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Electronics

THE WORLDWIDE TECHNOLOGY WEEKLY

APRIL 21, 1986

ERICSSON TRIES AGAIN TO CRACK U.S. MARKET

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"We did it!"

"I knew we'd close that sale. Did you see their faces?"

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ISDN COMPONENT NEWS

Vol. 2

The MH896XX Analog Line Interface Family A Bridge Over Troubled ISDN Waters

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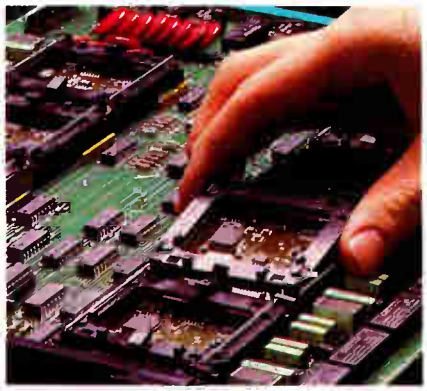

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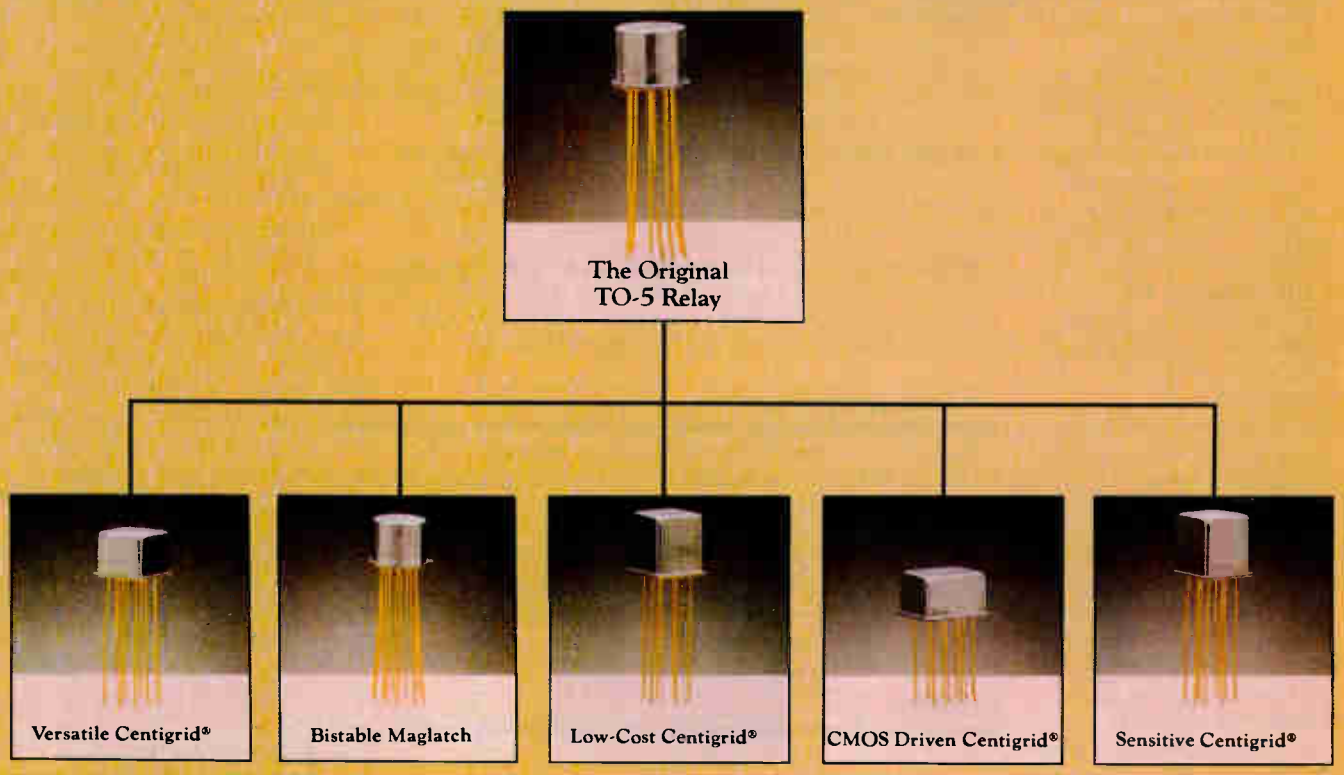

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PUBLISHER'S LETTER

When we sent Robert Gallagher, our man in Paris, to Stockholm to do the cover story on LM Ericsson (p. 57), we also asked him for his impressions of the Swedish capital and its mood soon after the assassination of Prime Minister Olaf Palme. Here is his report:

"I arrived in Stockholm to do my first round of interviews at Ericsson on March 5, less than a week after Palme's murder. I didn't really know what to expect, but the first outward sign that something was amiss came with announcements at the airport that 'contrary to normal practice' there would be passport verifications throughout the building and not just at the entry and exit of the international wing, as is usual at most airports.

GALLAGHER: Cloudberry-parfait-stained notebook.

"The next sign was to continue all through my trip: virtually every Swede I met asked how the news of the murder had been received outside Sweden. I assured them that the shock waves had been felt around the globe. Talking about it, most of them seemed disoriented, unable to cope with a crime without apparent motive.

"The country was quite a change from my usual beat. I was impressed with the directness and general tendency toward understatement from the executives I interviewed—a genuine counterpoint to the Latin exuberance I often encounter in my travels. Perhaps the most striking difference was the business lunch. In France, a lunch invitation most often means taking a couple of hours to eat a multicourse meal before, after, or between working sessions. When the Swedes invite you to a working lunch, they mean it. I'm sure that no other correspondent on the magazine has cloudberry parfait stains in his notebook.

"On the last night, I took a long walk around the old section of the city. I was happy with the trip, sure that I had a real feel for what was happening at Ericsson. My sole plan of action for the evening was to find a typically Swedish place to eat, and then turn in early before returning to Paris the next day.

"It wasn't long before I happened across an old tavern or beer-hall type of restaurant, paneled from floor to ceiling in smoke-darkened wood. When I was about to tuck into a plate of marinated herring and a mug of beer, two Swedes at the next table struck up a conversation.

"Like almost all of the Swedes I met, they were remarkably friendly and spoke splendid English. This restaurant made its own schnapps, they told me, and insisted that it would be a serious error not to have a glass to accompany my herring and beer. I, of course, complied. Many years of traveling have taught me that it's always dangerous not to follow the advice of the natives."

Laurence Altman

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WEEK 26

Ask us if we second source the popular X305 microprocessor architecture and we'll answer instantly: You bet.

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Our new Am29X305A 8-Bit Microcontroller is a plug-in replacement for the 8X305 chip you're using now. The same 200ns speed. The same highly integrated design that lets you read, mask, shift, operate on, rotate, merge and store data in a single instruction. Now available from two sources, assuring you of a steady supply for all your manufacturing needs.

One more thing. The Am29X305A is fabricated using our IMOX™ process, known throughout the industry for its outstanding performance.

And that makes the Am29X305A second to none.

WEEK 27

Floating point arithmetic is no longer the chore it used to be, thanks to our new Am29325 32-Bit Floating Point Processor.

Sure it's fast. A worst-case multiply takes but 150ns. But the real story is how easy it is to use. The Am29325 is a single-chip, non-pipelined, drop-in part—a true, easy-to-interface, black box solution.

Am29325

It's simple arithmetic.

Forget about internal pipeline registers, latency delay times, exotic software routines. Instead, start developing more powerful and more accurate array processors, desk top computers, digital signal processors and sophisticated robots that take less time to design and even less time to debug.

The Am29325. One easy-to-use chip that adds up to higher performance.

Could arithmetic be any simpler?

Design and application seminars are available for this product. Write or call for information.

WEEK 28

Every new IC claims reduced boardspace. But this baby delivers. The Am29C101 is a CMOS 16-Bit Slice, and the newest member of our 2900 family gone CMOS. It is equivalent to four 2901s. Plus one 2902.

The pin count went from 172 to 64. And package count from 5 to 1.

Power's part of the reducing program. You'll need only 0.7W. (Equivalent bipolar parts typically require 5.8W.)

Am29C101

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It's expandable for longer word lengths (16-, 32-, 48-bit systems, etc.). And it's available in 64-pin plastic or ceramic DIP, 68-pin PLCC, or ceramic LCC.

Ask for the Am29C101 and cut the fat out of your next system.

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WEEK 29

Announcing the Am29C827/28 high-performance CMOS Bus Buffers, the first members of AMD's hot new Am29C800 series—9 and 10-bit buffers, latches, registers and transceivers in CMOS. They're bipolar fast, CMOS cool.

Am29C827/28

Hot is cool.

Requiring only 80 microAmps of stand-by current, both parts have 8ns propagation delays for truly high-performance systems. With 24mA of drive, they can be used in place of or along with their Am29800 bipolar counterparts to match your drive and power requirements.

Additionally, both devices have MOS/TTL compatible inputs and outputs. (The Am29C828 has inverted outputs, the Am29C827 is non-inverting.) Board space is conserved because both have wide data widths. And their flow-through structure means simpler, more compact interfaces.

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BOOKS

A GRAPHICAL ENGINEERING AID FOR VLSI SYSTEMS

Paul J. Drongowski
UMI Research Press
$44.95/216pp

Paul J. Drongowski has come up with an engineering aid for the design of VLSI systems that emphasizes a functional approach to the description, analysis, and synthesis of VLSI circuits. Using a graphical hardware-description language, his technique describes the n-MOS VLSI system under design in a graphical notation called d-n that separates the specification of system behavior and structure from its physical design. The method moves VLSI design from a preoccupation with geometry toward the realm of programming, according to Drongowski, a member of the department of computer engineering and science at Case Western Reserve University, Cleveland. The novelty in his approach lies in its departure from textual or symbolic hardware-description languages, instead creating a language based on representational data types, the author says.

The author's method, which supports top-down and bottom-up hierarchical design, makes several contributions toward a true silicon compiler, he says. Its self-consistent, higher-level notation for n-MOS VLSI incorporates both data and control operations, and it furnishes limited translation—without wires—of a description to artwork. It also gives the designer the ability to mechanically administer and manage a large design hierarchy. Problems that the method cannot solve—including automatic placement of system components and wire routing, and space and execution-speed information—are simply reported to the designer, who is then responsible for evaluating and redesigning if necessary.

Lengthy appendices present the d-n notation, templates, and control and wiring algorithms, as well as delay analysis. One chapter and a related appendix explore cache-memory design in depth. Throughout, the author keeps a steady focus on real VLSI-sized problems.

PRINTED-CIRCUIT-BOARD BASICS

Theresa Kiko
PMS Industries
$14.95/86pp

In the highly competitive field of printed-circuit-board design and manufacture, this well-focused handbook will give buyers some needed help. Following an overview of the industry and the market, the author describes board classifications and materials, design, documentation, manufacturing, pricing, supplier qualifications, and standards for judging quality. Theresa Kiko, who is senior buyer for Honeywell Inc.'s Test Instruments Division, defines military specifications for materials as well as other board tests and standards. Subtractive process steps are illustrated in eight pages of color diagrams.

FUNDAMENTALS OF APPLIED ELECTROSTATICS

Joseph M. Crowley
John Wiley & Sons Inc.
$45/255pp

Ignorance of electrostatics might have been acceptable in the days when radiation and antennas were the overriding concerns in applied electromagnetism, says Joseph M. Crowley. But today there are large industries, such as office-copier and computer-peripheral manufacturing, that depend on a clear understanding of how the basic principles of electrostatics can be translated into practical devices. So the orientation of this book, developed out of a course the author teaches at the University of Illinois, Urbana, is toward bringing products to market rather than understanding complex solutions to Laplace's equation.

Each section explores some basic aspect of theory followed by a description of a device that is based on it. For example, Crowley presents maximum charge on an ink-jet printer as an application of the spherical geometry of electric fields with known voltages, and infrared television as a subset of piezo- and pyroelectricity under polarization. For readers who lack the time to work through the text systematically, an epilogue describes applications in selected industries, sciences, and technologies.

COMPUTER MODELING IN ELECTROSTATICS

D. McAllister, J. R. Smith, and N. J. Diserens
John Wiley & Sons Inc.
$34.95/130pp

This book assumes the reader is intensely interested in the theoretical side of electrostatics, particularly at the equation-solving stage. It's here that the heaviest use of computer time is encountered. The mathematics on which the book is based is a solution to Poisson's equation, which is difficult to solve without access to mainframe computers.

The monograph concludes with case studies of the hazards of transporting low-conductivity fluids and powders and an evaluation of the model. The authors' work can stand either as an introductory text on numerical methods or as an exercise in problem solving for designers working in materials transport and storage.

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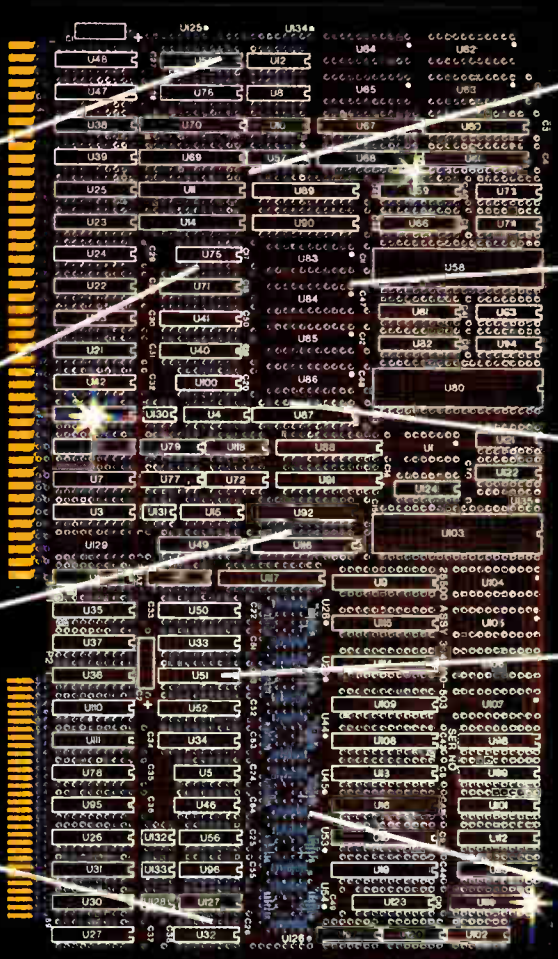

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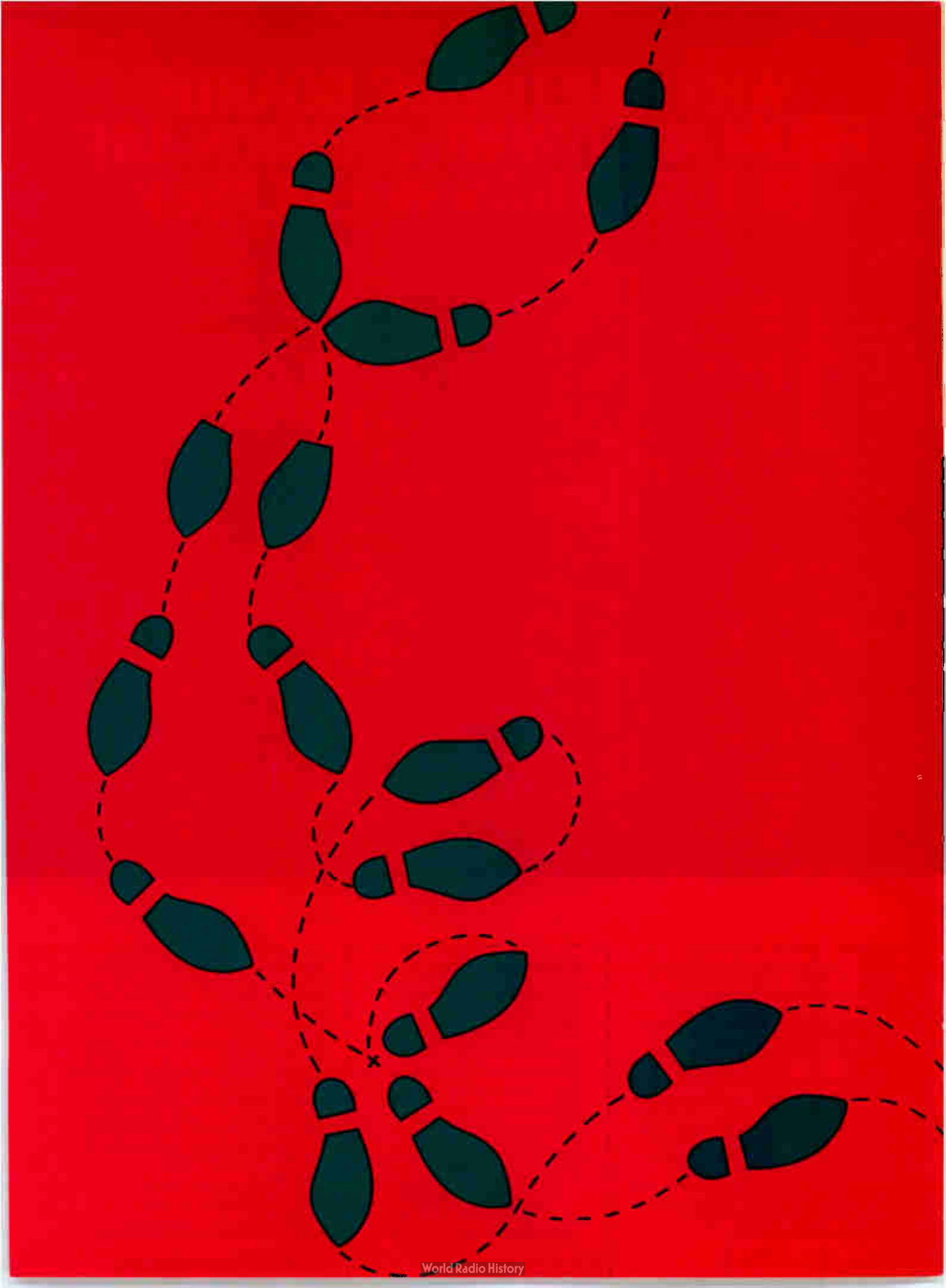

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Transputer Seminar Schedule

DATE	LOCATION	PHONE NUMBER
May 5	*Vancouver	(206) 453-8881
May 5	Chicago	(312) 382-3001
May 6	*Seattle	(206) 453-8881
May 7	Minneapolis	(612) 941-9790
May 7	Portland	(503) 620-1931
May 9	Salt Lake City	(801) 268-8440
May 9	St. Louis	(314) 521-6683
May 12	Dallas	(214) 234-8438
May 12	San Jose	(408) 988-6300
May 13	*San Jose	(408) 988-6300
May 14	Austin	(512) 346-9186
May 14	+Los Angeles	(818) 704-1655
May 15	*Los Angeles	(818) 704-1655
May 16	Houston	(713) 531-4144
May 16	Orange County	(714) 261-2123
May 19	Tulsa	(918) 744-9964
May 19	San Diego	(619) 565-9444
May 21	Oklahoma City	(918) 744-9964
May 21	Albuquerque	(505) 888-0800
May 23	Kansas City	(913) 342-1211
May 23	Phoenix	(602) 996-0635
May 27	Cherry Hill, New Jersey	(215) 322-7100
May 28	Orlando	(305) 660-9600
May 28	+ Baltimore	(301) 544-4100
May 29	*Baltimore	(301) 544-4100
May 30	Fort Lauderdale	(305) 660-9600
May 30	Washington, D.C.	(301) 544-4100
June 2	Indianapolis	(317) 844-5222
June 2	Huntsville	(205) 883-9630
June 4	Cleveland	(216) 831-9555
June 4	Atlanta	(205) 883-9630
June 6	Detroit	(313) 478-8106
June 6	Raleigh	(919) 878-8600
June 9	Parsippany, New Jersey	(201) 692-0200
June 9	Boston	(617) 449-7400
June 11	Smith Town, Long Island	(516) 351-8833
June 11	Toronto	(416) 665-7773
June 13	Denver	(303) 779-8060
June 13	Montreal	(514) 694-6110

*Morning seminar only.
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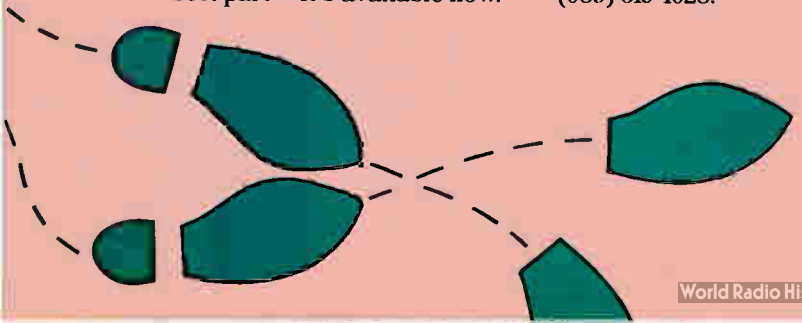

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SEIKO INSTRUMENTS

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TECHNOLOGY NEWSLETTER

COLOR VISION SYSTEM PROMISES BIG COST AND TIME SAVINGS IN CHIP TESTING

An inexpensive color vision system is finding defects in integrated circuits not discernible by any other automated chip-inspection setup. Researchers at the Center for Robotic Systems in Microelectronics at the University of California, Santa Barbara, report that the microcomputer-based system under development there can discriminate among upward of 30,000 shades of color—a key skill in spotting defects, which often show up as contrasting hues. Such glitches as thin spots in silicon oxide layers, which often do not show up in black and white vision systems, stand out vividly under color inspection. Moreover, the system has demonstrated it can spot thickness differences in semiconductor layers, down to 120 billionths of an inch, in less than 0.10 second. Cost is only about $9,000 for a color video camera, an IBM Corp. Personal Computer XT, and a digitizing board. □

CAD SYSTEM USES AI TO CUSTOMIZE GATE ARRAYS

Nippon Data General Corp. is turning to expert-system software to help customize gate arrays. The Tokyo company uses the artificial-intelligence language Mainsail for object-oriented programming in its new TEO/Electronics logic-circuit design system. Its Design Database Language provides direct output of a net list; the Procedural Language Interface gives direct access to the object-oriented data base. The system, it says, promises to halve the entry cost and triple the productivity of designing with Fujitsu Ltd. gate arrays when deliveries start in Japan in July. TEO/Electronics, which runs on Data General's DS/7000 engineering work stations, is only a preview of a more comprehensive setup that will be announced for the U. S. in May. Facilities for design with Fujitsu's standard cells and support for other vendors' application-specific integrated-circuit technology will be added. □

AUSTRALIAN COMPANY THINKS IT CAN OPEN UNIX TO COMMERCIAL USES

Austec International Ltd. says its virtual-machine Cobol environment offers a way to open AT&T Bell Laboratories' Unix operating system to commercial applications. The environment is said to let the huge existing library of Cobol applications, hitherto frozen out, run on Unix systems. In New York this week, the Melbourne, Australia, company will display what it calls a "conformable" environment that handles the operating system's input/output functions and permits many brands of hardware—running proprietary or open operating systems—to share data and code and to distribute files across a mixed network. Austec's Acebridge system is based on a Cobol compiler that generates a pseudo-object code translated by the environment at run time. It has already licensed Acebridge to AT&T, DEC, IBM, NCR, and Olivetti. □

BENCHMARK TO PUT SPOTLIGHT ON VECTORIZING PERFORMANCE

Supercomputer users may soon have a benchmark for comparing how well various vendors' compilers generate vector-processor code from Fortran programs for advanced scientific computing applications. Jack J. Dongarra, scientific director at Argonne National Laboratory's Advanced Computer Research Facility, developed what is perhaps the best-known benchmark for comparing performance of computer systems [*Electronics*, April 7, 1986, p. 16] and has now put together a set of about 250 Fortran loops that have vectorization potential. He plans to send out the set to about 10 vendors of advanced vector computers within the next few weeks. He intends to publish a report by early summer. "Some compilers do an excellent job of vectorization," says Dongarra, "but others do just an awful job, and users should at least recognize that there's a problem and have their vendors address it."□

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ELECTRONICS NEWSLETTER

TI SEES 1986 INDUSTRYWIDE CHIP SALES UP 15%, POSTS QUARTERLY LOSS

Now even conservative Texas Instruments Inc. is beginning to feel better about the semiconductor business. The Dallas company expects worldwide sales to grow 15% this year, a rate on the high end of most forecasts. Domestic sales will increase by only 10%, it figures. President Jerry R. Junkins gave TI's annual corporate forecast to stockholders last week, predicting worldwide sales would rebound to $24.7 billion, up from $21.5 billion in 1985. That's still below 1984's sales of $26 billion. "We believe this increase is achievable without substantial growth in demand for electronic end equipment. Customers' inventories were depleted well below normal levels in the first half of 1985, and a growing number are returning to normal procurement patterns," Junkins said. TI is still getting mixed signals on the outlook for end-equipment markets. Despite the brighter outlook, 1986 has started off on a down note for the company. It posted a first-quarter loss of $23.8 million versus a profit of $1.9 million a year ago. First-quarter sales fell 11% to $1.145 billion from 1985's $1.287 billion. □

OUTLOOK DARKENS FOR QUICK RESUMPTION OF U.S.-JAPAN CHIP TRADE TALKS

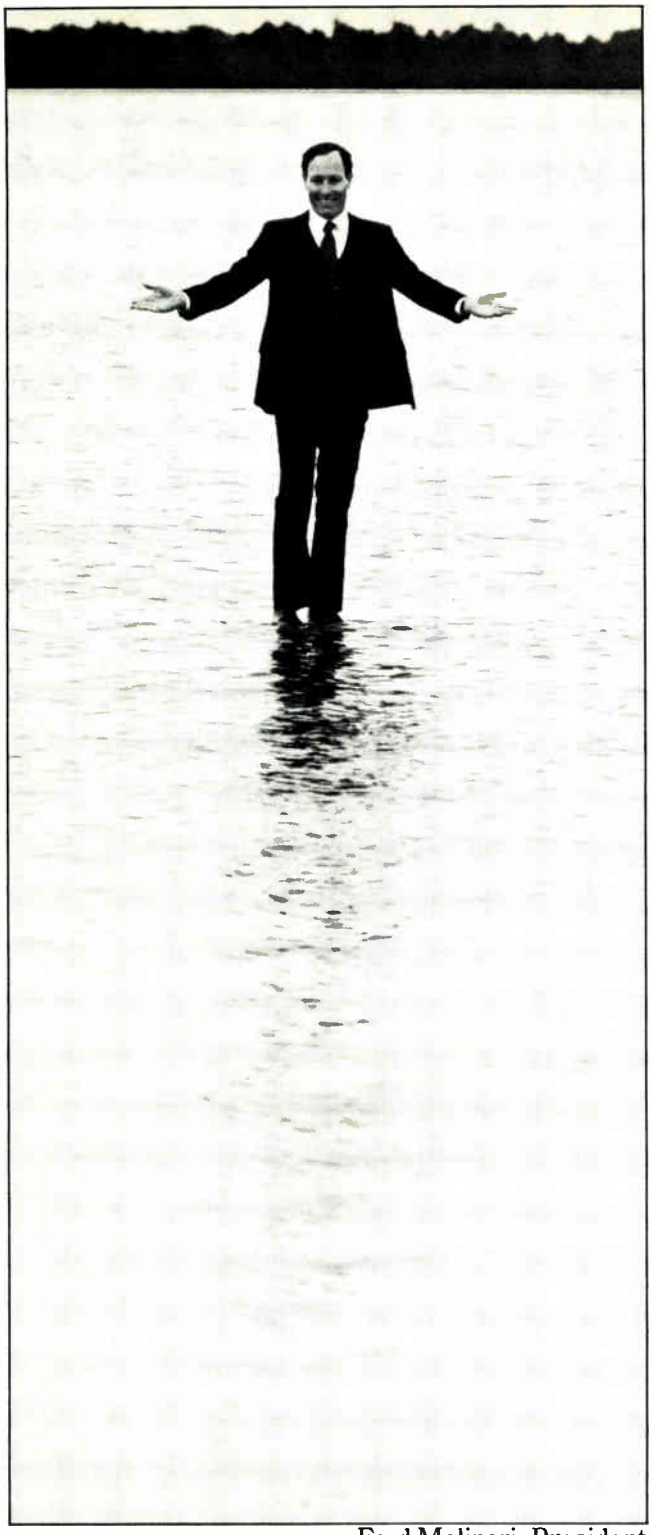
U.S. chip makers shouldn't expect trade talks between the U.S. and Japanese governments to get started again quickly. U.S. Trade Representative Clayton K. Yeutter said last week no definite date has been set to resume formal negotiations that broke off March 28 [*Electronics*, April 7, 1986, p. 15]. "That one [the chip talks] is not ready to come to a conclusion," Yeutter told a Washington meeting of the Electronic Industries Association. He said his office is maintaining informal contacts with Japanese counterparts in an effort to resume negotiations. He also said the Reagan administration had pressured Japanese Prime Minister Yasuhiro Nakasone during trade talks last week to import more U.S. products, including semiconductors. "Japan must simply become a major importer," Yeutter said. □

NSF SEES COOPERATIVE RESEARCH BETWEEN U.S. AND JAPAN AS A GOOD THING

Surprisingly, the National Science Foundation thinks cooperative basic research between the U.S. and Japan is good for both sides. Each could learn from each other, NSF staff members believe, possibly eliminating duplication of work and speeding up results in "critical areas of technology where intense research competition with Japan exists." In fact, some cooperative research has aleady started and the NSF is sponsoring a workshop May 12-13 at the University of California at Santa Barbara to discuss it. At one session on III-V semiconductors, an all-star panel of researchers will evaluate Japanese work. This meeting kicks off a series of nationwide programs that will promote research grants that the NSF is offering to U.S. scientists for work in Japan and focus on technologies where cooperation can be improved. □

ZENITH TO PACK TELETEXT CAPABILITIES INTO ITS DIGITAL TVs

Zenith Electronics Corp. apparently will take a different tack than most other color-TV vendors when it introduces its first digital TV receivers next month. Unlike other vendors, which have emphasized new digital capabilities such as the picture-within-a-picture feature, Zenith is touting the teletext capabilities of its digital line. Its prototype set contains a built-in decoder for receiving the World System Teletext format, with remote-control access and page selection. Though Zenith has offered an add-on decoder for its existing sets since 1983, the built-in teletext capability will be a first for the U.S. market, the company says. Zenith will also offer a low-cost thermal printer that can be attached to the set to print out teletext pages. □



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DT1401	General Purpose	32 SE/16 DI	12-16	2.5-50	2	12	50	16	Yes
DT1402-F	High Speed	32 SE/16 DI	12	125	–	–	–	16	Yes
DT1405	Low Level	32 SE/16 DI	12-16	0.16-6.7	2	12	50	16	Yes
DT1408	Simultaneous S/H	4SE	12	100	2	12	50	16	Yes
DT1406-8V	Voltage Output	–	–	–	8	12	125	–	–
DT1406-8M	Current Output	–	–	–	8	12	28.5	–	–
DT1406-8CL	Current Loop	–	–	–	8	12	28.5	–	–
DT1403	High Resolution	–	–	–	2 or 4	16	100	–	–
DT1414	General Purpose	16SE	12	25	–	–	–	16	Yes
DT1417	Digital I/O	–	–	–	–	–	–	32	–

Fred Molinari, President

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PRODUCTS NEWSLETTER

INTEL CHIP HANDLES MESSAGE PASSING FOR MULTIBUS II BOARDS...

A chip that will greatly ease the design of Multibus II products is on the way from codesigners Intel Corp. and VLSI Technology Inc., who provided the cell library. The Message Passing Coprocessor implements the Multibus II architecture's message-passing protocol without burdening the host processor. Also, it uses much less board space than message passers implemented with standard medium- and large-scale ICs. Samples will be available for $200 from Intel's Hillsboro, Ore., facility in May and from VTI's Application Specific Logic Products Division in Phoenix, Ariz., in June. □

...WHILE MICROBAR UNVEILS MULTIBUS II COMPUTER WITH A 68020

Microbar Systems Inc. is adding a new wrinkle to Multibus II. The Sunnyvale, Calif., company is using a Motorola 68020 microprocessor in the CPU of its single-board Multibus II-based computer, which will have up to 4 megabytes of RAM and sockets for up to 256-K bytes of PROM. The company says it picked the Motorola chip because it works better in a multitasking, real-time system. Up to now, all Multibus II CPUs have used the Intel 80186 processor. Microbar's computer card will sell for $2,443 in large quantities when available later in the second quarter. □

PYRAMID ENHANCES ITS RISC COMPUTERS

Users of Pyramid Technology Corp.'s 98x Isoprocessor reduced-instruction-set superminicomputer can boost the Unix-based machine's performance with a new input/output subsystem. The two-board set from the Mountain View, Calif., company contains an intelligent I/O processor with a peak transfer rate of 20 megabytes/s, up from the 11-megabytes/s rate of the original unit. The board has a disk controller and a high-speed channel interface to the 98x's 40-megabyte/s Xtendbus. The second board holds a tape drive, printer, and Ethernet controller. The two-card subsystem sells for $22,600. □

ITT PCs AIM FOR NETWORK AND MULTIUSER APPLICATIONS

The four new personal computers from ITT Information Systems are tailored for use in local-area networks and multiprocessor environments. The four Xtra XL models, which are compatible with IBM Corp.'s Personal Computer AT, run both Xenix 5.2 and MS-DOS applications. The models I and II, which are targeted as LAN file servers, break the 32-megabyte barrier MS-DOS imposes on disk-drive capacity. This enables LAN users to take advantage of the newer higher-capacity drives. The models III and IV, which are geared for multiuser work, incorporate an 80186-based processor board to alleviate the throughput bottlenecks common when users link a number of terminals to microcomputers. The systems are available now from the San Jose, Calif., ITT operation for $5,299 to $12,299. □

SPERRY ADDS 32-BIT MODELS TO ITS UNIX-BASED COMPUTER LINE

Sperry Corp. is boosting the performance of its Unix-based Series 5000 family with two new 32-bit 68020-based multiuser microcomputers. Earlier family members are 68000- and 68010-based machines. The new Series 5000/50 supports up to 32 users and provides a maximum 1.6 gigabytes of memory. It is available now from the Blue Bell, Pa., company for $23,030 to $28,530. The high-end Series 5000/90 will handle up to 88 users with a maximum 8 gigabytes of memory and is planned for June delivery with a price from $68,300 to $74,300. □

Electronics

FIVE-CHIP PROCESSOR RUNS 3-D GRAPHICS AT 30 MIPS

GE'S HARDWARE SOLUTION TO SOFTWARE PROBLEM IS 100 TIMES FASTER

RESEARCH TRIANGLE PARK, N. C.

General Electric Co.'s conviction that silicon can outperform software in three-dimensional graphics processing has yielded its first product: a high-performance 3-d graphics processor that GE claims is 100 times faster than similarly priced systems. Last week, GE brought out its Graphicon 700 processor, which it calls a hardware solution to a software problem.

"Typical software bottlenecks are now replaced by hardware accelerators," says Dale W. Rowe, general manager of GE's Silicon Systems Technology Department in Research Triangle Park, one of two GE units that collaborated in the development of the Graphicon. Aimed at engineering, scientific, architectural, geophysical, and medical applications, the processor will find its first significant use in enhancements to its computer-aided design and engineering systems to be introduced by GE subsidiary Calma Co. later in the year.

The Graphicon 700 is the first product from the Silicon Systems Technology Department, a unit of GE's Semiconductor Business Division, also in Research Triangle Park. GE started the department in March 1984 as a venture aimed at producing graphics processors for internal use as well as external markets. A secondary goal has been to promote the use of very large-scale integrated-circuit technology in GE products and systems, Rowe says.

The processor is built around five semicustom 10-MHz chips developed jointly by the Silicon Systems Technology Department and GE's Simulation and Control Systems Department in Daytona Beach, Fla. The chips use 2-μm CMOS technology and include three different-size gate arrays and one standard cell. They also implement 3-d geometry and image-rendering algorithms derived from GE's flight-simulation technology developed in Daytona Beach. GE estimates the chips will save up to 80,000 lines of Fortran code.

Unlike software-intensive 3-d graphics processors, GE's new machine uses four pipelined processors and a multiple-bus architecture that includes a 32-bit VME-bus and three nonstandard high-bandwidth buses. The result is a processor that performs more than 30 million floating-point operations per second.

The standard graphics processor includes 4 megabytes of display-list memory and a 12-by-24 color-lookup table. Z-buffer and frame-buffer memory boards can be added for up to 16 megabytes of display-list memory. System software and microcode is stored in a separate 2-megabyte local memory.

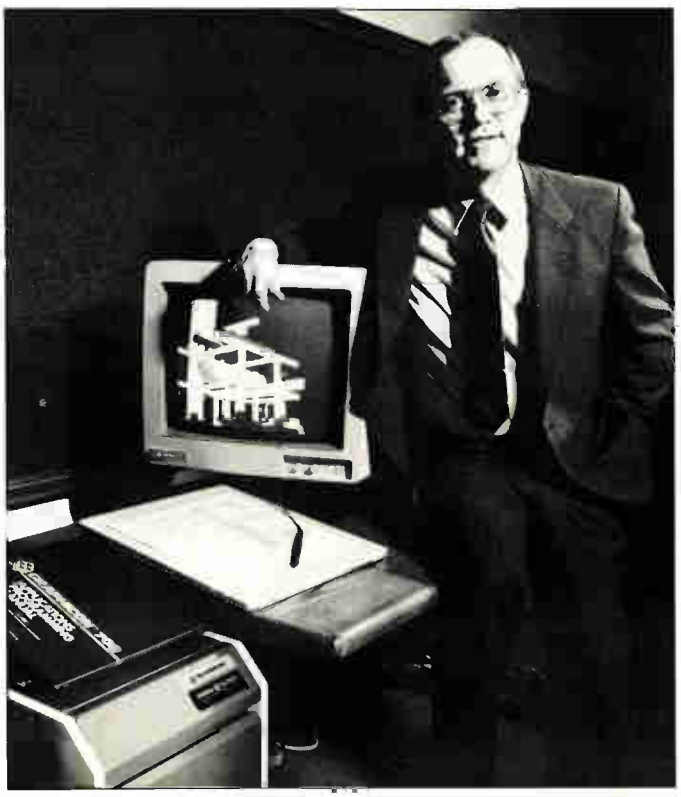
Calma says it plans to offer the new processor as a hardware option on its 3-d mechanical computer-aided design and engineering systems, which are based on the Digital Equipment Corp. VAX and MicroVAX II, beginning in the fourth quarter. The Graphicon will enhance the systems' high-end solids-modeling capabilities, "bringing into our customers' hands some capabilities they haven't been able to use in a real design situation," says Charles Thompson, director of mechanical products for the Milpitas, Calif., company.

ULTRAFAST. Calma, which kicked in about a third of the $20 million spent for development of the processor, says the Graphicon will display complex, 3-d images on its work stations up to five times faster than its current products for screen-refresh commands and up to 30 times faster for generation of shaded images. Rowe claims the processor will display highly complex, solid-shaped 3-d images at rates 100 times faster than competitive systems, and says it has outperformed competing processors such as those from Raster Technologies Inc. and Silicon Graphics Inc. in 3-d solid-shaded image processing.

"With this performance, you are going to see a sharp increase in solids modeling," says Rowe. GE sees applications for the Graphicon in industrial product and biomedical-equipment design, industrial and scientific research, and molecular modeling, as well as in analysis of vibration, stress, heat-transfer, or geophysical data—in addition to CAD/CAE.

GE will offer the Graphicon 700 to original-equipment manufacturers as well as directly to users. The processor will be available immediately as a stand-alone product or as a fully configured $65,900 system. *–George Leopold*

SOLIDS ENGINE. GE's Rowe says the 3-d graphics processor is 100 times faster than comparable software-based systems.



IBM FINALLY ADDS TOKEN-RING PIECES

ARMONK, N. Y.

Users and product planners alike have waited impatiently for the IBM interfaces that tie IBM Corp.'s Token-Ring Network to major segments of the computer world. Since the local-area network's introduction last fall [*Electronics*, Oct. 21, 1985, p. 16], only the connections for IBM's Personal Computers had been in the official picture.

Last week, major pieces of the puzzle dropped into place with the announcement of token-ring interfaces for System/370-architecture mainframe computers, as well as for the System/36 departmental processor. Developments from other quarters of the LAN industry also gave the ring a boost, including Texas Instruments Inc.'s introduction of a board for analyzing the operation of IBM-ring protocols (see next story).

Beginning early next year, IBM will begin delivering token-ring attachments for 370-type mainframes built around 3275 communications controllers. The System/36 interface to the ring will use a dedicated PC AT as a network server. These connections, as well as-yet-unannounced connections for the System/38 and Series/1 machines, have been conspicuous by their absence.

The 3275 communications controller used for IBM's mainframe link requires two hardware interfaces: a new version of the line attachment base (LAB) and a token-ring interface coupler (TIC). The LAB handles the multiplexing functions between the host communications channel, external communications lines, and up to four TICs.

SHIPPING. Each TIC provides one interface between the 3275 bus and the token ring. Functionally comparable to the token-ring adapter card for the PC, the TIC controls communications functions that include the medium-access-control and the Logical Link Control protocols specified in the IEEE-802.5 standard. Because each 3275 can support two LABs, a total of eight rings can be linked for just under $27,000 per ring connection.

IBM also unveiled a bridge program to connect rings, copper-line and optical-fiber repeater technology to extend the distance that signals can be transmitted between network access points, and a PC-based ring-manager program for debugging network operations.

Just last month, IBM let it be known that it was shipping its PC token-ring adapter card. "Now people can get hold of [a PC adapter card] and evaluate it," says networking consultant Harvey A. Freedman of Architecture Technology Inc. in Minneapolis. But Freedman expresses disappointment about the lack of cluster-controller connections for the widely used 3278 and 3279 terminals.

Network developers can also evaluate ring-adapter boards from Ungermann-Bass Inc.'s networking operation in Boca Raton, Fla. Ungermann-Bass bases the boards on its own chip set.

IBM's announcement also included a ring-bridge program for a PC AT that makes it possible for rings to be tied together into a single network. Ungermann-Bass beat IBM to market with such a bridge product, it claims, and also has among its hardware offerings interfaces for 3270-family terminals.

Another boost for the IBM ring LAN will be an interface to a variety of wide-area networks such as X.25 packet-switching services. It is said to be in advanced development at NCR Corp.'s Comten division in St. Paul, Minn. Giving nodes on the ring smooth access to such nets is the next major step, a Comten representative says, because most mainframes will not usually be attached directly to ring LANs.

Developers of IBM-compatible token-ring nets got their own boost last week when TI now says the price of its TMS380 five-chip set has fallen to $125 in orders of 25,000. Earlier quotes reportedly were around $200 per set.

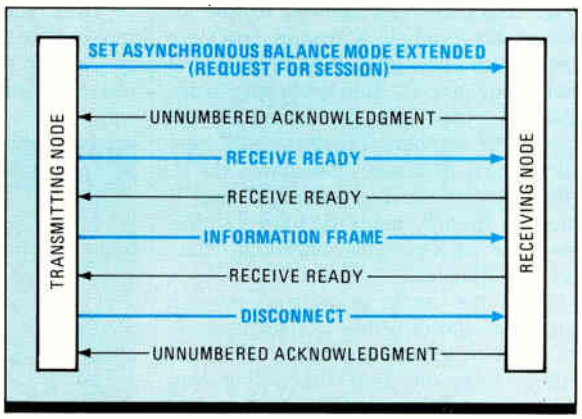
FIVE TO TWO. TI is also planning to reduce the set's five chips to two. An intermediate step will be the integration of the two bipolar ring-interface chips into one circuit, increasing the throughput of ring nodes from 4 to 16 Mb/s.

Texas Instruments is expected to provide samples of the high-speed node chip set in 1987. It is also preparing a sixth chip, which is a version of the 38020 protocol handler set up for use in ring-bridge hardware. *–Robert Rosenberg and J. Robert Lineback*

THE REVERSE ENGINEERING BEGINS ON IBM TOKEN RING

HOUSTON

Finally! After months of anxious waiting, companies wanting to plug their products into IBM Corp.'s Token-Ring Network can now get their hands on ring products from the computer giant. With adapter boards at last becoming available last month, local-area-net vendors and competing computer houses are launching crash reverse-engineering projects to analyze and implement the undocumented chatter that goes on between IBM products on the token ring. IBM's competitors figure it is essential to quickly implement the upper-level communication protocols of IBM's LAN to get a good start in what is expected to be a huge new networking market.



HOW'S THAT? TI's board lets designers of products for IBM's token-ring LAN see chatter at the Logical Link Control level.

The tough job of reverse engineering should be getting easier shortly, however. This week in Houston, Texas Instruments Inc., the sole source of IBM-approved token-ring adapter chips, will announce the availability of a new interface card for personal computers that lets network-product engineers observe all communication frames traveling on the LAN. This fall, Nestar Systems Inc., a third-party network systems house in Palo Alto, plans to use the new TI board to make a portable token-ring LAN analyzer work station. The system, housed in a Compaq Computer Corp. Portable 286, will cost about $14,995.

The portable LAN analyzer and TI's new adapter card for IBM-compatible personal computers are aimed at clearing huge software hurdles for third-party vendors planning products compatible with Big Blue's token ring. IBM has long promised an open token-ring system, agreeing to make adapter chips available from TI, documenting much of its architecture, and making its LAN

conform to standards in the IEEE-802.5 specification. But IBM has also added a number of network-management features atop the IEEE specification and hasn't told the intricate details of implementing these features to other computer and networking houses.

"Every detail counts in a networking product when you are attempting to be compatible with someone else's product," states Harry L. Saal, senior vice president of research and development at Nestar. "As a chip maker, TI has been concerned with hardware compatibility, and there is no question they have done their homework. IBM has verified it. That solves about 10% of the problem. Now you have to match the IBM interfaces at the software and protocol levels.

SNA CAPABILITIES. "IBM has not tens but hundreds of thousands of lines of code in their Logical Link Control, Netbios [network basic input/output system] control protocols, and the LU6.2 protocol," adds Saal. LU6.2 is a networking extension to IBM's advanced program-to-program communications protocol that brings capabilities found in its Systems Network Architecture to the token ring.

"IBM provides a certain level of reference information, which is a reasonable description of how the network hangs together, but it is certainly not a guide to implementation," says Saal. "You can only get the details by watching the system, and when it comes to debugging your own system, you have to watch your products and IBM's chatting back and forth on the same cable."

At the typical node on IBM's token ring, users are not allowed to see all information and data frames traveling around the LAN. Responding only to the node they are in, the token-ring chips usually strip off LAN-management frames. If standard adapters could copy all frames, it would slow down the 4-Mb/s network and potentially create a security breach, notes Richard Templeton, TI's LAN-product marketing manager in Houston.

But users such as network-product engineers and directors of management-information systems working at corporations using the IBM Token-Ring Network do need to see all the frames, and that's what the new TI interface card makes possible. The card is based on the same five TMS380 chips TI is selling for IBM token-ring attachment.

The TI board and system software can be set up in two basic addressing modes. In one mode, the board performs as a normal token-ring node. The other, an extended mode, is for communication-protocol analysis. The adapter's three extended-addressing modes can set up the host IBM Personal Computer or PC AT to copy all Medium-Access-Control (MAC) frames, all non-MAC frames (such as those used by IBM's Logical Link Control implementation), and data on frame lengths and header types.

Users can then page through the frames stored in the host PC to observe communication patterns, sequences, and timing under a variety of conditions. The TI adapter board provides a window on the handshaking sequences IBM uses for Logical Link Control file transfers, for example (figure, p. 19).

"If it were a matter of just setting up a link, it could be done from the spec," Templeton points out. "But the problem is, what happens when things break or when the receiver is not ready or there is congestion? All these exception conditions take place in the protocols, and the exception conditions don't always get well documented in specs." *–J. Robert Lineback*

STANDARDS

IT'S FULL SPEED AHEAD FOR OPEN-SYSTEMS GROUP

PALO ALTO

Three months after going public with a plan to promote the rapid implementation of computer-network standards, the Corporation for Open Systems has more than doubled its membership, hired a chief executive officer with the clout to knock heads together, and convinced some early skeptics that it means business.

More than 40 companies—vendors and users of various sizes—have ponied up COS's stiff membership fees for the privilege of a role in deciding which protocols will be implemented first and how the implementation will be done. More are joining almost daily.

COS scored a diplomatic coup this month by tapping as its president and CEO Lincoln D. Faurer, 58, a retired Air Force general who served as director of the National Security Agency from 1981 to 1985, and before that held a high-ranking post in the North Atlantic Treaty Organization. Faurer has no industry ties to offend any member, but at the same time clearly is no figurehead.

That's important, because even though COS was formed for the purpose of accelerating the progress of the open-systems interconnection reference model and the integrated-services digital network, its very diversity provides the potential for internal battles and delays.

"I think he's perfect," says analyst Jack Biddle III of the Gartner Group, Stamford, Conn. "They needed someone who could call up a CEO and be taken seriously." Faurer, he points out, is no stranger to power politics, with his background in international relations, government, and the military.

ENEMIES. Robert Metcalfe, founder of 3Com Corp., Mountain View, Calif., is also impressed. "COS has two enemies—outside companies that seek to use incompatibility to maintain market share, and an enemy within—ourselves," Metcalfe says. "How we make decisions is critical. The No. 1 way of overcoming the enemy within is to support a strong, decisive CEO." Metcalfe, who originally had some doubts about the role of COS, now says that 3Com will join.

FIRST EMPLOYEE. Lincoln D. Faurer is charged with putting the Corporation for Open Systems together from scratch.

Two other small Silicon Valley networking companies, Ungermann-Bass Inc. and Bridge Communications Inc., say they too will join COS. Work-station makers Sun Microsystems Inc. and Apollo Computer Inc. took the plunge in March, as did Procter & Gamble Co., a large user of networks. By year end, Faurer says, COS could have 100 members, divided about evenly between vendors and users.

Faurer, however, is still the only COS employee and must build an entire organization from scratch. As he describes it, that process is a

straightforward job of translating COS's goals into an organizational chart and then filling in the boxes on the chart.

COS's charter is to play an active role in the development of test procedures, test beds, and certification processes for ISDN and the International Organization for Standardization's OSI, and in deciding which protocols are implemented first [*Electronics*, Jan. 13, 1986, p. 21].

Key decisions are to be made by a "strategy forum" of representatives from the member companies, chosen according to the members' sales volume and the amount of their COS dues. The test procedures themselves will be developed by COS staff, in cooperation with outsiders when necessary. COS has budgeted $5.9 million for 1986 operations and $8.8 million for 1987. Nearly half of the 1987 budget is for research and development.

COS is not a standards group itself, Faurer says, but he acknowledges that it will have plenty to say about how standards are set. "We will 'bundle' company representatives to existing standards groups together so that they have visibility," Faurer says. "That way we can influence progress in the selection of standards."

What that means, Biddle says, is that no longer will representatives to standards bodies be able to stonewall in favor of their own companies' procedures. "Their lack of cooperation won't occur in a vacuum any more," Biddle says. "They are going to get caught."

The anti-IBM stance that was struck by COS, whose computer-vendor founders were afraid IBM Corp. would become the de facto standard-setter in computer communications, was partly defused when IBM joined the organization in February. "IBM had no choice but to join," comments one industry analyst. "Europeans would have been furious if IBM had refused; it would have been apparent that their decision [to back OSI] in Europe was mere window dressing."

'IBM had no choice but to join'

The next question for COS will be whether to accept foreign members. Under its charter, only North American companies can join. COS professes to be interested in foreign members, but seems in no hurry to change its charter. Nevertheless, it has formed an international committee, and most observers believe it will eventually accept foreign companies. Both Japanese and European companies have reportedly expressed keen interest in joining, but none has said so publicly.

Japan's Hitachi Ltd., in fact, says it has no plans to join, although it believes that its U.S. subsidiary may eventually be eligible. Several members of Europe's Standards Promotion and Applications Group (SPAG) have met informally with COS; but for the record, West Germany's Siemens AG and Nixdorf Computer AG say they are content to work through SPAG at present.

COS chose FTAM and X.400, two high-level OSI protocols, as its first strategic targets. Neither is due to be implemented until 1987. *–Clifford Barney*

COMPONENTS

MOTOROLA TAILORS A DSP FOR FILTERING

AUSTIN, TEXAS

Motorola Inc. engineers are in final design on an algorithm-specific digital signal processor they are tailoring for rapid execution of repetitive algorithms commonly used in DSP-based filtering applications. One example of how the DSP would be used is echo-canceling in telecommunications.

By adding a dab of on-board glue logic and a new low-overhead approach to interprocessor communications, the Motorola designers aim to open up near-endless filtering variations by cascading multiple copies of the chip. And by implementing the algorithms in silicon and trimming out unneeded DSP features, they expect to drive down the cost of digital adaptive and finite-impulse-response filtering.

The dedicated CMOS chip operates as a peripheral to general-purpose digital signal processors from Motorola, Texas Instruments, and others, and to general-purpose microprocessors and single-chip microcomputers. Its specialty is performing multiplication, accumulation, and coefficient updates all in a single 100-ns cycle.

The DSP56200, samples of which will be ready in the fourth quarter, will likely be the first available product of Motorola's DSP thrust recently disclosed in Austin [*Electronics*, March 10, 1986, p. 30]. The DSP-filter chip's interprocessor-communications architecture lets users cascade an arbitrary number of devices together with no measurable performance overhead, according to Bryant Wilder, manager of the Digital Signal Processor Operation in Motorola's Microprocessor Products Group.

CONCURRENT. The chip's communications logic runs independently but in parallel with the signal-processing engine, a core block containing a 16-by-24-bit multiplier and a 40-bit accumulator. Thus the chips will be able to pass data along at the same time they are computing the next result, Wilder says. The chip can also be programmed through registers to perform 4- to 256-tap filtering. The programmable filter taps and the cascading interface will allow designers to team up 56200 chips in a large number of configurations, increasing either the number of filter taps or the sampling rate as chips are added (table).

"You can connect approximately 200 chips together, without the need for any glue logic, before seeing any overhead associated with the cascading," according to Wilder.

Another feature aimed at outdistancing general-purpose DSP chips in echo-canceling applications is the 56200's ability to multiply, accumulate, and update the on-board coefficient random-access memory, all in a single cycle. Its multiplier and accumulator form an engine akin to the larger single-cycle arithmetic logic unit of Motorola's general-purpose 56000 DSP.

The algorithm-specific 56200 will potentially cost less to operate because users will not have to invest development resources in coding filtering algorithms. Motorola believes the chip is the first to implement in silicon the least-mean-squares algorithm used in adaptive and finite-impulse-response filtering. The die area of the 56200 has been tailored for lower cost as well—it will be less than

DSP CHIP FROM MOTOROLA CASCADES TO BUILD HIGH-TAP-COUNT FILTERS

Number of chips per filter	1				4				16			
Number of taps per filter	32	64	128	256	128	256	512	1,024	512	1,024	2,048	4,096
Maximum sampling frequency (kHz), finite-impulse-response filter	227	132	71	37	222	132	71	37	175	132	71	37
Maximum sampling frequency (kHz), adaptive filter	123	69	37	19	120	69	37	19	105	69	37	19

half the size of the more complex 56000.

Initial samples will be available for $25 to $50 each, says Wilder. Once the 56200 is in volume production, the price will likely fall to $10 to $20. Eventually, the algorithm-specific processor will cost about $5 in large quantities.

The 28-pin 56200 will have control registers for a number of programmable filtering options. The registers control, for example, a tap for direct-current signals and automatic rounding-off in the multiply-accumulate function. *–J. Robert Lineback*

COMPANY STRATEGIES

CAD FIRM ADDS INVESTORS TO EASE ANTITRUST WORRY

SANTA CLARA, CALIF.

Any worries that SDA Systems Inc. may have about the kind of financial backers it has should be put to rest by its latest round of financing. The startup, which builds design-automation systems for developing application-specific chips, was originally funded by a group of competing chip makers—GE Semiconductor, Harris, and National Semiconductor.

"We felt as if we were treading a fine line on antitrust matters," acknowledges founder and president James E. Solomon. Adding venture capital companies and private investors to its list of backers "has enabled us to sidestep the antitrust issue," he says.

Not only did Solomon broaden the base of his investors, but he also added significantly to the company's coffers. Last week he sold $8.3 million worth of preferred stock to a diverse group of electronics companies, venture capital companies, and investors.

The three-year-old SDA began life when National Semiconductor Corp. decided that it needed design tools to help it develop future-generation very large-scale integrated circuits. "Design times were getting longer and the number of revisions was increasing," recalls Solomon, who was then manager of the Santa Clara chip maker's MOS analog group. "We decided there would have to be a new design methodology and tools to go along with the method."

CORPORATE CREDIBILITY. National decided to spin off the company to create these tools. Solomon, who resigned from National in July 1983 to work on the venture, developed the idea of getting other manufacturers to finance the new venture, in the belief that corporate partners would lend greater credibility to the startup than would venture money alone.

National kicked in $1.5 million in seed money. Solomon then got GE Semiconductor, Harris Corp., and later Sweden's Ericsson to chip in $1.5 million each. At this point, Solomon felt he had the credibility to go to the venture community for financing.

Solomon had two reasons to approach the venture community: he needed the money and some business guidance. His corporate sponsors were hesitant to sit on SDA's board of directors because of the possibility of antitrust complaints. With venture capitalists on the board and financially committed to SDA, corporate partners were assured that their business interests would be well represented.

Solomon felt venture capitalists would be attracted to the enterprise because the corporate partners not only had a small equity position in SDA, but they also had a research and development relationship with the startup. This entitled them to early access to technology and tools developed by SDA and allowed them to influence the direction of new-product development.

Thus the venture capitalists had assurances that SDA's technology was sound. The corporate partners also benefited from leveraged R&D; they interacted with SDA individually, not as a group, but benefited from the technology the fledgling company was acquiring from interacting with all four partners.

SDA is targeting its integrated circuit design tools specifically to application-specific foundries. Addition of the new cash from last week's stock sale, Solomon says, "shows a strong belief in our approach to the computer-aided-design marketplace." *–Jonah McLeod and Robert J. Kozma*

PERIPHERALS

CAN CIPHER PATENT SHIFT 'THE BALANCE OF POWER'?

LOS ANGELES

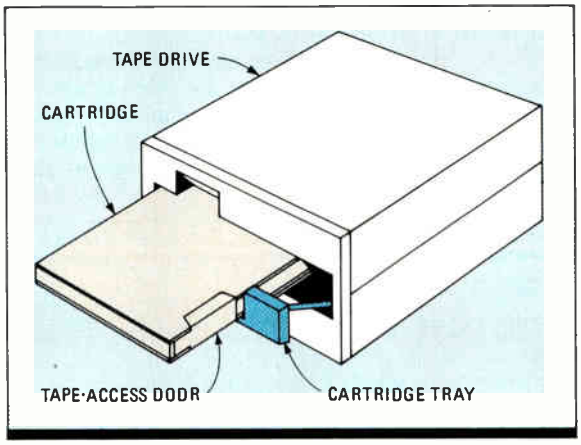
Whatever the outcome of Cipher Data Products Inc.'s drive to exploit its new tape-cartridge-loading patent, it certainly has got the industry's attention. The San Diego company has served notice that it plans to wring all possible advantage from the recently granted patent, which covers loading the industry-standard ¼-in. tape cartridge into drives built in the popular 5¼-in. form.

Cipher officials, on the advice of attorneys, are mum on the details of their intentions. But vice president and chief financial officer Thomas Anderson says "the balance of power could be changed" in the ¼-in. streaming-tape market if those plans are successful.

As the kickoff in the campaign "to protect technology covered by the patent," Cipher earlier this month "offered nonexclusive licenses" to the two sales leaders in streaming-tape units: Archive Corp., Costa Mesa, and Wangtek Inc., Simi Valley, Calif. [*Electronics*, April 14, 1986, p. 13]. A May 1 deadline is set for the initial reply from the two companies, but sources predict that months will pass before the issue reaches any definitive settlement. Meanwhile, Cipher officials may also target other drive makers using its loading technique.

By most accounts, Cipher's patent approval on Feb. 25 came as a shock, say competitors and industry observers. "Surprised? I think you could say that," says Archive president D. Howard Lewis.

The reason that usually well-informed executives got blindsided in this case is that Cipher's loading method—from the drive's end to be engaged by the read/write head—has been used as a generalized design approach by most drive makers since first products were announced in 1982, and the



PATENTED. Cipher's patent covers loading ¼-in. tape cartridges sideways from the small end of the tape drive.

technique was widely regarded as being in the public domain. Anderson says Cipher's drive was done first and so it initiated its patent filings that year.

Archive's Lewis vigorously disputes the validity of Cipher's claim. "It's not unique or clever. In fact, it's obvious." Although he says Archive attorneys are still studying the matter, Lewis's tone suggests that Archive likely will not go along meekly with the Cipher proposal. Wangtek vice president and general manager Whitney Lynn is more cautious, however. He says only that, for now, "we're looking at our options."

Making the issue even more pointed is how well ¼-in. cartridge tape drives are doing in the marketplace as the principal backup storage medium for large (upward of 20 megabytes) disk drives. After a slow start in 1982 caused by production glitches and high prices, demand is booming.

BIGGER GROWTH. In its latest report, computer-tape authority Freeman Associates Inc., Santa Barbara, Calif., again has boosted its projection for 1986 sales of 20- to 80-megabyte drives to 663,000, compared with 405,000 last year. Strong demand could send this total even higher, notes vice president Lee H. Elizer.

Any extra expenses that could affect this growth therefore concerns all participants, says Elizer. None of the parties involved will reveal specific terms sought by Cipher from Archive and Wangtek, but sources hint at a hefty financial package. It calls for an up-front payment and royalties on a sliding-upward scale that ultimately could amount to millions of dollars for both targeted companies, says one source.

Archive now is producing more than 20,000 drives per month, and Wangtek about half that. Kennedy Corp., Duarte, Calif., follows at perhaps less than half of Wangtek and somewhat ahead of Cipher, say market observers.

If Cipher's scenario plays out, manufacturers would have to pass the costs along to drive customers, who are very price-conscious. Higher prices could work against ¼-in. drives, says Elizer of Freeman Associates. Acceptance of optical storage drives may speed up, though product availability is years away and volume prices are much higher than the $550 per drive tab now prevailing.

Paying for the tape-loading patent could drive up prices

Kennedy, for one, has taken itself out of Cipher's sights, says president Frank C. Bumb, president of the Allegheny International subsidiary. Bumb says he pushed his lawyers for an opinion soon after the Cipher patent became public, and they pronounced the Model 8600 different enough from Cipher's that no patent infringement takes place. The Kennedy unit, in contrast to Cipher's, moves the cartridge into a fixed head.

CONTINUING RISK. Bumb and other executives agree that the Cipher patent affair illustrates a continuing business risk to companies involved with a fast-changing product. To remain competitive, designs have to be completed and production started before it is entirely clear whether widely-used technology could be covered by patents owned by others.

Cipher's pursuit of a return from the patent may not be entirely restricted to the ¼-in. product niche, either, in the view of financial analyst Paul A. D. Evans, who tracks computer peripherals for Wall Street's S. G. Warburgh, Rowe & Pitman, Akroyd Inc. Because the company concentrates more on the ½-in. tape field, it may be signaling competitors there, too. Evans believes they may be saying " 'Don't try to steal anything from Cipher or you'll get hurt.' "

While a deal may be worked out, informed outsiders guess that a legal hassle could be in the offing as positions harden and tempers flare. Kennedy's Bumb does not mind competitors squaring off. "I'll hold all their coats for them," he quips. *–Larry Waller*

ARTIFICIAL INTELLIGENCE

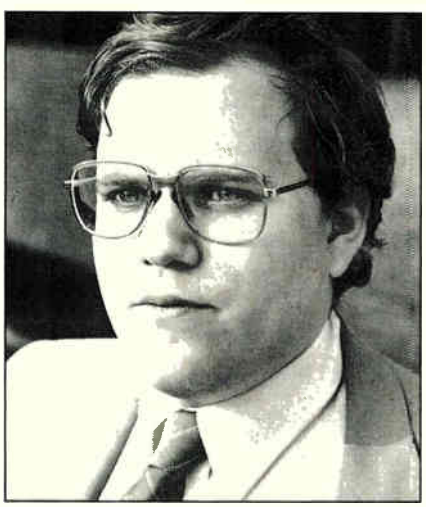
CAN CUSTOM AI COMPUTERS MAKE IT BIG?

CONCORD, MASS.

The market for artificial-intelligence hardware got a major entry last week from Symbolics Inc. But the debut raised questions about the form in which AI applications will be delivered as they move into popular use.

One view is that the advantages of symbolic processing for AI applications are so great that customers will pay a substantial premium for them. For example, Symbolics, which dubs its new gate-array-based computer the 3610AE, has priced the machine at about $45,000 for one-unit buys and about $31,500 in quantity (see p. 55). Howard Cannon, director of marketing, maintains that AI's "big payoffs" come with the complicated applications that demand the software environment and dedicated hardware of a symbolic processor.

Much of the immediate market for the new machines, says Cannon, will come from large end users who have already developed expert systems and want to deploy them. Sales will also come from value-added resellers who have been holding back on development because there was no way to deliver the applications, he adds. "In that sense, the 3610AE is a lever to help us sell development systems," says Cannon.



PAYOFF. Symbolics's Cannon sees AI's big payoffs in jobs needing dedicated hardware.

Others believe that the 36-bit 3610AE will be hard-pressed by makers of general-purpose work stations, who are scrambling to enhance Common Lisp support on machines that will cost far less. For doing Lisp work exclusively, says Harvey Newquist, editor of a newsletter called *AI Trends*, Scottsdale, Ariz., customers will probably opt for a specialized machine. But for those who will use Lisp only part-time, he says it's "probably better to go with general-purpose hardware."

PART-TIME LISP. Because most Lisp use will in fact be part-time, at least initially, "we maintain that the market for application vehicles will be dominated by 32-bit work stations," says publisher Susan Messenheimer of AIM Publications Inc., Natick, Mass. A significant market from pent-up demand within Symbolics's installed base—now approaching 2,000 units—will provide a market for the 3610AE machines, she adds. And Messenheimer concedes that Symbolics software offers a superior environment for AI development and complicated applications. But, she says, "special-architecture products have a limited potential." In her view, general-purpose numeric computers of the future will incorporate symbolic processing capabilities.

Sarah Spang, editor of the *Spang*

Robinson Report in Palo Alto, agrees that the future belongs to mixed (symbolic and numeric) computing. She is more optimistic, however, about symbolic processors as delivery vehicles. If or when competition from general-purpose numeric processors for AI applications grows, Spang says, "Symbolics will find a way to lower their prices." Symbolics will also move to incorporate numeric computing into its environment, Spang believes.

Symbolics's Cannon agrees that some AI applications can run easily on general-purpose hardware. But he disagrees that 32-bit work stations are the competitive threat. "My reaction to those people is that they should strip down the applications all the way and use a personal computer," he says.

Most elaborate expert systems require symbolic processing, and that includes more than hardware, says Cannon. In fact, he says, Symbolics' latest version of its Lisp package, called Release 7.0, is as important as the announcement of the 3610AE.

'Special-purpose architectures limit product potential'

Meanwhile, other AI vendors are eyeing the applications market. Texas Instruments Inc., which markets the Explorer Lisp machine, is at work on a 32-bit Lisp microprocessor under contract with the Defense Department [*Electronics*, March 31, 1986, p. 17].

"I really don't know if it's time yet to have a low-end delivery vehicle," says Joe Watson, vice president of advanced systems in the Dallas company's Data Systems Group. "I know it is important to deliver Lisp applications on general-purpose machines." In that regard, TI is pursuing relationships with both Apollo Computer Inc. and Sun Microsystems Inc. to adapt Explorer technology to their work stations.

Xerox Corp., Stamford, Conn., which already markets an AI work station selling for about $10,000, is also at work on a Lisp chip. Sales of the low-end work station are beginning to build, but one technical support representative describes the applications market as "still a bit in the future." *–Craig D. Rose*

BOARD TESTING

A FASTER WAY TO CHECK CIRCUIT BOARDS FOR EMI

OTTAWA, ONT.

Isolating and eliminating the causes of excessive electromagnetic emissions in printed-circuit-board designs to prevent interference has long been a laborious process. But this could change if automated tools like the in-house prototype developed by Bell-Northern Research in Ottawa catch on. The system—dubbed Emscan, for electromagnetic scanner—detects electromagnetic hot spots, color-codes them for contour mapping, and superimposes the map over a physical layout of the board generated by a computer-aided-design system.

The heart of the test bed is a six-layer pc board inside a fixture slightly larger than a briefcase. The board carries an array of 1,280 magnetic-field probes as well as control circuitry and an RS-232-C port to link the board to Bell-Northern's board-CAD system. When a board under test is powered up directly over the field-probe board, its wiring tracks generate magnetic fields that induce signals in the the scanner's probes. A receiver measures and digitizes the analog signals from the probes.

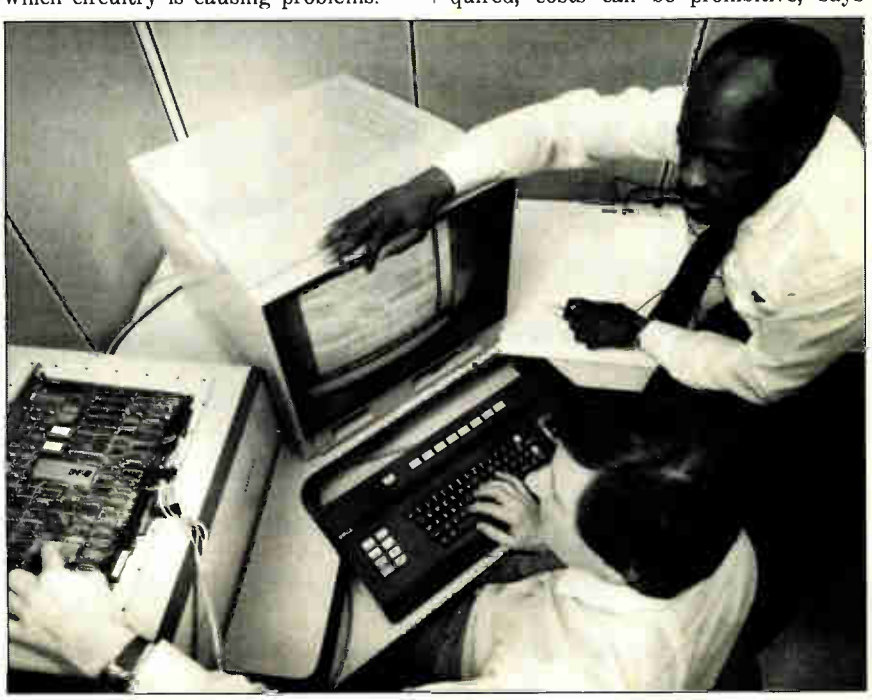
The Emscan controller relays the magnitude of the magnetic field generating the circuit-track currents to a computer, which represents differing field-strength levels with different colors. Then the CAD system superimposes the outlines of the components on the board under test over the color map of hot-spots, showing designers precisely which circuitry is causing problems.

Emscan's timing resolution can be adjusted from milliseconds to seconds to suit the problem being examined. A typical board test sequence operates at 1-to-10-ms resolution, though a 1-s interval might be needed for a board carrying low-frequency signals. At the high end, resolution "is really limited to the settling time of the probes," explains Stanislus Xavier, manager of generic engineering and design support at the Ottawa research laboratory.

Bell-Northern has applied for patents on the device, though it has no plans for Emscan beyond in-house testing and debugging. If interest in the technology is strong, however, spokesmen say other arrangements could be made.

STANDARDS. The idea for Emscan came four years ago with the realization that governmental and international regulatory bodies were certain to increase their emphasis on conformance testing to limit EMI. In the U. S., Part 15 of the Federal Communications Commission's rules for computing hardware specify acceptable levels of radiation, and Canadian EMI conformance-testing standards are established by the government's Department of Communications. Actual development of the Emscan hardware was launched a little over two years ago.

According to Frank L. Rose, chief of the technical standards branch of the FCC, Washington, a commonly used method to test product conformance to standards is to use a spectrum analyzer with hand-held radio-frequency probes and sweep a board to test individual components. But the hand-held process tends to be slow, and if rework is required, costs can be prohibitive, says



EMI MAPPER. Automatic mapping of a board's electromagnetic emissions at the prototype stage can cut redevelopment costs, says Xavier of Bell-Northern Research (upper right).

Xavier. "We wanted to pass those tests the first time out, and thus be able to reduce overall project costs."

Xavier estimates that 80% of the EMI in most systems can be eliminated at the pc-board level. "Emscan allows engineers to quickly evaluate circuit-board designs and to incorporate measures to control electromagnetic emissions at the prototype stage of pc-board development," he says.

"If fully trained personnel had to scan a simple board using manual analysis, it would take about two weeks. Using Emscan, the same job takes 15 to 20 minutes." Xavier adds that design-project costs would be reduced even more if automated conformance testing using equipment similar to Emscan were to catch on. *–Robert Rosenberg*

IC TESTING

ON-CHIP PROCESSOR MAY SIMPLIFY VLSI TESTING

AACHEN, WEST GERMANY

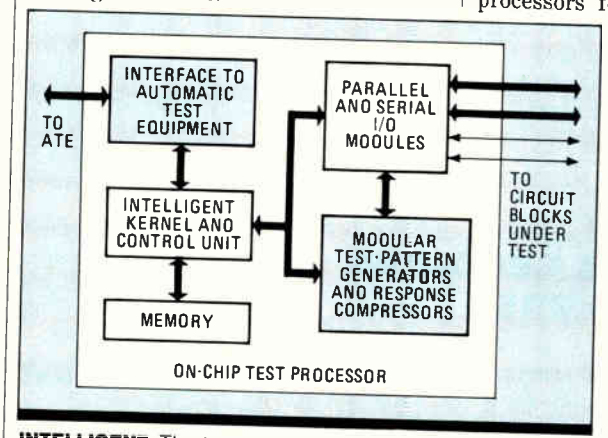
As very large-scale integrated circuits grow more complex and their pin count per gate decreases, it becomes harder to access an acceptably high percentage of on-chip devices for testing. Also, test times with external equipment are getting longer and today's test gear may not be usable at all for chips that are yet to come—chips with one million transistors or more.

A team at the Technical University of Aachen is taking a novel approach to testing VLSI circuits: an entire on-chip microprocessor that provides an intelligent interface to automated test equipment. Such a radical approach to on-chip test aids will of course add significantly to the cost of the chip, its developers admit, but the payback will justify that cost as chips grow more complex.

The test processor would allow chips to be tested more rapidly and on far simpler and less expensive ATE, for one thing. Fault coverage would be increased dramatically, reducing the costs associated with undetected failures. And, unlike other on-chip test aids, the processor would apply test patterns and check results at a chip's full operating speed, catching bugs that do not show up in reduced-rate testing.

So far, the Aachen experts have readied the test processor in breadboard form and built a gate-level simulation model. The processor, to be described in Paris at the Seventh European Conference on Electrotechnics April 21 to 23, "could be in silicon next year," says team leader Axel Hunger. The work, partially funded by the European Economic Community, is being done at the university's Institute for Communications Equipment and Data Processing. It is part of the Computer-Aided Testing for Europe project headed by Bull, the French computer maker.

SCAN-PATH. A well-known approach to on-chip testing is the scan-path technique, which captures the state of internal nodes with an on-chip string of serially linked registers. The scan-path method raises a chip's testability and ensures access to many circuit blocks, but almost all test actions must be initiated from external equipment—and often, not all parts of the circuit can be tested. Further, the scan-path method does not perform real-time tests under actual operating conditions.



INTELLIGENT. The test processor has an interface to ATE, a control unit, memory, pattern generators, and I/O modules.

With some of the intelligence of the external ATE moved onto the chip itself, however, the on-chip test circuits can control interface functions as well as a variety of tests—pseudorandom, functional, and on-chip self-tests, among others. And because of its better access to the circuit blocks, it increases the fault coverage without making additional demands on external test hardware.

The test processor's intelligence helps keep the ATE simple and less costly—a big advantage, as some test systems can cost several million dollars. The processor performs real-time tests by applying sets of test patterns and monitoring the responses to them.

The processor consists of an intelligent kernel with memory modules; an ATE interface; a peripheral-modules section with input/output circuits; and programmable test-pattern generators and response compressors based on linear-feedback shift registers. The I/O modules interface with the on-chip blocks to be tested. Part of the kernel is a comparator that checks these blocks' response against expected results. The section of the processor interfacing with the outside world uses serial or parallel I/O, depending on the ATE and the number of available pins.

Memory modules include random-access memory for the test patterns and RAM or read-only memory for the microinstructions. The total memory capacity may be anywhere from 32 to 124 words, depending on the application. The microinstructions represent the actual test procedures, and the RAMs contain those test patterns that cannot be generated by the programmable generators in the peripherals part.

Part of the kernel is a control unit. It manages and supervises the interactions of all modules under the control of the microprogram ROM. That includes the control of the output of the comparator as well as that of the test peripherals.

The structure of future on-chip test processors for VLSI chips must be as flexible as possible, Hunger says, "for it is unacceptable that a special processor be designed for each newly developed chip." Ensuring flexibility is a kernel that is the same for each circuit to be tested and a set of peripheral modules configured for each test method and for specific chips.

Another important consideration is overhead, says Hunger. To be cost-effective, on-chip test aids should not take up more than one tenth of the chip area. Therefore, assuming that chips of the 1990s contain one million transistors or more, the test processor should not have more than 100,000 transistors (at present, the Aachen breadboard has fewer than 100,000 transistors).

WORTH A MILLION. When the number of transistors goes beyond one million, the test processor's relative overhead drops because there is no need to scale up the processor for bigger chips. Only a few more I/O devices may have to be added to cope with the more complex circuits.

For present VLSI chips, with at most 500,000 transistors or so, a 100,000-transistor test processor would be too costly. Neither is a test processor of much benefit for circuits with regular structures only—for memories, for example.

Here, Hunger says, conventional test aids will do. But for big, irregularly structured, and complex VLSI circuits that also have imbedded regular structures, an on-chip intelligent test processor should be a boon. *–John Gosch*

INSIDE TECHNOLOGY

SPEECH PROCESSING: HEARING BETTER, TALKING MORE

LARGE VOCABULARIES AND SPEAKER INDEPENDENCE ARE COMING

by Robert Rosenberg

Speech processing—the topic of this two-part special report—promises one day to revolutionize the way humans interact with machines. Endowing machines with the ability to interpret and act on spoken instructions—the realm of speech recognition—is becoming an indispensable factory-automation tool, and research breakthroughs promise to soon transform it into a ubiquitous office tool. Within the next 18 months, several speech-processing companies are expected to unveil voice-activated typewriters, capping a highly competitive race. And speech synthesis—giving voice to digital data—is making rapid strides in freeing users from the tyranny of the display screen and terminal.

SPEECH RECOGNITION

MACHINES ARE BECOMING BETTER LISTENERS

The most exciting advances in speech processing are now coming in the realm of speech recognition, where machines are beginning to acquire the most distinctive human characteristic—the ability to interpret speech. Though the current generation of voice-recognition technology is limited to a relatively small number of simple human voice commands, this has been enough to earn a niche in the workplace. And on the horizon are large-vocabulary speech-recognition systems that one day may replace the keyboard as the primary input device for typewriters, word processors, and even computers.

This kind of market potential is attracting big players. At IBM Corp.'s Thomas J. Watson Research Center in Yorktown Heights, N. Y., dramatic strides are being made toward developing a prototype large-vocabulary, speaker-dependent, dictation-taking machine. And at AT&T Bell Laboratories, Murray Hill, N. J., researchers have also made big gains pursuing the more ambitious goal of a speaker-independent voice interface.

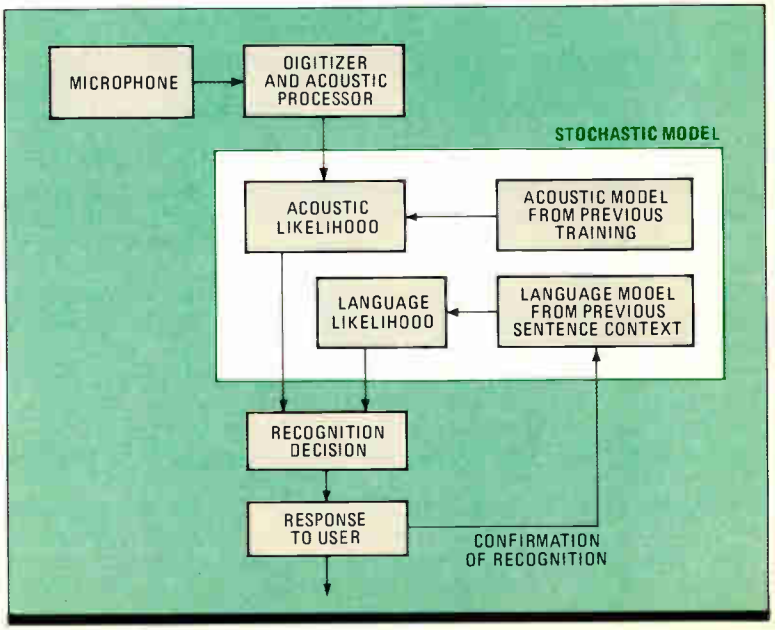
Machines that recognize a few isolated words are already being used in factories around the country for simple shop-floor chores such as incoming inspection and inventory control. With such a system, a worker uses voice commands to identify and count items being unloaded on a dock or passing along an assembly line without having to turn away to enter data with a keyboard. "The hottest application we see in the technology right now is voice recognition in the automobile industry [in the shop-floor applications]," says Stan Goldstein, conference organizer of Speech Tech '86 in New York and the publisher of *Speech Technology* magazine. Goldstein says several European automakers are expected to be among the 2,000 attendees at next week's big show at the Waldorf-Astoria Hotel in New York.

Industrial applications dominate the current market for voice-recognition products, according to analysts. By next year, however, an initial round of products aimed at office applications will be making their debut, predicts voice-processing analyst William Spain of Probe Research Inc., Morristown, N. J. "Right now, industrial users are buying 15 to 20 of these voice-recognition devices at a shot," he says. "However, they don't talk about it much, because they see it as a competitive edge."

Probe pegs the voice-recognition industry at $20 million last year—almost all of it for factory-floor automation—and is projecting a $1 billion figure by the end of the decade, based on the sales of office devices augmenting revenues from the factory systems.

TEMPLATE MATCHING

Speaker-recognition systems can be characterized by three parameters: the size of the vocabulary they can process, the degree of fluency they can handle (that is, whether the words can be spoken naturally or must be separated by discrete pauses), and the degree of speaker dependence—that is, to



1. DRAGON'S DECISION. Dragon Systems Inc. has decided to use a statistically based prediction technique called stochastic modeling to make recognition decisions.

what extent, if any, the speaker must train the system to recognize his voice before using it. Isolated words are easier to process than continuous speech, and speaker independence is about an order of magnitude more difficult to handle than a system that has been trained by the speaker.

Template-matching is the favored technique for small-vocabulary speaker-recognition applications. Templates—stored patterns—of the spectral parameters of individual words are produced by measuring energy versus frequency over time. Typically, these parameters correspond to the linear-predictive coefficients used to model the human vocal tract (see p. 29). These templates are stored in the system and compared with actual utterances in real time, usually using a proprietary algorithm. In a speaker-dependent application, the system is prepared by a speaker who repeats the same command several times. The more iterations of a template the system can store and compare against the utterance, the better the accuracy of the system.

For a laboratory technician hunched over a microscope or a factory worker inspecting parts on a conveyor belt, the ability to enter data with voice commands while both hands and eyes are kept busy can mean a big boost in productivity, according to Chriss Seelbach, president of Voice Industries Corp., Morristown, N. J., a new company that recently acquired the assets and technology of the Verbex Division of Exxon Enterprises, an early leader in template-matching technology.

"Exxon spent millions developing [the model 4000 recognizer], and it was the first to work over telephone lines," says Seelbach. The unit, which is the size of a video cassette recorder, has a 100-word recognition capability sustainable against 85 dB of background noise. The system is built around a Texas Instruments Inc. TMS32010 single-chip digital signal processor and a 6,000-gate array.

Votan also uses template-matching. The Fremont, Calif., company is shipping a device that performs both speaker-dependent and speaker-independent continuous speech recognition with limited vocabularies. Its speaker-dependent vocabularies are typically in the range of 64 words; speaker-independent continuous speech is usually confined to digits 0 through 9 and yes and no.

Votan processes the input speech waveforms using a TMS32010 and then applies a 6809 and its own proprietary chip to perform the computationally intense chore of template matching to two previously stored patterns. The Votan system implements a technique called dynamic programming to facilitate the pattern-matching search. Though dynamic programming is more complex than a standard search based on a matrix comparison of time and energy, it permits greater search flexibility.

Votan president James V. Ragano is unimpressed by the claims being made by researchers who have been promising to soon deliver large-vocabulary speech-recognition systems. He says that the problems associated with large-vocabulary-recognition systems are not intractable, but he thinks the solutions are not as far along as many people claim: large vocabularies are being hyped, he says.

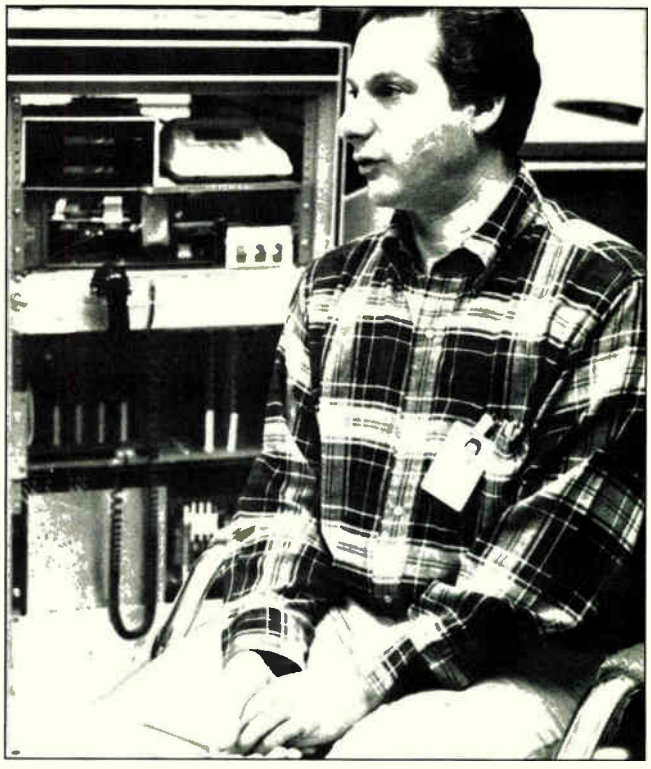
Large-vocabulary systems are generating a lot of excitement, largely because they could become the indispensable office-automation tool driving a voice-activated typewriter. "The speech-recognition industry is in a tremendous state of flux," points out Janet Baker, president of Dragon Systems Inc., a Newton, Mass., company that specializes in research and development of speech processing and licenses its recognition technology to the likes of Apricot Computers plc and IBM Corp. [*Electronics*, April 14, 1986, p. 16]. "The hockey-stick projections" of market growth made in years past were the fault of analyst naïveté, Baker says, but she is convinced that the technology is now ready. "The market is really taking off now."

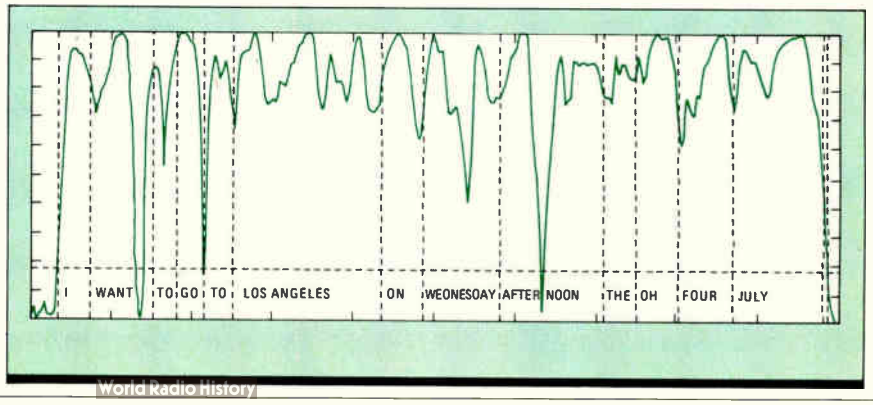
GIVING A VOICE TO THE PC

IBM's announcement last October of a voice-communications option for its Personal Computer appears to confirm Baker's optimism. IBM's initial products were modest: with a pc board and the right software packages, a PC user can issue DOS commands by voice or digitize incoming phone calls, store them, call up a listing on screen, and select one for playback. Another board converts text to speech. Perhaps more significant is IBM's quiet introduction of its Application Program Interface Reference, a manual describing the interface requirements for the voice option, which gives assembler-language programmers a toolkit for application development and could make voice processing the next hot area of competition among the big software houses.

Much of that assembler-programming toolkit comes from

2. CROSSROAD. Speaker-independent speech-recognition research is at a crossroad, says AT&T Bell Labs' Stephen E. Levinson.





3. UNIVERSAL APPLICATION. AT&T Bell Laboratories is attempting to develop speech-recognition technology to automate such tasks as airline flight scheduling.

Dragon. After licensing its discrete recognition drivers, language compilers, an applications interface, and development tools to IBM, Dragon's work has found a wider audience. Baker says that Dragon is demonstrating a 2,000-word, speaker-dependent, discrete-word, application-specific program that runs on IBM's Personal Computer AT and needs just one second to recognize a word.

"If we can [achieve this speed of recognition] on a single 80286-based machine, you can extrapolate how fast we could make it run on special-purpose hardware," says Baker, who estimates that a speedup factor of 10 to 100 can be achieved using custom circuits. In fact, Baker admits that Dragon has already entered into an agreement with a silicon foundry for application-specific integrated circuits, and she expects to see several original-equipment manufacturers announcing products before the first quarter of next year.

Dragon's approach is based on stochastic modeling—a statistical tool that explicitly models the probabilistic nature of various phenomena. "Our information comes primarily from two sources—acoustics and language—but the information we have to combine is often incomplete," says Baker. "Our approach is to look at the context of the delivered information, characterize the probability of certainty of that information, and quantify it. Then I take that information and compare it against previously attained information before making a decision" about a word (Fig. 1).

IBM is forging ahead with its own experiments in large-vocabulary speech recognition using a variation of stochastic modeling based on what are called hidden Markov models. Markovian modeling of speech is based on the work of Andre Markov, a 19th-Century Russian mathematician who developed the model to analyze the text of *Eugen Onegin*, a novel by Leo Tolstoy.

A Markov chain is a mathematical model in which behavior at some time (the present) is determined by behavior at some finite number of past time intervals. When applied to speech, the model permits behavior to be abstracted as a state model, with the behavior at one state based on previous states. Because speech patterns have such variety, however, the state process can only be estimated. They remain hidden to designers—hence the hidden Markov model.

When applied to speech, the model helps detect and classify spectral and language information. At the Watson Research Center, an IBM 4341 with three Floating Point Systems 190L array processors harnessed to drive an experimental 5,000-word dictation machine first demonstrated in October 1984 [*Electronics Week*, Oct. 15, 1984, p. 14] has already been supplanted by a PC-based prototype machine that can recognize 5,000 words in real time.

In the IBM approach, a 20-minute training session is needed to supply acoustical information to an acoustical processor. A signal processor operating at 20 kHz extracts vectors of 20 parameters from every 10 ms of speech. The vectors are compared with some 200 prototype vectors stored during the training period, and the best match of sample and stored prototype is labeled and sent to a linguistic processor. The linguistic processor uses the hidden Markov model to compute the likelihood of one of the labeled sets following another. As new information is received every 10 ms, the process is repeated and the statistical likelihood of a connection is revised.

20,000 WORDS NEXT?

IBM's demonstration of a 5,000-word prototype system last week may soon be superseded by a prototype 20,000-word dictation machine running on a PC AT. The PC AT system consists of a simple demodulator board to capture the signal from the microphone and two subsystems made up of three boards each. Common to both subsystems are a digital-signal-processing board and a host-interface board.

One subsystem, made up of the data-acquisition board, a DSP, and a host interface, takes care of the labeling; another, made up of a DSP board, a host-interface board, and a memory-management-unit board, matches the labels with the acoustic and phonetic models of the stored vocabulary.

To build a 20,000-word version of the recognizer, four sets of three boards consisting of one DSP grouping and three MMU groupings will be needed.

Researchers at AT&T Bell Laboratories are also using statistically based speech-recognition models, but in pursuit of the more ambitious goal of speaker-independent recognition. "We are worried about a different set of problems than those associated with a dictation machine," explains Stephen E. Levinson, a member of the speech research department's technical staff (Fig. 2). "We are looking for a speaker-independent recognition device capable of imparting its information content across a noisy environment like a telephone network so it can be acted on by another device" (Fig. 3).

At AT&T Bell Laboratories, the detection and classification capabilities of models using hidden Markov chains are being developed in parallel with models that temporally align a known with an unknown utterance. In its favored form, called dynamic time warping, a speech input is

4. CONTROL. Bell Labs has achieved continuous recognition to control an experimental robot.

intentionally distorted to make its spectral parameters align with a known sequence. The objective of such dynamic time-warping research is to find algorithms that are deterministic yet produce the minimum distortion when matching a test with a reference utterance. For example, using time warping, the spectral differences in speech from speakers having different vocal-tract lengths or between speakers with regional accents can be stretched like a rubber band to make them match the reference utterance—a technique that may be useful for achieving speaker-independent recognition.

Levinson says Bell Labs researchers are beginning to tackle speaker-independent recognition. "We are at a crossroads. We have learned how to do a moderate-size vocabulary: speaker-independent, continuous recognition on the order of a couple of hundred words with limited artificial grammar and semantics. The recognition experiment was embedded in a machine application that performed the task well, but it achieved only 95% correct sentence recognition" (Fig. 4).

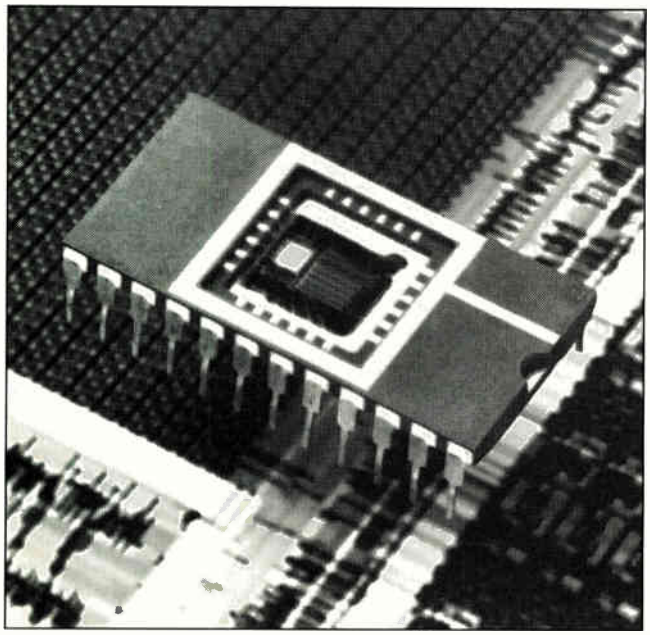
Besides AT&T's and IBM's heavy reliance on a statistical approach, other companies are bringing the techniques of artificial intelligence to bear on large-vocabulary speaker-recognition systems. Kurzweil Applied Intelligence Inc., Waltham, Mass., is using "multiple experts" to resolve language and acoustic perplexities in real time. Some of these "experts" reside in hardware-based custom circuitry, and others consist of software that runs on off-the-shelf hardware.

The problems of spectral and language understanding are divided up among the experts. To handle the acoustic front-end filtering, Kurzweil's KCS2408 digital signal-processing chip has the equivalent of eight two-pole filters; the company says the KCS2408 can do the work of forty 68000 microprocessors (Fig. 5). The spectral data is then handed off to the experts, which attack the language-based problems. For example, some language chores are apportioned to knowledge-base systems that resolve ambiguity between homonyms. Meanwhile, another set of experts is evaluating spectral information based on three previously stored templates. Other experts could be working on stochastic problems—statistically reevaluating a language decision based on new incoming data.

Speech Systems Inc., Tarzana, Calif., is also using AI techniques but is concentrating on phoneme-recognition—phonemes are the elements in a given language that constitute the smallest sequences of speech—and eschewing recognition based on complete words. Speech Systems' phonetic engine operates independently of an application by translating speech into a phonetic code that carries both statistical and phonetic information.

"There are several reasons we think a phonetic approach is superior to a system built around spectral information from a statistical model or from normalization of previously stored word templates," explains William S. Meisel, chairman and president of Speech Systems. "Since there are only 40 phonemes, and they have been studied to death over the years, they are a more appropriate unit to analyze than the millions of words in the English language. A phoneme-based system is a particularly appropriate vehicle for a continuous-speech recognizer because co-articulation problems can be reduced to a set of rules operating at the phonetic level. Also, phonemes are comparable across speakers, so when you develop a phoneme-based system, there is less of a need to train the system."

5. ADVANCED GUARD. Kurzweil AI-based recognizers are getting a boost from the company's custom digital signal-processing chip.



SPEECH SYNTHESIS

TALKING MACHINES MOVE OUT OF GADGET STAGE

Speech synthesis has shed its image as a gimmick to lure gadget-loving consumers. Synthetic speech in talking clocks, radios, and ovens has given way to devices that convert text to speech and voice-controlled store-and-forward systems that promise an end to telephone-tag in the office.

Storing the entire waveform of a spoken phrase—as in most of the current crop of voice store-and-forward systems—yields the the best synthetic speech. But using filters, analog-to-digital and digital-to-analog converters, and a computer with mass storage has its penalty: bit rates are high—typically 16- to 64-K to reproduce a second of speech.

Waveform coding is impractical for systems that deal with unlimited vocabularies, such as systems that convert text to speech. Text-to-speech systems keep the bit rates as low as 100 b/s, but the tradeoff is speech that is distinctly non-human, though intelligible. In the middle are systems that store fixed vocabularies and produce acceptable synthetic speech.

"It's just not as natural as you would want it. You won't mistake a machine for a human . . . yet," says John Makhoul, manager of the signal-processing department at Bolt, Beranek & Newman Inc., Cambridge, Mass. Nonetheless, he predicts that the problems associated with speech acoustics (the spectral problems) will be solved as the cost of memory drops. The problems associated with putting the right inflections (the prosody) in a text-to-speech system are "more difficult to crack, since deciding on intent and meaning requires artificial-intelligence capabilities."

Finding the best model to approximate human-speech acoustics is the speech researcher's quest for the Holy Grail. A common approach is to begin by modeling the human vocal tract as if it were a series of organ pipes. Flowing down these tubes are the two basic components of speech: unvoiced air movements and a voiced (pitch) component made by the vocal cords. The unvoiced portion can be modeled with a white-noise generator, and a periodic waveform of the voiced component produces a good approximation of the voiced output.

The pipes filter the two portions of sound; the crucial resonances for speech production are called formants, and in a typical male they correspond to 500, 1,500, and 2,500 Hz. So one key to modeling the waveform is finding a filter or set of filters that can change its resonance characteristics to match the crucial segments of speech. Another factor is getting the timing right as the switch from voiced to unvoiced is made.

The synthesizers themselves can be characterized by whether time- or frequency-domain compression techniques are used to keep bit rates low. Time-domain synthesizers try to recreate the waveform of the original speech. On the high end

of the bit-rate spectrum is pulse-code modulation, at 64 kb/s; at the low end are predictive waveform-synthesis techniques such as adaptive delta modulation, at 16 kb/s.

Frequency-domain synthesizers work from a parametric analysis of speech, achieving bit rates substantially below time-domain synthesizers. Simple formant-based synthesizers, which work with the crucial three formant frequencies, bandwidth, pitch, and gain, yield a product with a low bit rate. But formant calculations are tricky, so linear predictive synthesizers keep it simple with predictors based on the peaks in energy and pitch parameters.

Linear predictive synthesizers are built around a set of filters that predict when little change between one speech segment and another will occur, making it possible to remove spectral redundancy. In direct-form linear-predictive-coding filters, speech is synthesized by predicting the filter coefficients based on the weighted sum of past samples and the grossest features of the source signal, such as its periodicity. A lattice version of the linear-predictive-coding filter will tolerate a greater inaccuracy in the coefficient used, making it more robust and the output more like the human voice.

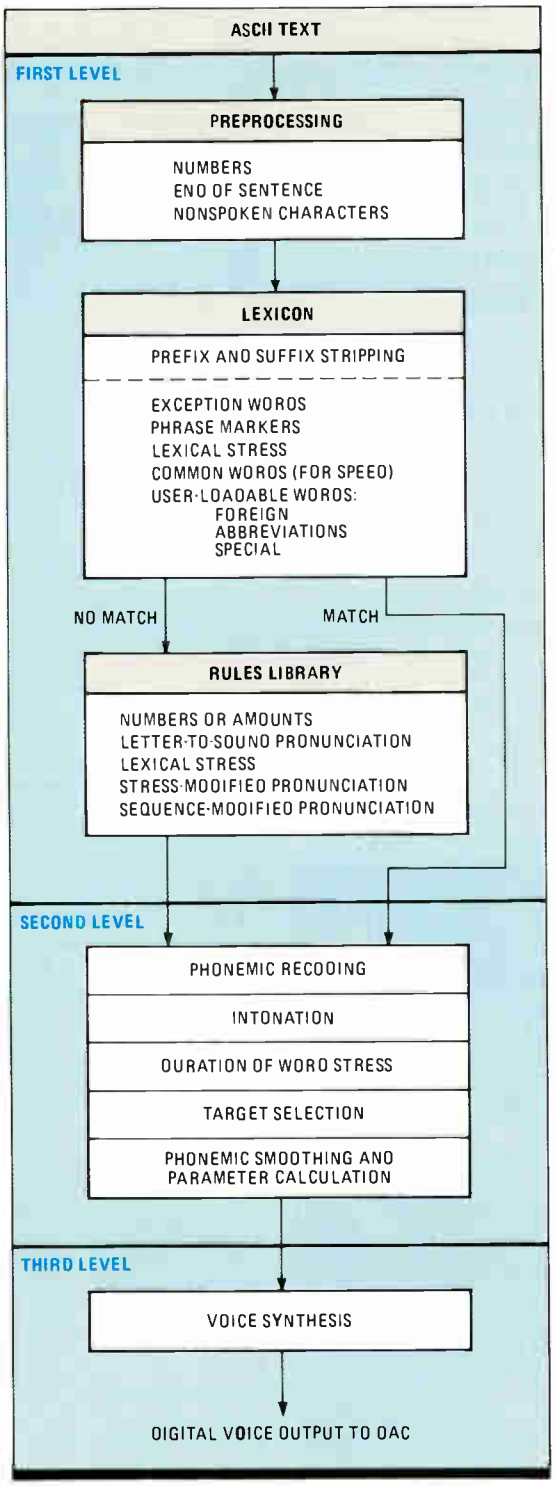
The biggest use of synthesizer chips right now is in voice-messaging systems such as those from Octel Communications Corp., San Jose, Calif., and VMX Inc., Richardson, Texas. Manufacturers of voice-messaging systems are combining proprietary compression algorithms with off-the-shelf synthesizers, and they are finding a ready market for systems that put an end to telephone tag in the office.

Text-to-speech systems are also using synthesizer chips. They are catching on because they make it possible to have any text coded in ASCII output as spoken words, freeing a user from the tyranny of the terminal. Text-to-speech systems take scanned or typed words and convert them into phonemes. After the phoneme string is created, it must be checked for syntax and punctuation. Then a check is run to decide on voice pitch and intonation. What results is a phoneme model that must be smoothed to form a continuously varying set of parameters to describe the frequency spectrum of an acoustical speech signal.

Two camps are at work on trying to find the best method to smooth the phoneme model. One group champions the joining rules derived from a stored pattern of human speech. The phoneme code is checked against the stored rules that smooth and modulate the pitch and intonation, making it approximate human speech. The other camp says that a purely mathematical description of the dynamics of speech holds greater promise.

Since shipments of DECtalk began, the single-port computer peripheral from Digital Equipment Corp., Maynard, Mass., has been acknowledged as one of the leading text-to-speech devices. The peripheral, which connects to an RS-232-C port, uses off-the-shelf hardware and three levels of processing software to achieve a text-to-speech conversion based upon formant synthesis (see figure). In level one, text is converted to phoneme code using both a phoneme-generating algorithm and a lookup dictionary that matches letters to phoneme sounds. Once the letters have been processed, the smoothing algorithm looks at adjacent words for clues to pronunciation and then applies rules to intonation, duration, and modulation.

TALKING. DEC's formant-based text-to-speech device uses off-the-shelf hardware and three levels of software.



Speech Plus Inc., Mountain View, Calif., is also using formant synthesis, delivering its text-to-speech system to original-equipment manufacturers such as IBM, Olivetti, TI, and Wang Laboratories. The CallText 5000 provides up to five data-to-voice channels from a single host. "We want the telephone to replace the data terminal as an economical means to get data," explains A. Keith Plant, company president.

First Byte Inc., Long Beach, Calif., is targeting Apple Macintosh users with its text-to-speech SmoothTalker, which consists of two modules: a front end that converts an incoming text string into phonemes and a back end that converts the phonetic string to speech. The front end is built around more than 1,200 prosody rules for adding stress, pitch, and inflection to the output. The modules can be used together for complete text-to-speech conversion, or the back end can be used alone for high-quality prestored word synthesis.

Voice-response systems—which run from hobbyist cards such as the Lis'ner 1000 from Micromint Inc., Cedarhurst, N.Y., for Apple and Commodore users to large multiport stand-alone systems used in order entry—are finding more applications and a better reception than text-to-speech systems. For example, phonemes for five different foreign languages have been developed for a 64-port, dual-tone, multiple-frequency system from Votrax Inc., Troy, Mich., for order entry and credit-card authorization.

This explosion of products—and the promise of more—moves Douglas O'Shaughnessy, a professor at the University of Québec's Institut National de la Recherche Scientifique, to sum up the state of this burgeoning art: "Synthesis is really here. It's just a question of how good you want it to sound and how much you can spend." □

Electronics SPECIAL ADVERTISING SECTION

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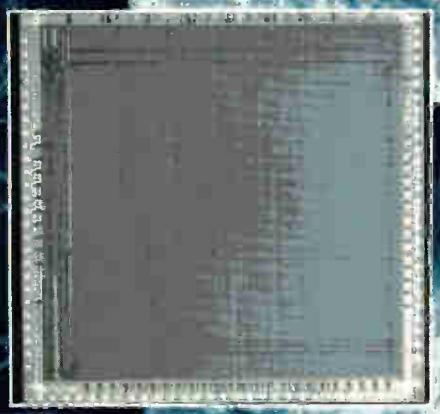
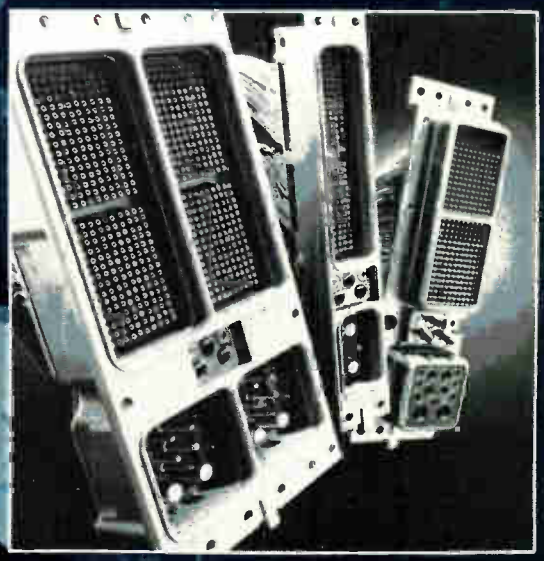




SPECIAL ADVERTISING SECTION

MILITARY ELECTRONICS

BOOMING INDUSTRY PROFITS FROM MAJOR ONGOING PROGRAMS

Military electronics is booming. The momentum of last year's budget increases will boost the Defense Department's spending on electronics to $56.5 billion, according to the annual forecast of the Electronic Industries Association. That's up slightly from the $55.9 billion spent in calendar 1985. And the EIA projects that DOD spending on electronics will remain at that level through 1987. Industry analysts are predicting that spending on defense electronics will grow, although slowly, as the Pentagon continues its push for high technology. For the DOD, the big item this year is the Strategic Defense Initiative, even though it's still a research and development program. The Pentagon has asked for a 74% increase in Star Wars funding, to $4.8 billion, and the program is loaded with electronics. "There will be growth in electronics markets even if all else goes down," the EIA states in its report. "That's because the modifications and upgrades of platforms and weapons systems are to be, in our opinion, mostly electronic."

The EIA's projections break down into

Amp designs connectors for aircraft systems

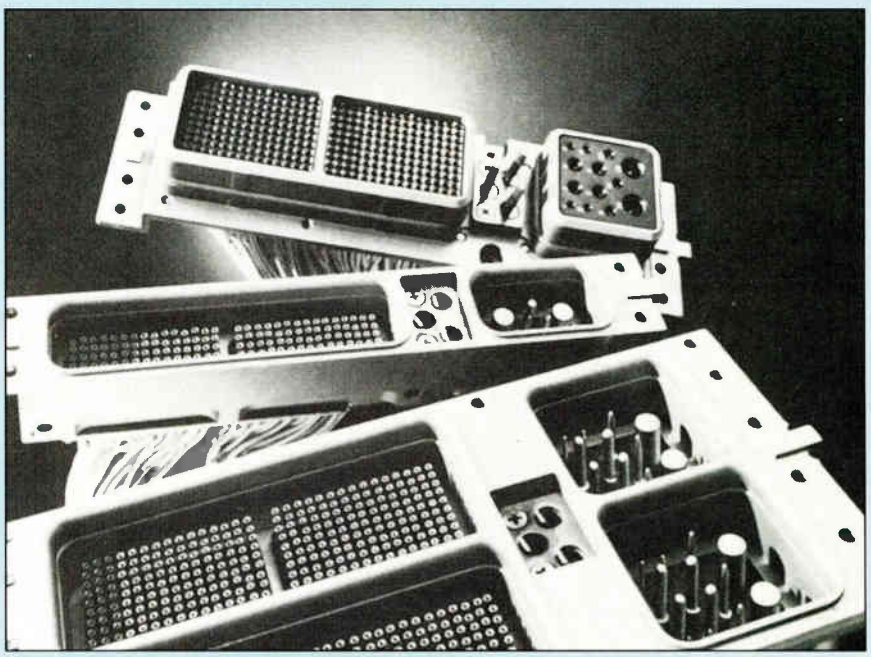
Amp Inc. has a new generation of standardized rack and panel connectors for aircraft applications.

Compared with the earlier Arinc 404 standard, Arinc 600 avionics connectors have significantly reduced mating forces (averaging 1.5 oz, compared with 8.5 oz for the 404 contacts), more contacts in housings proportioned to thinner black-box shapes, and floating, front-release keying.

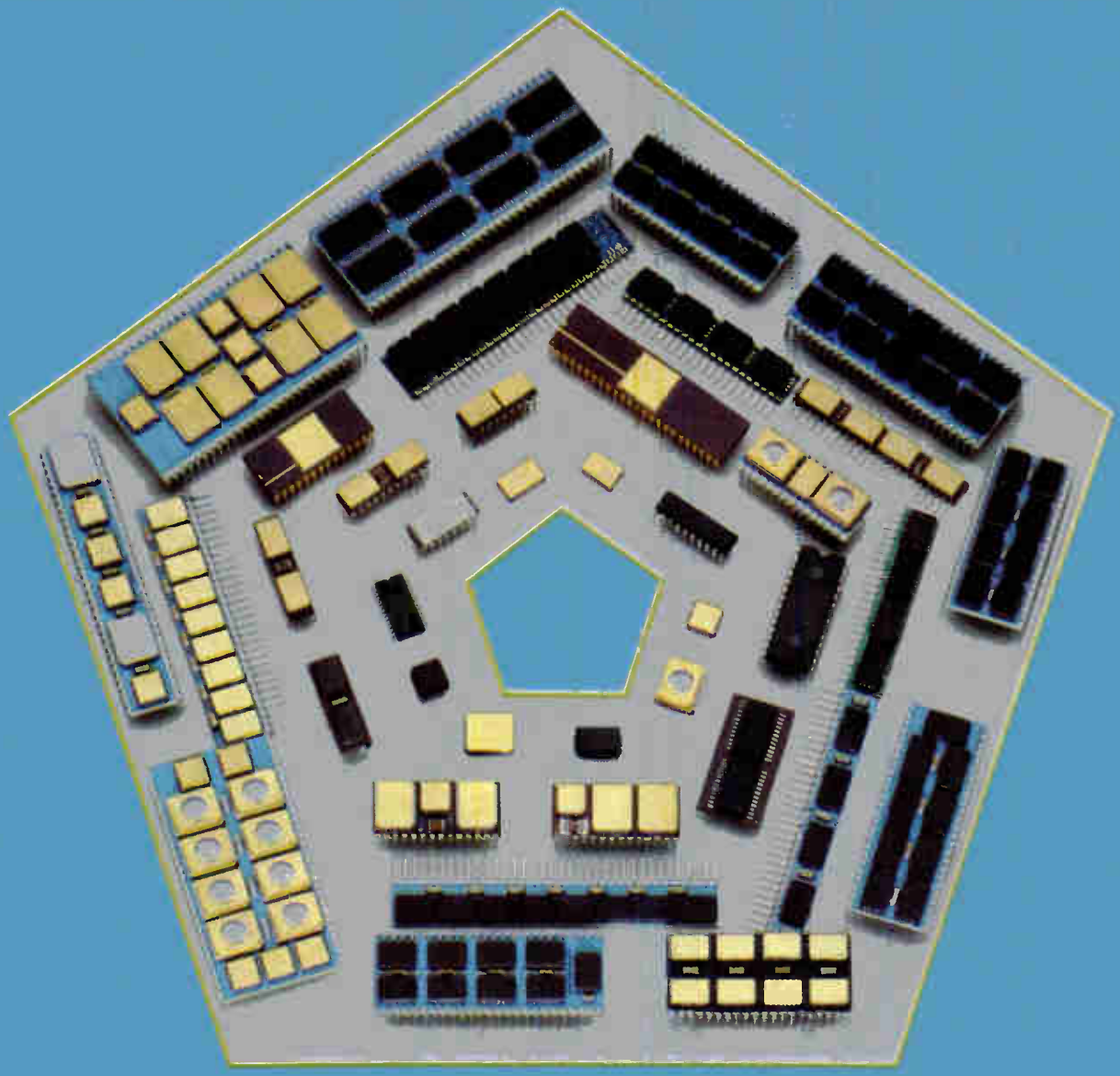
The new Amp devices, which are field replaceable, are manufactured to precise tolerances—within 0.006 of true position. Amp coaxial contacts for Arinc 600 connectors are applied with standard crimping tools, the same ones used for Arinc 404 contacts.

The Arinc 600 is the newest military-qualified connector family from the Harrisburg, Pa., company. Other lines include:

- RF coaxial connectors (MIL-C-39012), among them the SMA series. This series offers advantages in cable attachment techniques because the application tooling controls and maintains consistent SMA connector performance.
- Amp box contact connectors (MIL-C-55302)—two-piece, board-to-board connectors designed for systems requiring up to several hundred contacts per connector. The box design provides redundant electrical contact areas for added strength in applications in which the parts will undergo vibration and also allows for wide pin-alignment margins to facilitate mating.
- Rack and panel connectors with rear-release contacts and a wide variety of insert arrangements. All these connectors have interfacial and wire seals for harsh environments. Single- and double-insert shell configurations are available. Inserts come with various contact arrangements to accommodate size 22, 20, and 16 contacts for terminating a wire size range of 26 to 16 AWG.



MILITARY
MODULES AND MONOLITHICS



MILITARY CERDIPS/LCC's
Static RAM

SIZE	P/N	SPEED
16Kx1	DP9167	35ns
4Kx4	DP9168	35ns
2Kx8	DP9116	35ns
64Kx1	DP9287	35ns
16Kx4	DP9788	35ns
8Kx8	DP9264	65ns
1Kx8	DP9130*	85ns
2Kx8	DP9132*	85ns
32Kx8	DP92256	65ns
64Kx4	DP9186	35ns

*Dual Ported

Dynamic RAM

SIZE	P/N	SPEED
64Kx1	DP9164	100ns
256Kx1	DP91256	100ns
1Mx1	DP9001	100ns

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M68000 (-55 to +125°C)
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Dense-Pac currently supplies over 80% of the top 25 defense contractors in the United States with their military MIL-STD 883 semiconductor requirements.

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Circle 33 on reader service card

five key DOD budget segments:

■ Electronics and communications procurement should hit $7.6 billion this fiscal year, rising to $7.8 billion in fiscal 1987 and to $8 billion in 1988.

■ Spending on research, development, test, and evaluation will drop slightly, from $17.1 billion in fiscal 1986 to $17 billion in fiscal 1987 and then to $16.9 billion in fiscal 1988.

■ Missile electronics content in procurement is pegged at $5.9 billion in fiscal 1986. It will rise slightly to $6 billion in fiscal 1987 and to $6.1 billion in fiscal 1988.

■ The electronics procurement portion of the military's spending on ships will dip to $3.4 billion in 1987. It totaled $3.7 billion in fiscal 1986.

■ The electronic portion of ordnance and munitions is estimated at $1.6 billion for fiscal 1986, to remain level through fiscal 1987.

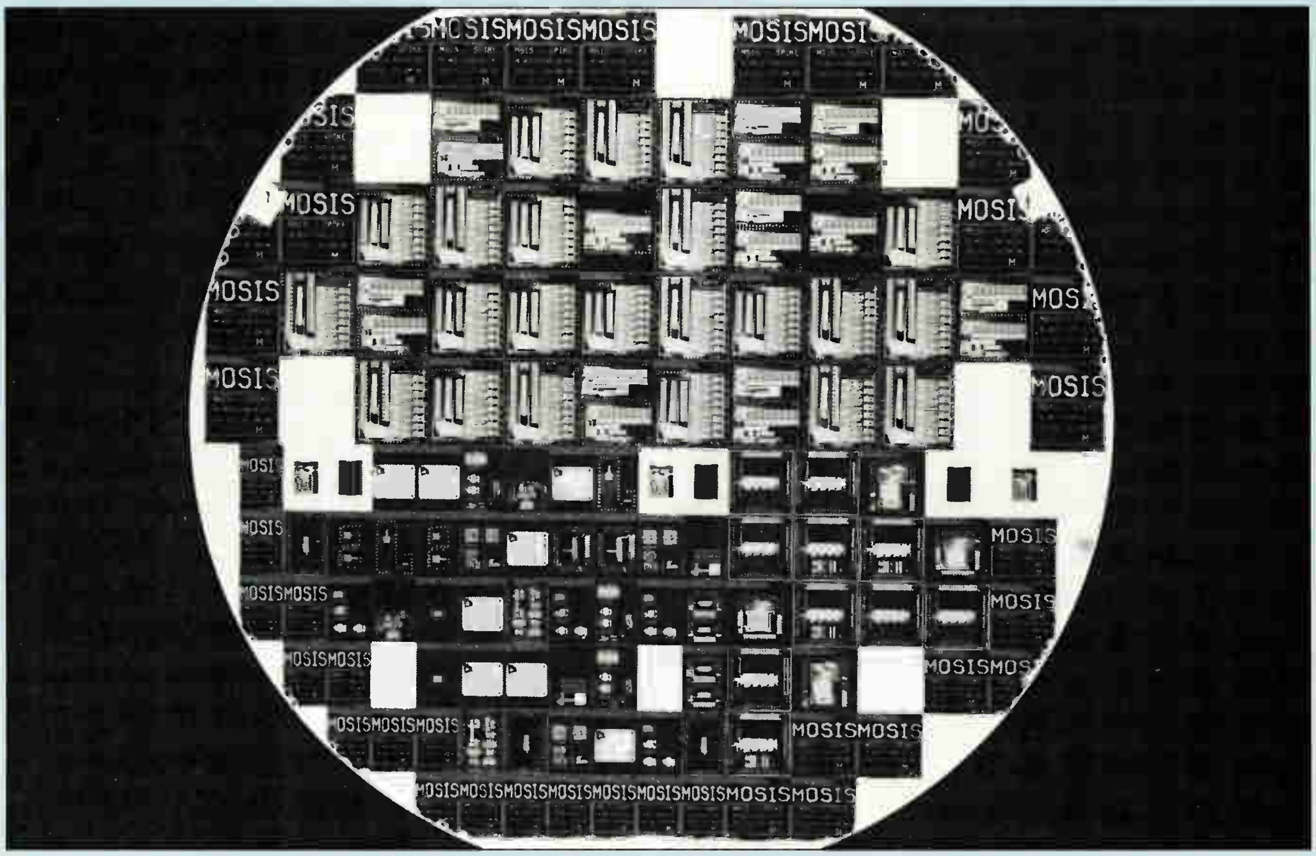
Another heavily budgeted research project, the Defense Advanced Research Projects Agency, got hit with a substantial cut last year—from a $770

Orbit Semiconductor increases density of its CMOS process

Orbit Semiconductor Inc. is after the small- to medium-volume customer that wants high-reliability processing and fast turnaround. The Sunnyvale, Calif., foundry, which specializes in CMOS and HMOS processes for military, medical, and commercial applications, has added 2-μm double-metal capability to its family of CMOS foundry processes.

The company was founded in November 1985 by Orbit Instrument Corp. and several employees of Comdial Semiconductor Inc. It has since concentrated on high-speed high-density processes, including 3- to 5-μm CMOS and HMOS in single or double poly and single or double metal. Orbit Semiconductor guarantees turnaround in no more than 10 working days for single poly and single metal CMOS and HMOS and in no more than 15 working days for double-poly or double-metal CMOS.

Its computer-aided design services include layout from a customer's logic drawings, design-rule checking, data sizing and conversion, and Versatec plots. It also acts as a prime contractor for photoplates. The company's CMOS processes meet MIL-ST-883C requirements, according to Gary Kennedy, president. About 40% of Orbit Semiconductor's revenue comes from sales to the military, including parts for command, control, and communications applications, Kennedy says.



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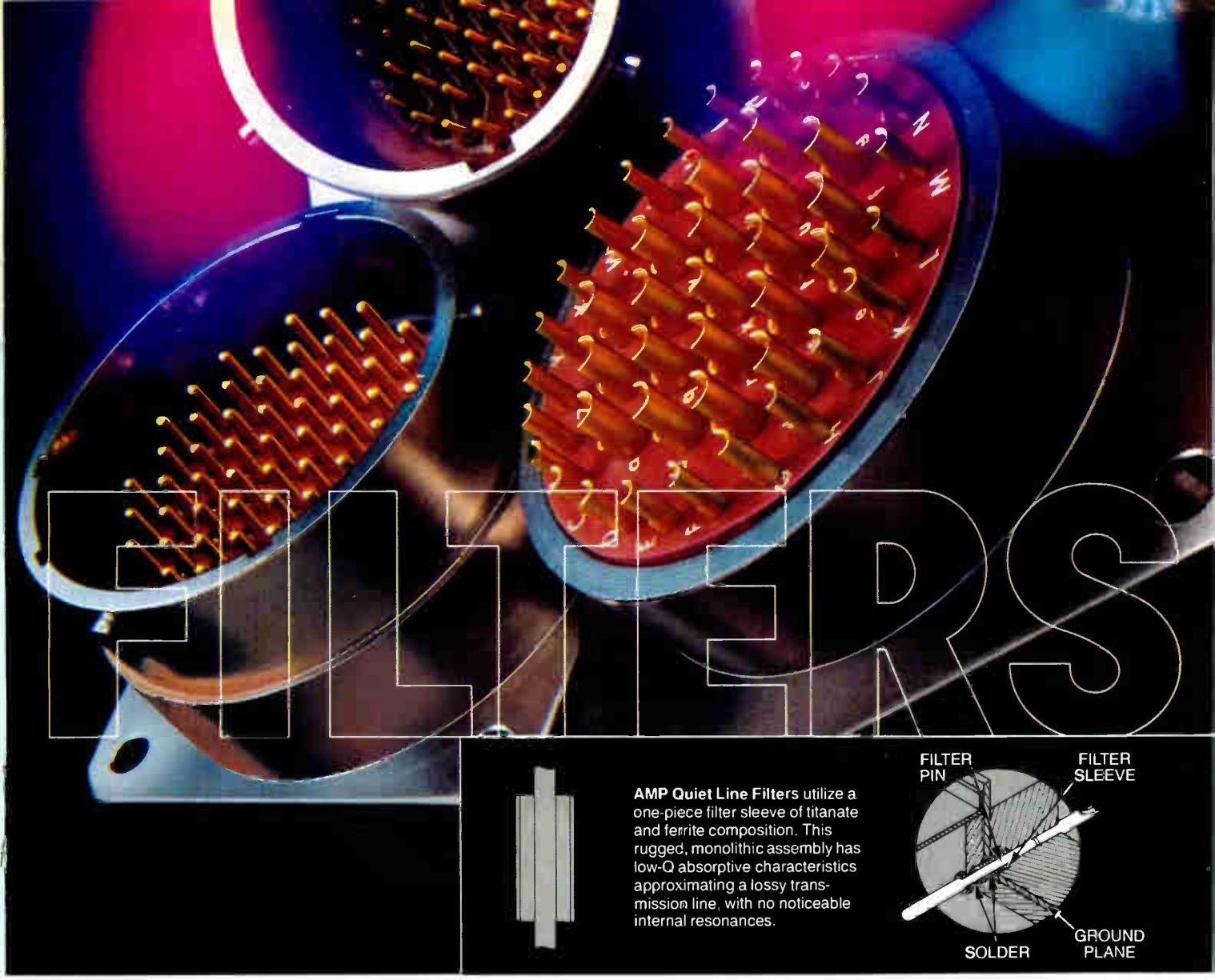


AMP Quiet Line Filters utilize a one-piece filter sleeve of titanate and ferrite composition. This rugged, monolithic assembly has low-Q absorptive characteristics approximating a lossy transmission line, with no noticeable internal resonances.

MIL-C-38999 type filtered connectors.

All the filter performance you need, without the long wait you don't need.

You're looking for a high-performance filtered connector to mate with MIL-C-38999 circular metal shell connectors. But you're not looking forward to waiting six months or more for delivery.

Look to AMP. Our filtered circulars deliver superior insertion loss with our outstanding Quiet Line absorptive filter design. And we deliver quicker. With your choice of styles, pin counts, wire terminations, and filter characteristics.

Reliability? Our advanced ceramic sleeve design is inherently more rugged than multiple-part filters—and it completely eliminates their all-too-typical internal resonances. The result is smooth, controlled roll-off with insertion loss independent of source or load impedance. And the same performance is available in MIL-C-83723 type connectors as well.

Look to AMP for help, too. From technical information to engineering assistance, we're ready to put what we know to work for you. After all, the way we perform is just as important as the way our connectors perform.

For more information, contact the AMP Filtered Connector Desk at (717) 780-4400. AMP Incorporated, Harrisburg, PA 17105.

AMP Interconnecting ideas

Circle 35 on reader service card

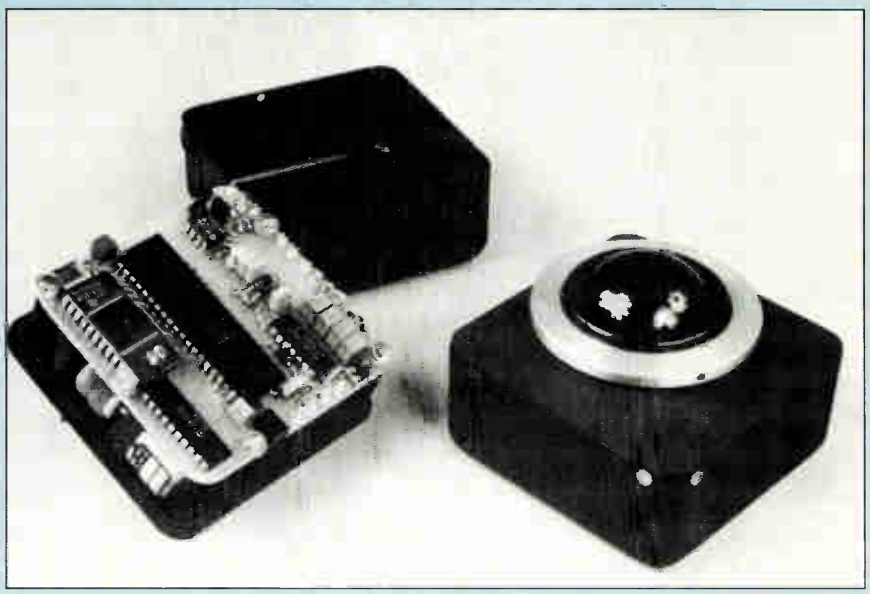
Measurement Systems joysticks come with programmable outputs

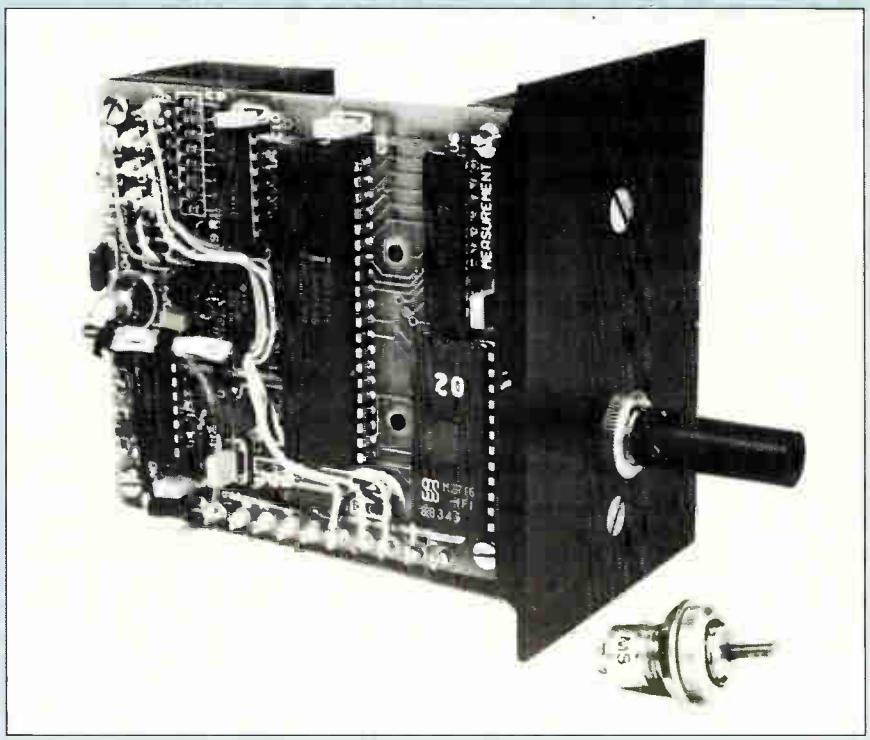
Measurement Systems Inc., a supplier of manual controls for military applications, has been adding to its joystick and trackball product lines. The newest member in its family of miniature force-operated joysticks, the 860 series, is designed for high precision in missile-guidance, plotting-board, visual-display, vehicle-control, and similar systems. Microprocessor-controlled conversion can be programmed to meet requirements for either an RS-232-C or RS-422 port.

The joysticks enable the operator to perform single-element positioning at high slew rates with small changes in applied force. Buyers can choose from standard or custom packages, including those with push buttons or paddle switches that also are coded on the serial line.

A new Measurement Systems low-profile trackball, model 621, has a 1½-in. diameter ball in a 3-by-3-in. case that extends only ¾ in. when attached to a back panel. The device uses incremental optical encoders that have light-emitting-diode and phototransistor sensing with a standard count of 140 pulses per revolution of the ball. More than two thirds of the maximum available ball curve is exposed, enabling the device to operate like a larger trackball, says the Norwalk, Conn., company. The unit puts out quadrature square waves or TTL level pulses and operates off a single +5 V dc power supply. Coded digital outputs for RS-232-C and RS-422 are available in a slightly larger case.

Military applications for the joysticks and trackballs include undersea vessels, Army tracked vehicles, radar, fixed-wing aircraft and helicopters, remotely piloted vehicles, and fly-by-wire systems.





million request to a final authorization of $660 million. This year's request is $838 million. That, too, could wind up being cut, although analysts believe that current Darpa programs won't lose their funding. Significantly, the agency does not do any research in-house. Instead research is farmed out to universities and industry.

Key Darpa programs include development of a battle-management system for the Navy; a Pilot's Associate program for the Air Force, in which artificial-intelligence techniques are being used to reduce the tremendous amounts of data that pilots receive in combat situations; and, for the Army, the Autonomous Land Vehicle, which will be

FROM THE FIRST FAMILY OF GATE ARRAYS... A PROUD, NEW ADDITION

I can remember when it all began at Hughes in 1979. With a single metal HCMOS 1000-gate array. Since then the Hughes family of military gate arrays has grown. In 1985 the 2 micron (l_{eff} = 1.2 microns), double metal U-series of channelless gate arrays was born, descended from the broadest, high performance line of HCMOS arrays in the semiconductor industry.

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Double metal HCMOS, l_{eff} = 1.2 microns, t_{ox} = 300A, clock frequency to 50 MHz. Five array types ranging from 1000 to 8000 equivalent gates.

U-Series Array Family
Double metal HCMOS II, l_{eff} = 1.2 microns, t_{ox} = 300A, clock frequency to 100 MHz. Ten channelless array types with 1000 to 41,000 gate complexities. Pin counts to 256. Each output drive capability of 7 TTL loads.

Joe Angleton, assistant laboratory manager for VLSI design at the Missiles System Group, is a primary originator of Hughes gate array efforts.

L5000–Series* Array Family
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*The L5000, L7000 and L10,000 array families are products licensed to the Hughes Aircraft Company by the LSI Logic Corporation for sale to military and government contractors.

A SLICE OF THE FUTURE
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Circle 80 on reader service card

HUGHES
AIRCRAFT COMPANY

SEMICONDUCTOR DIVISION
Industrial Electronics Group

See them at ELECTRO '86 Booths 1516 & 1518

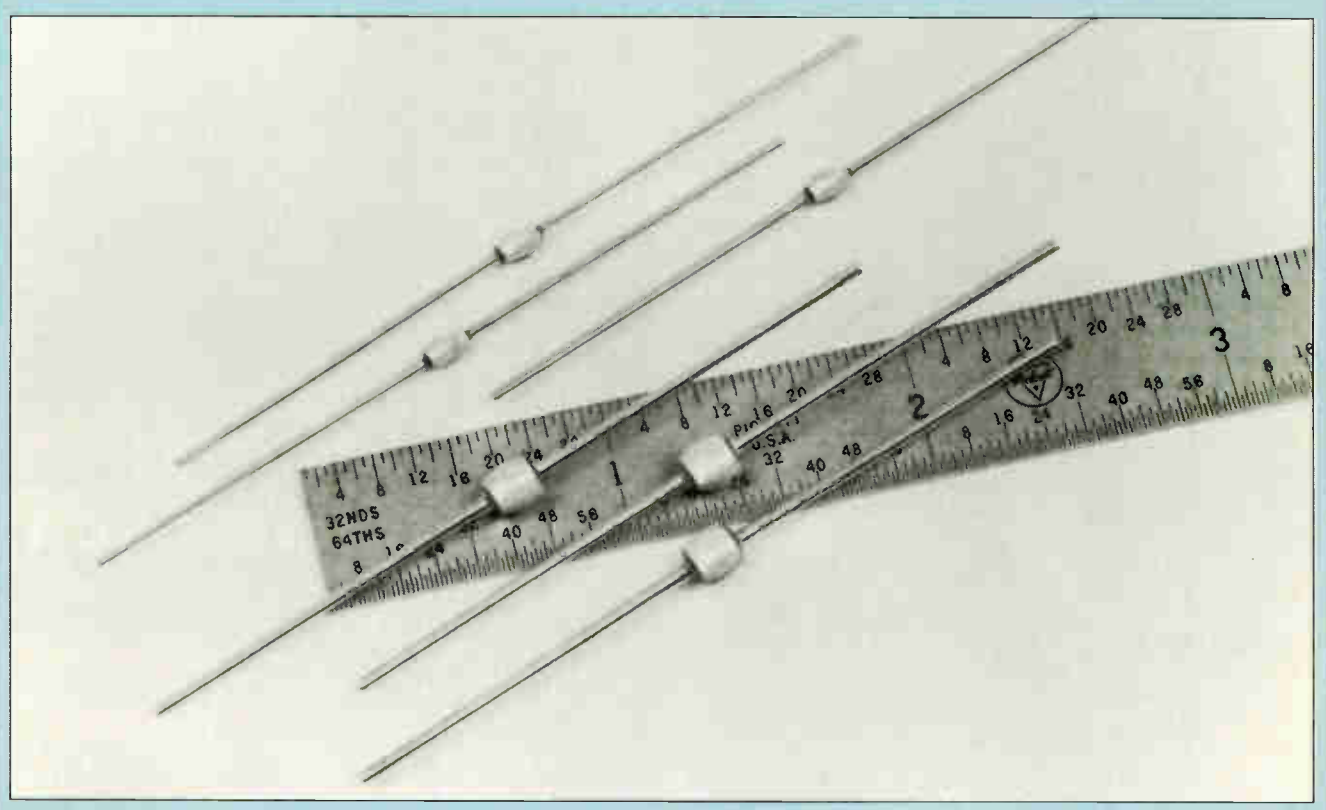
Semtech introduces bipolarity voltage-transient suppressors

Semtech Corp. has introduced two families of silicon bipolarity transient suppressors in which a single device provides voltage-transient protection symmetrically—for ac as well as dc signals. All the parts are designed for use in aerospace, military, and industrial equipment.

The suppressors come with peak pulse power ratings of 500 and 1,500 W. They're designed to protect sensitive components from large voltage transients, which can cause permanent damage. Rapid response time affords protection for integrated circuits, MOS devices, hybrids, and other voltage-sensitive components.

Both the 500-W peak pulse power devices (EIA part registration numbers 1N6106 through 1N6137) and the 1,500-W devices (1N6142 through 1N6173) have a nominal voltage of 10 to 200 V.

The devices are hermetically sealed in the Newbury Park, Calif., company's Metoxilite, which is fused directly to a silicon junction-tungsten, high-temperature assembly that is bonded with metal.



able to travel over virtually any terrain and report on what its vision system "sees."

Another huge DOD program involves the National Security Agency's effort to develop the national supercomputing center in Maryland. The NSA is asking for $53.6 million for software, graphics, and network development.

Military mission

The military market has had a tremendous impact on electronics in general. In most cases, that impact has been a positive one.

The military has accounted for important shares of electronics markets in the past year or so, often when commercial business segments were flat or down.

For example, the EIA projects that sales of semiconductors for military use, a small portion of overall industry sales, will grow from about $1 billion in 1983 to $2.45 billion by 1990.

And the Semiconductor Industry Association projects that U. S. semiconductor sales will hit $20 billion in 1990. At that time, semiconductors for military use will account for 12% of the total market, up from about 7% in recent years.

Having spent $1 billion on the Very High Speed Integrated Circuits program, the DOD is starting to see VHSIC Phase 1 chips designed into military systems. Already the program has contributed to several major industry developments, such as a group of high-technology IC fabrication lines.

One indication of the market's growth is that independent market researchers are tracking it more closely. Dataquest Inc.,

Transient Voltage Suppressors

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In production quantities!

Bi-polar Transient Voltage Suppressors

Semtech's proven series of silicon bi-polar transient voltage suppressors have both AC and DC signal protection. Offering peak pulse power ratings of 500 to 1500 watts for a millisecond, the response time is essentially instantaneous (less than 1×10^{-12}).

Semtech Originals

Designed by Semtech engineers, these versatile devices will protect even the most complicated circuits against large voltage fluctuations that can permanently damage sensitive components.
Only Semtech devices are hermetically sealed in Metoxilite and fused directly to high temperature metallurgically bonded assemblies.

Ideal for commercial, industrial, military and aereospace applications. Specifications include:

500 Watt
Peak Pulse Power

Types: IN6102 through IN6137
Break down Voltage V(BR):
From 6.8 to 200Vdc ± 10%
Peak Surge Voltage (Vsm): 11.0 to 286.0V
Peak Surge Current (Ism): 45.4 to 1.7A
Temperature Coefficient of (VBR): .05 to .11%/°C
Case Size (Max.): .140" D x .165" L

1500 Watt
Peak Pulse Power

Types: 1N6138 through 1N6173
Breakdown Voltage V(BR):
From 6.8 to 200 Vdc ± 10%
Peak Surge Voltage (Vsm): 11.0 to 286.0V
Peak Surge Current (Ism): 136.4 to 5.2A
Temperature Coefficient of V(BR): .05 to .11%/°C
Case Size (Max.): .180" D x .165" L

Eliminate early mortality failures

Ask about our high reliability specifications for our new HR500T series of bi-polar transient voltage suppressors! This entire series is screened to meet or exceed the high reliability requirements of the most stringent military and space applications.

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For all the specifications and our new catalog call 213/628-5392 or the office nearest you.
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THE ONLY QUICK-TURN GUARANTEE.

Feature Size: 2μ CMOS

	N-Channel	P-Channel
VTEO	0.5–1.0$_V$	0.5–1.0$_V$
BVDSS	>10$_V$	>10$_V$
$K^1 = \frac{\mu c}{2}$ linear region	21–25	6.5—8.5
B_E(Long Channel)	0.8–1.2$_V^{1/2}$	0.4—0.6$_V^{1/2}$
Cap. Gate 10^4 PF/cm^2	8–10	8–10
Cap. Poly to Sub 10^4 PF/cm^2	0.55–0.65	0.55–0.65
Cap. Metal to Sub 10^4 PF/cm^2	0.27–0.32	0.27–0.32
Junction Depth	0.4μ–0.6μ	0.2μ–0.4μ
P-Well Junction	2.5μ–3.5μ	
Poly P_S	15–30Ω/□	15–30Ω/□
Diffusion P_S	20–40Ω/□	60–100Ω/□
VTF Poly	>10$_V$	>10$_V$
ΔW	—1.0μ	—1.2μ
LEFF	1.0μ–1.4μ	1.3μ–1.7μ
Substrate Resistivity	2.5KΩ/□	1.2Ω/cm

Feature Size: 3μ CMOS

	N-Channel	P-Channel
VTEO	0.5-1.0$_V$	0.5–1.0$_V$
BVDSS	>10$_V$	>10$_V$
$K^1 = \frac{\mu c}{2}$ linear region	18–21	6–8
B_E(Long Channel)	0.8–1.4$_V^{1/2}$	0.4—0.6$_V^{1/2}$
Cap. Gate 10^4 PF/cm^2	5.9–7.0	5.9– 7.0
Cap. Poly to Sub 10^4 PF/cm^2	0.45–0.55	0.45–0.55
Cap. Metal to Sub 10^4 PF/cm^2	0.2–0.25	0.2–0.25
Junction Depth	0.6μ–1.0μ	0.4μ–0.8μ
P-Well Junction	3.5μ–4.5μ	
Poly P_S	15–30Ω/□	15–30Ω/□
Diffusion P_S	10–30Ω/□	30–70Ω/□
VTF Poly	>10$_V$	>10$_V$
ΔW	—1.0μ	—1.0μ
LEFF	1.4μ–2.0μ	1.8μ–2.4μ
Substrate Resistivity	2.5KΩ/□	1.0–1.5Ω/cm

2μ or 3μ Engineering Prototypes: We deliver on time or we absorb 30% of your fabrication cost.

It's nothing new. For the last 6 years, Orbit Semiconductor (formerly Comdial) has been the only foundry to guarantee on-time delivery for CMOS/HMOS engineering prototype or production runs.

High reliability 2μ and 3μ double metal or double poly. 10 working days for single poly and single metal. 15 working days for double poly or double metal. Quality processing that lets us deliver to Mil Std 883C requirements. Even mature processes (Synertek's) available. It's all part of the way we've earned our customer's confidence.

And when it comes to your production order, Orbit is your assurance of quality processes, and products delivered on time.

For more information on the only guaranteed on-time delivery, typical turnarounds and processes, contact: Gary Kennedy, President, 1230 Bordeaux Drive, Sunnyvale, CA. 94089. Or call (800) 331-4617, in California (800) 647-0222, (408) 744-1800, TWX 910-339-9307, FAX (408) 747-1263

ORBIT SEMICONDUCTOR, INC.

A subsidiary of Orbit Instrument Corporation.

What others promise, we still guarantee.

for one, says the military/aerospace market for semiconductor memories was $206 million in 1984 and should grow 150%, to $534 million, by 1989.

Top buyers

Other markets that are expected to gain from the military are connectors, power supplies, and the entire computer systems and communications area, which includes data security. Although both the military/government and the computer/peripheral markets for connectors should continue to grow, this year for the first time the government will overtake the computer industry as the top buyer of connectors. Manufacturers of power supplies have also benefited from an increase in demand from military equipment makers.

The federal Office of Management and Budget's third five-year information-technology budget is $15.2 billion for fiscal 1986, but that doesn't include embedded systems or computer and communications hardware and software listed under such general categories as control rooms. Early this year, the government had requests for proposals

At State of the Art, plating strengthens thick-film conductors

The growing popularity of surface mounting has given chip resistors a dramatic boost, particularly in military applications, says State of the Art Inc., a maker of high-reliability chip resistors. The problem is fabricating chips able to withstand high-temperature soldering methods.

The State College, Pa., company conducted a soldering technology test and development program to find ways to improve the reliability of its surface-mounted products. Now the company says that by plating the thick-film conductor materials with a dense nickel barrier, it has reduced the rate of solder-joint degradation by several orders of magnitude. The barrier prevents the formation of tin intermetallics, which reduce both adhesion strength and the volume of the solder joint.

State of the Art has been supplying surface-mounted devices to the military, through the Defense Electronics Supply Center. In addition to surface-mounted chip resistors, it manufactures custom passive networks, resistor networks for surface-mount applications under MIL-R-83401, and high-voltage resistors and resistor dividers.

out for over 200,000 personal computers; 100,000 of the machines are already in use at federal agencies. The Army alone wants 102,000. Meanwhile, the Air Force is developing a service-wide network of 32-bit work stations, valued by one consultant at $700 million. And the DOD plans to spend approximately $800 million to automate all its hospitals.

Spending on security

The DOD will also be spending a bundle on security, a hot subcategory in the computer/communications area. A survey last year of 17,070 DOD computers indicated that half should be upgraded with discretionary access control and one third should be replaced with systems that provide mandatory access control. To underscore the military's concern, the DOD Computer Security Center, Fort George G. Meade, Md., has set up a division to encourage vendors through seminars, industry conferences, and personal contacts to consider security in the design phase of its products.

The DOD is also pressuring contractors to set up standards wherever possible. One key area of interest is the

Malco offers line of high-density standard-module connectors

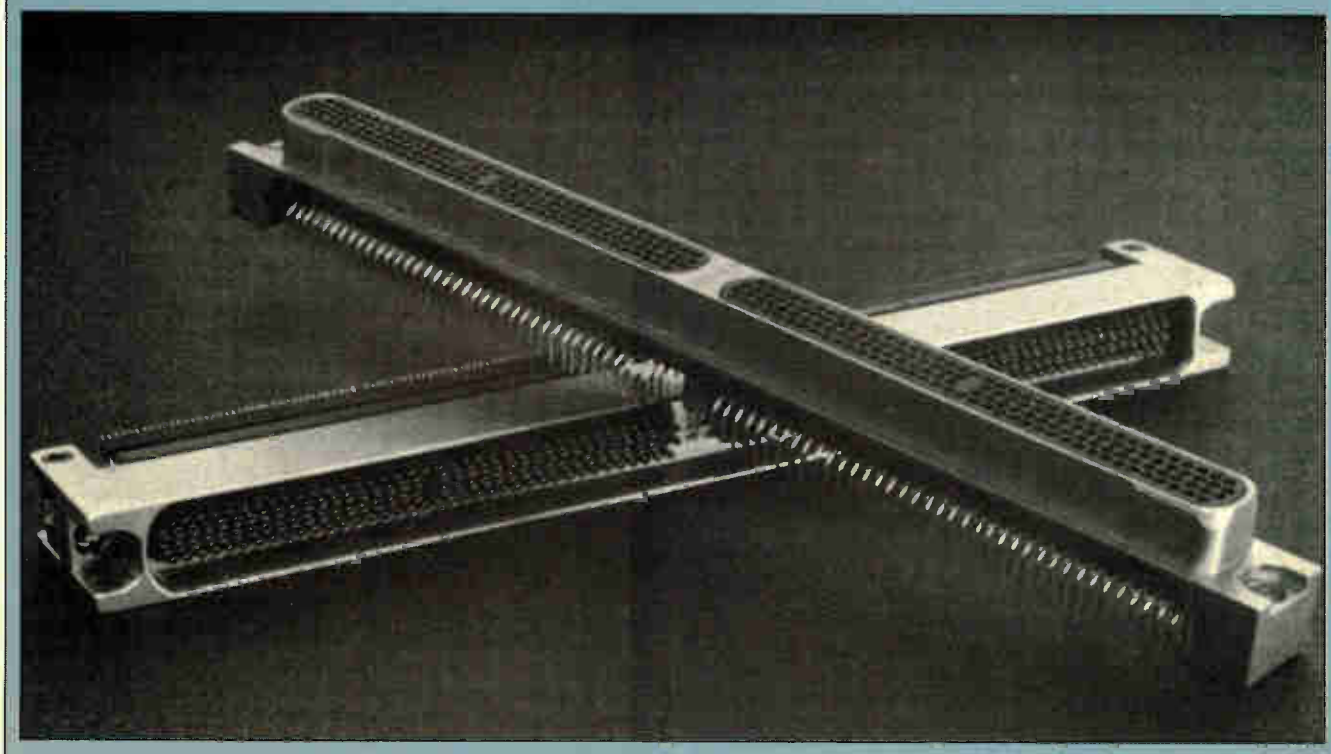
Malco-Microdot Co.'s high-density standard-module (HDSM) connectors are designed for new military systems that need increased pin outs in a smaller board area. Each connector has up to 304 high-reliability twist-pin contacts on 0.05-in. centers in four rows. Board area measures 4.6 by 0.36 in. For increased circuit density, connectors can be surface mounted on both the daughter- and the motherboard.

The buyer can specify modular inserts—coaxial, fiber-optic, or signal contacts, or a combination—and the inserts can be partially or fully loaded. Any contact can be replaced. Standard inserts have 76 twist-pin cavities and 5 coaxial or fiber-optic removable cavities. Twist-pin contacts have proven very reliable in high-density applications during their 15 years of use.

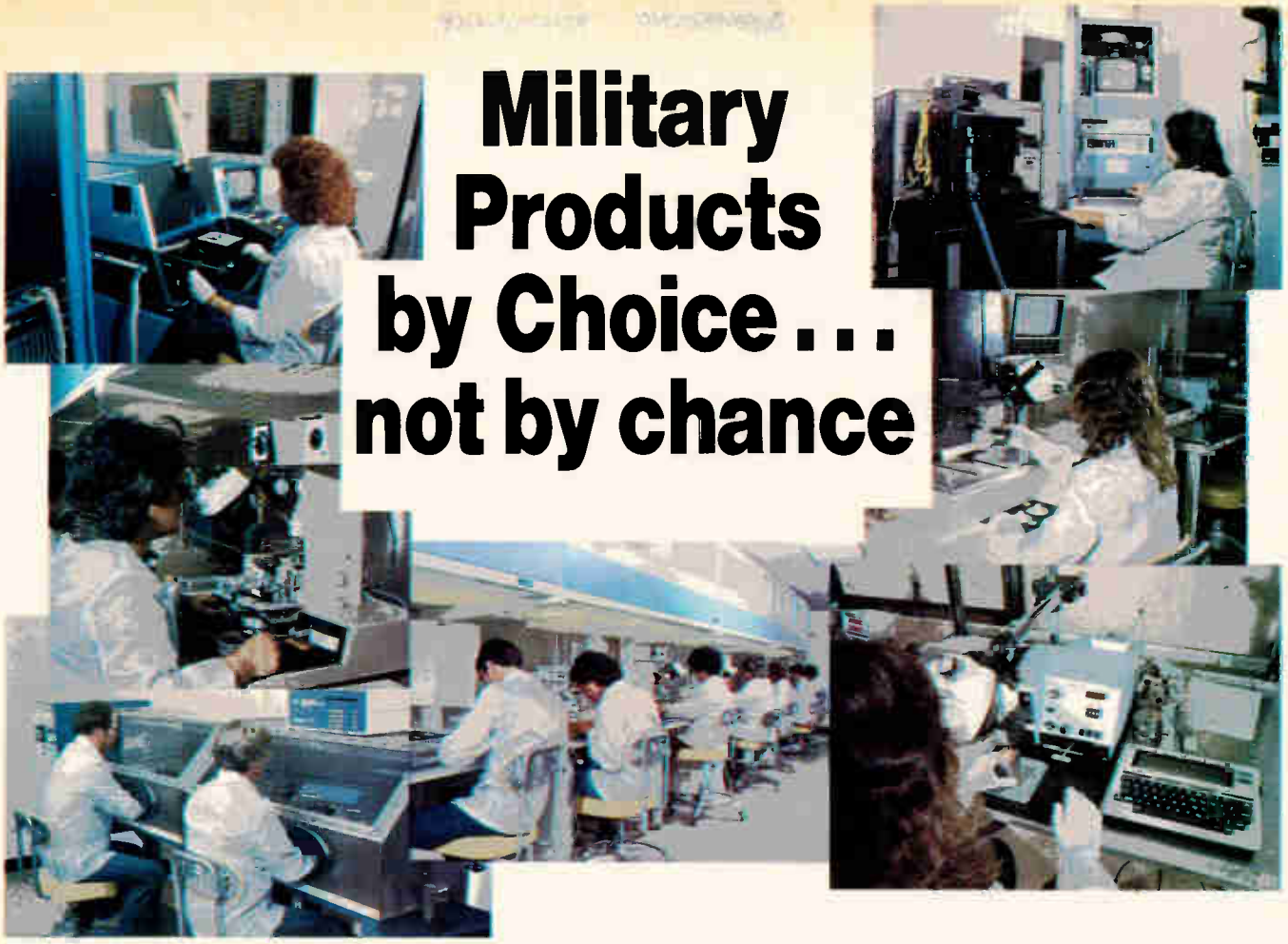
The connectors, which come in the same basic metal shell, can withstand vapor-phase soldering and other surface-mounting techniques, says the South Pasadena, Calif., division of Microdot Inc. Parts for plated-through-hole mounting are also available. After mounting, the daughterboard can move laterally for clamping of the heat sink.

Low-insertion-force contacts used in the HDSM connector have a maximum total insertion force of 55 lb for the 304-contact version. This insertion force translates to approximately 7 lb at each handle. Six-position rotatable keys are provided to customize each module and backplane assembly. Contacts will not mate unless both connector halves have the proper keying.

Malco, which originally developed the HDSM connector for Texas Instruments Inc., expects the part to become an industry standard.



Military Products by Choice . . . not by chance



We're in the business of making Military products because we want to be. It's by choice and not by chance that each product we make is designed, specified, manufactured, and tested as a Military circuit. There's no screening of products. From the very start, design and reliability is built into each device using the strict guidelines of MIL-M-38510. Our products are used in programs such as the F18 test system, the B1 bomber, the F15 and F16 fighters, and the Sparrow, Hawk, and Maverick missiles. And, our DAC87-CBI-V/B, D/A converter is now approved under DESC Drawing 83002.

Every Military Products Division device is made in a separate manufacturing facility in a very tightly controlled environment. All parts inventories and work-in-process are stored in nitrogen. All critical assembly process and inspections are performed under laminar flow hoods in a class 100 environment. Our lines are certified to MIL-STD-976 and MIL-STD-1772.

Every part and every process is fully documented and traceable. Numerous tests and inspections are made on each device to assure quality, reliability, and performance.

We make a broad line of very high performance A/D, D/A and V/F converters, multipliers, and operational amplifiers, compliant to the requirements of MIL-STD-883.

To make it easier for you, our product data sheets closely follow the Military slash sheet format. For more information, contact any of our local sales offices or call us in Tucson. If you'd like, we'll arrange a guided tour. You'll be impressed by the way we make our Military products by choice . . . not by chance.

For a copy of our new capabilities brochure, write: Military Products Division, Burr-Brown Corporation, P.O. Box 11400, Tucson, AZ 85734 (602) 746-1111

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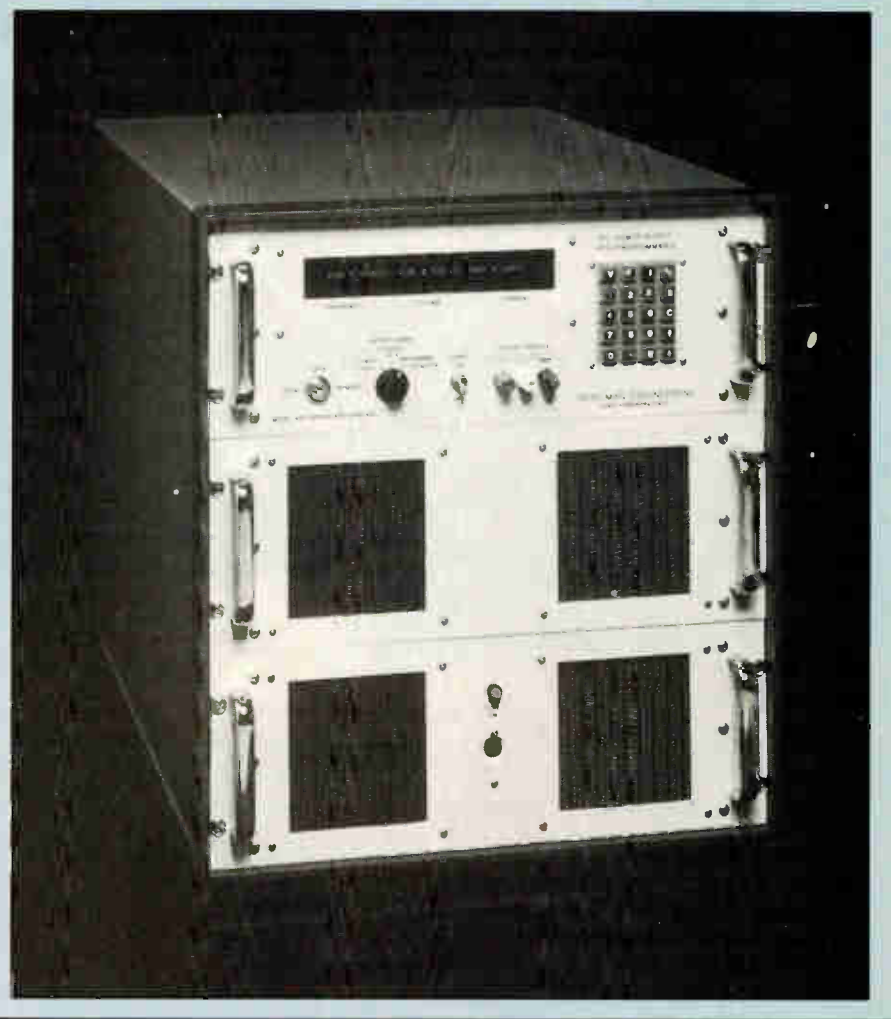
Improving Reliability

Circle 43 on reader service card

Behlman's intelligent ac power source reduces ATE system components



Behlman Engineering Corp.'s intelligent power source is designed for high reliability in both stand-alone and computer-controlled applications. The KB series of single and multiphase ac power sources meets such military requirements as those of the U.S. Air Force's Modular Automatic Test Equipment program. According to the Carpinteria, Calif., company, this allows for full use of the Control Interface Intermediate Language without supplementary hardware or software.

In addition, these parts reduce the number of ATE system components: each model has a microcomputer control and measurement system that independently verifies operating output voltage, frequencies, currents, and phase relationships, rather than just programmed values. On command, measurements are reported on a front-panel fluorescent display or on the host computer's display. The series is compatible with a number of standard interfaces, such as the IEEE-488 and the RS-232.

Self-diagnostic circuits carry out watchdog functions; results appear on the display or are sent to the host computer. Each model in the KB series can be programmed ei-

Hughes division concentrates on military connectors

Virtually every line from Hughes Aircraft Co.'s Connecting Devices Division meets military specifications.

Products include high-reliability high-density connectors with 110 contacts to the square inch and seals on the contacts to meet environmental requirements. Typical of the Irvine, Calif., division's multichannel fiber-optic devices is the high-shock MIL-C-28876. The scoop-proof aluminum shells have threaded couplings and five-key polarization. Cable strain relief on this device is designed to exceed military requirements.

Hughes's subminiature rectangular connectors, the MIL-C-28804 line, is designed for use in missiles, aircraft, ground-support systems; cable-to-chassis and cable-to-cable connections; and computers and other automated electronic equipment. Its MIL-C-28840 miniature circular connectors are designed for applications in which protection from electromagnetic and radio-frequency interference is critical.

Also available from the division are the MIL-C-55302 printed-circuit connectors for either multilayer pc boards or flexible printed wiring. These come with 10 through 70 contact positions along with a variety of contact terminal types and coupling styles. In addition, Hughes offers the MIL-C-85028 series of environmental connectors. Targeted at the Navy, the devices are moisture sealed for use in extreme environments. Applications include shipboard and undersea use.

ther through its own keyboard or through the host computer. The output values can be incremented and decremented with user-definable resolution.

Power configurations range from 100 VA to 54 kVA with a total harmonic distortion of less than 1%. Frequency configurations range from 45 to 10,000 Hz with 0.001% accuracy. All KB series ac power sources have tight line and load regulation and generate virtually no electromagnetic or radio-frequency interference.

Behlman also has introduced an aircraft-tachometer-test work station for certification, check-out, burn-in, and calibration of tachometers. The company says the totally electronic system replaces less reliable electromechanical devices.

Controlled by an IBM Personal Computer, an intelligent Behlman ac power source simulates tachometer generator outputs for unattended cycling and testing of multiple tachometers. Test results can then be printed out on the work station's printer. The standardized tests, which include point-by-point calibrations and variable-length sweeps, are tailored to tachometer generator types by software menu commands.

establishment of an integrated text and graphics exchange standard to help reduce the paperwork with which the Pentagon and its vendors have to deal.

Packard commission

In every military category, the DOD is trying to keep costs in line. As a further control on spending, the Presidential Commission on Defense Management, headed by Hewlett-Packard Co. chairman David Packard, has recommended that the military services rely more on off-the-shelf components and systems instead of budgeting for the costly development of custom hardware. "DOD should develop new or custom-made items only when it has been

(Continued on page 49)

Hughes brings out line of advanced logic structures

A family of semicustom advanced logic structures from the Semiconductor Division of Hughes Aircraft Co. combines the advantages of conventional gate arrays and standard cells.

The U-Series of channelless gate arrays, so called because they do not have dedicated routing channels, consists of 10 devices with 1,040 to over 40,000 equivalent two-input gates. Instead of routing channels, an interconnection grid links the array cells. The result is a high-performance semicustom design that is tightly packed and readily implemented.

The arrays are based on an 8-transistor cell that is repeated across the device. They are produced in a 2-μm double-metal CMOS process called HCMOS-II. Each array in the U-Series is distinguished by the number of equivalent two-input gates and the number of input/output pins. With eight dedicated power pins in each circuit, the number of usable I/O pins can be as high as 248.

Gate utilization in the channelless arrays depends on circuit complexity. Inverter delays have been measured at 400 ps, and counters have operated at well over 200 MHz. Output buffers can drive six full TTL or 24 LSTTL loads. Typical gate operating power is 8 μW per MHz.

Apollo/Mentor or Daisy work stations complete the front-end operations of schematic capture, logic simulations, timing estimation, and test vector generation.

The high degree of freedom in the layout of channelless structures makes automated placement and routing tools a must for circuit implementation, and the Newport Beach, Calif., division has developed integrated software tools that automate all design steps from schematic capture through generation of the mask tapes. Among these tools is a set of layout algorithms that completes the circuit's physical design. Results of the layout process are used with workstation routines to back-annotate data, so that timing performance can be evaluated further before mask making and fabrication.

The U-Series has been used primarily in complex high-performance military systems; Hughes also offers it for commercial and industrial applications where chip area per function and speed are key considerations. The company has developed a variety of designs for customers, and each U-Series member is available for design-in. Test structures, based on the 32,000-gate channelless array, are available on a selected basis. Hughes has sized each array in a number of packages, including side-brazed DIPs, leadless chip carriers, pin grid arrays, and flat packs.

Hughes' Connector Line: When You Care Enough to Spec the Very Best.

These hi-rel, hi-density connectors serve the military everywhere—eloquent testimony to their versatility, reliability and exclusive features.

- Highest contact density, with 110 contacts to the square inch.
- Super-sealing, with seals on the contacts in some environmental types.
- Positive polarization with our exclusive Polar-Hex center jackscrew coupling.
- MIL-C-28840 and MIL-C-55302 versions that incorporate superior design features and qualify to spec limits.
- And our MIL-C-28876 fiber optic connector, the only multi-channel type to meet mil spec.

For more information about our standard line, phone Bob Torres at 714-660-5829. In England, Hugh McInally at 932-47262.

HUGHES
AIRCRAFT COMPANY

CONNECTING DEVICES DIVISION
Industrial Electronics Group

Circle 47 on reader service card

National Instruments software converts pen-plotter calls to graphics

Among the companies creating new uses for the microcomputer is National Instruments. The Austin, Texas, firm teamed up with Versatec Inc., a Xerox Corp. subsidiary, to develop the Versaplot 9/GPIB-PC, which turns an IBM Personal Computer into a plotter/controller for Versatec's V-80 electrostatic plotters.

The combination of hardware, software, and plotter enables the user to download plotter data and controls from a large computer to a PC, freeing the larger computer to handle more productive tasks.

To run the software, which converts the user's pen-plotter calls to vector files and then to raster-control inputs, the user needs an IBM PC or compatible equipped with a National Instruments general-purpose-interface-bus card and an IEEE-488 cable to connect the PC with the plotter. With a program example supplied with the product, the user can type in the specifics of an application. The computer then converts the program's data into scanning lines and sends control input data to the Versatec plotter.

With the GPIB-PC interface, users can develop applications in IBM Professional Fortran, such as using the PC–to–V-80 plotter as a computer-aided-design work station. The GPIB handles data transfer rates between the PC and the V-80 as high as 1 megabyte per second.

The new product supports the major features and capabilities of the V-80 series, including adjustable clipping windows, plotting viewport, plot stripping, variable line widths, area toning, grid generation, and 90° counterclockwise rotation. Also included are several Versatec software extensions, such as additional drawing and special extensions, Versaplot parameter setting, and redefinable plot orientation.

National Instrument has also added Macmillan Software Co.'s Asyst package to its family of IEEE-488 applications software. This scientific software program for the IBM PC performs such sophisticated tasks as least-square approximation, convolution, integration, smoothing, and fast Fourier transforms.

Users of Asyst can address and control data-collecting instruments on the GPIB, collect data, and perform extensive analysis functions interactively. The GPIB can be used with any Asyst program already in the field.

Technipower has triple-output power supply

Technipower, a Penril Co. subsidiary, has developed a series of triple-output switching power supplies mainly for severe shock and extreme environments. The products meet MIL-901 shock standards and have MIL-704A transient protection. They incorporate MIL-type connector I/O circuitry for electromagnetic and radio-frequency interference filtering.

Two versions are available—the ac-source TVC at 105-125 V ac and the dc-source TYC at 21-30 V dc—both designed to meet reliability guidelines for NAV/MAT P-4855. Military applications include airborne and submarine systems along with aerospace and space optics.

The Danbury, Conn., company's switchers have a mean time between failure greater than 100,000 hours and can be repaired in the field. They provide full power—up to 300 W—at maximum operating temperatures (+85°C for TVC models, +95°C for TYC). They are conductively cooled.

Outside the military market, which accounts for over 80% of Technipower's business, the company sells its ruggedized switching power supplies to commercial customers in such fields as petroleum exploration, mobile communications, and rugged terrain construction.

established that those readily available are clearly inadequate to meet military requirements," the report states.
It suggests the actual testing of competitive prototypes before awarding contracts. The final report is due in June. Meanwhile, Defense Department officials have announced that they would take steps to reorganize the military's procurement system, adapting many of the Packard commission's recommendations. DOD officials say they will take steps to implement new procurement procedures that do not require legislative approval. Early Congressional reaction to the commission's report has been positive. The commission has made a number of recommendations to the DOD, among them the creation of an administrative post to more closely monitor military procurements.
Another major step is the establishment of a Joint Requirements Management Board, which will set up procedures for the selection and development of all joint weapons programs. ■

Dense-Pac targets military market with high-reliability subsystems

Dense-Pac Microsystems Inc. primarily designs and manufactures memory modules that contain off-the-shelf monolithic circuits, such as static RAMs, EPROMS, EEPROMs, and nonvolatile RAMs. The 30 basic modules, which are one sixth to one tenth the size of industry-standard DIPs, ranges from 128-K to 4 Mb in density with access speeds as fast as 25 ns. These high-reliability subsystems are intended for use in avionics, navigational, signal-processing, communications, and other military and aerospace applications.

The six-year-old Garden Grove, Calif., company is directing its marketing efforts toward prime and subcontractors to the U. S. Department of Defense. During the past two years, it has signed up 31 of the top 50 defense contractors as customers. It has also produced prototype modules for 50 defense-related programs in the preproduction phase and has supplied production quantities of parts for five multiyear defense programs.

In the past, Dense-Pac has produced most of its own substrates using thick-film technology. As the company's production volumes increase, however, it plans to start buying cofired ceramic substrates, a move geared to help it maintain its fast turnaround time.

FOR MORE INFORMATION

Amp Inc.
Harrisburg, Pa. 17105-3608
(717) 780-4400
Circle No. 35

Behlman Engineering Corp.
1142 Mark Ave.
Carpinteria, Calif. 93013
(805) 684-8311
Circle No. 46

Burr-Brown Corp.
6730 S. Tucson Blvd.
Tucson, Ariz. 85706
(602) 746-1111
Circle No. 43

Dense-Pac Microsystems Inc.
7321 Lincoln Way
Garden Grove, Calif. 92641
(714) 898-0007
Circle No. 33

Hughes Aircraft Co.
Connecting Devices Division
17150 Von Karman Ave.
Irvine, Calif. 92714
(714) 660-5701
Circle No. 47

Hughes Aircraft Co.
Semiconductor Division
500 Superior Ave.
Box H
Newport Beach, Calif. 92658-8903
(714) 759-2727
Circle No. 80

Malco-Microdot Co.
306 Pasadena Ave.
South Pasadena, Calif. 91030
(818) 799-9171
Circle No. 41

Measurement Systems Inc.
121 Water St.
Norwalk, Conn. 06854
(203) 838-5561
Circle No. 45

National Instruments
12109 Technology Blvd.
Austin, Texas 78727
(512) 250-9119
Circle No. 50

Orbit Semiconductor Inc.
1230 Bordeaux Dr.
Sunnyvale, Calif. 94089
(408) 744-1800
Circle No. 40

Semtech Corp.
652 Mitchell Rd.
Newbury Park, Calif. 91320
(213) 628-5392
Circle No. 39

State of the Art Inc.
2470 Fox Hill Rd.
State College, Pa. 16803-1797
(814) 355-8004
Circle No. 82

Technipower
P. O. Box 222
Commerce Park
Danbury, Conn. 06810
(203) 748-7001
Circle No. 81

IN JUST HOURS, THIS LASER PAIR CAN CUSTOMIZE A GATE ARRAY

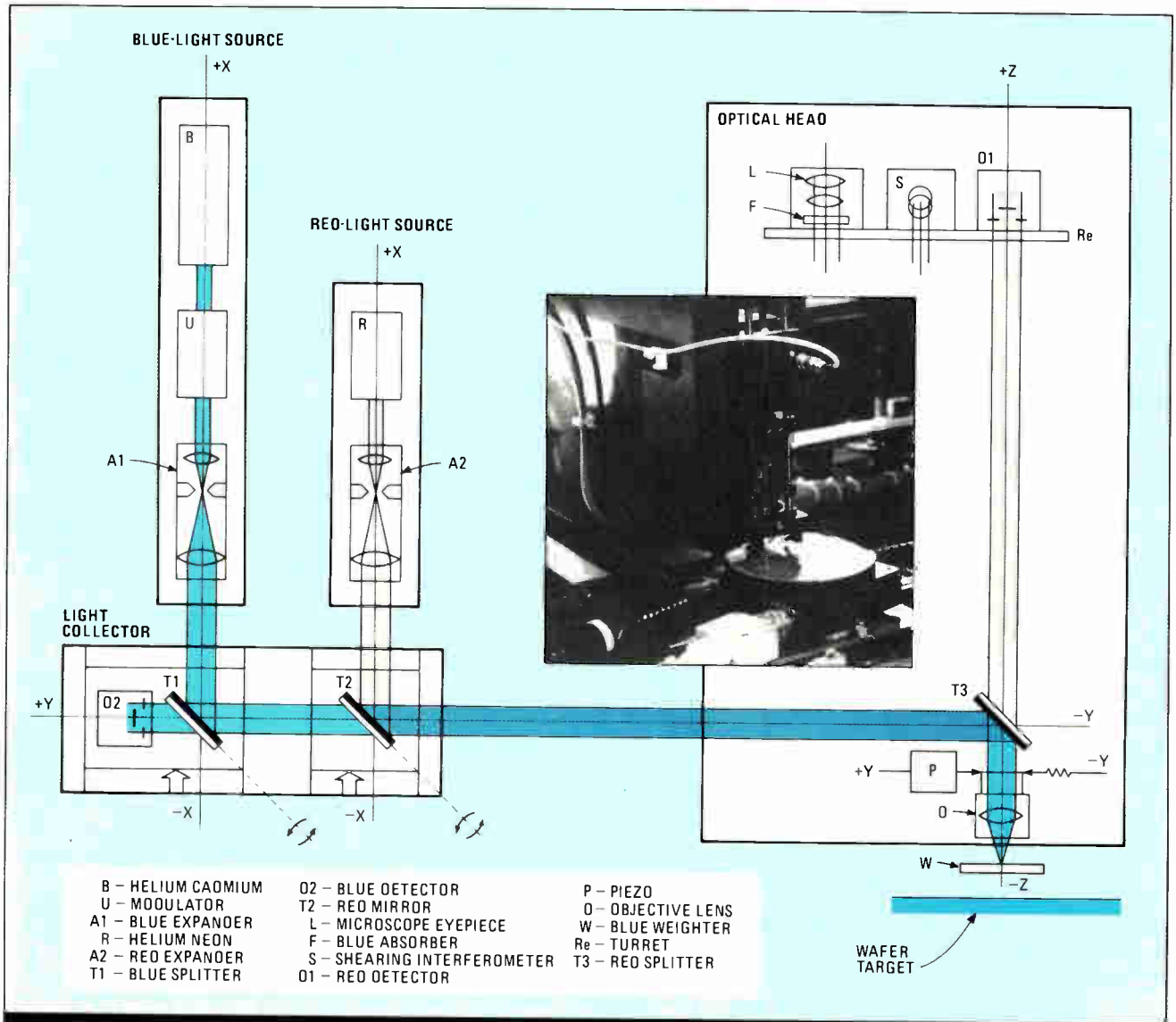
LASER-BASED MOBILE FAB FACILITY DOES 48 DIFFERENT RUNS IN 36 HOURS

A new laser-based method of customizing gate arrays can reduce the fabrication time of short-run application-specific integrated circuits to a few hours. The technique, about to be introduced by Lasarray Corp., is based on a patented laser pattern generator that uses two beams to customize complex circuits by exposing resist-covered connections on a partially processed wafer. A computer program directs the laser beams to follow a pattern of holes in a metal grid that is laid down on a chip design created by a silicon compiler. The chromium mask required in conventional customizing of gate arrays is eliminated, which not only speeds the circuit-writing process, but significantly lowers the cost of manufacture.

The Scotts Valley, Calif., company has incorporated its technology into a modular integrated turnkey system for the design, manufacture, testing, and packaging of semicustom ASICs in 2-, 3-, and 4-μm high-performance CMOS. Moreover, the system is mobile—it can be delivered right to the customer's door. It sells for as little as $3.2 million, a price within the range of most companies with large engineering staffs.

This could be a boon to system designers who choose gate arrays for their density but also must contend with their

TECHNOLOGY TO WATCH *is a regular feature of* Electronics *that provides readers with exclusive, in-depth reports on important technical innovations from companies around the world. It covers significant technology, processes, and developments incorporated in major new products.*



1. LASER WRITER. The laser pattern generator writes circuits on a wafer by using a scanning red beam to aid in guiding a blue writing beam.

higher costs and slower turnaround times compared with other ASICs. Lasarray believes its system is suitable for small companies with production runs of 20 to 10,000 chips per design type, research and development teams that need only a few prototypes, as well as avionics, space, and military applications that require high-quality gate arrays in low quantities with fast turnaround.

In its current configuration, Lasarray's system generates a finished wafer from a gate-array design developed on the Chipsmith silicon compiler from Lattice Logic Ltd., Edinburgh, Scotland. The software package for the compiler has access to all standard logic functions. It includes alphanumeric or graphic schematic capture, functional logic simulation, automatic placement and routing, automatic generation of test vectors and test programs, timing verification and simulation, and complete design and production documentation.

The availability of a completed prototype run typically takes only a few hours from the completion of design simulation. Usually, 36 hours is enough to complete 48 different prototype runs or small production batches, according to Lasarray vice president George Krautner.

Key to the Lasarray system is the laser pattern generator (Fig. 1), which consists of two lasers—a helium neon (red) scanning laser and a helium cadmium (blue) writing laser. The computer uses the scanning, or control, laser beam as a reference to guide the writing laser beam around each chip on the wafer. The writing laser beam performs the actual circuit customization by burning away connections on the metal grid, leaving the interconnection to be etched. All subsequent etching, fabrication, testing, and packaging processes are standard.

Working in unison with the laser pattern generator are the computer control system and the mechanical system. The computer program contains a map of the wafer and the individual die topology, which the laser system uses to find its way around the wafer's surface. Using data from the red scanning laser beam, the computer moves the mechanical subsystem that holds the wafer. The mechanical system consists of an X-Y axis assembly to position the laser beams, and a Z-axis assembly to hold and move the target wafer.

The entire Lasarray system is controlled by a built-in distributed computing system that consists of a central Digital Equipment Corp. PDP-11/73 minicomputer and four custom microprocessor-based local controllers. Also included in the package is an external DEC MicroVAX II-based design center operating under DEC's VMS operating system and configured to run the Chipsmith silicon compiler. It incorporates 5 megabytes of random-access memory, 470 megabytes of hard-disk storage, a 1,600-bits/in. tape drive for archival storage, a six-pen plotter, a printer, four VT220 terminals, and two graphics terminals.

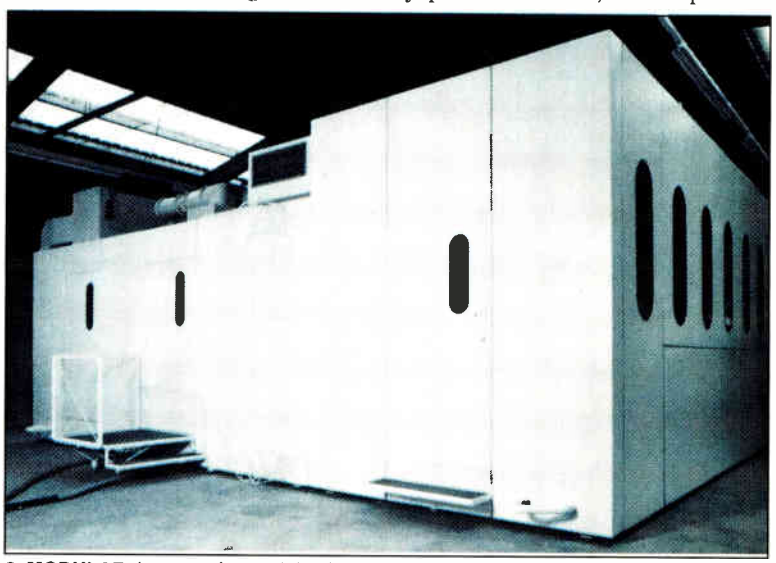
The stand-alone Lasarray system is made up of four separate but integrated modules consisting of clean rooms that contain all the equipment necessary for fabrication, test, and packaging (Fig. 2). First is a Class 10 clean room that houses the laser pattern generator as well as conventional contact and proximity mask-alignment equipment. After laser pattern generation, the wafers are passed along to an adjacent Class 100 clean room for processing. This second module contains equipment for photoresist deposition and baking, metal etching (chemical or plasma, depending on the design), and nitride-passivation-based plasma deposition and etching. A proximity mask-alignment station is provided for the passivation mask.

The third module is a Class 1,000 clean room for electrical test and device assembly. It is made up of a wafer-probe station for electrical die sort and a final 128-input/output test station. Equipment is also included for wafer sawing and breaking, epoxy die attachment, and semiautomatic aluminum ultrasonic bonding. The module also holds either a seam-welding or solder-sealing station for sidebrazed hermetic-package assembly, package-marking equipment, and optical inspection and manufacturing equipment.

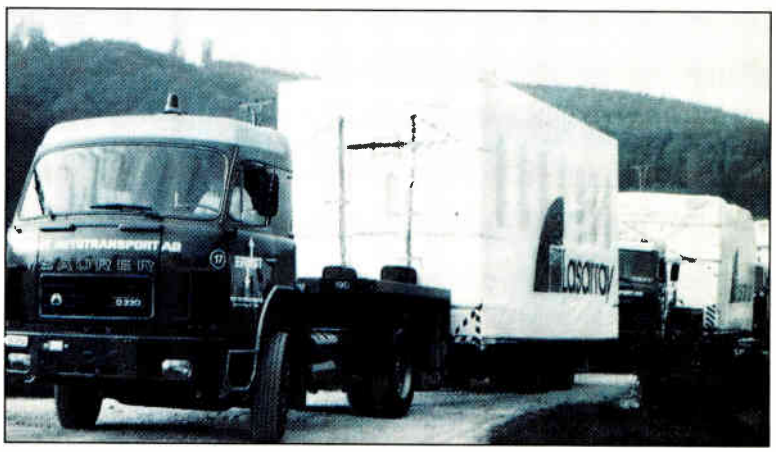
The fourth component is the service area, which includes all gas, chemical, and deionized-water sources, distribution and recovery systems, plus the laminar-flow air-conditioning systems. Together, the modules make up a completely self-contained manufacturing system measuring about 900 ft². It can be transported on flatbed trucks to the customer's site, constructed, and ready for wafer manufacture in 16 to 20 weeks (Fig. 3).

GUIDING WITH A GRID MASK

The Lasarray system uses standard-size CMOS wafers supplied by Lasarray to a customer's specifications. The only modification the wafers need is the addition of the patented grid mask that guides the laser pattern generator. The base wafer, with the prefabricated grid structure, allows fabrication of circuits with complexities of up to 3,200 two-input equivalent gates. Superfluous connections in the metal grid are removed by resist exposure and etching. Use of the grid mask, along with the fully processed wafer, makes possible



2. MODULAR. Lasarray's modular laser-based facility includes all necessary design, fabrication, and test equipment in 900 ft².



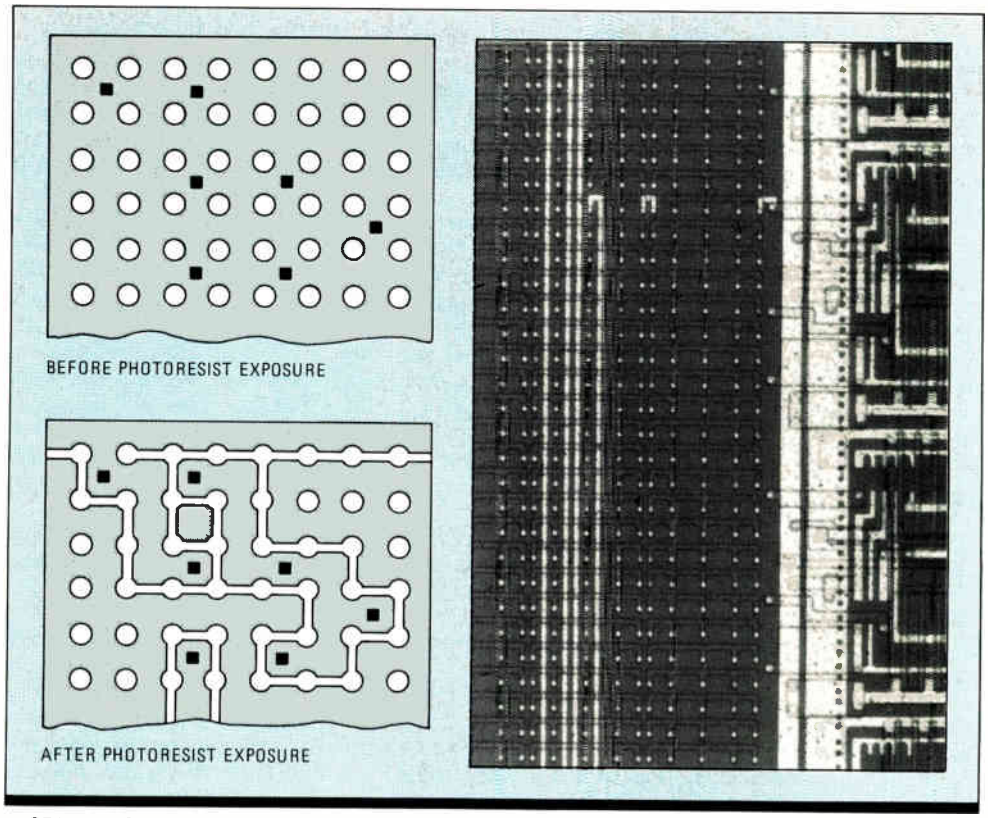
3. MOBILE WAFER FAB. Lasarray provides a laser-based wafer fabrication facility that can be loaded onto trucks and delivered to the customer's site.

electrical evaluation of the process control sites before wafer customization.

The grid can vary in density, depending on the type of circuit being designed and customized. The typical size of a grid element, or hole, is about 1 μm.

The desired electrical connections are created by local, straight-line laser exposure of the positive photoresist that covers the top metal layer. The regular layout of holes in the metal grid means that only the desired electrical connections remain after resist exposure and metal etching (Fig. 4).

The Lasarray wafers also include pads with normal input, TTL input, pull up/down, open drain, and tristate outputs. The number and placement of the I/O pads depends on the design provided by the compiler. These I/O-pad cells use a special interconnection scheme to precondition the wafer for subsequent laser pattern generation. In the scheme, a variety of the popular logic-interface configurations can be implemented by selecting any combination of 29 metal straps, which the writing laser treats like fuses and cuts according to the I/O configuration required by the application and logic family.



4. GRIDDED GUIDE. The framework for guiding the laser pattern generator over the surface of a wafer is a gridded array of 1-μm-diameter holes.

Setup of the laser pattern generator requires only two adjustments. First is placing and positioning the wafer on the X-assembly surface, which is done in much the same way a wafer is positioned on a standard wafer-probe station. This is followed by focusing the laser beams at the wafer's surface.

In the initial stages of pattern generation, an indexing optical head with piezoelectric servo-controlled mirror directs the laser beams to a focus at the wafer surface. The control laser focuses on the same point as the writing laser, and the light reflected on the surface is measured. The metal surface, the oxide surface, the gate elevations, and the contact holes each reflect the light with different intensities. Using these measurements, and with the help of an electronic signal-processing unit, the writing laser beam can be positioned accurately.

Based on data from the red scanning laser, the computer controls the blue writing laser, which is switched on and off according to the wafer's position and the metal-interconnection layout pattern of the customized grid. On/off switching is performed with a fast optical switch, which can produce up to 20,000 connections per second.

The scanning laser beam leaves the blue-sensitive photoresist unexposed. This beam also checks the position of the exposure lines with respect to the holes, thus dynamically correcting errors in the mechanical-movement system. For this, the optical system is fitted with a piezoelectric shifting element.

Exposure with the writing laser beam is noncontacting and can take place in any atmospheric environment. A vacuum is not required and the ICs are not charged.

To keep the scanning and the writing laser beams aligned, the scanning beam is adjusted by a dichroic beam-splitter in such a way that it passes through the same radiation path as the writing laser. The two laser beams are reflected in a collimator toward a lens head; this is done with a beam splitter for the writing laser beam and by a mirror for the scanning laser beam. A portion of the writing laser beam is deflected to a detector, which continuously monitors and controls the writing laser beam's alignment. Again, a portion of the scanning laser beam, through the use of a beam splitter, is reflected to the detector, resulting in a common guidance for the writing and scanning laser beams.

The same optical components are used for both laser beams, but the writing-laser-beam apparatus, unlike the scanning laser, contains a series-connected modulator, expanders, and lenses. The modulator switches the write-laser power on and off to achieve the desired removal according to the computer control program.

If the blue writing laser beam strays, the servo drives the mirror to recenter it. The writing laser beam is focused to a spot diameter over a distance of 2 μm, and the wafer moves at a speed of about 300 mm/s.

PINHOLE CONTROLS INTENSITY

The consistency of the laser beams' intensity is controlled by a pinhole apparatus within the laser beam expanders to ensure that the beams are free of image distortion. The intensity variations of the writing laser beam are kept well within the exposure specifications of the photoresist used on the wafer surface.

The Y-axis assembly includes a turret that holds three units: the laser-beam detector, a microscope eyepiece, and a shearing interferometer eyepiece. The microscope eyepiece is used for the setup and focus of the laser beam. The shearing interferometer eyepiece is used to check the quality and fineness of the writing beam's intensity. The turret assembly allows the selection of either eyepiece in combination with the lens head to facilitate setup and operation. The

Y-axis assembly has a 0.25-μm resolution.

The Y-assembly movement is controlled and monitored by a piezoelectric element and closed regulatory loop consisting of an operational amplifier and a high-voltage amp. The relative flatness, a measure of parallel error, between the Y-assembly movement and the X-assembly movement surface is less than 1 μm. The Z-axis assembly has a maximum mechanical error of 1 μm over a distance of 200 mm.

Exposure of a 100-mm-diameter wafer takes less than two hours. This throughput capacity, based on an 8-μm metal pitch, is not affected by the circuit's gate complexity. "Depending on the semicustom die size, this throughput rate represents several hundred to several thousand ASIC products per day," says Krautner. "When you consider that you may be integrating your circuit on a 1,000- or even a 2,000-gate array, this is one of the most impressive innovations of the laser-write method, with potentially large savings in both time and money."

FOUR DESIGNS AT ONCE

The laser system can produce up to four different designs simultaneously on one wafer using different laser-control data. This makes it possible to manufacture fully customized ICs in very small quantities. The quantity can even be less than the number of dice on a typical wafer, Krautner says.

Though the Lasarray system does not require the chromium mask used in conventional gate-array customization, the laser pattern generator can be used to manufacture such a mask at the user's option. This lets the user offload the production wafers onto the proximity aligner, thus freeing the laser pattern generator to support new design activity simultaneously with ongoing production runs. The data base for generating the metal mask is identical to the one used to drive and control the laser pattern generator.

The silicon compiler, says Krautner, can also convert a semicustom design to a full-custom mask set using a few simple commands added to the Chipsmith repertoire, without any additional design engineering effort. During this compiling process, all inactive and unused active areas of the silicon are eliminated to reduce the die size. This allows the ASIC to support the production requirements, achieving cost reductions and yield-per-wafer improvements.

The Lasarray system is simple enough to be operated by personnel who are not sophisticated in IC design and manufacture. "Because the entire process, from design through packaging, is computer aided, no semiconductor specialists are needed. An original-equipment manufacturer's personnel can be trained to use the system with little or no trouble," Krautner says.

Enhancements and improvements are being added to the Lasarray system, according to Krautner. Now in the works are a family of 2-μm double-layer-metal CMOS gate arrays, he says, in which the top layers are personalized using the laser-pattern-generator direct-write scheme. As the technology allows, the system will be available for fabrication of gate arrays using sub-2-μm techniques, which will allow densities as high as 4,800 gates. Also in development, says Krautner, are software packages that will allow the Lasarray system to be used with a 20-V bipolar-analog array family. □

UHLMANN: BOTH CATALYST AND DRIVING FORCE

Ernst Uhlmann is the primary catalyst and driving force behind the development of the Lasarray direct-write fabrication scheme. As president of Ernst Uhlmann Holding Ltd., Thundorf, Switzerland, he operates the FELA group of companies, which consists of 10 divisions and whose main activity up to now has been developing high-quality, state-of-the-art printed-circuit boards for low- to moderate-volume markets.

As monolithic integration of complex application-specific circuits evolved during the early 1980s, Uhlmann saw that his customers could benefit from a design and manufacturing system that would make small production runs cost-effective. He helped form a consortium of companies and research institutions called the Association for the Promotion of Microelectronics, and in 1981, Uhlmann formed a new division, FXL, to manage the development project.

In 1983, international patents were awarded on the laser pattern generator and its associated metal-mask grid design. The inventors were Jean-Michel Mayor, Jürg Steffen, and Peter Wüthrich. The patents are held by Ernst Uhlmann Holding Ltd. Spearheading this "mini-think-tank" is FELA E. Uhlmann AG, which invested $3.5 million in the development of the Lasarray system.

FELA Electronics AG designed the silicon-compiler interface, the laser-pattern-generator software control, and the hardware interface, and led the development of the laser pattern generator. FELA Planungs AG, Baden-Dacttwil, Switzerland, was responsible for the design of the processing module. FSRM (Fondation suisse pour la recherche en microtechnique), Neuchâtel, Switzerland, developed the optical requirements of the laser control and exposure methods, including the mechanical requirements of the laser pattern generator, its structure, and movement.

ESEC AG, in Cham, Switzerland, developed the hardware for the laser pattern generator, while Bircher AG, Beringen, Switzerland, developed the computer hardware system architecture and the control software for the laser pattern generator. Asula SA, Neuchâtel, consulted on the specifications for the lasers. CSEM (Centre suisse d'electronique et de microtechnique), Neuchâtel, assisted in the development of specifications for chemical etch, plasma deposition and etch, metal etch, and photoresist processing in the processing module. Micro Electronic-Marin, in Marin, Switzerland, provided wafer fabrication of the silicon-gate CMOS technology for the initial Lasarray gate-array product offerings. Lattice Logic Ltd., Edinburgh, Scotland, provided a modified version of its Chipsmith silicon compiler.

DRIVING FORCE. Ernst Uhlmann created a "mini-think-tank" of companies.

The FXL division is no longer part of FELA. It has been reformed as the Lasarray Corp., Scotts Valley, Calif. Manufacturing and assembly operations for the non-U. S. market will be maintained in Switzerland, with a design and sales operation in West Germany.

Heading the U. S. operations is Lasarray vice president George Krautner. He joined the company in 1985 after 10 years of management and marketing experience at such companies as Exar, Interdesign, and Universal Semiconductor, as well as eight years as an engineer at Raytheon Semiconductor, Honeywell, and Intersil.

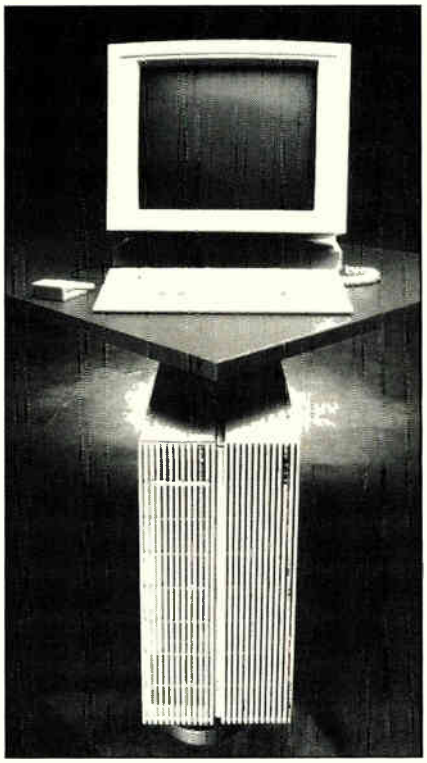
For the role his companies have played in the development of the laser-based direct-write-on-wafer technique, Uhlmann has been awarded the prestigious Oekreal-Innovationspreis by the Swiss government.

LOW-COST WORK STATION AIMS TO MOVE AI OUT OF THE LAB

SYMBOLICS DOES IT WITH 1-BOARD PROCESSOR BUILT WITH 7 GATE ARRAYS

Until now, hardware designed to work with artificial-intelligence software has been used mainly to develop, debug, and test programs. Because of their high cost, such systems are not practical for running programs in an office or factory. Now Symbolics Inc. wants to change that. It is coming out with a low-cost work station optimized for executing already developed AI software.

Aimed at AI applications delivery, the 3610AE (AE stands for applications engine) packs the key performance features of the Cambridge, Mass., company's 3600 series AI development work stations into a smaller package (Fig. 1). Because of its architecture, the 3610AE offers twice the performance of Lisp machines with comparable instruction-cycle times, says program manager James E. Kulp. Costs were reduced by switching to gate-array technology. As a result, the main processor has been reduced from 3½ boards to one.



1. AI STATION. The Symbolics 3610AE AI work station offers high-powered Lisp processing in a small package.

"This product dramatically reduces the cost premium of high-functionality symbolic-computing hardware over conventional computing hardware—the premium has been lowered dramatically and the functionality hasn't. That brings symbolic computing that much more into the mainstream," says Kulp. (AI programming languages such as Lisp manipulate symbols, hence the term symbolic computing; conventional Fortran and other programming languages perform numeric computing.)

To date, some 1,800 of the high-end 3600 systems have been sold to companies looking to develop AI software. Prices range from $66,000 to $89,000, depending on configuration. The low-end 3610AE, which is completely compatible with 3600 machines and can run software written on them, will cost $44,900 for a single unit; quantity prices are as low as $31,500.

Indeed, the introduction of a low-cost AI work station could boost applications delivery in a big way. "You're seeing people trying to solve big problems with the techniques and the tools that our system is optimized for," says Kulp. "In another year or so, there are going to be a large number of applications that are developed using AI techniques that need the power of symbolic computing to run. This product is designed to be there when those applications are there."

The 3610AE has two main components. The user interface consists of a keyboard, mouse, and high-resolution 19-in. black and white display with a resolution of 1,124 by 904 pixels. The system box houses the four boards that make up the processing hardware (Fig. 2)—the single-board processor, input/output board, console board, and random-access-memory board.

The single-board processor features seven 2-μm semicustom CMOS gate arrays. "We were aggressively pushing the latest, most powerful gate-array technology we could find," says Kulp. Symbolics began working on the gate arrays at the project's outset in mid-1984. And because they were using leading-edge technology, Symbolics found that there were no tools to determine how the finished design would perform. "We had to write our own simulation software on our own systems to simulate the whole processor, because there was no CAD system out there that could do it."

Shrinking the 3600 processor down to a single board involved a host of design considerations. "We didn't just take the old [3600 series] design and shove it into gate arrays. We did a very careful analysis of our architecture. In the partitioning of the gate arrays and in the implementation, we made a number of minor architectural changes," he explains. For example, the 3600 has a separate multiplier chip. In the 3610AE, the chip was removed and features to perform arithmetic quickly were incorporated into the basic design.

Overall, nearly 40,000 gates are used, with individual chips ranging from 3,000 to 10,000 gates. Each chip has been allocated a separate function. There is a sequencer, a memory-management unit, an arithmetic logic unit (also call the data path), and a tag processor. Two of the seven gate arrays are used to calculate addresses for the processor's two internal scratch-pad memories. (Unlike many machines, the 3610AE has no general-purpose registers; a portion of the stack, called the stack cache, is used instead.)

The remaining, and most complex, gate array is the memory controller. This chip handles memory-refresh functions, prefetches instructions, and controls memory accesses. Also on the board are the internal scratch-pad and microcode memories for the processor, the bus arbitration and the bus interface handlers. and system clocks. The processor has 16,000 112-bit words of control memory, which is 112 bits wide.

VLSI CONTROLLERS

The separate I/O board handles input and output functions. Where the 3600-family I/O controllers use medium-scale-integration technology, the 3610AE's I/O board was designed around the new generation of VLSI I/O controllers. It includes a disk controller, a serial I/O controller, and a clock/calendar. For data communications, the board supports the Transmission Control Protocol/Internet Protocol and the DECnet standard over Ethernet, or IBM Corp.'s Systems Network Architecture software when transmitting over serial I/O links. Also included is a Motorola 68008 microprocessor—an 8-bit version of the 68000. Dubbed the front-end processor, it is used for bootstrapping the system and as a diagnostic processor.

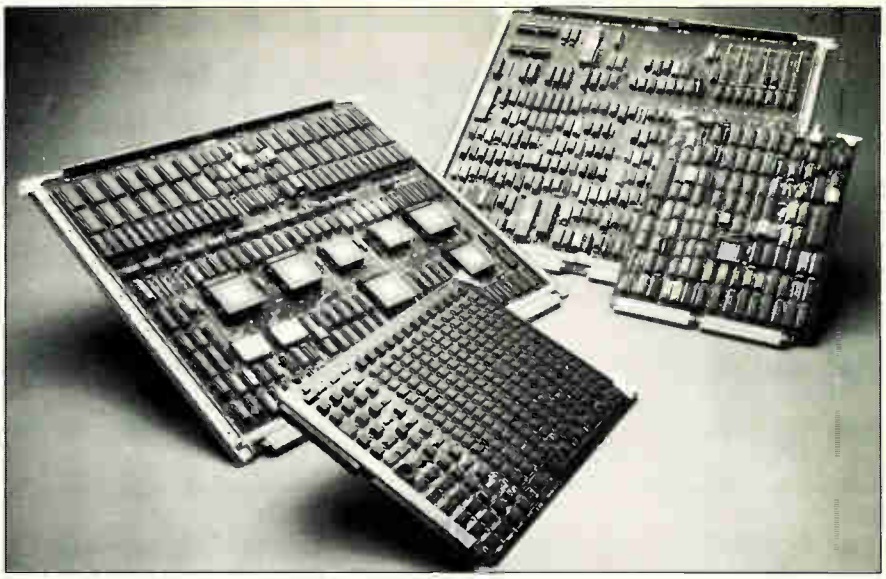
Also in the system box is a console board. A graphics display handler, the board offers the same graphics capabili-

ties available on the 3600 series.

The RAM board uses surface-mount technology. It has 1 million 36-bit words on one 8-by-10-in. board. The 3610AE also has access to up to 60 megabytes of virtual memory, and comes with 190 megabytes (unformatted) on disk.

The system's modular design—separate processor, I/O board, graphics board—will allow users to configure the 3610AE for special applications. As one example, the system might be used for embedded applications by using it without the I/O board. As well, modularity permits multiuser applications (up to four users at once), because more than one console subsystem can be plugged in to a configuration.

In software, the 3610AE supports Release 7.0AE, an enhanced run-time-only version of the Symbolics Lisp software environment. Featured is an object-oriented programming system with windowing, or the ability to run multiple applications on a single display simultaneously. In addition to Lisp, available programming languages for the 3610AE include Fortran-77, Pascal, Ada, and Prolog.



2. COMPACT. Under the 3610AE's hood are the four boards for the central processor, input/output functions, graphics display, and random-access memory.

A key feature that gives Symbolics' architecture a performance edge over other Lisp-based machines is the use of parallel data-type checking paths. Here Symbolics is boosting the speed of processing tags. In a tagged-architecture system such as the 3610AE, every word stored in memory contains extra bits that specify what type of data is stored in the word. Examples of data types include integers and character strings. Symbolics' machines use 36-bit words so that, in addition to 32-bit data words, 4 bits of tag information can be saved.

"Every system that's optimized for Lisp tends to have a tagged architecture. But the thing that's unique about ours is that the handling of the tags is done by a parallel tag processor," Kulp says. Using parallel data-type checking paths, the tags are processed at the same time as instructions. This reduces processing time from separate tag handling.

A second key hardware feature is the special support included for Symbolics' storage-management system. "The whole problem with storage management is to recycle the data items that aren't used any more for reallocation. So the trick is to find out which ones can be recycled," explains Kulp.

Called the "ephemeral garbage collector," the 3610AE's storage-management system allows the processor to recognize such short-lived data objects. "If you can separate out the things that are likely to last for a long time from the things that aren't going to last very long, then you can focus your storage-management cycles on the short-lived stuff, because that's the stuff that you care about."

For Lisp-based applications, which may ultimately run in a production environment where they will be on-line for days at a time, efficient storage management can be critical to system performance. The alternative is large, unpredictable slowdowns in the processing due to inefficient use of memory. "We don't think that anyone else has anything approaching the same capability. We feel very strongly that we have something very special there and unique," says Kulp. □

A COAST-TO-COAST EFFORT TO BUILD THE 3610AE

Symbolics Inc. applied the maxim "divide and conquer" to the challenge of building the 3610AE. Unlike previous development efforts at the company's Cambridge, Mass., headquarters, this time hardware and software engineers were miles apart. While senior project manager Ron Lebel headed up processor design in Symbolics' Los Angeles office, a team back east was hard at work on software.

"Federal Express made lots of money from us," says Lebel. Circuit boards and tapes filled with computer data were shipped back and forth as the group coordinated their work. "We've got a cross-country mail network, so we kept in pretty close contact even though we were 3,000 miles apart."

Program manager James E. Kulp, a cofounder of the company, headed the Cambridge group. After attending the Massachusetts Institute of Technology, the computer scientist joined a small consulting firm. Since 1981, he has been managing Symbolics' network, peripheral, and hardware projects.

Lebel developed the original concept for the 3610AE. He joined Symbolics in 1983 as a technical group manager. Previously, he coordinated the introduction of the 3670 Lisp processor.

SYMBOLS. Program manager James E. Kulp honchoed the 3610AE project.

SIGNALS. Senior project manager Ron Lebel developed the processor hardware.

PROBING THE NEWS

ERICSSON TRIES AGAIN TO CRACK THE U.S. MARKET

A BIG SUCCESS ELSEWHERE, IT NEEDS AMERICA TO KEEP GROWING

by Robert T. Gallagher

STOCKHOLM

The world's most successful exporter of public telecommunications equipment is going to make another stab at the scene of its biggest failure. Sweden's LM Ericsson AB, which has sold telephone exchanges to more countries than any of its worldwide competitors, aims to establish a major bridgehead in the massive U.S. market in hopes that the new revenue stream will catapult it into a period of sustained growth.

Trying to succeed in the U.S. is nothing new for Ericsson. It has tried hard, but without success, in recent years to crack the U.S. market. But in public telecommunications, its efforts have been blocked by the stranglehold that AT&T Co. and Northern Telecom Ltd. have maintained on that market. And the Swedish company's efforts in computer systems have been plagued by a lack of marketing focus. But for two fundamental reasons, the U.S. is now a priority for the company as never before.

One is that an enormous worldwide overcapacity in the production of telecommunications switching equipment is leading to an outpouring of marketing and technology alliances. About the only way for Ericsson to maintain its cherished independence will be to grab a piece of the world market large enough to keep its costs at levels where it is possible to sell at rock-bottom prices and still turn a profit. After the recent divestiture of the regional Bell operating companies (RBOCs), the U.S. market offers an enticing opportunity for a switch producer to substantially increase its sales. It is perhaps the world's only market where customers deal in both cash and high-volume orders; elsewhere, volume is low and credit is demanded. So Ericsson has big U.S. plans for its well-regarded AXE digital telephone exchange.

RED INK. Ericsson is also making a renewed assault on the U.S. market because of the sad state of its private telecommunications and office-automation subsidiary, Ericsson Information Systems AB. Outside of Scandinavia, it has no significant share of any major world market. Its own attempt to penetrate the U.S. market has left it with nothing to show for its efforts but a marketing disaster and a hemorrhage of red ink.

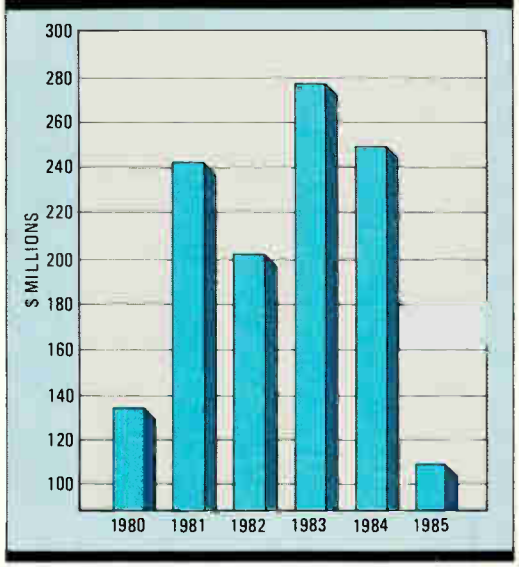
Capturing just a small percentage of U.S. market share could mean a windfall. To Ericsson, this objective probably looks far more attainable than the alternative. That would be to try and grab more substantial pieces of heterogeneous European markets where the choicest orders often go almost automatically to national suppliers.

Last year was a difficult one for Ericsson. Its Public Telecommunications Division suffered a significant decrease in profits because of a particularly onerous combination of rising development costs and soft prices worldwide in public switching gear. Information Systems experienced the stiffest losses of its history, with a major portion of the deficit due to a failed attempt to crack the U.S. personal computer market.

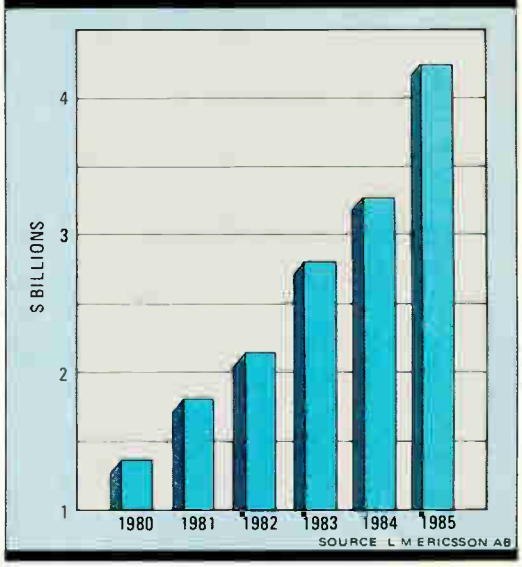
The Public Telecommunications Division and Information Systems are of almost identical size and together constitute nearly 65% of the company's total sales. Some of Ericsson's competitors feel this could mean that the company could in the long term be just a little too sensitive to the swings and vagaries of the world telecommunications markets.

"When you look at most of the big players [in the telecommunications busi-

ERICSSON'S PROFIT PICTURE IS ERRATIC . . .



. . . EVEN THOUGH SALES HAVE RISEN STEADILY



ness]," points out a top executive with one of Ericsson's European competitors, "you see companies like AT&T, which draw substantial revenues from transmission activities, and ITT, which sells consumer goods and a variety of industrial products. But Ericsson is nearly completely devoted to telecommunications, a market we all know isn't always very kind. This could mean that if competition continues to get even more severe and prices continue to fall, they could find themselves vulnerable."

Predictably, executives at Ericsson disagree. "I think that's a good issue, but the way we see it is that our concentration in telecommunications is one of Ericsson's main strengths," explains Bo Landin, the company's senior vice president for corporate strategy. "It provides homogeneity and allows management to concentrate on the core business.

"The essential point that this comment misses is that our business is far more geographically diversified than that of our competitors, and that is a perfectly valid alternative to product diversity," he stresses. "At any given time, one or more of our markets—like Saudi Arabia for several years—is generating substantial amounts of cash. That's why I don't see any real danger that we'll fall into that public telecommunications trap you can get caught in if you're underdiversified."

Landin points to Ericsson's customer list, which includes the telecommunications authorities of more than 50 countries worldwide, representing a total of nearly 14 million local and transit lines, either installed or on order, distributed over some 1,300 exchanges.

To that, the company adds orders or installations for the equivalent of nearly 1 million mobile cellular radiotelephone subscriber lines, or 60 exchanges in 21 different countries. Ericsson claims about 50% of the world market for mobile telephone switching equipment.

TENACIOUS MARKETING. Behind this penetration are two key facets of Ericsson's marketing approach. One is a tenacity in pursuing contract negotiations that surprises even some of the company's competitors. In France, for example, the Direction Générale des Télécommunications, after negotiating with Ericsson, decided to give 16% of its market to AT&T Electronics. But even though other potential suppliers have accepted the inevitable and dropped negotiations, Ericsson still hasn't given up because the deal has not yet been formally signed. Landin says that he expects AT&T to get the contract, but argues that giving up because of that would simply be bad business.

Ericsson's other principal strength is its product line, easily the most homogeneous in the public telecommunications industry. The centerpoint is electronic switching equipment that even competitors have difficulty criticizing.

By far its major seller, and the product that draws the competition's praise, is the AXE digital telephone exchange. What sets the AXE apart from competing exchanges is the stability and modularity of its architecture in general, and of its software base in particular (see "Modularity makes AXE the switch for all users," p. 60).

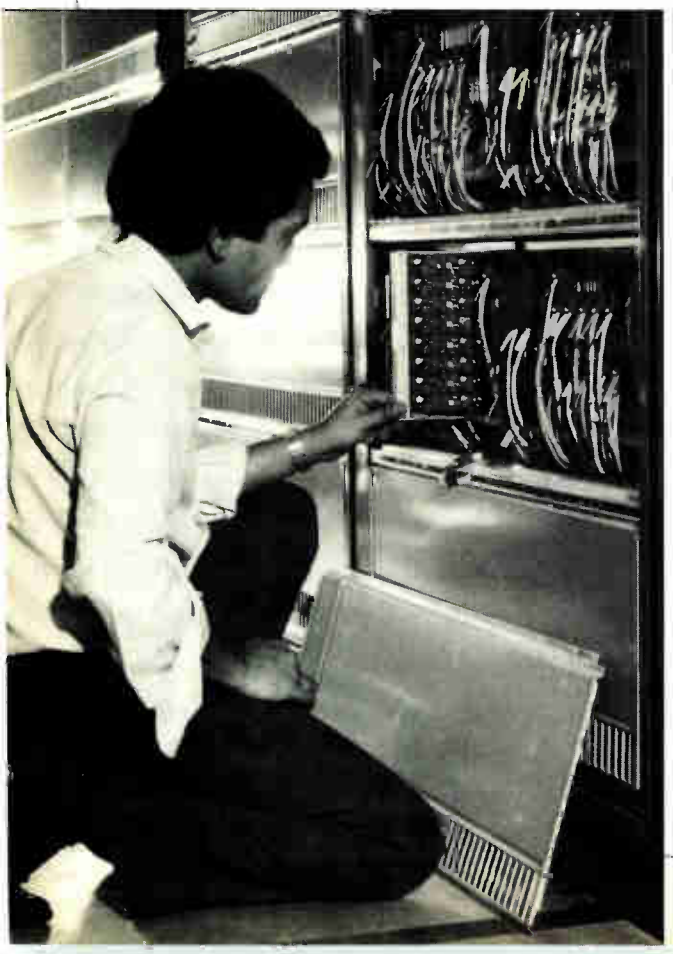
Now Ericsson must adapt the AXE for use in the U.S., particularly by the RBOCs. That is a challenge that company executives recognize as essential for the continued growth of their public telecommunications division.

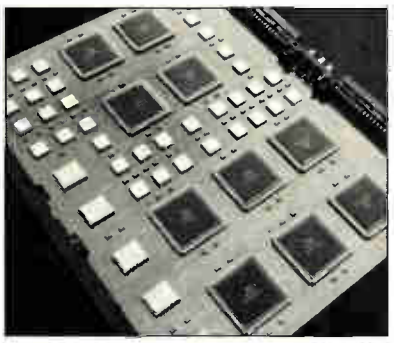
This effort is set against the somber background of ITT Corp.'s having thrown in the towel in its effort to establish its System 12 switch in the U.S. Landin disagrees fundamentally with ITT's publicly stated reason for having dropped its stateside effort: that orders for digital switches would peak in 1986, thus making a position in the market marginally profitable at best.

"Even if they do peak this year, volumes in the U.S. are so big that it isn't a major problem," he asserts. "Between the RBOCs and the independent companies there is still room [in the U.S.] for a couple of new suppliers."

Ericsson already maintains frequent

MEN AND MACHINES. Ericsson's hopes for major success in the U.S. rest mainly on two products: the AXE switch and the MD 110 PABX. Clockwise from below are the AXE and a logic board for its processor; the MD 110; and engineers at work on the U.S. version of AXE.





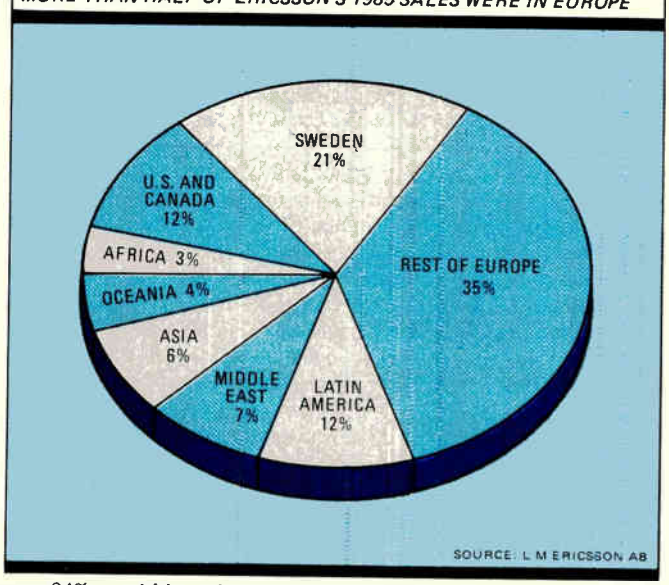
MARKETS. Stig Larsson (left) is pursuing a deal with DEC; Bo Landin see strength in concentration on telecom.

contact with the RBOCs, but the next major step toward achieving U. S. acceptance of the AXE should come by the middle of this year. By then, Landin predicts, Ericsson Inc., the company's U. S. subsidiary in Richardson, Texas, will have won approval as a supplier from the technical association of the RBOCs. "It's not impossible to win minor contracts [without this approval], but for major contracts it is absolutely essential."

Landin declines to disclose how much the adaptation of AXE to U. S. standards will cost the company, except that it is measured in "hundreds of man-years" and that he expects the total will be somewhat less than the $100 million ITT had spent when it decided to discontinue its own parallel effort.

As though this investment were not enough of a drain, 1985 operating results announced a few weeks ago could only be termed disappointing. Sales increased 11% to $4.23 billion, but profits fell a whopping 44% to $115 million (chart, p. 57).

MORE THAN HALF OF ERICSSON'S 1985 SALES WERE IN EUROPE



Key points of the results were a 34% drop in the earnings of the Public Telecommunications Division to $168.2 million and a fourfold jump in the total loss of Information Systems to $105.7 million. Otherwise, the cable, defense systems, and components divisions increased their profits, while the radio communications activity found its way back into the black after a loss in 1984.

Ericsson executives chalked up the fall in profits for public telecommunications to two causes: the cost of adapting the AXE exchange to the U. S. market and a worldwide price drop in public switching equipment. But Information Systems was feeling ever more strongly the sting of its unsuccessful attempt to penetrate the U. S. personal computer market.

EYE ON PROFIT. "Correcting the problems that arose in 1984 turned out to be more complex, and demanded more resources, than we had reason to anticipate a year ago," says Björn Svedberg, the company's chief executive officer. "Operations are now being focused primarily on improving profitability within Information Systems and our American subsidiary, Ericsson Inc., and on a recovery within public telecommunications."

The problem at Information Systems is much more basic than anything happening in other divisions. Many of the company's competitors find that its main weaknesses are a lack of a coherent product strategy and an overconcentration of its business in Scandinavia.

"As good as Ericsson is in public telecommunications, the position of Ericsson Information Systems is less clear," remarks an executive with one of the company's European competitors. "Viewed from the outside, they seem to be in some state of confusion. They have some very good products, for example, but no clear product policy. In addition, their technology is somewhat limited: they are, not surprisingly, very good in communications, but much weaker in office automation. Outside of Scandinavia, their market position tends to be weak. My own feeling is that they need some help from strategic alliances and joint ventures."

Criticism of this type is not lost on the Swedish company. Information Systems president Stig Larsson says that, in an effort to strengthen his company's position, he is in the process of hammering out a joint development accord with Digital Equipment Corp., Maynard Mass. Though the final terms are not yet settled, the two companies will establish a jointly owned facility in Stockholm to develop applications and systems for the banking market.

The two are complementary in this field—Information Systems with good penetration in work stations and automated teller terminals, DEC with a good position in back-office computers. Or, in the words of DEC marketing manager David Pepin, "It's like adding 1 and 1 and getting 3. What they have alone is good, and what we have alone is good. But put it all together, and we can bring a whole new dimension to the marketplace."

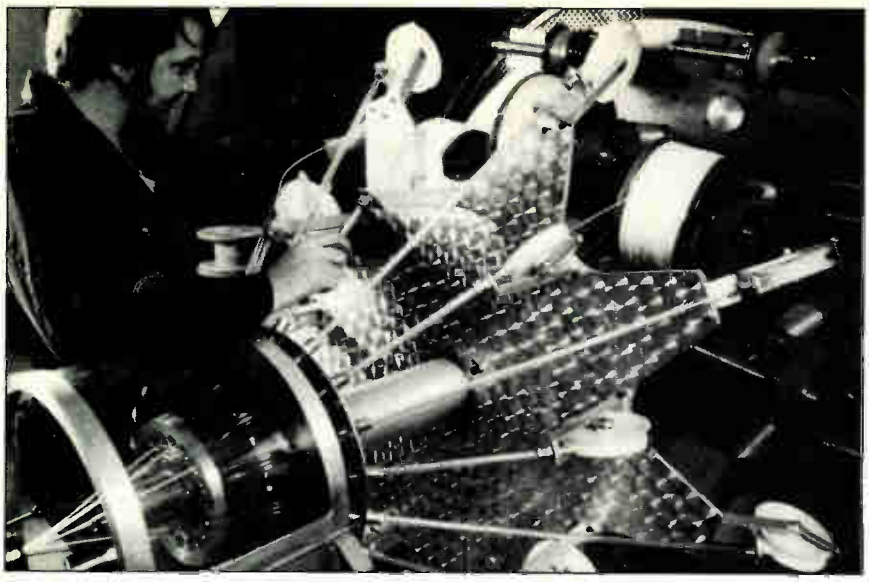
The question that is still unanswered is whether cooperation will stop at the development stage or continue to include joint marketing of systems. Information Systems could clearly use the marketing clout DEC could offer—particularly in the U. S., where Larsson admits that his company lost "several hundred million dollars" trying to market its personal computer.

No matter what the final details, the Ericsson division clearly needs this kind of cooperation pact to focus its activities, particularly for the U. S. market. Peter Thomas, the new president and chief executive officer of Ericsson Inc., believes that the first move the company must make is to become more responsive to the needs of the U. S. customers.

"We are trying to shift the emphasis from being a purely technology-driven company to one that is more marketing-driven. I'm probably an example of that move more than the fact I'm just an American," Thomas says.

The U. S. subsidiary found itself caught in an unpredictable, fast-changing marketplace after the company was launched in 1980 as a joint venture between LM Ericsson and Atlantic-Richfield Co., the energy company. Thomas believes the U. S. telecommunications marketplace is leading the way to changes in businesses around the world. He says LM Ericsson intends to benefit from the lumps Ericsson Inc. took in the early going.

Part of the changes at Ericsson Inc. have been to greatly narrow the focus of its troubled Information Systems Division, once located in Garden Grove, Calif. In the beginning, the young divi-



WEAVER. Ericsson makes glass fiber and spins it into cable for its own use and for sale.

sion was unprepared to take on Ericsson's vast product line.

"Probably the most significant and severe [problem] was in the area of information systems," says Thomas. "There is a good example of how [LM] Ericsson did not initially attempt to create a product strategy to fit the marketplace but rather concluded it has a lot of good products and then dumped them all on this American organization."

SOUP TO NUTS. "It has everything from personal computers to private branch exchanges, telephone sets, electric typewriters, office furniture, and 3270-compatible terminals. It was all dumped onto this very small and immature organization out in California, which proceeded to royally screw it up," says Thomas candidly. "Ericsson figured it all out, but lost a lot of money first."

As a result, Ericsson Inc. pulled out of the personal computer business in the U.S. last fall. Only 2% of its revenue came from the sales of those systems [*Electronics*, Oct. 7, 1985, p. 24]. The U.S. Information Systems Division has been moved to Richardson, where Ericsson Inc.'s Network Systems and new Radio Systems divisions are located along with the company's headquarters. The U.S. Information Systems Division markets primarily two lines now: the large MD 110 PABX system and a minicomputer-based transaction-processing system for the banking industry. Both have been strong products in the U.S. market, says Thomas.

It is the MD 110 voice and data PABX that is the principal technological attraction to DEC in striking up its joint venture with Ericsson. The product is also the centerpoint of the company's technological strategy and will serve a role within Information Systems similar to that played by the AXE in the Public Telecommunications Division. The MD 110 draws extensively on the AXE with a similar modular architecture both in terms of hardware and software. The software itself, however, is new and was written expressly for the MD 110.

One principal feature of the MD 110 is that, unlike most standard PABXs (which are generally made up of complex subsystems), it includes only two basic types of units—line interface modules and group switches, according to Olle Ljungfeldt, Information Systems' vice president for communications systems. The line interface module is a microprocessor-controlled unit that can be equipped with any combination of line or trunk circuits or any other telecommunications device. It is equipped with an internal digital switch and can function as an autonomous PABX or as one component of a larger system. Each line interface module carries a capacity of some 200 extensions.

To achieve larger PABXs, line interface modules are connected by 32-channel pulse-code-modulation links for traffic and control purposes. Two modules can be interconnected directly. Larger systems require a group switch. The group switch is a modularly expandable digital switch that transmits pulse-code-modulated voice, data, and control signals between line interface modules.

Group switches possess no control equipment; they are controlled by the connected line interface modules. Capacity of the switch ranges from 200 lines to more than 10,000. Ljungfeldt points out that the MD 110 was one of the first systems offering voice and data on a two-wire connection. He admits that sales were slowed down by early software problems, which he insists have been ironed out. The switch is produced predominantly in Sweden, and of the 400,000 lines, most are connected on the Scandinavian market.

The MD 110 is more than just a product for Information Systems; it is the system around which the company's near- to medium-term future is built. The company will be watching the development of the world market for advanced telecom services, hoping to make its mark with the coming of integrated services digital networks, an application for which it considers the MD 110 ideal. An early sign of how successful it is will be the first results of its accord with DEC, which the Swedish company is counting on heavily to help it penetrate the U.S. market that has brusquely rebuffed it. □

MODULARITY MAKES AXE THE SWITCH FOR ALL USERS

The jewel in the LM Ericsson crown is the highly modular AXE digital exchange, which was first put into service in Stockholm in 1977, seven years after development of the system was begun. Its modularity is its strength.

In software, that means a library of optional modules, each programmed independently of all others. Different modules interact by means of specified signals, which never change. Updating the software of a given module thus has no effect on the rest of the system.

In hardware, all physical elements, from components to printed-circuit boards to the cabinets that house them, can be easily and independently updated without compromising the overall integrity of the exchange. This makes it easy to incorporate new technologies as they become available.

For example, Ericsson's APZ 212, a central processing unit, can be added to a standard AXE exchange with absolutely no modification of the switch's basic software. It increases the call-handling capacity to 800,000 at peak hours, more than five times that of the AXE's standard APZ 211.

A direct result of this modularity is that the AXE, with a maximum capacity of some 200,000 lines per exchange, is being used in rural, urban, and suburban networks throughout the world. It also serves as the basis for Ericsson's integrated services digital network trials and the company's mobile-telephone exchanges. Ericsson calls the Keybridge international exchange operated in London by British Telecom, with a capacity of 53,000 trunks, is the world's largest digital exchange to date. The first APZ 212 was installed there at the end of 1984. *–R. T. G.*

HOW IBM PLANS TO PUT THE SQUEEZE ON CLONE MAKERS

ON THE LIST: MORE ON-CHIP FUNCTIONS, PATENTS, PLANT AUTOMATION

by Robert J. Kozma

NEW YORK

When business historians chronicle the personal computer industry, they may well refer to April 2, 1986, as the beginning of IBM Corp.'s Clone Wars. That date marked the first concentrated salvo that the computer giant fired on the makers of IBM-compatible personal computers.

By announcing more powerful, less-expensive versions of the Personal Computer AT and XT, making deep price cuts in the existing PC line, and introducing the PC Convertible, described as the smallest Personal Computer [*Electronics*, April 7, 1986, p. 45], IBM served notice that it has gotten tired of clone makers nipping at its heels.

The giant of Armonk, N. Y., also hopes to keep its smaller competitors at bay and stop erosion of its market share by integrating more circuitry on silicon and moving software into firmware, speeding product introductions, and trimming costs through automation.

The reason for IBM's new move in personal computers is simple: this product line is no longer a minor part of its business. The U. S. market is still getting bigger (chart). And IBM, which saw its 1986 first-quarter earnings and revenue rise just 3% to $1 billion and $10.1 billion, respectively, wants—and needs—PC sales to help its bottom line.

IBM remains the largest maker and seller of personal computers, with an estimated 42% of the total U. S. sales volume. In the highly visible retail arena, its share of market in units trails that of Apple Computer Inc., Cupertino, Calif., though IBM leads in dollar sales. But by both retail measures, IBM's market share has drifted lower over the past few months (see graphs, next page). The reason: customers are turning to the lower-priced personal computers that are claimed to be functionally identical to IBM products.

When IBM introduced its original PC in 1981, observers hailed the company's decision to go to an "open design." That decision also enabled IBM to quickly take over the market and give the market some product homogeneity. That standardization has come back to haunt IBM, however—just about anyone can now make a PC-compatible machine.

Now it wants to slow down the clone makers and give itself some room to maneuver. "A great general can win wars by changing the field of battle to his advantage," says David Carnavale, an analyst with InfoCorp., the Cupertino market-research company. IBM, he says, wants "never to be a fixed target. A moving target is more difficult to hit."

IBM's market share is eroding in the retail market

Market observers believe one way IBM will make life harder for the clone makers is by integrating more PC functions onto chips. IBM can easily do this because of its superior design abilities, says Seymour Merrin, vice president of the Gartner Group, Stamford, Conn. This, he says, will make the chips more difficult to copy.

Competing vendors would also find it "impossible to build clones from off-the-shelf parts," adds Amy Wohl, president of Wohl Associates, a Bala Cynwyd, Pa., market researcher. In unveiling the PC Convertible, IBM said that the product uses five new CMOS logic gate-array chips made in Essex Junction, Vt., and designed by its engineers there and in Essonnes, France. IBM noted that the chips "offer a fast and economical means of turning a completed circuit design into a finished product."

Observers point out that this new approach will let IBM change some of the chips it uses in its PCs just often enough that any manufacturer trying to copy the design won't have enough time to do so. "This will drive the clone makers crazy," says Wohl. She also feels that IBM will put more of its software into firmware, further frustrating manufacturers who want to ride IBM's coattails.

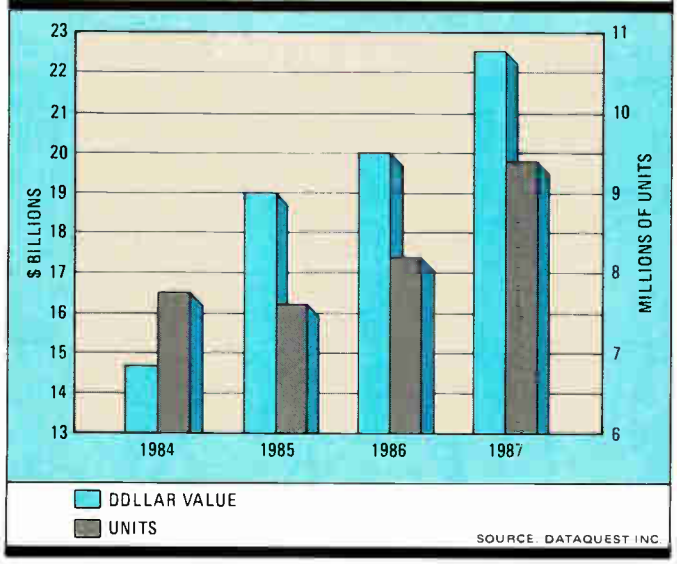
Another "good business practice" that IBM will employ, Wohl says, is patent protection. IBM will try to get patents for more of its products—and then enforce them rigorously. Although this may not stop copycat competitors entirely, it will force them to use their limited financial resources on legal maneuvers, she says.

But possibly the most important weapon in IBM's arsenal is its manufacturing ability. "IBM is one of the few U. S. companies committed to being the lowest-cost producer" of its products, notes InfoCorp.'s Carnavale, "and they've backed that up with serious money."

For example, IBM has built a sophisticated robot-operated manufacturing plant in Austin, Texas, that can produce one PC Convertible every six minutes. The manufacturing line can make other PC products as well, industry sources note. This plant will enable IBM to "manufacture on-shore cheaper than anyone else can manufacture off-shore," says Merrin of the Gartner Group.

The result of this increased emphasis on automation is that IBM can

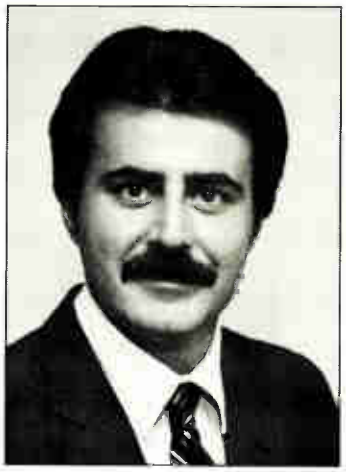
TOTAL PERSONAL COMPUTER MARKET KEEPS GROWING



maintain its high profit margins while offering consumers lower-cost computers. On April 2, IBM cut the price of its PC line by up to 25%.

Its competitors are downplaying the price reduction, saying they can still sell their products for less. But as InfoCorp.'s Carnavale says, IBM has reduced the incentive for users to turn to other hardware. "IBM won't grovel for the lowest price, but the PCs are now price-positioned so that fewer people will go to off-brand clones."

FOLLOWING THE LEAD. Makers of PC-compatible machines also recognize the importance of cutting their production costs and are following IBM's automation lead. At Texas Instruments Inc., "we have accelerated some of the automation efforts in our plants, but the main emphasis has been on design [of the products themselves] for lower manufacturing costs and easing the upgrade of one board for another," says Charles Boyd, manager of TI's Computer Systems Division of the Data Systems Group in Austin.



SWAVELY: IBM cuts fit industry trends, says Compaq's marketing head.

At Compaq Computer Corp., Houston, automated production lines get a cooler response. "Keep in mind that labor as a percent of the total cost of PCs is extremely small," says Michael S. Swavely, vice president of marketing. "It is typically less than 5%, while the major cost—90%—is in the components." Still, Compaq is pressing on the automation front. Late last year, Compaq hired the architect of an automated Apple assembly plant that builds Macintosh computers.

No matter the outcome of the automation battle, IBM will be very aggressive on the low end of the market by keeping prices as low as possible, says Merrin of the Gartner Group. On the higher end of the market, the company will price aggressively, but not as aggressively as it could, he thinks.

However, Merrin, the former president of Computer Works Inc., a computer retailer in Westport, Conn., doesn't think IBM needs to be aggressive at the high end. "If I were IBM, I'd play it substantially differently," he says "In my opinion, they could win on the high end. I believe in charging the highest price you can get. They don't need to lower prices because people will buy from them anyway."

But IBM's price cuts were in line with market trends and came as little surprise, says Compaq's Swavely. "The industry has been reducing prices about 15% to 25% per year. These reductions were certainly in that range," he says. Compaq itself trimmed the price of its low-end computers by 18½% to 20% when it introduced its Portable II.

IBM's price cuts bring the computer giant in line with the rest of the industry, agrees John V. Roach, chairman of Tandy Corp., Fort Worth, Texas. Roach indicates Tandy will not have to react to the price cuts because the company's machines are still priced well below IBM's. Overall, Roach does not expect this month's adjustments by IBM to spark any costly price wars.

"I think, based on the current costs of manufacturing, it is within the realm of possibility that the industry will naturally see decreases of prices by 30% to 40% during the calendar year," Roach estimates. "If anything, we are seeing a reaction of IBM to lower prices as opposed to it leading the way."

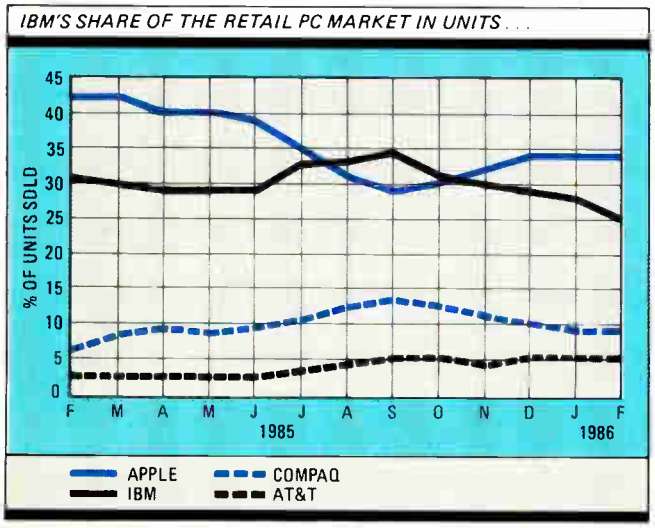
Nor are the price cuts enough to ward off foreign competition, maintains David Keller of stock-brokerage James Capel & Co., Tokyo. IBM didn't price its new models aggressively enough to really regain market share from the compatibles, says Keller. "IBM has given the Japanese too much room to come in and take a slice of the market," he says. "They'll compete at these prices."

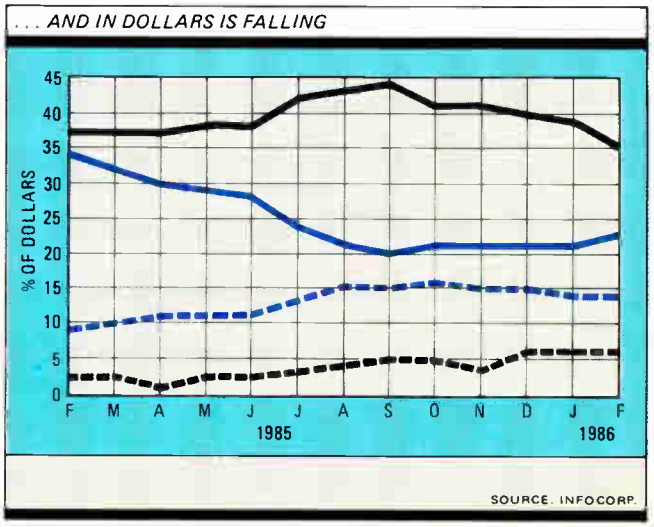
One group that IBM's price-cutting could hit is gray-market dealers and distributors. The smaller profit margins will make it less profitable for these sellers to offer compatible competitive packages comprising a PC and less expensive peripherals made by other suppliers, notes Fredrico di Trapani, director of marketing for Ing. C. Olivetti & Co. The Italian data-processing and office-equipment giant makes a line of PC-compatible computers sold in Europe by Olivetti and in the U.S. by AT&T Co.

"One of the principal results of what IBM has done will be to limit the flexibility of distributors who used to deal in a secondary market by buying basic configurations of PCs and adding disks," he argues. "The price reduction is generally so strong that it leaves little room for [dealers] to maneuver."

Observers say one move that IBM probably won't make—at least with any success—is to deviate from its original architecture. The PC family uses Intel Corp.'s 8086/80286 microprocessor running Microsoft Corp.'s MS-DOS operating system.

IBM will be unable to block the competition of compatible systems by modifying the PC standard with future revisions and enhancements, says Tandy's Roach. "There are many things you can do in the area of standards. But then if you change the standards, you risk hurting yourself as much as hurting the rest of the industry," he cautions. □





PLASTIC PC BOARDS: A TINY BUSINESS STARTS TO GO BIG TIME

DU PONT, GE, AND ICI SEE A POTENTIAL BILLION-DOLLAR MARKET

by Tobias Naegele

WILMINGTON, DEL.

A microscopic market is beginning to attract the attention of some of the world's biggest companies. When the Du Pont Co. last month bought Elite Circuits Inc., a San Diego maker of molded plastic circuit boards, it became only the latest industry giant moving into the fledgling business for these boards. Such powerhouses as Imperial Chemical Industries plc and General Electric Co. are also betting on molded plastic boards as the technology of the future.

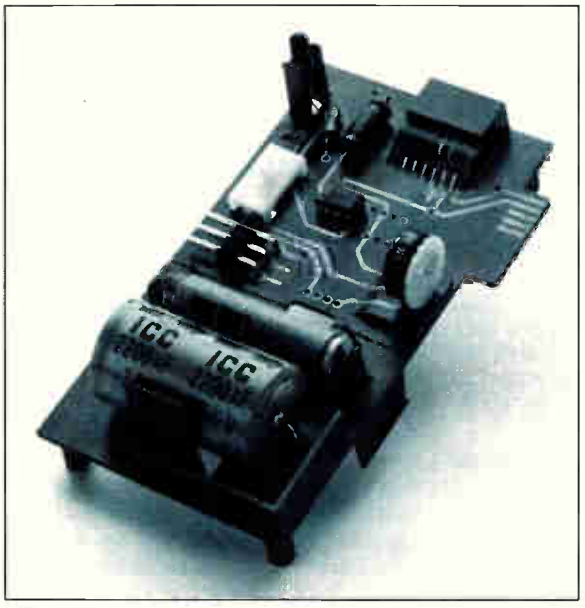
What these large players see is a market—now estimated to be worth only about $20 million a year—exploding into a $1 billion to $2 billion industry within the next decade. They believe that recent advances in thermoplastic materials, coupled with the electronics and auto industries' drive to automate, will propel this technology into the forefront of the $4 billion printed-circuit-board industry.

It's all beginning to happen now because of the availability of new, improved resins that can withstand higher temperatures while flowing easily in a molten state. They are helping open up applications for molded plastic circuitry in a wide range of products, according to Sean McKinley, commercial director of ICI's Electronics Group, whose U.S. headquarters is in Wilmington, near Du Pont.

Though debate swirls about the technology's potential market share and applications, most experts agree on the major advantages that molded plastic circuitry offers. The technology seems ideal for the kind of high-volume board production that the automotive, telecommunications, and consumer electronic industries are expected to require in the future because it offers significant improvements over conventional pc-board techniques in cost, manufacturability, and high-temperature operation.

Molded boards have a host of other advantages. For example, they can be molded into three-dimensional shapes that include connector housings and the like. Also, the additive plating processes that manufacturers use with them are less toxic than the subtractive processes that produce large amounts of chemical waste. In addition, molded-plastic boards are ideal for use with surface-mount technology. "We can mold in recesses for surface-mount devices, which can then be popped into place and protected by the board itself," says McKinley.

Because the technology is just beginning to emerge as a market force, there is no consensus on what applications will catch on first. Most people agree, however, that while the molded boards will not completely replace such competing technologies as rigid circuits, they will certainly gain a big chunk of market share.



BUILT-IN. Molded features on ICI board include a connector with 3-d circuitry (upper right) and a LED retainer (upper left).

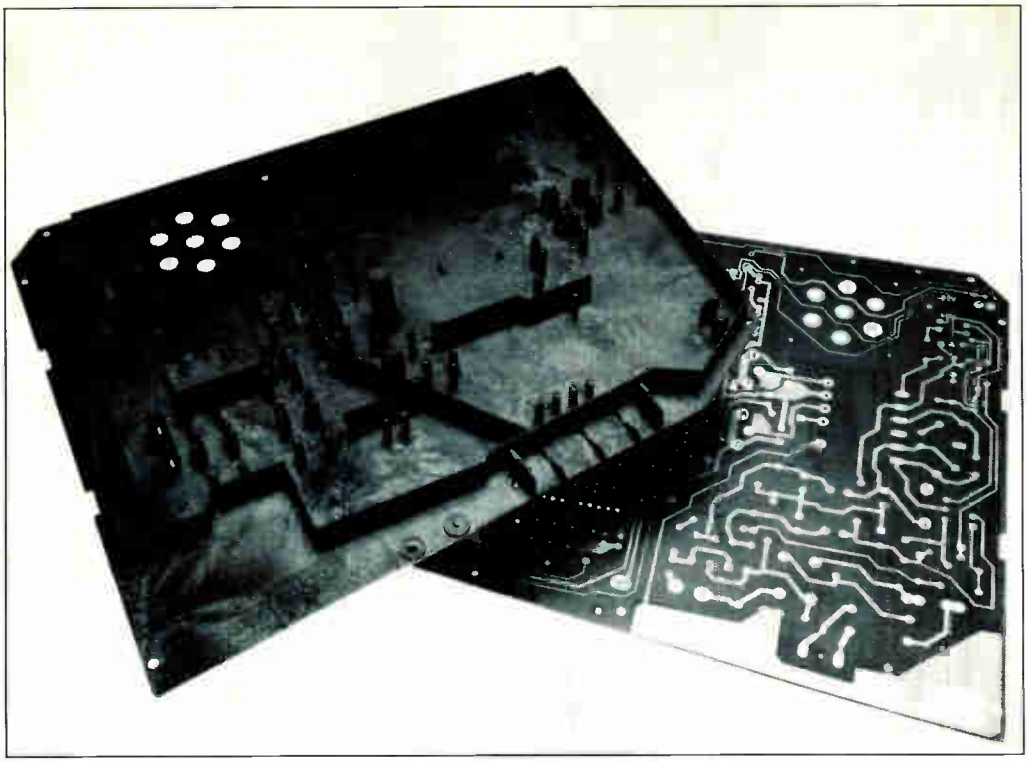
PRIMARY USER. The automotive industry should be the primary user of the technology in the near term, says James Bright, manager of business development for the Ultem product section at GE's Plastics Group in Pittsfield, Mass. But he adds that telecommunications equipment will ultimately be the biggest consumer of these boards.

A different view is held by Michael Kirsch, vice president of Phillip Townsend Associates Inc., a Marblehead, Mass., consultant to the plastics industry, who says that computers will swallow up about a third of the market for the molded boards. Automotive, consumer, and telecommunications markets will share the rest evenly, he believes.

Even though there is no agreement on which technologies will be hit hardest, observers close to the field agree that molded boards will gain their share from several areas. Kirsch says the traditional two-sided FR-4 boards will lose the most market share. Brewster Barclay, manager of international licensing at PCK Technology, a research and development division of Kollmorgen Corp. in Melville, N.Y., that licenses its molded-circuit-board technologies to ICI and others, suggests that likely targets will be flexible circuits used in places "where they're twisted through funny shapes"—though not in applications where the flexible circuit might have to bend.

A study by Phillip Townsend indicates that 20% of the domestic pc-board market will be within reach of molded plastic boards by 1990. But that doesn't mean the plastic-board makers will be able to garner such a high share, Kirsch says. He estimates that they will penetrate less than half of that niche.

"There are a number of retarding factors," he says. Kirsch points out the tendency of manufacturers to avoid the risk of moving into a new technology, the communication problems that arise from molders' unfamiliarity with the circuit-board business, and pc-board makers' lack of understanding of the molding industry. "But they are solving those problems." Kirsch notes that the resin-making companies—notably GE and Union Carbide, the Danbury, Conn., chemical company that is aiming two resin products, Radel and Udel, at the molded-pc-board market—have the most to gain from the new technology's success. They are driving the industry, he says, trying to get the molders and board makers together and "exerting influence on the end users to get them to



TWO FACES. Circuit-Wise's board has circuitry on one side and 3-d features on the other.

pull the technology through."

But molded boards may not be the best solution for every application because the costs associated with forging the molds is generally high, says GE's Bright. He says the technology does not become cost effective until a manufacturer is producing at a rate of 20,000 ft^2 of boards a year.

Phillip Townsend's Kirsch disputes that view. He says that for double-sided boards, the break-even point is between 5,000 and 18,000 ft^2, and break-even points for single-sided boards run from 28,000 ft^2 a year up to 60,000 ft^2 a year, depending on the application. Adds another industry expert: "You can get very cheap molds for, say, $5,000. Not every mold has to be a $50,000 item."

HIGH HOPES. So while hopes are high for the new technology, experts view it as complementary to many existing board-making techniques. They say that molded boards will discover their own niche markets and aren't "threatening to destroy other technologies."

That is what is most intriguing to board makers, PCK's Barclay says. In fact, he adds, there is a strong prospect that much of the new market for molded pc boards could develop out of "areas not traditionally considered part of the pc-board market to begin with." These include connectors, subassemblies, and other areas where molded boards could replace physical assembly.

Most of the parts built onto a conventional pc board—connectors, chip carriers, and peripheral fittings for items such as batteries and lights—can be molded directly into a three-dimensional thermoplastic pc board in one step, according to Samuel Weiner, manager of molded-circuit interconnects at Du Pont. That means major improvements in throughput over other manufacturing methods. But Weiner and others think 3-d boards aren't going to be widely accepted for another three to five years.

Initial applications of the molded 3-d boards have been in disk-drive assemblies and other items such as a daisy-wheel drive assembly made by PCK for use in Smith-Corona typewriters. PCK's Barclay says ICI's Electronics Group and others are well on their way with 3-d parts for applications such as automotive ignition and dashboard control.

GE: '3-d circuitry is where the greatest potential lies'

Others companies are less advanced with their 3-d circuitry, however. Circuit-Wise Inc., North Haven, Conn., which is working with GE, is currently producing single-sided 3-d boards that have circuitry on the board's flat side and 3-d features such as battery mounts and heat sinks molded onto the back. GE's Bright, who says GE uses both additive and subtractive resistless-plating techniques to put down traces on its single-sided boards, adds that the company "absolutely recognizes that 3-d is where the greatest potential lies."

He insists, though, that the technology is several years off. "Even if production quantities of 3-d boards were available today, the subsequent problems of stuffing and soldering them are substantial." Phillip Townsend's Kirsch concurs, saying that that most pick-and-place machines on the market cannot handle molded 3-d boards.

PCK Technology is probably the world leader in 3-d circuit-board technology, Barclay says. Unlike the GE–Circuit-Wise effort, PCK can actually plate up the sides of walls and around edges and corners—and not just on one side, but on two—thanks to the company's proprietary photo-selective additive-plating process for putting down copper circuit traces.

Earlier forays into injection molding for circuit boards failed for several reasons. The first thermoplastic resins developed by the chemical companies did not flow effectively through the molds, says McKinley of ICI. But by adjusting the compounds slightly, "we've increased the molding and postmolding temperatures that the resins can withstand by over 100°F," he says. "Very strong resin systems are harder to mold because they don't flow as easily. The resins we're working with now are getting to a point where they're rather easily moldable."

Not only are the newer materials more moldable, says Bright, but they are cleaner as well. Molded boards require no drilling, so there is no danger that debris created by a drill will return to haunt the manufacturer once plating and soldering begin. Rough holes and dust caused by drilling can result in short circuits and other problems.

The ability of the plastics to withstand heat is crucial to manufacturers, says PCK's Barclay, because early thermoplastics literally melted away when exposed to high soldering temperatures. ICI's Victrex, a polyethersulfone, and GE's Ultem, a polyetherimide, offer the highest heat-deflection temperatures available—410° and 408°F, respectively.

Each of the thermoplastics currently on the market has its own advantages, and all of the materials makers—Du Pont, GE, ICI, and Union Carbide—are selling those attributes hard. □

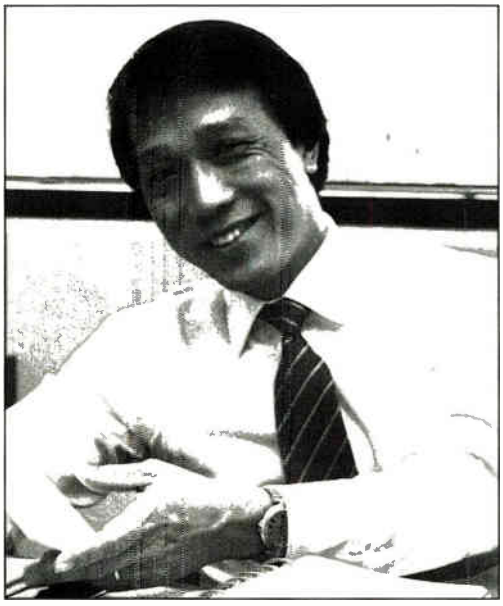
ONE MEMORY CHIP MAKER THAT'S MAKING MONEY

AFTER TWO YEARS, VITELIC GROWS MODESTLY IN CMOS DRAMS AND STAYS IN BLACK BY NOT BUILDING A FACTORY

SAN JOSE, CALIF.

Question: How many U. S. chip makers have recently entered the commodity memory-chip business? And, of these, how many are currently making money from these operations? Answer: One company, surprisingly, fits that tough set of specs. Called Vitelic Corp., the Silicon Valley startup was formed in late 1983 by a worried group of memory designers.

"We were very disappointed at the way the U. S. memory business was going," recalls Alex Au, president and chief executive officer. He saw domestic companies bowing out of the memory market in the wake of stiff competition from abroad. "That was very disappointing—if that kept up, we wouldn't be able to find a job," says Au, who was formerly director of VLSI research at Fairchild Camera & Instrument Corp.



ALEX AU. Vitelic's president is saving money by not investing in a fabrication facility right away.

So his team came up with a strategy that was able to attract the venture capitalists. First, the group decided to join the new generation of semiconductor manufacturers that decided not to build their own plant initially to fabricate chips. "We are selling our design strength," Au says. He doesn't think that is a compromise. "In any business, you have to work on the basics—that's design, product, and manufacturing. You can't back off."

Vitelic investor and board member Neill H. Brownstein is happy over what the San Jose company has done so far. "We initially thought it would be capital-intensive in the first three years, but it hasn't been," says Brownstein, a managing general partner of Bessemer Venture Partners LP, Menlo Park, Calif. "Of $15 million invested, $11 million is still in the bank, and it's profitable."

The second part of Vitelic's strategy was the hardest part to sell investors. Instead of choosing a neat little niche market to go after, its founders wanted plunge into the big time: the market for CMOS static and dynamic random-access memories. But investors signed up because Vitelic was also going after some of the fastest-growing niches in that commodity chip business.

While some would call it folly to jump into a market that many larger and more experienced U. S. suppliers have abandoned as unprofitable, Vitelic has demonstrated some initial success in pursuing this strategy. The two-year-old company has already introduced a 64-K DRAM and a 16-K SRAM; now it plans to add 256-K and 1-Mb DRAMs. And it's filling out its line to include application-specific memories, such as video DRAMs, dual-port SRAMs, and content-addressable memories.

"Their strategy is an interesting one," says Edward White, an analyst with E. F. Hutton Inc., New York. "Most people think that the memory market is a commodity business, or at least it will be. But there will be some specific [niche] segments of it." Those segments could be large if only because the overall DRAM and SRAM markets are so huge. Dataquest Inc., the San Jose market researcher, pegs the 1986 DRAM market at $1.78 billion, growing to $5.1 billion by 1990 (see chart). The SRAM market could hit $960 million this year and $2.4 billion by 1990.

AN OPPORTUNITY. Other small companies have targeted application-specific SRAMs, but no one else has set their sights on the application-specific DRAM market, says Michael Stark, an analyst at Robertson Colman & Stephens, a San Francisco investment banker. "There is an opportunity there for them," he says.

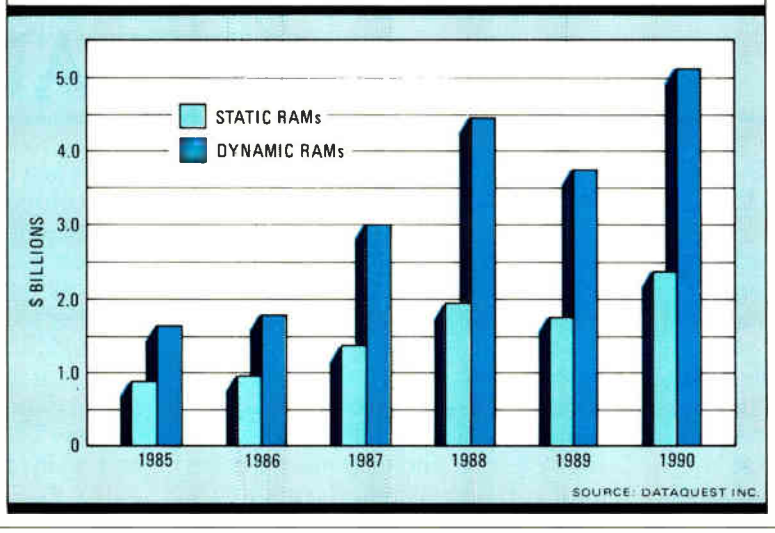
Revenues for the year ended March 31 were disappointing to Vitelic, however. The company generated only about $6 million in revenue, less than half the $14 million that it had initially projected. But it has been profitable for several months and business is picking up; next year, executives predict, there's a good chance of hitting $30 million in revenues, half from sales of their products and half from licensing fees. This kind of profitable performance during an industry recession was good enough for investor Brownstein, who says that "Vitelic was able to make lemonade out of lemons."

Helping Vitelic stay in the black is that "it isn't rushing out to build its own fab line," says E. F. Hutton's White. "That dramatically increases its chances of success [since building one is] way too expensive and they could get bogged down in manufacturing" rather than designing products.

Executives at Vitelic acknowledge this strategy. "There are very valid reasons in the semiconductor industry today for a startup to not build its own foundry," says Jack Ordway, vice president of marketing and sales. "It is more judicious to use your money for non-capital expenses."

Vitelic uses overseas companies to make its products. The first product, introduced a year ago, was a 64-K-by-1-bit

VITELIC: IN PURSUIT OF A GROWTH MARKET



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ripple-mode DRAM made by Taiwan's Electronics Research and Service Organization. Vitelic has also signed manufacturing agreements with Sony Corp. and NMB Semiconductor Co. in Japan and Hyundai Electronics Industries Co. in Korea and is soon expected to add a European manufacturing partner.

THREE GENERATIONS. Vitelic has also brought out 256-K DRAMs, and it has seen silicon on a 1-Mb DRAM. Also on the market are 8-, 16-, and 64-K SRAMs, and military versions of some products are due out later this year. "To our knowledge, we're the only company out there with three generations of CMOS DRAMs," Ordway says. "And in all three generations, we turned silicon in six months from design start."

Analyst Stark sees potential trouble spots in Vitelic's long-distance fabrication plans, however. "I don't see how you can combine one company's design technology and another company's manufacturing expertise and compete with companies that have integrated both operations," he says.

To get around this problem, Vitelic plans eventually to have its own fab line. Construction in San Jose of a large pilot line for 6-in. wafers, capable of producing $100 million to $120 million in annual revenue, could begin within a year. This factory would be particularly useful for supplying the U.S. military market that Vitelic plans to enter later this year. Au expects that even after five years, Vitelic will not be able to make even 20% of its own needs, which is why it signed long-term contracts with its current suppliers.

Vitelic has already signed up one distributor, Pioneer-Standard Electronics Inc. Pioneer-Standard chairman Pete Heller said the Cleveland company is carrying Vitelic's DRAMs because it likes the people at Vitelic and because it needs the products. He admits, though, that "it's too early to tell how successful the parts will be." *–Eve Bennett*

BOTTOM LINES

SUN REPORTS RECORD QUARTER

In its first quarterly report since going public earlier this year, Sun Microsystems Inc. says it chalked up record revenue and profits for the third quarter of fiscal 1986, which ended March 28. The four-year-old Mountain View, Calif., work-station maker says revenue came to $57.6 million, 37% more than the previous quarter and 70% over the comparable quarter of 1985. Profits amounted to $3.4 million, compared with $1.7 million for the previous quarter and $3.3 million for the comparable 1985 period. Those results helped push revenue for the first nine months of fiscal 1986 to $133.4 million, up 71% over the first three quarters of fiscal 1985.

ADAGE GETS AN $8 MILLION CREDIT LINE

Adage Inc., a supplier of computer-graphics work stations, has obtained an $8 million line of credit with the Bank of New England. It says it will use the new credit for near-term working capital needs. The Billerica, Mass., company recently acquired Lexidata Corp., a local maker of computer-graphics products.

SOFTECH ACQUIRES VIRGINIA COMPANY

Softech Inc., the Waltham, Mass., designer and developer of custom software, has acquired AMG Associates Inc., Arlington, Va., in a stock-purchase transaction. No price was specified. AMG designs software for automatic test-equipment systems that are used primarily in commercial and military avionics, propulsion, and navigation systems. It has extensive experience in Atlas, the abbreviated test language that is the international standard language for all ATE applications. It is supported by the Institute of Electrical and Electronics Engineers, and is endorsed by the Defense Department and the North Atlantic Treaty Organization. AMG, founded in 1976, reported revenue of $3.4 million in calendar 1985.

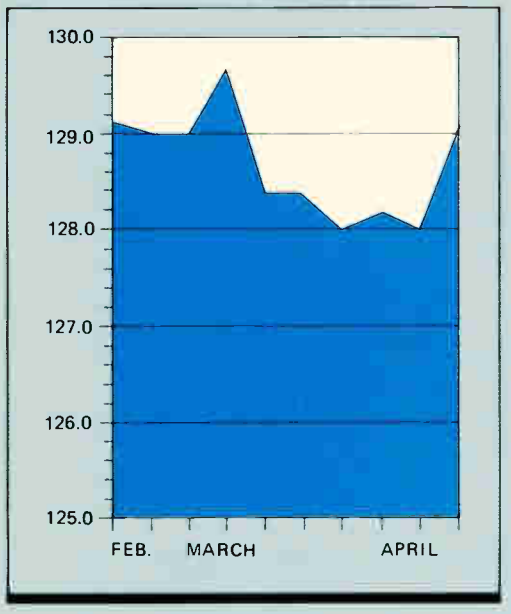
NEW AIDA FUNDING RAISES $6.1 MILLION

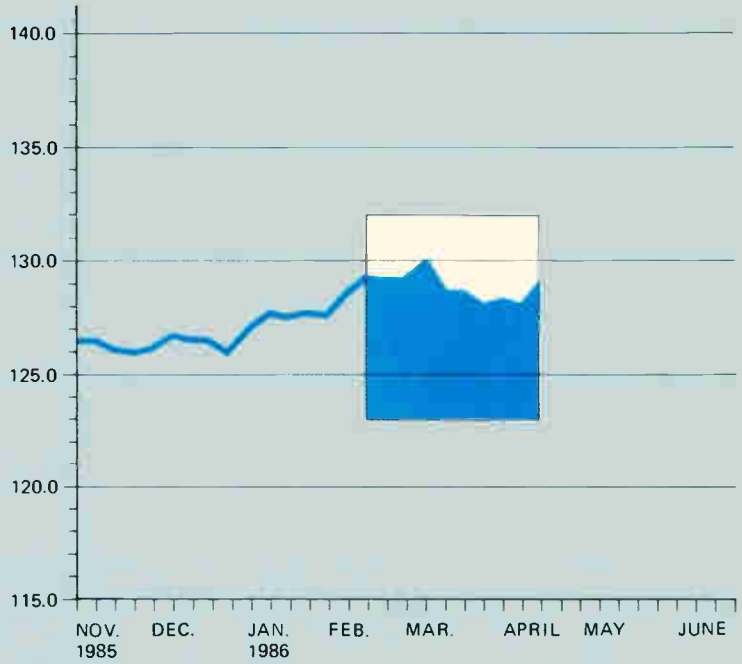
Aida Corp., a Santa Clara, Calif., maker of computer-aided engineering work stations, has raised $6.1 million through a second round of venture financing. The company says this brings to more than $9 million the amount of capital it has raised since its founding in 1984. Aida will use the money to boost its sales and manufacturing operations.

AMERICAN CIMFLEX BUYS LOGITEK

American Cimflex Corp. (formerly American Robot Corp.) has acquired Logitek Inc., a Troy, Mich., maker of advanced control products and systems, for an undisclosed amount. American Cimflex, a privately owned company based in Pittsburgh, makes products and systems for computer-integrated manufacturing operations. The 1986 combined revenues for the two companies are expected to exceed $35 million, versus $17 million last year.

ELECTRONICS INDEX





THIS WEEK	= 129.1
LAST WEEK	= 128.0
YEAR AGO	= 128.4
1982	= 100.0

The *Electronics* Index, a seasonally adjusted measure of the U.S. electronics industry's health, is a weighted average of various indicators. Different indicators will appear from week to week.

U. S. ELECTRONICS SHIPMENTS

Shipments ($ billions)	February 1986	January 1986	February 1985
Communications equipment	5.420	4.728	5.134
Radio and TV receiving equipment	1.022	1.017	0.952
Electronic and electrical instruments	4.783	4.842	4.784
Components	3.308	3.100	3.401

Shipments of domestically manufactured electronic goods surged upward by 6.2% in February, and this performance propelled the *Electronics* Index up nearly 1% last week to its highest level in over a month. Except for manufacturers of electronic instruments, whose shipments dropped 1.2% in February, all sectors of the domestic industry enjoyed a share of February's increase. The most vibrant performer was the communications-equipment sector, which saw its shipments explode by 14.6%.

But it was not enough to offset January's 19.3% drop in shipments. As a result, manufacturers' sales for the month remained at a level nearly 8% below those at the end of December. And from February 1985, sales of U. S.-made communications equipment advanced 5.5%—meager in comparison with some of the strong gains recently achieved by the industry.

Though February's gain represented the strongest monthly increase in shipments in over a year, the advance came on the heels of an 8% plunge in January for sales by manufacturers [*Electronics*, March 17, 1986, p. 61]. As a result, shipments by U. S. suppliers are at their lowest point since last October. And overall shipments were up from 12 months ago by only 1.8% in the month.

With February's 6.7% burst in component shipments, U. S. component makers appear to be set more securely on the road to recovery as orders from equipment makers start to trickle down. Not only did February mark the second consecutive month of rising sales by manufacturers, following January's 0.6% advance, but it was also the fourth month in the past five that the industry increased its components shipments.

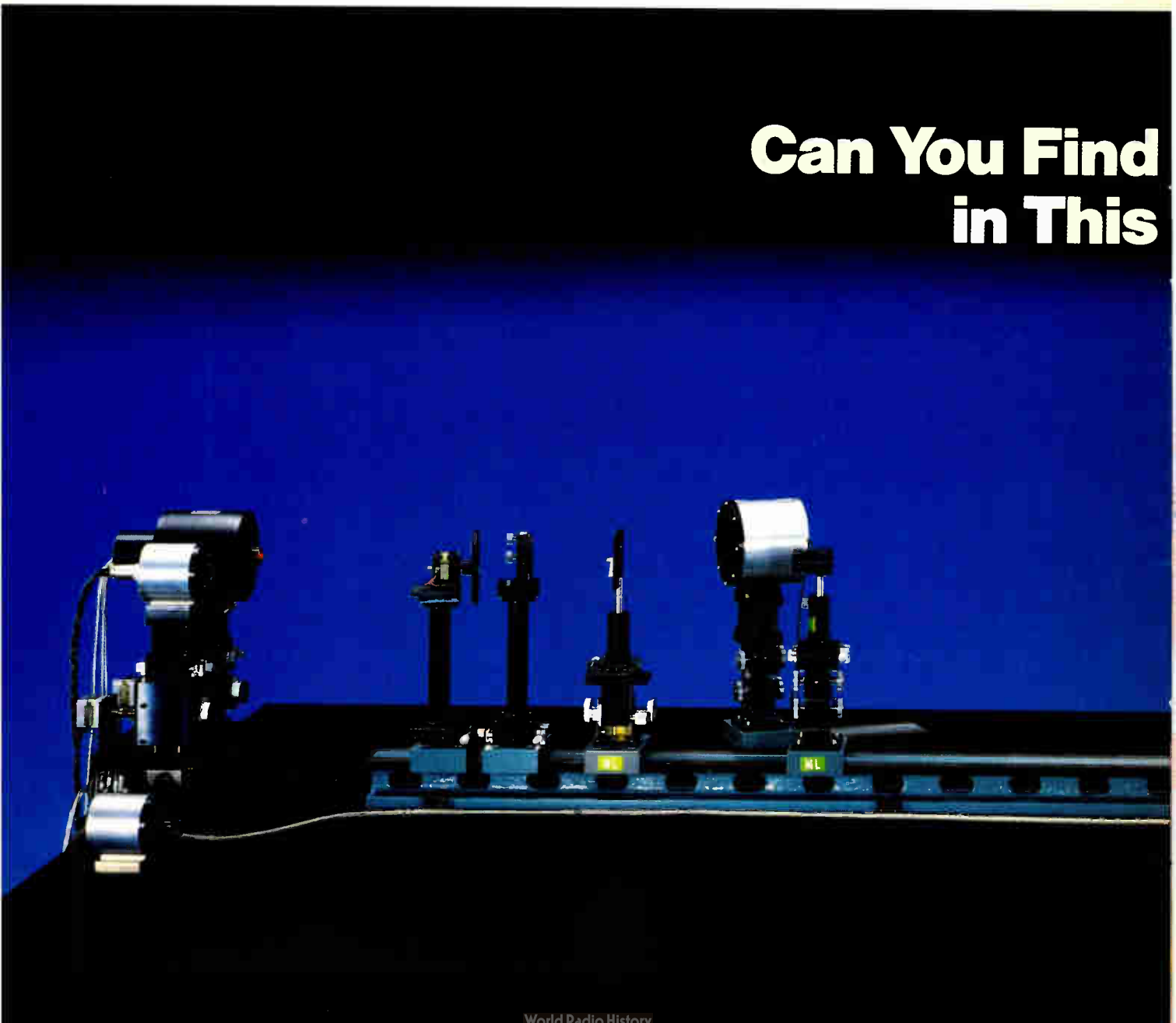
The industry's pickup in business was also reflected in the latest book-to-bill ratio, which rose to 1.15 : 1, its highest level in 21 months [*Electronics*, April 14, 1986, p. 64]. Semiconductor shipments in February reached their highest point since last June, but the industry has some ground to make up because shipments are still off by almost 3% from the level of a year ago.

For domestic producers of consumer electronic equipment, business continued to be erratic. Shipments in February rose 0.5%, following January's 1.8% decline. This most recent gain brought industrywide shipments to a level 7.5% higher than 12 months ago.

The instrument sector was the weakest performer in February. The month's 1.2% decrease in shipments came in the wake of January's 0.9% slip. As a result, instrument shipments by U. S. manufacturers are slightly below those of February 1985.

Yes, there is actually a laser here.
You just can't see it.
Because it's located in the Anritsu Optical Calibration Laboratory.
Now, if you're reading this in an ordinary home, office or factory, there are probably thousands of microscopic particles — dust, smoke, oil, etc. — in the air between you and this page.
And if you aimed a laser beam through *that* air, you'd probably see it. Because the beam would strike enough dirt and smoke and grime to make it visible.
But the environment in our Calibration Laboratory is carefully filtered and climate-controlled. So only a fraction of those particles remain.
That's why you can't see the laser beam here: because there's almost nothing but pure air to deflect it.
Nothing to diffuse the beam and reduce its power as it travels to its target. Nothing to make it anything less than a perfect source of light for calibrating optical standards.
Which means that each of the standards we use for checking out our optical products is just that much more accurate.
That translates into more accurate measuring instruments for fiber optic communications. More accurate optical spectrum

Can You Find in This



analyzers and optical time domain reflectometers. More precise optical power meters — the list goes on and on.
The Optical Calibration Laboratory is just one example of how Anritsu works to ensure the highest possible accuracy and reliability. In fiber optics, in radio and telecommunications equipment, in communications test instruments, in computers and data processing gear — in fact, in every single one of our more than 11,000 products and systems.
The right answer is always at Anritsu. Even if it's not immediately visible.

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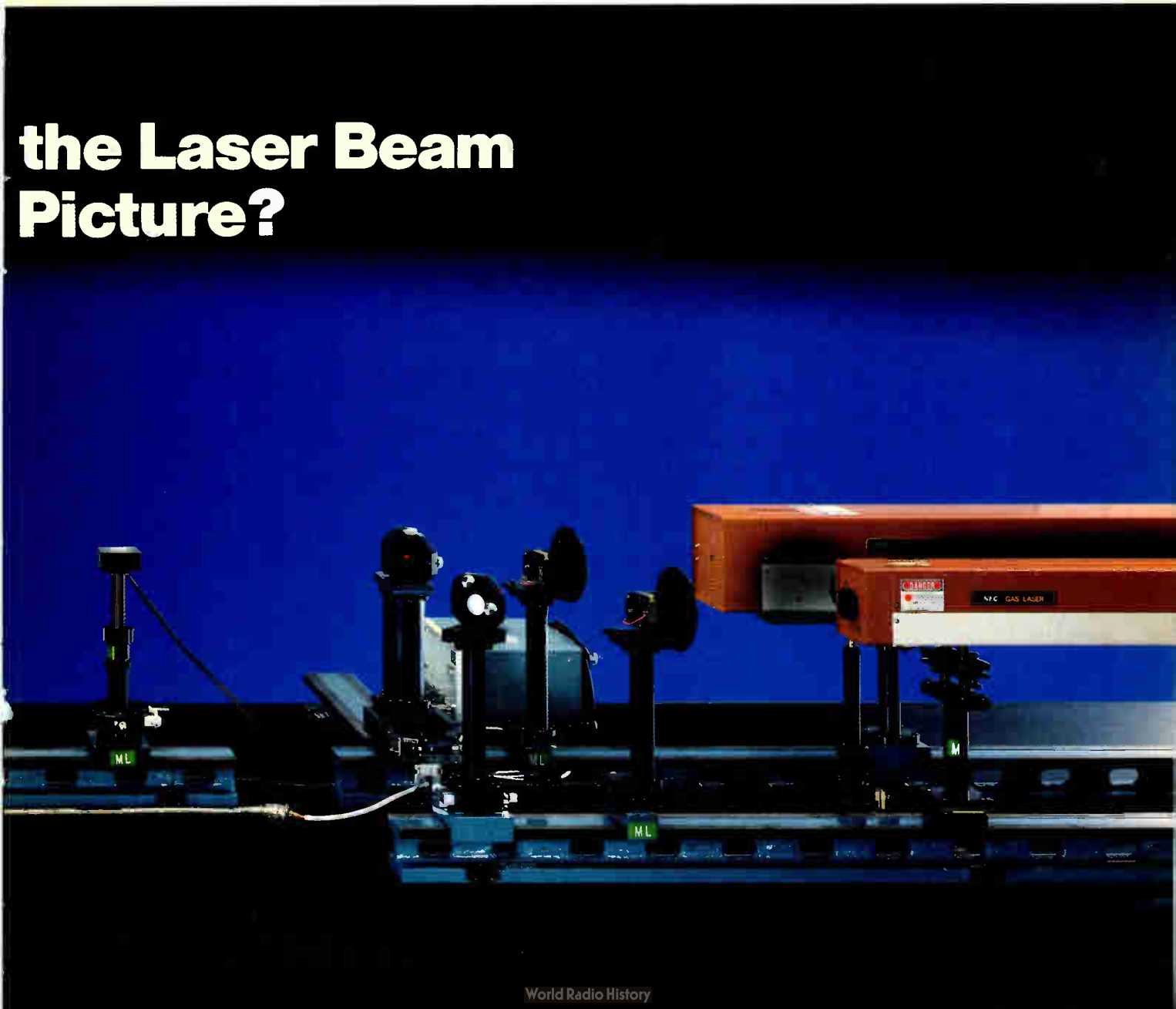
WE'RE ON THE MOVE. WORLDWIDE.

ANRITSU CORPORATION
10-27, Minamiazabu 5-chome, Minato-ku, Tokyo 106, Japan.
Phone: Tokyo 03-446-1111, Telex: 0-242-2353 ANRITU J

As of October 1, 1985, Anritsu Electric Co., Ltd. became Anritsu Corporation.

Circle 71 on reader service card

the Laser Beam Picture?



WHY DON ANSELMO LEFT AT&T AFTER 29 YEARS

CARROLLTON, TEXAS

After working for nearly three decades at AT&T Co., Donald R. Anselmo surprised fellow workers recently by suddenly resigning to join a four-year Texas startup called Mitek Systems Corp. as president and chief operating officer.

But his reason seemed quite simple: Anselmo, 50, had gotten hooked on startup ventures during his wide-ranging career at the communications giant and its research arm, Bell Laboratories. "I think I got the [the entrepreneurial urge] in about 1981," he says.

DONALD R. ANSELMO: His move shows he has caught the entrepreneurial bug.

At the time, he was heading a new strategic group in AT&T set up to commercialize the 3B minicomputer line. "Building a computer business within AT&T was like an entrepreneurial startup," Anselmo notes. "But instead of talking to venture capitalists or banks, we had to go to corporate for money." After launching the 3B line two years ago, he saw it grow from tens of millions of dollars in annual unit sales internally to hundreds of millions in total system sales outside the company.

"I have often told people if we were venture-funded and if we could have taken it public, we would have had a pretty good case," recalls Anselmo, puffing on a cigar in his new office at Mitek. "People might argue that the 3B computer business was protected within the womb of AT&T, but sometimes that womb was a tougher place than the outside world."

Anselmo's experience with AT&T's 3B minicomputer will be a big help at Mitek. He's now getting ready to go commercial with Mitek Systems, taking it from the stable internal world of product development to the topsy-turvy market for large computer networks. The Texas company, which incidently is 32% owned by AT&T, will introduce its new product line this spring: a family of Multibus-based, high-speed channel processors enabling a variety of computers and local-area networks to hook up to mainframes from IBM Corp. (see story, p. 74).

His training and initial experience was strongly technical. He joined Bell Laboratories in Whippany, N. J., after getting his BSEE from Virginia Polytechnic Institute in 1957. He earned an MSEE at New York University in 1959, and completed the Bell Laboratories Communications Development Training Program.

But in 1962, along with about 50 other researchers, Anselmo was chosen as one of the first employees of Bellcomm. The company was being formed in Washington at the request of the National Aeronautics and Space Administration to conduct system engineering and planning for the Apollo space program, which was just getting off the ground.

'SOMETHING SMALL.' The new company helped launch not only the American moon landings but also Anselmo's interest in startups. "I viewed it as an opportunity to get into something small, which I had always kind of liked," says the native of Washington. Anselmo was responsible for design of flight trajectories, lunar landing-site selection, and guidance and navigation studies—all analyzed by computer simulations. After Americans put a man on the moon, Bellcomm began phasing down, and Anselmo moved back to Bell Labs to develop a submarine cable system.

In 1977, he began his involvement in AT&T's computer thrust as director of Bell's Interconnection Laboratory in Whippany. The lab created packaging technology for multilayer printed-circuit boards, connectors, backplanes, surface-mounted components, and computer-aided design tools. Many of the packaging standards and designs became part of AT&T's 5ESS transmission switching system and 3B computer line.

In 1981, he was named to head the new AT&T group set up to commercial-

PEOPLE ON THE MOVE

BETSEY BLAKESLEE

☐ US West Inc. has renamed its Comm+ Systems subsidiary in Seattle and named Betsey Blakeslee as president of what will be known as the Network Systems Division. Blakeslee had been president of her own consulting firm, the Blakeslee Advisory Group, in Denver. Before that, she was with Boston's Towers, Perrin, Forster & Crosby.

ART STABENOW

☐ Moving from his spot as senior vice president of National Semiconductor Corp.'s Analog Components Group, Art Stabenow has become president and chief executive officer at Micro Linear Corp., San Jose, Calif. Prior to his seven years at National, Stabenow held a variety of management positions, including vice president of operations at Monolithic Memories Inc.

JOSEPH S. MATHIAS

☐ The new vice president of research and technology at Sperry is Joseph S. Mathias. He will be responsible for identifying and evaluating future computer technologies as well as coordinating research and development at Sperry Corporate Technology Centers with Microelectronics and Computer Technology Corp. Mathias joined the Blue Bell, Pa., Sperry Corp. subsidiary in 1959 as a supervisor in the Research Department's Advanced Materials Section. He also has held several management positions in production, research, and technology development.

JOHN CAMERON

☐ Taking the post of president at NBI Canada Inc., Toronto, will be John Cameron. He leaves his job as national manager of parent company NBI Inc., a Boulder, Colo., manufacturer of office-automation and technical computing systems. Cameron had served as national manager for the company's Canadian offices since joining NBI in 1984.

THOMAS N. KERN

☐ Sloan Technology Corp., a manufacturer of computer-based measurement and control instrumentation for thin-film applications, has appointed Thomas N. Kern president, chief operating officer, and a director. He succeeds David Shiffman, who died in January. Kern, 50, joined the Santa Barbara, Calif., company in June 1981 as vice president of finance and became chief financial officer in October 1982. He was appointed executive vice president and temporary COO in addition to his other responsibilities in August 1985. Kern came to Sloan after 23 years in various management positions with General Electric Co.

RICHARD R. MILLIGAN

☐ Calay Systems Inc., a maker of automated design systems for printed-circuit-board layout, has named Richard R. Milligan vice president of operations. He will oversee the Irvine, Calif., company's product development and manufacturing operations. Milligan comes to Calay from Systems Industries, Sunnyvale, Calif., where he served as senior vice president of operations.

ize the 3B line. This group formed the nucleus of what became the Computer Systems Division of AT&T Technologies Inc. After serving as director of marketing and engineering, Anselmo a year ago became head of an independent business unit that coordinated AT&T's product lines with a growing base of third-party startups, from which he first encountered Mitek.—*J. Robert Lineback*

TSENG SEES PERIL IN HYPING OF AI

CALABASAS, CALIF.

David Y. Tseng sees himself as a true believer in the real potential of artificial intelligence. But now he's beginning to worry about what's happening within this burgeoning—but sometimes baffling—technology. "The big danger is people overselling it," Tseng says, predicting that this hype, if it continues, will quickly result in inflated expectations, disillusionment, loss of interest, and a setback to development.

Tseng is not just your ordinary casual observer. He has a fine view of what's happening in the AI world: he heads Hughes Aircraft Co.'s Artificial Intelligence Center. He is convinced that more time is needed to implement practical applications of AI principles than most users are led to believe. But solid applications will emerge in the next few years, Tseng predicts, because the tools that AI entrepreneurs are now delivering to their customers are first-rate.

PROVEN IN PRACTICE. Tseng, who holds a PhD in electrophysics from Brooklyn Polytechnic Institute, has been at Hughes his entire career, joining the Research Laboratories in 1970. He believes that knowledge bases and expert systems must steadily emerge from the operations of major companies during the remaining years of this decade—and starting fairly soon—to demonstrate that AI is a mainstream technology. Otherwise, he says, "our credibility is an issue."

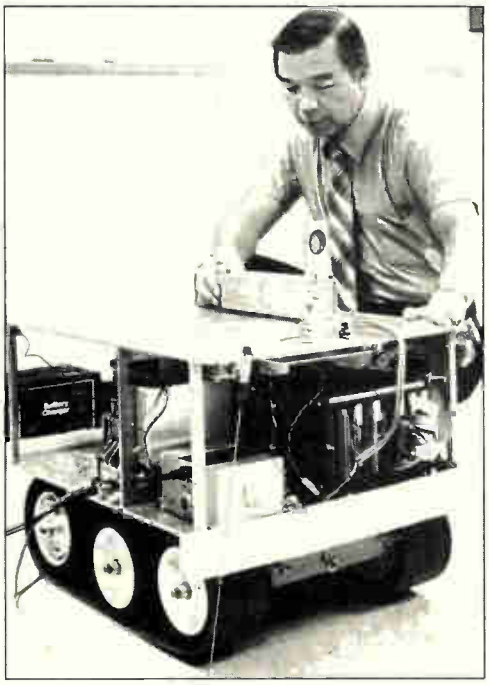
Tseng, 47, has been a hands-on AI practitioner for years, working on the groundbreaking algorithms that supported Hughes's automatic target-recognition systems in the 1970s. But as successful as they proved, algorithms are "too inflexible without the interactive features of AI," he says.

So in his role as head of the Exploratory Studies Department at the Malibu Research Laboratories, he pushed Hughes to lead the pace of development. His advocacy was a big factor in getting the lab's officials to spin it off in 1984, to allow Tseng to head it, and to move the center to the new Calabasas site on the western fringe of Los Angeles.

The center, which evaluates new AI hardware and software, also pushes basic long-range research and works on applications with both Hughes and outside customers. "We're the core of AI research at Hughes, available for consulting and advice," he explains. "But we don't try to influence every AI decision." Not that he could—in the $6 billion company, most groups have their own efforts under way. Tseng's toughest problem is distributing and exchanging technology, so he has come up with a different way to go about it. Groups send in people to work side by side with AI specialists for months on a project.

At the Hughes AI Center, which is just beginning its third year as a separate entity of the company's Research Laboratories Group, the activity is heating up on an array of tough problems posed by customers. Developing systems that use ultrasophisticated gear to replace human judgment with computer-vision techniques is at the top of the list of projects, most of which are tied to military contracts. "We're dealing with by far the most difficult applications in AI," says Tseng.

To handle the work flow, Tseng supervises 25 professionals—and this staff is growing. But fulfilling that need for talent is a headache, notes Tseng. Applying AI in a practical systems-oriented environment seems to require more than a pure computer science background, he says. —*Larry Waller*



DAVID Y. TSENG: There's no need for hype in selling the advantages of artificial intelligence.

NEW PRODUCTS

MODULAR POWER SUPPLIES SLASH PRODUCT DESIGN TIME

ULVECO'S EUREKA LINE WILL BE STOCKED IN WIDE RANGE OF RATINGS

All too often, system designers leave the power supply for last when they're working on a new product. Then they have to scramble to design one that not only has enough power and the right number of outputs but also conforms to international specifications.

Ulveco's answer is Eureka, a modular system with which designers can rapidly tailor a supply to equipment requirements in a matter of days. In addition, the company claims the supplies will conform to specifications of the Canadian Standards Association, Federal Communications Commission, Underwriters Laboratories, and VDE for electrical safety and radio-frequency interference.

At the heart of the system are compact secondary-regulator modules that operate from low-voltage ac input. These ac voltages are isolated from the power line by toroidal power transformers. Available with 115-, 230-, or 115- to 230-V primaries, these transformers are listed as recognized components by most standards agencies in North America and Europe, including UL, CSA, and West Germany's VDE. Transformers are available with various combinations of isolated secondary windings to match the quantity and types of regulator modules selected.

TIME SAVER. Two additional components make up the Eureka system—an input filter module and an L-shaped, open-frame, or closed-mounting chassis. All modules are available from stock in a variety of output-voltage and current ratings, saving design and assembly time.

A typical 100-W power supply with four fully regulated outputs would cost about $220. This is more than twice the $1/W ratio for which most engineers aim, but the company says shorter design time and instant agency approval make up for the higher cost. The semicustom approach is also cost-effective for prototypes and quantities in the hundreds or thousands, Ulveco says.

The Eureka system includes modules for switched-mode and linear regulators. Switched-mode modules are aimed at applications where wide swings in input voltage are expected and where high output power and low temperature rise are critical. Linear modules suit lower output-power requirements and stable input voltages.

MIX AND MATCH. In a matter of days, system builders can design a power supply that meets a variety of worldwide standards.

In either case, the modules dissipate 8 W when used with a heat sink. Overvoltage, overtemperature, and short-circuit protection are standard features on both types.

Eureka's rfi line-filter modules conform to VDE 0871B and the FCC's 20780B standards. The input filter modules are also available with hardware to connect to ac lines, such as power and voltage-selection switches, fuse, and line-cord socket.

Completing the system is the mounting hardware. Black aluminum L-frame chassis come in sizes that accommodate two, three, or four power modules, the transformer, and a line-input filter module. The L-frame also serves as a heat sink. Optional metal covers reduce radiated rfi and protect service personnel and the end user from contact with hazardous line voltages.

An added benefit of Ulveco's custom approach is that the power-supply modules can be distributed throughout the piece of equipment when space for a central supply is unavailable. The company also points out that the regulator modules alone can be used as supplementary or booster regulators when the power supply in an existing piece of equipment is overtaxed.

The components will be available in early May. In lots of 100 pieces, the switched-mode module costs $50, and single- and dual-output linear modules cost $40 and $45, respectively. A 160-VA rfi line-filter sells for $30 and the transformers range in price from $20 to $45, depending on the number of outputs. *–Steve Zollo*

Ulveco Inc., 323 Vintage Park Dr., Foster City, Calif. 94404. Phone (415) 574-1100. [Circle reader service number 338]

LINK TIES NON-IBM GEAR TO IBM HIGH-SPEED CHANNEL

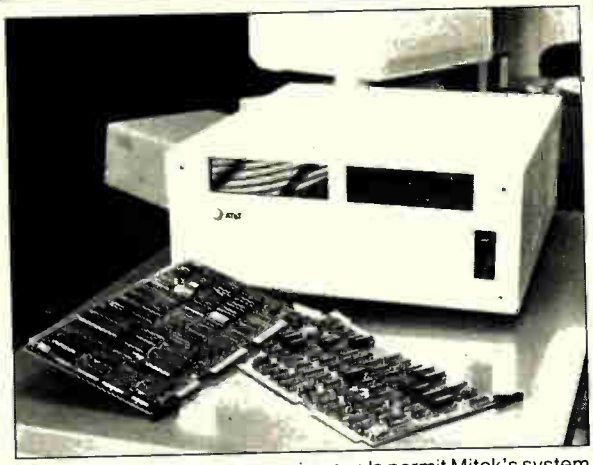
Mitek Systems' flexible interface processor lets users connect a variety of non-IBM gear directly to an IBM Corp. mainframe's high-speed internal channel. With the series 2000, users can attach plotters, peripherals, local-area networks, and the like to IBM hosts under operating-system environments such as MVS/SP, VM/CMS, and DOS/VSE.

The company has married its bit-slice-based channel-processor architecture to the flexible back end of a Multibus I card cage. Standard Multibus expansion cards and software can adapt the mainframe-channel link to a wide range of emerging LANs and non-IBM hardware, such as those running AT&T Bell Laboratories' Unix operating system. The bit-slice-based hardware and Mitek's channel-processor operating system

work together to provide data rates of up to 1.8 megabytes/s.

Mitek's series 2000, which will be available in June, will initially support direct-channel attachments of Ethernet-based LANs to IBM hosts. An M2100 system will also support remote connections to IBM and plug-compatible hosts through a 56-kb/s connection to a Synchronous Data Link Control interface.

"We are covering the majority of the LAN technologies this year," says Tom Butts, vice president of development. These will include the Transmission Control Protocol/Internet Protocol, X.25, and XNS. In the long term, Mitek will also provide support for token-ring and -bus networks, says Butts. AT&T Co. is using one configuration of the series 2000 to offer IBM mainframe connectivity for its Ethernet-based 3B network [*Electronics*, March 24, 1986, p. 13].



ADAPTABLE. Multibus expansion cards permit Mitek's system to link a wide range of non-IBM gear to IBM mainframes.

TWO CARDS. In addition to fully configured systems, Mitek has begun shipping an M1010 system that contains the basic channel-processor boards and four unused Multibus slots for custom configuration by system integrators. The M1010, series 2000, and a series of board-level IBM interfaces for OEMs are all based on a two-card channel processor. The two-card set provides software to run Systems Network Architecture protocols and a direct physical attachment to the IBM mainframe.

The channel-interface processor is based on two 2901 bipolar bit-slice chips from Advanced Micro Devices Inc. One Multibus card contains the processor's microsequencer and status presentation on the IBM channel. A second card performs direct-memory-access transfers between the channel and the system's random-access memory.

A third Multibus card, based on a Motorola Inc. 68000 microprocessor, handles high-level protocol conversions and controls the user interfaces. The Mitek channel processor's event-driven, multitasking operating system is stored in ROM. The real-time operating system controls the data flow between the IBM host channel and user interfaces.

A simple channel protocol is used to avoid the unnecessary overhead of attention interrupts or polling. The protocol conversion is transparent to the IBM host and application software as well to the applications running on the attached devices. No modifications are required to the IBM host operating systems.

Options for the series 2000 include an SNA3270 terminal emulator for file transfers and application program interfaces as well as SNA3770 emulation for remote job entry. The 2000 will support up to 64 logical units simultaneously.

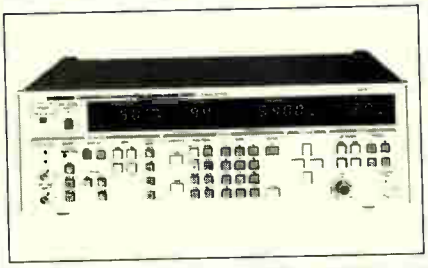
The 2000 sells for $24,000 for the SNA channel system and for $18,000 for the 56-kb/s remote link to an SDLC connection. A three-board set for systems integrators will sell for $13,000. The Mitek 1010 is still available for $20,000. —*J. Robert Lineback*

Mitek Systems Corp., 1303-B Marsh Lane, Carrollton, Texas 75006.
Phone (214) 242-8277 [Circle 339]

SIGNAL GENERATOR CHECKS AM STEREO

The LSG-245 AM stereo synthesized-signal generator was developed for Motorola Inc.'s C-Quam, the leading AM stereo system. The instrument operates over the entire AM band as well as in the intermediate-frequency range, functioning as a signal source for sensitivity, channel separation, selectivity, and distortion measurements.

The user enters all parameters from the front panel. The signal generator will store up to 100 sets of user-defined test conditions—frequency, output, and modulation. For fully automated environments, front-panel functions are controlled remotely with a rear-panel connector; a General Purpose Interface Bus is optional.

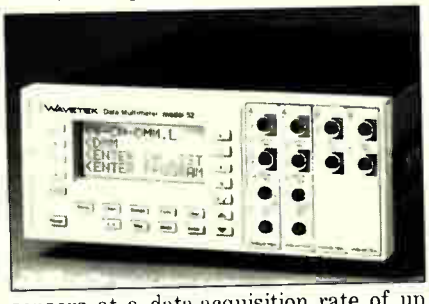


Delivery of the instruments is from stock. The LSG-245 is priced at $3,850.
Leader Instruments Corp., 380 Oser Ave., Hauppauge, N. Y. 11788. Phone (800) 645-5104; in New York State, (516) 231-6900 [Circle 352]

DATA MULTIMETER FITS IN 360 CU. IN.

The model 52 data multimeter offers the functions of a digital multimeter, data-logging and acquisition system, and process controller in a box that measures 3.5 by 8.5 by 12.1 in. Custom gate arrays and surface-mount technology have cut back on overall size; soft keys reduce panel space by trimming the number of keys required.

The model 52 handles up to four plug-in modules. In the optional multiplex mode, each plug-in can handle up to 60



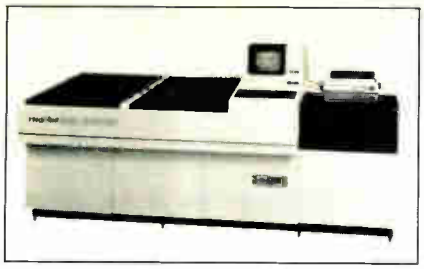
sensors at a data-acquisition rate of up to 40 data points/s. Resolution is to six digits, sensitivity to 1 μV, and accuracy to within 0.04%.

The multimeter's small size makes it useful for field testing, and its price is less than $3,000. A remote-only unit, the model 51, is lower in price, and units are available now.
Wavetek Corp., 9191 Towne Centre Dr., Suite 450, San Diego, Calif. 92122.
Phone (619) 450-9971 [Circle 353]

SYSTEM TESTS PC BOARDS FOR LEAKS

The Probot Series Six, a fixtureless test system for bare pc boards, now offers an option for leakage testing in the 1,000-V 500-MΩ area. The test system is based on two X-Y probes that test points as close together as 0.01 in. on a 24-by-27-in. board at a rate of 600 points/min. The Probot's programmable functions measure resistance between nets, test for continuity or discontinuity, and verify the presence of screened-on components.

Features of the Probot Series Six include the two servo-driven probes, a 16-bit expandable computer, printer, display, and RS-232-C port. An IEEE-488 port and paper-tape reader are optional.



The price of a system is $75,000, and the company will work with the customer to develop custom test applications. Systems are available now.

Owl Electronic Laboratories Inc., Pequot Industrial Park, Westbrook, Conn. 06498. Phone (203) 399-5951 [Circle 350]

UNIT CAN TEST 110 BOARDS BY ITSELF

A new autotransport mechanism distinguishes Integri-Test 4600, a fixtureless bare-board tester, from earlier models in the series. The unit tests a 7-in. stack—about 110 boards—with no supervision. Boards are handled individually using vacuum cups, and the stacking area can be detached for use with a conveyor line.

Integri-Test systems can test holes spaced up to 25 mils apart on boards measuring 24 by 24 in. at a rate of 350 points/min. The moving, computer-controlled probes check for short circuits, open circuits, and high-resistance leakage and can incorporate a high-speed autoranging resistance meter with a range of 0.01 Ω to 1 MΩ.

The introductory price for Integri-Test is $160,000 and delivery time is four to six months.

Kollmorgen Corp., Electronic Equipment Division, 320 S. Service Rd., Melville, N. Y. 11747. Phone (516) 420-4080 [Circle 351]

CARD ADDS MEMORY, PORTS TO THE PC AT

A new multifunction expansion board from Ide Associates adds up to 4 megabytes of RAM to the IBM Corp. Personal Computer AT for such data-intensive applications as large spreadsheets. The Supermax/EMS also includes two serial ports and one parallel port.

The system's memory is compatible with software applications written to expanded-memory specifications from Intel, Lotus, and Microsoft. Supermax/EMS software can also be used to create a virtual disk in PC-DOS, allowing the user to store files in the system's memory as if it were a disk. The software includes a print-spooling function, which uses the expanded memory to aid in printing large files.

The base board can be configured from no memory up to 1.5 megabytes. With a piggybacked daughter board, random-access memory can be increased up to 4 megabytes.

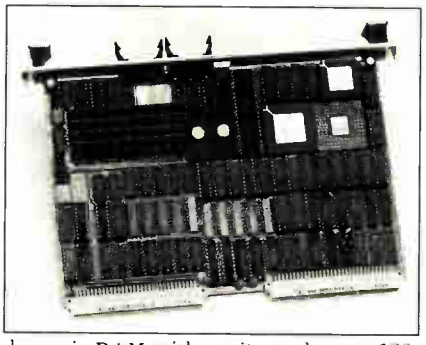
Prices for the Supermax/EMS range from $495 for a bare board to $2,595 for the 4-megabyte version.

Ide Associates Inc., 35 Dunham Rd., Billerica, Mass. 01821. Phone (617) 663-6878 [Circle 361]

32-BIT COMPUTER USES NO WAIT STATES

The HK68/V20 32-bit microcomputer is aimed at real-time applications and offers speeds up to 24 MHz or at 12.5 MHz with no wait states. The 68020-based board is designed for Unix development; it is supported by a number of operating systems derived from Unix System 5.2.

The computer's memory includes up to 1 megabyte of on-board dual-access



dynamic RAM with parity and up to 128-K bytes of EPROM. Other features are a high-speed memory-expansion bus, mailbox interrupts, and full master-slave interface to the VMEbus with 32-bit data path and 32-bit addressing.

A paged memory-management unit and on-board floating-point coprocessor are optional for the HK68/V20. Prices start at $3,595; delivery takes two weeks.

Heurikon Corp., 3201 Latham Dr., Madison, Wis. 53713. Phone (608) 271-8700 [Circle 359]

SCSI CONTROLLER COMES READY TO RUN

The TMC-820 host adapter card for the Small Computer System Interface has firmware for "plug and play" installation in a short slot of an IBM PC. It has no switches and does not require any additional software. The adapter connects with Seagate and Rodime embedded disk drives and with Teac tape drives.

The price is $99, and small orders will be shipped from stock. Large orders require 30 to 45 days.

Future Domain Corp., 1582 Parkway Loop, Suite A, Tustin, Calif. 92680. Phone (714) 259-0400 [Circle 360]

256-K EEPROM WRITES BYTES QUICKLY

A 5-V-only 256-K EEPROM, the model 28C256 uses the company's oxynitride CMOS process and Q-cell design for high write/erase cycle endurance. In page-write mode, its effective write time is 160 μs for a 64-byte page. In byte-write mode, the speed is 2.5 μs per byte, which the manufacturer says is four times faster than the industry standard.

The 28C256 features automatic byte-erase-before-write and an on-chip timer plus internal latches. Endurance is specified at 10,000 cycles per byte, although actual performance is expected to surpass this.

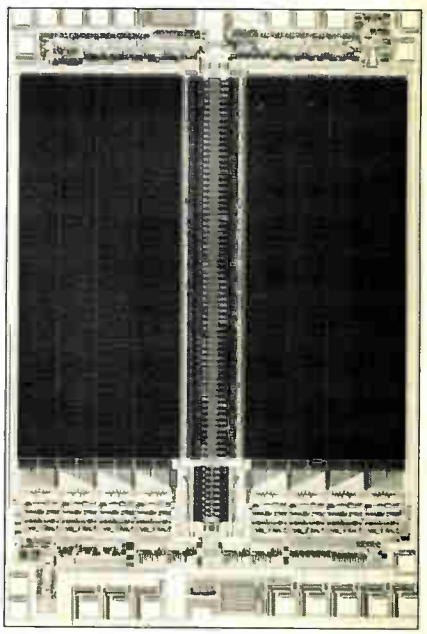
Samples are available now in a 28-pin Cerdip and 32-pin leadless chip carrier. In quantities of 100 or more, the 28C256 will sell for $195.

Seeq Technology Inc., 1849 Fortune Dr., San Jose, Calif. 95131. Phone (408) 942-1990 [Circle 354]

FAST 64-K CMOS EPROM USES 20 mA IN STANDBY

The CY7C261, a half-power 8-K-by-8-bit CMOS PROM, consumes just 100 mA and, with its auto power-down feature, reduces consumption to 20 mA in standby. And it does not sacrifice speed—the memory's maximum access time is 35 ns.

In a windowed Cerdip, the memory is ultraviolet-erasable and reprogrammable, with a floating-gate technology that lets the user program all cells, test for data retention, then erase prior to encapsulation. All cells are 100% tested. Claimed to be simpler and more cost-effective than bipolar processes, the



floating-gate technology uses 13 mask steps, compared with as many as 16 layers for bipolar processes.

Available in 300-mil, 24-pin standard plastic packages, the CY7C261 costs $75 each in hundreds for the commercial temperature range, or $120 in windowed Cerdip. Military versions are also available, and delivery is from stock in quantities of 1,000 to 5,000 pieces.

Cypress Semiconductor Corp., Product Marketing Department, 3901 N. First St., San Jose, Calif. 95134.
Phone (408) 943-2666 [Circle 355]

INTEL 80386 GETS DEBUGGING SOFTWARE

For developers rushing to market with products using the 80386 32-bit microprocessor, Intel has released the ES version of its Pscope-Monitor 386 debugging software. The ES version is an early engineering unit; registered purchasers will get the full-featured production version free as soon as it is released.

The P-Mon386ES includes host software that runs on an Intel System 286/310 using the Xenix 3.0 operating system. Users download programs into the target prototype memory, set hardware and software breakpoints, examine and modify memory and processor registers, and control program execution.

P-Mon386ES is available now for $3,495. The production version will run on an IBM Corp. Personal Computer AT.
Intel Corp., Literature Dept. W290, 3065 Bowers Ave., Santa Clara, Calif. 95051 [Circle 362]

GRAPHICS TOOL FOR UNITS RUNNING HP-UX

HP-GKS is a graphics library for HP 9000 technical computers and graphics peripherals running under HP-UX, Hewlett-Packard's version of AT&T Co.'s Unix operating system. It is a tool for applications developers working on drafting, process control, mapping, simulation analysis, and presentation graphics. They can use any HP 9000 hardware without writing special programs.

With HP-GKS, the application can draw up to 50,000 vectors per second on high-performance displays. Available output primitives are polyline, text, cell array, and fill area. Segment operations can be used to create, copy, associate, and delete segments.

HP-GKS for the HP 9000 Series 200/300 is $1,000; for the HP 9000 Series 500, it is $3,000. Both are available eight weeks after receipt of order.
Hewlett-Packard Co., Inquiries Manager, 1820 Embarcadero Rd., Palo Alto, Calif. 94303 [Circle 363]

MEETINGS

VLSI SYMPOSIUM TO HIGHLIGHT SUBMICRON WORK

More emphasis than ever will be given to the latest developments in 0.5-μm-and-below technology at this year's Symposium on VLSI Technology. Mark Reed, a researcher at Texas Instruments Inc., will give a paper on very large-scale integration of quantum-well devices, describing how a well can be made to store a small charge and allow very high-density functions.

Also, a paper from Mitsubishi Electric Corp. will discuss a high-throughput X-ray lithographic system for 0.3-μm devices. And in the memories session, a paper from Hewlett-Packard Co. will describe a 0.5-μm 16-K static random-access memory that boasts a 7- to 9-ns access time.

In all, the collection of papers to be presented at the San Diego meeting on May 28-30 "represents good progress on a broad front in circuit technology," according to meeting chairman Lewis M. Terman, VLSI engineering manager at IBM Corp.'s Thomas J. Watson Research Center. Sessions will cover interconnection, lithography, memories, MOS and bipolar devices, process technology, and reliability. A move to "better ways of using existing material" rather than develop new materials for interconnections will be reflected at that session, Terman says. A Hitachi Ltd. paper will compare titanium silicide with tungsten silicide for submicron CMOS devices.

Two committees, one from the U.S. and one from Japan, selected papers this year; the aim was for a 50-50 balance, Terman says. The symposium, he adds, tries to demonstrate a "willingness to exchange information equally" between the U.S. and Japan.

Semicon West '86 Standards Meetings, Semiconductor Equipment and Materials Institute Inc. (625 Ellis St., Suite 212, Mountain View, Calif. 94043), San Francisco Airport Marriott Hotel, May 19-22.

Distributed Computing Systems, IEEE Computer Society (William C. McDonald, System Development Corp., 4810 Bradford Blvd., Huntsville, Ala. 35805), Hyatt Regency Cambridge, Cambridge, Mass., May 19-23.

Naecon '86, IEEE (Naecon '86, 110 E. Monument, Dayton, Ohio, 45402), Convention Center, Dayton, May 19-23.

Computer Standards Conference, IEEE Computer Society (1730 Massachusetts Ave., N. W., Washington, D. C. 20036), Renaissance Hotel, San Francisco, May 20-22.

International Symposium on Multiple Valued Logic, IEEE (Joseph G. Tront, Department of Electrical Engineering, Virginia Polytechnic Institute and State University, Blacksburg, Va. 24061), Virginia Polytechnic Institute and State University, Blacksburg, May 26-28.

Automach '86, Robotics International *et al.* (Society of Manufacturing Engineers, 1 SME Dr., Dearborn, Mich. 48121), Hilton International Sydney, Sydney, Australia, May 26-30.

Information and Telecommunications Trends and Directions, Electronic Industries Association (2001 Eye St., N. W., Washington, D. C. 20006), Sheraton Islander Inn and Conference Center, Newport, R. I., May 27-29.

Frequency Control Symposium, IEEE and U. S. Army (Systematics General Corp., Brinley Plaza, Wall Township, N. J. 07719), Dunfey City Line Hotel, Philadelphia, May 28-30.

Symposium on VLSI Technology, IEEE and Japan Society of Applied Physics (Moiz M. Beguwala, Rockwell International, Semiconductor Products Division, 4311 Jamboree Rd., Newport Beach, Calif. 92660), Hotel Inter-Continental, San Diego, May 28-30.

High Frequency Power Conversion Conference, *Powerconversion & Intelligent Motion* Magazine (Sam Davis, 2472 Eastman Ave., Ventura, Calif. 93003), Cavalier Resort, Virginia Beach, Va., May 28-30.

ICA Telecom '86, International Communications Association (12750 Merit Dr., Suite 710, Dallas, Texas 75251), Georgia World Congress Center, Atlanta, June 1-6.

3rd International Network Planning Symposium, IEEE (Warren Falconer, AT&T Bell Laboratories, Crawfords Corner Road, Holmdel, N. J. 07733), Innisbrook, Tarpon Springs, Fla., June 1-6.

Syntopican XIV, Association of Information Systems Professionals (1015 N. York Rd., Willow Grove, Pa. 19090), St. Francis Hotel, San Francisco, June 2-5.

Printed-Circuit World Convention IV, Japan Printed-Circuit Association *et al.* (Institute for Interconnecting and Packaging Electronic Circuits, 3451 Church St., Evanston, Ill. 60203), Tokyo Prince Hotel, Tokyo, June 2-5.

International Conference on Consumer Electronics, IEEE (Marvin Gottlieb, M. Gottlieb Associates, 6009 N. Milwaukee Ave., Chicago, Ill. 60646), Westin Hotel, Rosemont, Ill., June 4-6.

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ELECTRONICS WEEK

ZILOG, HITACHI IN CHIP AGREEMENT

Zilog Inc. and Hitachi Ltd. have announced the first of a series of second-sourcing agreements that will eventually cover a whole family of products produced by the two companies. Zilog will supply the Tokyo company's 8-bit high-performance CMOS microprocessor, the HD64180, which is software-compatible with Zilog's own mainstay Z80. Another agreement in the works for later this year is for a CMOS chip that will be compatible with the many Z80 peripheral chips. The Campbell, Calif., company is now sampling Hitachi parts, but expects to have its own in a couple of months. These chips are aimed at the Z80/8085/8080 embedded-controller market, which the two companies say will reach $277 million this year.

DEC RECORDS BIG EARNINGS INCREASE

Digital Equipment Corp. has chalked up a whopping 86% increase in earnings for its third fiscal quarter, to $170.3 million from $91.7 million for the same period a year ago. Revenues for the quarter, which ended March 29, rose 14%, to $1.9 billion from $1.7 billion. Total revenues for the first nine months of the fiscal year were up 12% from a year ago, to $5.4 billion. President Kenneth H. Olsen credits the performance "in a relatively weak market" to being able to deliver "the kind of high-speed, integrated networking solutions that customers need."

AT&T TO REDUCE COMPUTER BUYING

On the same day last week that it reported a 50% increase in its earnings for the first quarter, AT&T Co. said it would cut computer purchases as part of a corporate cost-cutting plan. The decision is a blow to an already weakened computer industry because the company is its largest business customer. Half of AT&T's data and printing centers will be closed or consolidated and staff will be reduced 10%, all over three years. At the same time, the company announced quarterly earnings soared to $530 million from $354 million a year earlier.

NYNEX ACQUIRES TELCO RESEARCH

Nynex Corp., one of the seven Bell Operating Companies, last week acquired Telco Research Corp., a Nashville, Tenn., developer of integrated software products. Terms of the deal were not disclosed. Nynex, with headquarters in White Plains, N. Y., says acquisition of the 10-year-old company will help it provide customers with improved telecommunications-management software. Telco offers software products for a range of computers, from micros to mainframes.

SONY MAY FACE CAMCORDER FIGHT

Sony Corp. will face some stiff competition for its 8-mm video camcorders if four big players in the Japanese market make good on their plans to use the competing VHS-C system instead. Hitachi, Matsushita Electric Industrial, Sharp, and Toshiba are thinking about making compact cassette video recorders that use the format developed by Victor Company of Japan [*Electronics*, Jan. 13, 1986, p. 15]. All four companies make the earlier-generation Video Home System camcorders, with which VHS-C is compatible.

IBM FIRST TO USE A MEGABIT CHIP

IBM Corp.'s high-end 3090-series computers now are being shipped with 1-megabit random-access memory chips for central storage. The chips, developed and made by IBM at Essex Junction, Vt., and Sindelfingen, West Germany, were the first to be manufactured in high volume and are the first to be used in mainframe computers, says the company. The chip, made with 1.2-μm geometries and measuring 7.7 by 10.5 mm, will be used in all 3090s for increments of central storage in excess of 32 megabytes and will also be used for central storage upgrades. IBM says a number of machines housing the new devices have been running at several field locations and within the company since the last quarter of last year.

GRID SYSTEMS IN BIG LAPTOP DEAL

Grid Systems Inc., Mountain View, Calif., has delivered what it claims is the world's largest installation of laptop computers: 600 machines for Chrysler Corp. district sales and service managers. The applications software, written by Chrysler and contained in 512-K of read-only memory, provides a menu-driven report-retrieval system giving information on parts inventories, warranty issues, car sales, and inventory levels. The project cost Chrysler $5 million.

MITTERRAND SNAGS PRIVATIZATION

French Socialist President François Mitterrand says he will refuse to sign decrees by the country's new conservative government privatizing companies unless they are valued using the same formulas that the Socialists used to reimburse stockholders when the companies were nationalized in 1982. The right-wing coalition says it intends to implement its denationalization program by decree to avoid cumbersome parliamentary debate and to protect its razor-thin three-seat majority. The decrees then must be signed by the president to become law. Most observers doubt the French stock market can absorb transactions that large.

ATEQ COMPLETES THIRD FUNDING

Reflecting optimism that improved market conditions will make this the final round, Ateq Corp. has completed a $10 million third funding to manufacture and market its Core 2000 Custom Optical Reticle Engraving System [*Electronics*, Oct. 7, 1985, p. 40], as well as future product development. The Beaverton, Ore., company expects its first customer agreements within the next few months.

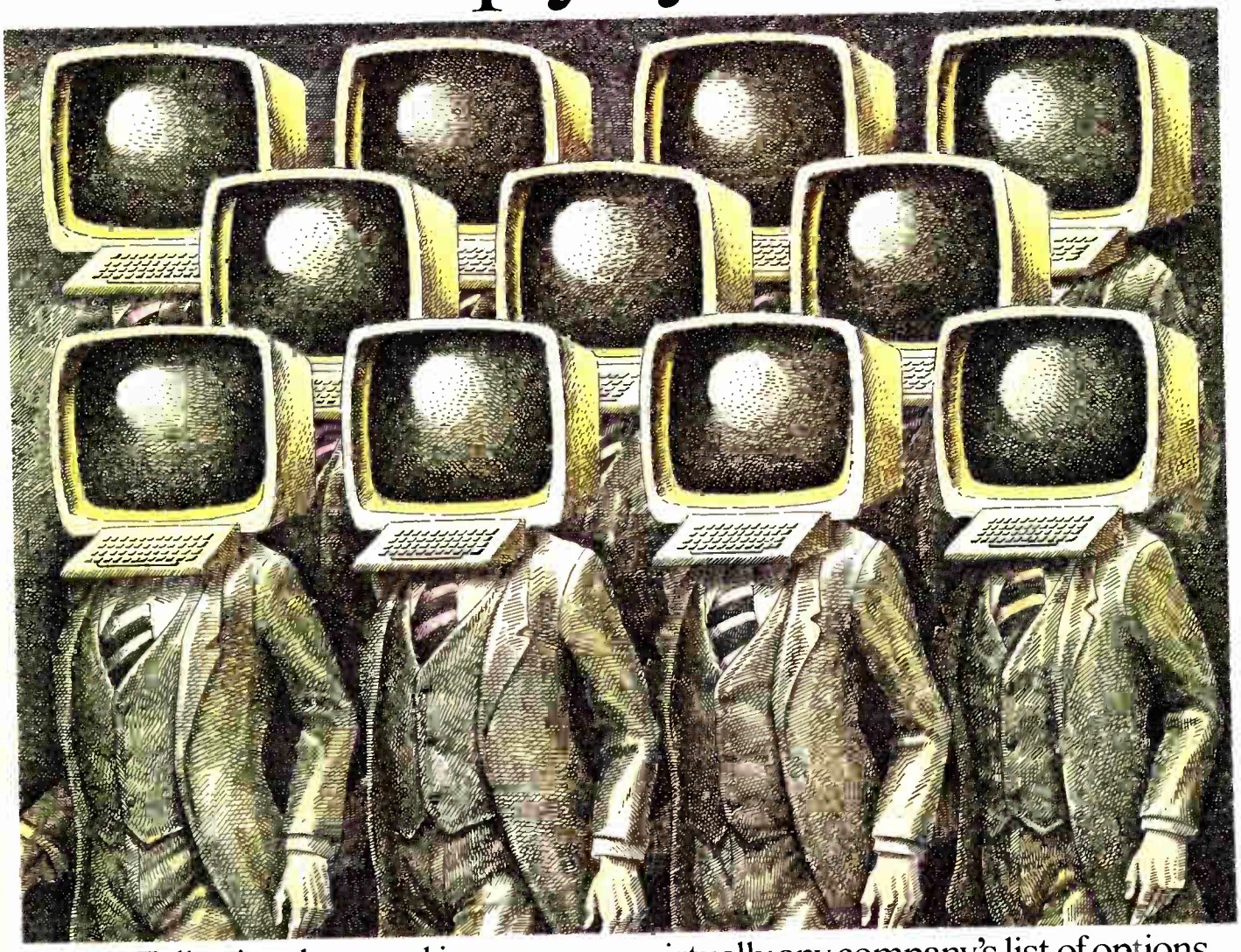
WANG PUSHES INTO KOREAN MARKET

Wang Laboratories Inc. has begun a major Far Eastern business thrust with the establishment of a Korean subsidiary. At the same time it announced the subsidiary, which is called Wang Computer Korea Ltd., the Lowell, Mass., company said it had purchased its Korean distributor, Computer Korea Ltd., Seoul. Wang's Korean presence will also be enhanced by a manufacturing facility scheduled to open later this year. The plant will produce the Wang Hangul PC and a printer interface. Wang Computer Korea Ltd. will offer the company's complete product line.

AEA, EIA-J FORM IMPORT GROUP

The American Electronics Association has formed a Joint Import Promotion Committee with its Japanese counterpart, the Electronic Industries Association of Japan. Representatives of Japanese and U. S. electronics companies will exchange product and procurement information, apprising each other of market opportunities in both countries. The first report is due in September.

All too often, you can become just another face in the crowd simply by following it.



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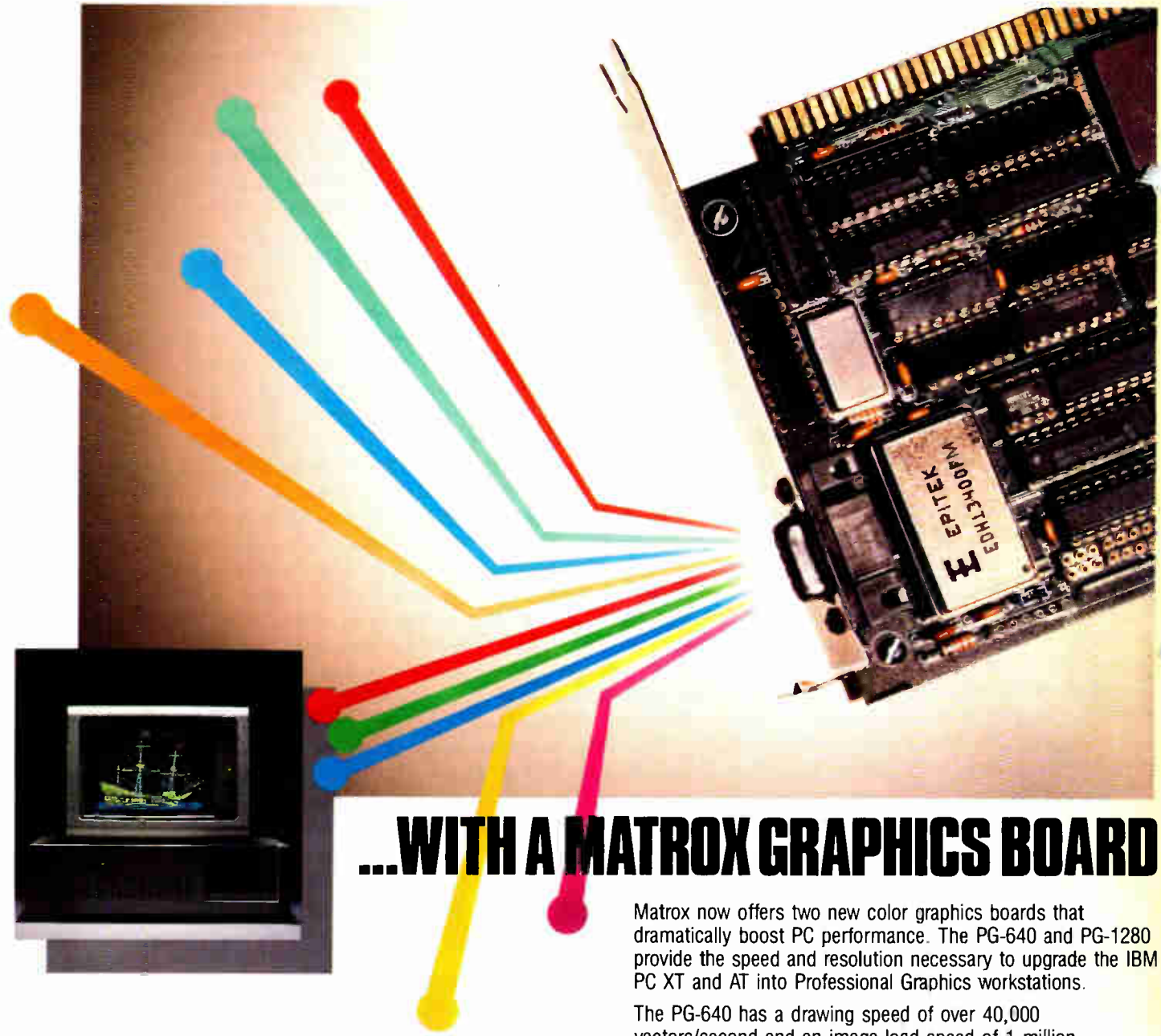

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