning to offer roughly similar parts that can substitute for each other. Compatibility continues to be a problem, but a move toward standardization on the part of the two connector camps led by Amp and Amphenol raises hope for a solution, Moulton thinks.

Ready. The next step is up to the computer makers, "since components are still first-generation but at the spot where they work," he holds. In fact, many companies are well into the design stages, and some terminal-to-peripheral and terminal-to-terminal links could emerge as early as next year.

However, "customers still want prices to come down more with more performance," Moulton says. On the supply side, HP's LaBelle is heartened by the pickup in interest: "For a while, it seemed there were more suppliers than users of fiber-optic components." **-Larry Waller**

ML93A



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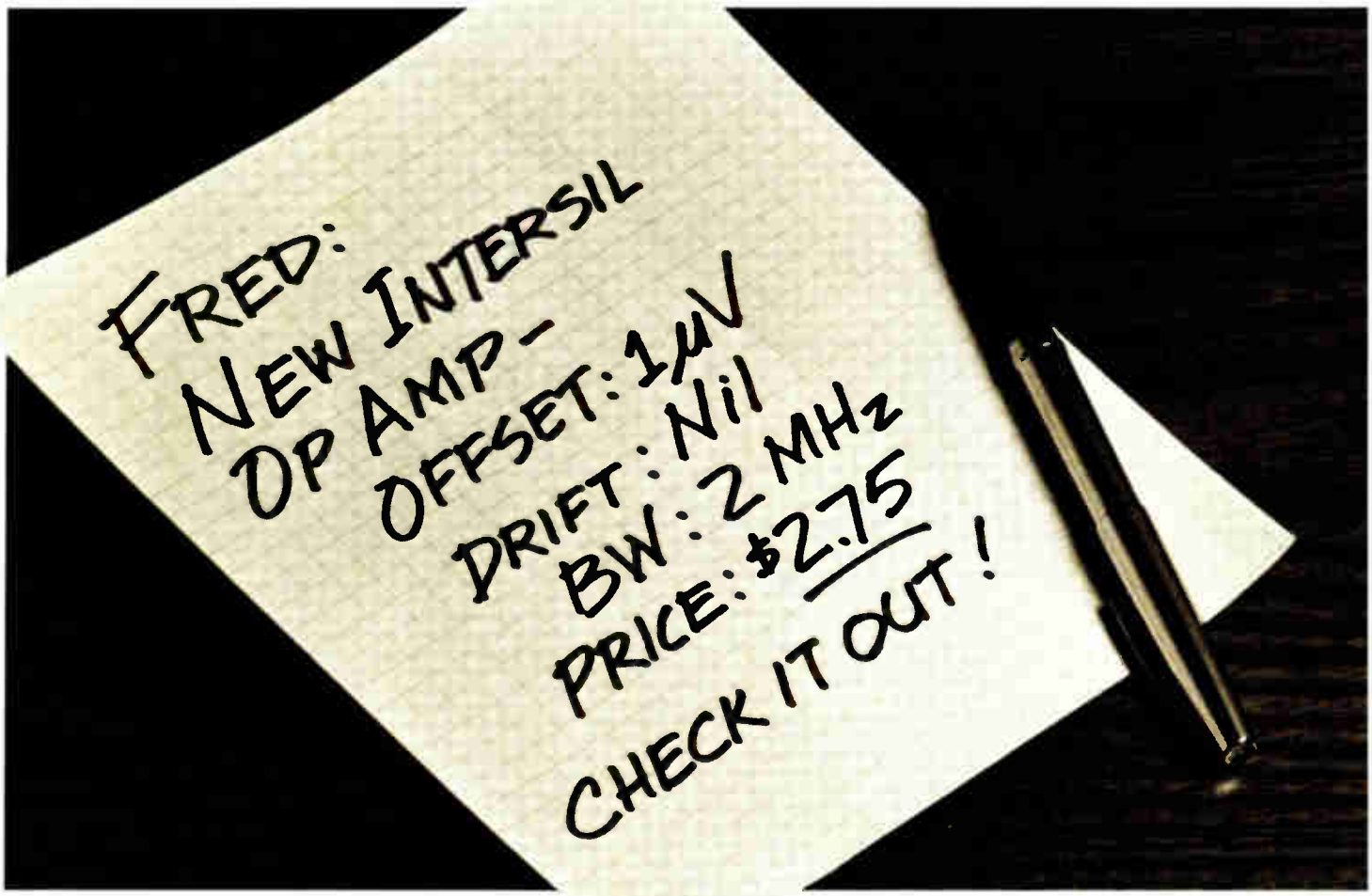

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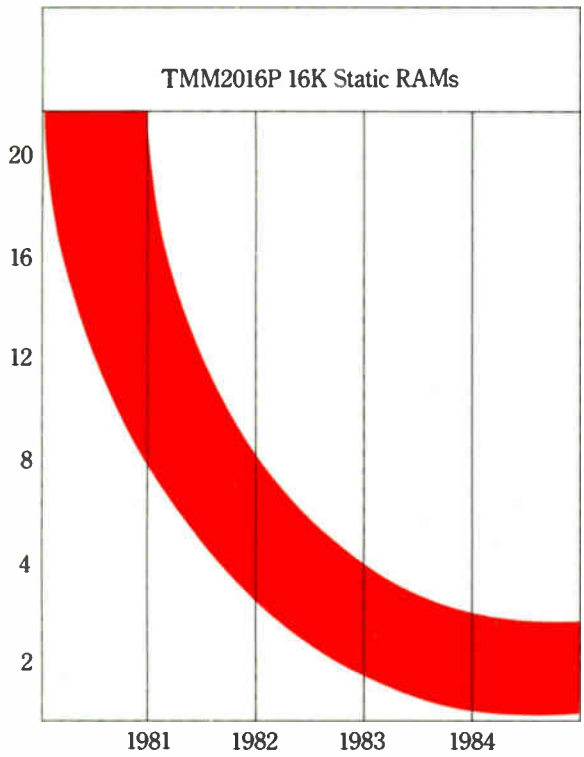

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Typical operating current of the TMM2016P is 60 mA. In the low power standby mode, operating current is reduced to 7mA (Typ.).

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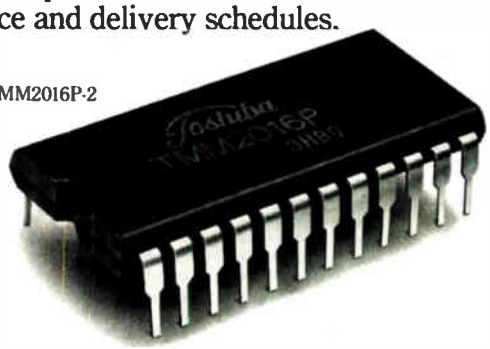
*1000 unit price for TMM2016P-2



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Washington newsletter

Benefits for missiles, avionics seen in Reagan budget . . .

Missile and aircraft electronics suppliers stand to be the biggest beneficiaries of President Reagan's revisions proposed for military spending in fiscal 1981 and 1982. Even though fiscal 1981 is already nearly half over, Defense Secretary Caspar W. Weinberger has asked Congress for a 4% **increase to $178 billion in existing obligational authority**—that is, money that may be carried over to later years—plus 13% more for fiscal 1982 than was sought in the Carter budget [*Electronics*, Jan. 27, p. 93]. That would raise spending authority to a peacetime record of $222 billion. Included in the total sought in fiscal 1981 and 1982 are, respectively, $48.2 billion and $68.5 billion for procurement, representing a 42% rise in the fiscal year to begin in October; $16.7 billion and $21.7 billion, for research, development, testing, and engineering, up 31%.

. . . as five producers get big boosts for tactical missiles

Outstanding increases are proposed for tactical missiles produced by such companies as **Raytheon, General Dynamics, Texas Instruments, Rockwell International, and Hughes Aircraft.** Fiscal 1982 missile procurement from Raytheon Co., for example, would jump to 364 (from 130 under Carter) on the Patriot and to 910 (319) for the infrared Sidewinder and would add nearly $115 million to the $35 million previously requested to upgrade the Improved Hawk. On the radar-guided Sparrow, which Raytheon and General Dynamics Corp. both provide, 905 additional missiles have been requested in 1981 and 1982, for a total of 4,550. GD would also get orders for 570 more Stinger missiles for fiscal 1982, raising that year's total to 2,544. A new Air Force buy of TI's HARM missile that homes in on radar would more than double orders to 270, while Hughes's antitank Tow missile would be increased in fiscal 1982 by 2,666 to 14,266.

Aircraft reflect multiyear buys

The enormity of the Reagan military budget increases—and his commitment to multiyear procurements—is also reflected in helicopters and tactical fighters. **Also notable is the nearly $2.5 billion sought to begin funding of the first five of a new class of bomber.** Proposed increases in helicopter buys include the Navy's SA-60B Lamps, on which IBM Corp. is prime contractor. It would jump to 18 units from the 8 proposed by Carter. Hughes Helicopter's AM-64 tank killer for the Army would rise to 14 from 8, while Sikorsky Aircraft's UH-60A utility chopper would increase to 96 from 78. Purchases of Grumman Aerospace's EA-6B electronic surveillance and attack plane would triple to 6 and its F-14A fleet defense fighter would rise to 30 from 24. Orders for Lockheed's P-3C antisubmarine warfare plane would double to 12, whereas those for the Air Force's McDonnell Douglas F-15 fighter would rise to 42 from 30. Similarly, purchases of the Air Force's General Dynamics F-16 multimission fighter would include 24 more planes, for a total of 120.

AT&T asks court to uphold FCC on new business

The Newark, N. J., Federal district court has been asked by American Telephone & Telegraph Co. to uphold last year's ruling by the Federal Communications Commission in the Second Computer Inquiry that the company, through a separate subsidiary, can manufacture and provide enhanced customer-premises equipment and services on a deregulated basis. **The action by AT&T came as its latest Federal antitrust suit went to trial in Washington Federal district court** following failure of attempts to reach an out-of-court settlement, although a settlement is still expected.

Washington commentary

Mixed signals on technology

"Long-term exploitation of our technological advantage," argues William J. Perry, "is fundamentally dependent on maintaining the health of the defense technology base." That truism from the former under secretary of defense applies as aptly to the nation's overall technological base as it does to the narrower segment serving defense needs.

Congressional and industrial leaders with an interest in technology should bear that in mind as they start weighing the budget cuts that affect engineering and science education and instrumentation, just as they should when reviewing the military budget increases sanctioned by President Reagan's Office of Management and Budget. For they and the President must realize that the U.S. has to cope with simultaneous technological challenges on two fronts: the growing Soviet military capabilities and the equally serious challenge in the nonmilitary marketplace from Japan and, to a lesser extent, Europe. What these challenges have in common is skilled manpower and technology, particularly electronics.

The view from the DOD

Thus far, the Reagan Administration's efforts to formulate a technology policy recall the observations of generals throughout history, who said that they found it easier to fight a war with an enemy than to negotiate with an ally. On the military side, Defense Secretary Caspar W. Weinberger—who has retained Perry as a Pentagon consultant—believes that the expensive Reagan program will be responsive to Soviet military growth. However, the White House has not yet evolved a coordinated trade and military spending policy with Japan or with the member nations of the North Atlantic Treaty Organization.

Military electronics contractors in the U.S. are delighted, of course, with the Reagan plan to gain leverage against the Russian bear by spending over the next five years some $169.5 billion in 1982 dollars over and above the Carter Administration's last budget of nearly $198 billion. They also like the OMB proposals to adopt multiyear contracting for longer production runs that purportedly will save up to 15% in a weapon's unit cost. Other savings over the longer term will come, the OMB says, "by encouraging investment in bottleneck industries where capacity constraints now impose high costs." Microelectronics, notes DOD consultant Perry, is just such a bottleneck.

Overseas, however, it is a different story. Japan prefers to continue its survival under the U.S. military umbrella while investing in industrial and commercial technology for export, rather than for self-defense. Despite this—and the absence of a Reagan policy to cope with it—Federal support for America's technological base in education will continue to erode under the OMB's spending programs.

Dealing with Japan and NATO

Maintaining as small an armed force as possible is good for Japan's expanding commercial trade with other nations, of course. They see no military threat from Japan, now one of the world's three leading economic powers. Japan is, however, committed to a marginal increase in defense spending following heavy pressure from the Carter Administration.

As for the Reagan team, the only proposal advanced thus far for trade concessions has been the heavy-handed threat by Transportation Secretary Drew Lewis calling for import quotas on Japanese cars. It produced cheers in Detroit but little else. The reaction from most hard-pressed American consumers was decidedly negative.

Similarly, a top-level Reagan delegation flopped at a private meeting of NATO leaders in Bonn last month. Led by Deputy Defense Secretary Frank Carlucci and Senate Armed Services Committee chairman John Tower (R., Texas), the group sought to persuade leaders from West Germany and other NATO allies to follow the Reagan lead and increase their own defense outlays. But, like Japan, Europe clearly has different economic priorities from the U.S., and the proposals had no more success than those made earlier by the Carter Administration.

Making "linkage" work

If President Reagan and his U.S. Trade Representative, William Brock, believe that there must be "linkage" between trade and foreign relations issues, then the White House must do substantially more thinking on converting that view into an effective policy for dealing with U.S. allies. More military electronics spending may be necessary; it also may be nice for business. But it cannot be considered an effective way of offsetting other domestic electronics markets lost to trade with Japan or the corporations lost to acquisitive European companies. A good starting point would be to maintain and build on the nation's technological competence, not to attempt to achieve a "new economic beginning" by cutting it further. That is a contradiction in terms.

-Ray Connolly

SCIENCE/SCOPE

Listeners of National Public Radio can now hear concerts live and in stereo, thanks to Western Union's Westar communications satellites. Before using the satellite network, NPR broadcast programs throughout the continental United States over telephone lines and land-based microwave links. The system was limited only to monaural signals, so programs that depended on good audio fidelity were duplicated on tape and distributed by mail to member stations. With the Hughes-built Westars, however, the radio network can broadcast with better sound quality and also transmit programs to some 220 stations at once.

Digital modifications to the weapon control system of the U.S. Navy F-14 Tomcat will enable the fighter to meet evolving threats through the 1990s. Enhanced tactical capabilities include electronic countermeasures, improved missile launch zones, coherent air combat maneuvering modes, and a digital display system. The key changes to the Hughes AN/AWG-9 system are the addition of a programmable signal processor and its companion radar data processor. These units can perform up to 7.2 million operations per second. The modifications will allow the F-14 to fully incorporate the improved AIM-54C Phoenix missile.

For the first time, a new battlefield data distribution system will provide an integrated capability for data communications, position location reporting, and identification for ground and air units. The secure, jam-resistant system, being developed for the U.S. Army, is called PLRS/JTIDS Hybrid. It combines and expands the proven capabilities of two high-technology systems -- PLRS, the Army/Marine Corps Position Location and Reporting System, and JTIDS, the Joint Tactical Information Distribution System. Hughes has entered the second phase of a five-phase accelerated development plan designed to meet the Army's critical need for reliable battlefield data communication by the mid-1980s.

Hughes Research Laboratories needs scientists for a whole spectrum of long-term sophisticated programs. Major areas of investigation include: microwave devices, submicron microelectronics, GaAs integrated circuits, ion propulsion, lasers and electro-optical components, fiber and integrated optics, pattern recognition, and new electronic materials. For immediate consideration, please send your resume to Professional Staffing, Dept. SE, Hughes Research Laboratories, 3011 Malibu Canyon Road, Malibu, CA 90265. Equal opportunity employer.

Three communications satellites ordered by AT&T (American Telephone and Telegraph Company) will live longer and handle more long-distance calls than earlier models. The new Telstar 3 satellites will serve 10 years instead of seven and have the capacity for 21,600 simultaneous calls instead of 18,000. These improvements are due chiefly to such technical innovations as solid-state amplifiers, better batteries, and a greater capacity for fuel to keep the satellites on station while in orbit. The new satellites will be based on the model Hughes is building for Indonesia, Telesat Canada, Western Union, and Satellite Business Systems. The first Telstar 3 is set for launch in 1983.

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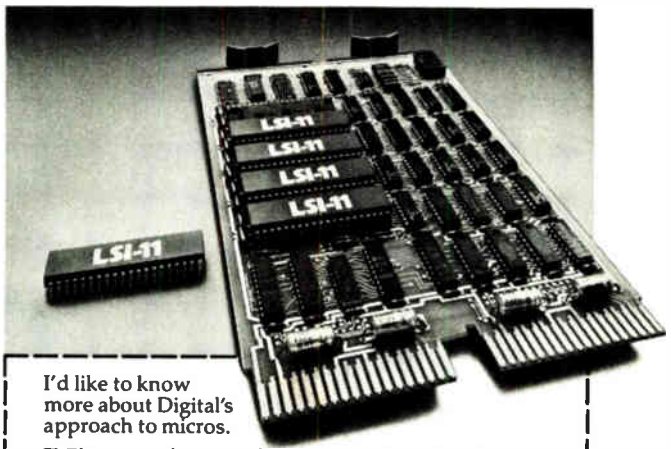

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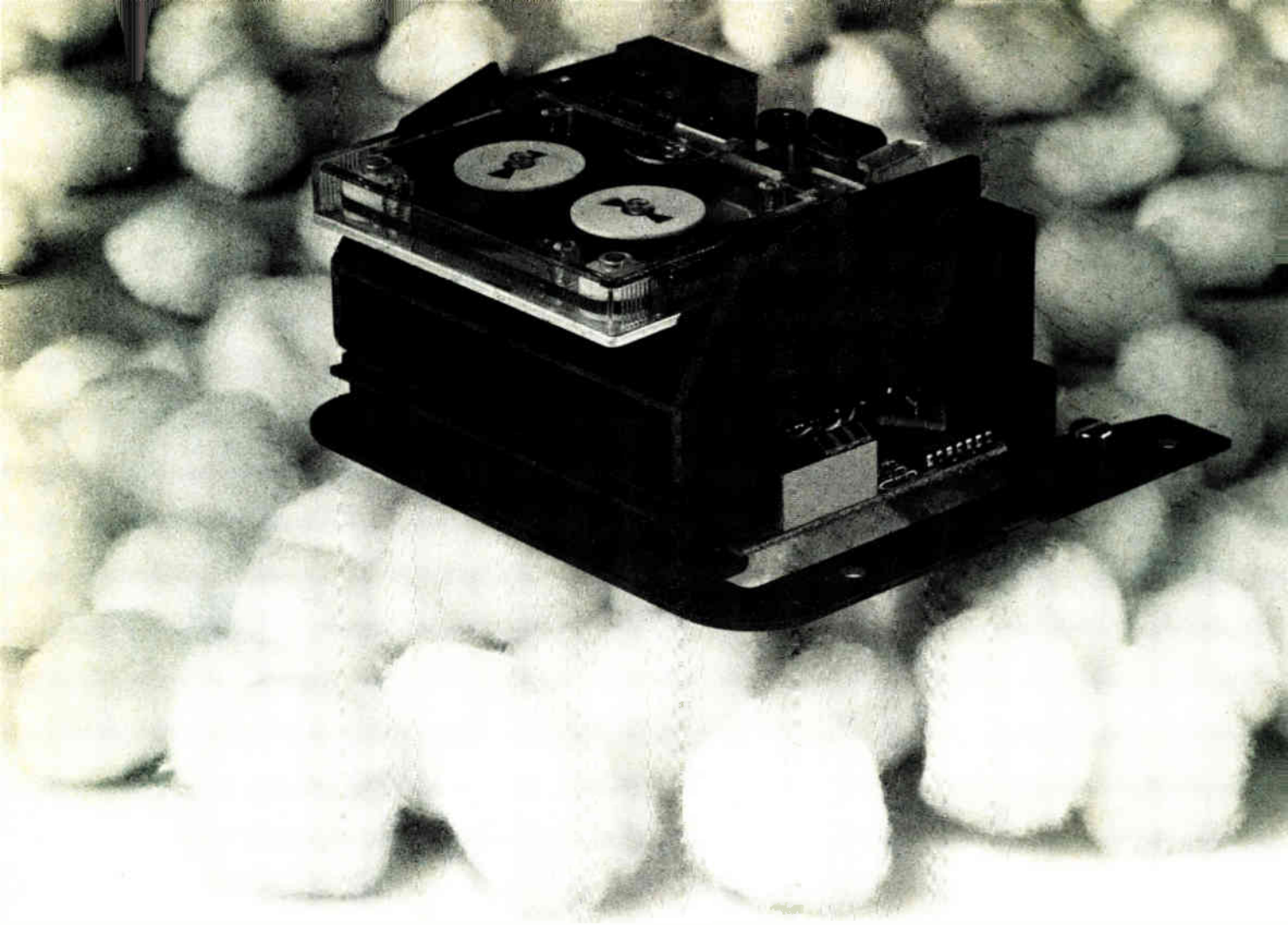

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International newsletter

Siemens multiplexes optical wavelengths

Seeking to push the high-transmission capacity of glass fibers even higher, researchers at Siemens AG in Munich, West Germany, are currently experimenting with optical components that may lead to a wavelength-multiplexing method for optical-communication switching systems. The components allow **the modulated near-infrared light from several sources of different wavelengths to be transmitted simultaneously over a single fiber**—not only in one direction but also bidirectionally. No lenses are employed. Instead, incoming light passes through a multilayer selective interference filter deposited on the polished, sloping face of a glass fiber. In two-channel unidirectional operation with a wavelength spacing of 70 nm., the total insertion loss checked in at 4 dB and the far-end crosstalk attenuation at 30 dB. In bidirectional transmission, the near-end crosstalk attenuation worked out to 60 dB.

Quartz vibrates at 525 MHz

A technique for producing quartz crystals so thin that they vibrate at a fundamental frequency of 525 MHz has been put into pilot production by the Compagnie d'Electronique et de Piézo-Electricité (CEPE), a Thomson-CSF subsidiary based in Sartrouville, near Versailles. The firm starts with quartz slices lapped to a thickness of some 33 μm, equivalent to a 50-MHz fundamental, and then **thins them down by ion bombardment to about 3.2 μm and a 525-MHz fundamental—the highest yet, says CEPE.** Though chips as thin as this are still experimental, the French firm expects to produce industrial versions with fundamental frequencies of 400 MHz.

NTT installs commercial 1.3-μm fiber-optic cable

Nippon Telegraph & Telephone Public Corp. has decided to start installing this spring 12 medium-capacity 32- and 100-Mb/s fiber-optic cable routes totaling 110 km and varying in length from 6 to 13 km. The Japanese corporation believes it is making **the world's first commercial use of cable operating at the long wavelength of 1.3 μm,** although some of its installations will operate at the shorter 0.8 μm. The 1.3-μm systems will use an indium-gallium-arsenide-phosphide laser with a 60,000-h lifetime, the 0.8-μm systems a gallium-aluminum-arsenide laser with a 400,000-h lifetime. NTT will also finish installation this spring of **a high-capacity 400-Mb/s field-test fiber-optic route** between an existing laboratory and one still being built.

Speech chip caters to low-volume users

Aiming at the manufacturers of security and other low-volume industrial systems, one small British microprocessor consultancy, Triangle Digital Services Ltd. of London, is launching a printed-circuit–board speech synthesizer. The IDS 910, which incorporates a speech chip of the company's own design, **synthesizes sentences, phrases, and even phonemes when triggered by any one of the three inputs:** 1 of 16 microswitch or reed relay contacts, remotely over a two-wire universal asynchronous receiver-transmitter interface, or more conventionally through an 8-bit parallel port. In the standard board, a 32-K programmable read-only memory stores the spoken numbers 0 to 9 as well as "point" and other key words. There are also two sockets for ROMs for the user's own selection of up to 70 additional words—a total that can be further extended with extra ROM boards. The $330 synthesizer will be available in the U. S. from Stynetic Systems Inc. of New York.

International newsletter

Toshiba uses C-MOS for 64-K static RAM

Toshiba Corp. may be the first chip maker to introduce a complementary-MOS 64-K static random-access memory. Now in development is an 8-K-by-8-bit 28-pin device with cells that measure 15 by 19 μm on a 4.6-by-6.55-mm (46,700 mil^2) die. Power dissipation is 50 mW active and just 100 μW on standby. Wafer steppers and 2-μm features have been used for the first pass on the RAM, which has no redundant elements.

The 64-K static RAM is over a year away, but this summer the Japanese company will supply **samples of the 8049 single-chip microcomputer, also in C-MOS.** With 3-μm rules, that chip will measure 22.8 mm^2 (35,350 mil^2) and draw 50 mW for active operation and only 50 to 500 μW while idling. Later this year, Toshiba will also be in production with a 64-K erasable programmable read-only memory—in n-MOS—with a pinout that matches Intel's.

Personal computers gain ground in the UK . . .

Three recent developments will encourage sales of personal computers in the UK. First, **the British Broadcasting Corporation has ordered 12,000 from Acorn Computers Ltd.** to sell to viewers of a series it will launch in January 1982 on programming by microcomputer. Then, Britain's National Enterprise Board, through a joint enterprise with American venture capitalist Jack Melchor [*Electronics*, Dec. 4, 1980, p. 69], is investing over $500,000 in Positron Computers Ltd., which is marketing a single-board computer aimed initially at the educational market. And third, Sinclair Research Ltd., Cambridge, is launching a more highly integrated version of its ZX80 [*Electronics*, Feb. 14, 1980, p. 80], which by using an uncommitted logic array from Ferranti Electronics Ltd. cuts the chip count from 17 to 4 and the price from $214 to $174.

. . . and another surfaces in Japan

Best known for its calculators, Casio Computer Co. has finally caught up with its name and entered the personal computer business in Japan. Its FX-900P is claimed to be **the first of its breed to feature complementary-MOS random-access memory with battery backup,** which can be expanded with optional kilobyte packages to a maximum of 32-K bytes. The single-package computer includes a 5½-in. cathode-ray tube that can display 16 rows of 32 characters.

Casio also announced for introduction in June a 2,508-word Japanese-English translator containing **a voice synthesizer with 263 English phrases for everyday conversation.**

Electronics employment in West Germany declines overall

The slump in West Germany's electronics industry is hurting some sectors more than predicted earlier this year [*Electronics*, Jan. 13, p. 134]. One of the latest victims is Siemens AG, the country's No. 1 electronics and electrical producer. By this month some 14,750 workers in the firm's communications, components, and other groups will be on shorter work weeks, out of a total work force in West Germany of about 235,000.

For the country's electronic data-processing sector, however, the labor situation is much different. According to the Frankfurt-based Central Association for the Electrotechnical Industry, in 1980 **the sector added roughly 10,000 people to its work force,** bringing the total to 56,000, and is likely to continue its hiring spree this year.

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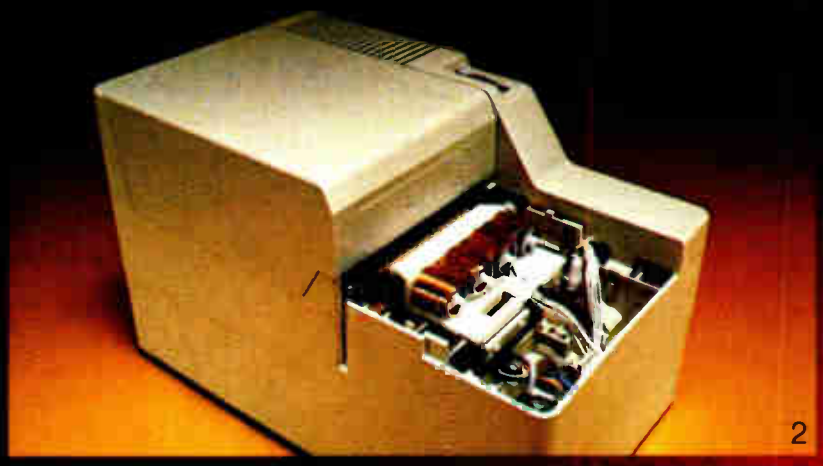
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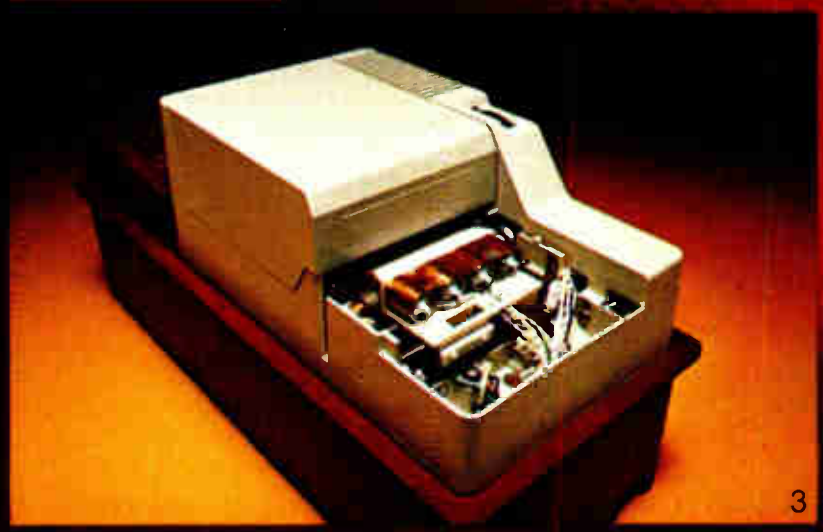
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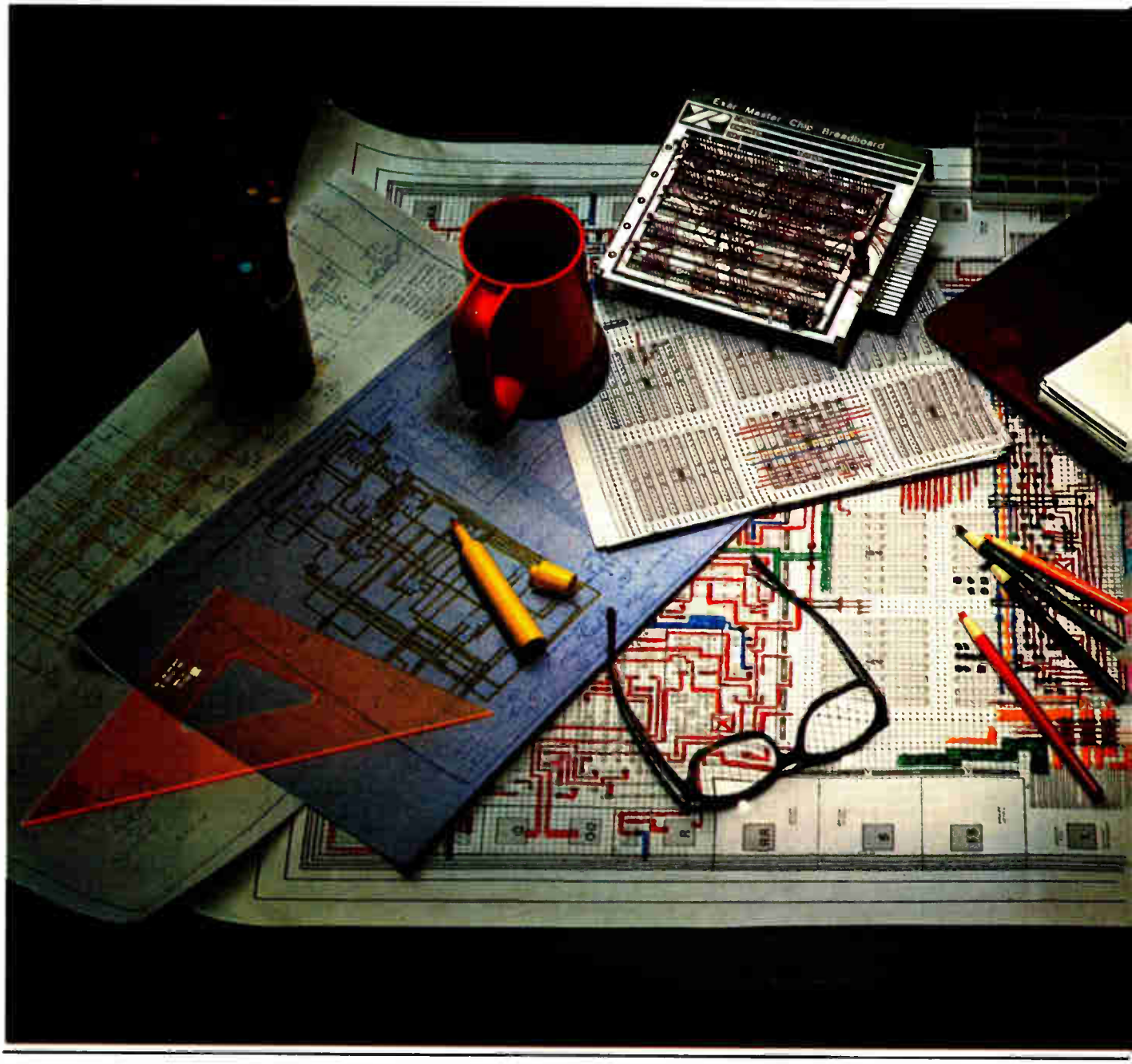

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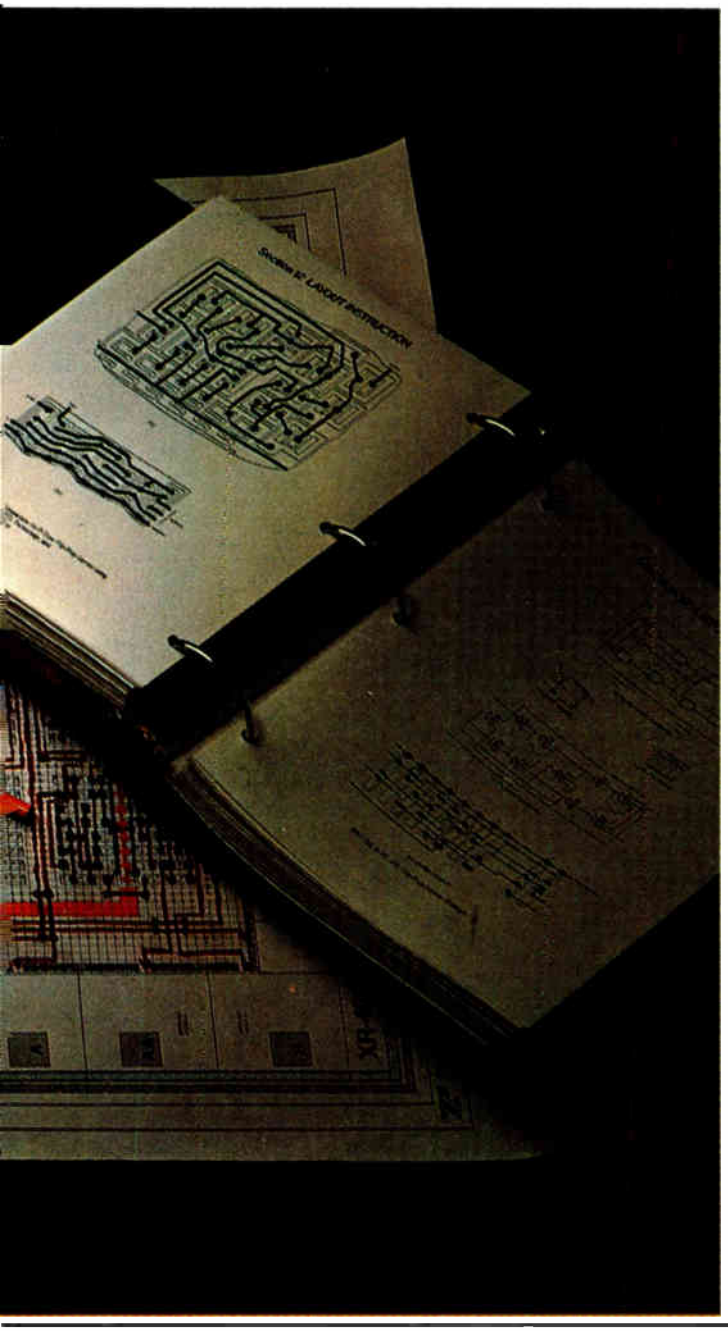

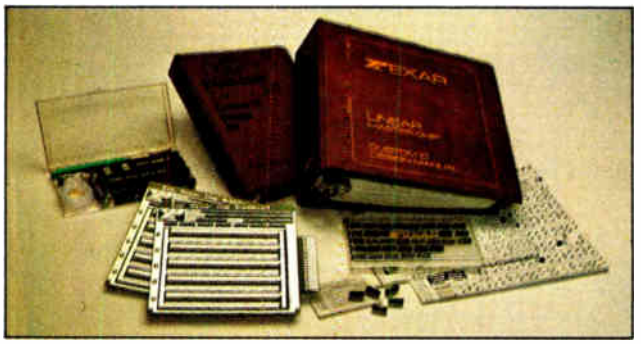

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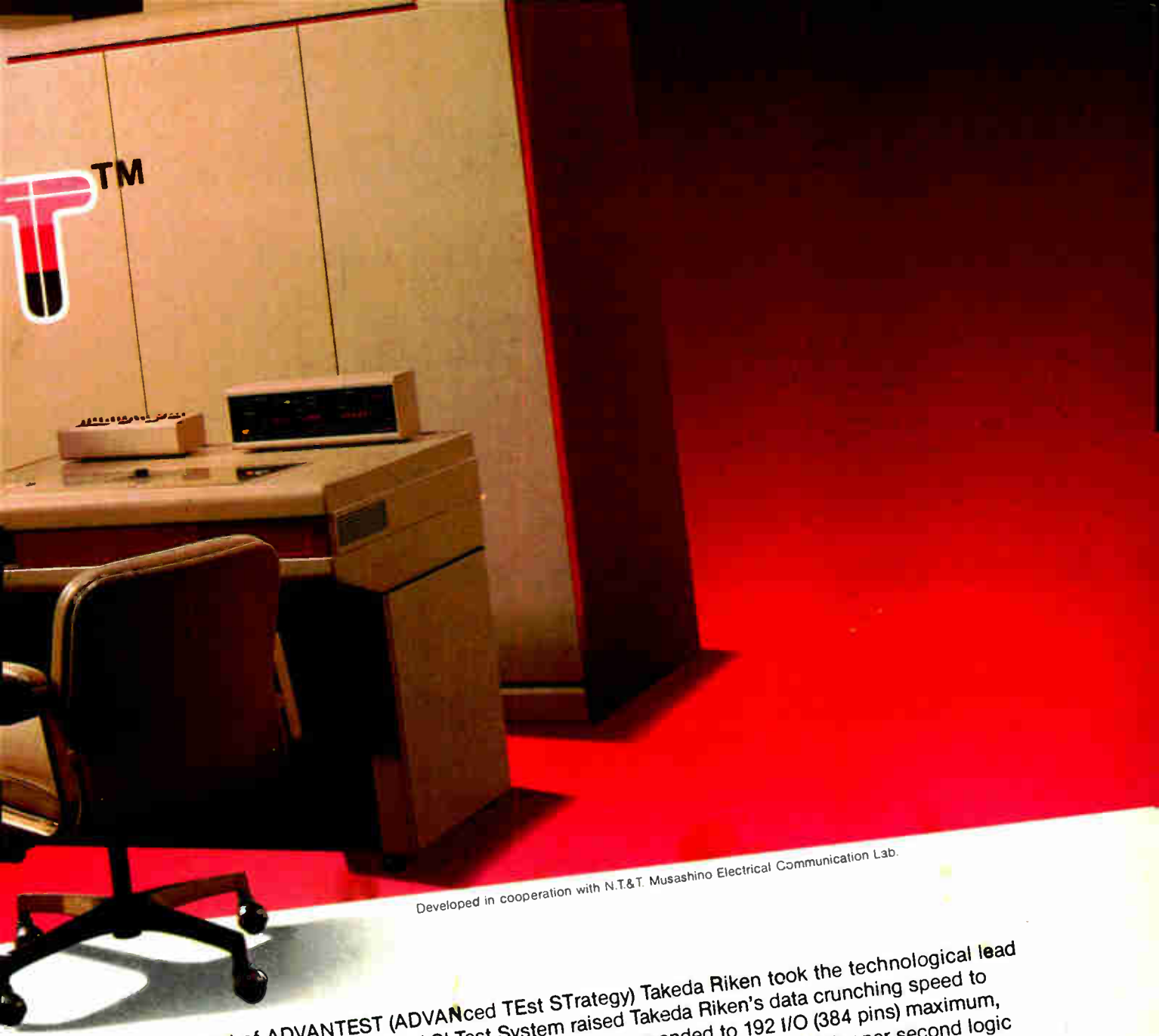

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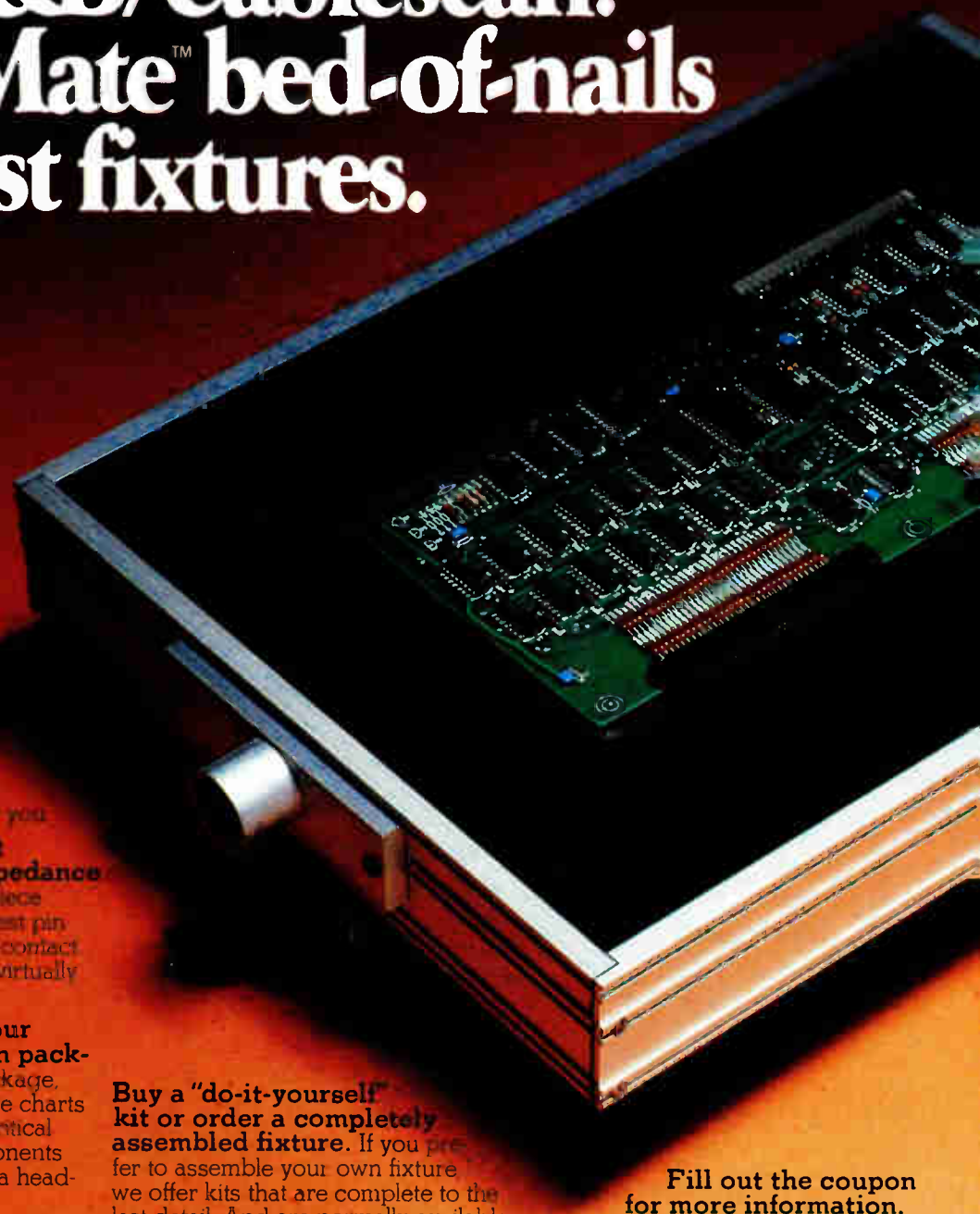

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Japanese trio pushes past the 3081 challenge

by Charles Cohen, Tokyo bureau manager

Hitachi, Nippon Electric, and Fujitsu each have single- or dual-processor setups that outdo IBM's largest machine

Japan's three major mainframe manufacturers have come up with three different approaches to compete with International Business Machines Corp.'s top-of-the-line 3081.

Hitachi Ltd., in a surprise move, introduced its M-280H computer with about 15% higher performance than the 3081 [*Electronics*, Feb. 24, p. 69]. But the M-280H performs only about 50% better than the company's previous top-of-the-line M-200H. In fact, together with the two-sizes-smaller M-240H, it forms the start of a new series, rather than being an extension of the old.

Even more surprising, the two new machines seem likely to force the retirement not just of the older M-170, -180, and -160II (see "Where Hitachi's other computer fits in," p. 78) but also of the relatively recent M-160H and M-200H. The former is only about two years old and the latter is little more than a year old. However, Hitachi has done well with both of them domestically and has perhaps sold enough of the export version of the M-200H abroad to go on to newer technology.

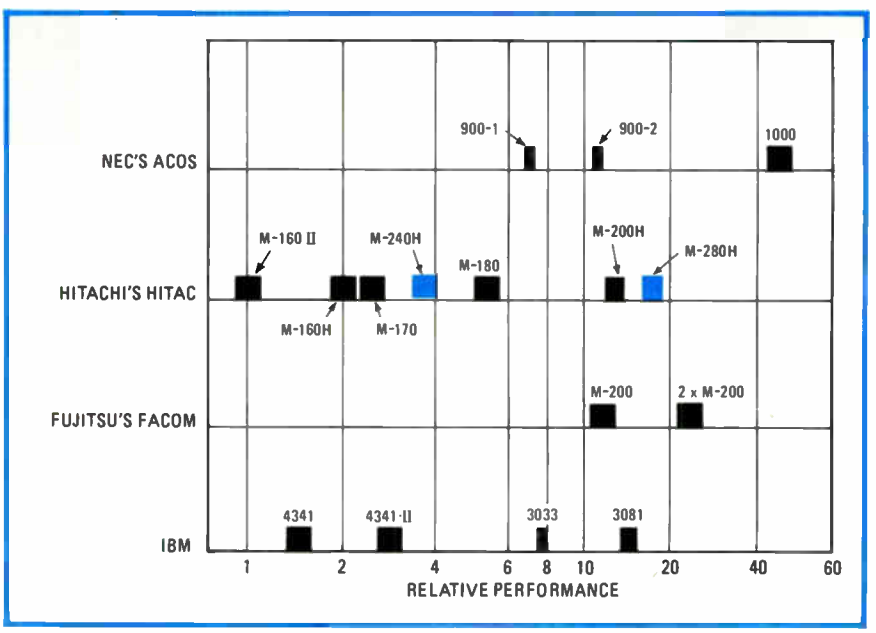
At ease. Meanwhile, Nippon Electric Co. is standing pat with its Acos system 1000, announced as a preemptive challenge to the 3081 [*Electronics*, Sept. 25, p. 64]. Configured with a single central processing unit, it has four to five times the performance of the previous top-of-the-line Acos system 900. A two-CPU configuration almost doubles this level of performance.

Fujitsu Ltd. claimed to be No. 1 in computer sales in Japan last year and says it will pull off the trick again during the current fiscal year, which ends on March 31. It will compete with a dual-processor configuration of its existing Facom M-200 until IBM announces a model larger than the 3081.

In the works. When that happens, Fujitsu will respond with a new S series slightly larger than the new IBM model. It says it has already developed new large-scale integrated circuits and new boards for an experimental single processor that will run at 25 million instructions per second. The ICs are four times as dense as those used in its present machines; and 121 are used on a board measuring about 7.9 inches (20 centimeters) square; 13 boards comprise the processor.

With the announcement of the new Hitachi computers and Fujitsu's expressed intention of coming out with a new series, the fiction of the joint development of Hitachi and Fujitsu computers has become completely unglued. Still, the software of the two companies' products will remain similar because both will remain essentially IBM-compatible, albeit not IBM-plug–compatible in Japan. NEC continues on its present course, which builds on Honeywell's architecture of the early 1970s, but is no longer compatible with it.

Software, too. Along with its introduction of the new computers, Hitachi announced a list of 25 pro-



Ahead. Hitachi's newest big computers (tinted) edge in front of their IBM rivals. Fujitsu's dual-processor M-200 is farther in front, and NEC's 1000 leads them all.

Where Hitachi's other computer fits in

Hitachi calls its M-240H the most compact large computer in the world. The processor in its maximum configuration of 8 megabytes of memory and eight channels boasts a throughput of 16 megabytes per second—more than the IBM 4341 group II—yet it fits in only 0.96 square meter of floor space. Its main memory uses 64-K chips, while its logic circuits are predominantly Hitachi's own 1,500-gate emitter-coupled-logic arrays, with some 550-gate ECL arrays. There is also a 32-K-byte cache memory using high-speed bipolar memory for improved performance. Monthly rental of the minimum practical system is $48,750.

The M-240H has three to four times the performance of the present M-160II, from which Hitachi expects users to migrate to the M-240H. This places it between the present M-170 and M-180H [*Electronics*, March 27, 1980, p. 126]. Thus in the future the firm may want to add another computer in the rather large gap between the M-240H and the M-280H, which is skewed toward the high side.

gram products, including new virtual operating systems for the M-280H and M-240H. New software products for these two computers and also for the firm's present M-160II, M-170, M-180, and M-200H will phased in from the end of this year through early 1983.

In addition, Hitachi has decided to unbundle a total of 30 software products for the six computers. Although the firm is providing some enhancement for its present computers, the decision to make this big investment in new software and the new advanced ICs were probably strong factors in its decision to produce the new computer line.

Great Britain

British reorganize videotex marketing and plan to propose standard to FCC

With the videotex market on the brink of vast expansion, the British, whose sales force was the first to range the world spreading the word about the television information service, are trying to recapture that initiative in the U. S. from the French and Canadians. At the same time, the basic videotex concept is widening from that of a single central data base on which all information providers may purchase space to one that routes users to private host processors. This greatly enhances its commercial appeal.

To pull their fragmented and disjointed marketing activities into a single operation backed by the government, the British have formed British Videotex and Teletext (BVT), a joint venture of British Telecom, the government's telecommunications entity, and Logica Ltd., a communications and software consultant. BVT's $3 million financing is split three ways: $1 million to promote videotex, linking TV via telephone to remote computer, $1 million to promote the compatible teletext technology and hardware of the British Broadcasting Corp. that broadcasts information in the blanking interval of telecasts, and $1 million to promote British videotex and act as a clearing house for inquiries to other makers.

U. S. approach. One of BVT's first tasks will be to submit a British industry proposal to the U. S. Federal Communications Commission on a videotex standard based on the British system. It takes into account the differing American and European line standards yet retains the full 40-character–line, 24-line format. BVT has hired Gary Rosch, a former senior FCC official who until recently was a lobbyist for the rival French Antiope videotex system.

British efforts in the U. S. have been stymied up to now by a marketing agreement that, in effect, gave General Telephone & Electronics Corp. exclusive U. S. marketing rights to the British system. But now BVT and Aregon International, a British software group, will be directly competing for that business.

Meanwhile, even as new technological developments broaden the scope of videotex to include private systems, the West German post office has been trying a gateway facility in which a user might ask for, say, a rail timetable on the public videotex service, then be automatically routed via a packet-switched network to the railroad's own data base for more information. The Bundespost has hired Aregon to provide the software for such a service.

Aregon is also stretching videotex for the Common Market Commission by implementing a gateway to Euronet, a trans-Europe packet-switched data-retrieval service. It also has a contract from West Germany to develop a message-switching service based on videotex. And in the U. S., where it will compete with BVT, Aregon has opened an office in Anaheim, Calif. In the belief that videotex in the U. S. should play on American hardware, the firm has developed its own IVS-3 system to run on Digital Equipment Corp. VAX computers; BVT is staying with the GEC 4080s that are used by British Telecom. **-Kevin Smith**

Briefcase computer has plasma display

They began by designing a portable data terminal but ended up producing a computer in a briefcase, complete with a plasma display, a full ASCII keyboard, a 92-K magnetic-bubble memory, and a 300-bit-per-second acoustic coupler to link it by telephone to a remote computer.

"As we talked to customers," explains Brian Lumb, managing director of Microdata Computers Ltd., "we began to realize that the only way to meet all their require-

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ments was with a microprocessor-based system that could be dedicated to specific tasks with the customer's own firmware." Now the Hayes, Middlesex–based start-up company is about to test the customer's response with a first sample production batch of the 17-pound briefcase computer.

It has been hailed as the ultimate executive toy, but at around $7,900 the Zilog Z80–based system has to earn its keep, and first takers have real jobs of work in mind. One newswire service, for example, is attracted by the computer's text-processing package and the useful 40-character-by-12-line plasma display. Also, a feedstock company wants it for its consultants so that they can work out feedstock supplements when visiting farmers.

Perhaps the unit's most distinctive feature is the slim plasma display. Its 480 five-by-seven-dot-matrix characters are controlled by an F8 microprocessor, freeing the Z80 for other tasks. The display also makes line operation essential, so that the computer has to include a switched-mode supply that can be switched to 240- or 120-volt operation.

Essential. Though the most expensive item in the package, Lumb believes the display is essential to making the computer easy for the unskilled user to operate. It is the only portable way of presenting the menus of options used at every stage to control the computer and aid the user in working his way through an application program.

The bubble memory, says Lumb, is used in place of a disk store and is organized in much the same manner. To load it with data, such as text that must be retained or the results of a program, the user has only to push the command button, select the file store option, and then transfer the named file. Also, the user can at any time call up a display of the files stored and the percentage of the store they occupy. Then, if any overflow is likely, it can be stored on an optional 1,200-bit-per-second cassette unit.

Apart from the bubble memory, there are also 32-K bytes of read-only memory and the same amount of random-access memory. About 14-K bytes of the ROM is programmed at the factory with the computer's operating system, a Basic interpreter, and a text editor. The remaining 18-K bytes of ROM stores the customer's application programs in 8-K-byte segments. These programs might be developed by a software house for the customer and then written into ROM to dedicate the computer to specific tasks. When a program is called up it is transferred into the computer's RAM.

A miniature 40-column thermal printer can be optionally fitted, but more usefully there are an RS-232-C and an 8-bit parallel interface for coupling the unit to an external 80-column bidirectional printer. Software options include a Pascal interpreter.

Microdata has set out to provide all the facilities—though on a reduced scale—that could be found in a personal computer. The question now is how many people will be prepared to pay close to $8,000 for them. Rival systems are already available—programmable calculators equipped with sales application software that sell for around $1,000. That is tough competition. Even so, Lumb is convinced that the richness of the resources provided by his machine will attract plenty of customers. **—Kevin Smith**

West Germany

Telex plus phone plus data terminal brings office of the future closer

West Germany's post office has approved a combination telephone, teletypewriter, and data terminal for connection to the public telephone network by way of a private branch exchange. Manufacturer Nixdorf Computer AG is pleased, since it is expanding into the communications area and the permission to send data over the public phone lines is helping to create a big demand for the Datatel system 8811.

According to the Paderborn-based computer maker, its Office Communications division has already received many orders from government agencies and organizations. The first units will be installed this year, "and in 1982 we expect to sell well over 1,000 systems," says Harald Winkel, product marketing manager for the 8811. Depending on the number of peripherals involved, the terminal will sell for anywhere between $2,500 and $7,500.

Multifaceted. A compact 18 by 26 by 15 centimeters (roughly 7 by 10 by 6 inches), the 8811 brings the office of the future a big step closer (see p. 157). As a two-way device, the system can be accessed by two dial numbers, one for phone traffic only and the other for phone or data communications. In a typical application, the 8811 ties to a PBX system within a firm so that it can carry on a dialog with a central computer at the firm's headquarters. At the same time, the user can call a party at headquarters, maybe to discuss the very data simultaneously being received by the computer. He (or she) may also use the system as a teletypewriter to send a telex from his desk directly to another desk in another office.

All lines from the PBX to the computer can be addressed by a collective number. When that number is dialed, the PBX automatically searches for a free line and establishes a connection to the computer.

In control. The basic terminal can have various input/output devices connected to it. It is controlled by a Rockwell PPS-8 microcomputer that contains the operating software and subprograms needed to monitor the keyboard and display, generate the call signals, keep tabs on data traffic, and control the peripheral devices by means of a universal channel program. Data communications with a computer, carried out by

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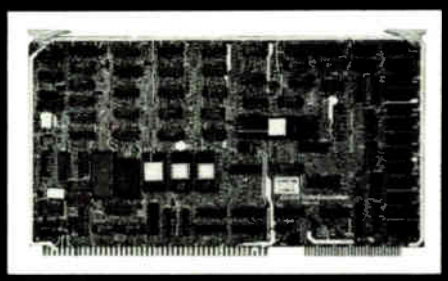

Z8000* Memory Management Processor Board features 4MHz Z8000 running with unique paged/segmented memory management. Includes interrupt controller, interval timers. Can also support PROMs and 9511 APU. Multi-User operating system available. Standard Board $795
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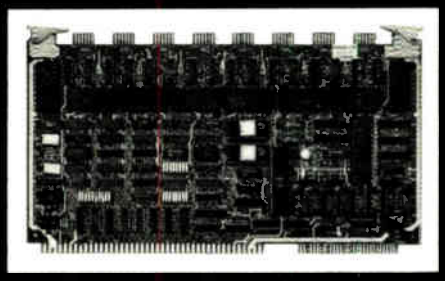
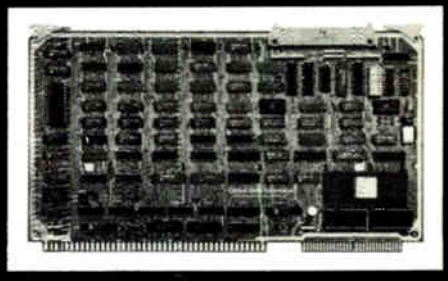
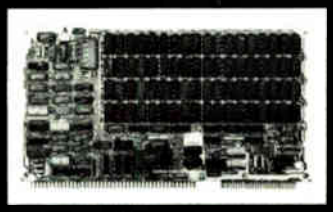


Intelligent Octal I/O Board provides 8: RS-232 ports controlled by on-board 2650 microprocessor. 16K of dual-port RAM allows data transfers with no bus overhead. Includes standard terminal driver program, can hold 4K custom driver program in PROM. $700.



ANSI Winchester Controller fully conforms to the proposed ANSI standard for 8" winchester disk drives. Custom microprogramming available to interface with other disk drive interfaces. Controls up to eight drives. $550.



32K-128K Dynamic RAM Board features low power consumption, standard parity checking, and ultra-high reliability.
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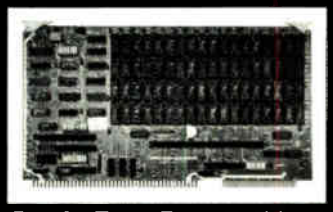
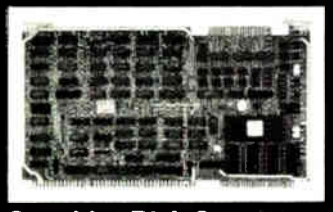
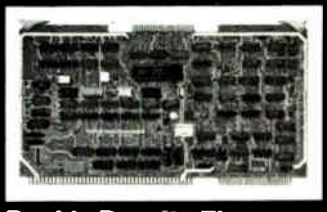


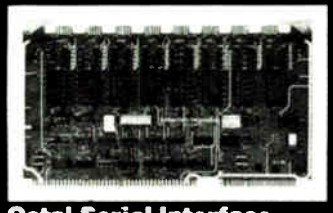
Static Ram Board adds either 16K or 32K of static memory to a Multibus system. 16K—$620
32K—$1100



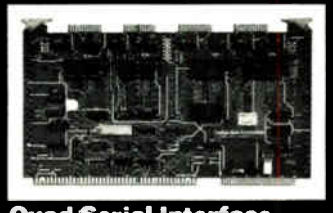
Cartridge Disk Controller Board provides DMA transfers to or from cartridge disk drives with capacities of 10 or 20 Mbytes. $435



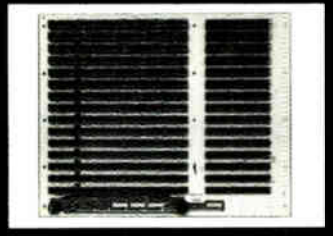
Double Density Floppy Disk Controller adds from one to four double density standard sized floppy disk drives, either single or double-sided. $315



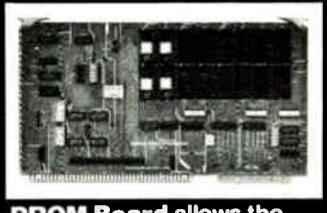
Octal Serial Interface Board allows up to eight EIA RS-232 interfaces. $330



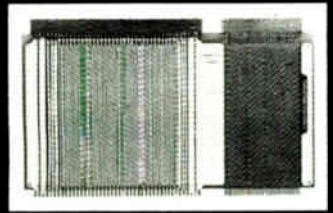
Quad Serial Interface Board hooks up to four EIA RS-232 interfaces to your system. $280



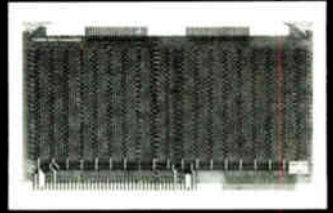
Mother Board can hold up to 15 Multibus cards with both P1 and P2 provided for each card position. $315



PROM Board allows the user to hook between 1K and 128K of PROM to a Multibus system. $140



Extender Board will raise a board being tested up to a height of 6.9 inches. $60



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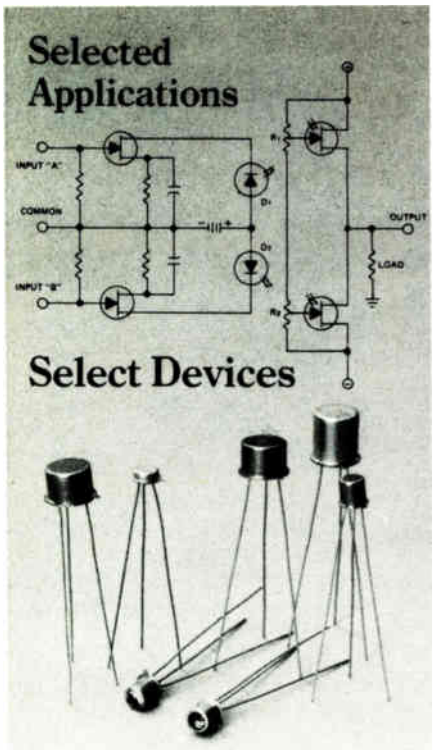

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Data output devices include printers and cathode-ray-tube displays. To guard against unauthorized use, an identification card reader can be installed in the basic unit. Also, with the aid of a computer, a terminal can store messages in a memory for later transmission to other Datatel subscribers. In the automatic mode, it can function with no operator present. **-John Gosch**

France

Matra-Harris, Intel negotiations stall

Because the French government is setting such stringent conditions for its approval of the deal, Matra-Harris Semiconducteurs SA may yet see its plans for a joint venture design center with Intel Corp. fall through. MHS is itself a joint venture between France's Matra Group and Harris Corp. of Melbourne, Fla.

One of the conditions unacceptable to the Santa Clara, Calif., company is a $40 million loan to the venture. The design center would produce masks for n-channel MOS integrated circuits for telecommunications, data-processing, and automobile applications, enlarging Intel's market share in France.

As part of the arrangement, Intel would transfer its n-MOS technology to Matra-Harris in Nantes, and Matra-Harris would supply complementary-MOS know-how to Intel. Matra-Harris officials point out that they are already developing C-MOS versions of several Intel products, including the 8048 microcomputer and the 8086 microprocessor.

While neither company will comment officially on the agreement until it is finalized, Matra-Harris general manager Marc Lassus does not hide the fact that MHS has been talking with a number of U. S. MOS manufacturers over the past few months. "It is not a question of access to a technology or a process—using Harris's C-MOS technology, we can already do H-MOS," Lassus explains. "It is for access to architecture and software for microprocessors." Conversely, Intel, of course, is already using C-MOS in the form of its high-performance, H-C-MOS, technology.

Too ambitious? Is the youthful company trying to bite off more than it can chew? The original 1979 agreement between Matra and Harris covered only C-MOS technology. A subsequent accord, signed last December, added Harris's bipolar know-how. Only in late February did MHS start its first commercial production—of 4-K static C-MOS RAMs. "It could appear too ambitious," says Lassus. But he notes that the C-MOS and n-MOS processes are very similar.

On the question of a joint venture with a joint venture, Lassus concedes "ménages à trois" are difficult. But he insists Intel and Harris could cooperate, via Matra, because "their product lines are complementary." As that changes, Lassus says MHS would negotiate rights to circuits individually. **-Kenneth Dreyfack**

Great Britain

Clay outdoes crystal as display medium

One unlikely candidate for an electronic display medium—a suspension of mineral clays—is causing quite a stir in the electro-optics community. Its proponents and developers, the physics department of Brunel University, Uxbridge, Middlesex, have tagged such a colloid with the electrofluorescent dyes regularly used in colored liquid-crystal

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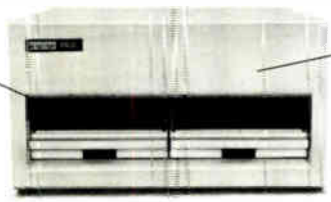

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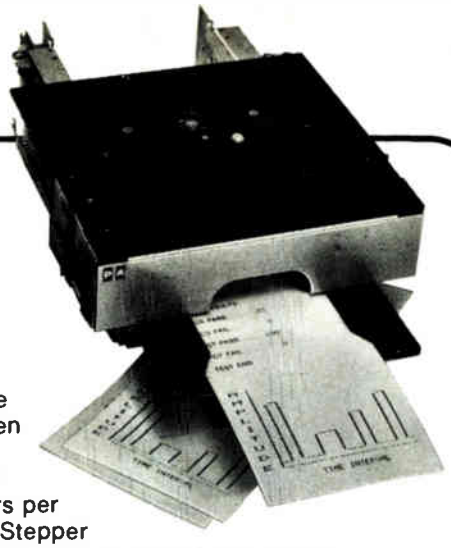

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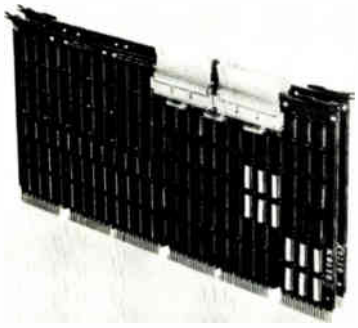

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Electronics international

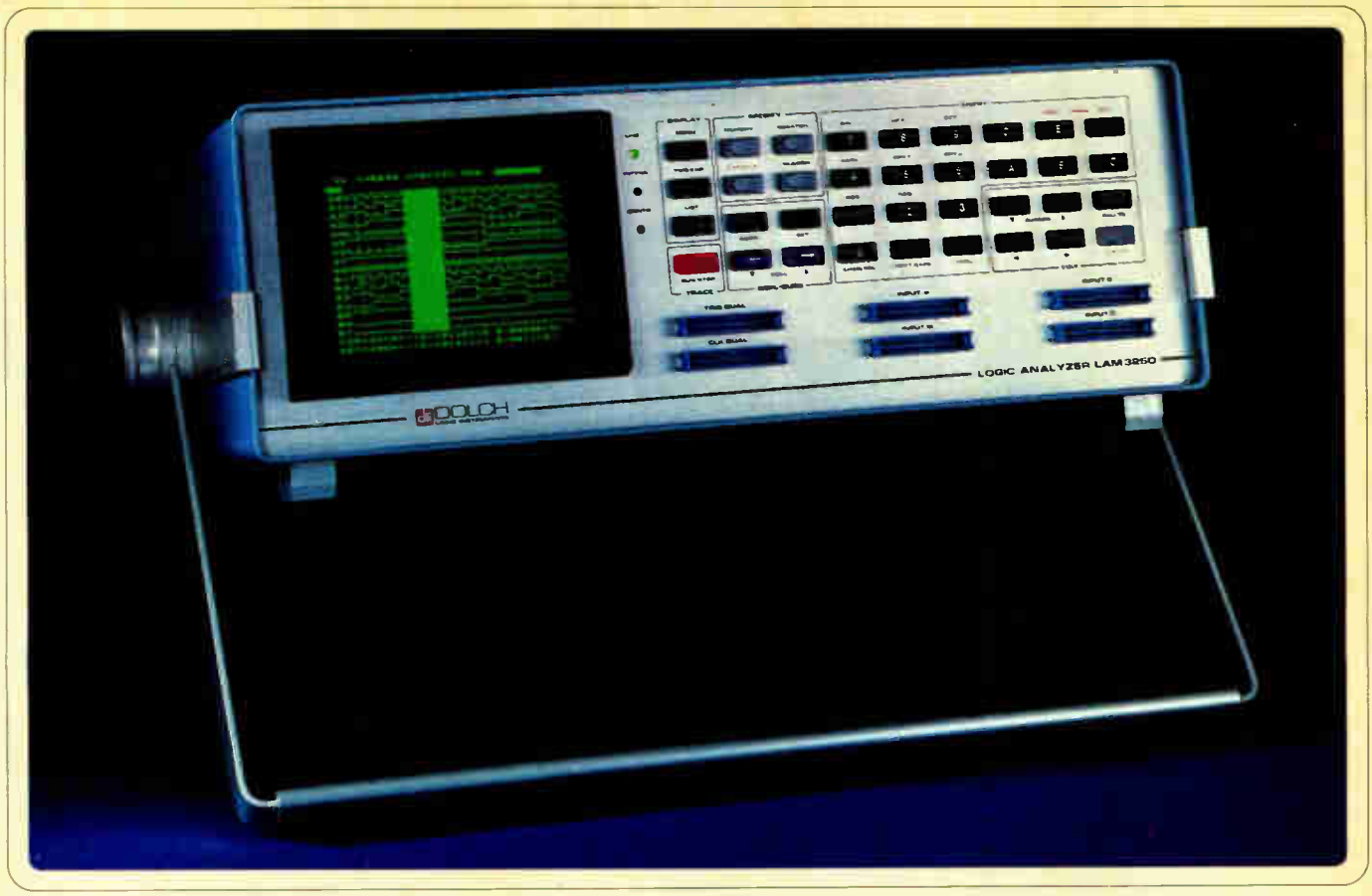
displays, subjected it to a low electric field, and observed a contrast ratio between its on and off states 20 times better than that of comparable LCDs.

Another view. Though no device work has yet been carried out on this high-contrast electrofluorescent effect, its great potential as a display has already attracted one offer of research funds from one U. S. and two UK companies. Sceptics argue, however, that the colloid's stability and freedom from electrical migration have yet to be proved.

Display operation relies on electrofluorescence, a phenomenon in which light incident on a fluorescent molecule or chemical group is absorbed and re-emitted at an increased optical wavelength. Both absorption and emission are highly directional and can vary from zero to a maximum that depends on the angle of incident light. In principle, a solution of fluorescent dye molecules could be aligned in an electric field, switching from zero to optimal absorption and hence fluorescence.

Practical. In practice, however, the molecules and their electrical dipole moment are so small that excessive electrical fields would be needed. This problem can be obviated by binding the dye molecules to clay particles, which disperse in water and other media as rigid, charged, needlelike particles about 1 micrometer long. These particles can be aligned in a relatively low-amplitude field of 1 kilovolt per centimeter. In the display surface there are channels or gutters into which dyes such as acridine orange can be absorbed with their long axis parallel to the gutter.

In preliminary experiments to test the theory, the group applied electric fields to the test cell and then illuminated it with vertically and horizontally polarized light. An extremely high degree of dye order was demonstrated, some 20 times better than that obtainable with comparable liquid crystals. However, Prof. Brian R. Jennings believes the new effect is not in conflict with LCDs but could be used to create completely new displays. **-Kevin Smith**



32 TO 64
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Dolch Logic Instruments' third generation logic analyzer, the LAM 3250, lets you meet your troubleshooting needs now, and expand for the future. The LAM 3250 records up to 32 channels of information at sampling rates to 50 MHz, and with optional Channel Expansion Probes, its capability can be extended to 64 channels. And there's more.

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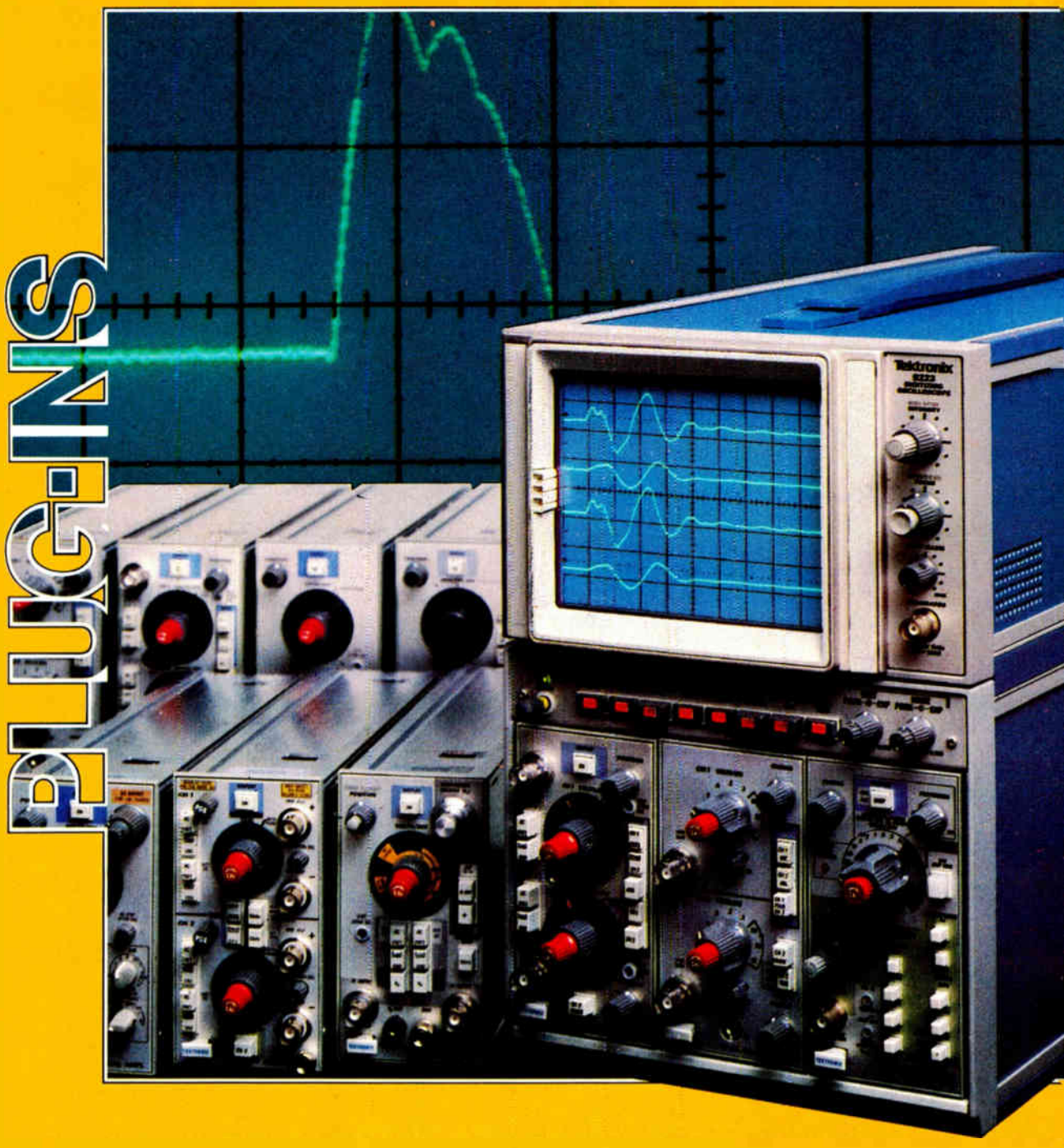
Circle #85 for further information

Circle #252 for demonstration

Introducing digital



storage with plug-in flexibility– a new 5000-Series Scope.

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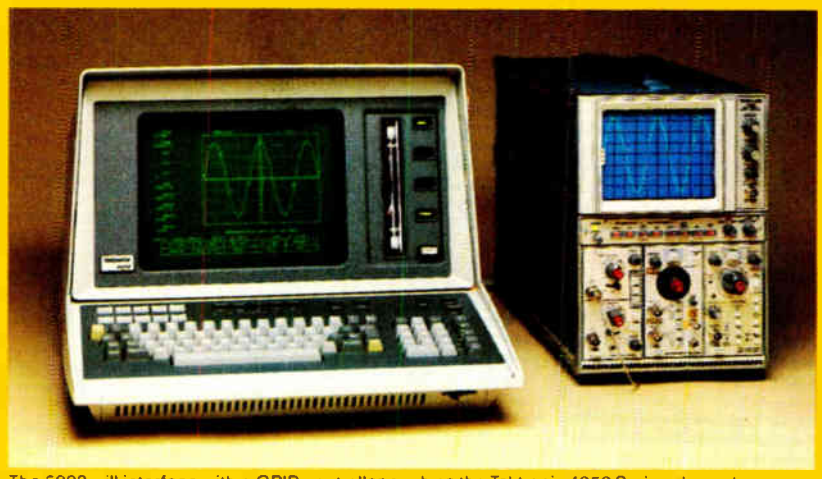
X-Y Mode

With the simple push of a button, stored signals up to 10 MHz can be displayed in the X-Y mode. For repetitive signals both X-Y and Y-T can be displayed simultaneously.



The 5223 will interface with a GPIB controller, such as the Tektronix 4050 Series shown here.

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Using the 5223's optional GPIB interface, you can integrate waveform acquisition with an intelligent terminal. Once transferred by a GPIB compatible controller, the digitized waveforms can be both processed and stored for later recall. Because the 5223 is both a "talker" and a "listener," reference signals can easily be input for comparison or review.

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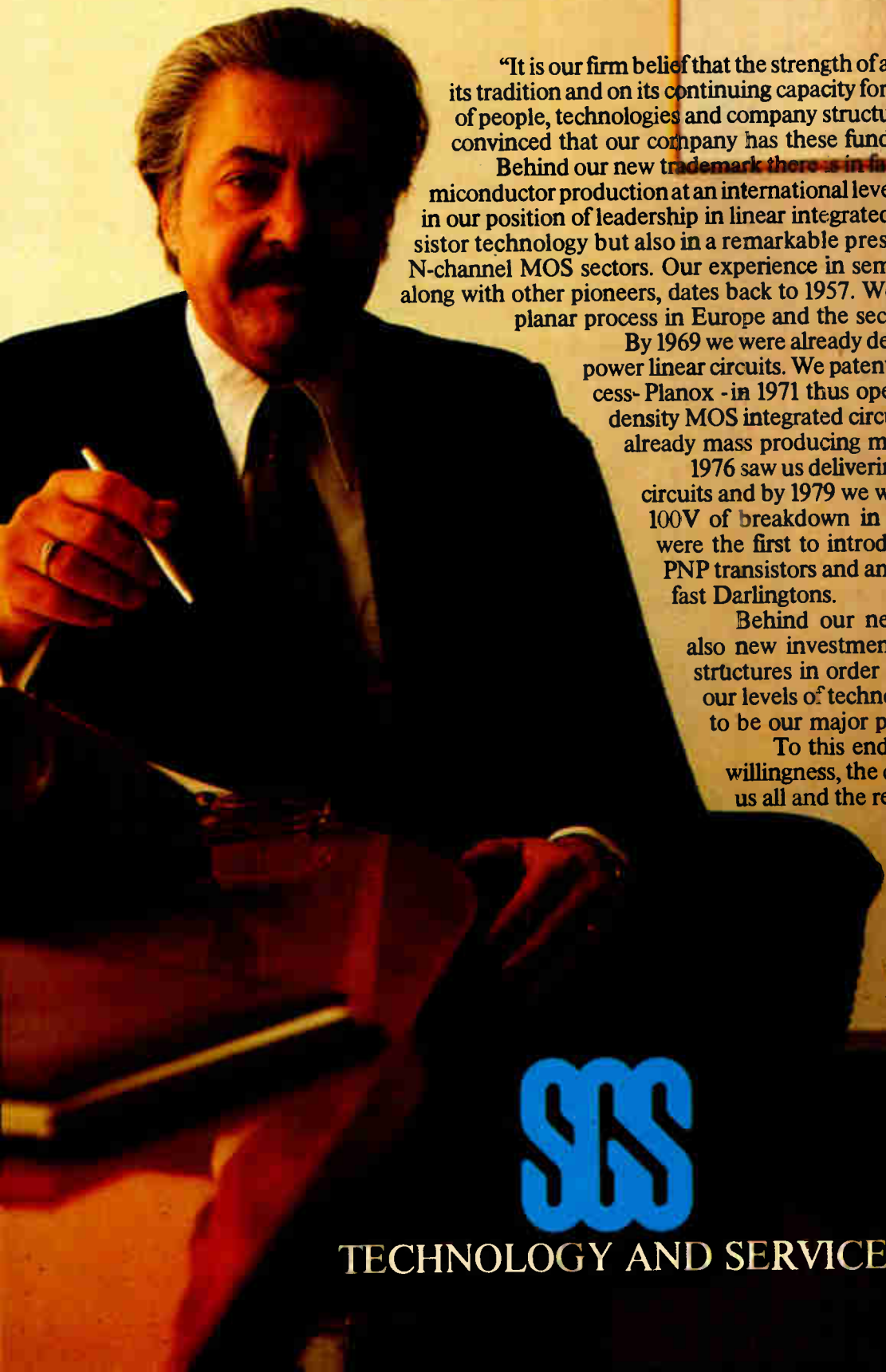

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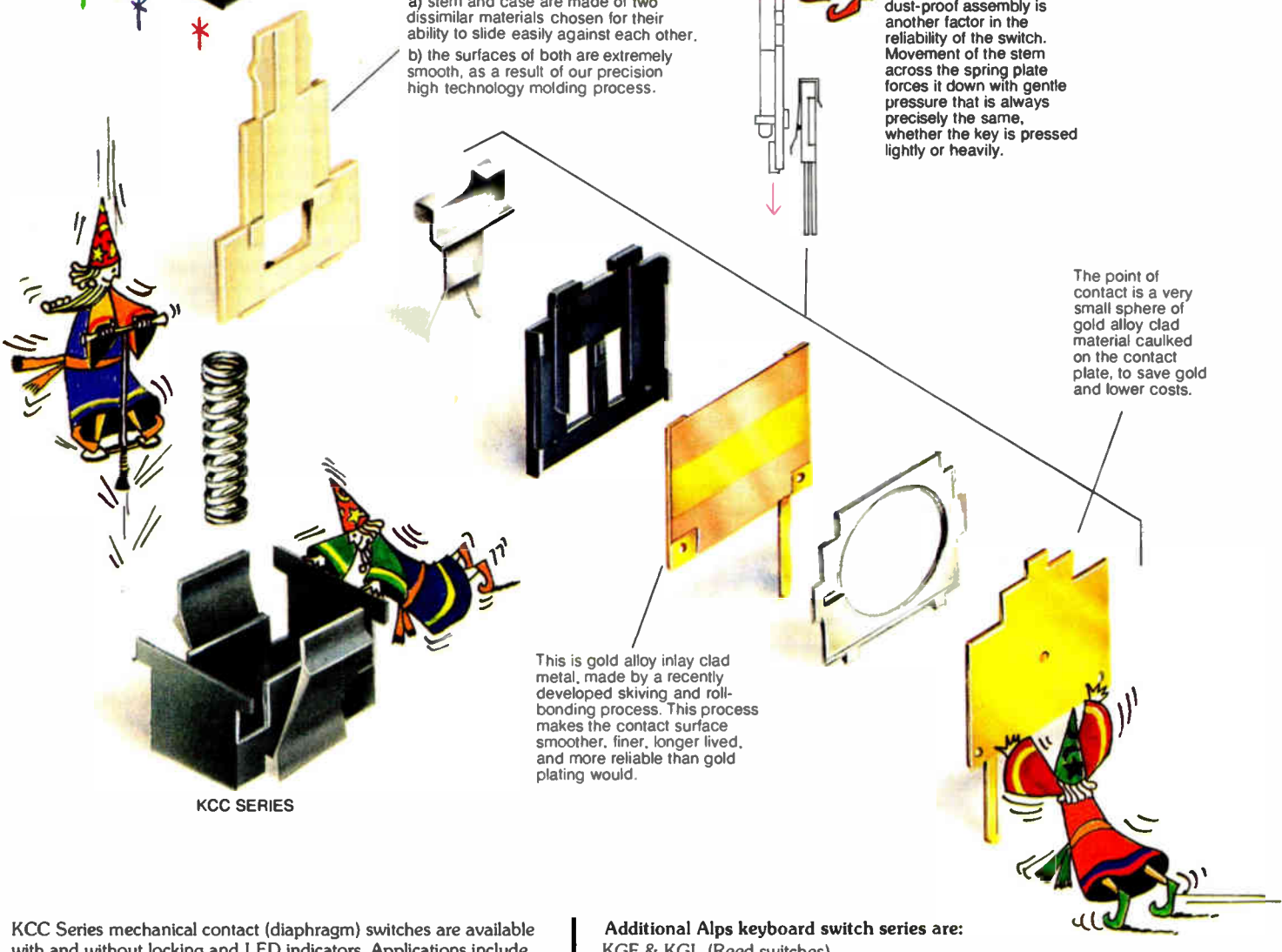

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Energy firms buying technology

Makers of C-MOS and D-MOS attract acquisition or investment from GE, Westinghouse, CIT-Alcatel, and Exxon unit

by Bruce LeBoss, San Francisco regional bureau manager

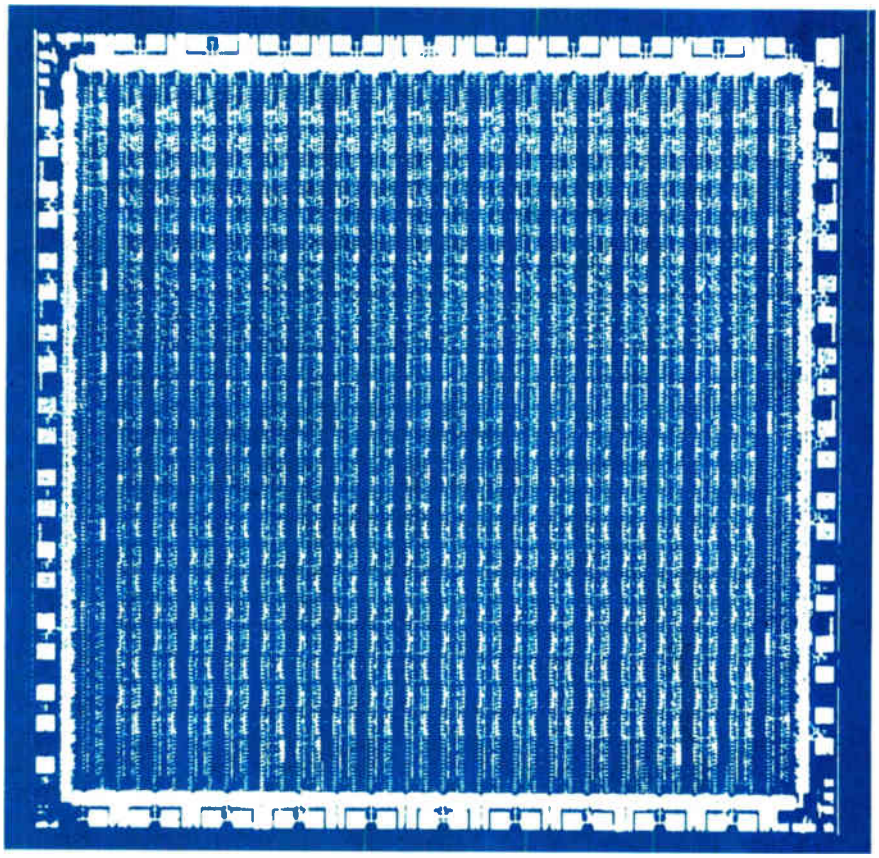
On the surface, General Electric Co.'s purchase last month of Intersil Inc. appears similar to many other acquisitions of independent semiconductor makers by major users grown tired of facing short-supply situations. But on digging deeper, the $235 million deal bears an even stronger resemblance to recent technology-motivated acquisitions by several major manufacturers of energy-related systems.

Although Intersil has gained a reputation as a multitechnology company, one making memories, microprocessors, and other integrated circuits for a wide range of analog and digital applications, the Cupertino, Calif., firm has attracted attention in recent years with its strong programs in complementary-MOS and double-diffused MOS power field-effect transistor technologies. Similarly, no less than three other Silicon Valley semiconductor firms have made noticeably loud rumblings in the C-MOS and D-MOS power FET technologies.

For example, soon after GE's disclosure last fall of its proposed purchase of Intersil, traditional rival Westinghouse Electric Corp. of Pittsburgh acquired 14.6% of the outstanding shares of Siliconix Inc. and disclosed its intention to reach a minimum 20% equity position in the Santa Clara, Calif., firm. Westinghouse has since built up its interest in Siliconix to 21.6%, at a total cost of about $14 million. What's more, in a document filed with the Securities and Exchange Commission, Westinghouse says it "reserves the right to purchase a sufficient number of shares to control Siliconix and/or propose some form of combination by merger or otherwise."

Previously, Exxon Enterprises Inc. of New York, the new business venture arm of Exxon Corp., quietly purchased an estimated 17% to 18% interest in Supertex Inc. of Sunnyvale, Calif., for an undisclosed amount of cash [*Electronics*, July 31, 1980, p. 34]. And more recently, CIT-Alcatel, the telecommunications subsidiary of Compagnie Générale d'Electricité ("the GE of France," as one industry observer puts it), acquired 25% of Semi Processes Inc. of Santa Clara [*Electronics*, Jan. 31, p. 47]. The French firm paid $4.5 million as part of an accord that included loans to Semi Processes and other considerations.

Twin technologies. No mere coincidence, each of the four firms in which an ownership position was acquired manufactures both C-MOS and D-MOS devices, a fact of no small significance to their investors. "Clearly, CIT-Alcatel sees us as a C-MOS and D-MOS company, and not just as an investment opportunity or

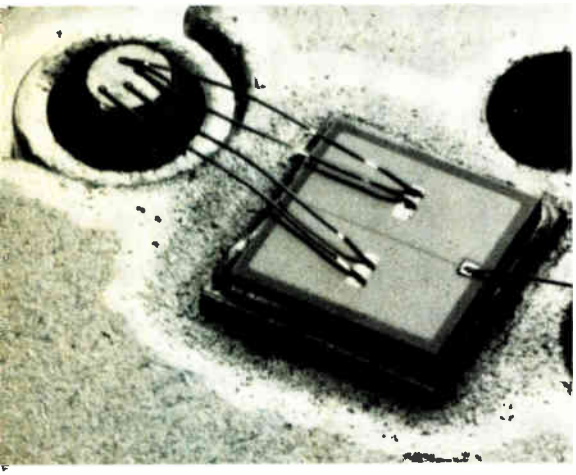


Logic array. Semi Processes Inc., in which CIT-Alcatel of France has acquired a 25% interest, manufactures this mask-programmable Isoplanar C-MOS uncommitted logic array.

an in-house supplier of their semiconductor needs," states Robert Freund, president of Semi Processes. Similarly, Francis T. Thompson, the head of the Westinghouse Electronics Technology division and a newly elected member of Siliconix' board of directors, notes, "There is considerable synergism between the electronic component needs of Westinghouse and the products of Siliconix."

The C-MOS large-scale ICs that Siliconix manufactures, Thompson says, "are especially beneficial in industrial control circuits, because of their high noise immunity and reduced power-supply requirements." Siliconix's D-MOS power transistors, which it calls V-MOS FETs because they use a vertical current-flow structure, will find increasing application in commercial, industrial, and military power systems.

Similarly, "there is a lot of synergism" between the C-MOS and D-MOS activities of Supertex and the products being developed by various Exxon units, notes Supertex president Henry C. Pao. For example, "rather than being on a head-on collision course with Zilog, Exxon looks at our peripherals as sort of a complement to Zilog's microprocessors." Also, observers expect Supertex's C-MOS technology eventually to be the kernel from which Zilog spawns a family of C-MOS processors and peripherals of its own design.



Another option. In addition to its C-MOS technology, Semi Processes has D-MOS capability, as illustrated by this power chip from the Santa Clara, Calif., firm.

In the interim, the C- and D-MOS Supertex technologies are expected to play an important role in the product offerings of other Exxon units. One in particular, Reliance Electric Co., manufactures telecommunications equipment, power supplies, and motor controls. For example, "D-MOS FETs are ideally suited for energy-control systems because they have very high switching speeds," an order of magnitude faster than bipolar devices, Pao notes. "Otherwise, a great deal of power is used up just in switching," he adds.

The energy-control systems built by Exxon units employ many custom circuits to protect their proprietary position in the marketplace. "That's where C-MOS shines, because it is much faster and easier to design circuits in C-MOS than in bipolar or n-channel MOS technologies," states Pao. And energy-management systems, typically, are in noisy environments. C-MOS is immune to noise, he notes, and consumes less power.

Although its volume is estimated to be about $4 million, Semi Processes is likely to play a key role in future offerings from CGE, a $4 billion supplier of large power-generating systems, transformers, and telecommunications equipment. To illustrate, Semi Processes also has long-term technology-assistance agreements with CIT-Alcatel whereby the California firm would be enabled to begin manufacturing a number of advanced telecommunications circuits. It also will have a 20% ownership of a new IC-manufacturing subsidiary to be established by the French firm.

The joint venture is being viewed by industry observers as CIT-Alcatel's means of enhancing its position in C-MOS so as to compete more effectively in France and other European telecommunications markets against rivals Matra SA and St.-Gobain-Pont-à-Mousson. Both French firms have access to C-MOS technology via affiliations with U. S. suppliers Harris Semiconductor Corp. and National Semiconductor Corp., respectively.

Unquestionably, the C-MOS/D-MOS acquisition expected to have the biggest impact on a manufacturer of energy-related products is GE's purchase of Intersil. That relationship

ENERGY COMPANIES VERTICALLY INTEGRATE

	Amount (in $ million)	% interest
Intersil (General Electric)	$235	100
Semi Processes (CIT Alcatel)	4.5	25
Siliconix (Westinghouse)	14	21.6
Supertex (Exxon)	(NA)	17–18

Source: *Electronics*

was initiated on two fronts, recalls David J. Fullagar, vice president for research and development engineering at Intersil. "GE was looking for a power FET technology for its lifetime light bulbs"—GE expects to build 10 million or more annually.

Secondly, GE's Motor Business group was interested in power FET technology to achieve energy savings, Fullagar notes. "Previously, motors that ran in process control and other applications, for example, weren't controlled." Rather, they ran at full speed, and processes such as fluid flow were controlled by mechanical valves. Until recently, it was cheaper to run the motors at full speed than it was to build motor controls. "But with the cost of energy today," he continues, "that's no longer true."

Many uses. "Every division of GE could benefit from C-MOS IC technology," states Fullagar. With the exception of producing dynamic random-access memories, "C-MOS is potentially no more expensive than other processes. Additionally, we are more and more seeing a marriage of analog and digital functions on the same chip, and C-MOS is excellent for analog technology, whereas n- and p-channel MOS are not," he maintains.

Commenting on these acquisitions and other steps by systems companies to integrate backwards into semiconductors, Erich Bloch, vice president and assistant group executive for technology at IBM Corp., recently told members of the Semiconductor Industry Association that "vertically integrated manufacturers that produce for their own use and sell as well are the newest and most aggressive competition to the industry. The vertically integrated semiconductor manufacturer is no longer an exception. In the future it could be the rule." □

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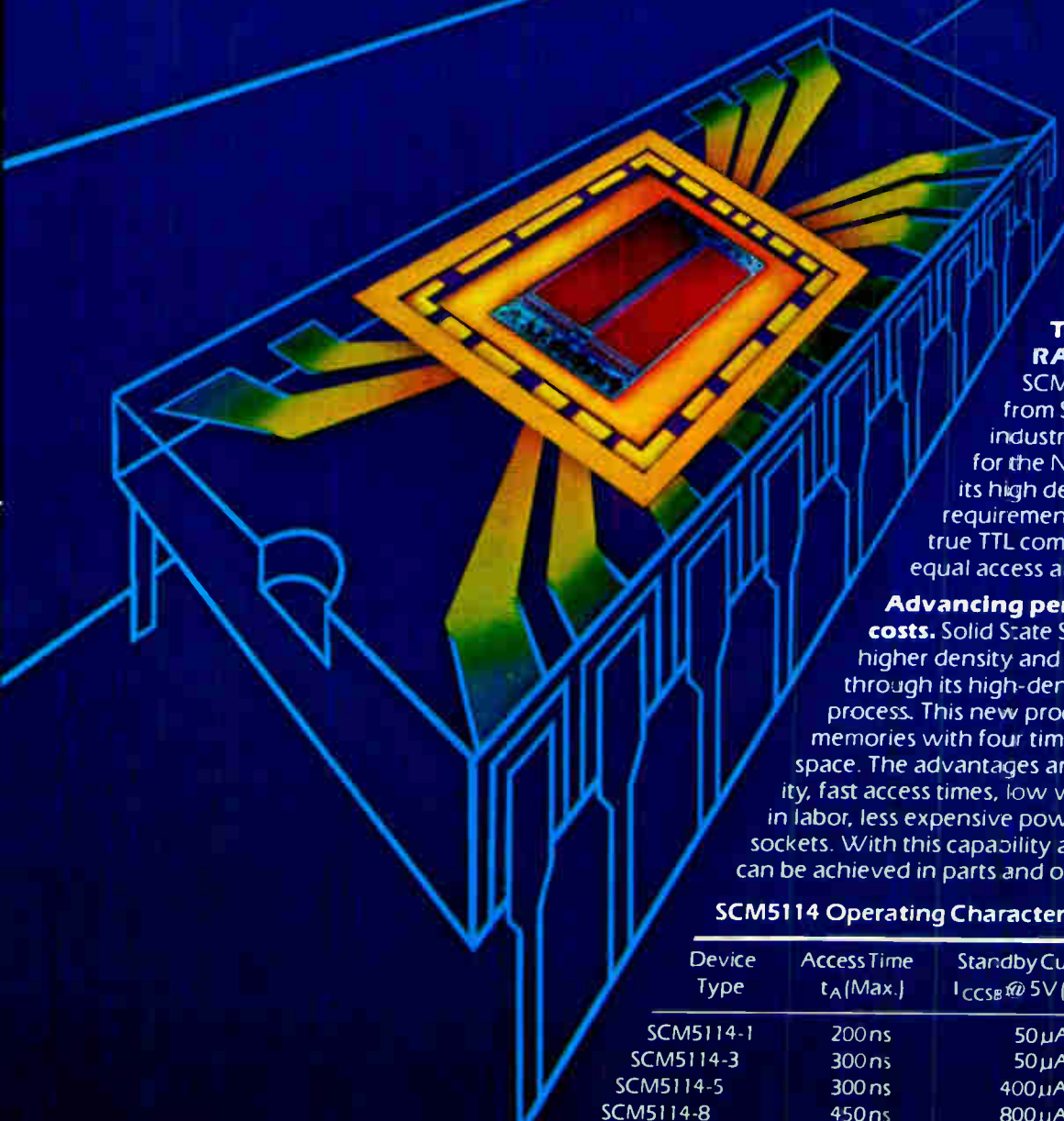

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SCM5114-3	300ns	50µA	2.0V
SCM5114-5	300ns	400µA	2.0V
SCM5114-8	450ns	800µA	4.5V

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Solid state

Are U. S. C-MOS makers falling behind?

Japanese manufacturers at ISSCC talk of 2-μm processes while Americans are just getting down to 3 μm

by John G. Posa, Solid State Editor

The 1981 International Solid State Circuits Conference, just held last month in New York, crystalized two issues. One is that complementary-MOS is destined to become the dominant semiconductor technology, perhaps before the next decade. The second fact is that some Japanese companies are further along than their U. S. rivals with C-MOS processing, and this is a major reason why some U. S. chip makers seem to be losing their edge.

The ISSCC provided ample evidence for C-MOS's pending popularity. At one of the evening panel sessions—on n-channel MOS versus C-MOS for very large-scale integration—even the most skeptical panelists agreed that the need for both technologies is apparent; most, however, argued that soon the majority of MOS chips will be designed in C-MOS. This belief was echoed by panel member Richard Pashley of Intel Corp. in Santa Clara, Calif., one of this country's foremost n-channel memory designers.

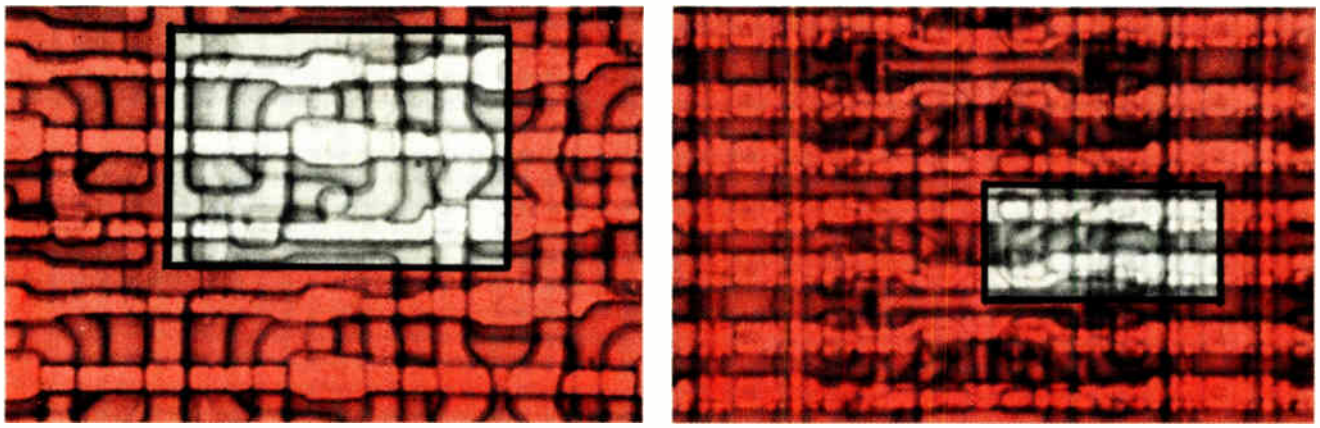
But while Toshiba, Hitachi, Oki, Sharp, and other Japanese companies are bolting ahead with advanced, second-generation 2-micrometer C-MOS processes, traditional suppliers of C-MOS in the U. S. are just now scaling down from 5 μm to 3. Indeed, some U. S. C-MOS houses have yet to make the switch from metal to polysilicon gates—a must for any appreciable density level.

Lateness in adopting silicon gates is just a symptom of a larger problem: U. S. companies have, in general, failed to take advantage of the density and speed tricks figured out by n-channel chip designers. The reason is that companies here have tended to concentrate on one or the other technology; and even at those companies where both have been pursued, the efforts have, all too often, been kept separate.

National Semiconductor Corp. is one exception. At its all-4-inch facility in Salt Lake City, Utah, double-level polysilicon (P^2C-MOS) processing of devices as small as 2 μm achieves a C-MOS capability rivaling n-MOS in speed and density. "We can transport our n-MOS designs—even native devices—to C-MOS with little effort," claims Andrew G. Varadi, vice president of MOS ICs at National in Santa Clara, Calif. National currently has 4-K random-access memories in production but plans 16-K announcements before year-end—for both microprocessor and fast-RAM markets.

The Harris Semiconductor group, the largest U. S. supplier of 4-K C-MOS static RAMS, is a competitor without n-MOS capability that is fighting hard as well. The Melbourne, Fla., company has been using silicon-gate C-MOS exclusively for more than three years. (For that matter, American Microsystems has always used silicon-gate C-MOS.) Though not yet in production of a 16-K static RAM, Harris "will have a major commitment to a full line of 16- and 64-K parts," declares James F. Townsend, advanced product planner for memories, and they will arrive in 8-, 4-, and 1-bit widths.

Some failures. As for specific products, attempts in the U. S. to



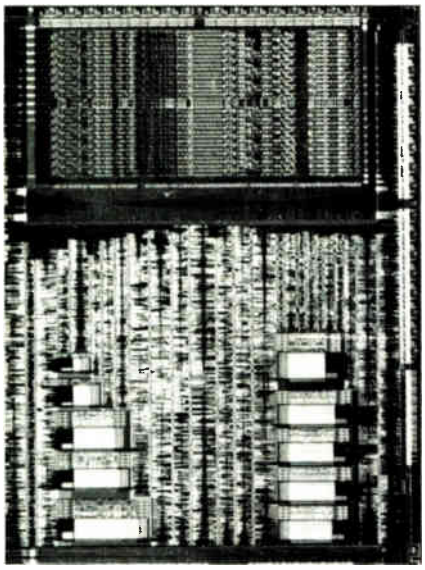
Second generation. Hitachi's Hi-C-MOS process (left) produced a 28-by-40-μm cell and a 4-K static random-access memory back in 1978. Though U. S. companies seemed more interested in C-MOS's low power, Hitachi scaled down to Hi-C-MOS II for a 14-by-28-μm cell.

produce C-MOS versions of single-chip microcomputers like the popular 8048 have, for example, been stalled. In the meantime, Nippon Electric Co. has announced such a part, Toshiba Corp. will provide samples of one this year, and Oki Electric Industry Co. says it is not far behind. The Japanese also are the only ones currently producing 16-K static RAMs organized both by 1 bit and into bytes in C-MOS [*Electronics*, Dec. 18, 1980, p. 118].

The very first ISSCC session, on static RAMs, contained five papers, four from the Far East. Moreover, the first two papers, from Toshiba and Hitachi Ltd.'s Central Research Laboratory, described two 4-K C-MOS memories with blinding, 18-nanosecond typical access times. U. S. companies are hard pressed to match that performance with scaled-down n-MOS, and n-MOS is supposedly faster than C-MOS.

That first session kicked off the conference on a gloomy note. Said one technologist from Rockwell International Corp. of Anaheim, Calif., "I have never seen more depressed people in one place. The Japanese are taking it all away."

The low power consumption of C-MOS is most often cited as the reason why it will be a must for VLSI. Hewlett-Packard Co. of Fort Collins, Colo., delivered a paper at the ISSCC on an extremely impressive 32-bit microprocessor, executed in n-MOS—probably because of a recent decision to shelve development of advanced C-MOS on sapphire [*Electronics*, Sept. 11, 1980, p. 106]. Though not printed in the proceedings, it was brought out at the session that the chip consumes 7 watts. In contrast, a C-MOS 32-bit microprocessor built by Bell Laboratories in Murray Hill, N. J., dissipates only 500 milliwatts. Granted, the 100,000 transistors in Bell's IC amount to less than one quarter of those in HP's, but Bell also says its chip embodies more of a true central processing unit's functions.



U. S. C-MOS. A 32-bit C-MOS microprocessor from Bell Labs indicates that some U. S. firms are ready to battle the Japanese.

In the telecommunications area, the panel members alleged that C-MOS will without question be the technology of choice, and nobody in the room took issue with that. "The reason," says Donald Wollesen, C-MOS research and development manager at American Microsystems Inc. of Santa Clara, Calif., "is technical but simple. With n-MOS, you simply can't construct a current mirror off the plus rail [positive supply]." Without this circuit, differential amplifiers are not as practical, and these are the basis for operational amplifiers and for linear circuits in general.

To say that the U. S. possesses no C-MOS expertise is, of course, absurd. But "U. S. C-MOS companies have spent too much time on standard C-MOS," says a memory designer from Mostek Corp. of Carrollton, Texas. "Some of them still think that every time you use an n-channel transistor, it must have a p-channel load. That is simply not true. Not only does it waste area, it actually reduces speed."

Picking parts. In particular, when it comes to memories the Japanese discovered early on that only the peripheral circuits need be C-MOS; the array is best left as n-channel for the highest density, particularly if a second level of polysilicon is used for the load devices. Meanwhile, U. S. manufacturers—more overwhelmed by C-MOS's potential for super-low power drain—stuck with full six-transistor static RAM cells. They got the low power, but at the cost of large chips with mediocre access times. And as it turned out, the Japanese were able to get the lower power anyway.

Thus, agree two Intel C-MOS process engineers, "U. S. manufacturers have viewed the p-type devices in C-MOS as a necessity rather than as a tool." The Mostek memory designer explains that, used cleverly, p-MOS devices will eliminate the need to bootstrap and allow sense amplifiers to be built with gains of 10,000. Using these design twists, "C-MOS can be made faster regardless of any speed differences inherent in the technologies themselves," he says.

Just starting. The Intel process engineers agree that "only now are U. S. companies exploiting the p-channel transistors in C-MOS." And, ironically, it is taking the n-MOS chip vendors to figure out how to do it. At the ISSCC, there were no high-performance memories from Harris, Intersil, Hughes, National, Motorola, RCA Corp., or AMI—the manufacturers known for their C-MOS products. Instead, Intel Corp. unleashed a 25-ns (typical), 4-K C-MOS static RAM that uses n-type wells so that it can be gently eased into a high-performance n-MOS production lines.

Elsewhere, that plan is already in action: "Every new C-MOS memory will be built with n wells," declares National Semiconductor's Varadi.

Bell Labs' 32-bit microprocessor is built with its so-called twin-tub-domino C-MOS technique. The twin-tub idea refers to the diffusion of separate n- and p-type wells to simultaneously optimize the performance of both p- and n-channel transistors, respectively. The dominoes refer to an innovative way of clocking several n-channel switching transistors connected to a single p-type load. After precharging, pulses ripple through the gates—like dominoes—for high speed with low power. That is the way to use C-MOS; but is Bell Labs really known for its C-MOS developments?

Other U. S. companies seemingly furthest along with advanced C-MOS processes are also not yet really known as C-MOS suppliers, either. Motorola, having licensed Hitachi's Hi-C-MOS process, is also gearing up to make fast, high-density devices like 16-K static RAMs. □

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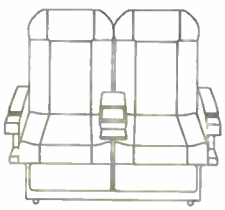

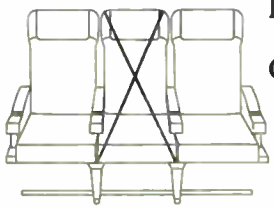

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Gordos Corp. of Bloomfield, N. J., Standard Grigsby Inc. of Aurora, Ill., and W. Gunther GmbH of Nuremberg, West Germany, will soon become Gordos International Corp. with headquarters in New Jersey. All three companies manufacture different types of switches and relays, and though all hold leading positions in particular market sectors in their own countries, each lacks the technical and marketing expertise to vault into a dominant position on the international scene.

"I think we're going to be able to give the Japanese a run for their money in our home markets," observes George B. Marchev, president of Gordos and soon-to-be president of Gordos International. "We'll be looking at niches they don't fill, and we believe we can hold our own in Europe, the U. S., and Third World countries. We'll be going after some of the domestic market in Japan, too," he says.

Marchev, 58, has been with Gordos since its founding 34 years ago and has helped direct the company through technological and business developments. In December 1978, Gordos was acquired by Flint Industries Inc., a privately held company based in Tulsa, Okla., with interests in energy services, construction, and electronics. Flint will own 80% of the new Gordos International combination.

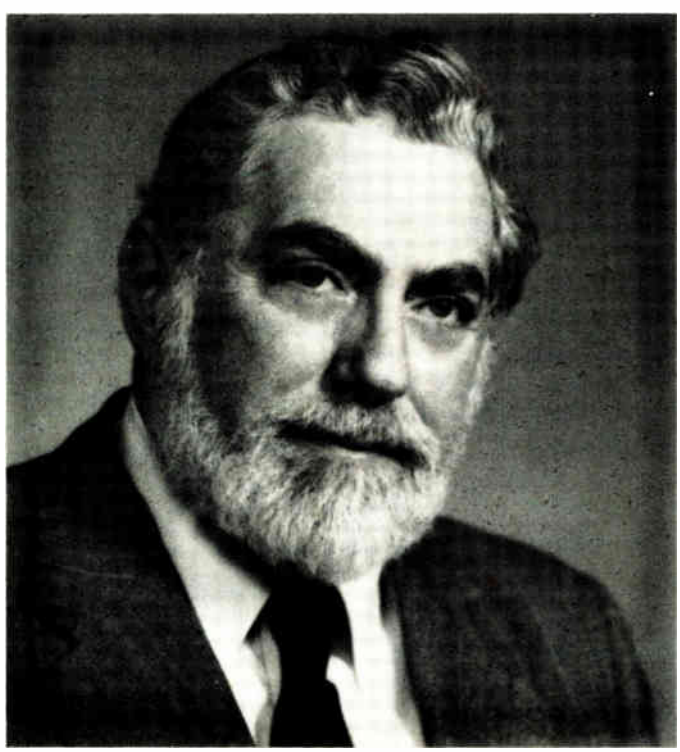
As a supplier of reed switches, reed relays, mercury switches, mercury-wetted reed relays, solid-state relays, and thick-film hybrid products, Gordos expects to have about $20 million in sales this year.

At present, the company also supplies input and output interfaces and data-acquisition boards for microprocessor-based systems, and it expects to expand this business rapidly with the technical savvy from Standard Grigsby and manufacturing expertise from Gunther.

Standard Grigsby and Gunther have been owned separately by Roy H. Slavin since 1973 and 1976, respectively. Slavin, 35, who has a background in law and economics, will become executive vice president of marketing for Gordos International.

With sales of about $8.5 million, Standard Grigsby manufactures rotary and automotive switches. At the top of the company's product line are programmable rotary-encoded logic devices (P/RELs) used extensively in home computer-game controls. "Standard Grigsby needs the thick-film hybrid capability Gordos has," observes Slavin. "With that higher-level technological capability, we'll be able to decrease prices and realize a 30% components savings for the P/REL products."

The P/REL line at Standard Grigsby is somewhat automated,



Relays are his business. George B. Marchev will head Gordos International, which will combine Standard Grigsby Inc. and Gordos Corp. of the U. S. with W. Gunther GmbH of West Germany.

but it is Gunther that will be supplying the automation know-how from Germany for all Gordos International operations.

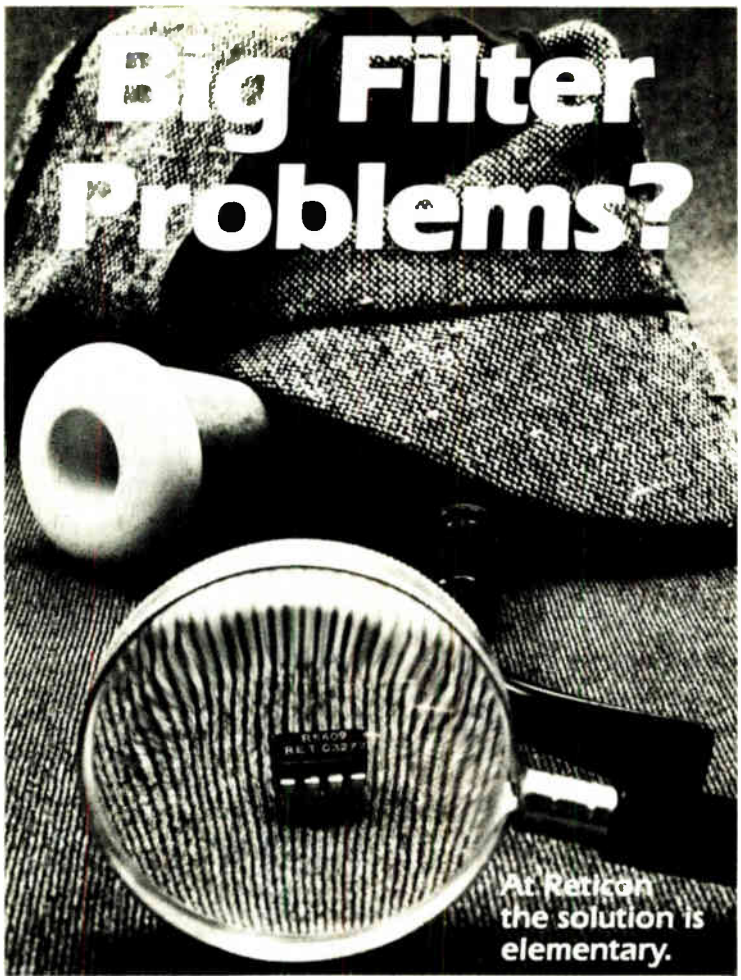
Gunther, whose sales were about $13 million in 1980, is a manufacturer of reed switches, reed relays, and mercury-wetted devices. Slavin notes that the reed-switch line is completely automated and that both the reed relay and the mercury-wetted lines are 80% automated. What's more, Gunther designs and manufactures its own automated equipment and will provide this hardware for the Stateside divisions of Gordos International.

Automation a key. "Up until now we've been able to successfully manufacture in Third World countries," says Slavin. "But labor-intensive manufacturing is becoming increasingly expensive, and with automation, we won't have to deal with those cost increases. We'll be reaching new markets and that will increase volume." He explains that these multinational marketplaces were inaccessible to a Gordos, a Standard Grigsby, or a Gunther as individual companies, but that the combined muscle of the three together "will even give us the manufacturing and marketing strength to be able to go into the Orient to get additional business."

The capital infusion for this automation venture is coming from Flint Industries, which is acquiring both Standard Grigsby and Gunther for an undisclosed amount of cash and stock. "I think everybody in the electronics business competes on a worldwide basis—or should," says P. Kenneth Lackey, vice president for finance at Flint. "This is particularly difficult with the rising desire to buy from local interests that is displayed in many countries. You've got to get a foothold in a country to compete there. We think we're going to be able to do that with Gordos International," he says.

Not only will there be an interchange of technology and manufacturing knowledge among the three companies, but also an exchange of marketing capabilities in the home countries.

Closer to home. Marchev, whose company has been shipping 20% of its product overseas—10% to Europe



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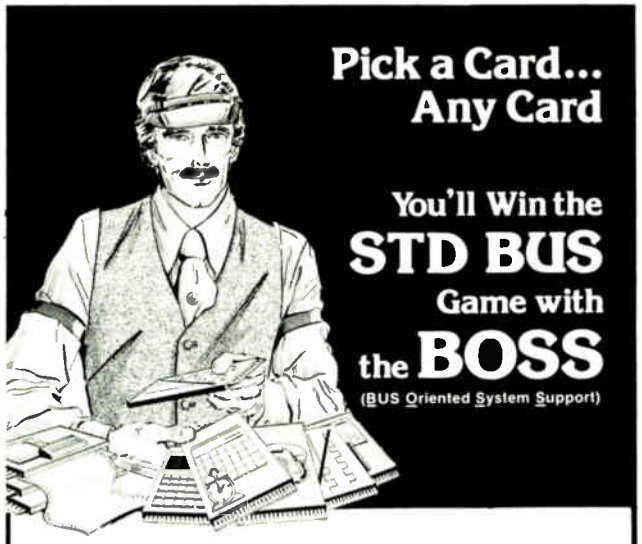

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NORTH CAROLINA

Probing the news

Economic strategist. Roy H. Slavin, whose background is in economics and law, will be Gordos' vice president of marketing.

and 10% to Japan—notes, "Gunther has been supplying switches to Hughes. But Gordos's marketing people are closer geographically and culturally to a Hughes than a German company could be, so we'll market Gunther's products in the U. S. We expect they'll do the same in Europe for us with companies like Siemens," he adds.

Marchev sees Gordos International continuing to supply sensors, relays, keyboard components, and P/REL devices. He wants to broaden the thick-film technology used throughout the company and possibly expand the solid-state relay technology.

He also envisions developing much of the test equipment Gordos has been building for internal use for the relay and switch industry as a whole and notes that companies like IBM Corp. have already expressed interest in such gear.

Standard Grigsby and Gunther have been growing at a rate of 30% to 40% per year and Gordos at about 20%. Marchev would like to sustain that 20% rate for Gordos International, noting that such a growth rate would be excellent in view of the fact that the relay and switch business "is not an immature business." Gordos International expects to have earnings in excess of $40 million in 1981. □

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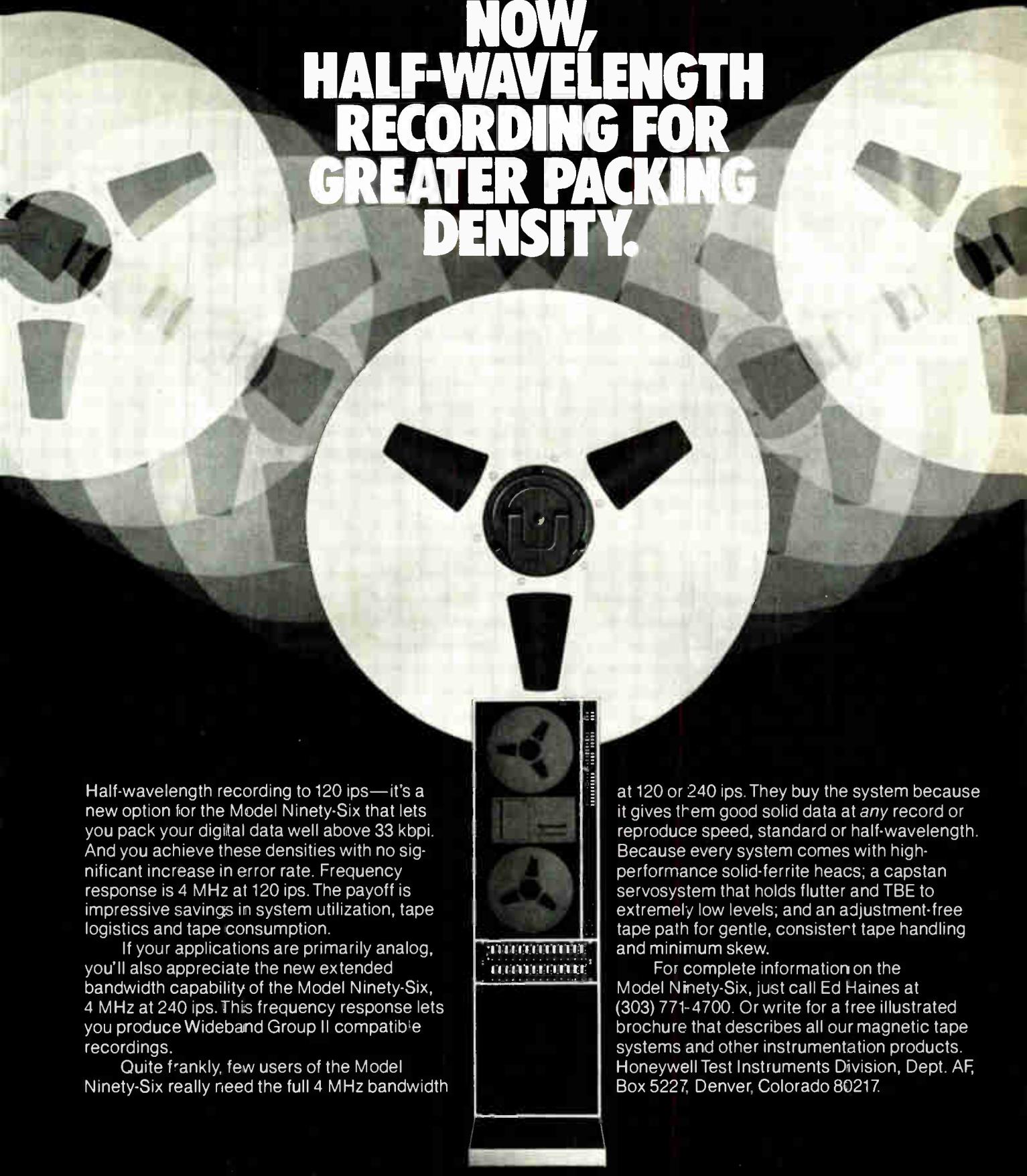

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Government

Budget cuts split industry, academia

Reagan proposals please manufacturers, but slashes in funds for education and instruments upset R&D community

by Ray Connolly, Washington bureau manager

Most electronics manufacturers say they are happy with President Reagan's spending and tax cut plans; most academic and other research institutions are not. And in the Congress, ultimate arbiter of spending and taxes, the tide seems at the moment to be running in Reagan's favor despite some predictably deep divisions.

"Existing odds on big defense increases are way up," says one Senate technology staff member. "So are the odds on big cuts in education, space, and taxes. But social program cuts represent the biggest unknown, and reaction against these could affect everything else. The structure and moods of the Congress has definitely changed, of course, but human nature hasn't. Every member is still looking out for the interests of his jurisdiction."

Looking out for No. 1 also gets top priority within the electronics industries and academia, where divisions run deep. Strong support for the Reagan program has emerged in an Electronic Industries Association letter to the President that calls his effort "skilfully stripped for action and tailored for impact" and urges Congress "to expedite its passage intact." Nevertheless, the EIA would like to see "a specific tax incentive for R&D and specific tax relief for Americans working abroad" included in the "second phase."

The reaction of the American Electronics Association also is favorable to the Reagan economic plan, if not quite as sublime as that of EIA. The AEA wants a bit more incorporated, and sooner, including a strong 25% R&D tax credit for corporate investments above the average of the last three years; restoration of restricted stock options to aid retention of key employees; and a capital gains tax cut to spur investment, such as the one provided in Senate bill S. 75 already introduced by California Democrat Alan Cranston.

Iron is hot. Though both the EIA and the AEA believe the need for speed is essential to the success of the Reagan program—"while he is still riding the crest," as one member put it—some are troubled by the many vacancies at senior cabinet levels throughout the executive branch, as well as by the dual-track legislative approach being taken by the Administration on taxation: one bill for individual tax cuts and a second for all others. "A two-track tax bill has never passed," says one association source. "It is evident that the package that goes in will not be the package that comes out," despite the EIA's pleading.

The nation's engineering and science teachers, however, are in far more trouble than any segment of the electronics industries, to judge by the drastic funding cuts proposed for the National Science Foundation and its programs to upgrade engineering education and the outdated, deteriorating instrumentation in the country's academic laboratories. Leading educators in these fields were distressed initially by the Reagan plan to chop NSF outlays by $26 million in fiscal 1981 and by $16 million more in 1982 before reductions ballooned in the four following years—it adds up to a six-year cut of $527 million out of a budget that does not total $1 billion a year [*Electronics*, Feb. 24, p. 63]. Now they are altogether dismayed by reports that

Why top jobs go begging

With severe reductions already proposed by the Reagan Administration for nearly every segment of science except the military, who wants the job of science adviser to the President? That is the question being asked by some members of the White House Office of Science and Technology Policy, who note that the Reagan program is alienating much of the scientific and engineering community. Nevertheless, there is a statute requiring an OSTP headed by a science adviser.

President Reagan could abolish the job with a White House reorganization that would become effective only if Congress did not take contrary action within 60 days of the plan's submission. Some OSTP sources believe that may happen now that the appointment of leading candidate Simon Ramo is reportedly mired in Federal ethics and disclosure regulations that preclude an appointee's retention of a corporate interest. (Ramo's TRW pension is said to be tied to future company profits.)

Ramo and others reportedly in line for top science and engineering jobs outside the Department of Defense may not want them now, suspect OSTP sources, who add that they are not even certain about their own futures. Unable to affect the proposed budget changes, "what person worth his salt could go up on Capitol Hill and testify in support of them? I can't think of anyone who could do it honestly," says one OSTP staff member.

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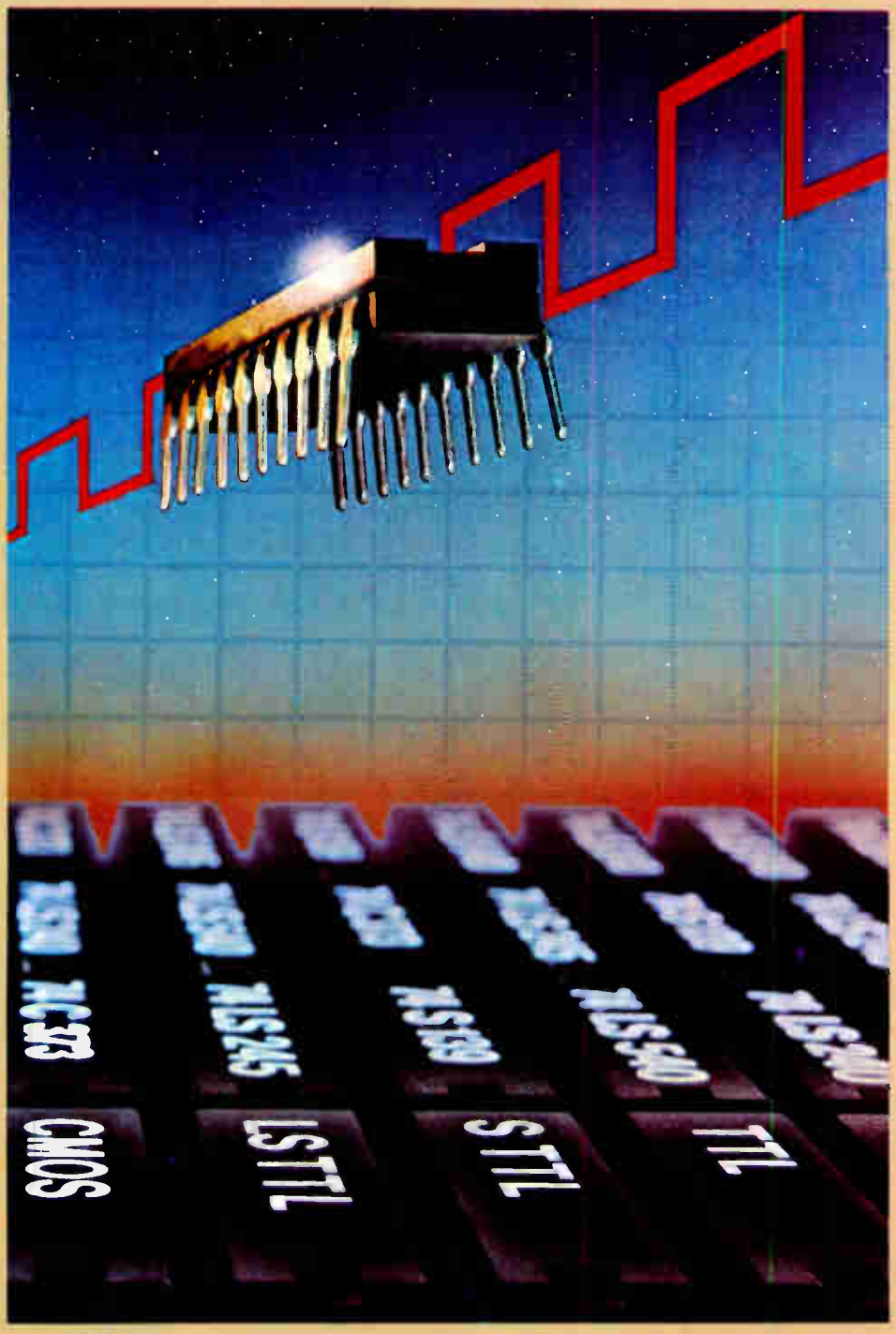

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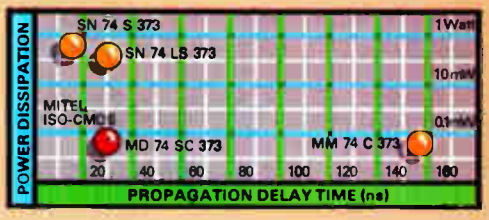

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MD 74 SC 373 Octal Transparent Latch
MD 74 SC 374 Octal D-Type Flip-Flop
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another $40 million may be cut from the foundation's 1982 education funds, bringing them down to one third of the Carter Administration's proposals.

Also set for elimination is the entire $98 million in so-called cross-directorate programs overseen by the NSF for new university instruments and programs for women and members of minorities in science. In the classic tradition of looking out for No. 1, no electronics trade group has yet spoken out against these cuts, even though these areas are crucial to the development of future professional talent.

Speaking out. One Republican who has expressed concern is Sen. Harrison "Jack" Schmitt of New Mexico, the former astronaut who now heads the Commerce subcommittee on science, technology, and space. His concern is the "increasing uncertainty in the direction of national science and technology policy," he said late last month. He mentioned in particular "the absence of a science adviser to the President" and the fact that only three of the eight top science and technology posts in the Administration have been filled.

Names of likely nominees abound in Washington, of course. One is Simon Ramo, TRW Inc.'s vice chairman and cofounder, for science adviser. Others are Richard De Lauer, TRW's executive vice president, for under secretary of defense for research and engineering, and Hugh P. Donaghue, Control Data Corp.'s assistant to the chief executive, for head of the National Telecommunications and Information Administration in the Commerce Department. Yet even if nominations are made, they still require Senate confirmation.

Thus Schmitt noted accurately that "there is no administrator of the National Aeronautics and Space Administration, no administrator of the National Oceanic and Atmospheric Administration, no under secretary of defense for research and engineering, and no assistant secretary of commerce for productivity, technology, and innovation." □

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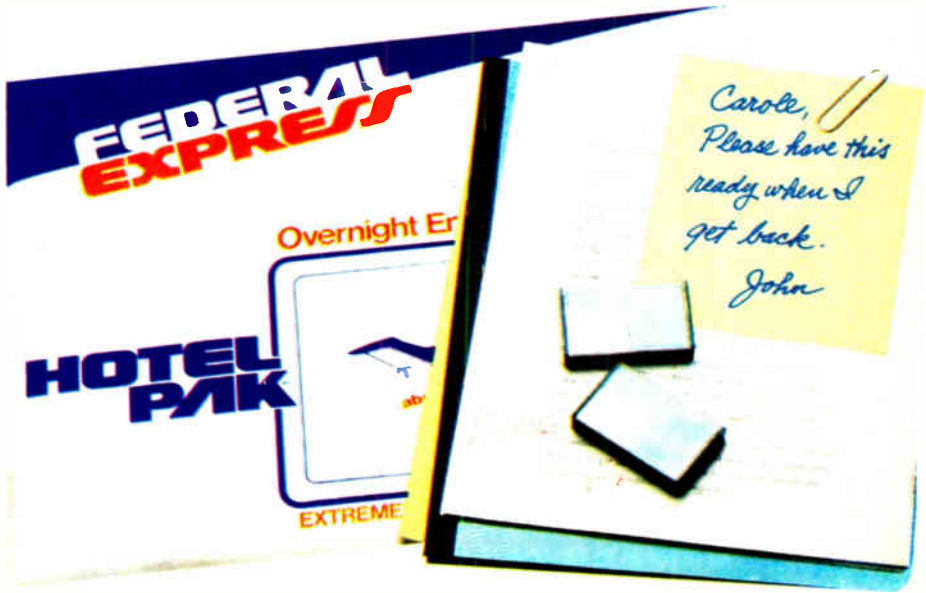

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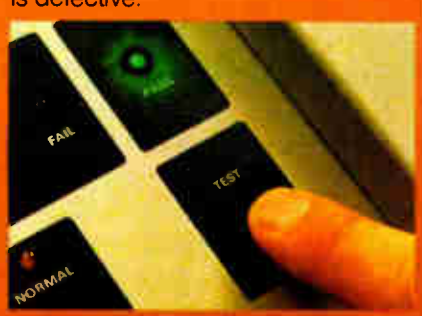

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New Products

The software industry is teeming with activity, trying to keep up with an ever-increasing hardware sophistication. Semiconductor technologies are putting over 100,000 devices on each silicon device, enabling machines that qualified as the best mainframe computer only a few years ago to be realized on a single chip. The low cost and ready availability of smaller, more-powerful computers permit their use in settings that were unheard of ten years ago. In-house computers are now being found in all segments of industry, business, and even the home. Correspondingly, mainframe computer manufacturers are packing more bang per buck into their machines, enabling more users to be served faster and more efficiently.

The task of software

However, without software, a computer is but an empty brain. (See "What is soft about software?", below.) And with each new computer that is introduced, the software task is multiplied, since instruction sets are usually unique.

To solve the problem, manufacturers usually try to maintain some degree of compatibility with older models. Ironically, however, the greater the improvement in performance, the more incompatible the new model is likely to be. This is because architectural improvements are a major source of both improved performance and unique new instruction sets.

(Continued)

FROM GEARING UP

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Let's start with two names: Sanders and CalComp.

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9 TOUCHING DOWN.

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The problem of incompatible instructions sets among different computers is compounded by the fact that the amount of useful software that can be written for any given computer is virtually limitless. And with each new speed or capability landmark that the latest computer passes, there is a corresponding new range of applications that need software written for them.

Programmers needed

The great need for software has led to estimates that the number of programmers required by 1984 will be ten times the amount available. (See "Programmer Shortage"). Most of these programmers will be writing application software—programs written in a high-level language and designed to solve some real-world problem. As computers become faster, more problems are lending themselves to solution in high-level languages. And since application software has traditionally been written for each type of computer separately, a large investment in programmer man-hours has been made by all the major computer manufacturers. As proof of the vastness of this task, refer to the section on application software ("Application Software: The Infinite Task"). It discusses software that is available for the solution of problems in business, manufacturing, and the office.

Structured programming

Another aproach to the programmer shortage is to train the ones we have to be more efficient. The greatest testimonial to the need for improved programmer efficiency is the way structured programming techniques have caught on, especially in university courses. A great many such courses are now taught using them. With good structured techniques, an entire programming problem can be solved without writing a single line of actual code. This structured solution, in the form of graphs and English-like statements, can then be translated into whatever computer language is available and well suited to the task.

To aid that process all the new computer languages pay particular attention to including convenient ways to implement the structured techniques so as to produce programs that are reliable and well documented. Ada, the newest "structured" language, joins Pascal and others that are discussed in the high-level language section ("High-Level Languages: Toward the Universal").

Yet another approach to the programming crunch attempts to raise the level of the languages that the programmers use so that each instruction they write does as much as several standard computer language statements. The most exotic form of that approach is automatic program generators. These languages accept very-high-level statements as input and generate an output that consists of high-level statements in a popular language like Cobol. There are very few of these as yet, but they are surely on the way.

An effective way to multiply your programming efforts is to write them in a language that runs on a standard operating system. Such a system allows programs to be developed on one machine and then be transported to other machines that use the same operating system. The section entitled "Operating Systems: The Backbone of Software" examines several standard operating systems.

Program storage advances

Advances in mass storage technology are paralleling the demand for more software and larger programs and data bases. A few years ago the large storage capacities of a hard disk were available only to mainframe users. But the new 5.25-inch models will bring the luxury of on-line megabyte capacities even to microsystem users. Those and similar advances in floppy disk and magnetic tape technologies are opening doors to new application areas for software houses and original-equipment manufacturers. In fact the new 3.5 inch microfloppy disk driver can be used even in portable equipment. Again, mainframe mass storage devices are becoming correspondingly faster, smaller, and less expensive. The section entitled "Media: The Place Where Software Is Kept", explores this ever-advancing frontier. □

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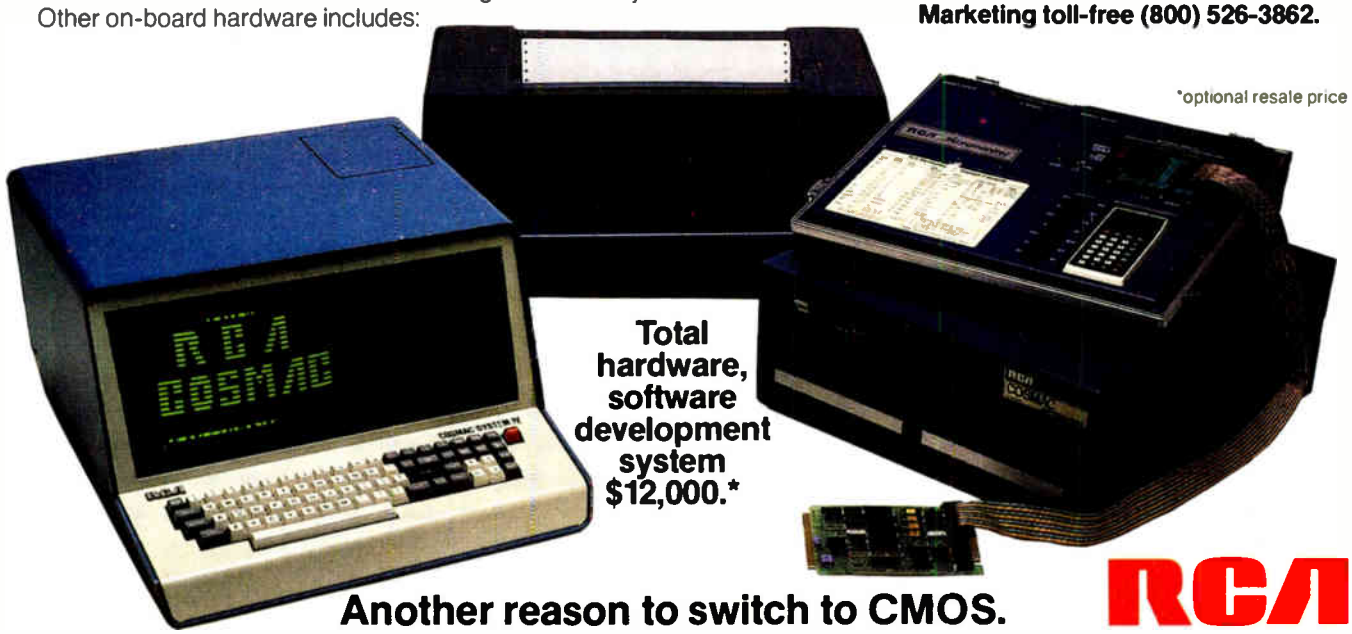

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APPLICATION SOFTWARE: THE INFINITE TASK

Constant demand for software to meet ever-widening range of applications

As computer systems become faster and more flexible, more application areas continue to open up to them. And with each new application, there is software that must be written to deal with it. An increasing number of these application areas can be dealt with by the use of a high-level language. Such languages enable programs to be developed much more quickly and with much greater reliability. High-level language programs are also easier to document and are just plain more readable.

More and more real-time situations that require fast response are becoming computer-controlled, since the hardware itself is become faster. Areas like digital signal processing are a great challenge to programmers. Real-time programming solutions, however, are usually written in assembly language, at least in the most critical situations. But that is changing somewhat, since several of the newer operating systems are written in specialized high-level languages designed to handle input/output tasks.

Even the pizza parlor or the corner grocery store can afford to own a small-business computer nowadays, and business software is definitely proliferating among such users of low-cost computer systems. Accounting packages to handle all the various booking tasks are also available over the telephone via hookups with expanding telecommunication networks. Other office software like word processors and financial packages can sharpen a business's approach.

Computer-aided design

The computer has proven to be a great help in several areas other than pure number crunching. Computer-aided design (CAD) is one such area. Many segments of the design process are treated by CAD, including applications ranging from component modeling to circuit layouts for integrated circuits.

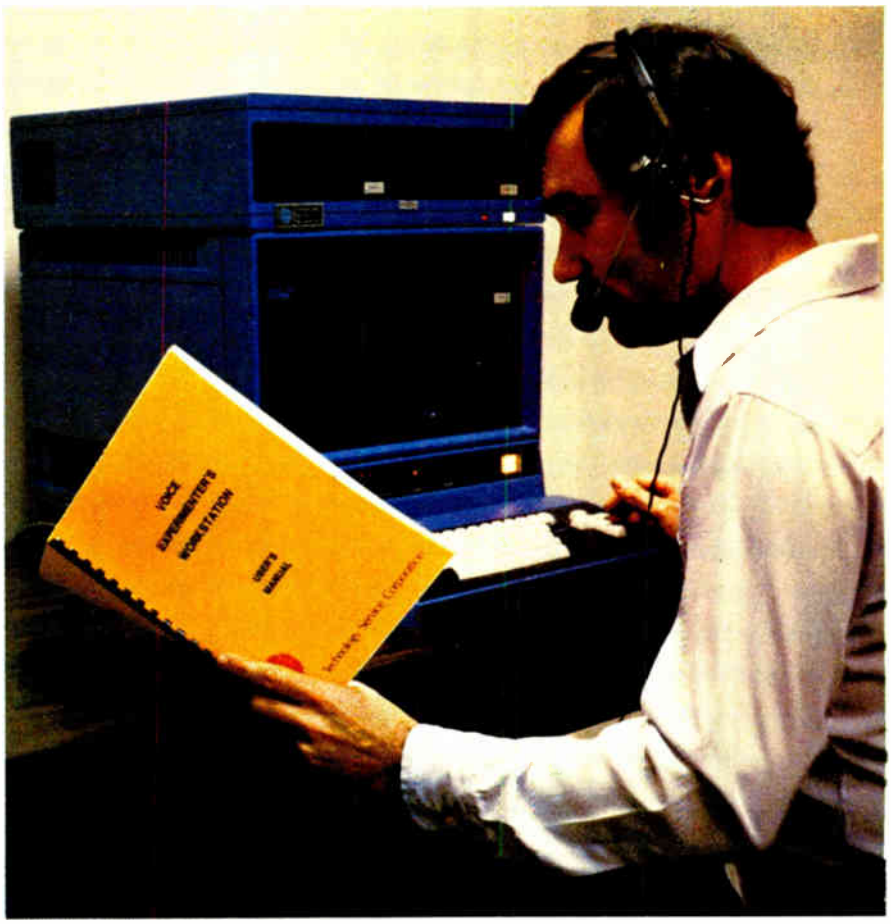
For some time now, several universities have had automated printed-circuit layout facilities, notably the Stanford Research Center, where the Mars robot's manipulative "arms" were designed. At this center a circuit schematic specification could be entered into a program running on the local minicomputer and the output would be a printed-circuit layout for a double-sided board. Industry has now developed even better software packages to assist in multilayer printed-circuit board layout as well as in Multwire and similar techniques.

Certainly the most dramatic use of computer-aided design is in the layout of the interconnection patterns for the various mask levels in a very-large-scale integrated circuit. High-resolution color graphics terminals can be very helpful in multilayer layouts, with each level represented by a different color. There are as many rival algorithms to approach that problem as there are manufacturers offering equipment. Several special-purpose software design tools have been invented just to help lay out the metal and polysilicon interconnection mask levels of a gate array. One towering achievement this year was IBM's announcement that it had successfully utilized a 5,000-logic-cell gate array (each cell a three-input NAND gate) to build an experimental 360. Several software design tools were invented for this project and one hopes that they will eventually find themselves being incorporated into commercially available software

packages.

As the very-large-scale integrated circuit age comes out with chips that are increasingly dense, the skillful packing of the circuitry and its interconnections will become increasingly subject to computer aids. Computers can investigate numerous possible solutions to a given problem, evaluating the practicality of each. Thus optimal solutions are much more likely to be found.

Computer-aided drafting machines have been in existence for some time. Gerber Scientific began as a firm that manufactured automated textile-cutting machinery and grew to become one of the finest CAD manufacturers in the area of automated drafting for the design of mechanical parts, as well as for circuit layouts and other user-defined applications. Many other systems are also available, including several that use ordinary plotters rather than specialized computer-controlled drafting machines. The software to run all this hardware has been a long time coming, but now it's finally arriving and in gale force.



Computer-aided manufacturing

Manufacturing processes are peculiarly susceptable to automation, called computer-aided manufacturing, or CAM. The most direct control that a computer can provide is at the electromechanical level itself. At this level numerical controllers can guide the every movement of a metal lathe or the intricate actions of a textile fabric handler. Manufacturing situations where chemical fluid flow must be controlled is another good example of a process very amenable to computer control. An intricate network of valves, along with fluid-level, temperature, and other sensors, can easily be put under program control. The advantage of computer control, of course, is that a change in the process is easily accomplished in the software. Production schedules can be more easily met when a changeover is as simple as loading a new program into the computer controller.

Almost every manufacturing process entails several steps that can be monitored and controlled with the help of a computer or a network of computers. The ultimate manufacturing aid is the robot. More robots are finding their way into manufacturing situations, especially ones that are either hazardous to humans or extremely tedious. Also, of course, robots can be built to be much stronger than humans—or King Kongs for that matter. The software to control a robot's movement, however, is a formidable problem. Most robots are highly specialized for this very reason—the more specialized, the less sophisticated is the controlling program.

Computer-aided manufacturing is a rapidly growing area, ranging from numerical controllers to the special production-scheduling programs that assist the manager in his chore of deciding which lines should run what when.

Business software

With the great proliferation of both minicomputers and microcomputers, an increasing number of businesses are finding that an in-house computer system is an effective way to handle business records, as well as day-to-day activities. A general ledger program can help the basic records, while an accounts payable program can handle the records of accounts for which there is a balance due to the business itself. An accounts receivable program manages the accounts that are maintained by the company for suppliers and other services that are purchased by the company itself.

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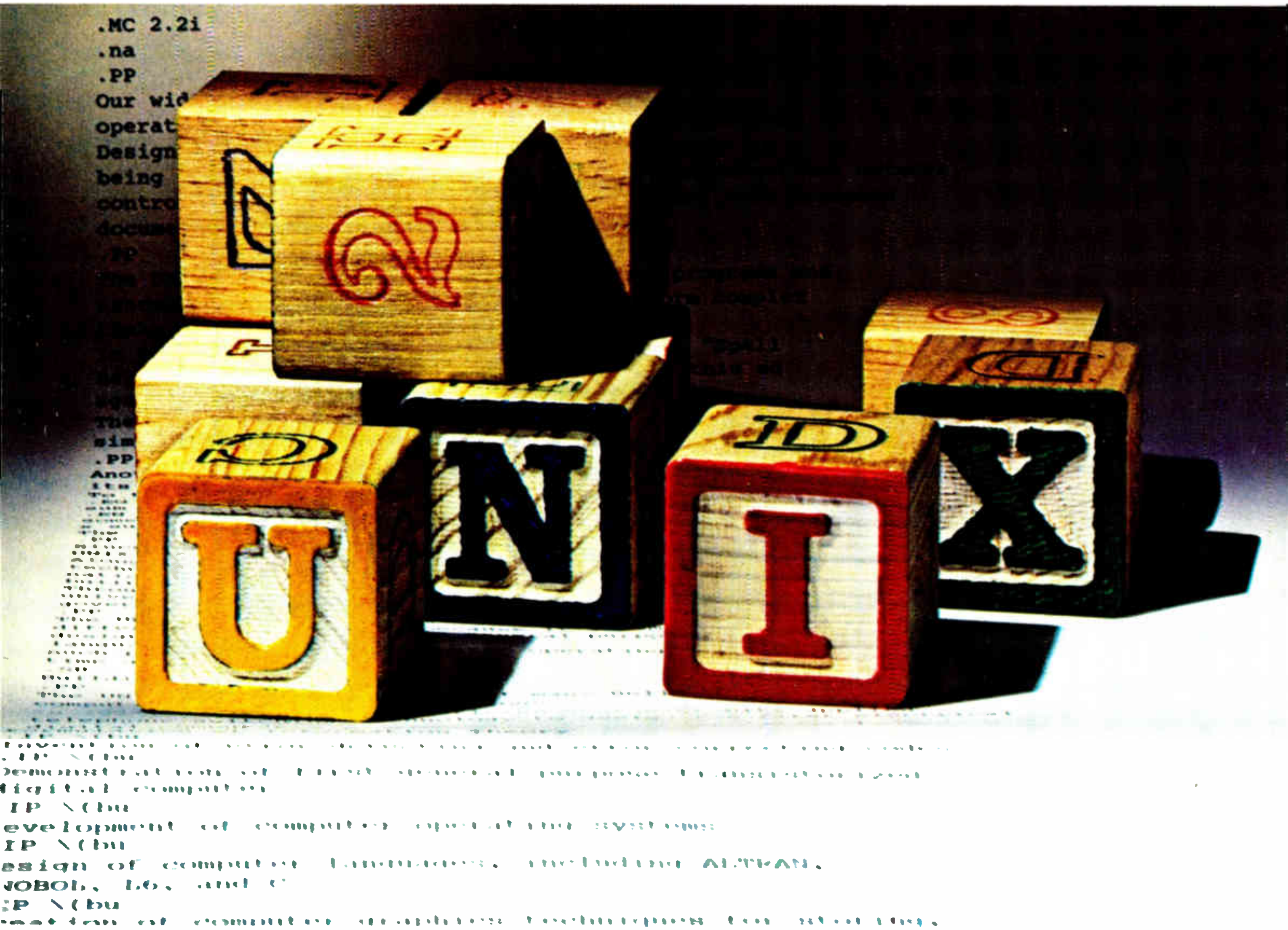

The computer printout in the picture above contains the instructions and input needed for the *UNIX* system to format and produce the text on the opposite page.

Our widely accepted *UNIX*™ operating system is simplifying the use of computers. Designed to handle a variety of applications, it is being used to manage and maintain the telecommunications network, control experiments, develop software, process text, prepare documents, and teach computer science.

The *UNIX* system allows users to take small programs and assemble them like building blocks to perform complex tasks. In text processing, for example, the command "Spell Bell Labs Ad" tells a computer to proofread this ad against a dictionary filed in its memory. The program that performs the task was created by simply combining several smaller *UNIX* programs.

Another useful feature of our *UNIX* operating system is its ease in typesetting mathematical expressions. To typeset an equation like

$$\sum_{i=1}^{\infty} \frac{1}{x_i} = \pi$$

someone need only type: "Sum from i = 1 to infinity 1 over x sub i = pi." The computer does everything else.

Since 1969 the Bell System has installed more than 1100 *UNIX* systems. Along with other Bell Labs innovations in computing technology, these systems are enhancing the way the nation's telecommunications network is planned, designed, built, and operated. Through licensing agreements with Western Electric, universities have installed over 800 *UNIX* systems, and government and industrial facilities are using over 400.

The *UNIX* operating system can be used with computers of different manufacturers because it is small, cleanly designed, and written in a general-purpose programming language. Such portability in a computer operating system saves time and money.

Building on the past

The *UNIX* system is just one of many Bell Labs advances in computing science and technology over the years. Among our innovations:

- Application of telephone switching concepts and technology to early computers
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- First design of AND and OR gates for diode circuitry
- Formulation of Information Theory
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- Demonstration of first general-purpose transistorized digital computer
- Development of computer operating systems
- Design of computer languages, including ALTRAN, SNOBOL, L6, and C
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Looking ahead

Computing technology is having a major impact on the telecommunications business. It's increasing the Bell System's ability to provide new services and handle existing ones more efficiently. Today, for example, the nationwide telecommunications network links thousands of software-controlled electronic systems, making it by far the world's largest distributed processing network. We and our partners—Western Electric and the telephone companies of the Bell System—are putting technology to work so that the network will continue to evolve and expand its information-handling capabilities. The object, of course, is to meet the fast-growing and changing needs of Bell System customers.

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From Science: Service

Of course there are many tasks other than bookkeeping that can be automated in a place of business—for instance, the calculations involved in the payroll for all company employees. This software must access a data base that maintains the records containing the pay rate, the hours worked or salary, the latest social security and income tax rate scales, and several other vital pieces of data.

The need for several different programs having access to the same information, or data base, has given rise to numerous software packages that share a data base and that run on everything from mainframes to microcomputers, as well as some specialized minicomputers. (Telecommunications permits any business that can afford it to access mainframe computers and the extensive software base that most mainframes support). Data-base management systems, or DBMs as they are called, give access to a common data base that is shared by different application programs, possibly written in several different languages; they also permit the interactive computer terminal operator to inspect records and

What is soft about software?

In 1842 Charles Babbage proposed the idea of using a punched card to program the actions of a machine designed to make arithmetic calculations. Until that time the punched card's most exalted position lay in its ability to program the motions of a Jacquard loom. That program was one of the first pieces of software, though only in the twentieth century would it be called such.

What the punched card did was to allow a general-purpose machine to perform a very specific set of tasks. The electronic machines of today are not so very different. Those that are termed "numerically controlled" often accept a program in the form of paper tape, which is similar to an indefinitely long punched card. But the term "software" is most often associated with general-purpose computational machines—computers. Its purpose, however, is exactly the same—that is, to program a specific set of actions to be performed in sequence for the accomplishment of a computational task.

But why soft?

"Soft" because what is hard and fast about a computer is its basic capabilities. Those hardware functions are fixed at the time of manufacture and include primarily its instruction set. The program, or software, merely specifies some group of these basic instructions to be performed in sequence. Since those specifications can be changed, the computer is said to be programmable and all the programs that may be run on the machine are its software.

Firmware is semi-soft

Firmware is simply software that has been programmed into a read-only memory, or ROM. Or to put it another way, it is hardware (ROM) that has been programmed to contain a piece of software—hence firmware.

Programs are usually loaded into a computer's voltile, or random-access, memory. In this way programs and data may use the same area of memory for executing different programs at different times. Often programs will modify a set of data during execution. If any of the locations that are changed reside within the body of the program itself, then this program is said to be self-modifing. Self-modifying code can never be programmed ito a read-only memory and therefore can never become firmware. To make a program firmware-eligible it must put all modifiable addresses in writable memory and therefore not in the read-only memory where the program itself resides. This is quite easy to do at the time the program is written, but it is often very difficult to alter a self-modifying program to move its write-memory references out of the code area.

Self-modifying code

Nowadays self-modifying code is considered a bad programming practice and is usually avoided. However, much proven software was written before the advent of cheap, reliable read-only memories and hence of firmware itself. A compromise solution taken by manufacturers who want to use read-only memories for their already field-proven, but self-modifying, code is to use the ROM only for storage. When the program is to be executed, it is simply moved into (RAM). □

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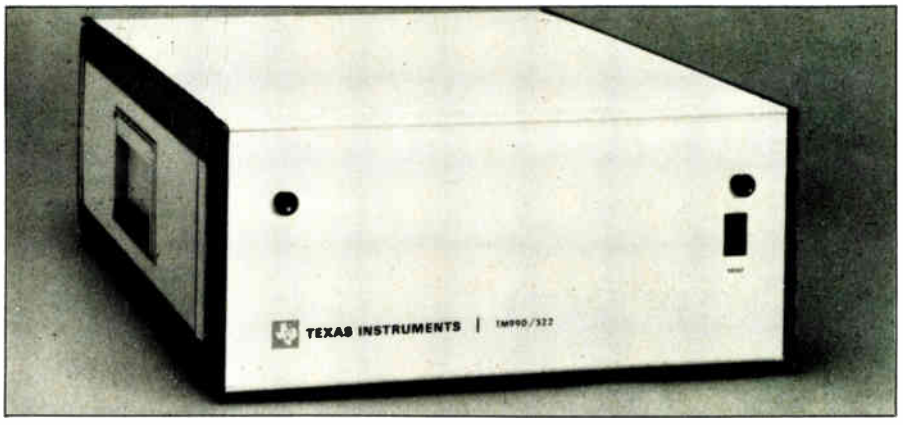
update the data base.

One such specialized minicomputer, from Tandem Corp., uses total redundancy in both the processor hardware and the mass storage of data. Write operations to disk go to both disks of a redundant pair, but read operations are performed from the disk whose head is closest to the desired track of information. Redundant hardware greatly decreases the possibility of a catastrophic loss of records that could very well break a small company.

IBM's business software is one of the most extensive available, with custom installations a common practice. On the other hand, one of the newer offerings is Hewlett-Packard's data-base management system for its minicomputers, which interfaces with its popular languages. Even microsystems are getting data-base managers, like MDBS from Micro Data Based Systems, which sports interfaces for five popular microcomputer CP/M-compatible languages.

Office software

Many other tasks around the office can be streamlined by introducing computerized aids. Word processing is a prime example, and it benefits especially from systems based on television monitors. Most permit the user to insert, delete, and perform global search and replacement operations on text displayed on its screen, as well as on several pages held in memory. Some, however, go further and add the ability to "cut and paste." That capability permits blocks of text to be moved about and positioned between two former



lines of the original text. Other advanced features include the automatic generation of letters with the proper format and return address, plus a variable sender's address and several options for the letter body itself. Some are also set up to allow easy filling in of forms by prompting the users for information entry, after which the completed form is generated. Yet others will store records, perform statistical operations, and produce reports that summarize and expand upon their internal data base. There is even one that supplies special keytops with its software that depict the editing functions it provides.

After editing, text is dumped onto a system printer. Better systems work with the printer to perform right and left justification of the text, as well as automatically hyphenating and renumbering pages.

Another office task that welcomes automation is in the mail room, for which there are programs that alphabetize all the names and addresses on the various company mailing lists. They also allow easy insertions, deletions, and updating of those records. The lists are usually dumped onto a printer that may use form-feed labels for later attachment to envelopes, though occassionally envelopes can be printed on directly, or special window envelopes can allow the addresses to show through.

A newly arising area of software is in packages that are aimed at helping the businessman himself to make better decisions in the management of the responsibilities entrusted to him. Financial planning packages can organize and maintain relationships among many variable economic conditions simultaneously, allowing the financial planner to manipulate certain variables to see the effect that a change in one or more will have on the others. These software aids can help predict future economic consequences of actions today, thus extending the manager's field of vision. Other assistance can be found in information networks that give their users access to stock market and other financial data. Some software packages allow not just access to current information but also transaction record keeping and limited forecasting capabilities. □

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HIGH-LEVEL LANGUAGES: TOWARD THE UNIVERSAL

Languages featuring program structures can treat more application areas

In the beginning there was Fortran. Then came mighty Cobol, but always there was Fortran. Now perhaps we are seeing a real challenge to the power inherent in the mammoth amount of software available in Fortran. A challenge from languages that answer the needs that only became apparent after years of programming experience—like those that led to structured programming.

Of course good structured programming techniques can also be applied by Fortran programmers, but the newer languages allow structured programs to be coded much more conveniently. In the end, however, it may be the wider applicability of so-called structured languages that causes them to replace the more specialized languages like Fortran and Cobol. The Department of Defense has settled on a handful of languages for its applications and is taking pioneering steps toward consolidating the features needed for all its applications into a single language.

Many of the available structured languages like Pascal also increase programmer productivity, because of the increased likelihood of correct program design when using them, as well as easier debugging and greater readibility. There are at least four structured versions of Basic available too, as well as more exotic but increasingly useful languages like Lisp.

All in all, it looks as if Fortran, which is on offer from virtually every disk-based system, had better watch out—though right now it still wins hands down.

Pascal

The most popular of the structured languages is Pascal, which is becoming available on an ever-increasing number of microcomputers, minicomputers, and mainframes. It features a structure that not only is more readable but also is an effective mechanism for isolating modules for debugging simplicity. Modular isolation ensures that any programming errors are local to the routine they reside in and therefore affect only those segments of the program that use the offending routine.

The requirement of declaring all variables, along with the classic structured programming statements, leads to a programming language in which more reliable code can be written. One problem with Pascal has been that all variables and subroutines must be declared at compilation time. That practice inhibits modular programming by prohibiting separate compilation of modules, greatly complicating the software design process.

Some of the newer Pascal compilers, however, do allow separate compilation. Texas Instruments' microprocessor Pascal does support separate compilation and adds several other extensions, including extensive real-time facilities for synchronizing processes with external events. TI has created a gamut of software tools to support the spectrum of programming environments ranging from its full-blown minicomputers to inexpensive, ROM-based systems.

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contenders in the business are introducing Pascal too. Hewlett-Packard did for its minicomputers, as did Tektronix for its popular universal development systems. Just this year Intel introduced Pascal/86, a significant addition to its stable of high-level languages.

In the smaller microcomputer arena we find a morass of Pascals being offered, all with slightly different features. Outstanding among those is the UCSD Software System, which sports none other than a Fortran compiler, written in Pascal, for the programmer who just can't quit. There is also a version aimed at allowing the original-equipment manufacturer to write operating systems for his products in Pascal, offered by Enertek Inc.

Ada: language of the future

The United States Department of Defense made what may turn out to be a landmark decision when it decided to fund the programs that led to the creation of the new computer language called Ada. Its need was to come up with a language that could be used in all of the tremendously various programming situations that the armed forces have. Now business tasks are performed on machines that run Cobol, many of which are from IBM. Scientific investigations may be performed on large Digital Equipment Corporation minicomputers, in, say, Fortran. Weather systems control may utilize special-purpose array processors in a specialized macro-language. Real-time process control situations are often handled by dedicated microcomputers that are programmed in assembly language. To top it off, each military installation might choose many different manufacturers to provide the hardware and software to perform the very same job. As a result a tremendous amount of duplicated effort occurs.

The Defense Department should be commended for having the foresight not only to apprehend this problem but also to be flexible enough to invest the dollars necessary to analyze it and come up with a workable solution. Its immediate actions involved choosing just a select few relatively standardized languages for all processing problems. The department, however, also undertook a multiphased program to determine if it was possible to create a single programming language that could conveniently solve all its problems.

After almost seven years of research and development, Ada has emerged. The method used to decide just how Ada was to be written started with contracts with many different respected software houses to write specifications for their solution to the language problem presented by the DOD. These specifications were then submitted to the knowledgeable public—respected software consumers, writers, and teachers. They also returned a report that detailed their evaluation of the language specification. Many such

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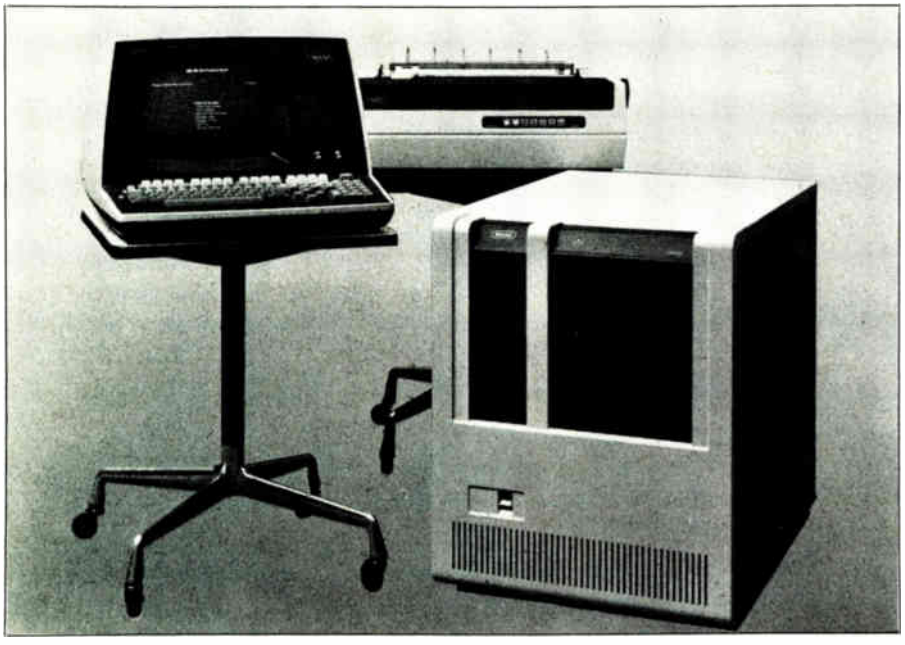
reports were reviewed during the lifetime of the specification process, which terminated in July 1980 when the specification was published. Several iterations were gone through, in which the information gleaned from the reports was resubmitted as needed features to those writing the specification. The final specification contract was awarded to a programming team at CII-Honeywell Bull in Paris.



To Pascal programmers Ada will be familiar in many respects. It shares with Pascal most of the control statements and the data-typing facilities, as well as the ordinary operators like +, -, *, /. It is also block-structured like Algol and offers the exception-handling capabilities of PL/1. The key to its universality, however, lies in its ability to be extended in a manner that does not yield a non-portable result. In this way special extensions can be attached to a program to allow it to access specialized functions for everything from statistical operators to real-time process control.

In order to achieve this extensibility, a new program module was invented, called the package. The package makes possible a programming environment that includes a subroutine package plus a set of data types and access rights to other packages. There are many additions to the subroutines that are needed to define an entire program environment, including private data types, procedures, and access to machine-level structures. All of the components can be hidden from the user of a package so that they become transparent to the programmer. In addition, every Ada compiler will be able to be so extended simply by specifying the package's name within any user's program. The specified package must of course be resident on the computer, but if it is there, all the programmer has to do to access it is declare it as he would a subroutine.

Currently there are several different types of Ada projects going on, such as compilers, and package clearinghouses. Both the Army and the Air Force have active compiler contracts out that will likely bear fruit in 1982. There are also numerous minicomputer and microcomputer compilers in the works.

The C language

The computer language C was designed and constructed at Bell Laboratories. It is a highly structured language that retains many of the features of assembly language as well. It is becoming available for a wide number of computer systems, since it is a requirement for any system wishing to run the increasingly popular operating system Unix. The reason is that Unix is written in C and therefore requires a C compiler for proper operations. Unix is now available for several mainframes, Digital Equipment Corporation's minicomputers, and Z80-based microcomputers that run the CP/M operating system.

Lisp

A relatively little used language, called Lisp, has become the hallmark of artificial intelligence studies. It features the ability to process lists of related information in a highly efficient manner. This allows conceptual categories to be mirrored in a computer program in a way that encourages ambitious projects. This language is also finding application in computer-aided design projects that use high-level methods for analyzing and solving a complicated

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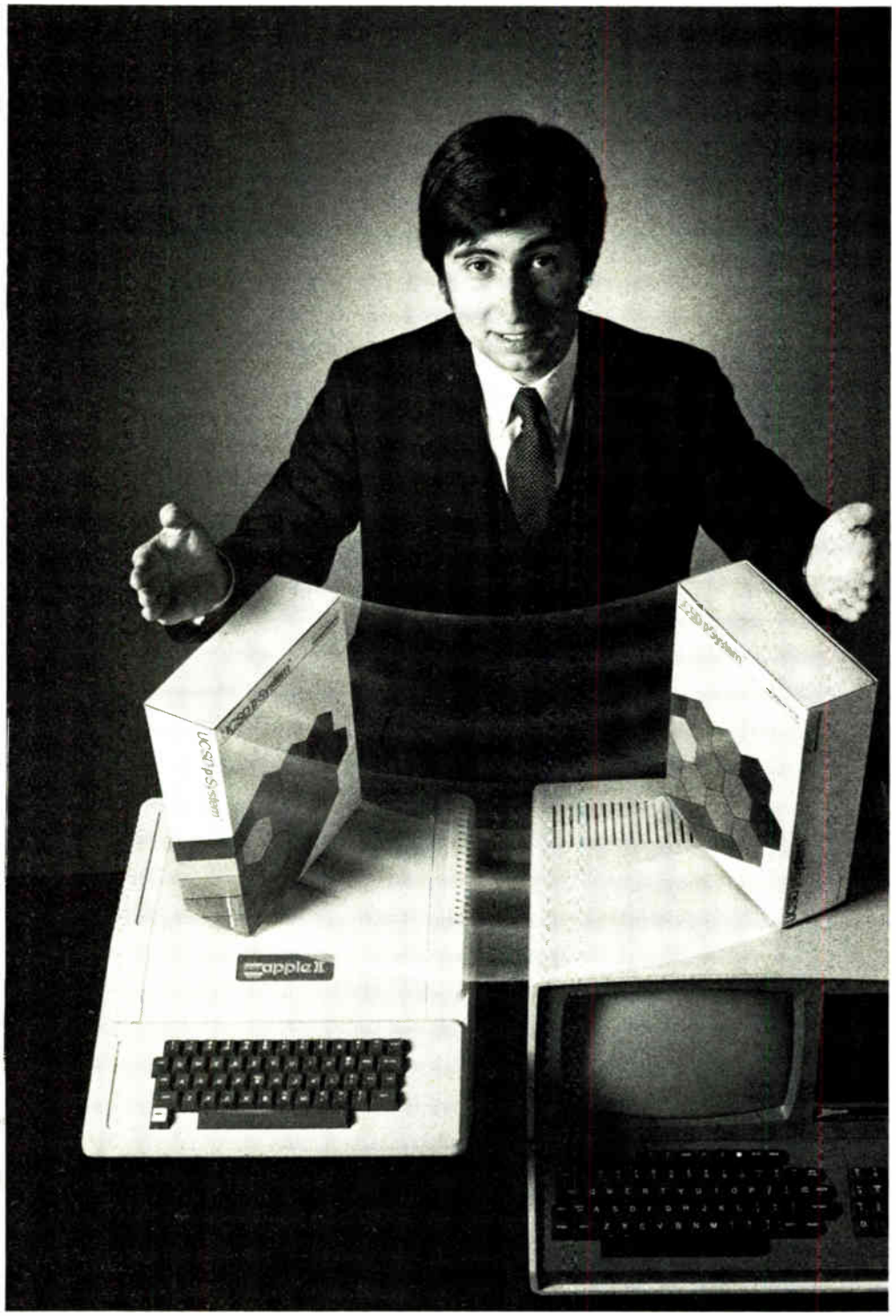

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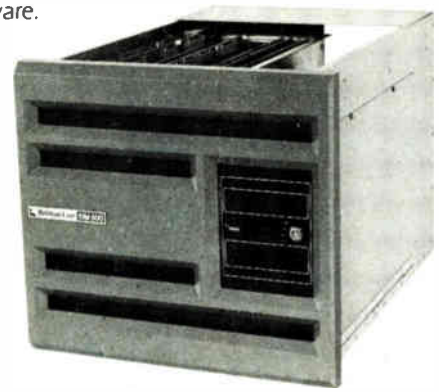

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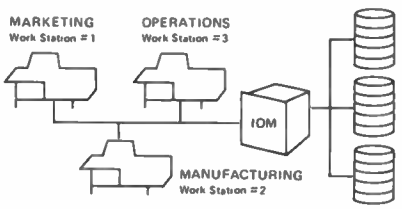

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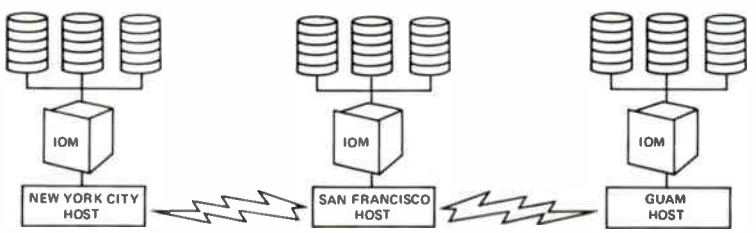

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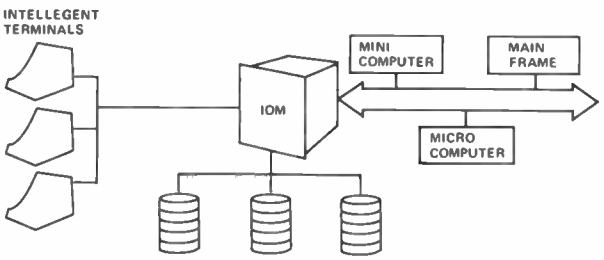

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integrated-circuit layout problem. It is available for many mainframes, several minicomputers, and CP/M-based microcomputers.

Good old Basic is now available for practically every computer system. It is available in either an interpreted or a compiled version. If a program is interpreted, each Basic statement is executed sequentially, whereas compiled versions first convert the entire program into machine language statements and then execute that program sequentially.

Structured Basic

Structured versions of Basic are also available. These translators include the classic control structures characteristic of structured programs, as well as providing explicit declaration segments that list the variables used in any one program and what their types are.

An increasingly popular way of providing Basic capability is to put the language in a read-only memory. Basic in ROM allows a turnkey system to come up in Basic whenever the machine is turned on. It also enables single-board computers to be programmed in Basic rather than assembly language, thereby increasing the productivity of the product development department. National Semiconductor Corporation has in fact written a version of Basic for its NS800 microcomputer. This version can be purchased with the Basic interpreter on chip, thus creating a one-chip Basic computer capability.

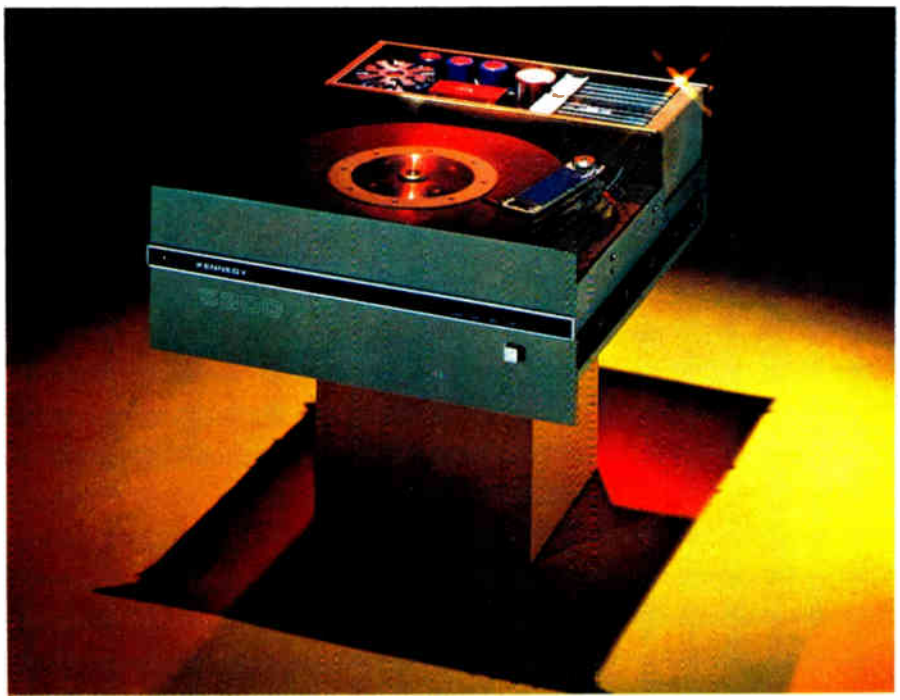
Mainsail

One example of a new language is Mainsail from Xidak Inc. in Los Altos, Calif. Mainsial

was developed by Clark Wilcox and Greg Jirak, both of whom have had a significant amount of software experience. They recognized a need and masterminded both a new language, Mainsail, and a new company, Xidak, to fill it. The language offers a number of features that make it particularily useful for specialized applications; for instance, Intel is using Mainsail in its ever-widening projects to employ computer-aided design.

Mainsail offers a full range of data types, including floating-point for high-precision scientific investigations, bit vectors and specific bit manipulation, and variable length strings that are descriptor-based, plus full data-type security and enforced error checking at both compilation and operating time. Mainsail is also an extremely modular language consisting of separately compiled segments that are joined together to form an executable program but not all of which need to be resident in the computer's main semiconductor memory at any one time. As a result very large programs can be run using Mainsail. There is also a separate interface and body portion to each Mainsail module, which greatly increases the effectiveness of its modularity. The separate interface portion specifies the variables and services that the module offers to users. The body portion contains the actual code that performs the functions specified in the interface portion. In addition, a working set of general-purpose modules are kept in memory for all users.

Mainsail also features a very sophisticated mass memory storage allocation mechanism that includes dynamic allocation of records and arrays under user



control. It can also dynamically—that is, during program execution—alter the range and therefore the size of arrays. There is also an extensive number of compilation-time features, including interactive control of macro-instruction definitions and evaluation of constant expressions from the system console terminal. Mainsail automatically searches procedure libraries for specified modules that are called in by a user's program. Also, generic procedures may be constructed in which the data types to be used need not be specified until compilation time. The compiler's symbol table can also be saved and restored.

Mainsail is not just a compiler either—it is an entire development system. The front end of the language translator generates an intermediate code that makes it very easy to run the system on many different types of hardware; thus Mainsail is highly portable. It has a source-level debugger that has both cathode-ray-tube and hard-copy terminal output formats, as well as an extensive number of other facilities, including single-step execution, examination and alteration of selected variables, conditional breakpoints, and a standard-error diagnostic facility. Also, a full-screen text editor and program management system will become available soon.

Forth

Forth, in vented by Forth Inc., Manhattan Beach, Calif., is one language that allows the user to add his own commands. It maintains a system library of command calls that is actually a list of addresses of the routines that execute the commands. The user may employ any of the existing library commands to build up more complicated versions.

A kind of high-level assembly language, Forth offers many interesting features not generally available in other interpretive languages. It is not as fast as assembly language, but it is much faster than interpreted Basic, and further, it allows the user to customize the language to a specific application area. By defining new special-purpose commands and adding them to the library, Forth can be made into a language that conveniently fits the user's needs.

For instance, if a statistical language is required, those needed functions can be added to the library and subsequently utilized as new commands. Similarly the language might be customized to serve as an electronic filing system or to perform complex financial calculations.

The beauty of Forth is that it can always be further modified and updated. No other language offers such an extensive ability to tinker and fine-tune it to the user's needs.

Fortran and Cobol remain the most widely used languages and are available for virtually all sophisticated computer systems. They continue to serve the scientific and business communities well, but in the end they will not be able to complete with the increased programmer productivity and program reliability that the newer structured languages can provide. They will, however, continue to be used for a long time, since there is a tremendous number of man-years that will not and should not be cast aside carelessly. □

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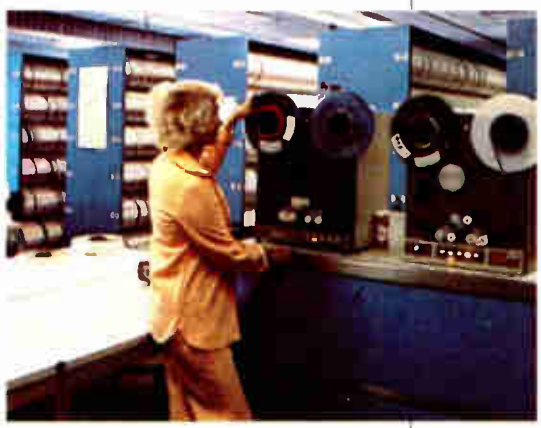

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OPERATING SYSTEMS: THE BACKBONE OF SOFTWARE

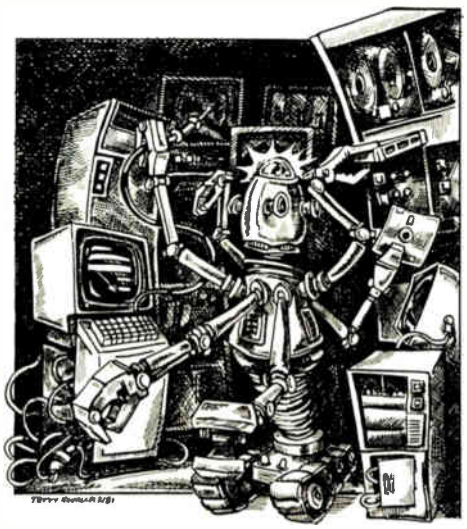
Microsystems are getting more-sophisticated operating systems that emulate mainframes

System-level software—the operating system plus its utilities—is the most basic program in any computer system. It knows the whereabouts and protocols of all the input and output devices, the mass storage devices, the special-purpose hardware like real-time clocks, and every other machine-level component that requires program control. It also harbors the all-important interface between the computer system and the human user; this includes everything from disk file access to character echoing while in a full-duplex mode.

The user interface has been the subject of a great deal of research, with several operating systems being written with the optimization of this interface as one of the primary driving forces behind their creation. Other considerations include the switch from assembly language to high-level languages for system implementations. Yet another important issue is software portability, since this capability ordinarily requires that the same operating system be resident on every machine that wants to use the portable programs.

The Unix operating system

Unix is a trademark for a family of operating systems that were developed by Bell Laboratories. Unix was designed with one key



objective in mind: to create a programming environment that would be friendly to the user while allowing maximum flexibility. This charter resulted in an operating system that is unusually simple to learn and yet that can provide a very effective tool for program development.

The user interface for the Unix system is called the "shell" and it functions as the command line interpreter. It accepts commands from the user for file maintaince and program execution. It also contains extensive facilities for passing data between programs—which is one of its strongest attributes.

From the beginning Unix was a multiuser operating system, and it continues to be so even as it is being trimmed down for microcomputer environments. This plus the liberalization of Bell's licensing policies with regard to it will make it a major force in computer operating systems well into the 1980s.

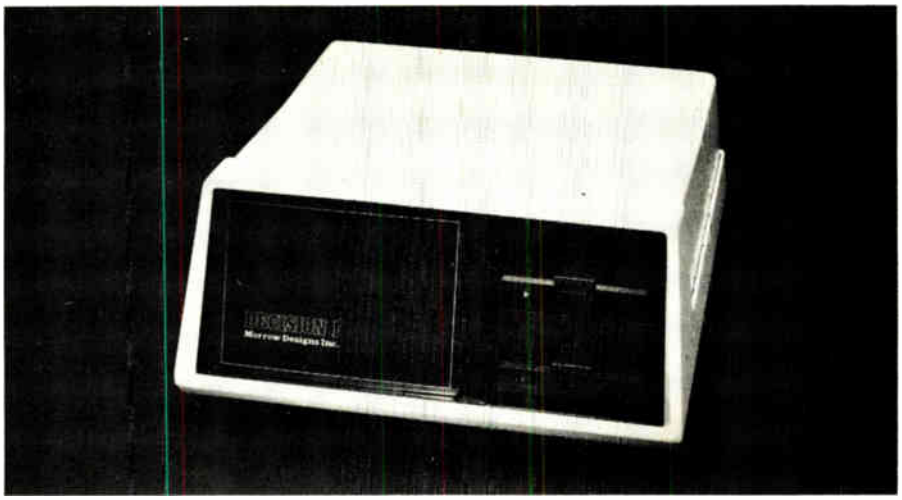
CP/M

At the other end of the spectrum is CP/M, which has become a de facto standard for 8080-based microcomputer systems. Although CP/M does not offer the complicated structures found in larger operating systems, it does supply the user with full floppy disk access, as well as all the utilities needed for an 8-bit memory-bound (64-K bytes or less) system. CP/M is the brainchild of Digital Research, a company started by Gary Kildall because of his frustration with the lack of a disk-based operating system for microsystems. It has grown in popularity until today it has more languages and application programs available for it than for practically any other operating system. Though Unix offers more sophisticated program control like the services of pipes and forks, CP/M is all that is needed for many 8-bit applications such as word processing. It also fits very nicely into a microcomputer's limited address space, since it typically occupies only about 12-K bytes.

There is also a multiuser version of CP/M available called

MP/M. This version extends the facilities of CP/M to more than one user simultaneously and also gives access to very large disk files such as those found on hard-disk–based systems. Both MP/M and CP/M will shortly become available for the 8086 microprocessor, though of course the applications packages that run on 8080s will need to be translated into 8086 code before being used on this new system.

CP/NET is the latest addition to the Digital Research stall of operating systems. It allows many users to share expensive resources, such as hard disks and open-reel tape drives. It can be implemented in many different configurations, like ring and star loops, but in each case an MP/M system is the master and CP/M systems are satellites serving the many users. In this way each user has his own processing unit to execute his programs but also has access to common files and the large files kept on the infrequently used mass storage devices. This capability should serve well in many environments such as office information centers, inventory control, and word processing.



Oasis

An example of a new multiuser operating system that runs off microsystems is Oasis. The Oasis operating system is marketed by Phase One Systems Inc. of Oakland, Calif., and is designed to enhance Z80-based microcomputer systems. Oasis has many of the commands found on much larger systems. It can handle multitasking, floppy and hard disks and real-time inputs via interrupts, and it has an integral printer spooler. It includes "help" functions for all of its commands so that users may learn the system as they go.

Extensive utilities are provided for disk file manipulation and text editing. The text editor is almost a word processor, and the application program Script is, in fact, one. Script provides an easy means of producing manuals, documentation, letters, and so on. Included in the Script package is a more powerful general-purpose text editor with such features as global changes, line wrapping, text finding, macro-instructions, text moves to external file copies, and access to other Oasis system commands. It also provides many printing and formatting capabilities—text justification, page alignment onto an odd- or even-numbered page, gap numbering, headings and footings, centered chapter and appendix headings, automatic table of contents, and many more like boldface characters, global variables, access to current system date and time, and name and address file merging functions. Up to sixteen users can utilize these memory-resident reentrant routines at any one time.

Oasis supports program development in assembly language, Basic, and Cobol. Its Cobol conforms to the ANSI 3.23 standard, which embraces most level 1 and 2 features, including their extensions. Its Basic provides a program development system with an editor, interpreter, and debugger. It also features access to the operating system for file management, device driver alterations, and the printer spooler.

The assembly language development system has several utilities available that assist in program development, among them an assembler debugger and a linkage editor. The linkage editor supports multiple object program linkage, displays the load map, and allows the creation of an absolute program from a relocatable one.

There is also a great deal of application software available for use on the Oasis system. Business packages for general ledger, accounts payable and receivable, mail list, order entry, inventory control, and word processing are but a few. Others include special-purpose packages for medical billing, dental office management, architects' and designers' timekeeping, and job cost analysis. Many communications programs are available too, such as those to emulate IBM's bisynchronous communication protocol, generate reports, and perform network data-base management, and general-purpose billing.

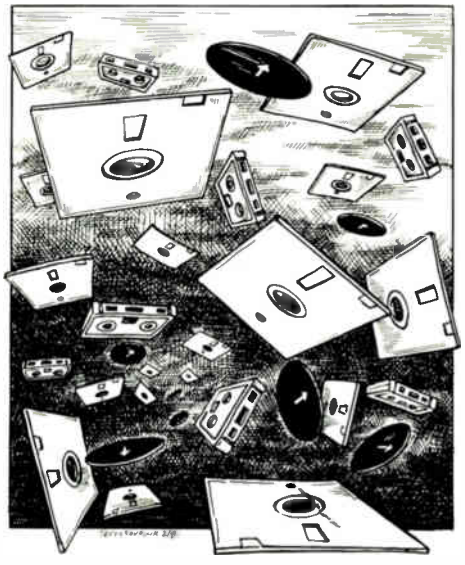
Oasis will be competing for the same market segment as Digital Research's MP/M and Microsoft's Xenix. Only time will tell which will come out on top, though the leaders are well perceived today.□

MEDIA: THE PLACE WHERE SOFTWARE IS KEPT

Software is finding that bigger and faster mass storage devices speed program development

Even though software is not as concrete as hardware, it still needs a place to be. Most of the time any given piece of software, or program, spends its time in a mass storage device—that is, either on magnetic disk or on tape. Whenever it is to be run, it is transferred into random-access memory for execution.

Mass storage devices are getting smaller and faster, just like every other electronic offspring. They are also being offered in packages that are scaled down from mainframe implementations. For instance, the hard disk, traditionally a mainframe storage device that was very expensive and complicated, is now available in a tiny, 5.25-inch version that is affordable by even the microcomputer system developer.



Tape drives too are getting smarter and more cost-effective. Streaming tape drives permit easy transfer from disk to tape, and sophisticated cartridge and open-reel models allow virtually unlimited amounts of information to be conveniently stored on a medium that is both inexpensive and reliable.

Fixed-disk drives

The leader in fixed- or hard-disk drives is the 14-inch version, which offers the greatest amount of storage per dollar. Fourteen-inch drives like the Century Marksman store from 80 to 160 megabytes, and the Trident over 300 megabytes. Another advantage of drives of this type is that they are available with removable disk packs. Removable packs are admittedly relatively expensive when compared with floppy diskettes, but their near-hundredfold greater storage capacity make them a valid system solution in many cases. The Shugart SA4000, for example, combines 60 megabytes of storage with a 7-megabit/second transfer rate. Of course the mainframe and minicomputer manufacturers market their own versions that boast similar features. For instance, Burroughs has several models, like the FD211 with a 20-megabyte capacity and the FD214 with 80 megabytes. These drives employ an interface that is similar to that of the company's floppy-disk drives—in fact, they use the same controller electronics.

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Left: Pascal-1 controls ESI's laser trimming system. The laser repairs semiconductor memory chips, replacing faulty cells with alternates.

Below: ESI dominates the industry in the computer-controlled laser adjustment of microcircuits. Pascal-1 programming flexibility gives ESI access to many different markets.

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technology, IBM, has led the way to 14-inch drives with much greater recording densities than can be handled by conventional ferrite read/write heads. With thin-film heads a 14-inch drive can achieve densities resulting in over 300 megabytes of storage.

The advantages of thin-film heads, however, has not yet come to 8-inch fixed-disk technology. All the contenders use conventional ferrite heads to achieve storage capacities in the 5-to-50-megabyte range. These drives are coming in at less that $1,000 and have become so popular as to be almost commonplace. Practically all the major disk manufacturers are starting to offer 8-inch models, such as Shugart's SA1000, which stores 5 to 10 megabytes, and Priam's 34-megabyte model. Other disk technology leaders like Kennedy, Micropolis, and Pertec are also offering 8-inch versions, as well as such Japanese concerns as Hitachi, Nippon Electric, and Fujitsu. Moreover, when thin-film heads come to 8-inch drives, they should give the larger models a run for their cost/performance ratio.

However, the most cost-effective fixed-media drive is the 5.25-inch versions that are appearing that can store up to 5 megabytes in the same space as a normal 5.25-inch floppy. These drives will dip below the $500 mark this year and are already priced below the same-sized floppy-disk drive of not so many years ago. We should see more and more original-equipment manufacturers burying these drives inside equipment to provide reliable and relatively maintainance-free mass storage at remote sites. In fact, before very long the new, inexpensive fixed-disk technology will probably become standard equipment in all computer systems right down to the microcomputer. We will probably see even smaller fixed disk drives in the near future, perhaps in the 3.5 inch size.

The backup problem

One major problem with the new sealed-enclosure fixed-disk drives is that of duplicating, or backing up, the data stored there. Because of the vastly greater storage capacity of the hard-platter drives, there is no cheap method to duplicate them up that does not involve a large amount of backup media. For instance, a 10-megabyte drive can be backed up by standard single-density IBM 8-inch floppies, but it will require forty of them to do the job. Although the new double-sided, double-density versions reduce that number to ten, that is still a lot of disks (and would cost about $50). The removable-disk packs are an answer, but both the media and the drives cost even more.

The logical solution is magnetic tape, and several manufacturers are beginning to offer an integral cartridge tape drive within the same cabinet as their disk drive. This can greatly simplify the backup problem, but at a significant cost, especially in comparison with the low base price of the 8- and 5.25-inch drives.

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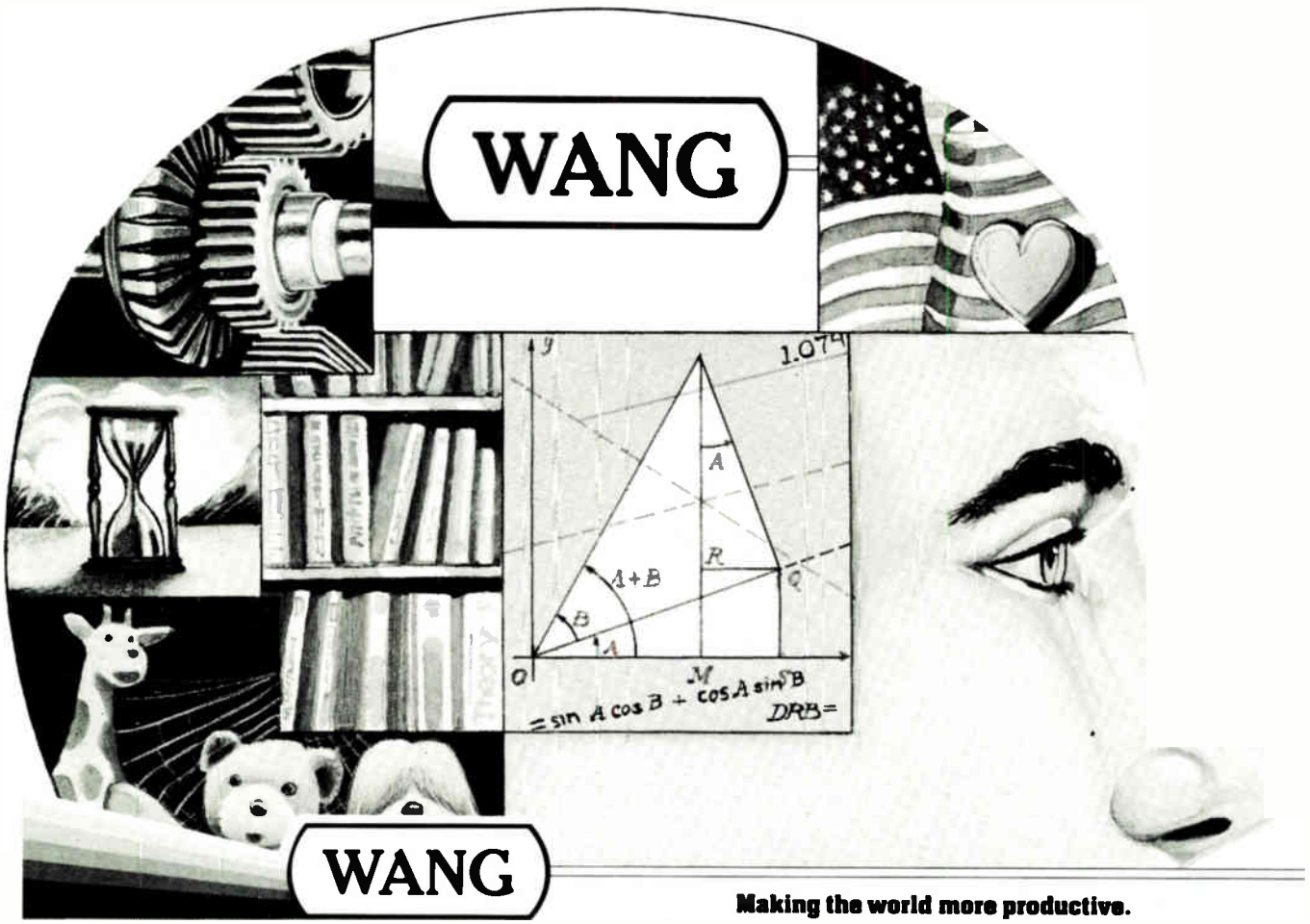

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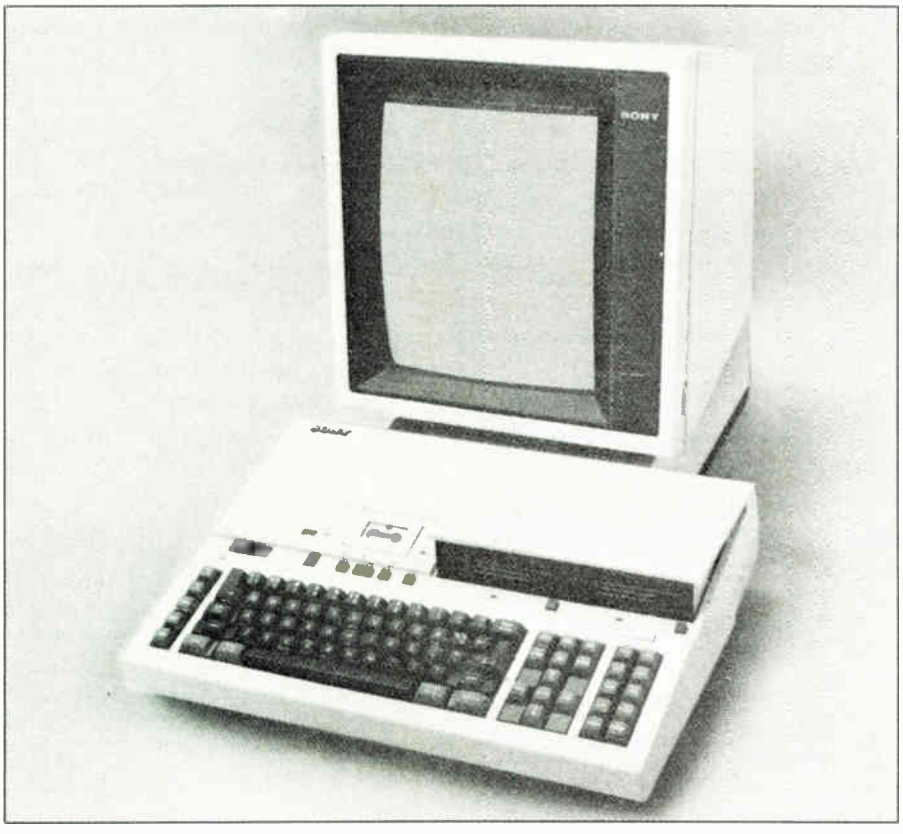
tape, and several manufacturers are beginning to offer an integral cartridge tape drive within the same cabinet as their disk drive. This can greatly simplify the backup problem, but at a significant cost, especially in comparison with the low base price of the 8- and 5.25-inch drives.

If an open-reel tape drive is already resident in the system, there is no backup problem, since it can be used for that purpose. But for a microsystem the cost of such a tape drive could be more than that of the hard-disk system itself. Other, less-expensive removable cartridge tape drives can be purchased, several of which are optimized for backup applications. These are called streaming tape drives, as they possess the ability to accept data from the disk in a relatively continuous stream; still, these drives can require several minutes to copy a large disk.



The backup problem has not been unambiguously solved yet, but much work is being done on it and a standard way of handling it is sure to emerge soon.

Floppy-disk technology

One elegant solution to the mass storage problem in small computer systems is to pair up a 5-megabyte fixed-disk drive with a 1-megabyte floppy-disk drive, thus achieving backup while using only five floppies. These 1-megabyte 8-inch drives are possible because of their double-sided (and thus dual head assemblies) and double-density recording format, giving them an effective fourfold advantage over the standard 256-K-byte 8-inch floppy. A lot of development time

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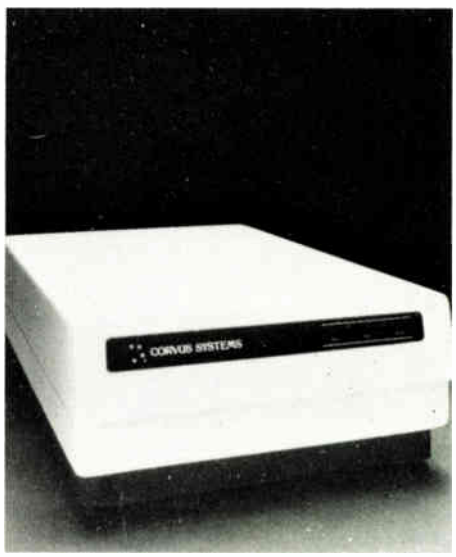
and engineering effort were required to make the dual-sided format reliable, but now that the problem has been satisfactorily resolved, practically all major manufacturers are offering the quadruple storage capacities of these drives or will soon do so.

Unfortunately there is no standard recording format for 5.25-inch floppies, the resulting incompatibility making them slightly less convenient than 8-inchers. However, their extremely low cost (approaching $100 in large quantities for consumer-grade equipment) makes them ideal in cost-sensitive situations. The quadruple-capacity double-sided, double-density formats found on the 5.25-inch versions can yield as much as 512-K bytes of storage capacity. That makes the 5.25-inch models effective solutions for problems that required 8-inchers several years ago, especially considering that their small size matches nicely with the trend to microminaturization. Perhaps it's too late, but if a standard recording format were adopted for the 5.25-inchers, they could become the solution of choice even in future medium-sized computer systems.



And what's more, now there is even a 3.5-inch version from Sony. This micro-floppy holds 128-K bytes and is used in Sony's new word processor. □

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PROGRAMMER SHORTAGE

More programmers than ever are needed to meet the growing demands of industry

It has been predicted that by 1984 the programmer shortage will be so acute that there will be ten job openings for every programmer. The proliferation of small, cost-effective computers has opened the door to a host of new applications, all of which require software. To meet this challenge industry leaders are coming up with several strategies, including: inventing better programming techniques so as to increase the productivity of the existing programmers; making the programs that are written count for more by making them transportable to other hardware configurations; and most ambitious of all, creating very-high-level languages that produce as output several lines of a popular high-level language from a single line of very-high-level language (often called automatic program generation).

More efficient programming methods

It all began with the introduction of top-down program development by teams within IBM; now it's called "structured programming" and is taught in virtually every introductory college-level programming course. The term refers to a programming method that allows the development of a complete solution to a problem before a single line of code is written. The problem is solved by using a combination of graphical representation and English sentences. Once a solution is found, it can be coded in any language that is adequate for the job. It can also, usually, be found using a pencil-and-paper emulation, enabling the programmer to verify its correctness before coding.

When the actual program is coded, only three control structures are allowed. That permits other programmers to easily understand the program, as well as making the code more reliable. It also makes the programs much easier to maintain, since changes in a top-down design affect only portions of the program further down the tree. The structured solution also serves as excellent documentation that is both accurate and easy to understand.

However, no matter how good the methods become, we will still need programmers to use them.

Because of the proliferation and growing capability of computers, programmers are in increasingly shorter supply. They are demanding continually higher salaries and are being organized into more and more complex team efforts in an attempt to glean as much productivity as possible from this scarce resource.

We are also finding that programmers are not only being trained by computer science departments. Since software is becoming so important, most regular engineering departments are requiring that their graduates have a fundamental ability to do both high-level and assembly language programming.

It is still true, however, that of the total number of lines of code written, the majority are handled by personnel that have had no formal training in programming. With microprocessors finding their way into practically every new product that involves electronic control circuitry, the design engineer has had no choice but to train at least some of the existing staff in the art—fast approaching a science—of computer programming. □

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Perhaps another consideration that gives GTE Systems such an edge is our advantageous location. Here, in an impressive suburban community just 20 minutes from downtown Boston, GTE professionals enjoy the cultural and educational riches of this prized New England city, the intellectual stimulation of our famed Route 128 electronics belt and the recreational advantages of our distinctive seasons so enhanced by easy access to winters in New Hampshire and Vermont and spectacular summers on the sandy beaches of Cape Cod. All this in an area that claims the extraordinary benefits of easily affordable homes, both in suburban and rural areas.

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NEW PRODUCTS

Meeting the challenge of new application areas

As software science matures, a slew of marketable products is being brought forth to meet the challenge of new application areas. Not only are we witnessing the advent of new computer languages, but in addition new kinds of software are appearing. These include everything from sophisticated program development tools, like full-screen text editors, to "check-box" canned programs that allow nonprogrammers to generate executable code.

A unique event this week will allow those unfamiliar with specific software tools to see them demonstrated first hand. That event is the Fifth International Conference on Software Engineering to be held in San Diego on March 9–12. It is called a Tool Fair, and it will feature a whole range of tutorial demonstrations showing how to increase programmer productivity by using more helpful tools. These presentations will expose participants to time-saving techniques involving programs like financial planners, program development aids, and many others. The conference will also feature several important speakers like Niklaus Wirth, author of Pascal.

For years now, mainframe vendors have been supplying their users with application software

packages that can be integrated into their host computer environment. Many of those packages can be bought on a custom basis with the manufacturer supplying support personnel to help integrate the package into the user's system. The alternative is to have internal programmers patch the program into the system themselves, an option that can be risky for smaller users who do not have the necessary expertice and/or the proper system documentation.

The answer to this dilemma is to use a "standard" software configuration that already supports a wide range of applications. In this way most of the present and future needs of the system's users can be met by purchasing compatible packages that have already been integrated into the host environment.

In the 8080 microcomputing area that goal is being served by a third-party software house called Lifeboat Associates. The firm is responsible for adapting a large number of programs to the popular CP/M operating system from Digital Research. One can choose from practically all the popular computer languages—Fortran, Cobol, APL, PL/1, C, Algol, Lisp, Forth, and a host of others. Also many utility programs, like data-base managers, are being offered as accessories for the language of the user's choice.

Third-party software houses do not actually write the programs themselves, but instead adapt them to an already existing operating system environment so that all the user has to do is plug the supplied disk into the system to be up and running.

We shall see more and more of the third-party software house approach as the need for software continues to grow. They offer an opportunity not only to the software house itself, but also to the independent programmer who may have his work published and distributed by the third-party concern in return for a monthly royalty check. □

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The STR-810 digital recorder is designed for data logging, data acquisition and as a system loader. Using either the 3M DC-300A or DC-300XL cartridges, packing density is 1600 bpi, for respective data capacities of 2.3M bytes and 3.4M bytes per cartridge, using four tracks. Features include microprocessor-controlled tape movement and read/write electronics. For maximum versatility, interfaces include RS-232 and IEEE-488. Or, using control and status lines available, you can interface to specific microcomputers such as LSI-11 and 8080. EPI's optional ANSI X3.56 formatter, with NRZI or phase-encoded personality cards, turns the 810 into a plug-in component for industrial instrumentation and mini/microcomputer-interfaced peripheral markets. Price: $756 in quantities of 100. **STR-STREAM** is a high-speed, high-capacity version of the 810 designed for Winchester disc backup. Density is 6400 bpi for 17M bytes capacity per cartridge. Features include advanced head design, MFM formatting and compatibility with 8" or 14" discs.

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EPI's STR-610 is a compact, low cost digital recorder that's ideal for use with POS terminals, smart CRT terminals and as a general peripheral for mini/microcomputer-based systems. The 610's recording density is 800 bpi for a capacity of 168K bytes/track, using a two-track 3M DC-100 mini-cartridge. Formatting is ANSI Standard and interfacing is parallel, with a variety of options. Price: $280 in quantities of 1,000. **The STR-LINK III** is a high-speed (9600 baud), portable program loader that uses the STR-610's drive system and shares the same specifications. It is used as a field service tool for diagnostic work or as a peripheral in a mini/microcomputer system. STR-LINK III uses a serial RS-232 interface for data communications or data terminal applications, and it can be controlled through RS-232, ASCII control codes, or manually. Price: $1,615 in single quantity.

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STR-LINK II is EPI's proven medium-speed (1200 baud) universal portable program loader for programmable controllers and process control systems. Using a standard cassette, it features switch-selectable transmission modes for maximum flexibility. Price: $1,889 in single quantity.

For maximum design freedom, proven reliability and high data integrity through Speed Tolerant Recording technology, remember EPI—the company that doesn't forget the OEM's needs. For more information, contact Electronic Processors Inc., P.O. Box 569, Englewood, Colorado 80110. Phone (303) 761-8540.

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New multiprocessing computers use data flow

The architecture used by all current computers stores programs and data in a general-purpose memory. That common storage area is the primary defining characteristic of von Neumann architectures. Its limitation is that each instruction and datum must be fetched from this commom memory sequentially. That makes the bandwidth of the memory bus the limiting factor on the maximum speed at which programs may be executed. The program counter steps through the program one instruction at a time, continuously alternating between fetching and executing. That is the essence of a von Neumann architecture, and its biggest disadvantage is the bottleneck presented by the memory bus.

An alternative to the von Neumann approach is the data-flow architecture originating from MIT and now under study at nearly all major computer science research facilities. A data-flow machine preprocesses the instructions in a program to determine when each may be executed so that some may be processed simultaneously by separate execution units. For example:

1. A=0 B=1 C=2 D=3
2. C=A+B
3. $B=B^2$
4. D = D + 1
5. A = D + B

No statement can be executed before No. 1, which initializes all the variables. Next, statement 2 may be run, but so can statement 4, since it does not depend on any other statement but No. 1. If this data-flow machine has at least two execution units, it can execute these statements simultaneously. Statement 3 must wait for 2 because B should not be replaced until after 2 has used it, and statement 5 must wait for 3 and 4, since it uses these updated values. After 2 and 4 finish, 3 is executed next and then 5.

All programs have such a flow of data, but it is an especially difficult software problem to discern the flow and to utilize it properly. Multiprocessors—computers with several execution units—require some sort of data-flow management. This management can be done either at compilation time with special time-to-execute tags attached to instructions or at operating time with some sort of look-ahead mechanism to determine the appropriate time to execute each instruction. □

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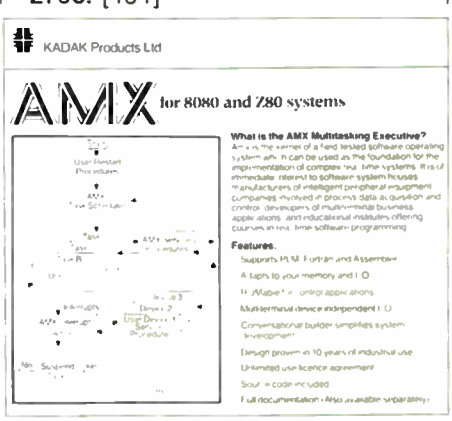

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Members of this exclusive circle of PRIAM Winchester disc drives have several uncommon things in common. With database capacities from 10.8 to 158 megabytes, they all have the same interface. And they all connect quickly and easily to the typical microprocessor I/O bus through PRIAM's SMART Interface.

A simple adapter, added to the SMART Interface, is all you need to provide your system with the remarkable reliability of Winchester disc drives. And PRIAM's DISKOS drives have the broadest available capacity range, with the lowest cost-per-megabyte, for microprocessor-based systems.

How Smart Is SMART?

With its own sophisticated preprogrammed microprocessor, PRIAM's optional SMART Interface gives you these disc subsystem functions:

- Controls any combination of one to four PRIAM Winchester disc drives.
- Serializes and deserializes data and formats disc with selectable sector sizes of 128, 256, 512 or 1024 bytes.
- Full sector buffering permits data transfers at any rate up to 2 megabytes per second, with programmed I/O or DMA.
- Automatic alternate sector assignment makes disc defects transparent to the host processor.
- Overlapped-command and implied-operations capability improves system throughput in multiple-drive systems.

The single 8" x 14" SMART Interface printed circuit board mounts on the PRIAM disc drive and draws power from the drive; or it can be mounted separately to maintain the basic drive size envelope.

Meet The Elite! PRIAM's High-Capacity, Cost-Effective 14-Inch Disc Drives

PRIAM's high-technology 14-inch Winchester disc drives are available with capacities of 34 and 68 megabytes, with a 158-megabyte version on the way. And they all fit in the same 7" x 17" x 20" package, including optional power supply. Fully servoed linear-voice-coil head positioning provides fast, precise and reliable data retrieval. Average positioning time is only 45 milliseconds, and track-to-track is a fast 8 milliseconds for high throughput.

Use of a brushless DC spindle motor assures mechanical simplicity, positive disc speed control, and operation of PRIAM drives with power sources anywhere in the world without change. No relays, no mechanical brakes, no brushes, belts, or pulleys. Pure, reliable electronic control. Elegantly simple!

The Talk of the Town: PRIAM Eight-Inch Disc Drives

When you want to debut a Winchester disc drive where you now have an 8-inch floppy disc, PRIAM's DISKOS 2050 and 3450 fit right in. And they give race-horse performance to your system by expanding your database to 21 or 35 megabytes, with head-positioning times of only 45 milliseconds average and 8 milliseconds track-to-track.

From the same technical family tree as their bigger brothers, PRIAM 8-inch drives use linear-voice-coil positioning and brushless DC motors. In the next generation, they will permit database expansion to 70 megabytes, in the same small, interface-compatible package.

If a simpler, even lower-cost drive will serve your purpose, the DISKOS 1070 gives you 10.8 megabytes of capacity, with stepper-motor positioning for seek times of 73 milliseconds average and 23 milliseconds track-to-track. Not as fast as other PRIAM family members, but still just as SMART when used with PRIAM's SMART Interface.

Other Interface Options!

Is SMART too smart? PRIAM also offers a lower-cost serial-bit NRZ data interface for the OEM who wishes to design the complete controller or to purchase one. This interface, similar to the evolving ANSI standard, has an 8-bit bidirectional microprocessor interface for all spindle motor and head positioning controls.

And if you have an existing storage module controller, PRIAM offers an SMD interface to extend the life of your controller and software and put Winchester disc drive benefits into your system quickly and easily.

For complete information about the SMART Interface and the members of the SMART SET of PRIAM Winchester disc drives, RSVP by telephone or mail to:

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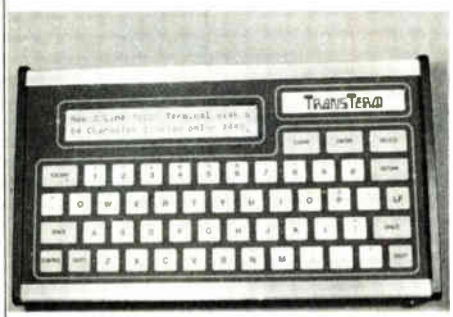
The TransTerm 1 utilizes a 64-character 5×7 dot matrix liquid-crystal display organized in two 32-character lines with an underscore cursor. The displayable character set is the standard 96-character ASCII complement.

The TransTerm 1 keyboard contains 53 membrane keys in a



typewriter-style layout.

The unit communicates in full-duplex RS-232 serial asynchronous ASCII with 20 mA current loop or RS-422 available as options. Switch-selectable baud rates of 300, 1,200, 2,400, and 9,600 are included.

Three operating modes are switch-selectable to allow a teletypewriter-compatible mode, block send mode, or polled multidropping operation (up to sixteen units).

The unit measures 11.7″ wide by 6.9″ deep by 1.75″ high and consumes 10 watts of power via a 115 Vac wall plug-in transformer.

The TransTerm 1 is available for only $449.00 in single quantities. Production shipments will begin in February 1981.

For more information, contact Computerwise, Inc., 4006 E. 137th Terrace, Grandview, MO 64030; (816) 765-3330. [192]

Multiprocessor Operating Systems for the 8080 and 8085

MTOS-86MP and MTOS-85MP are the first general-purpose, multiprocessor, multitasking operating systems for microprocessors. The two are equivalent at the user level. Each one allows up to 16 CPU boards (all 8086 or 8080/8085) to be placed on a common bus. The operating system assigns tasks to a CPU as required: if a task wants a CPU and one is available, that task will run on the available CPU. There is no master-slave relationship among the processors: the same copy of MTOS runs on all processors equally.

For information contact Bernard Mushinsky, Industrial Programming Inc., (515) 938-6600. [193]

JASPOL—a problem-oriented language

JASPOL, an acronym formed from the abbreviation of Problem Oriented Language developed by Japan System Science Co. (JASS), is defined as a precompiler that generates Cobol statements from source programs written in JASPOL grammar. JASPOL is basically a language for EDP (electronic data processing applications).

JASPOL grammar is based on Cobol and includes a pattern (main logic) for data processing that allows a user to generate programs without being concerned about wide-band logic—a logic directs the main program controls. A complete blocking of local processing such as a control level gap ensures greater readability by several times in these programs than in comparable Cobol programs.

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In addition, JASPOL has such functions as automatic transfer the generation of wide-band logic and VERB (including in-core sort, sequence check, double check, table search, and decision table) which allows one to create the same processing program that occupies ½ to 1/10 the space of the same program in Cobol. A user's own coding, which permits one to write Cobol code directly, is also available. If user's own coding is increased too much, the merits of JASPOL and the program size savings will be reduced compared with Cobol. This is an exception, though. On an average, JASPOL programs are one third the size of comparable ones written in.

Any combination of logics (such as matching, summarizing, and listing) are available.
Japan System Science Co., Inc. Uchiyamashinwa Bldg., 3-5, Kojimachi 3-chome, Chiyoda-ku, Tokyo 102, Japan Telephone Number: (03)263-5801 [194]

Z-80 Microcomputer Diagnostics

Laboratory Microsystems, 4147 Beethoven Street, Los Angeles, California 90066, announces a complete set of diagnostic programs for Z80 microcomputers running under Digital Research CP/M. Test configuration is controlled from the keyboard, and errors may be audited on the terminal or list device. Exhaustive tests for flexible disk drives, memory, CPU, and serial printers are ready for immediate shipment. Further information and price list are available from the address above. [195]

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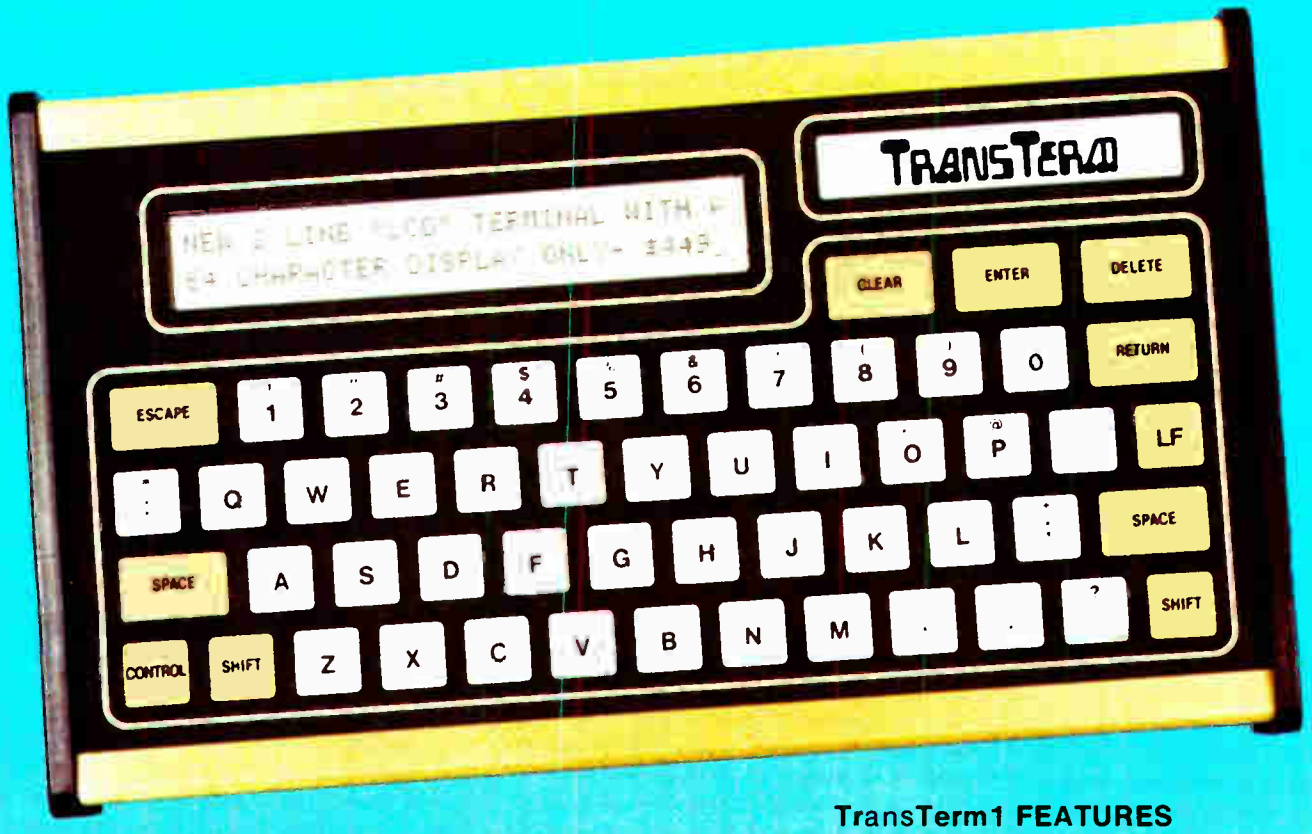

The TransTerm 1 is a compact. low cost alpha-numeric keyboard/display terminal designed for efficient man-computer communications. The TransTerm 1 consists of a two line 64 character liquid crystal display and a 53 key TTY style key-board packaged in a 2" high by 12" wide by 7" deep case. The terminal communicates in full duplex RS-232 serial asynchronous ASCII with 20 ma current loop or RS-422 available as options.

The TransTerm 1 is ideal for applications where low cost and minimum size or portability are desir-able. The TransTerm 1 can be used on a horizontal desk-top surface or mounted on a vertical plane. Typical applications include:

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All facilities of the complete C language are supported, including bit fields and defined types, as described in B. Kernighan and D. Ritchie, *The C Programming Language*, Englewood Cliffs, N. J., Prentice-Hall, 1978, the accepted reference for C. In addition, the compilers come with the Whitesmiths, Ltd. Portable C Library, which provides approximately eighty functions useful for string manipulation, formatted data input/output, and controlled storage allocation, all in a machine-independent fashion.

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These products complement the existing line of C compilers from Whitesmiths, Ltd., including resident compilers for the 8080 under CP/M and for the PDP-11 family under RT-11, RSX-11M, RSTS/E, IAS, and UNIX. Cross compilers for the 8080 are also available for any of the DEC systems; a similar cross support

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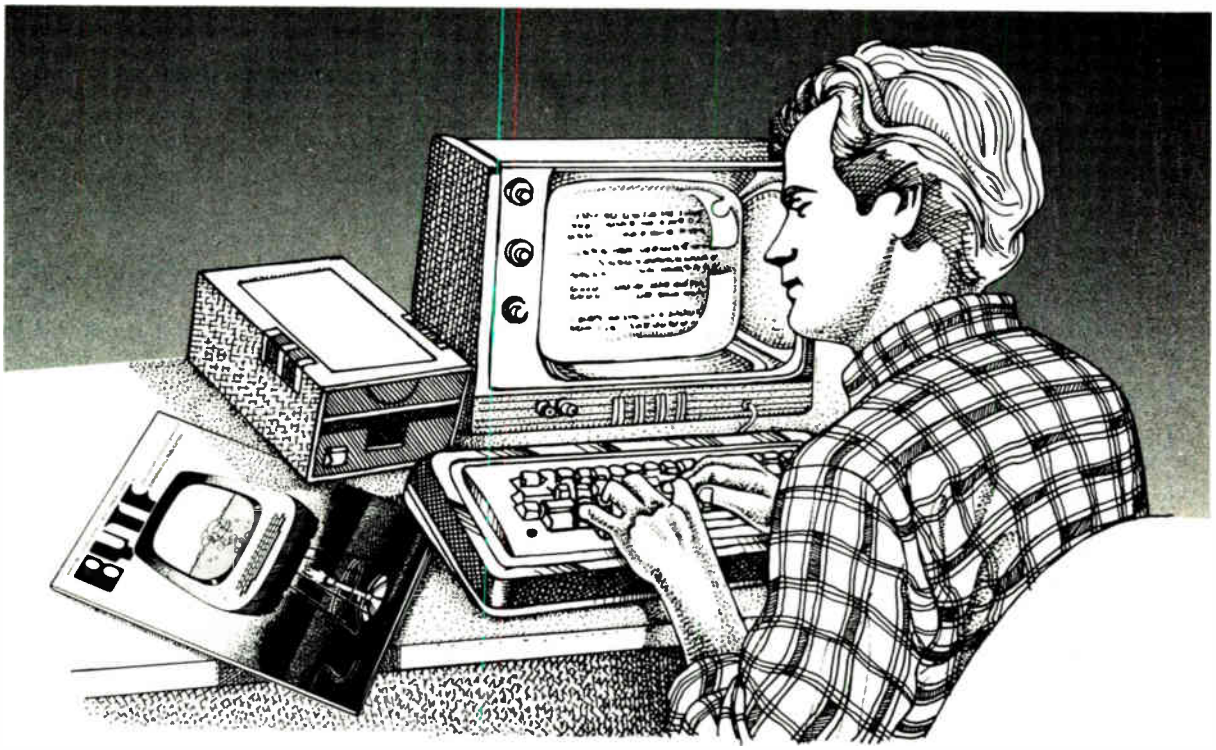

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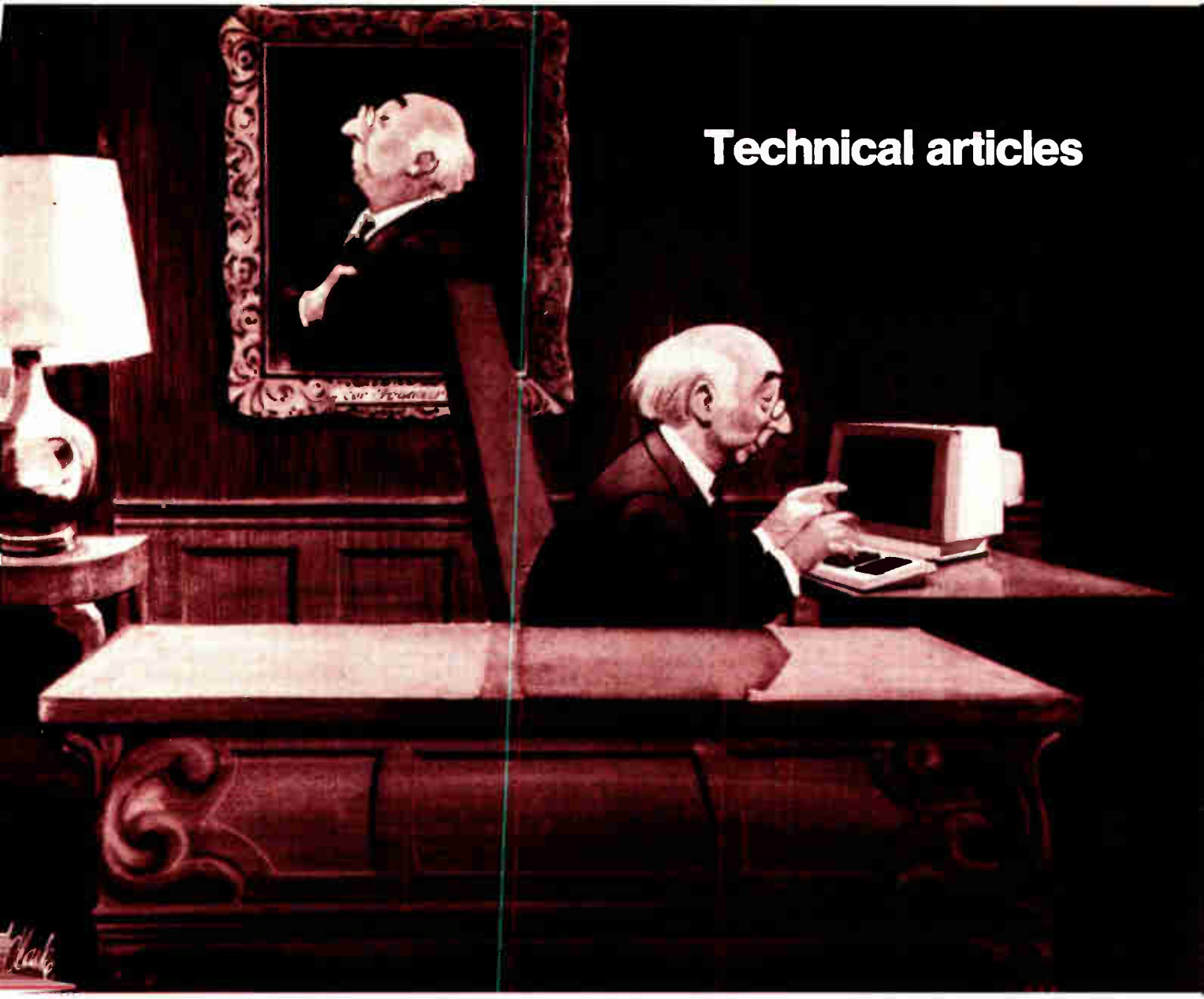


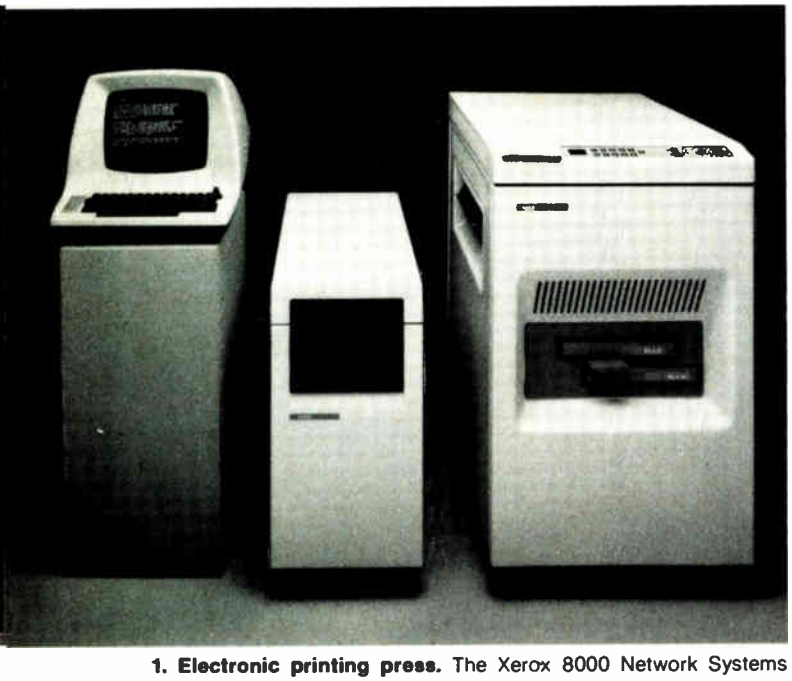
SPECIAL REPORT
Automating offices from top to bottom

Software architectures that integrate many new jobs are making computer systems at home with top management and clerical workers alike

by Tom Manuel, *Computers & Peripherals Editor*

☐ The crest of the new wave in office automation, which is reaching into areas beyond mere word processing, is seen in systems that comprise more than single stand-alone or clustered terminals. The work stations of these new systems are tied together by local networks and offer a variety of capabilities such as electronic message services, access to data bases, personal computing, and printing. Moreover, expensive hardware resources such as disk memories and laser printers may be shared by many work stations, and information may be exchanged among them.

At the forefront in bringing the computer into the office is the application of software architectures and the techniques of modern computer science. Virtual memory, large addresses, partitioning, multitasking and inter-task communication protocols, bit-map displays, new data-access methods, content-addressable or associative indexing, and a productive modular programming envi-



1. Electronic printing press. The Xerox 8000 Network Systems Print Server station delivers 12 pages per minute of high-quality electronic laser printing for users of an Ethernet-based office system. The printer is shown in the box on the right.

ronment, for example, have been developed primarily at universities for large computer systems. Now these techniques have been married to the cost-effective distributed systems made possible by local networking and by the availability of low-cost, powerful microcomputers and large but affordable quantities of memory, with the result that modular and flexible office systems are beginning to appear in the marketplace. No longer is the work station geared only to the secretary or clerk. The new systems do so much that they are being perceived as a necessity by top-level managers and professionals.

Who's doing what

Some of the recent office automation product announcements have come from companies with long experience in office systems or distributed data processing, who have clear commitments to supplying systems for the integrated office systems.

Xerox Corp.'s Office Products division in Dallas late last year introduced several office automation products with functions that can be integrated into a total system through Ethernet. This is the company's well-known local network, which it continues to develop jointly with Digital Equipment Corp. in Maynard, Mass., and Intel Corp., Santa Clara, Calif., and is licensing at a very modest fee. The initial 8000 series contains a centralized, sharable file storage system called a file server, a laser printing station called a print server (Fig. 1), and communications servers. The communication servers can connect products to the net that have no built-in Ethernet interface or they can connect individual Ethernets together or to long-distance networks. Xerox's system is built upon a solid foundation of software technology that it has been quietly working on for several years.

Perhaps the leading company today in combined experience and technology in local networking, distributed data processing, and integrated electronic office systems is Datapoint Corp., San Antonio, Texas. Datapoint, over several years, has gradually assembled a state-of-the-art integrated electronic office system with local networking used by many customers.

Keeping the improvements coming, Datapoint has recently announced a new, very powerful, top-of-the-line processor, the model 8800, for the Attached Resource Computing (ARC) network (Figs. 2a and 2b). The 8800 handles 1 million instructions per second, and systems can be created using as many processors as required—50 of them, for instance, interconnected with ARC and using the company's new Resource Management System (RMS) operating system, would make a computing system able to handle 50 million instructions per second, according to Victor D. Poor, executive vice president for research and development.

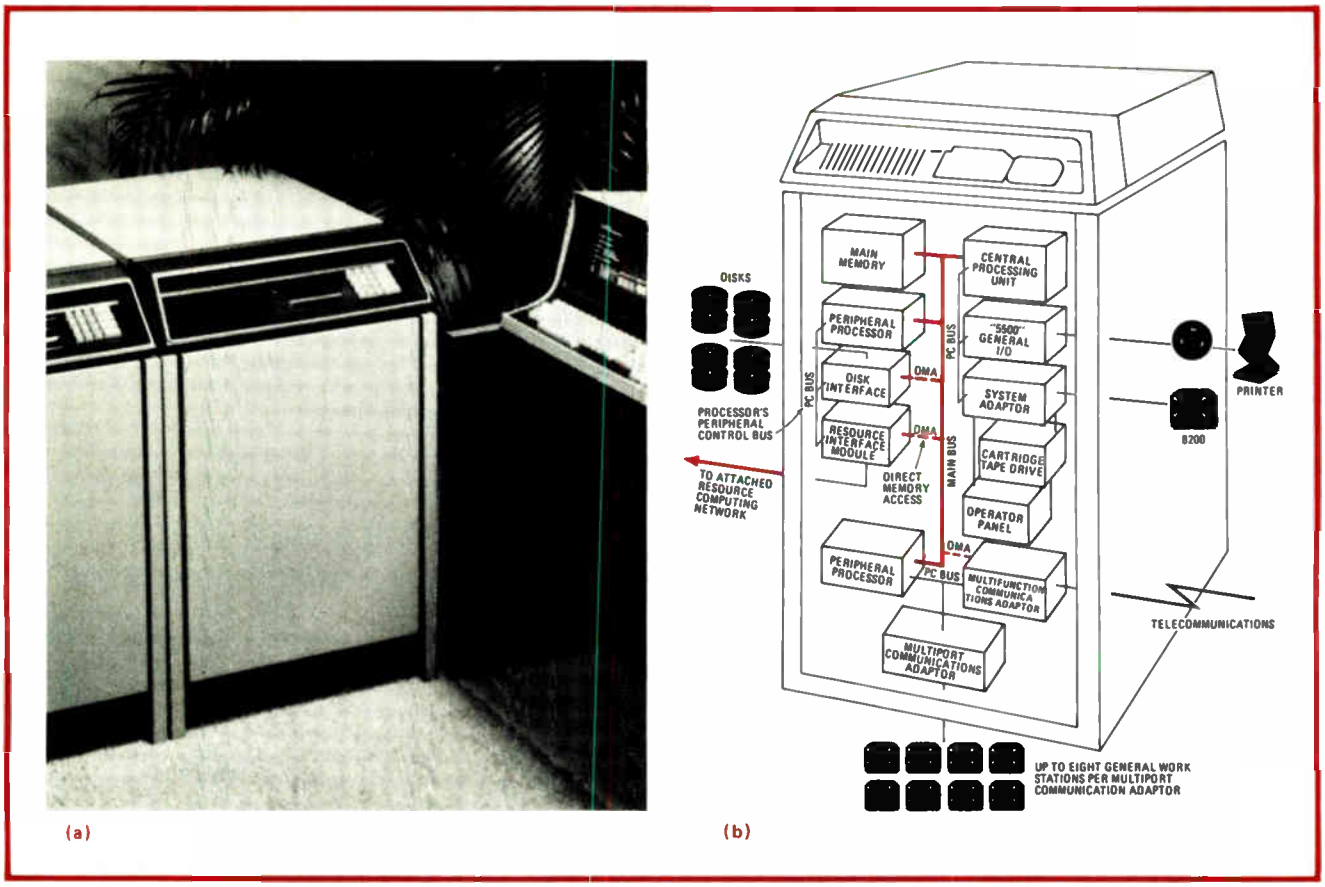
Taking a slightly different approach is Prime Computer Inc. of Natick, Mass., which added software for office automation to its large 32-bit minicomputer systems. Many terminals can be connected to these minicomputers and the minicomputers can be interconnected by the Primenet network. To the broad spectrum of data-processing and business-analysis software available on these systems, Prime added software for word processing and for what it calls management communication and support, which includes electronic mail, electronic filing, and activity management. The system, like Xerox's and Datapoint's, is based on well-developed software.

The Electronic Office Systems group of Northern Telecom Inc. (formerly Northern Telecom Systems Corp.), Minneapolis, Minn., was a pioneer with Datapoint in distributed data processing. It has introduced word-processing software (called Omniword), high-quality printers, and a powerful processor work station, the model 585. The 585 will put a new top on the line of processors that can be interconnected with the Omnilink local network.

Startup companies are also aiming at this new field. Apollo Computer Inc. in Billerica, Mass., and Convergent Technologies, Santa Clara, Calif., have developed low-cost 16- and 32-bit microcomputer systems using some of the newest hardware and software architectures. The 32-bit Apollo Domain and the 16-bit Convergent Family, like the Xerox and Datapoint systems, spring from a software-based technology and a new concept in computer architecture. The architecture is basically a network of powerful personal computer work stations with advanced software and video display techniques. Both the Apollo and Convergent systems are being marketed to original-equipment manufacturers as foundations for integrated office systems and both systems have a good software development environment.

Others get involved

Many other companies have products that automate parts of the office or single functions like stand-alone word processing. Some of the larger, more significant companies, like IBM, DEC, Exxon, Burroughs, Honeywell, Hewlett-Packard, and Wang, offer all, or most, of the pieces for totally integrated systems. The pieces can



2. Outside/inside. The powerful, 1-million-instruction-per-second Datapoint 8800 computer is shown in (a) in an office with a keyboard/display work station. The interior of the compact 8800 appears in (b). The 8800 can serve other systems in the ARC network.

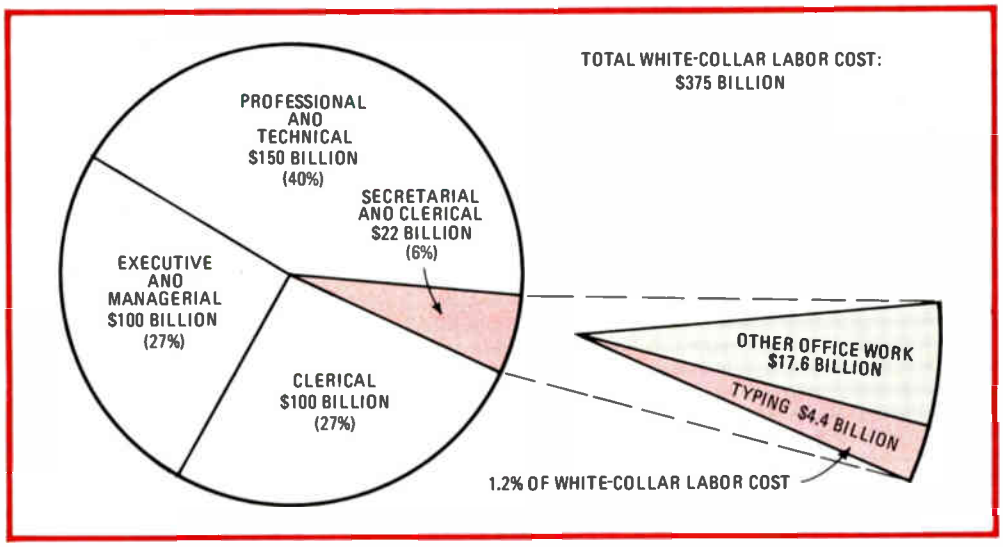
usually be interconnected, but these companies have not yet taken a total system integration approach. Undoubtedly they are working in this direction.

Wang Laboratories Inc., Lowell, Mass., long a recognized leader in clustered and stand-alone word processors as well as distributed data processing, appears to be well on the way to a fully integrated system and is working on local networking. International Business Machines Corp. has issued statements of direction indicating future moves to integrate products from its three major computer system divisions. Exxon Corp., with a $200 million collection of businesses operating in the information-processing field as Exxon Enterprises, New York, has recently consolidated three of its systems companies (Qyx electronic typewriters, Vydec word processors, and Qwip facsimile systems) into the Exxon Office Systems Co. Initially it looks like an integration of marketing, and probably purchasing. Integrated manufacturing will likely come later. There is no indication how soon Exxon will be able to start integrating the products of this new company. Exxon's Zilog Inc. in Cupertino, Calif., offers its MCZ-2 microcomputer systems, Z-Net, and software for building office systems.

DEC, the minicomputer leader, so far is only testing the waters in integrated office systems. The shared-logic, word-processing systems on the PDP-11 have access to the standard data-processing and -communications functions currently available on these systems. DEC also has its WS200 Series of clustered word-processing systems and the WS78 stand-alone word-processing system, which is price-performance–competitive with the IBM Displaywriter and the Wangwriter.

Though no company in Western Europe is yet offering a completely integrated office automation system tied together with a local network, several companies clearly have most of the pieces. West Germany's Siemens AG offers small-business computers and word-processing systems that communicate with each other. According to Ian A. Galbraith, director, Communications and Information Systems division of Mackintosh International Co., a research and consulting firm in Luton, Beds., England, and San Jose, Calif., the strategies of companies like Philips Gloeilampenfabrieken of the Netherlands, Nixdorf of West Germany, and Olivetti of Italy indicate they are likely to offer integrated systems soon. Mackintosh has recently published a report entitled "Electronic Office Equipment—European Market Trends to 1983."

Nexos Office Systems Ltd., Bristol, England, a company with word processing and facsimile systems, is working on software to provide a higher level of integration in office systems beyond text and data handling. It is writing application software—"a mountain of software," says Chris Ellis, director of strategy at Nexos—to add image and voice along with text and data to supply the next level of integrated computer-based office information systems. This software is being written for the Delta 2 computer from Delphi Communications, Los



3. Office work. Most of the workers in offices are not secretarial and typing personnel and most of the work done by the secretarial staff is not typing, which represents only 1.2% of office labor costs. New office systems must help with numerous other functions.

Angeles (an Exxon Enterprises Co.). The architecture of the Delta 2 computer combines the best features of a large computer and the bandwidth and switching flexibility of a private automatic branch exchange (PABX). The Delta, which could be called a locally distributed multiple computer, has a variable number (up to 32) of six different types of processors, some of which can be redundant, closely coupled into a single system. The processors cannot stand alone. The computer is driven by a hierarchical distribution of operating system functions.

Nexos has a joint development effort with Delphi Communications for integrated office systems. No products have been announced. Nexos has also acquired the European manufacturing and marketing rights for the Delta 2 computer.

For non-typists

The approach being taken by Nexos is particularly important in Europe. "While it may be acceptable to put CRT terminals with keyboards on the desks of middle managers in the U. S.," Ellis says, "it won't work for the average European middle manager. In the U. S. you already have a critical mass of those managers who have been exposed to terminals and can type, at least minimally, but not in Europe. It would probably be exaggerating to say that 5% of middle managers in Europe can type." If the manager cannot or does not want to type, then how can he add his comments to a computerized message displayed on his screen? He will add what Ellis calls a "voice note," which gets digitized and distributed with the text message (and perhaps also an image message) within the network.

Governments in several Western European countries are sponsoring and investing in programs for office automation. For example, the French government is investing at least the equivalent of $250 million to develop an electronic office equipment industry. The Swedish government, through Televerket, the country's telephone company, has a policy of encouraging office automation and has been conducting an experiment for several years, called Office 85, that is unique in Europe. Some of the participating companies have been Philips, Telefon AB L M Ericsson, Stockholm, and Xerox.

Fujitsu America Inc.'s Word Machine terminal for IBM and IBM-compatible systems and the companion application software from Fujitsu running on the mainframe deliver a combination of office services. The package includes word processing, electronic filing, message and document distribution, and data processing.

The term office automation is somewhat misleading. The integrated electronic office systems do not replace office workers. Rather they perform functions that can increase the productivity of all in the office—from clerks and secretaries to top management—by assisting with mundane tasks that must be done every day. Much of this work involves handling information in large quantities, in forms such as the written word, numerical data, and voice messages. The goal of electronic office systems is to manage this information quickly and efficiently freeing the office worker for more thinking and decision making.

Delegating the details

The machines can gather, file, store, process, retrieve, and move information. They can perform most of the details of information sharing and delivering messages—getting the right information to the right place at the right time. This is the most time-consuming office activity, so automating these functions will improve productivity the most.

In so-called word processing, the actual typing of letters and documents is a small part of the picture. Estimates have put the cost of typing at only a little over 1% of the total white-collar labor costs (see Fig. 3). Looking for information, sending or receiving messages, getting signatures and approvals, mailing, and playing telephone tag takes up most of the time. Systems to aid in these areas also offer great potential for saving and productivity.

The telephone, the typewriter, and the copy machine have improved office productivity in the past, but new tools are needed. Computers—ubiquitous in data processing and factory automation—must address mundane office tasks like the following: electronic message service; electronic filing and retrieval; printing and copying; and integrating information from analysis, modeling, person-

al computing, and data processing into formal reports and informal messages.

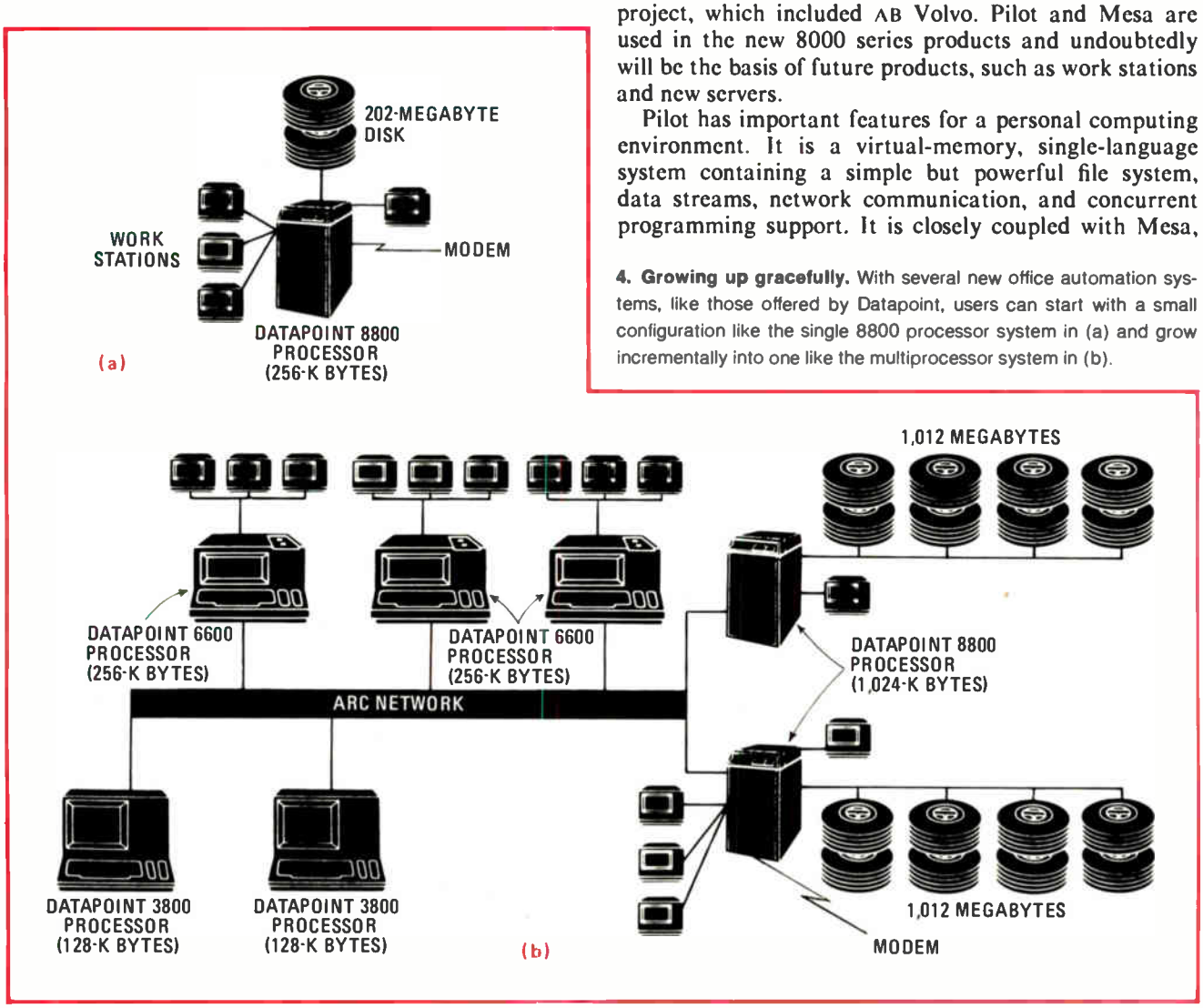
Advanced operating software such as Xerox's Pilot operating system, the Mesa language, and the rest of the tools in this powerful programming environment make highly integrated electronic office systems possible. This programming environment and the operating features of Pilot enable Xerox to offer products in an integrated office system like the one it announced in December and will permit it to offer quick and cost-effective enhancements as well.

Xerox spent about four years developing its software base for office systems. Its goal was to apply computer science to office automation. "Computing, in the strict data-processing sense, has been almost unaffected by computer science. But that study's techniques are the fundamental principles needed for office automation," according to David Liddel, vice president and general manager of Xerox's Office Systems business unit.

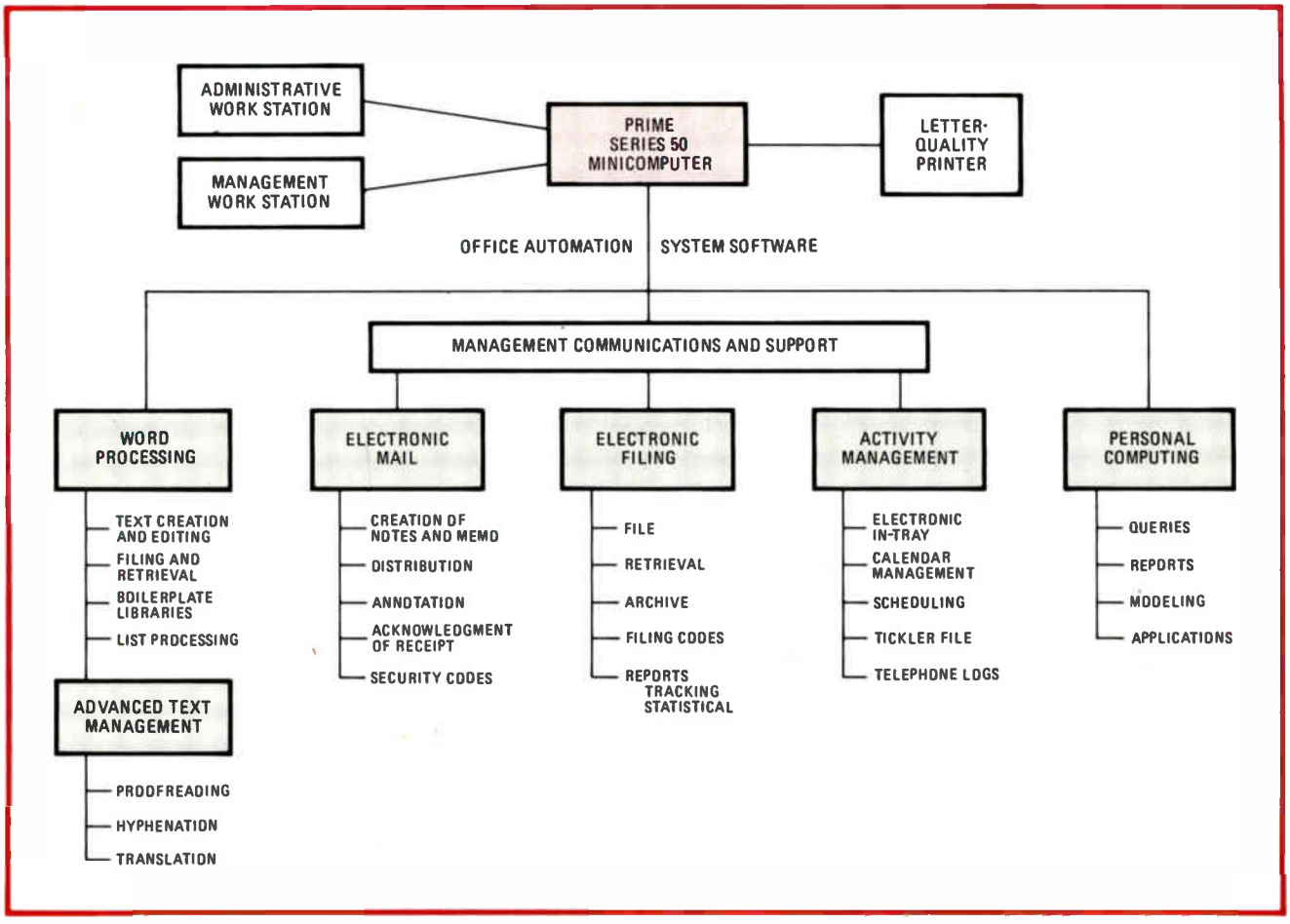
What is different about the Xerox approach? "Well, we took networking, a 10-year-old notion, and applied the concept to powerful personal computers at each terminal," says Liddel. Then, more significantly, the firm looked at software from a different perspective. "We took the idea that software has a long life—it transcends hardware life—and developed some to provide a system software development environment for production of modular, long-lived application software that would be hardware-independent. With its rapid development cycles, the hardware for these applications could be redone every few years and we would use memory instead of logic wherever possible."

The projects at the Xerox Palo Alto Research Center and their Office Systems Business Unit development group, also in Palo Alto, involved development of the Ethernet local networking scheme, the Alto personal computer, the Pilot operating system, and the Mesa programming language—though the Alto is purely an experimental computer. All these projects have been thoroughly tested within Xerox by the groups that developed them, using what they had already done to bootstrap further development—a method that helped make them more productive in pushing the system further. The work has also been tested at over 1,500 other Xerox offices (all interconnected with Ethernets) and in several large test installations outside of Xerox, including the Boeing Co. in Seattle, Wash., the U. S. Congress, the Office of the White House, and Sweden's Office 85 project, which included AB Volvo. Pilot and Mesa are used in the new 8000 series products and undoubtedly will be the basis of future products, such as work stations and new servers.

Pilot has important features for a personal computing environment. It is a virtual-memory, single-language system containing a simple but powerful file system, data streams, network communication, and concurrent programming support. It is closely coupled with Mesa,



4. Growing up gracefully. With several new office automation systems, like those offered by Datapoint, users can start with a small configuration like the single 8800 processor system in (a) and grow incrementally into one like the multiprocessor system in (b).



5. Task force. Prime's Office Automation System software has many functions to help with the large variety of office tasks. It automates much of the information management for an office far beyond word processing and is oriented toward managers and professionals.

the system's only programming language. Now that it is economically feasible to dedicate a powerful personal computer to each user, Xerox decided to design a complete software system to optimize service to that user and also function as the user's representative in a large community of autonomous personal computers and other information resources.

The hierarchical virtual memory of up to 2^{32} 16-bit words is mapped into a large, essentially unbounded file space. At the Pilot level, the file system is a simple primitive for accessing large amounts of information in large files that have no recognized relationships. File structuring is left to applications programs. Mesa is a modular high-level systems programming language designed to work with Pilot. It has full data typing like Pascal; interfaces and communications features that support the separate development and subsequent system integration of modules; and a source language debugger.

Laying the foundation

This kind of software development and operating environment, coupled with powerful microcomputers and a high bandwidth network, lets Xerox offer a series of compatible products that can serve as building blocks for a user beginning an office automation system on a small scale and building it incrementally, up to large completely integrated systems.

Like Xerox, Datapoint has invested many years and much money in developing and testing the software needed to evolve the integrated electronic office. But unlike Xerox, Datapoint has a substantial customer base using fully commercial products functioning as integrated electronic office systems that it has introduced over several years. These products, interconnected through its four-year-old local network ARC, represent several stages in the evolution of integrated office systems. The latest additions to the Datapoint systems came last fall. They include the flexible, multitasking, resource-sharing RMS operating system; a content-addressable data-access method, Associative Index Method (AIM); and a new processor handling 1 million instructions per second, the model 8800.

Also taking the approach that software is long-lived whereas hardware tends to be the opposite, Datapoint engineers designed RMS for a 10-to-20-year life. It is an advanced operating system with flexibility at the user program side that isolates the processor-dependent part in as small a module as possible. The nucleus, which allocates resources and performs controlling, monitoring, scheduling, and dispatching tasks and activities, is a relocatable library file. For RMS to run on a new Datapoint processor, only the nucleus library needs to be changed—the rest of RMS and all application programs remain untouched.

Bringing data-base management up to date

Like many other software solutions of computer science origin, data-base management systems were developed for large mainframe systems and tend to be elegant but inefficient. But with larger and larger amounts of data being kept in office systems, much more efficient data-management techniques will be needed. Enter a new concept: the data-base machine, which implements a proven software solution in specialized hardware and microcode. The machine offloads the data-management function from the central processing unit and puts it in a special processor between the CPU and the disks, much as the communications processors, or front-ends, took the communications load from the CPU.

This hardware implementation of a software solution from computer science, in the form of a relational data-base management system, may be applied to distributed, integrated electronic office systems. A new company, Britton-Lee Inc. of Los Gatos, Calif., is now delivering the first test units of the IDM 500 data-base machine—an ideal component for addition to medium-sized and large integrated office systems as a central file system and central store for an electronic message service.

The IDM 500 is a Z8000-based data-base processor capable of processing .3 million instructions per second. It interfaces easily with the processor in an office system network through a standard IEEE 488 bus on one side and with any standard storage module disk drive on the other. The key to its effectiveness is its ability to do the data-management processing on the disk byte stream in real time at the disk speed. For larger and faster disks, a data-base accelerator option—a hardwired emitter-coupled-logic–based microcoded processor with a 100-nanosecond bus—is available for an additional $10,000. Optimized for data-base processing, it can perform at an incredible 10 million instructions per second. The basic IDM 500 costs $50,000. Britton-Lee is working on a second model, a scaled-down version that will be priced in the $15,000-to-$20,000 range.

The system is somewhat like a super traffic cop. One of its key functions is organizing independent processes and all the traffic among them. RMS breaks the computer apart at the transaction level so users and user programs can define the system environment at the time the task is defined. For applications such as office automation, it is not possible to plan the system environment in advance and build a fixed system to perform the predefined job because no one knows in advance what the tasks are going to be.

One of the major challenges in the development of RMS was managing the traffic among tasks. The system had to be designed so that the traffic could move smoothly, quickly, with no bottlenecks or locks among a great many processes requiring resources that can be located anywhere in the network. This took several years of work, point out company officials.

The multitasking and partitioning is general. Interprocess communication is made through the network protocol. Two programs can communicate with each other on the same processor or on different processors; they can also be on the same processor one day and on different processors the next without changing any software. Multitasking and interprocess communication is done through Unix-like pipes; but the RMS pipes are more general and flexible. RMS removes task interconnection and partitioning from processor dependence—there is no longer a direct processor-to-partition correspondence.

The capabilities of RMS combine with those of the 2.5-megabit-per-second Advanced Resource Computing network and processors and terminals of varying capabilities (including the powerful new 8800) so that every terminal, intelligent or not, has access to every function in the net or any service connected to the net. For example, a black box supplying a new service like an ARC Communications and Emulation software package that emulates an IBM 3270 communications display terminal can be installed in an ARC network processor, and immediately every terminal can look like a 3270 to an IBM computer system.

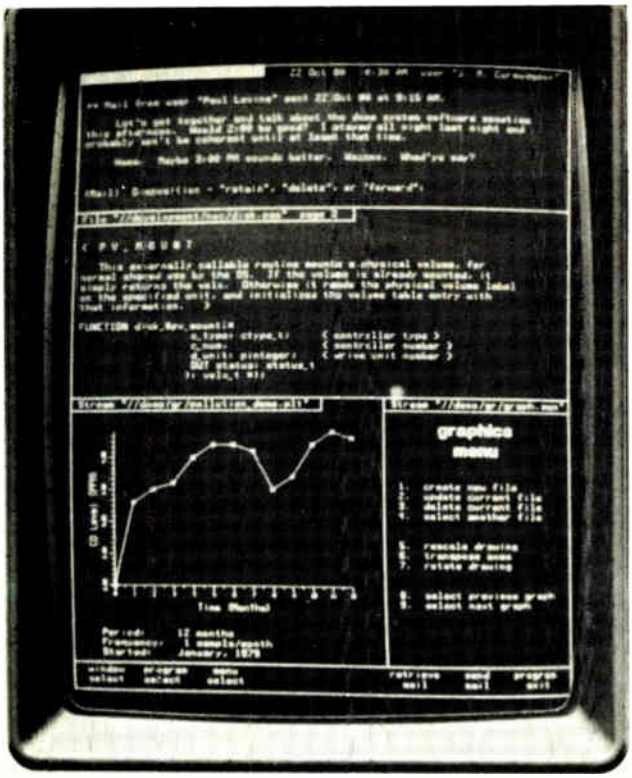
Most importantly, effective office systems must maintain flexibility in reorganizing network resources to define a task only at the time it is to be done. Datapoint's Associative Index Method system for information retrieval creates the index when the request is made. No fixed indexing structures have to be created when the information is stored. When data is stored, the criteria or combination of key words the future recovery of that information will require is unknown. The person or the program who will request recovery is usually also unknown. AIM provides a flexible information retrieval resource for an integrated office system.

Starting small

The compatibility and integration of Datapoint products—two of Datapoint's specialties (two others, also important, are good access methods and good local distribution systems)—let customers start their office system very small, add to it in small increments, and build it into as large and complex a system as they need (Fig. 4).

Prime Computer has taken a different tack. It built its complete, highly integrated Office Automation System on its Prime 50 Series multifunctional 32-bit superminicomputer systems. Using the extensive software base and the Primenet networking of these systems, Prime developed office system software for managers and professionals in large companies, as well as for the secretaries and clerks. For the managers, the system goes well beyond word processing, combining electronic mail, correspondence management with filing and retrieval capabilities, an electronic in-tray, calendar management, appointment scheduling, and a tickler file. It also contains an advanced text management system with multiple dictionaries for proofreading (Fig. 5).

Each user has access to two modes of operation—the office automation mode and the data-processing mode. The file structure and data-access methods are common and there is a function to move files back and forth between the two modes. In the data-processing mode, the user can access all Prime data-processing languages,



6. Many faces. The screen of the Apollo Computer bit-map display is divided into as many subscreens as needed to display the operation of all the concurrent processes. The screen shown has six areas: one across the top, one along the bottom, and four in the middle.

applications, and communications functions, including financial modeling and data-base management systems. These give a kind of personal computing facility to help management and workers use their time better. Prime's concept of effective office automation is similar to that of other leading companies, including person-to-person messages, better management communication, personal computing and information retrieval, and access to the company's data-processing functions, with word processing taking a diminished, but still important, role.

Easy for executives

The company's manager of office automation products, Peter J. Schlegel, says that "management and professional people will accept and welcome terminals at their desks once they see what they will do for them as part of an integrated system, especially in electronic mail and personal computing capabilities." Prime's management, all the way to the top—including Kenneth G. Fisher, president and chief executive officer—makes effective use of the in-house office automation system.

Most companies will automate offices incrementally, and a terminal on every desk is a long way off. However, the trend is evident, and the coming desktop terminals may very well resemble the experimental terminal being developed and tested at the Electronic Office Systems group of Northern Telecom. This terminal looks like a call-director telephone but has more buttons, a small display screen, and a pull-out alphanumeric keyboard. It is connected to a PABX such as Northern Telecom's SL-1 just as if it were a telephone—which it is, and much more. It accesses systems for message sending, meeting scheduling, word processing, filing, business system modeling, timesharing, and data-base management.

The use of PABXs and existing two-wire telephone cabling to carry and switch data as well as voice is an example of another beginning trend. The NTI experimental terminal, which the company declines to photograph for publication, is a telephone with a standard handset as well as a full-function terminal connected to the world through one two-wire cable. This trend, however, will not make high-bandwidth local area computer networks obsolete. These will still be used where the terminals are powerful personal computers in an integrated resource-sharing system requiring much broader bandwidth than the two-wire cable can muster.

Also for OEMs

Apollo Computer and Convergent Technologies are also offering distributed systems with many advanced architectural software and hardware concepts that could be used by OEM companies as a base for automated integrated office system for the 1980s. These systems have distributed functionality, modular expansion, and a good software development environment, like the complete office systems of Xerox and Datapoint but without the office automation application software.

The basic features of the Apollo Domain system are a dedicated central processing unit with a high-speed bit-map display for each user; an integral high-performance local network; a processor-independent high-level design of virtual memory, global network address space, operating system and languages, network protocol, and standard multibus I/O; and use of advanced hardware technologies such as VLSI CPUs and Winchester disks.

The bit-map display of the Domain system, as in the other systems that have it, is a flexible, effective interactive user interface. Different windows on the screen keep the user aware of what is going on in the various concurrent processes in the system. The display system has a bit-map memory in a square array of 1,024 bits on each side. Of these, 800 by 1,024 bits are constantly refreshed on a bit-map cathode-ray-tube display. The remaining 224 by 1,024 bits store a variety of character fonts and symbols. A hardware bit mover within the CPU can move a rectangular area of any size from any place on the screen to any other place on the screen at a rate of 32 megabits per second—"fast enough so that displays can be switched as fast as TV programs can switch cameras," says David L. Nelson, vice president for systems development at Apollo.

The display memory and program memory are on separate buses. But they share the same address space, so the CPU can instantaneously access display memory and alter its contents. The bit mover can move rectangles from display memory to program memory, where the CPU efficiently performs operations on displayed information such as an exclusive OR on two or more graphic representations. Then the information moves quickly back to the display to show the resulting graph. The CPU

can access program memory, the display memory can refresh the CRT display, and the bit mover can be moving rectangles around the screen or into or out of program memory, all in parallel and without interference.

Because of this parallelism and the Domain operating system, many concurrent programs can be executing for each user and each program activity can be displayed in an independent rectangular window on the screen—a facility that could be called virtual terminals—as seen in Fig. 6. Apollo calls the windows pads, because they are like pads of paper with one page visible at a time. The multitasking, multidisplay Domain system allows several pads to be "on the desk" at one time. The user environment at the screen is a three-dimensional volume: 800 bits across, 1,024 bits vertically, and as many bits deep as needed.

Convergent's computer architecture is also based on the concept of transferring intelligence from the customary CPU to highly intelligent distributed work stations.

The Convergent system has a desktop minicomputer for single users networked with other work stations and servers and powered by an advanced "premier" 16-bit operating system. The real-time, multitasking CTOS operating system is a set of processes communicating through a precisely specified message-passing protocol. "Because it is message-based, the operating system can be distributed over the network," says Ben Wegbreit, vice president of sales and marketing and designer of the operating system.

Making the connections

CTOS was planned from the beginning to be distributed over local and, eventually, long-distance networks. The distributed operating system is like a spinal cord to the collection of single-user minicomputers that make up the system. "We have really distributed the operating system," says Wegbreit.

Though the hardware technologies used by Convergent Technologies will change, the operating system architecture will remain stable. Software supported by the operating system will remain compatible across the product line and across time. The software base can evolve and grow while old software that is useful continues to serve unchanged.

The Convergent family of systems will offer a network consisting of work stations with one minicomputer, one CRT display, and one keyboard for one user; the CTOS operating system; high-level languages (Cobol, Fortran, Pascal, and Basic); a data-base management system; and a data-communication foundation. OEM companies and large end users will supply application software.

When asked why they developed this type of system, Allen Michels, Convergent's president and cofounder, indicated that it was to satisfy the public's voracious appetite for computational and informational power. "Look, for example, at the big demand for Apple computers and the IBM Displaywriter." The Displaywriter, an entry-level, stand-alone word-processor system announced by IBM in June of last year, is now, according to industry sources, in a nine-month order backlog. More and more users are demanding that higher rates of valuable information be made available in various forms, such as business graphics in almost real time.

7. **A boon in the office.** The complete personal minicomputer for office use from Convergent Technologies is a three-piece desktop arrangement of keyboard, screen, and computer with lectern face. Disk drives are in floor-standing cabinets that fit neatly beside a desk.

"A second trend, complementary to this computational voracity, is the plummeting price of computation," says Michels. Convergent's logical conclusion was to put big computational power right on the desk.

Its desktop minicomputer is packaged in an ergonomically designed three-piece system. It has a rotating and tilting CRT display, a detached keyboard, and a lectern enclosure, with clips for holding documents, that houses the processor electronics (Fig. 7). It uses a small amount of desk space and creates a logical triangular relationship between the operator's eye, the display, and the lectern, Wegbreit points out. For a minimum of desk space, one model comprises simply the display and keyboard for the desk, with a floor-standing enclosure for the electronics.

The market outlook

Most analysts agree that the market potential for office automation is very large. It is difficult, however, to find any two observers who agree on the definition of the market. Strategic Inc., the San Jose, Calif., market research firm, in a report released last November on local area networks, has based its definition upon what it considers the dominant long-term technical solution to office automation—the distributed-control local networks with intelligent devices attached.

The report projects that this market, including that for the attached intelligent equipment, will reach $200 million by 1985 and $1 billion in 1990. It goes on to say that less than 2% of the potential market will be penetrated by 1985 and 3% will be tapped by the end of the decade.

According to other sources, the word processing market will be close to $1.5 billion and the small-business computer market may be about $3 billion in 1981, but these two markets overlap considerably. □

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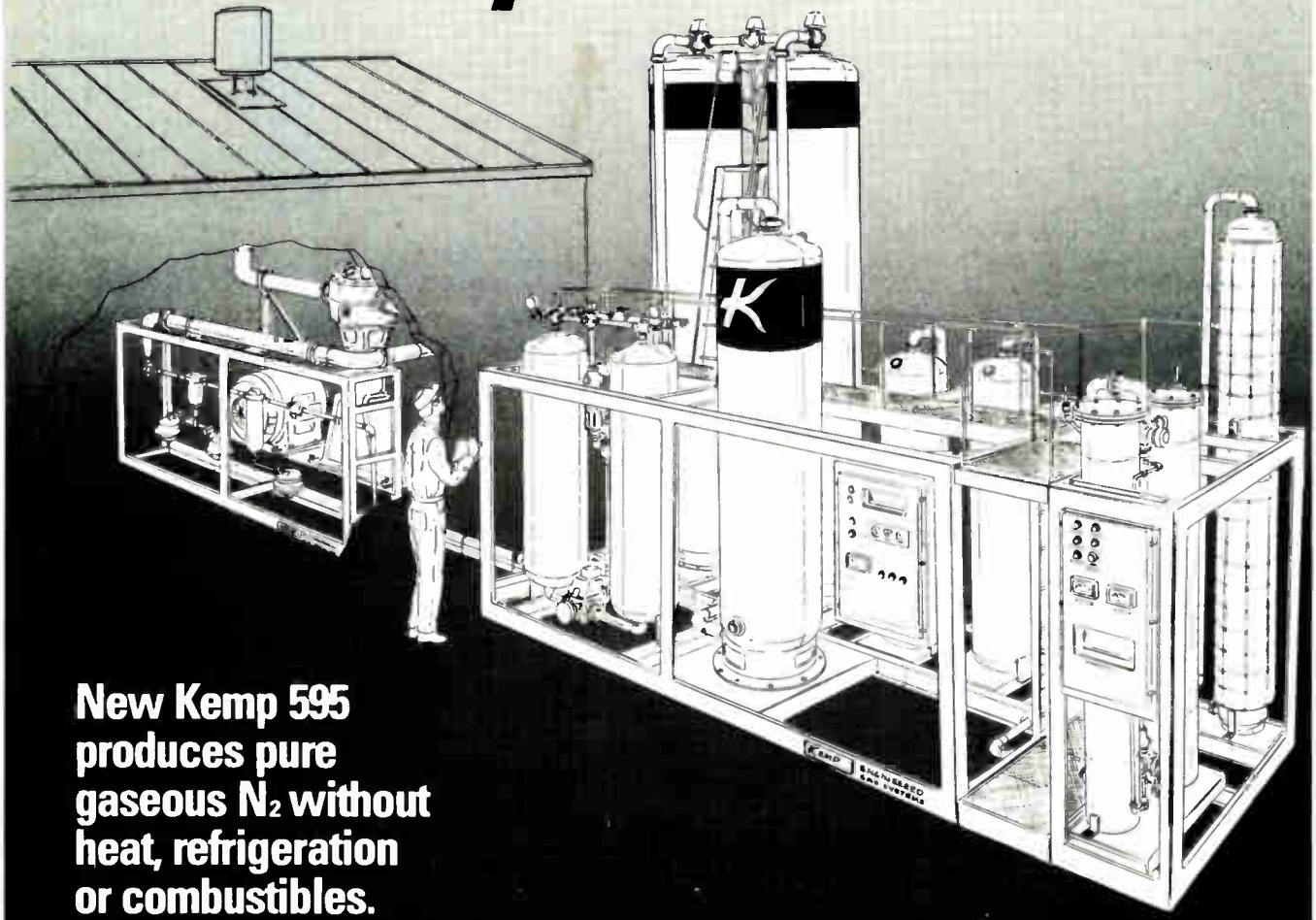

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Portable software for electronic mail makes it hardware-independent

Word processing and data-base management add to the message system's usefulness

by John M. McQuillan and David C. Walden, *BBN Information Management Corp., Cambridge, Mass.*

☐ Advances in digital equipment design, large-scale integration, distributed processing, and programming languages are providing local and nationwide, private and public data networks with communication capabilities unavailable only a few years ago. The latest of these developments is the first computer-based message system (CBMS) capable of running on virtually any computer or terminal. Called InfoMail, it is an application software package from BBN Information Management Corp. designed to work on already installed computer bases, ranging from the single host with single or multiple applications to the multiple host and all types of coaxial cable and fiber-optic local networks.

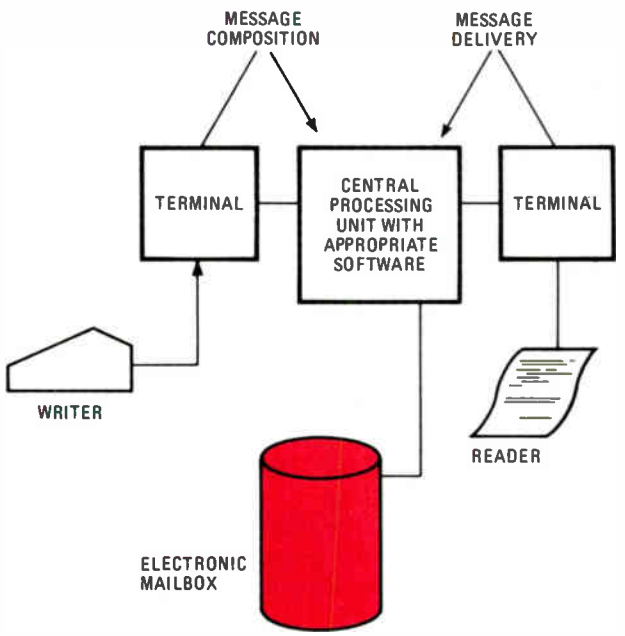
A CBMS is essentially an electronic mail system that also incorporates word-processing capabilities and data-base management for storage and retrieval of information. This integration of electronic mail with the word and data processing so necessary for the industrial research and development laboratory, factory, or office of the future can save hours of time for its user. It is also of interest to original-equipment manufacturers who are involved in the various forms of local networks, in distributed-processing work stations, terminals and computers, and in word-processing gear and software. These suppliers need to know how a hardware-independent message- and data-handling system functions so that they may incorporate it, or similar software packages of their own design, in their equipment. Alternatively, they may wish to make their gear as compatible with InfoMail as possible.

InfoMail may be thought of as a kind of electronic mail, although it is more than that. Electronic mail is a catch-all term for many different kinds of message-sending technology, ranging from facsimile to communicating word processors to telex systems and now to computer-based message systems (see "A long time coming"). Even with this broad range of technologies, it is possible to define electronic mail as simply any electron-

A long time in coming

The computer-based message system, or CBMS, owes its existence to the store-and-forward message-switching systems that were introduced in the early 1960s and form the basis for telex and TWX technology. These systems computerize the store-and-forward process but offer relatively poor user services. For example, users must manually check the reliability of the messages as they come in, number them, and log them. The systems have a limited editing capability, and a complicated approach to addressing other users—factors that today's computer-based message systems handle automatically.

InfoMail, BBN Information Management Corp.'s portable software product for sophisticated electronic mail, was developed as a result of parent company Bolt Beranek & Newman Inc.'s experience on the first packet-switching network, Arpanet, where programming is dependent on a specific central processing unit. Then in 1971, the first network-oriented CBMS was installed on several Digital Equipment Corp. PDP-10 computers in the network. This message system, though primitive by today's standards, was successful. It led to a second and finally third generation of CPU-dependent software dubbed Hermes. This is running at 15 Arpanet installations, supporting several thousand people.



How much does it cost?

If the InfoMail computer-based message system (CBMS) software package is installed on an in-house computer system, the one-time license fee is in the range of $20,000 to $75,000. The exact amount depends on the computer and the capabilities needed. An adequate level of computer power and enough terminals so that the user population has ready access is assumed to be in place.

A rule of thumb is that a medium-sized mainframe computer can support several hundred CBMS users. With such an installation, senior-level users will have their own terminals. More junior CBMS users will share terminals with one or two others.

The overall cost (not counting labor) of a system of this type is estimated by sources independent of BBN to be in the range of $0.50 per message. This is a low per-message cost and compares favorably with the cost of alternatives such as memorandums, telephone calls, and telex messages. However, the real advantage of CBMS lies not in the cost but in the time saved and the increased capabilities for meaningful and accurate communication.

ic system for transmitting information from a sender to a receiver in the form of a message. Like many such systems, therefore, InfoMail uses computer networking to assist in message delivery. But unlike them, it is also a computer-based message system (CBMS)—one that helps compose and store messages in electronic mailboxes assigned to each end user.

It therefore adds word processing to assist in message composition and data base management for storing and retrieving information in the electronic mailboxes. InfoMail provides these services plus the networking at a cost estimated to be 50 cents a message (see "How much does it cost?" above).

Documents, files, and forms

To assist in message composition, the InfoMail software has features dubbed documents, files, and forms after the actual inputs with which each is concerned.

In InfoMail, any document can be referred to electronically as an ordered set of named fields of information. For example, it may have fields of information labeled "date," "to," "from," and "subject," whereas other documents such as customer orders might have fields like "part number," "order number," and "quantity." Sometime in the future, a CBMS will be able to send and receive documents in which some fields contain information that is not even in text form. For example, document fields might include voice messages, facsimile pages, or even computer programs to be executed when the message is received.

Documents are stored in a data base to which InfoMail gains access by a hash key. A hash key resembles an address and consists of a unique document identifier or the combination of the identifier and a field name. Thus, even a randomly chosen document may be accessed quickly.

Documents are stored in the computer with data structures that permit other fields of the same document to be found quickly once any field is found. Thus, the system can access a random list of documents or all the documents within that random list having a common field.

A single systemwide data base of permanent documents is shared by all users of InfoMail. In such a setup, the space needed for document storage is kept to a minimum, documents are transferred rapidly from one user to another, and communications overhead is reduced. Moreover, a single user may easily store copies of a given document in several of his files.

A CBMS like InfoMail must also support files for all of the different types of information that can be sent in a document. In InfoMail, these files consist of ordered lists of document identifiers, plus the documents, or identifiers of other files, plus the files. Data-base storage by the CBMS means that the files may efficiently be created, retrieved, modified, and deleted. Documents and files may also be inserted and deleted at any position within a file that contains them. Because files may contain other files, InfoMail supports a hierarchical file structure, which models conventional paper-handling systems. Copies of the same document may be in several files since this, too, models the conventional approach.

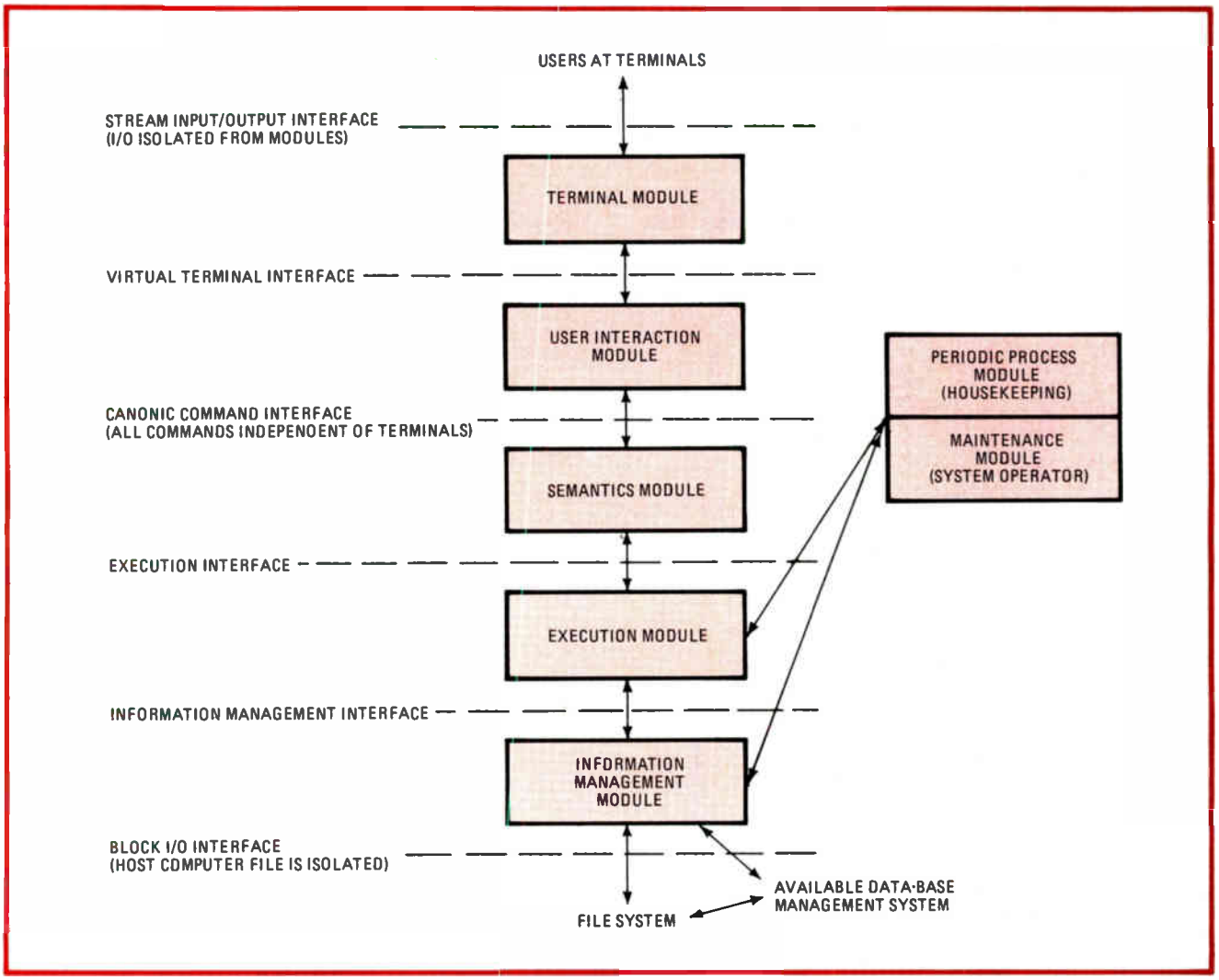
The final building block to go along with documents and files is a forms capability. Software forms are the electronic equivalent of the fill-in-the-blank form that is common for many applications such as engineering change orders and requisitions. InfoMail provides a forms capability as easy to use and as general as making up a form on paper. In the future a "smart" form will be developed by BBN. It will have the intelligence for handling the information it contains—for example, by asking different questions depending on the answers it has obtained to earlier ones.

Forms are a general mechanism for entering data into documents or creating data (for example, by collecting statistics) or for displaying the contents or partial contents of documents. For instance, when a user creates and sends a memorandum by specifying the "to," "subject," "date," and "from" fields and the body of the memorandum, he or she is filling in a form.

In addition, the forms capability makes it possible to vary the display of documents. As a result, it is easy for the user to reformat documents—for example, by printing only a few of the fields in each of a set of documents. The same capability also transforms documents into other documents. For example, with it a user can add new fields to a set of existing document.

User to user

Besides assisting the user in message composition, the CBMS must be able to help in message delivery by optimizing communication between users. For a user to communicate with another person, any document to be sent must have some address fields ("to," "forwarded to:" or "cc:"). Specific addresses in address fields may be the name (or alias) of an individual user or of an address list or of a file user (a file tag). Though this last



1. Multiple modules. There are seven software modules in the InfoMail computer-based message system. These are written in Ratfor and are designed with appropriate interfaces for operation independently of the type of computer or terminals used in the communication network.

feature is not yet available on InfoMail, ultimately InfoMail will be able to send documents to individuals, address lists, files, and combinations of these.

There will be no distinctions apparent to the user between addresses for individual users, user aliases, address list names, and file tags. Thus they may be mingled at will in the address fields. However, interuser communications does make a distinction between the physical address (the computer in which the user's mailbox is stored, plus his account name or number there) and the user name. This later label may be the person's name and/or other identifying information like a department number. The software simply looks up user names in its directory to convert them into physical addresses. As a result, two users may exchange messages without knowing where each other's mailbox is located.

The process interface

In some instances an InfoMail user may find it desirable to interface other software to the CBMS directly. For example, he may have a program that prepares a monthly summary of a large body of (say) production data that is sent to a number of other persons. In one approach, the user's program creates a computer file, turns it into an InfoMail document, and then sends that document to the distribution list. However, if the user's program automatically produced the summary, the program could instruct InfoMail to send the document automatically to the distribution list. In this case, what is known as a process interface gives external programs access to InfoMail. With this interface, a program can call up as subroutines the various commands the user normally types in.

Networking arrangements

While handling documents, files, forms, communications between users, and other program interfaces, the CBMS must, as mentioned earlier, operate in many different computer architectures. Of all these possibilities, the most common in major corporations is one that has a number of different long-distance and local networks provided by different vendors. In some cases these overlap and interconnect.

The installation of the CBMS on a number of separate computers linked by communications lines raises the question of computer communication. The InfoMail pro-

cedure is based on what is called an application protocol for exchanging messages—a protocol that is independent of the physical path that connects the two computers, which may be a direct line.

The layered approach to computer communications, in which application software is independent of the physical mode of communications, is by now universally accepted as a necessary design principle in this area. Well-known examples of such layered communications protocols include the International Standards Organization's Reference Model, the X.25 of the International Consultative Committee on Telegraphy and Telephony, and International Business Machines Corp.'s System Network Architecture (SNA).

Internal modules

InfoMail's application software system comprises a set of modules that provide all the software paths between a terminal and a controlling computer. For example, the terminal module (Fig. 1) is an operating system for data or message entry. It controls the user terminal and interacts with the human operator through what is called the stream I/O interface. Through a virtual terminal interface, the terminal module communicates with the user interaction module.

The user interaction module accepts user commands and parses them (breaks them into computer-usable components) while supplying default arguments (ambiguity decisions) where possible. In addition, it assists the user in a number of ways—it permits him or her to edit and repeat incorrectly typed commands, provides lists of command options, and gives examples and descriptions of commands.

The user interaction module interfaces with the user terminal and the user semantics modules. It also handles a standard set of terminal routines that isolate the rest of the InfoMail system from the idiosyncrasies of the host computer's I/O systems. This is one key to the CBMS's portability from computer to computer. Between the user interaction module and the semantics module, an interface passes commands that are independent of terminal type, syntactically correct, and in a highly structured format.

For its part, the semantics module takes care of user manipulation of the documents and files discussed earlier. It executes the commands the user gives and enforces the rules about what a user can and cannot do with documents and files. Furthermore, the semantics module handles certain defaults that are beyond the capability of the user interaction module.

The semantics module is coupled by the execution interface to the execution module. This module provides a number of important subroutines that can be called either by the semantics module or by the periodic process module. It includes subroutines for sending and receiving documents, editing documents and files, interpreting forms, and establishing compatibility with host computer operating system files. Many of the future CBMS enhancements that were mentioned earlier will be handled by this module.

What is Ratfor?

The high-level language Ratfor (for Rational Fortran) is one of the best known of a number of available Fortran preprocessors. A preprocessor shields the user from many of Fortran's deficiencies while keeping its chief advantages. Fortran is in widespread use, and high-quality compilers are available for it. Ratfor permits the Fortran programmer to use structured programming (commands such as while, for, if/else, switch) and long mnemonic variable and routine names. These facilities enable programs to be written rapidly.

The programmer's code, written in the Ratfor language, is translated into conventional Fortran code by a Ratfor preprocessor. From there, the code is compiled into an executable program by the available Fortran compiler. Although this makes program compilation a two-step process, experience has shown it is more than worth the extra cost in terms of shorter development times, easier program maintenance, and better programmer morale.

Portable software. The chief advantage of Ratfor software for computer-based message systems is program portability. There are substantial differences in different Fortran compilers and in the underlying machine characteristics. Worse yet, Fortran programs may take advantage of special machine characteristics like floating word or character size that may not be easily transferable.

Users of Ratfor have aimed at software portability from the outset. They have chosen standard versions of the language and avoided features that cannot be accommodated uniformly by the different Ratfor-to-Fortran preprocessors. Furthermore, since Ratfor can be used as a system programming language, Ratfor preprocessors are written in Ratfor itself, easing the bootstrapping process to new computers. And finally, some Ratfor preprocessors produce output in other languages such as Bliss or PL-1, which of course signifies even greater possibilities for Ratfor portability.

Features. One of Ratfor's major features is that it passes many lines of the source program (assignment statements and subroutine call statements) directly through to Fortran without translation. Thus, if the user wants to maximize portability, he must avoid using the most machine-dependent Fortran statements (input/output, character handling). They must be handled with calls to appropriate subroutines and functions.

To date, Ratfor has not dealt cleanly with Fortran's deficiencies in string handling and pointer manipulation. The user expecting to write high-performance portable systems programs in Ratfor will have to adopt appropriate data structures and programming conventions to work around these problems.

Fortunately, it is easy to learn about Ratfor. Major system programs have been written in Ratfor (and other Fortran preprocessors) by a number of groups over the last several years. Ratfor and its use in creating portable software is discussed in "Software Tools," edited by Brian Kernighan and P. J. Plauger and published by Addison-Wesley Publishing Co. in 1976. Also concerned with Ratfor is the advanced systems group in the computer science and applied mathematics department of the University of California at Berkeley.

Why does electronic mail fail?

Some trials of computer-based message systems, or CBMSs, have failed. There are several reasons for this. If the computer is too slow, people will not want to use it. If the computer has too much downtime, people become discouraged. Certainly, if it destroys messages or loses files, they stop using it.

But the most common reason people give for not using a CBMS is that they are "too busy to use it." Yet a CBMS is designed to cut, not increase the communications burden. In fact, Bolt Beranek & Newman Inc. has determined that failure usually relates to some unhappy experience in using the system.

For example, engineers may have used the system and had a hardware problem, or they have made a mistake and have not been able to correct it. Moreover, they may not have had adequate training and introduction to the system, or may simply be afraid to try it. An equipment manufacturer planning to install a CBMS or an engineer-user who wants one in his office must remember to give beginning users enough help.

The information management module provides a database management system suited for a CBMS. In a sense, the information management module is the memory system for a hypothetical computer designed to manipulate documents and files. In turn, the programs that call this module can be thought of as the equivalent of the instruction set for the hypothetical computer. The information management module provides a highly structured capability for creating, retrieving, modifying, and deleting documents and files.

The information management module may be called by the semantics, the execution, or the periodic process module. It provides a standard interface that isolates the InfoMail system from the idiosyncrasies of the host computer file system, just as the user interaction module isolates InfoMail from the host system's terminals. This isolation from the host hardware is key to InfoMail's portability.

Two more

The periodic process module handles those InfoMail functions that are executed periodically rather than at the user's command. These functions are either short- or long-term. The short-term periodic processes include the transfer of documents between users and the polling of the interfaces in order to transmit messages between computers by InfoMail; these processes are attempted at some appropriate frequency. The long-term periodic processes include housekeeping of the InfoMail systemwide document data base and document retrieval from computer archives.

The last of the software modules, the maintenance module, runs manually as needed. It adds users to the system, changes the user directory, compiles new forms, and carries out other functions that must be provided by a system operator. Almost all the software in these modules is written in Ratfor, a structured programming language that a preprocessor translates into a standard version of Fortran (see "What is Ratfor?", p. 170).

Applications beyond just mail

Today it is highly feasible to organize a research and development facility, laboratory or office around a CBMS like InfoMail. Yet many companies have still to adopt the CBMS technology, and some have tried and failed (see "Why does it fail?" above). In a typical working installation, members of the technical and engineering staff use the CBMS for daily communication on their projects, for exchanging drafts of reports, and even for transmitting modules of software. Management uses it for project control, for work assignments, and for staying in touch with activities of the staff. Moreover, many professional staff members have terminals both in the office and at home, so the home can be used as a work place when necessary.

Manufacturers of original equipment can install a CBMS capability in their computers, distributed processing stations or networks, to create systems they then can sell to a wide base of customers. For example, in sales management a CBMS builds and maintains records of customer names and the dates of contact and follow-up by phone or mail. Sales personnel can construct these documents with the aid of a special form that asks for the customer's name, address, and telephone number and that can be updated to include the date and type of further activity. These files can then be used as the basis for future direct mailings. Local networks sold to business users may wish to incorporate such features.

Keeping track

Document management is another example of a CBMS application. For example, libraries keep track of the periodicals they acquire and other publications by means of documents kept on line in the CBMS. Likewise, legal departments can have litigation support systems based on CBMS documents.

Records management is ideal for a CBMS. BBN, for one, maintains its company telephone book in the CBMS. Many of the business records of the different operating divisions are also kept in this form so that they can readily be compiled and combined into reports and summaries of previous activities and current status. One group keeps track of its computer terminal inventory this way, according to purchase date, user, model of terminal, and account number. In short, there are many common business problems that can be solved by the CBMS approach.

In the future, a CBMS will make it possible to automate complex structured procedures such as the budgeting and forecasting process or the purchase requisition system. These are all activities that can be conducted semiautomatically by means of a sophisticated electronic mail system that distributes questions, gathers replies, and then organizes the collected information. Still other uses will develop as engineers become familiar with the advantages of a hardware-independent CBMS. □

Voltage-detector chip simplifies V-f converter

by Lloyd Powell
David Taylor Naval Ship Research and Development Center, Annapolis, Md.

One-chip voltage detectors such as Intersil's ICL8212 contain all the necessary reference, discharge, and hysteresis circuitry needed to build a simple voltage-to-frequency converter. Providing a 0-to-1-kilohertz output for a 0-to-2-volt input in its basic range, the low-cost circuit requires only a few additional passive components, including an operational amplifier.

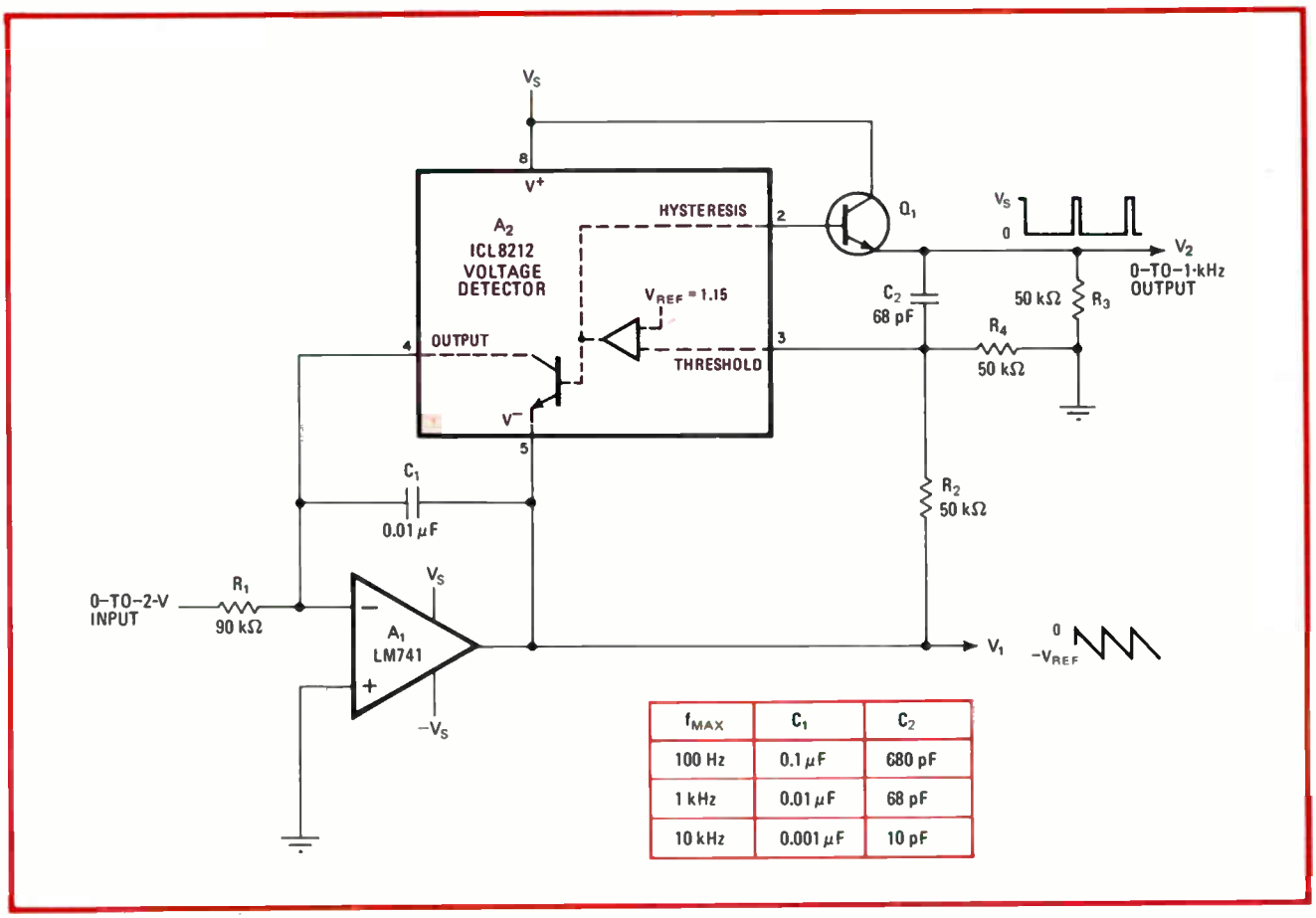
As shown, A_1 integrates incoming signals until its output voltage, and hence also the voltage across capacitor C_1, becomes $V'_{ref} = V_{ref}(R_2+R_4)/R_2$, where V_{ref} is the internal reference voltage of the ICL8212. At that instant, A_2's comparator goes high and switches its output transistor. While transistor Q_1 provides a positive-going output pulse, C_2 holds A_2's comparator high, so that C_1 is discharged quickly, in just 5 microseconds. Thus the process of integration and discharge occurs at a rate given by output frequency $f = V'_{in}/V_{ref}R_1C_1$.

Linearity and offset are better than 0.2% over the 0-to-1 kHz voltage-to-frequency range, assuming the operational amplifier used has low offset voltage and bias current. Suggested capacitance values for other frequency segments are given in the box in the figure. The input-voltage range can also be selected by means of R_1. For greatest accuracy, capacitors having the highest stability should be selected, and thus those of the silver-mica and polycarbonate type should be used where practical. For less stringent applications, those of the ceramic and disk type will suffice.

Supply voltages may range from ±2 to ±18 v without loss of circuit linearity. □

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 $75 for each item published.

Cost-effective conversion. Micropower voltage detector chip and op amp form integrating V-f converter. Simple, low-cost circuit has 0.2% linearity over 0-to-2-volt input range. Frequency range, nominally 0 to 1 kilohertz, is chosen by appropriate selection of C_1 and C_2 (see box).



f_{MAX}	C_1	C_2
100 Hz	0.1 μF	680 pF
1 kHz	0.01 μF	68 pF
10 kHz	0.001 μF	10 pF

Four chips generate pseudorandom test data

by Wayne Sward
Sperry Univac Division, Salt Lake City, Utah

The inexpensive pseudorandom-bit-sequence generator shown here requires only four integrated circuits and will serve well in testing digital data links. Joined through a minimum of interconnections, it will furnish a recurring 511-bit string suitable for a variety of other applications as well.

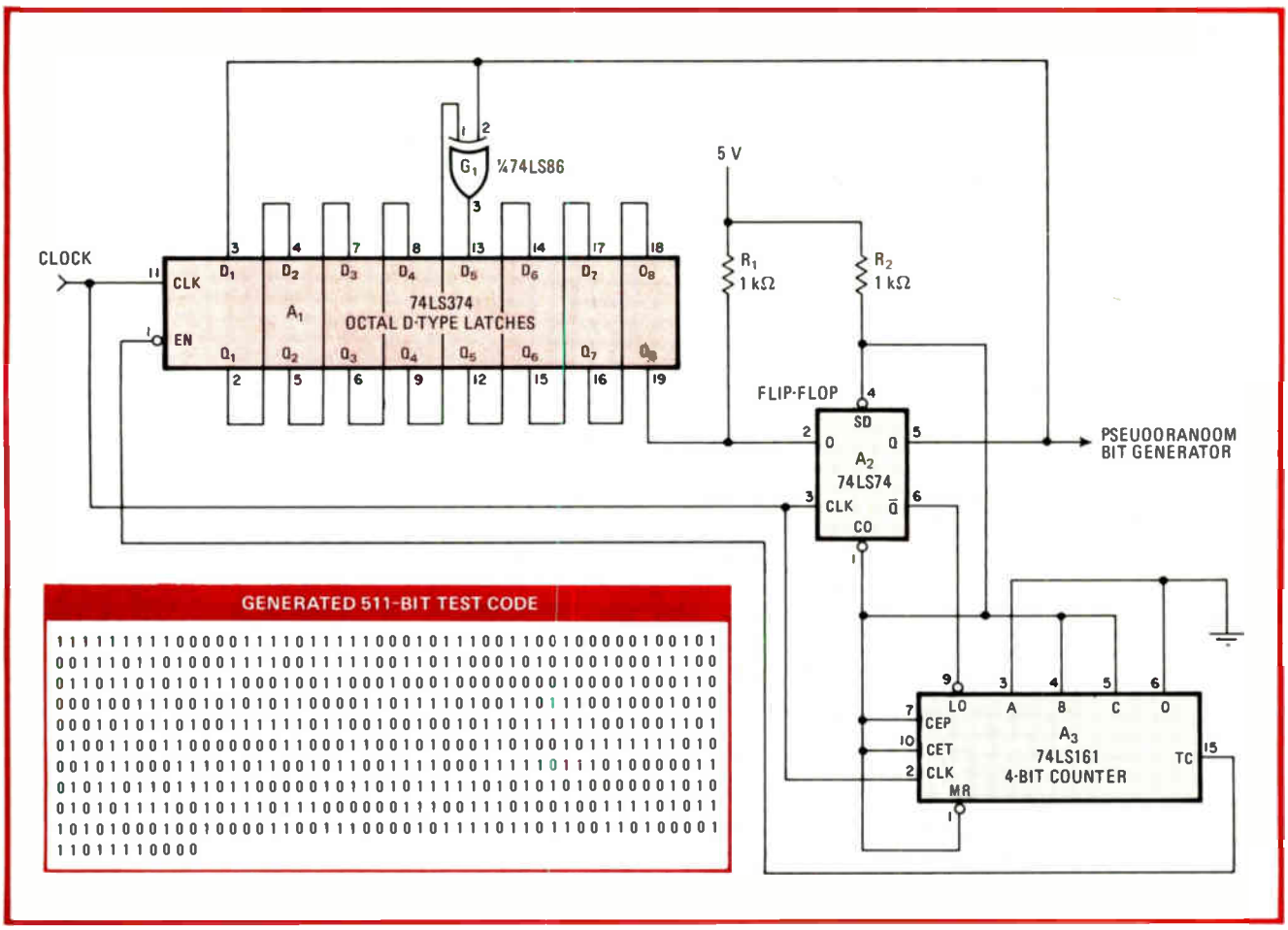
The octal D-type latches in A_1, along with flip-flop A_2, form a 9-bit serial shift register that drives binary counter A_3, which detects the register's illegal all-zero state; exclusive-OR gate G_1 provides the required feedback connection. On power-up, the outputs of A_1 assume arbitrary logic values, and the 11-megahertz system clock steps the bits to the load input of A_3. When the first logic-1 bit cycles through to A_3, the counter presets to 6. As long as at least 1 bit in the shift register thereafter contains a logic 1, A_3 can never reach a count of 15. Consequently, its terminal-count output will always remain low.

If only zeros should appear in the shift register after power-up or during the course of operation, however, A_3 will eventually reach a count of 15, and its terminal-count output will go high. This action forces the three-state outputs of A_1 to become inactive, or an open circuit, and a logic 1 will be introduced (through resistor R_1) into the data stream, at the D input of A_2. This bit is detected by A_3 on the following clock cycle and normal operation is restored. Note that the circuit configuration eliminates the nine-input gate that is usually required at the input of the counter in order to detect the existence of an all-zero state.

The test code generated by this circuit is shown in the table, its format being compatible with the popular HP3780 bit-checking data unit. Of course, if the format of the test code must be altered, it may be changed simply by connecting the load input of A_3 to the appropriate stage of the shift register.

If the low-power Schottky chips used in this generator are all replaced by their standard Schottky equivalents, the bit rate can be extended to 26 MHz, though with a slight penalty in power dissipation. No additional wiring changes will be required. □

Self-correcting code. Simple generator provides a serial string of 511 pseudorandom bits suitable for testing digital data links at up to 11 MHz. The code, in a format compatible with the popular HP3780 test generator or data-bit checker, is easily changed by connecting the counter to the appropriate stage of shift register A_1–A_2. Bit rates to 26 MHz are achieved by replacing ICs with their Schottky counterparts.



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Low-power f-V converter turns portable tachometer

by Dan Watson
Intersil Inc., Cupertino, Calif.

Placing a frequency-to-voltage converter in the form of a complementary-MOS timer and operational amplifier at the front end of an analog-to-digital converter reduces the power, wiring complexity, and costs associated with designing an efficient digital tachometer or anemometer for field use. When combined with the multifunctional capability of such a-d converters as Intersil's ICL7106, a direct or scaled reading of the input parameter expressed in revolutions per minute can be readily determined with few additional parts.

The ICL7106 contains not only all of the required clock and display-driving circuitry, but also a reference, so that the external reference voltage normally required in circuits of this type can be omitted.

Signals applied by a magnetic or optical transducer to the input of the ICM7555 timer (powered by the converter's reference voltage) are converted into fixed-width pulses of corresponding frequencies. The ICL7611 micropower op amp integrates these pulses, and consequently the smoothed signal introduced to the a-d converter is a direct function of the input frequency. Thus, the signal will have an amplitude of

$$V_{in} = (RPM/60)(t_{pw})(V_r)(E)(R_4/R_3)$$

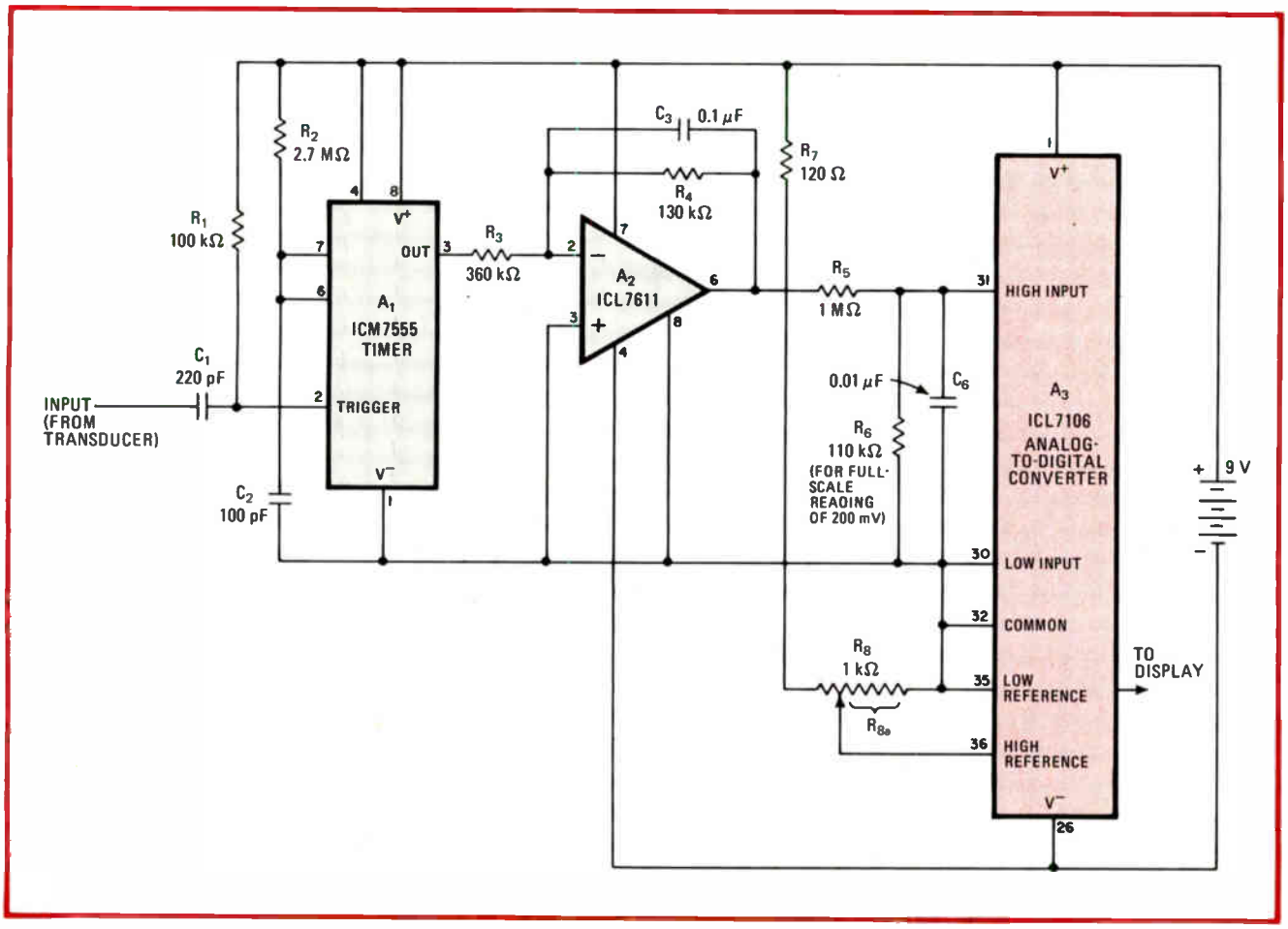
where

t_{pw} = pulse width of timer = $1.1\ R_2C_2$
V_r = reference voltage of ICL7106 = 2.8 volts
E = number of events per revolution from the magnetic or optical sensor, the number of fan or propeller blades, or the number of point closures per revolution in an automotive application.

The converter's full-scale output is 200 millivolts. Note that the V^- timer port is powered by the internal low-reference voltage of the converter, precluding the need for a second reference because of the rail-to-rail output swing of the ICM7555.

The output of the converter is given by $n = (V_{in}/V_r)(R_7+R_8)/R_{8a}$. The a-d converter contains on-chip display circuitry for driving a liquid-crystal display. If a light-emitting-diode display is desired, the a-d converter can be replaced with its sister unit, the ICL7107. □

Restless wind. Complementary-MOS chips combine to make a simple, cost-effective flea-powered digital tachometer or anemometer for field use. Input signals of corresponding frequency from magnetic or optical transducers are converted into voltages by A_1 and A_2, and then into the equivalent digital output by A_3. R_3–R_4, and R_7–R_8 set the scaling multipliers.



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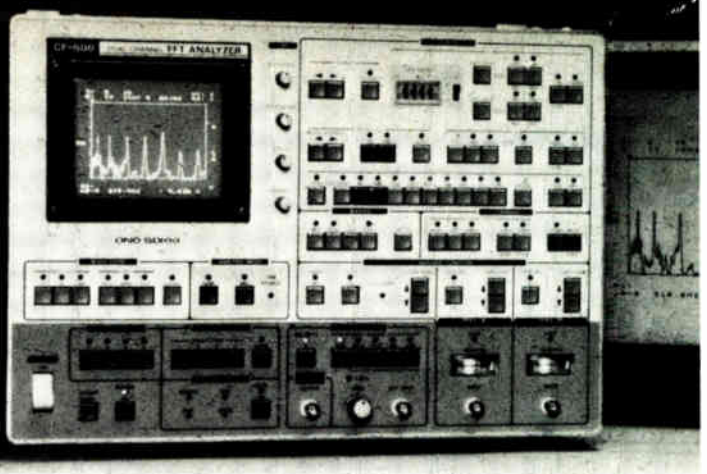

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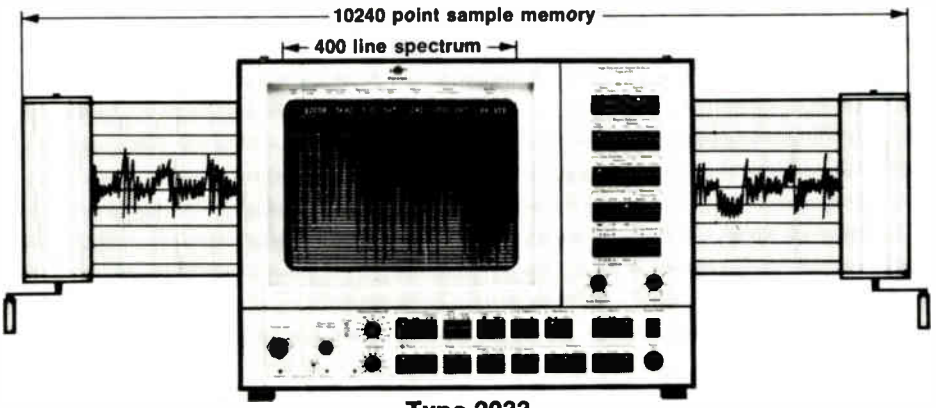

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80-452

Speech chip timeshares a 2-pole section to create a 12-pole filter

Linear predictive coding derives filter coefficients for the words spoken by a toy called Milton

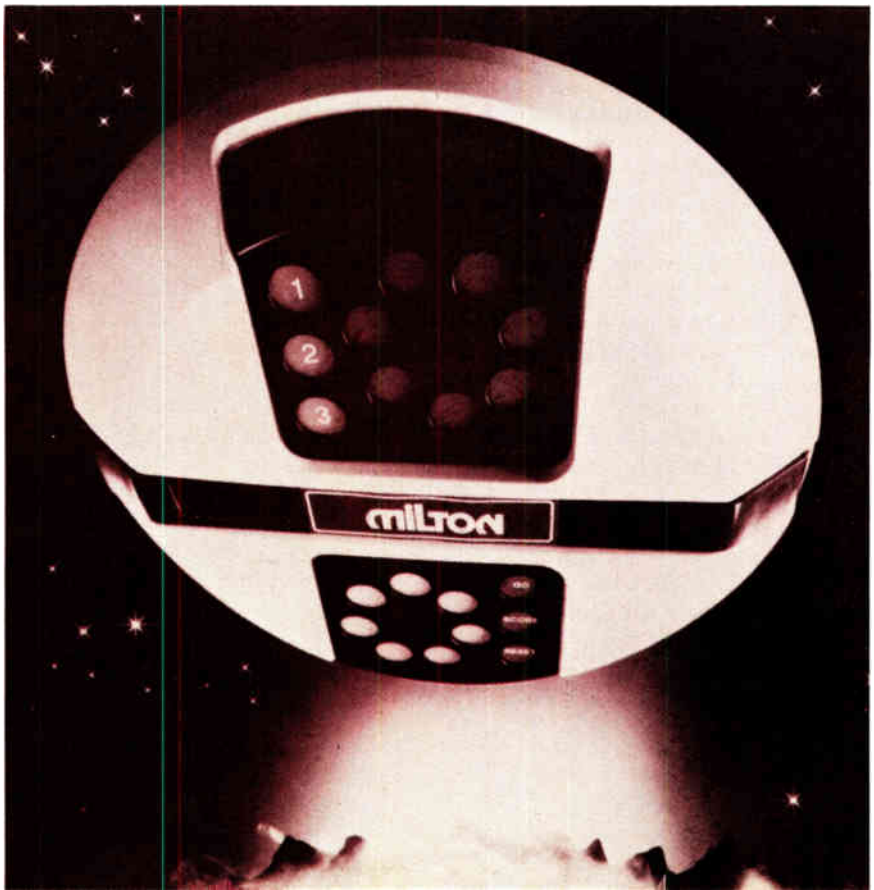
by Paul Ahrens, Klaus Skoge, and David Vetter, *Milton Bradley Co., Springfield, Mass.*, and John Stork, *Speech Technology Corp., Santa Monica, Calif.*

☐ The novelty and declining cost of speech-generating integrated circuits is capturing the imagination of toy-makers everywhere. But there were no low-cost speech ICs around when a phrase-matching game called Milton was being planned for its 1980 introduction.

To build Milton, one of the first toys to use synthetic speech, Milton Bradley collaborated with Speech Technology Corp. on the design of its own chip, which was then fabricated in n-channel MOS technology by General Instrument Corp. The device is in some ways similar to the one Texas Instruments Inc. developed for its exclusive use in its Speak & Spell learning aid [*Electronics*, Aug. 31, 1978, p. 109].

In both speech synthesizers, the passage of voiced or unvoiced sound through the vocal tract is modeled by using periodic or random excitation to drive a multistage digital filter (Fig. 1). In both, linear predictive coding determines the filter coefficients needed to model the different states of the vocal cavity. Both designs also shrink the filter drastically to fit it on a small chip. But where the Speak & Spell chip uses a pipeline multiplier to reduce its filter's size, the Milton chip uses one two-stage filter section, multiplexing it up to six times in order to create the equivalent of a 12-stage digital filter.

This approach also proves to be highly flexible in terms of the different levels of speech quality obtainable from the same chip for different applications. Data rates of 1,800 to 2,200 bits per second yield high-quality speech; 1,000 to 1,200 b/s is often more than adequate for many applications; and with formant-coded vocabularies 400 to 600 b/s is sufficient.



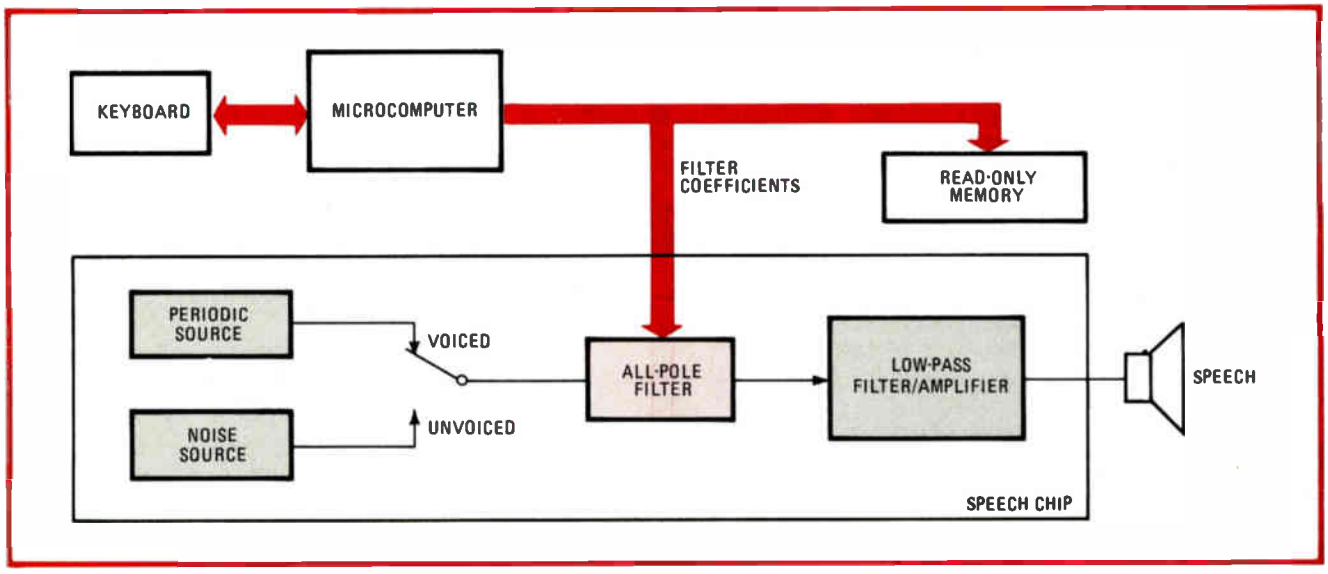
Talk to me. One of the first toy makers to use electronic speech synthesis, Milton Bradley devised Milton, a game that cheers, prompts, and razzes its players.

The digital filter techniques used are standard ones. Being well developed and easily simulated in computer programs, they can be relied upon to speed chip development. Also, as they can realize complex filters out of a very few timeshared serial logic elements, chip area is kept small, yields high, and cost low.

Linear prediction

The inputs to the synthesizer are derived from a spectral analysis of a recorded human voice speaking the passages to be synthesized (see "Squeezing Milton's voice into memory," p. 179). For Milton the passages consist of partial phrases like "kick the . . .", "brush your . . .", and "drink your . . . ," which are matched by the players to words like "habit," "teeth," and "milk." Prompts, encouraging phrases, and razzes bring the total to about 60 seconds of speech.

There are many techniques for spectral analysis of a



1. Milton's mouthpiece. The block diagram of Milton's speech-generating circuits, consisting of an input device (in this case a keyboard), a microcomputer, a read-only memory, and a speech-synthesis IC driving a speaker, is quickly becoming a classic configuration.

sampled voice signal. Among these, the covariance, autocorrelation, and lattice, or partial autocorrelation (parcor), methods of linear prediction are readily implemented on computers and execute rapidly on machines that have floating-point hardware.

Linear predictive coding (LPC) assumes that an all-pole filter—that is, one with no zeros in its transfer function—can model the vocal-tract transfer function, while periodic excitation or pseudorandom noise can model the driving sources—the glottis in the first, voiced case or a turbulence-generating constriction in the second, unvoiced case.

As the vocal tract changes constantly, the filter coefficients must change periodically, typically every 10 milliseconds for adult male speech. Once the pitch and voicing information is known, the coefficients may be extracted by linear predictive analysis. The magnitude of the source signal is then scaled in order to compensate for the filter gain, thereby providing the correct amplitude at the output.

An LPC program and subsequent data-compression programs were written in house in Fortran to run on an IBM 370/158. The LPC program analyzes the sampled speech data in segments called frames. Each frame coincides with a pitch period in voiced segments and with a default frame-length in unvoiced segments. The result is a set of linear predictive coefficients for each frame. These are the coefficients of the linear predictive polynomial characterizing the filter when it models that frame. The cascade form of the filter dictates that each such polynomial be factored into its quadratic terms, one for each filter stage.

In memory

Figure 2 is a block diagram of the speech synthesizer, identifying major functional blocks and showing major data paths. It needs the following parameters to generate a basic frame of speech:

- The voiced/unvoiced distinction.
- A set of 12 filter coefficients.
- Pitch period information.
- Amplitude information.
- A repeat count.

These speech parameters are accessed from an external read-only memory (shown in Fig. 1), which stores addresses for the filter coefficients rather than the coefficients themselves. These addresses point to memory locations in a ROM on the synthesizer chip that stores the filter coefficients. The filter's output drives a digital-to-analog converter whose output is externally filtered before driving a speaker.

The cascade form of the filter is shown in the dashed area of Fig. 2. As in any digital filter, the multipliers are the most critical part, in terms both of their timing and of the chip area required for their implementation.

Several schemes for serial pipeline multipliers were considered and turned down. Although a pipeline multiplier could achieve higher throughput at a given clock rate, the increase in chip area over a conventional design could not be justified. The best compromise between chip area and clock rate was found to be two simple, serial/parallel multipliers implementing one second-order filter section.

Figure 4 is a diagram of the second-order section used. It has two poles and no zeros. The main data path is serial, and the coefficients are presented in parallel in signed magnitude form. But the multipliers can handle only unsigned coefficients, so the magnitude goes to the multipliers and the sign controls the functions of the adder/subtractors receiving the multiplier outputs.

To implement a 12-pole filter with this one second-order filter section, the interval between input signal samples—typically 100 microseconds—is divided into six multiplication cycles of 16.7 μs each. During the first multiplication cycle, the input to the filter comes from the excitation function block. During the five remaining cycles, the input to the filter during each cycle is that output from the filter that was generated during the previous cycle and that has been delayed till needed in shift registers SR_1 and SR_4. The output of the sixth (and

Squeezing Milton's voice into memory

To encode the speech in the Milton game, the waveforms were sampled and the samples digitized. Then to minimize the problem of synthesizing fluent speech, segments of speech that would occur in the game in only one context—as in a question, for example—were sampled in that context. Those occurring in more than one context were sampled in isolation. Great care was taken to arrange the rhythm and intonation of the game's vocabulary, so that segments of speech occurring in different contexts would sound natural in every instance. Proper intonation and rhythm are critical for making synthesized speech sound natural and not mechanical.

In theory, the chip should require 15 bytes of input to synthesize a segment, or frame, of speech. But if all 15 bytes were used to full precision for each frame, the bit rate for an average rate of 100 frames/second would be a prohibitive 12,000 bits/second, requiring an impractical 720 K to store the speech parameters required for Milton. A variety of techniques was needed to reduce the parameter storage to an economically manageable level. First, it was found that five filter sections, instead of the six for which it was originally designed, produced adequate speech. Thus, the game multiplexes the single filter only 5 times, saving 2 bytes.

Second, one of the parameter bytes contains a 6-bit field indicating how many frames are to be synthesized using the current parameters. In principle, this repeat count field makes it possible to reduce the storage requirements by grouping successive pitch periods that are sufficiently alike. Each group is then represented with an average parameter set and a repeat count equal to the number of pitch periods in the group.

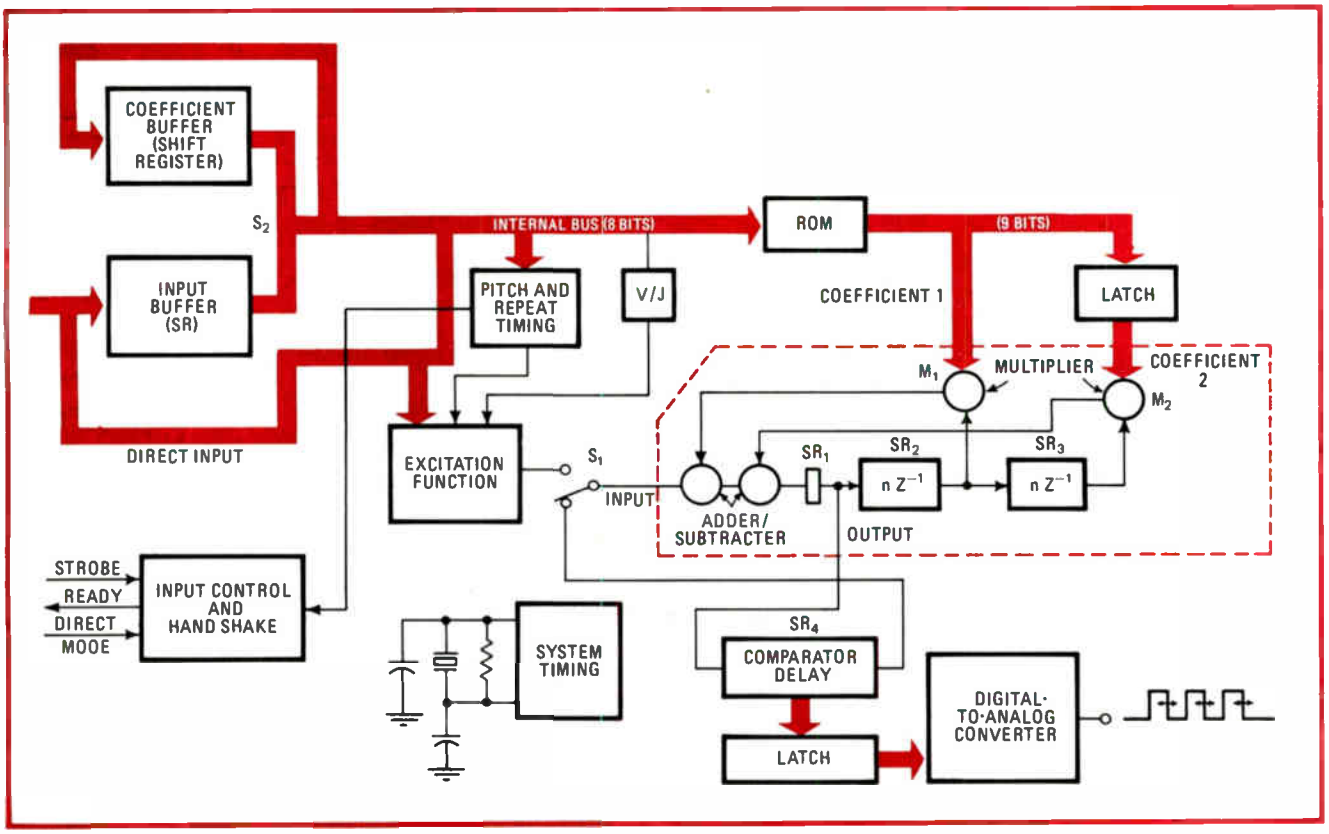
Finally, the filter coefficients are not all of equal importance. The coefficients going to certain of the filter sections require less precision than those going to others. With appropriate sorting of the coefficient pairs to ensure adequate precision in those pairs requiring it, significant savings are possible with little perceptible loss in quality.

The overall result is a reduction to an average of about 76 bits/frame. With an average repeat count of five, the actual number of stored bits required per frame of speech is about 15. For Milton, this corresponds to a storage requirement of about 1,500 b/s of speech—little enough to fit Milton's vocabulary in his external 96-K ROM.

last) cycle is equivalent to the output of a 12-pole filter. Seven significant bits from it are latched into the d-a converter during the following cycle, while the filter is processing the next sample from the excitation block.

The excitation of the filter comes from two sources—a periodic signal with a single impulse per period for voiced segments and pseudorandom noise for unvoiced segments. The amplitude of the excitation is specified as a 5-bit mantissa with a 3-bit exponent and yields an approximation of the logarithmic scale.

For unvoiced segments, the term "pitch" obviously does not apply. However, the pitch and repeat informa-



2. Open wide. The two-pole digital filter section (dashed area) is driven first by the excitation function, after which switch S_1 toggles and the filter is driven by its own recirculating output through shift registers SR_1 and SR_4 to create the equivalent of a 10- or 12-pole filter.

tion is used to specify the duration of the segment.

The filter coefficients are only indirectly specified from the byte-wide ROM outside. What is actually specified externally is a sign bit and a 7-bit address of a particular coefficient residing in an internal ROM. The reason for this is that in certain ranges the coefficient magnitudes are needed with 9 bits of precision, which the synthesizer ROM is designed specifically to handle, but the standard outside ROM is not.

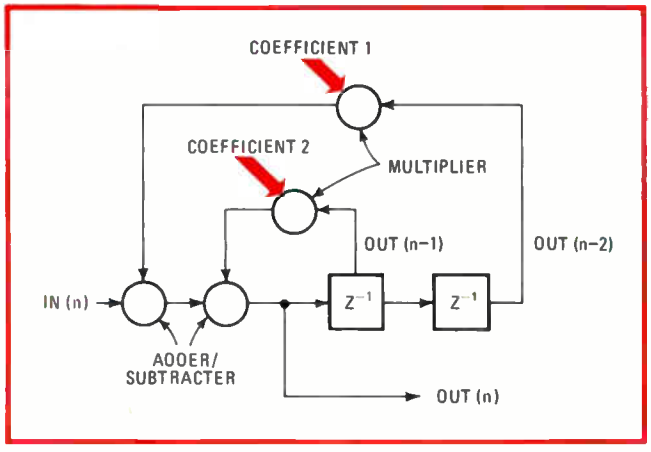
Addressing the coefficients

The seven address lines of the internal ROM are fed by seven lines of the internal data bus. The timing of the bus is such that for each multiplication cycle, the second coefficient is transferred ahead of time and stored in a latch while the first coefficient is latched directly into the multiplier at the start of the cycle. This is shown in Fig. 2. Not shown is the fact that when each coefficient address is on the bus, the corresponding sign bit is also there on the eighth line and must be latched to be presented to the adder/subtractor at the proper time.

The coefficients and other parameters reside in the coefficient buffer, which is a dynamic shift register 8 bits wide and 15 bits long. They are constantly recirculated in such a way that each parameter appears on the internal bus at a particular time during each sampling period. Actually, only the filter coefficients need appear every sampling period, but it is simplest to allow the other parameters to appear as well.

Letting in the parameters

There is also an input shift register of the same size as the coefficient buffer, but static. Its inputs connect to eight data-input pins; it is normally clocked from the data strobe, which is also an input to the chip. The input buffer can therefore be loaded asynchronously from the external ROM. When it is full and the synthesizer needs another set of data, as signaled by the repeat count being exhausted, a transfer cycle takes place. During the transfer cycle, which lasts for one 100-μs sample period, the input buffer is clocked synchronously with the coefficient buffer. The new set of parameters will then appear on the internal bus and be loaded into the coefficient buffer. When the transfer cycle ends, the ready line is asserted to signal to the outside that the chip is ready to receive the next set of parameters, to be implemented when the current set expires.



4. Cascaded. A second-order filter section is timeshared over a sample interval of about 100 microseconds; intermediate data is stored in the delays z^{-1} and z^{-2} and fed back to the start of the section in time for the next of five or six sampling intervals.

The pitch and repeat timing block consists of two cascaded-down counters—both loaded initially during the transfer cycle. The low-order one is the pitch counter and it is decremented every 100-μs sample period. Upon reaching zero, it signals the start of a new pitch period and causes the excitation block to present a new impulse to the filter. It also decrements the second, or repeat, counter and is then reloaded.

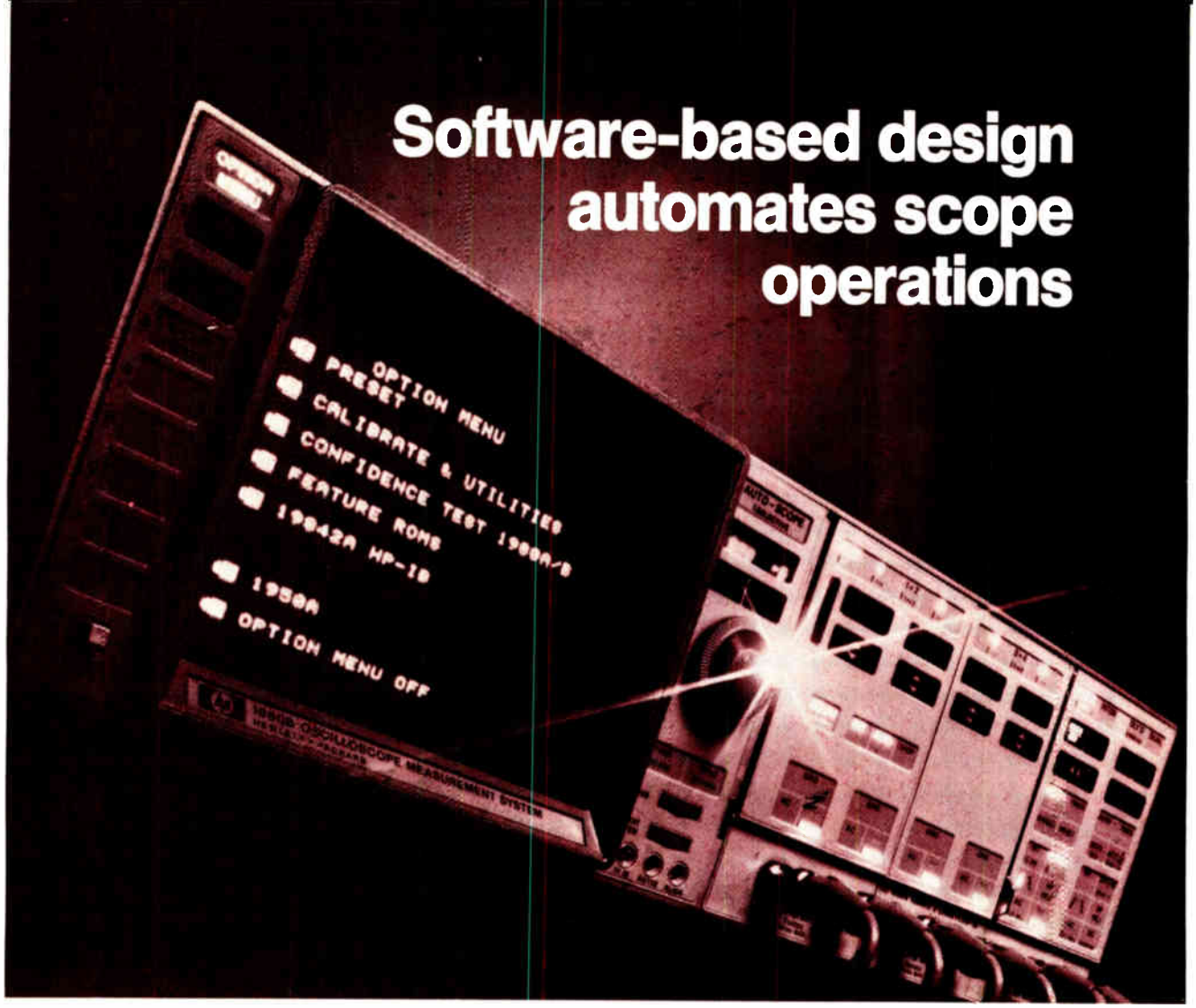
When the repeat counter reaches zero, the input control block is signaled to initiate a transfer cycle if a new set of data is available in the input buffer; otherwise, another pitch period is initiated with the existing data set. This will continue until new data becomes available.

A pulse-width-modulation scheme was adopted for the digital-to-analog converter. The binary output of the filter is loaded into a counter, which is then counted down at the system clock rate. The d-a converter output is kept high while the counter is counting down and otherwise is low. As a result, the width of the output pulse is a function of the binary output of the filter.

The counter is reloaded at a constant rate, using new filter output values as they become available. Consequently, the d-a output is a square wave with constant frequency and a modulated duty cycle. Demodulation is achieved with a low-pass filter for driving the speaker. □

3. Brother Sam. Milton's successor in speech synthesizing toys is a game called Say It Again Sam. Other toy manufacturers have recently introduced entertaining and educational products using the low-cost ICs that have become available since Milton was first planned.

Software-based design automates scope operations



With digital controls, text display, and firmware options, scope makes calibration and signal measurement a snap

by Paul Austgen, William Watry, and Michael Karin, *Hewlett-Packard Co., Colorado Springs Division, Colo.*

☐ Software designers are making their presence felt in areas once dominated by push-button switches, wafer switches, and potentiometers. Hewlett-Packard's model 1980 oscilloscope measurement system relies far more heavily on software in its design than does any previous waveform measurement system. As a result, significant contributions have been made to the calibration, operation, and measurement capabilities of the system.

The software-based design of the 1980A/B (the cabinet style 1980A and rack-mountable style 1980B) revolutionizes the man-oscilloscope interface (Fig. 1). One rotary control now services all variable functions—deflection factors, sweep, and so forth. The functions are grouped logically and can be selected by depressing touch panels that light and internally produce an audible click.

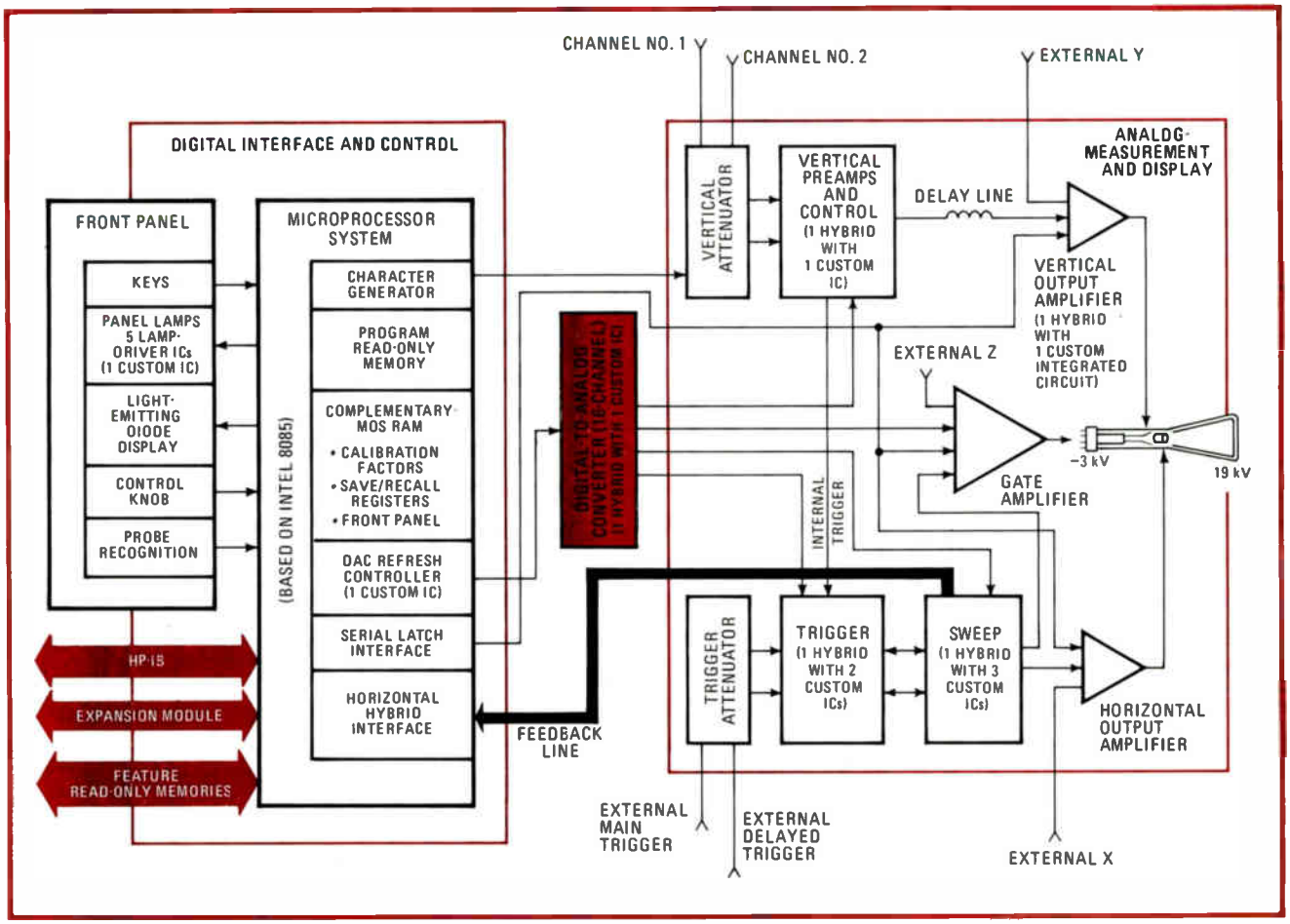
This improved panel arrangement is possible because all of the 1980's functions, with the exception of some minor CRT controls, are controlled digitally through the system software. The instrument can operate with much greater flexibility, not only internally but through HP's interface bus (HP-IB).

The system's software-based design required a computer architecture. In this architecture, shown in Fig. 2, all front panel and remote interfaces are digital. Further, all analog measurement and display functions are digitally controlled, either through the scope's custom, 14-bit, 16-channel digital-to-analog converter or by means of digital latches.

But what makes the 1980 truly unique is that its operation can be automated, with its Intel 8085 microprocessor interactively controlling its functions. This is possible because a feedback line included in the design can flag the digital processor when an input signal is detected.

The advantages that microprocessor control provides

1. A new face. The 1980's front panel is unlike any other oscilloscope's due to software-based design. One rotary knob controls all functions selected by touch panels; text appears on the screen.



2. Broadened scope. The 1980 scope performs in ways no previous scope has because all analog functions (right) are controlled by the digital system (left) through a special d-a converter. Further, feedback from the analog side tells the processor when a signal is present.

can be seen by examining the system's calibration and setup procedures. Understanding these operations will help clarify the central role the feedback line plays in automating operation.

Scope calibration, for example, has traditionally been a tedious process requiring a trained technician. With the scope on and a calibration signal applied, the technician opened up the scope and mechanically adjusted numerous components to obtain the desired response at various internal nodes. During this process the maintenance manual had to be frequently consulted.

Simple calibration

Because of its computer architecture, however, the 1980 can be calibrated with an entirely different procedure. Except for manufacturing or repair adjustments, calibration is accomplished entirely from the front panel. Internal software computes the calibration factors and stores them in the system's memory. The scope stores not only the routines for calculating those factors, but calibration instructions as well. With the 1980's internal character generator, these instructions can be presented to the operator step by step on the scope's cathode-ray tube.

The calibration procedure remains manual, but to a much lesser degree than ever before. Following the instructions displayed, the operator slews the front-panel rotary control until the internally or externally supplied calibration signal occupies the designated location on the 1980's screen. A key is touched, the software is informed, and the scope records a data point.

When a sufficient number of points have been entered, the system's 8085 processor calculates the calibration factors for a particular calibration sequence and stores them in nonvolatile random-access memory. After calibration, the RAM can be write-protected by throwing a switch on the rear panel.

An entire calibration procedure usually takes only 25 minutes. Also, as the unit need not be moved physically, it can be calibrated in its working environment and, in systems, left in the rack. In fact, several calibrations can be made for several different operating parameters and stored in a controller for later recall.

Soft effort

Calibrations can be performed as simply as this because the major 1980 subsystems are controlled by digital data placed in latches and analog voltages provided by the 16-channel digital-to-analog converter. Figure 3 shows this arrangement for the channel 1 control section.

Each front panel function, including rotary control, is associated with a set of variables occupying a dedicated location in nonvolatile memory. The values placed in

these locations determine the latch and the d-a converter inputs that control operation of the input circuits.

The calibration procedure establishes a direct correspondence, assumed to be linear, between the three-digit number appearing on the light-emitting-diode display and the actual binary-coded decimal number presented to the converter. The d-a converter requires BCD inputs between 0 and 2,999; the actual voltage output by a converter channel for a particular number depends on the design of the circuit it feeds.

The relationship between the front panel setting and the number presented to the converter, the d-a conversion number, can be expressed as:

$$\text{DAC} = (\text{Front panel setting} \times A) + B$$

where A is a slope and B is the zero intercept of a straight line. If a number of data points equal to the number of unknowns is taken, the equation can be solved explicitly for A and B. This is exactly what the scope's processor does.

In addition to the previously mentioned advantages, this method calibrates the analog functions continuously over their entire range. This results in greater measurement accuracy and resolution than with scopes calibrated only for individual 1-2-5–sequence settings. With the 1980 for example, deflection factors can be changed from 2 millivolts to 10 volts or sweep speeds from 5 nanoseconds to 1 second per division, and each point will still provide a calibrated measurement.

The way in which this is accomplished is illustrated by the process for setting the sensitivity of channel 1 (Fig. 3). The process for setting the sweep is quite similar. As shown in the figure, the attenuator, coupling, and a gain switch (for highest sensitivity) are controlled through latches; d-a converter channels control amplifier gain, position, and balance.

Continuous calibration

Assuming that the desired channel setting is part of a 1980 state previously stored in memory, the channel 1 setup can be accomplished almost automatically. The operator merely presses the recall key, or a recall command can be sent by an HP-IB controller. The scope's processor then takes over, recalling the state information stored for channel 1.

Channel 1 state information is stored as a three-digit sensitivity number that represents a particular variable-parameter setting. Associated with that number is an exponent called the range number. This information, stored in binary form, is displayed in engineering format on the LED above the rotary control.

In setting up channel 1, the processor first takes the range number (-3 in this instance) and, by automatically noting the division ratio of the probe, determines which of the four possible ranges to set up. It does so by setting the gain and attenuator latches.

Next, the processor uses the range number to select the channel 1 balance DAC number, generated by a separate, self-calibration routine that is fully automatic. The range number is also used to call up the calibration factors for the range established during calibration. For the vertical channels, these relate to gain and offset.

As indicated, the calibration factors establish a linear relationship between the front panel setting and the number used to program the d-a converter. Based on a stored algorithm, the processor uses these factors to calculate the DAC number that produces the desired sensitivity for the chosen range. Thus calibration is continuous, applying to any desired sensitivity for any range.

Once all the DAC numbers have been calculated, they are sent to a memory area from which they can be accessed by the d-a converter's refresh controller. This controller will then transfer them serially to the hybrid converter, freeing the processor for other tasks. The converter generates the analog voltages needed to set the vertical preamplifier and gain amplifiers.

The processor also takes the channel 1 state information, reformats it for decoding, and places it in the formatted data buffer. The refresh controller accesses this information as well and sends it to the LED decoder, which is part of the hybrid converter. From there, the data is sent to the display LEDs, allowing the operator to turn off the CRT character generator. The user can also view such settings as intensity or position, which are not displayed on the CRT.

This entire process is performed automatically after a single recall command is issued, since the conditions have been previously defined and stored. If an unstored state is desired, the operator can select a range and sensitivity using the function key and rotary control, or a controller could simply transmit the desired setting through the bus. Information would be entered in the state-information memory location and the processor would treat it as stored information.

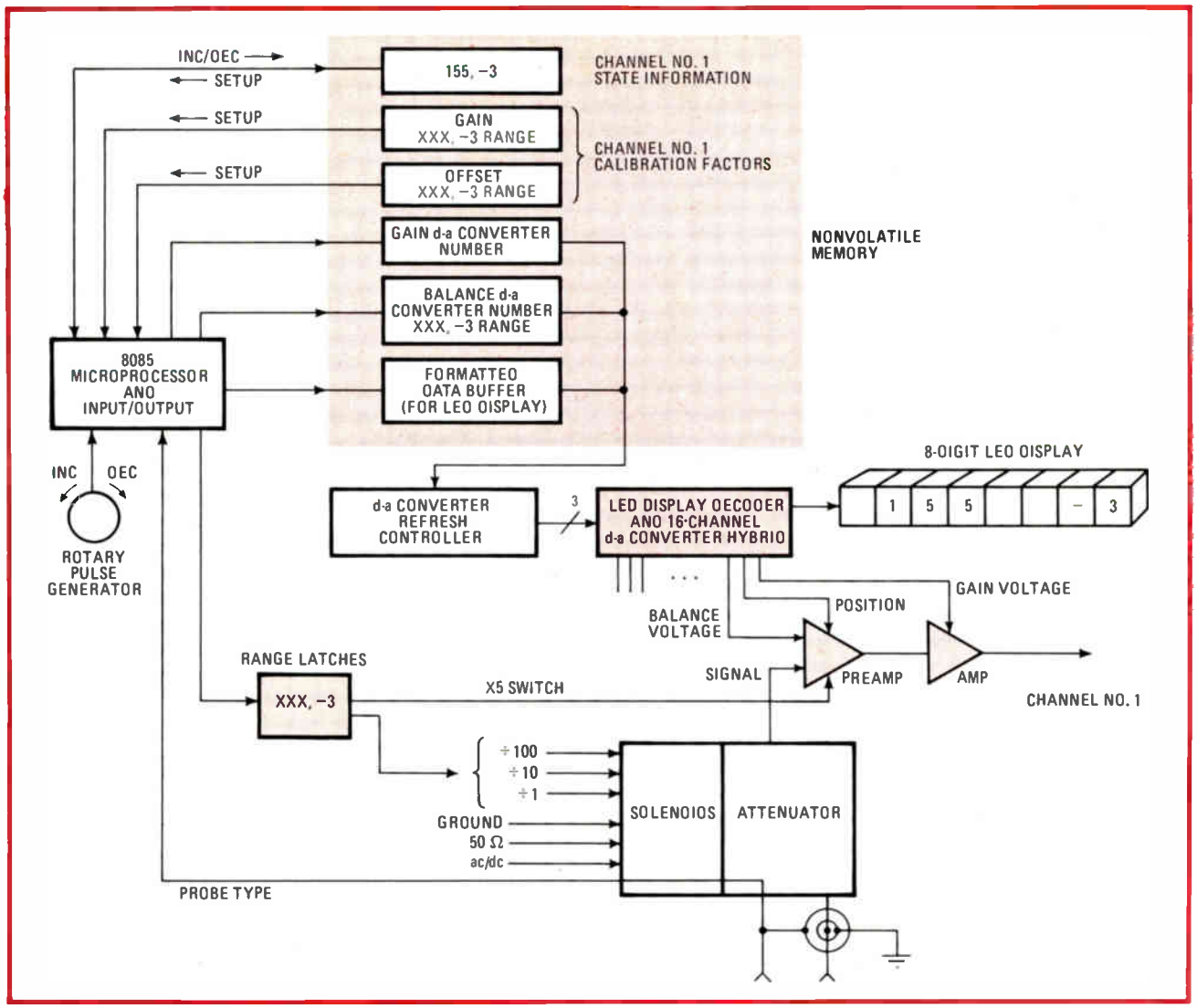
Softly tuned

The variable parameter of a function is adjusted manually with the rotary control, which drives a rotary pulse generator. Tying a single rotary control to whatever function is currently under software control minimizes the confusion created by an array of controls.

The state of a variable parameter, such as sweep or sensitivity, may be changed by the operator to accomplish one of two things—set a specific value without any regard for trace position or set trace position regardless of value. In the 1980, this is accomplished by using the rotary control in either of two modes: coarse or fine. In the coarse mode, emphasis is placed on number setting, while in the fine mode the primary objective is smooth and responsive control of the viewed display. The scope is normally in coarse mode, and the user selects the fine mode by pressing the touch key above the rotary control.

The system processor services the rotary control inputs similarly in both modes. First, it performs a complete setup based on state information for the particular function range. (If no sensitivity conditions have been established for the range, a default sensitivity number is used.) This procedure ensures that the hardware is in a known state and also lets the processor select the calibration factors appropriate to the range.

During setup, the rotary control hardware samples the control knob rotation for a period of 70 ms. After initial setup, the processor checks whether rotary control has been set to a range limit. If it has, and if the knob



3. Memory connection. Nonvolatile memory (top) plays a key role in the 1980, storing setups and calibration factors (here, for channel 1) for processor use. The processor returns to memory digital values with which the d-a converter sets the vertical preamp and amplifier.

position exceeds that limit, the LED display will blink and the state remain at the limit point.

If the control is not at the limit, the processor calls an increment/decrement routine that changes the variable parameter in a manner that depends upon whether the fine or coarse mode has been selected and upon the direction and velocity of the control knob rotation during the routine. The rotary control is sampled again, and if a change is sensed the routine is looped.

If the coarse mode is engaged, the routine uses the impulses generated by turning the rotary control knob to successively step through the coarse-number sequences: 100, 150, 200, 300, and so on by hundreds to 900. A new DAC number is calculated only when rotation is ended.

In the fine mode, the routine bases the successive sweep or sensitivity setting on the preceding setting and the angular velocity of the rotary control.

For slow rotation the step is 1, permitting any number between 100 and 999 to be directly set. For fast rotation, the routine multiplies 10% of the last setting by a velocity factor and adds the result to the last setting.

Thus, if the rotary control accumulates a count of six on a fast rotation, this is equivalent to a velocity factor of 0.2. If the last setting were 100, then the new one would be 102; if it were 900, the new one would be 918. The proportionality helps maintain smooth control of the trace as viewed on the screen.

Auto-Scope

The most significant aspect of these calibration and setup routines is that control of the scope is not accomplished mechanically but through software. This, along with the inclusion of a feedback line, is what enables the 1980 to be the first oscilloscope capable of autoranging—a feature referred to as Auto-Scope.

When the Auto-Scope key is pressed, the scope's processor assumes control of the feedback process—in particular, the determination of the parameter for the trigger flag—to examine the input waveform. Using an internal algorithm, it then attempts to adjust the various range and sensitivity numbers so that the CRT displays a waveform three divisions high by two cycles wide. Nomi-

nal, or default, settings are used if the signal exceeds certain capabilities of the 1980. (For example, the fastest sweep searched in Auto-Scope mode is 10 nanoseconds per division, which means that for signals greater than 20 megahertz, more than two cycles are displayed.)

To understand how the 1980 applies the Auto-Scope algorithm, two basic concepts must first be considered: trigger flag operation and maximum wait times.

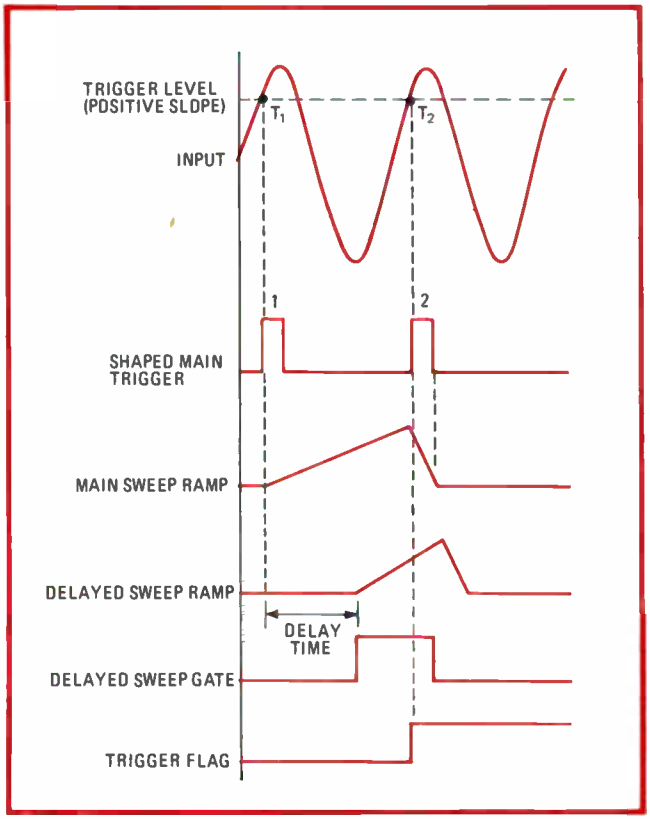
Trigger flag operation is illustrated in Fig. 4. When set for a given trigger level and slope, the 1980's main trigger circuit will produce the shaped trigger waveform for the input signal shown. The first main-trigger pulse starts the main ramp generator, and the programmable delay-time generator.

The 1980 has two ramp generators, the main-ramp generator and the delayed ramp generator. After the delay-time generator counts down the programmed delay, it starts the delayed ramp generator, which drives the delayed sweep gate high. The gate stays high, or open, for a period of time equal to 11 times the sweep setting.

If a second trigger occurs while the delayed sweep gate is open, the trigger flag is set high. This event is relayed via the feedback path to the processor, which is thus informed of the signal's presence.

For the trigger flag to be set, therefore, the input waveform must generate a trigger twice within a given period. If the process is initiated just after a possible trigger, and not just before, as shown in Fig. 4, it will take almost two full cycles of the input before a trigger flag is set. The time it takes to determine whether a flag will be set with a given set of trigger conditions is equal to the maximum wait period.

Based on this process, Auto-Scope works by performing four major sets of events: preset, vertical search, horizontal search, and postconditioning.



4. Flagging the processor. To send a trigger flag to the 1980's 8085, an input signal must first trigger the main sweep ramp, as well as the delayed-sweep ramp after a variable delay time. When this opens the delayed sweep gate, a second trigger can set the flag.

During preset

During preset, the 1980's function and mode values are initialized to a known state, serving three purposes:

- If the operator has inadvertently placed the scope in a state in which viewing the trace would be difficult or impossible, then a reasonable state is restored. For example, a very long delay time might result in a trace not being visible.
- Modes more likely to result in a viewable trace are selected. For example, ac coupling and a nominal trigger-level value are selected for the main-trigger circuit.
- Certain modes are temporarily selected to define the state of the hardware during Auto-Scope operation. These relate specifically to hardware definition.

In the Auto-Scope mode, the delay time is set to zero and the delayed sweep time is set so that the delayed-sweep gate is on for at least 42 ms—the maximum wait time required to detect a 50-hertz signal. The entire sweep cycle may be reset under program control if a trigger flag is detected, or if 42 ms has elapsed. In effect, this setting permits the main-trigger signal to latch the trigger flag. The hardware is designed such that the trigger event that started the main sweep and the delay-time generator will not latch the trigger flag, even though the delay time is set to zero. It takes a second trigger event to cause a trigger flag.

The vertical search is conducted next so that a signal of known amplitude may be be used later, in the horizontal search. This sequencing prevents vertical overload and decreases the effects of noise on the primary signal.

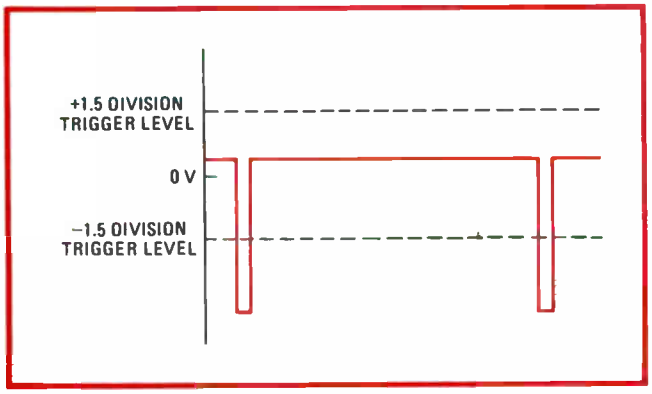
As previously shown in Fig. 3, vertical sensitivity is broken into four ranges with continuous vernier control. A vertical search is performed from range to range beginning with the least-sensitive range in case large-amplitude signals are present.

Vernier control

The vernier is first set to 1:1, which corresponds to 1.00 volt per division on the 1-to-10-V range. The 1980's automatic probe detection system identifies the presence of a 1:1 or 10:1 probe, adjusts the Auto-Scope range, searches, and reads out accordingly.

The main-trigger source is set to the channel being searched. Ac coupling is used as the vertical coupling as well as the trigger-path coupling to maximize the probability of finding a trigger at a fixed trigger level. The trigger level is first set to +1.50 divisions. If a signal large enough to cause a trigger is present, then the search continues on this range.

For sine waves and other 50%-duty-cycle signals, +1.50 divisions would be a sufficient criterion. With ac coupling, however, waveforms with a duty cycle greater than 50%, such as that shown in Fig. 5, would not be detected using this criterion. Here, the largest peaks



5. Setting the trigger. In the Auto-Scope mode, setting the trigger level to +1.5 divisions during vertical search will find the right sensitivity for 50%-duty-cycle signals but not for under-50% signals like the one above. So a second search is done at −1.5 divisions.

occur at a negative rather than a positive trigger level; so the trigger-level sign is changed, and the test is repeated on each range searched.

When a signal is located on a particular range, then a new portion of the algorithm will begin on that range. The input attenuator is now fixed, and the d-a converter slews the amplifier from its highest gain, 1:1, toward its lowest, 1:10. The converter slew can be broken into much finer increments than the range slew can because the settling time of the variable amplifier is very short compared with the input attenuator's.

If the trigger flag is lost, then the displayed amplitude of the signal peak corresponding to the trigger-level polarity is 1.5 divisions. For sine and other 50%-duty-cycle signals, the display is three divisions peak to peak; for signals that approach 0% or 100% duty cycles, it may be as small as 1.5 divisions peak to peak.

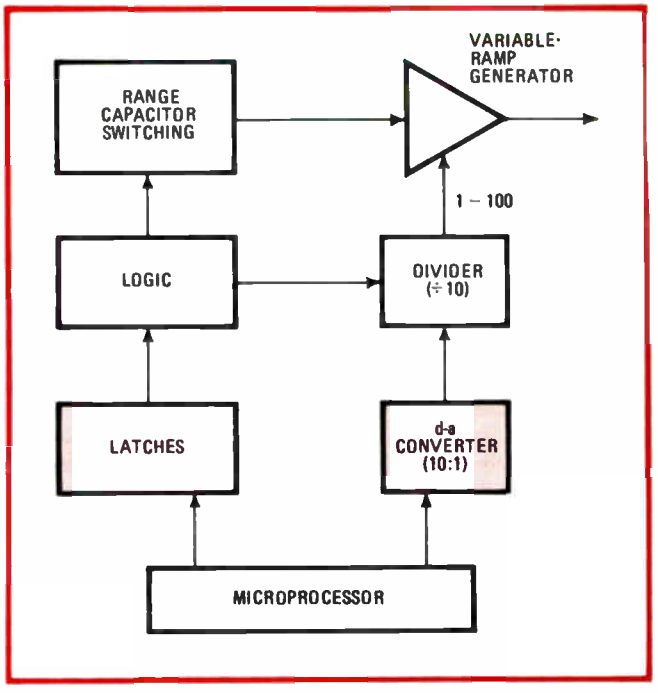
All vertical searching is conducted with a wait time of 42 ms as well, to detect a signal as low as 50 Hz. Since, the trigger flag driver routine returns as soon as a flag is detected, searches proceed rapidly at higher frequencies. When a signal is detected on a channel, a flag is set in memory for later use by the postconditioning algorithm. Also, the sign of the trigger level at which the peak was found is stored for later reference.

Horizontal search

With the vertical search completed on all channels, the algorithm begins setting the sweep speed, based on a channel's input signal. The trigger source is set to the first channel on which a signal was detected, and its level is set at one third of the peak value, with the sign determined by the value previously stored.

Programmable-sweep speed is controlled using the circuit shown in Fig. 6. The sweep is hardware-switched through latch patterns into nine ranges from 5.00 to 9.99 ns/division up to 1.00 to 9.99 seconds per division. A variable-sweep-rate generator controlled by the d-a converter gives vernier capability within each range.

Although the vertical search guarantees capture as low as 50 Hz, signals of much higher frequency could have been successfully detected, since the occurrence of a trigger flag is asynchronous with the search request. Therefore, the horizontal search begins on the fastest



6. Digital sweep. After a horizontal search, the scope's processor looks for the right vertical sweep rate, first setting the range to its fastest time with the latches and capacitor-switching logic (left). All possible range settings are checked by slewing the converter (right).

sweep range and progresses downward in sweep time until a total elapsed time of 42 ms on the sweep has been searched. In this way, higher-frequency signals are detected rapidly, and the scope will already be on the correct final range for that frequency.

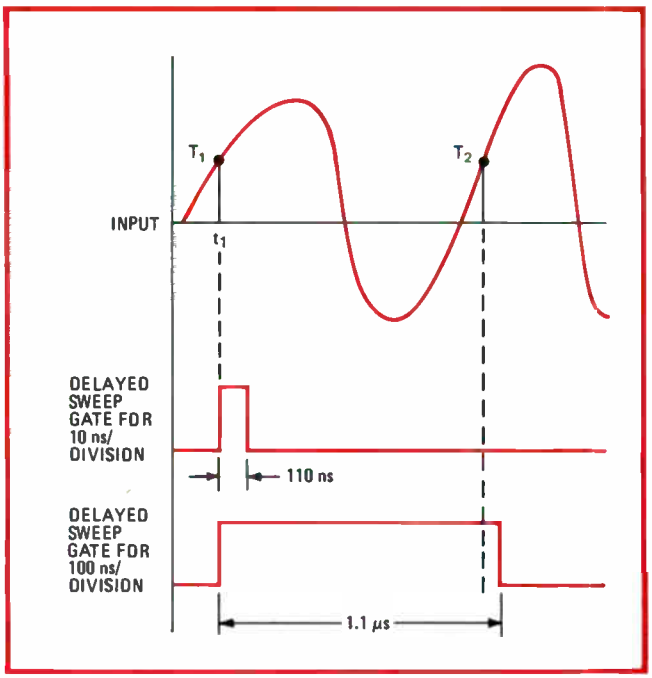
By using the faster sweeps first, there is no need to wait for a trigger flag any longer than twice the interval of the delayed sweep gate for the particular range being searched. As an example, consider the sine wave in Fig. 7. If a search is conducted on the 10.0-to-99.9-ns/div range, the gate is about 110 ns in length. The software automatically passes the maximum necessary wait time to the trigger flag driver so that the search does not wait any longer than 220 ns.

To set the trigger flag, trigger event 2 must occur within the delayed-sweep gate. In this case, it does not, and the search is advanced to the next, 100-to-999-ns/div, range. For this range, the gate would be about 1.1 microseconds in length, once again corresponding to 11 divisions of sweep, and a trigger flag is detected.

The desired sweep speed is therefore between 10.0 and 100 ns/div, so the range is reset to the 10-ns/div range and left there. The DAC is now slewed from 10.0 ns/div toward 99.9 ns/div until a flag is detected again. This slew is rapid, because no capacitor or current switching is involved.

Postconditioning

Using all the information determined from the vertical and horizontal searches, the scope is set up in accordance with the postconditioning phase. The main sweep setting is multiplied by two so that two cycles are displayed. The delayed-sweep speed is set to 10 times main sweep, the delay time is set to zero. The horizontal mode is set to



7. Right rate. To find the right horizontal sweep rate in Auto-Scope mode, the processor first uses the highest sweep range (10 ns/div) to open the delayed sweep gate. If the trigger flag is not set on this range, the next highest is tried.

MAIN.

Vertical channels with detected signals are turned on, others are shut off, and the vertical positions are set according to the channels with signals; if no signals are found, nominal settings are used.

Software links are set up so that expansion modules may also participate when the Auto-Scope key is activated. The function also supplies an alternative Auto-Scope algorithm that preserves important signal-conditioning paths and only sets up the vertical channels engaged. Also, vertical-coupling, trigger-source, and external-trigger levels are preserved. For HP-IB users, several commands allow the programming of custom Auto-Scope algorithms for particular situations.

Expandability

The 1980 accepts two separate hardware options plus seven firmware features. Hardware options add extra measurement hardware while firmware features consist only of read-only memory and use the available hardware to implement features or measurement sets.

As shown in Fig. 8, memory space is allocated for each of these expansion capabilities. Hardware options now include a front panel expansion module, the 1950A two-channel module; a repetitive-waveform storage card will be available in the near future.

Firmware features adapt the 1980 for tailored applications. For example, the 19810A sequence ROM, used in conjunction with the probe, lets the user remotely program a sequence of up to 25 keystrokes associated with each front panel input. The sequence may then be executed by pressing a probe button. Other ROMs might include preprogrammed test sequences that also display step-by-step operator instructions on the CRT.

All hardware options are accessed in a general manner; that is, resident firmware does not refer to an option by name or number. Instead, identification is always contained in the option's ROM. When the option menu key is pressed, the mainframe firmware checks for the existence of each option by checking a key word in memory location. If the option exists, then the option menu is written according to the ASCII string that resides in the option ROM and displayed on the CRT. In addition, during the main program all options and features respond to any rotary control motion.

The feature ROMs are accessed through soft keys. A bank of keys to the left of the CRT, they may be defined through software. Soft-key functions change with operations being performed, and their function is identified on the CRT. These soft keys can also be controlled through the bus.

Because the system directly or indirectly polls all enhancements, and because the enhancements may also contain ROM, the possibilities for future hardware or software expansion are extensive. In addition, because the 1980's architecture is partitioned, there is flexibility for design changes in the system itself if future needs dictate such changes.

Even though the system's software has a large number of built-in features, the imaginative programmer can still tailor the instrument to particular measurement needs through computer control and the HP-IB. In fact, all the 1980's features can be programmed through the HP-IB. Even the front panel settings are directly programmable, a direct result of the software-based design.

The bus in the 1980

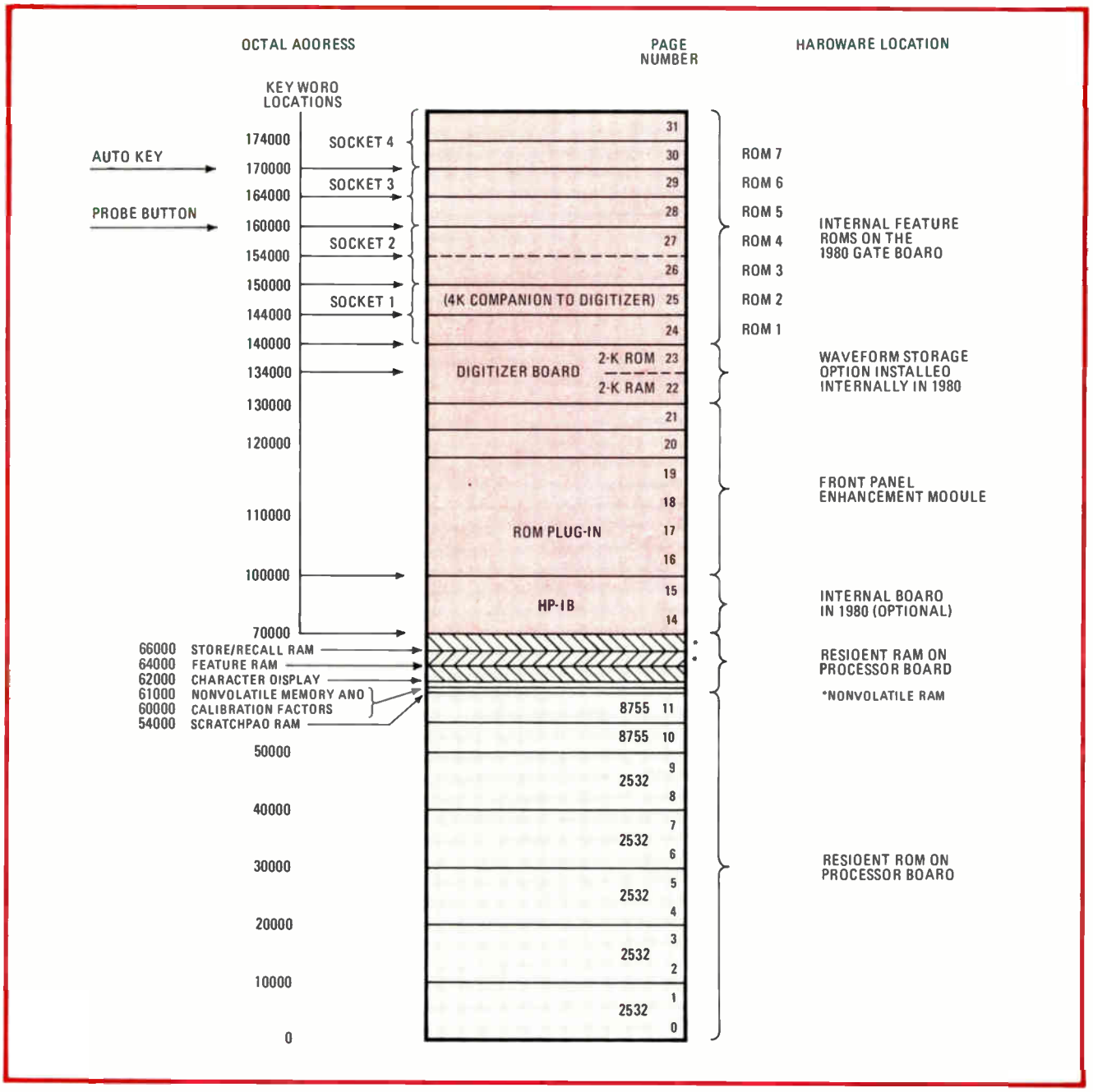
The hardware implementation of the HB-IB in the 1980 is delightfully simple. It employs an Intel 8291 to control handshaking and protocol, two Motorola MC3447 octal bus transceivers for interfacing with the bus itself, a 4K-by-8-bit ROM containing the HP-IB firmware, and a 74LS05 that buffers the interrupt and trigger signals from the 8291. No other ICs are used.

In addition to permitting programming of all front panel settings, this simple interface also makes it possible to:

- Convey all front panel state and setup information to a controller, including deflection factors, sweep speeds, and so on.
- Write text on the CRT in normal or reverse video, with blinking and underline.
- Lock out the front panel execution, informing the controller if a front panel key has been pressed.
- Give the user access to the Auto-Scope software and its signal search capabilities.

With these features, the 1980 can bring a great deal of power to automatic and semiautomatic test systems. For example, a controller program can initialize a test console and then ask the test operator what test is desired by writing a menu on the 1980 CRT. The operator can then choose a test by pressing the appropriate soft key, and the controller will load the appropriate test program.

Most testing might be done automatically, but at some point, the test program might need to know the rise time of a particular signal. By displaying instructions on the



8. ROM for growth. A variety of ROM-based hardware and software options (top) can be added to the 1980. A key word in the first memory location of each ROM identifies the option, whose name is displayed on the scope's screen next to the soft key that lets the operator select it.

CRT, the controller can direct the operator to probe a certain point. Knowing what the waveform should look like, the controller is able to set the 1980 so that the rising edge of interest is displayed.

By assigning the rotary control to delay time and instructing the operator to place the 10%, and then the 90%, point of the rising edge on the center graticula as it reads the delay values from the 1980, the controller can make a semiautomatic rise-time measurement. If the waveform storage option is installed, the controller can instruct the 1980 to store the waveform, transfer the data to its own memory, and subsequently transfer this information to the controller.

A microcomputer-controlled oscilloscope with a 16-channel d-a converter and trigger feedback to the processor offers abundant possibilities for improved measurement features. Some of the routines already developed include automatic balance self-calibration, which on command automatically determines the DAC number required to furnish the offset resulting in zero-trace shift with gain change. To the operator it means elimination of trace shift as sensitivity is varied and front panel interlocks to turn off lamps and lock out keys that have no effect on the trace being viewed, thus reducing operator confusion.

The list includes not only the delta-time and delta-voltage measurements but also measurement capability and user convenience never before available. □

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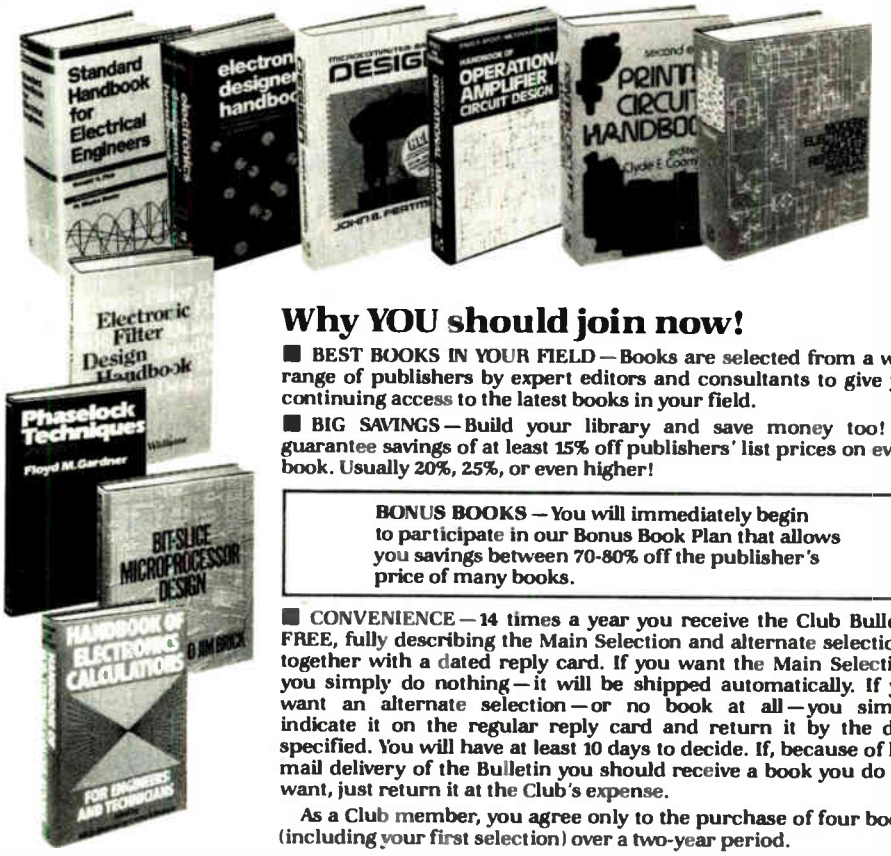

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Adapting a home computer for data acquisition

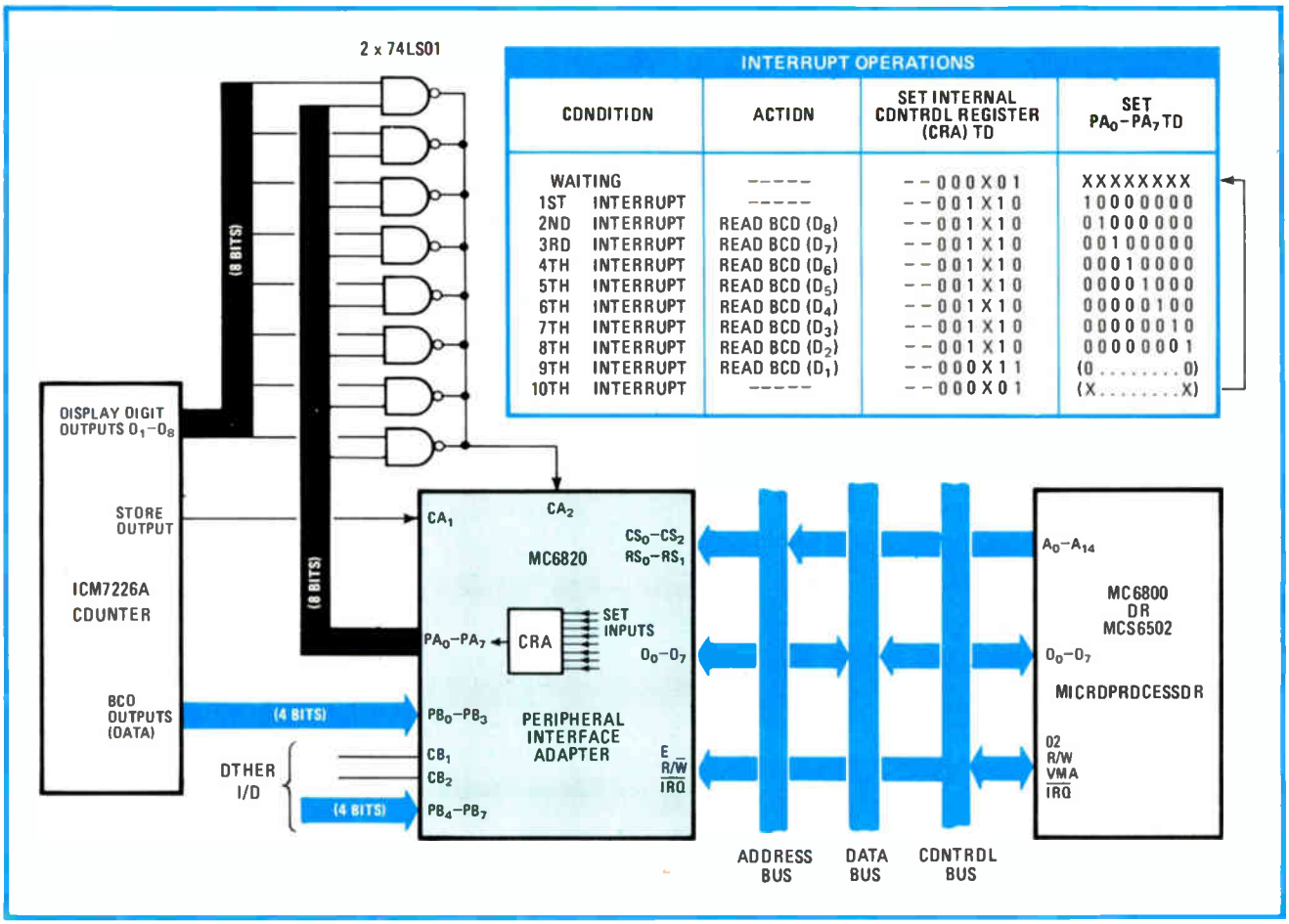
by Peter Bradshaw
Intersil Inc., Cupertino, Calif.

A personal computer, of the kind made by Apple and Atari, can be easily interfaced with an instrumentation module if a machine interrupt is used to overcome their inherent incompatibility—a condition attributable to the different clock speeds at which module and machine run. The interrupt scheme shown here facilitates the transfer of data by exploiting the data-ready signal available on most modules that generate a multiplexed binary-coded decimal output. Thus, the computer can be freed for other tasks, as in any timeshared system.

As an example, consider the arrangement in the figure whereby the Intersil 7226 multipurpose counter is interfaced with the popular MC6800 or MCS6502 microprocessors, which are at the heart of many personal computing systems. After the counter measures a designated interval, its store output moves low, signaling the MC6820 peripheral interface adapter with an interrupt request. This interrupt should be serviced within 100 milliseconds and control register CRA and the ports PA_0–PA_7 set to the required bits (see table).

Thereafter, an interrupt is generated through the PIA's CA_2 port and the 74LS02 open-collector NAND gates each time the multiplexed display-digit outputs of the counter match that of the bits on the PA_0–PA_7 lines. The BCD output data corresponding to each display digit D_1–D_8 is thus successively applied to the PB_0–PB_3 inputs (at a 4-kilohertz rate) and then to the processor.

The second through ninth interrupts should each be typically serviced in less than 244 microseconds. This task can be easily accomplished if proper priority is assigned to the interrupts. Thus the data will be read in



Prompt servicing. Using an interrupt scheme, instrumentation modules and other data-gathering processors with BCD multiplexed outputs can be readily interfaced with home computers such as the Apple and the Atari. Interrupts for reading the data corresponding to each display digit of counter in succession are generated by the microprocessor system itself, which produces a pulse at CA_2 each time the contents of its updated PA_0–PA_7 output register equal that of the scanned display digit outputs D_1–D_8.

less than 4 ms, so there will be no problem with data overruns (200 ms between measurements).

Ideally, the first interrupt should either include a check to ensure that digit D_8 is not high and the input is correct or else be followed by a statement that creates an interrupt when line D_1 is high. In addition, the computer bus will usually require some form of bidirectional buffering to the peripheral interface adapter.

The same system can be used with any processor in the MC6800 series; with other processors, a more complex interrupt-handling scheme is required. □

Engineer's notebook is a regular feature in *Electronics*. We invite readers to submit original design shortcuts, calculation aids, measurement and test techniques, and other ideas for saving engineering time or cost. We'll pay $75 for each item published.

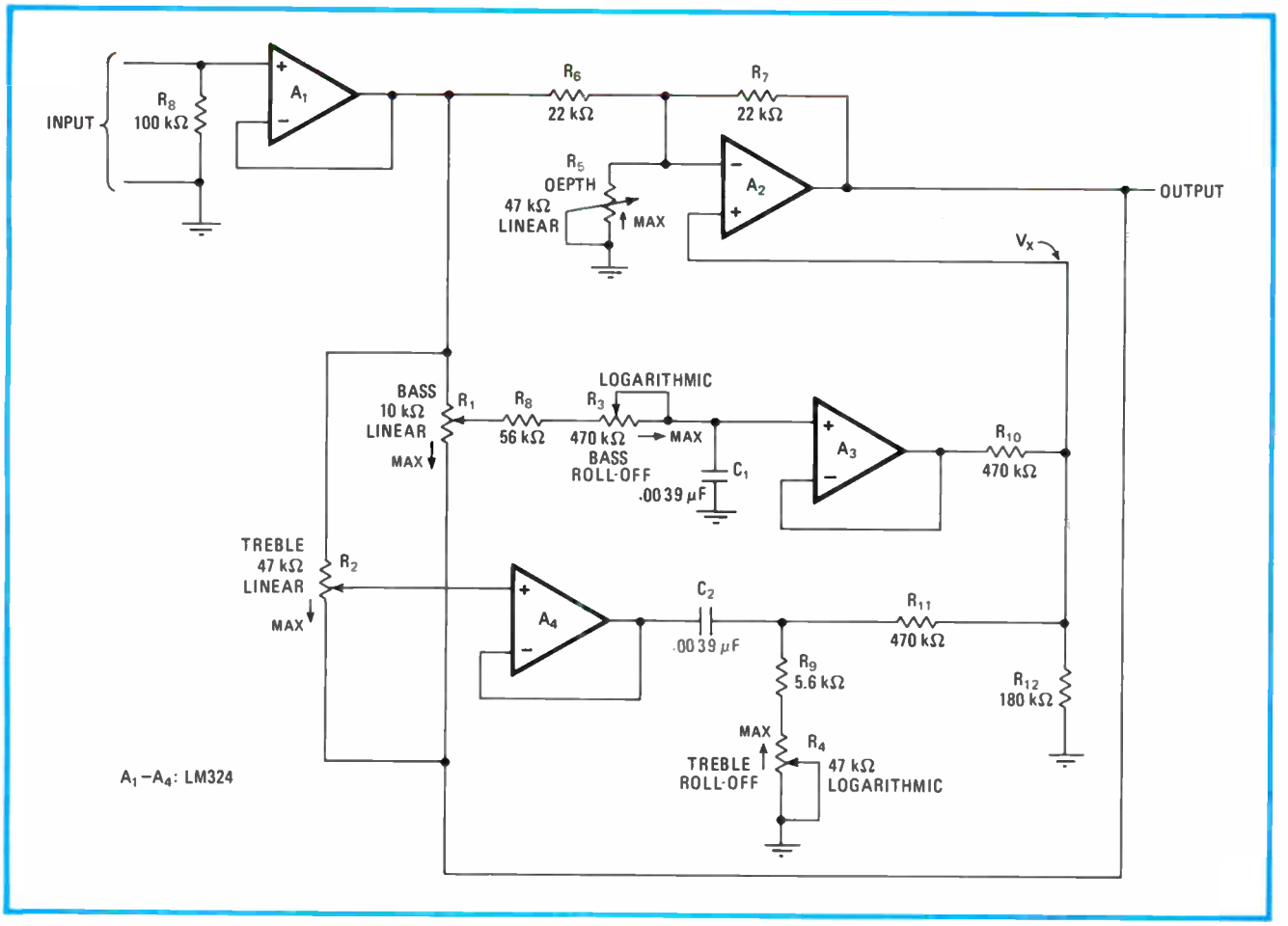
Parametric equalizer improves Baxandall tone control

by Henrique Sarmento Malvar
Department of Electrical Engineering, University of Brazilia, Brazil

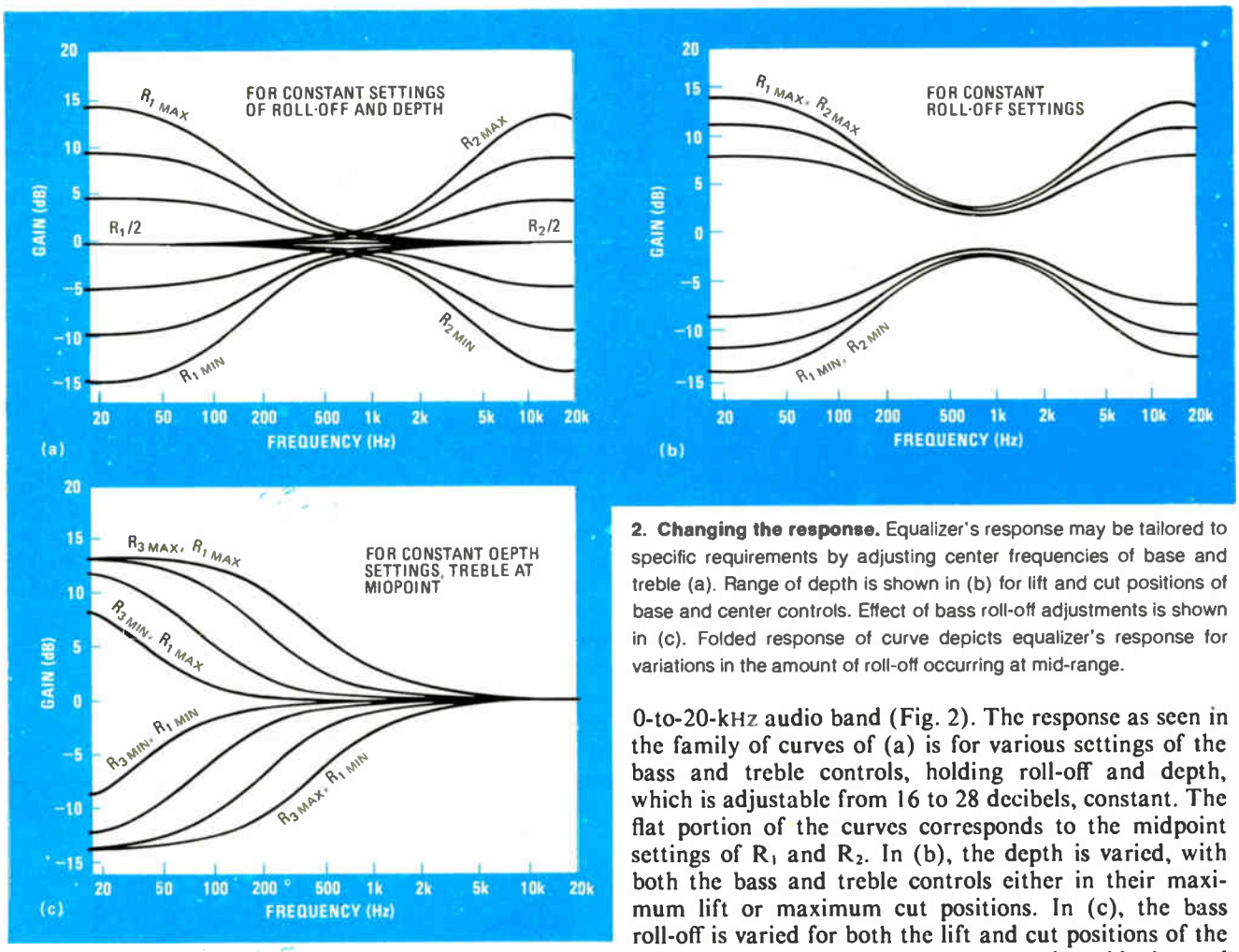
Simple active filters are used here to build a continuously adjustable parametric equalizer having the same general response as the popular Baxandall circuit, which utilizes a switch-selectable scheme for bass and treble equalization. Center frequencies for both upper and lower bands, as well as their individual roll-off characteristics, may be independently controlled, and the depth of the equalization is also adjustable.

The circuit (see Fig. 1), an adaptation of an idea proposed by Thomas,[1] utilizes positive feedback and/or feed-forward principles to achieve the type and amount of equalization required. Five potentiometers set the aforementioned parameters, with the circuit operating on all simultaneously.

The center of the low-frequency passband is set by R_1. If the wiper of the bass control is moved towards the input operational amplifier, A_1, more of the low-frequency components of the input signal will pass through low-pass filter $C_1R_3R_8$ and appear at V_x, with potentiometer R_3 determining the roll-off. Because op amp A_2 inverts the signal, partial cancelation of the low-frequency components occurs and the total bass content is reduced at the output. As R_1 is moved in the opposite direction, a positive feedback loop around op amps A_2 and A_3 is formed, and the bass gain increases. In similar



1. Trimming timbre. One-chip equalizer provides continuously variable control of bass and treble center frequencies, as well as individual roll-off characteristics. Depth of audio-band equalization is also adjustable. Unit costs little more than standard switch-selectable devices.



2. Changing the response. Equalizer's response may be tailored to specific requirements by adjusting center frequencies of base and treble (a). Range of depth is shown in (b) for lift and cut positions of base and center controls. Effect of bass roll-off adjustments is shown in (c). Folded response of curve depicts equalizer's response for variations in the amount of roll-off occurring at mid-range.

fashion, the center of the high-frequency passband may be set by R_2, buffer amp A_4, and filter $C_2R_4R_9$. In either case, trimming potentiometer R_5 controls the amount of negative feedback to op amp A_2, thereby setting the depth of response.

The performance of the circuit can be seen from measured curves taken by an X-Y plotter over the 0-to-20-kHz audio band (Fig. 2). The response as seen in the family of curves of (a) is for various settings of the bass and treble controls, holding roll-off and depth, which is adjustable from 16 to 28 decibels, constant. The flat portion of the curves corresponds to the midpoint settings of R_1 and R_2. In (b), the depth is varied, with both the bass and treble controls either in their maximum lift or maximum cut positions. In (c), the bass roll-off is varied for both the lift and cut positions of the bass control, with the treble control at its midpoint and the depth control held constant. These curves, if folded back on themselves, would depict the equalizer's response for a variable mid-range roll-off, for various lift and cut settings of the treble control, with the bass control at its midpoint and the depth held constant. □

References

1. M. Thomas, "Tunable audio equalizer," Wireless World, September 1978, pp. 58–63.

Processor's refresh facilities double as interval timer

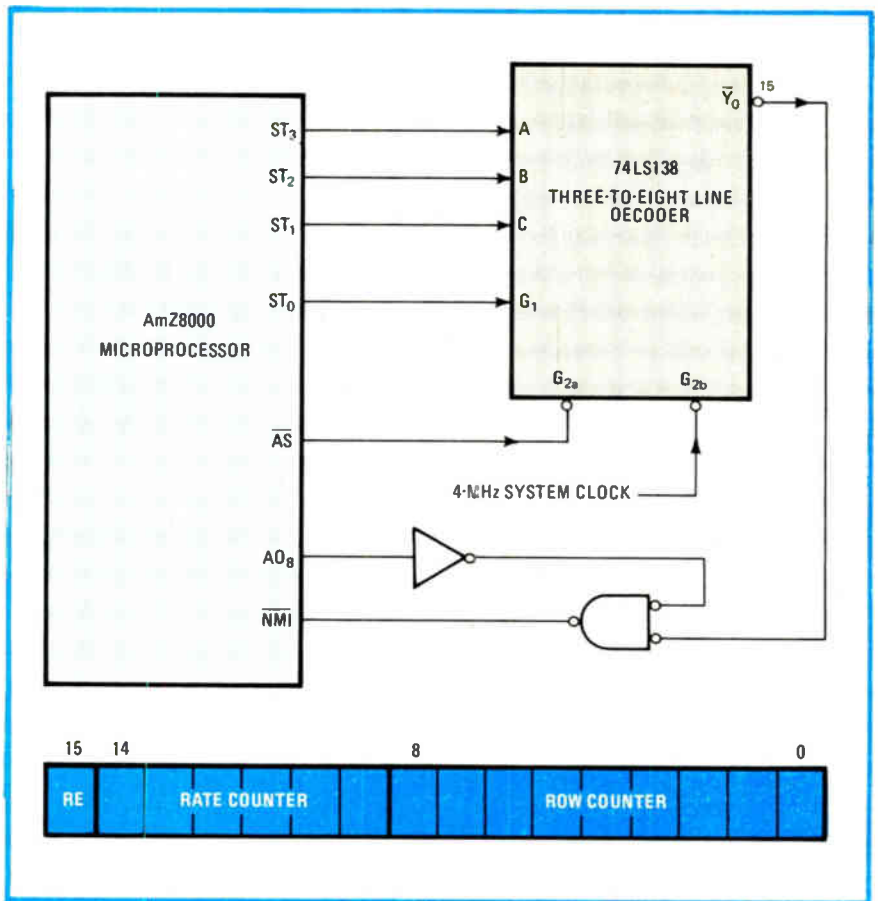
by Steven Dines

Advanced Micro Devices Inc., Sunnyvale, Calif.

In the typical microprocessor-based system, circuitry needed to generate interrupts and the refresh signals required to hold the contents of dynamic memories are implemented with extensive logic external to the central processing unit. Microprocessors such as the AmZ8000, however, have on-chip facilities to satisfy the dynamic memory refresh requirements. With little software and minimal hardware (a line decoder and two gates), these facilities can also serve as an interval timer.

As seen, the processor's refresh function is controlled by a hardware refresh register. The register has three fields: a refresh-enable bit (RE), a rate counter, and a row counter. Under program control, refresh is enabled by writing a logic 1 into the RE position and disabled by writing in a logic 0. The rate counter is initialized to set the desired refresh cycle time between 1 and 64 microseconds. When the cycle is exhausted, the central processing unit inserts a new refresh cycle into its program sequence, refreshing the row of memory determined by its stepping row counter value. The row counter is then incremented by two, and the CPU begins the next timing interval.

The refresh cycle is functionally similar to a memory-read cycle, so to ensure that the circuit can differentiate between them, the status output lines of the processor,



LABEL	STATEMENT	COMMENTS
INVAL:	LOM REGSAV, R0, 16	; SAVE CPU REGISTERS
	CLR R0	; SET R_0 TO ZERO
	LOCTL REFRESH, R0	; DISABLE REFRESH
	CALL SCHED	; PERFORM ANY HOUSEKEEPING
	LD R0, INTPAR	; LOAD INTERVAL PARAMETERS INTO R_0
	LOCTL REFRESH, R0	; REINITIALIZE REFRESH REGISTER
	LOM R0, REGSAV, 16	; RELOAD USER REGISTERS
	IRET	; RETURN TO USER

Internal interrupts. Software-based interval timer for refreshing dynamic memories, made possible by such versatile processors as the AmZ8000, has adjustable refresh-cycle and interval times. Only minimal hardware—a three-to-eight-line decoder and two gates for counting the number of refresh cycles per interval—is required.

ST_0–ST_3, are set to LLLH during refresh. This output is decoded using the 74LS138 three-to-eight line decoder. Lines ST_1–ST_3 drive the decoder's select lines, A–C, and ST_0 drives the active-high enable input. The two active-low enable inputs are driven from the system clock and the address strobe, $\overline{AS}$, which goes low during each refresh cycle. When the rate counter times out, the address strobe moves low and the address of the row counter is placed on the address lines.

Thus, during a refresh cycle, the decoder's $\overline{Y}_0$ output will be driven low, synchronous with the $\overline{AS}$ and the system clock. This output is then fed to an active-low AND gate, along with the inverted AD_8 line, which only moves low when the row counter reaches a count of 128. Therefore the AND gate's output will go high only after the rate counter has timed out 128 times, assuming the refresh counter is initialized to zero.

Because the counter can be initialized to virtually any value, the refresh-interval time (which is the time between refresh cycles) is adjustable from 1 microsecond to 8.194 milliseconds. The refresh-interval time is given by $T_0(128 - C_0)$, where T_0 is the time-out interval of the rate counter and C_0 is the initial value of the refresh counter.

The output from the AND gate, which indicates the end of the timing interval, is then introduced to the nonmaskable interrupt ($\overline{NMI}$) of the CPU. The CPU then enters the service routine, writing a 0 into bit 15 of the refresh register to disable the refresh operation so that it itself cannot be interrupted. Before returning control to the CPU, it reinitializes the refresh-row counter to the desired value and reenables refresh. This starts the timing of the next interval, at the end of which the CPU will be again interrupted. □

Engineer's newsletter

Digital calculator can have analog uses

To retrofit calculators with an analog capability, Ben Johnson of Kaltek Calculator Technology has built a $14.62 module that works with both fixed and programmable machines. The RC-111 module requires only a few additional parts to make four connections to the calculator—two for the power supply (which can be anything from 3 to 15 volts) and two across the constant-add key. The engineer who wants to use the module for **measuring resistance, capacitance, light intensity,** and the like even gets an application note for his money. Johnson has applied his invention to such diverse applications as photocurrent and thermistor measurements. Write to him at Box 7462, Rochester, N. Y. 14615, for further information on the RC-111.

Where to find ideas for improving computer manuals

The inadequacies of software and other computer documentation is a common complaint. Not only is there too little of it, but what is available is also often poor in quality. To improve matters, the Society for Technical Communication has devoted one issue (Vol. 27, No. 1) of its journal, "Technical Communication," to the writing and presentation of computer manuals. Short, magazine-style articles discuss **how to plan software manuals and prepare graphics for them,** how to write and edit computer manuals, and how to make both more useful, as well as many other topics. Write to the society at 815 15th St., N. W., Washington, D. C. 20005, or call (202) 737-0035.

Applying Zilog chips in networks

In the microprocessor-dominated world of distributed processing, the Zilog family of chip processors and associated components has carved out a distinctive niche for itself. To encourage still wider use of its products, the company is offering designers through July of this year 10 technical courses covering component families, development and general systems, and data communications. Some of the courses will be held in Cupertino, Calif., but others will be conducted by correspondence.

For instance, there is **a five-part home-study seminar for the advanced engineer that deals with the Z8000 architecture** and instruction set, memory management, and peripheral interfacing. Other course topics include the Z80, Z8, PLZ programming (Zilog's own Pascal-like language), and the components of Zilog's Z-Net local network. For more details, call Kathy Trappen at (408) 446-4666, ext. 5586, or write to her at 10340 Bubb Rd., Cupertino, Calif. 95014.

IEC standardizes n-port network terminology

"Letter symbols for telecommunications and electronics," the latest International Electrotechnical Commission standard, is of fundamental importance to the international telecommunications community because despite its very general title it applies specifically to linear n-port networks—**the basic building blocks of all telecommunications systems.** The document, the second supplement to IEC publication 27-2, discusses impedance matrixes; transfer and open-circuit impedances; admittance, transfer, and scattering matrixes; and reflection factors at network ports.

Approved by 43 countries, Publication 27-2B is available for 10 Swiss francs from the Information Officer, IEC, 1 Rue de Varembé, 1211 Geneva 20, Switzerland.

-Harvey J. Hindin

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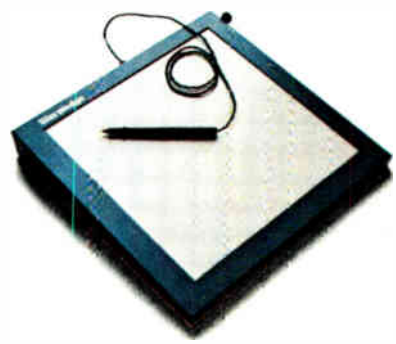

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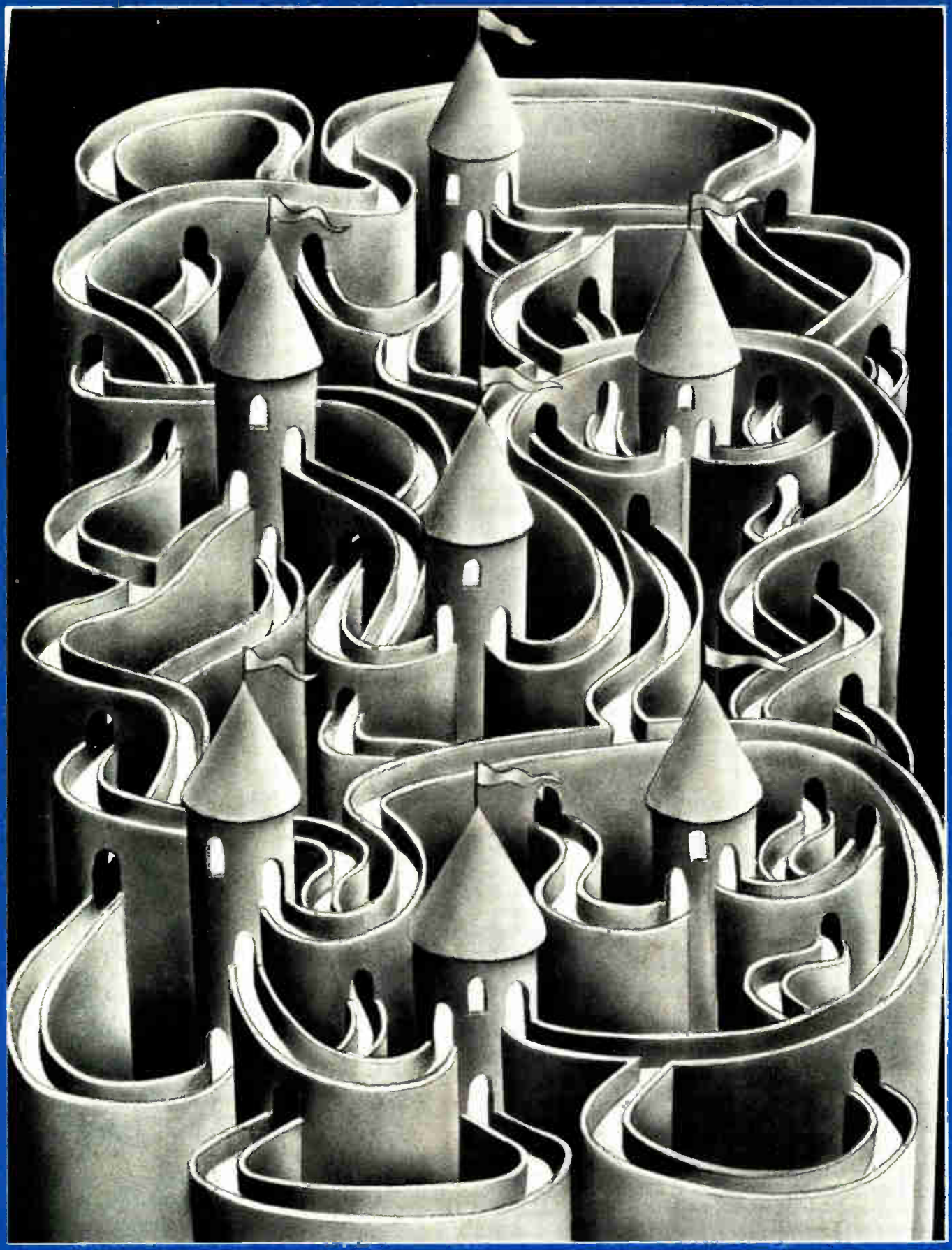

Test #1 You are a guard in this maze fortress and have the duty of visiting all seven towers starting with the middle tower. You may leave the tower by either doorway and return through the other. If you visit all seven towers only once, never using the same path twice, what is the only course you can take?

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Some major differences between a GenRad system and all others.

At GenRad we genuinely believe our systems can test your printed circuit boards more efficiently than any other system. The reason? A GenRad system is significantly different from other systems.

Take software, for example. We made sure ours was well defined and well integrated with the hardware from day one. And we continue to update it. (Nine major enhancements in as many years, actually). The result? Systems we sold nine years ago are still testing today's board designs. Can anybody else say that?

Another key difference is programming support. We have 8 Regional System Centers worldwide, where you'll find as many as 10 complete GenRad test systems in operation—with 20 or more of our people ready to develop test programs for you. No one else can provide you with programming support like that.

And consider our credentials. GenRad has been a leader in testing for 65 years. And our sales are now over $150 million. But perhaps the best testimony to our commitment to our customers is the fact that we have more board testers in use worldwide than anybody else.

Some specific product differences to get you moving in the right direction.

GenRad makes both functional and in-circuit testers. A lot of our customers use both advantageously. No matter which you choose, what's important is how long it takes to do a test program. And how much help the system gives you automatically.

The advantages of a GenRad functional system.

When it comes to functional testers our systems give you plenty of help. A good-sized library of functionally modelled IC's, for example, can save a lot of time in developing a test program. We just happen to have the largest library in the business. Over 2000 SSI and MSI devices and over 100 LSI devices.

Also an accurate simulator can keep you from going down a lot of blind alleys while working on a test program. So does the ability to prepare programs incrementally and do nodal verification. You'll find all of these things on a GenRad functional tester. But not on anybody else's.

The GenRad 1795 Functional Test System

The GenRad 2270 In-Circuit Test System

When it comes to troubleshooting, isolating faults directly to a single IC can be a tremendous timesaver. Our special beyond-the-node software linked to a diagnostic resolution module lets you do just that.

The advantages of a GenRad in-circuit system.

You want pretty much the same things in an in-circuit system that you want from a functional system—simple program prep and comprehensive diagnostics to maximize throughput. Look for a test system that does more than dump out a rough first pass of a test program.

Look for one with software so automatic you get a program that's almost ready to run as is.

In that regard, you're going to be interested in these exclusive GenRad features: Automatic Bus Disable which frees the programmer from having to manually write a lot of extra tests in order to isolate the IC under test from the effects of other ICs on the bus; feedback squelch to automatically deal with troublesome spikes; and memory behind each pin to allow patterns to be applied and sensed in parallel. Go ahead and check out other systems, but you won't find these exclusive features on any of them.

One final thing to keep in mind. If you're going to design with two kinds of logic (and who isn't today?) your tester ought to be capable of testing two logic families simultaneously, right? Both our in-circuit and functional testers can.

The logical conclusion. And an offer that's hard to pass up.

If you've followed us this far, it ought to be pretty clear whose system can do the best job of testing your printed circuits. Now how about a wall-size version of our labyrinth to show the world your mental circuits check out okay, too? We'll send you a giant poster if you drop us a note on your letterhead. And, by the way, if you'd like to know more about a GenRad System, the best course of action is to call us.
How about right now?

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Circle 262 on reader service card

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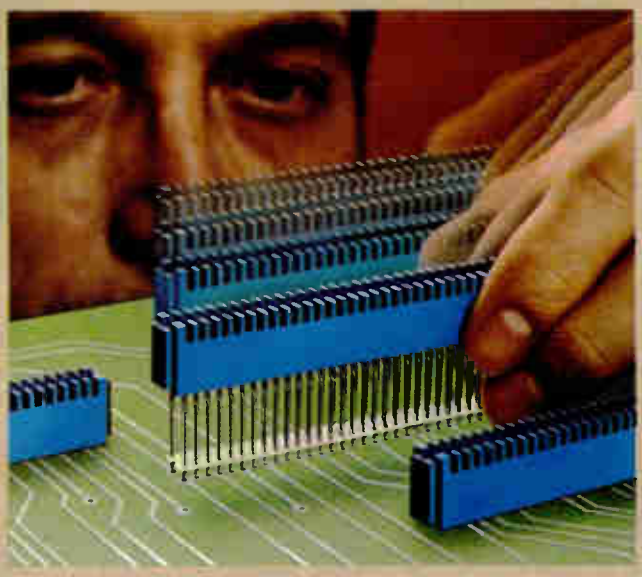


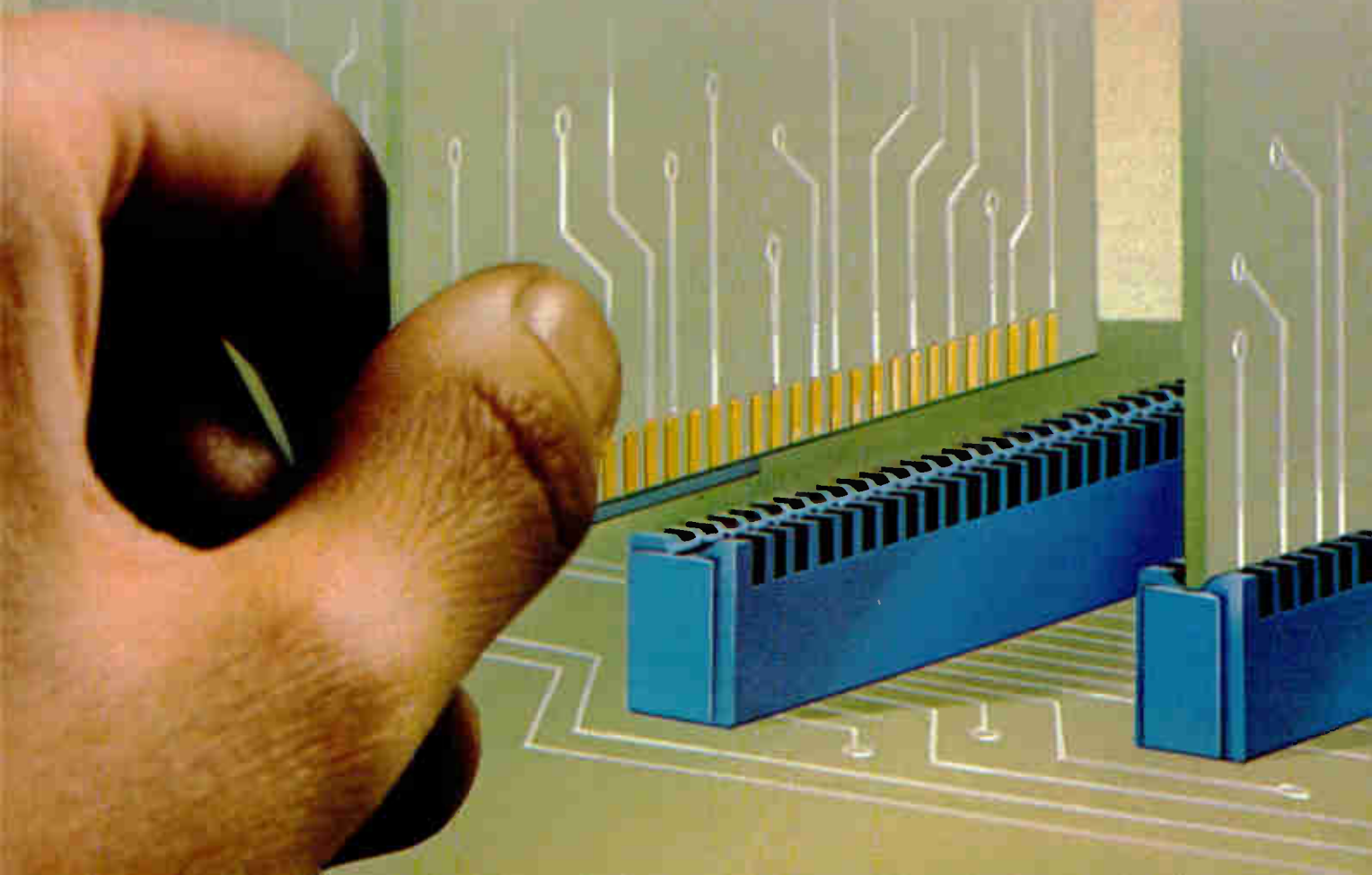
Preassembled to cut backplane production time. Designed for mother board insertion without damage to plated-through holes.

The one-step AMP PACE Connector does a lot to make your production simpler—and free from worry.

Using our unique ACTION PIN contact compliant design, just press the connector into place. Assembly is complete. There's no solder or costly, time-wasting rejects.

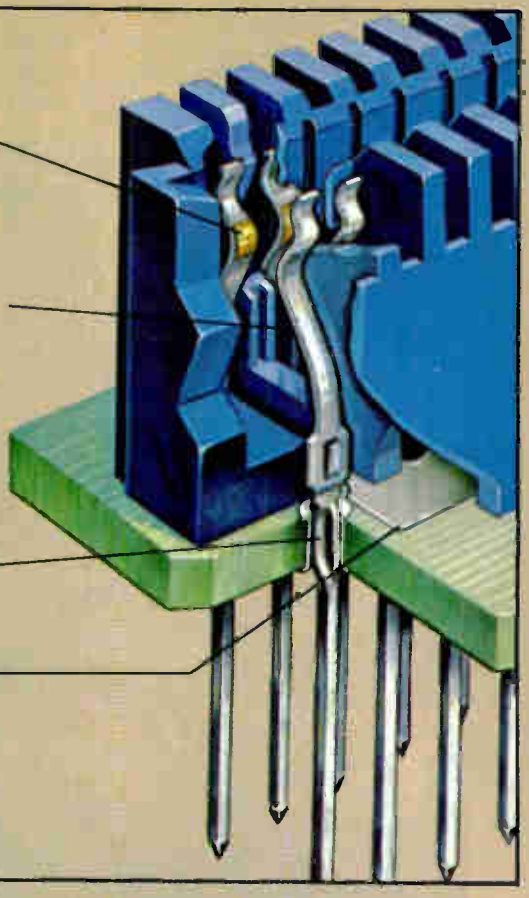
Even our Accu-plate precision plating avoids waste. By pinpointing gold only on the final contact area and using nickel and tin elsewhere, you don't pay for what you don't need.

The AMP PACE Connector. It's good enough to forget.



AMP Facts

Description: preassembled card edge connectors for .100" x .100", .100" x .200", and .125" x .250" centerlines; size 15 to 61, dual position.
Contact Rating: 3 Amp
Contact Resistance: Spring contact to test board—8 milliohms
Total circuit resistance—9 milliohms
Operating Temperature: −55°C to +85°C
Voltage Rating (Sea Level): .100" centerline spacing—1000 VAC
Insulation Resistance: 5,000 Megohms
Durability: 100 cycles
Salt Spray: MIL-STD-1344, Method 1001
Thermal Shock: MIL-STD-1344, Method 1003
Physical Shock: MIL-STD-1344, Method 2004
Humidity: MIL-STD-1344, Method 1002, Type II
Vibration: MIL-STD-1344, Method 2005



For more information, call the AMP PACE Connector Desk at (717) 780-8400.
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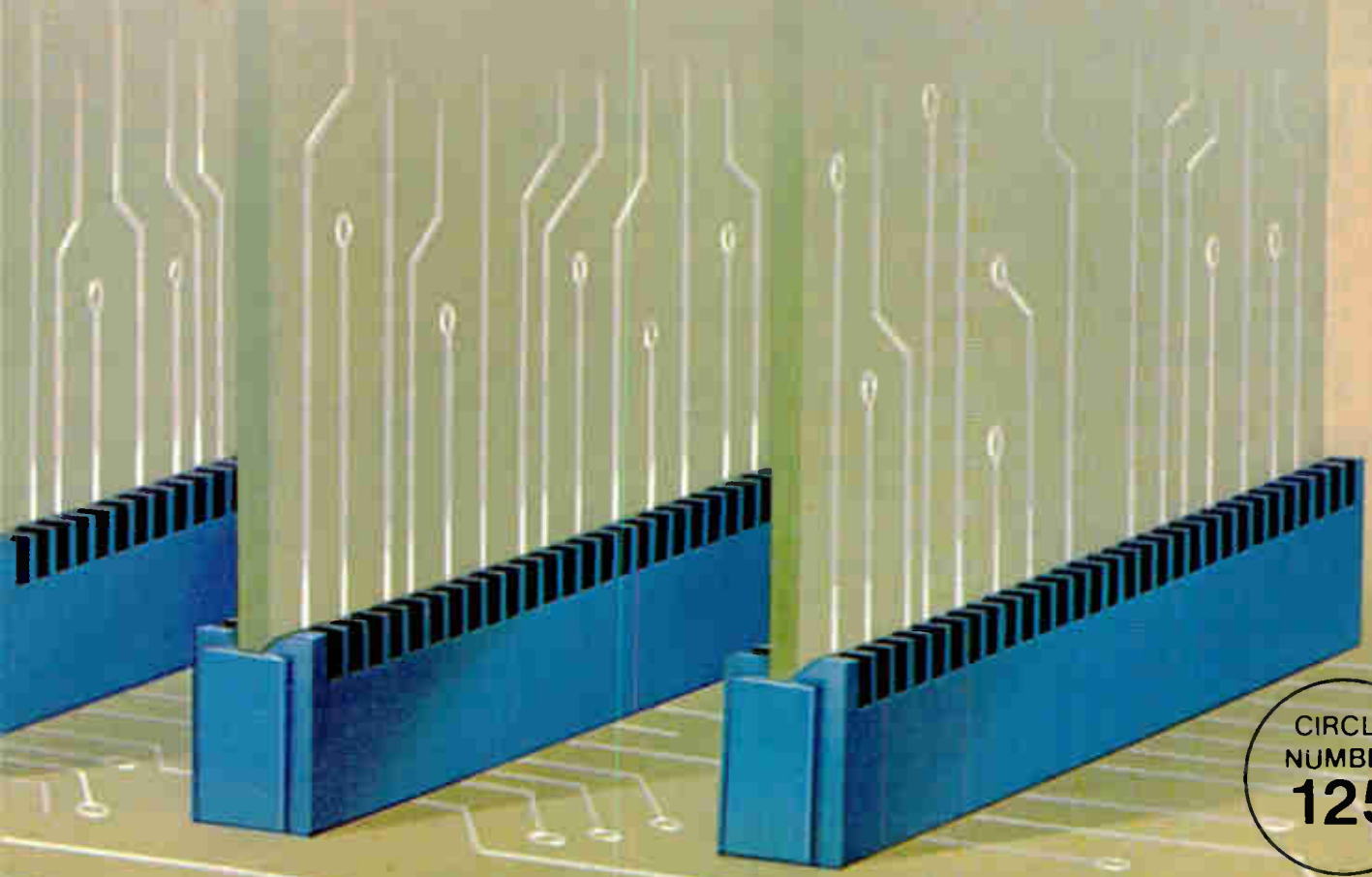

CIRCLE NUMBER 125

Intel–soaring aloft with the M2732 EPROM.

Introducing the M2732 EPROM. Now available for VLSI military microcomputer designs that soar above the rest.

For military and hi-rel systems, Intel's new 32K EPROM is ready to take off today. Built in full compliance with the Class B requirements of MIL-STD-883B, Methods 5004 and 5005, the M2732 is the newest member of Intel's growing family of military VLSI products. And it's available in volume now.

For applications ranging from shipboard and ground communication systems to avionics and missile control, the M2732 offers distinct advantages. It's not only the highest density military EPROM available, it's also designed to maximize the performance of today's advanced 16-bit microprocessors, like the M8086. Plus its pinout provides the natural upgrade path from 32K to 64K, 128K and even 256K-bit parts.

An EPROM to match your microprocessor

To get all the high-flying performance possible out of today's military microprocessor-based systems, it takes memory components with features as advanced as the M2732.

Features like high speed and low power. With an access time of 450 ns, the M2732 is fast enough to operate with the M8086 or M8085A. And its automatic power-down capability cuts average power dissipation by 60-80%.

The M2732 also features superior control capabilities. Its 2-line control structure eliminates bus contention—an important consideration in today's multiplexed-bus microprocessors.

Plus the M2732's reliability is unsurpassed. Like our M2716 EPROM, the M2732 undergoes tougher-than-military quality control tests to insure they'll retain their programs for years to come. With Intel's decade of EPROM experience, it's no wonder we've shipped more military EPROMs to more military programs than any other supplier.

A JEDEC-approved pinout to set your sites on today

Right now you can start planning for future memory upgrades, by designing in the M2732. Its pinout conforms to the JEDEC-approved Standard for Byte-Wide Memories, from 16K through 256K bits. So you'll be able to upgrade easily from an M2732, without changing your design or board layout. And because of this compatibility, the M2732—like the industry standard M2716—will be available from second source suppliers.

Intel's military VLSI strike force

Our advancing line of military VLSI products—like the new M2732—reflects our strong commitment to military customers: namely, to continue to deliver the broadest line of VLSI devices possible to military systems designers. From devices like the M8086, M8085A, and M8048, to military EPROMs, bipolar PROMs, static and dynamic RAMs, and microprocessor peripherals.

We've shipped hundreds of thousands of these high-performance VLSI devices to vital military programs over the past four years. And we'll continue this commitment for years to come. Not only in components, but in support, such as our advanced development tools, including the Intellec® system and ICE™ in-circuit emulation modules.

So the next time you're on the lookout for state-of-the-art military VLSI devices, look to the leader—Intel. For further information on military products, or a copy of our 1981 *Military Products Data Catalog*, contact your local Intel sales office/distributor. Or contact Intel Corporation, 3065 Bowers Avenue, Santa Clara, CA 95051. Telephone (408) 987-8080.

Circle 201 on reader service card

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24-bit machine is fast without cache

48-bit memory words, high-speed backplane, efficient page swapping give big minicomputer a price-performance edge

by James B. Brinton, Boston bureau manager

The model 300 from Harris Corp.'s Computer Systems division "is 18% to 30% faster on Whetstone benchmarks than the VAX-11/750," claims Benjamin L. Harrison, director of product marketing at the division. "Even more to the point," he adds, "it costs as much as 10% less than the 11/750 in equivalent configurations."

The machine is the latest in the division's line of 24-/48-bit superminicomputers, as it dubs them. Priced at less than $100,000 in its least complex configuration, the 12-megabyte virtual-memory model 300 will be vigorously sold against Digital Equipment Corp.'s VAX product line. "The 300's price-performance ratio puts it right between the 11/750 and 11/780," says Harrison.

The feature that will likely strike most customers first is the 300's 24-bit central-processing-unit word length (memory word length is 48 bits). Sixteen-bit and 32-bit machines are much commoner. But Harrison says the choice is justified: "You don't need 32- or 64-bit precision for business functions and rarely in the scientific or engineering markets Harris has traditionally served. In all these areas, 24 bits usually is more than enough precision and generally offers large enough address space. And where higher precision is needed, our machine allows us 48-bit double precision with only a 6% penalty in execution time versus single precision. That's hardly any penalty at all compared with most 32-bit machines." Harrison also feels the 24-bit format is particularly well suited to graphics applications.

The 300 is organized for speed. Its backplane runs at 19 megabytes per second; by contrast, that of the 11/750 runs at about 5, and that of the 11/780 at just over 13 megabytes/s. And the 300's MOS main memory reads and writes 48-bit words, cycles in 400 ns, and has a 290-ns access time.

In addition, the 300's bus structure has 48 parallel lines for data and another 20 for addressing. In main memory cycles, the system simultaneously transfers 24- or 48-bit data words, a 20-bit address, and, where appropriate, error-correcting codes as well—all in a single cycle. The maximum size of physical main memory is 2 megabytes. The machine's microprogrammed central processor cycles in 300 ns, and for more speed, instruction fetching is overlapped with execution.

Steps have been taken to limit unnecessary, time-consuming page swapping in the virtual memory system. The 300's operating system includes an algorithm that displaces pages in main memory, primarily on the basis of individual priority of a job associated with a given page or of the page itself and secondarily on its frequency of use. Thus, the least frequently used, lowest-priority pages are written over first, making memory management about as efficient as is possible without resorting to a cache organization.

Bigger page. According to Harris sources, the 300's main memory is actually faster than the caches of some competing units. The Harris system of page swapping is more efficient than the first-in, first-out paging approach used by some competitors. Also, at 3-K bytes, page size on all Harris machines is large compared with that of competing systems and makes fewer page transfers necessary in the first place.

The smallest 300 comes with an 80-megabyte Winchester disk drive,

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streaming-tape backup, 192-K bytes of error-checking and -correcting memory, and an operator's cathode-ray-tube console. The price for this configuration is just under $100,000 and includes Harris's Vulcan 9.A operating system, which makes the 300 compatible with Harris' larger and smaller machines.

Though compatible with other Harris operating systems, version 9.A is more oriented toward communications. This makes the 300 a candidate for the job of a smart satellite computer connected to a larger machine like Harris' 48-bit 800—a system about equivalent to an IBM 3033. The 300 also could act as a host, using Harris 80s and 100s as satellites. And in complex network applications, the 300 can serve in both roles simultaneously.

The 300 can handle up to 48 user terminals simultaneously and interactively; it was designed to support concurrently users performing interactive program development, time-sharing, multistream batch processing, multiple remote job entry, and real-time processing. Because its operating system is reentrant, one copy serves all users, and compiler-generated code can be made reentrant as well.

The 300 will come with a full suit of software. Languages available already include Fortran, Basic, Cobol, APL, RPG II, Snobol, Forgo, and Pascal; C is forthcoming. There are 18 applications-support packages available, with more being added.

Optional power. For more speed, the 300 is available with a hardware floating-point processor, operating concurrently with and independently of the CPU. It also uses the 48-bit-wide memory bus and, in double-precision operations, employs an 8-bit signed exponent and a 39-bit mantissa to reach more than 11 decimal digits of resolution.

For greatest speed, there is optional shared memory. This eases interfacing with outboard array processors for all-out number crunching. Harris has a joint agreement with Floating Point Systems Inc. of Beaverton, Ore., to supply such equipment. Nor should the 300 become input/output-bound. It can support up to 24 logical I/O ports with an aggregate input rate of 19 megabytes/s, and an aggregate output rate of about 8 megabytes/s. The number of ports supported at any given time will depend on the bit rate of the system's peripherals.

First deliveries of the 300 are due in 60 to 90 days.

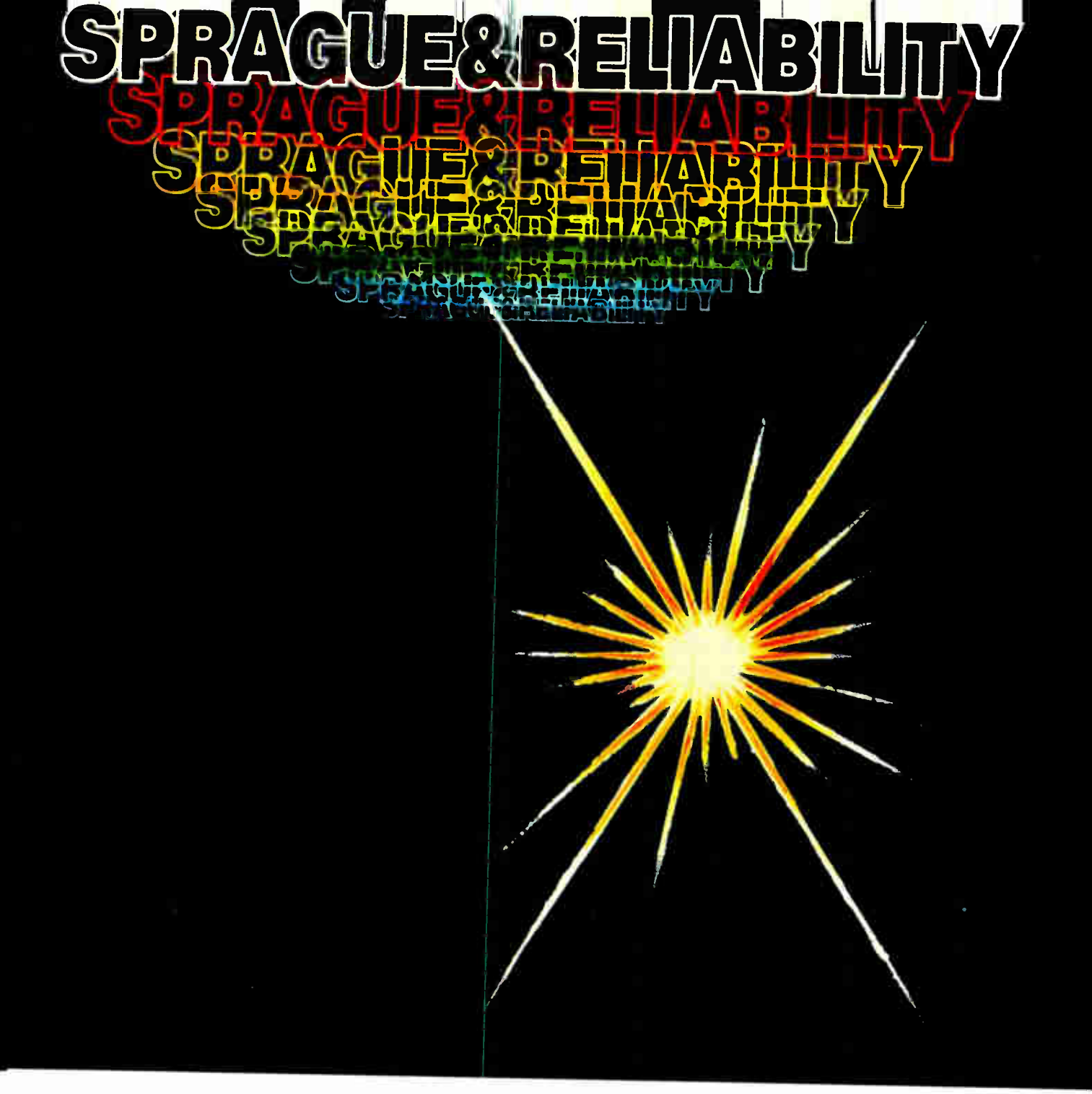
Harris Corp., Computer Systems Divison, 2101 Cypress Creek Rd., Fort Lauderdale, Fla. 33309. Phone (305) 974-1700 [338]

Repositioning to attack VAX

Simultaneously with its announcement of the model 300, Harris Corp.'s Computer Systems division is repositioning its model 500 data processor to compete more favorably with Digital Equipment Corp.'s VAX-11/780. The 500 is a little lower both in price and performance than the 11/780: the 11/780 achieves single-precision Whetstone benchmarks of 1,000 to 1,100 per second and the 500 runs at about 835; but in double-precision operation, the difference between the two computers almost disappears, with the Harris machine running at 782 Whetstones/s and the 11/780 at 790 to 800 Whetstones/s.

Unlike the 300, the 500 central processing unit is rarely sold as a packaged system, making direct price comparisons difficult. But, according to Benjamin L. Harrison, product marketing manager at the division, Harris is doing two things to create a more favorable price-performance ratio for the 500. "We are increasing minimum memory size from 192-K bytes to 384-K bytes at no increase in the CPU's $99,600 base price. Second, we are cutting the price of maintenance by 5 to 12% and breaking out software maintenance as a separate item."

Taken together, these moves are the equivalent of 10% to 30% price cuts, depending on hardware configuration and also on the sort of maintenance requested by the customer.



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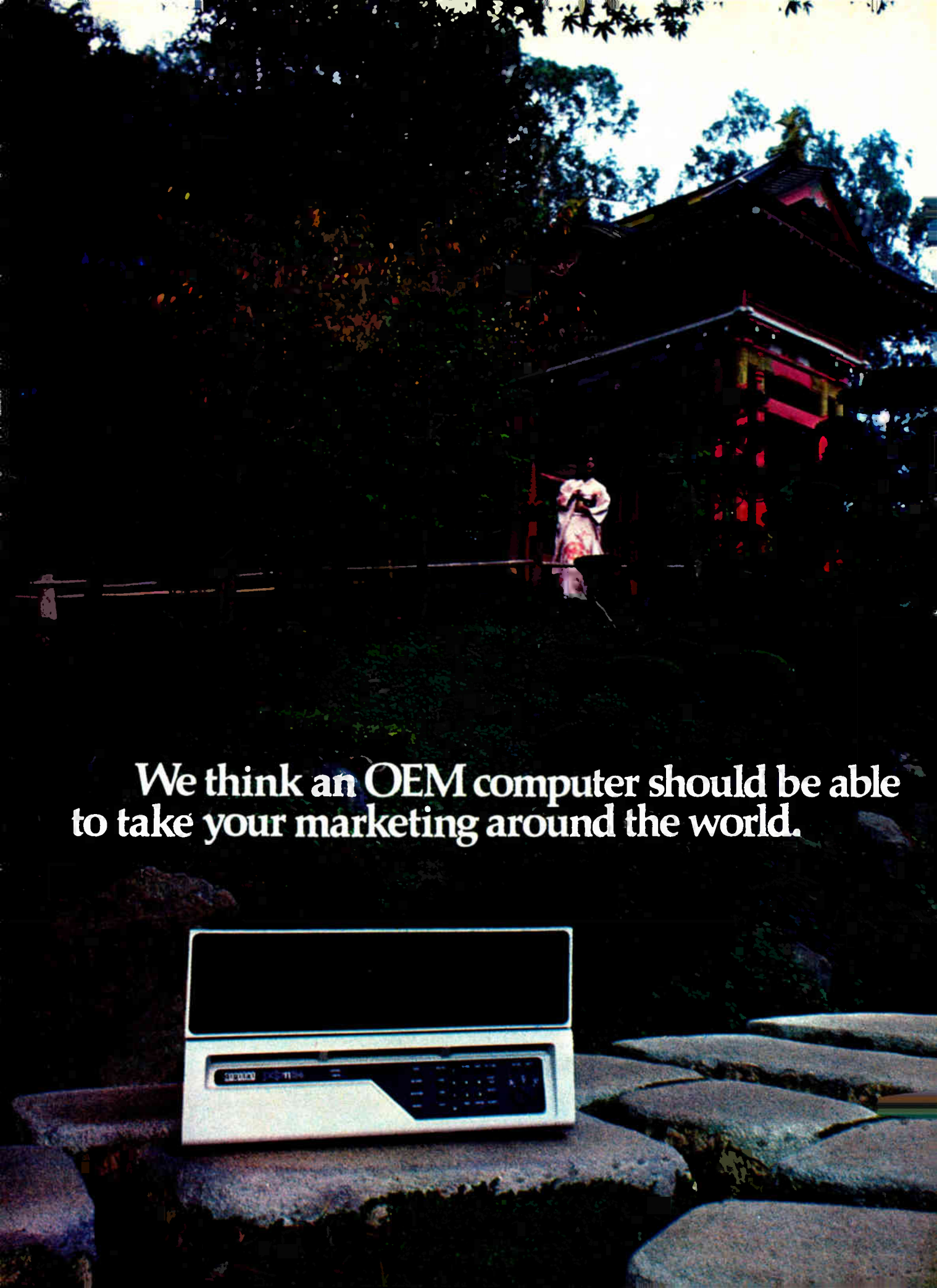

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Circle 205 on reader service card

Bubble cassettes work at −20°C

Read/write unit accepts magnetic-bubble cassettes varying in capacity from 100 K to 1 megabit

by Bruce LeBoss, San Francisco regional bureau manager

Although at present more costly than other magnetic media, bubble-memory technology offers microprocessor-based systems a unique combination of nonvolatility, long-term reliability, and data integrity, even in harsh environments. Now National Semiconductor is adding several other dimensions to the technology with the development of a magnetic-bubble memory cassette system.

Designated Bublset, the new system consists of a read-write unit, less than 3 by 4 by 6 in. in size, that automatically accepts magnetic-bubble cassettes ranging from about 100-K to 1 megabit in capacity. In contrast, a physically larger cassette-type system being marketed by Fujitsu Ltd. of Japan is limited to one 256-K unit [*Electronics*, Feb. 24, p. 212].

According to Frank Stempski, product marketing manager for magnetic-bubble products, the system was developed in response to the need for a removable, nonvolatile solid-state memory in such applications as numerical machine-tool control, data loggers and recorders, portable terminals and intelligent test equipment, and military systems in harsh or dirty environments. Bubble-based storage systems, of course, have no moving parts and thus are not subject to the mechanical failures of tape and disk storage.

Antifreeze. The Bublset's temperature range of −20° to +70°C extends well below the Fujitsu system's and that of most competitive media, which are limited to 0°C, Stempski states. The lower range is needed on oil-well data-logging systems and on power-demand meters located outside buildings, as well as in many shipboard and airborne applications, such as flight-management recording systems.

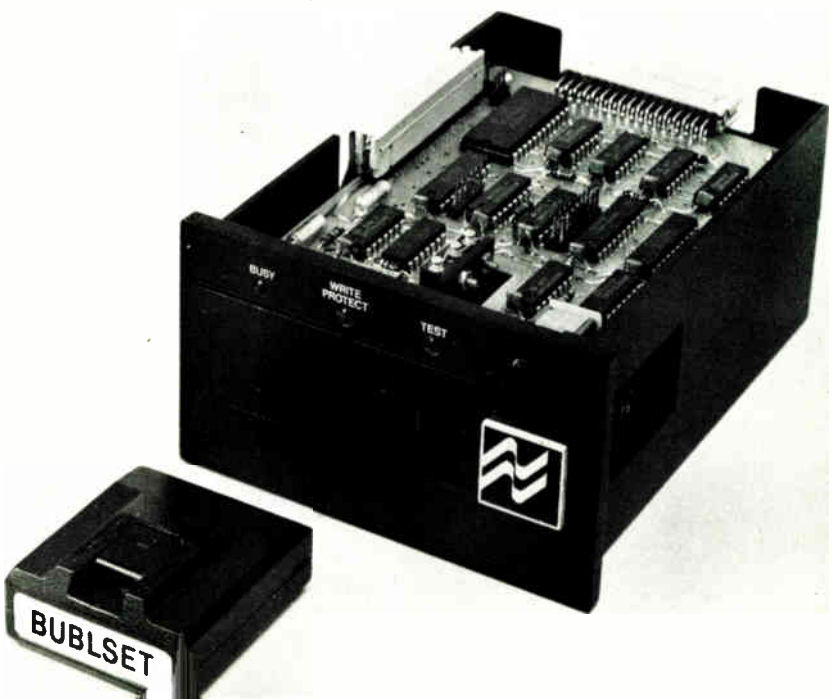
The Bublset cassette has no function or coil drivers and no sense amplifiers—it contains only the bubble memory and temperature-sensing circuitry. This cost-effective simplicity is achieved through a proprietary set of bubble-memory support circuits that National will soon offer with others of its bubble-memory components. "The design avoids the data loss typically due to powering up or down or from removing a magnetic-tape cassette during operation," says George Reyling Jr., manager for magnetic-bubble memory systems.

The bubble-memory controller detects and corrects errors automatically. It has built-in self-test features as well as an automatic write-protection feature.

The system comes with two selectable ports—an RS-232-C serial interface and a byte-wide parallel port for interfacing with microprocessor-based systems. Its +5- and +12-V power-supply requirements and the low power consumption typical of bubble-memory technology increase its suitability for portable applications, Stempski notes.

National, which already has made presentations of the bubble-memory cassette system to a few selected customers, will make the Bublset available in the general marketplace in the second half of this year. For industrial-grade versions, the Bublset will be priced in the $1,000 range in small quantities. The price includes the read/write system and a minimum-capacity (100-K) bubble-memory cassette. Prices of the cassettes will vary with capacity. Militarized and ruggedized versions will be available next year.

National Semiconductor Corp., 2900 Semiconductor Dr., Santa Clara, Calif., 95051. Phone (408) 737-5000 [339]



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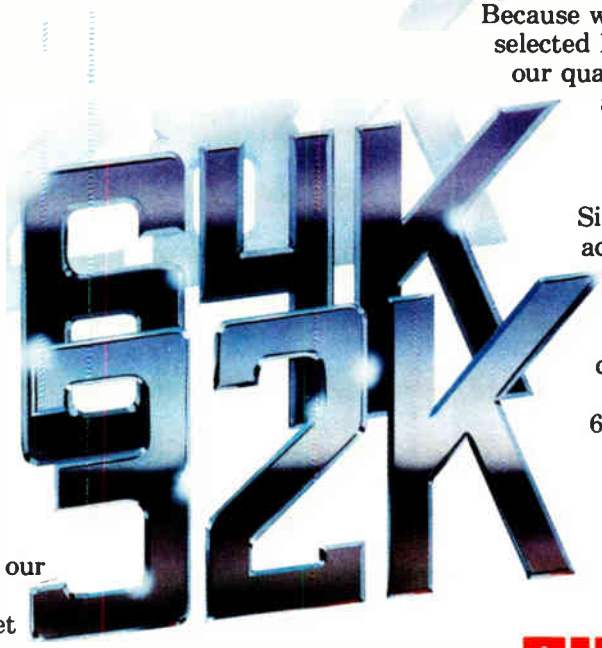

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Circle 209 on reader service card

Chip controls high-resolution graphics

Controller handles a display memory of 256-K 16-bit words and can draw figures at 800 ns per pixel

by John G. Posa, Solid State Editor

The bugaboo in building a sophisticated yet economical color graphics terminal has been the lack of a sufficiently powerful graphics display controller (GDC). With the μPD7220 GDC, display memory can be as large as 256-K 16-bit words—the equivalent of over 4 million pixels.

For graphics, display memory can be organized into a 2,048-by-2,048-pixel display or a 1,024-by-1,024-pixel display with 4 bits per dot, or any other such combination. Up to 40 rows of 80 characters each can easily be accommodated, and over 20 such screens can be stored in display memory. Multiple 7220s can be used to add colors or to access a larger display memory.

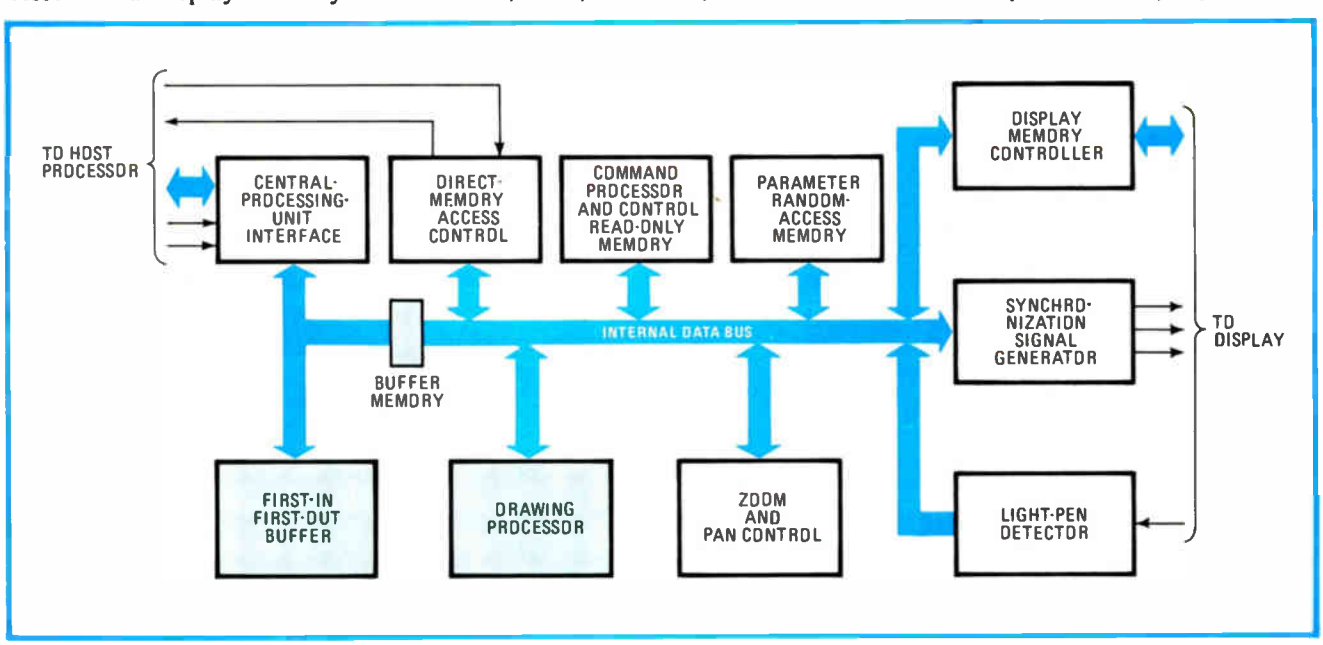
Alphanumeric characters and intricate graphics symbols are accessed in a display memory much larger than what is actually displayed, so the screen can be partitioned. In each section, information can be scrolled up and down, and characters and graphics can be intermixed.

Quick. Beyond raw resolution, the 7220 has two outstanding features: the ability to alter the contents of a 16-bit word in memory in a single read-modify-write cycle, and the ability to draw pictures with an on-chip figure-drawing processor. A read-modify-write cycle consumes four cycles of the system clock, which runs at 5 MHz or faster; in this period, the GDC can set or clear any bit or bits in a word and thus edit text or draw lines, arcs, circles, and rectangles at 800 ns per pixel.

Directly compatible with the 8080, 8085, and 8086, the 7220 can be connected to such microprocessors as the Z80 and 6800 with a small amount of peripheral logic. It recognizes 18 commands, some of which can be used to synchronize multiple 7220s. A zoom command lets the graphics be enlarged by factor as large as 16. Others control direct-memory access, permit inputs from a light pen, or enable the cursor's position to set or read.

The μPD7220 will be available in limited quantities in May for under $100. Volume production is set for September or October, at which time the price will drop to about $50 or $55. The chip will also be available through Intel Corp. A complete graphics display module is in design at NEC Microcomputers.

NEC Microcomputers Inc., 173 Worcester St., Wellesley, Mass. 02181 [340]



Good graphics. The μPD7220 alphanumeric and graphics display controller from NEC addresses a display memory holding much more data than is on the screen. It has an on-chip drawing processor and a 16-by-9-bit first-in, first-out buffer to ease asynchronous data transfers.

Super High Speed 64K Dynamic RAMs

OKI on-line VLSI technology delivers the 65,536-bit NMOS dynamic RAM available in 3 super-fast access times—with error protection: MSM3764.

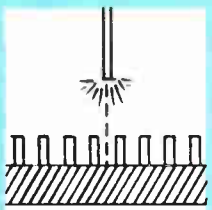
MAXIMUM SPEED OPTIONS

OKI produces the one-chip 64K NMOS DRAM in 3 very fast access times to optimize system applications and performance:

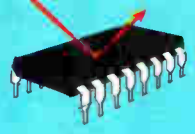
120 ns – MSM3764-12
150 ns – MSM3764-15
200 ns – MSM3764-20
(industry standard)

E-BEAM VLSI FOR MAXIMUM DENSITIES

64K bits of dynamic RAM on a single chip! Confirms again OKI's strong on-stream capabilities in VLSI memory technology. Based on OKI's solid 3-year headstart in Electron Beam lithography. Begun in 1977, now fully on-line, OKI application of E-Beam defect-free masks is now producing high density chips: working products with close geometries that yield 6x or more functions than standard masking procedures.



ALPHA PARTICLE PROTECTION



The destructive bombardment of line data by alpha particles is eliminated by OKI's state-of-art 64K DRAM fabrication process. To assure total data protection, a key error prohibitor is built into every MSM3764 — through silicon doping, and unique design and manufacturing techniques.

In extensive life-cycle testing, the Double-Poly doped 64K device has experienced zero failures from alpha particle exposure.

TWO PACKAGING OPTIONS

Ceramic
OKI MSM 3764 AS, packaged for high-rel applications.

Plastic
OKI MSM3764 RS, for cost-efficient commercial/industrial applications, available May 1.

VOLUME AVAILABILITY

OKI is now filling qualification, preproduction and production orders for MSM3764 from stock. OKI's Hachioji facilities and the new $72,000,000 Kyushu fabrication plant are both now producing this device.

OKI MSM3764. The fastest 64K RAMs shipping from any memory source today. OKI is now delivering the ultimate in work-horse VLSI. 65,536 bits of dynamic NMOS RAM on a single 16-pin chip: optimized for MCU system applications requiring high speed, high density and high performance.

Volume production of the 3764 in three very fast access-time configurations—resistant to soft errors through advanced circuit design; resistant to alpha particle damage through unique processing steps—gives OKI 64K DRAM users an important edge. For main-frame memories, buffer memory, peripheral storage systems—virtually any microprocessor-related environment where high quality, strict reliability and compact layout are critical design criteria.

Availability of a more workable, more usable, faster 64K RAM underscores OKI's significant lead in VLSI memory product design and production. Today's ability to supply results from our early commitment of time, manpower and capital resources to the mastery of E-Beam lithography—at least three years before most memory suppliers began E-Beam machine experimentation and trial runs.

For full technical data and specs on MSM3764, send the coupon below. For qualification orders of the OKI 64K RAM—at 120, 150 or 200ns—contact Mary Briganti, Inside Sales Manager, OKI Semiconductor, 1333 Lawrence Expressway, Santa Clara, CA 95051. (408) 984-4842.

OKI MSM3764 — 64K NMOS dynamic RAM

( ) Please send data sheet and volume pricing.
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Circle 211 on reader service card 211

Communications

Acrylic polymer makes tough fiber

Plastic optical fiber survives physical extremes, lowers costs for 60-meter data links

One of the many obstacles original-equipment manufacturers face in developing fiber-optic data links has been the unavailability of inexpensive fiber cable of high physical and optical quality. Hewlett-Packard's solution to this problem for its HFBR-0500 data link [*Electronics*, Dec. 18, 1980, p. 83] is Nissho-Ewai American Corp.'s acrylic fiber. Developed by Mitsubishi Rayon of Tokyo, these step-index fibers, called ESKA by their manufacturer, are more flexible and lighter in weight than glass fibers. And compared with the other inexpensive, more commonly known fibers made of polystyrene, they have lower attenuation, better tensile strength, more flexibility, and physical stability at higher temperatures.

"We have spent nine months working with the various device and connector manufacturers in the U. S. to develop and optimize their components to effectively operate with ESKA cables. Now there are active devices in the visible and infrared ranges, as well as connectors, that are ESKA-compatible," says Roy H. Yahiro of Nissho-Iwai. The compatibility exists for both grades of fiber—industrial and display. Featuring an attenuation acceptable for data links up to 60 meters long, the industrial grade is a better fiber than the display type, which is cost-competitive with polystyrene fiber and suitable for such applications as light guides, illumination panels, automotive uses, electrical appliances, and toys.

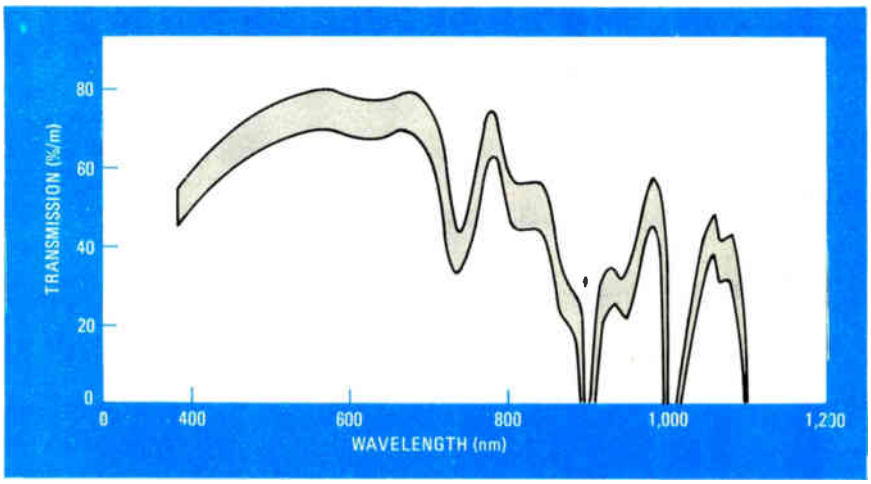
Chemistry. Both fiber grades have an acrylic polymer core of polymethyl methacrylate sheathed with a polymer containing fluorine. The sheath polymer has a lower refractive index than the core polymer—a standard approach that helps keep the light energy in the core.

The chemical composition of both core and cladding is the key to the fiber's physical properties, which are all-important when practical data links or display devices are built. ESKA fibers can handle up to 80°C, with intermittent exposure to 100°C. Temperatures of −30°C for 30 days cause no change in light transmission or the fiber's flexibility.

"The fiber can be knotted tightly at room temperatures," Yahiro says. Significant transmission loss does not occur unless the fiber is bent on a radius under 1 cm and does not drop below 90% relative transmission until the bending radius is under 0.5 cm. He adds that "it's not attacked by epoxy adhesives." Dilute sulfuric acid, gasoline, and organic solvents have little if any effect on the fiber's light transmission. Other specifications on flexibility, breaking strain, and weatherability are documented, along with test procedures, in the parent company's technical bulletin.

According to Yahiro, bulk fiber, bristles, and jacketed fiber are available in a range of diameters and lengths depending on the grade needed. But ESKA is also available in assembled light guides, light sensor heads, photocouplers, panels, and displays, and so on. Mitsubishi Rayon's Tokyo laboratory will make custom samples suitable for customer testing. Prices vary widely with diameter, grade, length, and configuration.

Nissho-Ewai American Corp., Broadway Plaza, Suite 1900, 700 South Flower St., Los Angeles, Calif. 90017 [401]

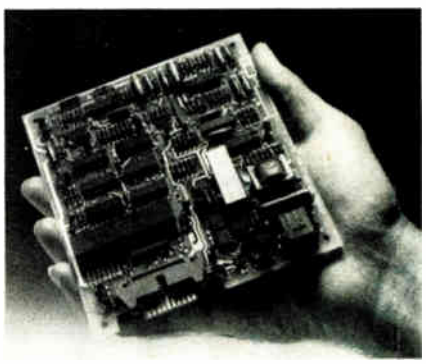


Spectral transmission. An inexpensive acrylic optical fiber, ESKA has losses low enough for 60-meter data links. The shaded area indicates variation with grades and types of ESKA.

Direct-connect 1,200-b/s modem is 30 in.²

The smallest 1,200-b/s single-card modem available is the CM2020, according to Intertel. Measuring only 30 in.², the microprocessor-based modem is a direct-connect device registered by the Federal Communications Commission and compatible with Bell Telephone's 202S. It improves mean time between failures and eliminates the cost of installing dial-back hardware and data-access arrangements.

The CM2020 modem has test circuitry on board for either self-testing or testing via data-transmission

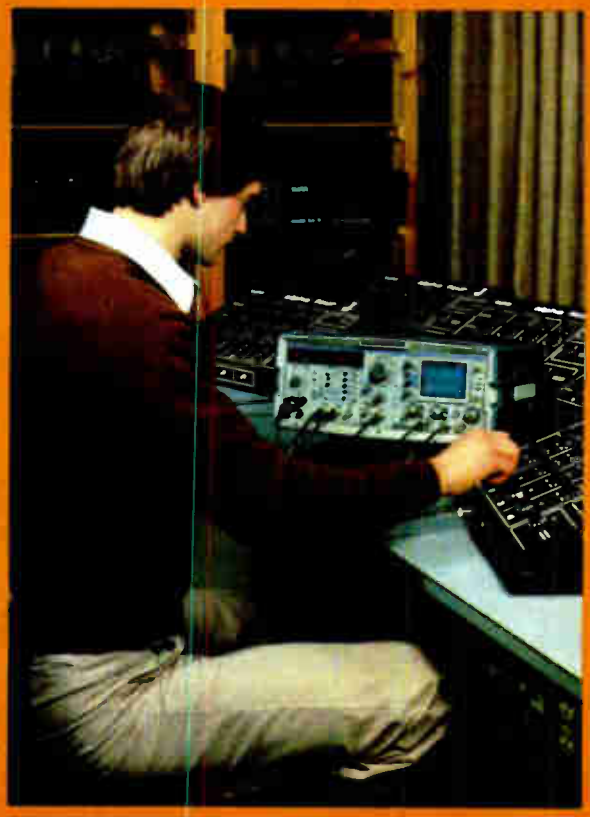


TM 500 now gives you the quickest distortion measurements ever.

Introducing the AA 501 Distortion Analyzer and SG 505 Oscillator. Fast, automated and accurate.

This new pair of TM 500 Plug-ins makes distortion measurement truly automatic to save you both time and money. For production testing, the AA 501's automatic speed provides substantial labor reduction with no loss in accuracy. Together, the AA 501 and SG 505 have the lowest harmonic distortion plus noise (THD+N) rating in the entire industry: 0.0025%.

The SG 505 Oscillator outputs a sine wave with the lowest residual distortion on today's market (.0008%). The AA 501 Distortion Analyzer uses digital processing to lock in on test signals, set levels and adjust the notch filter for nulling. All measurements, including dB levels are precalculated and then displayed on an LED readout.



The AA 501 and SG 505 are both TM 500 Plug-ins that can be installed in any of five mainframes, including rackmount, bench and portable. They can also be separated and still used as a team, even though miles apart. Or configured with over 40 other TM 500 Plug-ins currently available.

To find out more about the AA 501 Distortion Analyzer and SG 505 Oscillator, contact your local Tektronix Field Office or write Tektronix, Inc.

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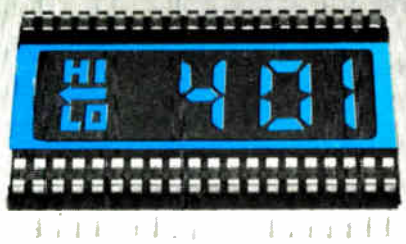

To meet your most stringent requirements, special wide temperature range, fast response liquid crystal fluids, such as −20° to 85° C, with a total cycle time of less than 100 ms at 6 Vrms are also available.

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equipment; selectable call origination that supports automatic dialing, dial-through, and conventional dialing; and economical installation and operation.

The CM2020 card modem is available to original-equipment manufacturers for $199 each. The maximum that can be ordered at this introductory price is two modems.

Intertel, 6 Shattuck Rd., Andover, Mass. 01810. Phone (617) 681-0600 [403]

Fiber-optic multiplexer transmits real-time data

The model CMX-832 is a low-cost, eight-channel, time-division fiber-optic multiplexer that transmits data in real time (without storing it in buffers) and has no restrictions on character bit width or protocol. It has no need for the waiting and other interaction between individual data channels that is necessary in statistical multiplexers. Its electrical channels are full-duplex RS-232-C.

The CMX-832 has a maximum channel data rate of 19.2 kb/s, asynchronous or synchronous. In the synchronous mode, switches select the terminal clock rate of 1,200, 2,400, 4,800, 9,600, or 19,200 b/s.

Powered by 115 V, 60 Hz, from an ac wall outlet, the multiplexer is available for $2,700. Extension units, which may be added to the basic unit to handle an additional eight channels, are priced at $2,000 apiece. Delivery is 10 weeks after receipt of an order.

Canoga Data Systems, 6740 Eton Ave., Canoga Park, Calif. 91303. Phone (213) 888-2003 [404]

Voice/data multiplexer has large channel capacity

Designed for voice, data, or simultaneous voice and data transmission, the series 6223/6224 system tailored voice and data multiplexer has a fixed data rate of 1.544 Mb/s, like conventional pulse-code modulated multiplexers, and uses only that bandwidth required to accommodate the voice data traffic. It can be used with a voice and data satellite and Bell T1 or other data circuits.

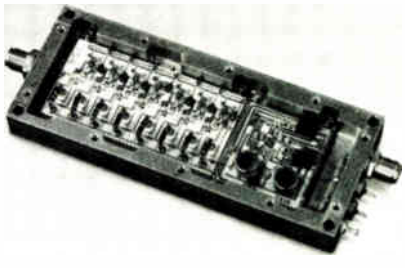
The 6223/6224 series features a choice of 2 to 24 channels. Channel capacity is increased by simply plugging in a card. The aggregate and individual channel rates can be varied, and various interfaces may be selected for aggregate and channel ports. Throughput efficiencies can be as high as 99.4%.

The series 6223/6224 starts at a price of $8,385.

Aydin Monitor Systems, 502 Office Center Drive, Fort Washington, Pa. 19034. Phone (215) 646-8100 [405]

Logarithmic i-f amplifiers operate to 2 GHz

Intended for use in electronic warfare and radar systems and monopulse tracking receivers, the logarithmic intermediate-frequency amplifier, the ICL-5 series, is the industry's first i-f–to–logarithmic-video amplifier to operate at 2 GHz, says the manufacturer. The hybrid circuits cover the frequency range of 600 to 2,000 MHz and have a stable



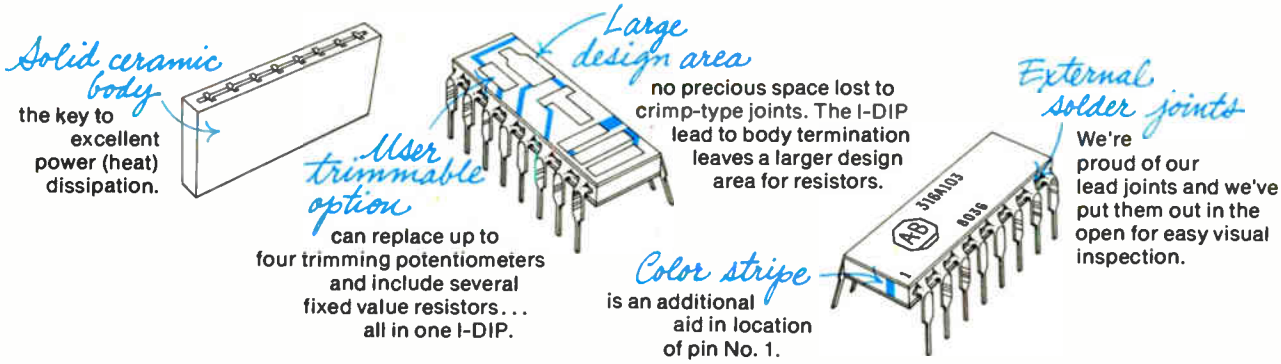
log linearity over operating temperatures as high as 85°C and a deviation of less than ±1 dB. The logarithmic amplifiers can be used with the full intrinsic i-f bandwidth in many applications for highly accurate amplitude measurements over extremely high bandwidths.

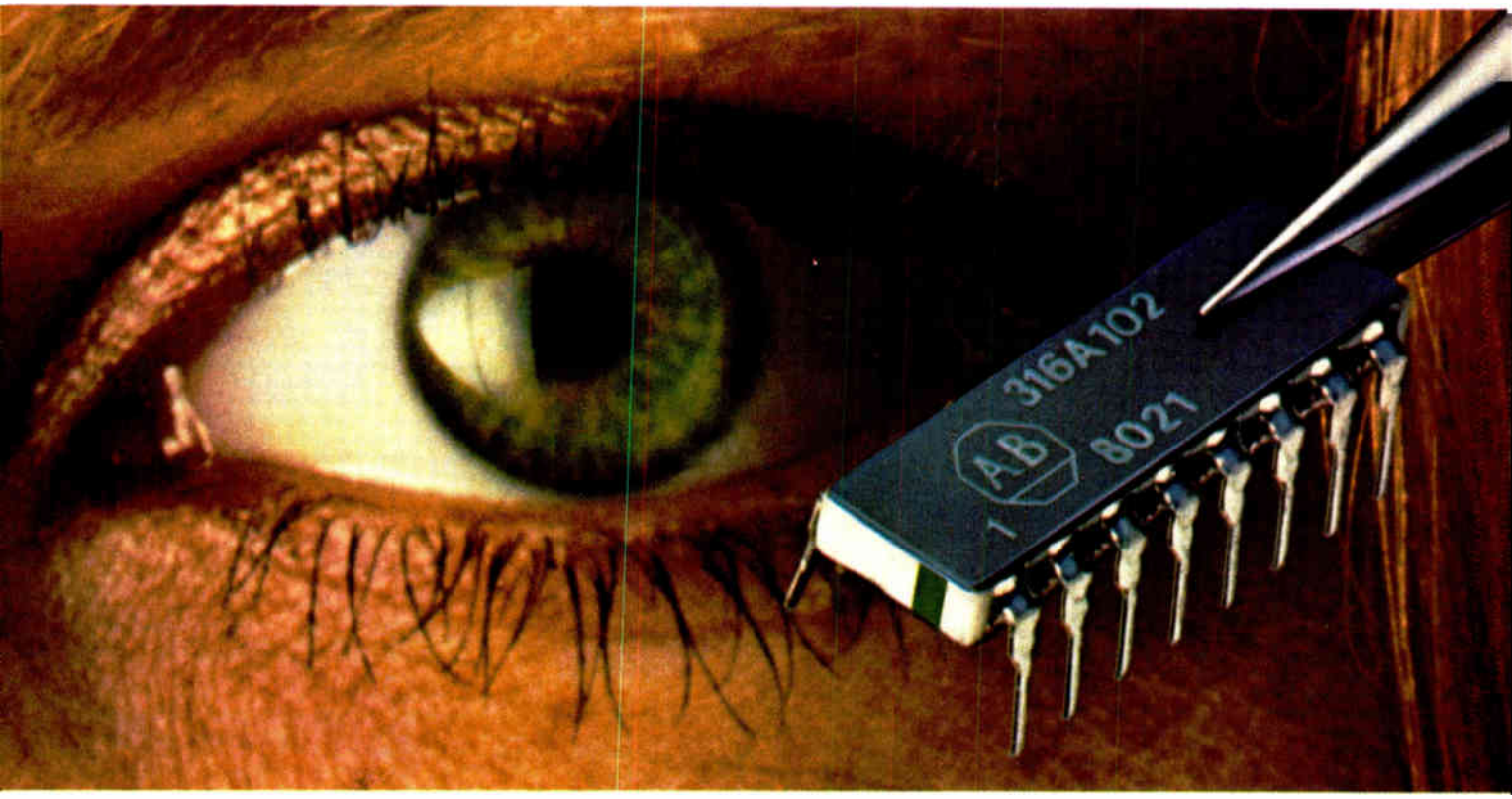
The ICL-5 series range in price from $1,600 to $2,900 in small quantities.

Varian Associates, Beverly Division, Salem Road, Beverly, Mass. 01915. Phone (617) 922-6000 [407]

See the difference between Allen-Bradley I-DIP quality networks and other look-alikes.

All resistor networks are not created equal. With Allen-Bradley, you get an innovative and superior system of network elements...substrate, ink, edge termination, leads. Result: far more room for more resistors; higher power ratings and higher resistance values. In addition, you can select from an extensive line of proven standards for greater assurance of consistent quality and availability. Write today for fact-filled brochure on all the competitive differences. Ask for Publication EC2501.





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Milwaukee, Wisconsin 53204

EC 215
Circle 215 on reader service card

Instruments

Bare-board unit tests 10^4 points/s

System supports four stations, generates own test programs from boards known to be good

The Probe 1001 bare-board test system supports up to four test stations, each testing 1,000 points every 100 ms. Each of the four test stations may test separate boards, or all may be programmed to test the same product.

To speed tests, the system applies impulses to all points at once and receives a return signal only if there is a flaw in the board, instead of checking for the absence of a return impulse as most other testers do, according to Canby Chang, president of Express Computer Systems. Another factor that increases speed is the use of a 16-bit FS990 microcomputer from Texas Instruments Inc., instead of the 8-bit units found in many other testers.

The go/no-go tester's remote units can be located up to 50 ft from the central unit. Each consists of a Texas Instruments VDT 911 terminal and a fixturing head for testing boards. Two main fixturing options are available: a bed of nails for bare-board testing and edge connectors for backplane testing. ECS will also customize fixtures to make them compatible with any existing testers a firm may have, Chang says. The central unit also includes a VDT 911 and a test fixture, as well as the central processing unit, 64-K bytes of main memory, and two Shugart single-density SA-801R floppy-disk drives with 256-K bytes.

The system is the first product to be introduced by ECS, which has been providing testing services for Basic 4, Burroughs, Memorex, and others for the past four years. The firm decided to move into manufacturing to capitalize on its expertise and to expand into what it sees as a rapidly growing market pushed by the increasing use of multilayer boards.

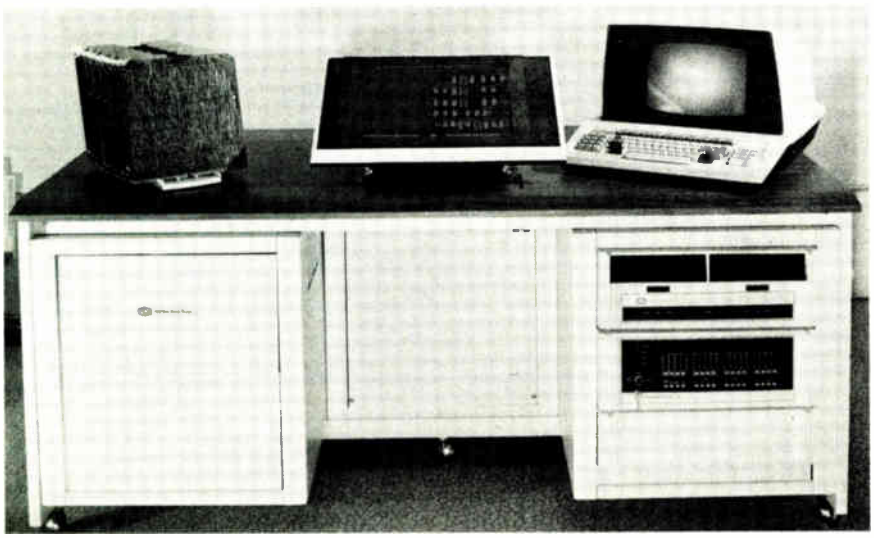
Learner. The Probe 1001 can be programmed either by placing a known good board on the fixture for automatic programming or by using a schematic to key in data for each of the points to be tested. When the auto-learn program is used, the system enters the data read from the good board into memory in the form of a machine-language internal object file; the remaining boards can then be checked using the test executive program.

Through manual data entry, users can avoid the difficulty of locating a good board and can have a test program ready to go when the first board comes off the assembly line. The pin positions and numbers can be keyed in by a nontechnical person in about three hours, Chang says.

The system uses two power supplies. The supply for the central unit and its disk drives provides 150 W at 5 and 12 V. The second, which provides 400 W at 5 V, goes to the buffer card and supplies power to the fixture for testing the boards.

Options for the system include a vacuum pump, a 10-megabyte hard-disk drive from Control Data Corp., and a choice of printers. The basic unit, which tests 256 points, lists for $23,247. Additional test points can be added in 128-point increments, priced at $5 to $6 per point, with a maximum of 7,680 points. Prices for the remote units have not yet been set, but they will start at under $5,000 each, the firm says. Delivery is in six weeks.

Express Computer Systems Inc., 1441 S. State College Blvd., Anaheim, Calif. 92806. Phone (714) 991-3512 [351]

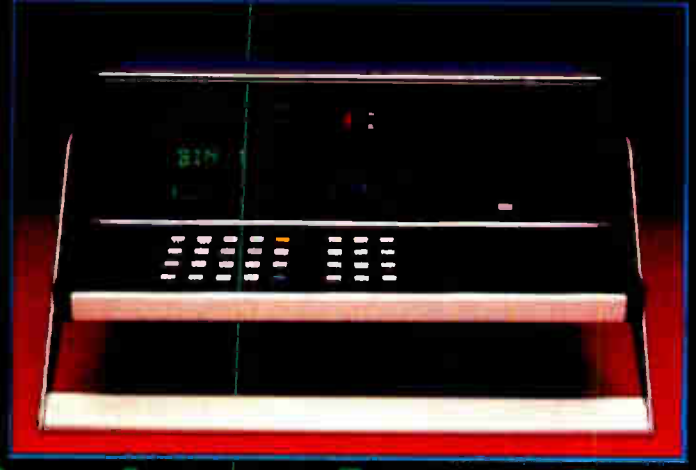


Unit measures fiber loss with specified accuracy

The FT series of portable fiber-attenuation measurement equipment has a measurement range of +6 to +60 dBμm and an accuracy of to within 0.2 dB. It is the only portable system of this type, according to the manufacturer, to have a specified accuracy as well as a specified resolution and measurement range. It is designed to make simple and repeatable loss measurements on either raw or connected fiber in the field.

It contains a microscope and features synchronous light generation and detection, as well as a fiber positioner and audio communications over the test fiber. The wavelength, bandwidth, and spot size of the source may be specified by the user. Source wavelength is 850 nm standard, 1,200 and 1,500 nm optionally. The launch-spot size can vary from 250 to 25 μm. Resolution of a reading is to 0.01 dB.

The equipment is packaged in an aluminum briefcase and can operate off either a 110- or 220-V line. It can



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Get the complete view of your LRC measurements with the new 2100 and 2110 VideoBridges from ESI. They're the first LRC meters to combine effective software, memory, a CRT and keyboard, to give you interactive operation... with a price comparable to LRC meters with only LED readout.

Both VideoBridges will display 12 impedance and loss characteristics, measureable at test frequencies from 20 Hz to 20 kHz, at programmable voltage or current levels, with accuracy from 0.05%.

With the 2110 VideoBridge, you can program your test conditions on cassette, acquire the data, store it, and manage and display your test results. You can store test programs for different components, for repetitive testing needs.

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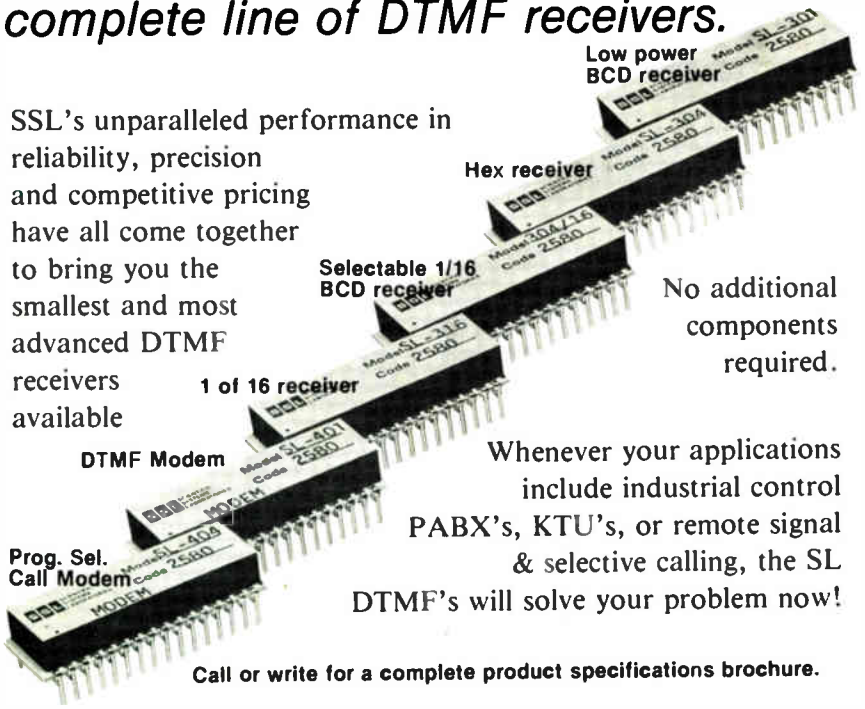

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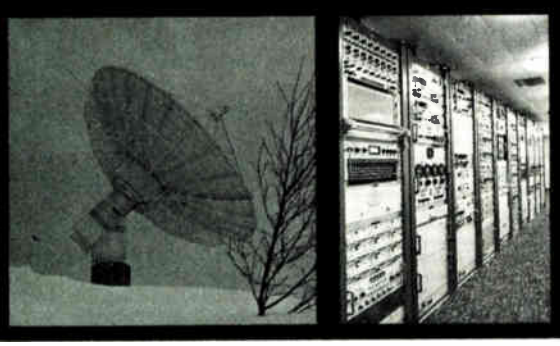

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(213) 882-9616
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218 Circle 264 on reader service card

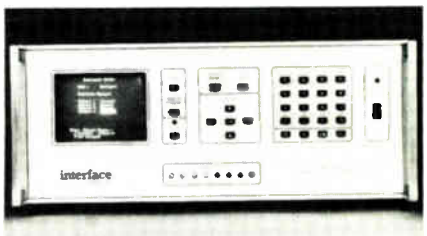
New products

be delivered within 60 days. Pricing information is not yet available.
Fiberguide Instruments, 1101 State Rd., Princeton, N. J. 08540. Phone (609) 921-9127 [353]

Bus analyzer checks out digital avionics electronics

The model 429 bus analyzer employs multiple microprocessors, a cathode-ray-tube display, and a keyboard and is designed for checking out digital avionics using the new ARINC 429-3 specification for digital information transfer systems over a shielded twisted wire pair. That document, developed under the coordination of Aeronautical Radio Inc., standardizes the electrical interface characteristics, data format, and bus timing to be used in all aspects of avionics electronics. It will be used on such aircraft as the Boeing 757 and is planned for use on the Airbus A310 and the Fokker F29.

The bus analyzer can generate



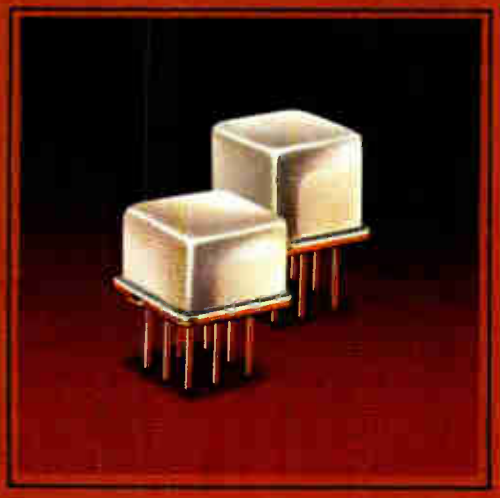
and transmit data patterns while simultaneously receiving, monitoring, and analyzing them. The 429 uses a 6809 microprocessor to control the keyboard and display and to prompt the user through menus for control programming and data preparation.

Eight independent data channels can be programmed for transmit or receive functions. Data entry and readout can be handled in engineering units or in binary or hexadecimal formats.

A basic 429 with a second microprocessor responsible for input/output control sells for $11,995. Seven optional I/O-channel microprocessors may be added, and IEEE-488 and RS-232-C interfaces are also

TO-5 RELAY UPDATE

The Centigrid: You're making it the next industry standard



When we first introduced the Centigrid® we called it The Relay of Tomorrow. But you liked it too well to wait . . . the ultra-low profile; the terminal spacing that permitted direct pc board mounting; the same low coil power and excellent RF switching characteristics as the TO-5. You began putting it into your new designs immediately. And you've never stopped.

Then, early in 1978, we introduced a companion relay: the sensitive Centigrid II, designed for applications requiring ultra-low power dissipation. The can was just a tad taller, but it still took up only .14 sq. in. of board space. And it still offered the same TO-5 proven reliability. You took to it almost as fast as the original Centigrid.

Now that both Centigrid relays are qualified to levels "L" and "M" of MIL-R-39016 (including internal diode suppressed versions) they are fast becoming industry standards. If you'd like complete specification data on either or both, call or write us today.

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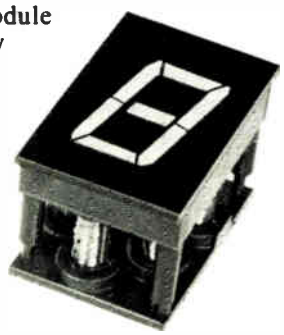

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Telephone: (416) 624-3020
Telex: 06-961437

220 Circle 265 on reader service card

New products

available. The instrument is available for immediate delivery.
Interface Technology Inc., 150 E. Arrow Highway, San Dimas, Calif. 91773. Phone (714) 599-0848 [354]

Bus-compatible ohmmeter features 0.1-μΩ resolution

The three sensitivity settings on the model 4300 digital ohmmeter cover every resistance application, from circuit-breaker contacts to huge utility transformers, with 0.1-μΩ resolution. Three selectable voltage ranges are 20 mV, 200 mV, or 2 V. The unit has a precision constant current source that supplies six decade values from 10 A to 100 μA for testing. The voltage and current ranges provide up to 18 different resistance ranges with load power dissipation varying from 20 W to 2 μW. A four-wire kelvin input lead is used to compensate for errors. An IEEE-4888 interface is available as an option for use of the unit in automatic testing. The model 4300 sells for $2,195 and is available for delivery in 30 days.
Valhalla Scientific, 7576 Trade St., San Diego, Calif. 92121. Phone (714) 578-8280 [355]

4½-digit DMM has eight measurement functions

Whereas many conventional 4½-digit multimeters offer only five functions, the model 2380 push-button DMM provides three more. It measures dc volts, dc current, ac volts, ac current, and resistance, and in addition decibels, dc volts plus ac volts, and dc current plus ac current. The 2380 does a 25,000-count analog-to-digital conversion. The instrument also provides true root-mean-square values of complex waveforms by measuring ac and dc simultaneously. It has a bright 0.6-in. light-emitting-diode display and is priced at $345. Delivery is from stock.
United Systems Corp., 918 Woodley Rd., Dayton, Ohio 45403. Phone (513) 254-6251 [357]

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Circle 221 on reader service card 221

Components

Flexible module interfaces sensor

Module filters, compensates for, isolates, and amplifies signal from thermocouple

Among the problems of thermocouple temperature measurement is the frequent need to tailor the interface electronics to the thermocouple and the application. In addition, it is often necessary to add filtering, isolation, compensation, and other features peculiar to a given need. Now Analog Devices is offering a module that appears to have almost all these extras.

The 2B50 thermocouple transmitter combines input protection, isolation, high common-mode rejection, amplification, filtering, and cold-junction compensation in a single package only 1.5 by 2.5 by 0.6 in. in size. It can be jumper- or resistor-programmed to compensate for seven of the most commonly used thermocouples: types J, K, T, or E, R, S, and B. The unit allows both internal or remote-reference–junction temperature sensing and compensation (the latter using a 2N2222 transistor) for even greater flexibility.

Applications may include electrically noisy ones: the 2B50's input is transformer-isolated, capable of handling ±1,500 V peak continuously, and its transient voltage protection meets IEEE standard 472-1974:SWC. Protection against differential voltages of 220 V rms is guaranteed; common-mode rejection at 60 Hz is 160 dB, minimum; 60-Hz normal-mode rejection is a minimum of 70 dB. Input filtering erases errors caused by electromagnetic or radio-frequency interference.

The user has a choice of standard or low-drift units. The standard 2B50A exhibits an input offset drift of ±2.5 μV/°C maximum and gain nonlinearity of ±0.025% maximum. For more demanding applications, the 2B50B offers ±1 μV/°C maximum input offset drift and ±0.01% maximum gain nonlinearity. Maximum gain temperature coefficient for the two versions is ±35 ppm/°C for the 2B50A and ±25 ppm/°C for the model B.

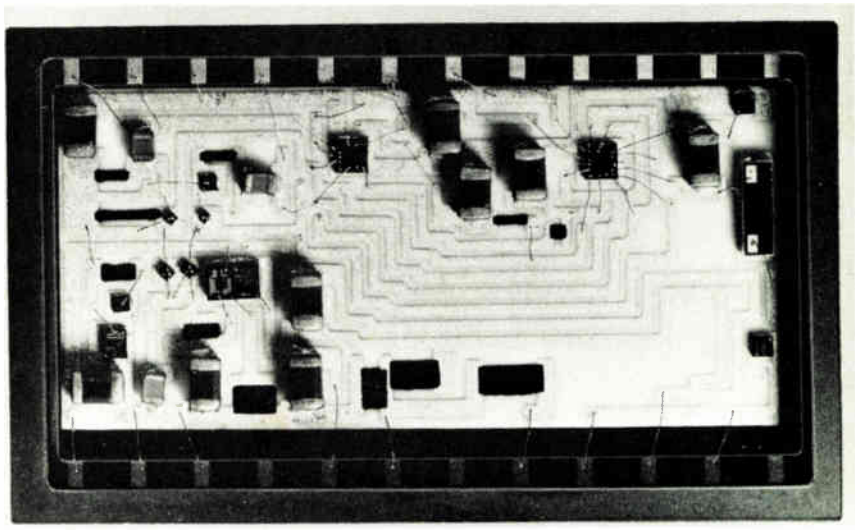
Input span is user-adjustable from ±200 to ±5 mV, coinciding with a gain range of 50 to 2,000. Output voltage is normally ±5 V, but may be scaled to ±10 V with a resistive divider. Power supply requirements are ±15 V at 0.5 mA, and +13 to +18 V at 15 mA. Although performance is specified over a 0°-to-70°C temperature range, it is possible to operate the 2B50 over a −25°-to-+85°C range with some derating.

Hundred-unit prices are $86 for the 2B50A and $103 for the B. Delivery is from stock.

Analog Devices Inc., Route One Industrial Park, P. O. Box 280, Norwood, Mass. 02062. Phone (617) 329-4700 [341]

V-f hybrids have no added frills

V-f converters are stripped of features that analyzer makers find unnecessary



Dynamic Measurements Corp. uses the term "OEM-tailored" to describe its new family of 2-, 5-, and 10-MHz voltage-to-frequency converters. The firm means by this that it has stripped away some features original-equipment manufacturers might view as frills, in order to give them only what they need at a price about half that of competing units. DMC's first hybrid circuits, they are small in size, too—each occupies a double-width dual in-line package.

Most of the V-f converters DMC sells go into analytical instruments, specifically devices such as gas and liquid chromatographs, spectrophotometers, and thermal analyzers. According to John J. Toohey, marketing director for the company, "there's a lot inside V-f converters that people in these areas just don't need." He cites as examples input differential amplifiers and counter capabilities; "most users have their own front ends," and most "have something like an RCA 4040A at the output already," he says.

If the premise is correct, the 3800 family should prove popular with OEMs. Toohey says that the key specifications of the new converters meet or exceed those of competing units, and at least one (the 2-MHz 3802) appears to be, he claims, almost without competition in the marketplace.

Most V-f converter business is

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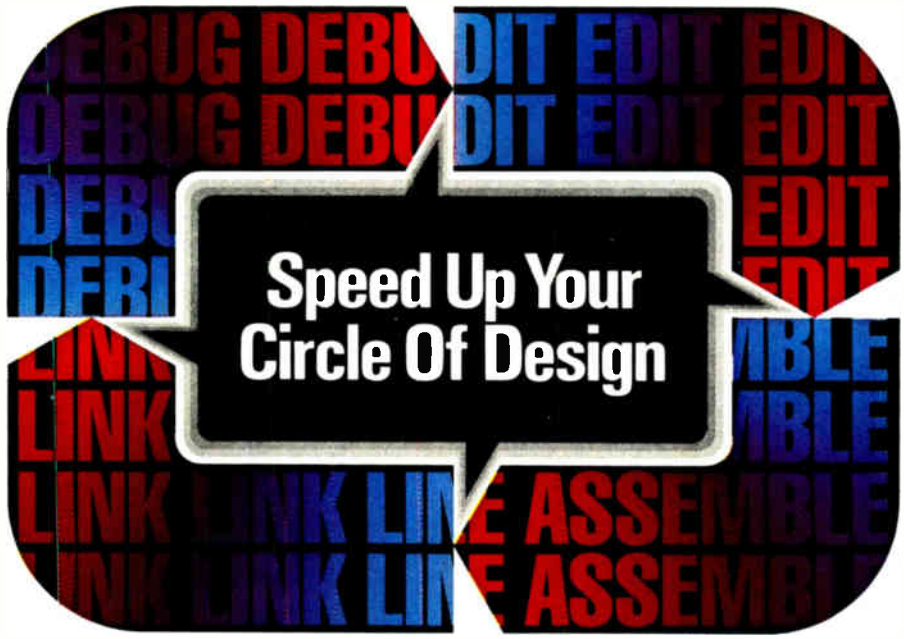

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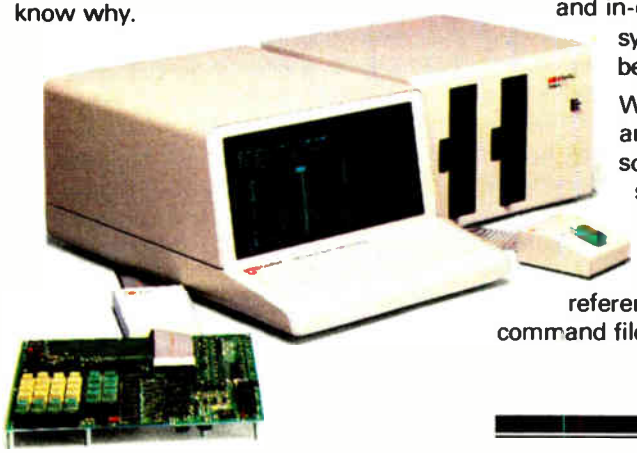

GenRad 2300 Series Stand-Alone Universal Development System. Supported processors: 8080, 8085, Z-80, 6800, 6802, 1802; the 8086, 68000, 6809 and 6502 are supported with the GenRad 2302 Slave Emulator.

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New products

concentrated at 1 MHz, that being the most popular full-scale frequency in common use. At 2 MHz, the 3802 offers either two times the resolution or equal resolution at twice the speed of 1-MHz units. Nonlinearity is 0.01 ± 0.015%. Its gain temperature coefficient is ±75 ppm/°C, with units as tightly specified as ±15 ppm/°C available. Zero-offset temperature coefficient is ±25 μV/°C.

There is competition for the 5-MHz 3805, but Toohey feels that the unit wins any comparison of specifications. Its linearity is within 0.01 ± 0.02% of full scale; gain and zero-offset temperature coefficients are equal to those of the 3802.

Offering the highest resolution or throughput is the 3810, with a 10-MHz full-scale range. Only one or two companies compete in this speed range, says Toohey, who adds that "the 3810 is as good as the rest and costs less." Its nonlinearity is 0.05 ± 0.05%, gain temperature coefficient is ±100 ppm/°C, and zero offset drifts at ±25 μV/°C. Units with gain tempcos of 50 and 25 ppm/°C are available.

Work both ways. Each of the new hybrids is user-programmable to act as a frequency-to-voltage converter. Though this feature will be of more interest to makers of optical data links than to analytical-instrument manufacturers, the idea of filling requirements for both V-f and f-V converters with a single unit—thus increasing pricing leverage—will attract many customers with dual applications.

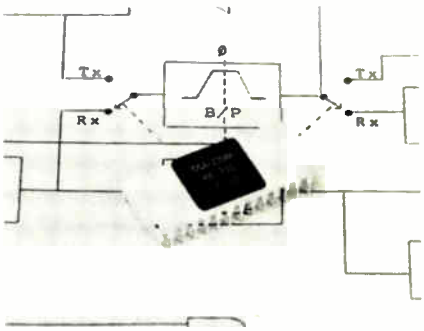
The prices undercut two of DMC's modular converters by about one third. The price in 100-unit lots for the 3802 is $49; for the 3805, $69; and for the 3810, $79. The firm will also offer military versions of the converters, and Toohey expects their reliability to be high because of the low parts count resulting from the "frill removal."

The manufacturer expects to provide samples by the end of this month and to be in full production by April.

Dynamic Measurements Corp., 6 Lowell Ave., Winchester, Mass. 01890 [342]

Encoder/decoder can handle 511 audio frequencies

A 28-pin complementary-MOS device, the MX305 monolithic programmable encoder and decoder can generate, detect, and notch any of 511 discrete audio frequencies derived from a single crystal reference. As external support, it requires the crystal or a ceramic element, a code-program plug or dual-in-line-packaged switch, and two or three resis-



tors and capacitors. It covers the EIA RS-220-A standard tones: 2,805 to 1,402.5 kHz; 600 to 1,500 kHz; 1,800 to 2,000 kHz; and 1 kHz. The operating voltage range is 4.5 to 7.5 V. The receiver bandwidth is pin-selectable as ±1.6% or ±3.2%. Each is $28.18 in thousands.

MX-COM Inc., 8060-F Silas Creek Pkwy. Extension, Winston-Salem, N. C. 27106. Phone (919) 748-0505 [344]

300-V power op amp delivers up to ±150 mA

The PA08 and PA08A 300-V operational amplifiers have been designed to drive up to ±150 mA into resistive, capacitive, and inductive loads. The maximum available output power is a function of the load, but can be as high as 42 W into a resistive load when a single power supply is used. Internal thermal resistance is 6.5°C/W from junction to case for a maximum internal dissipation of 26 W at a junction temperature of 200°C. The op amps can operate with dual supplies between ±15 and

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WOLF LOESCHER
MANAGING DIRECTOR
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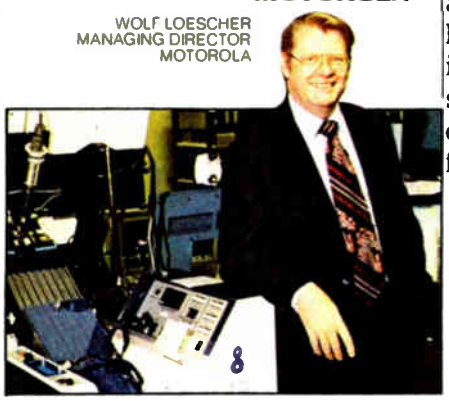

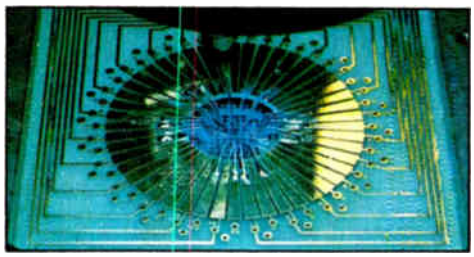

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MANAGING DIRECTOR
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Circle 225 on reader service card

±150 v and with single supplies from 30 to 300 v. Slew rate is 30 v/ms and gain bandwidth is 5 MHz. The price for 100 is $59 each for the PA08 and $69 apiece for the PA08A. Production quantities are delivered within four to eight weeks.
Apex Microtechnology Corp., 1130 E. Pennsylvania St., Tucson, Ariz. 85714 [345]

LCD shows both analog and digital information

A liquid-crystal display that shows both analog and digital information comes in a standard 0.9-by-2-in. package for use in instrument systems. The UCE 8624 has 14 horizontal bars over 3½ digits. The digits are 0.5 in. high in a seven-segment format with decimals. A National 3914 decade-bar or cursor driver may serve the analog display; an Intersil 7126 or other digital decoder driver may be used for the digital display. Prices vary with customer-specified configurations.
UCE Inc., 24 Fitch St., Norwalk, Conn. 06855. Phone (203) 838-7509 [346]

Membrane touch switches are backed by processor

The Electronic Packaged System (EPS) series of membrane touch switches includes a one-chip microprocessor and is supported by low-cost interface components. The microprocessor and such components as resistors and transistors are incorporated on a printed-circuit board behind the touch-panel TIP switch. Control and diagnostic functions can be designed into the EPS at the factory to suit a variety of end products. Since the polymer-membrane switches are configured to customer specifications, prices vary.
Oak Switch Systems Inc., P. O. Box 517, Crystal Lake, Ill. 60014. Phone (815) 459-5000 [347]

Seven-segment LED display measures 2 in. in height

The MC205107 is believed by its manufacturer to be the first 2-in.-high seven-segment light-emitting-diode display. The LED has a viewing angle of 90° and a luminous intensity of 50 millicandelas per segment at 0.10 A. It comes mounted on an epoxy-laminate circuit board in package configurations of one or more characters and delimiters with direct lamp connections or integrated support electronics. The colors available are red and amber. Decimal point, colon, and degree signs can be designed in.
Modern Information Methods, 2860 Bay Rd., Redwood City, Calif. 94063 [348]

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can program 2 kinds of patterns, 8 pcs each at one time!

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■ **PROGRAMMABLE U.V. EPROMs**

8K bit	2758	2708	
16K bit	2516	2716	
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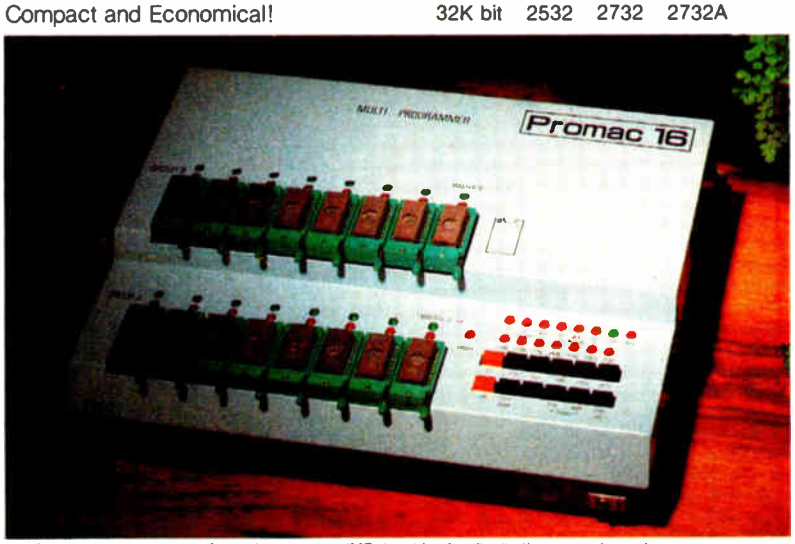

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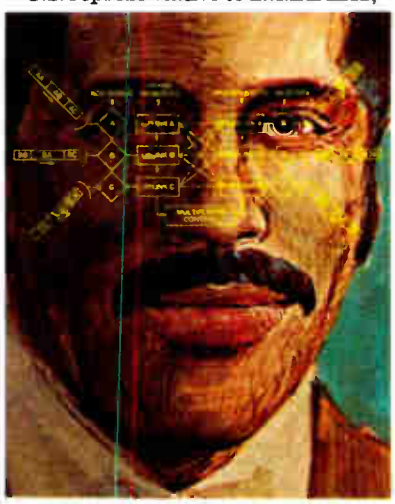

the most recent international communications organization providing satellite communications to the maritime community. COMSAT's latest projects include telecommunications products manufacturing, integrated CAD/CAM systems, domestic and global technical and support services, environmental monitoring, satellite-to-home subscription television. Additionally, COMSAT Laboratories performs supporting research and development in communications satellite technology and related areas.

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Semiconductors

Fast 16-K RAM idles on 75 mW

Power-miserly 55-ns static device self-tests, swaps in extra columns if faults found

A half-dozen semiconductor manufacturers are nearing production of 16-K-by-1-bit high-speed MOS static random-access memories. But the market for such parts is not infinite in size, so to capture the lion's share, an innovative product is a must.

Mostek's MK4167 innovates. With a 55-ns maximum access time and a 400-mW typical power consumption, it meets the requirements for high speed and low power dissipation. When the memory is deselected, power usage drops typically to 75 mW, and if the primary supply fails, the chip can be powered through its write-enable ($\overline{WE}$) pin on typically just 50 μA. Current is sourced through $\overline{WE}$ so that V_{cc}—the power source that has just failed—need not be gated. Mostek calls this battery back-up arrangement its Datasave mode [*Electronics*, Jan. 27, p. 129].

The device keeps active power use low with a sense amplifier that allows half-row selection. The die is partitioned into two arrays of 128 rows by 64 columns with sense amplifiers, like the one shown in the figure, down the middle. If this were an ordinary static RAM, all 128 cells in each row would be fed current during sensing, even though only one cell is selected. Because of the design of Mostek's sense amp, half of this wasted current is conserved.

The output of the row decoder goes high and a pulse of the precharge signal activates the gates of the row driver transistors on both sides. However, before a half-row line can go high, a clock on the transistor's drain must be asserted, and since ϕ_{right} and ϕ_{left} are decoded from the low-order address line, A_0, only half a row will be enabled at a time.

Once enabled, that half-row is kept high by a high-impedance load. Upon leaving the row, the row decoder's output falls, and the inverse of this signal drives two static pull-down devices that ground both half-rows. Despite all of this dynamic circuitry, the memory behaves as a fully static device.

To ease manufacturing and maximize yield, the device features a unique self-test mode and redundancy. The self-test mode pinpoints poor high-impedance loads on the row lines and poor active pull-ups in the clock circuits. In a third test mode the chip functions with half-row line voltages below the normal level, a procedure that decreases the stored voltage and detects marginal cells. Weak cells, once spotted, are replaced from two spare columns, one for each half-cell.

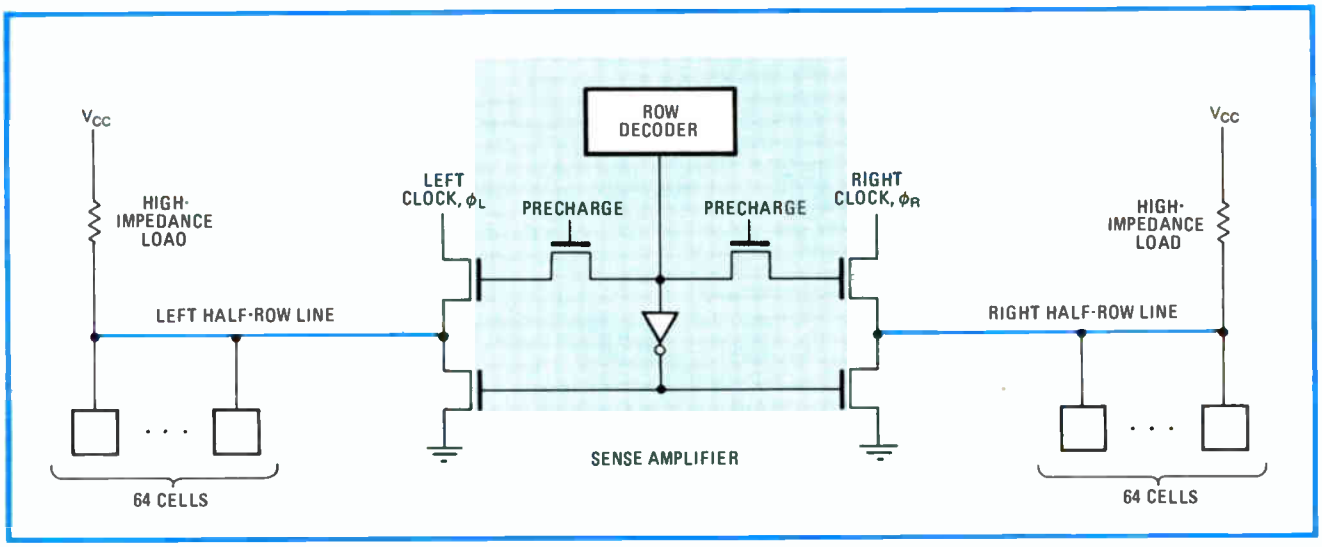
Confesses. Another first for this chip is the user's ability to determine which columns have been substituted. The user activates a roll-call function, as it is called, and cycles through each column address. The output of the chip will be high only if the column addressed is a spare.

Although volume production of the MK 4167 is not scheduled until later this year, samples may become available as early as next month. The 55-ns part will be priced at $71 in quantities of 100, and a 70-ns version will cost $64 in like lots.

Mostek Corp., 1215 W. Crosby Rd., Carrollton, Texas 75006. Phone (214) 323-6000 [411]

Signal-processing, -generation ICs are voltage-programmable

For use in electronic musical instruments, voice synthesis, and precision low-frequency test equipment, the CEM 3300 series audio-signal–generating and –processing integrated circuits feature accurate linear or exponential voltage control of their



Half at a time. The design of the sense amplifiers in Mostek's MK4167 16-K static random-access memory saves half the current needed to enable one entire row in a conventional RAM by selecting only half a row. A high-impedance load then keeps the half-row high.

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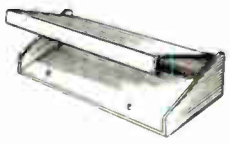

Various models have 12, 16, 53, 66, 67, 95, or 96 keys; 3 or 4 modes. Encoded boards have 7 data bits, 2-key roller and logic data resting high are standard features. Keyboard switches are thermoplastic nylon; alloy terminals and contacts.

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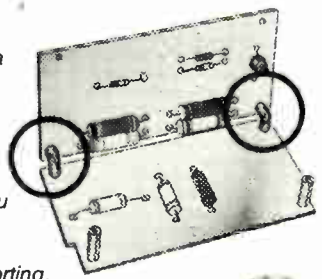

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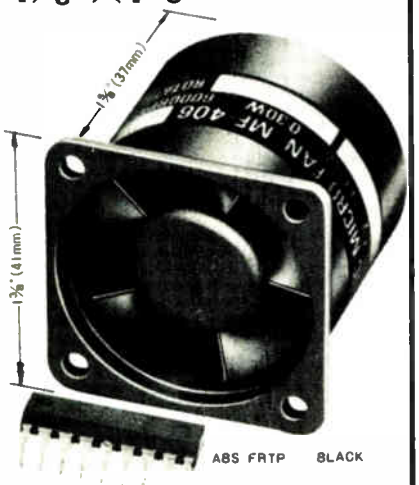
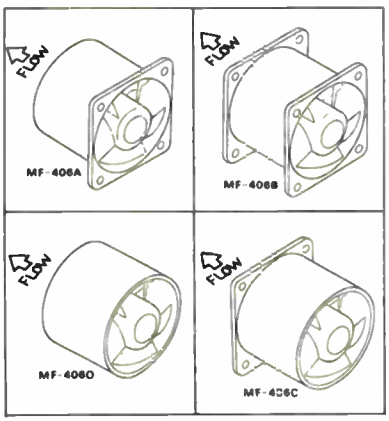
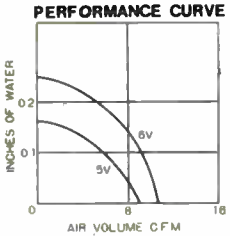




PERFORMANCE CURVE



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New products

functions over a wide range (10,000 times better than conventional units, says the manufacturer). The devices also feature low noise and distortion, low temperature drift, and low feedthrough of the control signal into the output.

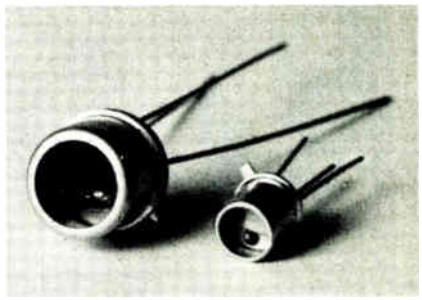
The CEM 3310 voltage-controlled envelope generator, on command from a logic signal, produces a transient waveform for sweeping amplifiers or filters. The attack, decay, sustain, and release portions of the waveform can be varied from 2 ms to over 20 seconds. Voltage feedthrough is 90 μV maximum. The CEM 3320 filter can produce any of several two- and four-pole responses. It has a pole-voltage sweep greater than 12 octaves and includes a fifth transconductor for controlling the amount of resonance. The CEM 3330 and CEM 3335 dual voltage-controlled amplifiers feature linear and exponential control of gain. The two independent amps have a distortion of less than 0.1% and better than −100-dB noise. A voltage-controlled oscillator, the CEM 3340, allows both the exponential and linear sweep of frequency over a 50,000:1 range. It generates buffered triangle, sawtooth, and voltage-variable pulse-width outputs, operating from 0.001 Hz to over 500 kHz.

The CEM 3300 devices come in 14-, 16-, or 18-lead dual in-line plastic or ceramic packages. Delivery is from stock in quantities less than 100 but takes 12 weeks for larger orders.

Curtis Electromusic Specialties Inc., 110 Highland Ave., Los Gatos, Calif. 95030. Phone (408) 395-3350 [413]

Silicon photodetectors are sensitive to blue light

With response near that of the human eye, a family of blue-sensitive silicon photodetectors is designed for photographic and photometer applications such as illumination and exposure meters and colorimeters. The short-circuit current output of the detectors, which operate with moderate reverse bias, is linear over



several decades of illumination. The devices come in both TO-18 and TO-5 hermetically sealed packages—models NSL-710BG and NSL-780BG, respectively. In 100s, the two models sell for $3.92 and $4.84, and in quantities of 1,000, they sell for $3.09 and $3.81, respectively.

National Semiconductors Ltd., 331 Cornelia St., Plattsburgh, N. Y. 12901. Phone (518) 516-3160 [414]

N-MOS chip controls stepper motor, serves as interface

The CY512 intelligent positioning stepper-motor controller serves as an interface between a keyboard or microprocessor system and any four-phase stepper motor. The chip can be programmed by the user with either ASCII-decimal high-level language commands and data or binary commands and data. It can either store a command sequence as a program for later execution or accept individual commands for immediate execution. The CY512 provides ramped step-rate capability in both absolute and relative position modes. It can handle up to 8,000 steps per second and has an external direction indicator line that provides TTL-level signals to show the direction of motion at all times.

The 40-pin device has 21 high-level, function-oriented instructions called up by single-letter labels (P for position and S for slope, for example). It uses a single +5-v power supply and is priced at $145 in single quantities. Delivery is off the shelf.

Cybernetic Micro Systems, 445-203 S. San Antonio Rd., Los Altos, Calif. 94022. Phone (415) 949-0666 [415]

WHY NEW YORK IS A SOLID STATE FOR THE ELECTRONICS INDUSTRY.

Look at what New York State offers the electronics industry, and you'll agree: It's more profitable to do business in New York State.

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Microcomputers & systems

Drive mates with microcomputers

5¼-in. Winchester disk drive is packaged to interface with several small computers

Hard on the heels of its introduction, the first 5¼-in. Winchester disk drive from International Memories Inc. [*Electronics*, Jan. 27, p. 55] has already been packaged with a controller, an interface, and the software necessary to make it a complete disk system. Corvus Systems Inc., which did the packaging, is actually offering a family of such drives, each tailored to the interface requirements of a different microcomputer system. The packaged drives have in common a 6.9-megabyte capacity (5.8 megabyte formatted), a minimum seek time of 10 ms, average seek and latency times of 50 and 8.3 ms, respectively, and power consumption of 120 W.

Different members of the model 5 family will interface directly with the most popular microcomputers, such as the TRS-80 models 1 and 2, Apple models 2 and 3, Altos, Alpha Micro, Intertec Superbrain, NEC PC-8001, and Ontel computers, as well as all S-100–bus-based computers running under CP/M or Oasis. Each of these is priced at $3,750 in single units; another version, the 5L, interfaces with Digital Equipment Corp.'s LSI-11 series and costs $4,250 in single units.

Corvus is also currently developing interfaces for the TRS-80 model 3, the Commodore Pet, Zenith Z-89, Atari 400 and 800, and HP-85 computers. The model numbers of the drives reflect the microcomputers with which they interface. Thus, for an Apple computer, the appropriate drive is model 5AP, for Altos, the model 5AL, and so on.

The system package includes the drive itself, which has dimensions compatible with the form factor of a standard 5¼-in. floppy-disk drive; an intelligent, Z80-based controller card; an intelligent interface card with firmware; and the software appropriate for interfacing with a given microcomputer. Each drive also has a power supply adaptable to a variety of line standards.

The 5L version directly emulates DEC's RL01 cartridge tape drive and appears to the LSI-11 bus as a DEC RLV11 option in control of a single cartridge disk drive. The interface card in the 5L connects the LSI-11 bus and the Corvus bus, which in addition to data paths includes all necessary control lines for the disk interface.

Each of the drives is compatible with the Corvus Mirror, a video-cassette-recorder backup method that can load a VHS cassette with 120 megabytes at 1 megabyte per minute. The drives may also be used with the Constellation, a local network whose host multiplexer allows up to 64 microcomputers to communicate with each other and to share peripherals. In the case of LSI-11s, eight systems can be linked.

First deliveries of the model 5 disk systems will begin this month, with volume deliveries scheduled for the second quarter.

Corvus Systems Inc., 2029 O'Toole Ave., San Jose, Calif. 95131. Phone (408) 946-7700 [371]

Array processor handles over 4 million pixels

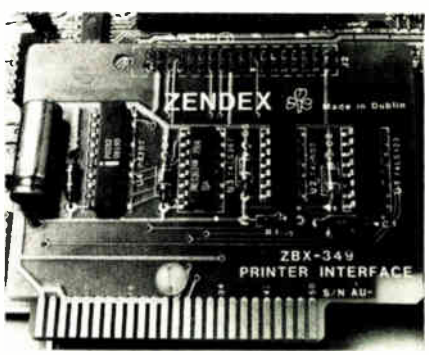
Compatible with Digital Equipment Corp.'s PDP-11 or VAX systems, the IP8500 image array processor extracts high-resolution color or monochromatic displays from up to 20 512-by-512-by-8-bit memories. A fully configured IP8500 system can store a 1,024-by-1,024-by-32-bit image with graphics and alphanumerics on a 512-by-512-by-32-bit window. Up to twenty 512-by-512-by-8-bit memories can be organized under software control to store a 4,002,304-picture-element monochromatic image (2,048 by 2,048 pixels), for example.

The IP8500 is designed for such remote-sensing and three-dimensional computer graphics applications as Landsat, aerial infrared photography, processor-control synthesis, multi-image comparison, and movie-like animation. Intensity, zoom, and scroll on any configuration of the logical image space are fully supported by the processor. The typical price for a single-user system will be approximately $70,000.

DeAnza Systems Inc., 118 Charcot Ave., San Jose, Calif. 95131 [373]

8080-based microcomputers get line printer interface

An Intel SBC-80/10B or /24 or a Zendex-80/05 single-board microcomputer based on the 8080 can now run a Centronics line printer. The ZBX-349 printer interface, a single-board module, plugs directly into the microcomputer's connector and is bolted to the card with hardware supplied by the manufacturer. An 8-ft-long cable connects the 50-pin edge of the ZBX-349 interface to the 8-bit parallel connector of a Centronics line printer. No hardware or



software modifications are necessary. The module is available for $190 per unit and delivery is from stock to four weeks.

Zendex Corp., 6680 Sierra Lane, Dublin, Calif. 94566. Phone (415) 829-1284 [375]

TM990 16-bit computer obtains IEEE-488 interface

The TM990/314 single-board module interfaces the TM990 16-bit computer module with an IEEE-488 general-purpose interface bus so it can be connected to digitally controlled instruments. By putting a TM990/314 module into each computer in a system, the module can also serve as a communications link, becoming in effect a high-performance, multidrop communications bus. The module features direct memory access and a self-diagnostic mode. Its maximum data rates are 200-K bytes/s in the receive mode and 180-K bytes/s in the send mode. The single-unit price is $785. Demonstration software for verifying the correct operation of the TM990/314 board comes on two erasable programmable read-only memories and sells for $90.

Texas Instruments Inc., P. O. Box 225012, M/S 308, Dallas, Texas 75265 [376]

Interactive CRT terminal adds onto microprocessor emulator

To make it easier for a designer to view a microprocessor's contents or a system's status, an interactive cathode-ray-tube terminal display has been added to Millennium's MicroSystem Emulator. The terminal connects to an auxiliary RS-232 port in the emulator and displays up to 24 lines of information at a time, so that more status data can be viewed in fewer steps. For example, all the register contents of the targeted microprocessor can be displayed at a single stroke. The CRT displays blocks of memory or 23 lines of real-time trace memory at one time. In addition, registers, memory locations, and input/output ports can be displayed automatically whenever execution is halted.

Also available is an optional 8-K bytes of random-access memory to extend the mappable memory of the MicroSystem Emulator so users can debug larger program modules in their systems.

For current users of the MicroSystem Emulator who want to add the CRT terminal capability, the cost will be $2,000. This includes the additional 8-K bytes of RAM. A new emulator with the CRT terminal will sell

for $5,250, and the 8-K-byte RAM will cost $1,000.

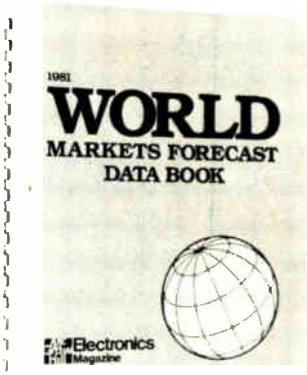
Millennium Systems Inc., 19050 Pruneridge Ave., Cupertino, Calif. 95014. Phone (408) 996-9109 [378]

HP 64000 logic-development system is expanded

The model 640005S emulation-terminal system transfers the real-time, functionally transparent emulation and analysis features of a 64000 development system to a user's own computer. Also coming soon for use in the 64000 are Pascal compilers and real-time emulators for the 6802, 6809, and 68000; the Z8001 and Z8002; and the 8086 and 8088, as well as a compiler for the 6800 and an emulator for the 8048. Prices are not available yet.

Hewlett-Packard, 1501 Page Mill Rd., Palo Alto, Calif. 94304 [379]

RESEARCH



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Computers & peripherals

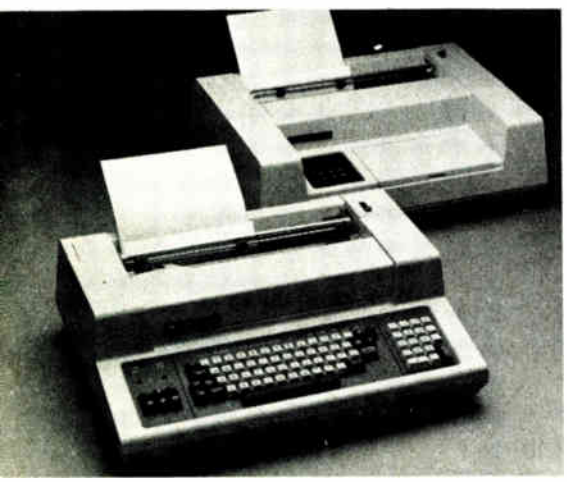
Matrix printer starts at $1,200

132-column impact printer's keyboard option makes it a fully interactive terminal

Joining the ranks of low-cost, low-speed printers are two 132-column 7-by-9-dot-matrix printers from Texas Instruments. One, the 840KSR, has a keyboard and can transmit as well as receive data. Both impact printers produce hard copy at 75 characters per second; the 840KSR is priced at $1,345 (with keyboard) and the 840RO at $1,195 (without) in single units.

The KSR model (keyboard send-receive) is designed for use as an interactive timesharing terminal, carrying out input/output functions for both mini- and micro-computers. Both friction-feed printers can be operated remotely, both have a 256-character data buffer, a 32-character nonvolatile memory accessible by the operator, selectable international character sets, and 33 control-character print symbols.

The printers also come with self-diagnostics that run on power-up. Snap-in ribbon cartridges with life expectancies of 2 million and 7 million characters are available. The latter, a re-inking ribbon cartridge, is standard on the RO (read-only) model, but the cartridges are interchangeable.



The units' serial interfaces conform to EIA RS-232-C or CCITT V.24 standards. The base units have selectable data-transfer rates of 110, 200, 300, and 600 b/s, but higher rates are available. The option package recommended for timesharing applications includes 1,200 to 9,600 b/s rates, an extra 2,000-character buffer, a numeric keypad, and an RS-232 cable. These options raise the KSR's price to $1,735.

A forms-preparation option package gives the printer forms control, a tractor-driven paper feed for multiple copies, and paper-out detection (in the RO model). With this package, the RO costs $1,415 and the KSR is $1,590. Other option packages are available, as well as single options. Delivery is set for June.

Texas Instruments Inc., P. O. Box 202145, Dallas, Texas 75220. Phone (713) 373-1050 [361]

Card stores 1 megabyte for PDP-11/44 minicomputer

A semiconductor memory for use in PDP-11/44 minicomputers, the Pincomm 44S memory module puts up to 1,024-K bytes of storage on a single card. The memory is also available in 512-, 256-, and 128-K-byte increments. All versions are compatible with the regular or extended Unibus in systems other than the PDP-11/44. Either 64-K-by-1-bit or 16-K-by-1-bit MOS dynamic random-access memories are used, depending on the capacity required.

The memory is compatible with Digital Equipment Corp. diagnostics, although its own diagnostics provide a full functional check of the data and error-correction circuits. Random-access memories on the board include two spares and fit into sockets rather than being soldered on. The memory can be switched off line to aid in troubleshooting and can be interleaved with another memory of equal size.

Memory organization of the Pincomm 44S is 39 bits wide, consisting of two 16-bit data words plus 7 check bits. The check bits make possible single-bit error correction and double-bit or multiple-bit error detection. The 256-K-byte version of the Pincomm 44S is priced at $3,995; the 1,024-K-byte version is $13,440 in single units. Quantity discounts are available, and delivery is from stock to 30 days.

Standard Memories Division, Trendata Corp., 3400 W. Segerstrom Ave., Santa Ana, Calif. 92704. Phone (714) 540-3605 [366]

Interactive video display terminal costs $699 in 100s

An interactive cathode-ray-tube terminal, the Dialogue 30, has a separate keyboard with the full set of 96 ASCII characters, plus 21 control characters and 11 characters for line drawings; yet it sells for only $699 in quantities of 100 to 249. The data format is 24 lines by 80 characters. The characters use a six-by-eight-dot matrix and have descenders for readability.

The Dialogue 30 operates on line or in the local or monitor modes with full- or half-duplex communication protocols, using an RS-232-C asynchronous interface for data rates up to 19.2 kb/s. It automatically tests all functions on turn-on. A standard programmable serial printer port and a numeric pad are included, as are such user-friendly features as a non-glare display, key tops that ease eye strain, and quiet operation due to the absence of a cooling fan.

Deliveries begin in June. Discounts are available for larger-quantity orders; for example, in 1,000s the terminals sell for $599 apiece.

Ampex Corp., 200 N. Nash St., El Segundo, Calif. 90245. Phone (213) 640-0150 [363]

Switch for high-speed storage control has 16-by-24 matrix

With a matrix of 16 by 24, or 384, cross points, an addition to the system 100 series of computer and

peripheral switches is the largest matrix switching system available for use with IBM's high-speed disk-storage control units, says its manufacturer.

Three other new matrix sizes are also being announced: 16 by 8, 16 by 12, and 16 by 16. All offer solid-state circuitry, self-diagnostic capability, and high-speed switching. The switches can handle data-transfer rates of up to 3 million characters per second and, thanks to the high-speed switching of matrix nodes, control units may be dynamically reconfigured while the channel remains active, without stopping the computer. A diagnostic display panel monitors all channel data passing through the entire switch system.

Data/Switch Corp., Landmark Square, Norwalk, Conn. 06851. Phone (203) 853-3330 [364]

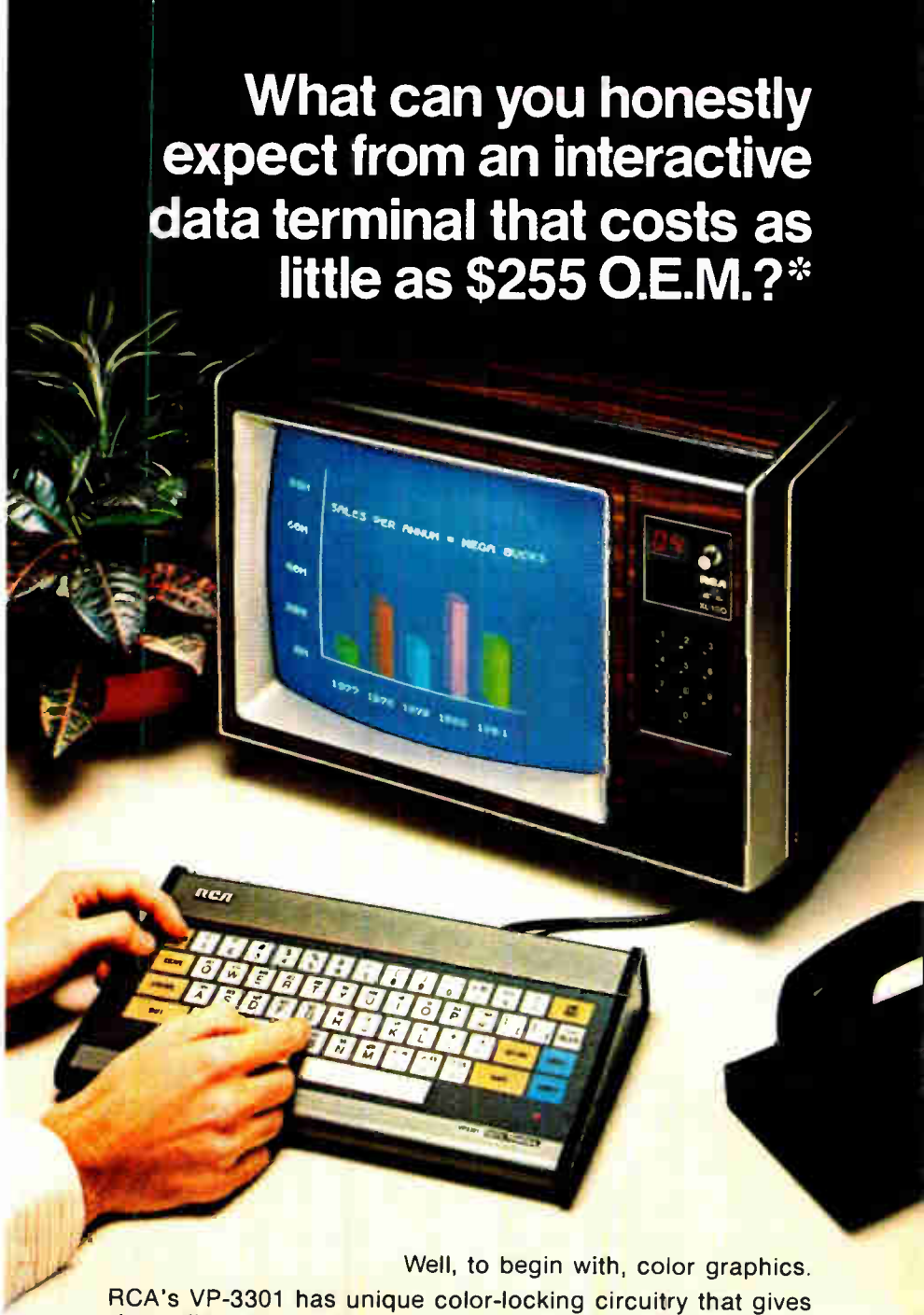
Graphics display system has CAD/CAM capabilities

The 1351S graphics display system combines a powerful graphics generator with a high-resolution, large-screen X-Y display to provide the complex drawing capabilities required for computer-aided design and manufacturing (CAD/CAM). The system consists of an HP model 1351A graphics generator and an HP model 1311B 14-in. directed-beam electrostatic display with tilt stand. The unit has a standard IEEE-488 interface or optional RS-232-C or 16-bit parallel interface bus. The display is continuously refreshed by the graphics generator so the computer or controller it is connected to is free to process or collect data.

The display addresses and displays 1,020 by 1,020 points on the cathode-ray tube using both alphanumeric and vector presentations. It also has 32-K bytes of memory. A display management capability allows the 1351S to put different information on as many as four displays. Prices start at $10,450 and deliveries take six to eight weeks.

Hewlett-Packard Co., 1501 Page Mill Rd., Palo Alto, Calif. 94304 [365]

What can you honestly expect from an interactive data terminal that costs as little as $255 O.E.M.?*



Well, to begin with, color graphics.

RCA's VP-3301 has unique color-locking circuitry that gives you sharp, jitter-free color graphics and rainbow-free characters.

Plus much more: Microprocessor control. Resident and programmable character set. Reverse video. State-of-the-art LSI video control. 20 and 40 character formats. RS232C and 20 mA current loop. Six baud rates. Eight data formats. ASCII encoding. Light-touch flexible-membrane key switches for reliability and long life. CMOS circuitry and a spill-proof, dust-proof keyboard for hostile environments.

The VP-3301 can be used with a 525-line color or monochrome monitor or a standard TV set through an RF modulator.** It serves a wide variety of industrial, educational, business and individual applications including communication with time sharing and data base networks.

All this—for as little as $255. And it's made by RCA. So get the whole story about the surprising VP-3301 today. Write RCA MicroComputer Marketing, New Holland Avenue, Lancaster, PA 17604. Or call toll-free: 800-233-0094.

**Model VP-3303 with *built-in* RF modulator—$270. O.E.M.
*Quantity price. Monitor and modem not included.

RCA

Circle 235 on reader service card

Power supplies

Dc-dc units have 2:1 input range

Members of power-converter family are 72% efficient over specified ranges

The 153-member DCS family of dc-dc converters wraps a wide assortment of input and output ranges and other features in 30-, 50-, and 100-W packages. The converters accept three 2:1 input ranges—9 to 18, 18 to 36, and 36 to 72 V. Maintaining efficiency over such wide ranges is not easy: the DCS modules perform quite respectably at 72% efficiency, a figure that varies less than 3% over each model's input range [*Electronics*, Feb. 24, p. 261].

In each power rating a DCS unit is available with outputs of 5, 12, 15, 24, 28, ±12, ±15, or ±18 V in single-, double-, or triple-voltage output options. In all, 17 different output configurations are possible.

The external synchronization input, if used, reduces overall system noise when the DCS converters are run at 18 to 22 kHz on a system clock, and an external disabling signal (also provided for) will minimize power use. Both features require only a TTL signal at 20 mA. A disable command places a DCS converter in a standby mode with output at 0 V and power dissipation of 0.75 W. Soft start returns the module to normal operation.

The temperature coefficient of the primary output is 0.1%/°C. For that output, line regulation is 0.2% over the full input range, and load regulation is 0.2% from 10% to 100% load. Maximum baseband noise is 15 mV peak to peak at 20 kHz. Input-to-output isolation is 1,500 V. All specifications are guaranteed for the full operating-temperature range of −25° to 70°C. Various members of the family may be connected in parallel for increased current capacity.

Standard on each DCS converter

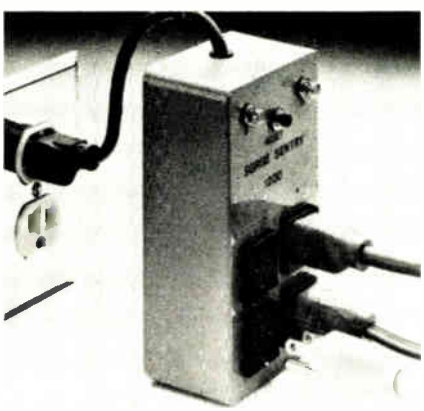
are four front-panel light-emitting diodes that indicate operating status; also standard are input and output protection with automatic recovery and partial regulation of derived outputs. Optional features include fully regulated derived outputs, panel mounting, and extended input ranges.

Prices for the DCS series converters run from $219 to about $450, with discounts available to original-equipment manufacturers. Delivery takes four to six weeks. An eight-page design guide is available upon request.

Intronics Inc., 57 Chapel St., Newton, Mass. 02158. Phone (617) 332-7350 [381]

Power surge controller dissipates 600 kW in 100 μs

The Surge Sentry power surge control device is designed to protect electronic equipment by shutting it off when the voltage on the power



line drops to a low value or zero and then suddenly surges on again. The model SS-120-D detects even short surges and shunts away potentially damaging voltages within picoseconds. On its front panel, a small neon light indicates when a power surge occurs, a reset button restores power, and four 120-V receptacles make it possible to protect as many pieces of equipment at one time. The unit has a rated dissipation of up to 600 kW within 100 μs. It sells for $132.50.

RKS Enterprises Inc., 643 South 6th St., San Jose, Calif. 95112. Phone (408) 288-5565 [383]

200-W switching supply is UL-recognized

Recognized by Underwriters Laboratories, the triple-output model 20E5/±12 belongs to a line of 200-W multiple-output switching power supplies. It has outputs of 5 V at 30 A and ±15 V at 1 A and inputs of 100 to 132 V ac and 200 to 260 V ac. Line and load regulation for the 5-V output are 0.2% and 0.3% of full scale, respectively. Auxiliary outputs exhibit a 0.1% line regulation and a 1% maximum load regulation over specified input and load ranges. Ripple and noise for all outputs are limited to 30 mV. The 20E5/±12 features overload and overvoltage protection for the main inverter, reverse polarity protection, logic inhibit, soft start, remote sensing, and remote sense protection.

In quantities of 1 to 10, the triple-output model 20E5/±12 sells for $240. Quantity discounts are available to original-equipment manufacturers. Delivery is off the shelf.

Nortel Ltd., 31149 Via Colinas, Bldg. 608 Westlake Village, Calif. 91361. [384]

32-output high-voltage system is microcomputer-controlled

The Bertan high-voltage enclosure, controlled by an internal dedicated microcomputer with software in

read-only memory, has up to 32 individual 3- or 7.5-kV outputs. Voltage settings and voltage and current limits can be individually set for each output either from the front panel or remotely through an RS-232-C or an optional IEEE-488 bus. Called the B-Hive, the unit allows both 3- and 7.5-kV plug-in modules of either positive or negative polarity to be mixed in any order. It automatically identifies the modules and initiates the appropriate protecting and operating routines.

The system can be used to control standard Bertan programmable power supplies with voltage outputs to 50 kV and up to 225 W of power. It has a line and load regulation of 0.001% and 0.005% of full scale, respectively; a ripple of less than 100 mV peak to peak at full output; maximum outputs of 3 kV at 3 mA dc or 7.5 kV at 1 mA dc; and a temperature coefficient of 50 ppm/°C over the range of 0° to 50°C.

Housed in a 19-in. rack-mountable enclosure $6^{31}/_{32}$ in. high by 20 in. deep, the B-Hive is priced at $2,935 and up.

Bertan Associates Inc., 3 Aerial Way, Syosset, N. Y. 11791. Phone (516) 433-3110 [385]

Sine-wave inverters offer dc-to-sinusoidal-ac conversion

The Powermark series Z sine-wave inverters convert dc power into sinusoidal ac power using a ferroresonant transformer. The inverters provide primary-to-primary isolation, a high degree of noise isolation, current limiting, precise waveform shaping, and inherent static voltage regulation. Available in 50- and 60-Hz models, the inverters have power ratings ranging from 200 to 2,000 VA. They feature output of 115 V ac or 115/230 V ac, a line regulation of 1% maximum for line variations between low line and high line, and overload and short-circuit protection. Prices begin at $1,065.

Topaz Inc., Powermark Division, 5577 Kearny Villa Rd., San Diego, Calif. 92123 [386]

100-W switcher uses LSI control for extra features

In a series of low-power 100-W open-frame switching power supplies, a custom large-scale integrated control chip not only increases reliability by reducing the component count but also protects the main output against overloading, detects power failures, adds remote sensing to the main input, and provides logic-controlled inhibition for electronic shutdown of outputs.

The 16 models in the Teeny Tiny-Mite (TTM) series weigh a maximum of 3 lb and are housed in a 9-by-4.87-by-2.75-in. anodized chassis. They operate at 40 kHz rather than the traditional 20 kHz and are 50% more efficient than otherwise comparable single-output linear units, says the manufacturer.

The supplies have an input range of 85 to 130 V ac and two to five outputs ranging from 5 V at 12 A to 24 V at 2 A that remain in regulation for 20 ms in case of nominal ac power failure. The switchers' passive voltage-sequencing function, which operates between −5 V and +12 V, makes them useful in memory applications.

The TTM units range in price from $205 to $275 depending upon configuration.

LH Research Inc., 14402 Franklin Avenue, Tustin, Calif. 92680 [387]

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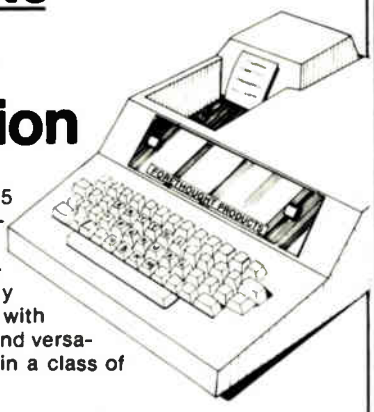

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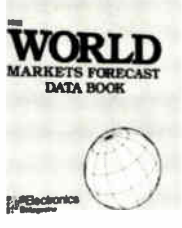

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Products Newsletter

Zilog's 4-K-by-8-bit quasi-static RAM self-refreshes

A 4-K-by-8-bit quasi-static random-access memory that performs and controls its own refreshing, **effectively acting as a static RAM,** is available from Zilog Inc., Cupertino, Calif. The Z6132 n-channel MOS RAM sells for $39, $40.75, and $43.25 in versions with 350-, 300-, and 250-ns access times, respectively. It operates from a single +5-V supply and conforms to the Z-Bus specification used by the Z8000 microprocessor and Z8 single-chip microcomputer families.

64-K dynamic RAMs come on strong

With a $1 billion market estimated by 1984, manufacturers of 64-K dynamic random-access memories are getting prolific with announcements of availability. **Advanced Micro Devices Inc.,** Sunnyvale, Calif., has evaluation models of its n-channel MOS RAM, the Am9064, and plans to market it this fall. The 2164 from **Intel Corp.,** Aloha, Ore., is available with 150-, 200-, or 250-ns access times for $81.20, $64.95, or $52 apiece respectively, in orders of 100. Finally, **Toshiba America Inc.,** Irvine, Calif., has its TMM4164C ready with access times of 120, 150, and 200 ns priced at $49, $39, and $29, respectively, each in 100-unit quantities.

NS16000 family of microprocessors is ready in samples

National Semiconductor Corp., Santa Clara, Calif., will have samples ready this spring of the first member of its NS16000 family of microprocessors fabricated in the short-channel n-MOS process it calls X-MOS. With a 32-bit internal architecture and a 16-bit external data bus, the NS16032 central processing unit can **directly address up to 16 megabytes of memory with its 24-bit address bus.** Also coming by year-end are a clock generator, memory management unit, interrupt control unit, and CPU with 16-bit address and data buses.

DG enters graphics market, beefs up 32-bit Eclipse

With its Dasher G300 **graphics display terminal and Trendview chart-generation software package,** Data General Corp. of Westboro, Mass., is entering the computer graphics market. The display offers polar-coordinate plotting, arc drawing, filled geometrical shapes, relative positioning, user-defined line styles, and a variety of text-plotting formats. It can be delivered in 90 days for $7,400 or less. DG also has upgraded its 2-megabyte **Eclipse MV/8000 computer to offer 3 or 4 megabytes of main memory** for larger resident programs and faster operation.

Avocet Systems expands line of CP/M cross assemblers

Avocet Systems now offers **microprocessor cross assemblers for nine of the most popular chip families.** The Dover, Del., firm has added to its XASM line units that handle the Motorola 6809, the Intel 8051, MOS Technology's 6502 and 650X, the Fairchild F8, the Mostek F8/3870, and the National COP400 families. All the cross assemblers run on 8080- and Z80-based computers under CP/M and cost $200 each.

Medium-sized computer added to Perkin-Elmer line

To fill a hole in its computer line, Perkin-Elmer Corp.'s Computer Systems division in Oceanport, N. J., is bringing out a 32-bit model 3230, competitive in power with Digital Equipment Corp.'s VAX-11/780 but priced near the VAX-11/750. The 3230's **basic central processing unit is under $47,000.** With half a megabyte of main memory, 80-megabyte disk drive, operating system, and three terminals, it costs $100,000.

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Career outlook

The IEEE pursues education

■ In Richard W. Damon, the Institute of Electrical and Electronics Engineers has a technologically oriented president for 1981. When he is not working on business for the IEEE, he is director of the applied physics laboratory at Sperry Corp.'s research center in Sudbury, Mass., and has put engineering education high on his list of priorities for the coming year.

Damon has asked for a review of the educational activities board and wants the IEEE to develop a long-range plan for education. As an example he cites the improved accreditation procedures adopted by the Accreditation Board for Engineering Technology. "I want to put major emphasis on continuing education. In no way can an engineer have a lifelong career without continuing education," he points out. "The IEEE has a responsibility to provide that to its members by offering self-study programs and courses developed outside of the Institute."

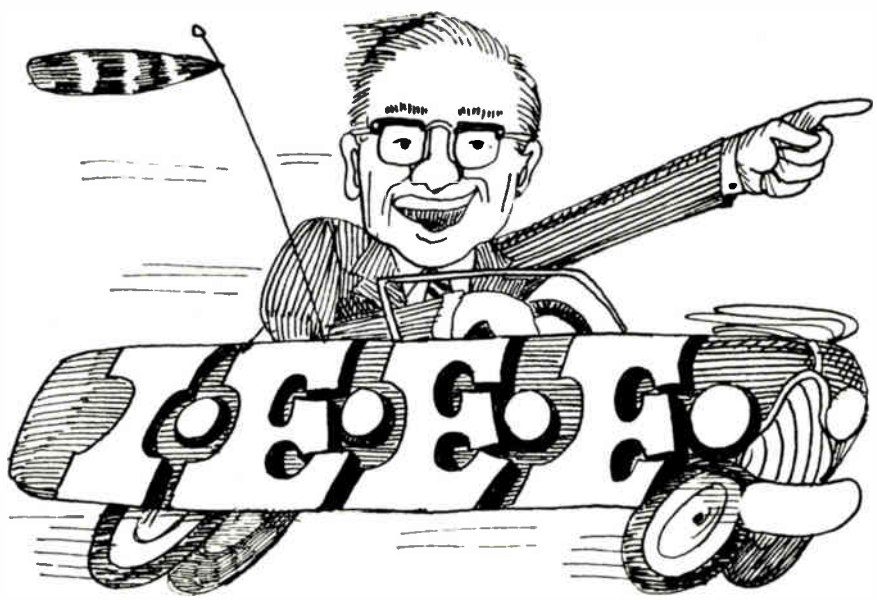
As part of this engineering education, Damon believes that the Institute should be more responsive to members' needs for industry news, and he has advocated that each society publish its own magazine. "There's a need to increase the number of applications-oriented papers we publish," he says. To that end, magazines on circuits, computers and micrographics, and communications are soon due off the presses.

Regarding undergraduate schooling, Damon notes, "an engineering education is the best one a student can have today. Our whole economy and society depend on solving technical problems. In Japan, 20% of the undergraduate student population is in engineering; but in the U. S., it's only 5%," he says.

For solving those problems, "some engineers don't make good managers, but many do. There have been quite a few high-level managers drawn from the ranks of engineers," he adds.

Damon believes that industry and university cooperation in the area of educating engineers is very important, and although the IEEE has yet to define a position on the subject, he thinks it should have a role to play. "Universities are hard pressed for equipment. Add to that the fact that students who ought to go on to graduate school are discouraged from it because of the high salaries offered by industry," he observes. "It is in industry's self-interest to ensure the facilities are well equipped to produce the needed people and to maintain an engineering standard. I see the IEEE, academicians, and industry people coming together to help solve some of these problems," he points out.

-Pamela Hamilton



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