DECEMBER 15, 1981

SYSTEMS ON CHIPS STAR AT ISSCC/97

Ethernet controller links Unix-based machines/ 133

Solving the complex problems of ECL board testing/ 146

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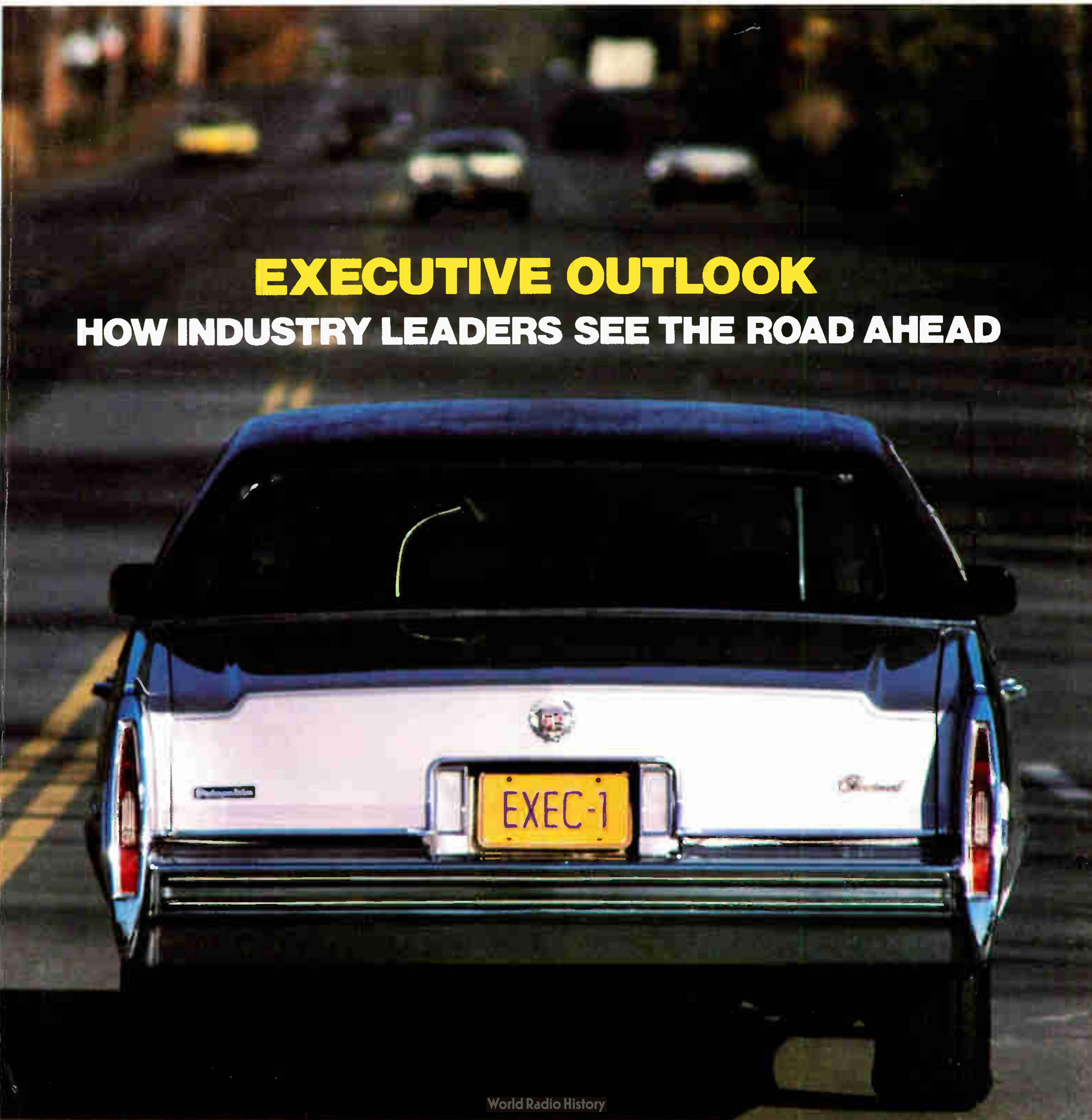
Electronics®

EXECUTIVE OUTLOOK

HOW INDUSTRY LEADERS SEE THE ROAD AHEAD



CIRCUIT BOARD TESTING: SHOULD IT BEGIN IN PRODUCTION OR IN THE LAB?

Some successful companies charge production with the responsibility for developing test procedures. Others give the job to the design lab. And with many it's a shared responsibility.

However, if these methods were decided by the standards of yesterday's technology, you may increase today's productivity with a different approach. Consider these points:

Testing options begin in the lab. With today's product designs using microprocessors, memory and other LSI circuits, the question "How to test?" will arise long before a design is released to production. When asked in the hardware/software definition phase, electronic manufacturers can opt for one of three approaches: 1) Not to design for testability, thus leaving test development responsibility to production. 2) Design for go/no-go self test, covering a "critical" subset of board functions, and leaving fault isolation to skilled technicians in production as well as the field. 3) Design for thorough self test, including diagnostics, which facilitate fault isolation, thus providing a total test solution for R&D, production and field service.

Can you afford to design for testability? Let's take a look at the trade-offs. Option 1 appears to offer the shortest design cycle. However, the designer will probably take longer than planned in design turn-on. And design follow-up with production often takes more effort than expected. Longer production test development time is also likely to delay shipments.

Designing in a go/no-go self test (option 2) solves some of the problems associated with option 1. However, a limited self test may still lead to failures at system turn-on. And without fault isolation, expensive technician time will be needed in production and field service.

At first glance, option 3 may seem to require too much of the designer's time. However, the payback can be significant in reduced debugging time and enhanced test effectiveness. After all, the designer best understands the product structure and critical aspects of its operation. And the designer has the tools and the opportunity to implement design features often required for high fault-coverage testing of complex LSI circuitry.

A decision that impacts production most. Whatever the decision, production will feel its effect most. A balance must be found between design time and a viable board test solution. HP provides that balance with the 3060A Board Test System. Equipped with the High Speed Digital Functional Test Option (HSDFT), it delivers the flexibility to solve your μP and LSI board testing problems whether you design for testability or not.

For example, the 3060A can activate μP-based, designed-in stimulus firmware and measure the dynamic board response using Signature Analysis. If self-stimulus isn't available you can use the HSDFT programmable stimulus capability (Figure 1).

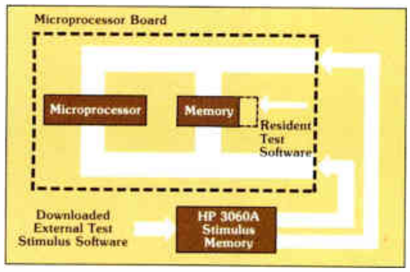


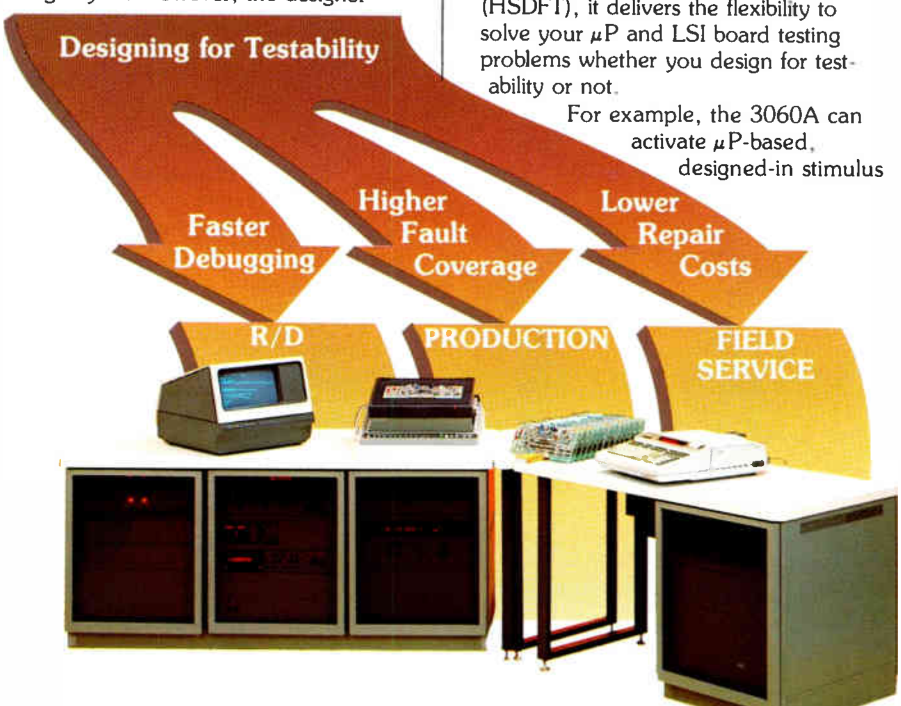
Figure 1 — The 3060A can activate resident test stimulus software or provide that stimulus from its own RAM.

Test stimulus software developed for design turn-on can even be leveraged for production test by downloading from your design system (such as the HP 64000) into 3060A stimulus RAM. Or, alternatively, HP's 3060A Digital Functional Test software provides easy-to-use stimulus and measurement programming procedures.

For fault isolation, the 3060A HSDFT software provides automatic backtracking via in-circuit visibility on the basis of a topological description of the board. And, these procedures can be used as the basis for effective field service repair using HP Signature Analysis instrumentation (HP's 5005A).

The bottom line? Rapid software development, thorough testing, high throughput and efficient field troubleshooting — the complete solution. That's worth investigating.

For more information. Let HP help you optimize your investment in design, test and service. Write Hewlett-Packard, 1820 Embarcadero Road, Palo Alto, CA 94303. Or call the HP regional office nearest you: East (201) 265-5000, West (213) 970-7500, Midwest (312) 255-9800, South (404) 955-1500, Canada (416) 678-9430.



HP Circuit Testers— The Right Decision

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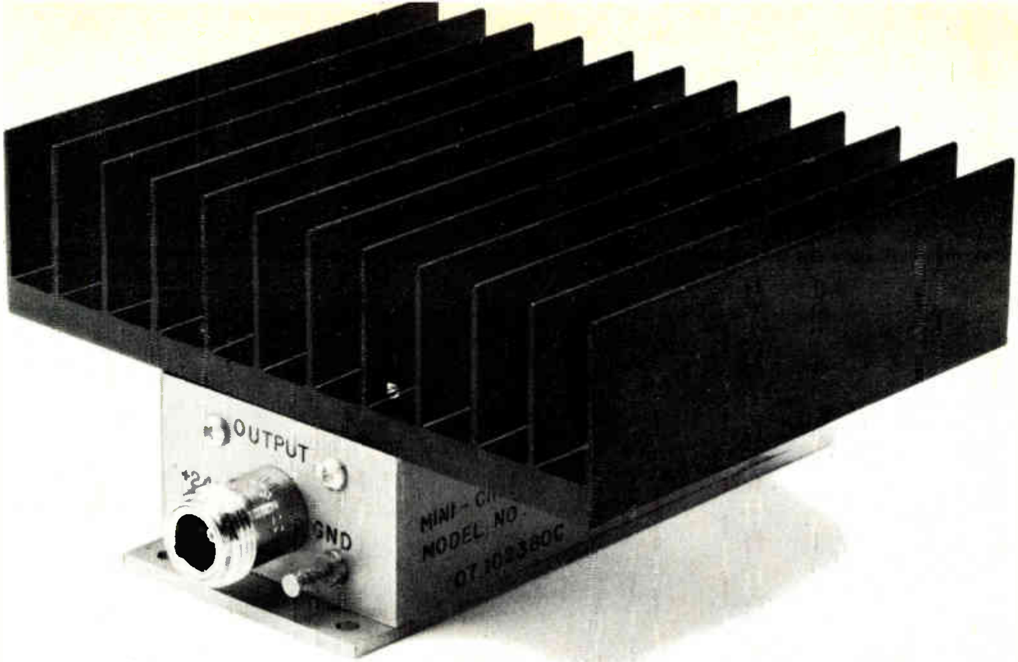

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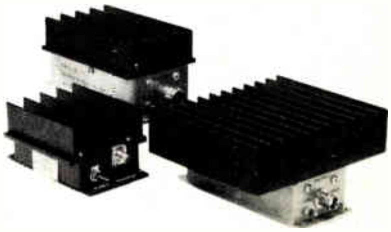

* Model No.	Freq. MHz	Gain dB	Gain Flatness dB	Max. Power Output dBm 1-dB Compression	Noise Figure dB	Intercept Point 3rd Order dBm	DC Power Voltage	DC Power Current	Price $ Ea.	Price Qty.
ZHL-32A	0.05-130	25 Min.	±1.0 Max.	+29 Min.	10 Typ.	+38 Typ.	+24V	0.6A	199.00	(1-9)
ZHL-3A	0.4-150	24 Min.	±1.0 Max.	+29.5 Min.	11 Typ.	+38 Typ.	+24V	0.6A	199.00	(1-9)
ZHL-1A	2-500	16 Min.	±1.0 Max.	+28 Min.	11 Typ.	+38 Typ.	+24V	0.6A	199.00	(1-9)
ZHL-2	10-1000	15 Min.	±1.0 Max.	+29 Min.	18 Typ.	+38 Typ.	+24V	0.6A	349.00	(1-9)
ZHL-2-8	10-1000	27 Min.	±1.0 Max.	+29 Min.	10 Typ.	+38 Typ.	+24V	0.65A	449.00	(1-9)
ZHL-2-12	10-1200	24 Min.	±1.0 Max.	+29 Min.*	10 Typ.	+38 Typ.	+24V	0.75A	524.00	(1-9)
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Electronics

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Highlights

Cover: Industry leaders see recovery, but a tough year, 122

In its worldwide survey for the annual Executive Outlook on economic conditions, *Electronics* finds a general expectation of a turnaround in 1982, but disagreement on the timing. The Reagan Administration's long-range economic plans also wins praise from many, and competing in world markets is getting renewed attention from executives in every country.

The cover design is by Art Director Fred Sklenar; the photograph is by Jim Lukoski.

Circuits conference marks maturing of VLSI, 97

Next February's International Solid State Circuits Conference will include papers on a broad spectrum of very large-scale integrated circuits, indicating beyond question that VLSI technology is now the mainstream of solid-state design around the world.

Controller plus software add up to Ethernet link, 133

New interconnection tools, notably a network controller and software, make it possible to link Digital Equipment Corp. computers with the Unix operating system into an Ethernet.

C-MOS gate packages help build high-speed systems, 137

A family of high-speed complementary-MOS logic circuits fills the requirement for low-power interface chips to link the new fast C-MOS memories and microprocessors. The gate propagation delays of the new series come close to those of low-power Schottky-TTL packages.

In-circuit testers take on emitter-coupled logic, 146

Testing emitter-coupled logic is more than a question of chasing after its speed, and a series of in-circuit test systems is designed to cope with the test problems posed by ECL-based systems. These problems include the lower voltage levels, exacting resistance requirements, and nodes that handle both wired-OR and complementary outputs.

Character-oriented display incorporates bit-map capabilities, 151

A multifunction work station includes a video subsystem that adapts to the user's design needs with add-on options that give it such bit-map display characteristics as graphics, subscripts and superscripts, and boldface and double-width and -height characters. Also, its character fonts may be modified through software changes.

. . . and in the next issue

Packaging very large-scale integrated circuits: a special report . . . the state of the art in electrochromic displays . . . test strategies for the 1980s: a new series.

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Any waveform you can draw can be entered directly in volts on the new 5910 generator by means of a 1024 x 4000 matrix. Or instead of manually plotting the points, set the Autoprogrammer to rapidly create any waveshape that can be expressed using loops that involve basic arithmetic functions. Either way, your waveforms can be reproduced repetitively, at any amplitude, with excellent waveform resolution.

By adding this arbitrary waveform capability to our popular GPIB-compatible 5900 function generator, Krohn-Hite offers you double function for your dollar. You have at your fingertips the versatility of a function generator with a bank of nine Storage Registers and an Autoprogrammer with self-contained memory for storing up to 360 steps. Or you can select ARB and produce your own waves digitized to 12-bit resolution.

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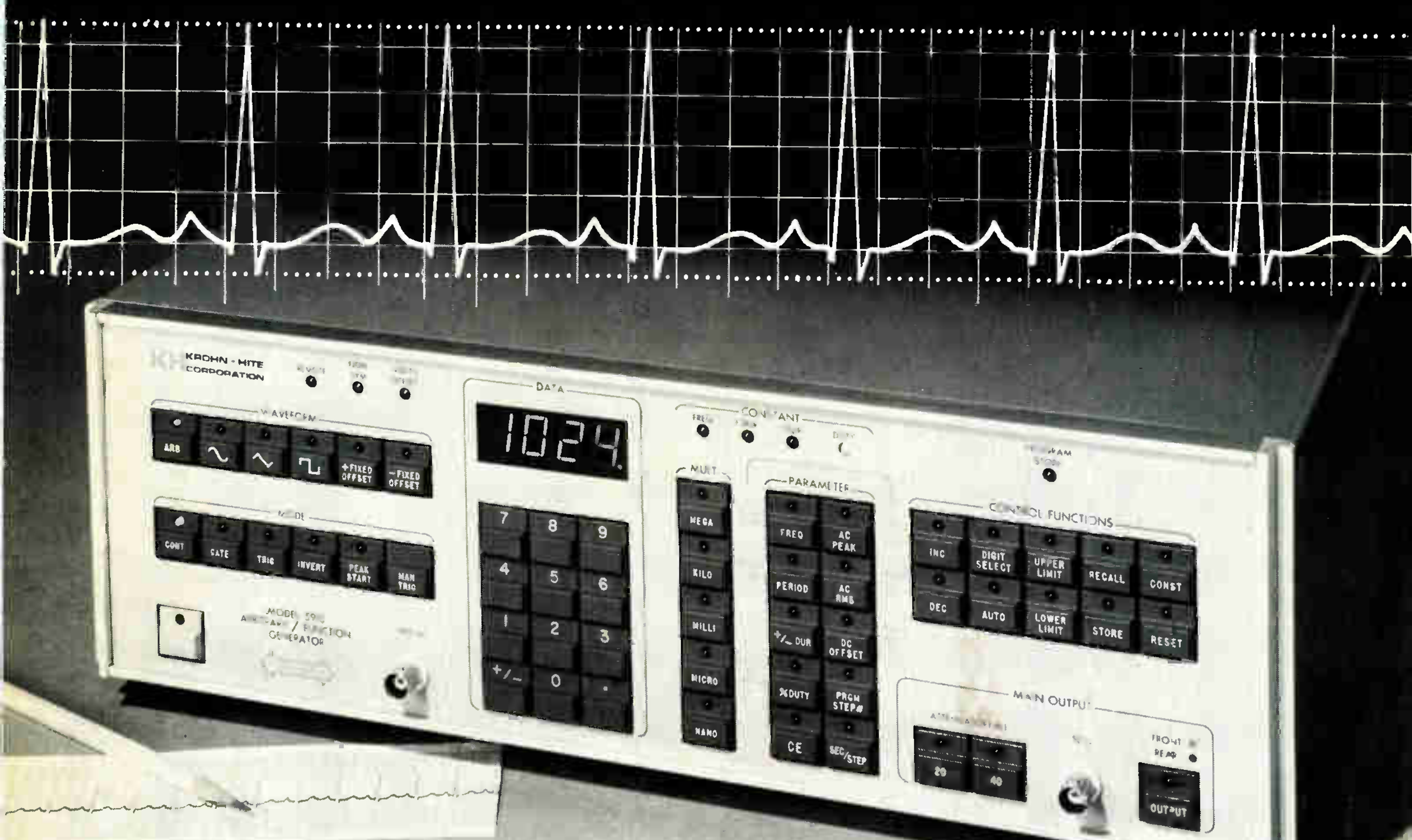

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Publisher's letter

Back in the winter of 1971, the editors of *Electronics* decided that they needed a strong news feature to complement the magazine's highly respected annual world markets survey and forecast. One of them came up with the idea of polling a representative group of chief executives about what concerned them most about the coming year. Thus, the first executive outlook story appeared in the Jan. 3, 1972, issue of *Electronics*. It has since become a year-end tradition that with this issue embarks on its second decade.

Many things have changed in the 10 years since that story idea was broached. There have been recessions and inflation, administrations have changed in Washington, D. C., and some of the editors and writers who worked on that initial outlook piece, along with the executives they first spoke with, have moved on. But there are some concerns that never seem to change. For example, even then there was some worry about trade with Japan as well as about the shrinking technological advantage enjoyed by U. S. electronics firms. And there was some concern about the handling of the economy by the (Nixon) Government.

But one change in the scope of the annual coverage has mirrored that of the electronics industries themselves: the gradual strengthening of what has become a worldwide outlook. Take the executive outlook in this issue (p. 122). Of the 19 industry leaders who were interviewed, six are from outside the U. S. and a seventh heads the U. S. arm of a Japanese company. What's more, there has been a corresponding convergence of concerns.

Associate managing editor Howard Wolff, who coordinated the effort in New York, says, "It's interesting to note that, while the Americans, French, English, and Germans all are worried about their Japanese competitors, the Japanese themselves express a grave concern over what they euphemistically label trade friction: that is, the growing consensus by other governments that Japanese domination of their domestic markets must be somehow kept under control." Aside from that, there is universal concern about recession, inflation, personnel shortages, and the like.

Another interesting facet of the executive outlook article, as Howard points out, is that it focuses the attention of those questioned by the magazine's editors around the world on a list of a half dozen or so major issues selected by the magazine. Thus, the reader is assured of learning about the universal concerns that are getting the attention of the top executives rather than those that are of interest only to each of the companies individually.

In any event, the executive outlook has grown into a traditional event that now appears in an issue of its own, separate from the markets survey. And nowadays, with the globe having shrunk considerably from the way it was 10 years ago, it can truly be said that there is a single international executive outlook in the electronics industries.

Wanted: a consumer/industrial editor

Electronics has open a challenging editorial position for an electronics engineer with a bent for journalism. Right now, we're looking for someone who can write and edit articles on the latest trends in the areas of consumer and industrial electronics, which include video, audio, speech synthesis, and personal computing in the former and robotics and energy management in the latter. A bachelor's degree and experience in design are desirable. We offer excellent salary and benefits. Write a letter telling us about yourself to the Managing Editor (Technical) at *Electronics*, 1221 Avenue of the Americas, New York, N. Y. 10020.

If nine to five finds you between 1 MHz and 1 GHz, we just made your job a lot easier. Because your new partner, the Wavetek Model 1080 Sweep Generator, is a real workhorse.

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Model 1080 is ready to go to work the moment it's out of the box. No mainframe to mess with, just plug it into the wall.

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Readers' comments

Of scenarios and sophists

To the Editor: It is unbelievable to me that the American Electronics Association continues to make headlines with its "projection" that the number of electrical engineering graduates must triple in five years ("U. S. asked to help produce EEs," Nov. 17, p. 96). Here's another projection using the AEA approach but different premises.

The number of graduates (in engineering) has approximately doubled since 1973—about a 9% annual rate of increase. The Wall Street Journal (Nov. 17, p. 1) reports that employment of engineers among 164 employers fell 8% since March. That amounts to an 8% drop in seven months, or an annual rate of 14%. Projecting this figure over five years would mean that about half the present engineers will be out of work and there will be no jobs for the new graduates who will number 54% more than now. This is about as believable as the AEA's predictions.

Back in the real world, the engineer's purchasing power is decreasing. In 1960, I started at $7,200. The consumer price index has since increased by a factor of 3.15, making an equivalent starting salary today $22,600. With today's higher taxes, it can be seen that the 1960 graduate was better off than 1981's.

Shortage? The data indicates otherwise.

Richard G. Wiley
Syracuse Research Corp.
Syracuse, N. Y.

A good hobby

To the Editor: It's been a long time since I've honestly felt there was a shortage of skilled people in the electronics industry.

In recent years, I've been recommending that young career-seekers avoid electrical engineering. It's a good hobby but a poor livelihood. The classifieds tell the story. Nobody seriously needs engineers. The headhunters want to stuff their filing cabinets, but that's about it.

I'm sure your Career Outlook column and editorial articles take the shortage attitude for a reason: engineers, uncertain of their positions, want to read that their skills are in demand. There may be more sinister reasons, but the flavor of your verbiage is probably the result of more simple and direct motives.

I'd like to see articles that more realistically reflect the serious problems seasoned engineers have when they want to make a change. I contend the majority of your readers have a far more accurate picture of the EE career field than your magazine presents. As mature problem solvers, they'd like to study the situation from a factual source.

Floyd G. Carle
Garden City, Kansas

Remedial electronics

To the Editor: Congratulations on your editorial in the Oct. 20 issue ("Opportunity, not license," p. 26) in which you excoriated the University of the District of Columbia for its high-pressure advertisement in The Washington Post. Surely, UDC's claim of a "high quality" engineering education is at odds with the fact that 90% of its freshmen cannot read at the ninth grade level.

There is, however, another point that was overlooked. How did UDC receive its accreditation from the Accrediting Board for Engineering and Technology in the first place? ABET is the successor to the discredited Engineers Council for Professional Development, which was accused of being much too lenient in granting accreditation. Clearly, ABET is following the same route.

Part of the problem is the "you scratch my back and I'll scratch yours" attitude on the part of the college professors who comprise the accrediting teams. These teams—IEEE calls them the Boards of Visitors—are appointed by the various engineering societies. Care is taken to ensure that no whistle-blowers or boat-rockers are included.

I have formally requested that ABET initiate an immediate reaccreditation of UDC, and I have volunteered to be a part of the team. Would anyone care to bet on the outcome?

Irwin Feerst
Massapequa Park, N. Y.

Interested in higher performance software?

The Mark Williams Company announces **COHERENT**,™ a state of the art, third generation operating system. **COHERENT** is a totally independent development of The Mark Williams Company. **COHERENT** contains a number of software innovations not available elsewhere, while maintaining compatibility with UNIX*. The primary goal of **COHERENT** is to provide a friendly environment for program development. The intent is to provide the user with a wide range of software building blocks from which he can select programs and utilities to solve his problems in the most straightforward manner.

COHERENT and all of its associated software are written totally in the high-level programming language **C**. Using **C** as the primary implementation language yields a high degree of reliability, portability, and ease of modification with no noticeable performance penalty.

Features

COHERENT provides **C** language source compatibility with programs written to run under Seventh Edition UNIX, enabling the large base of software written to run under UNIX (from numerous sources) to be available to the **COHERENT** user. The system design is based on a number of fundamental concepts. Central to this design is the unified structure of i/o with respect to ordinary files, external devices, and interprocess communication (pipes). At the same time, a great deal of attention has been paid to system performance so that the machine's resources are used in the most efficient way. The major features of **COHERENT** include:

- multiuser and multi-tasking facilities,
- running processes in foreground and background,
- compatible mechanisms for file, device, and interprocess i/o facilities,
- the shell command interpreter—modifiable for particular applications,
- distributed file system with tree-structured, hierarchical design,
- pipes and multiplexed channels for interprocess communication,
- asynchronous software interrupts,
- generalized segmentation (shared data, writeable instruction spaces),
- ability to lock processes in memory for real-time applications,
- fast swapping with swap storage cache,
- minimal interrupt lockout time for real-time applications,
- reliable power failure recovery facilities,
- fast disc accesses through disc buffer cache,
- loadable device drivers,
- process timing, profiling and debugging trace features.

Software Tools

In addition to the standard commands for manipulating processes, files, and the like, in its initial release **COHERENT** will include the following major software components: **SHELL**, the command interpreter; **STDIO**, a portable, standard i/o library plus run-time support routines; **AS**, an assembler for the host machine; **CROSS**, a number of cross-assemblers for other machines with compatible object format with **'AS'** above; **DB**, a symbolic debugger for **C**, Pascal, Fortran, and assembler; **ED**, a context-oriented text editor with regular expression patterns; **SED**, a stream editor (used in filters) fashioned after **'ED'**; **GREP**, a pattern matching filter; **AWK**, a pattern scanning and processing language; **LEX**, a lexical analyzer generator; **YACC**, an advanced parser generator language; **NROFF**, an Nroff-compatible text formatter; **LEARN**, computer-aided instruction about computers; **DC**, a desk calculator; **QUOTA**, a package of accounting programs to control filespace and processor use; and **MAIL**, an electronic personal message system.

Of course, **COHERENT** will have an ever-expanding number of programming and language tools and basic commands in future releases.

Language Support

The realm of language support is one of the major strengths of **COHERENT**. The following language processors will be supported initially:

- **C** — a portable compiler for the language **C**, including stricter type enforcement in the manner of **LINT**.
- **FORTRAN** — portable compiler supporting the full ANS Fortran 77 standard.
- **PASCAL** — portable implementation of the complete ISO standard Pascal.
- **XYBASIC**™ — a state of the art Basic compiler with the interactive features of an interpreter.

The unified design philosophy underlying the implementation of these languages has contributed significantly to the ease of their portability. In particular, the existence of a generalized code generator is such that with a minimal effort (about one man-month) all of the above language processors can be made to run on a new machine. The net result is that the compilers running under **COHERENT** produce extremely tight code very closely rivaling that produced by an *experienced* assembler programmer. Finally, the unified coder and conformable calling sequences permit the intermixture of these languages in a single program.

Operating System

In part because of the language portability discussed above, and in part because of a substantial effort in achieving a greater degree of machine-independence in the design and implementation of the **COHERENT** operating system, only a small effort need be invested to port the whole system to a new machine. Because of this, an investment in **COHERENT** software is not tied to a single processor. Applications can move with the entire system to a new processor with about two man months of effort.

The initial version of **COHERENT** is available for the Digital Equipment Corporation PDP-11 computers with memory-mapping, such as the PDP 11/34. Machines which will be supported in the coming months are the Intel 8086, Zilog Z8000, and Motorola 68000. Machines for which ports are being considered are the DEC VAX 11/780 and the IBM 370, among others.

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News update

■ Twice-jilted Gould Inc. finally may be about to acquire a semiconductor manufacturer. From its Rolling Meadows, Ill., headquarters, the electronics and electrical products conglomerate late last month announced an agreement with American Microsystems Inc. by which the Santa Clara, Calif., firm would become a wholly owned Gould subsidiary. The proposed deal involves an exchange of stock valued at about $200 million.

Previous Gould attempts to acquire a chip maker were thwarted when the unwilling targets were snatched up by other bidders. Schlumberger Ltd. got Fairchild Camera & Instrument Corp. [*Electronics*, June 7, 1979, p. 42]. And Mostek Corp., another Gould target, found its white knight in United Technologies Corp. [*Electronics*, Oct. 11, 1979, p. 100].

But this time, there are smiles on both sides of the table. Gould, with sales in 1980 of around $2.2 billion, has promised autonomous operation for AMI, whose sales that year were $129.4 million. And AMI board chairman and president Glenn E. Penisten says he is "optimistic" about the marriage.

C-MOS. Gould was particularly attracted to AMI's complementary-MOS lines, says Gould's investor relations director John W. Gannon. C-MOS is the most frequently mentioned technology in Gould's internal surveys of future process-technology needs, he says. Though Gould will be "just another customer" for AMI, "it will gradually expect to get a larger percentage of their sales," Gannon adds. The company currently purchases from $25 million to $30 million in semiconductor devices annually.

Gould already has some circuit-design capability internally and now AMI provides the needed production complement. Some 60% of AMI's integrated-circuit output is in custom or semicustom devices, with 25% to 30% of current chip production in C-MOS.The firm now devotes about 25% of its chip output to p-channel MOS devices, with the rest n-channel MOS. **-Wesley I. Iversen**

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People

TI's McDonnell leads revolution in the hills of East Tennessee

On the surface, Johnson City, Tenn., may appear to be an unlikely site for an up-and-coming Texas Instruments Inc. division, but don't be fooled by the rustic mountain terrain. Although the East Tennessee location is miles away from traditional technology hubs, TI's corporate fathers have plans to make the Electronic Controls division a star performer in the 1980s, explains Millard McDonnell, manager of the operation.

The division, not quite two years old, is part of a quiet, ongoing evaluation—an industrial-automation revolution. It is rapidly arming factories around the world with solid-state programmable controllers, which are replacing traditional mechanical relay switches and boosting plant productivity with the flexibility of digital technology.

Friendly. TI's Millard McDonnell says the secret of getting industrial firms to use microelectronics is user friendliness.

McDonnell says that bringing microelectronics to the industrial world has been no small task for controller manufacturers, which include the likes of Gould Inc.'s Modicon division and Allen-Bradley Co. But TI learned early on that the key to replacing relays is "keeping it user-friendly," notes the West Texas native, who graduated from Rice University in Houston with a five-year degree in electrical engineering.

McDonnell, who joined TI in 1958, hastens to add that "reliability is the way to stay in the factory once you get there. Features and prices are important in this business, but in the long run, reliability is the most important—it must run and run and run."

The next major challenge facing programmable-controller makers is local networks in the factory area, which, like office networks, will allow distribution of intelligence and communication between machines. Because manufacturing controls are crucial to safety and profits, the reliability of these factory networks must be much higher than in the office of the future.

"It's very, very different from office networks," McDonnell says. "If a word processor misses a bit, then what you've got is a mad secretary. If a factory network fails, then you may end up with 50,000 gallons of milk on the floor, or, even worse, a fatal accident."

Jackson looks for Altos to triple sales in 1982

In 1977, when David Jackson started Altos Computer Systems, the buzzword was bus-oriented systems. But Jackson had a different idea: rather than make a microsystem that could be everything to everybody through a wealth of plug-in boards, why not make a single-board computer that was most things to most people?

"If you build a machine with the best price-performance ratio in its field, you don't have to define your market, it defines itself," claims Jackson—a statement that departs widely from the old established marketing philosophies.

His idea worked, since today Altos is one of the largest microsystem manufacturers, shipping at a rate that should mean a gross of $65 mil-

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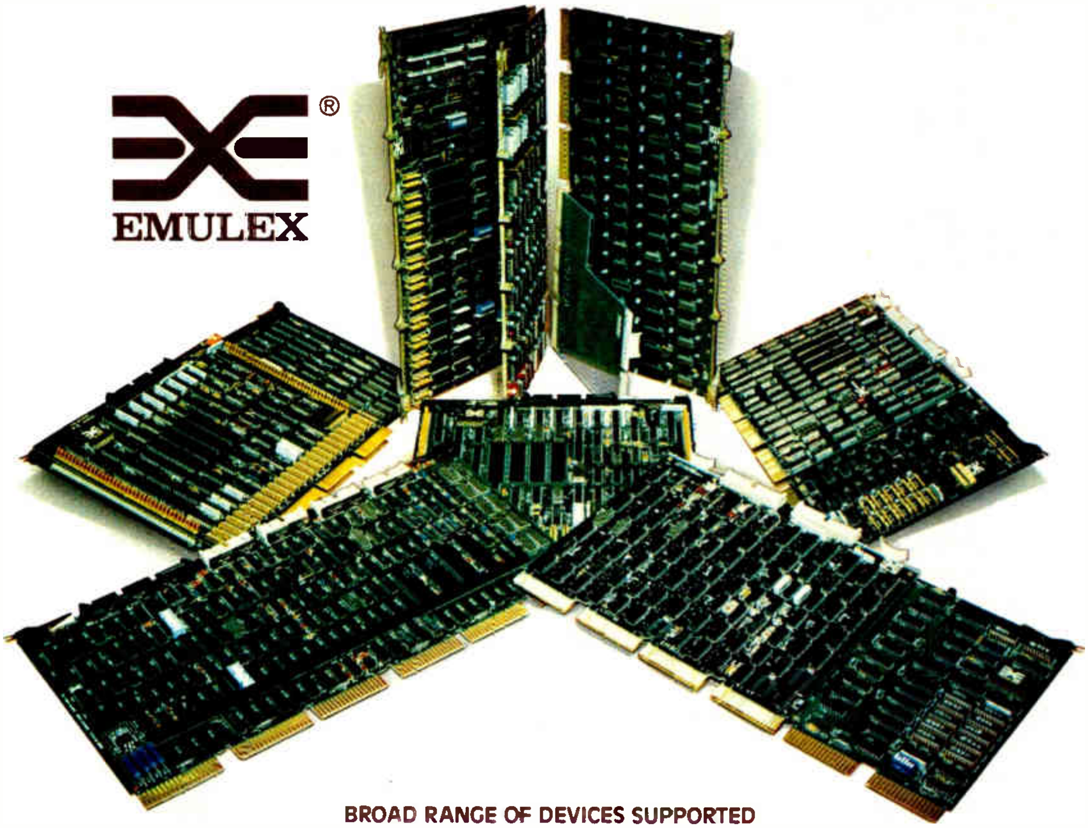

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Circle 15 on reader service card

lion next year after $20 million for 1981. Jackson's long-term goal for Altos is "to join the ranks of Prime and DEC," hoping for sales in excess of $500 million in five years.

The 44-year-old Jackson came to the U. S. in 1963 from London with a London University degree in math and physics. Subsequently, he worked as an engineer on a variety of digital-computer–related projects at several established firms. However, Jackson's aspiration was always to run his own company.

In 1969 he made his first attempt, starting Peripheral Technology with $40,000 he had made in the stock market and $500,000 that he acquired in venture capital. About a year later, it became clear that the company was not going to be the lifelong project that Altos is and he bailed out, selling the company to Pertec Computer Corp. for a profit of about $100,000.

"In 1971, when Intel invented the microprocessor, that started me thinking. I spent the next five years working for computer firms in nonengineering capacities, finally with DEC, refining my ideas." And in 1977, it all came together with the Z80-based single-board microsystem that has made Altos so successful.

Paying off. David Jackson has parlayed his single-board idea into a top industry spot.

"We've always been technology-driven, and we intend to stay that way," notes Jackson. For the immediate future, Altos is preparing to ship its eight-user microsystem, an 8086-based affair that sells for $10,500, with a choice of MP/M-86, Unix, or Oasis operating systems. ☐

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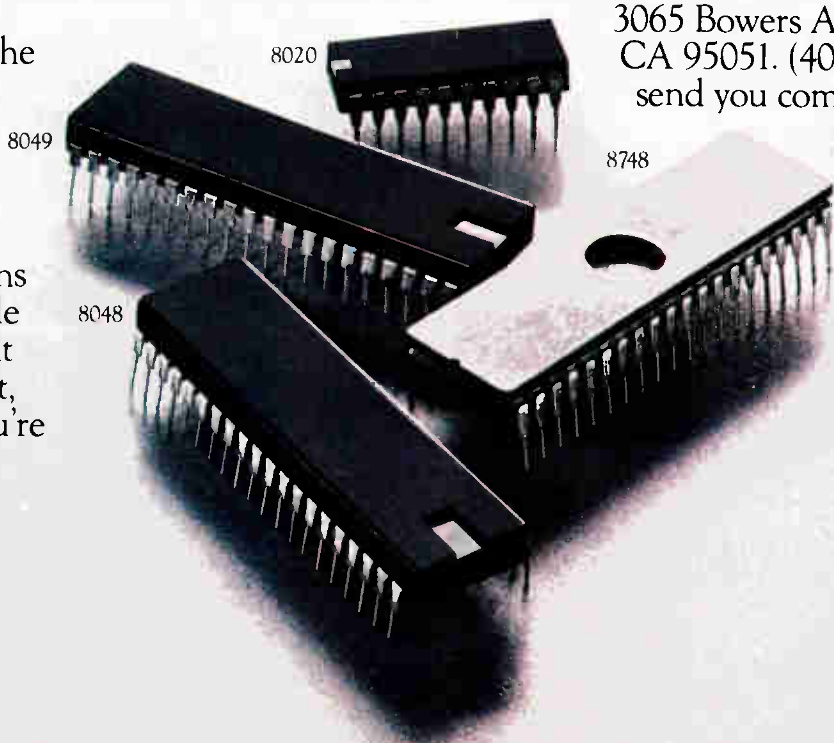

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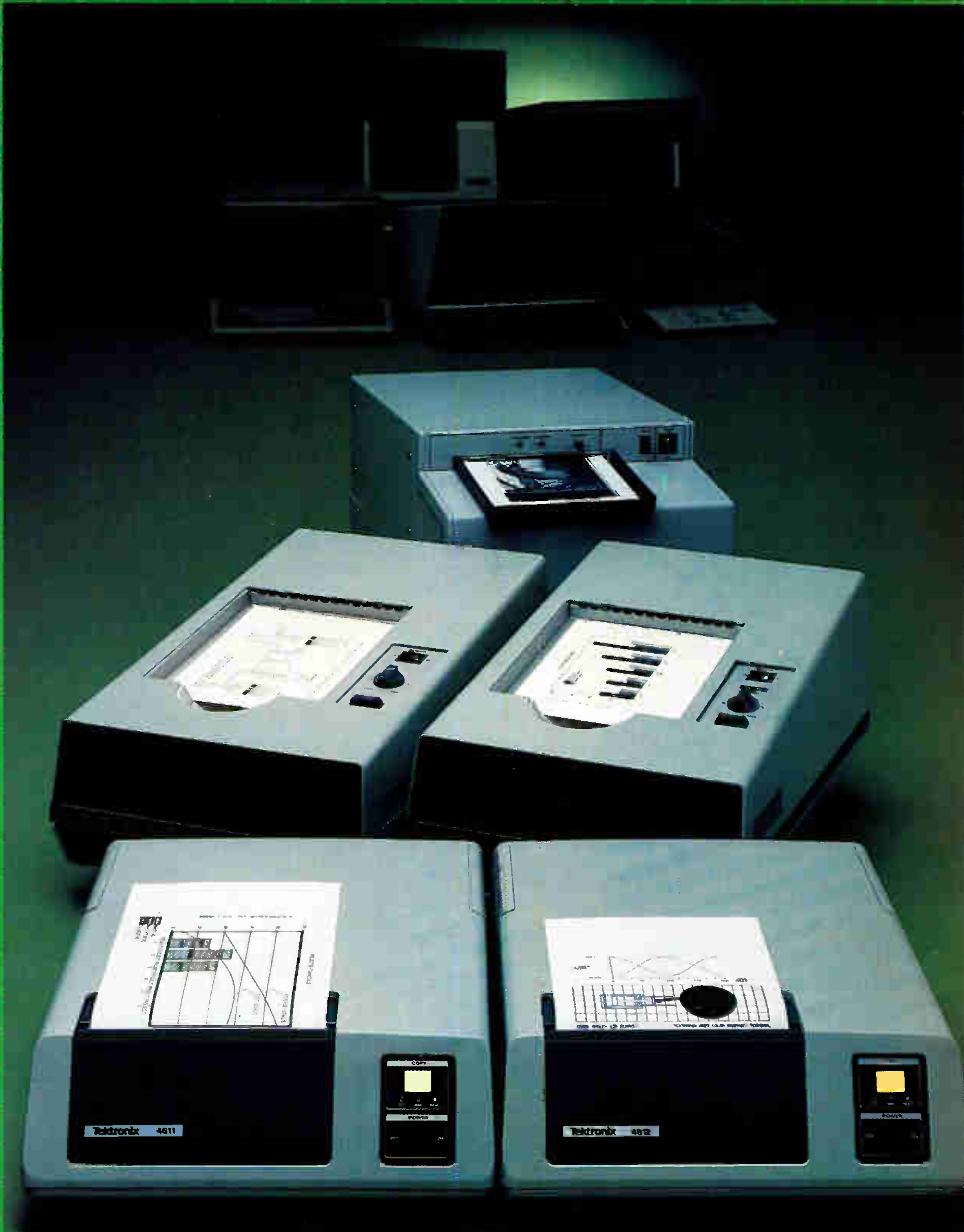
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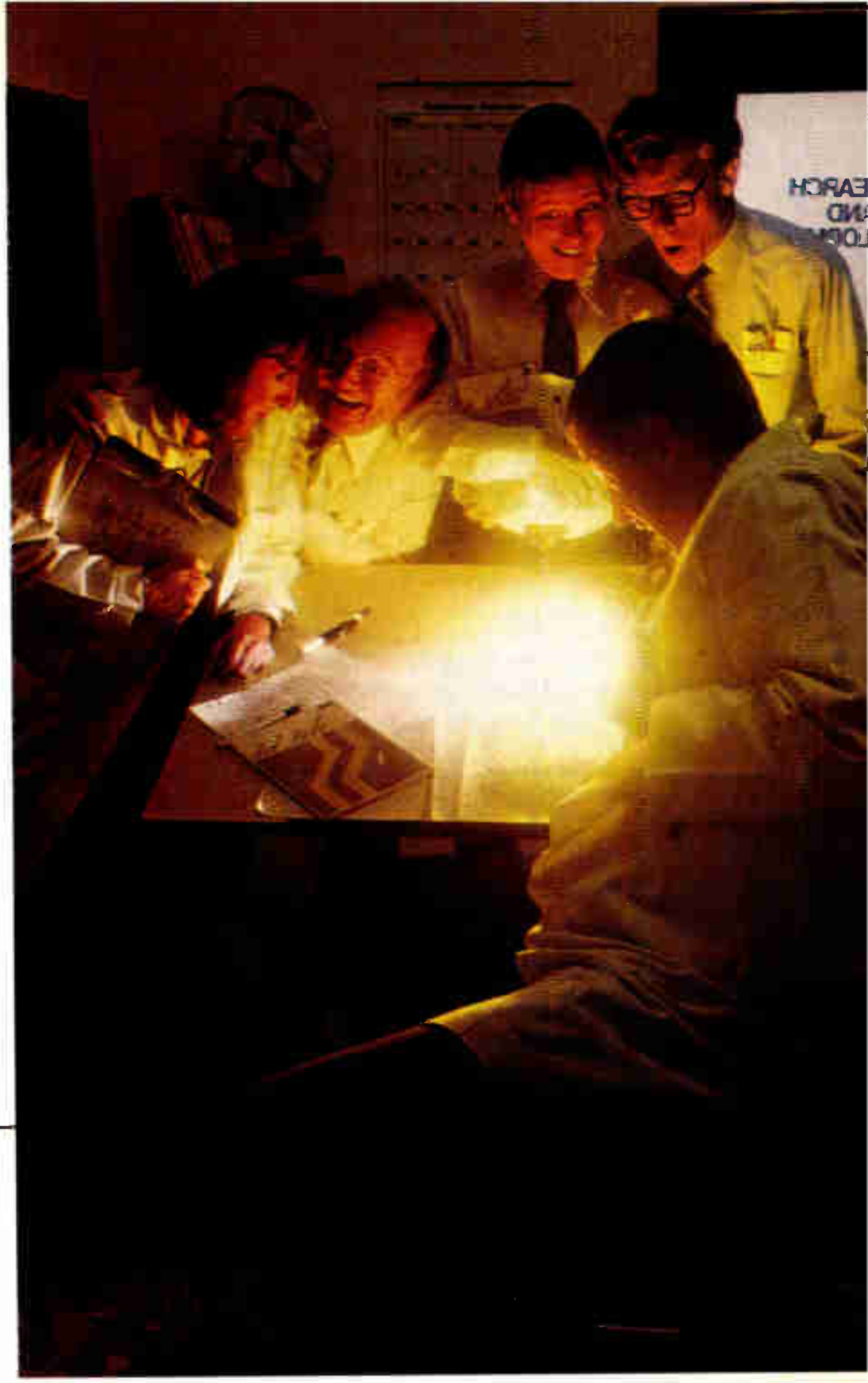

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Universities' fear of R&D bills is misplaced

A piece of legislation whose passage is of vital and immediate concern to the high-technology community in the United States has up till now been moving smoothly through the Congress. However, its critics have begun to make headway with their lobbying such that they could derail the measure.

At stake are two bills, one in each house. They would redress, if only to a small degree, the egregious imbalance that now exists between the amount of research and development money that flows from the Federal government to small businesses and the grants to other recipients, principally the colleges and universities. It is estimated that small businesses now receive a mere 4% of the $40 billion annual Government R&D dispensation. But it is well known that these same small businesses engender far more than their share of technological innovations.

Enter the colleges. Understandably worried that any funds to someone else would eat into their pot, they have mounted a campaign against the bills, which were introduced in the Senate by freshman Republican Warren Rudman of Vermont and in the House by Democrat John J. LaFalce of New York. The college administrators, academic scientists, and Government research officials explain that every little cut smarts in these days of vast slashes in basic science budgets.

Rudman's bill has 86 cosponsors in the Senate, and the House bill carries close to 100 names. Ordinarily, support like this would guarantee passage. But now the House Committee on Science and Technology and the House Committee on Energy and Commerce have both asked for a shot at the LaFalce bill before it gets to the floor. Both committees are viewed by Capitol Hill observers as sympathetic to the universities' side.

Rudman's bill would require Federal agencies with annual R&D budgets over $100 million to establish small-business innovation research programs. Those programs would receive at least 1% of the funds the agencies allot to outside R&D.

The LaFalce bill in the House differs from Rudman's mainly in that the amount to be diverted to small businesses would be at least 3%. However, Rudman's bill exempts grants and contracts from other sources while LaFalce's are not. In both bills, the percentages mandated are minimums.

The universities claim they do not object to spreading Federal seed money among small businesses so much as they are opposed to the rigid quotas. Some spokesmen for the academic science establishment suggest that the SBIR programs should compete for agency funds just like other programs.

To respond, first of all, the growth rates of small businesses generally outstrip those of large corporations, generating more new jobs than other segments of the society. Certainly, in a time of climbing unemployment, any enterprise that adds jobs to the economy should be encouraged.

Secondly, the amount of money involved here is relatively paltry by Government standards—the LaFalce version in its present form would provide but $1.2 billion a year.

Most of all, the critics' suggestion that small businesses should throw their lot in with big business is cynical, to say the least. The small entrepreneur has neither the time nor the resources to lobby for Federal funds. Under the system now in effect, small high-tech firms have received next to nothing—what is to say they will do better in the future?

The Rudman and LaFalce bills deserve to be passed, and without further delay. A clear signal from the Government that it encourages small business is imperative.

TRANSWAVE'S Tiny BASIC MICROCOMPUTER K-8073

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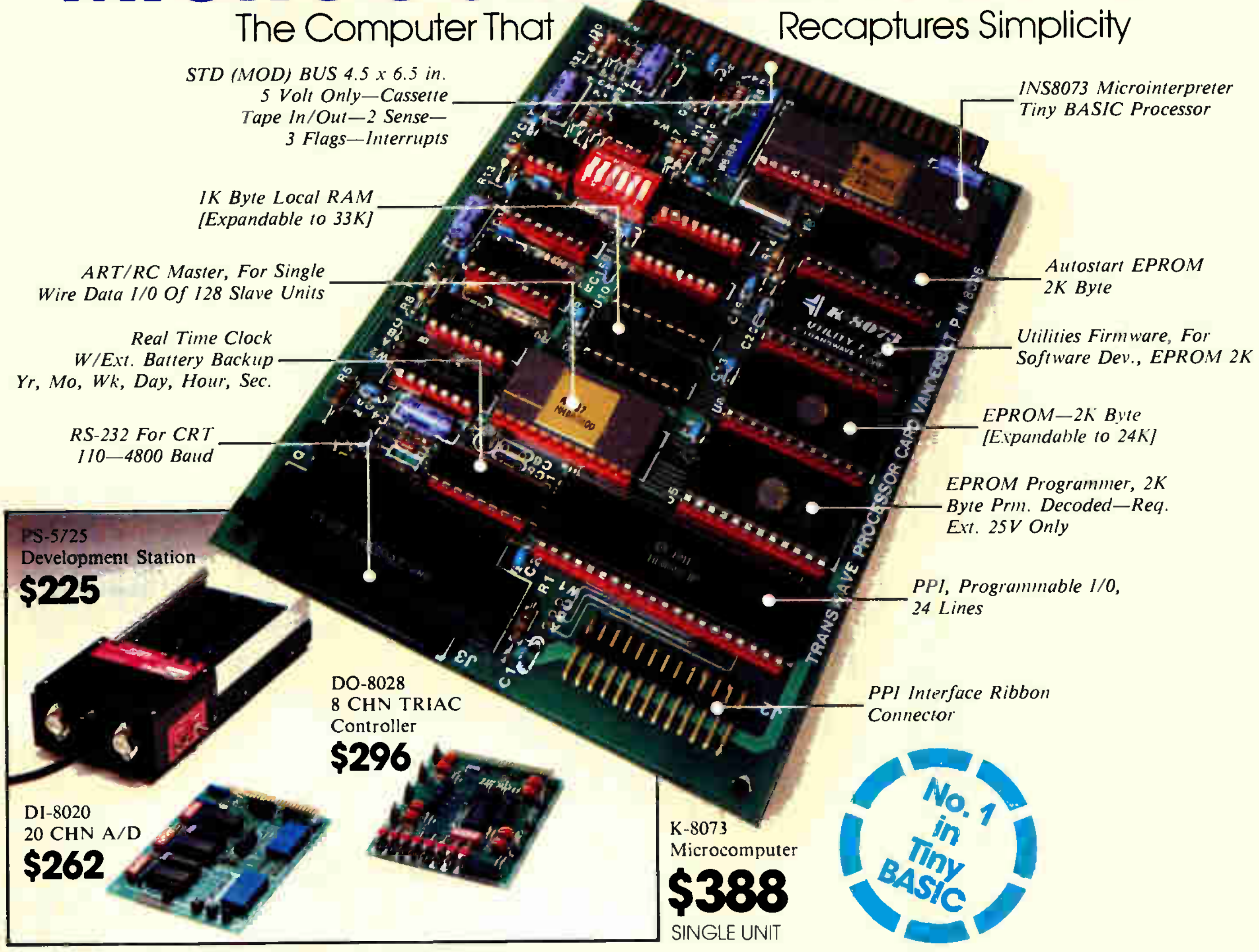

INPUT ▶▶▶▶▶▶ DECISION ▶▶▶▶ OUTPUT

TODAY'S NEEDS

How many times have you thought about designing or purchasing the ultimate intelligent control system but were discouraged by the R&D time or price? Transwave took the initiative of designing one for you. Combining versatility with low cost, the K-8073 Tiny BASIC Microcomputer has already taken the lead in the process control market. Programming is reduced to mere hours because of the on-chip Tiny BASIC Microinterpreter. I/O is extended to previously unheard of limits because of the on-board ART/RC (Asynchronous Receiver Transmitter/Remote Controller).

This processor-like chip provides bi-directional serial communication between the K-8073 and its remotely located peripheral I/O devices. In addition, the K-8073 can operate in a standalone, satellite, or host mode. When interfaced thru RS-232, you can utilize your host computer, large or small, for polling, editing and mass data storage.

INPUT

The DI-8020 is a 20 channel A/D input module designed to collect data from remote sensors monitoring temperature, humidity, light, pressure, etc. Each A/D module is capable of monitoring 16 analog and 4 digital signals. Remarkably versatile, the DI-8020 is adaptable to any environment.

In addition to an extensive input range, this A/D module eliminates the usual installation hassles because of the unique ART/RC communications route. A single twisted pair or coaxial wire serves as the bi-directional DPW (Data Pathway) between the DI-8020 and the K-8073 Tiny BASIC Microcomputer.

DECISION

After receiving data, the K-8073 executes from your EPROM based Tiny BASIC program.

OUTPUT

Completing the cycle of I→D→O is the D0-8028; an 8 channel TRIAC Control Module. This board features 8 optically isolated TRIACS with a maximum rating of up to 300 Watts AC control per channel. Receiving commands from the K-8073 via the full duplex DPW, you can daisy chain as many as 128 of these "slave" stations.

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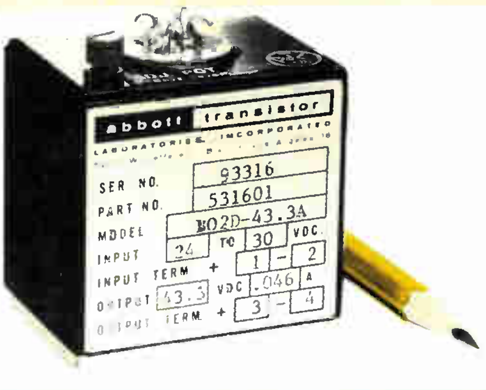

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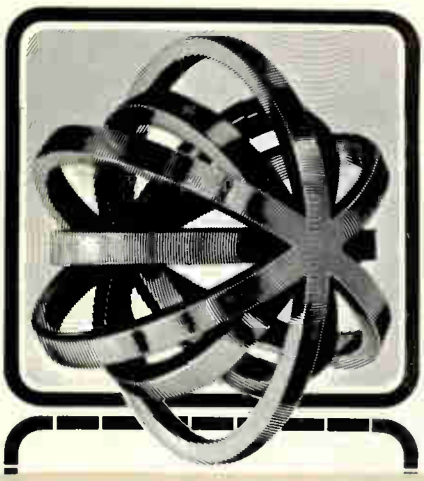


Meetings

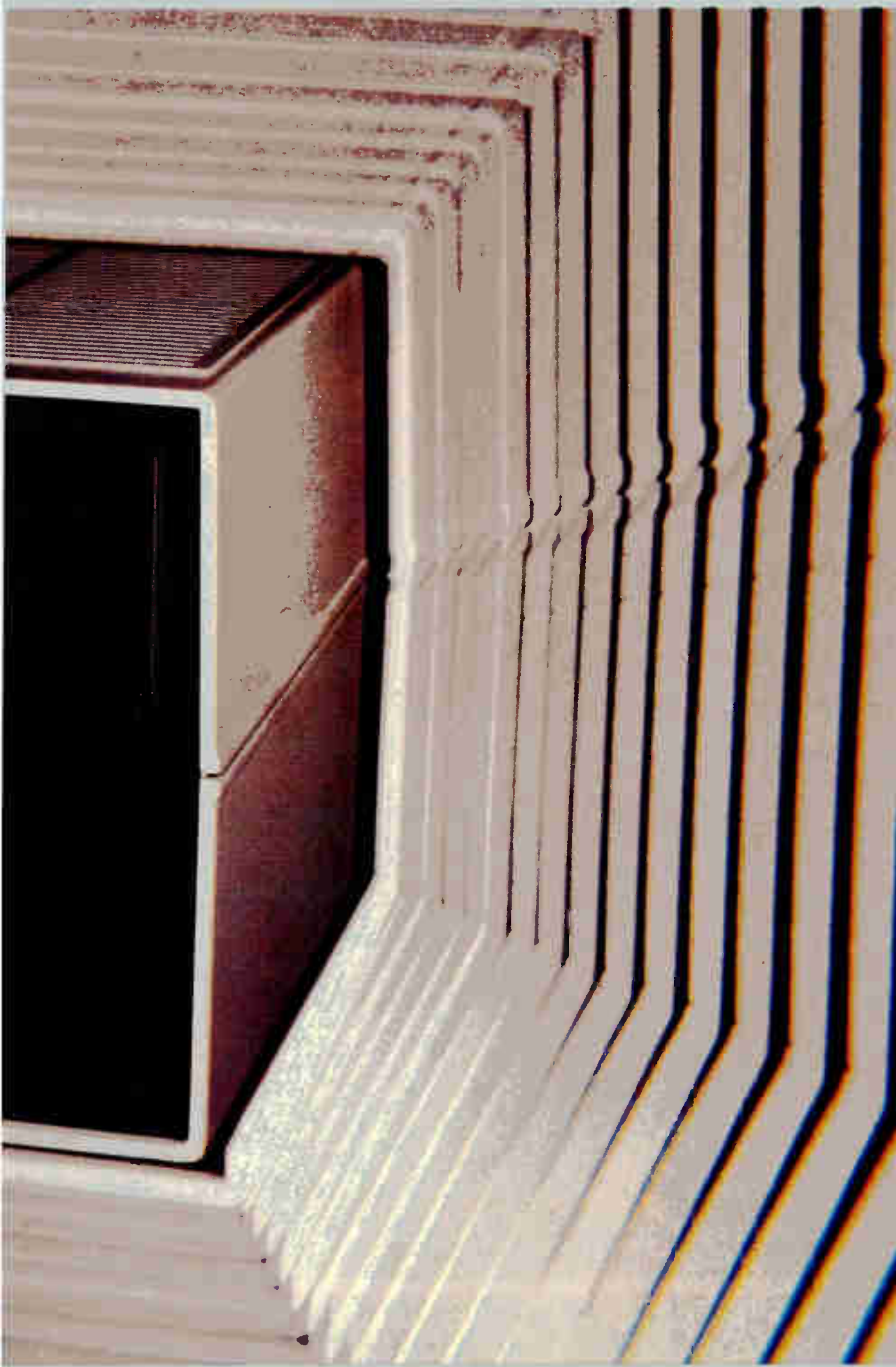
International Winter Consumer Electronics Show, EIA (2001 Eye St., N. W., Washington, D. C. 20006), Convention Center, Las Vegas, Nev., Jan. 7–10, 1982

Symposium on Silicon Processing, National Bureau of Standards (Elaine Cohen, A308 Technology Building, NBS, Washington, D. C. 20234), Le Baron Hotel, San Jose, Calif., Jan. 19–21.

Internepcon/Semiconductor International Data and Telecommunication show, Cahners Exposition Group (222 West Adams St., Chicago, Ill. ... necticut Path, Framingham, Mass. 01701), South Padre Hilton Resort, Brownsville, Texas, Feb. 3–5.

16th Annual Television Conference, Society of Motion Picture and Television Engineers (Lynne Robinson, 862 Scarsdale Ave., Scarsdale, N. Y. 10583), Opryland Hotel, Nashville, Tenn., Feb. 5–6.

5th European Exhibition and Congress for Telecommunications, Online GmbH (Postfach 10 08 66, D-5620 Velbert 1, West Germany), Düsseldorf Fairgrounds, West Germany, Feb. 8–11.



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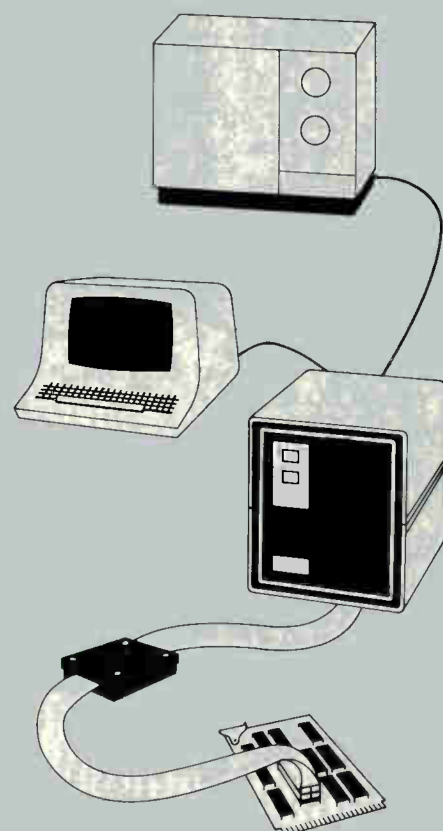

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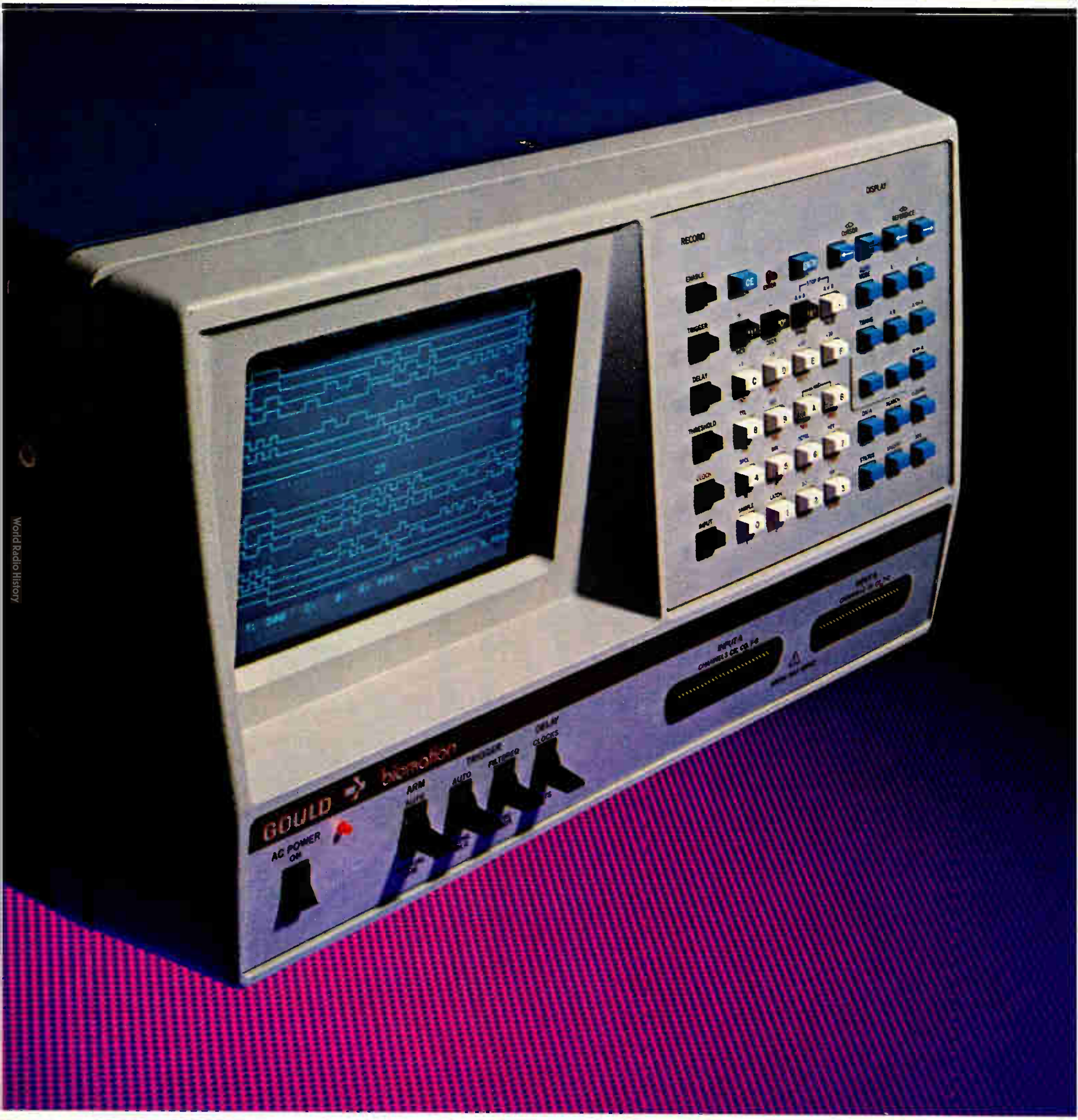
GOULD BIOMATION **K100-D**



7 reasons why the K100-D is now the world's best-selling logic analyzer.

How the general-purpose K100-D beat out H-P to become #1.

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In head-to-head comparison, the K100-D came out looking so good, it's now the best-selling logic analyzer in the world. Here's why:

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For automated troubleshooting and production ATE, the K100-D features a fully-programmable GPIB interface.

To help you support a wide variety of bus-oriented systems, there are standard high-performance probes, specialized probing accessories and detailed application notes available on all the popular microprocessor systems currently in use.

2. It's concise.

The K100-D monitors 16 channels in time domain, 32 in data domain, so you can probe enough points to pin down problems at their source.

3. It's fast.

A 100 MHz clock rate resolves signals to 10 nanoseconds. The front end is also sensitive enough to capture glitches as narrow as 4 ns.

4. It's deep.

1024 words deep in memory—for faster, more accurate debugging. The K100-D extends the length of data you can trap from your system at any one time.

5. It's clear.

The K100-D has a large keyboard and interactive video display, a comprehensive status menu, highly useful time domain display, and data domain readout in user-specifiable hexadecimal, octal, binary or ASCII.

6. It has remote diagnostics.

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For a free copy of our "Logic Analyzer Comparison Guide," request card for microprocessor system application notes, and T-12 Communicator information, just circle the appropriate reader service numbers. Or contact Gould, Inc., Instruments Division, Santa Clara Operation, 4600 Old Ironsides Drive, Santa Clara, CA 95050, phone (408) 988-6800.

The T-12 "top hat" for the K100-D provides logic analyzer remote diagnostic capability. Other options include the GPIB Analyzer and RS232 Serial Data Analyzer.

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Circle 31 for APP Note request form
Circle 32 for T-12 communicator data

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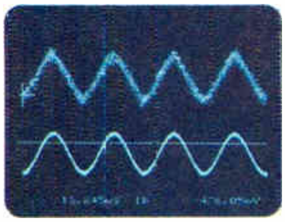

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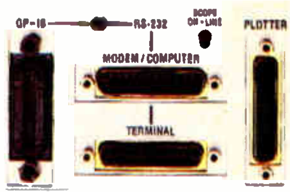
Integrate the 4094 into your digital measurement system with the fully bi-directional GP-IB and RS-232 digital I/O option.



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High-power TWT has multi-octave span

By placing very small T-shaped segments along the length of the tube, Varian Associates has developed the world's first multi-octave traveling-wave tube that combines high power and continuous-wave operation. The segments supply negative dispersion control, which synchronizes the tube's electron beam with its propagating electromagnetic field. Researchers at Varian's Microwave Tube division in Palo Alto, Calif., report that **their tube covers the 6:1 frequency ratio from 3 to 18 GHz; models designed over the past 30 years did little better than 2:1.** The helix tube is targeted for the power stage of military electronic-countermeasure systems, such as jammers, and can generate about 250 W (+54 dBm). Harmonic output of the tube was kept below 5 dB—an exceptional figure compared with the 3 dB usually obtained in 2:1-ratio versions. The efficiency ranges from 5% to 12.5%. The work is sponsored by the U. S. Naval Research Laboratory in Washington, D. C., which also has awarded Varian another contract for a 2-to-18-GHz design.

Thin-film GaAs sheets form huge solar arrays

On the heels of their success in growing thin single-crystal layers of gallium arsenide with the Cleft approach [*Electronics*, May 19, p. 38], researchers at the Massachusetts Institute of Technology's Lincoln Laboratory, Lexington, Mass., are now mapping a scaled-up Cleft process aimed at producing monolithic solar-cell arrays up to 4 ft on a side. **If successful, the effort would result in the largest-area single-crystal semiconductors to date.** In the plan, large master panels of ceramic would be placed in an epitaxial reactor and coated with single-crystal GaAs. The 2-by-4-ft GaAs sheet then would have front contacts and an antireflection coating applied and only then would be separated from its master panel. The system would cut costs drastically by offering huge economies of scale and by side-stepping several fabrication, encapsulation, and packaging phases. Cleft-built solar cells already have shown 21% efficiency in tests.

Processor from National to use Eurocard format

A new board line based on its P²C-MOS NSC800 chip set is expected to emerge from National Semiconductor Corp.'s Microcomputer Systems division in the second quarter of 1982. The line will not be based on Intel's Multibus as its predecessors were. **It will use a single-width Eurocard 100-by-160-mm format designed solely for complementary-MOS devices.** The target market of the Santa Clara, Calif., division is primarily users seeking more speed and power than they are getting from their RCA 1802s.

DEC adds triple CPUs to mainframe line

Digital Equipment Corp. is unveiling new hardware and software for its DECsystem-10 and -20 mainframe computers. Most eye-catching is a triply redundant multiprocessor system, called SMP, or symmetric multiprocessing, by the Maynard, Mass., firm. The new capacity **uses three DECsystem-1091 central processing units with at least 1 million 36-bit words of memory.** DEC expects many of the triple-CPU systems to be retrofitted to existing mainframes. The firm also is marketing a more powerful version of its DBMS software, plus enhanced Fortran and Cobol compilers. Depending on the application, the new software may be from 18% to 100% more powerful than older versions. Finally, the company is making its RPO7 high-density disk memory available for DECsystem use; the 498-megabyte drive will have a data-transfer rate of 2.2 megabytes/s.

NCR to introduce denser n-MOS, C-MOS cell libraries

Look for NCR Corp. to expand its semicustom logic line next year with two new standard-cell libraries for customer use. Scheduled for first-quarter availability is an improved version of NCR's original silicon-gate n-channel MOS semicustom offering, brought out when the Dayton, Ohio, company entered the merchant semiconductor market earlier this year [*Electronics*, July 14, p. 48]. The new n-MOS cell library will **expedite customer designs that employ 4-μm minimum geometries and perhaps up to 3,000 gates per device.** In comparison, NCR's original semicustom line involved a 6-μm process and a maximum of about 1,000 gates per chip. Also in the works is a standard-cell library for designs using a complementary-MOS process, expected to be ready for customer use during the second quarter.

Hydroplaning could yield smoother IC wafers

A new polishing technique for semiconductor materials promises very smooth surfaces free of mechanical defects, faster polishing, and, by implication, improved yield and throughput. Called hydroplane polishing by its developers at the Massachusetts Institute of Technology's Lincoln Laboratory in Lexington, Mass., the system may beat today's mechanical and chemical polishing approaches. **So far used on gallium arsenide and indium phosphide, the technique removes material at up to 30 μm per minute,** as much as 60 times faster than other methods, and the surfaces produced are flat to within 0.3 μm and free of mechanical damage. In the new process, semiconductor wafers are mechanically suspended about 125 μm above the surface of a smooth, spinning disk coated with continually replenished etchant solution; the wafers thus hydroplane just above the disk's surface. The new method was developed to satisfy the stringent surface-quality requirements of molecular-beam epitaxy.

Nestar net to add CP/M capability

A significant increase in capability is coming for Nestar System Inc.'s local network. The Palo Alto, Calif., firm will shortly offer CP/M compatibility, enabling users to store, retrieve, and share CP/M files and programs. **Now Nestar users can ship only Apple-DOS and assembly-language files and programs around the net.** With the new version, they can switch among the various operating systems while staying on the network.

Addenda

Kenneth Olson, president of Digital Equipment Corp., has been named winner of the 1982 medal of achievement awarded by the American Electronics Association. **The medal, given annually since 1959, recognizes significant contributions to electronics.** Olson was honored because, in the words of the citation, "he is generally credited with launching the minicomputer industry when he founded DEC in 1957." . . . RCA Corp. plans to have a **stereophonic sound version of its SelectaVision VideoDisc player on the market in June 1982.** By the end of the coming year, 20 stereo disks will be available, says Thomas G. Kuhn, vice president of the VideoDisc division.

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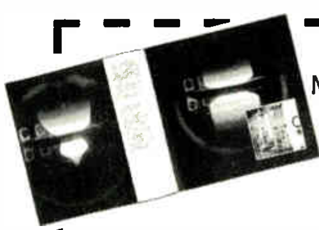

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Infrared camera relies on large monolithic array

by Roderic Beresford, Components Editor

Sensitive platinum silicide detectors are fabricated in array made mostly using n-channel MOS technology

Why struggle with compound semiconductors if silicon can do the same—or better—job? That is the question RCA Corp. is asking, now that it has demonstrated an infrared TV camera based on platinum silicide detectors that can resolve temperatures to within a fraction of a degree.

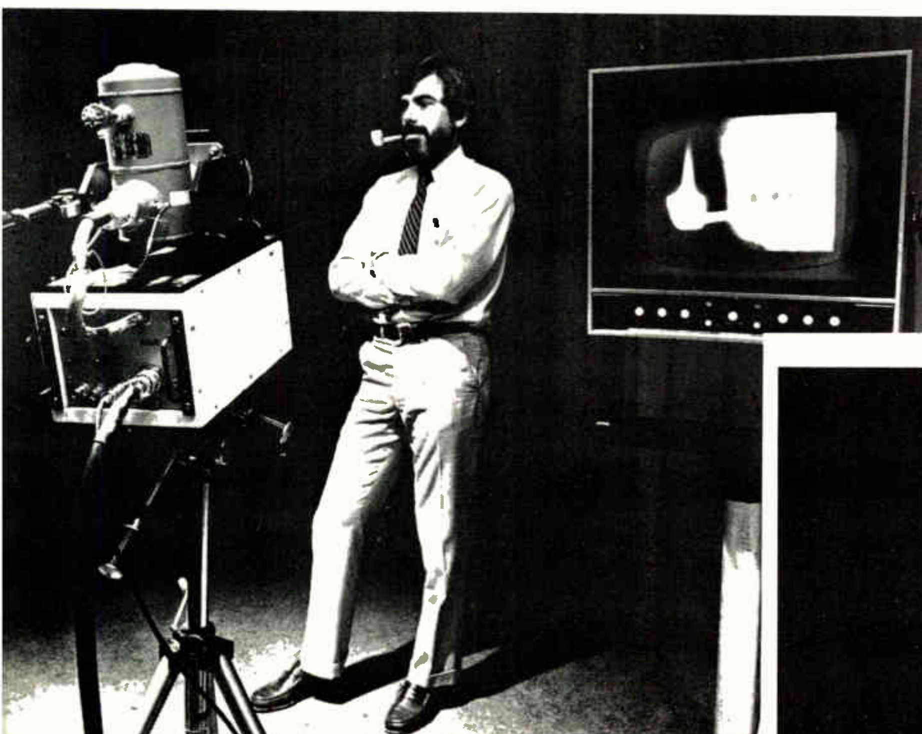
The sensitive picture-sensing elements are readily fabricated on the same chip with a charge-coupled-device readout array. This combination promises thermal-imaging systems at a much lower cost than those based, for example, on mercury-cadmium-telluride sensors that cannot be fabricated monolithically.

The military has been using exotic materials like mercury-cadmium-telluride for years because of their high conversion efficiencies for wavelengths of 3 to 6 micrometers—a must for arrays with relatively few elements to be scanned across the scene. However, because its array is stationary, RCA can use a detector with a much lower efficiency in a staring focal plane array, as it is commonly called.

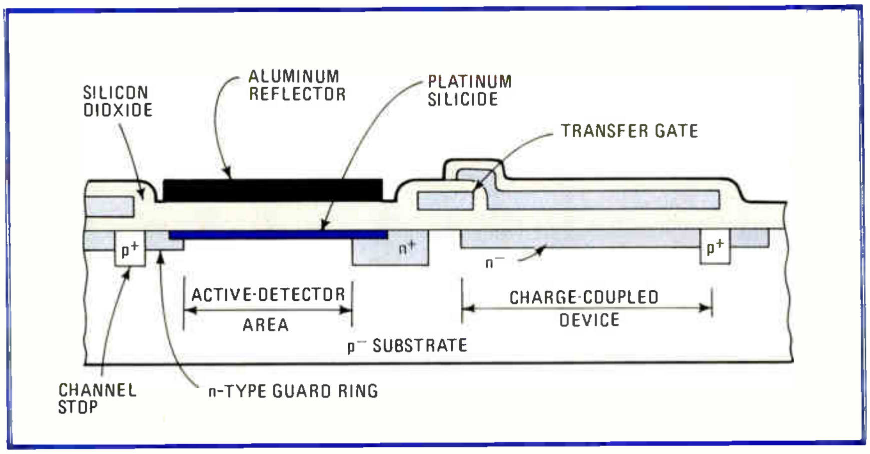
The 64-by-128-element array [*Electronics*, Nov. 30, p. 33] is the largest staring IR imager ever reported—the sensor chip is over 350 mils a side. Its quantum efficiency of a few percent at 3-μm wavelengths marks an order of magnitude improvement over the first Schottky-barrier-diode PtSi detectors developed by RCA two years ago at its Princeton, N. J., research laboratories with support from the Air Force Systems Command's Electronics Systems division, Hanscom Air Force Base, Mass. RCA Automated Systems division, Burlington, Mass., developed the camera.

Conventional process. Except for the PtSi detectors, the imager is fabricated on a 3-inch wafer with a conventional double-polysilicon n-channel MOS process that produces the transfer gates and an interline-transfer buried-channel CCD array for reading out the photogenerated charges (see figure).

The key to fabricating the detec-



Hot shots. An experimental infrared RCA camera detects heat variations of a fraction of a degree C. Its 64-by-128-element sensing array, housed in a Dewar flask, is immune to blooming when a hot object is in focus. Closeup shows the detail obtainable.



IR sensor. A platinum silicide Schottky-barrier detector is formed on a silicon substrate containing n-channel MOS gating and charge-coupled-device read-out electronics. The aluminum layer reflects infrared energy back into the active detector area.

tors is the precisely controlled deposition of platinum on the same silicon surface, points out Walter F. Kosonocky, a Fellow on the technical staff in Princeton who directed the effort. Uniformly thin layers of the pure metal—between 20 and 200 angstroms thick—are vacuum-evaporated, sintered to form PtSi, and then etched to remove the unreacted metal.

The response of the detectors is so uniform—less than 0.5% root-mean-square variation—that minimal processing is needed to generate the video signal for a television monitor. This precision is in sharp contrast to compound-semiconductor sensors whose properties are much harder to control.

RCA's PtSi detectors operate by internal photoemission from the silicide itself. Incident photons with energies above the Schottky barrier height and below the silicon bandgap level generate charge pairs in the thin metal layer. The charges drift apart under the influence of the Schottky barrier's reverse-bias field.

No blooming. Under high illumination, the diode becomes slightly forward-biased, and the photocurrent saturates—additional excess carriers will not contribute to the signal. As a result, the imager does not suffer from blooming. Furthermore, because the diode does not store minority carriers, it can recover quickly from an optical overload.

To operate the camera, the sensor chip must be cooled down to about 80 K, the temperature of liquid nitrogen, to reduce the dark current. The laboratory prototype uses a liquid-air filled Dewar flask, but for portable applications, a microrefrigerator could be fitted to the ½-in. package housing the chip. A germanium lens focuses the incident radiation onto the sensor array.

According to Kosonocky, RCA will soon have a 200-by-200-element array, and TV-like resolution will follow. The company is researching the market potential for the camera and says that a product could be out in 18 months.

Besides the military applications that originally motivated the project, a low-cost IR imager is expected to be widely used in medical and industrial settings. RCA's can, for example, image the veins of a person's body.

Communications

AT&T to offer dial-up 56-kb/s data service

Moving toward the long-term goal of establishing nationwide service on a completely digital network, American Telephone & Telephone Co., New York, announced it is readying its dial-up system to handle digital data at a 56-kilobit-a-second rate. Though this service for its business customers will not be available before 1983, on January 1 of the new year AT&T will make public the input specifications for the network-channel terminating equipment that it will supply for the digital hookup.

If there are no regulatory hitches, then AT&T will offer purely a transmission capability, unlike its unregulated subsidiary which will offer data processing as well (see "Bell's value-added service born again," opposite). It will also offer access to proprietary packet-switching networks.

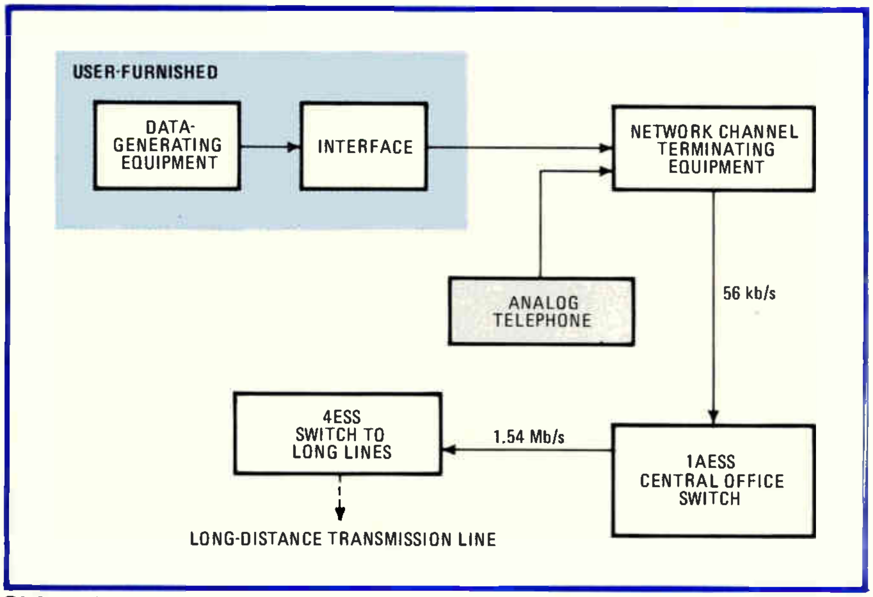
Currently, AT&T transmits data through its Digital Data Service. This service can operate as high as 56 kb/s, but special, dedicated lines must be used and the service is not switchable. Other companies' services—Tymeshare Inc.'s Tymnet and General Telephone & Electronics Corp.'s Telenet—also offer data transmission through a packet-switching network, usually at a 9.6-kb/s rate with higher speeds available. According to estimates, the 56-kb/s rate could satisfy as much as 90% of the needs of business for long-haul data transmission.

Full duplex. Sending 56 kb/s over the two-wire lines connecting the telephone to the switching office was not the problem; this and higher data rates can be easily handled over the typical distances involved. Rather, the problem was to obtain the full-duplex transmission. Half-duplex is easier, and this is what Bell engineers will rely on with time-compression multiplexing.

Using a burst mode of transmission, the line is operated half-duplex at 144 kb/s. This is twice the 56-kb/s rate, plus additional overhead bits. With buffering, each end of the data conversation may control the line during the burst or remain silent. The result is equivalent to full-duplex transmission at 56 kb/s.

Existing long-haul facilities already have a substantial amount of digital capability, but some analog facilities are being replaced. With echo cancellers and other such bit-distorting gear removed, the lines are suited for the new service.

So are the Bell Systems' existing



Dial up. An interface added on the user's premises gives access to the dial-up digital data service being readied by AT&T that will use much of its existing facilities.

central-office switches. The No. 4ESS switch is already a time-division–multipexing digital switch which handles 64-kb/s digitized voice signals. It can be readily modified for digital data at 56 kb/s.

A bigger problem lies in modifying the No. 1AESS. It is a space-division–multiplexing switch, usually used with analog voice signals. It can handle 56-kb/s baseband digital signals with modifications added on circuit boards. These boards provide, among other functions, the balance for hybrid conversion circuits, as well as interfaces to adjust impedance and voltage levels. The No. 1AESS also needs software to operate in the 56-kb/s data mode and to perform loop-back tests to the customer's standard interface.

Access. Ac-powered terminating equipment will be installed on the customer's premises. It will include two analog voice lines that allow a data call to be initiated with a voice hookup. This procedure is required by AT&T's electronic switches. The box's eight external wires also include four for digital data and two for control. Actually, its interface is similar to the one used with Bell's own present DDS.

The box performs "a basic minimum number of functions and does not require that much intelligence," according to Gary J. Handler, AT&T's manager of network planning. It has a Bell Laboratories–developed microprocessor but needs neither signal processors nor software control. It also has buffering and some custom large-scale integrated circuits for its time-compression–multiplexing mode.

AT&T described its channel-terminating equipment at the National Telecommunications Conference in New Orleans on December 1. It is not the first to come up with the idea of an end-to-end switched data service on the public network. A similar 56-kb/s service in Japan uses special dedicated switches, and Canada has a switched data service at 9.6 kb/s. There are also services of limited geographic extent in Germany and Scandinavia. **-Harvey J. Hindin**

Bell's value-added service born again

While American Telephone & Telegraph Inc.'s regulated operations prepare to transmit 56-kilobit-a-second data directly over phone lines, the company also filed in late November with the Federal Communications Commission a plan to offer by January 1, 1983, data-processing capabilities through its Advanced Communications Service. The plan, in compliance with the FCC's Computer Inquiry II ruling, also calls for the formation of a fully separate affiliate on or before June 1, 1982, to handle the service.

ACS will be a packet-switching network with computing power permitting data-generating and -receiving equipment with diverse protocols to communicate with each other. It will have storage and communications-processing capabilities and will manage data networks as well as transport data. First promised almost three years ago, ACS encountered software problems, which have only recently been ironed out or may not yet be fully resolved. This situation may also limit the kinds of services to be offered initially.

ACS would start with $3 million in cash and $56 million in assets from AT&T and Bell Laboratories. The affiliate would issue equity shares to be held by its parent. Up to $434 million would also be supplied over a four-year period to support the new venture until it is on its own. Bell competitors are unhappy at this arrangement since the new organization would not have to go to the usual sources of money and pay market rates.

AT&T sources, pointing out that its filing with the FCC concerns financial not technical matters, will not say what kind of services ACS will provide. Nor will it speculate on data rates and equipment to be accommodated.

The new service will affect the business of many suppliers of value-added communications services, however. These companies provide packet-switched services to their customers using, in many cases, AT&T telephone lines. Just how Bell will allocate the hard-to-get lines for long-distance packet switching among these companies and its affiliate remains to be seen. **-H.H.**

Production

Hopes brighten for silver-bromide resist

As engineers strive for finer integrated-circuit geometries and greater throughput, they sometimes find these two goals mutually exclusive. Electron-beam lithography, for example, achieves the fine geometries, but often requires more exposure time than the relatively less precise optical techniques.

One answer to this problem would be more sensitive—and thus faster—photoresists, and it would be even more helpful if such resists were sensitive to the three most popular exposure media—light, electron beams, and X rays.

Now a group at the GCA Corp., led by senior scientist Jerome M. Lavine and Joseph I. Masters, manager of the Bedford, Mass., firm's photo-materials research department, has devised a resist technique that can boast all these advantages. Moreover, it may be only a year or two away from the marketplace, according to GCA, which is best known in semiconductor circles for its success with step-and-repeat optical lithography systems.

The basic material is one of the oldest photosensitive materials in current use, silver bromide. It has been a main ingredient for more than 20 years in emulsions for high-resolution photomasks. But until now, it has been unsuccessful as an on-wafer resist because of problems with contamination of the emulsion and coating defects such as pinholing.

Emulsion banished. GCA's answer was to eliminate the emulsion. Instead of applying the usual kind of emulsion resist and then curing and exposing it, a user first would lay down a polymer layer that produces a smooth surface for the photosensitive material. A coating of silver bromide is then evaporated atop it. The typical layers of silver bromide are about 2,000 angstroms thick, but the thickness of the polymer layer can be varied to suit the development and etch needs of the process line.

Not only are there no emulsion defects like pinholes, but the deposition process takes place in a vacuum chamber and is almost totally free of particulates. Lavine says that silver bromide is "from tens to thousands of times more sensitive" than common resist materials. So its shorter exposure times would translate directly into greater productivity.

Further, because the material is sensitive to a variety of wavelengths, users could combine exposure modes in the same resist step, thus allowing X-ray or electron-beam systems to expose finer features while also exposing the larger geometries with ultraviolet light. With the present technology, such multiple exposures entail multiple resist steps, and this slows production.

Under the UV light, at wavelengths from 2,600 to 3,000 Å, silver bromide has a sensitivity of about 50 microjoules per square centimeter, said to be more than a tenfold improvement over polymer resists. At the usual 7-Å X-ray wavelength, sensitivity is at least as good as in the UV spectrum and is nearing electron-beam sensitivity of 10^{-9} to 10^{-10} coulombs/cm.^{2}

Lavine says that next year's work will concentrate on optimizing sensitivity and resolution, as well as improving edge acuity. Two approaches are being considered.

First, the company will experiment with silver bromide applied in very thin layers in order to eliminate diffraction as a source of fuzzy edges. The second approach will be to dope the silver bromide with other elements or compounds, a technique Lavine expects will reduce grain size and help control sensitivity.

Another group studying a resist for more than one type of lithography is Sperry Corp.'s Research Center in Sudbury, Mass. It has successfully combined electron-beam and UV lithography using Shipley Co.'s 300-series resist [*Electronics*, Nov. 30, p. 40]. **-James B. Brinton**

Software

CP/M house plans rapid expansion through marketing change and money

From $6 million this year to $20 million next would not be bad growth for any company, but it is positively stunning for one specializing in software, a field noted for having many small shops each turn-

Intel spreads its operating-system reach

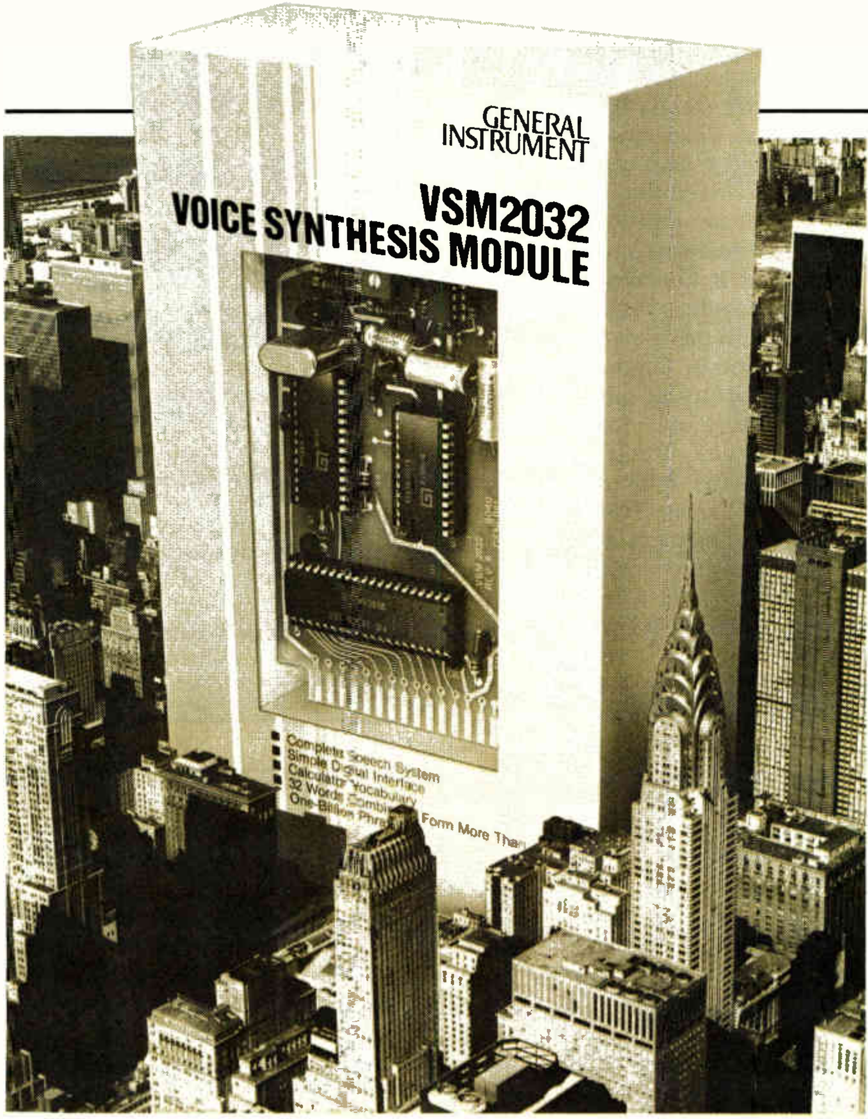
Unwilling to put all its eggs in one or even two baskets, Intel Corp., Santa Clara, Calif., will be backing all the currently popular operating systems for its 16-bit 8086 microprocessor. It has contracts with Digital Research for its CP/M- and the multiuser MP/M-86 and with Microsoft for MS-DOS. It also is after Bell Laboratories' Unix and is negotiating with Microsoft for its version of Unix, called Xenix.

In addition, Intel is pushing its own real-time operating system, iRMX-86, most recently by embarking on a joint venture with Lifeboat Associates—already the largest 8-bit software distributor—to form a users' group called iRUG Corp. The first meeting is to take place during the National Computer Conference in June. New York-based Lifeboat will manage the program, with Intel supplying the money and equipment to kick it off.

Lifeboat itself will be using Intel's new 86/330 8086-based minicomputer to start making its programs compatible with iRMX-86. "We are going to our OEMs and contracting with them to write software for iRMX-86 and expect to print our first catalog in 1982," says Tony Gold, Lifeboat's president. Microsoft has already promised to bring up its languages under iRMX-86.

Intel's software distribution operation [*Electronics*, Sept. 8, p. 39] will sell Digital Research's CP/M- and MP/M-86 line of operating systems and languages. It is also putting CP/M-86 on a chip—in fact, the same chip that houses its iRMX-86 operating system, the 80130, only with a reprogrammed read-only memory. And Intel is likely to commit the other operating systems it is backing to silicon in the near future. **-R. Colin Johnson**

The talk of the town!



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"Hear it like it is" at Winter CES, Las Vegas.

ing out a few products.

Nevertheless, this is the leap in sales predicted by company president Gary Kildall for Digital Research Inc., the Pacific Grove, Calif., software house that authored CP/M, the industry-standard 8-bit operating system. The boom is coming about largely because of a drastic change in marketing strategy coupled with the infusion of a hefty amount of venture capital.

All of it is aimed at establishing for six-year-old Digital Research, which is still privately held, a dominant position in the marketplace for software for 16-bit microprocessors. The company was forced to these moves because it lost its longtime partner in the 8-bit arena. Microsoft Inc., Bellevue, Wash., which has high-level languages for CP/M, developed its own operating system for the IBM Personal Computer, based on the 16-bit 8088 microprocessor, and does not plan to support CP/M-86 [*Electronics*, Oct. 6, p. 37]. Moreover, Lifeboat Associates, the New York publisher that is the major distributor of 8-bit software, joined forces with Microsoft and declined to distribute 16-bit software from Digital Research.

Kildall plans to use the venture capital to buy the high-level languages he needs. "OEMs want a total language environment for 16-bit machines," he points out. In September, Digital Research bought Compiler Systems Inc., Sierra Madre, Calif., authors of the popular C-Basic for business applications. And in November, it agreed to acquire M.T. Microsystems Inc., Carlsbad, Calif., authors of Pascal/MT. Digital and these companies have about $11 million in sales this year.

With acquired languages added to Digital Research's own PL/1, Kildall is already off to a pretty good start, and he is looking to fill out his in-house 16-bit catalog by buying companies offering high-level languages such as Cobol and Fortran. Possibilities include CIS-Cobol from Micro Focus, APL/86 from Vanguard Systems Corp., Forth from Stack Works, Lisp from The Soft Warehouse, and C from three different companies. Application programs will be developed further by expanding the training and support of both original-equipment manufacturers and end users.

New distributor. As for distribution, "we are shifting our emphasis on who we want to reach from a large number of small OEMs to a small number of large OEMs," says Kildall. Accordingly, Digital Research recently signed up Hamilton-Avnet, one of the largest electronics distributors, to stock its software. The large OEMs Kildall has in mind include IBM Corp., for whose Personal Computer Digital Research has configured its CP/M-86. A version for IBM's Displaywriter is scheduled to be shipped this month.

Kildall is counting on making inroads into IBM's Personal Computer market, even though IBM itself is backing Microsoft's MS-DOS with its software publishing operation. Many features of the Unix operating system are incorporated into MP/M-86, Kildall explains, which should make it attractive. Moreover, the multitasking system that allows several jobs like edit, compile, and print to be run simultaneously is available, while a similar version of MS-DOS is still being developed. Kildall hopes that the convenience of using MP/M-86, as has been reported by Digital Research's 20 OEMs and 3,000 end users, might persuade IBM to offer it, too. **-R. Colin Johnson**

Price cut makes Unix stronger contender

As Digital Research with its CP/M operating system squared off against Microsoft's MS-DOS, a suddenly much cheaper version of Unix, Bell Laboratories' popular operating system for mainframes and minicomputers, acquired a new dimension in the 16-bit microprocessor world. Western Electric in November announced it was dropping the price on Unix, which is a multitasking system, such that it will be much more competitive with Digital Research's multitasking MP/M-86 for microprocessor systems. The new price means systems can be sold with as little as $1,000 tagged on for the license fee. Previously, the manufacturer of a multiuser computer system would have had to charge several thousand dollars for Unix.

Western Electric's announcement detailed what is called the Unix system 3, a new version of the Unix version 7 system, and is supplied with the Programmer's Workbench—a set of program development tools—as well as a source-code control system. The previous arrangement was one in which Western Electric required an OEM to prepay $50,000 toward future billings of $750 for the first user on a single processor and $250 for each additional and simultaneous user on the same processor. The package that Western Electric now offers asks the original-equipment manufacturer to pay a flat fee of $25,000 for the system 3 license plus $100 per processor for single-user systems and $250 per processor (not per user) for systems that are designed for anywhere from 2 to 16 users.

Bell has gone even further with high-volume OEMs. It reduced the single-user price to $70 and the price for from 2 to 16 users to $125, for vendors who purchase $1 million worth of Unix. If a vendor purchases over $2.5 million worth, the price sinks even more, to $40 for a single-user system and $50 for a 2-to-16-user system. **-Martin Marshall**

Fiber optics

Separated signals aim at gigabit rate

Challenged to top the hundreds of megahertz data rates that can be obtained from step-index optical fibers, experimenters at ITT's Electro-Optical Products division and the Stevens Institute of Technology have devised a new multiplexing scheme designed to give fiber-optic communication networks gigabit data rates. Unlike wavelength-division multiplexers, an older technique that uses input signals at different wavelengths, the new approach funnels

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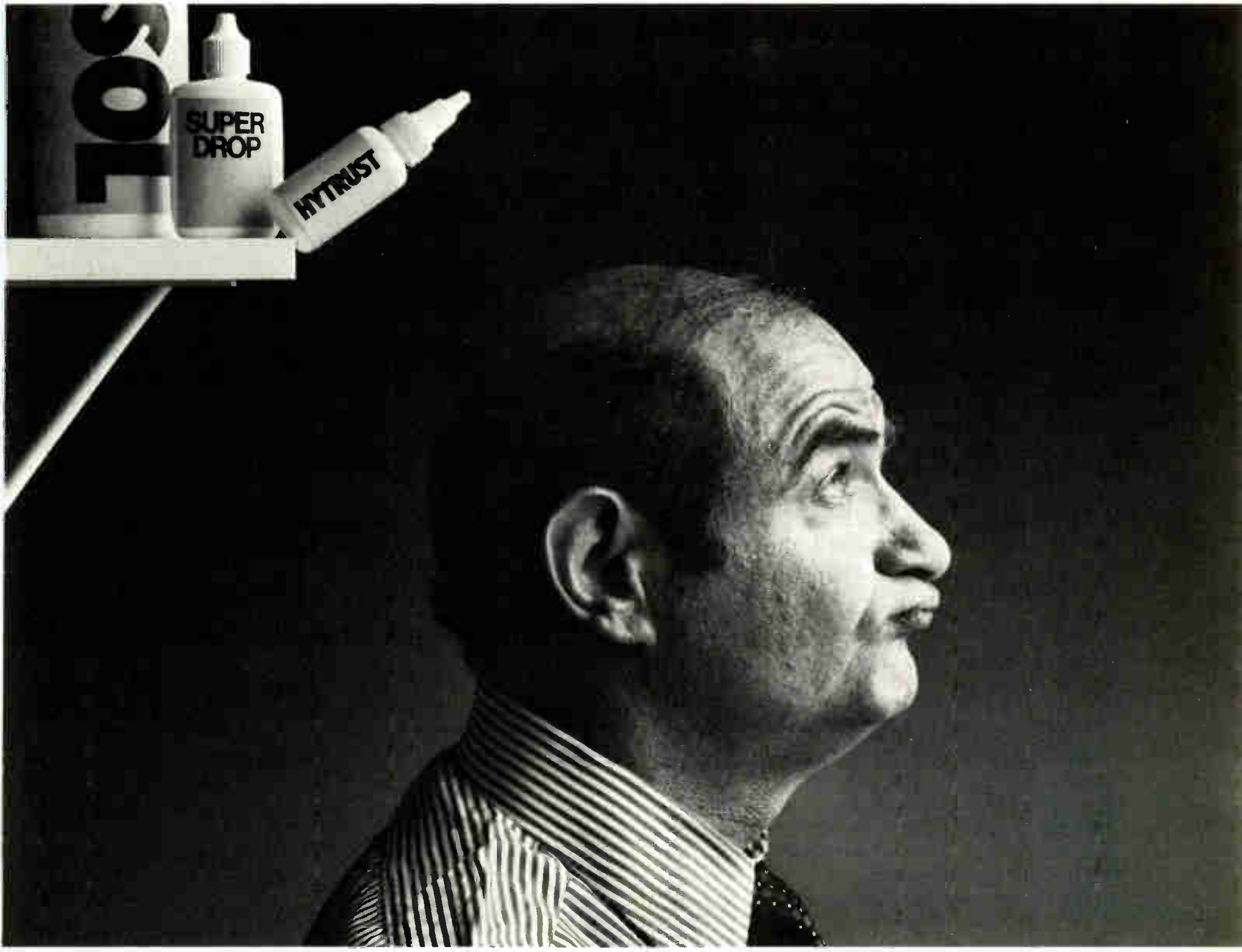

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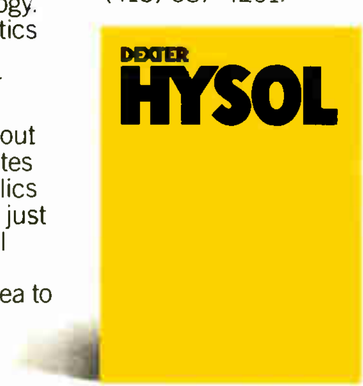


Circle 43 on reader service card

separate signals of the same wavelength down the fiber.

Playing the angles. Key to the new technique, says Gerald J. Herskowitz, professor of electrical engineering at Stevens in Hoboken, N. J., is the fact that the plane-wave angle incident to the fiber's axis, as it is reflected at the core-cladding interface, is constant as the wave propagates down the fiber. Thus, if several plane waves of the same frequency are sent on their way at different propagating angles, and if these different waves can be separated at the receiving end, a multiplexing scheme is automatic. Herskowitz, George A. Gasparian at ITT in Roanoke, Va., and their co-workers have taken the first steps to do this.

Classic lenses. A classical biconvex lens is used to focus two separate input waves into the test fiber at different angles. At the end of the fiber, the two beams, tagged with different modulation frequencies, are separated by another well-known device, a fresnel lens.

The bulk of the energy in the waves comes out of the fiber in concentric rings and the fresnel lens focuses these rings into separate spots. The optical power in each spot is then detected and displayed by the spectrum analyzer. One important parameter of the multiplexing system, the crosstalk, is determined by the ratio of the detected powers at the modulating frequencies.

Herskowitz and Gasparian did their work in cooperation with scientists at the U. S. Army Communications Research and Development Command at Fort Monmouth, N. J. Much must yet be done to ready the technique for practical application. For one thing, the crosstalk, which depends on the fiber used, is around −10 decibels to −15 dB or some 15 to 20 dB worse than theory predicts.

A more accurate model of the system is needed. Also, both the input and output coupling lenses must be improved. What results are obtained also depends on things like the roughness of the core-cladding interface, the fiber's refractive-index uniformity, and any microbends in the fiber itself. **-Harvey J. Hindin**

Local networks

Voice studied for Ethernet network

Convinced that Ethernet, the local network it is backing, must transmit voice, Intel Corp. of Santa Clara, Calif., rolled out a report last month that in effect says to prospective network customers, "Don't worry, we're looking into it, and it looks feasible."

Some two years of studying the problems involved with adding voice to the packet-switched network were described by Intel's Donald K. Melvin at the National Telecommunications Conference in New Orleans. The project's aim is to make Ethernet competitive with other upcoming local networks—like those of Wang Laboratories—that will handle voice transmissions.

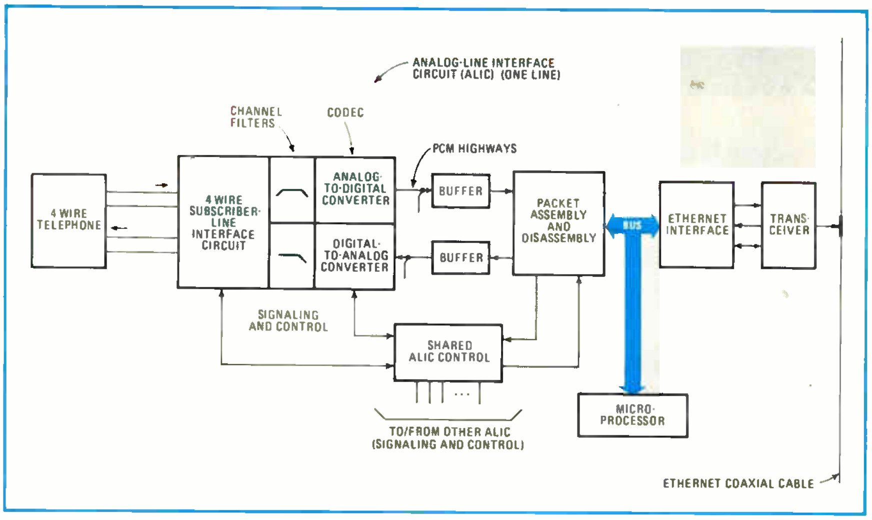
Melvin's feasibility study showed that a combination of voice and data could use Ethernet's standard contention-access, baseband digital transmission over its coaxial cable. In the study, he relied on experimental voice-transmission circuits on breadboards and a computer synthesis of key critical factors like traffic loading, transmission delay, and the mix of voice and data on the network. (Actually, Intel will not disclose any timetable for developing chips to do the job. Interface chips for the data-only Ethernet are first due next year.)

Results. For a network used exclusively for voice traffic that accepts a 50-millisecond round-trip maximum delay, Melvin concludes that up to 100 simultaneous conversions may occur during traffic peaks. If only one third of the telephones are busy at the peaks, then 300 phones may be connected.

In the case where 35% of the network's bandwidth is devoted to data and the allowable round-trip delay is a (still acceptable) 100 ms, then Melvin says 78 simultaneous calls may take place. He believes that both these scenarios could yield effective service.

To combine voice and data, Intel will have to build new interface modules for telephones on the public network, as well as for work stations on Ethernet alone. There could also be gateways to private automatic branch exchanges and the public telephone network.

A typical telephone-net interface module, shown in the figure, would provide the usual line-interface functions such as ringing and two-to-four-wire conversion, as well as digital buffering for eliminating packet jitter. Also included are packet assembly and disassembly, signaling and control, Ethernet media access, and transceiver and codec functions,



Interface. The telephone network interface module studied by Intel shows the usual telephone-subscriber-line interface and codec functions, as well as the functions involved with placing packetized voice and data onto the Ethernet coaxial cable.

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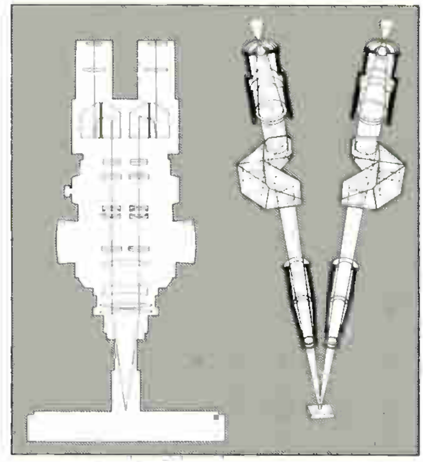

The common main objective system of the Wild stereomicroscope, left, offers the advantage over the Greenough system, right, in that the intermediate image planes are parallel to the object plane and there is no tilt between them.

Wild Heerbrugg and Leitz Wetzlar: World leaders in macroscopy and microscopy

all under microprocessor control.

The PABX gateway would provide similar functions but also converts packetized voice into analog or pulse-code–modulated digital signals for connection to the public network.

Problems. Intel has concentrated its first investigations on echo and delay, which are the primary determinants of voice quality. Delays in gaining access to an Ethernet cable vary from moment to moment because of the network-access contention and arbitration scheme.

Packet buffering can only do so much; moreover, it and its memory management are expensive, and too much buffering is disconcerting to the user. What is needed is to optimize the number of packets transmitted and their length, a problem Intel continues to study.

Intel is also looking into the snags variable delays cause for both PABXs and telephone central-office switches. The best solution to the delay and echo problem is to minimize the number of telephones connected to the Ethernet. To make this number as large as possible, however, Intel has been looking at various schemes that could allow up to 10% of the transmitted packets to be lost without voice-path impairment, Melvin says.

The amount of echo and delay that can exist before the user is bothered depends on the architecture of the system. Thus, two- or four-wire hybrid design, the kinds of modules present, the use of echo cancelers, and the like, are all relevant to the network capacity problem, says Melvin. Other factors Intel is considering include the mix of voice and data and also the bandwidth of the system's data terminals.

Obviously, if Ethernet is to be used with telephones, the grade of service would have to be planned in advance, based in part on usage habits, traffic peaks, and densities. "Additional research, experimentation, field trials, and performance standardization are necessary before these systems can be widely used—especially when there is access to the public switched network," Melvin says. **-Harvey J. Hindin**

News briefs

IBM realigns all U. S. marketing

The promised second phase of its marketing reorganization was announced by IBM Corp. To segment its U. S. market by customer instead of by product type, IBM will be combining the resources of the Data Processing, General Systems, and Office Products divisions into two new marketing divisions. To start up next month, each will market IBM's full product line to its assigned customer groups. The National Marketing division, headquartered in Atlanta, will sell to small, medium-sized, and some large customers. The National Accounts division of White Plains, N. Y., will serve selected large customers having complex information processing needs, such as the Fortune 500 companies and the large financial institutions. Both divisions are part of the Information Systems Group created last fall.

Glass transmits across entire infrared spectrum

A new infrared-transmissive glass is searching for applications. It is the first amorphous material that transmits as well as or better than other materials across the entire 1-to-11-micrometer wavelength range of the IR spectrum, according to Barnes Engineering Co. in Stamford, Conn. Until now, transmission media covered this spectrum in sections. For example, silica- or fluoride-based glasses would cut off at about 4 and 8 μm, respectively; some crystalline materials transmit in the 10-to-11-μm range. Barnes is looking to license the manufacture of the material, which it declines to describe for publication, to whoever has any ideas for its use. It may also enter into joint ventures. Possible applications include lasers, lenses, IR domes, thin-film dielectrics, and in medium-loss fiber optics.

U. S. production systems to be made in Japan

A joint venture, GCA Sumitomo Shoji Japan Ltd., established by GCA Corp. of Bedford, Mass., and Sumitomo Corp. of Tokyo, should begin manufacturing GCA's DSW 4800 wafer stepper-lithography and its Wafertrac wafer-processing systems in Japan early next year. The move anticipates a switch by Japanese integrated-circuit makers from 1:1 projection aligners (like Perkin-Elmer's Micralign systems) to steppers for next-generation 64-K and 256-K memory chips, says GCA. Sumitomo currently markets GCA's capital equipment products through its Sumisho Electronic Systems Inc. division.

Xerox releases higher-level Ethernet protocols

Details of the higher-level protocols used in its Ethernet-related products have been released by Xerox, hoping to encourage others to develop equipment for the local network. The documents, "The Internet Transport Protocols" and "Courier: The Remote Procedure Call Protocol," are available from Xerox Corp., Office Products Division, Network Systems Administration Office, 333 Coyote Hill Rd., Palo Alto, Calif. 94304.

Photovoltaics

Solar storage cell looking still better

Three years after receiving a Federal government contract to develop an inexpensive solar-energy technique combining silicon photovoltaics and fuel cells, Texas Instruments Inc. reports "all major milestones have been met." However, the Dallas firm cautions that it considers the project "a high-risk proposition" because of the need to conduct more tests to prove reliability.

The novel solar energy concept combines conversion and storage functions [*Electronics*, Nov. 6, 1980, p. 39]. Its prime investigator, E. L. "Pete" Johnson at TI, says it should provide electricity at nearly the same cost as residential utility rates.

Tiny silicon spheres, immersed in a hydrobromic-acid electrolyte, create a current that splits the aqueous solution into liquid bromide and hydrogen gas. These elements are


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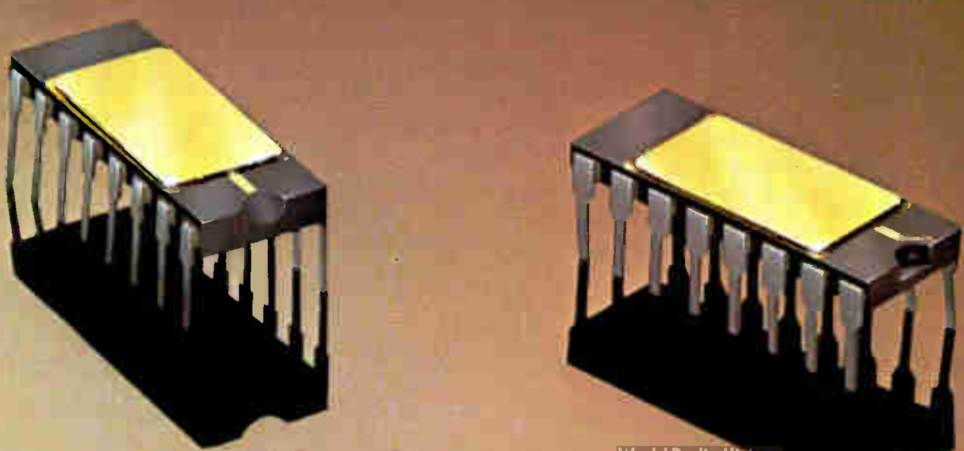
DRAMs

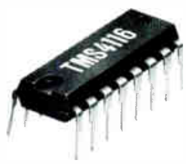
from Texas Instruments

PART NO.	ORGANIZATION	ACCESS	CYCLE	MAX. POWER OPER.	MAX. POWER STBY.	PACKAGE
TMS4116-15	16K × 1	150 ns	375 ns	462 mW	20 mW	NL-Plastic
TMS4116-20	16K × 1	200 ns	375 ns	462 mW	20 mW	NL-Plastic
TMS4116-25	16K × 1	250 ns	410 ns	425 mW	20 mW	NL-Plastic
TMS4164-15	64K × 1	150 ns	280 ns	200 mW	27 mW	NL-Plastic JDL-Sidebraze
TMS4164-20	64K × 1	200 ns	350 ns	200 mW	27 mW	NL-Plastic JDL-Sidebraze
TMS4164-25	64K × 1	250 ns	410 ns	200 mW	27 mW	NL-Plastic JDL-Sidebraze



Major performance improvements at lower costs

Readily available, TI's new TMS4164 64K DRAM brings higher system performance at lower overall system cost to your new designs and upgrades.



Best speed/power combination — In all the world, only the new TMS4164-15 offers 150-ns access time and 280-ns cycle time coupled with the lowest power dissipation for such a device. Only 140 mW typical — a 50% reduction compared to 16Ks.

And, our 200- and 250-ns versions have even lower typical power dissipations — 125 and 105 mW — ideal for small systems demanding low active power.

Faster cycle times also mean refresh overhead is reduced from 2.4% to 1.8%.

"Elegant" chip design — In addition to lowering power requirements, TI's unique epitaxial silicon technology virtually eliminates the effects of substrate noise and dramatically increases operating margins. And, this innovative design also results in a 64K chip that's the smallest in production.

Overall economies — Having 64K bits in a single package substantially boosts system capability and reduces system costs.

Compared to four 16Ks, the single 300-mil, 16-pin package saves board space and eases layout. As does the single +5-V power supply — normally you would need three.

System operating margins are improved. As is reliability. Interconnects and system test are reduced. As are cooling requirements.

The TMS4164 is in distributor stocks ready for off-the-shelf delivery. It is supported down-the-line by knowledgeable, accessible field sales engineers in TI's 50 sales offices across the nation. Help, whenever you need it, is only a phone call away.

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EPROMs

from Texas Instruments

PART NO.	ORGANIZATION	ACCESS FROM ADDR.	ACCESS FROM C/S	MAX. POWER OPER.	MAX. POWER STBY.	PACKAGE
TMS2708-35	1K × 8 3 power supplies	350 ns	120 ns	800 mW	—	JL-Ceramic JDL-Sidebraze
TMS2708-45	1K × 8 3 power supplies	450 ns	120 ns	800 mW	—	JL-Ceramic JDL-Sidebraze
TMS27L08-45	1K × 8 3 power supplies	450 ns	120 ns	580 mW	—	JL-Ceramic JDL-Sidebraze
TMS2716-30	2K × 8 3 power supplies	300 ns	120 ns	720 mW	—	JL-Ceramic JDL-Sidebraze
TMS2716-45	2K × 8 3 power supplies	450 ns	120 ns	720 mW	—	JL-Ceramic JDL-Sidebraze
TMS2516-25	2K × 8	250 ns	120 ns	525 mW	131 mW	JL-Ceramic JDL-Sidebraze
TMS2516-35	2K × 8	350 ns	120 ns	525 mW	131 mW	JL-Ceramic JDL-Sidebraze
TMS2516-45	2K × 8	450 ns	120 ns	525 mW	131 mW	JL-Ceramic JDL-Sidebraze
TMS2532-30	4K × 8	300 ns	—	840 mW	131 mW	JL-Ceramic JDL-Sidebraze
TMS2532-35	4K × 8	350 ns	—	840 mW	131 mW	JL-Ceramic JDL-Sidebraze
TMS2532-45	4K × 8	450 ns	—	840 mW	131 mW	JL-Ceramic JDL-Sidebraze
TMS25L32-45	4K × 8	450 ns	—	500 mW	131 mW	JL-Ceramic JDL-Sidebraze
TMS2564-45	8K × 8	450 ns	120 ns	840 mW	158 mW	JDL-Sidebraze

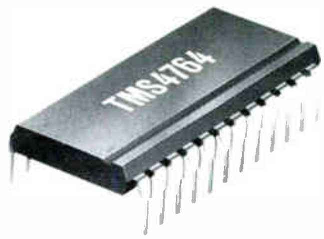
ROMS						
TMS4732	4K × 8	300 ns	120 ns	440 mW	110 mW	JL-Ceramic NL-Plastic
TMS4764	8K × 8	300 ns	120 ns	440 mW	110 mW	JL-Ceramic NL-Plastic

The broad choice for optimum system performance

From the workhorse 16K to the industry's first 64K, TI offers 5-V, fully-static EPROMs to fit your every design need. With high performance, and access times as fast as 250 ns. For today's new systems and upgrades. Preparing for what is to come.

Use TI's TMS2500 family for program and fixed parameter storage during system development and prototyping where you need to change data quickly and easily. Check out their cost effectiveness for use in initial production when you are in a hurry to get to the marketplace.

Maximum compatibility — The pinouts for TI EPROMs are derived from popular industry-standard ROMs so that all members of the family are plug-compatible with each other. And will be with those that are on the way. Which makes upgrading a simple design task, and prolongs product life.



Easy programming — You avoid mask charges by programming TI EPROMs yourself using widely available programmers and a single TTL-level pulse. You program in any order — individually, in blocks, at random. Erasing is only a matter of ultra-violet.

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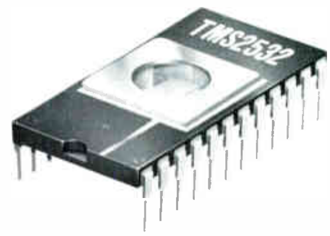


Coming soon:

- A new EPROM family with very fast access times
- A high-density 128K EPROM for tomorrow's systems

Economical, high-density ROMs — When your programming will not change or need to be updated, using large-capacity ROMs in large numbers can achieve the lowest cost of any semiconductor memory. TI offers two high-density ROMs tailored for the job — the 32K TMS4732 and the 64K TMS4764.

Both are high performance memories with low power dissipations, typically less than 400 mW. Maximum access and minimum cycle times are 300 ns. They are fully static — no clocks — and require only a single 5-V power supply. Reliability is enhanced by the use of N-channel silicon gate technology during fabrication, and all outputs are TTL compatible.

These ROMs are plug-compatible with TI's 32K and 64K EPROMs. After you have defined your programming using TI EPROMs with their inherent savings, you can switch to TI ROMs for the economies of volume production. A system designed with appropriate memory addressing can utilize TI's 32K or 64K EPROMs or TI's 32K or 64K ROMs on the same printed circuit boards in the same 24- or 28-pin sockets.

SRAMs from Texas Instruments

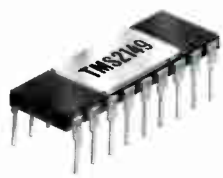
PART NO.	ORGANIZATION	ACCESS		MAX. POWER		PACKAGE
		FROM ADDR	FROM C/S	OPER.	STBY.	
TMS2114-15	1K × 4	150 ns	70 ns	330 mW	120 mW	NL-Plastic
TMS2114-20	1K × 4	200 ns	85 ns	330 mW	120 mW	NL-Plastic
TMS2114-25	1K × 4	250 ns	100 ns	330 mW	120 mW	NL-Plastic
TMS2114-45	1K × 4	450 ns	120 ns	330 mW	120 mW	NL-Plastic
TMS2114L-15	1K × 4	150 ns	70 ns	248 mW	72 mW	NL-Plastic
TMS2114L-20	1K × 4	200 ns	85 ns	248 mW	72 mW	NL-Plastic
TMS2114L-25	1K × 4	250 ns	100 ns	248 mW	72 mW	NL-Plastic
TMS2114L-45	1K × 4	450 ns	120 ns	248 mW	72 mW	NL-Plastic
TMS4044-12	4K × 1	120 ns	70 ns	303 mW	108 mW	NL-Plastic
TMS4044-20	4K × 1	200 ns	70 ns	303 mW	108 mW	NL-Plastic
TMS4044-25	4K × 1	250 ns	70 ns	303 mW	108 mW	NL-Plastic
TMS4044-45	4K × 1	450 ns	100 ns	303 mW	108 mW	NL-Plastic
TMS40L44-12	4K × 1	120 ns	70 ns	220 mW	60 mW	NL-Plastic
TMS40L44-20	4K × 1	200 ns	70 ns	220 mW	60 mW	NL-Plastic
TMS40L44-25	4K × 1	250 ns	70 ns	220 mW	60 mW	NL-Plastic
TMS40L44-45	4K × 1	450 ns	100 ns	220 mW	60 mW	NL-Plastic
TMS2147H-3	4K × 1	35 ns	35 ns	660 mW	165 mW	NL-Plastic JL-Ceramic
TMS2147H-4	4K × 1	45 ns	45 ns	660 mW	165 mW	NL-Plastic JL-Ceramic
TMS2147H-5	4K × 1	55 ns	55 ns	660 mW	165 mW	NL-Plastic JL-Ceramic
TMS2147H-7	4K × 1	70 ns	70 ns	660 mW	165 mW	NL-Plastic JL-Ceramic
TMS2149-3	1K × 4	35 ns	15 ns	660 mW	—	NL-Plastic JL-Ceramic
TMS2149-4	1K × 4	45 ns	20 ns	660 mW	—	NL-Plastic JL-Ceramic
TMS2149-5	1K × 4	55 ns	25 ns	660 mW	—	NL-Plastic JL-Ceramic
TMS2149-7	1K × 4	70 ns	30 ns	660 mW	—	NL-Plastic JL-Ceramic

Speed demons and other performance leaders

Where speed is the top priority in storing variable data, TI's fast SRAMs win hands down. Two new memories from TI — TMS2147H and TMS2149 — offer an access time from address of a scant 35 ns. Access time from chip select can be a lightning-fast 15 ns. Yet maximum operating power is only 660 mW.

They are just the ticket for use in cache, control store, and high-speed buffer applications.

High performance TMS2147H — Organized 4K × 1, this new SRAM offers access times from address or chip select of 35, 45, 55, and 70 ns, and has a chip select, power down feature. Maximum operating power is 660 mW, with standby power at 165 mW.



High performance TMS2149 — This new SRAM is organized 1K × 4, and has an access time from chip select as fast as 15 ns. Allowing you to take full advantage of system decoding delays and get the performance you expect. Access time from address is 35, 45, 55, and 70 ns.

Because of TI's low power, both memories come in space-saving 18-pin, 300-mil ceramic and plastic packages. And, both are ready for delivery now.

If your system calls for slower speeds but you still want high performance, check our new 4K TMS4044 and TMS2114 static RAMs. The 4K × 1 and 1K × 4 offer 120 ns and 150 ns access times respectively, with maximum operating power only 220 mW and 248 mW on the low-power versions. Both represent a dependable, reliable solution to simplify your microprocessor system design.

Coming soon:
- A new 2K × 8 static RAM with 120 ns access times
- A high-density, high-performance 16K × 1 static RAM
- A MOS memory subsystem for cache memory design

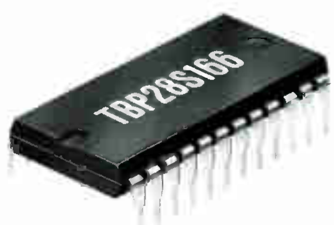
PROMs from Texas Instruments

PART NO.	SIZE	ORGANIZATION	TYPICAL ADDRESS ACCESS TIME	TYPICAL POWER DISSIPATION
TBP18S030 TBP18SA030	256 Bits 256 Bits	32W × 8B	25 ns	400 mW
TBP24S10 TBP24SA10	1K Bits 1K Bits	256W × 4B	35 ns	375 mW
TBP28L22 TBP28LA22	2K Bits 2K Bits	256W × 8B	45 ns	375 mW
TBP28S42 TBP28SA42	4K Bits 4K Bits	512W × 8B	35 ns	500 mW
TBP28S46 TBP28SA46	4K Bits 4K Bits	512W × 8B	35 ns	500 mW
TBP24S41 TBP24SA41	4K Bits 4K Bits	1024W × 4B	40 ns	475 mW
TBP28S86-60 TBP28SA86-60	8K Bits 8K Bits	1024W × 8B	35 ns	625 mW
TBP28S86 TBP28SA86	8K Bits 8K Bits	1024W × 8B	45 ns	625 mW
TBP28L86	8K Bits	1024W × 8B	65 ns	275 mW
TBP24S81-55 TBP24SA81-55	8K Bits 8K Bits	2048W × 4B	35 ns	625 mW
TBP24S81 TBP24SA81	8K Bits 8K Bits	2048W × 4B	45 ns	625 mW
TBP28S166-55 TBP28S166	16K Bits 16K Bits	2048W × 8B 2048W × 8B	35 ns 45 ns	675 mW 675 mW

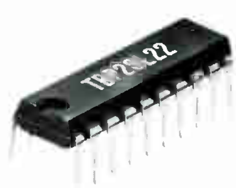
A = OPEN COLLECTOR; L = LOW POWER

Top performers across the board

Name your design needs in bipolar PROMs. Fill them quickly from the industry's broadest choice. At Texas Instruments.



Low densities to high — Your choice ranges from a 256-bit PROM — often needed but difficult to find — to a new high-performance 16K device. You can choose from by-4 and by-8 organizations. With maximum address access times as much as 20 ns faster than data sheet specifications thanks to speed screening.



Better heat dissipation — Many TI PROMs in plastic packages now incorporate advanced copper-clad stainless steel leadframes which improve thermal characteristics by 20% to 25%. Result: Lower operating temperatures in the circuit which boost product reliability.

Convenient programming — TI's PROMs eliminate many programming problems and reduce programming costs. A single specification programs all members from 1K through 16K, using any of the popular programmers on the market. Or for no fallout whatever, you can have TI program, symbolize, and ship your PROMs to you (200-piece minimum order per program per scheduled delivery).

Space-saving packages — You can order many TI PROMs in 300-mil wide packages that save 50% in board space. The 600-mil package is also available — both widths in plastic or ceramic.

More advantages — All TI PROMs incorporate titanium-tungsten fuse lengths. All have low current PNP inputs to permit easy interfacing with MOS and bipolar microprocessors. All are Schottky-clamped for the best speed/power combinations.

Coming soon:
- Registered PROMs ideally suited for microprogrammed pipeline systems

Read and file this guide. As a quick reference to TI's broad selection of semiconductor memories, it can quickly put you on the right track to solutions for design problems.

For more detailed information on any of TI's semiconductor memories, call your authorized TI distributor.

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Circle 47 on reader service card

stored separately and, when electricity is needed, are recombined in a hydrogen bromide fuel cell. The acid solution is then returned to the solar chemical converter for use again.

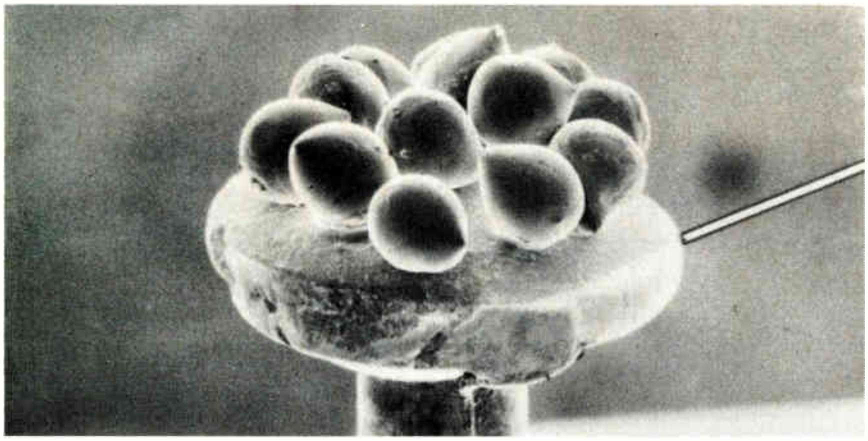
An important milestone recently attained is that TI has been able to store the hydrogen safely, using a technique that combines the gas with a powdered alloy of calcium and nickel, says Johnson. He discussed the closed-loop system at this month's International Electron Devices Meeting in Washington, D. C.

Converting the hydride compound back into gas and the alloy requires less pressure and lower temperatures than if other alloys, such as iron and titanium, were used, he says. Heat from the liquid-bromide storage unit is enough to store and release the hydrogen.

New ground. Johnson also announced that TI's Central Research Laboratory in Dallas has also "plowed new ground" in developing an efficient hydrogen bromide fuel cell that meets the program's power goal of 300 peak watts output. "Most practical devices have been limited to several other chemicals—like hydrogen-oxygen, which received wide application in space programs," Johnson explains.

"In changing the feed stock, you have to address a whole new set of technology problems, like corrosion, material technology, design and construction," Johnson continues. "So from a materials standpoint, it's like starting over."

With less than a year left on the



Tiny cells. Microphotograph shows TI's spherical silicon solar cells, 10 to 15 mils in diameter. The spheres, cast in a glass matrix, offer a conversion efficiency of 13%.

Electronics review

Department of Energy pact, most of the remaining work has to do with reliability of the system. Corrosion remains a major concern, Johnson indicates. TI continues to offer no timetable on possible commercial products, only saying it is targeting its work toward residential applications. **-J. Robert Lineback**

Office automation

Copier marketer adds word processing

Savin Corp. is hardly a household word, but thousands of office workers know the company through its copiers. Now it aims to make its brand even more common in offices by introducing two families of work stations that integrate word-processing, data-processing, and communications capabilities.

The Valhalla, N. Y., firm is counting on its reputation in copiers to bolster sales of its new systems, which sell for as little as $7,800. Such a price is comparable with bottom-of-the-line equipment from major suppliers like Wang Laboratories Inc. and Digital Equipment Corp.

Says company vice president Abraham Ostrovsky, "Customers know that Savin understands office operations and can respond to the users' requirements." He is convinced the firm can sell around several thousand work stations over the first year of sales. Deliveries will start at year end.

Enhanced. To create the two families, each of which has four members, Savin added its own software and some hardware enhancements to Convergent Technologies Corp.'s three-piece work stations that feature a high-resolution video-display terminal (see p. 151).

Savin has enhanced the detachable keyboard with interchangeable front-panel strips that express functions as simple English words like "bold" or "underline." Thus users can perform complex functions simply by a single touch rather than through memorized keystroke codes.

Each customer gets a custom data-processing software package under Savin's approach. The customer describes how his business works, then goes through a detailed question and answer session with Savin programmers who then design an appropriate software package. This approach allows data collected by a company for one application be used for other applications.

Savin is not the first to use Convergent Technologies 8088- and 8086-based series of work stations. In November, NCR Corp. Dayton, Ohio, announced its WorkSaver systems, to be delivered in April of 1982 for $7,795. Early in the second quarter of 1982, Burroughs Corp. of Detroit, Mich., will also be introducing a small business system based on Convergent's hardware, the B20.

Savin's top-of-the-line IS 2000 uses a 5-megahertz 8086 processor, 256-K bytes of random-access memory, and 8-K bytes of read-only memory. Its mass store contains an 8-in. floppy-disk drive with 0.5 megabyte of formatted storage and a 20-megabyte Winchester-technology disk drive. **-Steve Zollo**

Peripherals

Optical storage tape holds 50 gigabytes

The supremacy of magnetic tape as for low-cost archival storage may be challenged in the near future by a new medium that promises bit densities that are orders of magnitude greater and cost much less per bit. The medium is optical tape, which stores bits of information not as magnetic flux units, but as the presence or absence of small holes drilled into its surface.

The holes are drilled by using a laser beam to melt the highly reflective, silvered surface of the tape, exposing areas of low reflectivity. Bits are read by detecting the reflective scattering of laser light from the tape. The result is a medium that, though not erasable like magnetic tape, is a permanent one suitable for purposes of archival storage.

Drexler Technology Corp., Mountain View, Calif., is developing the tape using its own Drexon laser-recording material usually applied to optical disks. While acknowledging that it may be well into 1983 before production quantities of the tape—and the read/write mechanisms to go with it—are available, company president Jerome Drexler notes that his company has developed a prototype tape that it will make available to researchers in sample quantities.

Many bits. "Right now, we are using 5-micrometer holes, but there would be no problem in going to 2.5-μm holes," Drexler asserts. He points out that a 2,400-foot tape 70 millimeters wide could store 50,000 megabytes using 5-μm holes. To original-equipment makers, price of the tape is expected to be under $5,000 per 2,400-ft reel—a cost of 10¢ per megabyte. Using 2.5-μm holes would permit 200,000 megabytes to be stored at a cost of 2.5¢ per megabyte. By contrast, magnetic-tape storage costs about 15¢ per megabyte.

The tape could be used in an open-reel configuration with a 50-mil-thick-coating applied to the reflective surface to prevent dust particles from interfering with the recording process. But Drexler envisions another way. "I see it sealed in a cassette, and a 50-mil window in the package would replace the coating on the tape," he says.

Uses. A long reel of 35- or 70-mm optical tape could be used in recording satellite transmissions or retaining geophysical data for oil and gas exploration, computer and document archives, and off-line tape libraries, Drexler says. He also sees smaller optical cassettes with tape about 3 mm wide and 50 ft long and capacities of about 25 megabytes. These could be used with personal and business computers.

At present, Drexler has developed only a prototype reader/writer that handles small strips. At least one of its customers is at work on a commercial version. Its introduction is expected before the second quarter of 1982. **-Martin Marshall**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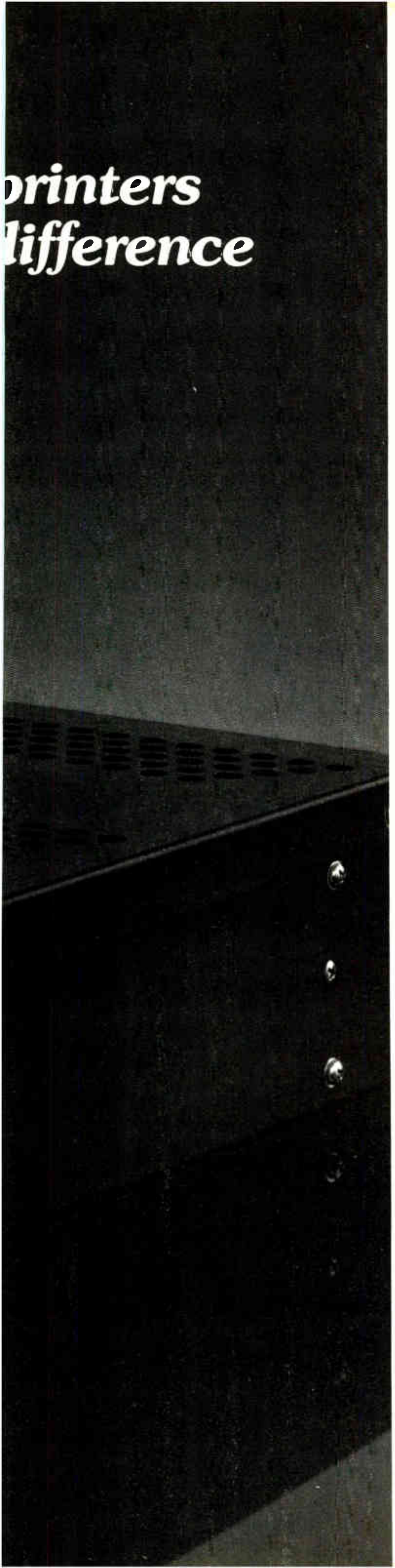

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Model DPP-Q7 Parallel. Seven-column numeric printer. Two hundred forty lines/min. Selectable positive or negative TTL full-parallel BCD input plus input storage register. Same size, shape and interfaces of digital panel meters. Only 4.4 pounds. Selection of printout formats. 115/230 VAC power.

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New

Model APP-20 Serial. Similar to alphanumeric APP-20 Parallel model, but designed for full serial 20mA optoisolated and RS-232-C data input. Seventy-five to 9600 baud data rate. Needs only two wires to interface. Can be remotely located from hazardous data source. Tall characters. Selectable inverted text/lister printing.

New

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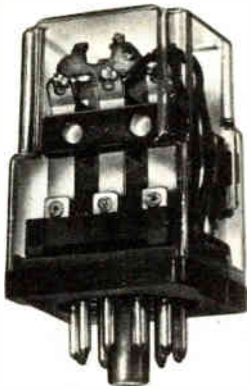

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Washington newsletter

Postal Service gears for electronic mail

The U. S. Postal Service and four telecommunications carriers have signed agreements to provide transmission links between volume mailers of computer-generated mail and the Post Office's electronic mail service, known as E-Com. The four firms are TRT Communications, ITT World Communications, Netword, and Taipan Industries. **Also, 25 major mailers have applied for technical certification as of Dec. 1 to use E-Com.** Three other companies, Dialcom, Western Union International, and Graphnet, have applied for E-Com access and are evaluating the interconnection agreements. Slated to begin Jan. 4, E-Com will allow volume mailers to transmit their messages through the telecommunications carriers to 25 serving post offices where they will be mailed.

FCC ponders allocation of transponders

The issue of allocating transponders on communications satellites is heating up. The Federal Communications Commission currently has three inquiries under way that are expected to result in decisions by early next year. Whatever the FCC decides, however, the matter is almost certain to end up in court. **One controversy is whether satellite owners may take the auction-lease route, as RCA did in November,** to determine which companies would get to lease seven transponders, with the right to lease going to the highest bidder. That squeezed out companies that had been expecting a first-come, first-served allocation. Another dispute involves outright sales of transponders. Hughes has sold 18 for a total of $201 million on a satellite to be launched in May 1983, and RCA has also sold two transponders. The third issue before the commission is a proposal to completely deregulate domestic communications satellites.

Support grows for 'right-to-tape' law

Support for what is called right-to-tape legislation is growing in response to the U. S. Court of Appeals decision making it illegal to videotape copyrighted TV programs for noncommercial use. Bills have been introduced in the House and Senate with the Senate version moving very quickly. **Backers of the Senate bill include Sony Corp., the National Association of Retail Dealers of America, the National Citizens' Committee for Broadcasting, and 3M Corp.** The bill, which has 30 cosponsors, would permit home recording for private use. Testifying before the Senate Judiciary Committee on the bill, Joseph Lagore, president of the Sony Consumer Products division, argued that "to ban this equipment would surely have a dangerously negative impact on technological innovation and development of any kind in this country. Why would someone spend billions of dollars needed to create new technology in the fashion we have here only to have it banned or recalled a decade and a half later?"

Navy wins approval for LAMPS production

After several weeks of agonizing over rising costs of the LAMPS Mark III SH-60B antisubmarine warfare helicopter, the Defense Department has finally approved the Navy's request to put the electronics-crammed choppers into production in the current fiscal year (see p. 64). A memo from Deputy Defense Secretary Frank C. Carlucci to the Navy approved limited initial production of the system—**18 helicopters and the backfitting of 10 ships to accommodate them**—in fiscal 1982, at an estimated cost of about $700 million. Carlucci also authorized the Navy to initiate advance procurement of 48 LAMPS helicopters in fiscal 1983, for which the Pentagon will request $970 million.

The Navy's skewed priorities for antisubmarine warfare

Christmas will not be very merry this year at Lockheed-California Co. in Burbank, Calif. The reason: the Department of Defense's decision to support Navy Secretary John F. Lehman's plan to cancel production of Lockheed's P-3C Orion aircraft, which are used for antisubmarine warfare patrols. After deciding to proceed in fiscal 1983 with the production of 60 Orions at the rate of a dozen a year, the Navy secretary reversed himself upon listening to his carrier admirals.

The infighting for funds is becoming increasingly competitive, and the admirals argue that they can make better use of the money by buying more Harriers and F-18Ss, while relying on IBM Light Airborne Multipurpose System shipboard helicopters for antisubmarine defense. Lehman proposes to stop P-3C production for five years and then restart the line in 1988. In reality that decision will kill the program.

Lockheed's grim picture

This cancellation, coupled with the company's termination of the unsuccessful L-1011 commercial jet transport, leaves Lockheed-California with only the low-volume line of the TR-1 high-altitude reconnaissance plane, a variant of its U-2R, and a handful of other classified efforts at its Skunk Works, formally known as Advanced Development Projects. As a result, as Lockheed Corp. president and chief executive Larry Kitchen put it in a mid-November letter to Lehman, "The viability of Lockheed-California Co. would be in great jeopardy." If it folds, Kitchen warned, it will represent the loss of "the only existing integration and production capability for airborne antisubmarine warfare in the free world."

The P-3, with its 10,000 pounds of avionics, has done well for Lockheed. When sales to foreign allies are included, the company has turned out 523 of the four-engined Orions, although only 40% of these are the latest C models. To shut down production now, disband the team of contractors, and then restart a cold production line in five years would more than double the plane's unit cost of $34.5 million to nearly $75 million, when an annual inflation factor of 7% is included. Of course, Lehman is unlikely to have to face that problem in five years, as he well knows.

Other Navy options for the P-3 are available under the awkward acronym of SLEP/Cilop—for service life extension program and conversion in lieu of procurement. By Lockheed's estimate, Cilop would cost nearly $4.38 billion over eight years. That covers upgrading 182 planes at $23.8 million each plus nonrecurring costs. The figure is based on upgrading 36 planes each year after a three-year lead time. Lockheed, of course, would rather build new ones.

Loss of foreign military sales dollars to the U.S. is another argument advanced by Lockheed's Kitchen. The Netherlands, for example, uses older P-3As for the most part, but is scheduled to take delivery of three more P-3Cs in fiscal 1983 concurrent with the Navy purchase. Australia, which has P-3Bs it plans to upgrade, had planned to buy 10 P-3Cs in the fiscal 1984–86 timeframe. Japan, says Kitchen, "is accelerating its license production and is planning to extend its production quantity from 45 to 90 or 100" planes, while France and West Germany are interested in the Orion for their antisubmarine warfare aircraft needs of 40 and 20 planes respectively.

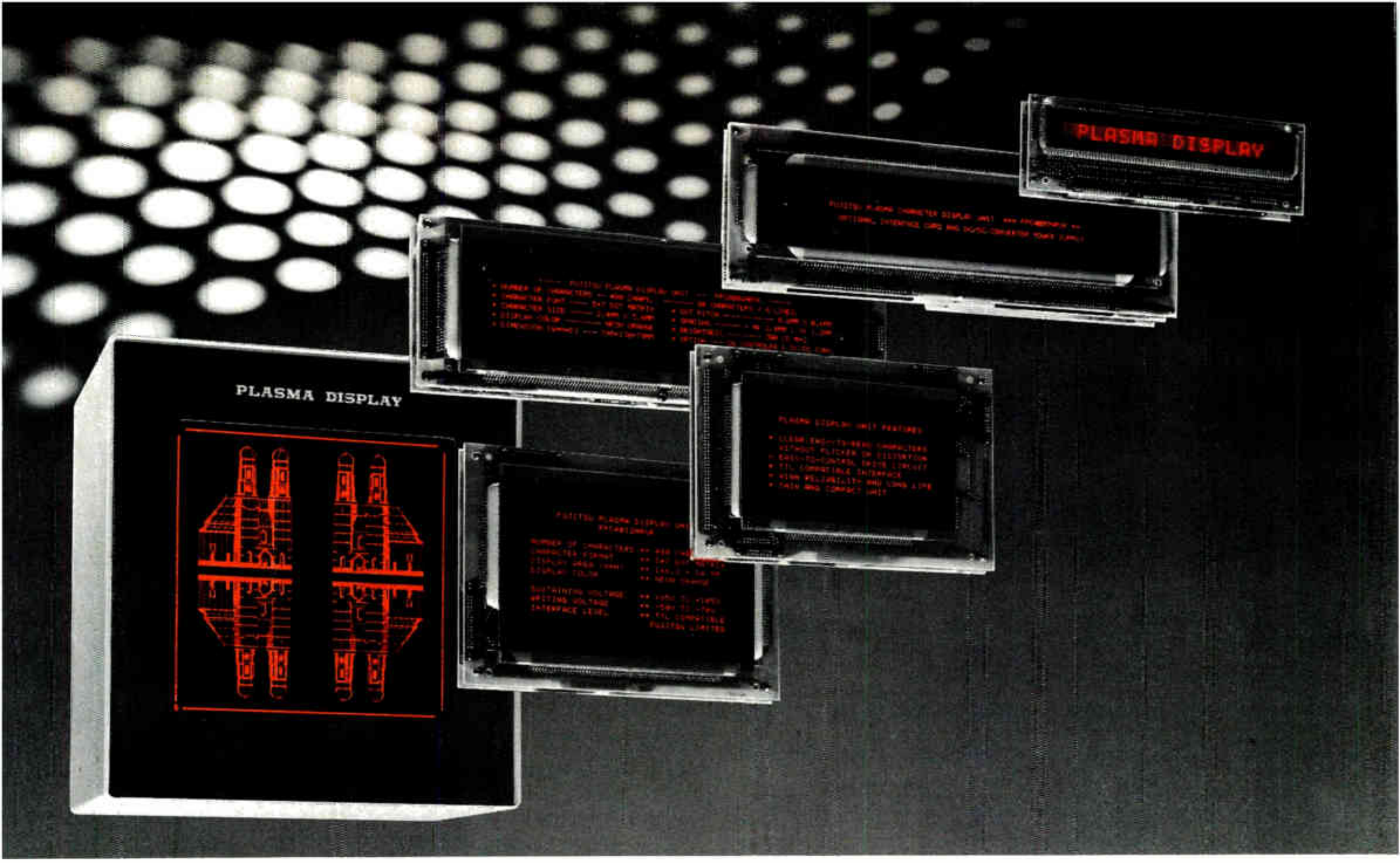
Whether Lockheed-California lives or dies is far less critical to the country than maintenance of its long-range antisubmarine warfare capability—although the first, unfortunately, may be inextricably interwoven with the second.

Range is the name of the game in airborne antisubmarine warfare for the Navy today. It will be more so in the years ahead as the Soviet Union increases its undersea fleet and builds on its existing ability to stand off from a task force and use cruise missiles launched under water from distances of more than 250 miles. Fleet air defense, however crucial, will be of little help in such circumstances.

When the Pentagon distributed its fearful 100-page assessment of Soviet military power earlier this year to rationalize its escalating spending program to a questioning Congress and its constituents, it ranked the growth of Russia's submarine fleet near the top of its threat list. "Over the past 10 years," the Pentagon maintains, "the Soviets introduced two new versions of the Victor nuclear-powered attack submarine (SSN) and developed the Alfa high-technology attack submarine. In 1980, the Soviets produced Oscar, the prototype of a new class of nuclear-powered cruise-missile attack submarine (SSGN), which is about twice the size of any previous SSGN. High priority is being devoted to antisubmarine sensor technology applicable against ballistic-missile submarines."

If that is the case, then Lehman's priorities for airborne antisubmarine warfare require a great deal more explanation. Lockheed Corp., for one, is determined to see that Congress seeks it out.

-Ray Connolly



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In addition, Fujitsu's character and graphic display units are smaller and thinner, with the same screen size, because Fujitsu has redesigned the circuits to reduce the size of the units. There's also a new look on the screen. Clear, highly visible characters and graphics against a darker background give you a more distinct image which is easier to read both straight on and well off to the side.

Of course AC drive and inherent memory are still features of the full lineup. And you can choose from a wide variety of designs to suit any application, including measuring instruments, computer peripheral and terminal equipment, and graphic design units. The result is the most advanced plasma display unit available today. At Fujitsu Component Europe, B.V., which started in November, an experienced staff is on hand to give you full details.

CHARACTER UNITS (For units with character generator control)

Model	No. of Characters	Character Format	Character Size (mm)	Power Source
FPC1601NRCA*	16 (16 chars. x 1 row)	5 x 7 dot matrix	8.0 x 10.2	V_{CC} = +5V V_{GG} = +12V
FPC3201NRCK	32 (32 chars. x 1 row)		4.0 x 5.6	
FPC4002NRCK	80 (40 chars. x 2 rows)		3.1 x 4.4	
FPC3208NRCK	256 (32 chars. x 8 rows)		3.0 x 4.2	
FPC4012NRCK	480 (40 chars. x 12 rows)		3.0 x 4.2	
FPC8002NRCK	160 (80 chars. x 2 rows)		3.0 x 4.2	
FPC8006NRCK	480 (80 chars. x 6 rows)		3.0 x 4.2	
FPC8012NRCK	960 (80 chars. x 12 rows)		3.0 x 4.2	

* Also includes V_{sub} = -5V

GRAPHIC UNITS (For units with graphic generator control)

Model	Effective Display Area		No. of Effective Lines		Dot Pitch (mm)	Power Source
	D(mm)	W(mm)	D	W		
FPG0707NRUC	78	78	128	128	0.6	V_{CC}=+5V V_S=+80V~+110V V_W=+140V~+160V
FPG0805NRUA	18.6	153	32	256	0.6	
FPG0909HFUA	217	217	512	512	0.423	V_{CC}=+5V V_S= +85V~+105V V_W=-55V~-75V

Character and graphic color: neon orange

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Circle 136 on reader service card

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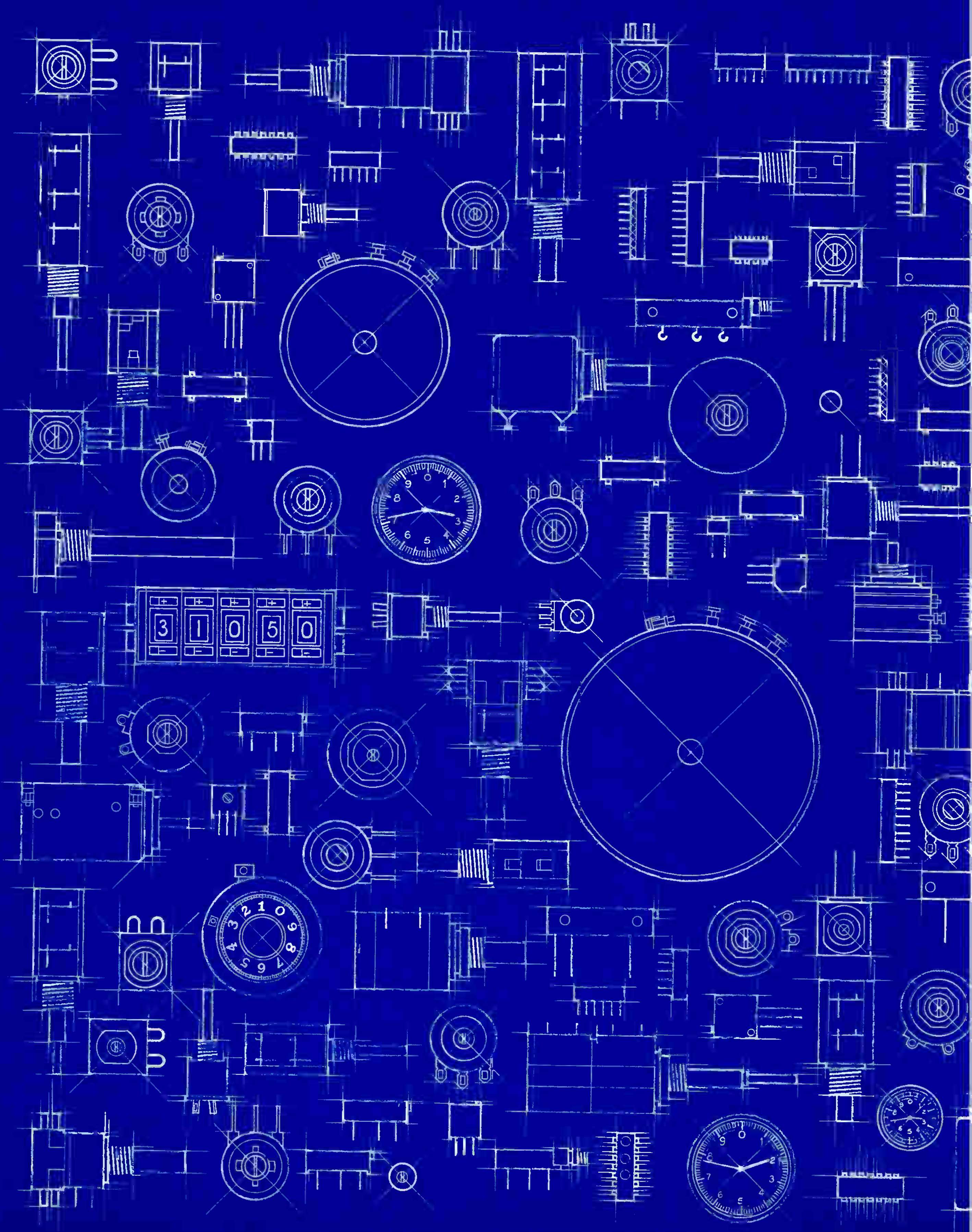

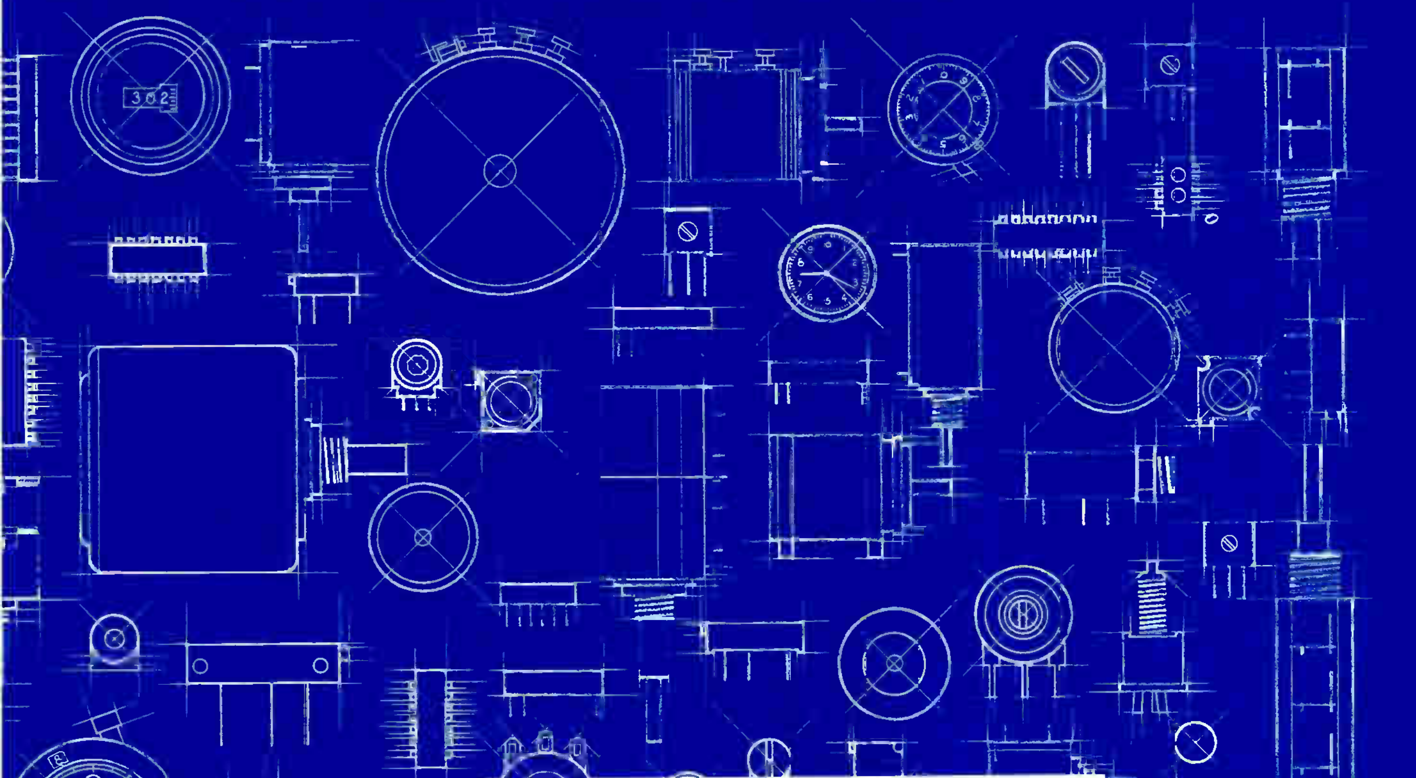

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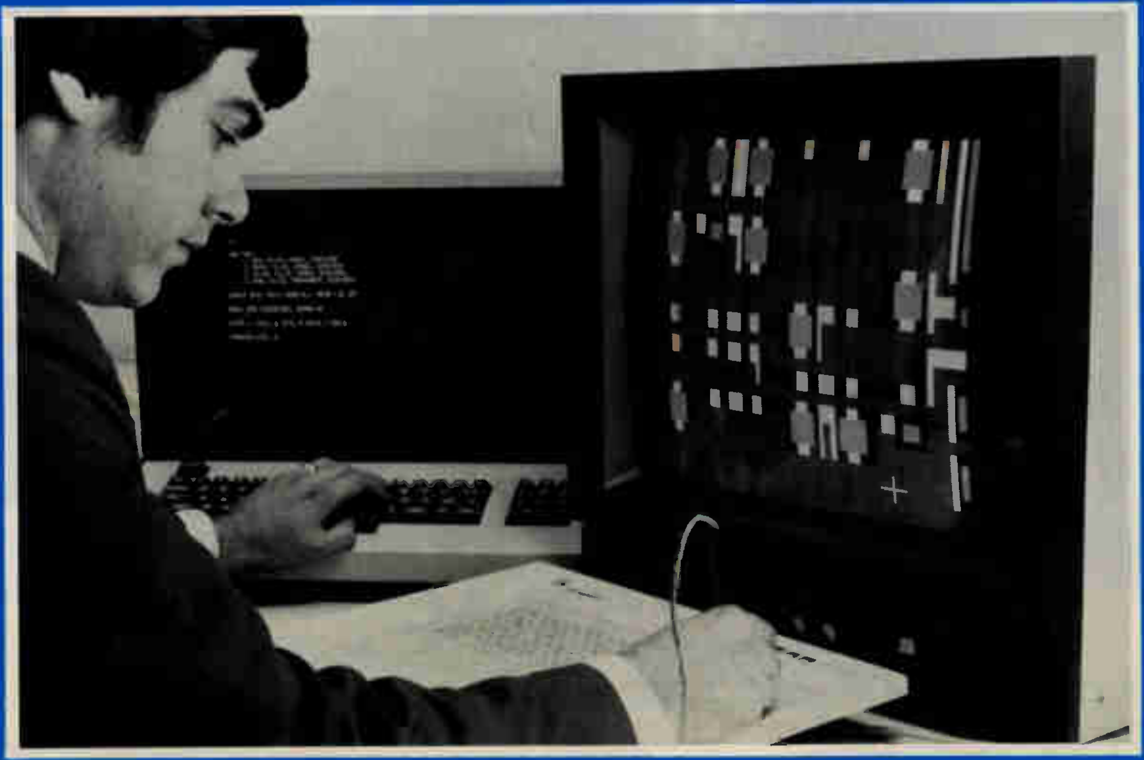
Circle 67 on reader service card

Dec. 15, 1981

Electronics International

World's fastest IC can get faster still: page 81

Designer checks a mask layout that owes its unusual density to a revised version of Gaelic computer-aided design software: page 82



NEC, too, to make gate arrays

Nippon Electric Co. has followed Fujitsu, Oki Electric, Hitachi, and Toshiba into the gate array business. Initial products will include TTL **devices with 1,000, 550, and 250 gates and complementary-MOS devices with 2,100, 1,300, and 800 gates.** The TTL devices will have an internal propagation delay of 2 ns for a fanout of 3 and a 3-mm lead length. The C-MOS devices will have a 12-ns delay for the same fanout and lead length. By the end of next year the firm expects to be able to offer TTL devices with 3,000 gates, C-MOS devices with 10,000 gates, and emitter-coupled-logic devices with 2,000 gates.

Real-time holography analyzes stresses

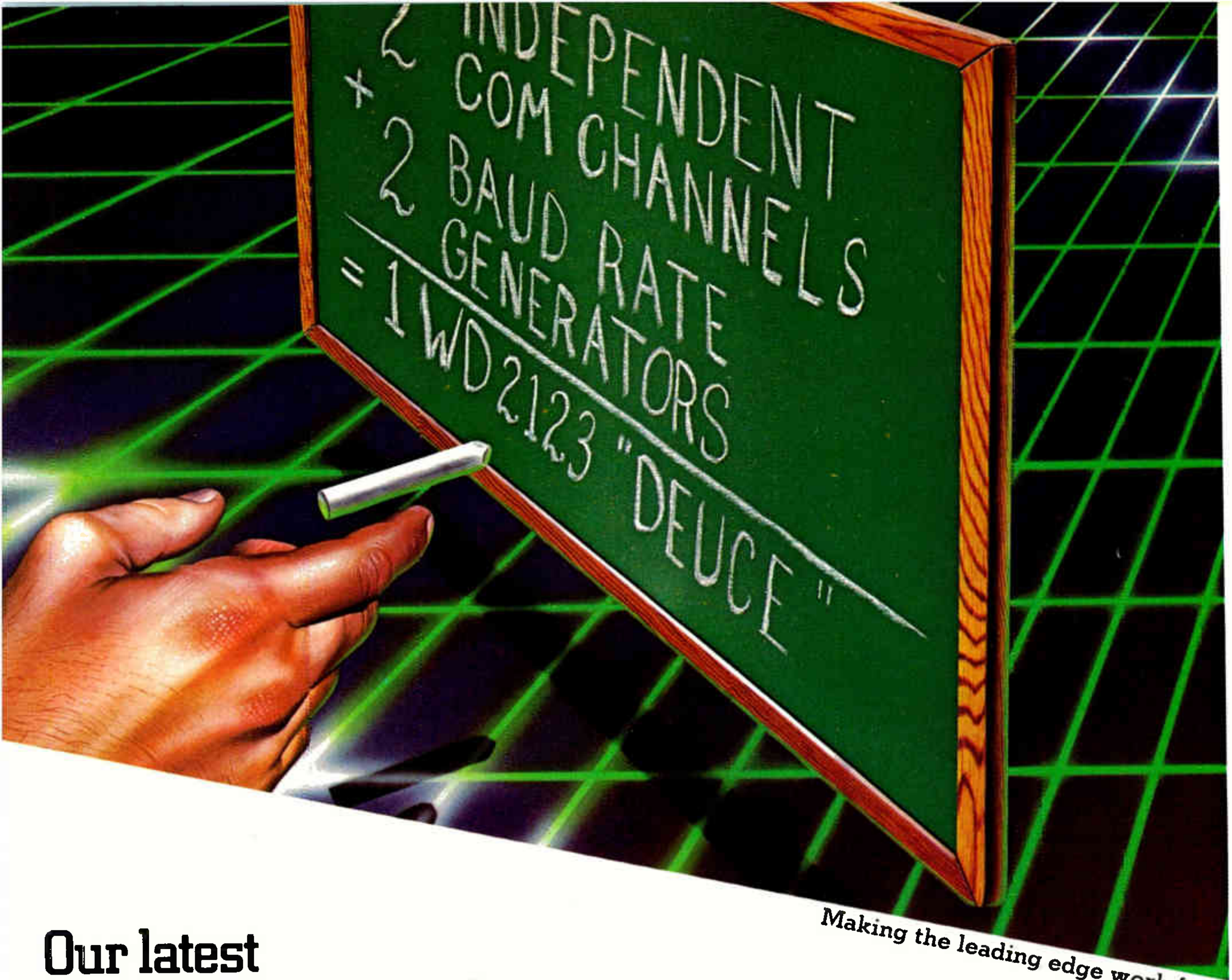
A system using holography in real time to analyze stresses in materials has been developed at the Thomson-CSF central research laboratory in the Paris suburb of Corbeville. Using bismuth silicate crystal [*Electronics*, July 19, 1979, p. 72], the unit displays the deformations of vibrating objects up to 20 mm square directly on a video monitor and thus **avoids the need for photography.** Based on an argon laser with a wavelength of 514 nm, the system could include signal digitization in future versions to facilitate measurement of the deformations.

Japan plans cut in computer tariff

Japan will cut its computer import tariff next spring to roughly 7% from a current 9.1% as part of a **new effort to ease trade friction with the West.** Computers are among 2,000 items for which Japan will speed up by two years tariff reductions already agreed to in the Tokyo round of the multilateral trade negotiations. Last May, Japan agreed to slash semiconductor tariffs next spring to 4.2% from 10.1%, five years ahead of schedule.

Addenda

Britain's ICL is now producing software for the Sinclair ZX81 home computer, **over 250,000 of which have now been produced worldwide** in either the $150 wired-up form or the $100 kit form. According to Sinclair Ltd., it is the industry's fastest-selling computer. . . . Videlec AG, in Lenzburg, Switzerland, a joint venture of Brown, Boveri & Cie in Baden and Philips of the Netherlands, is **giving up production of smaller liquid-crystal displays—mostly used in watches**—but will continue to manufacture larger LCDs. The low cost of small units from Japan on the world market has made Swiss production uneconomic. . . . Siemens AG is delivering 10,000 teletypewriters to Saudi Arabia. These, plus the 17,000 the West German company has already installed there, will give the country a Telex network **as dense as that of many highly industrialized nations.** . . . Matra-Harris Semiconducteurs SA of Paris and Intel Corp. of Santa Clara, Calif., are jointly funding Cimatel, a center for the **design of n-channel MOS devices for European and other markets.** Circuits designed by Cimatel, to be based in Paris and Nantes, France, will be manufactured by both companies. . . . An agreement on laying a phone cable **directly between Israel and Egypt and on helping Egypt establish a communications link with the Sinai** has been signed by the two countries. West Germany's Siemens is to supply the necessary equipment within the next six months. . . . Thorn Consumer Electronics Ltd. in the UK and Japan's Mitsubishi Electric Corp. will **share technical information relating to television technology** in such areas as chassis development, production technology and quality control.



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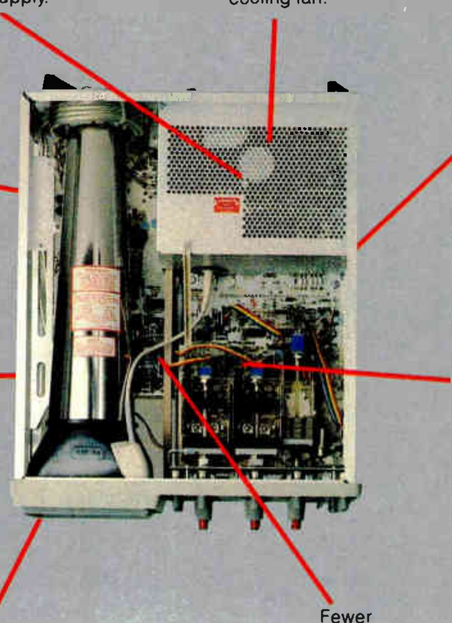

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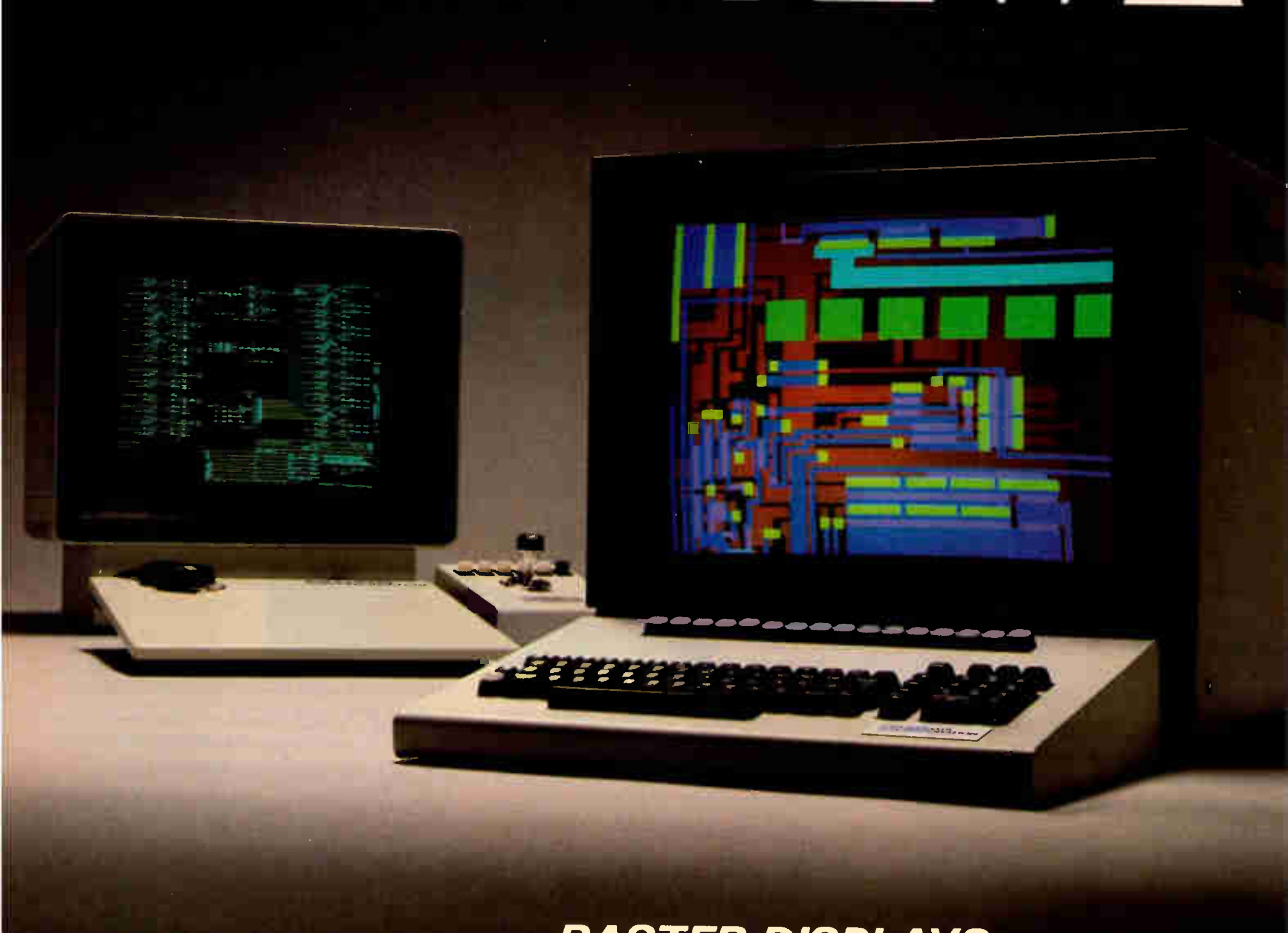

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by Robert T. Gallagher, Paris bureau manager

Planar enhancement-mode switching transistors and ungated load transistors achieve 19-ps delay

Researchers at Thomson-CSF have developed what they claim is the world's fastest circuit at room temperature, while leaving themselves room to beat their own record. The 11-stage ring oscillator uses gallium arsenide of only normal mobility, a standard gate length, and complex logic to achieve an announced 22-picosecond propagation delay at 25°C [*Electronics*, Nov. 30, p. 55]. Mounting the test circuit in a laboratory package has trimmed this figure to 19 ps.

The basis for the circuit's speed is electron confinement at its gallium-aluminum-arsenide and GaAs heterojunctions, as it is for a similar device developed at Fujitsu Laboratories Ltd. [*Electronics*, Oct. 20, p. 73]. The basic difference between the two is that, while Fujitsu uses recessed-gate technology, the Thomson circuit is based on planar enhancement-mode switching transistors and ungated load transistors. The Japanese company claims a propagation delay of 17.1 ps at liquid nitrogen temperature.

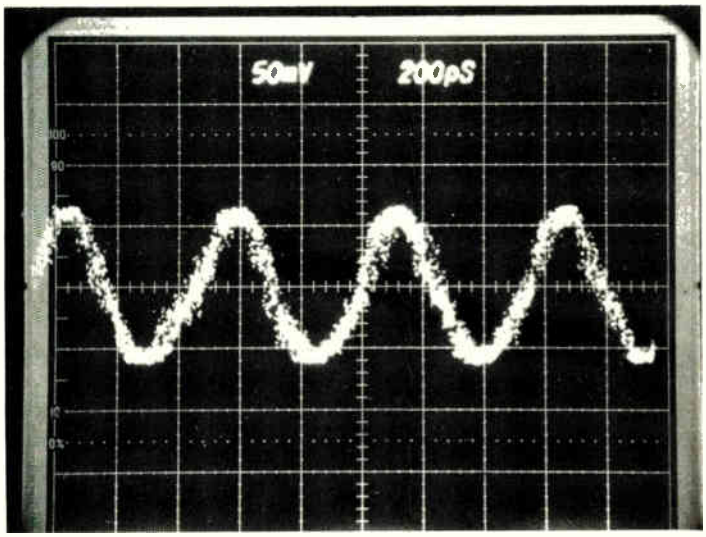
The technology is based on an experiment to determine the effect of the thickness of epitaxy on the transistors built on it. On a chromium-doped substrate, an undoped p-type GaAs layer 1 micrometer thick, an undoped GaAlAs layer 60 angstroms thick, and a silicon-doped GaAlAs layer 700 Å thick were deposited in turn by molecular beam epitaxy.

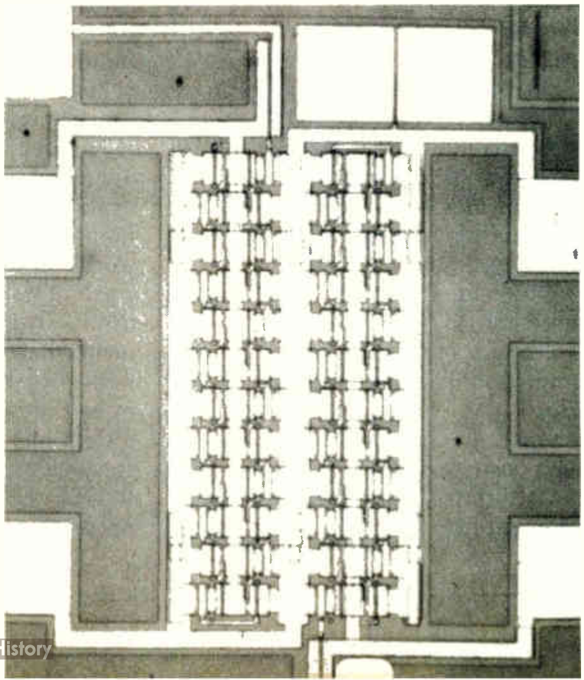
Next step. The wafer was then cut into two equal parts, with the first left intact. The other received chemical etching to remove 200 Å. Both halves were then treated identically: gold over germanium nitride was deposited and annealed to form source and drain contacts, and then an aluminum gate was deposited directly on the top epitaxy layer without any recess.

As a result, all tested transistors on the first half of the wafer were depletion-mode, whereas those on the second half were enhancement-mode. Tested at 10 gigahertz, both types of transistor showed a minimum noise figure of 2.3 decibels.

The first improvement in the circuit's speed will derive from simplifying its logic. "Our objective is to get down to 10 ps at room temperature before we start working at 77 K," says Nuyen Linh, manager of the microstructures section at the company's central research laboratory located in the Paris suburb of

Proof positive. Oscilloscope screen (left) shows the output waveform of the 11-stage ring oscillator from Thomson-CSF. Right microphotograph shows two of the devices.





Corbeville. "I feel that we can do that simply by changing the logic from field-effect-transistor logic with low pinch-off voltage to direct-coupled FET logic. Other improvements we can make are the use of higher-mobility materials and a change in the geometry to shorten the gate length. When we go to liquid nitrogen temperature, that will improve speed and heat dissipation."

The present circuit exhibits an electron mobility of 4,000 square centimeters per volt per second, works off a 3.5-V power supply, and consumes a hefty 6.6 milliwatts per stage though both the power supply and consumption will be dramatically reduced by the conversion to direct-coupled FET logic.

Great Britain

Continuous computing systems catch on with Western European hardware makers

Resilient computer systems, capable of quickly recovering from a hardware or software fault, are assuming an increased significance as computer terminals move into the general office and more and more office staff become dependent on them. Tandem Computers in the U. S. was first to the market with a resilient dual-computer system and has rapidly built a $200 million business with it. Now other manufacturers are joining in and still more will be forced to follow. Within the last month alone the entries have been:

- Britain's Computer Technology Ltd. launched Momentum, its answer to data protection.
- International Computers Ltd. revealed how it will exploit the dual-processor architecture of its newly launched 2988 to improve the resilience of its system.
- A U. S. start-up, Stratus Computers Inc., announced the Stratus/32 Continuous Processing System [*Electronics*, Nov. 3, p. 167].
- In a continuing effort, the Danish electronics company, Christian Rovsing in Copenhagen, is building a reputation for duplicated high-reliability systems.

Different. Computer Technology's approach to resilience differs from Tandem's in several respects. According to its managing director Bob Finch, CTL wants to move nonstop computing down market from the high-cost specialist defense and public utilities sector and has aimed Momentum at the small-systems market—the segment starting from $77,000 and extending to, say, $144,000 for a system supporting 100 terminals. To begin with, the company, headquartered in Hemel Hempstead, Herts., offers a range of graded options so that a customer, as his business becomes more integrated with large numbers of computer terminals, can progressively add protection to the firm's series 8000 16-bit computers.

Momentum comprises a range of hardware and software options, some already well proven. Added to the series 8000 data-base management system, for example, Momentum copies every transaction in progress, throwing away the copies after each update. Then, if a transaction fails, the system falls back to the last valid checkpoint and tries again. To guard against disk-head crashes, data can be read to paired disks so that the failure of one causes an automatic changeover to the other, with no break in on-line service.

Next, a single processor can be upgraded to a dual-processor configuration to guard against a processor failure, the two processors sharing workload and disks. When one processor goes down, the other can pick up its workload. A data-management map of all current transactions—at the file level—is preserved in both processors and is updated by a data link between the two processors operating at 1 or 2 megabits per second. Tandem, by contrast, connects processors over a high-bandwidth data-base, using it to copy data rather than just file locations. Connected terminals can be switched manually, though CTL has plans for automatic changeover.

Though CTL can offer only dual processing (Tandem can run up to 16 processors in harness), the company hints that Momentum could be extended to larger multiprocessor configurations connected by a local network, a technique that squares well with the parent group's office automation strategy.

CTL marketers concede that they may not be offering the same level of uninterrupted operation as Tandem, but they are confident that they can meet the requirements of large sectors of commercial environment at a far lower cost.

Connect. For London-based ICL, resilience will flow from its fast-evolving multiprocessor architecture in which two or four processors can be linked without a significant loss of performance. By more tightly segregating jobs, so that interprocessor communication and, hence, overheads are minimized, ICL is achieving performance factors of between 1.7 and 1.9 for its dual machines.

Basic to the new system resilience—which is slated to give uninterrupted service for periods in excess of three shift years, or 7,500 operating hours—is a continuous-control software facility that lets one dual processor monitor the other. Then, if a failure or error occurs, one mode will diagnose the problems and reconfigure the system after removing the doubtful element. The process is carried out without operator intervention and will be completed within three minutes. Continuous control, says ICL, will be released in phases. **-Kevin Smith**

CAD revision packs logic tightly on chips

No computer program can yet match a skilled integrated-circuit designer's ability to pack the maximum number of logic functions onto a chip, but Compeda Ltd.'s latest

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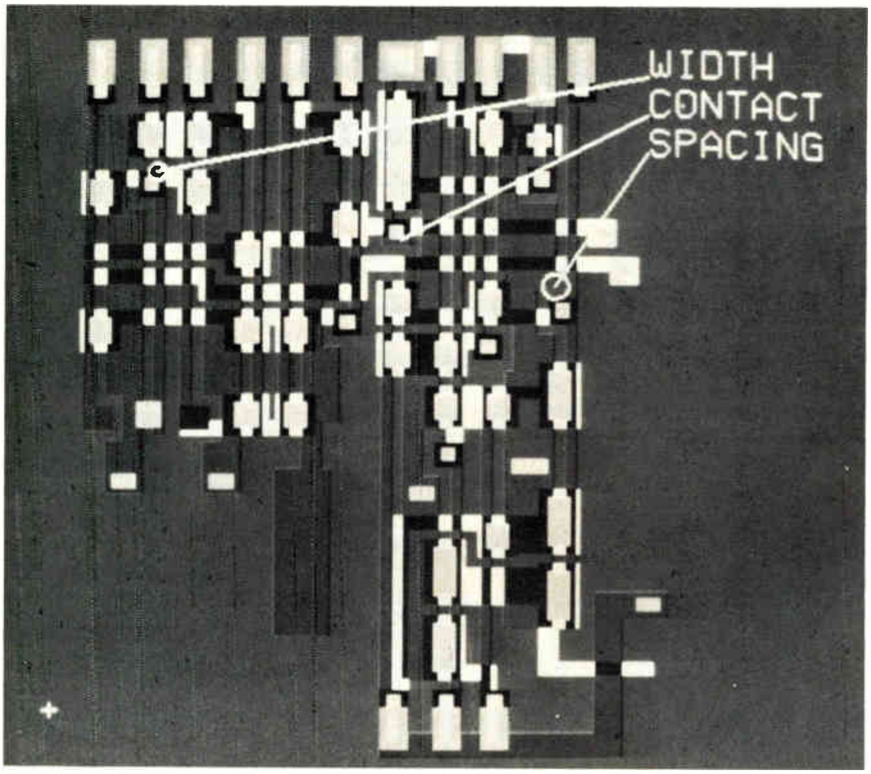


Errors checked. This color graphics terminal output resulting from Gaelic CAD software highlights design rule violations over an entire very large-scale integrated-circuit layout.

version of its Gaelic circuit-design package is much closer to that ideal.

Developed by Edinburgh University, Gaelic's great strength as a commercial system is its ability to automatically place and route assorted sizes of logic blocks chosen from a standard cell library [*Electronics*, March 30, 1978, p. 62]—a technique of crucial importance in the design of very large-scale ICs. The package was picked up by Compeda Ltd., Stevenage, England, a three-year-old computer-aided-design company established by Britain's National Research and Development Corporation (now merged with the National Enterprise Board) to commercialize software developed in British universities.

Slow beginning. The first version of Gaelic—though it has had successes like a prestige sale to General Electric Co. in the U. S.—had annual sales of only $1 million, proving it far from an out-and-out winner. But with software sales of over $5 million a year, Compeda itself is accounted a success. One reason, says Kenneth Baker, Compeda's commercial manager, was that Gaelic was little more than a language for conveniently representing and manipulating geometric shapes. Also its 32-bit orientation was ahead of the market and was economic only on large, multiuser installations. Today, however, Gaelic will run on industry-standard Digital Equipment, Prime, IBM, and other 32-bit computers. Typically, a three-work-station system would cost in the region of $320,000. Alternatively, users already committed to a CAD system can buy the software separately for around $20,000 a year, for a minimum of three years on a three-work-station system.

Today, Gaelic incorporates a set of modules to assist the designer at every stage in the design process, among them: automatic layout and mask making, color editing, schematic preparation, design-rule checking, and logic simulation. These are all interconnected by a software communications highway so that the output from one module is immediately available to the next. A management highway module tracks the design process, and a gate-array-routing package is in the offing.

In its new version, Gaelic's most striking feature remains its automatic layout capability. Initially chip layouts were between 30% and 50% larger than handcrafted designs, but with the latest version of Gaelic, now being benchmarked, the chips run anywhere from the same size to 30% larger than their manual counterparts, according to Baker.

The starting point of the program is a global placement routine whose function is to reduce routing runs between cells and bonding pads to a minimum. Compeda engineers, in common with others, use a model in which connections are represented by stretched rubber bands, causing cells with a high connectivity to be pulled closer together. Time-critical signal tracks can be assigned additional weighting.

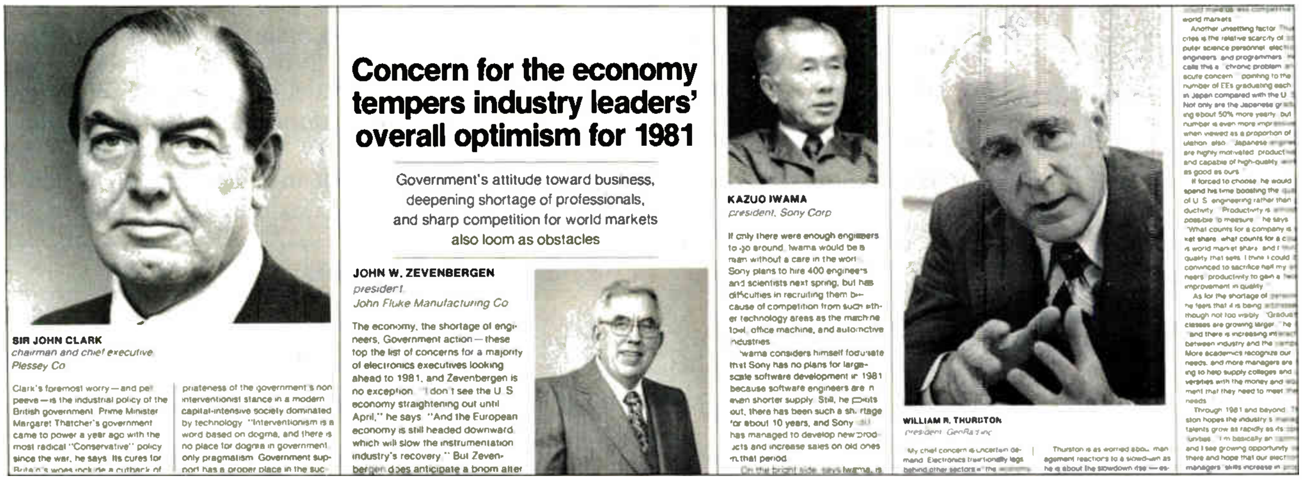
Layering. From this initial placement, the program works much like a stonemason packing a dry stone wall—placing first the large cells and then filling in with smaller cells. After each layer has been placed, the global placement routine is repeated. A battery of algorithms is available to optimize placement by different routines. "It's rather like turning up the skill factor in a game of computer chess," says Ken Loosemore, a Compeda software expert.

The placement routine also takes care of routing. It connects up ground and supply in a single metalization-masking stage, interdigitating the two supply lines from opposite ends of the chip. Another facility is the ability to vary the width of power-bus tracks so that, as the current in a particular track section drops, the width of the track automatically shrinks as well.

Gaelic's color graphics and bit-pad facility makes the different mask layers easy to identify. In fact, the Gaelic package can handle three layers of interconnection. Also, its schematics-preparation module helps an engineer turn his rough notes for a logic diagram into drawing-office documentation.

The design-rule-checking facility

Important editorial



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Electronics

Where important people read important editorial is now particularly easy to use. Violations of track width and spacing rules, or contact transgressions, are clearly indicated on both the graphics terminal and the printout. Also, the user can apply different design rules in different sectors of the chip. A regular random-access-memory structure, for example, could thus be designed with the tightest rules.

The logic simulator automatically generates logic-timing diagrams of all output signals for any specified logic block and specified set of input signals. Baker accepts that many potential customers will be more familiar with other simulation packages such as Spice or Tegas and points out that these can readily be interfaced with the Gaelic system.

The end product, says Baker, allows a high degree of optimization and, if desired, operator intervention, achieving a finished design in days rather than months. Gaelic, he believes, is now poised for a rapid takeoff in a field that right now has no market leaders. **-Kevin Smith**

West Germany

Siemens tests implanted injector that meters insulin to diabetics

Electronically controlled insulin dosage units have, for the first time, been implanted in a number of diabetic patients in Europe. Developed at Siemens AG, the implant holds a four-week supply of insulin and may be remotely programmed by an external hand-held device to pump insulin into the body at set rates.

One patient has been wearing his unit since April of this year. On two others, the implants have been in place since August and September. No complications have been reported thus far, says Manfred Franetzki, who heads the system's development at Siemens's medical-engineering group in Erlangen.

Although the ongoing tests have been successful so far, Siemens considers its system still in the research stage. "Commercial devices and routine implantations are still several years away," Franetzki cautions.

Companies and medical institutions on both sides of the Atlantic are working on implantable injectors. In the U. S., the Sandia National Laboratories in Albuquerque, N. M., implanted a similar device earlier this year. But according to Franetzki, its insulin reservoir requires refilling every two days, and the supply tubing between the reservoir and the dosage unit, both internal, poses problems.

The Siemens device, in contrast, needs refills only once every four weeks. Also, the reservoir and pump are integrated into one unit, eliminating the need for extra tubing. The company is now weighing whether to offer a trial unit to medical experts in the U. S. for evaluation. The present version contains a peristaltic pump, control electronics, a lithium battery, an insulin reservoir, and a septum for replenishing the reservoir. All components are hermetically encapsulated in a titanium pacemaker casing, a metal that the body readily accepts.

Size and weight. Weighing about 170 grams with a full reservoir and roughly the size of a pack of cigarettes, the unit is connected to a catheter with an opening that is 0.3 millimeter in diameter. The reservoir—it holds about 10 milliliters of insulin—is refilled through an injection needle through the skin. Refilling is usually done by a physician. The battery, rated at 3.2 volts, lasts at least a year for daily injections of 50 insulin units. The average diabetic, Franetzki explains, needs about 40 units a day.

The system's programming unit, about the size of a pocket calculator, has both programming and monitoring functions. Powered by a 5.6-V battery, it programs the implant's insulin pump for any one of 12 basic injection rates and any of 12 demand

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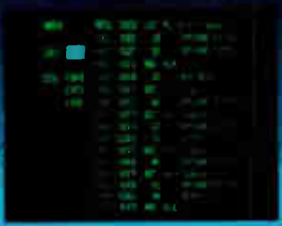

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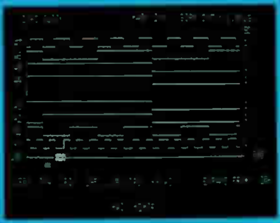

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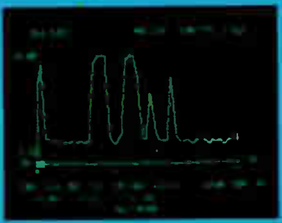

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The *PI*-540 resides in the expandable System 5000 mainframe. RS-232 and IEEE-488 interfaces are available.

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doses—the patient sets the rate and dose on the programmer and holds the device near the implant, no more than 15 centimeters away.

Coded rate and dose information is then inductively coupled from the programmer's transmitting coil through the body tissue to the implant's receiving coil. For sending monitoring information from the implant to the programmer, the motor coil of the pump is also used as a transmitter.

Because a malfunctioning implant could be disastrous to the patient, the Siemens designers have gone to great lengths to implement safety measures. One is keeping the interior of the implant at less than atmospheric pressure. That way, neither a leak of the pump nor a leak of the reservoir or the filling septum can lead to an uncontrolled release of insulin into the body. Further, the reservoir is made of a special compound-foil plastic material. The catheter is made of durable polyethylene and, for protection and long life, is surrounded with a silicone rubber sleeve. In the case of overdosing as a result of faults in the electronic circuitry, the pump automatically shuts itself off.

For proprietary reasons, Siemens is not disclosing a detailed description of the unit's electronics at present. But it will say that an encoder in the programmer codes both the basic rate and demand dose in the form of pulses, the pulse spacing representing the code.

The pulses are modulated onto a 25-kHz carrier that is inductively coupled from the transmitting coil to the receiving coil in the implant. There the carrier is demodulated, and the pulses are used to operate the pump motor.

For low current consumption, the implant's circuitry is designed around a complementary-MOS device. The other components in the circuit are discrete. Eventually, the circuit will be hybridized, Franetzki says, "and one day it may pay to use integrated-circuit techniques." Continuing work is aimed at reducing the size of the implants and increase reservoir refill intervals. **-John Gosch**

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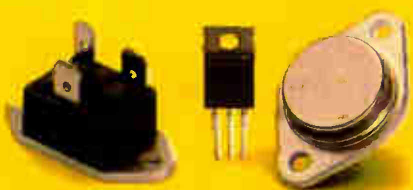
●	Telephony/EDP printers	
	Domestic appliances (washers; micro-wave ovens; cookers)	●
●	Low-power motor control (500 W typical)	
	Medium/high-power motor control	●
●	SMPS (switched-mode power supplies)	
	SRPS (series-resonance power supplies)	●
	CRT deflection	●



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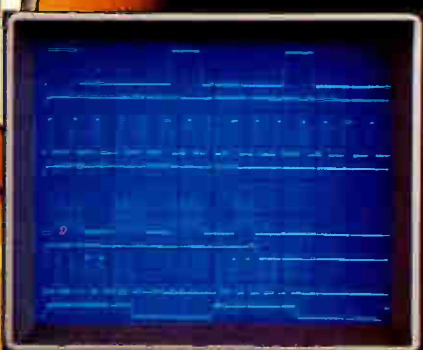
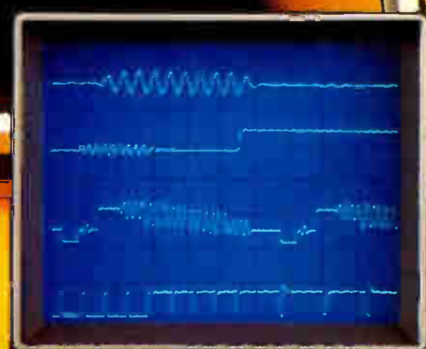
- 4 memories and 2 channels give multiple display modes over a 60 MHz bandwidth.
- A trigger delay of –9 to + 9999 divisions that effectively stretches memory capacity and provides pre-/post- triggering.
- IEEE/IEC-Bus for systems operation and further signal analysis.
- Multiple single-shot mode for capture of successive transients.
- Plus TV triggering, X-t recorder type roll mode and X-Y recorder output.

PM 3310 sets a new standard in digital storage



Two input channels and four memories allow eight traces to be displayed for detailed analysis and comparison. The in-house developed Profiled Peristaltic Charge Coupled Device (P^2 CCD) allows 50 MHz data to be sampled in a cost-effective manner.

Easy operation is another big PM 3310 plus. Parameter settings, for example, are stored with the relevant signals and can be recalled for display.



An accurate –9 to + 9999 division trigger delay extends the basic benefits of A/D conversion. This facility is used here to pick out a particular TV colour burst.

Philips Industries, TQ III-4-62, Eindhoven, The Netherlands.

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Circle 364 on reader service card

Plotter, processor, and software join to draw graphs

by Robert Neff, Tokyo bureau

Packaged unit also has CRT, keyboard, and diskette drive; interactive graphics language can be learned in one day

Computer graph generation traditionally has required, in addition to a computer, a separate plotter and software package, usually in Basic. The Graphwriter, which Yokogawa Electric Works Ltd. will start delivering this month, combines everything into one stand-alone unit for the first time. It uses a proprietary language called Sing that Yokogawa says is far more friendly than Basic.

The Graphwriter is a follow-on to Yokogawa's Graphmate, which went on sale a year ago. It is the instrument maker's third office-automation product entry. The new unit is far more powerful than Graphmate, which lacks the Graphwriter's full alphanumeric and kana keyboard, cathode-ray-tube monitor, on-board optional floppy-disk drive, and Sing (for super-interactive new graphics).

Capable of automatically drawing on three axes with two pens to provide contrasting thicknesses or colors, the Graphwriter can turn out a host of graph designs in any pattern, including histograms, radar charts, and donut graphs, from data that is keyed in. It also writes numerals, letters, and a limited set of kanji characters and symbols in any size. Axis scales may be either linear or logorithmic. The Graphwriter can add lines and columns in numerical charts and bar graphs, compare data, accumulate, and compute moving averages.

So simply does Sing guide the user through the screen-displayed menu and operating steps that someone with no computer experience can master the Graphwriter in one day, says Hiroshi Shibuya, manager of the product marketing department at Yokogawa's instrumentation and medical-systems division.

Shibuya describes Sing as belonging to the category of "super-easy" languages, more simple than Visicalc and Sord Computer Systems' Pips. He states that this is a big advantage in Japan, at least, where only 0.6% of the population can program with Basic.

The Graphwriter, priced at $5,715 in Japan, is built around a Z80A central processing unit and boasts 44-K bytes of read-only memory and 18-K bytes of random-access memory, including 4-K bytes of user area. RAM can be extended by another 16-K bytes in a model that also packs a floppy-disk drive for data files and is priced at $7,512.

The floppy disk, a more universally accepted standard than the Graphmate's external microdisk unit, allows users to save data and formats for future processing or revision. The display is a 7-in. monochrome flat-face CRT. The Graphmate has only a single-line 16-digit display.

Color plots. The plotter element can hold 420-by-297-mm paper or overhead-projector film, either of which can be fixed electrostatically for maximum security. The pens, available in four colors and in water- or oil-based fiber or ceramic construction, move at up to 20 cm/s at a resolution of 0.05 mm. Data may be keyed in while previously entered data is being plotted.

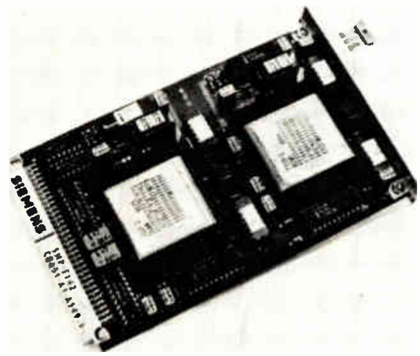
The Graphwriter measures 355 by 574 by 740 mm and weighs about 25 kg without the optional disk drive. Yokogawa plans initial monthly production of 50 to 100 Graphwriters, with exports to start after a year of domestic marketing experience.

Shibuya expects the product's market to diverge initially into two major categories. Perhaps 75% of the Graphwriter's purchasers will use it for sales management and marketing reporting functions, Shibuya guesses, and the other 25% will use it to make photographic masters for offset printing plates. But Yokogawa is also planning additional application software packages to

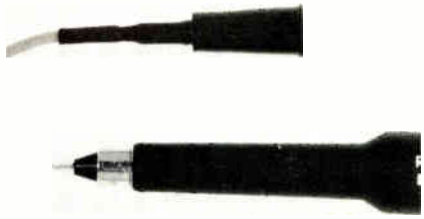
extend the Graphwriter's market to other as yet unspecified areas.

With existing software, the Graphwriter may be used for a variety of purposes, including technology management and patent applications, arrangement of research results, planning, and quality control. Shibuya argues that the Graphwriter makes sense even for users of the big computers that usually lack graphics-software flexibility. In fact, he maintains that because such users buy many Graphmates, they are bound to flock to the Graphwriter.

Yokogawa Electric Works Ltd., 9-32, Naka-cho, 2-Chome, Musashino-shi, Tokyo 180, Japan. Phone (0422)-54-1111 [441]

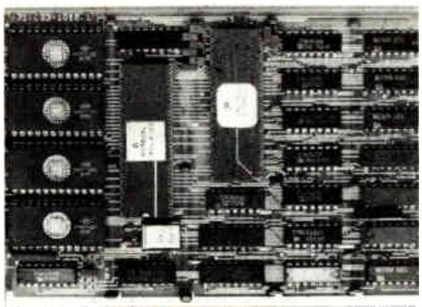


Magnetic-bubble-memory banks with 128-K to 1-megabit capacities are continued in the Siemens Microcomputer Expansion Boards SMP-E140 (controller), -E141 (128-K), and -E142 (256-K). Siemens AG, Zentralstelle fuer Information, Postfach 103, D-8000 Munich 1, West Germany [444]



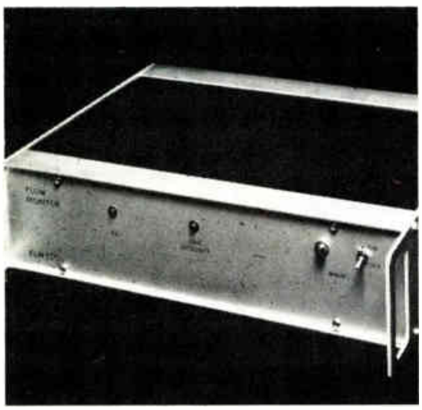
A 4-in. probe accessory explores wire-wrapped terminals on edge and multiway connectors. It has an adaptor that fits the 88 series of probe tips. A socket on its free end can be joined to a 0.025-in.[2] wire-wrapped post Greenpar Connectors Ltd., P. O. Box 15, Harlow, Essex CM20, 2ER, UK [447]

The 2018 and 2019 signal generators have a frequency range of 80 kHz to 520 MHz and 80 kHz to 1,040 MHz, respectively, and a 10-Hz resolution. They can store up to 50 settings in a nonvolatile memory. Marconi Instruments Ltd., Longacres, St. Albans, Herts. AL4 0JN, England [442]

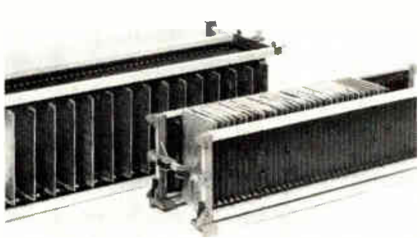


The MC6809 microprocessor and MC6844 direct-memory-access controller are on this printed-circuit board. The 2716/2732 erasable programmable read-only memories may also be placed on the board. PEP GmbH, Gutenbergstr. 9 b, D-8950 Kaufbeuren, West Germany [445]

The Frequency Decade ND 1M has a frequency range of 10 Hz to 1 MHz and a resolution of 0.01 Hz. Frequency is keyed in and shown on an eight-digit display. The output voltage is adjustable in 10-, 1-, or 0.1-dB steps. Schomandl, Ingolstaedter Str. 68d, [448] Munich 46, West Germany

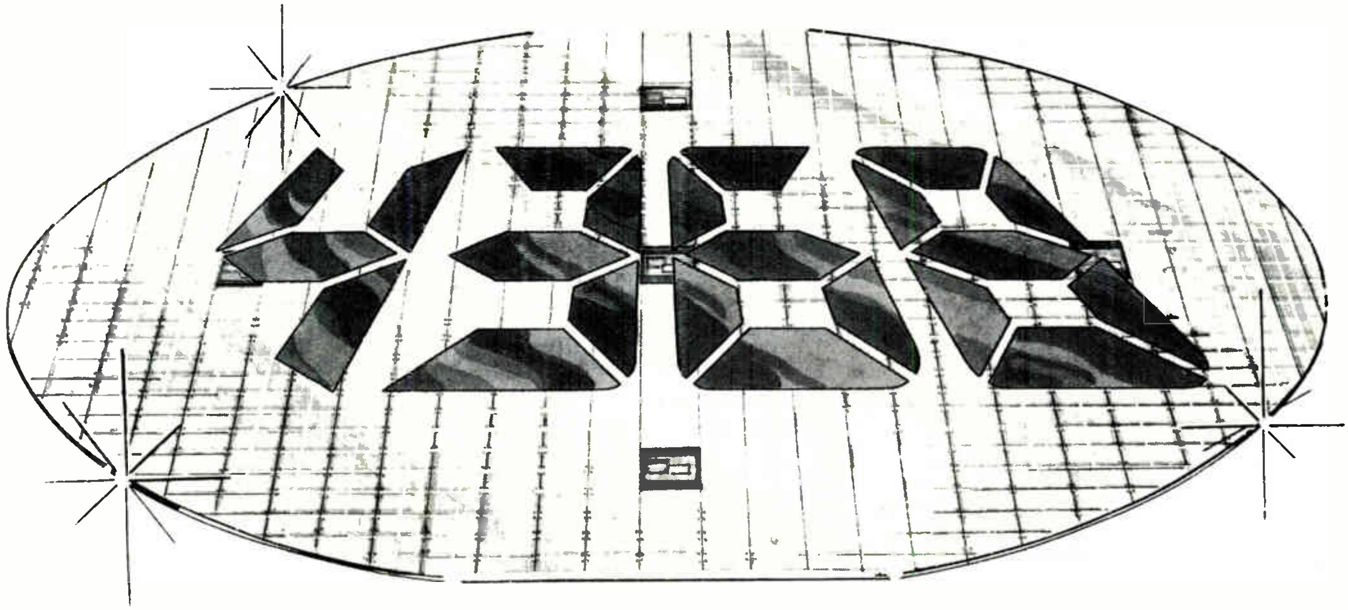


A fiber-optic cable is used by the FLM 135 to carry a modulated optical signal that measures flow in hazardous areas at distances up to 1,500 m from monitoring gear. An alarm is sounded if the fiber breaks. Optronics Ltd., Cambridge Science Park, Milton Road, Cambridge CB4 4BH, UK [443]



Up to 43 sizes of printed-circuit boards and double Eurocards, measuring 160 by 233 mm and held with cam-type clamps, may be stored and transported in these racks. Imhof-Bedco Standards Products Ltd., Ashley Road, Uxbridge, Middlesex UB8 2SQ, England [446]

Temperatures from −50° to +999°C are measured with the AT3 digital thermometer, which uses type K thermocouple sensors. The AT4 and AT5, with permanently attached probes, measure temperatures from −55° to +125°C. Avo Ltd., Archcliffe Road, Dover, Kent CT17 9EN, UK [450]



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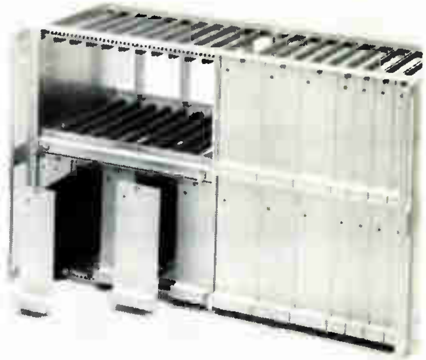
New products international

This Servogor 430 is a one-to-three-channel vertical recorder used in the laboratory, out in the field, and for general service. Recordings are made on 120-mm wide paper at from 3 cm/h to 60 cm/min. Metrawatt GmbH, Thomas-Mann-Str. 16-20, D-8500 Nuremberg, West Germany [451]

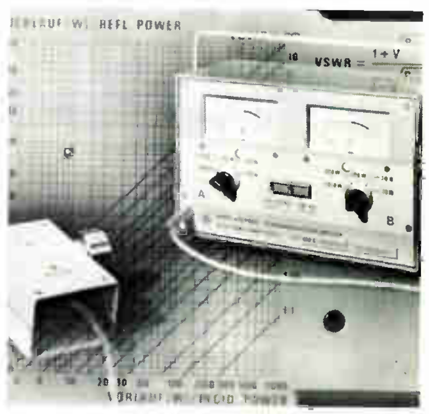


Printed-circuit boards with nominal depths of 100, 160, or 200 mm may be accommodated in the type 21 rack. Profiled aluminum rails with threaded holes in the back make for precise and easy connector mounting. AKA Mayr AG, CH-8635 Duernten ZH, Switzerland [456]

The type 622 power supply is used for satellite communications at unmanned earth stations. It was developed for traveling-wave tubes with an upper limit of about 400 W of continuous-wave power. Mean time before failure is 3,200 h. Microtest Ltd., 18 Normandy Way, Bodmin, Cornwall, UK [452]

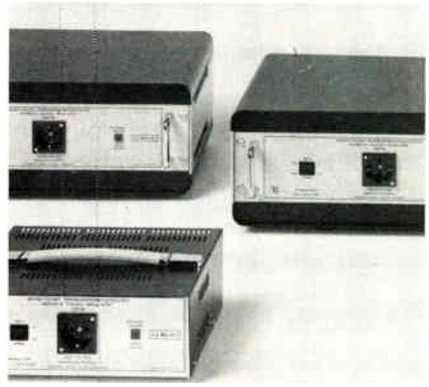
The VAC ACE desoldering unit has a power unit incorporating a vacuum pump and desoldering gun with a ceramic heater. The gun may be grounded when used on sensitive components. Light Soldering Developments Ltd., Spencer Place, 97/99 Gloucester Rd., Croydon CR0 2DN, UK [458]

The FSU 800 is a very portable, compact unit that can fusion-splice optical fibers 125 to 300 μm in diameter in approximately 15 minutes. It operates from an outlet supply or battery and has an attenuation loss around 0.2 dB. Sieverts Kabelverk, S-172 87 Sundbyberg, Sweden [453]

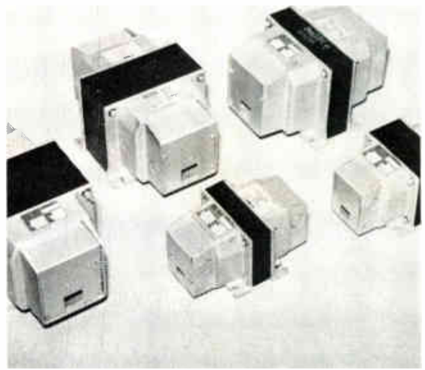


The 240-W NAUS5 and 1,100-W NAUS6 directional power meters are suitable for power and voltage standing-wave-ratio measurements on modulated and unmodulated power stages in the 25-to-1,000-MHz range. Rohde & Schwarz, P. O. Box 801469, D-8000 Munich 80, West Germany [459]

New products international



Designed to handle 250, 500, and 1,000 VA respectively, the EA-MS 603, 605, and 610 magnetic voltage regulators operate from 160 to 250 V. In addition, they have a frequency of 50 Hz and an output voltage of 220 V ±3%. Eltronix GmbH, D-7770 Ueberlingen, West Germany [460]



Transient noise is killed in data systems with the Deltec DT super-isolation transformers. They provide a common-mode noise-rejection ratio of 140 dB and have ratings of 250 VA single phase to 15 kVA three phase. Gould Power Conversion, Rhosymedre, Wrexham, Clwyd. LL14 3YR, UK [461]

Computer-aided design and drawing has a new high-resolution graphic-display system in the Picture Interaction Computer System (PIC) 1000. It has a flicker-free color monitor that displays clear pictures at 50 frames a second. Bosch GmbH, Bosch-Str. 7, D-6100 Darmstadt, West Germany [465]

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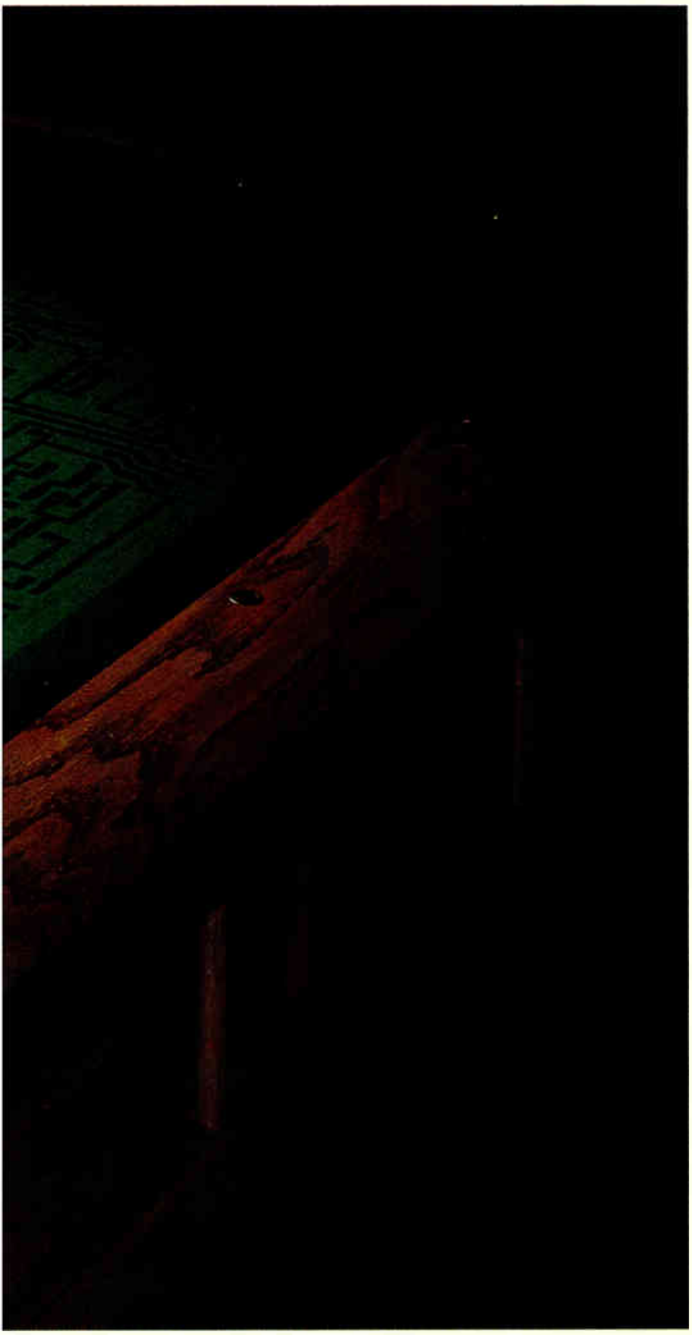

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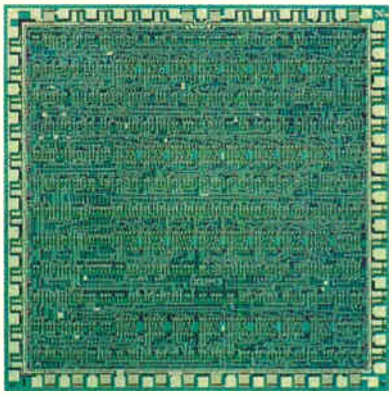

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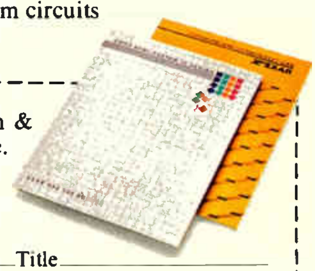

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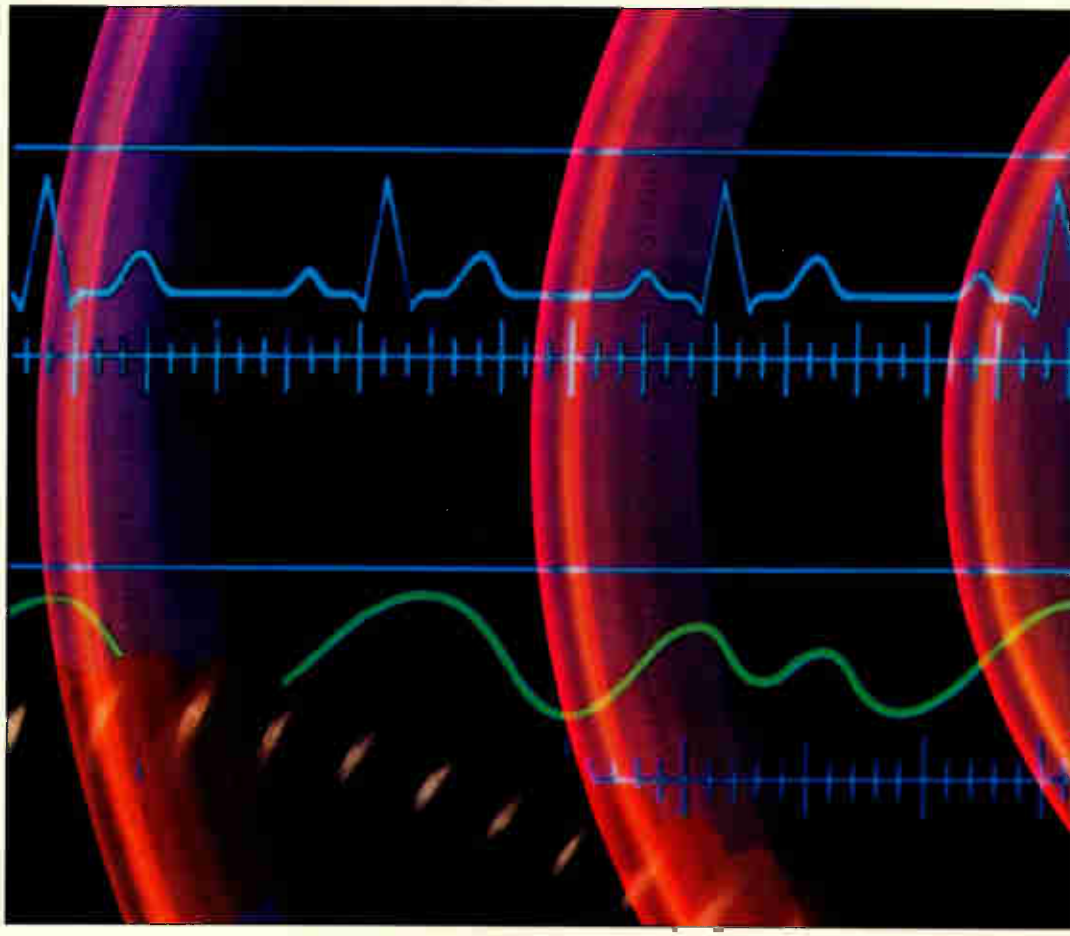

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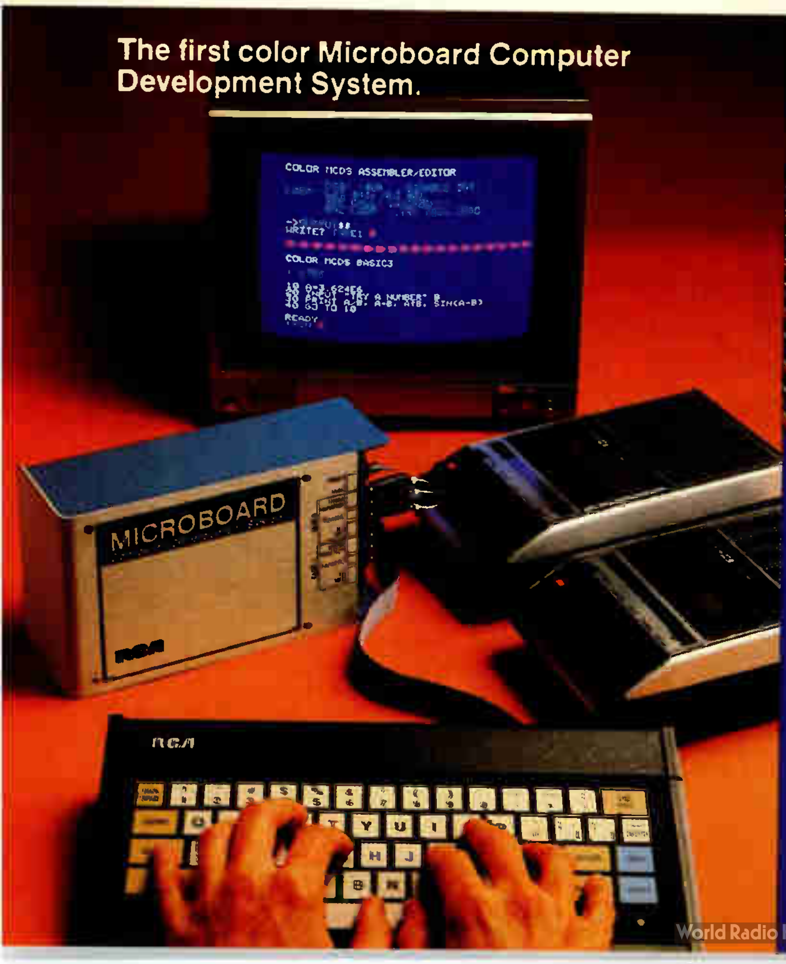
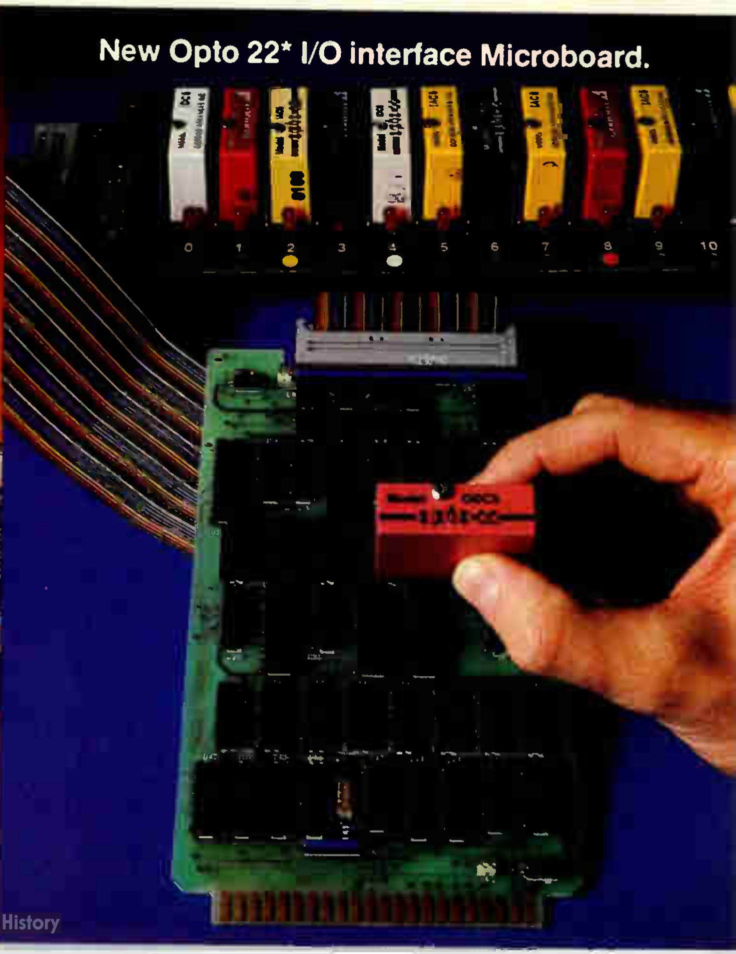


The first color Microboard Computer Development System.



New Opto 22* I/O interface Microboard.

These new products will help you to use the power of board-level computers to solve many more of your application problems.

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The first color development system for 1802-series microprocessors. Ideal for developing your own 1802 microprocessor, Microboard, or color video applications.

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The CDP18S695V1 comes complete with color monitor, full keyboard and promprogrammer for only $1499.** Other models as low as $499.** at that price the system is an ideal BASIC language controller.

New I/O interface.

Opto 22* module interface Microboard CDP18S662 provides 24 bidirectional parallel I/O lines. Solves your power problems by interfacing directly with industry-standard optically isolated plug-in modules and racks.

Unique circuit design enables you to select the direction of each signal line. No Microboard changes or programming required.

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Five new Microboard computers.

Based on the new 1805 microprocessors with built-in counter/timers. The new counter/timer features include real-time event counter, pulse-duration timer and program decrement counter.

And these new microprocessors have 22 additional powerful instructions, including one-instruction call and return, and 4 instructions to load and store 16-bit words.

We've put these features of the 1805 to work for you on five new Microboards. Each is a complete computer system, with read-write memory, parallel and serial I/O ports (available on 4 of the 5), power-on reset, expansion interface and ROM sockets.

Ideal for solving your 1805 or 1806 microprocessor prototyping needs, or for systems requiring timers and counters.

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Designed to stand up to tough industrial environments. Seven sizes, from 4 to 25 slots. Built-in Universal Backplane accepts all Microboards.

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And a Microboard I/O module card which mounts into a 4-slot segment of the chassis, and holds up to 8 industry-standard optically isolated power modules in any mix of AC or DC input or output signals. Complete with mating 4-slot cover with barrier strips for power connections.

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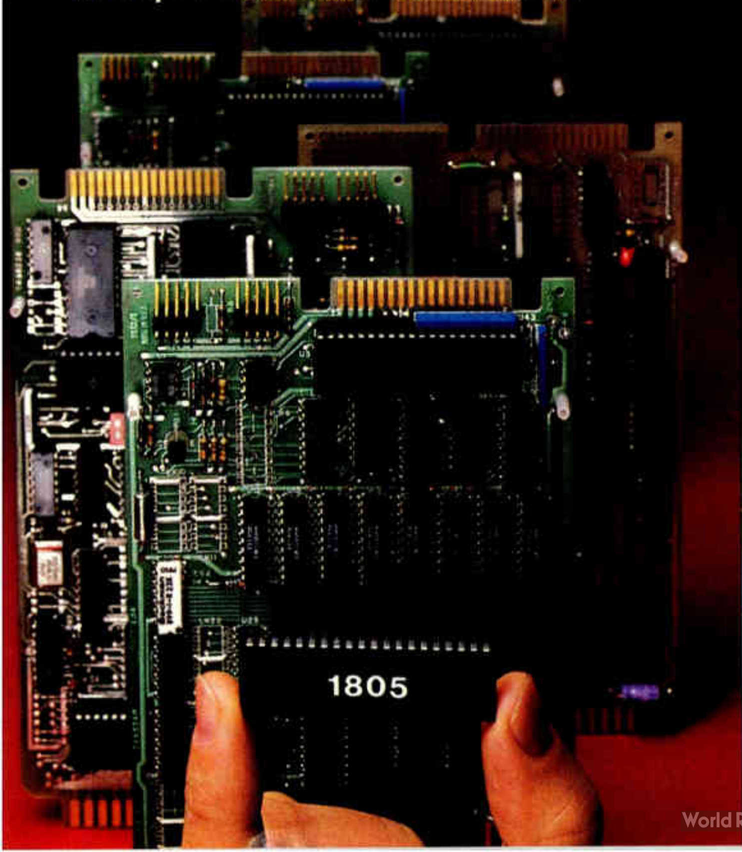
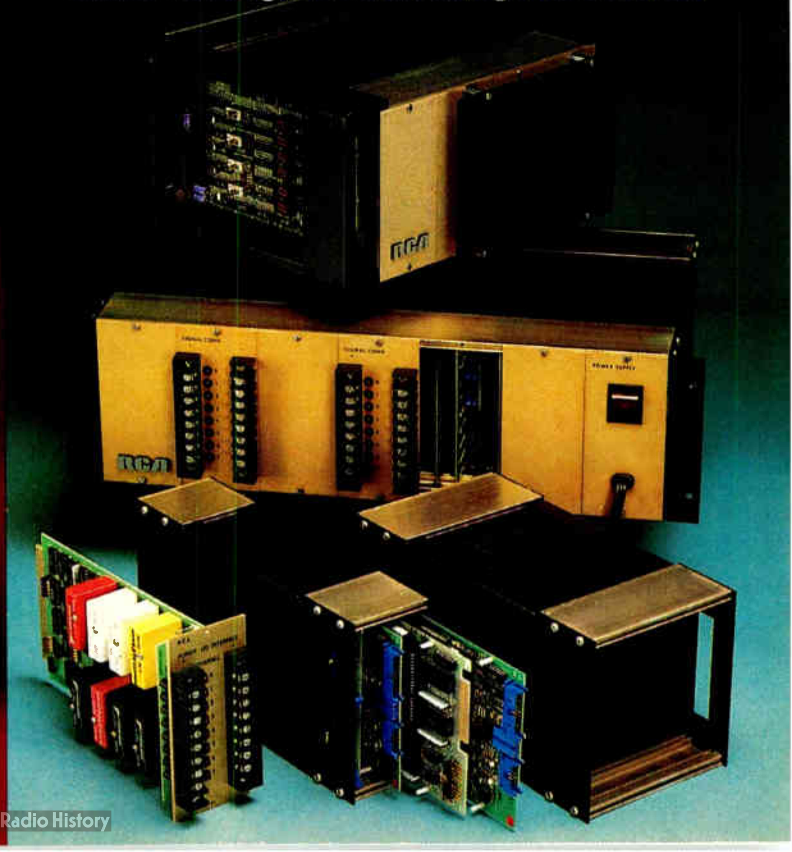
Five new Microboard computers with 1805 microprocessors and counter/timers.



Rugged, versatile family of 16 industrial chassis and signal-conditioning Microboards.



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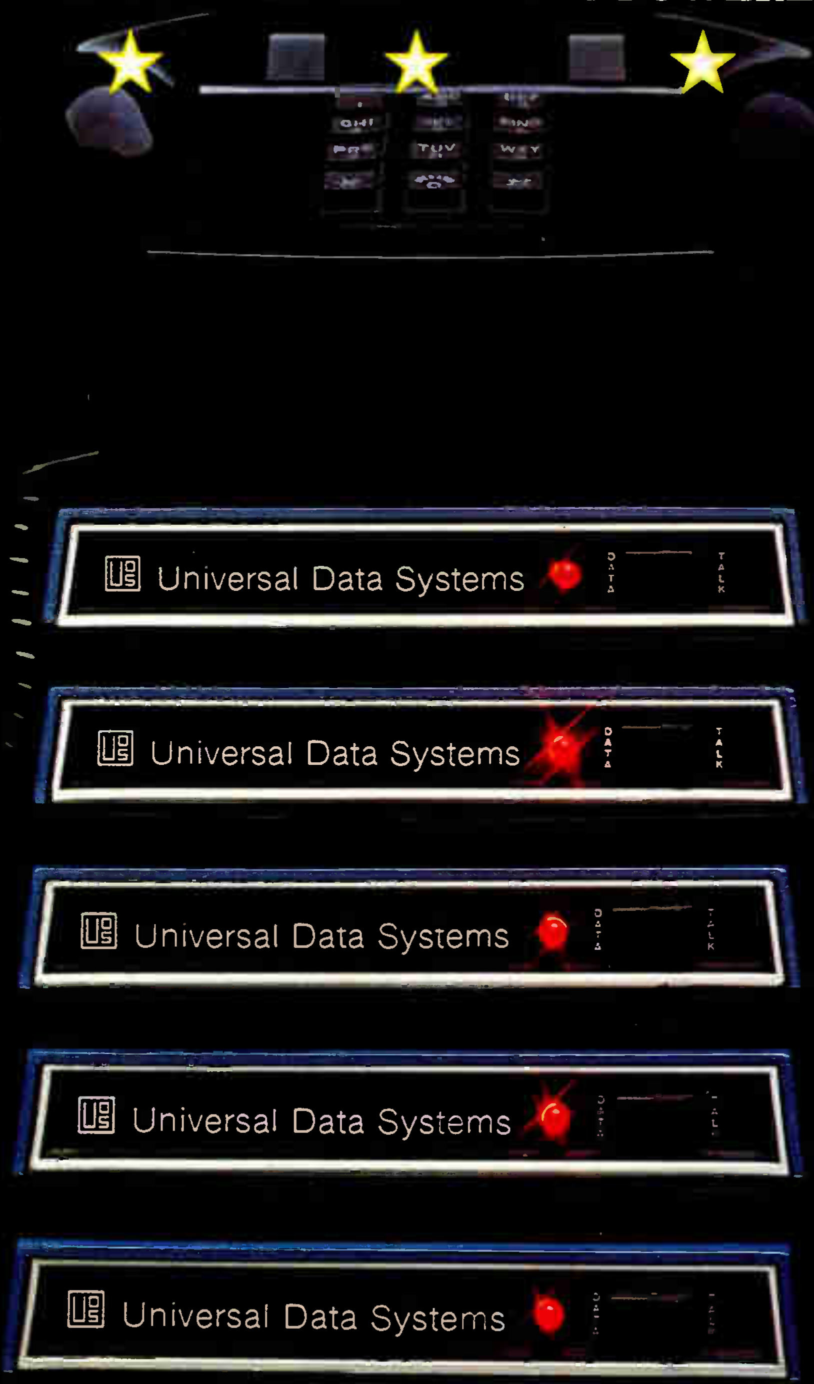

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ISSCC: VLSI earning its keep

1982 circuits conference, a cornucopia of papers and panels, shows spread of very large-scale integration

No one topic grabs the spotlight at the 1982 International Solid State Circuits Conference—they all will. From Feb. 10 to 12, San Francisco's Hilton Hotel will be the stage for over 300 authors and more than 100 panelists to explain and debate topics ranging from 1-micrometer circuit patterning to single-chip systems comprising hundreds of thousands of devices.

The diversity of the circuits makes global trends trickier to spot, but one thing is clear: chip designers have settled down to business with very large-scale integration. For the huge memories that have resulted, laser-based redundancy seems to be the technique of choice for improving yield. For the complex logic and processing units that have also come about, design automation is growing in significance as designs strive for shorter turnaround times.

Downscaling is speeding up n-channel MOS, complementary-MOS, and gallium arsenide circuits alike. A raft of communications chips will be found in next year's proceedings, including single-chip systems to process data and synthetic speech. A larger number of monolithic microwave components will soon make possible integrated transmitters and receivers, as well.

Notwithstanding the preeminence of static and nonvolatile memories at the 1982 conference, innovation in dynamic random-access memories has not been relinquished to Japanese manufacturers by U.S. firms. Besides a byte-wide 288-K chip made by IBM Corp. with a 2-μm n-MOS process, late papers on 256-K chips employing laser redundancy are expected from both Bell Laboratories and Motorola Inc.

Soft errors. Among the problems facing any attempts to build such large memories, soft errors induced by alpha particles promise to rear their troublesome heads anew with the scaled-down geometries. IBM reports effective control of soft errors for 2.5-μm geometries using a buried n-type layer. However, Monte Carlo simulations at the firm's Yorktown Heights, N.Y., laboratories show that dynamic RAMs with 1-μm features will not find significant relief from the particles, even if epitaxial layers, buried implants, or Hi-C (high-capacitance) structures are employed.

Mitsubishi Electric Corp. will offer a novel dynamic RAM architecture. Word-line delay is reduced by storing the logic-1 level as 1.7 times the supply voltage—without using boosted clocks.

Intel Corp. will be sharing the spotlight with several Japanese firms in the ISSCC session on static RAMs. Not unexpectedly, scaled-down double-polysilicon MOS processes are now yielding 64-K devices. Hitachi Ltd.'s HI-C-MOS-II memory checks in with a 65-nanosecond access time and 200-milliwatt power dissipation; again, laser programming of polysilicon links is employed to boost yields. Toshiba Corp., too, opted for a fault-tolerant C-MOS design, and the six-transistor cell in its chip holds power dissipation down to 15 mW. Besides showing its 50-ns n-MOS 64-K static RAM, Intel will discuss laser redundancy for 16- and 32-K chips and a novel static RAM compatible with emitter-coupled logic.

Hints of future improvements in static RAM speed and density are also evident in Intel's preview of H-MOS-III. The process features 1-μm electrical channel lengths and refractory metal contacts for holding down parasitic resistances in the next round of memory capacities.

A diverse collection of nonvolatile memories—most from domestic makers—will surface in session 9. These range from a Fujitsu Ltd. 2-K part that exploits a nitride barrier up to Intel's 128-K erasable chip complete with redundant rows and polysilicon fuses. Highlights between those extremes include an RCA Corp. 8-K C-MOS-on-sapphire electrically erasable memory with an access time under 40 ns and a 64-K programmable chip that Harris Semiconductor Group made in its junction-isolated bipolar process.

Reflecting the importance of logic

arrays for automating the design of very large-scale ICs are several papers covering technologies ranging from C-MOS to ECL. Testing fast logic at its rated speeds is one likely use for the gallium arsenide chips developed jointly by Hewlett-Packard Co., Stanford University, and Podell Associates of Palo Alto, Calif. They will report on circuits for generating and detecting random bit streams at 2.5 gigabits a second.

It seems that ECL will accompany GaAs into this subnanosecond realm, as will be demonstrated by Motorola with a 2,500-gate master-slice chip that includes on-chip diagnostics. The slice's oxide-isolated walled-emitter gates switch 1-milliampere currents in 250 picoseconds. Toshiba claims that C-MOS can do that too; it will present a 6,000-gate array with propagation delays well below a nanosecond.

In linear and data-conversion circuits, bipolar processes are forging the path to 16-bit accuracy, with MOS switched-capacitor techniques following close behind. Notable among the latter's successes is an instrumentation amplifier with 12-bit linearity and 120-decibel common-mode rejection from the University of California at Berkeley.

Glimpses of the bright future for bipolar technology in data conversion will come in the form of Harris's monolithic 16-bit digital-to-analog converter built with dielectric isolation and a 14-bit dual-slope converter from Signetics Corp. with an on-chip precision sample-and-hold amplifier.

Tell and trig. Telephony and trigonometry are still challenging analog designers. Intel will be showing off its family of n-MOS switched-capacitor circuits for coder-decoder and filter applications. Among the eye-openers is a universal generator from Analog Devices Inc. that synthesizes all of the trigonometric functions to accuracies within 0.04%.

Session 2, on digital signal processors, is dominated by 32-bit arithmetic processors, but there will be one 64-bit model there, too. Four of the 32-bit models will be described.

Perhaps the most specialized of the mathematics processors is the 32-point fast-Fourier-transform C-MOS processor from the Electronic Systems division of TRW Inc. It operates on 32 complex data samples simultaneously, computing 32 complete Fourier coefficients.

Texas Instruments Inc., for its part, will describe a 32-bit single-chip microcomputer that is ideal for signal processing, but also will fit nicely into any high-speed mathematics application. It exhibits a 200-ns cycle time, a 32-bit adder-subtracter, and a 16-bit multiplier. It also includes a 144-by-16-bit data memory and a 1,536-by-16-bit program memory.

HP will detail a high-speed math chip set that performs 64-bit floating-point operations. It adds, subtracts, multiplies, and divides at speeds of up to 1 million operations per second.

The other two chips, to be described by Motorola and Matsushita Electronics Corp., are much more specialized. The first performs error correction for the National Aeronautics and Space Administration's 30-gigahertz systems using convolution, whereas the second implements a 14,400-bit-per-second digital modem.

In session 10, Nippon Electric Co. will show off its single-chip Winchester-technology disk controller, and TI will demonstrate how a 152-bit horizontal control read-only memory with 256 states can be reduced using a compression algorithm to require less than 10,000 ROM cells.

Microwave ICs. Monolithic integrated circuits for the microwave region of the spectrum have been a

MEMORIES

Session	Description	Source
18.1	A 20-ns 4-K static random-access memory, built with complementary-MOS, is compatible with 10K emitter-coupled logic.	Intel
7.1	Word-line delays in dynamic RAMs are reduced by charging the storage plate to 1.7 times the supply voltage.	Mitsubushi
7.2	A 288-K dynamic RAM with byte-wide read and write operations is fabricated with 2-μm ground rules.	IBM
1.5	Monte Carlo simulations of soft-error rates in dynamic RAMs with 1-μm features show that buried layers and Hi-C structures are poor defenses against alpha particles.	IBM
9.1	32-K electrically erasable programmable read-only memory gives a 90-ns access time plus erasure by word, subpage, full page, or bulk.	Motorola
9.4	Four fuse-selected redundant rows go into a 128-K erasable programmable ROM with access time under 200 ns.	Intel
18.4	Scaled-down n-MOS processing packs static cells into 0.5 mil^2 for a 50-ns 64-K RAM.	Intel
18.6	Fault-tolerant 64-K C-MOS RAM consumes only 15 mW in operation; access time is 70 ns.	Toshiba

GALLIUM ARSENIDE AND OPTICAL CIRCUITS

Session	Description	Source
14.1	Gallium arsenide circuits generate and detect random bit streams at 2.5 Gb/s, 8-bit words at 5 Gb/s.	HP, Stanford, Podell Associates
11.3	Four-stage monolithic GaAs field-effect-transistor amplifier for satellite communications in 7.25-to-7.75-GHz band has 1-W output, 33-dB gain.	TI
11.4	Monolithic 8.8-to-10-GHz GaAs voltage-controlled oscillator combines metal-semiconductor FET, tuning varactor, tuning inductors, and bypass capacitors and resistors.	TI
11.5	10-GHz three-stage amplifier owes 29.7-dB gain and 4.0-dB noise figure to three identical 0.5-μm common-source FETs.	TI
13.3	Bipolar chip for selection, biasing, and 100-MHz modulation of a group of diode lasers includes failure-detection and power-limiting circuits.	Bell
13.4	Optically coupled bipolar amplifier achieves 160-dB isolation, uses optical feedback for 0.05% nonlinearity.	Burr-Brown

DMOS regulator shatters 40-V barrier. And a few hallowed traditions. TL783. New from Texas Instruments.

Remember when 40 V was the highest that adjustable, three-terminal regulators in single-chip form could produce? Forget it. TI's new positive-output TL783, in a TO-220 package, handles an I/O differential voltage up to 125 V. The maximum output current is 0.7 A.

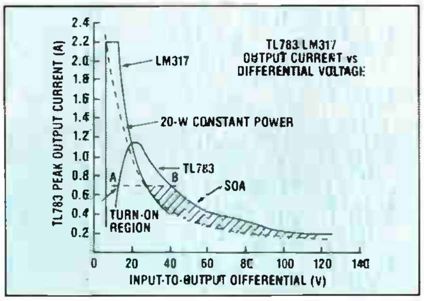
Now power supply designs for a wide variety of high-voltage applications, including plasma displays, CRT-biasing circuits in TVs and computer video displays, and telephone communications equipment, can benefit from the space-saving, improved reliability, and reduced cost features that their lower voltage counterparts enjoy.

Line regulation for the TL783 is 0.02%/V. Load regulation, 0.5%. Typical temperature coefficient of 0.4% and an initial accuracy of ± 4% are significant operating characteristics.

Because TL783's reference terminal can float free above ground and draws less than 0.1 mA, it can be configured into a highly versatile, adjustable precision current regulator. The TL783 can start with 100 V, instead of the previous 40-V maximum, to produce a better regulated current output, 0.02%, over a larger range of load resistances, even at low-mA currents.

TL783 (DMOS) vs LM317 (BIPOLAR)

CHARACTERISTICS	TL783	LM317
I/O differential	125 V	40 V
Max. output current	0.7 A	1.5 A
Initial accuracy	±4%	±4%
Temp. coefficient	+0.4% (typ)	±1% (typ)
Line regulation	0.02%/V	0.04%/V
Load regulation	0.5%	0.5%
Dropout voltage	10 V at 400 mA	3 V at 1.5 A
Failure modes	No comparable failure mechanisms	Prone to thermal runaway, secondary breakdown, and current hogging



Now, about tradition. We're doing it in DMOS because, for high-voltage capability, it's better than bipolar.

Reliable performance is further enhanced by the DMOS output transistor's SOA (Safe Operating Area) characteristics — no secondary breakdown — no thermal runaway. Some of the TL783's protection circuitry is internal thermal shutdown with a zener temperature sensor and a current limiting-circuit. The thermal shutdown circuitry automatically turns the regulator off above 165°C, and back on when it cools. The current limiting circuit adjusts the output current so that the voltage-current product does not exceed 20 W.

Forget 40 V. For more information on the new TL783, contact your nearest authorized distributor, or write Texas Instruments Incorporated, P.O. Box 202129, Dallas, Texas, 75220.

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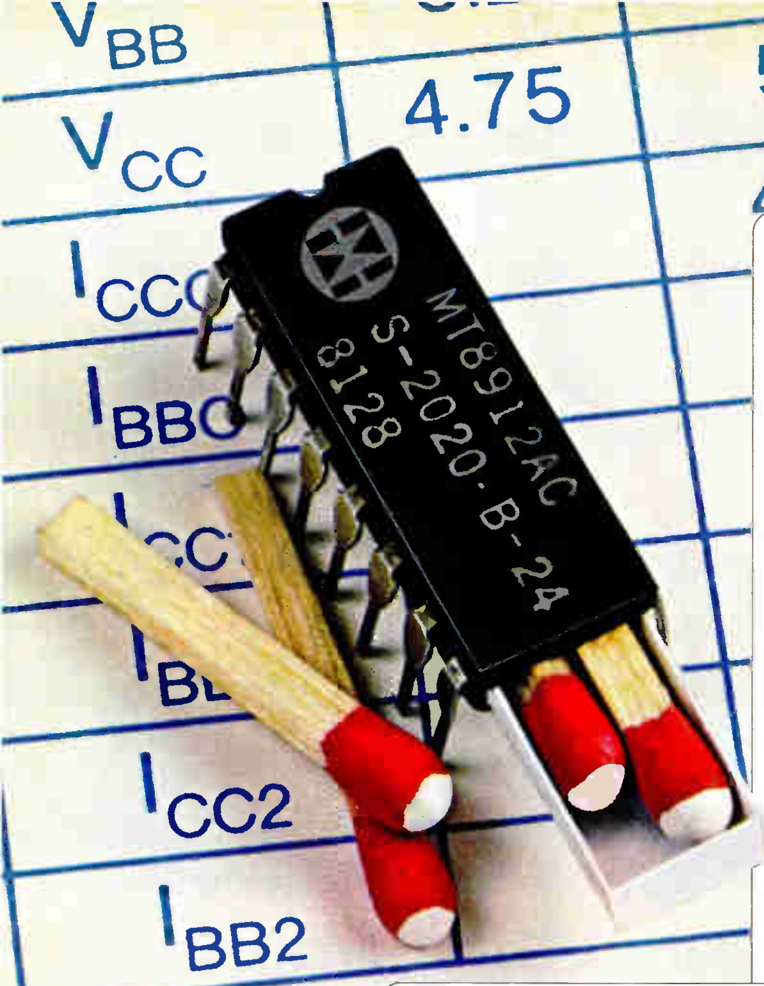

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THE MT8912 ISO²-CMOS PCM FILTER.

When the specs are examined, it's clear that the Mitel MT8912 PCM Transmit/Receive filter can offer your application significant advantages.

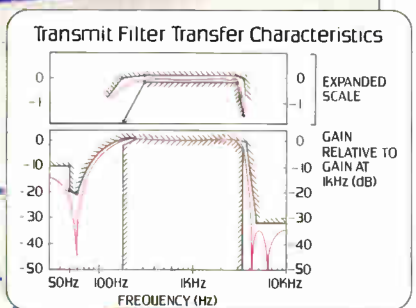
Low power consumption is just one such advantage. The MT8912 operates at a mere **20 mW** typical without power amps. Other units come in at as much as 280 mW.

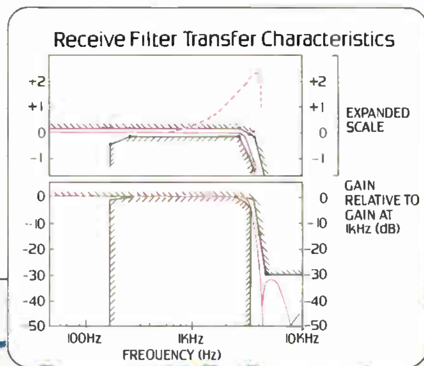
Idle channel noise. With the MT8912, it's extraordinarily low–typically **6dBrnc0** total C message noise at output.

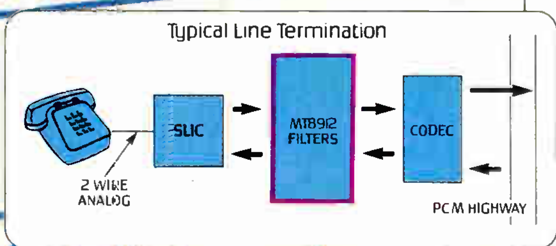
Consider too the MT8912's **power supply rejection ratio: 40 dB** at 1kHz. In addition, the Mitel MT8912 is pin for pin compatible with the Intel I 2912. It meets AT&T D3/D4 and CCITT G712 specifications. The receive filter includes sinx/x correction and there is external gain adjustment of both transmit and receive filters.

All in all, it's a case of hot specs guaranteeing you hot performance.

Find out more about what the Mitel MT8912 can do for your application by contacting your local Mitel sales office.







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BUILDING BETTER COMMUNICATIONS

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long time coming because of the unique circuit-design problems that reign at frequencies of thousands of megahertz. Silicon technology at lower frequencies had the computer as a market, but there is as yet no mass market for microwave ICs.

Although many possibilities are now under investigation, the components to be described at the ISSCC focus on the range of separate parts needed to put together monolithic microwave receivers. It is still too early for a cost-effective complete monolithic receiver; in fact, the optimal process technology has yet to be selected.

While GaAs is clearly favored, researchers at General Electric Co. will report they have made large-gate-width metal-semiconductor field-effect transistors on sapphire that operate at 3 GHz, as experimental devices. Further work will be needed before the practicality of the units is demonstrated.

The big push is in monolithic GaAs parts because they can be made to have better electrical specification than SOS devices. For example, TI researchers, practically dominating the GaAs sessions with four papers, have designed a four-stage power FET with a 1-watt output and 33-dB gain in the 7.25-to-7.75-GHz frequency range. It is designed for active-antenna-array applications.

Other work at TI's Dallas facility has produced an 8.8-to-10.0-GHz GaAs FET voltage-controlled oscillator with all its associated parts on a 1.1-by-1.2-millimeter chip—an unheard-of small size. Adding to the list of parts needed for a complete receiver, a 10-GHz, three-stage amplifier with a 4.0-dB noise figure and 29.7-dB gain has been built. Such state-of-the-art specifications for a low-noise amplifier are achieved through a common-source configuration of three identical FETs having 300-by-0.5-μm gates.

Lower numbers. Apart from all the work on monolithic microwave ICs, the needs of designers interested in data and voice communications at lower frequencies are not being ignored. Modem manufacturers will want to look at Berkeley's n-MOS 16-tap adaptive transversal filter, which provides 50 dB of echo suppression at data rates of 80 kilobits per second.

They will also want to hear the results of a collaboration between NEC and the Musashino Laboratories of Nippon Telegraph & Telephone Public Corp. to develop a single-chip, n-MOS analog front end for modems. It contains all the front end's filters, equalizers, zero-crossing detectors, and a-d and d-a converters on a 7.14-by-6.51-mm chip.

Designers of private branch exchanges and digital switches will be pleased to learn about the 256-channel cross-point array developed jointly by Plessey Ltd. and Stentor AS in Norway. The nonblocking design, for use in European 32-channel, 2.048-MHz, pulse-code-modulated systems, is similar to one recently developed VLSI chip has a power consumption of only 200 mW. □

GENERAL-PURPOSE AND DEDICATED PROCESSORS

Session	Description	Source
6.1	Automated design yields a 32-bit complementary-MOS processor with 17,000 gates of random logic and a 2-K random-access memory.	NTT
2.5	Single-chip 32-bit microcomputer integrates a 16-by-16-bit multiplier, 32-bit arithmetic and logic unit, and memories for data and programs.	TI
10.5	32-bit processor chip set embodies over 660,000 1-μm n-MOS transistors on six very large-scale integrated circuits.	HP
19.6	A 16-bit C-MOS systolic array processor performs pattern matching for speech recognition at 25,000 words per second.	Bell Laboratories
10.2	Single-chip adaptive array processor incorporates eight 8-bit parallel processors using 81,000 transistors.	NTT Musashino Laboratory
2.2	A 2-μm C-MOS process spawns a 32-point fast-Fourier-transform processor.	TRW
10.1	Compression technique fits a wide horizontal microcontrol read-only memory into the same space that a vertical format would allow.	TI
2.1	Floating-point arithmetic processor chip set adds, subtracts, multiplies, and divides 64-bit quantities.	HP

LOGIC ARRAYS AND SINGLE-CHIP SYSTEMS

Session	Description	Source
14.4	Three-level metalization, oxide isolation, and walled-emitter transistors join forces for an emitter-coupled-logic master slice array having 2,500 250-ps gates.	Motorola
6.3	Layout generator varies programmable-logic-array sizes in an automated very large-scale integrated-circuit design system.	IBM
6.4	Self-testing PLA finds all of its own stuck faults and shorts by addressing each transistor with shift registers.	Siemens
3.4	Monolithic generator of trigonometric functions, even the arctangent, synthesizes them with accuracies as close as ±0.02%.	Analog Devices
8.2	Differential switched-capacitor techniques bring 12-bit accuracy and 1-mV offsets to MOS amplifiers.	University of California at Berkeley
8.5	Monolithic digital-to-analog converter holds 16 bits monotonically over 0° to 70°C thanks to dielectrically isolated bipolar process.	Harris
10.4	Winchester-disk controller on a single chip can handle 1.5-megabyte-per-second data rates.	NEC
2.4	Single-chip digital modem runs at either 9,600 or 14,400 b/s.	Matsushita
2.3	Error-correction chip supports 30-GHz data rates and features on-chip convolution.	Motorola
19.4	N-MOS audio synthesis chip packs in 64-K of read-only memory for up to 90 seconds of voice, music, or sound effects.	NEC
12.2	Analog n-MOS front-end for modems crams filters, equalizers, zero-crossing detector and data converters onto a single chip.	NEC and NTT
16.3	One 5-μm n-MOS 256-channel cross-point array handles 32-channel 2.048-MHz pulse-code-modulation switches yet consumes only 200 mW.	Plessey and Stentor

This report was prepared by Roderic Beresford, Harvey J. Hindin, R. Colin Johnson, and John G. Posa.

Computers

West wary of Japan's computer plan

University and industry experts agree that fifth-generation effort is a giant step but predict that it can be done

by Tom Manuel, Computers & Peripherals Editor

U. S. and European academicians and computer company executives generally agree that the Japanese have bitten off a very large piece to chew on indeed with their proposed fifth-generation computer project [*Electronics*, Nov. 17, p. 83], but that they may succeed. Moreover, it would be a big mistake to underestimate what Japan will be able to do, the experts warn.

Jonathan Allen, professor of electrical engineering and computer science and director of the research laboratory for electronics at the Massachusetts Institute of Technology in Cambridge, says, "We have good reason to be very, very concerned." Another academic leader in computer science, Bruce H. McCormick, director of the integrated systems laboratory and professor of information engineering and bioengineering at the University of Illinois at Chicago, says, "I think they're dedicated to go get it. . . . [The U. S.] shouldn't fold up its tent, but it's going to be tough competition."

McCormick points out that the fifth-generation project is only one of several that the Japanese have going at present. Other separate programs exist in areas such as robotics, personal computers, and supercomputers. But "in a way," he says, "this one is the scariest."

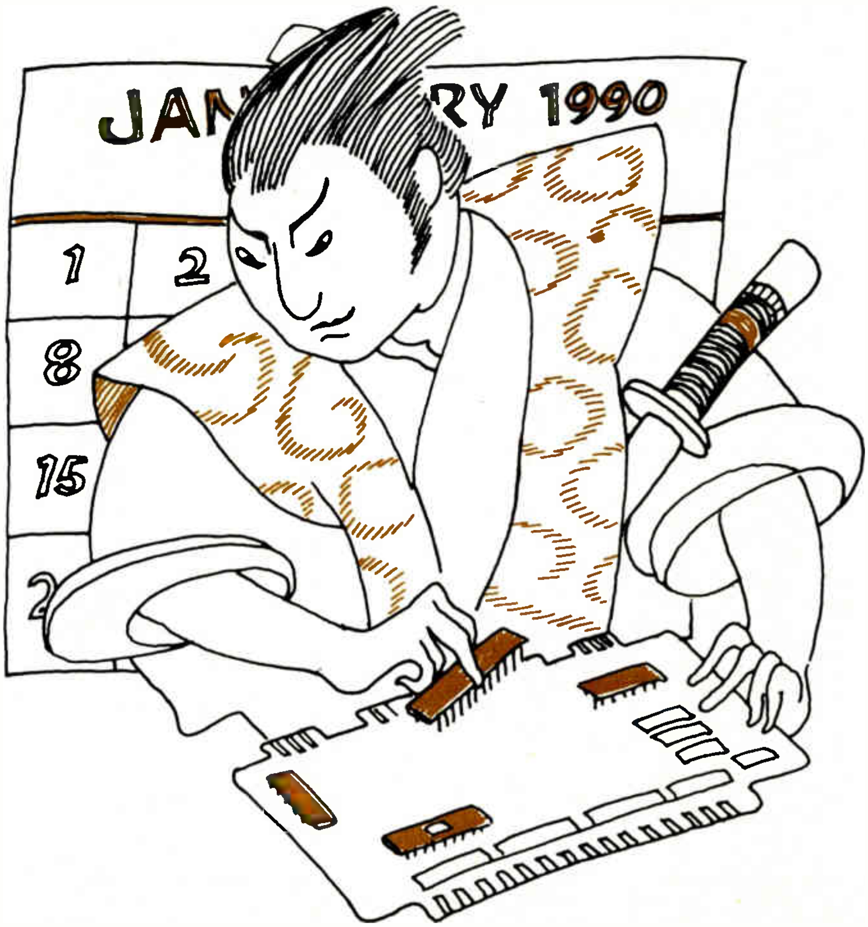
The project, planned as a 10-year joint effort by Japanese industry and universities and coordinated and partially funded by the government, is considered to be extremely ambitious. However, computer executives seem to be taking the announcement of the project rather calmly—they do not appear to be as concerned as the academicians.

"The Japanese are quite good and there is always the possibility that they could capture leadership," says John R. Opel, president and chief executive officer of IBM Corp. But he is also quick to point out that he does not consider that a very strong likelihood. "I don't think they'll surpass IBM," he says.

"There is no doubt that by 1990 there will be enormous advances in computer architectures," he adds. But it is his opinion that the fifth-generation talk "has more of a public-relations flair to it than reality."

A senior director in the data-processing division of Siemens AG in Munich says, "If that project turns out to be successful, then the Japanese will be out front in computer technology. But it is a big if, and we doubt that they can pull it off. The goals are almost utopian."

The kinds of knowledge-based and -inferring computers conceived by the fifth-generation project have not been built anywhere—only some basic research on several concepts has been done. Because the project is aimed at moving into areas that are



essentially uncharted in the marketplace, "it is not going to be easy [for the U. S.] to respond," explains McCormick.

He was one of the three U. S. researchers invited to give guest lectures at the Tokyo conference where the proposals were presented—the other two were Allen of MIT and Edward A. Feigenbaum, head of the artificial intelligence laboratory at the Stanford University Computer Science department in Palo Alto, Calif. In addition, there were three invited lecturers from Europe—Wolfgang Bibel of the Technische Universität of Munich; Giles Kahn of France's national computer and automation research institute in Rocquencourt, and Philip Treleaven of the University of Newcastle-upon-Tyne, England.

Great Britain sent a seven-man team of computer academics to the Tokyo conference; and the team was impressed with what it heard, but found some of the plan's premises not yet proven. For example, "Knowledge systems or so-called expert systems in which a computer can make inferences from a limited set of data have only been demonstrated in one or two specific applications like medical diagnosis" says a member of the UK team. "The Japanese want to turn it [knowledge information processing] into a generalized computer tool, but it's not yet obvious that you can do that," says a UK researcher.

Even if the complete project fails to reach its goals, it is agreed that there will be many successful results from the subgoals. Another attendee at the conference who works for a major U. S. computer company says, "The key issue is the many worthwhile results that the Japanese computer industry will gain as fallout."

He goes on to say, "At first sight, some of the overall goals seem unattainable. However, there are checkpoints in the project every three or four years where the goals can be changed and adjusted to reality—the Japanese have shown an ability to shift targets" in other of their long-range projects.

Yet the feeling is that it is not a good idea for U. S. computer industry to get too complacent about this Japanese project. It need only remember how Japan took leadership positions in steelmaking and consumer electronics and recall its growing predominance in automobiles and semiconductor components, notably 16- and 64-K memory chips. As many observers note, the Japanese are very good at planning, engineering, and working together on large, long-term projects.

"It's a false comfort to think the Japanese have no talent for creativity, and that the U. S. has a corner on innovative ideas," Allen says. "In fact, the U. S. industry gets so enamored with the big idea that it neglects the kind of nitty-gritty details at which the Japanese excel—the ability to grab an idea, assess it, follow up alternatives in a systematic way, select the best alternative, and push it to a good solid product."

Culture gap. The U. S. is not doing anything now in the form of a national, cooperative effort. And, it is not likely to, either, according to a number of experts.

John H. Clippenger, president of Brattle Research Corp., Boston, views U. S. response to the Japanese project as much a problem of culture as of technology. "When I saw how the Japanese are breaking the technology down, I realized that in each area, the U. S. has already done significant work, and that all that is needed in many cases is development or engineering," he says.

Significant research in artificial intelligence and knowledge-based systems has been in progress for many years in the U. S. and Europe, as well as some in Japan. The Japanese project will be building on work done at MIT, Stanford, and Carnegie-Mellon University in the U. S., and the universities of Newcastle and Edinburgh in Great Britain, for example. Also, several U. S. companies are currently doing some development in this area [*Electronics*, Sept. 11, 1980, p. 93].

At this point, for example, Hewlett-Packard Co. is doing work in applying artificial-intelligence research in the areas of expert systems, natural language, novice user interaction with systems, programmer environments, and speech recognition. Texas Instruments Inc. and Schlumberger Ltd. are working on speech recognition and artificial intelligence as well. According to Clippenger, "the foundations of a fifth-generation computer capability already exist in the U. S."

In addition to the companies noted, he says, for example, that Bell Labs is strong in voice recognition, natural-language processing, and transparent systems. Much the same is true for IBM, he feels. But he is pessimistic about any chance for a coordinated effort in the U. S. □

Can Europe form a common policy?

The Japanese fifth-generation computer effort has focused growing attention on the latest European Economic Commission attempt to forge a European computer policy that will enable firms to catch up both with the U. S. and the Japanese. The Battelle Memorial Institute and other consulting firms are in the second year of a three-year study aimed at identifying long-lead-time research and development needs centered largely on data processing. But the inability of nationalistic governments and competing firms to agree on cooperating in the commercial area stalled earlier Common Market efforts in the computer field. A senior director in the data-processing division of Siemens AG in Munich says that the long-lead-time project could provide a basis for a coordinated effort in Europe, "but that presupposes that the various countries identify themselves with the need for a combined effort and that different companies cooperate."

Though EEC experts say the Japanese fifth-generation project is still only a series of proposed objectives for the future aimed largely at U. S. firms including IBM, they concede the Japanese have previously demonstrated their ability to move forward in the computer area. This is bad news for European firms, "many of whom are managing to stay profitable only by technical linkups with the Japanese. But this is dangerous for the future of European industry," a Common Market official observes.

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Components

Industry warms to high-temp R&D

Government program's semiconductor know-how fuels commercial developments aimed at oil and gas firms

by Roderic Beresford, Components Editor, and Linda Lowe, Boston bureau

A major Government-funded research and development program in high-temperature semiconductor devices has just slid into the lap of industry. Work at Sandia National Laboratories has shown the feasibility of fabricating a wide range of semiconductors that can be used in environments where temperatures commonly reach 300°C or more.

Oil- and gas-producing companies probably have the greatest interest in such technology because their deep-well exploratory operations can reduce the risk of drilling a dry hole if they use electronic parts that can withstand high temperatures. Because of this need, firms like Schlumberger Ltd., Gearhart Industries Inc., and Dresser Industries Inc. are beginning to increase their commitment to high-temperature–electronics development and design, says Anthony F. Veneruso, former director of the Sandia program in Albuquerque, N. M.

This information transferral occurred during the High-Temperature Electronics and Instrumentation Conference in Houston, held Dec. 7 and 8, where papers describing Sandia's geothermal logging instrumentation development program were delivered to companies with a commercial stake in such devices.

Veneruso himself is an example of the increased commercial commitment. He recently moved to Gearhart, where his duties as manager of the Houston development laboratory include supervising work on high-temperature logging instruments.

"The Sandia program was a catalyst," says Veneruso. "It raised the awareness about the potential of high-temperature electronics in an industry relatively unfamiliar with it and showed these firms what kinds of expertise they needed to continue research on their own." Although developments in the near future will rely on silicon-device technology, the eventual commercialization of gallium phosphide, or other wide-band-gap semiconducting materials, promises operating temperatures higher than those that are possible with silicon.

GaP widens. Junction leakage currents—a central problem in integrated-circuit design for high temperatures—depend on thermally generated carriers, whose numbers drop with increasing bandgap. Recent work at Sandia documents the advantages to be expected from GaP, a material with a wider bandgap than silicon.

Diodes and transistors fabricated with GaP operate reliably between 300° and 400°C, and a 500°C capability is in sight. These devices are made in magnesium-doped epitaxially grown layers.

Sandia's approach encouraged not only oil and gas firms, but also component companies to jump into the high-temperature–electronics business. Sandia contracts already have permitted heat-resistant hybrid circuits, complementary-MOS parts, and instruments to be developed by firms like Teledyne Philbrick, Harris Corp.'s Semiconductor Group, and General Electric Co.'s Space Systems division [*Electronics*, Aug. 14, 1980, p. 41]. Others with high-temperature–electronics programs include Burr-Brown Research Corp., Micro Networks Co., and MicroPac Industries Inc.

"I think the work Sandia started

HIGH-TEMPERATURE MATERIALS TECHNOLOGY: STATE OF THE ART AT A GLANCE

Process	Materials						
	GaAs	GaP	SiC	AlGaAs	AlGaP	InGaP	Si
Substrate formation							
Crystal growth	Good	Poor					Excellent
Semi-insulating	Good	Poor					Excellent
Impurity introduction							
Diffusion	Poor	Poor	Poor				Excellent
Ion implantation	Good	Poor	Poor				Excellent
Epitaxy							
Liquid phase	Good	Good	Poor	Good	Poor	Poor	Poor
Vapor phase	Good	Poor		Good			Excellent
Molecular beam	Good	Poor		Good			Poor
Region formation							
Native oxide			Poor				Excellent
Chemical etching	Good	Poor	Poor	Good	Poor	Poor	Excellent
Deep-level isolation	Good	Poor		Good			
Metalization							
Contacts	Good	Poor	Poor	Good	Poor	Poor	Excellent

● Excellent ● Good ● Poor

SOURCE: SANDIA LABORATORIES

gave a lot of impetus to small, 'Lone Ranger' research operations buried in many companies," Veneruso comments. Agreeing with him is Paul L. Sinclair, manager of Schlumberger's Microelectronics Systems group in Houston. "We've been building electronic components for down-hole exploration for decades, but development of high-temperature–circuit prototypes only got under way in 1980. It's still a relatively small program, but it's going to grow fast."

The Schlumberger group will concentrate on developing circuit designs, Sinclair adds. "We're scouting for components houses to build the parts for us."

Needed now. The time is ripe for high-temperature electronics because of dwindling supplies of gas and oil from traditional sources, Sinclair maintains. "Every developed country is scrambling for new sources; the last five years have seen phenomenal growth in geophysical well-logging operations, which I'd estimate have been growing at a rate of roughly 33% a year."

Probing deeper and deeper past many strata for fuel, drillers encounter steadily rising temperatures, which at the bottom of a well can reach a peak of 275°C. In addition, a promising new oil-recovery method, using steam injection, must deal with temperatures that can reach a point around 250°C.

So the need for all types of heat-resistant parts—sensors, amplifiers, signal conditioners, converters, and digital-processing and -transmission equipment—is increasing dramatically. "I anticipate that this will become the dominant technology for our industry in the next 10 years," Sinclair asserts.

"We're rather constrained by what chips the semiconductor makers can produce for us," he adds. "Although there are definite benefits to be gained from GaP, it is going to be years before we get our hands on this material in commercial ICs."

In the meantime, making do with silicon will soon be a lot easier, because Harris Semiconductor in Melbourne, Fla., is about to make generally available its dielectrically isolated C-MOS parts, which are specified for 350°C. The group will base its product plans on the sentiments of the narrow market.

"There is not enough demand to warrant an entire high-temperature edition of the 4000-series logic family," points out Harris's Scott Falater, an analog product designer, "although we now have that capability. We are looking at universal gate chips, in which specific configurations could be selectively powered up by pin programming."

Dielectric isolation clears up two common failure modes in junction-isolated chips—latch-up and parasitic device formation. Otherwise, the fabrication process is not so different from conventional room-temperature C-MOS. However, circuit designs must consider device behavior at high temperatures.

For example, forward-biased diodes drop only about 100 millivolts at 300°C, so biasing schemes based on diode strings are ruled out. Furthermore, leakage currents from a transistor's collector-base junction get so large that the net base-current flow reverses, requiring bias circuits that can source and sink current.

Work needed. Although much of the Harris effort has been focused on circuit design "there is still much process refinement to be done," says Falater. A major stumbling block is electromigration—the rupturing of metal interconnects by current flow that is aggravated as the temperature rises.

In addition to this problem, the stability of metal layers is a prime concern for hybrid-circuit makers. Thin-film processes for passive components have demonstrated excellent performance in the temperature range of 350° to 500°C [*Electronics*, Jan. 3, 1980, p. 39].

Interconnection with the thick-film components, however, requires a special treatment. The usual gold-to-aluminum bonds that connect chip pads to wires and then to the thick-film conductors last only about 100 hours at 200°C. Burr-Brown gets up to 1,000 hours of operation by using an aluminum-composition bond wire and doping the gold films with platinum and palladium. The formula helps minimize the bond's intermetallic phases. □

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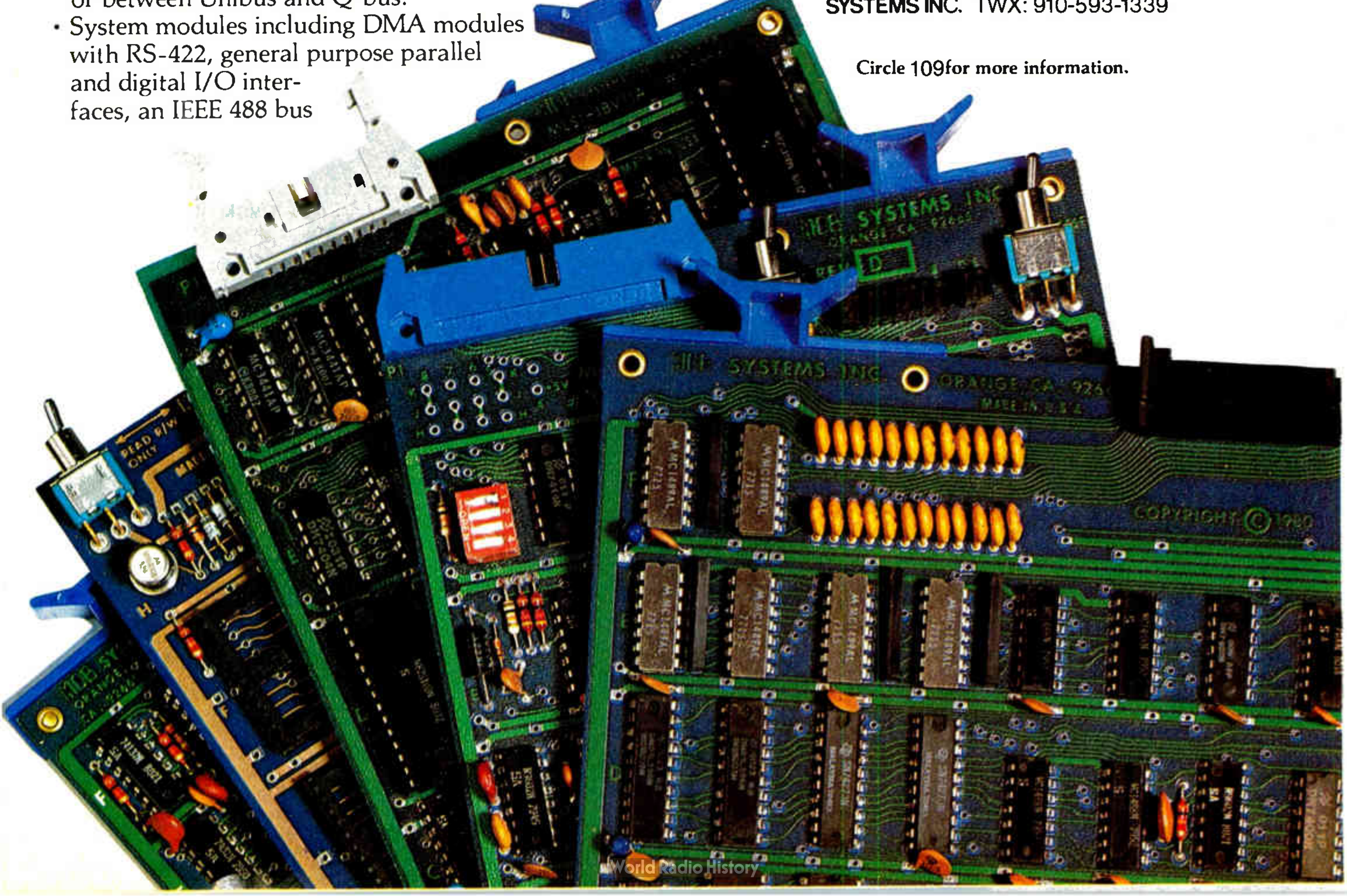


Microsystems

Self-testing processors cut costs

Manufacturers, happy with technique, are considering larger chips to house diagnostics—Motorola adds 2% more silicon

by J. Robert Lineback, Dallas bureau

Adding on-chip microprocessor hardware and new testing techniques that examine blocks of circuitry independently of each other appears to be a promising way of reducing production costs on future high-density devices. Already, it is clear that using hardware to execute production tests has distinct speed advantages over software diagnostic schemes. As microprocessor volumes continue to build and prices slide, the time that it takes to weed out defects in semiconductors at the factory becomes an increasingly critical cost factor. At the same time, manufacturers must avoid the pitfalls of reducing test coverage and risking a costly drop in quality and a rise in angry customers.

To expedite functional testing, many designers are now considering using slightly larger dice to house special self-test hardware. In most cases, this diagnostic silicon will be completely transparent to customers and will be used strictly in house. The issue simply comes down to a tradeoff—yield vs test time—and it appears that manufacturers are becoming more willing to settle for fewer parts per wafer in order to reduce test times, which are rapidly growing as circuit complexity increases.

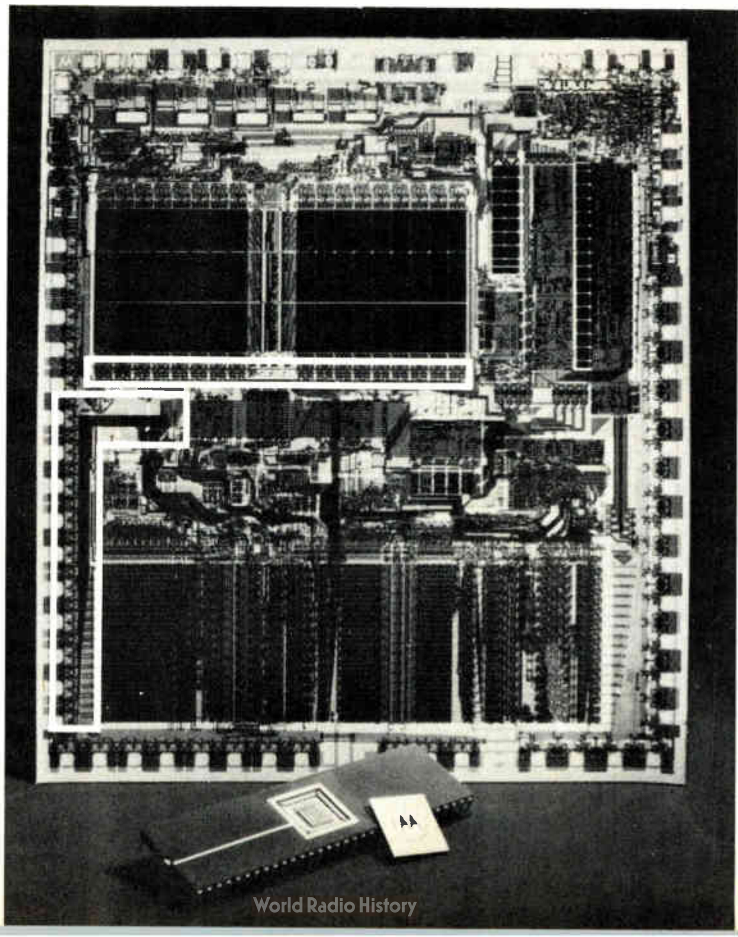
Motorola Inc. has been highly successful in reducing production test times on its 68000 16-bit microprocessor through the use of an extra 2% of silicon on the die and a unique partitioning test method. The extra real estate, which has been on the device since the firm first began offering 68000s more than two years ago, contains diagnostic hardware that causes the microsequencer to quickly exercise its own internal instructions.

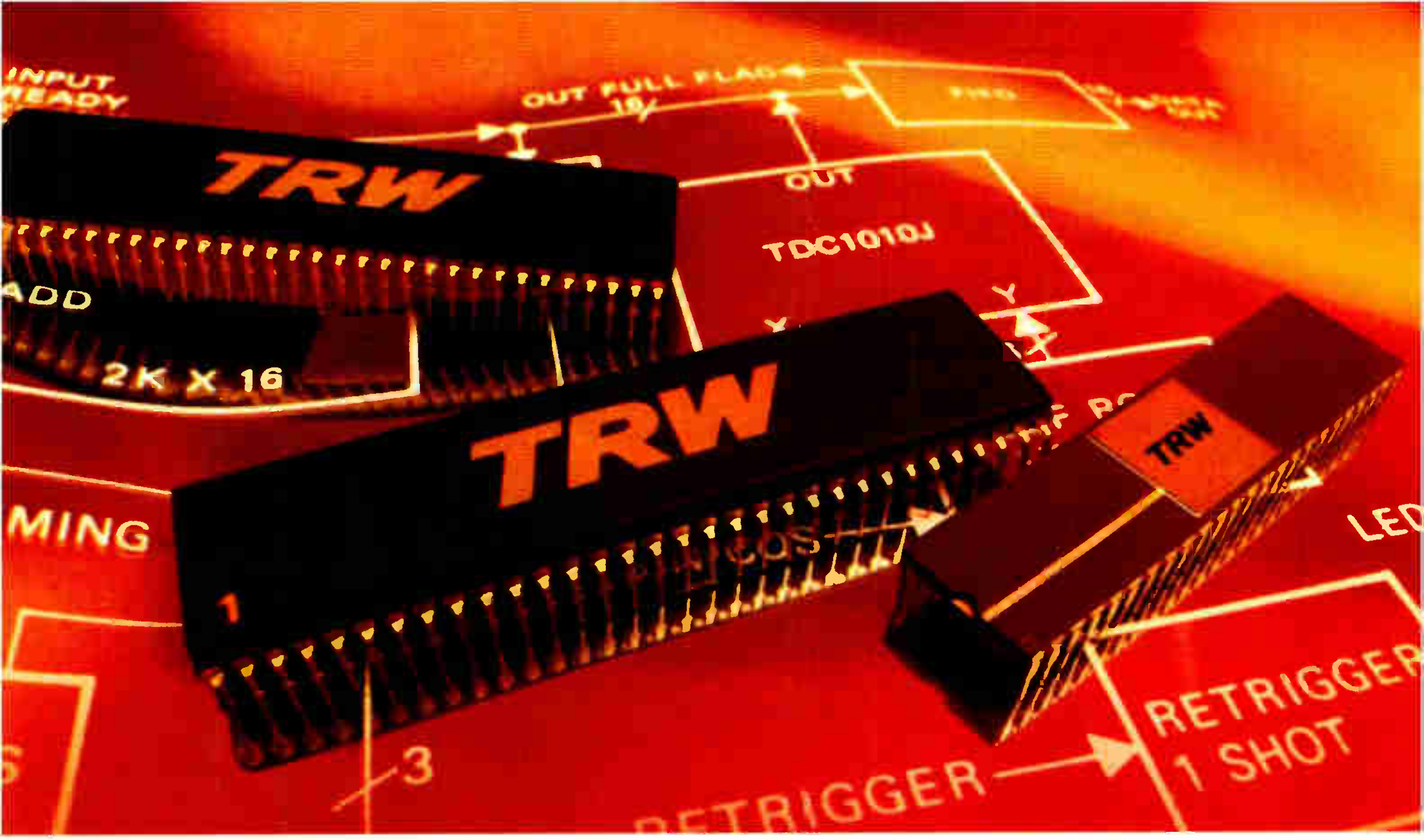
At the same time, the extra hardware isolates the microsequencer from the rest of the chip's data and address registers—essentially dividing the microprocessor in half, explains Mike Spak, staff engineer in Motorola's MOS microcomputer design operation in Austin, Texas. "Another way of saying it is that we tried to separate the control part of the information from the data-handling part of the chip," he says. "So, we try to first guarantee the control part, which is the microsequencer.

"I think the key to understanding the philosophy is that we are not attacking the problem from just a single-chip 'black box' perspective. We are really cutting it down and doing the same kind of thing that used to be done with pc [printed-circuit] boards," Spak states. "We test certain pieces of it independently to guarantee that the whole thing works together. I think it [partitioning of the tested blocks] will be there more and more as systems get larger and technologies get denser."

2% solution. Although he declines to discuss the impact on yields, Spak says the extra 2% silicon has significantly saved time in volume testing. "There have been no dollar figures placed on it, but it does cut the time down from what would have been a matter of several minutes to several seconds," he adds. Be-

Test map. The outline indicates the silicon added by Motorola to its 68000 microprocessor for self-testing. The company says the addition saves time.





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cause the task of checking the sensitivity of the 68000 microsequencer's instructions is time-consuming, the control block is first tested by itself. This lets Motorola ensure that the individual instructions are not sensitive to one another.

One failure does it. A Fairchild tester monitors the microsequencer's performance at the data and address buses. If the microsequencer misses a single bit, the part is rejected. But if it passes, the rest of the 68000's 17 data and address registers are tested along with the "proven" microsequencer. Using this special hardware and partitioning of the chip lets Motorola execute a thorough program of production tests in the shortest time.

At Zilog Inc., microprocessors are not partitioned during testing, but it may be only a matter of time before design complexity gives the technique a clear advantage, says Bernard L. Peuto, director of component production development. "I see a trend developing for two reasons," Peuto states. "One, the hardware is getting more and more complex. You may have more engineers working on it, in which case they have to have an agreement on how their pieces fit together.

"Also, as the hardware gets more complex, from a logical standpoint you really have more and more blocks that can be isolated and treated independently of any other blocks, which is one way to reduce the complexity of the [testing] task," says Peuto.

Software's role. Although Zilog is using on-chip hardware to test its 8-bit microprocessors in production, the Cupertino, Calif., firm is not using self-diagnostic features to monitor its Z8000 16-bit in manufacturing testing. "There were some features put on it when we were debugging it, but they are not used in production," he explains.

Instead, Zilog uses software to test the Z8000 because it is not microcoded. Peuto believes the use of special on-chip hardware will increase a manufacturer's functional wafer tests, but software will continue to play the major role in parametric evaluations, which are often used by customers for incoming inspection.

Meanwhile, at Texas Instruments Inc., Karl M. Guttag, who headed development of TI's 99000 16-bit microprocessor architecture and logic, agrees that complexity is the key issue in determining whether to use self-testing circuitry on chip in volume production operations. TI considered a partitioning scheme in the early design stages of its 99000, says Guttag, but decided it would give no testing advantage.

Because the part operates at seven times the speed of TI's older 9900 16-bit unit, it can run seven times more test software, Guttag states. In addition, the simple architecture of the microprocessor also makes it easier to "tell what's going on inside the machine.

"I would agree that as processors get more complex, there may be an advantage to partitioning," he says. "Right now, I see that happening in kind of a parallel sense, which would let you check out two or three things at the same time. We are not doing that, but we are investigating it."

Two strikes. Intel Corp. agrees with that view. It believes the trade-offs currently do not weigh in favor of dedicated on-chip test hardware because of the cost of large dice and the burden of proving that the test circuitry itself is in working order. Intel is using software along with the microprocessor's general circuitry to check the chip, which is designed for ease of testability.

"There are three important things to consider in weighing the completeness of your test coverage," notes Joseph Louie, product engineering manager for microprocessors and peripherals. "First, do you exercise every node and how do you exercise every node? Then, have you tested for sequence sensitivity for the operating code? And third, what about timing coverage and something like asynchronous testing?"

But that does not mean the Santa Clara, Calif., firm is not currently considering special test hardware for its future chips. "Time is where the tradeoff comes in," Louie notes. "Do you want to put in some test circuitry to reduce that test time? And what's most economical? That's the real question." □

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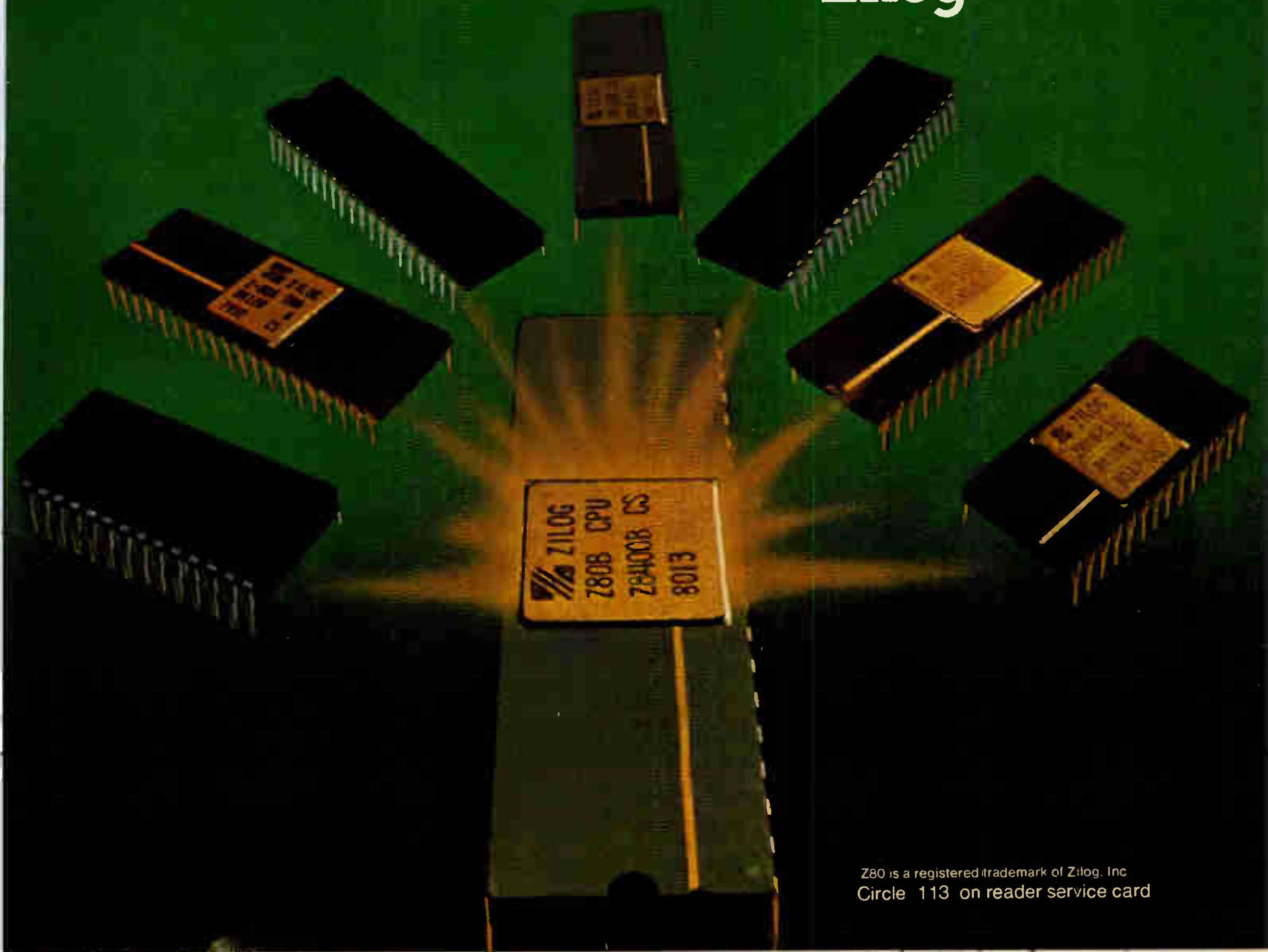

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CONNECTICUT, Danbury	Schweber Electronics	(203) 792-3500
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FLORIDA, Ft. Lauderdale	Hamilton/Avnet Electronics	(305) 971-2900
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FLORIDA, Orlando	Hall-Mark Electronics	(305) 855-4020
†FLORIDA, Orlando	Pioneer/Orlando	(305) 859-3600
FLORIDA, St. Petersburg	Hamilton/Avnet Electronics	(813) 576-3930
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ILLINOIS, Bensenville	Hall-Mark Electronics	(312) 860-3800
†ILLINOIS, Chicago	Bell Ind	(312) 982-9210
ILLINOIS, Chicago	Newark Electronics Corp.	(312) 638-4411
†ILLINOIS, Elk Grove Village	Kierulff	(312) 640-0200
ILLINOIS, Elk Grove Village	Pioneer/Standard	(312) 437-9680
ILLINOIS, Elk Grove Village	Schweber Electronics	(312) 364-3750
ILLINOIS, Elmhurst Industrial Park	Semiconductor Specialists, Inc /Chicago	(312) 279-1000
ILLINOIS, Schiller Park	Hamilton/Avnet Electronics	(312) 671-6090
INDIANA, Indianapolis	Graham Electronics Supply, Inc.	(317) 634-8202
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MISSOURI, Earth City	Hall-Mark Electronics	(314) 291-5350
MISSOURI, Earth City	Hamilton/Avnet Electronics	(314) 344-1200
NEW JERSEY, Fairfield	Hamilton/Avnet Electronics	(201) 575-3390
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NEW JERSEY, Cherry Hill	Hall-Mark Electronics	(609) 424-0880
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NEW YORK, Vestal	Harvey Electronics	(607) 748-8211
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NORTH CAROLINA, Raleigh	Hall-Mark Electronics	(919) 832-4465
NORTH CAROLINA, Raleigh	Hamilton/Avnet Electronics	(919) 829-8030
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OHIO, Centerville	Hamilton/Avnet Electronics	(513) 433-0610
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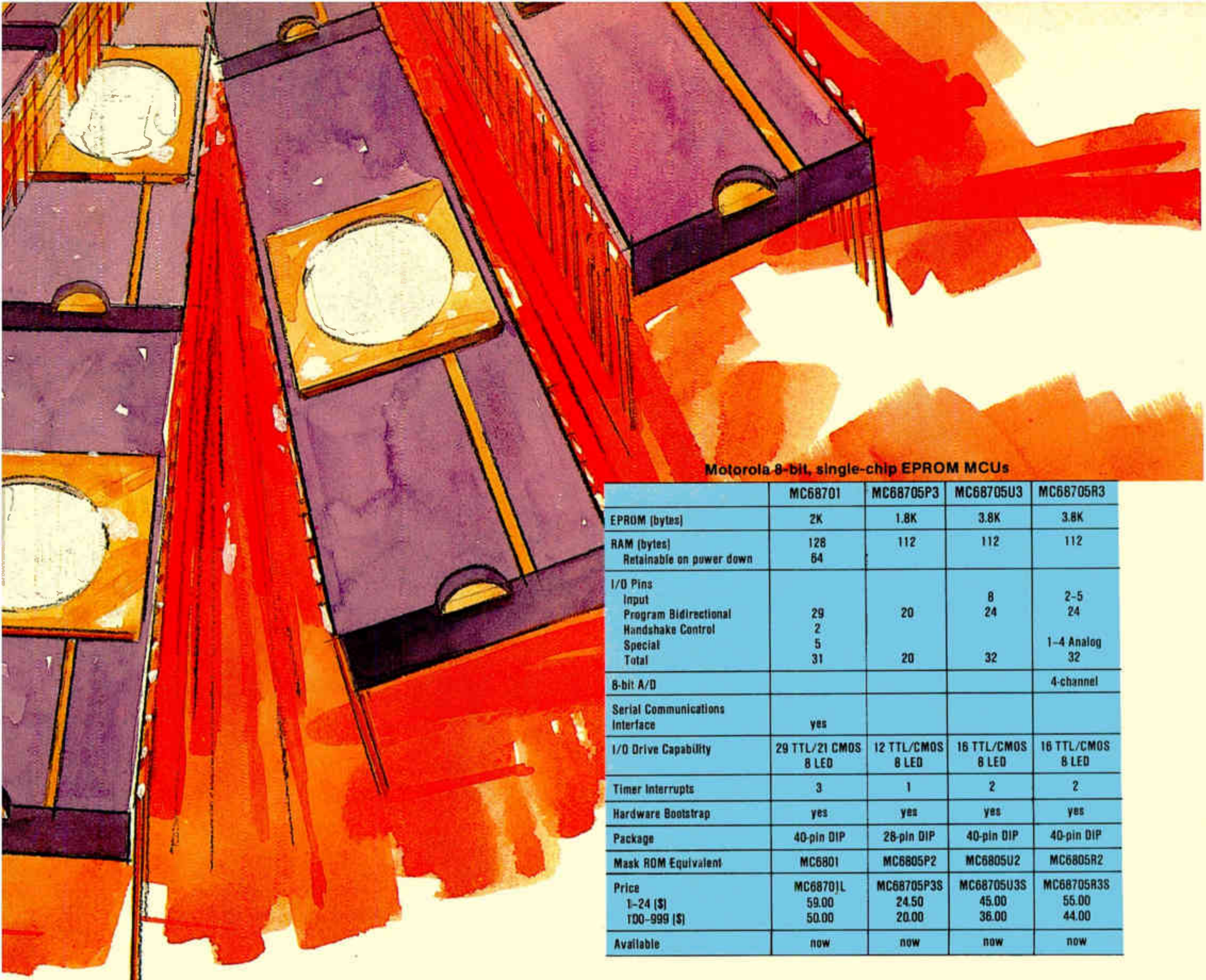

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	MC68701	MC68705P3	MC68705U3	MC68705R3
EPROM (bytes)	2K	1.8K	3.8K	3.8K
RAM (bytes) Retainable on power down	128 64	112	112	112
I/O Pins Input Program Bidirectional Handshake Control Special Total	 29 2 5 31	 20 20	 8 24 32	 2-5 24 1-4 Analog 32
8-bit A/D				4-channel
Serial Communications Interface	yes			
I/O Drive Capability	29 TTL/21 CMOS 8 LED	12 TTL/CMOS 8 LED	16 TTL/CMOS 8 LED	16 TTL/CMOS 8 LED
Timer Interrupts	3	1	2	2
Hardware Bootstrap	yes	yes	yes	yes
Package	40-pin DIP	28-pin DIP	40-pin DIP	40-pin DIP
Mask ROM Equivalent	MC6801	MC6805P2	MC6805U2	MC6805R2
Price 1-24 ($) 100-999 ($)	MC68701L 59.00 50.00	MC68705P3S 24.50 20.00	MC68705U3S 45.00 36.00	MC68705R3S 55.00 44.00
Available	now	now	now	now

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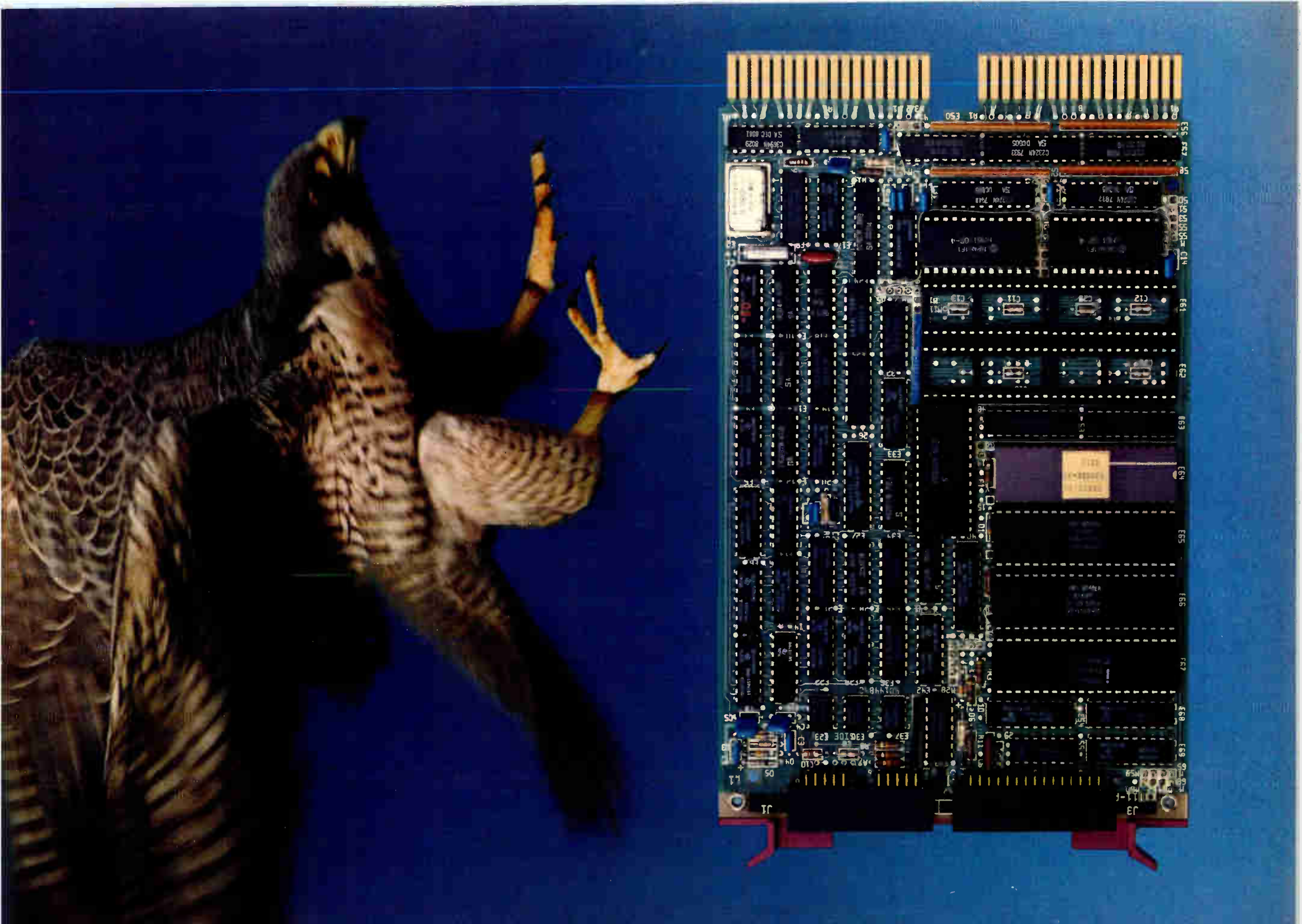

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Industry leaders see turnaround in 1982 but disagree on length and depth of the recession

Initiatives by the Reagan Administration designed to help business draw applause from top executives even as they wait for interest rates to start downward and keep a watchful eye on foreign competition and the world market situation

MILTON GREENBERG
president, GCA Corp.

Optimism is the order of the day at the Bedford, Mass., headquarters of the semiconductor-manufacturing-equipment maker Greenberg leads. "I think we'll see an economic upturn early in 1982, at least by the second quarter," he says. An easing of interest rates, which he expects will decline steadily through midsummer next year, will help. The real spark igniting the recovery, however, should come from the brightening expectations of businessmen both in electronics and in industry at large.

"There's nothing consciously willed about this, no cabal meeting behind closed doors and voting to be optimistic this quarter, but I see glimmers of a gathering consensus that 1982 will be a better year." The psychological impact of such a consensus, he says, will be a powerful, if intangible, factor in any upswing.

Chief among the more tangible spurs to recovery will be "a more generous level of investments" due to falling interest rates, the specter of both domestic and foreign competition, and improved industry-government relations. "The Reagan Administration is on the right track economically, and there's a growing appreciation of high-technology industry as the instrument of choice in bettering our balance of trade. But there's still a long way to go on both those fronts."

Industry leaders can do more to foster government support, Greenberg stresses. "In this state, you already see executives getting more politically active: our Massachusetts High Technology Council is a strong lobby for government measures that enhance the climate for business."

Easing tax and bureaucratic burdens on companies, rather than a proliferation of protective legislation, is the course he prefers to see government take. "I want a helper, not a protector. We live in an international marketplace where the distinction between foreign and domestic competitors is an artificial one."

Corporate planning and investment scenarios at GCA during 1982 will reflect his optimism, he says. "Our research and development budget, for instance, which grew from around $11 million to over $16 million in 1981, will get a similar increase this year."

ROBERT S. PEPPER

vice president and general manager, Solid State division, RCA Corp.

"We all understand the long-term outlook very well," says Pepper, "but 1982 is the toughest year I ever faced in terms of finalizing the numbers." The near-term concerns faced by business center around the uncertain outcome of the Reagan economic program. "We don't have a track record of operating in a high-interest-rate economy. Our ability to forecast might be suspect."

The interest-rate problem is twofold for RCA, because the company must fund capital for new developments like the video disk, and the cost of capital puts a heavy burden on the profit-and-loss picture. The problem also affects RCA's customers' ability to sell to *their* customers. High interest rates are a depressant that causes delay in placing orders.

As a result, inventories are leaner, and moving product becomes highly dependent on contractors supplying what is needed on schedule. "This requires close control, and makes it a lot tougher to run a business."

Longer term, however, he is optimistic. "Pervasiveness of the electronic technology is with us. Growth will occur, but we must position our resources for the long term. This is difficult for this country because traditionally we have tended to look shorter term than competitors."

Pepper worries over what he considers the U. S. failure to come to grips with the changing world competitive picture. The ground rules have changed, he holds, from a world where all the resources the country needs were under its control and where the competition was basically domestic.

As a result of the failure to adjust to the new rules, U. S. imports and exports are way out of balance. In contrast, "the Japanese have targeted and supported businesses that look promising for export and dropped weaker businesses. They really encourage exports, and that is the name of the game."

Long-term survival may depend upon a lot more cooperation among government, management, and labor, he believes. "In management-labor relations we need interaction on problem solving, not a contest in which there are winners and losers. We've got to produce a desire on both sides to do an understanding job. They will either succeed or fail together—they're not separable."

His scenario for 1982 shows modest growth in dollars with continued severe price pressures and significant excess worldwide capacity. He expects a gradual ("on the high side of modest") upturn to occur but no earlier than the second half of 1982. Even then, it will not be spectacular. "The industry won't be sold out in the third quarter, believe me."

MICHAEL C. J. COWPLAND

president, Mitel Corp.

The economy fills the foreground of Cowpland's view from Kanata, Ont., a suburb of Ottawa, Canada's capital city. But somewhat surprisingly in this period of a troubled worldwide economy, his outlook for North America is strictly upbeat.

He bases his optimism on the presence of Ronald Reagan in the White House. The Administration's overall program, he believes, "will save the world economic position of the U. S. I'm encouraged by his record to date. In 6 to 12 months, things will start to look rosy."

On the prospects of the semiconductor industry, he is equally optimistic. "It will be out of the slump by the end of 1982 and back to the old growth rates. What we have now is just a hiccough in the industry of the future. The chip people give too much value for the money for it to be otherwise. Don't worry about the Japanese in the long run; the trend line is up, and they won't stop it."

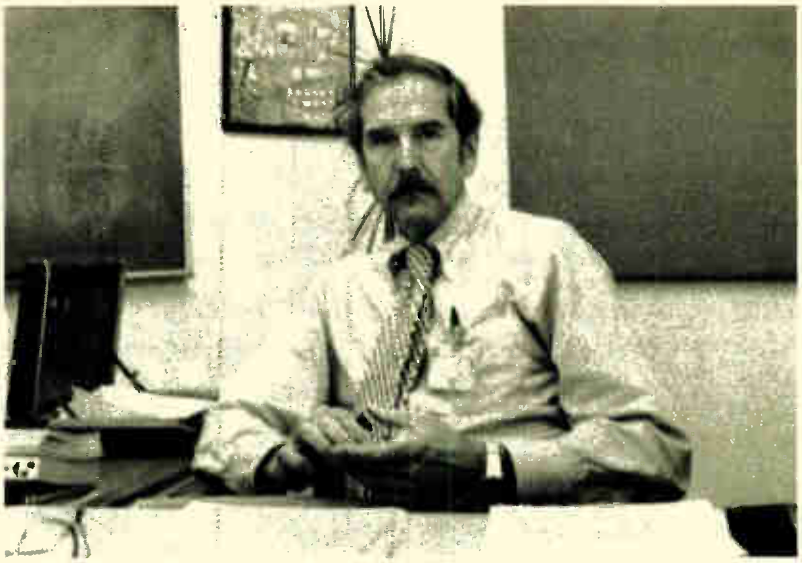
The keys to all this? For Cowpland, they are improved productivity and reliability. "The productivity of semiconductor-industry labor will go up, and the reliability issue will disappear very shortly as the U. S. addresses both problems."

R. W. KLUCKMAN
president, Zenith Radio Corp.

Despite predictions that the recession could persist into 1982, Kluckman is optimistic and expects continued overall strength next year in the market for color television receivers. The industry "has been surprisingly strong during the past couple of years," running counter to trends of previous years in which color TV sales had a tendency to track automobile sales.

"During the past recession, the consumer made his decision to purchase color TV and consumer electronics instead of going on vacation and buying automobiles, and there's no reason to believe that should change during 1982," he observes. Also contributing to his optimism are new opportunities for color TV sales, given the growth of cable and subscription TV services.

The first half of 1981 was stronger than the second half, but in the aggregate, the color TV industry "will have a very good year in terms of unit volume," says the Zenith executive. The coming year—though equally strong overall—should reverse that trend, showing more relative strength during the second half after a slower period during the first six months of 1982.



CHARLES E. SPORCK
president, National Semiconductor Corp.

The economy is first on Sporck's worry list, as it is for many executives. "We won't see the turnaround in semiconductors until the general economy turns around, and that won't happen until there are major changes in the interest rates. Instead of asking when the turnaround will occur, maybe we should be asking whether we have seen the bottom of the recession."

The forecasts released by the Semiconductor Industry Association are too optimistic, he thinks. "Those forecasts were created a few months ago, and from what we've seen since then, we believe that the growth will be less than that cited by the SIA."

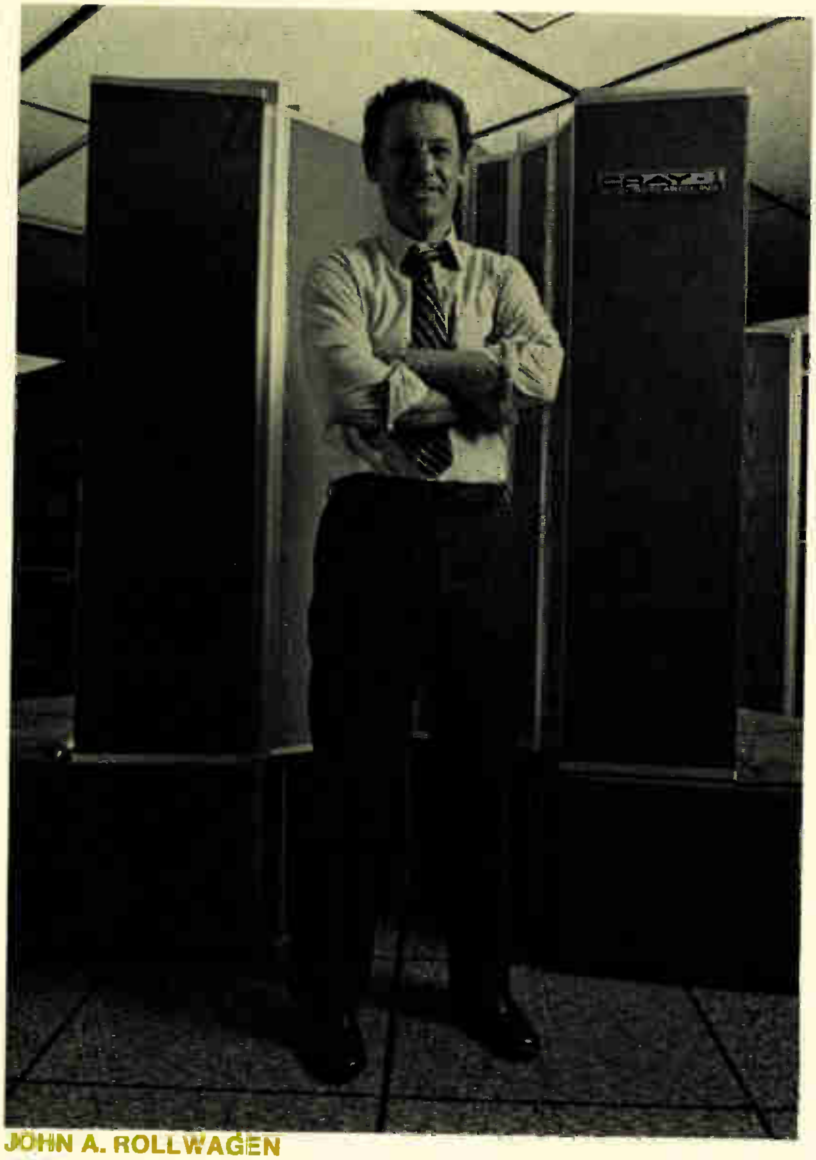
He has no objections to the association's projections beyond 1982. But for next year, he suggests that the percentage growth figure could be down 50% from the SIA's worldwide prediction of 16.9% for solid-state devices and 20.4% in total integrated-circuit dollar volume.

He does not believe that the high interest rates will be a limiting factor on capital expenditures. "What influences us most is the demand for products and the anticipated demand for products." The semiconductor industry in general, and National in particular, have enough bricks and mortar in place to take care of capacity requirements in an upturn, but the limiting factor will be manpower, in Sporck's view.

The fluctuation of the dollar in Europe also has an effect. "We are selling in local currencies and have local competitors. That means that U. S. vendors have to sell at about the same price as local competition, and it means a decline of about 25% in the U. S. dollar price. The impact is on profitability, not volume." In general, Europe's business is down, and he expects the European upswing to trail the American recovery.

The Government-business relationship has been improving over the past few years, in that the Government has begun to realize the importance of a strong industrial base, he believes. "The industry is beginning to feel that it can talk to government," he says. "They are encouraged by examples such as the Government's insistence that the Japanese bring in their new tariff rates in April 1982 instead of 1987."

In a broader sense, he wants the Government "to establish an environment which places us on a competitive footing with the Japanese. There must be some principle of equivalency." The key to that effort, he feels, is the acknowledgement that U. S. manufacturers "are in a restricted trade environment, not a total free-enterprise system. We as a government must recognize that and plan accordingly."



JOHN A. ROLLWAGEN
chairman, Cray Research Inc.

Maintaining internal corporate growth and technology leadership at his Mendota Heights, Minn., supercomputer maker concerns Rollwagen more than the general economy. "The Japanese have specifically stated that they intend to build a computer that is 67 times more powerful than the Cray I by 1990. Our only defense against them is to do it first," he says.

Cray continues to purchase "a significant portion" of some types of components from Japan—particularly 4-K bipolar memory devices. Though the balance could swing even further in the short term, Rollwagen sees that trend reversing in the long run. U. S. semiconductor suppliers are reacting to the Japanese threat by actively installing reliability and quality-control programs of their own, he notes.

He has few complaints about Reagan Administration policies, though he would in some cases like to see regulatory agencies "make decisions more quickly and openly about export licenses." From a personal viewpoint, he supports the Reagan approach for turning the economy around. "The trouble is, it's not going to work very fast." He worries that some—particularly Congress—may give up too soon on the Reagan economic program.

R. W. MILLER
general manager, LSI Products division, TRW Inc.

The lack of qualified design personnel is No. 1 on Miller's list of concerns for the future. "I think it will continue to get worse," he says. The lack of trained personnel is one factor, as is the difficulty in attracting engineers, due to the housing problems around the division's headquarters in La Jolla, Calif.

In the long term, he sees industry's proposed support of university technical departments helping alleviate the crunch. But for more immediate answers, TRW is looking outside the U. S. "We're continuing to look at offshore satellite design centers in the Far East. Some cultures there encourage people to become professionals, but local economies can't support them, making foreign investment welcome."

Looking at the uncertainty of the economy, Miller's main concern is predicting its effects. "We have great difficulty forecasting when customers will take programs which have slid and firm them up," he explains. Eighteen months ago, new-product programs were active, "but since then a vast majority of them are on the skids."

This poses a looming problem for semiconductor makers that have recently boosted their capacity. "Looking to 1983, should we be developing broader markets?" Unless the demand rises to meet the increased output, "there will be a pricing effect until that capacity starts to get used."

KEISKE YAWATA
president, NEC Electronics USA Inc.

If nothing else, Yawata finds himself in a unique position from which to look at 1982: "We are a U. S. company, even though our financing comes from Japan." While most of the firm's activities concern marketing products from its Japanese parent, its Electronic Arrays division in Mountain View, Calif., is expanding its U. S. manufacturing operations.

Taking a look at the subject that nearly universally tops this year's list of major concerns, the economy, he believes it is too soon to assess the impact of the Reagan Administration's policies. However, he says, the moves are in the right direction.

As for the current recession, Yawata believes the semiconductor industry will turn around in the fourth quarter of next year. "The turnaround will very quickly create shortages. The big surge will not come until 1983."

One development that concerns him is the recent court decision holding the vendors of video-cassette recorders liable for consumers' copyright infringements of material such as old movies. "This may lead to a surcharge upon the initial sale of the VCR to cover copyright licensing" and affect the market, he says.

The consumer sector in general will rate as moderately strong in the U. S. next year and show particular strength in Japan. But for real strength, watch office automation. "It is the hottest thing in Japan, along with personal computers and minicomputer-based systems."

GEORGES PEBEREAU
managing director, CIT-Alcatel

Though Pebereau's preoccupations for 1982 are predictable enough—the generally poor state of the world economy, the depressed condition of the market, and high interest rates—the change to a Socialist government in France with a massive nationalization program and plans to reinflate the economy to create jobs set the country apart from its monetarist-dominated neighbors. Indeed, CIT-Alcatel's parent Compagnie Générale d'Electricité is on top of the list of those to be nationalized.

"As the state takes over control of the CGE it will, thus, take a majority interest in CIT-Alcatel," he notes. So the relationship of the state to the company will be that of any majority shareholder to a company.

"Exactly what difference that will make to us is not for me to say, but there are two specific things worth noting. First, the government has already publicly expressed its desire not to change for the sake of change. Second, the stated technological priorities of the government—telecommunications and data processing, for example—coincide with what have been the priorities of CIT-Alcatel for a long time."

On the international level, Pebereau hopes that next year world standards will be set for the Télématique communications-oriented data-processing program. "One of our principal priorities for next year is to make inroads into the American market, particularly in the field of telecommunications," he says.

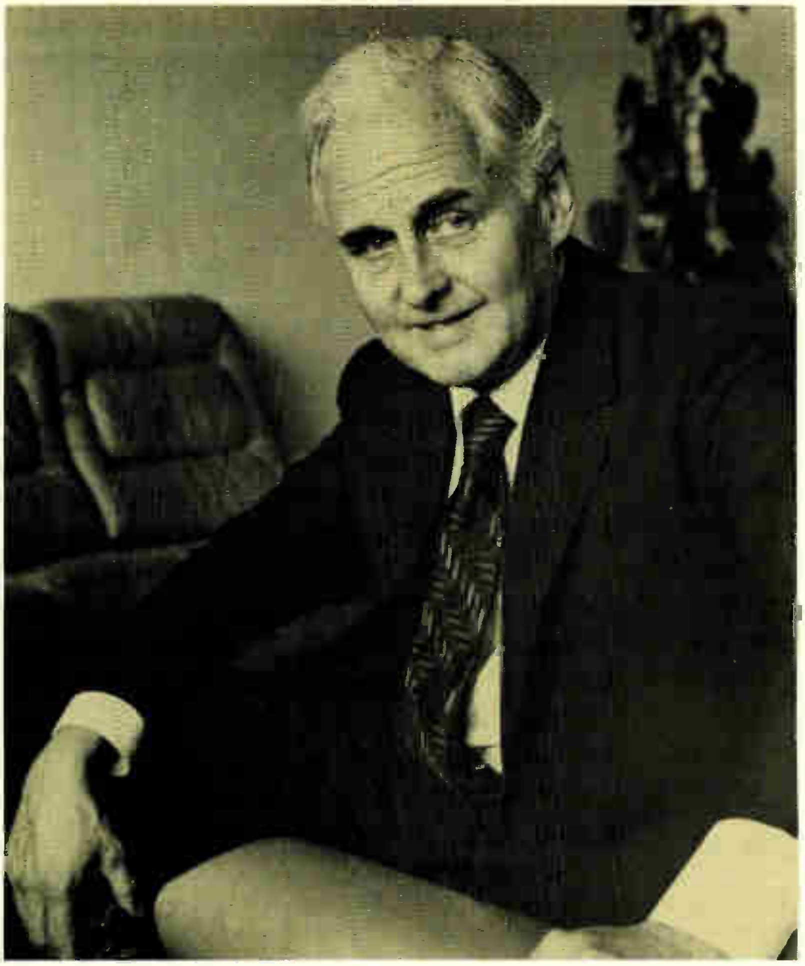
LUBO MICIC
managing director, ITT Semiconductors Group

The view from Micic's office in Freiburg, West Germany, is dominated by the sluggish economy. He sees the Western European semiconductor industry as having hit bottom, a position it will maintain for some time, "giving little hope for some recovery in the near term."

A concomitant concern is high interest rates, a condition that will stifle investment in new technologies. Tight money is also creating the need for a new type of executive, he notes, one with a good understanding of cash management. "It's no longer enough just to have good designers, good technologists, and good production engineers."

For the further development of microelectronics, much capital will be needed, "and it must be invested at the right time and in the right spot," he says. Among the companies that can handle this best are those that are part of a large corporation, like ITT, that operates worldwide and that embodies a rich pool of know-how and resources. As for selling to the Japanese, it need not be a problem, says Micic. If a semiconductor maker adopts their quality concepts, sells at reasonable prices, and offers good service, it can do good business with them.

But productivity can be a problem if a company does not keep working at it. Increasing productivity requires a continuous effort and the kind of diligence that has helped the Japanese on their road to success.



SIR WILLIAM BARLOW
chairman, engineering group, Thorn EMI plc

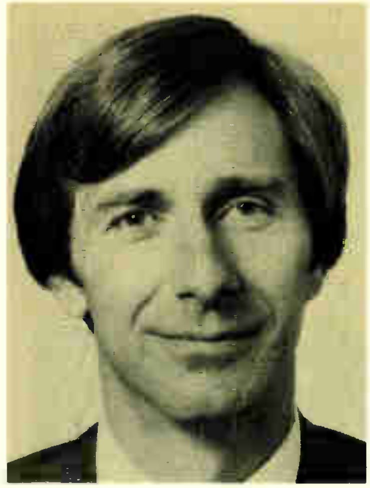
The British economy is still bumping along, so the prime concerns now are how to prime the pump and how to push industry away from the older declining sectors into newer high-growth sectors exploiting cheap microcircuit technology. Not too surprisingly, Barlow believes that telecommunications should play a key role in showing the way.

In fact, his advocacy of the need to invest in a modern telephone network at a time of economic stringency eventually led to his resignation as chairman of the post office organization last year. Belatedly he appears to have made his point: the government is now formulating plans to raise additional finance from the private sector—something that France was doing 15 years ago, as he points out. But he would like to see at least double the $300 million being mooted.

Sir William is more positive about other government initiatives. He welcomes the relaxation of the post office monopoly, as competition both improves performance and provides a check to union power. Indeed, he is widely credited with turning the BPO's successor, British Telecom, from a stodgy civil service organization into a surprisingly aggressive commercial enterprise.

He also welcomes the formation of the new Ministry of Information Technology. At long last, he says, government policy is developing a clear focus.

But British industry must take much of the blame for its poor competitive situation. "We spend only half as much as the Japanese and Americans on product design and development," he says. "There's not enough evidence that companies are prepared to pump in money."



WILLIAM E. FOSTER
president, Stratus Computer Inc.

The concerns of the chief executive officer of a new computer firm are not all that different from those of an established company's leader. For example, Foster is concerned about component availability, particularly 64-K random-access memories.

"Till now, we have had no trouble getting 64-K parts. But we are surprised that so few major users have adopted 64-K RAMs so far, and wonder whether in 1982 there might be a great increase in demand. If there is, allocations could be a possibility" that would affect his Natick, Mass., company. However, "most of the major computer vendors' older products can't deal effectively with the 4- and 8-megabyte main memories 64-K RAMs make possible," eliminating retrofits.

Foster wonders whether high-margin memory may not be helping pay for some of the increasing costs of software development. "Software still is relatively cheap in comparison to its value, and it used to be given away almost free. The market doesn't yet reflect the real cost or value of software, and until pricing policies are rationalized, computer makers may be tempted to keep margins and prices up."

To attract money, start-ups will need unique products. "There is less new money coming into venture capital now than a year ago, and fewer new funds are being formed. Venture houses are going to be increasingly selective as 1982 wears on."

KENT W. BLACK
president, Commercial Electronics Operations, Rockwell International Corp.

For anyone in the avionics business, it is necessary to keep a wary eye on factors affecting the sales of planes. The two biggest current impediments are the air controllers' strike and the rising cost of fuel, which have caused airlines to delay purchases for about two years until new models of fuel-effective craft reach the market. By that time, the controller force should be restafied.

Thus Black sees a hazy short term. "I think 1982 and '83 will be years of transition in the avionics industry. There's a very bright outlook if you look ahead two years, but it's mixed over the short term."

Fuel costs also knocked small-plane buyers out of the marketplace to a large degree, but that setback was offset by increased sales of business jets and twin-engine planes to operators that moved in when trunk carriers stopped serving smaller cities following deregulation. "Then the controller strike put that into a tailspin," he says.

When things do turn around, Black sees little foreign competition, since the Japanese, his major concern, have shown little interest in avionics. However, in telecommunications, the story is different. "NEC, Fujitsu, and a number of other suppliers to NTT are already showing strength here."

He sees mostly good things coming from the new Administration. "I believe in them. I've seen a lot of progress in the removal of 'export disincentives' and less interference from agencies like OSHA."

TAIYU KOBAYASHI
chairman, Fujitsu Ltd.

Overseas problems in 1982 will cause more knitted brows than will domestic problems in Japan. Everybody is keeping an eagle eye on the moves of Japanese companies, Kobayashi says, and there are apt to be repercussions.

Thus the company will enter the U. S. market for personal and small computers through Fujitsu-TRW as inconspicuously as possible—so he does not anticipate any problems. But he fears that other computer and peripheral-equipment manufacturers may opt for much more rapid entry into the American market, the largest one available.

The chance of new friction being generated is great, he fears. Fujitsu would like to try to reduce that heat by expanding the territorial range of its exports, but Kobayashi feels that the prospects are not good. Neither developing countries without oil, the Eastern Bloc, nor China has money, so exports are not possible without international help.

His pessimism extends to the current slump, which he does not think will end next year. At present, social security costs are rising and higher wages lead to higher taxes because of bracket creep. These factors combine to squash hopes for additional discretionary spending. There is no hope for an improvement without a decrease in Japan's taxes, he says, though the government is trying to reduce expenditures.

Fujitsu's chief also believes that not much business can be expected from Nippon Telegraph & Telephone Public Corp.—although 20% of Fujitsu's sales are to NTT, that figure will drop. Kobayashi says the reason is that, while Fujitsu overall is growing at a 15% rate, sales to NTT are growing at about 5% at best.

KATSUSHIGE MITA
president, Hitachi Ltd.

Like his fellow executives in Japan, Mita is worried about trade friction. For example, limitations on the export of automobiles to the U. S. affect the firm's sales of automobile components. Now, exports of videocassette recorders are especially high, leading Mita to wonder what sort of heat that might cause.

As for the domestic economy, the high cost of oil precludes a significant upturn next year, he feels. The sluggishness results in good sales for such products as computers and large-scale integrated circuits and poor results for products such as motors. Thus there is a need to redesign poorly selling items to improve their chances, meaning that Hitachi must maintain its research and development budget at about 6% of sales, or about $565 million, as it endeavors to upgrade the old offerings while developing new ones.

Meanwhile, the firm must arrange capital investment for expansion and modernization of plants. In the past, it was able to generate the necessary funds through depreciation and profits, but next year it will have to go to the equity markets.

Engineers are in short supply, and it is exceedingly difficult for Hitachi to hire more. One solution is to start up engineering subsidiaries because they can operate with less stringent personnel rules—for example, they can recruit at the less prestigious universities. Also, this year there were about 100 women among the 1,000 college-trained engineers and technical persons hired by Hitachi.

FREDERICK A. WANG
vice president of market planning and development, Wang Laboratories Inc.

"The recession will either lessen in 1982—or we'll just get used to it." If that outlook makes Wang appear a fatalist, he hastens to add that his attitude is an optimistic one. He believes that companies, even small ones that delayed major purchases in 1981, will perceive capital outlays as a necessity rather than a mere cash drain and will be investing in computer products like those his Lowell, Mass., company makes.

So he sees more of a business-as-usual year ahead for high-technology companies. "I do think that interest rates can't go on at the levels they hit this year; they have to decline." More importantly, he counts on the pressure for increased productivity and for aggressive innovation to spur industry recovery from the effects of the recession.

Demand for technological solutions to productivity problems, which in recent years lagged behind the technology actually available, is beginning to catch up as a result of recessionary problems, he observes.

U. S. industry's need to stay competitive with foreign rivals also makes recovery likely in 1982. "America still has the most stimulating environment for innovation," and that, says Wang, is the key to competing successfully, as well as to a high level of industry spending over the coming year. "The Japanese have very cost-effective, well-thought-out products, but I don't see them producing the next-generation technologies."

EARL J. ROGERS
chairman, Precision Monolithics Inc.

The semiconductor industry will not see a turnaround before the fourth quarter of next year, and that is causing some concern in the Santa Clara, Calif., headquarters of PMI. However, Rogers is quick to point out his firm's business, linear integrated circuits, does not track the rest of the semiconductor industry. "We haven't seen the crunch that others have. For us, a recession means a flat line, not a down one."

He does see some silver lining showing. "During a recession, the yields go up because the operators work more diligently. In addition, companies usually make process improvements during a recession.

"The net result is that, while the wafer line slows up, we get better-yielding wafers and sometimes get the same number of good dice out of the system." He adds that the industry is currently using about 30% of its fabrication capacity.

Turning to the American work force and economy in general, Rogers says it is too early to see if the Reagan economic program will work. "It took the Great Society programs 20 years to get us into this mess, and we should give Reagan half that time to reverse it."

The Government, he believes, "should restore the work ethic to the populace. It could, for example, reduce payments to the unemployed, so that people will want to go back to work." He is not sure that there are personnel shortages. "There is, right down the line, a shortage of people who want to work."

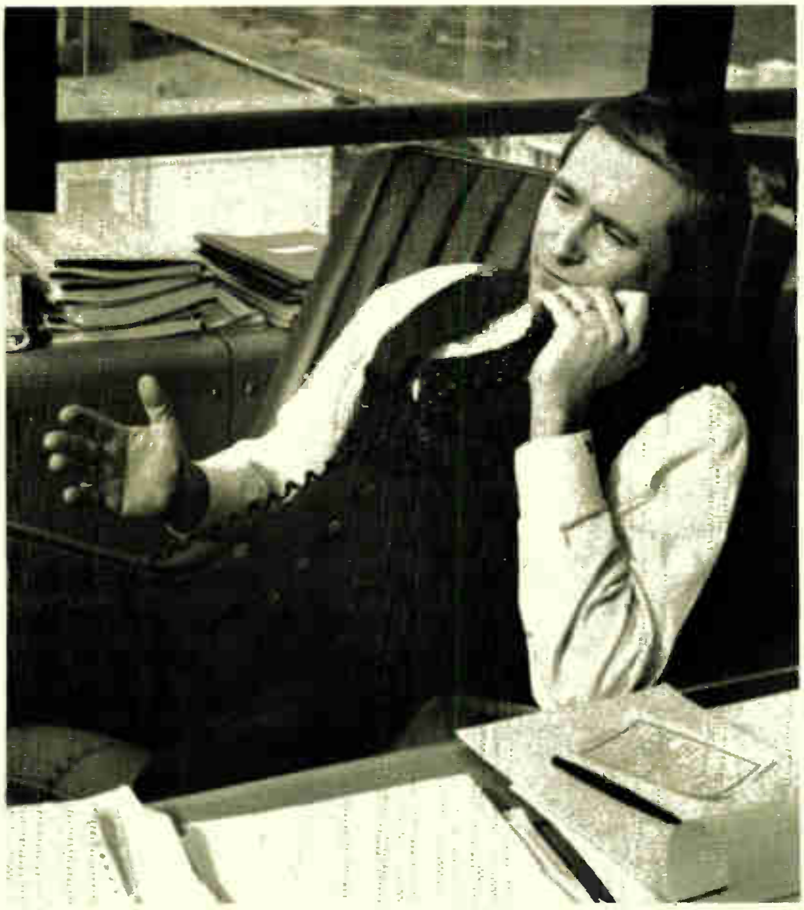
PAUL MIRAT
president, Thomson-EFCIS

Generally pessimistic about the economic outlook for 1982, Mirat nevertheless feels that in the semiconductor industry there will be opportunities for companies strong enough to withstand the shock of the world recession. "I really cannot see us coming out of the current economic dip before the end of 1982," he states.

"Worldwide, most semiconductor companies are at a more or less equal level of technology, but I don't see this as the area for investment. My strategy would be to invest in design and software, to weather the storm of the recession, and be ready for the upswing with a new generation of standard, rather than custom, integrated circuits."

For Mirat, the structure of a company is essential to its ability to be innovative and to grow. "The companies that are organized vertically with a semiconductor division and then divisions producing manufactured goods using the semiconductor division's products: these are the companies that have enough depth to invest, even when times are difficult next year."

For any European firm to successfully take advantage of this sort of structure, he is convinced that it must establish itself outside Western Europe. "The European market represents just 20% of the world. It is impossible to restrict yourself to this portion and to be a real innovator, and the production of original products and new components to build them around is not a follower's business," he says.



JOHN V. ROACH
president, Tandy Corp.

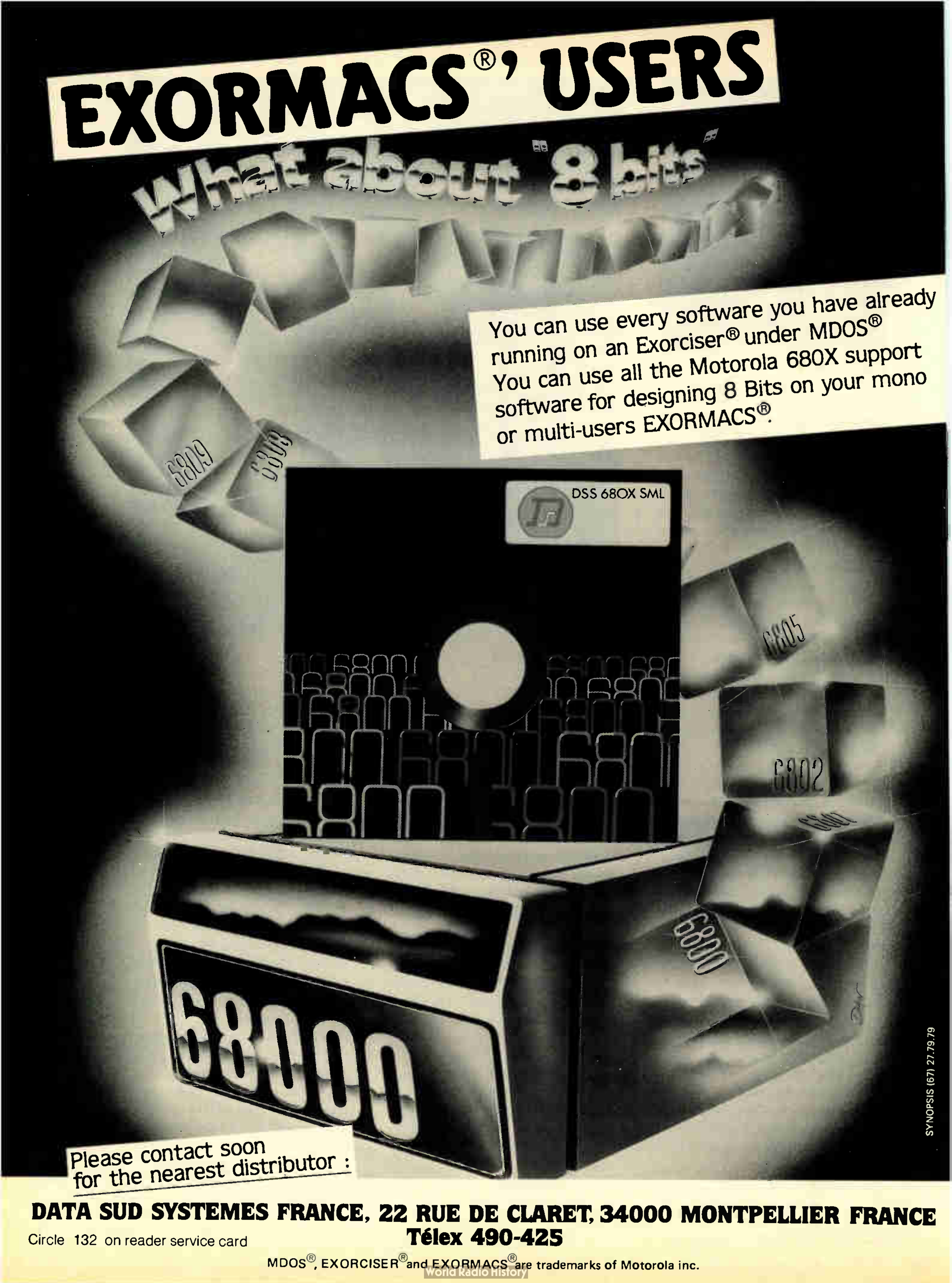
The consumer electronics market may be ailing, but Roach has a prescription for what he considers the right medicine: high technology. Without new state-of-the-art products, consumer-electronics manufacturers may find sales susceptible to severe slumps during recessions.

But one thing that does not worry him is a consumer-electronics recession in 1982. "Certainly, history has shown that consumers will continue to buy interesting, innovative new electronic products regardless of the general economic environment," he says. For Tandy, that meant a 1981 that lived up to expectations—including a 57% earnings increase in the third quarter.

The key is always to have an arsenal of innovative products, whether the economy is hot or cold. "Companies recognize this and will continue to push very hard on new-product developments independent of any temporary market conditions." In fact, he adds, advances in consumer electronics may accelerate during tough times as highly competitive retailers seize on innovations to help slug it out.

One area on which Roach is keeping his eye is the personal-computer market. An example of the consumer-technology blitz, the personal-computer picture shows Tandy as the volume leader with its TRS-80 line. But 1981 saw a flood of competitors enter the market—among them such giants as IBM, Xerox, and Hewlett-Packard. "I guess 1982 will be the year that we see just how those competitors stack up," he says with a grin.

In addition to healthy computer activity, he sees a promising year for telephone and video products, which are also experiencing great strides in technology. 1982 also will be a personal landmark for Tandy's president and chief executive office: in July, he will become chairman.



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Software pack and controller link DEC computers in an Ethernet

Machines running under Unix operating system can communicate with one another in local network

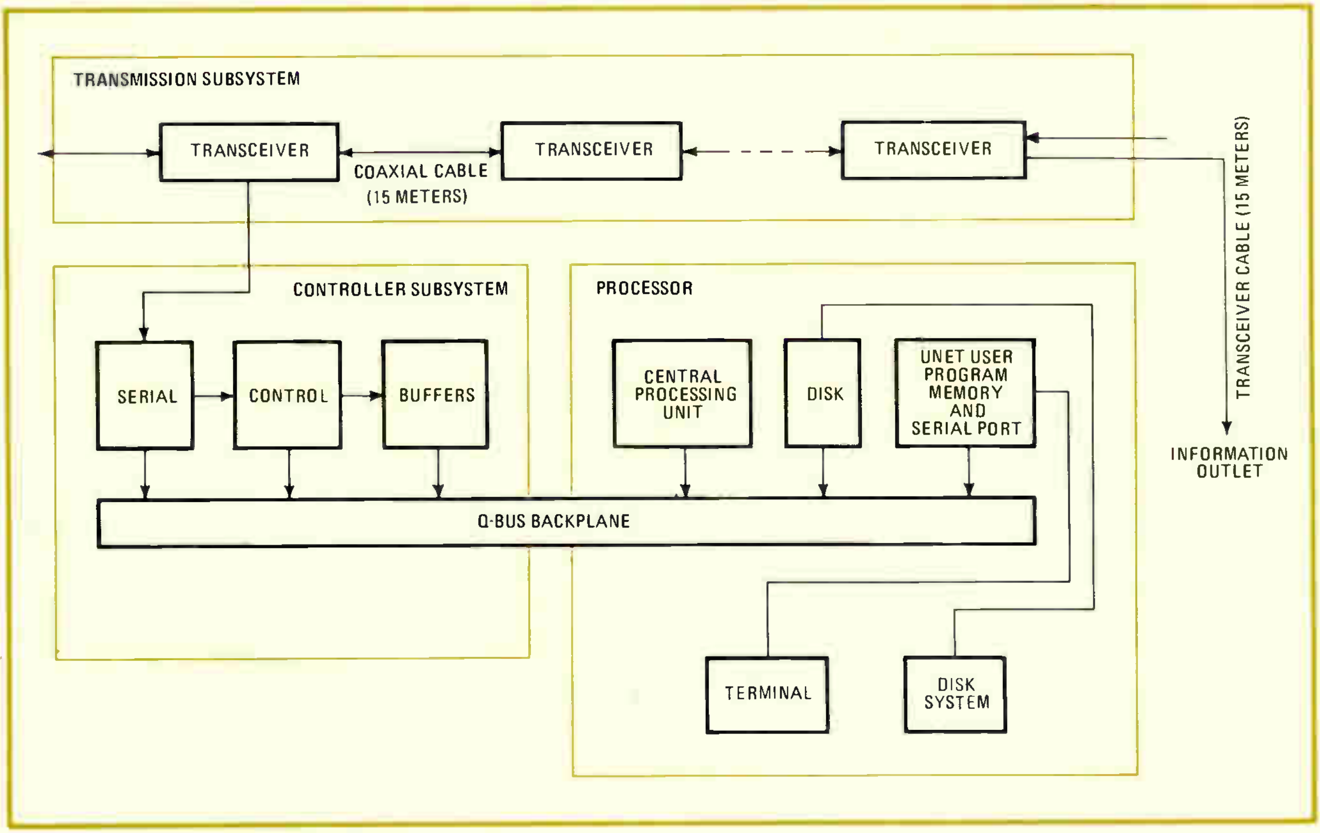
by Ronald C. Crane, *3Com Corp., Mountain View, Calif.*

☐ Designers of data-generating and -receiving equipment now have some useful interconnection tools with which to realize the well-publicized Ethernet approach to a local network. A newly introduced Ethernet controller and Ethernet-related software will link Digital Equipment Corp. computers that use Bell Laboratories' Unix operating system. The controller can also be used with other available software drivers to provide link-level communications between machines with DEC's own operating systems; that is, it provides the physical and data links of the International Standards Organization's reference model for open-systems interconnections.

Ethernet and Unix look to be two emerging *de facto* standards, so it was an obvious choice to design network software that could be used with Unix and an Ethernet controller. 3Com's Unet software implements software layers of the ISO's reference model.

Combining Unet and the controller eliminates the need for users of Unix-based DEC computers to write the software needed for communication between two or more machines over Ethernet. Only the ISO session layer is not accounted for, but its functions are taken up by the other layers. The Ethernet specifications, as published by DEC, Intel, and Xerox, take care of the physical and data-link levels of a local network's layered hardware and software architecture. These are necessary but not sufficient to connect equipment, since they ignore higher-level software problems.

The Defense Advanced Research Projects Agency's internet and transmission-control protocols were chosen



1. Three boards. The 3Com Ethernet controller for DEC computers using the Unix operating system comprises three printed-circuit boards that plug into the Q-bus backplane. The transceiver, Unet software, and other components are also 3Com designs.

to implement the network and transport layers because they were available standards. The end-user capabilities, such as mail and file transfers, are provided by a 3Com-designed presentation and application layer.

A complete Ethernet local computer network for the LSI-11 Q-bus processor can be constructed from available components (Fig. 1). These include the Ethernet transceivers (introduced early this year) and Q-bus controller (just introduced as the QE model, or the 3C200). What's more, with last month's introduction of a Unibus controller, any PDP-11 or VAX machine can have an Ethernet capability.

It is important to note that participation in Ethernet communications is not limited to DEC products. Any Unix-based machine with Unet and either a parallel or serial port can make use of a low-cost LSI-11 and a gateway to make the connection. For example, 3Com makes use of this approach to connect an Onyx machine running Unix to an Ethernet.

Inside the controller

The QE controller has the chore of interfacing the Ethernet transceiver with the internal bus of the LSI-11 processor. Directed by Unet or other driver software resident on the LSI-11, it performs buffering, cyclic redundancy generation and checking, flag and address recognition, phase encoding and decoding, and serial-to-parallel and parallel-to-serial conversion (Fig. 2). The input/output structure and speed of the LSI-11 determine how these functions are partitioned between hardware, software, and microcode.

For example, the amount of buffering in the controller is determined by the latency and speed of the I/O system. Clearly, the buffer size must exceed the product of the data rate and I/O latency. Since I/O systems may have transfer rates less than the network bandwidth, the QE controller has full-packet buffers to keep up with the network bit rate.

The controller checks the data passing through it by means of a cyclic redundancy code. The Ethernet CRC is the 32-bit polynomial from the Autodin II military packet-communications system and is implemented in hardware on the QE controller.

In an Ethernet system, the controller must watch every packet that passes to determine whether to accept it. Full-packet buffers can greatly speed this recognition process for the system.

With partial buffers, the host processor must check the address upon the arrival of the first part of the packet. It can reject the packet, but many unwanted bits may funnel through the buffer to the processor, wasting I/O system cycles. With one or more full-packet buffers, the packet remains in the buffer until it is accepted by the software, thereby saving I/O cycles. Using a full-packet buffer and software address recognition minimizes the hardware content of the QE controller.

Standard Manchester encoding and decoding with a 50% duty cycle is used for data transmission (see "Inside Ethernet," p. 136). Assigning the encoding and decoding functions to the QE controller simplifies the interconnection to the transceiver by reducing the number of wires.

Together with an Ethernet transceiver, the QE controller can both transmit and receive packets through a common coaxial cable. It has no on-board intelligence; instead it is controlled through registers in the I/O space of the LSI-11 by the Unet software resident on that machine. The two registers are the transmitting control register and the receiving control register.

The controller provides 32-K bytes of memory, which can be any 32-K byte boundary in the LSI-11's memory, and data transfer takes place via memory-mapped I/O. For the controller's purposes, this memory is viewed as sixteen 2-K-byte packet buffers. Any space not used as packet buffers can serve general system use.

Code is necessary for address recognition and for implementing the random retransmission time period, as well as for loading and unloading the buffers. This code can be interrupt-driven and requires three vector locations when operated in that mode.

The QE controller has independent receiving and transmitting sections, but they operate similarly, so to explain the transmitting section is to explain both. This section has two first-in, first-out memories, which are 4 bits wide and 16 words deep. One FIFO keeps the numbers of the buffers awaiting transmission, and the other keeps those that have completed successful transmission.

When the software wants to transmit a packet, it writes its buffer number in the pending FIFO. When the controller transmits a buffer's contents, it removes the buffer number from the pending FIFO, copies it into the completed FIFO, and sets the done bit. The software removes a buffer's pointer from the completed FIFO by clearing the done bit.

The low-order 4 bits of the control word go into the pending FIFO when the XWBN (transmit write buffer number) signal is on. While these bits are being read from the control register, the contents of the done FIFO appear in the buffer's number field. Before it is transmitted, the packet is aligned in the buffer so that its last byte of data coincides with the last byte of the buffer.

The first word in each buffer is called the header and contains the address of the first byte of the packet. The controller transmits the buffer contents pointed to by the header of the pending FIFO. If the FIFO contains more than one packet, the controller transmits them back to back over the network.

Handling collisions

Ethernet's binary exponential back-off algorithm is implemented by the controller's software. When the controller detects a collision, the software must delay (back off) an appropriate length of time before attempting retransmission

The length of the time that the software delays must be an integral multiple of a packet slot time (512 bit times, or 51.2 microseconds). The integral multiple is chosen as a uniformly distributed random integer greater than or equal to 0 and less than 2^K where K is either the number of retransmission attempts for the packet being transmitted or 10, whichever is less. If the number of retransmission attempts exceeds 16, then something is wrong or the network is very heavily loaded, and error reporting to higher-level Unet software occurs.

When the controller detects a collision, it sets the JAM status bit. Any other packets in the pending FIFO remain undisturbed. When the time comes to retransmit, the software merely sets a JCLR signal. If another collision results, JAM comes back on. The software then waits a random amount of time before setting JCLR again.

When the transmission finally succeeds, the controller sets XDONE, alerting the software to a successful transmission. If the FIFO contains pointers to other packets waiting for transmission, the controller waits for the minimum interframe spacing time and transmits the next packet without processor intervention.

In the QE controller, all received packets begin at the same place in each buffer: 528 bytes from the beginning. This spacing leaves exactly enough room in the buffer for a packet of maximum size, plus 4 frame-check-sequence bytes and 2 guard bytes. After receiving a packet, the header points to the first free byte past the end of the packet and the FCS.

If the header is zero or points to the odd guard byte, the received packet has exceeded the legal size. This procedure ensures that oversize packets are rejected. The sign bit of the header, when on, indicates an FCS error. The packet, as received with the offending FCS, remains in the buffer.

The controller receives packets and writes them into the buffer specified by the contents of the head of the FIFO. If the receiving FIFO is empty, the controller ignores packets passing by on the network. After receiving a packet, the controller sets the RDONE signal.

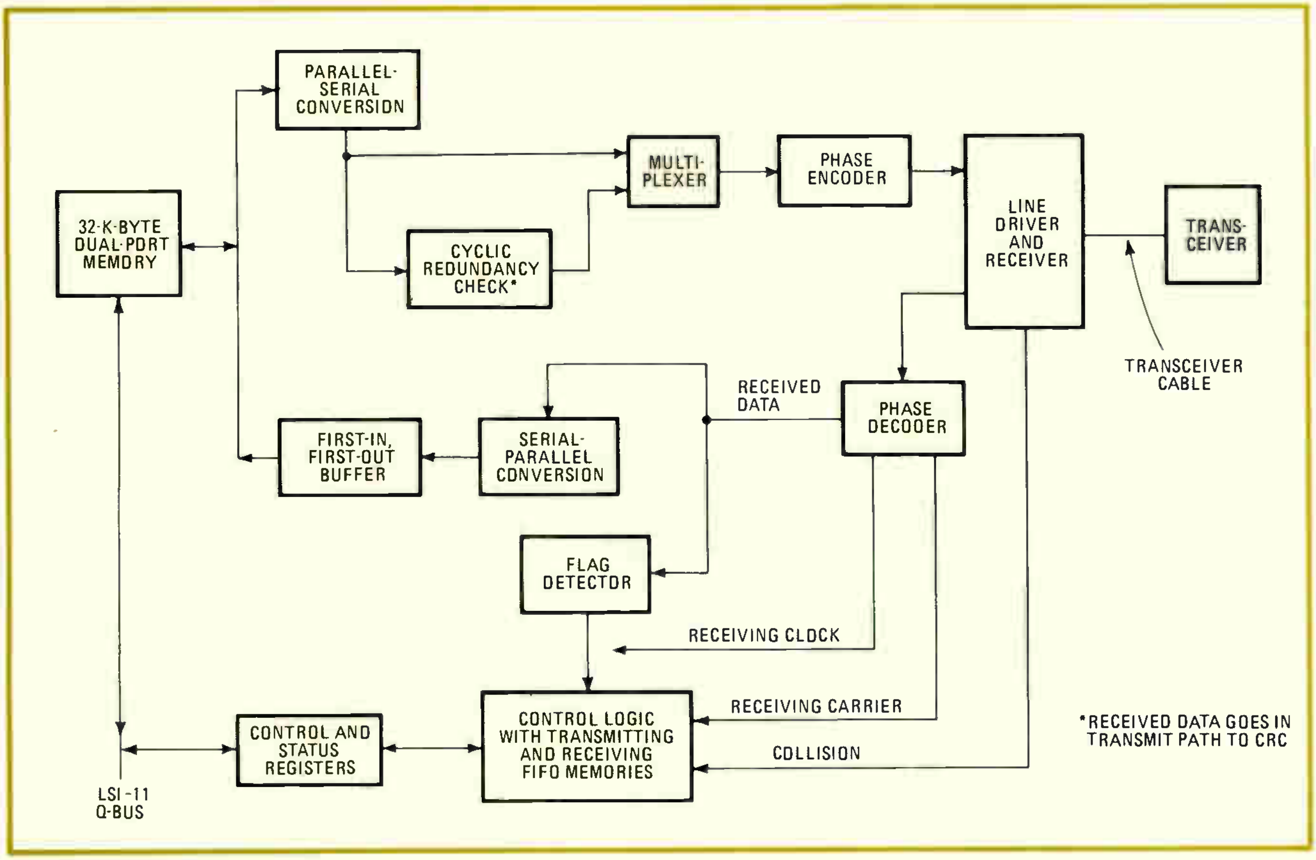
If there are other entries in the receiving FIFO, the controller can receive other packets without processor intervention. The software then clears RDONE and removes the head entry from the FIFO by setting RCLR. This memory-mapped approach is particularly attractive for small, stand-alone systems whose software can make use of the 16 packet buffers directly without incurring any bus cycles for data transfers to memory outside the controller's 32-K-byte buffer area.

Operational experience

In the Ethernet system implemented by the QE controller, all packets, regardless of their destination, are written into available receiving buffers. Controller software compares the destination address of each packet with the Ethernet address of the processor.

Each uninteresting packet consumes about 85 μs of LSI-11/23 time to start an interrupt, compare the destination address, resubmit the buffer, and return from the interrupt. To determine how much of the processor resources will be necessary to perform these address-recognition chores, the time it takes to recognize software addresses must be calculated.

An Ethernet packet has a 64-bit preamble, 48-bit destination and source addresses, a 16-bit data-type word, 368 to 12,000 bits of data, a 32-bit CRC word, and a 96-bit packet gap. Thus a packet can range in length from 672 to 12,304 bits. Statistical experience at Xerox indicates that roughly 80% of the packets will be minimal and 20% will be maximal in size. The average packet length for these conditions is therefore about



2. What's inside. The Q-bus controller performs a variety of communication functions without microprocessor control. These include line driving and receiving, phase encoding and decoding, cyclic redundancy checking, buffering, and memory management.

Inside Ethernet

Ethernet is a bus-oriented communications system providing 10-megabit-per-second bandwidth and supporting up to 100 stations using 50-ohm coaxial cable as its bus. The Ethernet specification calls for a carrier-sensing, multiple-access transmission system with collision detection. This means that in order to transmit a packet, a station must wait for quiet on the network and then start to transmit. During the transmission, the station also watches for collisions with other transmitters.

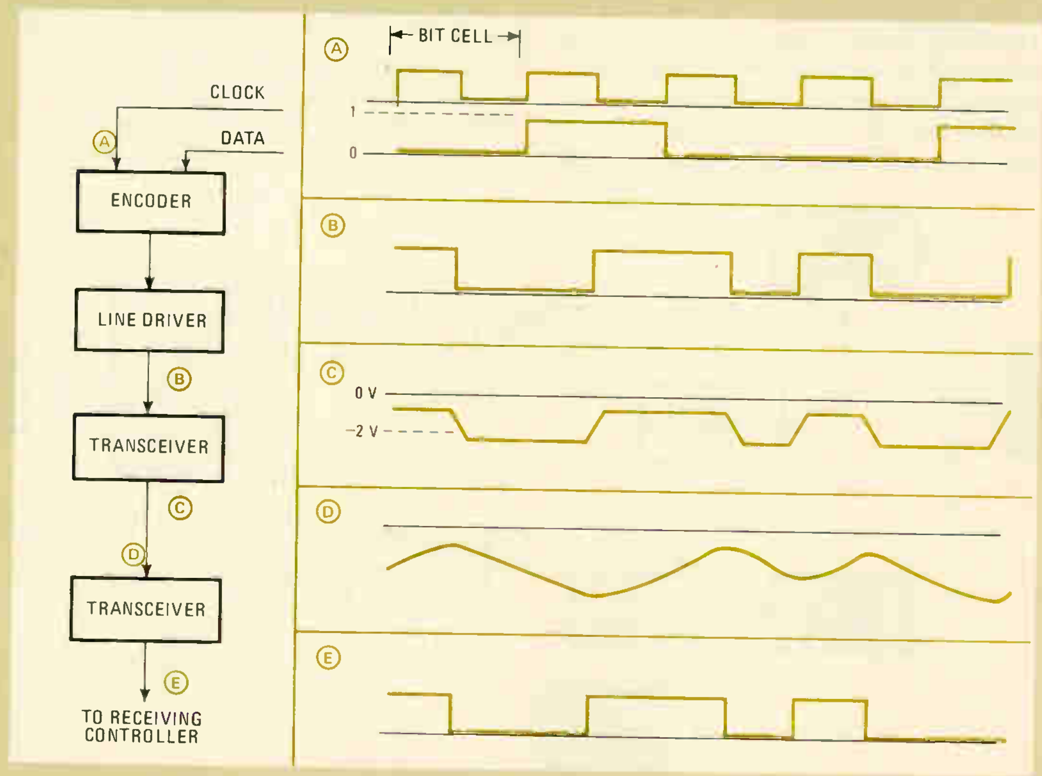
If a collision does occur, the station transmits 4 to 6 additional bytes of jamming data and then aborts the packet. The extra bytes ensure that any other participant in the collision is sure to see it. The station then waits a random amount of time before attempting to retransmit. At the end of this period, it tries to transmit at the earliest opportunity, deferring to packets in transit.

The Ethernet transceiver makes a high-impedance connection to the common coaxial cable and provides electrical isolation between the cable and the twisted pair going to the controller. The transceiver cable carries the signals and all necessary power. Its signaling uses balanced differential signals, typically from emitter-coupled-logic drivers operating between ground and +5 volts.

Tracing the signal and timing waveforms through the interface points of an Ethernet system is the easiest way to understand this local network's operation. The figure illustrates the signal flow through an Ethernet system from the clock and data signal present in the controller before phase encoding, through the transceiver, coaxial cable, receiving transceiver, and finally, the receiving controller.

As the network specifications require, clock and data are exclusive-ORed together to produce a Manchester-encoded data stream. To maintain a 50% duty cycle, each bit cell of the encoded data is divided into halves. The first half of the bit cell contains the complement of the data bit and the second half contains the bit. The line driver in the controller sends this Manchester-encoded data to the transceiver.

The transceiver converts the signal on the transceiver cable, which is equivalent to a differential drive, into a unipolar drive on the coaxial cable. It also limits the minimum rise and fall times of the waveform to minimize noise-producing reflections in the cable system. Since the signal undergoes attenuation and distortion as it travels through the coaxial cable, the transceiver provides equalization for the cable distortion and restores a balanced signal for the transceiver cable to send to the receiving controller, confirming a successful transmission.



3,000 bits. Since the Ethernet data rate is 10 megabits per second, the average packet duration is 300 μs.

With the 85-μs time it takes an LSI-11/23 to recognize an address, a very heavily loaded Ethernet (that is, 37% of the net's equipment on line) would keep busy 11% of all the LSI 11/23s attached. It is a simple matter, given what is known as the Ethernet offered-load percentage, to calculate the percentage of processor time dedicated to address recognition: $P = L \times 85/300$.

Studies of experimental Ethernets at Xerox indicate that a typical load is 1%. During shorter periods, however, maximum utilization in the busiest interval is much higher. About 3.6% over the busiest hour, 17% over the busiest minute, and 37% in the busiest second are typical. For any of these figures, the capacity of the QE controller is more than adequate. □

C-MOS support logic helps build unified, high-speed systems

High-speed process gives gates low-power Schottky TTL speed while retaining the advantages of metal-gate C-MOS units

by Ken Karakotsios and Larry Wakeman, *National Semiconductor Corp., Santa Clara, Calif.*

☐ Scaling down and enhanced processing have dramatically raised the speed of complementary-MOS circuits, producing fast memories and microprocessors that draw little current. But the absence of low-power interface devices has created a need for C-MOS chips to glue these components together. After all, the full benefits of C-MOS's low-power diet are realized only when the entire system is built from the one technology.

The HC series of high-speed C-MOS gate packages, to be supplied by National Semiconductor and also Motorola Inc. of Phoenix, Ariz., are designed precisely for this role. This family, which incorporates both 74HC commercial and 54HC military versions, operates at Schottky TTL speeds but retains the attractive dc electrical characteristics of the metal-gate CD4000B and 54C/74C C-MOS families. In addition, internal circuitry has been added or improved for more symmetrical switching behavior and also for greater protection against static discharge.

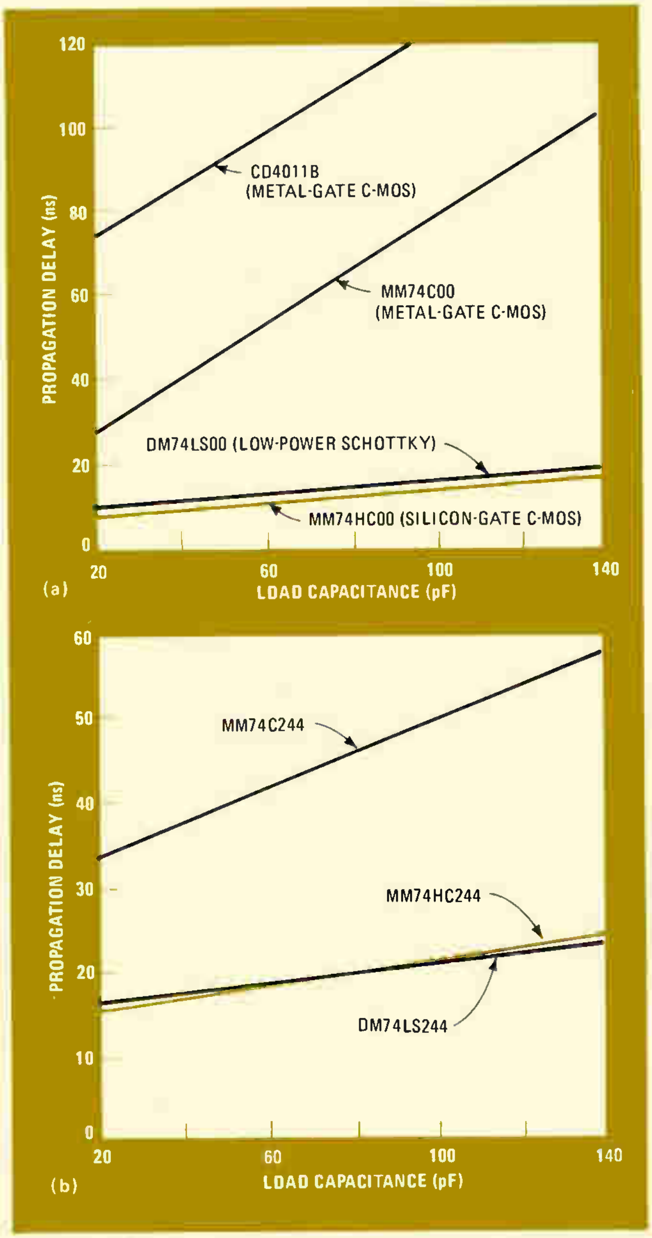
Good mixers

The devices are easily mixed with components from other logic families, even bipolar ones. Some HC devices are further able to accept the higher logic-1 voltage levels delivered by older C-MOS gates, truncating them to the HC's 5-volt operating levels.

The short propagation delays of HC logic are attained through a single-polysilicon C-MOS process, similar to the double-polysilicon process (P^2C-MOS) used by National for its NSC800 microprocessor [*Electronics*, Nov. 22, 1979, p. 111]. Optimized for 5-V operation, it features a recessed-oxide structure to reduce parasitic capacitances and increase transistor gains, so that gate-propagation delays are an order of magnitude shorter than in metal-gate C-MOS circuits.

Designed to meet the dc electrical characteristics of standard C-MOS logic, all devices in the family conform to standard input and output specifications. In addition to the attractively low power and near-zero input current characteristic of all C-MOS circuits, members retain the high input-noise immunity usually associated with C-MOS logic. Standardized output buffers allow symmetrical current sourcing and sinking for equal output rise and fall times, thus simplifying system design.

The family will begin with about 100 devices, with more types to be added at a later date. A wide assort-



1. LS-TTL-like. The propagation delays of HC-type complementary-MOS standard (a) and bus-buffer (b) gates are nearly equal to those of low-power Schottky TTL packages. Because of high current-driving capabilities, speed varies little with loading, unlike older parts.

TABLE 1: A COMPARISON OF LOGIC FAMILIES					
Family type	Low input voltage, V_{IL} (V)[a]	High input voltage, V_{IH} (V)[a]	Low output current, I_{OL}[a,b]	High output current, I_{OH}[a]	Supply range (V)
74HC (silicon-gate C-MOS)	1.0	3.5	4 mA	−4 mA at V_{out} = 4.2 V	3.0 − 6.0
74C (metal-gate C-MOS)	1.5	3.5	360 μA	−360 μA at V_{out} = 2.4 V	3.0 − 15.0
CD4000 (metal-gate C-MOS)	1.5	3.5	360 μA	−120 μA at V_{out} = 4.6 V	3.0 − 15.0
74LS (low-power Schottky)	0.8	2.0	4 mA	−400 μA at V_{out} = 2.7 V	4.75 − 5.25

[a] V_{CC} = 5 V [b] V_{out} = 0.4 V

TABLE 2: THE FAN-OUT CAPABILITIES OF HC DEVICES*			
Device type	Buffer type	Output current (mA)	Low-power Schottky TTL fan-out
54HC	standard	± 3.4	8
	bus driver	± 5.1	12
74HC	standard	± 4.0	10
	bus driver	± 6.0	15

*V_{out} = 0.4 V or 4.2 V, V_{CC} = 5 V. All values are guaranteed across the entire recommended operating temperature range.

ment of small- and medium-scale integrated-circuit packages is being offered, most of which are pin-for-pin and logically equivalent to their low-power Schottky TTL counterparts. Additionally, several functions that are uniquely implemented in the RCA Corp.'s CD4000B series of C-MOS logic are provided.

Beating low-power Schottky

A typical HC gate delay, about 10 ns, is similar to LS-TTL but far faster than the 4-to-5-megahertz rate specified for metal-gate C-MOS parts. As with other C-MOS logic, the speed of HC parts is determined by loading: as fan-out and load capacitance are increased, device propagation delay increases. Like LS-TTL, HC logic offers standard and bus-driver outputs. Figure 1 shows some of the typical propagation-delay versus output-capacitance curves for a standard output device (the 74HC00) and a bus-driving device (the 74HC244), plotted along with their LS-TTL and metal-gate C-MOS equivalents.

The metal-gate 74C00 and CD4011B exhibit a larger initial delay and a greater delay variation with load than the 74HC00 and 74LS00. The HC and LS-TTL devices have similar output impedances, so that their speed variations are nearly the same. The 74HC244 bus driver has the same delays as the 74LS244 at small loads, but exhibits a slightly larger variation in delay due to the increased impedance of its output buffer. Except where these circuits must drive very large loads or where every nanosecond counts, such minor differences in speed can be reconciled by adjusting the specified delays.

Temperature variations also affect propagation delay and can be an important design consideration. In C-MOS, this variation stems from changes in the gain of n- and p-channel transistors due to differences in carrier mobility. The propagation delays of both the 74C00 and the 74HC00 increase about 0.3% per °C. Bipolar circuits are affected by a different set of internal parameters, the factor that accounts for the slightly different temperature variation of LS-TTL.

Family dc characteristics

Standard-output 74HC devices can source and sink 4 milliamperes of current, whereas the bus-driver versions can drive 6 mA. A logical-low input voltage (V_{IL}) may be as high as 20% of V_{cc}, and a logical-high one (V_{IH}) may range from V_{cc} down to 70% of V_{cc}. These input levels are specified over the entire 3-to-6-V supply range.

Table 1 compares the 74HC, 74C, CD4000, and 74LS logic families. The 74HC family has input levels comparable to those of other C-MOS logic families, but with the current drive of the LS-TTL. Moreover, 74HC current driving is typically symmetrical—unlike LS-TTL outputs, which usually source less than they sink.

The HC logic family has the very low quiescent power dissipation of standard C-MOS ICs, which is several orders of magnitude below that of LS-TTL. Figure 2 charts supply current as a function of frequency for a NAND gate and flip-flop from each logic family.

A drastic difference in current requirement can be seen between the C-MOS and LS-TTL devices at frequencies below 1 MHz because the bipolar devices consume direct current, even when not switching. The 74HC devices draw slightly more current than other C-MOS parts because their low-impedance output buffers must source and sink LS-TTL–level currents.

Figure 2 shows the current required by a single gate when it is switching; however, all gates in a package draw dc current. Thus, the bipolar 74LS200 package will draw four times the current of one gate (at 10 kilohertz). But if only one C-MOS gate is switching, then only one gate will draw power.

If the quiescent current consumed by all gates is counted in, the current used by the C-MOS packages remains as shown in the graphs. This puts the power crossover frequency—the point at which a C-MOS package draws more power than its counterpart in LS-TTL—at about 10 MHz.

Surprising crossover effect

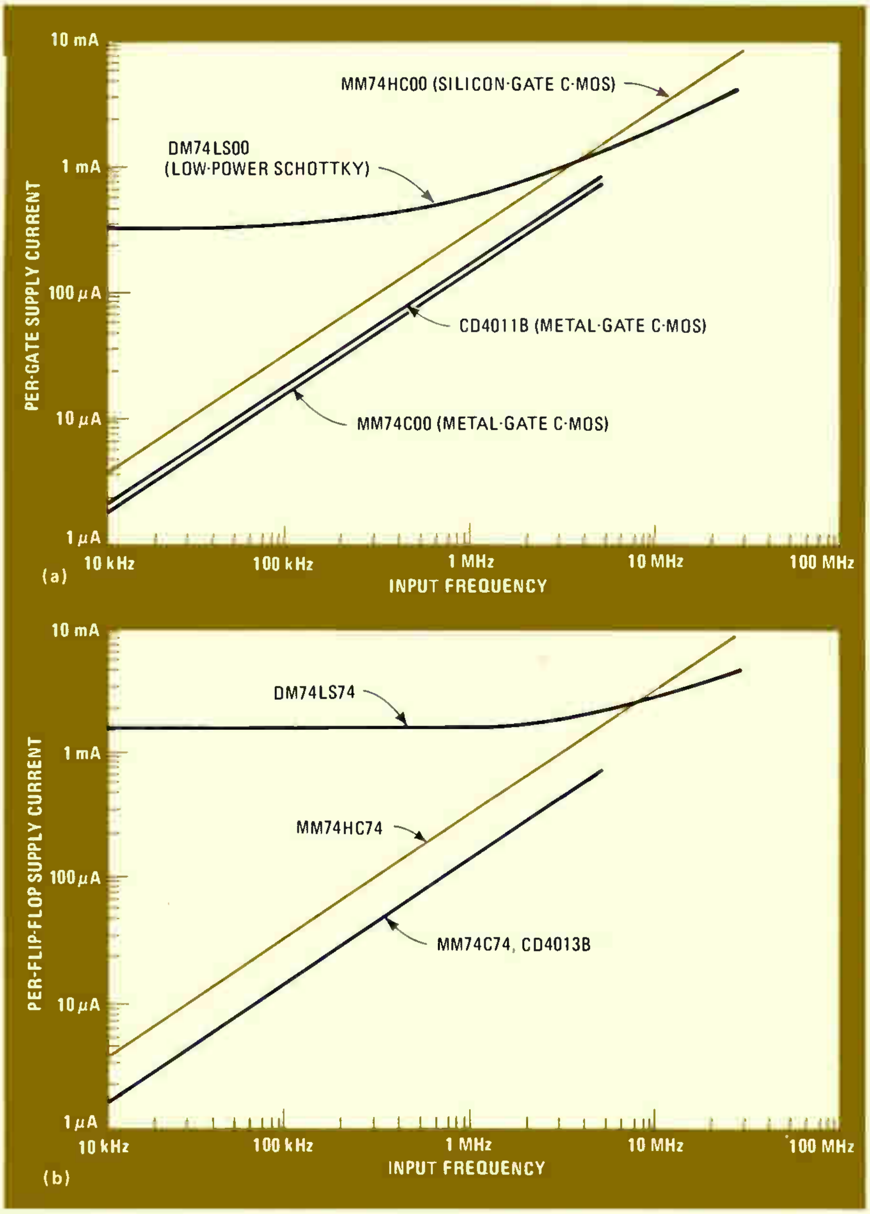
It might seem that as the complexity of a C-MOS component rises, the power crossover frequency should get lower. But, in fact, the opposite will most likely occur. For instance, if a counter is operating at the power crossover frequency of a NAND gate, each subsequent counter stage switches at half the frequency of the previous stage. In a C-MOS circuit, this means that each stage will use half the power of the stage before it, one fourth of the current in the third stage, and so on.

But in a TTL circuit, every stage will draw a similar amount of direct current overall—therefore, the C-MOS device will consume much less power than will an equivalent circuit built with LS-TTL technology.

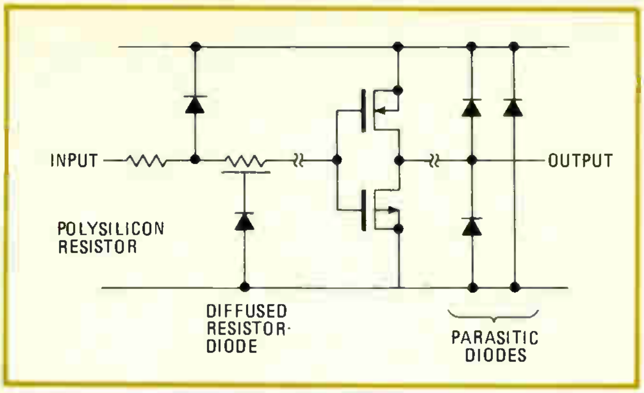
As with any MOS circuits, HC logic gates must be protected against damage from the excessive electrostatic discharges that can occur during assembly and handling. So a new input-protection mechanism, working in conjunction with output parasitic-drain diodes, is used to clamp these voltages to a reasonable level, minimizing a chip's susceptibility to damage.

Figure 3 shows a schematic of the input-protection network employed. It consists of three elements: a polysilicon resistor, a diode connected to V_{cc}, and a distributed resistor-diode device connected to ground.

The polysilicon resistor, connected to the input pad, is used to slow down fast input transients and dissipate some of their energy. This resistor is connected to the two diodes, which clamp incoming spikes and prevent large voltages from appearing across the two transistors' gates. These diodes were made larger than those used in metal-gate C-MOS parts to enable greater current shunting and to render them less susceptible to damage. More-



2. Extended crossover. A marked difference in the power usage of C-MOS and LS-TTL devices can be noted at frequencies below 1 megahertz because the bipolar devices consume direct current, even when not switching. The power crossover point marks the frequency at which the C-MOS device begins to draw more current than its bipolar counterpart. The power crossover point for both gates (a) and flip-flops (b) is approximately 10 MHz.



3. Static control. To clamp static voltages, a polysilicon resistor, a diode, and a diffused-resistor–diode device is used at each input pad. At each output, parasitic diodes perform the same function. These drain diodes are also ringed by supply and ground regions.

over, the parasitic diodes that connect the drains of the output transistor to the substrate also prevent damage by clamping static voltages. Both the p- and n-channel drain diodes are ringed by regions tied to V_{cc} and ground so as to lower substrate resistance and currents.

The HC logic family, being C-MOS, retains many of the design rules that apply to CD4000B or Motorola's 54C/74C parts. Input voltages leading to HC circuits should not exceed V_{cc} or become less than ground. The devices should not be powered down while their inputs are left active.

In harsh environments, where there is a lot of power-supply or input-transient noise, inputs should have additional protection in the form of a series resistor or clamp diodes or both. The choice of the resistor can be critical since it will add some delay to the circuit.

Output rules for HC gates are again similar to those for metal-gate C-MOS devices; but because of the larger output drive of HC gates, more care must be exercised not to overdrive their outputs. The output voltage also should not exceed V_{cc} or become less than ground.

Whenever driving resistive loads, power dissipation per package should be calculated at the rated ambient temperature to ensure that the maximum dissipation is not exceeded. The steady-state output current should not be greater than 25 mA per output (37 mA for bus-driving outputs), to avoid short circuits and excessive currents. For the same reason, the total supply current should not exceed 50 mA (75 mA for the bus-driving devices).

Power-supply layout, including capacitor placement, is more critical than for metal-gate devices because switching-transient currents are much larger and also briefer. The inductance and resistance of power buses are more important. Although layout requirements are not as critical as those of TTL, careful power-bus routing and an increased use of bypass capacitors near the gate packages will maximize noise immunity.

Lowering power consumption

To reduce system power consumption, supply and switching currents should be minimized in accordance with some simple guidelines. Switching currents are related to the amount of capacitance on signal lines and to the frequency at which these signals switch. Reduction of circuit interconnection capacitances—by keeping printed-circuit–board traces short and by decreasing coupling between signal lines—will minimize switching currents. Accordingly, related high-frequency gates should be grouped to shorten printed-circuit–board traces on critical hf paths.

A second cause of excessive power in C-MOS circuits is through currents, as they are called. These flow through both the p- and n-channel transistors when a gate's input is making the transition between logic levels. Thus, the time spent between input logic levels should be kept to a minimum. In systems based on LS-TTL or C-MOS logic, waveform rise times are ordinarily sharp enough to minimize power consumption. Any slow-rising waveforms should be squared up to reduce transition times.

Low-frequency oscillators tend to have slowly rising resistor-capacitor timing waveforms that cause through currents. So in these applications, it is sometimes better to employ standard 54C/74C or CD4000B series parts. An alternative solution would be to use a Schmitt-trigger oscillator, since its internal positive feedback can be used to keep the circuit out of the transition region.

Besides shortening transition times, maintaining solid input-logic levels will also reduce unnecessary internal currents. This demand is automatically met when a C-MOS device drives another C-MOS device, because its outputs will be close to the supply voltage or ground. If the input-logic voltages are not kept close to the supply voltage, input transistors may actually conduct a slight amount of current. The device will still function correctly, so long as minimum logic levels are maintained, but an excess supply current will result.

In many designs, HC logic may be mixed with other C-MOS logic or TTL types. HC logic-level specifications are not quite compatible with TTL output specifications, however. If an LS-TTL device drives a C-MOS device, and if the TTL gate's output high level is around 4 V, the input p-channel transistor of the C-MOS gate will be slightly on, causing internal currents to flow. To increase compatibility between the two logic families, pull-up resistors from the inputs to V_{cc} can be used.

In addition, several members of the high-speed C-MOS family have been designed to have TTL-compatible inputs. Some of the latches and buffers have input levels specified at 2.0 V and 0.8 V to ease interfacing and to eliminate the extra pc-board space required by the pull-up resistors. Interfacing HC outputs with TTL gates requires no extra circuitry, since they can handle a fan-out of 10 LS-TTL loads (eight loads for the 54HC).

When 54HC/74HC, 54C/74C, or CD4000B logic families share a common power supply, no logic-level translation is needed—all three C-MOS families are input- and output-compatible. However, if CD4000B or 54C/74C devices are operating from a 10-V or 15-V supply, a logic-level conversion down to the 5-V 54HC/74HC supply is necessary. This purpose is supplied by the 54HC4049/74HC4050 circuits. These inverters and buffers are high-speed versions of the CD4049 and CD4050B devices. Their upper input-protection diode has been omitted, enabling the input voltage to exceed the supply. Thus, for operation at 5 V, input logic levels up to 15 V will be translated. □

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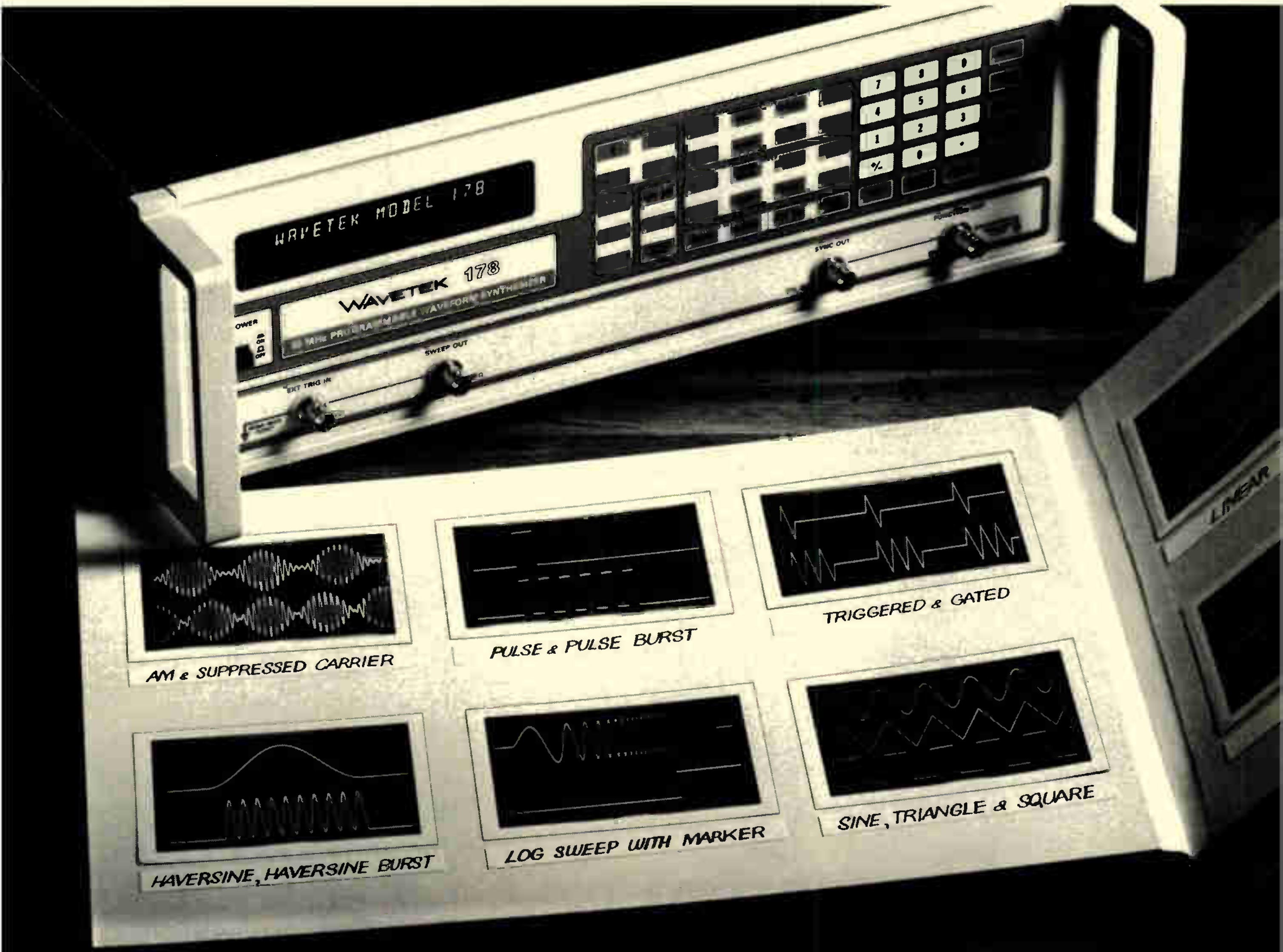


A few shots to remember from our 50 MHz programmable waveform synthesizer.

High-frequency sweep oscillator uses discrete components

by Charles A. Walton
Walton Electronics, Los Gatos, Calif.

Offering a wide frequency range and low distortion, this high-frequency sweep oscillator uses discrete components to deliver a clean sine wave of 0.3 to 70 megahertz with a control voltage of 0.5 to 2.5 volts. The oscillator's total harmonic distortion factor is less than 3%.

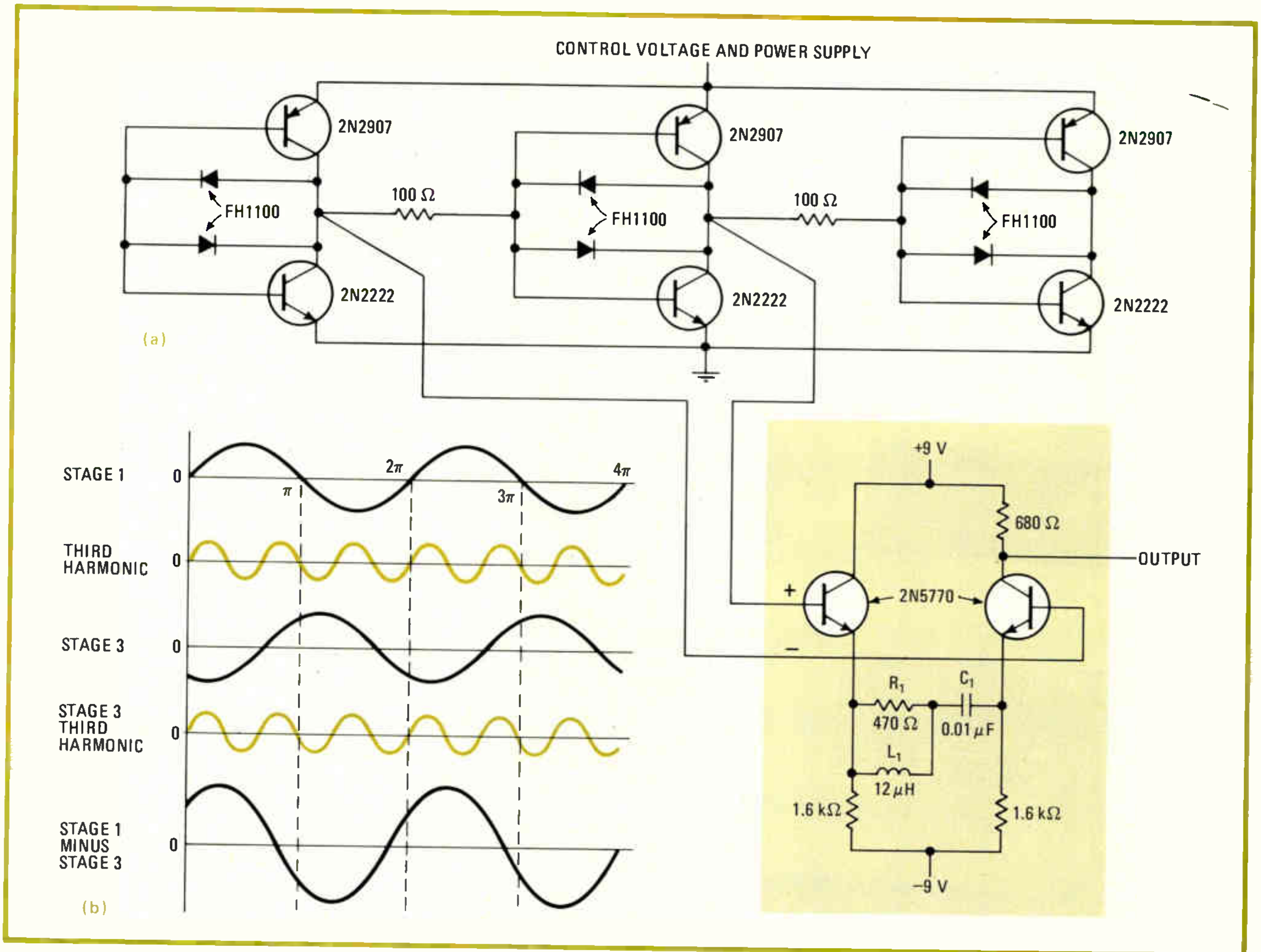
The circuit (a) uses a triple-stage inverter. It has an overall positive feedback at a frequency where each stage has a phase lag of 60° in addition to an inversion lag of 180°, resulting in a total phase lag of 720°. The oscillator frequency is varied by controlling the collector's supply voltage and current—a higher collector supply voltage results in a higher frequency of oscillation.

By using complementary npn and pnp transistors, symmetrical rise and fall times are generated for each stage, thereby eliminating even harmonics. In addition, diode clamps in each stage prevent saturation and minimize odd harmonics. The third harmonic generated is 360° out of phase in successive stages (b).

The oscillator output is taken from a pair of successive stages and subtracted with a differential amplifier, thus canceling the third harmonic. The fifth harmonic is damped by the bandwidth limitation of each stage. Moderate decoupling between stages using 100-ohm resistors avoids parasitic oscillation. As a result, the overall low harmonic distortion allows a good-quality sine wave to be created.

The signal amplitude is 0.5 V peak to peak at 3 MHz, 0.7 V at 10 MHz, and 0.8 V at 15 MHz. The differential-amplifier stage is a convenient point to shape the amplitude versus frequency characteristic.

The high-frequency sweep oscillator, used in a proxim-



Sweeping oscillator. Increasing the supply voltage of this oscillator (a) reduces the stage-time delay, thus increasing the frequency of oscillation. Also, harmonic distortion is low due to the use of complementary npn and pnp transistors and the diodes. R_1, L_1, and C_1 shape the high-frequency envelope. The differential-amplifier output cancels third harmonic (b). Signal amplitude is 0.8 V peak to peak at 15 MHz.

ity electronic access system for control and identification, drives a sensing coil and searches through the high-frequency spectrum (3 to 30 MHz) for resonances in a credit-card key. The resonances, once they are found, are used to determine the identity of the bearer. □

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.

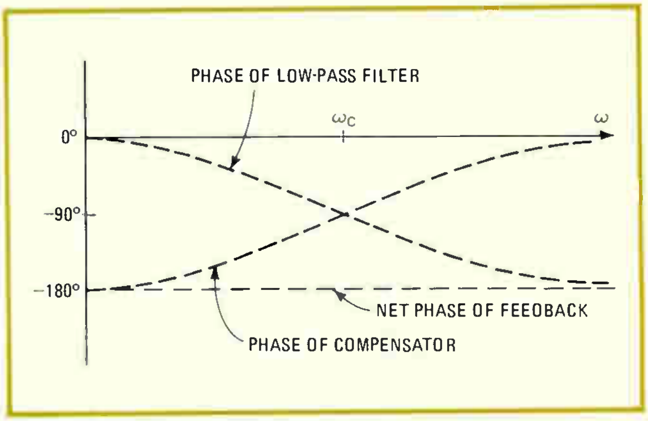
Phase compensation stabilizes pulse-width–modulator system

by Christopher S. Tocci
Clarkson College of Technology, Potsdam, N. Y.

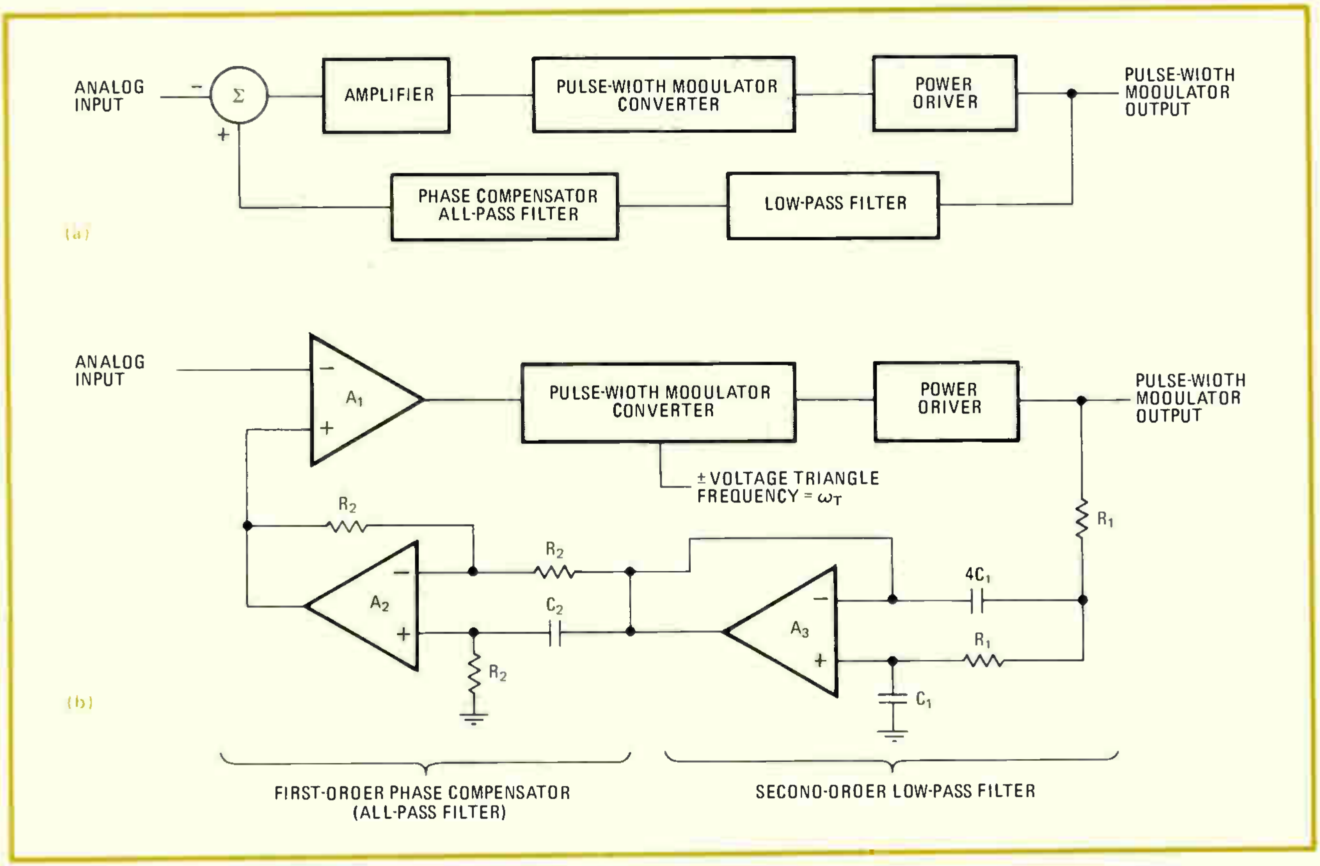
Unlike conventional modulation circuits, this phase-compensated pulse-width modulator employs negative feedback to improve system linearity under varying load conditions—without adding excessive cost to the system. This technique may be used when the average value of the modulator's output is the controlled variable.

The system (Fig. 1) produces a pulse-width–modulated form from an analog input by using a converter to make a differential comparison of that input and a triangular waveform. This information is fed into a fast switching comparator (power driver) having a small amount of hysteresis. The output then feeds back through the phase-shift network comprising a low-pass filter and phase compensator (an all-pass filter).

The phase-shifting properties of the filters and the feedback are shown in Fig. 2. A net phase shift of 180° indicates that together the low- and all-pass filters form an inverting amplifier in terms of the averaged output



2. Phase. The figure shows the individual phase versus frequency characteristics of a second-order low-pass filter, first-order phase compensator, and the feedback network. The feedback network provides a constant 180° phase shift with respect to the input.



1. Stable. A phase-compensation technique (a) used in this system provides negative feedback and enhances system stability under varying load conditions. Hardware implementation of the system (b) uses a second-order Butterworth low-pass filter and a first-order phase compensator for a constant 180° phase shift of the feedback information.

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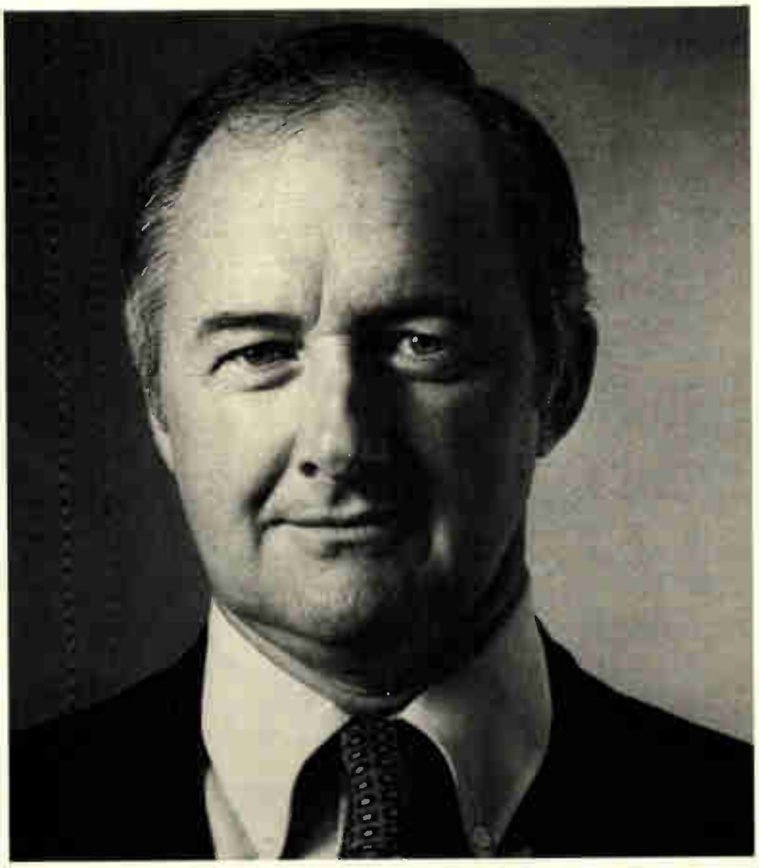

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with respect to the input analog signal.

The low-pass filter by itself must be an even-order part to obtain a constant 180° phase difference with respect to the input. If the amplifier has the typical first-order roll-off at 10 hertz (LM741), then the net phase differential will approach −90° at the summing input with respect to the feedback.

The filters have equal cutoff frequencies. If the switching frequency ω_T is suppressed by 40 decibels ($\omega_C \approx \omega_T/10$), the circuit's feedback error is reduced. □

Quad op amp helps reconstruct sampled data

by Kamil Kraus
Rokycany, Czechoslovakia

Analog waveforms for digital data systems may be reconstructed with this signal processor. It uses a quad operational amplifier that serves both as a sample-and-hold module and filter.

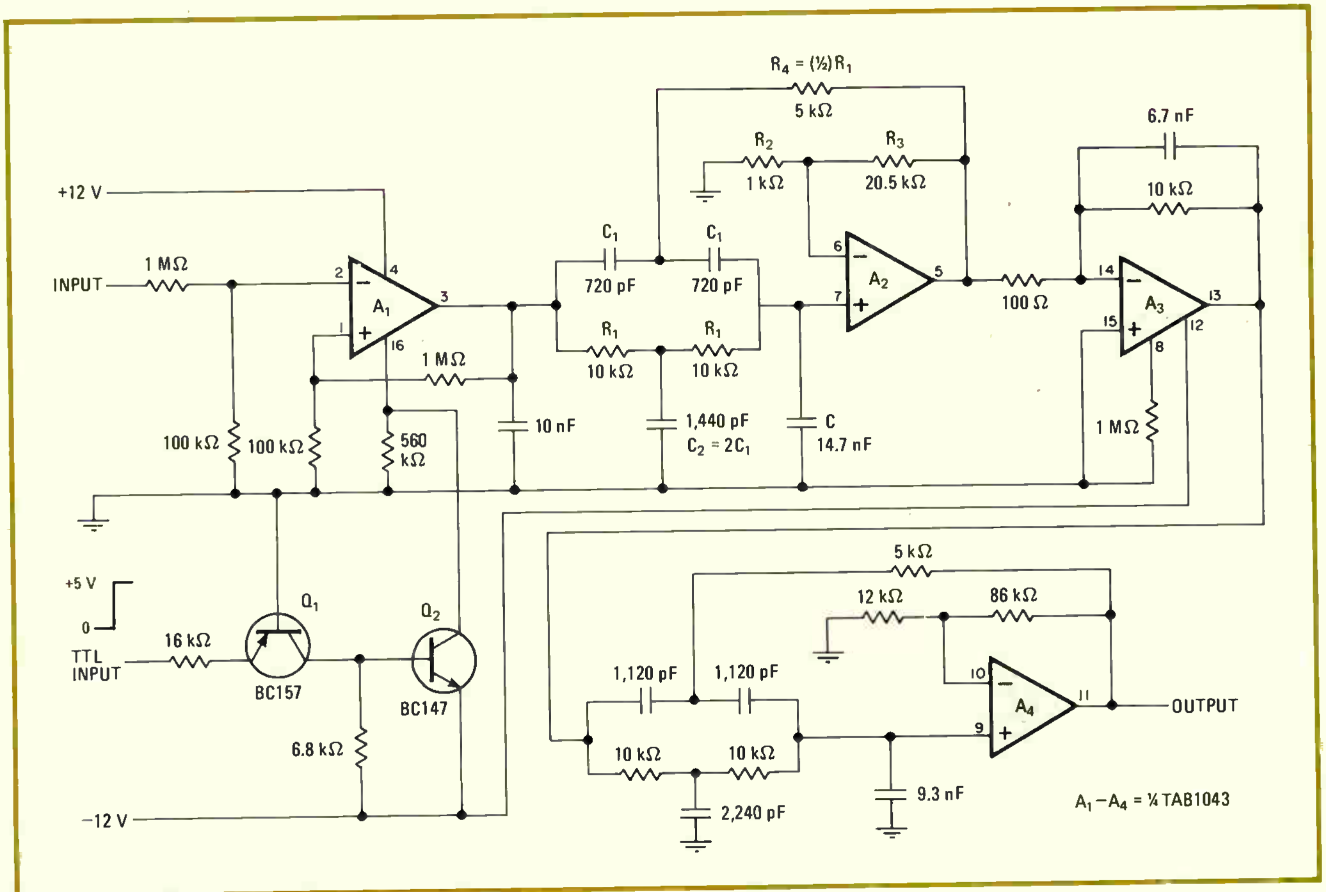
Transistors Q_1 and Q_2, and operational amplifier A_1 make up the sample-and-hold circuit shown. Its input is TTL-compatible. The low-ripple (<0.5 decibel), fifth-order elliptical filter that follows recovers the analog waveform. The passband insertion loss is less than 0.5 dB, and the circuit's stop-band attenuation is greater than 55 dB. A standard communications bandwidth of 3.4 kilohertz is achieved by using a sampling frequency of 8 kHz and a popular elliptical (Cauer) low-pass filter.

Op amps A_2 to A_4 depict the practical implementation of two twin-T networks and an integrator, which comprise the elliptical filter. The normalized transfer function of a single twin-T network is given by $F_1(s) = k_1(s^2+d)/(s^2+bs+a)$ where k_1, a, b, and d are constants that are related to the filter's component values by $d = 1/c_1^2$, $a = 1/c_1^2(1+2m)$, $b = 2(2+m-k)/c_1(1+2m)$, $m = c/c_1$, $k = (R_2+R_3)/R_2$, $k_1 = k/(1+2m)$, c and c_1 are normalized capacitances, and R_1 whose value is 10 kilohms is normalized to equal 1 ohm. Thus, the normalized transfer function of this entire filter is:

$$F(s) = \frac{-17.6(s^2+1/0.02)(s^2+1/0.06)}{(s^2+0.32s+1.27)(s^2+1.01s+0.83)(s+0.70)}$$

and it may be varied by appropriately selecting filter elements. Practical values of C_1 may be obtained from $C_1 = c_1/2\pi f_p R_1$, where f_p is the cutoff frequency.

The overall gain of the circuit is 17.6. The circuit's sample-and-hold will track a 5-volt input signal at 0.5 V/microsecond and hold the signal for up to 100 μs. □



Recovery. This simple circuit built with one operational-amplifier chip derives analog information from its 8-kHz digital-equivalent input. An elliptical filter employed to recover the waveform in a 3.4-kHz baseband uses two symmetrical twin-T networks and an integrator whose characteristics may be varied by selecting the appropriate filter elements. The unit costs around $5.

Board testing meets the challenges of ECL

ECL's negative voltages, terminator requirements, and design opportunities present special test problems in the production arena

by Joe Prang, *GenRad Inc., Concord, Mass.*

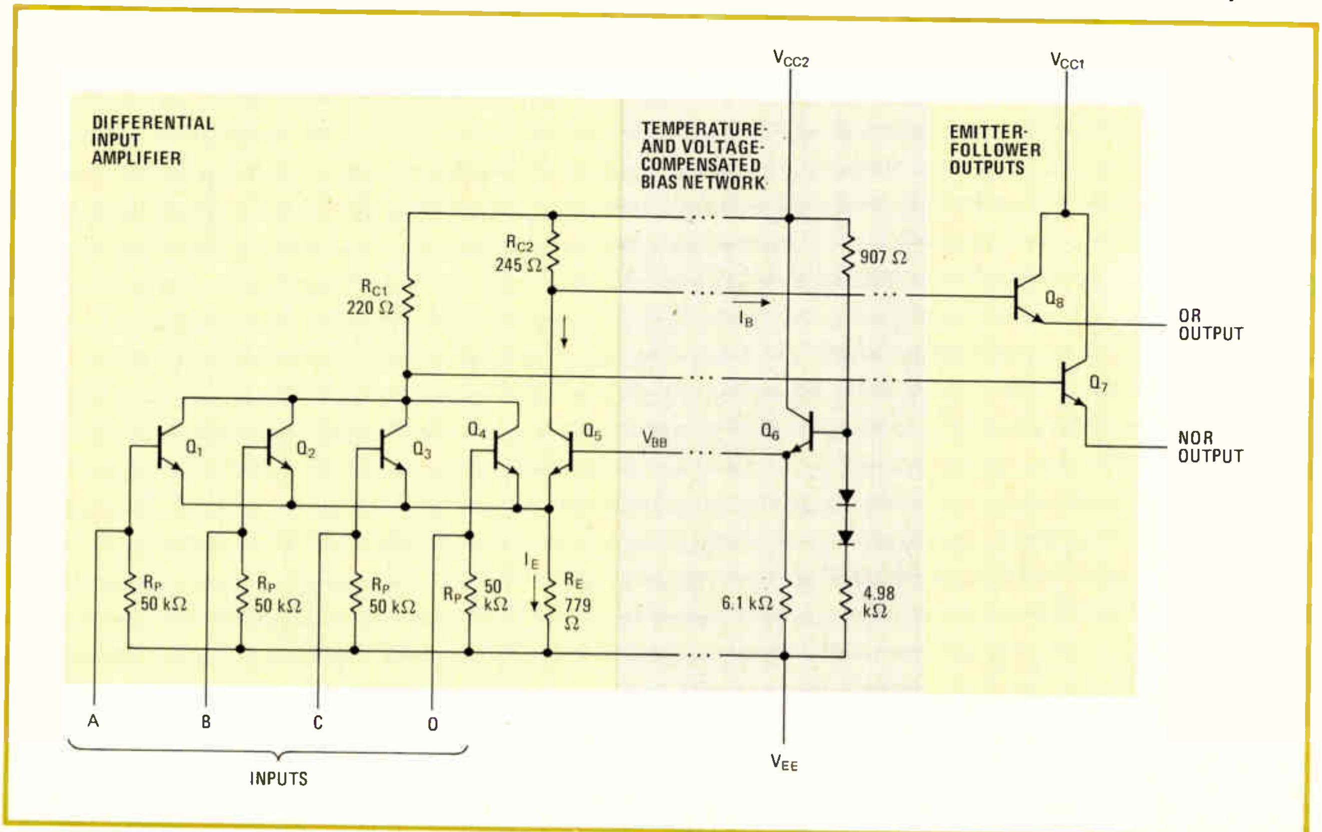
☐ Emitter-coupled logic is proving a boon to system designers who need faster digital signal processing than TTL can provide. But for test engineers and production managers, these high-speed bipolar circuits present a whole new set of board-test problems.

Some of the difficulties arise out of the characteristics of ECL itself. Because it relies on lower voltages and smaller voltage swings to transmit data at high speeds, the instrumentation used for testing ECL-based boards must be able to both source and sense different voltages more precisely than is the case for other types of logic.

Other problems are due to the fact that ECL both constrains and frees the designer in certain areas. On the one hand, its speed—to 200 megahertz in some instances—dictates use of transmission-line-quality terminators on signal paths so that data can be communicated without degradation. But then the resistive elements on such boards must be tested with greater accuracy than before.

On the other hand, ECL allows the designer to use wired-OR as well as complementary outputs. Thus the outputs of different components are often wired to the same node, with the result that each component must be activated or deactivated independently for faults to be diagnosed down to the component level.

Another freedom designers working with ECL have is the ability to use it in conjunction with TTL, letting ECL handle only those tasks demanding the highest speed and thus using less of this more costly logic. These mixed-logic designs require instrumentation that can, say, drive



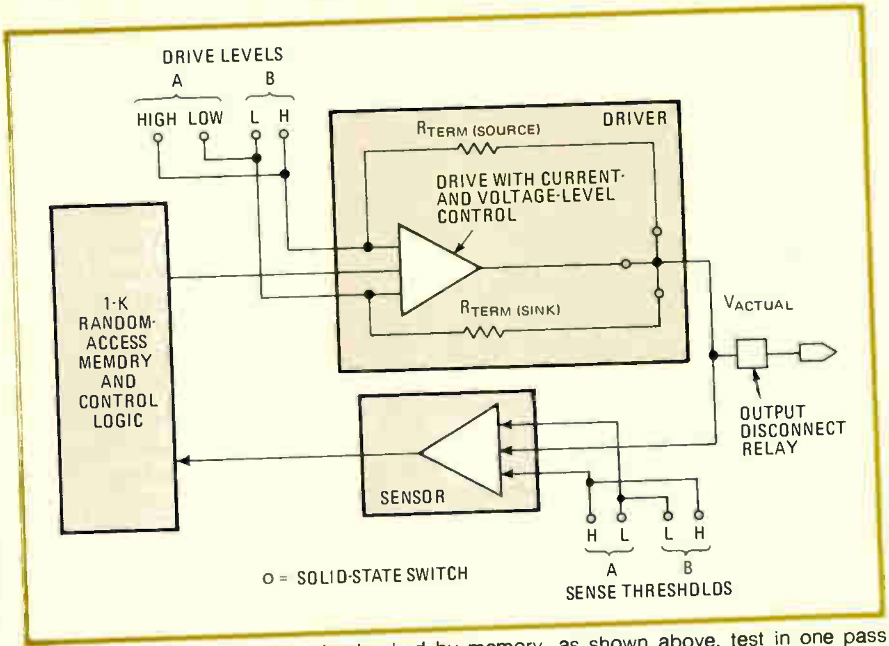
1. Challenger. The generic ECL part above shows some of the reasons this logic requires special testing. Its low collector resistances (R_{C1} and R_{C2}) make logic swings narrow and output currents significant. Outputs can be wire-ORed, making testing tougher.

circuits at one type of logic level and sense at another. Further, such instrumentation must be extremely flexible so that changes in design or boards of different designs can be accommodated without extensive and costly overhaul of the tester.

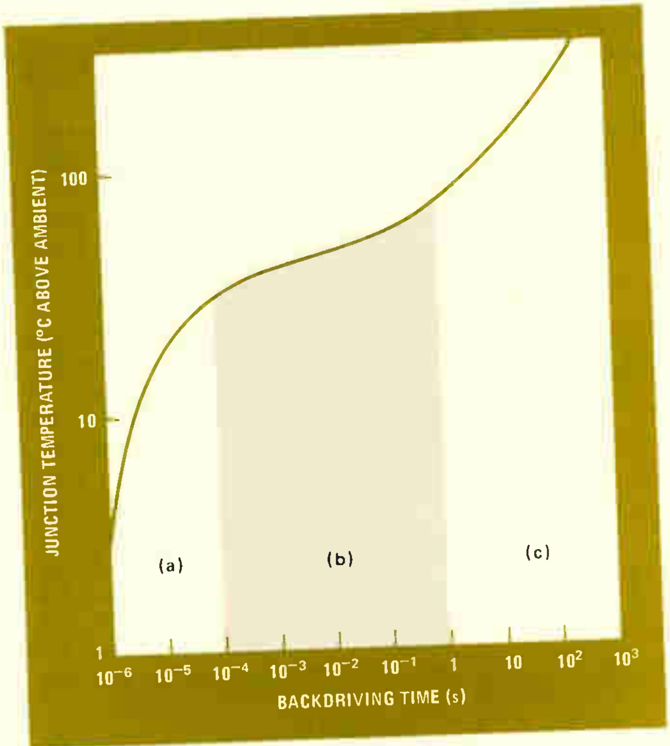
These observations derive from a comprehensive study of ECL and ECL designs that led to the creation of the 227X family of in-circuit test systems. In this family, the basic in-circuit approach has been expanded by improvements in both hardware and software in order to make ECL testing as straightforward as that of any other logic family.

To check the logical functioning of any individual component using an in-circuit approach, the test system must take command of the device's input so as to control the state of its output. This is done by sourcing or sinking enough current at the device's input to override the output of any device that may be driving it, a process that is usually referred to as back-driving.

To back-drive an ECL device like the one in Fig. 1 from a logic high (−0.8 volt) to a logic low (−1.69 V), the tester must sink an amount of current that is dependent on the value of the base-biasing resistor (R_{C1} or R_{C2} in Fig. 1), the output-transistor gain, and the base-emitter voltage drop of the output transistor. For typical values of 220 ohms, 20-, and −0.7 V, respectively, that current works out at 90 milliamperes using a saturated-transistor model. The actual value is lower—typically 67 mA—because the external circuit usually includes a terminating resistor that sinks about 23 mA from the node.



3. Smart pins. In the 227X, pins backed by memory, as shown above, test in one pass without having to hold a back-drive level while fetching instructions. The R_{TERM} resistors let devices be checked even if on-board terminators are missing.



2. Heat transfer. For ECL devices in dual in-line packages, temperature rises at the output transistor junction, as shown for a back-drive sink current. In (a) the sharp rise is due to dissipation at the junction alone, while in (b) heat spreads to the header, case and leads. When they can dissipate no more (c), the rise speeds up.

Though this current may not seem large, manufacturers' ratings for ECL devices make it significant. Typical ratings for surge, continuous, and normal output source currents are 100, 50, and 22 mA respectively. Thus, if a tester is sinking enough current to override a logic high, it must do so for a very short time so that the 67 mA falls into the area of the output surge current. Research data for ECL devices (Fig. 2) indicates that, if a test is executed in a subsecond time-frame, the junction temperature rise caused by back-driving does not exceed the manufacturer's specified limit of 125°C and thus there is no short- or long-term degradation of the integrated circuit. Actual experience with ECL testing over several years has confirmed this data.

Back-driving an ECL device from logic low to logic high requires the tester to source less current and does not subject the device to a high current. The sourcing current needed is determined by taking the difference between the reference voltage, 2 V, and the logic high level and dividing by the external terminator resistance, typically 47 Ω. Thus the tester need typically supply only 23 mA to override a logic low.

Sourcing is thus easier for the tester and does not require the ECL device to supply high currents. Moreover, while the 227X family can handle the currents needed in either back-drive situation, its special circuit-analysis software, trademarked INHIBITS, can determine how to set a preceding layer of logic so that the tester need only override logic lows.

The 227X's driver-sensor hardware (Fig. 3) is also designed to minimize test duration and protect against excessive back-drive currents. This is done by using dedicated memory behind each driver-sensor pair to minimize test duration. Testers without such memory must intersperse loading and execution, maintaining the state of devices while detecting faults and thus increasing back-drive time.

In addition, a parallel pin controller compares the actual with the expected logic states. Thus back-drive time is independent of the number of device inputs and outputs. If parallel sensing is not used in a tester, test sequences must be repeated for each output pin, or time must be taken to scan each sensor at each test step. In either case, test and back-drive time increases.

To control back-drive current at each driver pin, local feedback monitors unique to the 227X family are employed (Fig. 4a). The monitors automatically shut down the driver when a high back-drive current has been present for the maximum allowable time.

Accurate drive levels

Once a sufficient but controllable back-drive current is generated, control of the resultant logic voltage is important. The specified voltage ranges for ECL can have very small swings, as little as 370 millivolts in the worst case. Accurate drive levels to meet such stringent specifications are achieved in the in-circuit back-drive situation by providing local voltage-monitoring and compensation circuitry at each driver.

The circuitry in Fig. 4a has several key aspects to its design. The driver reference-voltage source, controlled by software in the user test program, is independent of the driver back-drive current supplies. (Independent back-drive sources ensure that the reference does not vary when the back-driving loads of the device under test change.) The feedback circuit compares the actual voltage at the driver output with the reference-voltage source. Each driver has its own monitor or compensation circuit to make adjustments on a driver-by-driver basis.

In a "rail" driver design (Fig. 4b), the back-drive–current supplies also serve as the reference voltage (V_{high} and V_{low}). Any change in loading can cause the supply (reference) to vary up and down; hence the driver output voltage is not stable. Monitoring the driver voltage at its output compensates for changes in the voltage level of the back-drive current supplies, as well as the voltage drop across transistors Q_H and Q_L.

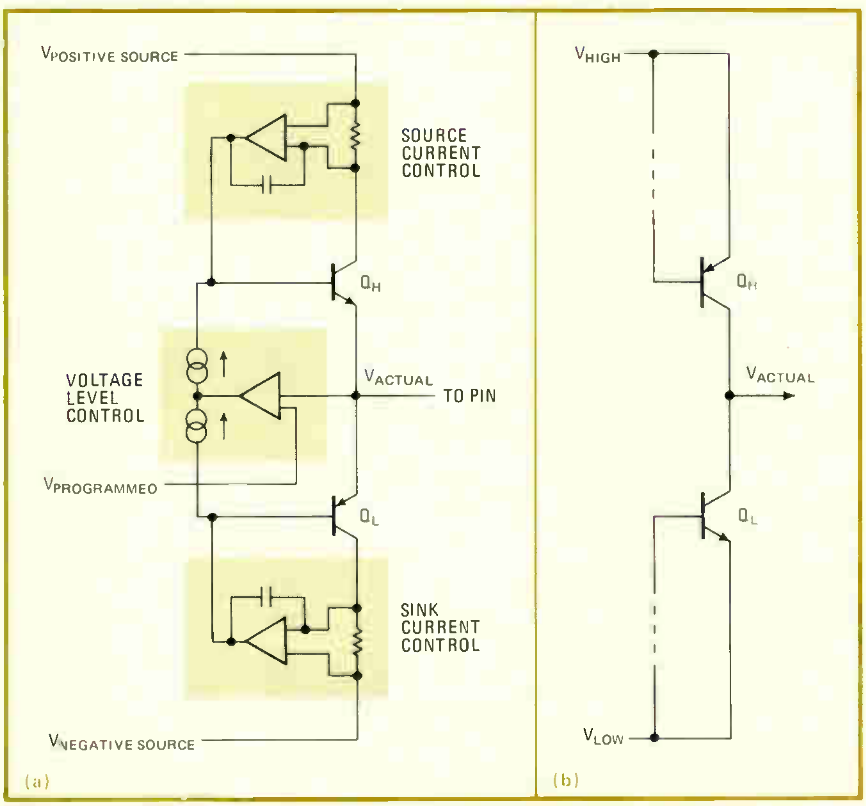
The rail driver can have voltage drops in the hundreds of millivolts across its output transistors, and these vary depending on loading. Maintaining a voltage in the specified range across all pins is difficult. The use of compensation at every 227X driver ensures that the effects of varying loads are handled directly at the individual driver without being propagated to other drivers. Isolating the operation of a driver is difficult in the rail design because noise is coupled by the back-drive supply from driver to driver.

To ensure that this accurate drive voltage is present when all outputs of the device under test are sensed, the sensor associated with each driver is strobed at each test step. Thus, when testing or debugging an ECL board, the system has direct access to both the outputs and inputs of the device being tested.

Achieving accurate drive and sense levels for ECL's negative logic voltages is not sufficient to thoroughly test a board that contains logic conversion to and from TTL. To stimulate and verify inputs at one logic level and sense outputs at another requires dual references for drivers and/or sensors.

Independent pin-level–programmable drive levels and sense thresholds for 227X testers are shown in Fig. 3. The drivers used to block feedback may be in a TTL area while the inputs of the device under test are in an ECL area. Thus, drivers to both positive and negative voltages may also be required simultaneously.

Maintaining a stable ground reference point for the device and tester also helps to create precise logic levels. As a comparison, TTL has a noise margin of approximately 1 V, whereas ECL has approximately only 0.5 V. Noise must be minimized because any fluctuations in the ground are directly coupled to the output. To counteract noise problems, ECL device designers often provide multiple



4. Controlled drive. The 227X family's driver (a) not only monitors current, but also uses a separate programmed voltage (the switched high or low voltage seen in Fig. 3) to control the pin voltage. Rail driver configurations (b) lack these dual controls.

IC ground pins so a high output load current can be provided while the ground is stable.

To minimize noise, the 227X testers provide logic levels programmable from +16 V to −8 V. This eliminates the need to float the printed-circuit board in order to produce negative voltages from a positive-voltage–only driver. Driver signals are routed to the bed-of-nails fixture in cables with parallel ground-return lines to minimize any coupling. Finally, the fixture itself includes a ground plate directly beneath the board under test. This plate helps minimize coupling and provides a low-impedance ground-return path.

Terminating ECL signal lines

Pull-up resistors on TTL bus lines provide a current return to a power supply to create the proper reference voltage. In ECL designs, however, termination resistors ensure proper impedance matching of the communications lines between devices. In addition, because of ECL's open-emitter outputs, the time constant formed by the load capacitance and the terminator resistor must be precisely correct to maintain a signal's transmission time. Thus, unlike TTL pull-ups, the wrong-value terminator slows down an ECL circuit at high frequencies and creates mismatches that cause reflections and ringing.

The method of termination is typically a series resistor to a −2-V reference, which reduces power dissipation more than would parallel resistors between, say, −5.2 V and ground, another ECL termination method. The value of the termination depends on the characteristic impedance of the communications path, with circuit-board etch being typically 100 Ω and cabling being 50 Ω.

The importance of the termination value means that tests that merely verify the presence or absence of a resistor are not accurate enough for ECL. Therefore, all 227X testers include true analog test instrumentation, with 14-bit accuracy available to each pin. A four-line matrix provides both access to source and measurement instruments and the use of extended guarding.

Extended guarding ensures that current cannot flow through parallel paths to the measurement node, and thus it isolates the terminator being tested from the effects of connected ICs and terminators.

A typical application of guarding is to a pair of parallel termination resistors between −5.2 V and ground. In this situation the parallel path is through the other resistor in the pair and any coupling capacitors or internal IC impedances between −5.2 V and ground. The use of guarding and precision instrumentation is often not available on high–pin-count testers, where analog test capability has been removed to allow more digital pins. In these designs the digital driver typically supplies the test source voltage. The inaccuracies of using a digital driver, due to the varying back-drive transistor voltage drops described previously, severely compromise the testing of the terminator.

Ensuring the presence of a terminator resistor when testing the digital IC connected to it is as important as testing for the correct value during the analog test. Terminators are typically located at the end of the signal path in good transmission design. Thus, in a multiboard system the ICs driving the outputs of a board may not have terminators on that board. Rather than force the user to customize each test fixture with switchable load resistors, the test system has internal termination resistors for each driver/sensor.

The resistors are used to terminate automatically all open-emitter outputs (perhaps every node on the board) as a protection against typical manufacturing faults like missing or misinserted terminators. Since these faults are unpredictable, the user of a system without internal terminators must either create program flow control to

The speed myth about ECL testing

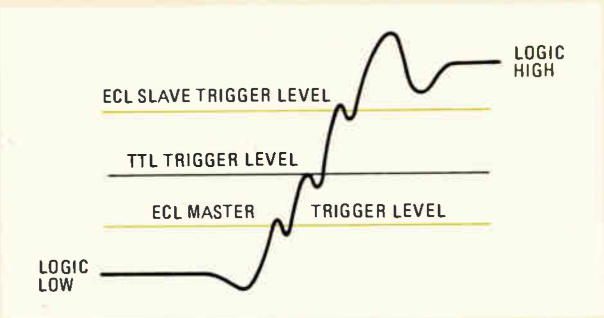
A widespread misconception about emitter-coupled-logic board testing is that the test system must be able to check the devices at their rated speed.

At-speed testing is really needed only for two reasons: to check a device's parameters and to test a device whose functionality is speed-dependent.

In-circuit testing of logic devices is intended to check functionality, not ac and dc parameters. The most cost-effective way to ensure parametric compliance is to check the individual devices at incoming inspection or perhaps to have them checked by an independent semiconductor testing house. Handling devices during board assembly will not change these parameters.

Unlike many MOS and TTL devices, ECL devices do not have minimum operating speed requirements. Dynamic n-channel MOS random-access memories, for example, have a minimum keep-alive rate—the frequency with which charge that has leaked off bit-storing capacitors must be replenished, or refreshed. Since ECL devices store bits in cross-coupled transistor flip-flops which will not change with time, they are fully static, and as such, they do not have keep-alive rates as many MOS devices do.

TTL devices can be subject to double-triggering—switching twice for a single logic transition. The phenomenon occurs because real digital waveforms are often not ideal and because TTL devices trigger at a single level, as indicated below. ECL devices operate internally in a master-slave mode—transitions must first be latched by a master before they can be transferred to the slave that controls the device output—and the master and slave have different trigger levels. The separation between levels makes double-triggering of ECL virtually impossible.



SOFTWARE MODEL FOR A 10102 DEVICE

Listing	Comment
.HEAD; .SIZE 16; .INPUT (4 6 10 12=A, 5 7 11 13=B); .OPENE (2 3 14 15=NX, 0 0 0 9=X); .DL (4, 5, 6, 7, 10, 11, 12, 13); .END HEAD;	description of pin functions
.DISAB (X) IL (A, B); .HOLD (A, B); .END DISAB; .DISAB (NX); PH1 (A, B,); .HOLD (A, B); .END DISAB;	output disable
.INH (X, NX); PH1 (A, B,); .HOLD (A, B); .END INH;	input inhibit
.HFORCE (NX); IL (A, B); .END HFORCE; .HFORCE (X); IH (A); .END HFORCE; .HFORCE (X); IH (B); .END HFORCE;	beyond-the-node bus diagnostic (Busbust)
.MAIN; SSP (X, NX); IC (A, B) OS (X,NX) OH (NX) OL (X); IH (A) OL (NX) OH (X); IH (B) IL (A); IH (A); SPN (X, NX); ID (A, B) OI (X, NX); .END MAIN;	truth-table test

skip all ICs that missing terminators make untestable or replace and retest misdiagnosed ICs.

Much has been said about the problems of automatically generating tests for bus-structured TTL circuit boards. ECL boards compound this problem several times because every output can be wire-ORed with others. Thus automatic test generation (ATG) must:

- Identify the presence of the bus node (that is, a node driven by two or more outputs) and which are the devices that drive it.
- Determine how each device can be disabled from driving the bus.
- Generate an all-devices–disabled, go/no-go bus test before individual devices are tested.
- Perform beyond-the-node diagnostics should the go/no-go test fail.

To achieve all this, the 227X ATG process adds two unique tools to the basic techniques of generating in-circuit tests. First, ATG software analyzes the circuitry that surrounds the device under test, in addition to simply matching models with devices. Second, the models for devices provide more information than just the appropriate truth-table test. The analysis of the surrounding circuits, described in the user's topology description file, identifies what components are connected to the device under test. Pin functionality descriptions in the models help distinguish what devices in addition to the test one are driving an output node.

The model 10102 ECL device is described in the tester model seen at left. In the program, the Head section describes pins as INPUT, OPENE, and so on, to allow the ATG process to identify where devices with multiple open-emitter (OPENE) outputs are wired-ORed to form a bus. Once the bus has been identified as present, disable procedures called DISAB are extracted from the models for all devices driving the bus. By putting these procedures together, ATG automatically creates a go/no-go test for the bus that ensures that no contention exists. Should this test be passed, then individual devices on the bus can be tested with the assurance that detected failures are due to some defect in them and not others. The disable function is also needed in these individual device tests to guarantee that only the test device is communicating with the bus.

Should a go/no-go bus test fail, individual devices on the bus cannot be tested in an isolated manner due to the contention problem. To ensure that component-level diagnostics are maintained without operator intervention, ATG automatically creates test procedure BUSBUST to handle these "beyond-the-node" diagnostics. Once again, information is extracted from the models—HFORCE and LFORCE—to identify the contribution of each device to parametric measurements being made at the bus node. The faulty device(s) can thus be isolated from the good ones driving the bus.

Completing isolation

Controlled back-driving and automatic bus disabling are two ways the 227X extends the basic in-circuit technique to ensure test isolation of components that drive the device under test or share a common bus with it. A third and equally important effect occurs because the circuit board is powered and stimuli are applied to various nodes during tests, which can create feedback.

Feedback paths in the board design may affect the static state of the devices driving the test one. Glitches and instability result, causing an intermittent test of an IC. The best solution is to prevent changes in the state of the logic driving the device under test.

Circuit analysis and the model for each device can once again be combined to solve this problem. In this case, the analysis attempts to locate what drives the device. This function, trademarked INHIBITs, can use the pin functionality data in a model to determine which devices with an output type of pin share a node with an input-type pin on the device being tested. The actual procedure (.INH in the model) is extracted from the model and included in the truth-table test for the device being tested. The inhibit function prevents any change in the output state for a change at either input due to feedback, noise, and so on, by choosing from the truth table the output state least sensitive to a change on the input pins. Thus, the node where back-driving is taking place is protected. In a similar way, INHIBITs can set the logic states for low-current back-driving. □

Custom video control delivers advanced font graphics

Video subsystem in multifunction work station adapts to user's design needs with add-on options, software-modifiable fonts

by Mike Ramsay and Theodore A. Shaffer, *Convergent Technologies, Santa Clara, Calif.*

☐ The most important person-to-computer interaction in an information system is through the terminal. The computer's face to the world is usually a video display and, in designing a system, the display screen, the video logic behind it, and the display-driving software should be given special attention. This was done in the design of the video subsystem for the Convergent Technologies' Integrated Work Station (IWS). The result is an innovative video-display system that is easy to look at, simple to understand, and comfortable to work with. It can also be easily adapted by a system builder to specific applications.

The IWS has a custom-designed character-oriented display; but with its high-performance row-buffer architecture and available add-on extensions, it achieves some capabilities of bit-map displays—graphics; double-width, double-height, and boldface characters; and subscripts and superscripts—while preserving the speed and display dynamics of character displays.

The display system has a character font that can be modified by software, so changes are quick and easy. An interactive font-design program is provided (see "An interactive font designer," p. 154) so that system builders can design their own character fonts.

Ergonomic (human engineering) issues played a strong role in the overall system design because users of the IWS are expected to spend large amounts of time—possibly most of their working day—in front of the display. Thus, physical features such as high resolution, highly legible characters, an antiglare screen, and a tilt-and-swivel display are included. Also, the ergonomics of the system's software proved equally as important.

The IWS multifunction work station, which has the capability of a small minicomputer, uses the Intel 8086 microprocessor, high-density random-access memory, and the custom-designed video display packaged in three units—central processing unit, display, and keyboard—for a compact desk top configuration (above). Systems can be configured either as single-user, display-based minicomputers with up to 1 megabyte of RAM and 60 megabytes of Winchester-drive disk storage, or a cluster of up to 16 work stations that share mass-storage resources. In the cluster configuration, all the work stations remain computers with their own operating systems, making possible fast response when running user application programs.

In order to produce high-quality characters and graphics, custom video logic was designed with speeds that exceeded those of commercially available large-scale integrated video chips. The system was also designed to give the system builder flexibility in tailoring the display's features for specific applications.

Another requirement determined from prospective users was the option of either 80 or 132 characters per row. A wider row is required for previewing line-printer output in traditional data-processing applications and displaying 12-month tables in financial modeling.

Character density on the display also proved crucial to the design. With too few characters, not enough information is available at a single glance; with too many characters, legibility will be poor. On the 15-inch screen that was chosen, a good compromise between high density and legibility was achieved with 34 lines of characters.

The size of each character cell was established at 10 dots wide by 15 scan lines high. With 34 information-character lines and one retrace character line, the total number of scan lines is 35 × 15, or 525—the same as the RS-170 standard for TV scanning, except the IWS display is refreshed at 60 hertz noninterlaced instead of the standard 30 Hz interlaced, making the display flicker-free. Still, the IWS can be interfaced with RS-170–compatible projectors, monitors, and video printers.

With these design criteria, the video display capabilities achieved can be summarized as follows:

- Thirty-four lines of 80 or 132 characters a line.
- A character generator, called a font RAM, for storing up to 256 user-defined characters and graphics.
- Four standard character attributes usable in all 16

possible combinations of underline, reverse video, half-bright, and blink functions.

- Facilities for adding double-height, double-width, boldface, subscript, and superscript capabilities to the display's character attributes.
- A 10-by-15-dot character cell.
- Separate whole-screen attributes: characters per row, reverse video, half-bright, and blank.
- Expandability of the font RAM to 512 characters.
- Provisions for including line attributes.

These capabilities are implemented in the video subsystem, which consists of a 10-by-12-in. logic board in the CPU card cage, the display, and an interconnecting cable up to 12 feet long.

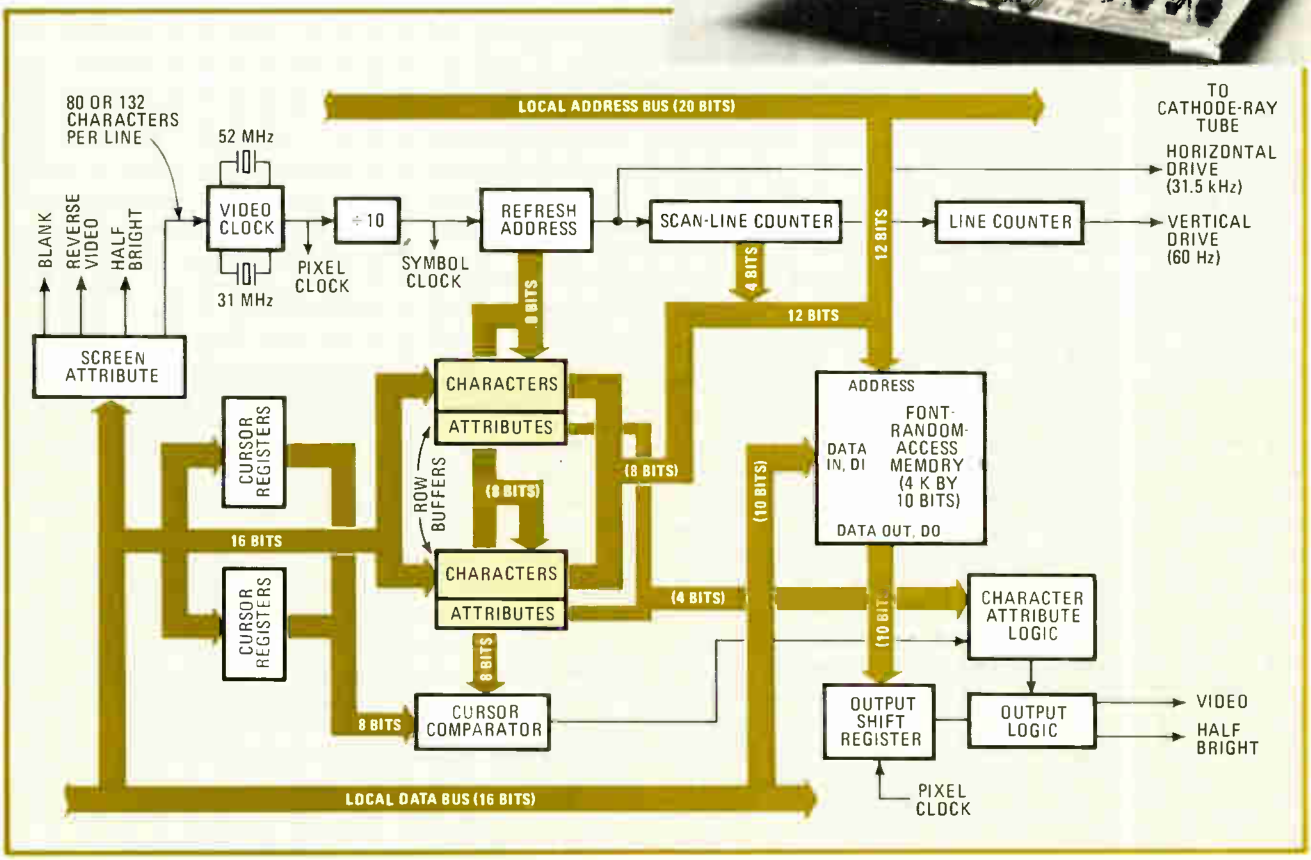
The implementation of row buffer architecture to achieve the performance required became a technical challenge, although the architecture itself is not unique. Figure 1 includes a block diagram of the video control board. The row buffers are made of high-speed bipolar RAMs. They can contain up to 256 8-bit character codes and 4-bit attribute codes, though only 132 are used. The attribute codes go to the character-attribute logic. The character codes pick up 4 bits of scan-line address, representing each of the 15 scan lines of the character cell on their way to the font RAM, where they form a 12-bit address. The font RAM, implemented in 10 4-K-by-1-bit static H-MOS (high-speed MOS) chips, contains 15 10-bit data words for each of the 256 characters represented by the 8-bit code from the row buffers.

All 150 locations of the character cell are user-definable and can be loaded from the system memory over the local data bus through a direct-memory-address transfer. DMA is also used to transfer character and attribute data from system memory into the pair of high-speed RAM row buffers. While one is being loaded, the other is being read for refreshing the screen.

The DMA transfers consist of short, three-word blocks. After each block is transferred, the local data bus is available to the CPU or other DMA channels. A succession of three-word transfers is required for each character row. The time during which the video control occupies the bus depends on the number of lines displayed and the number of characters per line. In the worst case, it holds the bus approximately 20% of the time.

The data out of the font RAM is first loaded into a 10-bit emitter-coupled-logic output shift register and then serially shifted out through the output logic and becomes the data stream to the display. The 4-bit character-attribute codes are decoded in the character-attribute logic, and then used to modify the output video

1. Block and board. The large board is the basic video control board for the integrated work station. Riding on top is the advanced features option board. The block diagram of the main video control board in the work station shows the dual row-buffer architecture with the font RAM implemented in high-speed semiconductor memory to provide a high-performance character-oriented display.



stream going through the output logic. Cursor registers are provided with each row buffer. These are loaded at the beginning of each character row and specify the cursor position, if any, for that row. The video clock, output shift register, and output logic are all implemented using Motorola's Inc.'s 10000 series logic.

Frosting on the cake

The capabilities of the basic video subsystem can be extended with an add-on expansion board. Word- and document-processing are areas in which the functional capabilities of the work station and enhanced video capabilities can be well-utilized. A study of the functional requirements of these areas indicated the need for several desirable add-on features.

First, the character attributes are expanded from four to ten to add superscripts and subscripts with controllable offset, boldface characters, double underline for accounting, and cursor selection on a character-by-character basis. Line attributes are added for double-height and double-width characters. Two other extensions are a 10-by-15-dot matrix cell for a user-definable cursor character and expansion of the font RAM to 512 characters for quick alternation of character sets.

These features are implemented through character manipulation rather than with specialized character sets. Thus the 512-character set is maintained independent of the attributes invoked.

The hardware implementation consists of a second printed-circuit board called the advanced video control board mounted on top of the video control board. Two 40-pin connectors join the two boards. All the additional features, except the font RAM expansion, are implemented on a single add-on board. An additional add-on board is dedicated to the 256-character expansion of the font RAM. Thus the option permits either attribute or font expansion.

Expansions of the character attributes—superscripts, subscripts, offset, double underline, cursor-select, and boldface—are accomplished with attribute-mapping executed in what is called a style RAM that is mounted on the add-on board on top of the main video control board. This RAM has as its address the 4-bit character attribute codes from the row buffers.

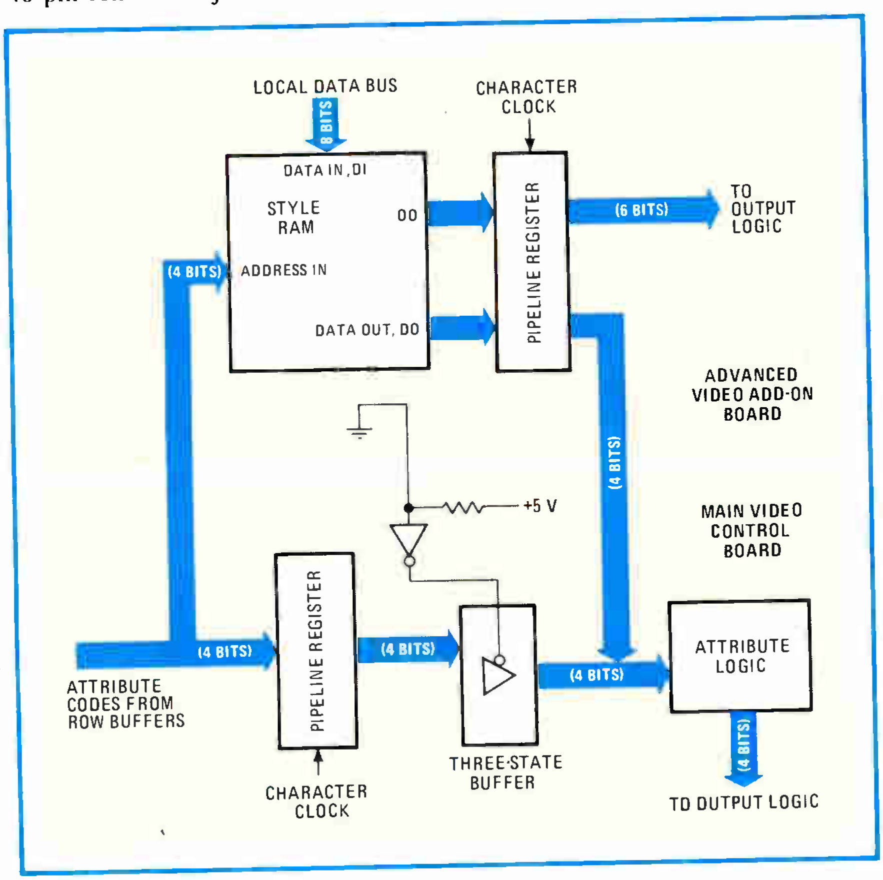
Data can be loaded into the style RAM with a DMA transfer from system memory. Data coming out of the RAM consists of a single bit for each of the 10 implemented attributes—the six new ones enumerated above and the four standard ones.

For a given loading of the style RAM, up to 16 combinations of the 10 attributes can be invoked. Figure 2 shows the style RAM on the add-on board and how the attribute codes are rerouted to the address input of the style RAM. Data out of the RAM corresponding to the four standard attributes is passed back to the main video control board for decoding in the attribute logic. The six additional attributes are processed on the add-on board and then are routed to the output logic on the main video control board.

Character attributes for superscript or subscript are displayed by causing the characters to be offset higher or lower within the character cell. The amount of offset is determined by the offset attribute. For superscript and subscript with no offset, the character is moved by two scan lines in the desired direction. With the offset set, the character is moved by four scan lines, and two scan lines are removed from within the character cell, truncating the character height. The font is reduced in this manner in order to retain maximum character legibility.

The relative position of the character within the cell is determined by the scan-line counter-address input to the font RAM. Usually, this counter addresses the low-order 4 bits of the font RAM in the range 1 to 15, corresponding to the 15 scan lines in each character cell. By altering this addressing sequence, character offset is achieved.

For double-height characters (a line attribute), the scan-line count is simply incremented every other scan line. The point at which the row buffers are transferred is delayed by



2. Add-on. A style RAM and pipeline register on the advanced video add-on board add six character attributes. These, plus other circuitry on the add-on board, create a video controller that gives the display features similar to that of bit-map displays.

An interactive font designer

The Convergent Technologies font designer is a software product that is used interactively to design character sets. Whereas most computer systems have what are termed hard read-only-memory–based character sets, the 256 characters in this system are called soft because they can be modified using software. A standard character set is supplied, but a user can develop a customized character set to replace it or define multiple character sets that can be called up dynamically by application programs.

The font designer screen, as shown in the figure, is divided into six windows, called frames—the scaled-character frame, the character frame, the character-code frame, the work-area frame, the sample-text frame, and the sample-text character-code frame.

While the character frame displays the character being edited in true size, the scaled-character frame above it displays a greatly enlarged version that is easier to work with. The character-code frame contains the two-digit hexadecimal code of the character being edited.

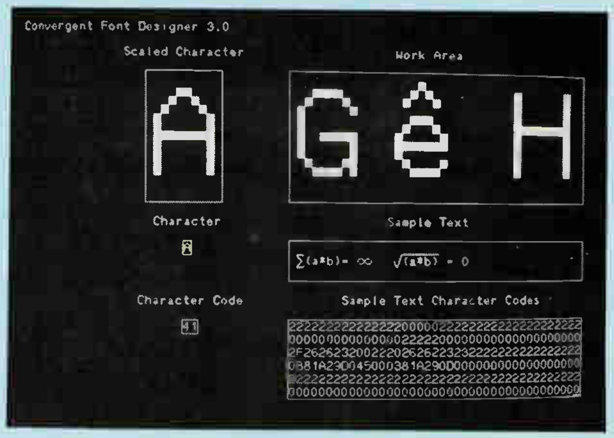
To modify a character, the user either types the character into the character frame or types the hexadecimal code into the character-code frame. At this point, the enlargement appears in the scaled-character frame. Each cell in the scaled character frame represents one pixel in the 10-by-15-dot matrix of the character. Editing consists of positioning the cursor at individual cells, which are turned on or off with function keys on the keyboard. As the pixels are modified in the scaled-character frame, the character frame is concurrently updated to reflect those changes. More advanced editing features allow blocks of pixels to be turned off or on or moved from one area to another.

Characters can be edited in the work-area frame as well. The advantage of this frame is its 40-pixel (4-character) width, which can be used to draw multicell symbols or to examine the relationships between characters when they are adjacent. Blocks of pixels can be moved or copied back and forth between the scaled character frame and the work-area frame.

The sample-text frame displays three rows of 40 actual-size character cells each so that a representative sample portion of the font currently being worked on is also visible. As the user types into this frame, characters are displayed as they appear in this font.

Characters may also be entered into the sample-text character-code frame in the form of hexadecimal codes vertically arranged. As the codes are typed into this frame, the characters, in the current-font, are displayed in the corresponding position in the sample-text frame.

Several input and output commands are available to merge fonts. The read-font command is used to read part or all of a font file into the current-font memory. The write-font command does the opposite—writing from the current-font memory into a file. The read-text command reads from an ASCII-coded file into the sample-text frame for judging different fonts using the same sample text.



the appropriate amount. Superscript and subscript in conjunction with double-height characters result in the display of single-height characters offset to either the top or bottom half of the double height row.

The implementation of these line and character attributes is also accomplished with circuitry on the advanced video add-on board. An alternate line counter is synchronized to the main video control board counter. Output from this alternate line counter, in conjunction with the appropriate character and line attributes, address a programmable ROM. The output from the PROM is passed back to the main video control board to become the low-order address bit to the font RAM. The PROM is programmed to do the scan-line manipulations needed.

Double-width characters are implemented by loading every other character from the row buffer into the output shift register on the main video control board and clocking the register at half the normal rate. Thus every other character in the row buffer is displayed.

Boldface characters are generated by stretching every illuminated dot in the character cell to two dots in the horizontal direction. All vertical lines thus become wider. A single OR gate is required on the add-on board which, when selected by the bold-enable line from the style RAM, gates the serial video stream with a 1-bit delayed version of itself.

User definition of cursor shape is accomplished through the use of a dedicated 10-by-15-bit RAM on the add-on board. This RAM is loaded by a DMA across the local data bus and contains the bit pattern for the user-defined cursor character. The RAM is addressed from the scan-line counter. The 10-bit output is loaded into a shift register and then output serially and exclusive-ORed with the main video stream. The standard cursor is disabled but the 2-Hz blink rate is superimposed on the new cursor in the output logic.

An additional 256 characters are added to the font RAM by parallel connection of another 256-character RAM. Each chip has three-state outputs and can be selectively enabled. This is accomplished by dedicating an additional style RAM output to character set selection. Thus, either font can be selected on a character-by-character basis. Either font RAM is loaded and read with a DMA transfer across the local data bus. The character set selection for loading is made by a dedicated bit in the screen attribute register. □

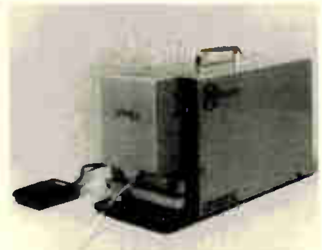
INTERCONNECTION CITY NEWS

NEW Flat cable notcher and multiple terminator, hand press or optional power press.

Circle 146 on reader service card

NEW, in line "JAGUAR" IDC series of mass termination .100" and .156" center connectors for wire-to-board discrete wire or ribbon cable applications.

Circle 147 on reader service card



NEW Model JT-1 semi-automatic self indexing all electric I.D.C. Terminator.

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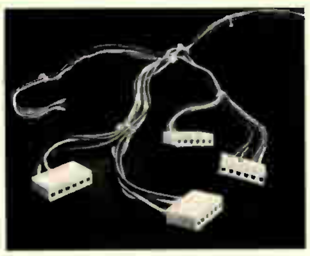

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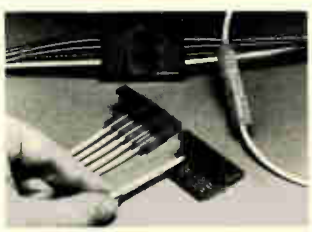
NEW Simple pliers for field terminating Series 2300 power connector.

Circle 151 on reader service card



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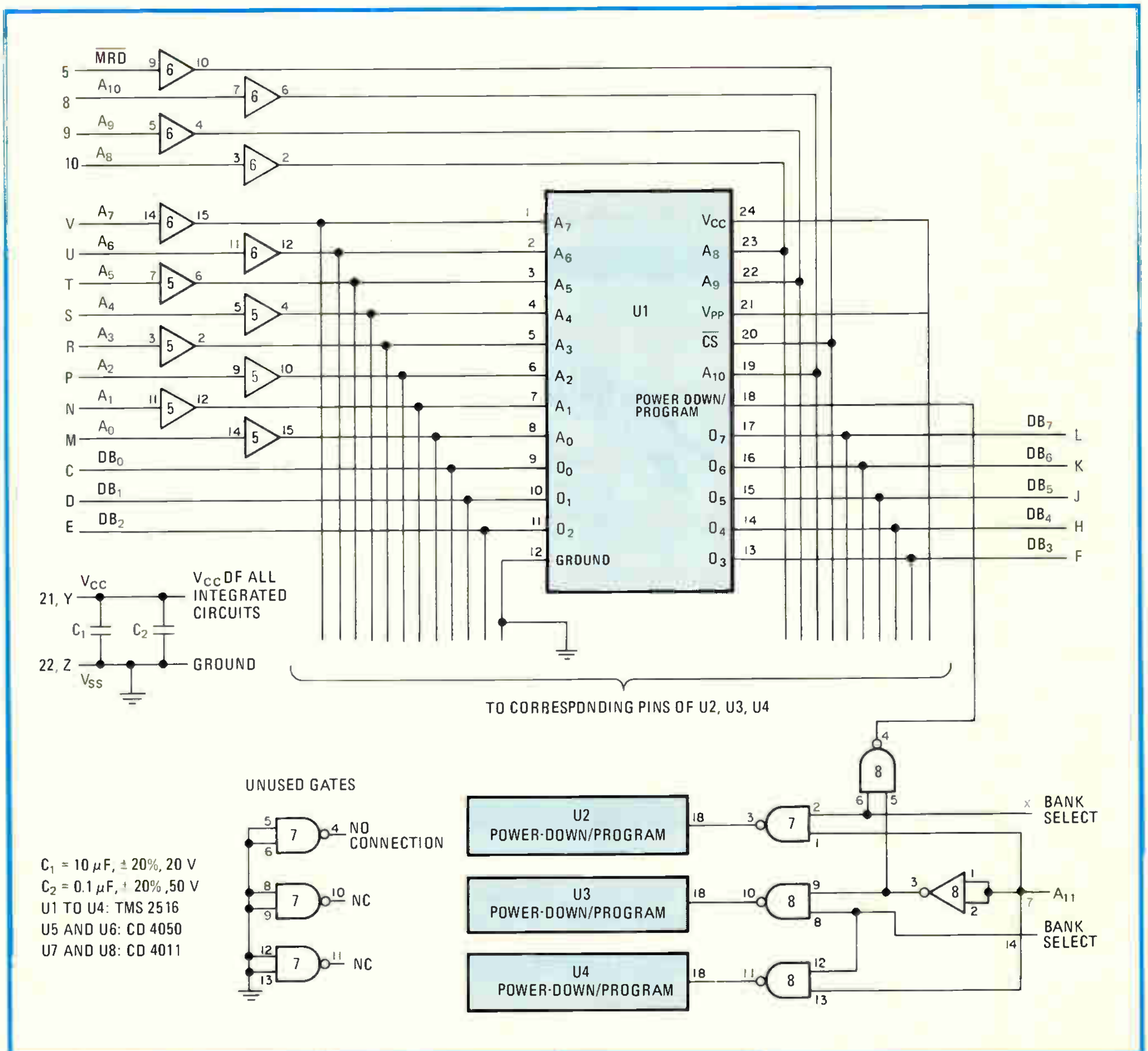
Program pinch calls editor and assembler at random

by P. R. Ramraj
ISRO Satellite Centre, Bangalore, India

As software is developed, it usually needs to be able to call quickly on its editor and assembler from paper tape, magnetic tape, a floppy disk, or a semiconductor memory. This program pinch transfers editor or assembler programs at random from erasable programmable read-only to random-access memory.

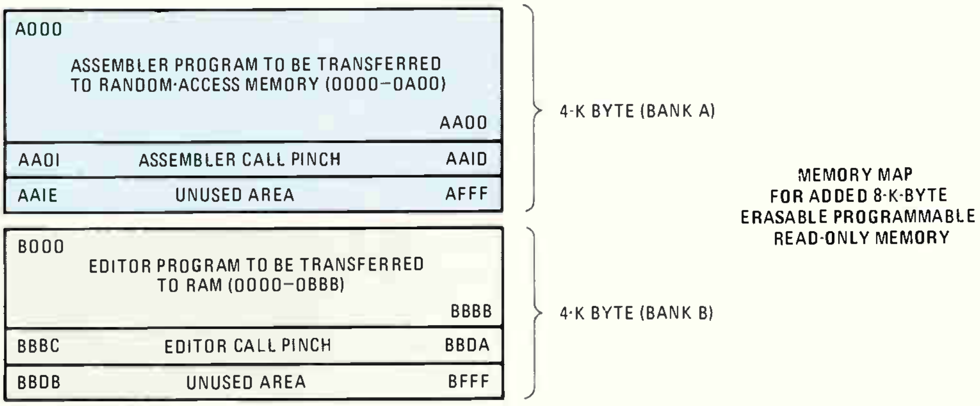
The RCA Cosmac development system (CDS-II) has a resident editor and assembler (level-I) on paper tape.



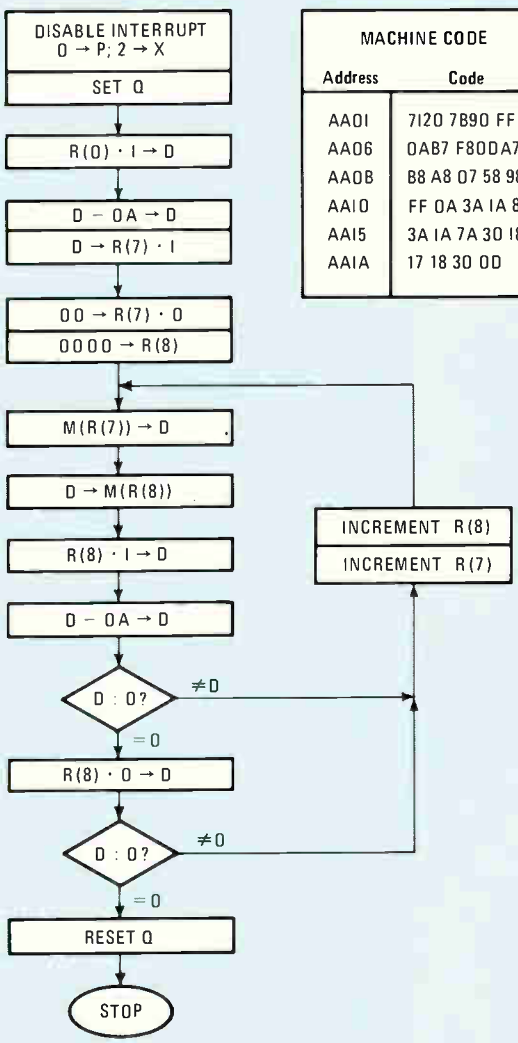
No.	FROM		TO		Remarks
	Module-slot No.	Pin No.	Module-slot No.	Pin No.	
1	Memory module-slot No. 5	X	Address latch and decoder/ slot No. 10	5	Bank A for 4-K-byte erasable programmable read-only memory
2	Memory module-slot No. 5	14	Address latch and decoder/ slot No. 10	4	Bank B for 4-K-byte E-PROM

Memory bank. CDS-II provides unused space for memory banks (slot 1 to 7). Slot 5 is selected to accommodate an 8-K-byte E-PROM card that will hold the assembler and editor. Banks A and B, which are allotted for an assembler and editor, each have a 4-K-byte E-PROM, and a program pinch is appended with each of them.

PROGRAM PINCH: MEMORY MAP, FLOW CHART, AND MACHINE CODE



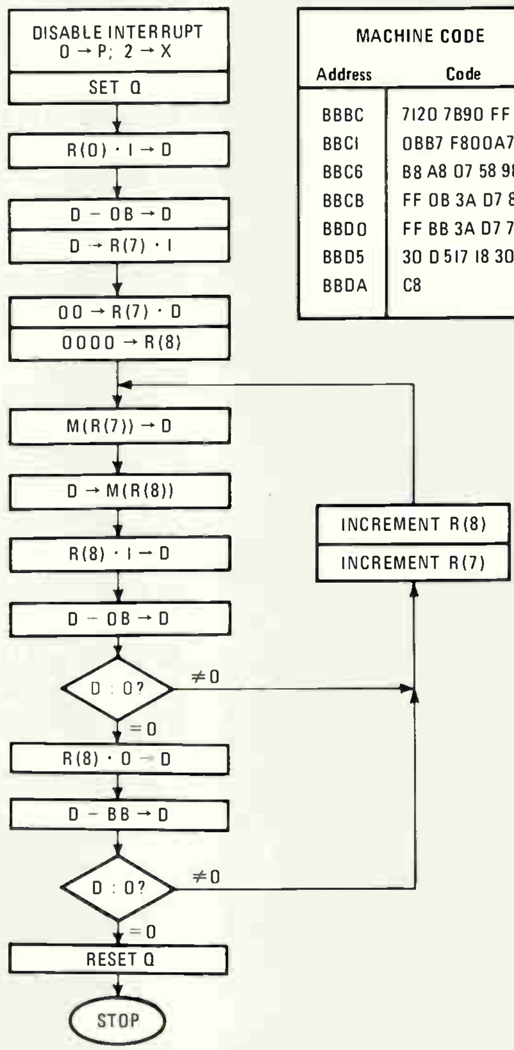
FLOW CHART FOR ASSEMBLER CALL PINCH



MACHINE CODE

Address	Code
AA01	7120 7B90 FF
AA06	0AB7 F80DA7
AA0B	B8 A8 07 58 98
AA10	FF 0A 3A 1A 88
AA15	3A 1A 7A 30 18
AA1A	17 18 30 0D

FLOW CHART FOR EDITOR CALL PINCH

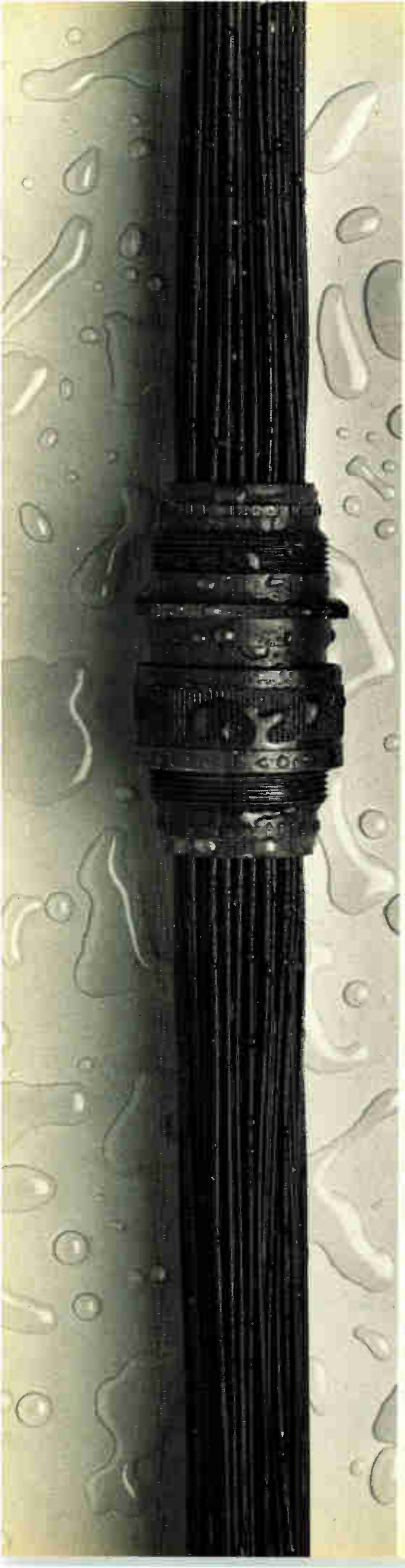


MACHINE CODE

Address	Code
BBBC	7120 7B90 FF
BBC1	0BB7 F800A7
BBC6	B8 A8 07 58 98
BBCB	FF 0B 3A D7 88
BBD0	FF BB 3A D7 7A
BBD5	30 D 517 18 30
BBDA	C8

During program development, the UT20 command temporarily transfers the editor (3,004 bytes) and the assembler (2,561 bytes) to a RAM, beginning at the 0000 location. The calling time for the program is about 3 minutes and tends to increase if the user wishes to switch from assembler to editor or vice versa.

The flow chart, memory map, and machine code for the program pinch presented in the table are designed to aid the CDS-II software development. Banks A and B are allotted for an assembler and editor in ROM respec-



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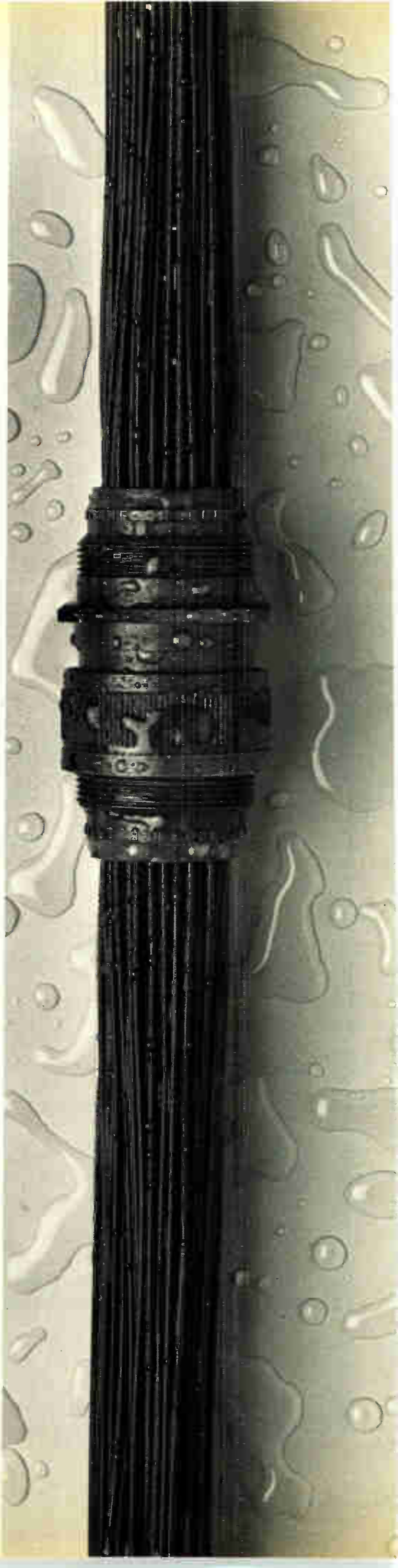

tively, and the appropriate program pinch is applied to each of them.

The added 8-K-byte E-PROM card hardware and modifications are shown in the figure. AA01 and BBBC are the starting locations for the assembler call pinch and editor call pinch. The assembler and editor programs are transferred to RAM using locations 0000 through 0A00 and 0000 through 0BBB.

Both programs test RAM availability by starting from 8000 and decrementing down with successive write-read operations. Initiating a program pinch using command UT20 and specifying the starting location automatically sets the data pointer to the respective program to be transferred to 0000, after disabling the interrupt.

A Q flip-flop is set to give an indication of transfer (on the control/display panel) and then, once the transfer is over, reset, so that the user can proceed with program development. The length of the program pinch is less than 32 bytes, and the call for any software aid hardly takes 0.2 second at the clock rate of megahertz. ☐

Computer notes

Pocket computer scales computer-generated plots

by Cass R. Lewart
System Development Corp., Eatontown, N. J.

Every good plotting program should be able to calculate scales for the X, Y, or Z axes automatically because users cannot always anticipate the scales they will need for computer-generated plots. Linear scale values for such plots may be generated with this program, written in Basic for the Radio Shack pocket computer, given the minimum and maximum values of a variable's range. In addition, it may easily be modified for other Basic computers or translated into other languages.

The scale values are integer multiples of the interval value, which is a product of an integer power of 10 and 1, 2, or 5. Therefore, values like −0.5, 0.0, 0.5, 1.0 . . . , 1.24, 1.26, 1.28 . . . , and 100, 200, 300 . . . are allowed, but not −1, 4, 9 . . . , 1.2, 1.31, 1.42 . . . , and 0, 4, 8 . . . . Given the minimum (MIN) and maximum (MAX) values of the array to be plotted and the approximate number of scale intervals (N), the program computes four parameters: a new minimum (MINP), a new maximum (MAXP), the interval size (DIST), and the number of scale intervals (NP) that best fit the plot. These parameters satisfy the following:

SCALE-VALUES PROGRAM FOR COMPUTER-GENERATED PLOTS

```
  5 "Z" PAUSE "SCALE BY C.R. LEWART"
 10 INPUT "MIN? "; X
 15 INPUT "MAX? "; Y
 20 INPUT "# INTERVALS? "; N
 25 IF (X < Y) * (N > O) GOTO35
 30 BEEP 2: GOTO10
 35 D = (Y − X) / N: J = D / 10 ^ 7: E = INT LOG D
 40 F = D / 10 ^ E:  V = 10
 45 IF F < √50 LET V = 5
 50 IF F < √10 LET V = 2
 55 IF F < √2  LET V = 1
 60 C = V * 10 ^ E:  G = INT (X/C)
 65 IF (ABS  (G + 1 − X/C) < J) LET G = G + 1
 70 H = INT (Y/C) + 1
 75 IF (ABS (Y/C + 1 − H) < J) LET H = H − 1
 80 BEEP 1
 85 PRINT "NEW MIN =", CG
 90 PRINT "NEW MAX =", CH
 95 PRINT "NEW INTERVAL =", C
100 PRINT "# INTERVALS = ", H − G: GOTO 10
```

$$(\mathrm{MIN}-\mathrm{DIST})<\mathrm{MINP}\leq\mathrm{MIN},$$

$$\mathrm{MAX}\leq\mathrm{MAXP}<(\mathrm{MAX}+\mathrm{DIST}),\ \text{and}$$

$$\mathrm{N}/(2.5)^{1/2}<\mathrm{NP}<[\mathrm{N}(2.5)^{1/2}+2]$$

The program avoids having an unnecessarily large range between MINP and MAXP by introducing a narrow gate ±J (line 35) around the MIN and MAX values. It also provides for prompting and input error trapping. ☐

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.

SCALE PROGRAM EXAMPLES

Key entry	Display	Remarks
SHIFT Z	SCALE BY C.R. LEWART	Start program
	MIN?	First example:
−3.1 ENTER	MAX?	
11.1 ENTER	# INTERVALS?	
5 ENTER	NEW MIN = −4	Beeps when ready
ENTER	NEW MAX = 12	
ENTER	NEW INTERVAL = 2	Resulting scale:
ENTER	# INTERVALS = 8	−4, −2, 0, . . . 12
ENTER	MIN?	Second example:
75 ENTER	MAX?	
2,000 ENTER	# INTERVALS?	
40 ENTER	NEW MIN = 50	Beeps when ready
ENTER	NEW MAX = 2,000	
ENTER	NEW INTERVAL = 50	Resulting scale:
ENTER	# INTERVALS = 39	50, 100, . . . 2,000.

Engineer's newsletter

Test service reveals soft errors in RAMs

Burn-in tests to detect soft-error sensitivity in 16- and 64-K random-access memories are desirable to ensure highly reliable parts. But RAM users have not had an independent testing laboratory that offers such service. Sensing a market—even for 256-K RAMs, it claims—Reliability Inc. of Houston has set up its Interception service to do the job. **Its test sequence comprises four phases: initialization, multipattern test, burn-in stress, and cool-down.** Initialization, performed at 25°C, checks for proper board operation, and then the multipattern test at 70°C runs testing patterns through the RAMs. The burn-in sequence, run at 125°C, also checks the RAMs with various testing patterns, and the cool-down is performed under bias. Further information on these and custom test sequences is available from the company at P. O. Box 218370, or call (713) 492-0550.

A no-cost way of ending ringing

The ringing that occurs when a high-speed signal travels along a wire or printed-circuit–board etch is a classic design problem: since there can be ambiguity as to whether the ringing signal is a 1 or a 0, latch elements may be set in the wrong state. John DeFalco, manager of LSI design at Honeywell Information Systems Inc. in Billerica, Mass., points out that many MOS circuits, unlike Schottky TTL, have inadequate clamping to stop this ringing. His simple solution is not to use an expensive discrete-diode clamp, but instead the diodes already present in a spare TTL part. **He simply places the TTL diode's input near the end of the transmission line.** If this chip is grounded but not powered up, only the diode is used—no extra load current is required.

How to interface data with phone system

Engineers responsible for designing equipment to interface with American Telephone & Telegraph Co.'s **new 56-kb/s switched-data service** will want a copy of Technical Reference PUB 61310. Available for $21 from the Publisher's Data Center, Box C738, Pratt Street Station, Brooklyn, N. Y. 11205, it describes the interface's specifications.

Group to purvey videotex news

Because opportunities in the videotex industry have grown so rapidly, a grass-roots movement is under way for an association to apprise manufacturers of hardware and software, information providers, data banks, and potential users of videotex services as to what is going on. **The U. S. Videotex Industry Association, as it is known, is an educational, not a lobbying group,** says spokesman Jack O'Grady of John Adams Associates in Washington, D. C. Interested parties should contact O'Grady at 1825 K Street N. W. or call him at (202) 466-8320. Future meetings are planned to establish bylaws and a clearinghouse for videotex information.

Standard aids mobile-radio makers

One of the problems plaguing manufacturers of mobile radio equipment is the lack of standards for measuring the spurious emissions conducted by antenna terminals. These are particularly important in mobile radio because the available spectrum is so congested that **spurious emissions are almost sure to cause interference problems.** This measurement problem has now been addressed by the International Electrotechnical Commission. Its standards publication 489-3A describes how to make the measurements and can be had for 17 Swiss francs from 1, rue de Varembé, 1211 Geneva 20, Switzerland.

-Harvey J. Hindin

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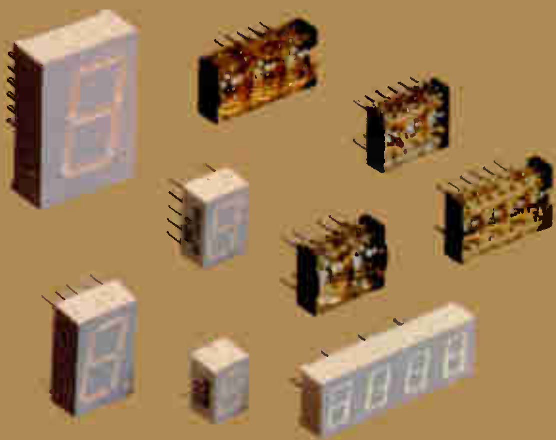

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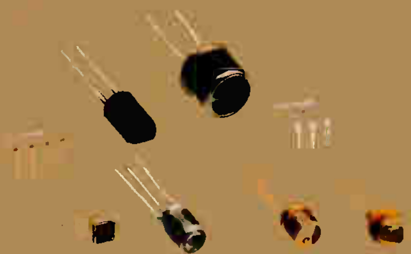

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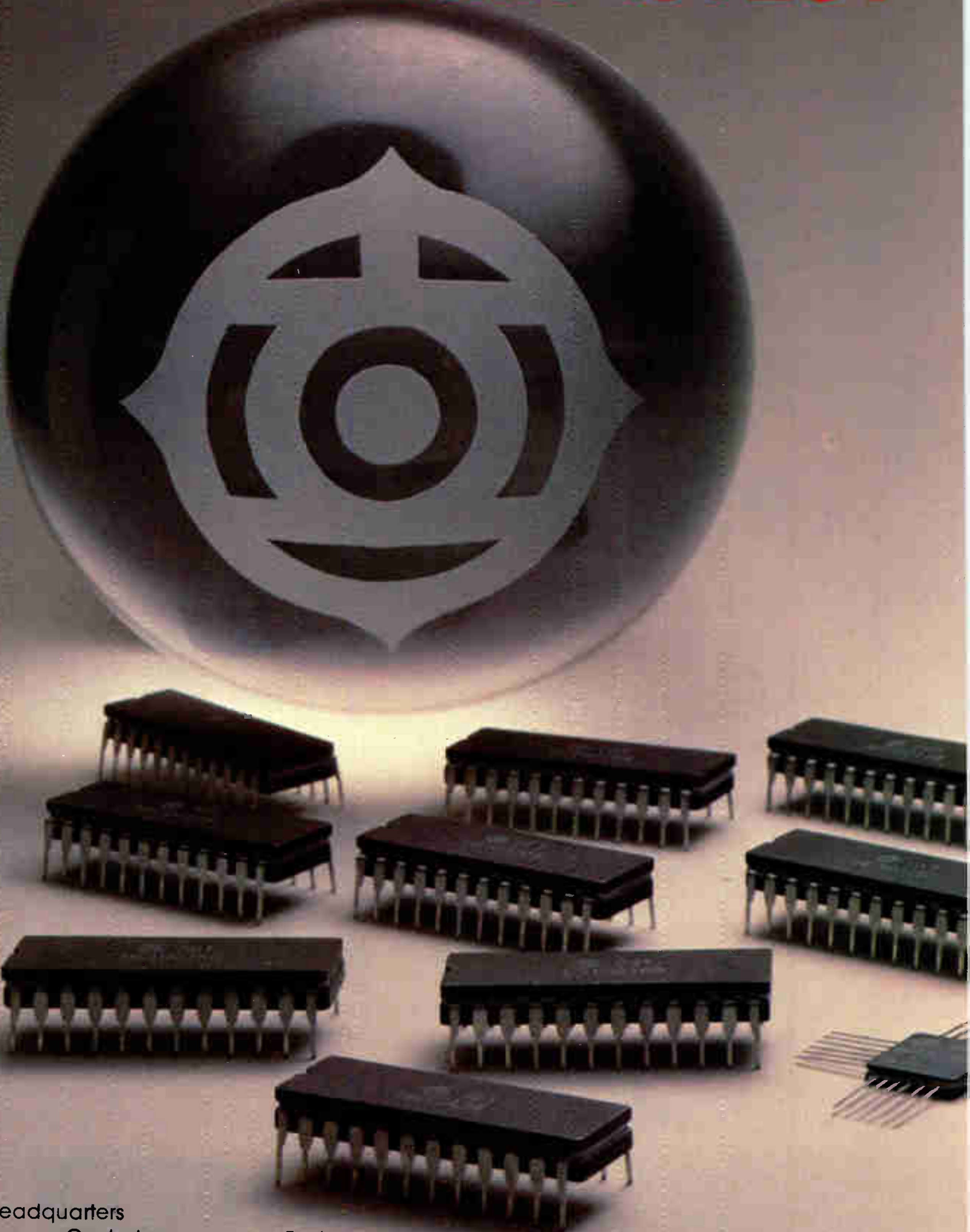

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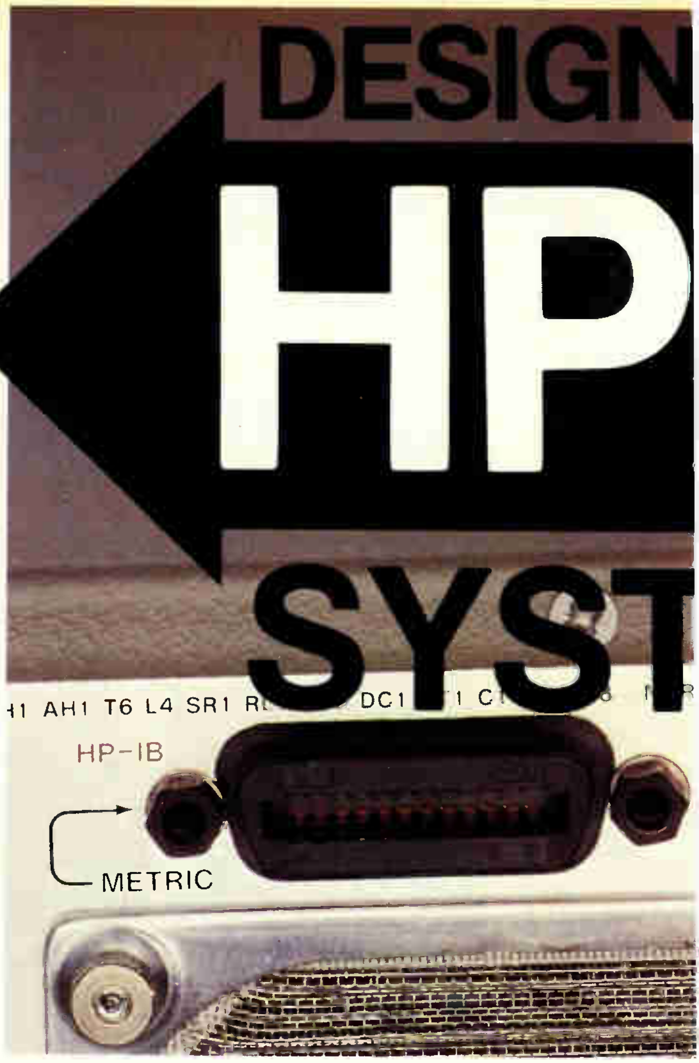

The familiar HP-IB (Hewlett-Packard Interface Bus) symbol is HP's way of identifying instruments and computers that conform to the IEEE-488 standard. But it means much more than just bus architecture and system compatibility. The HP-IB symbol also stands for the documentation and support that helps you get a measurement system operational in weeks instead of months.

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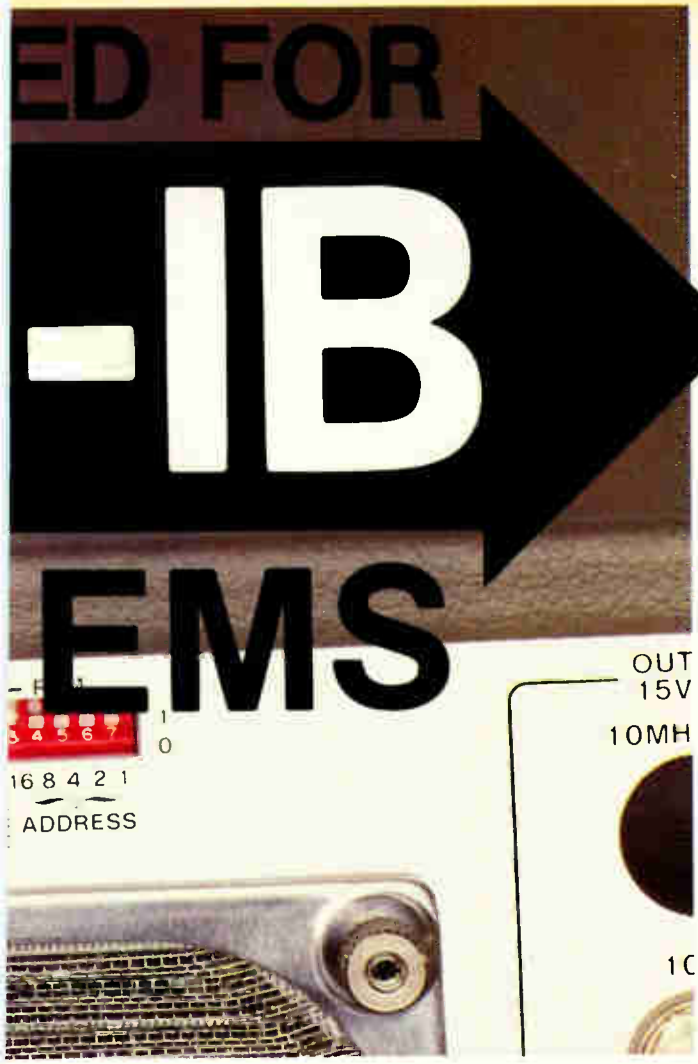

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Instruments

Tiny terminal aids field service

Calculator-sized unit has built-in modem for two-way communications with host

A small company called Pinetree Systems Inc. is tackling two of the biggest problems in today's field-service industry—getting good service data and providing on-site help to field technicians. It is doing so with an inexpensive handheld terminal, called the model DP2002, that puts field-service people in two-way communication with the home-office computer over telephone lines, radios, and satellite links.

The Z80A-based terminal, which measures 6 by 3¼ by 1¾ in. and weighs 11 oz, "makes it more likely that the field technician will file an accurate report," according to Rufus Coomer, vice president and director of marketing for the three-year-old company. That opinion is backed by the company's experience with an earlier one-way model, the DP2001.

In operation. The information to be reported—such as travel time, time to repair, parts used, and so forth—can be specified by the purchaser. Pinetree will set up the system software, which is stored in 8-K bytes of read-only memory, to give prompts on its 16-character light-emitting-diode display, so that the field technician will supply the appropriate alphanumeric information. Entered data is stored in 2-K bytes of random-access memory, more than enough to store a full day's service calls. Reports can thus be filed in a burst mode, as well as one at a time.

At the home office, the reports are accepted by the model DPR1004, a benchtop receiver designed originally for use with the DP2001. The data receiver provides an interface between two to four separate lines and the host computer.

The unit automatically receives data, checks it, and responds to the sender, acknowledging receipt or asking for retransmission. The receiver can translate the information into computer-compatible form, as well as transmit data from the computer to the user.

In the latter mode, the receiver is able to provide the DP2002-equipped field technician with support. The technician can enter a code that describes the type of fault encountered, and the computer will find the appropriate repair action stored in its data base.

The receiver will then transmit this information to the DP2002, which can store consecutive steps in its internal RAM. Coomer notes that the DP2002's memory is expandable; and when 64-K chips are readily available, they can be used to replace the current RAM.

Given a customer's requirements, Pinetree can set up a system in six to eight weeks. Key to that flexibility is the fact that the DP2002 terminal is a software-intensive unit.

"Most people, for instance, use a hardware chip to generate tones," Coomer says, "whereas we do it in software to have more flexiblity in setting up communications protocols." The unit is programmed in assembly language, and its message checking is also done in software. Messages can be encrypted, and its self-diagnostics can isolate faults to a chip and in some cases to a pin.

The DP2002 is priced between $500 and $600, depending on the software required. The DPR1004 is priced at $4,000 to $4,800.

Pinetree Systems Inc., 734 Greenview Dr., Grand Prarie, Texas 75050. Phone (214) 641-7500 [351]

Signal generators serve radar, communications uses

Solid-state technology combined with the spectral purity of cavity tuning produces the high-performance test signals of the HP 8683A/B and HP 8684A/B microwave signal generators for communications and radar applications. Instead of klystrons, the active oscillator elements are bipolar transistors for the 8683 and gallium arsenide field-effect transistors for the 8684.

A key component in each is the mechanically tuned cavity, which provides high stability and nonspurious signals. The microprocessor corrects for the inherently nonlinear cavity tuning.

Communications applications are covered in two frequency bands: 2.3 to 6.5 GHz in the 8683A and 5.4 to 12.5 GHz in the 8684A. These units feature 0 to -130 dBm power output, calibrated low-distortion frequency modulation with ±5 MHz peak deviation at rates from dc to 10 MHz, and calibrated and metered amplitude modulation with 0% to 70% modulation depths at rates from dc to 10 kHz.

For radar and military applications, the 8683B, with a range of 2.3 to 6.5 GHz, and the 8684B, with its range of 5.4 to 12.5 GHz, are used. These units have an increased power

ROMs

MOS STATIC ROMs (+5 Volts)

Character Generators[3]

Organization	Part Number	Access Time (ns max)	No. of Pins
128 × (7 × 5)	MCM6670P	350	18
128 × (7 × 5)	MCM6674P	350	18
128 × (9 × 7)	MCM66700P	350	24
128 × (9 × 7)	MCM66710P	350	24
128 × (9 × 7)	MCM66714P	350	24
128 × (9 × 7)	MCM66720P	350	24
128 × (9 × 7)	MCM66730P	350	24
128 × (9 × 7)	MCM66734P	350	24
128 × (9 × 7)	MCM66740P	350	24
128 × (9 × 7)	MCM66750P	350	24
128 × (9 × 7)	MCM66760P	350	24
128 × (9 × 7)	MCM66770P	350	24
128 × (9 × 7)	MCM66780P	350	24
128 × (9 × 7)	MCM66790P	350	24

Binary ROMs (+5 Volts)

Organization	Part Number	Access Time (ns max)	No. of Pins
1024 × 8	MCM68A308P	350	24
1024 × 8	MCM68A308P7[4]	350	24
1024 × 8	MCM68B308P	250	24
2048 × 8	MCM68A316AP	350	24
2048 × 8	MCM68A316EP	350	24
2048 × 8	MCM68A316EP91[4]	350	24
4096 × 8	MCM68A332P	350	24
4096 × 8	MCM68A332P2[4]	350	24
8192 × 8	MCM68A364P	350	24
8192 × 8	MCM68A364P3[4]	350	24
8192 × 8	MCM68B364P	250	24
8192 × 8	MCM68365P25	250	24
8192 × 8	MCM68365P35	350	24
8192 × 8	MCM68366P25	250	24
8192 × 8	MCM68366P35	350	24

CMOS ROMs (+5 Volts)

Organization	Part Number	Access Time (ns max)	No. of Pins
256 × 4	MCM14524	1200	16
2048 × 8	MCM65516P43	430	18
2048 × 8	MCM65516P43M[4]	430	18
2048 × 8	MCM65516P55	550	18

[3]Character generators include shifted and unshifted characters, ASCII alphanumeric control, math, Japanese, British, German, European and French symbols.

[4]Standard Patterns for MOS ROMs:
- MCM68A308P7 — MC6800 MIKbug/MINIbug ROM
- MCM68A316EP91 — Universal Code Converter and Character Generator
- MCM68A332P2 — Sine/Cosine Look-Up Table
- MCM68A364P3 — Log/Antilog Look-Up Table
- MCM65516P43M — MC146805 Monitor Program

PROMs

ECL PROMs

Organization	Part Number	Access Time (ns max)	No. of Pins
32 × 8	MCM10139	20	16
256 × 4	MCM10149	25	16

TTL PROMs

Organization	Part Number	Access Time (ns max)	Output	No. of Pins
512 × 8	MCM7641*	70	3-State	24
1024 × 4	MCM7643	70	3-State	18
1024 × 8	MCM7681	70	3-State	24
2048 × 4	MCM7685	70	3-State	18
2048 × 4	MCM7689	—	3-State with Registers	20
2048 × 8	MCM76161*	80	3-State	24

Not all package options are listed.

Operating temperature ranges:
- MOS — 0°C to 70°C
- ECL — Consult individual data sheets
- TTL — Military −55°C to +125°C, Commercial 0°C to 70°C

MOTOROLA MEMORIES

Motorola has developed a very broad range of reliable MOS and bipolar memories for virtually any digital data processing system application. And for those whose requirements go beyond individual components, Motorola also supplies Memory Systems and Micromodules.

New Motorola memories are being introduced continually. This selector guide lists all those available as of December 1981. For later releases, additional technical information or pricing, contact your nearest authorized Motorola distributor or Motorola sales office.

Data sheets may be obtained from your in-plant VSMF Data Center, distributors, Motorola sales office or by writing to:

Literature Distribution Center
Motorola Semiconductor Products Inc.
P.O. Box 20912
Phoenix, AZ 85036

MOTOROLA MEMORIES Selector Guide

RAMs ROMs PROMs EPROMs EEPROMs

December 1981

MOTOROLA

MOTOROLA

RAMs

MOS DYNAMIC RAMs

Organization	Part Number	Access Time (ns max)	Power Supplies	No. of Pins
4096 × 1	MCM4027AC-2	150	+ 12, ± 5 V	16
4096 × 1	MCM4027AC-3	200	+ 12, ± 5 V	16
4096 × 1	MCM4027AC-4	250	+ 12, ± 5 V	16
16384 × 1	MCM4116BP15	150	+ 12, ± 5 V	16
16384 × 1	MCM4116BP20	200	+ 12, ± 5 V	16
16384 × 1	MCM4116BP25	250	+ 12, ± 5 V	16
16384 × 1	MCM4517P10	100	+ 5 V	16
16384 × 1	MCM4517P12	120	+ 5 V	16
16384 × 1	MCM4517P15	150	+ 5 V	16
16384 × 1	MCM4517P20	200	+ 5 V	16
32768 × 1	MCM6632L15[1]	150	+ 5 V	16
32768 × 1	MCM6632L20[1]	200	+ 5 V	16
32768 × 1	MCM6632L25[1]	250	+ 5 V	16
32768 × 1	MCM6633L15	150	+ 5 V	16
32768 × 1	MCM6633L20	200	+ 5 V	16
32768 × 1	MCM6633L25	250	+ 5 V	16
65536 × 1	MCM6664AL12[1]*	120	+ 5 V	16
65536 × 1	MCM6664L15[1]	150	+ 5 V	16
65536 × 1	MCM6664AL15[1]*	150	+ 5 V	16
65536 × 1	MCM6664L20[1]	200	+ 5 V	16
65536 × 1	MCM6664L25[1]	250	+ 5 V	16
65536 × 1	MCM6665AL12*	120	+ 5 V	16
65536 × 1	MCM6665L15	150	+ 5 V	16
65536 × 1	MCM6665AL15*	150	+ 5 V	16
65536 × 1	MCM6665L20	200	+ 5 V	16
65536 × 1	MCM6665L25	250	+ 5 V	16

TTL BIPOLAR RAMs

Organization	Part Number	Access Time (ns max)	Output	No. of Pins
256 × 4	MCM93422	45	3-State	22
256 × 4	MCM93L422*	60	3-State	22
256 × 9	MCM93478*	60	3-State With Latches	22
256 × 9	MCM93479*	45	3-State	22
1024 × 1	MCM93415	45	Open Collector	16
1024 × 1	MCM93425	45	3-State	16

*To be introduced.

[1]Motorola's innovative pin #1 refresh

[2]All MOS memory outputs are three-state except the open collector MCM2115A series.

MOS STATIC RAMs (+5 Volts)

Organization	Part Number	Access Time (ns max)	No. of Pins
128 × 8	MCM6810	450	24
128 × 8	MCM68A10	360	24
128 × 8	MCM68B10	250	24
1024 × 4	MCM2114P20	200	18
1024 × 4	MCM2114P25	250	18
1024 × 4	MCM2114P30	300	18
1024 × 4	MCM2114P45	450	18
1024 × 4	MCM21L14P20	200	18
1024 × 4	MCM21L14P25	250	18
1024 × 4	MCM21L14P30	300	18
1024 × 4	MCM21L14P45	450	18
1024 × 1	MCM2115AC45[2]	45	16
1024 × 1	MCM2115AC55[2]	55	16
1024 × 1	MCM2115AC70[2]	70	16
1024 × 1	MCM21L15AC45[2]	45	16
1024 × 1	MCM21L15AC70[2]	70	16
1024 × 1	MCM2125AC45	45	16
1024 × 1	MCM2125AC55	55	16
1024 × 1	MCM2125AC70	70	16
1024 × 1	MCM21L25AC45	45	16
1024 × 1	MCM21L25AC70	70	16
4096 × 1	MCM6641P20	200	18
4096 × 1	MCM6641P25	250	18
4096 × 1	MCM6641P30	300	18
4096 × 1	MCM6641P45	450	18
4096 × 1	MCM66L41P20	200	18
4096 × 1	MCM66L41P25	250	18
4096 × 1	MCM66L41P30	300	18
4096 × 1	MCM66L41P45	450	18
4096 × 1	MCM2147C55	55	18
4096 × 1	MCM2147C70	70	18
4096 × 1	MCM2147C85	85	18

CMOS STATIC RAMs (+5 Volts)

Organization	Part Number	Access Time (ns max)	No. of Pins
256 × 4	MCM5101P65	650	22
256 × 4	MCM5101P80	800	22
256 × 4	MCM51L01P45	450	22
256 × 4	MCM51L01P65	650	22

ECL BIPOLAR RAMs

Organization	Part Number	Access Time (ns max)	No. of Pins
8 × 2	MCM10143	15	24
256 × 1	MCM10144	26	16
16 × 4	MCM10145	15	16
1024 × 1	MCM10146	29	16
1024 × 1	MCM10146A*	10	16
128 × 1	MCM10147	15	16
64 × 1	MCM10148	15	16
256 × 1	MCM10152	15	16
256 × 4	MCM10422*	15	24
4096 × 1	MCM10470*	35	18
1024 × 4	MCM10474*	25	24

EPROMs

MOS EPROMs

Organization	Part Number	Access Time (ns max)	Power Supplies	No. of Pins
1,024 × 8	MCM2708C	450	+ 12, ± 5 V	24
1024 × 8	MCM27A08C	300	+ 12, ± 5 V	24
2048 × 8	TMS2716C	450	+ 12, ± 5 V	24
2048 × 8	TMS27A16C	300	+ 12, ± 5 V	24
2048 × 8	MCM2716C	450	+ 5 V	24
2048 × 8	MCM2716C35	350	+ 5 V	24
4096 × 8	MCM2532C	450	+ 5 V	24
8192 × 8	MCM68764L	450	+ 5 V	24
8192 × 8	MCM68766L	450	+ 5 V	24
8192 × 8	MCM68766L35	350	+ 5 V	24

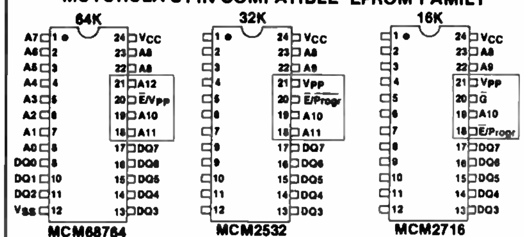
EEPROMs

MOS EEPROMs

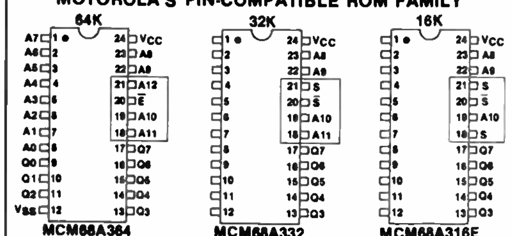
Organization	Part Number	Access Time (ns max)	Power Supplies	No. of Pins
16 × 16	MCM2801P	10 μs	+ 5 V	14
32 × 32	MCM2802P*	15 μs	+ 5 V	14

EPROM/ROM COMPARISON

MOTOROLA'S PIN-COMPATIBLE EPROM FAMILY



MOTOROLA'S PIN-COMPATIBLE ROM FAMILY



INDUSTRY STANDARD PINOUTS

output of 10 dBm and a pulse modulator and generator with rates from 10 Hz to 1 MHz in five ranges. The A models sell for $12,000 and the B models run $15,000. Delivery takes 12 weeks.

Hewlett-Packard, 1820 Embarcadero Rd., Palo Alto, Calif. 94303 [354]

Analyzer traces 64 channels to memory 4,096 words deep

Giving flexibility to the KLA logic analyzer is a floppy-disk drive that stores front-panel setups, known-good-response reference information, and the instrument's operating software. Three analyzers are available: 32-, 48-, and 64-channel versions, models KLA-32, -48, and -64, respectively.

Each has asynchronous clock speeds of up to 100 MHz and 2,048 or, optionally, 4,096 words of memory. The instrument can record simultaneously with up to four clocks and 12 clock qualifiers, which helps track down faults in multiplexed systems. Glitches as short as 5 ns are latched and stored in a memory separate from data so that the unit can be triggered on glitches. For easy recognition, glitches are displayed as half-height lines on the 9-in. screen.

Data can be displayed in timing-diagram, hexadecimal, decimal, octal, binary, ASCII, or EBCDIC formats, with optional disassemblers to display microprocessor programs in the device's memory. Personality probes for 8- and 16-bit microprocessors are also available as options. Prices start at $15,000, $17,000, and

Circle 180 on reader service card

$19,000 for the 32-, 48-, and 64-channel versions.

Kontron Electronics Inc., 630 Price Ave., Redwood City, Calif. Phone (415) 361-1012 [353]

Dual-furnace scanning unit measures directly in calories

Easy to use, but under 6800-control, the model DSC-4 differential scanning calorimeter can operate unattended for such quality control applications as materials composition, purity additive levels, and thermal or oxidation degradation levels.

The calorimeter employs dual furnaces with a power compensation method that permits measurement of samples directly in calories. Multistep programming in the program mode allows up to four sequential steps to be selected for automatic operation, thereby permitting not only automatic sample analysis but also complete recycling of the DSC-4 for the start of the next analysis. An automatic setup routine guides the operator through the proper sequence for entering parameters.

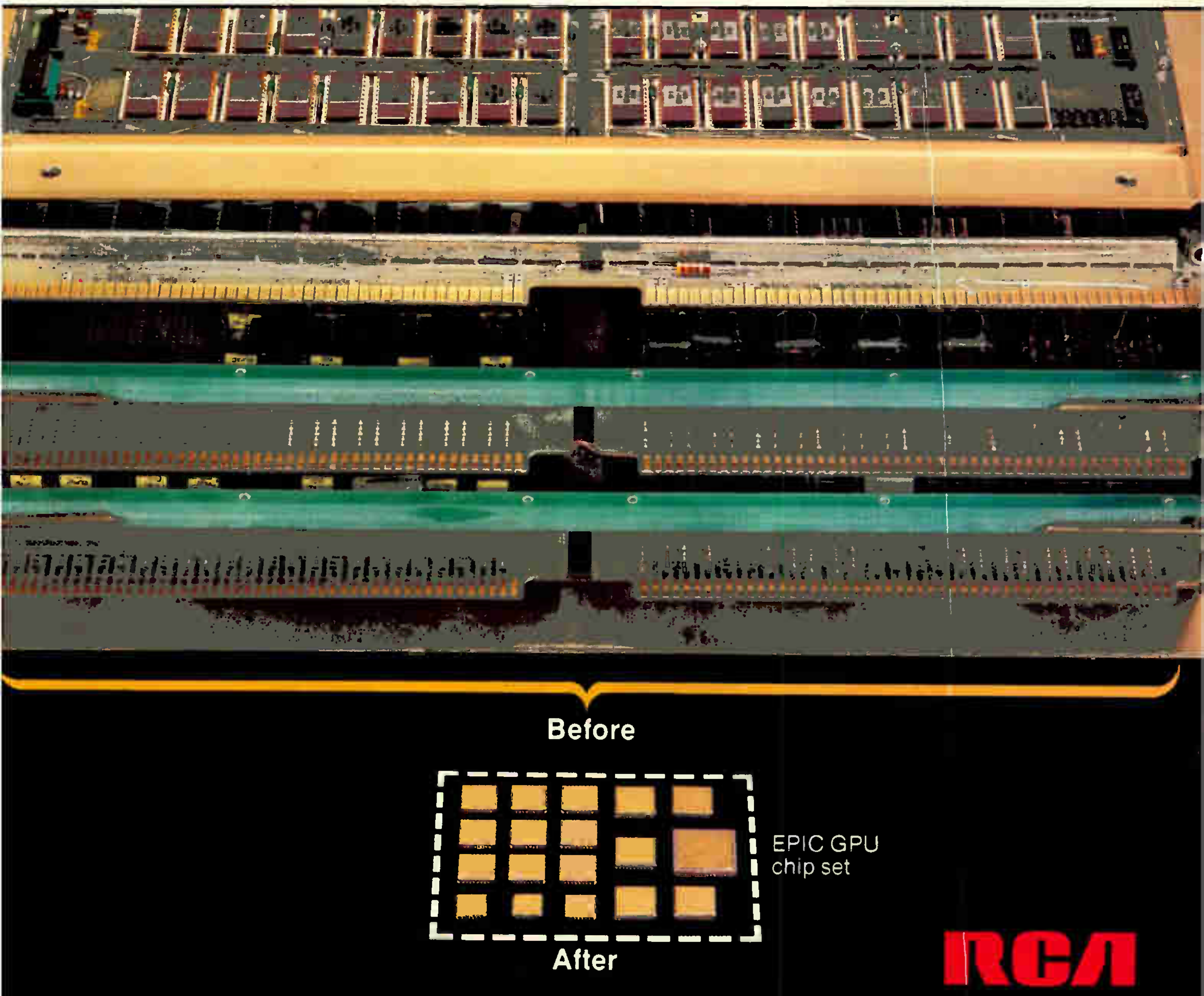
When coupled to the thermal analysis data station, the DSC-4 has an interactive video-screen display, a wide selection of programs, and facilities for writing programs in Basic. Available immediately, the DSC-4 sells for $15,000.

Perkin-Elmer Corp., Main Avenue, Norwalk, Conn. 06856. Phone (203) 762-1000 [355]

Data logger converts into front-end terminal

The portable Cyber I data logger has both an integrating digital voltmeter for 60-Hz rejection and a high-speed analog-to-digital converter, as well as a peak-hold feature.

The 10½-in.-high logger packs 16 multiplexer channels per card for a total of 384 sensor channels. Its turnkey read-only memory software includes rosette analysis, thermocouple linearization, cold junction compensation, tape-cartridge re-



Before
EPIC GPU chip set
After

cording, and RS-232-C communications-link handlers.

The table-driven software lets the user mix scan rates, channel sequence, transducer types, channels for results, and calculation units at will, to fit the needs of a test. Once defined, test parameters are saved on a tape for instant reloading.

The peak-hold feature, also in ROM, has general appeal but is designed for peak-load measurements in static and fatigue testing. The Cyber I meets stand-alone logger needs, but it can act as a distributed-system front end, gathering data at 20,000 channels/s. Burst memory allows 20,000-channel/s operation for short periods in the stand-alone mode. With delivery to start in the first quarter of 1982, the data logger will sell for below $25,000 with signal conditioning for 64 channels.

Cyber Systems Inc., 2031 East Cerritos, Anaheim, Calif. 92806. Phone (714) 772-2051 [356]

Programmable pulser works in three modes

Programmable in three modes—frequency, time, or constant output—the Power Pulser provides direct operation of relays, solenoids, valves, motors, and numerous other electrical, electronic, and electromechanical devices. The pulser can be set from 0.2 to 16 V dc at currents of up to 3 A. From a keyboard, the operator can program pulse frequencies from 0.00005 Hz to 5 kHz, pulse duty cycles of 0.1% to 100%, and quantities of 1 to 99,999,999 cycles. The operator can enter pulse on and off times of 0.0001 to 999.999 s, as

New products

well as run times of 1 s to 9,999 h and 59 min. Alternatively, the unit can serve as a programmable dc power supply.

The data and test status are automatically calculated, converted to the other program mode, and quickly recalled by push button and light-emitting-diode display. Guaranteed for one year, Power Pulser is approximately $1,000 and available for immediate shipment.

Signals and Systems Inc., 333 Park St., Troy, Mich. 48084. Phone (313) 585-0600 [357]

Unit distinguishes between analog and digital traces

Computer technology gives the Dianagraph chart recorder the visual advantage of analog recording with the accuracy of digital print-out.

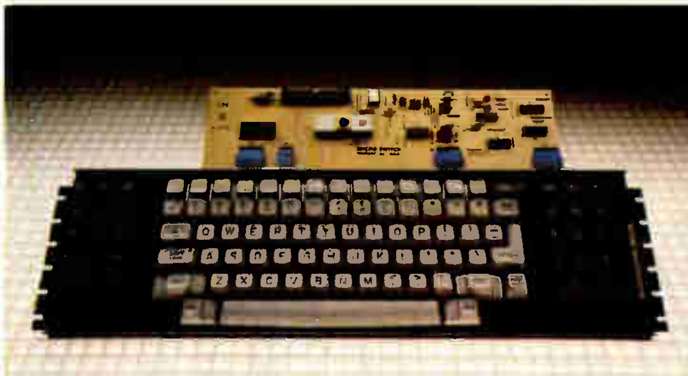
Analog and digital records for up to 12 inputs can both be printed side by side on fanfold computer paper. The analog records are identified by a number inserted into the traces every 5 in., while digital columns are identified at the top of each page.

The printer's use of standard typewriter-style ribbon eliminates the chore of cleaning the pen. Carbon-interleaved fanfold paper can be used to make duplicate records.

Models with 5 and 12 channels are available. Options available include a calculation and control package for analyzing and modifying data, a fast mode for such high-speed data input as electroencephalographs and electrocardiographs, cassette storage, and a computer interface. The Dianagraph starts at $4,900, with delivery taking six weeks after receipt of order.

Bailey Instruments Inc., 515 Victor St., Saddle Brook, N. J. 07662. Phone (201) 845-7252 [358]

Wouldn't it be great if every kind of keyboard had our kind of performance?



SC Series Capacitance Membrane Keyboard

KD Series Touch Panel Keyboard

SD Series Hall Effect Keyboard

CT Series Contact Membrane Keyboard

Now they do.

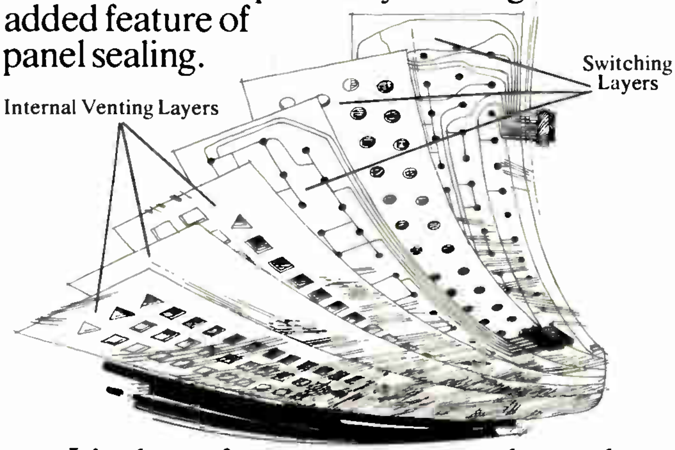
Until now, getting a keyboard at the price you needed could have meant giving up the kind of performance you wanted.

But not anymore.

Because, with the introduction of three new membrane keyboards, MICRO SWITCH has become the world's only full-line supplier of reliable keyboards. We offer a high-performance and cost-effective solution for virtually any application.

Now, in addition to our time-proven Hall effect offerings, you can specify MICRO SWITCH SC Series full-travel capacitance membrane or CT Series contact membrane keyboards, and KD Series touch panel membrane keyboards.

Whatever type of seal you need, all you have to do is ask. The capacitance membrane units are the world's only capacitance keyboards with all the benefits of membrane sealing. And we're the first to solve the venting problems associated with previous membrane designs. Both our capacitance membranes and contact membranes are internally vented to maintain their seal while preventing switch collapse due to air pressure or temperature changes. And for especially severe environments, the touch panel keyboards give the added feature of panel sealing.



It's those features, among others, that make these new keyboards more reliable than other capacitance and hard-contact designs.

And because all three new keyboards have been designed with traditional MICRO SWITCH quality and reliability, each carries a 1% Acceptable Quality Level and 2-year warranty.

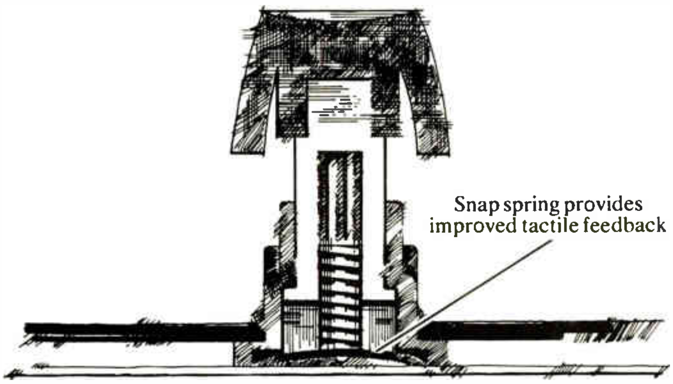
Now any combination of keyboard features you can name can have the MICRO SWITCH name on it.

Now your keyboard specifications are only limited by what you want. Not by what you can get.

Our full-travel series, for example, are available in a wide variety of keyboard configurations, with a choice of over 40,000 legends.

Because legends are screened on our touch panel designs, the graphic possibilities are endless. And, we can combine full-travel and touch panel actuation in a single assembly, featuring either capacitive or hard contact technology.

We make it easier to comply with European standards, because our full-travel membrane designs are available in low-profile versions to meet world requirements.



And, the actuator module for the full-travel membrane keyboards helps achieve new levels of tactile feedback and operator satisfaction.

So you can come to MICRO SWITCH for the keyboard technology, travel, actuation, sealing, appearance, profile, electronics, and special features you need.

And get them all - backed with the experience and full application support that's been a MICRO SWITCH tradition.

Being able to design a keyboard to fit any application is important. But doing it to fit any operator is imperative.

It's important to understand that half of any keyboard application is a human being. There's probably no keyboard manufacturer who understands that better than MICRO SWITCH.

Our unique human factors research—an intensive, on-going program for over 20 years—has given us the tools to develop industry standards for key speeds and multi-key rollover; tactile, visual, and audible feedback; and various keytop shapes, spacing, configurations and travel. We're continually improving the man/machine interface.

This human factors research is part of

what makes our keyboards unique. And it's part of every keyboard we make.

Instead of resting on our laurels, we're relying on our research.

Being able to add state-of-the-art capacitance membrane, contact membrane, and touch panel keyboard types to our Hall effect offerings is the result of extensive planning, research and testing.

But it's only the beginning.

Each of these keyboard types will be continually subjected to the refinements growing from our human factors research, customer feedback, and our unmatched R&D facilities which include backup by our Honeywell corporate facilities.

Also, every keyboard customer benefits from a manufacturing capability that stands unmatched: it's large enough to handle the most extensive order; responsive enough to give the modest order the same kind of intensive, individualized and quality-conscious attention.

All of these efforts are to make sure that, as your keyboard needs change and grow, you'll always have the choice of a progressive alternative with one unchanging feature: the MICRO SWITCH name. With all the performance that name implies.

For more information on our keyboard technologies, call 815-235-6600. Or write, MICRO SWITCH, the Keyboard Consultants, Freeport, IL 61032.

MICRO SWITCH
a Honeywell Division

Bridging the generation gap.

How Fairchild makes past and future come together.

Series 20

Since 1965, Fairchild Test Systems has tried to make each new product generation compatible with its predecessor. It's just a more efficient way of doing business.

And we've been doing business longer than anybody else.

It all started with our Series 500. A precursor of the Sentry[R] series, the 500 used discrete transistors and vacuum tubes. The same year also saw the Series 4000, our first IC tester. Then came the 5000, the first computer-controlled tester.

That's a lot of firsts. Industry firsts. That's why we're The First Family of ATE.

And Fairchild's Series 20 carries on the tradition.

This state-of-the-art LSI/VLSI tester will solve just about any testing or characterization problem you have. Today or tomorrow. You can test MOS and bipolar microprocessors, gate arrays and memories up to 20 MHz. Plus bit-slice microprocessors and peripheral and memory devices beyond 20 MHz.

And when it comes to compatibility, the device performance boards on your existing Fairchild test equipment are totally compatible with the Series 20.

If you're interested in just production testing, you still need a system that keeps pace with future technology. And won't obsolete your existing equipment.

Series 10

Our new Series 10 production tester is compatible with Sentry and Series 20 systems, thanks to our new, standard M³ operating software.

And the Series 10 is designed to be flexible, yet affordable. You can increase CPU memory from 128K to 256K words. Plus, we're developing options like enhanced timing, algorithmic pattern generation and 120-pin VLSI capability.

Speaking of options, SAGE, our new program debugging tool, combines intelligent color graphics and FRIENDLY™ software. It provides a menu of options to debug any problem, so you don't have to depend on complex computer language.

Compatible with our Sentry and Series 20 systems, SAGE displays all programmed stimulus and response to and from the device under test. And offers you the ability to modify the program stimulus interactively. With SAGE, you'll spend less time debugging. And have more time for actual device testing.

To tie all our systems together, there's Integrator. A powerful host computer that helps you get the most out of your test equipment.

Integrator can control, manage and communicate with up to eight remote test systems, whether you're using our engineering or production testers. It can interpret, analyze and modify device test results and programs. With Integrator, your test systems can be completely dedicated to testing.

SAGE

Fairchild continues to bridge the generation gap. And as today's technology becomes more complex, we'll continue to be modular, expandable and compatible. So you won't have to worry about obsolescence.

Integrator

That's the simple solution.

But we've been doing that for years.

For more information, contact Fairchild Test Systems Group, 1601 Technology Drive, San Jose, California 95115, (408) 998-0123, Ext. 2732. Fairchild Camera and Instrument Corporation.

Circle 189 on reader service card

FAIRCHILD

A Schlumberger Company

The First Family of ATE.

RS 232 and RS 449, bring them together with our subminiature Ds. It's easy.

Save your systems from obsolescence. Bring them up to the standard with AMPLIMITE subminiature D adapters.

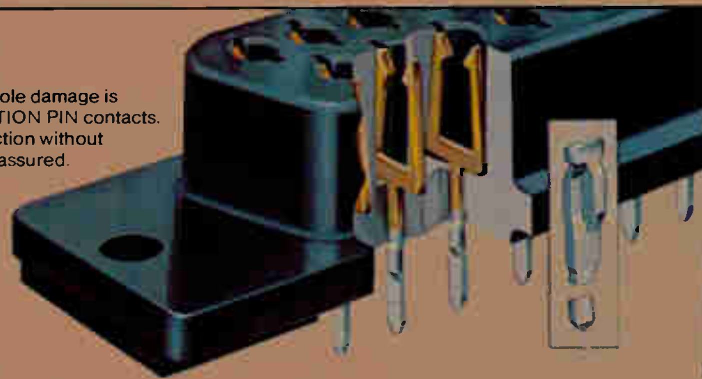
They interface RS 232 with the new RS 449 cable-to-cable or directly to your equipment. One way or the other, you save the cost of major redesign.

Our subminiature Ds also give you the widest choice. Metal shell and all-plastic connectors. Filtered assemblies. Mass termination styles. Standard, high density and MIL-C-24308 versions. And the most complete selection of accessories made.

You bring a lot together with our AMPLIMITE connector system.

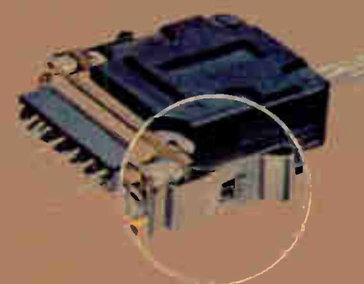
AMP Facts

Plated-through hole damage is avoided with ACTION PIN contacts. Gas-tight connection without soldering is also assured.



Two styles of slide latch clips simplify plug and receptacle mating.

Metal-shelled shielded connector provides EMI protection.



Spring latch assembly allows easy harness hook-up to RS 449 standards.

For more information, call the AMPLIMITE Connector Desk at (717) 780-8400.

AMP Incorporated, Harrisburg, PA 17105.

AMP means productivity.

CIRCLE NUMBER 125

Microcomputers & systems

Talking board mixes in effects

S-100 speech synthesis card uses d-a converter and mixer to add special audio effects

Speech, sound, or a combination of the two can emanate from a computer equipped with the Synthetalker, an S-100 compatible speech synthesis board. Using the Votrax SC-01 synthesizer, with its 64 phonemes, four inflection levels, and automatic phoneme timing, the Synthetalker has both preset and program control over the speech pitch. A trimmer potentiometer sets the preset pitch or an on-board 8-bit digital-to-analog converter can be used to vary the pitch by controlling the SC-01's oscillator. In addition, this combination yields tremelo, multiple voices, or other special effects.

Operation of the talking board is straightforward. The words and or phrases to be synthesized are first broken down into phonemes. Their corresponding codes are then selected from a table and sent to the Synthetalker one at a time as the SC-01 requests them at a rate averaging 70 b/s. The SC-01 ready line may be polled or configured to generate an interrupt when the SC-01 is ready for the next phoneme.

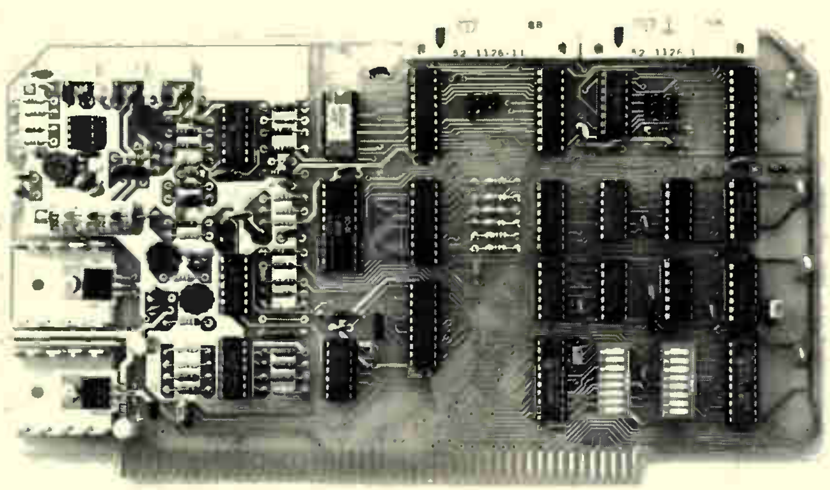
The sound of software. Sounds have more diverse origins. They may be created from the SC-01 phonemes, by waveform synthesis with the d-a converter, or by a combination of both. Sound effects can be generated along with speech by mixing the outputs of the SC-01 and the d-a converter, or sounds may be mixed with speech by sending waveform values to the d-a converter at an audio rate. Speech and sound can also be mixed with an external audio signal; an external audio line input is provided. The mixing of the d-a converter and external input with the speech is under program control.

A digitally controlled attenuator on the output of the mixer permits software control of the Synthetalker's volume. The output of the attenuator is processed by a fourth-order Butterworth low-pass filter to minimize the speech- and sound-generation aliasing frequencies and is available as an audio line-output. An on-board audio amplifier also provides a 250 mw signal to an 8-Ω load. All audio inputs and outputs are on RCA-type phone jacks, allowing easy interconnection to audio systems with shielded cables.

Two 8-bit ports, one for input and the other for output, are provided with ribbon-cable connectors. Each port includes a program-controlled strobe line and two jumper-controlled control/status lines. The input port can support an extra keyboard or joystick circuitry.

As a bare board, Synthetalker will be available in three weeks for $64.95. Pricing and availability of kit or assembled-and-tested boards are expected in six weeks.

Ackerman Digital Systems Inc., 110 N. York Rd., Suite 208, Elmhurst, Ill. 60126. Phone (312) 530-8992 [371]



128-K-byte memory emulates Apple II disk drive

For $750, Apple II owners can buy a 128-K-byte random-access-memory card that emulates a floppy-disk drive. Called the 128KDE Soft Disk, the card has access times 300 times shorter than a floppy disk and thus prevents the Apple from bogging down in disk-intensive tasks.

The 128KDE, which uses sixteen 64-K RAM chips, can be placed in any slot and can be accessed with the standard Apple DOS 3.3 commands. Its software supports three cards and thus three fast-access disk drives.

A Mount command enables users to store the contents of a floppy disk in one emulated disk drive, and an Update command copies the contents of the emulated disk back onto a floppy disk in 18 s. The software also supports Integer or Applesoft firmware cards.

The board is delivered from stock.

Legend Industries Ltd., P. O. Box 112, Pontiac, Mich. 48056. Phone (313) 674-0953 [373]

Memory card expands SBC 86/12A systems

Designed to augment the Intel Intellec SBC 86/12A microcomputer, the CI-8086 memory module is available in 32-K- to 512-K-by-9 bits. The CI-8086 is compatible with both 8- and 16-bit Multibus-based systems.

A single board, the memory plugs directly into the backplane of any Multibus-compatible system. It generates and checks even parity with selectable interrupt on parity errors. On-board refresh-control logic allows maximum processor throughput. Data access time is 270 ns; cycle time is 400 ns.

The memory is addressable in 16-K increments for up to 16 megabytes of storage. The board measures 6.75 by 12 in. and consumes under 8 W. The CI-8086 sells for $795 as a 128-K-by-9 board and for $1,995 as a 512-K-by-9 module. Delivery is from stock.

Chrislin Industries Inc., Computer Products Division, 31352 Via Colinas, Westlake Village, Calif. 91362. Phone (213) 991-2254 [374]

NEC offers Multibus card using its version of 8086

Using its own μPD8086 16-bit chip as a central processing unit, NEC has constructed a Multibus-compatible single-board computer. The BP-0186 has 32-K bytes of high-speed random-access memory, with sockets for up to 32-K bytes of read-only memory or programmable ROM. System memory can be expanded to a total of 1 megabyte.

In addition, a serial RS-232-C synchronous-asynchronous interface with software-selectable bit rates and 24 buffered, programmable, parallel input/output lines enhance the system.

The heart of the BP-0186, the μPD8086, can directly address 1 megabyte of memory over its 20-bit address bus. It features fourteen 16-bit registers accessed by 24 operand-addressing modes for complex data handling and flexible memory addressing. The optional 8087 floating-point coprocessor may be installed to add over 60 numerical instructions and hardware support for multiple-precision-integer and floating-point data types.

For applications that require additional processing capacity, the BP-0186 has multimaster capabilities, allowing multiple CPUs or intelligent controllers to share the system bus. Available for immediate delivery,

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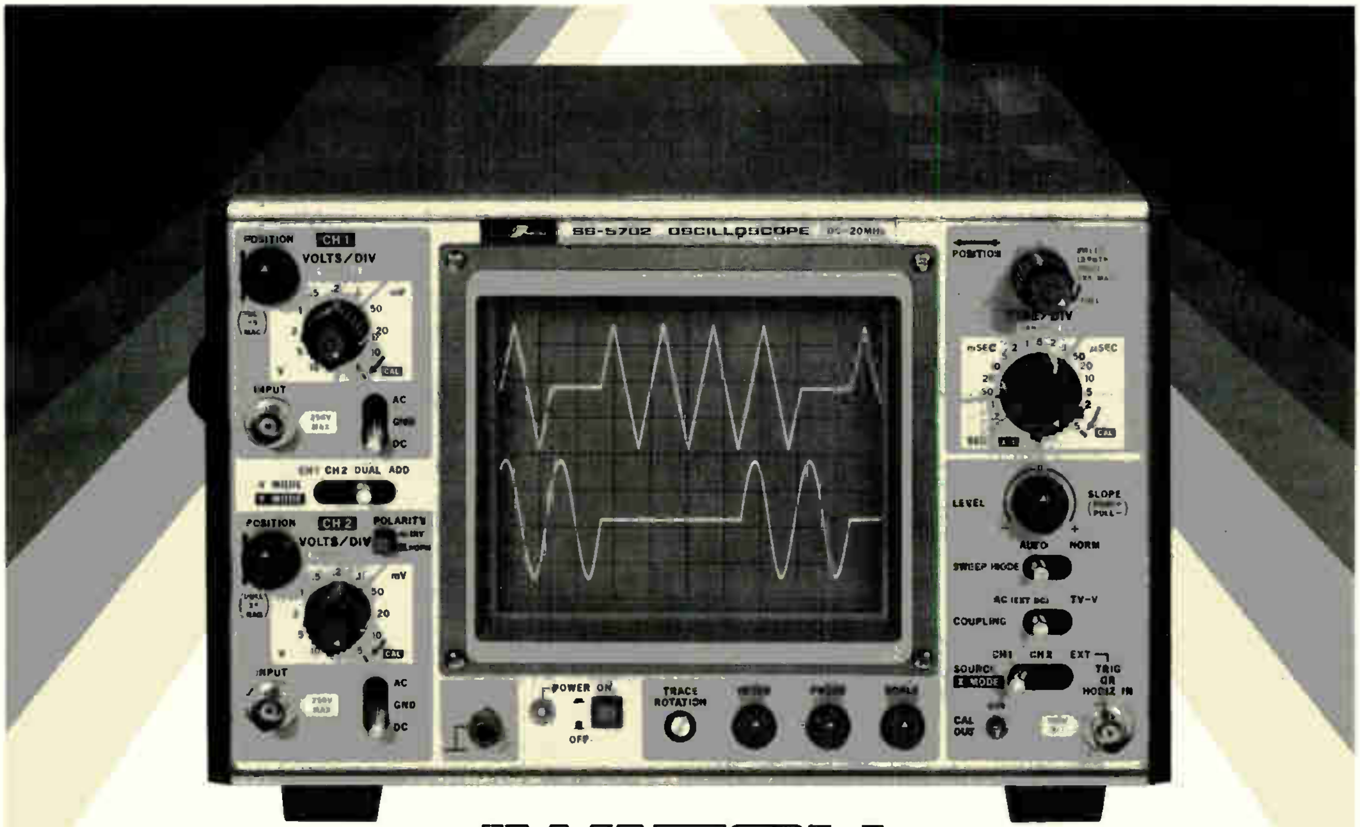

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the BP-0186 is priced at $2,100 each.

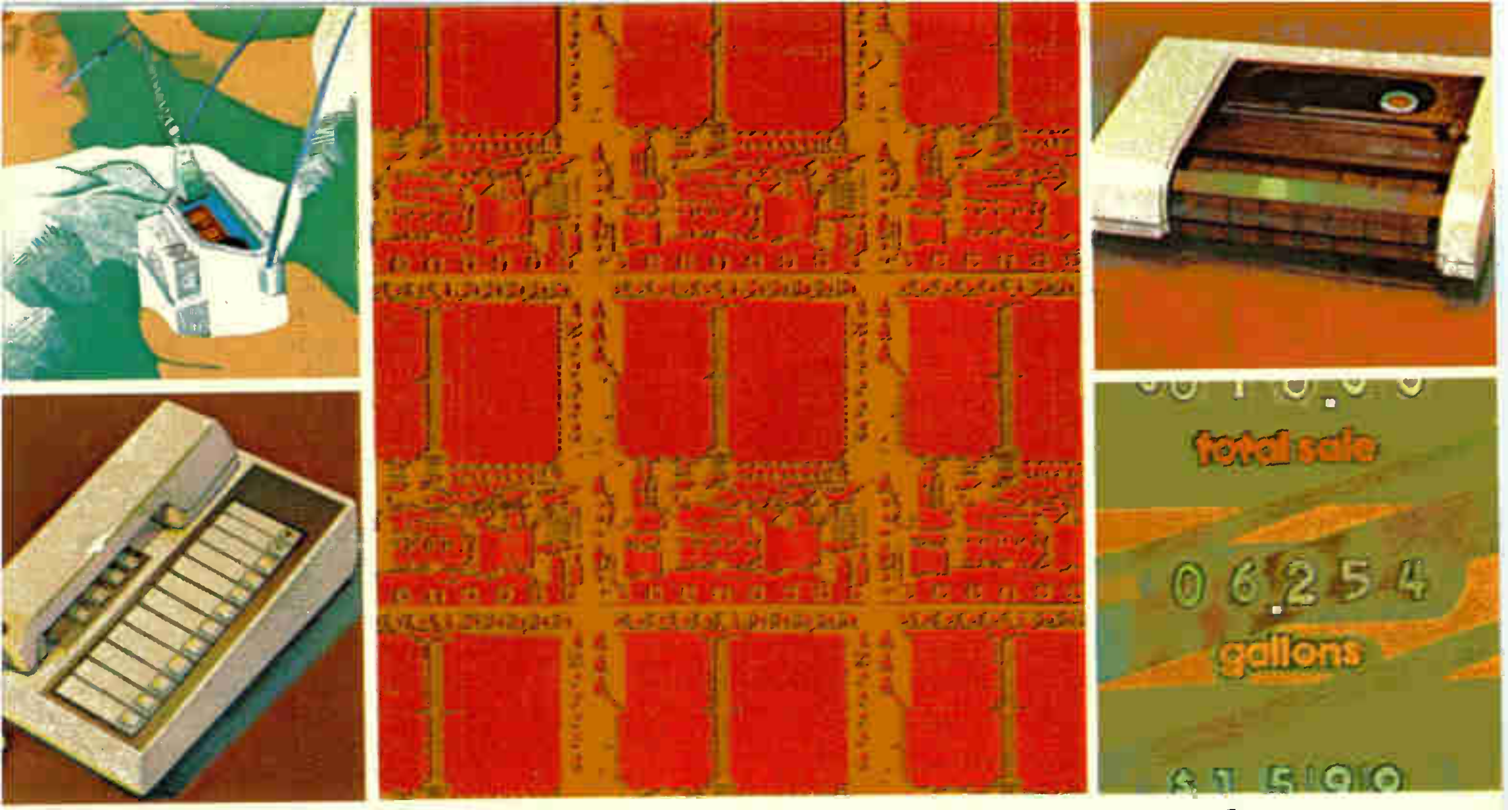
NEC Electronics USA Inc., Microcomputer Division, 1 Natick Executive Park, Natick, Mass. 01760. Phone (617) 655-8833 [375]

Desktop unit processes data and runs instruments

The model 48 puts not only data-processing but also General-Purpose Interface-Bus control capabilities into a desktop unit. The heart of the system is a four-layer, single-board GPIB controller that features two independent GPIB ports, each with a bus transfer rate of over 14-K bytes/s. The controller also includes an RS-232-C serial port and two parallel data ports.

A 12-in. cathode-ray-tube terminal with a full 80-by-24-character display has scrolling capability and features a 25th line for displaying system status, as well as the time and date. A Qwerty keyboard is used for manual entry of data, and a $1,500 impact dot-matrix printer produces hard copy 132 columns wide.

The model 48 is supplied with the CP/M operating system, as well as a text editor, assembler, and debugging software. An enhanced Basic, called GPIBasic provides direct GPIB commands. Each command, such as IEEEOUT, takes the place of the multiple commands that would be needed if straight Basic were used.



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Circle 49 on reader service card

The model 48 IEEE-488 bus controller and computer system is priced at $5,500, with shipment 30 days after receipt of order.

Systel Computers Inc., 538 Oakmead Parkway, Sunnyvale, Calif. 94086. Phone (408) 746-2901 [377]

Q-bus controller handles IBM's OEM Winchester drive

The Quad 3000 is a single-board Q-bus controller that supports IBM's 680, a recently introduced 64.5-megabyte Winchester disk drive for original-equipment manufacturers. It has an aggregate data-input rate of over 2 megabytes/s and a 4-K-byte on-board high-speed buffer.

The Quad 3000 incorporates National's proprietary controller microengine, the transfer processing unit (XPU), which implements a 4-bit-wide microword architecture with bit-slice components. The unit's architecture is identical to that of the Hex 3000 Unibus multidevice controller, the company says.

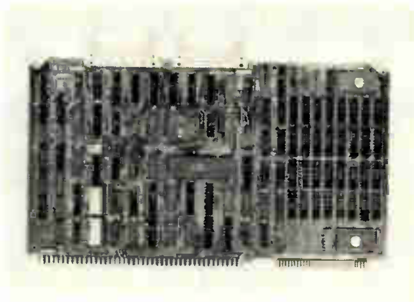
Large OEMs can use the model 680 controllers simply by changing the form factor and bus interface; the microengine, device-interface hardware, and microcode remain the same. Delivery will begin in the second quarter of 1982, and the unit will sell for under $3,000.

National Semiconductor, 2900 Semiconductor Dr., Santa Clara, Calif. 95051. Phone (408) 737-5000 [376]

Controller runs ¼-in. tape drives at 192 kb/s

The Pico-mate ¼-in. cartridge-tape interface adapter controls one or two Kennedy Corp. model 6450 ¼-in. cartridge-tape drives, yielding up to 46 megabytes of unformatted storage. A parameter block interface lets the Pico-mate be incorporated into any Multibus system, appearing as a ½-in. magnetic tape, an alternate Winchester back-up device. The Pico-mate is a full direct-memory-access bus master, with a typical

New products



data-transfer rate of 192 kb/s.

The Pico-mate executes 31 commands, including buffered and direct data-transfer operations. Direct commands transfer data between system memory and a moving tape, with a 64-byte first-in, first-out buffer easing bus conflicts. Buffered transfers use on-board static random-access memory (of 2- to 16-K bytes) to buffer each block of data while data integrity is verified.

The unit, which imports popular operating systems, is programmable for 8- or 16-bit data systems and can address 16 megabytes (24 address bits). The price in original-equipment-manufacturer quantities is $1,081, with delivery 30 to 45 days after receipt of order.

Computer Products Corp., 2415 Annapolis Lane, Plymouth, Minn. 55441. Phone (612) 559-2034 [378]

Controller drives motors rated up to 5 A/phase

Carrying on-board stepper motor logic, the ST60 Stepping Motor Controller is Std-Bus–compatible and provides four independent dc output-driver circuits that can operate motors rated up to 5.0 A/phase at up to 60 V dc. For heavier loads it can be used in parallel.

The high-power driver card comes with the logic to generate full- or half-step sequences, fully isolated inputs and outputs, and three signal inputs for limit switches or general-purpose use.

The controller sells for $275 each in lots of 10.

Standard National Corp., 212 Main St., North Reading, Mass. 01864. Phone (617) 942-0514 [379]

 Circle 200 on reader service card

Circle 392 on reader service card

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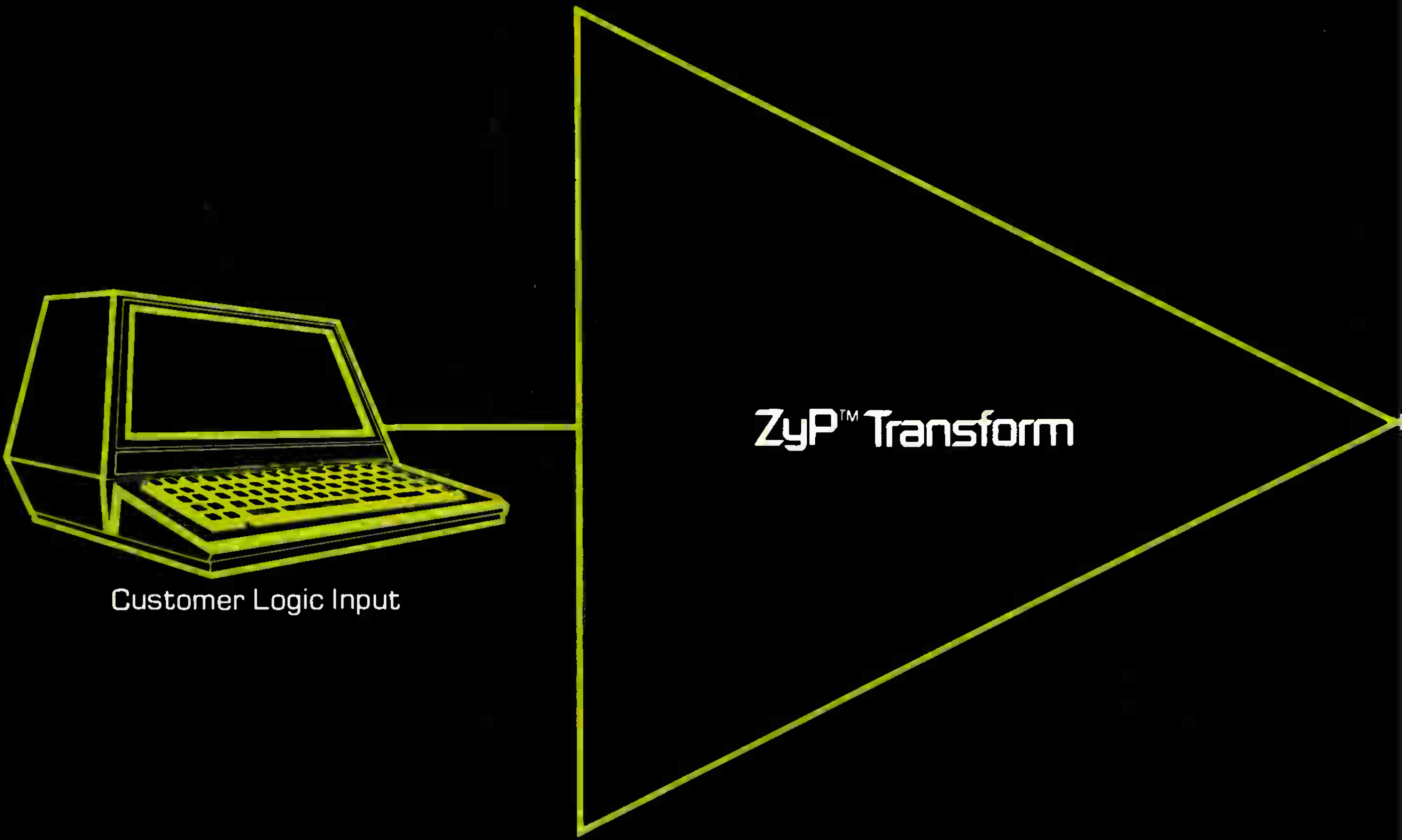

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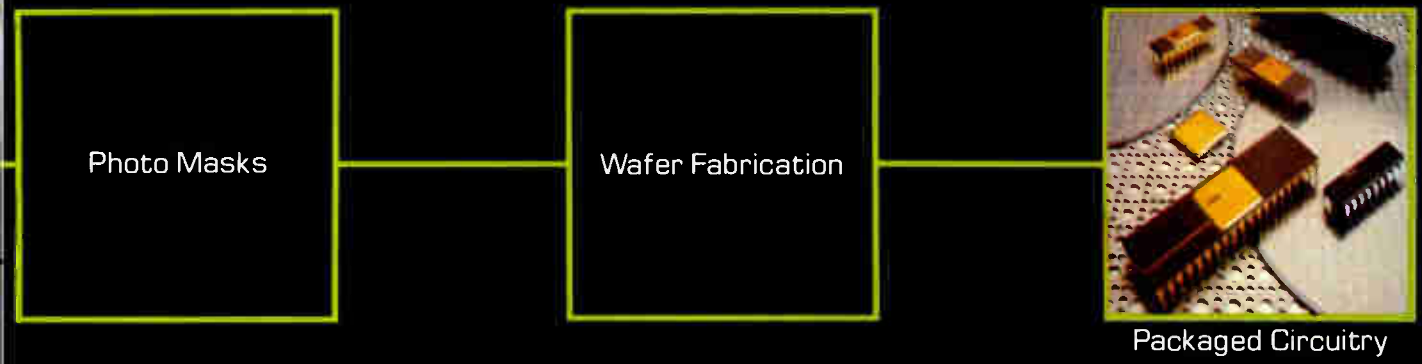

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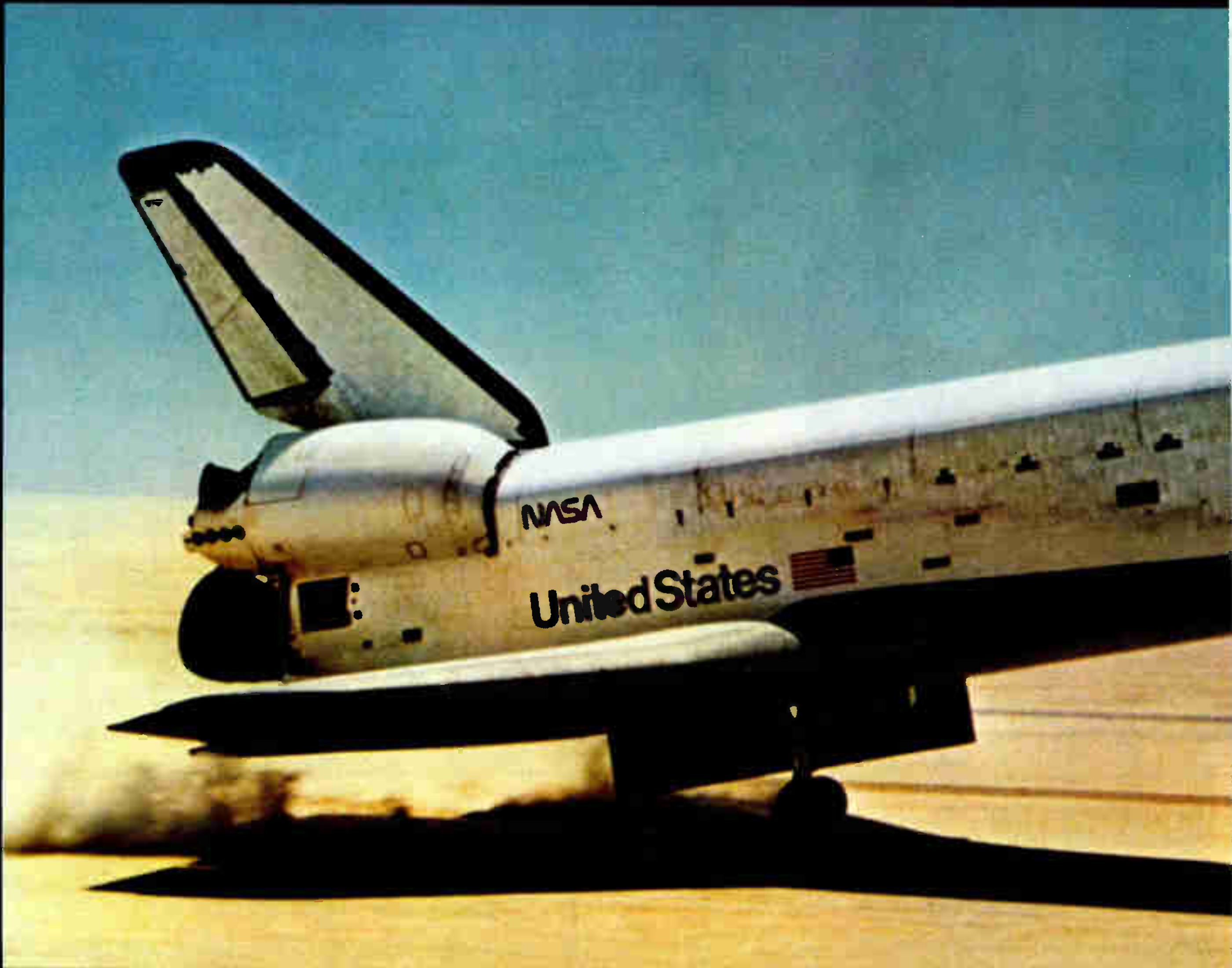

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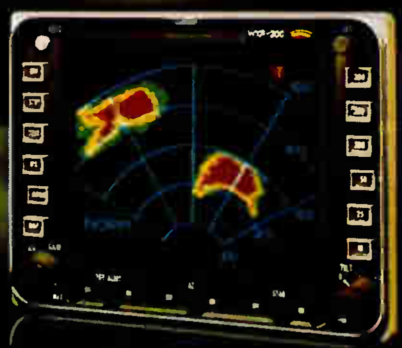

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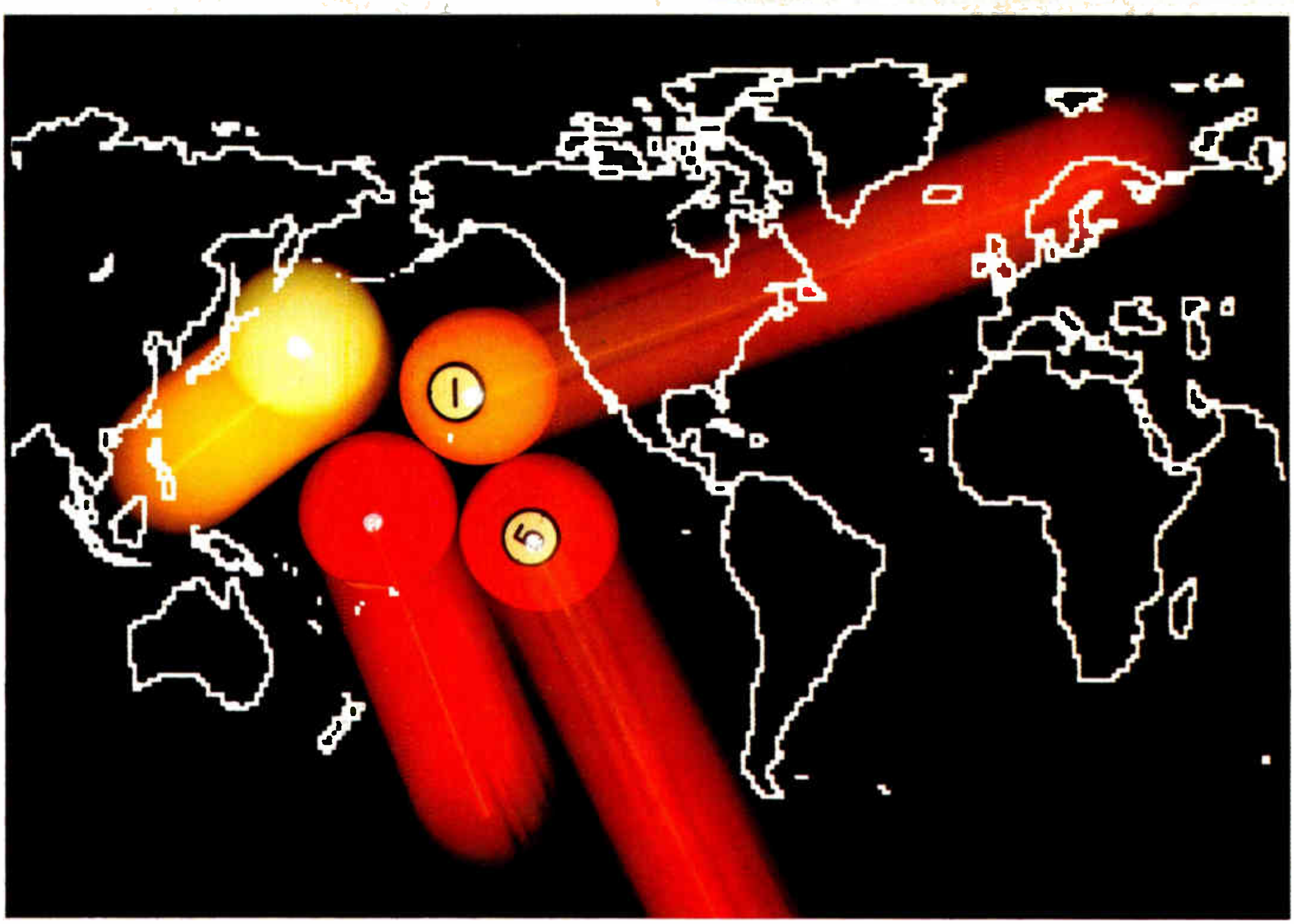

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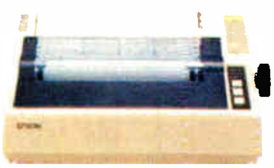

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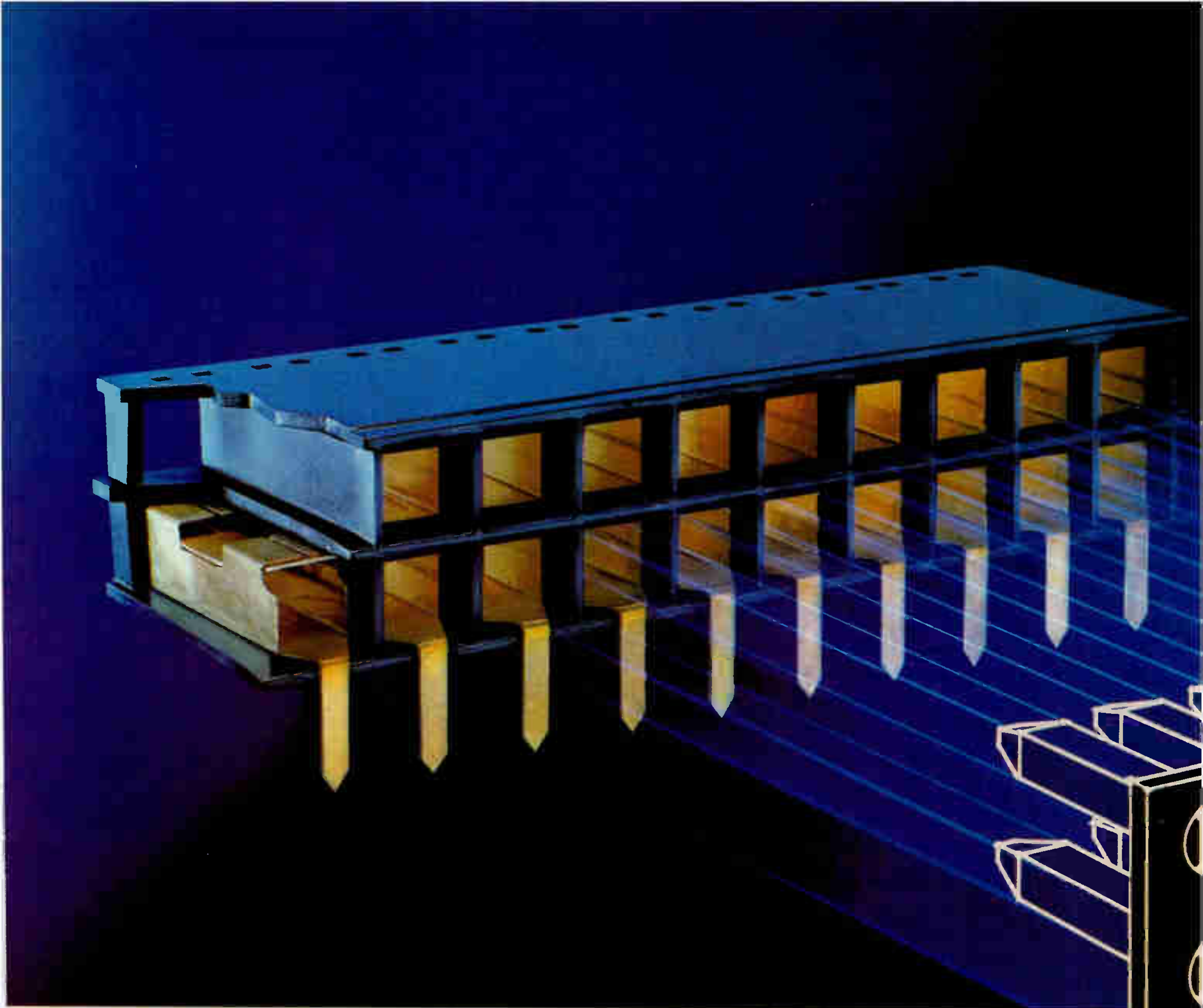

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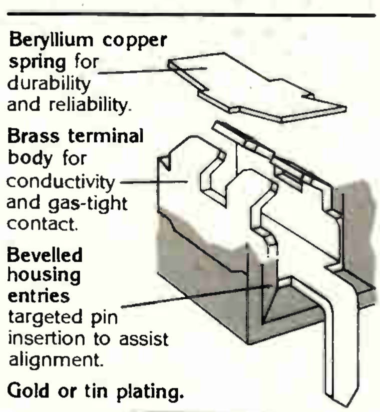

Constant mechanical pressure is exerted on the pins by this all-important spring. And that pressure remains . . . even after repeated cycling. The spring also will absorb stress from a misaligned insertion and continues to apply strong, perpendicular retention force

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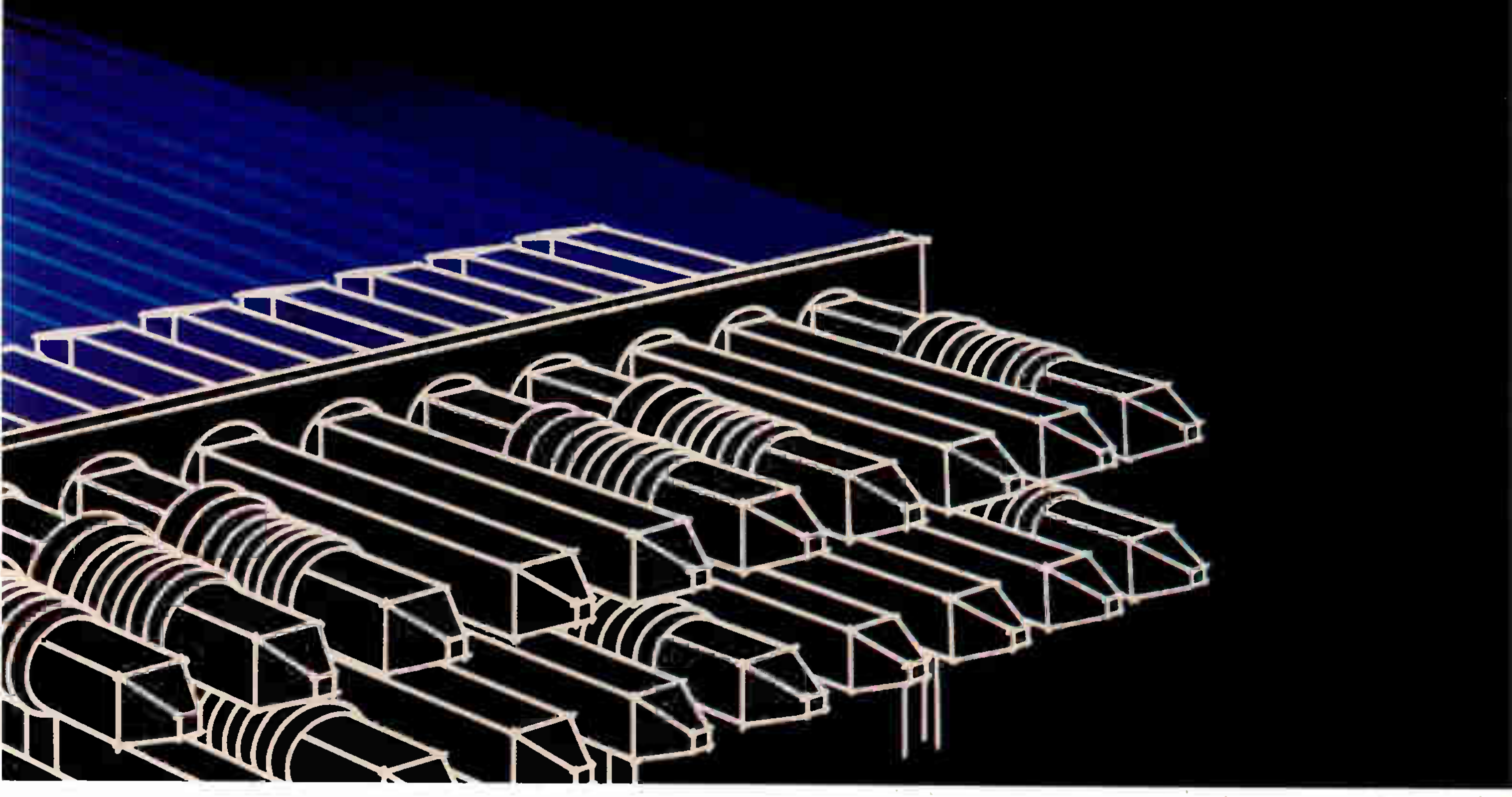

to the inserted 0.64mm (0.025") square pin.

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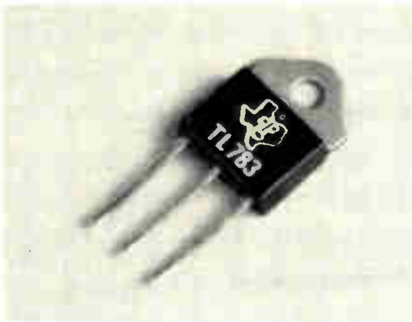
Circle 209 on reader service card

Components

Bipolar regulator has D-MOS output

Technologies combined in 125-V part that imposes own safe-operating-area limits

Combining bipolar and double-diffused MOS technologies, Texas Instruments Inc. is unveiling a three-terminal voltage regulator capable of handling an input-to-output differential of up to 125 V. Designated the TL783, the regulator is housed in a TO-220 package and sells for $1.73 each in quantities of 100. It is available for delivery now.



TI is targeting the positive-output, adjustable regulator at applications involving high voltage differentials, like power supplies for plasma displays. The bipolar and D-MOS combination came out of work in TI's telecommunications operation, explains Delbert Whitaker, division manager of linear functions.

Although the TL783's differential rating has been set at 125 V, Whitaker indicates that the bipolar-D-MOS technology promises to be able to achieve 200 V in the foreseeable future. The D-MOS output transistor carries the regulator's high-voltage burden without secondary breakdown and thermal-runaway effects. The D-MOS process also increases switching speeds.

The TL783 delivers a maximum of 0.7 A and is limited automatically by a special circuit to an output of about 20 W. The part also features line regulation of 0.2%, load regulation of 0.5%, a typical temperature coefficient of 0.4%, and an initial accuracy of ±4%.

The unit has an internal thermal shutdown using a zener temperature sensor. It is automatically turned off above 165°C, and on again when it cools. A current-limiting circuit also adjusts the output to 20 W.

The thermal cut-off and 20-W roll-off features—along with a stack of zener diodes in a safe-operating-area circuit—confines the part's operation within a self-imposed safe operating area over its total input-output differential voltage range of 10 to 125 V.

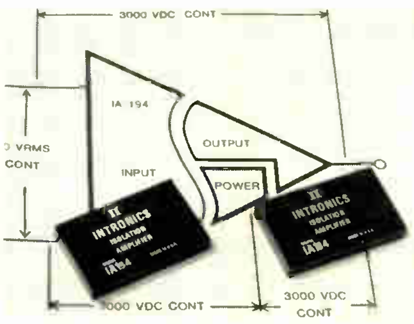
The TL783 can also provide good current regulation at low current since its quiescent current is less than 0.1 mA.

Texas Instruments Inc., Central Literature Response Center (SC-138), P. O. Box 202129, Dallas, Texas 75220. Phone (214) 995-5900 [341]

30-kHz isolation amp slews at 0.05 V/µs

Boasting a 30-kHz bandwidth and a 0.05-V/µs slew rate, the IA194 magnetic isolation amplifier has the frequency range and slew rate of an optical amplifier but the stability inherent in magnetic devices. Isolation in three ports—input, output, and power—is 3 kV dc.

The device has a 100-µs settling time, a 90-dB common-mode rejection ratio, and an externally programmable gain of 1,000:1. Its 0.1% linearity ensures its compatibility with 10-bit data-acquisition systems.



Although input noise is held to 3 μV in the 10-Hz-to-1-kHz range, its maximum current noise in the same range is 40 pA.

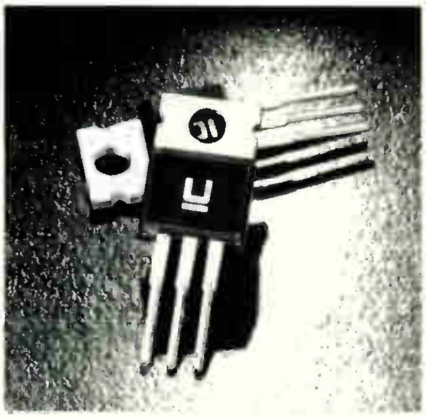
Taking into account the effects of offset, temperature, and linearity, the accuracy of the IA194 is ±0.5% over the full range of 0° to 80°C. In quantities under 10, the amplifier is priced at $119 each. Delivery is from stock to six weeks.

Intronics, 57 Chapel St., Newton, Mass. 02158. Phone (617) 332-7350 [343]

Schottky devices serve as output rectifiers, catch diodes

Joining the USD 800 and 900 series of power Schottky rectifiers are the 600 and 700 families of single- and dual-chip rectifiers, rated at 6 to 16 A.

The single-chip 600 series and dual-chip 600C series feature peak



reverse-voltage ratings of 20, 35, 40, and 45 V. The current rating for the single-chip versions is 6 A, while the dual-chip models' center tap is 12 A. Forward voltage for either series is 0.55 V at 8 A per diode.

The two 700 series have identical peak-voltage ratings. Current ratings are 8 and 16 A for single- and dual-chip versions, respectively, and forward voltage for either series is 0.55 V at 8 A per diode. The devices, housed in TO-220 packages, are suitable for output rectifiers and catch diodes in high-performance, fast-switching power supplies. Prices for the 600 series are $1.10 and $1.81 for 1,000-piece lots. The 700 series bears tags of $1.37 and $2.26 in like quantities. Delivery is from stock.

Unitrode Corp., 5 Forbes Rd., Lexington, Mass. 02173. Phone (617) 861-6540 [344]

Fast power MOS FET has 800-V breakdown voltage

Extending Hitachi's line of power MOS field-effect transistors [*Electronics*, May 19, p. 81] is the 2SK351, a device with a breakdown voltage of 800 V and a 80-ns switching time. It is suitable as a switching power device for equipment using an ac line voltage of more than 200 V.

MOS FETs have an advantage over bipolar parts in these applications because bipolars suffer large power losses at switching, break down more easily at high temperatures or under surge currents, and cannot easily be used in parallel operation to handle large power loads. Computer-aided design and structural analysis help the 2SK351 attain its high breakdown voltage by giving the part stability and uniformity in the electrical field distribution.

Other specifications include a drain current of 5 A, a 125-W maximum channel dissipation, and an on-resistance of 3 Ω, 1.7 Ω typically. The triple-diffused MOS isolation arm, housed in a TO-3 container, sells for $19 in lots of 1,000.

Hitachi Information Service, 77 Water St., 22nd floor, New York, N. Y. 10005. Phone (212) 425-4845 [345]

LED array substitutes for mechanical meters

As an alternative to mechanical meters in instruments and status- or position-indicator panels in process-control systems, the HDSP-8820 10.58-cm light-emitting-diode graph array offers 101 red elements, each 1.52 mm wide.

Package and drive requirements make the array easy to design into a system or instrument. It has a single in-line–package configuration for standard sockets and printed-circuit boards. The common-cathode LED arrangement simplifies interfacing with a microprocessor.

The array has ±1% resolution and consumes typically 140 mW. In quantities of 249, the HDSP-8820 sells for $40. Delivery is from stock.

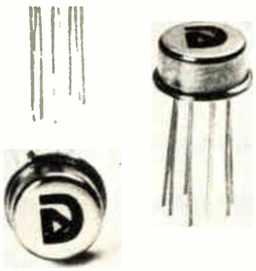
Hewlett-Packard Co., 1820 Embarcadero Rd., Palo Alto, Calif 94303. [346]

60-MHz op amp is stable at closed-loop gains over 10

With a gain-bandwidth product of 60 MHz and a 50-V/μs slew rate, the AM-411 operational amplifier serves those applications that require high-frequency capabilities and excellent dc input characteristics, such as analog-to-digital converter input buffering, digital-to-analog converter output amplification, active filters, and sample-and-hold circuits.

The device's input characteristics include maximum bias and offset currents of 50 pA and a common-mode rejection ratio of 80 dB. Its input offset voltage is a maximum ±1.0 mV and offset voltage drift is typically 5 μV/°C.

The AM-411 settles in 1 μs to 1%. It is an uncompensated device that is stable at closed-loop gains of greater than 10 without external compensation. Its ouput drive capability is ±12 V at a minimum ±10 mA.



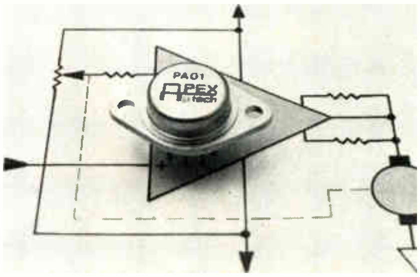
Housed in an eight-lead hermetically-sealed TO-99 case, the AM-411 operates over two ranges: the 0°-to-+70°C range or the military range of −55° to +125°C. In quantities up to 24, the military version sells for $32.50 each, while the other offering costs $10.50 each. Delivery is from stock to 10 weeks.

Datel Intersil, 11 Cabot Blvd., Mansfield, Mass. 02048. Phone (617) 339-9341 [347]

$20 5-A, 30-V op amp has 2.6-V/μs slew rate

Giving high voltage and current at low prices, the PA01 operational amplifier costs $20 each in 100-unit lots. It is rated for supplies up to ±30 V; its output current is ±5 A.

To achieve these ratings, the PA01 has a tracking junction and thermistor-compensated class AB biased emitter-follower output stage, rather than the class C output stage of other economy power op amps;



class C stages exhibit higher crossover distortion.

Additional characteristics include a 2.6-V/μs slew rate, a 110-dB common-mode rejection ratio, and an initial input bias current of 50 nA maximum. At full load, its open-loop gain is a minimum of 91. Output power is a function of case temperature and load characteristics; at 25°C it can be as high as 115 W into resistive dc loads or 50 W into ac transducers. Delivery is from stock.

Apex Microtechnology Corp., 1130 East Pennsylvania St., Tucson, Ariz. 85714. Phone (602) 624-0273 [348]

Capability is what puts it ahead today.

The Fairchild Series 30/333 H

For comprehensive fault isolation, no other system comes close.

The new Fairchild 333 In-Circuit Test System is the most advanced system ever developed for isolating faults on large, complex, analog, digital and hybrid PCBs.

It offers an expanded 2,207 digital test point capability—each point with its own driver, and an analog test section with 959 test points. It can test LSI and VLSI IC's on boards with advanced, bus-oriented designs, and it can also fully test mixed logic boards such as ECL/TTL.

The 333 also includes such innovative design features as FAULTS,™ WIREGEN,™ and our new Datalogging Analysis Program—the most powerful management analysis package available today. And our new Testing Diagnostic Center provides all the tools to quickly isolate faults—including BUSPROBE,™ which tracks bus-oriented failures right to the IC.

You get both functional and in-circuit capabilities in one economical system.

Key to the increase in fault isolation capability is the 333's new high-speed digital test section. Called FAST-TEST,™ this optional 256 pin high-speed section uses Fairchild's own FAST™ semiconductor technology. It not only allows you to test dynamic parts with parallel patterns at speeds up to 2MHz, but permits high-speed functional exercise of strategic LSI devices, giving you both digital capabilities in one economical in-circuit system. And because FAST-TEST comes with its own built-in sequence processor, initializing devices is far easier and overall test efficiency is maximized.

Fairchild's HI-CURRENT™ testing power supplies enable the 333 to deliver more digital test capability than any other in-circuit test system available today, allowing even very large PCBs to be fully exercised.

Along with an expanded analog test section, the 333 also provides enhanced guarding techniques for more accurate component measurements. And a wide selection of software-controlled IEEE instruments is also available.

Improved software makes every test easier.

The 333's software is designed not only to improve in-circuit testing performance, but to significantly reduce test program preparation and maintenance times. The FAST-TEST device library is included with the CHIPS LSI Test Program Compiler. FAULTS, our automatic test program generator, has been improved with digital testing

Compatibility is what keeps it ahead tomorrow.

ybrid In-Circuit Test System.

routines including bus-disable and feedback loop disable techniques, as well as initialization problem detection software and automatic program generation. And a special editor facilitates fast keyboard control of the entire package.

WIREGEN, the new automatic fixture wiring program, uses program input data to develop a fixture-wiring scheme. UUT circuit designs and the system's test pin matrix are matched during wire assignment. The result—a fixture efficiently wired, and one that speeds program optimization and simplifies future wiring changes.

Our new Datalogging Analysis Program lets you review and track board and component failure histories, using any one of a variety of output formats. And operator analysis and yield analysis programs offer a new level of visibility to in-circuit test site management.

System compatibility—the unique Fairchild advantage.

While other ATE companies are developing "one-of-a-kind" systems, Fairchild has designed the 333 with a full range of compatible features that make it your most cost-effective ATE investment. Because the fixturing, test programs and software on the new 333 are compatible with other Series 30 in-circuit test systems (the models 303S and 323), you save time, money and the maintenance problems common to competitive systems. In addition, compatibility makes training and operation far easier, and system users maintain their valuable expertise from one Fairchild system to another.

System compatibility is perhaps the single most important consideration in terms of "total cost of ownership." And it's an advantage that Fairchild is committed to today and tomorrow.

For more information on the new Series 30/333 for large, complex, analog, digital and hybrid boards, write or call Fairchild Test Systems, 299 Old Niskayuna Rd., Latham, NY 12110; (518) 783-3600.

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CLICK A

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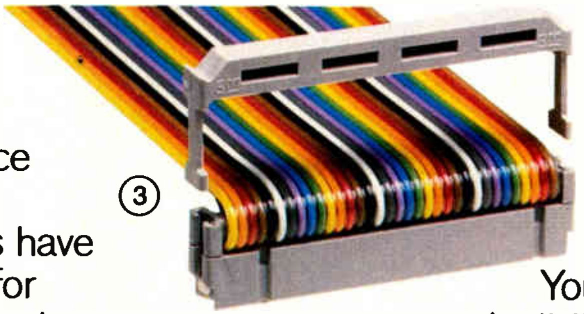

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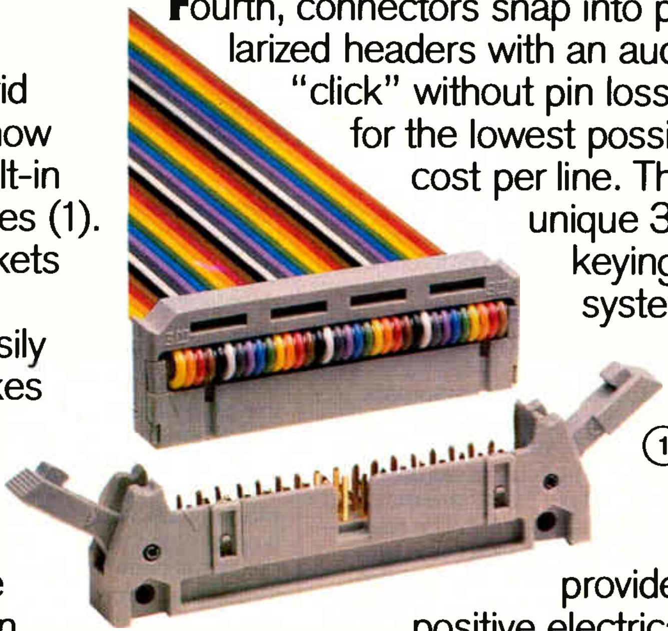
Fourth, connectors snap into polarized headers with an audible "click" without pin loss, for the lowest possible cost per line. The unique 3M keying system (4) provides positive electrical polarization, prevents even a partial mismatch, and helps reduce equipment damage and field maintenance.



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sound for 6-way better assembly.

Fifth, 3M's patented U-contact is ultra-simple. But it's superbly functional, proven reliable in thousands of applications.

Sixth, Scotchflex Brand sockets and headers in this grid range include 10, 14, 16, 20, 26, 34, 40, 50, and 60-pin sizes. They give you the same dependable mechanical and electrical performance as other 3M components.

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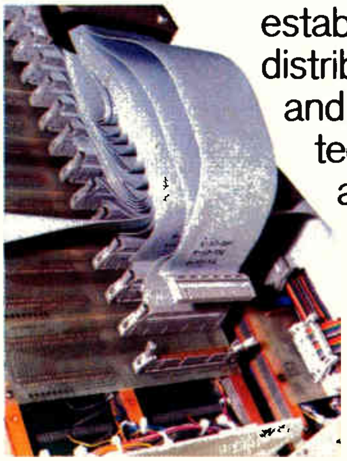

The Sourcebook—Free

All the technical data you'll need for Scotchflex Brand mass termination products is in our complete Scotchflex catalog. It's yours free. Ask your 3M Scotchflex distributor, or write Electronic Products Division/3M, Building 225-4S, 3M Center, St. Paul, MN 55144.

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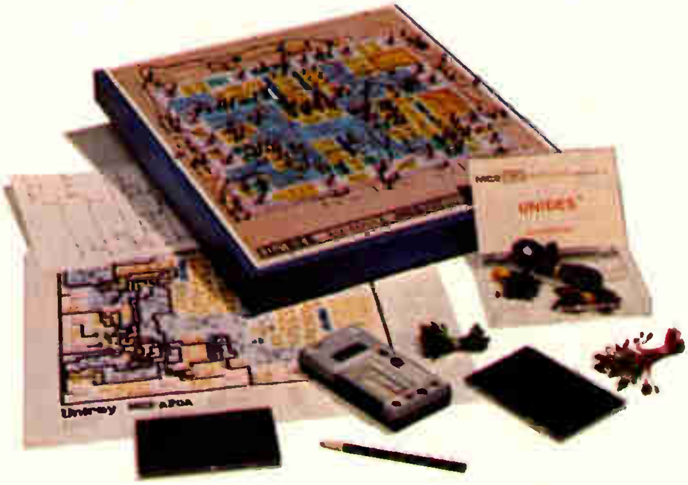

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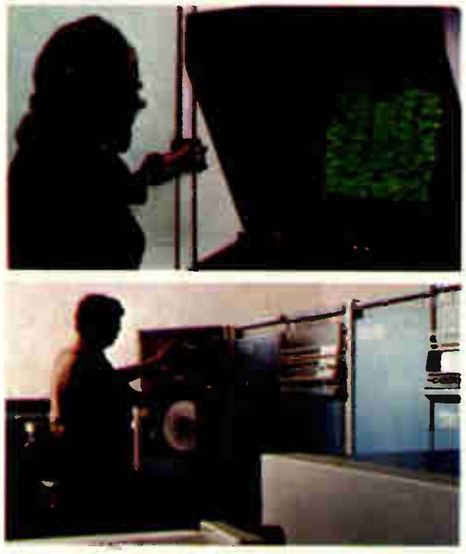

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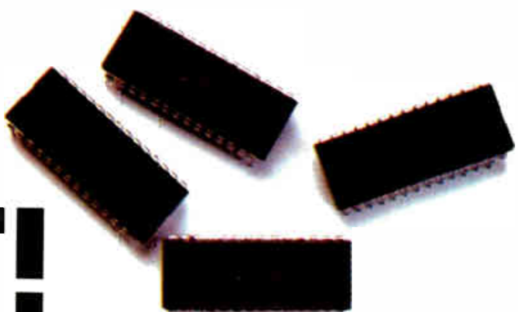

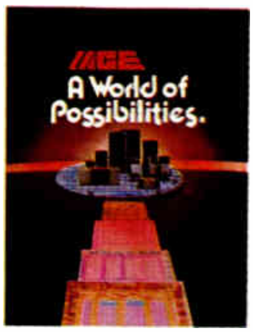

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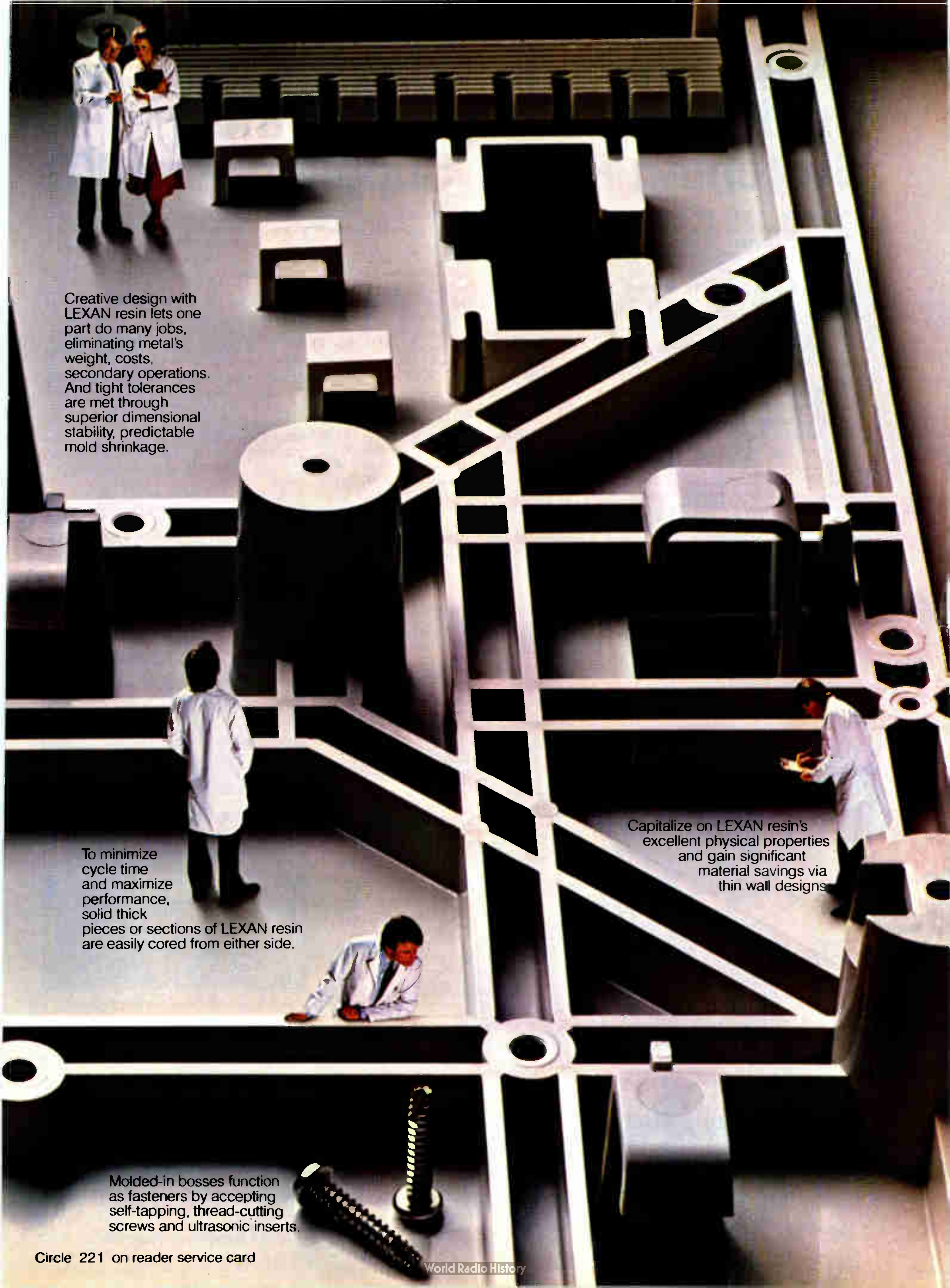
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Customer: What modules are you talking about and how do they work?

ACDC Salesman: O.K., we produce input modules, converter modules and output modules. We have 16 different board modules that make up 50 different power supplies. We take various combinations out of stock and assemble them in a chassis, interconnecting them through a mother board. It's fast, reliable, and it eliminates hard wiring.

Customer: I see, you can make up most any switcher I could want right out of stock. You say no hard wiring...what's wrong with wiring?

ACDC Salesman: Harnesses are a point of potential failure. There are possible cold solder joints vulnerable to everything including shipping vibration, not to mention noise considerations in how the harnesses are placed throughout. No one has ever successfully introduced a switching supply without hard wiring until our RS/RT Series.

Customer: When you say you test the daylights out of them, give me some details.

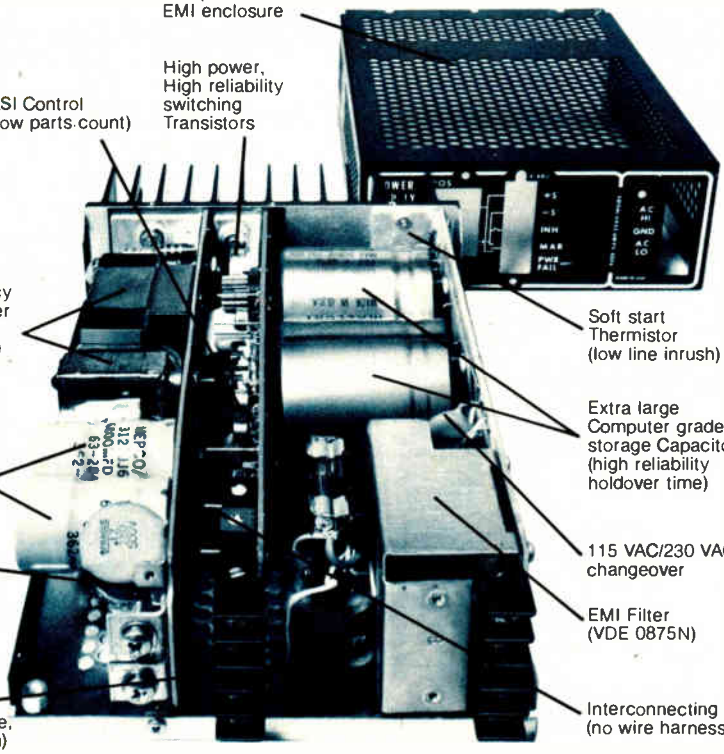
ACDC Salesman: O.K. First, all of our active devices are 100% screened. We stable bake, temperature cycle, and then 100% electrical test. All to MIL-STD-883B. The modules themselves are computer tested. When we assemble them into the final unit, we first Auto-Test, then burn-in for 48 hours at 50°C under full load, cycled, Auto-Test again with computer print out- serialized. You get one copy of the hard test data and we keep a copy. In other words we all know exactly what you're getting.

Customer: Everything sounds good, but what about the cost?

ACDC Salesman: Simple. We save you money because instead of building a hundred of these and fifty of those, etc., we continuously build thousands of the same modules each month. That saves us, and you, money. We test everything thoroughly and that eliminates warranty returns, reworks and all those costly problems. Believe me, if you've ever seen the production of power supplies, you'd know we have a uniquely superior product here...and, at a fantastically low price.

Customer: It sounds to me like you've brought power supply technology up to date.

ACDC Salesman: Thanks...we think our RS/RT Series are the switchers of the 80's.



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SINGLE OUTPUT					
OUTPUT VOLTS	OUTPUT CURRENT				
	RS50	RS100	RS150	RS300	RSF375
2	10.0	20.0	30.0	60.0	—
5	10.0	20.0	30.0	60.0	75
6	8.0	9.0	25.0	50.0	—
12	4.5	9.0	13.5	27.0	31
15	3.6	7.2	10.8	21.0	25
18	3.0	6.0	9.0	18.0	—
24	2.5	4.5	7.0	13.0	15
28	2.0	4.0	6.0	11.5	—

RT Series/Triple Output

MULTIPLE OUTPUT				
	TRIPLE			QUAD
	RT100	RT150	RT300	RQ300
MAIN OUTPUT	5V 20A	5V 30A	5V 60A	5V 30A
AUXILIARY OUTPUTS	12V 2A 15V 2A	12V 5A 15V 4A 5V 5A	12V 5A 15V 4A 5V 5A 24V 2A	12V 5A 15V 4A 5V 5A 24V 4A
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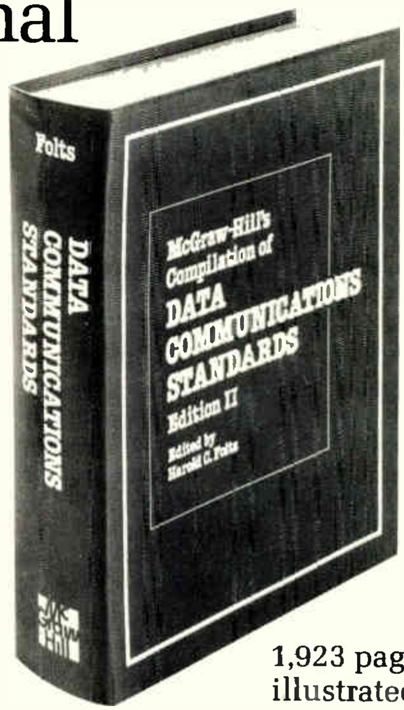

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EL1

Semiconductors

2 nA holds data in 64-K static RAM

C-MOS device's companion has n-MOS array; competitive pricing is two years away

Samples of 64-K static random-access–memory chips with as many transistors as the upcoming generation of 256-K dynamic RAMs will be available in Japan in March. Toshiba Corp. says that it expects to be able to deliver the first production shipments of its two new types of 8-K-by-8-bit complementary-MOS devices toward the end of 1982.

One, the TC5564P, is a true C-MOS device. The other, the TC5565P, incorporates an n-channel MOS memory matrix in a p-well with C-MOS peripheral circuits.

Both devices are made in a double-level polysilicon process with minimum line widths and spacings between lines of 2 μm, using 10:1–reduction direct-step-on-wafer projection lithography. They also share the same 100-ns maximum access time, 100-ns minimum cycle time, and Jedec type B 28-pin dual-in-line package.

Also common to both is the use of redundancy to increase yield, although the full C-MOS part incorporates an extra two rows and one column, whereas the n- and C-MOS RAM only has two columns. Laser programming of the extra rows or columns is used.

Seishi Okamoto, semiconductors application group manager, foresees the market for the high-priced pure C-MOS model in equipment that must retain memory with battery backup for months. Typical products include cash registers, pocket computers, and numerical- and industrial-control equipment.

Devices that require the n- and C-MOS chip include equipment that must only retain memory on battery backup for at most a few days and equipment where the added cost over a straight n-MOS device is warranted by the lower power consumption. Many applications using earlier 4- and 16-K static memories have been very price-sensitive and generated a huge market for n-MOS RAMs.

However, Okamoto says that he is unable to predict the breakdown of the market for 64-K devices. Increased emphasis on low-power designs may increase the premium that manufacturers are willing to pay for C-MOS parts.

The fully C-MOS version with six transistors per cell is fabricated on a 5.92-by-7.49-mm chip, with each cell measuring 19 by 22 μm. Typical standby current is a mere 2 nA; operating current is 2 mA/MHz with a 5-V power supply. This low-power level has been achieved by careful system design rather than by using dynamic circuits. Some use of bootstrap circuits is made for high speed, and sensitive flip-flops are used as sense amplifiers. Data is retained over a range of 2 to 5 V.

The n- and C-MOS RAM incorporates high-resistivity polysilicon-load resistors for the memory cells in the second polysilicon layer. This permits a decrease in cell size to 15 by 19 μm, and a corresponding reduction in chip size to 4.97 by 7.22 mm. The standby current for this model is increased to 1 μA, but the operating current is the same 2 mA/MHz as the fully C-MOS version.

Initially, samples will be available only in Japan at 60,000 yen (about $280) for the fully C-MOS chip and 50,000 yen for the n- and C-MOS part. Pricing for samples sold in the U. S. is not yet set. Toshiba sources say that the price per bit is expected to cross that for 16-K RAMs in 1984. (The price of a 16-K C-MOS parts in Japan today is 2,000 yen and falling.) These RAMs will also be available in flatpacks for use in applications where the user does not replace individual chips.

Toshiba Corp., 72 Horikawacho, Saiwaiku, Kawasaki 210, Japan [419]

C-MOS arrays boast 2-ns gates

2,000- and 6,000-gate arrays compatible with 74LS parts use double-metal process

A double-layer–metal complementary-MOS silicon-gate process that National Semiconductor is calling M²C-MOS adding speed to the firm's thrust into C-MOS gate-arrays. The first two parts made with the process, the 2,000-gate SLX 6320 and the 6,000-gate SLX 6360, have 3-μm geometries and typical gate delays of 2 ns.

The 2-ns typical gate-delay specification is a real one. Notes Dick Hunt, director of data-processing industry marketing for semiconductor products at National, "We specify that figure using a fan-out of three to four devices driving 100 mils of metal each." With C-MOS technology the arrays can be power misers, too. Each gate dissipates 20 μW per megahertz of switching frequency: with a typical switching frequency of about 5 MHz, the 2,000-gate and 6,000-gate arrays would draw 200 mW and 600 mW, respectively.

The arrays employ n-well technology, which is to their advantage, according to Hunt. "All of the scaling, lithography, and feature-size–reduction techniques that have been developed for other parts are applicable to our n-well C-MOS efforts," he says.

The SLX family maintains full compatibility with the 74LS family of parts. "Both ac and dc characteristics have been designed to match those of 74LS," says Hunt. For example, the output buffer's current and capacitive drive characteristics match those of the 74LS family, and the arrays' input buffer improves on the comparable 74LS characteristic. The propagation delay of the SLX family output buffer driving 50 pF is 8 ns typically; the family's TTL input

buffer has a typical propagation delay of 4 ns, faster than that of the 74LS family.

Samples of the SLX 6320 and 6360 will be available in the first and second halves of 1982, respectively. Fujitsu has announced a similar product, but the typical gate delays of the devices are on the order of 4 ns. Motorola is expected to announce a competing product, but its gate delays are as yet unknown.

National plans to support the SLX family with an integrated computer-aided design system that is accessible from remote locations. The system is to include routines for logic simulation, test generation and grading, and automatic placement and routing. Hunt says this system will make turnaround times of only 12 to 14 weeks a reality.

National Semiconductor Corp., 2900 Semiconductor Dr., Santa Clara, Calif. 05051 [411]

Customized gate arrays can replace 80 devices

Designers will be able to use two integrated Schottky TTL semicustom gate arrays in logic-replacement applications requiring higher input/output or gate count. With gate delays of 4 ns, the devices can take over from standard low-power Schottky devices.

The 8A1260 has 1,200 gates and 60 I/O pins and substitutes for up to 65 low-power Schottky devices. The 8A1542 has 1,500 gates and 42 I/O pins for replacing more than 80 devices. Both dissipate 168 μW per gate and operate over the $-55°$-to-$+125°$C temperature range.

The customer designs the gate arrays by simulating the required logic function with the Signetics time-shared Tegsim program, submitting the result with a logic diagram. Signetics completes the chip design using computer-aided design to ensure 99% first-pass success.

The arrays are available in plastic and ceramic dual in-line packages and leadless chip-carriers. In 5,000-piece lots, the 8A1260 ranges in price from $28 to $40, and the 8A1542 runs $26 to $36, depending on package type and pin count.

Signetics, 811 East Arques Ave., P. O. Box 409, Sunnyvale, Calif. 94086. Phone (408) 739-7700 [413]

Static RAM can be accessed in 35 ns

Organized into 1,024-K words by 4 bits, the TMS2149 static random-access memory benefits from Texas Instruments' scaled n-channel MOS silicon-gate technology. The 4-K-device offers a worst-case access time from address of 35 ns—its access time from chip-select is just 15 ns. In addition, its maximum operating power is 660 mW, leading to a speed-power product of 23,500 pJ. The RAM operates from a single 5-V power supply.

With speed ranges of 35 to 70 ns, the TMS2149 is offered in both ceramic and plastic 300-mil, 18-pin dual in-line packages. The device is available immediately for $8.45 each in 100-piece quantities.

Texas Instruments Inc., P. O. Box 202129, Dallas, Texas 75220 [417]

256-K dynamic RAM takes up 0.46-in.^{2}

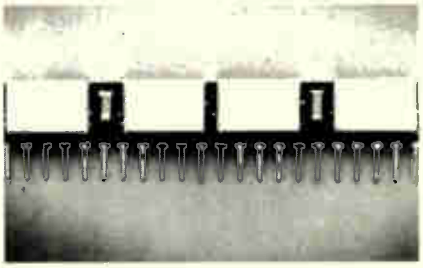
Occupying 0.46 in.^{2}, or just slightly more board space than a standard 16-pin dual in-line package, the EDH-4256 256-K-by-1-bit dynamic random-access memory may interface directly with high-performance logic families like Schottky TTL. It has on-chip address and data registers and two chip-select methods.

On a 22-pin single in-line package, the device uses four 64-K RAMs in leadless chip-carriers and two 0.1-μF decoupling capacitors. Operating from a single +5-V supply, it dissipates only 540 mW when active and 110 mW on standby. Its input-noise immunity minimizes false triggering of the inputs.

The compact memory is suitable for applications that require error checking or in systems using unorthodox bit counts—for example, in word processors, single-board computers, test equipment, and military electronics.

Two versions are available, a device with 150-ns access time for $123 in 100-unit lots and one with 200-ns access time for $112 in like quantities.

Electronic Designs Inc., 230 Eliot St., Ashland, Mass. 01721. Phone (617) 881-5244 [415]



4-K C-MOS RAMs are radiation-hardened

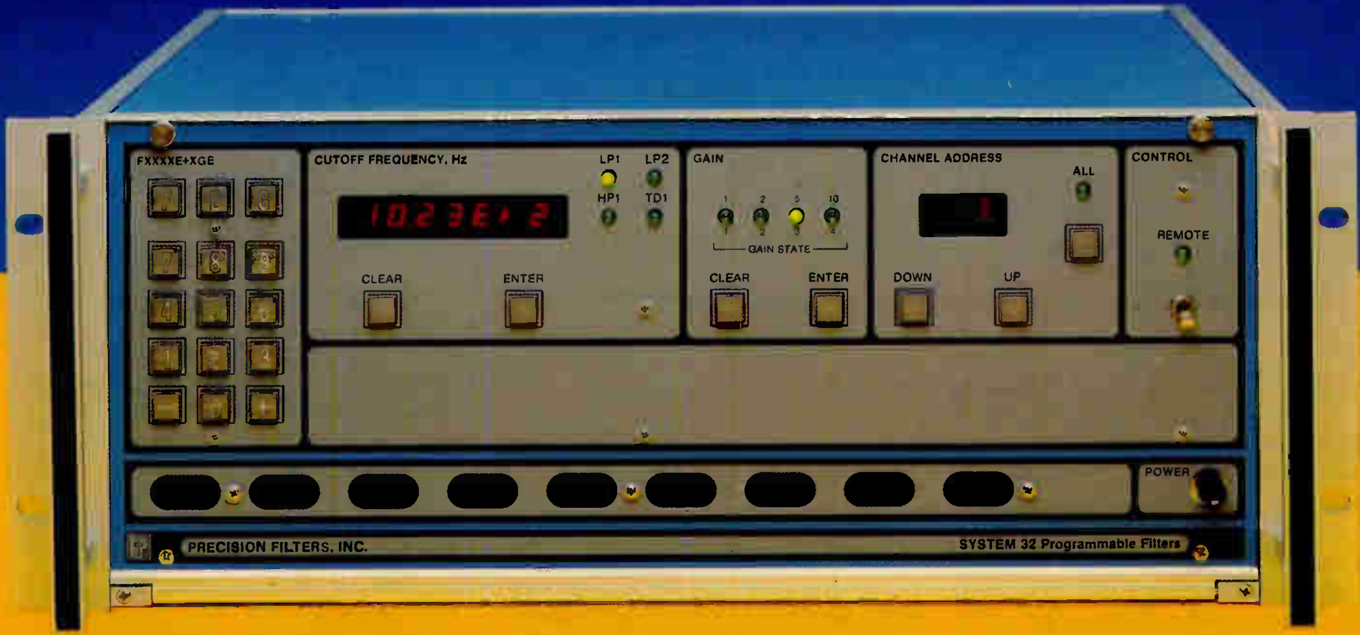
Two 4-K complementary-MOS static random-access memories are constructed using radiation-hardened, self-aligned silicon-gate technology for such applications as satellites, nuclear instrumentation, and tactical and strategic weapons systems.

The HS-6504RH is a 4,096-by-1-bit RAM, and the HS-6514RH is a 1,024-by-4-bit version. Typical access time for both is under 250 ns. They consume 8 mW/MHz typically, 25 mW/MHz at worst, and 500 μW on standby. Both memory devices have a total dose capability of 5×10^5 rad silicon and also latch-up-free operation of greater than 5×10^{11} rad silicon/s.

A 64-K version, the HS-6564RH, can be constructed using 16 of either of the two devices mounted on a ceramic substrate and screened to MIL-STD-883-B. Both the HS-6504RH and 6514RH are available in either dual in-line packages or leadless chip-carriers for $400 each in 100-piece quantities.

Harris Corp., Programs Division, P. O. Box 883, Melbourne, Fla., 32901. Phone (305) 724-7800 [414]

DOUBLE TROUBLE FOR ALIASES



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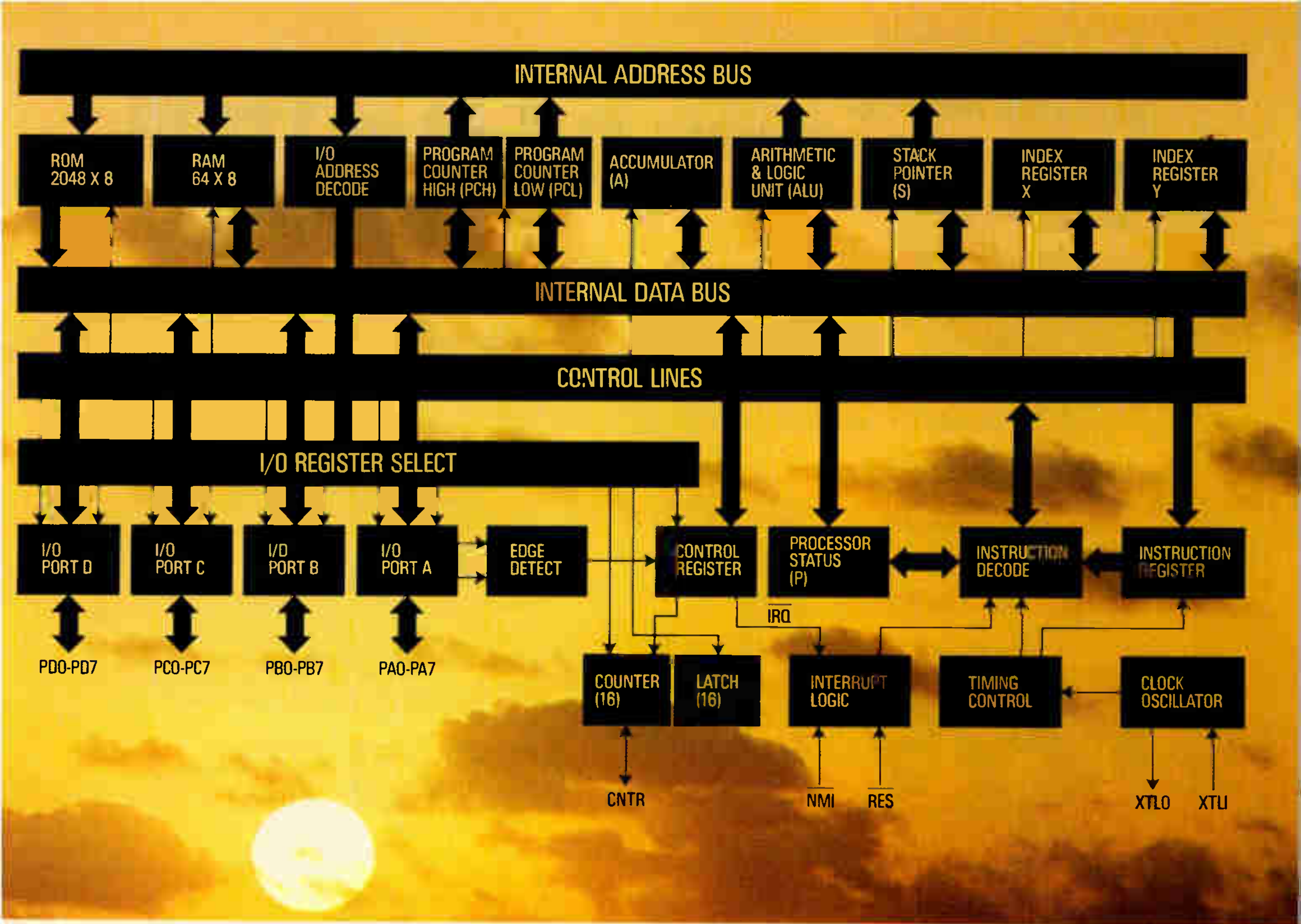

The 6500/1 One-Chip Micro. First, look what it's got. Then, look what it costs.

$10.50 at 1,000. And there's more good news. No masking charge for the on-board 2K x 8 programmable ROM. And, the MOS 6500/1 is available in either 1MHz or 2MHz versions.

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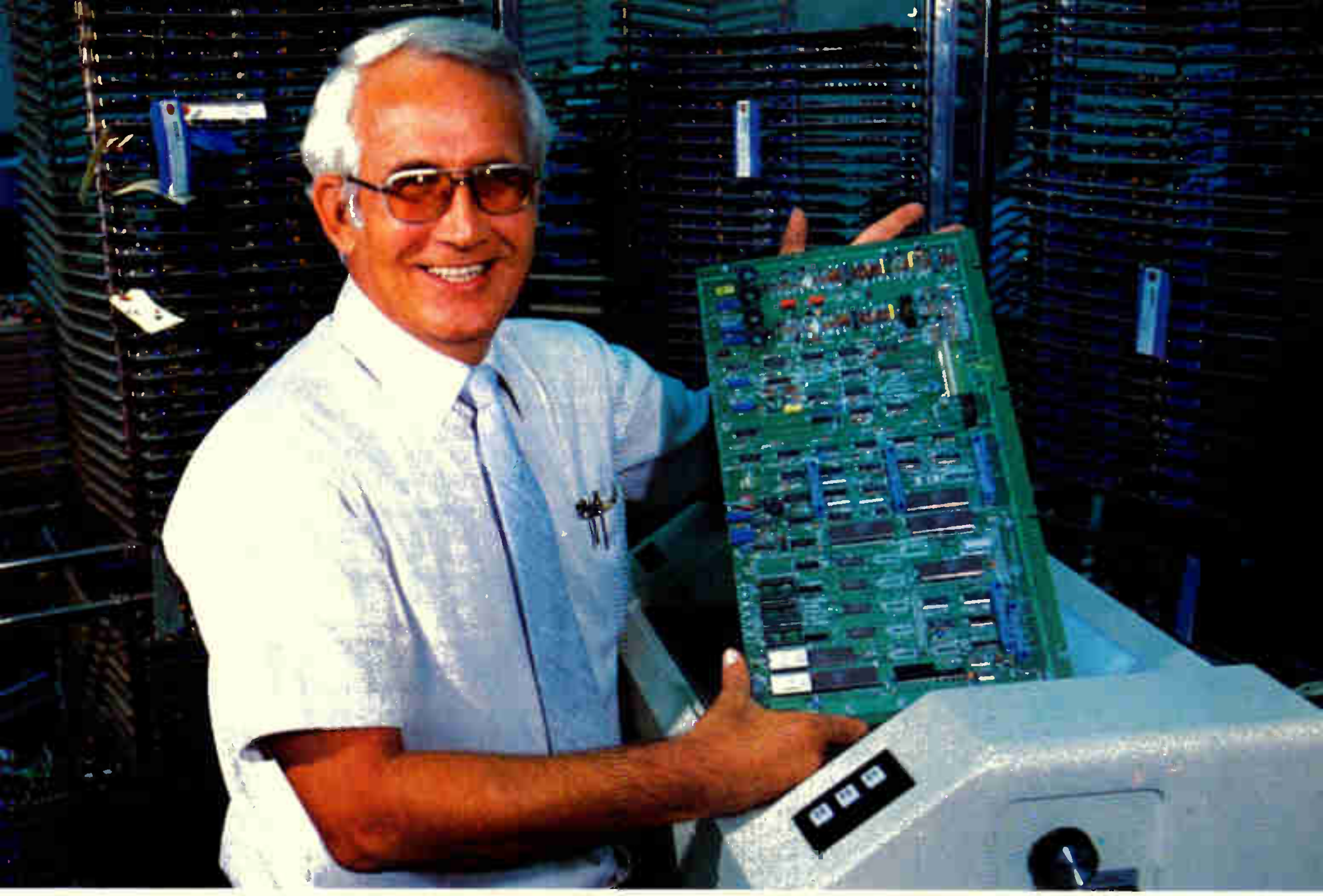

Computer Peripherals doubles production with Universal Automatic Insertion Equipment.

Luther "Duke" Galloway, manufacturing engineer of Computer Peripherals, Inc., Campton, KY, analyzed the company's printed circuit board production and concluded that they could save a quarter million dollars per year by automating circuit board component insertion with Universal Instruments equipment. He also concluded that production could be more than doubled on one shift.

Corporate management gave the go-ahead and Duke ordered a Universal Multi-Module® DIP Insertion Machine (3600/hr), a Dual-Head VCD Axial Lead Insertion Machine (25,000/hr) and a 60-Station Component Sequencing Machine to provide component reels for the VCD machine. The System is controlled by a Satellite Controller® computer-based system. A Program Generation System was also ordered to allow fast, easy and highly accurate insertion pattern program generation.

In theory, these insertion rates are equal to the average production of 17 people. In actuality, the increased production made possible by the Universal Instruments automatic insertion system, also has increased Computer Peripherals productivity dramatically. Through the use of the Universal automatic insertion equipment, production schedules can handle even periods of peak demand.

Even more, Computer Peripherals is taking on more work from other Control Data divisions, some of whom were buying their circuits from outside vendors.

Board reject rates have dropped because, with automatic insertion equipment, as Duke Galloway comments, Computer Peripherals has increased quality and reliability at lower cost. "It has been possible for us to build in quality from the beginning. You are as accurate as your program tapes are. We know that by developing good programs, we increase the reliability and quality of the boards, as we lower cost and increase production. Good tape programs mean good boards."

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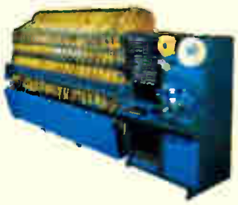
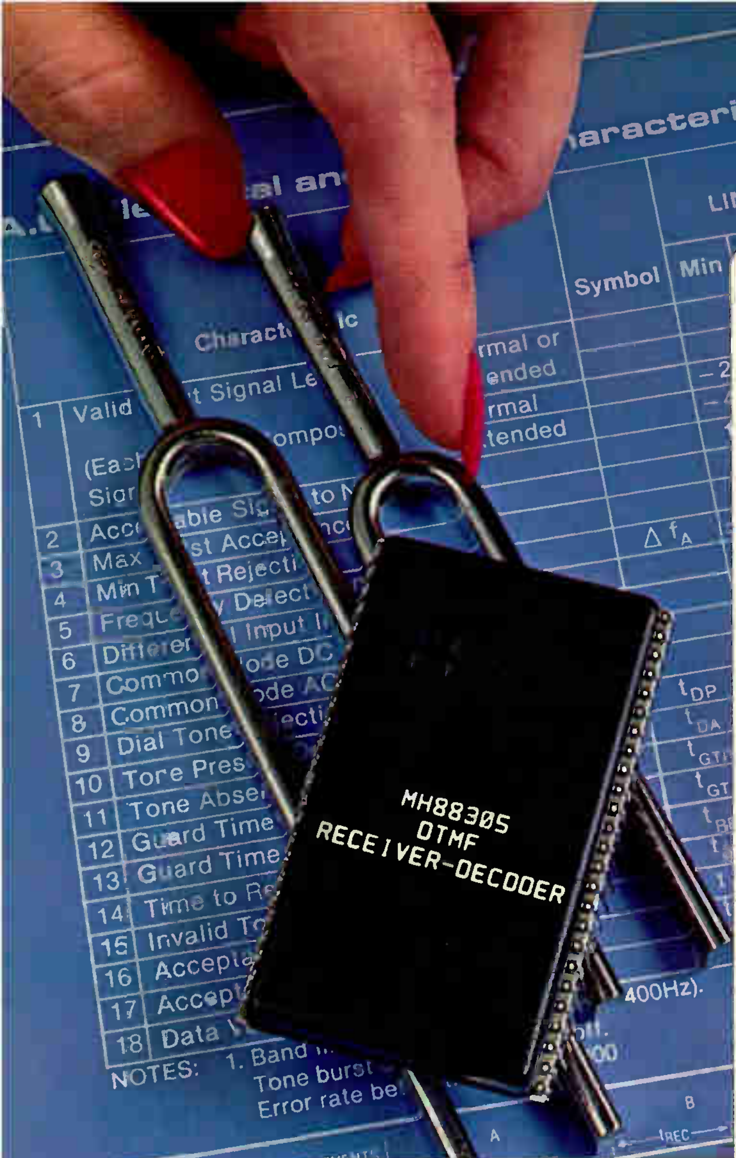


Component Sequencer

Program Generator



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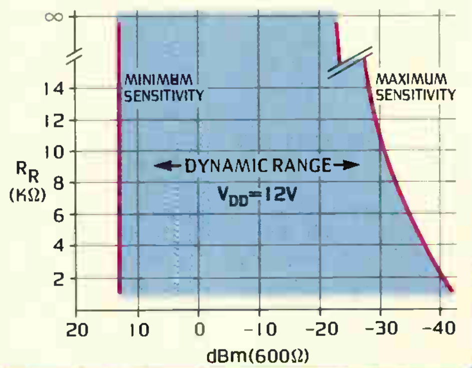

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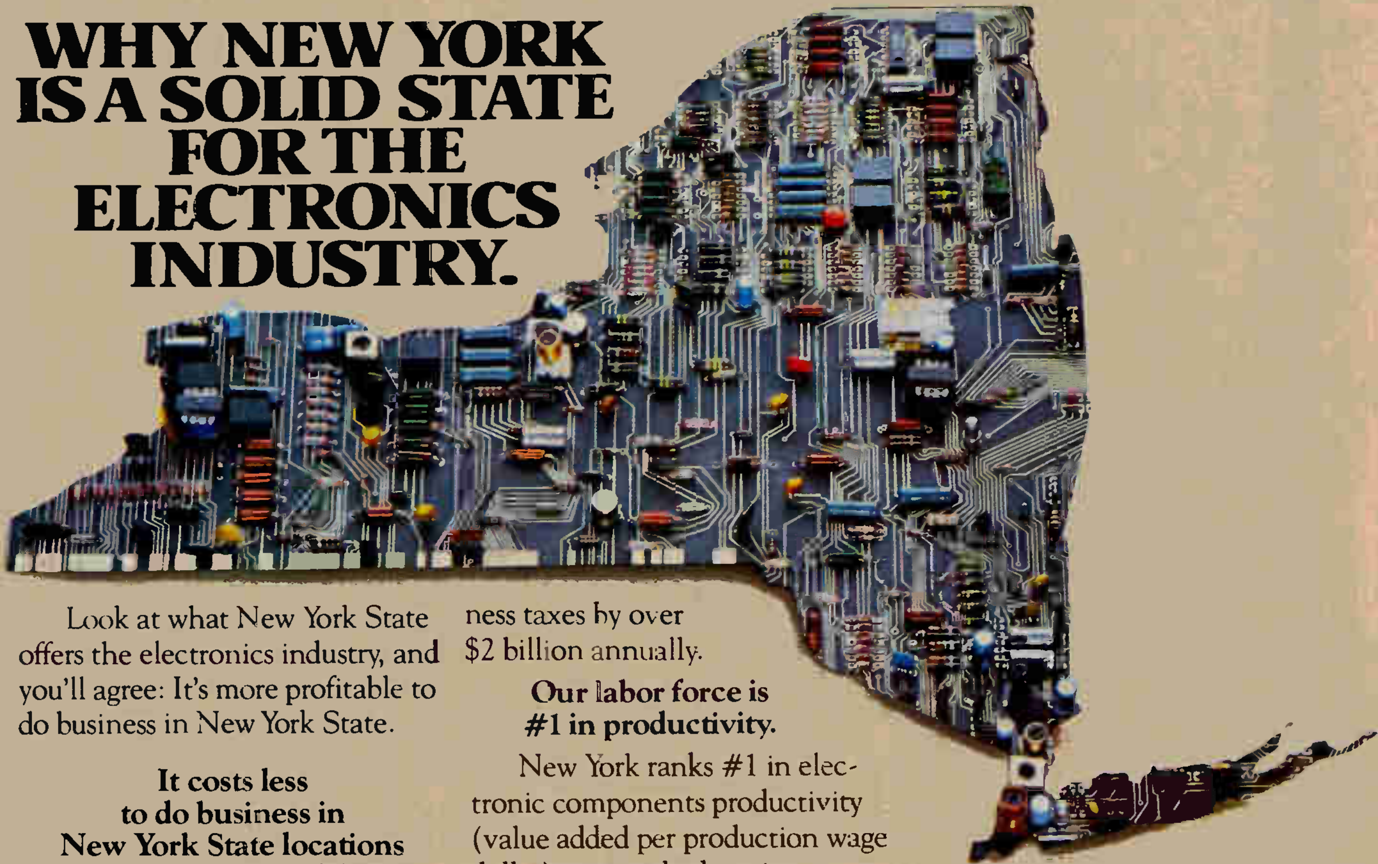

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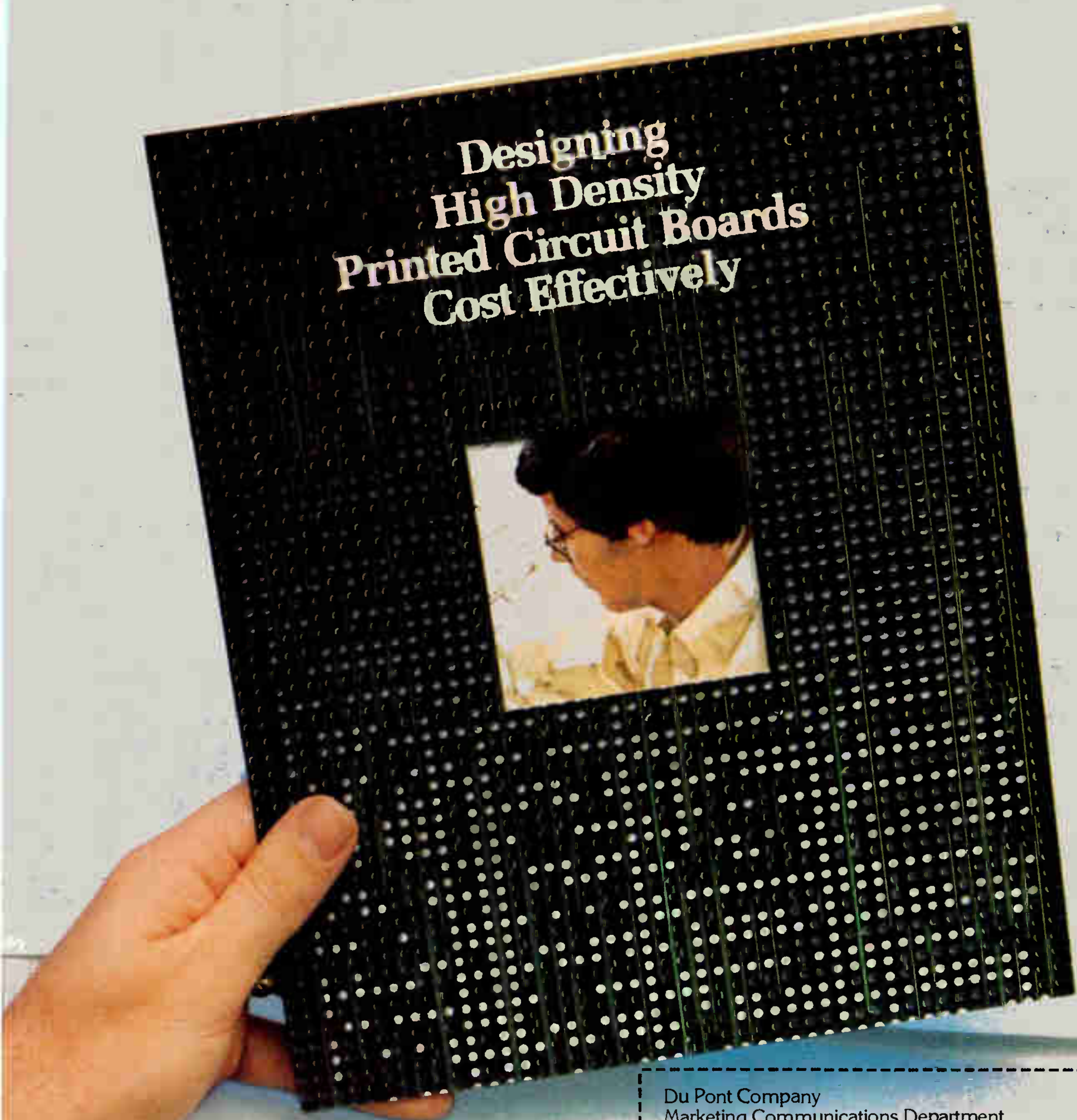

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Industrial

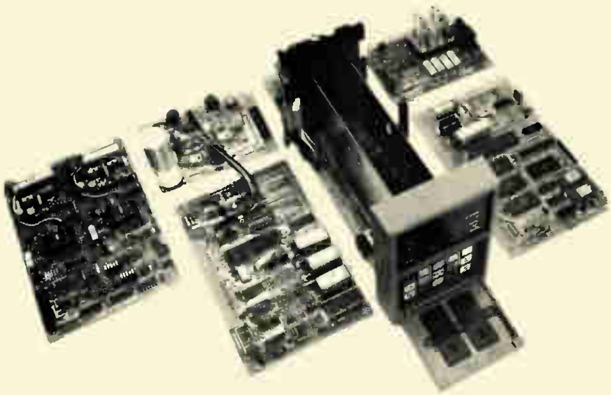
Loop controller has ±1° accuracy

8085-based single-loop temperature or flow controller can interface with computer

An 8085 is at the heart of a versatile modular process controller from Honeywell—the UDC 500, for universal digital controller. This single-loop temperature and flow controller is intended for furnace or boiler lead-lag control, temperature control in ovens, air-fuel ratio and other flow-ratio control, multizone kiln and distillation-column control, among other things. At any point on the temperature scale for types J, K, and T thermocouples, the UDC 500's accuracy is to within ±1°F. This high accuracy can help a furnace pass stringent inspections, aid in saving fuel, and result in high product consistency.

At $1,400 for the basic unit with one input and one output (it can be equipped with an extra one of each), the UDC 500 is not inexpensive compared with the less sophisticated controllers it seeks to replace. But the addition of an RS-422 interface card permits it to be connected to a computer network using the High-level Data-Link Control protocol, opening up numerous possibilities at the system level. Customers with the need to control simple machines and to make them work together can use this feature. Honeywell sees these users as a large segment of the industrial control market.

The UDC 500 also justifies its price with a very high level of functionality combined with simple operation. During normal operation with the front panel door closed and locked, the operator sees two four-digit light-emitting-diode displays, nine indicator LEDs, and four buttons. The top digital display is dedicated to one process-variable input value; it can be set to read temperature in degrees Fahrenheit or Celsius and to show tenths of a degree or not, as required.



The lower digital display can read out the setpoint or the output value for one of the two possible outputs. The four buttons allow the operator to select what is shown on the lower display and to change the displayed value manually if necessary. LEDs indicate status (automatic operation or manual), tell the operator what's on the bottom display, and light up if one of two possible alarms has been tripped.

The front panel door when opened reveals several data-entry keys used in setting up the control loop. For security, a switch on one of the circuit boards must be accessed to change the basic algorithm used by the microprocessor or to change alarm or control-output action. Data is stored for 10 years or more in electrically erasable programmable read-only memory from General Instrument, thus preventing data loss on power failure without need for battery backup. Standard ROM contains routines for the unit's power-up self-test, automatic tuning, and calculation of such as integral square root and ratio bias adjustment.

Two alarms can be set to monitor two independent events each, for a total of four events. The event can be a high or a low on either the process variable, the deviation, or the output. Optional relays can activate external equipment when alarm setpoints are exceeded.

The control output can be an analog signal that is current-, time-, or position-proportioning. It may also be set for on-off, on-off duplex, and three-position step control. The controller can accept two inputs, which can be different variables. Analog input is scaled, filtered, and sampled at 3 Hz. The sampled signal is amplified and converted into digital form; it then passes through isolation to the microprocessor.

The UDC 500 accepts thermocouple signals directly, without the need for a temperature transmitter and its associated power supply. The controller is compatible with most standard sensors, pressure transmitters, and final control devices. It occupies 3.62 by 5.39 in. in a panel.

Honeywell Process Control Division, Dept. 436, 1100 Virginia Dr., Fort Washington, Pa. 19034 [381]

Unit brings 16-bit power to industrial control system

The Macsym 10 measurement and control system operates in harsh process-control and manufacturing environments. It features a rugged package suitable for rack mounting with NEMA-12 enclosures, an operating temperature range of +5° to +50°C, dust immunity, an operator's keylock for security, and a solid-state memory eliminating moving parts that are found in tape-cartridge units or floppy-disk drives.

The Macsym 10 is available with 27 input/output cards for up to 512 I/O connections. Up to 8,000 connections can be made by adding an expansion chassis. It is programmable in an enhanced form of Basic optimized for measurement and control applications called Macbasic. It includes a 16-bit central-processing unit with floating-point firmware; a 96-K-byte random-access memory (expandable to 128-K bytes); an ana-

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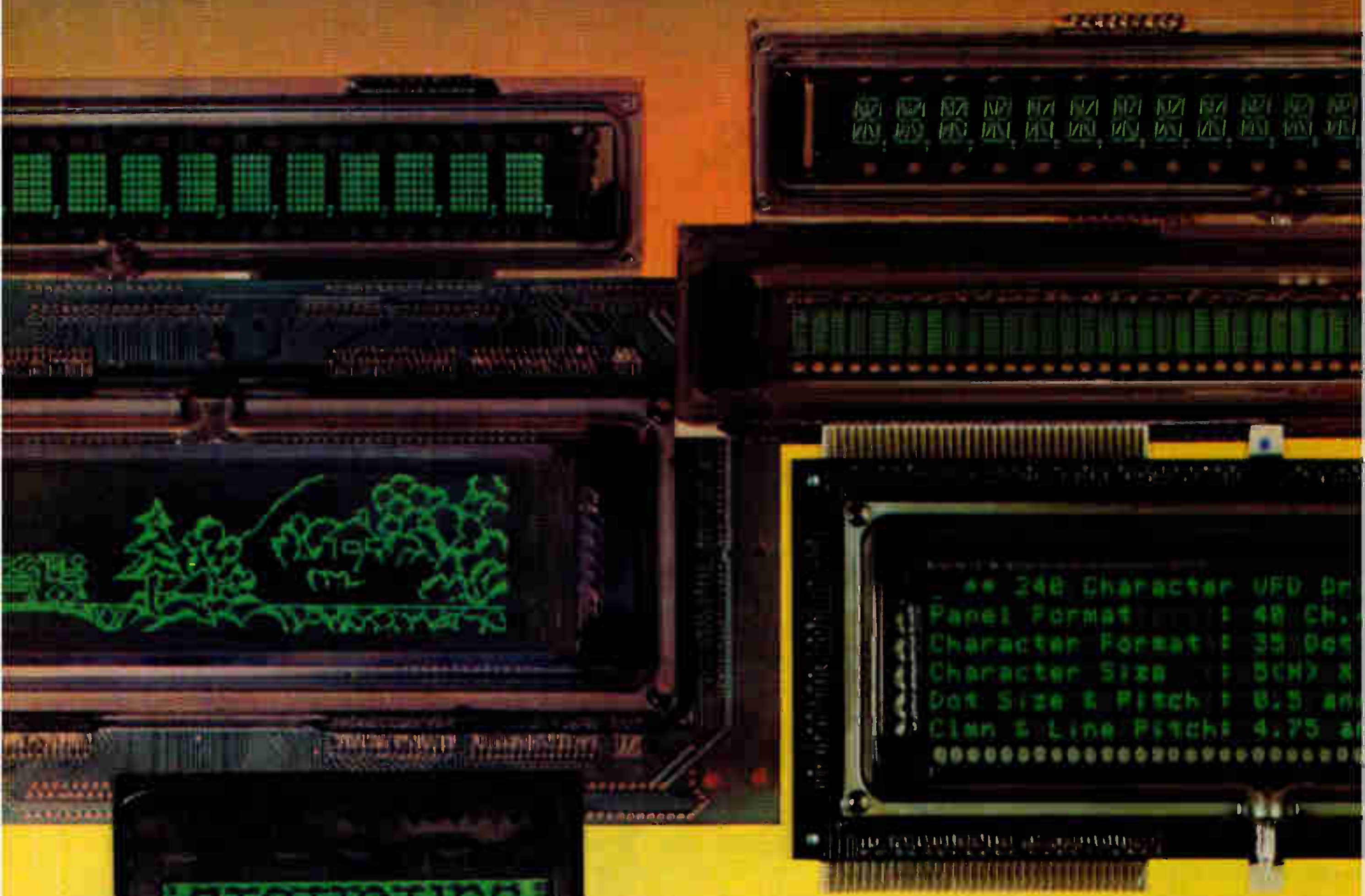
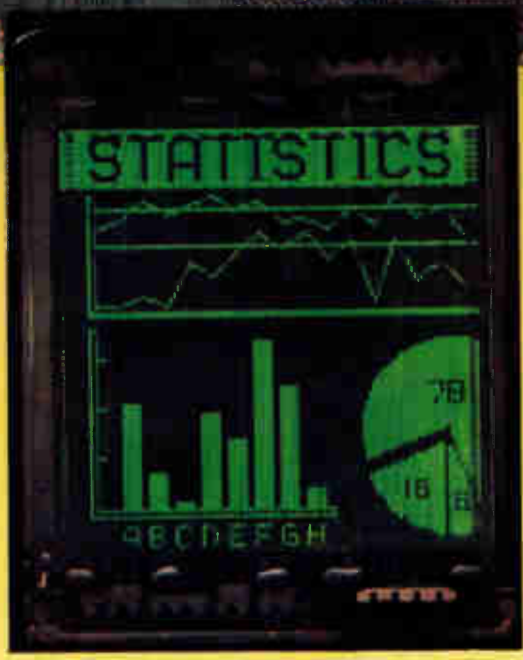

The brilliance and conciseness of our new high density 128 x 128 and 256 x 64 dot matrix display panels—made possible by our advanced double-matrix structure—exemplify the wealth of benefits afforded by "itron" fluorescent units. Let's enumerate some of the other reasons they'll enhance your designs' future.

Take alphanumerics. As the inventors of fluorescent technology, we naturally offer the widest selection of 14-segment and dot matrix arrays—from 5 mm to 15 mm in character heights, and packages ranging from 14-segment 8-character mini-units to complete 240 character 5x7 dot matrix plug-in panels. and everywhere in-between.

Their proven performance record, combine with cost-conscious pricing and ease of installation to make for time and money savings. And, their easy readability—even under high ambient light conditions and at extreme viewing angles—as well as low power requirements, are other good reasons why "itron" flourescent displays will embellish your equipments' capabilities. As there're many more things to be said for "itron" fluorescent displays, contact us for particulars.

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Patented and Manufactured by
ISE ELECTRONICS CORP.

INTERNATIONAL REPRESENTATIVES

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FRANCE: Europavia France. 5 Avenue Leon Harmel 92167 Antony Cedex. Phone: 666-21-10. Telex: 42204381

UNITED KINGDOM: ITT Meridian. West Road Harlow. Essex CM20 2BP Phone: 0279-35351. Telex: 817202

SWEDEN: AB Nordqvist & Berg. Box 9145 S 10272. Stockholm. Phone: 08-690400. Telex: 10407

DENMARK: E. V. Johanessen Elektronik A-S. Titagade 15-2200. Copenhagen. Phone: 01/839022. Telex 16522

HONG KONG Phone: 5-232420. TAIPEI: Phone: 351-0293.

Circle 258 for Sales Contact

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EASTERN OFFICE: 41 Madison Avenue, New York, NY 10010 ● (212) 481-3440 ● Telex: 12-5469
CENTRAL OFFICE: 1822 Brummel Drive, Elk Grove Village, IL 60007 ● (312) 439-9020
WESTERN OFFICE: 22410 Hawthorne Blvd., Torrance, CA 90505 ● (213) 373-6704 ● Telex: 67-4910
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Circle 259 for Literature Only

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For information about Spectrum Control and EMC technology, write: Spectrum Control, Inc., 8061 Avonia Rd., Fairview, PA 16415. Call: 814-474-1571.

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(ROM) 40K bytes*

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For the IBM Personal Computer dealer nearest you, call (800) 447-4700. In Illinois, (800) 322-4400. In Alaska or Hawaii, (800) 447-0890.

Trim the cost of laser trimming

A smart approach to containing costs and boosting productivity.

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For a detailed appraisal of how the Smart Laser Trim System can fill your needs, contact Chicago Laser Systems.

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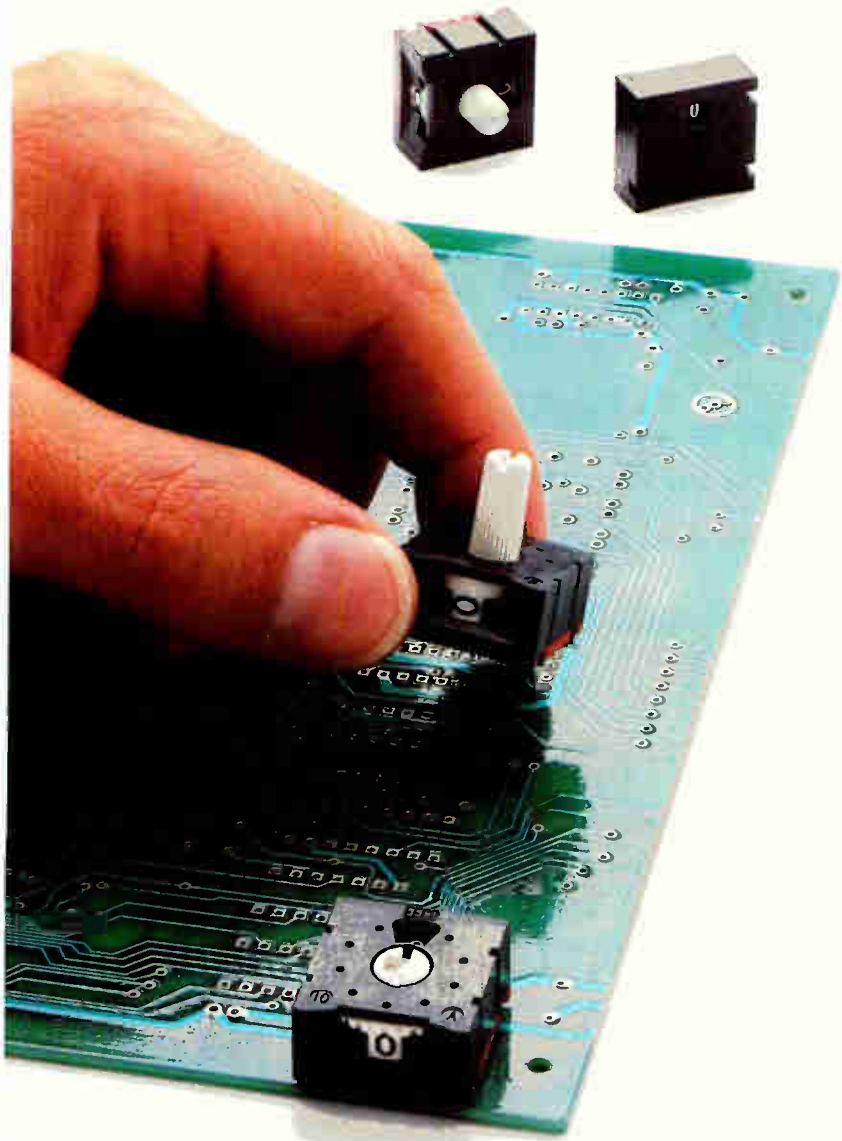

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The better alternative to the printed circuit board mounted thumbwheel switch, EECO's STRIPSWITCH™ makes selecting coded outputs for digital circuits easy and economical.

CODE VERSATILITY. Available in a wide variety of codes, including 10- and 16-position switch modules, STRIPSWITCH can be used alone, or in combination. Mounted side by side on your PC board, they team up to let you mix and match codes in one space-saving assembly.

SIMPLICITY. Simple to design in and simple to use, STRIPSWITCH requires a minimum of PC board space and eliminates costly wiring. They can be mounted horizontally or vertically on either side of the board without hardware. Adjustments are even easy, since their design allows mounting on the card edge to provide accessability without pulling the card. Plus, STRIPSWITCH' low profile permits close card spacing.

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RELIABILITY. Introduced by EECO in 1975, STRIPSWITCH remains first in sales and first in reliability. This means positive detent action, legible markings and consistent codes. Both the 2100 Series and the low profile, standard bottom sealed 2600 Series offer years of quality performance.

EECO's exclusive one-piece terminal board holds 2100 Series STRIPSWITCH modules firmly in place. One part number designates the number of stations in the strip – up to four – and helps make your manufacturing and parts inventory easier.

And as the only manufacturer of this type switch with a distributor value added program, EECO also means reliable service – fast delivery and competitive prices. Our distributor value added program can reduce lead times from several weeks to a few days.

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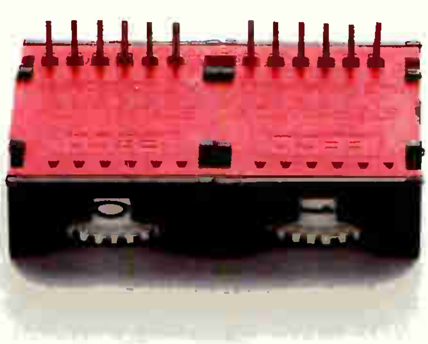

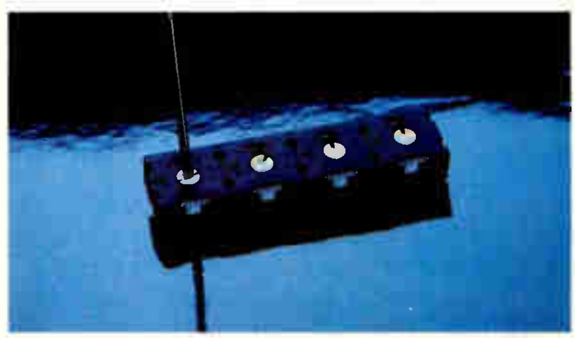

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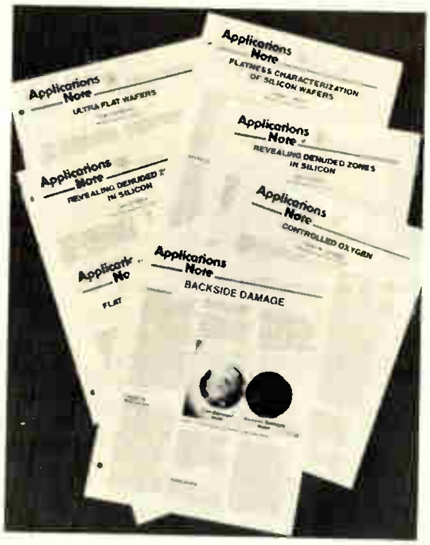
EECO Incorporated

New literature

Programming a 16-bit chip. "The 68000: Principles and Programming" by Lee J. Scanlon, describes the 68000 16-bit microprocessor and how to program it. In its nine chapters, the book discusses Motorola's Cross Macro Assembler 14 addressing modes and 56 instruction sets capable of handling everything from integer arithmetic to bit manipulation. The book summarizes the support circuits that can be interfaced with the 68000, as well as the fundamental input/output operations, and provides a survey of the hardware and software support products currently available. The book (No. 21853) sells for $14.95 plus $1 for shipping and handling and 4% sales tax for Virginia residents. Visa and Mastercharge cards are accepted. For purchasing and further information, contact Group Technology Ltd. at P. O. Box 87, Check, Va. 24072 or phone (703) 651-3153. Circle reader service number 421.

Voice data entry. A four-page brochure entitled "Trends in Data Entry by Voice" reports on major advancements in the capabilities of voice-data entry systems that will improve productivity in manufacturing, quality-control, materials-handling, and numerical-control programming applications. The brochure includes reports on market projections, the economies and efficiencies of voice data entry, and it describes the hardware and software systems for both original-equipment manufacturers and end users. Threshold Technology Inc., 1829 Underwood Blvd., Delran, N. J. 08075. Phone (609) 461-9200 [422]

Wafer fabrication. A series of technical application notes have been issued by the Electronics division of Monsanto Co. for the wafer fabrication industry. The issues, which concentrate on determining wafer needs and optimizing yield, include "Backside Damage," "Flatness Characterization of Silicon Wafers," "Controlled Oxygen," "Revealing Denuded Zones in Silicon," "Flat Location Consequences," and "Ultra Flat Wafers." These application



notes can be obtained by writing to B. G. Marchetta at Monsanto Electronics, P. O. Box 8, St. Peters, Mo. 63376. [423]

Apple computer references. Two publications are now available for the Apple user. "The Micro/Apple," Vols. 1 and 2, edited by Ford Cavallari, contains articles on the Apple computer and comes with a floppy disk of the microcomputer programs listed in the articles. Both volumes sell for $24.95 including the floppy disk. "What's Where in the Apple," by William F. Luebbert, describes Apple II firmware and hardware. It contains an atlas and a gazetteer that provides over 2,000 locations of peeks, pokes, and calls. The names and locations of various Monitor, DOS, Integer Basic, and Applesoft routines are listed. It sells for $14.95. Micro Ink Inc., 34 Chelmsford St., P. O. Box 6502, Chelmsford, Mass. 01824 [424]

Temperature measurements. The 1981/82 edition of the "Temperature Measurement Handbook" contains over 220 pages of products and technical articles on sensors and accessories such as indicators, controllers, and extension wires for applications ranging from cryogenic temperatures to over 2,200°C. For a free copy write to Gregory C. Nanigian at Nanmac Corp., 9–11 Mayhew St., Framingham Center, Mass. 01701. [430]

Logic-array design. A manual from Applied Micro Circuits Corp. shows logic and system designers how to implement logic functions on monolithic integrated circuits by using the Q700 high-speed logic-array series. The book contains procedures and rules to interconnect a library of predesigned logic elements—macros—such as gates, flip-flops, and multiplexers; directions for entering the time-shared data base for simulation and net-list generation; and specifications on the production of these high-performance very large-scale integrated chips. The manual is available on a registered subscription basis for $300 for the first year. This fee is credited to customers when ordering their first Q700 Quickchip. For a copy of the manual, contact Applied Micro Circuits Corp., 10626 Bandley Dr., Cupertino, Calif. 95014. Phone (408) 257-4030 [425]

Data-conversion products. Application notes AN-13, -14, and -15 contain information on three design ideas for Teledyne Semiconductor's data-conversion product line. With the AN-13, the user can build a remote-control, dual-range analog-to-digital converter using Teledyne's 7106/7107 a-d converter. The AN-14 describes a way to modify a digital multimeter to measure frequency using Teledyne's 9400 frequency-to-voltage converter. The AN-15 details a simple way to use the 7106/7107 a-d converter to measure its own power supply. All three notes are available upon request from the advertising department of Teledyne Semiconductor, 1300 Terra Bella Ave., Mountain View, Calif. 94043. Phone (415) 968-9241, ext. 451 [426]

Capacitors. The Passive Components division of Thomson-CSF has published a brochure comparing its IRD capacitors made from metalized polyester film with the NPO, X7R, and Z5U monolithic ceramic capacitors. Charts and graphs compare the two in operating-temperature range, temperature characteristics, dc voltage coefficient, dissipation factor, insulation resistance, aging rate,

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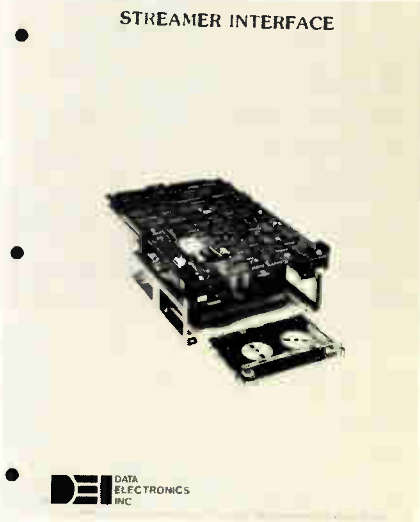
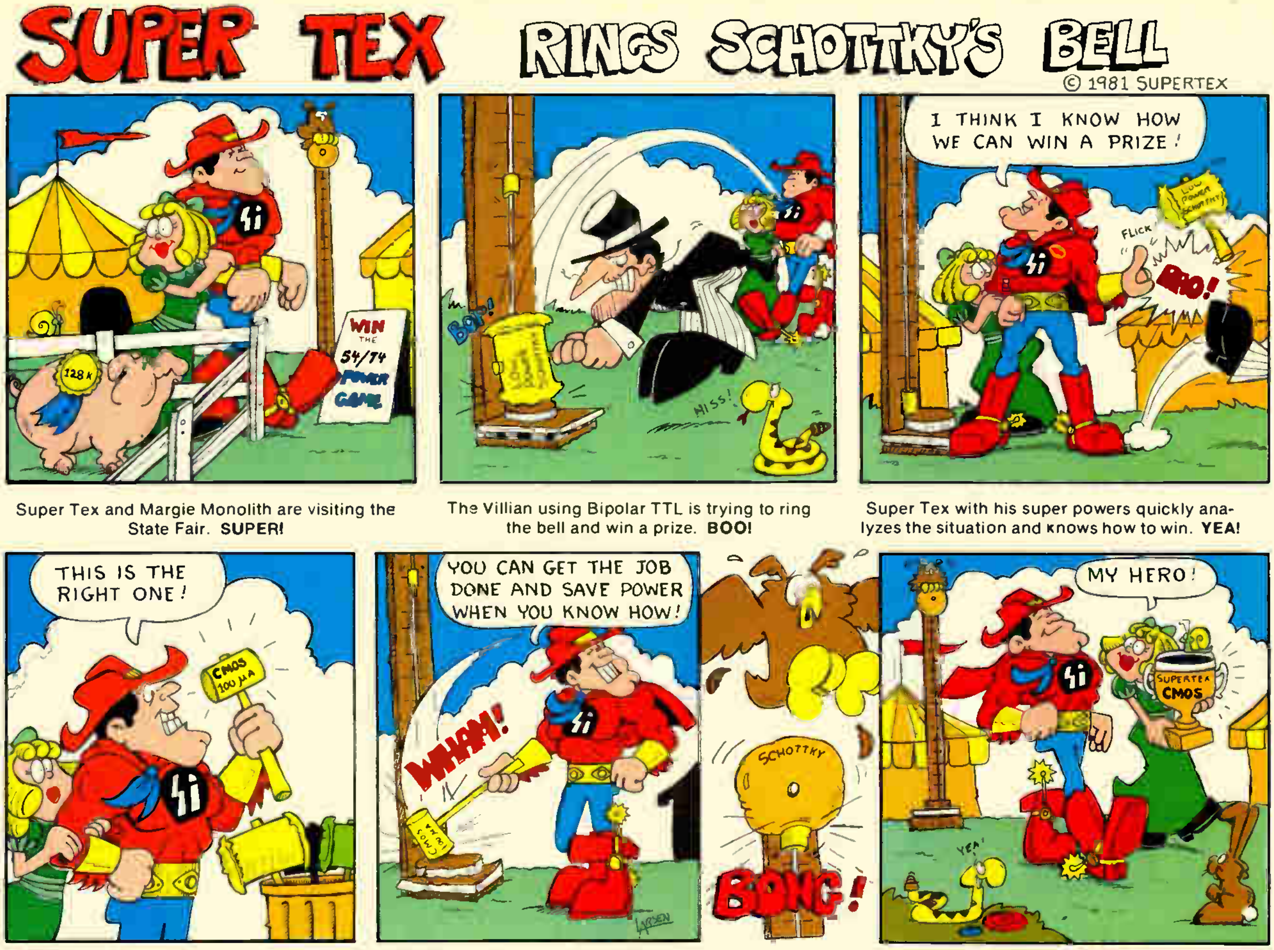
standard capacitor tolerances, electrode construction, size, lead spacing, capacitor range, and typical pricing. The brochure is free from Thomson-CSF Components Corp., 6660 Variel Ave., Canoga Park, Calif. 91303. [427]

Interfacing streaming-tape drives. Design factors relating to interfacing Data Electronics Inc.'s streaming ¼-in. digital cartridge-tape drive, the Streamer, are discussed in a 60-page manual. The book summarizes specifications, input/output signal requirements, timing diagrams, and streamer formats, and describes the drive's modes of operation. For further information and copies of the manual, contact Data Electronics Inc., 10150 Sorrento Valley Rd., San Diego, Calif. 92121. Phone (714) 452-7840 [428]



Latest Motorgram issue. The current issue of Motorgram contains an article on the "Recovery of Silver Lost in Film Processing" that presents the history of the Prospector 624, an automatic electrolytic silver-recovery machine. The issue also contains a section entitled "From the Chief Engineer's Handbook" that provides data on the design, operating characteristics, and advantages and disadvantages of permanent magnet synchronous motors. For a copy of this issue, Vol. 61, No. 3, write to Bodine Electric Co., 2500 West Bradley Place, Chicago, Ill. 60618. [429]



Super Tex and Margie Monolith are visiting the State Fair. **SUPER!**

The Villian using Bipolar TTL is trying to ring the bell and win a prize. **BOO!**

Super Tex with his super powers quickly analyzes the situation and knows how to win. **YEA!**

Knowing how to achieve results with low power consumption, Super Tex selects the CMOS hammer. **HUZZA!**

Right over might. **GONG!**

Super Tex explains to Margie that by using Supertex CMOS hammers, TTL interface can be done at low power. **VICTORY!**

(To know how Super Tex did it, see the specs below.)

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By utilizing state of the art, oxide isolated, Silicon Gate CMOS technology combined with HMOS scaling techniques, Supertex offers a family of CMOS interface circuits with the highest performance available today. This new family of circuits meets LSTTL speed specifications at less than 1% of the power consumption.

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54/74SC138	1 of 8 Decoders
54/74SC139	Dual 1 of 4 Decoders
54/74SC237	1 of 8 Decoders with Latched Address
54/74SC238	1 of 8 Decoders
54/74SC239	Dual 1 of 4 Decoders
54/74SC240	Octal Buffer
54/74SC241	Octal Buffer
54/74SC242	Quadruple Bus Transceivers
54/74SC243	Quadruple Bus Transceivers

Device No.	Description
54/74SC244	Octal Buffer
54/74SC245	Octal Bus Transceiver
54/74SC373	Transparent Latch
54/74SC374	D-Type Flip-Flop
54/74SC533	Transparent Latch
54/74SC534	D-Type Flip-Flop
54/74SC540	Octal Buffer
54/74SC541	Octal Buffer
54/74SC563	Transparent Latch
54/74SC564	D-Type Flip-Flop
54/74SC573	Transparent Latch
54/74SC574	D-Type Flip-Flop

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Important editorial


Electronics review

Air Force working on single language for its computers

Ada's modularity sparks interest for civilian uses

Ada's father speaks many languages

Can Jovial spell DO

Special report: Ada, the ultimate language?

Electronics worldwide editorial announces and interprets all important technological developments.

Take Colin Johnson and the Countess of Lovelace...

Similar backgrounds. Colin Johnson is a computer engineer who earned an MS from the University of Michigan and taught microprocessors at Wisconsin School of Electronics. He's also our software editor. The Countess of Lovelace was a computer expert, too, and the world's first programmer as evidenced by her work on Babbage's Difference Machine in the 1840's. Their paths would cross in Minneapolis on December 2, 1980. The catalyst would be Electronics. The result would be technology interpretation in its highest form.

The rendezvous. After a decade of development, through the foresight and funding of the Department of Defense, a new computer language was formed in 1980. It would be the answer to the Pentagon's demand for a single, tactical systems language that would reduce software costs. It was named *Ada*, because of the early programming contributions of Augusta Ada Byron, the *Countess of Lovelace*. Characteristically, Electronics had related Ada's progress during its military/industrial development, but it was now up to Colin to interpret its significance and importance to engineers and managers throughout the world. *What better way to interpret than to learn the language itself?* Colin learned that Ada's prime architect, Honeywell, was planning a three-day industry-only seminar in Minneapolis given by Ada's author, Jean Ichbiah. After a great deal of persistance (plus $3000 in attendance fees), Colin was introduced to Ada as the only journalist/participant at the seminar. The rest is history. Colin immediately embraced Ada and produced the exclusive, in-depth report which appeared in Electronics' February 10, 1981 issue.

Epilogue. Ada remains Colin's favorite, as he believes that Ada will become *the* international standard computer language. The story of Colin and the Countess typifies Electronics' editorial commitment to first-hand reporting and interpretation. In Electronics, important technology *becomes* important editorial.

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- **6502** . . . . #27-6, $16.99 ☐
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- **8080A/8085** . . . . #10-1, $15.99 ☐

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PET and the IEEE 488 Bus (GPIB)

by E. Fisher an C.W. Jensen

Provides chapters on all aspects of the General Purpose Interface Bus. Includes lines, signals, specifications, and much more. #31-4, $15.99 ☐

Microelectronic References

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by Adam Osborne and Gerry Kane

The one source for complete, objective and accurate information on 4 and 8 bit microprocessors. This book describes virtually every 4 and 8 bit microprocessor on the market today, and allows you to evaluate any device or combination of devices. #42-X, $19.95 ☐

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A total reference book on virtually every 16-Bit microprocessor, this book permits objective evaluation and comparison of these new devices. #43-8, $19.95 ☐

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Binder - #19-5, $6.99 ☐
Six Updates - #98, $25.00 ☐

Handbooks

68000 Microprocessor Handbook

by Gerry Kane

This handbook offers more information about the 68000 than the manufacturer's data sheets. #41-1, $6.99 ☐

CRT Controller Handbook

by Gerry Kane

Describes five devices in the same thorough detail you'll find in Volume 3. Contains 13 tables and 149 separate illustrations. #45-4, $6.99 ☐

8089 I/O Processor Handbook

by Adam Osborne

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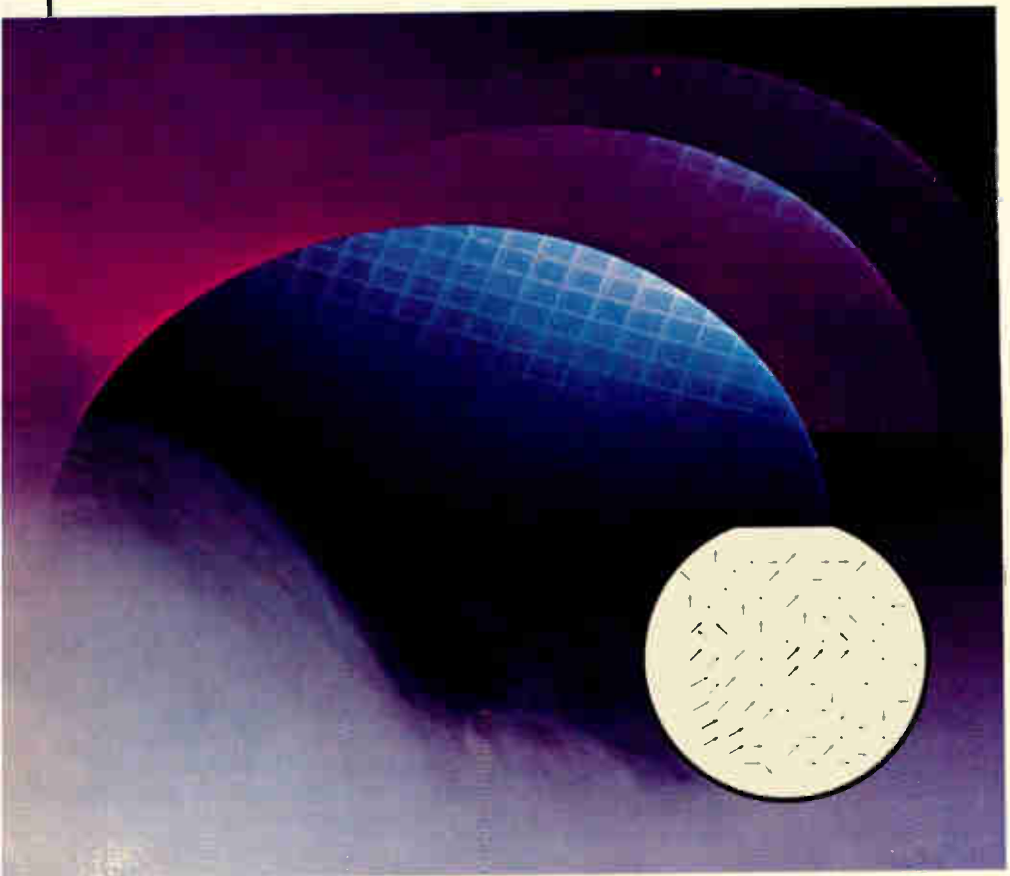

OVERLAY SCALE

0.50 μm

The inset shows a vector map of the Model 300 overlay performance measured against a contact-printed, first-level using electrical patterns distributed over a four inch wafer. Combined magnification/distortion and alignment errors are measured using this technique.

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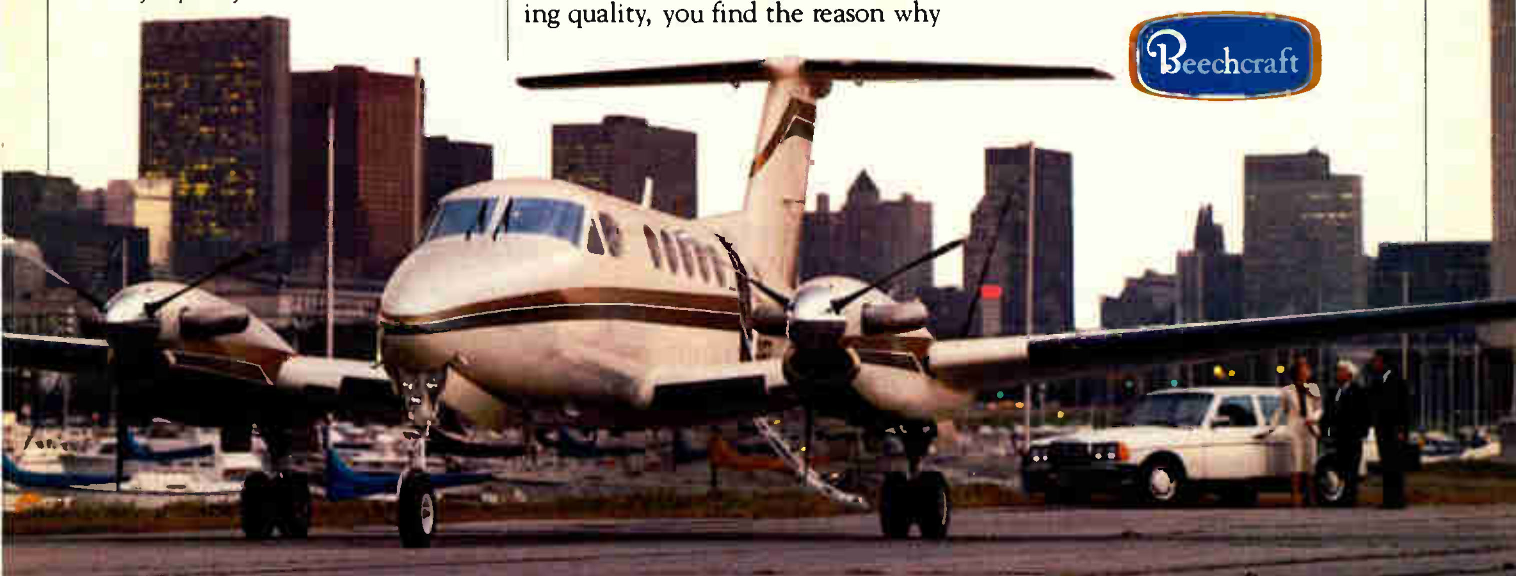

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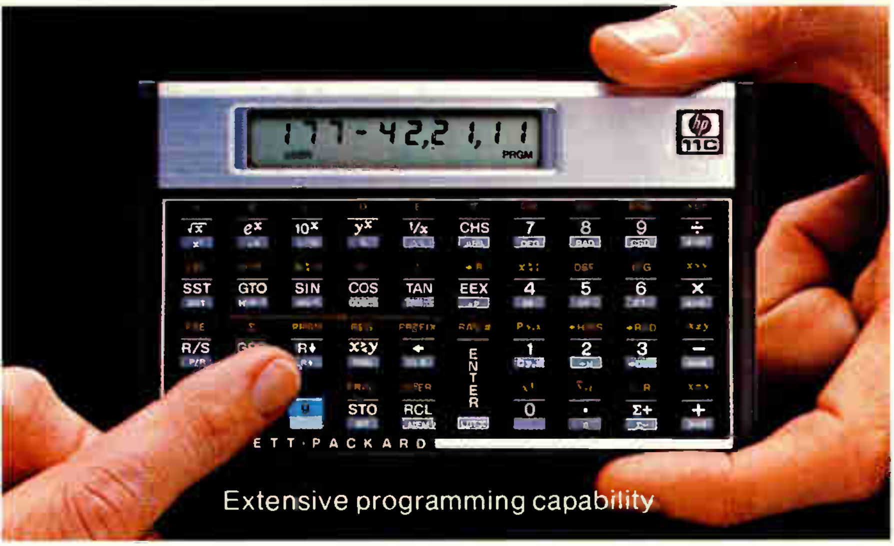
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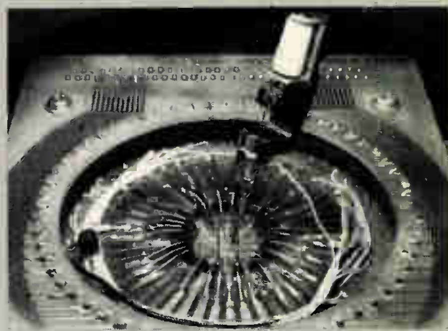

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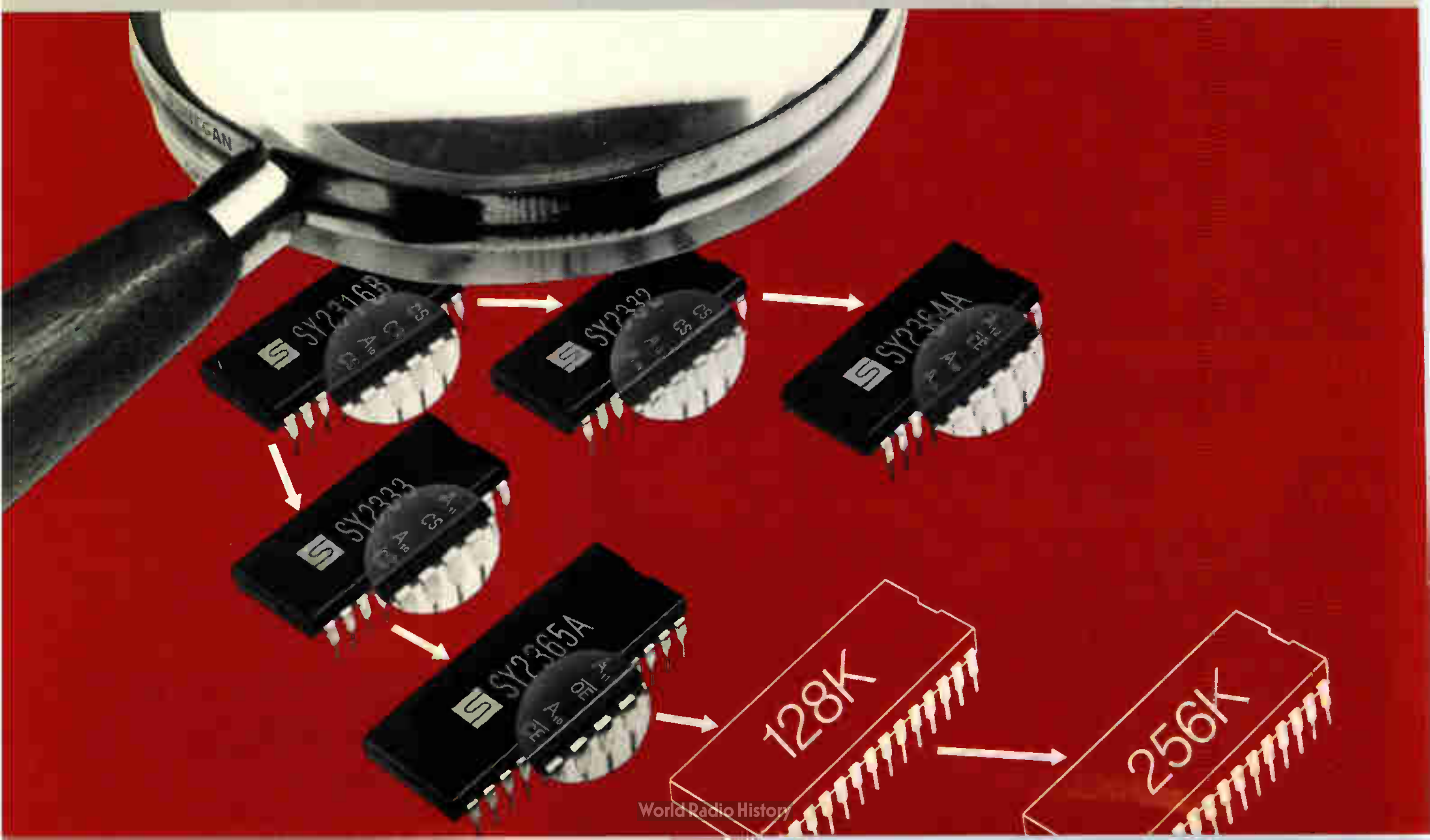

Products Newsletter

Height of 8-in. floppy shrinks to 2 in.

Claiming an ambitious hard-error rate of one reading error in 10^{12}, Micro Peripherals Inc. of Chatsworth Calif., has introduced the first 2-in.-high 8-in. floppy-disk drive. The slim-line design allows the drives to be mounted under a keyboard or **to be stuffed two abreast into a single standard-width 8-in. form factor.** With both single- and double-sided and single- and double-density versions, the drives, labeled models 41 and 42, have capacities of from 400-K bytes to 1.6 megabytes. Pricing is $300 for the model 41 and $400 for the model 42 in large quantities. The units have an average access time of 83 ms and consume 28 W.

Triac drivers employ GaAlAs LEDs

Using gallium aluminum arsenide, as opposed to gallium arsenide in its infrared light-emitting diodes, TRW Optron is expanding its line of 110-V ac triac drivers to include components with threshold trigger-current ratings of 5 mA. Existing versions rated at 30, 15, and 10 mA use GaAs LEDs. The Carrollton, Texas, facility of Electronic Components Group of TRW Inc. is also unveiling its **first 220-V ac triac drivers: OPI-3020, 3021, 3022, and 3023, which are designed for trigger ratings of 30, 15, 10, and 5 mA,** respectively. The 10- and 5-mA versions use the GaAlAs LEDs, and the 30- and 15-mA units use GaAs LEDs. In addition, look for TRW to add four zero-voltage crossing parts with identical ratings, in which the 10- and 5-mA models will also employ GaAlAs LEDs.

Color terminal bows at under $1,000

Made possible through single-board construction, product volume, and a price breakthrough in usually costly analog cathode-ray-tube driver circuitry is the IS 2048 color-capable intelligent terminal costing less than $1,000. **Priced at $995 each in 600-unit lots, Intelligent Systems Corp.'s unit is said to offer features found on units two to three times as costly**: a total of 16 colors, a 13-in.–diagonal CRT, RS-232-C communications at selectable rates up to 9,600 b/s, 72-key ASCII keyboard, and editing commands. Delivery from the Norcross, Ga., firm begins in January.

Personal computer network links IBM, Xerox entries

Joining other Corvus Systems Corp. 5-megabyte Winchester-technology disk drives developed for Apple, Tandy, Cromemco, Intertec, Dynabyte, North Star, Vector Graphic, and Altos computers are 5¼-in. Winchesters for the IBM and Xerox 820 personal computers. At the same time, the San Jose, Calif., firm announced that the Xerox 820, the IBM Personal Computer, and the Apple II have been interfaced with the Corvus Omninet network, which is based on twisted-pair transmission. **The 5-megabyte drives are priced at $3,750 for single units** and will be available in mid-January. The Corvus mass-storage systems are based on the plated-disk IMI 5007 drive, which has a 96-ms average access time and a 960-kilobyte/s transfer rate. The system includes a Z80-based controller card, an intelligent interface card with firmware, and a 5¼-in. floppy-disk form factor.

ROM simulator hastens designs

Design times of read-only memory–based systems can be reduced with the Romsim-1A ROM simulator because the S-100-compatible board **eliminates the repeated downloading and burning of programmable-ROMs during firmware development.** Instead, a host S-100 computer loads code in the random-access memory of Inner Access Corp.'s board and cables from the Romsim to a destination board allow complete simulation of a programmed PROM. Thus ROM-stored code can be checked for compatibility with its associated hardware and software before a single PROM is burned. The Belmont, Calif., firm's Romsim emulates the 2758, 2798, 2716, 2516, 2732, 2532, 2764, and 2564. The $495 package includes software support in the Basic and Forth languages; delivery is immediate.

Digital attenuator exceeds 88 dB

Designed for communications and communications-test applications, as well as digitally controlled automatic gain control, Analog Devices Inc.'s new **AD7111 accepts 8-bit parallel inputs, latches them, and uses the code to set the attenuation of analog signals in 0.375-dB steps** to a maximum of 88.5 dB. The Norwood, Mass., firm specifies a frequency range of dc to several hundred kHz for the unit. Its total harmonic distortion is said to be −91 dB with output noise limited to 70 $nV/Hz^{1/2}$. In hundreds it sells for as little as $16.

Hardware, software make system fail-safe

Citing twin achievements in automated software development and fail-safe hardware architecture, DOSC Inc., of Albertson, N. Y., unveiled the DOSC FailSafe distributed processing system. Such software achievements as automated structured programming, reduced program maintenance, and lowered software down-time, are coupled with **a hardware architecture that provides redundancy, prevents loss of the data base, and eliminates long response times.** The basic $79,400 system includes two each of 80-megabyte disks, 16-megabyte disk cartridges, data-base manager computers, data-base–controller computers, and 200-character/s printers.

Drafting system costs under $100,000

The new CDA system from Data Technology Inc., Woburn, Mass., approaches computer-aided drafting from the draftman's point of view. **The system displays commonly used drafting terms and symbols** on its cathode-ray-tube terminal rather than using specially designed and often unfamiliar ones. The menu-driven system operates through a Digital Equipment Corp. LSI-11 microcomputer with a 5-megabyte disk and a Tektronix 4014 display and also a coordinate digitizer and automatic drafting plotter. The basic system includes software and is priced just below $100,000.

Militarized parts invade market

Claiming an industry first, Analog Devices Inc.'s Computer Laboratories division in Greensboro, N. C., has unveiled its MOD-1205MB, a militarized analog-to-digital converter capable of 12-bit conversions at rates up to 5 MHz. **Aimed at signal-processing applications, the unit has a signal-to-noise ratio of 63 dB**. The converter is packaged on a 5-by-5.43-by-0.5-in. board and includes track-and-hold amplifiers with 25-ps aperture uncertainty, an encoder, and output registers. It sells for $4,995.

Meanwhile, for an extra 10% (or 20¢, whichever is greater) Precision Monolithics Inc., Santa Clara, Calif., will provide infant-mortality testing for all its devices. Any PMI part may now be ordered with burn-in to MIL-STD-883, method 1015, condition B. A marking of BI identifies these devices, which have been tested at PMI's option for either 160 hours at +125°C or 80 hours at +150°C.

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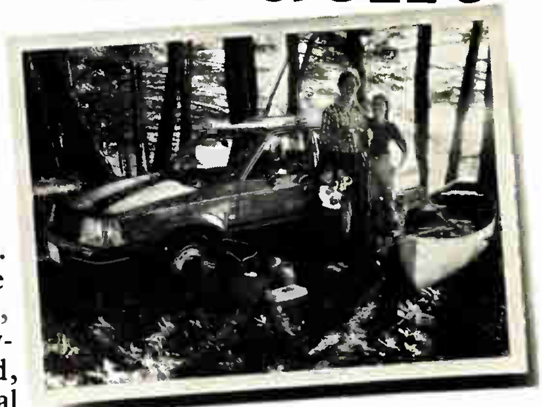

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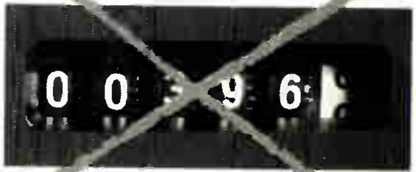

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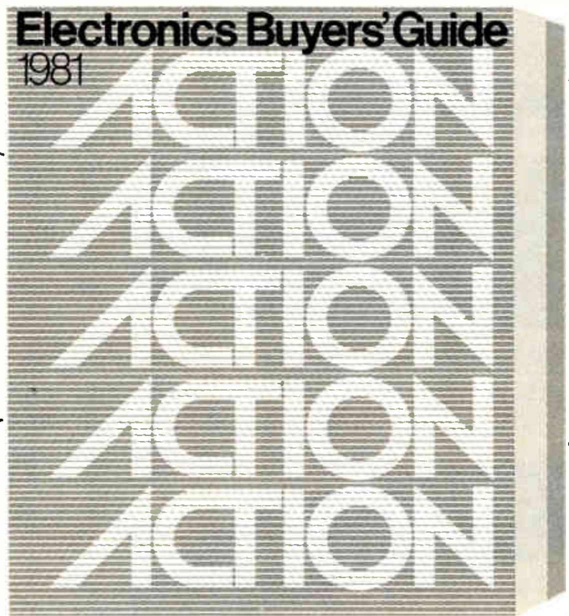

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Career outlook

WIGS class of '82

The first graduates of the Wang Institute of Graduate Studies in Tyngsboro, Mass., will receive their master's degrees in software engineering next August. For about 25 of the students, that diploma will represent a two-year investment, during which they balanced a part-time academic schedule with their regular jobs in local computer companies. For another five full-time students, hailing from as far away as Colorado and California, the cost of the degree includes giving up a year's worth of paychecks.

The return on the investment, however, could be considerable. The program aims at turning out an elite corps whose software-engineering skills, buttressed by planning, managerial, and human-resource talents, suit them for positions as first-line project leaders and as high-level software architects [*Electronics*, Aug. 14, p. 92].

Funded by a private grant from An Wang, president of Wang Laboratories Inc., and his family, the institute recently received degree-granting authority from the state.

It expects a wait of about three years for review and accreditation by the New England Association of Schools and Colleges. WIGS had no trouble meeting its first-year enrollment goals, but will move carefully in its future growth, says Nancy Martin, professor of information technology. "Our first priority is a quality program; we currently have three faculty members, and I expect that number must double before we double the student-body size." Martin reports that WIGS hopes to have three more professors on board by next fall.

The part-time students at the institute are employed by about 15 local high-technology firms; WIGS is currently working with about 15 firms across the country on joint agreements by which the companies would grant paid leaves of absence to employees pursuing the one-year full-time degree program.

Additionally, a gift from the Wang corporate fund will allow 10 future full-time students to receive research assistantships. This program would pay students a small monthly salary for working on research projects at the institute, in addition to paying for their academic fees and books—tuition and fees total nearly $8,000 for the full degree program.

Applications for admission to the institute now come from all over the country. While WIGS is expanding its outreach efforts, the emphasis is on explaining the nature of the WIGS program, which differs from most university-based degree programs in its stress on industry-oriented course work and research projects. Although all the applications for next fall's entrants will not be in until next February, Martin projects that WIGS probably will be able to accept only about a third of those applying for places.

Work required. Admissions standards also differ from university programs. They include a minimum of two years' work experience in a software-related field and specific expertise in computer-science and mathematics disciplines. WIGS also requires strong written and oral communications skills.

WIGS prides itself on its orientation to the needs and realities of industry, and starting in January, the class of '82 will get to sink its teeth into a major problem-solving project similar to those they will encounter on the job. WIGS hopes that in the future companies will suggest such projects, work with students on their completion, and even award grades for work performance. However, Martin notes, such projects cannot be confidential but must be in the public domain.

The first work project will be assigned by the WIGS faculty, and will lead within a year to a specific software product that WIGS will distribute to industry. WIGS also decided recently to publish an annual technical report, detailing curriculum and training methods and relating the programs and results of students' work projects. The first reports should be out by the end of this year.

-Linda Lowe

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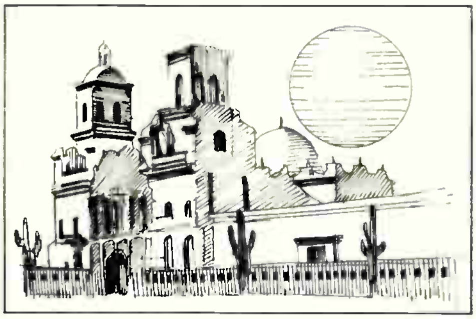

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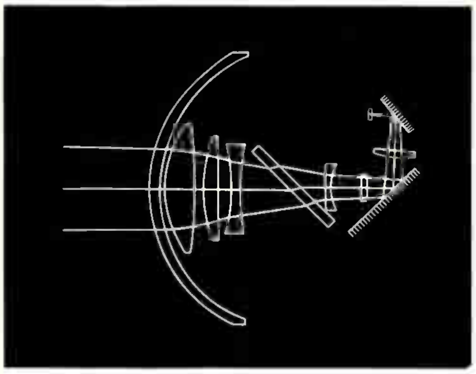

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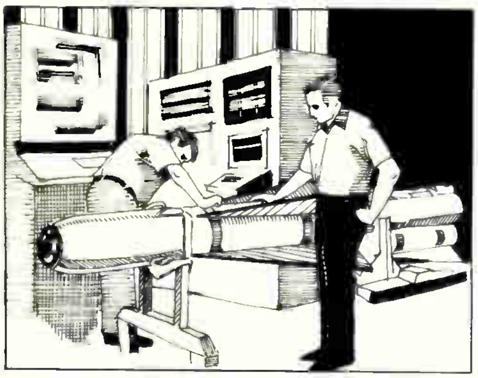

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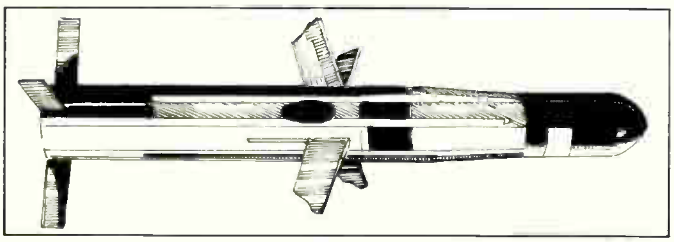

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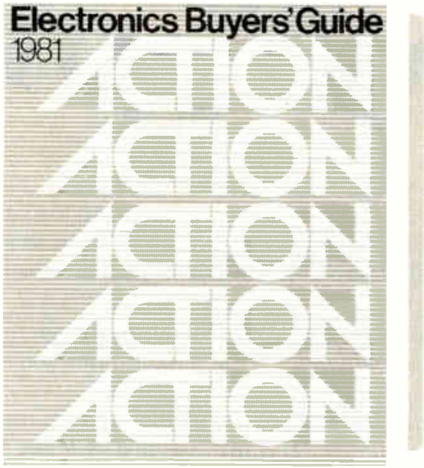

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