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Electronics

THE WORLDWIDE TECHNOLOGY WEEKLY

JANUARY 20, 1986

WHAT'S WORRYING INDUSTRY LEADERS

PAGE 37

1986 EXECUTIVE OUTLOOK

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The RTP-650A is the only portable data recorder that gives you bigger performance than a reel-to-reel.

- **DC to 40kHz frequency response on 14 (or 21) channels** — at a 76.2cm/sec (30 ips) on Beta format video cassette tape. Covers twice the IRIG WBG1 bandwidth on any of the other six tape speeds. WBG1 is selectable for an even better SN ratio.
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- **FM, DR and PCM recording — three modes in all** A first for a desktop data recorder.
- **Optionally available GP-IB port** lets you easily configure a computer-controlled data acquisition and processing system.

And it's easier to use than any other data recorder.....

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- **Programmable settings for simpler operation** Even an unskilled operator can use it on site.

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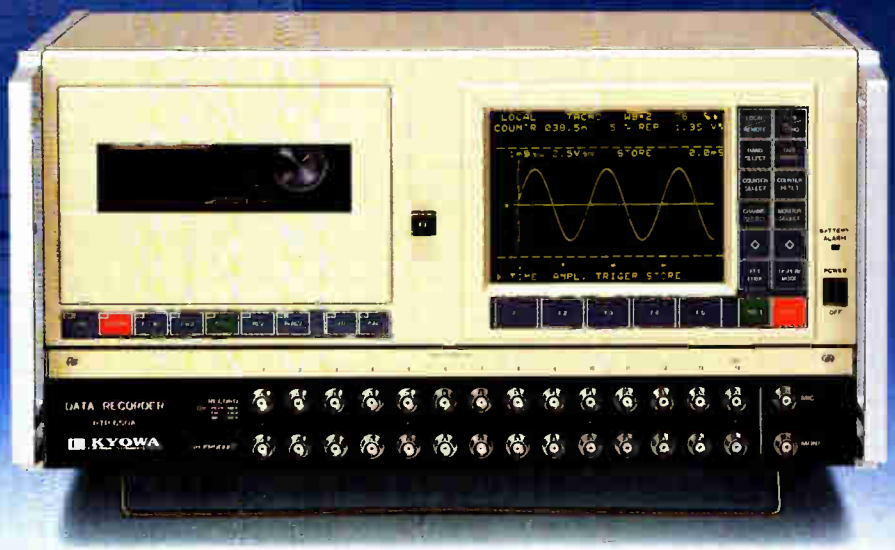

RTP-650A

VIDEO CASSETTE DATA RECORDER

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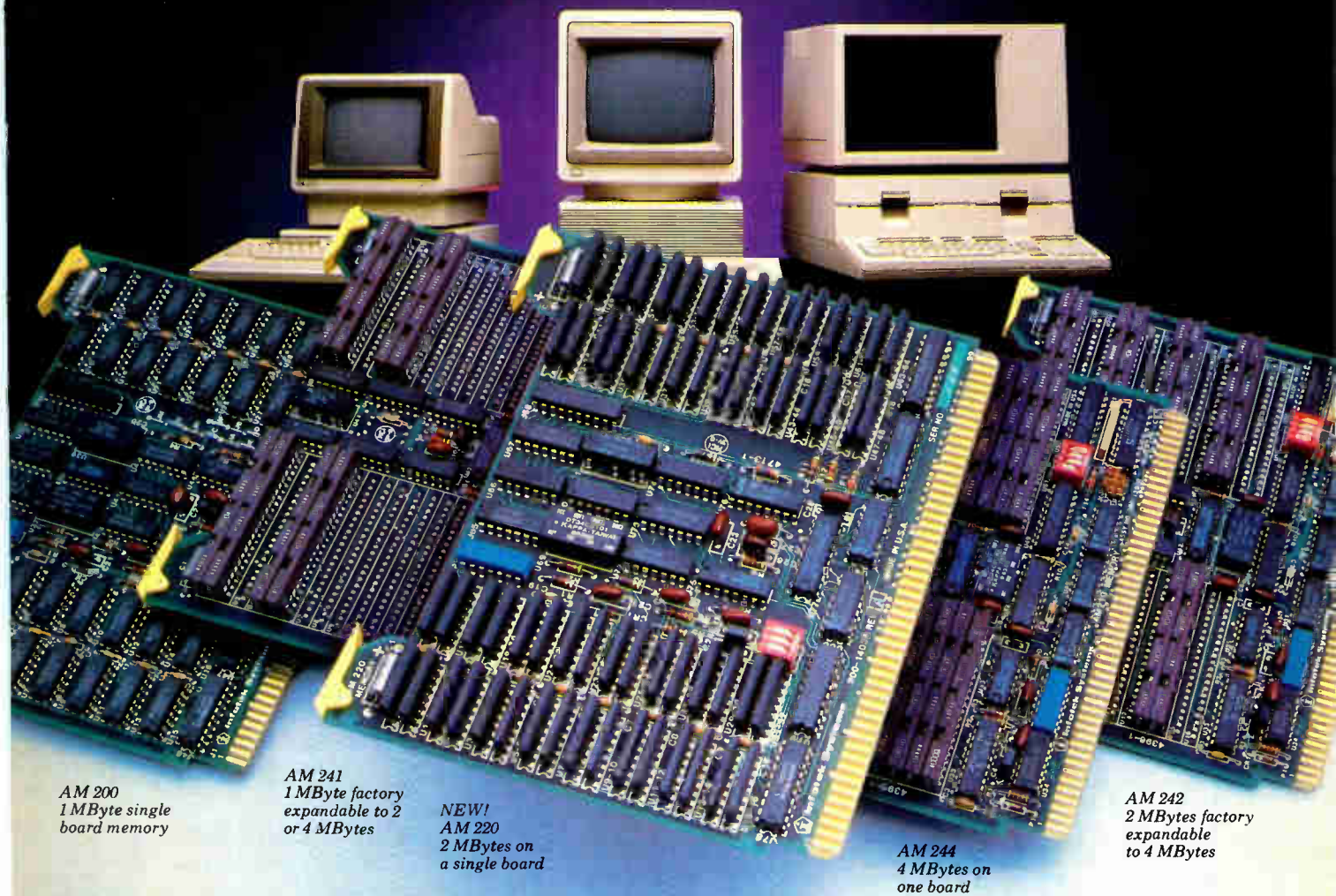

AM 200
1 MByte single board memory

AM 241
1 MByte factory expandable to 2 or 4 MBytes

NEW!
AM 220
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AM 244
4 MBytes on one board

AM 242
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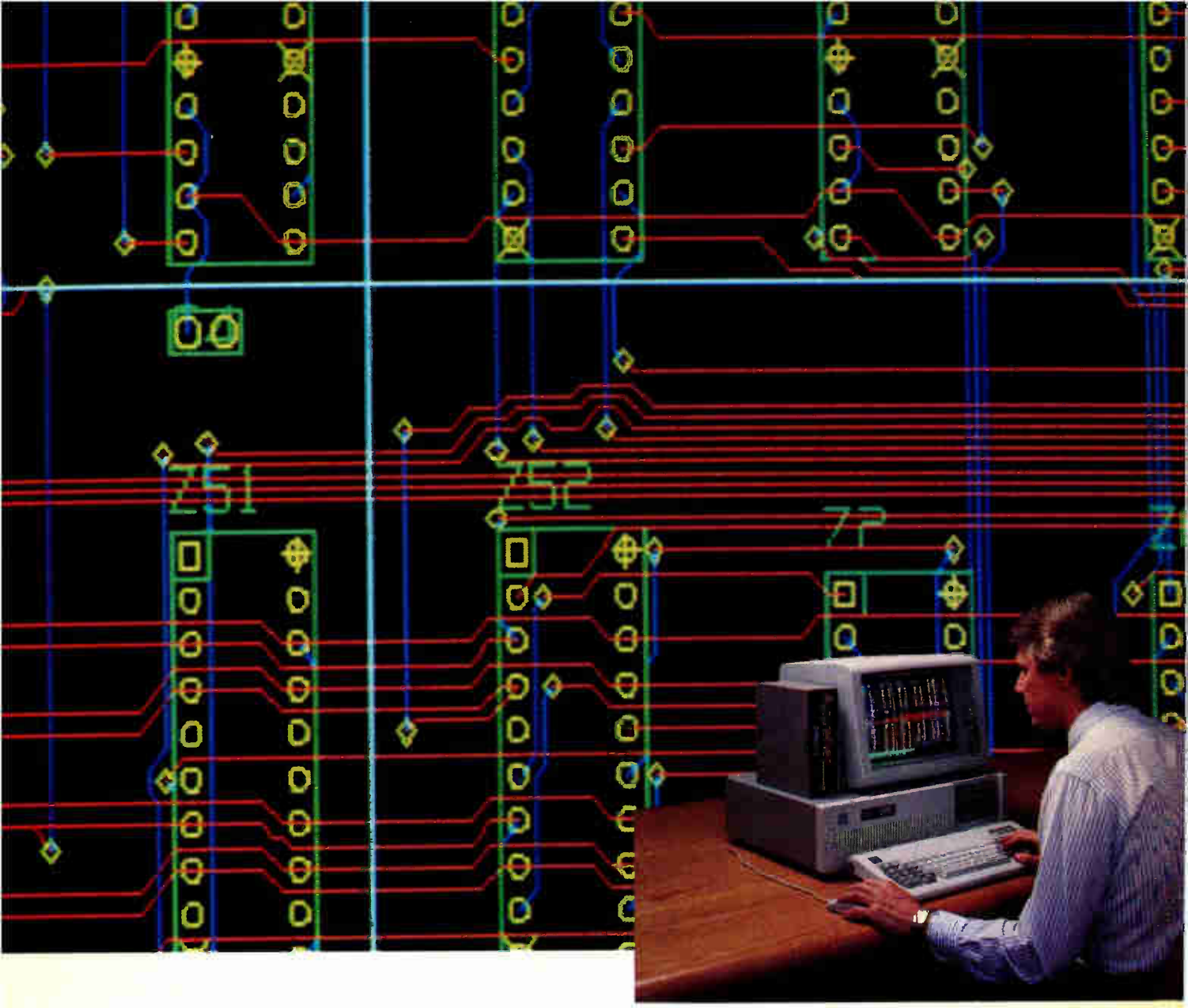

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JANUARY 20, 1986 VOLUME 59, NO. 3

Electronics

NEWS

INSIDE TECHNOLOGY

PROBING THE NEWS

COVER

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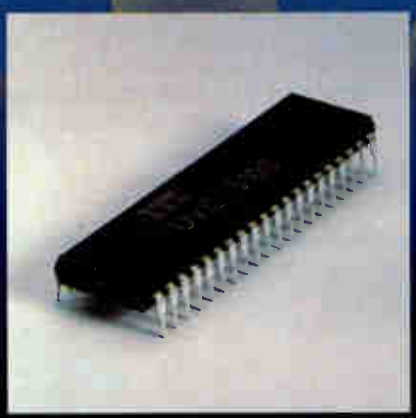
NEW PRODUCTS

DEPARTMENTS

High-speed A/D-D/A Converters

And what you ought to know about them today.



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PUBLISHER'S LETTER

A good roundup story is a lot like an iceberg: much more is hidden below the surface than appears above it.

Though this year's Executive Outlook (p. 37), tips in at 10 pages—not an exceptionally long piece—a three-month effort underlies it.

Our annual outlook began in late October with an editorial strategy session led by editor-in-chief Bob Henkel and business editor Bob Kozma, who shepherded the piece from the initial assignment to layout. Out of the session came 11 questions that our editors figured would cover the key concerns of business leaders for the year ahead. Bob Kozma sent the assignment out to the 11 bureaus we have in the U. S. and overseas, assigning each correspondent five interviews with company presidents or heads of divisions.

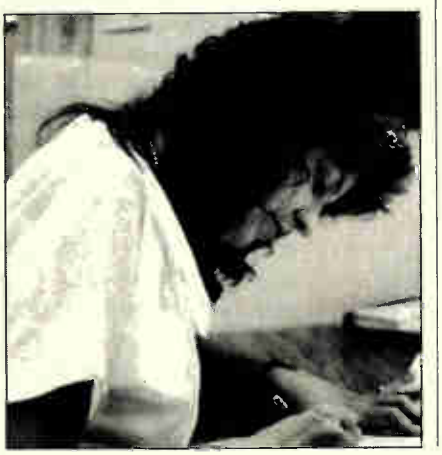
As the returns from the field started coming in, Bob realized that the one note that sounded clearly was one of uncertainty about the year ahead. With that input, art director Fred Sklenar proposed at the late-November cover meeting for the issue a photo showing executives in an office setting that projects a pensive, downbeat mood.

Often an idea framed in words doesn't quite make it visually, but this one did, mostly because of the groundwork of art assistant Annamaria Palma. After sifting through hundreds of shots at two photo agencies, she eventually winnowed out a dozen color transparencies. Then Fred, Anna, and Bob Henkel narrowed it to three, finally settling on the through-the-vertical-blinds shot you see on the cover.

Credit Annamaria, too, with the layout—far different from the report's appearance in past years. Traditionally, our Executive Outlook ran as a sequence of short interviews, with a shot of each executive quoted. The cast changed each year, of course, but over the years the piece took on a too-familiar style.

Bob Kozma and Annamaria found a way to give it a fresh look. Instead of structuring the layout around individual interviews, they built it around the five questions that surfaced most often. Instead of a picture for each person quoted, Annamaria chose nine drawings, one for each of the headline quotes. "It got away from the yearbook look we had before," she says. The finishing touches on the new look were color charts showing how company leaders responded to the five questions. □

DESIGNING. Palma redid the yearbook look.



Laurence Altman

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MEETINGS

TWO OPTICAL CONFERENCES GET TOGETHER

Because of a similarity in technical content, the Optical Society of America decided to couple two of its major meetings—the Conference on Optical Fiber Communication and the Topical Meeting on Integrated and Guided-Wave Optics. Both will be held at Atlanta's Marriott Marquis Hotel, with OFC running Feb. 24-26 and IGWO Feb. 26-28. Usually, OFC is held early each year and IGWO every other year around April.

"People had trouble choosing between conferences," says Barbara Hicks, director of meetings for the Optical Society, which sponsors the conferences along with the Laser and Electro-Optics Society of the Institute of Electrical and Electronics Engineers. She hopes the trial arrangement will provide more convenience for scientists and "cut down on their expenses."

Tying the conferences together will be two joint OFC/IGWO sessions on Feb. 26. The first will report on recent results with high-speed semiconductor laser modulation, the second discusses photodetectors.

At the morning session, researchers from the Tokyo Institute of Technology will explain how they have achieved 9 Å of continuous electrical tunability using a multielement integrated laser structure. The afternoon session on photodiodes will feature F. Capasso of AT&T Bell Laboratories with a description of advances in new superlattice and quantum-well structures.

OFC's total of 22 sessions and 145 papers will cover such topics as integrated optics and lightwave systems, communications-systems architectures, and optical components. The nine sessions of 71 papers at IGWO will report on advances in integrated-optics devices and circuits for telecommunications, sensing, and signal-processing applications.

ICCA-7: 7th International Conference on Assembly Automation, IFS (Conferences) Ltd. (35-39 High St., Kempston, Bedford MK42 7BT, UK), Zurich Fairgrounds, Zurich, Switzerland, Feb. 4-6.

International Conference on Data Engineering, IEEE Computer Society (1730 Massachusetts Ave. N. W., Washington, D. C. 20036-1903), Bonaventure Hotel, Los Angeles, Feb. 5-7.

Electronic Printing Systems, Dunn Technology Inc. (1855 E. Vista Way, Vista, Calif. 92083), Hilton Riviera, Palm Springs, Calif., Feb. 9-13.

Eurocast 86: 2nd European Cable and Satellite Television Conference, Förderverein Satelliten-Rundfunk und andere Kommunikationssysteme (Swiss Industries Fair, P. O. Box CH-4021, Basel, Switzerland), European World Trade and Convention Center, Basel, Feb. 11-13.

IEEE Annual Meeting, IEEE (IEEE Annual Meeting Department, 10th floor, 345 E. 47th St., New York, N. Y. 10017-2394), Red Lion Inn, San Jose, Calif., Feb. 18-19.

Mechatronics Japan, Nihon Keizai Shimbun (1-9-5 Otemachi, Chiyoda-ku, Tokyo, 100, Japan), Tokyo International Fairgrounds, Feb. 18-21.

Semiconductor Procurement Conference, Dataquest Inc. (1290 Ridder Park Dr., San Jose, Calif. 95131), Hyatt Regency Hotel, Monterey, Calif., Feb. 19-21.

ISSCC: 1986 IEEE International Solid-State Circuits Conference, IEEE *et al.* (Lewis Winner, 301 Almeria Ave., Coral Gables, Fla. 33134), Anaheim Hilton Hotel, Anaheim, Calif., Feb. 19-21.

AutoCADcon 86, CAD Design Systems Inc. (1305 Remington Rd., Suite D, Schaumburg, Ill. 60195), Westin Hotel O'Hare, Chicago, Feb. 20-21.

SMTA Meeting, Surface Mount Technology Association (P. O. Box 1811, Los Gatos, Calif. 95031), Hyatt Anaheim, Anaheim, Calif., Feb. 24.

OFC '86: Conference on Optical Fiber Communication, IEEE and Optical Society of America (OSA Meetings Department, 1816 Jefferson Pl. N. W., Washington, D. C. 20036), Marriott Marquis Hotel, Atlanta, Feb. 24-26.

Micad '86: Third International Conference and Exhibition on CAD/CAM, World Computer Graphics Association Inc. *et al.* (Caby C. Smith, WCGA, Suite 399, 2033 M St. N. W., Washington, D. C. 20036), Palais des Congrès, Paris, Feb. 24-29.

Nepcon West 86, Cahners Exposition Group (Show Manager, Nepcon West 86, Cahners Exposition Group, 1350 E. Touhy Ave., Des Plaines, Ill. 60017-5060), Convention Center, Anaheim, Calif., Feb. 25-27.

IGWO '86: Topical Meeting on Integrated and Guided-Wave Optics, IEEE and Optical Society of America (OSA Meetings Department, 1816 Jefferson Pl. N. W., Washington, D. C. 20036), Marriott Marquis Hotel, Atlanta, Feb. 26-28.

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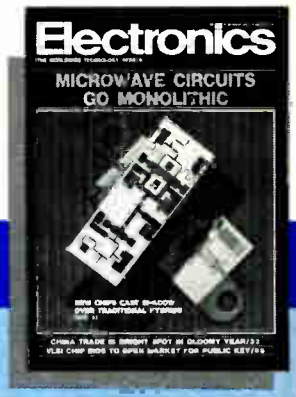

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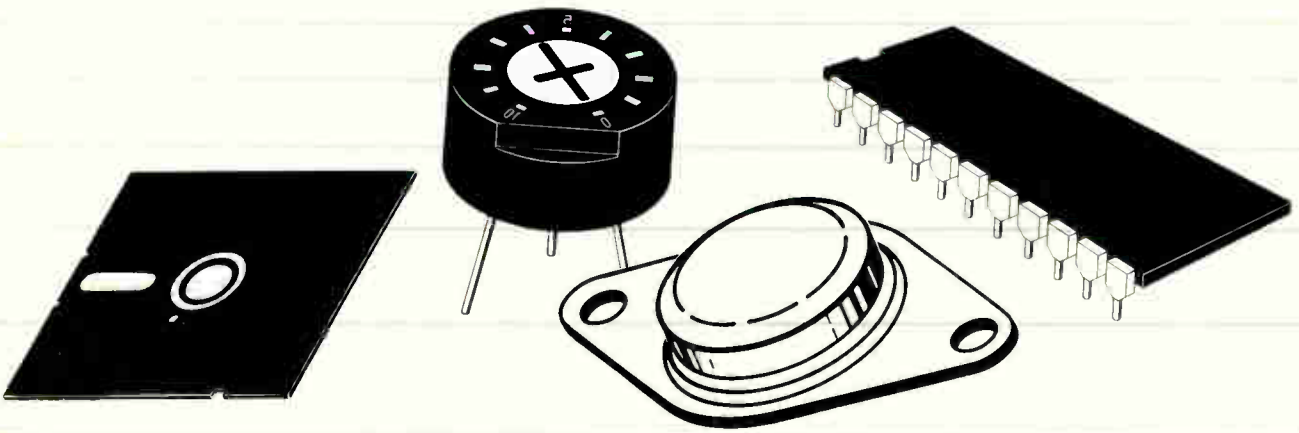

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TECHNOLOGY NEWSLETTER

INMOS REVAMPING ITS TRANSPUTER LANGUAGE

Look for Inmos International plc to beef up its transputer programming language. The extended Occam language is aimed at easing development of fault-tolerant and self-adaptive computer systems based on multiple transputers. The current Occam language [*Electronics*, Nov. 30, 1982, p. 89] is too restrictive for these applications because it can handle only single-dimensional arrays and fixed-word-length integers. Occam 2, under development for the past year and slated to enter beta testing next month, contains IEEE-754 floating-point operations, multiple-length integers, support for multidimensional arrays, and utilities equivalent to those in a Fortran library. It will operate initially on an IBM Corp. Personal Computer/XT, PC AT, and compatibles with a transputer evaluation board, or on Inmos's D100 integrated work station, which is based on a Motorola 68000. A month later, Occam 2 will also be made available for Digital Equipment Corp.'s VAX minicomputers running under the VMS operating system. □

TOUCH-SCREEN WORD PROCESSOR HEADS FOR CHINA

Touch-screen technology could open up a potentially enormous market for word-processing equipment: the People's Republic of China. Intech Systems Inc., a subsidiary of Detector Electronics Corp., last week demonstrated its CP2054 Character Processor, which uses an analog-resistive cathode-ray tube with a grid that creates more than 65,000 touch-sensitive spots in a 256-by-256-pixel format. Operators work with the touch screen, which can display 13,000 Chinese characters, instead of using a keyboard. The Minneapolis company hopes to sell about 1,000 of the machines in 1986, at a cost of about $5,000 each, and already has an outlet through a computer distributor in Beijing. □

HARRIS AWAITS OK FROM NSA

Because the National Security Agency now actively controls the release of successors to the industry-standard DES encryption chip through its commercial Comsec (communication-security) program, Harris Corp. has had to delay the introduction of its HS3447 Cypher I. The 16-pin CMOS chip transmits at up to 20 Mb/s in either output-feedback or linear-cycle modes. Aimed at unclassified encryption applications, it can be used in standard or spread-spectrum communications applications. The Melbourne, Fla., company wanted to market the HS3447 at the end of 1985, but still awaits agency approval. Informed sources speculate that intra-agency turf battles are stalling the Comsec approval process. □

SHAPE-MEMORY ALLOY WITHSTANDS ELECTRICAL HEATING

The shape-memory family—alloys that contract when heated and then return to their original shapes when cooled—will get a valuable new member this month when TokiAmerica Technologies Inc. begins shipping its Biometal, a titanium-nickel alloy whose crystalline structure makes it possible to heat it electrically. Such heating has not been feasible until now because wires made from the alloy tend to develop hot spots and break, says the Irvine, Calif., company. TokiAmerica sees myriad applications for the wires where extremely light and small actuators are needed. As a replacement for a solenoid, the alloy wire could achieve a 100 : 1 weight reduction, the company claims. Other potential applications include use in lightweight moving toys, for example, or in automotive jobs such as trunk-release or rearview-mirror control systems. The technology was developed at Tokyo's Waseda University. □

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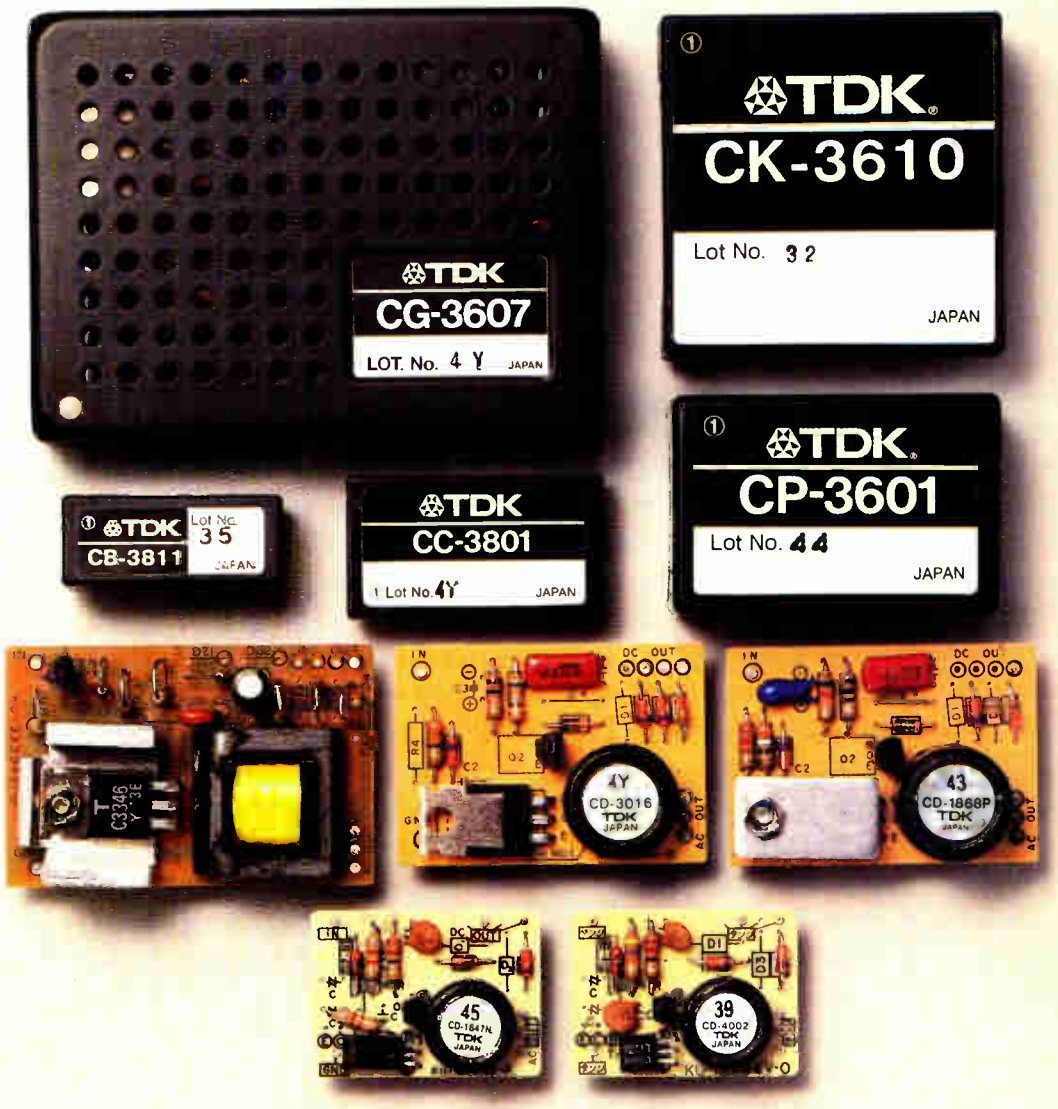

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ELECTRONICS NEWSLETTER

IBM SET TO MOVE INTO LAPTOP MARKET

Computer market analysts are convinced that IBM Corp. will make its long-awaited entry into the struggling laptop personal computer market with a bang this week. That's when the Internal Revenue Service is expected to declare IBM the winner of a contract for at least 15,000 laptops; at the same time, the company should make a formal product announcement. The new model, variously nicknamed the Clamshell, the PC Convertible, and the P-14, is said to have 512-K of internal memory, a built-in 1.2-kb/s modem, and two configurations. A low-end model with an LCD and either a single 3½-in. floppy-disk drive or a cartridge memory will cost between $1,000 and $1,500, says analyst George F. Colony, president of Forrester Research Inc., Cambridge, Mass. Colony says a fancier model will sport an electroluminescent screen and two 3½-in. disk drives and sell for $2,500 to $3,000. □

A GLIMMER OF HOPE IN BOOK-TO-BILL FIGURE

Four consecutive monthly improvements in the U. S. semiconductor market's book-to-bill ratio are prompting cautious optimism from industry leaders. Reaching its highest point in 16 months, the indicator of U. S. semiconductor-market well-being rose to 0.98 in December, according to the Semiconductor Industry Association, San Jose, Calif. U. S., European, and Japanese semiconductor manufacturers doing business in U. S. markets reported increases in both bookings and billings during the month. A representative for Intel Corp., Santa Clara, Calif., points out that the ratio is "starting from such a very, very low base that it doesn't mean a total turnaround." Officials at National Semiconductor Corp., also of Santa Clara, expect a steady increase in bookings and sales, with a 10% increase in business for 1986. "I think we've seen the bottom of the slump," one comments. □

APPLE REPORTS ENCOURAGING FIRST QUARTER

Taking his cue from a recent movie, Apple Computer Inc. president and CEO John Sculley says the company is ready to go "back to the future," now that its first-quarter results show improved gross margins and higher inventory turnover. "The reorganization is behind us," Sculley says, referring to last year's layoffs, cutbacks, and resignation of Apple cofounder Steven Jobs. Apple reports net sales for the first quarter at the "second-highest level ever achieved" by the Cupertino, Calif., company: $534 million, some $164 million below its record-high quarter. Indications are that it is hinging hopes of stronger business-market penetration on the Macintosh. Apple released a spate of newly enhanced products that exploit the Mac's graphics capabilities. Headlining them is the Macintosh Plus, which has 1 Mb of user-configurable RAM—twice that of the current model—and a 128-K ROM. □

DEC RELEASES FIRST OF A VOLLEY OF MAJOR PRODUCTS

The opening round in what will soon become a barrage of major product announcements is Digital Equipment Corp.'s first Unix work station, unveiled last week. Based on DEC's fast-selling MicroVAX II computer, the Vaxstation II/GPX work station incorporates a very large-scale-integration graphics coprocessor and is priced below similar offerings from Sun Microsystems Inc. and Apollo Computer Inc. Later this month, DEC likely will introduce a high-end dyadic processor capable of executing 7 million to 8 million instructions/s. Also rumored to be in the works are a multiprocessor version of the MicroVAX II, a MicroVAX II model that will be a server for a network of IBM Corp. Personal Computers, a fault-tolerant DEC cluster, and an IBM PC-compatible personal computer. □

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PRODUCTS NEWSLETTER

HP'S 300-MHz DIGITAL SCOPE COMES IN AT UNDER $8,000

Hewlett-Packard Co. continues to chip away at the price advantage that analog oscilloscopes have over their digital-storage counterparts. The Palo Alto company is about to unveil a 300-MHz scope that sells for less than $8,000. Analog scopes of this bandwidth sell for about $6,000, but digital scopes' automatic features and faster, more accurate measurements make them more cost-effective, says HP. The new scope, which boasts a ±200-ps timing accuracy and a 200-MHz sampling rate, is a follow-on to HP's 50-MHz 54200A/D models, which have timing accuracies of ±2 ns. □

NOW IBM PCs CAN CONTROL HIGH-END PRINTING

Applications software frequently contains only rudimentary printing commands, so the features of high-end printers have been out of reach for users of many popular word-processing and spreadsheet programs. Now the PrintKey program for the IBM Corp. line of Personal Computers lets the user tailor commands to the features of specific high-end printers. With the memory-resident program from North West Software Associates in Spokane, Wash., the user creates single-character macros that become printer commands. They will invoke optional character sets, proportional spacing, color, graphics, and other features of advanced printers. PrintKey costs $89.95. □

GOULD UNVEILS SUPERMINI THAT OUTRUNS DEC'S VAX 8650...

Just introduced by Gould Inc.'s Computer Systems Division are both a new top end for its PowerNode Unix superminicomputers and an entry-level business computer that sets a new price/performance level. The Fort Lauderdale, Fla., division claims its new PowerNode top end, the PN9050-SP dual-processor system with a multiplication accelerator, outperforms Digital Equipment Corp.'s new high-end VAX 8650 by 25% and costs 25% less. Prices are $275,000 for the single-processor PN9050-SP and $400,000 for a dual-processor model. The company says the entry-level $39,000 PN6040 shatters price/performance records by offering 1.5 times the power of a 1-mips VAX-11/780, whose prices start at over $100,000. □

...AND A SECURE VERSION OF UNIX

Gould also is offering the first in a line of secure versions of the Unix operating system developed by AT&T Bell Laboratories. Called UTX/32S, it is being submitted to the National Security Agency for certification at the C1 level of security. The next versions will be for the B1 secure level, and Gould promises that by 1990 there will be a version for the most secure level, A1. Gould promises to keep the secure Unix versions compatible with its present UTX/32 hybrid Unix, which adheres to both the AT&T System V and Berkeley 4.2bsd de facto standards. License fees range from $4,500 to $27,000. □

DATA BASE IS REFERENCE LIBRARY ON HAZARDOUS CHEMICALS

The second version of Safeware Inc.'s hazardous-chemical data base has more parameters for each chemical and runs 60% faster than its predecessor. The Santa Clara, Calif., company credits both improvements to rewriting the package in C. The original version could store 30 parameters—such as physical properties, effect on health, and storage requirements—but the C version, called Safechem II, will handle more than 80 parameters for each chemical. Safechem II comes with data on 1,000 chemicals; when used on an IBM Corp. Personal Computer with a 10-megabyte hard disk, there is room for up to 10,000 chemicals. A single-site license costs $2,500. □

Electronics

HONEYWELL WEIGHS IN WITH A SENSOR-LEVEL FACTORY NET

NEW ENTRY COMES AS STANDARDS BODIES FOCUS ON SUCH NETS

COLORADO SPRINGS

The efforts to standardize local-area networks are trickling down to the lowest levels of industrial and office automation. A number of industry trade associations and chip makers are now focusing their attention on establishing standard pathways for connecting distributed analog sensors and actuators to intelligent host systems.

For example, Honeywell Inc.—with a giant presence in office and factory control systems—has been quietly working on its own low-cost serial bus tailored for process controls, energy management, and instrumentation. Integrated circuits for its Control Point Bus, or CPB, are expected to enter beta testing in June and will be available for sampling in the third quarter.

CPB and its competitors, such as Intel Corp.'s Bitbus, represent the next—and probably lowest—layer of the proverbial onion in automation hierarchies, and the issue of a standard promises to heat up this year as computer LANs take shape in factories. The Instrumentation Society of America's new SP50 committee is in the early stages of defining simple controller networks. Honeywell is participating in the effort. Abroad, the International Electrical Council has polled its members to determine the characteristics of low-level nets, known as field buses.

In March, the Institute of Electrical and Electronics Engineers is expected to act on a recent committee recommendation to launch standards definitions centered initially on the Bitbus promoted by Intel [*Electronics*, Oct. 28, 1985, p. 19]. Don Loughry, chairman of the Instrumentation Computer Interface committee, insists that any standard will not be merely a stamp of approval on a commercial product such as Bitbus.

"Intel has assured us the discussions will be open-ended and if there are ways to improve it to satisfy broader needs, they will support it as long as they understand what we are doing and feel it is justified," says Loughry. The chairman is passing the recommendation to the IEEE standards body.

In addition to courting the IEEE, Intel's OEM Modules Operation in Hillsboro, Ore., plans to orchestrate a growing commitment to Bitbus by announcing later this month that 21 manufacturers support the 2,400-bit-per-second link. The list of companies reportedly will include makers of minicomputers, robots, data-acquisition sensors, programmable controllers, and interface components. Still, other network schemes are likely to surface during the year as the market evolves.

GEAR UP. Honeywell's Sirsi says there's big market potential for control-net products.

End-product business in new energy-management and factory-control networks is expected to reach $200 million to $300 million by the end of the decade, according to Ramesh Sirsi, director of programmable data-acquisition products at Honeywell's Signal Processing Technologies venture in Colorado Springs. Honeywell plans to offer interfaces to its CPB network in its expanding signal-processing cell library for integration into data-acquisition ICs, says Sirsi.

The company is readying ICs for simplified nodes

The first CPB interface ICs will cost about $14 each at year end. Honeywell intends to drive the cost down to below $9 in high volume during 1987.

"Our Control Point Bus is intended for the low end of data busing, where you are operating data-acquisition sensors or actuators with a first-level controller. There may be some sort of intelligence, but it is minimal at the majority of the nodes," says Robert V. Krzyzanowski, the company's program manager for CPB controllers.

The protocols have been pared down for the simple nodes, and CPB has been designed to optimize throughput over relatively slow serial paths. It provides adjustable address fields, programmable error correction, and quick message-collision recovery. The initial aim is to offer efficient messaging with 100-kb/s or lower speeds. Krzyzanowski says the CMOS controllers now appear to promise higher speeds—from 150 to 250 kb/s. But CPB's master/slave, poll-response addressing scheme is the centerpiece of the Honeywell strategy for achieving fast and efficient access to high-priority sensors and actuators.

NICKNAMES. The protocol offers programmable features to minimize overhead of message-management bits when possible. Address fields can be set on the fly to 7, 14, or 22 bits wide. The chip interfaces also enable slave nodes to be lumped into classes for quick access to critical devices. On-board registers can be used to give nodes short nicknames for small bus configurations. Error detection can be tailored for 8- or 16-bit cyclic redundancy checking.

The CPB circuits contain an on-chip Manchester codec with a jabber timer. The programmable timer will unilaterally stop transmission over the bus whenever a "jabbering" device ties up the line for longer than a set time. With 3 bits, the Manchester codec can then quickly synchronize data streams to keep the bus operating.

"We have come up with a subset approach that is more attuned to low data rates but highly efficient control systems," adds Krzyzanowski. The protocol operates as a poll-response scheme, in contrast to the round-robin addressing of larger LANs. Slaves along the bus

respond only when addressed by a bus master. Up to 16 devices can reside at each node, and the initial ICs are being packaged for CPB networks containing up to 128 nodes. Honeywell officials believe typical applications will consist of many fewer points—from 4 to 32. The CPB transmission medium typically will be twisted-pair wire, but optical fiber will be supported for those working in electrically hostile environments.

Two interface ICs have been designed. The first to become available will be used to create what Honeywell calls nonautonomous slave nodes and master nodes. Nonautonomous slaves, as well as the master, will have a low-cost microprocessor or microcontroller at the node to handle input/output for attached logic devices and CPB polling.

The nonautonomous-slave/master IC contains a protocol-control state machine, a serial interface for an off-chip transceiver, the Manchester codec, CRC circuits, timers, a generic microprocessor interface, and registers for addresses, data, and control. The chip will be housed in either a 28- or 40-pin package.

A second CMOS interface chip, for autonomous slave nodes—which have no microprocessor—contains extra registers to interpret commands and conduct simple direct-memory-access operations. This chip will cost about $16 when Honeywell starts volume shipments next year. *–J. Robert Lineback*

CONSUMER

JUST AS CDs TAKE OFF, DIGITAL TAPE ARRIVES

LAS VEGAS

Just as Compact Disc players are turning into a mass-market item, another digital audio technology has appeared on the scene at the Winter Consumer Electronics Show in Las Vegas.

The latest upstart is a tape cassette standard from Japan. While most audio manufacturers at the show were trumpeting their CD offerings, Onkyo U.S.A. Corp. was quietly showing a prototype DAT player/recorder to selected showgoers in a curtained-off area at the January show. Industry executives wonder, however, about the proper market positioning of DAT, and some fear that a premature introduction could hurt soaring CD sales.

Known as the DT-1000, the Onkyo unit apparently is the first DAT machine to make an appearance at a CES, though Sony and others have shown prototypes in Japan. A number of manufacturers, including Sony, are expected to begin gearing up DAT introductions here soon, and next June's Summer CES in Chicago is a likely launching pad.

"We'll have our announcement later this year," says Marc Finer, product communications manager for Sony Corp. of America's Consumer Audio Products Division in Park Ridge, N. J. "I can't say when. But we think it will be later this year through early 1987 when the industry will really start to get behind DAT."

ROTARY HEAD. The Onkyo player is planned for introduction sometime next year with an estimated price tag of about $1,000, though it could be higher, according to David Birch-Jones, national product advertising manager for Onkyo in Ramsey, N. J. The unit is based on the rotary-head (R-DAT) format, one of two standards formalized last fall by a committee embracing 81 member companies.

Compared with the stationary-head (S-DAT) format, the R-DAT approach requires a slightly larger player, but uses a smaller cassette size (2.875 by 2.167 by 0.375 in.), thereby offering more miniaturization potential for such applications as automobile sound [*Electronics Week*, Oct. 15, 1984, p. 12]. Also, because R-DAT players can be made with the same kind of head and drum assemblies as

U. S. CONSUMER MARKETS EXPECTED TO RISE 5% TO $26 BILLION IN 1986

The Electronic Industries Association/Consumer Electronics Group projects 5% growth, to $25.6 billion, in U. S. factory sales of consumer electronics goods this year. Fueled by better-than-expected growth in such hot product areas as video cassette recorders and Compact Disc players, last year's figure hit $24.5 billion, according to projections released at the Winter Consumer Electronics Show, held Jan. 9-12 in Las Vegas. That's a 6.4% increase over 1984's $22.9 billion. Assuming reasonable markups at retail, the numbers translate into more than $33 billion in 1985 sales and over $35 billion this year, points out William E. Boss, vice president of the EIA consumer group.

Though 1985's VCR sales didn't match the prior year's dizzying 87.6% growth over 1983, factory VCR shipments still grew by a whopping 41.7% to 11.8 million units, thanks to falling prices driven by intense competition and manufacturing economies of scale. The EIA group projects VCR growth will slow significantly this year, rising about 5.5% to 12.5 million units. But that should extend VCR penetration into some 40% of U. S. households by year end, up from about 30%.

On the audio front, consumer enchantment with the CD startled even the industry's most optimistic. As recently as the Summer CES last June, the EIA group was predicting shipments of 600,000 CD players in 1985. The organization projects, however, that when the final numbers are in, the figure will be closer to 850,000, more than four times the 208,000 players sold in 1984.

The pace will continue at a heady clip this year. Manufacturers are expected to move some 1.5 million additional CD players in only the third year since the product's launch. By contrast, color TV was 11 years old before 1 million units were shipped, and VCRs required six years to reach that level.

Not all the numbers are as heartening. Telephone sales were down by 15% in 1985 to 26.5 million units, for example. And last year was a difficult one for makers of home computers, which the industry defines as those intended principally for use in the home and retailing for less than $2,000.

Factory shipments of home computers dropped almost 20% in 1985 to 4.1 million units, down from 5.1 million moved in 1984. But sales are expected to rebound to about 4.5 million in 1986, nearing the 4.8-million-unit mark recorded in 1983, the home computer's big growth year. Despite the difficulties experienced by hardware makers last year, however, home computer software sales continued to flourish, rising by 25% to 50 million units. Another 30% jump to 65 million units is expected this year.

One category new to the EIA consumer group's figures is satellite earth stations, which the organization began tracking only last year. Just five years after the first earth-station exhibitor signed up to exhibit at the 1981 Winter CES, factory shipments reached the 600,000-unit mark. At about $1,500 per system from the factory, that's roughly $900 million worth of products. And sales are expected to top $1 billion this year, with sales of 700,000 units projected.

Buoyed by the hot VCR category and color-TV sales that rose by 5% to 16.9 million units, last year's total video sales climbed by 13.1%, for about $11.6 billion in sales. That compares with 6.7% growth for total audio, which contributed about $6.6 billion of last year's factory sales. *–Wesley R. Iversen*

those used in 8-mm video cassette hardware, they could be made less expensively, says Sony's Finer.

Sony, for one, is in the R-DAT camp. And both Finer and Onkyo's Birch-Jones believe the rotary-head technique will become the de facto industry standard.

Birch-Jones downplays any negative DAT impact on CD sales. Initially, he says, the primary customer for home DAT player systems will be the audiophile who already has a CD player and wants to add equivalent audio quality for taping. What's more, he says, CD players can be made more cheaply than can the more complex DAT players, dictating a higher price for the digital tape units compared with the optical-disk machines, "at least for the first few years."

DAT'S GOOD. Onkyo's Birch-Jones does not think that digital audio tape products will have a negative impact on Compact Disc sales.

The Onkyo official notes that "in the car, DAT could have a big impact on CD." Because the 4.7-in. optical disks are wider than the standard openings found in automobile dashboards, CD players require some cutting for permanent aftermarket installation in cars. DAT players can be made to fit the standard opening and will offer equal or better audio performance than the CD, Birch-Jones says. He predicts that car DAT players will follow right on the heels of the larger home units.

Onkyo's prototype DT-1000 is housed in a standard-size home audio deck and contains a slew of integrated circuits that Onkyo officials say eventually will be reduced to three or four large-scale ICs. With two tape speeds—8.15 or 12.225 mm/s—the machine offers maximum recording and playback times of 120 or 80 minutes, respectively.

Despite what some believe could be a headlong rush by manufacturers later this year to move consumer DAT toward commercial reality, Finer warns that care must be taken in positioning the product properly. "You can't directly copy or encode from the CD format to DAT or vice versa [without converting to analog] because the sampling rates are incompatible." Optical technology will always have advantages over any tape technology, including stability, quicker access time, and more flexible programmability, he says.

Care must also be taken not to cause confusion with a new technology following so quickly the CD and new 8-mm video formats, he says. "The consumer and the retailer are capable of absorbing only so many new formats and configurations within a certain time frame," Finer warns. "We believe there's a market out there for DAT. But whether it's the marketplace that anybody envisions remains to be seen." *–Wesley R. Iversen*

MILITARY

AUDIT AIMS TO TIGHTEN RESEARCH RULES

WASHINGTON

The Department of Defense has at last set a date—next July—to enforce guidelines aimed at eliminating duplication in research contracts. The move stems from a recent audit conducted by the DOD's inspector general.

Stricter guidelines for research contracts were to have been incorporated into existing DOD regulations by last July, says the audit. But a Pentagon representative says they won't go into effect until this July in order to bring in-house research and university grants and research under the same literature-search and justification requirements.

The audit shows that duplicated research has wasted millions of dollars for the Pentagon, despite a directive that its 73 research laboratories search a DOD data base to ensure that proposals don't merely reproduce existing projects. The audit, conducted by the DOD's inspector general between April and November 1984, shows that because many of the labs did not comply with the order, research was duplicated to the tune of $32 million in 1982 and 1983.

The House Government Operations Committee asked to see the DOD Laboratory Contract Studies and Analyses following September 1983 hearings on the extent of overlapping DOD research. Along with research duplication, the audit found that many research contracts either lacked documentation showing a military purpose or were irrelevant.

The study found that labs did literature searches for only 17% of the 4,774 contracts completed during the 1982 and 1983 fiscal years. As a result, 95 contracts worth $32.6 million duplicated other DOD research. But that figure is probably low. The auditors also discovered that the DOD data base was incomplete—37% of research contracts and 58% of the resulting technical reports were not reported—and thus the audit could document duplication on only about 2% of all DOD research contracts during the period.

Literature searches could save millions of research dollars

DOD laboratories are responsible for investigating evolving technologies that can be used in developing weapons systems. During fiscal 1982 and 1983, they operated with a budget of $9.3 billion, of which $5.4 billion went to industrial companies, universities, and private individuals for research contracts.

WORST RECORD. Although audit results from all three service branches showed missing documentation, Navy labs appeared to have the worst record: only 3 of 118 Navy research contracts studied included evidence of the required literature searches. In addition, the report singles out two contracts awarded by the Naval Research Laboratory that duplicated previous Air Force research. The contracts, worth a total of $343,000, were awarded by the Washington labs in 1981 and 1982 to investigate failure mechanisms in gallium arsenide FETs. The Air Force Rome Air Development Center, Rome, N.Y., did the same research in 1978, the audit notes.

But duplication of basic research is often difficult to detect, says an official at the U.S. General Accounting Office.

"You can have a lot of things in basic research that appear duplicative, but really aren't," says Paul Math, who directs the GAO's government procurement studies. He likens the problem to cancer researchers from different organizations who are all looking for different solutions to the same problem.

The audit also found that the labs were not justifying the military value of their research. "To identify the necessity, urgency, and appropriateness of proposed research contracts, DOD components must justify the military need for the research in terms of current priorities, tasks, and objectives," the study notes. But because justifications were unavailable for half the contracts examined, the military relevance of 1,312 of the 4,774 contracts awarded during fiscal 1982 and 1983 could not be established. *–George Leopold*

SEMICONDUCTORS

'SMART ANALOG' ICs DUE FROM TEXAS STARTUP

AUSTIN, TEXAS

Solid-state analog and digital worlds have merged at 14-month-old Crystal Semiconductor Corp., Austin's first semiconductor startup. The result will be a new breed of CMOS integrated circuits for communications, data conversion, and signal filtering, placing the muscle of analog circuitry under the watchful control of digital logic. Crystal calls its mixture Smart Analog, or digitally enhanced analog, and plans to introduce at least 16 of these products.

The digital side of Crystal's designs typically take up as much as half the die. With that portion, digital circuitry provides, for example, microprocessor interfaces, continuous self-calibration capability for data-acquisition chips, programming circuits for universal filters, and adaptive features for telecom and token-ring network transceivers. Many of these functions were not previously possible in single-chip form.

Crucial to Crystal's strategy is that the digital blocks also make it possible to tap existing foundries—the ones that are now pumping out 3-μm single-metal, double-polysilicon digital CMOS—as a source of high-performance analog components. What little analog performance is lost to 3-μm CMOS is more than made up for by better-operating digital logic, says engineering vice president and cofounder Michael J. Callahan Jr.

"Bipolar designs might be able to match performance of transistors better than CMOS. But with CMOS digital complexity, the performance difference can be offset and analog performance guaranteed over temperature, and long-term drift problems and other changes due to environmental conditions can be eliminated," Callahan says. The digital portions of Crystal's designs also enhance the testability and manufacturability of complex analog functions, allowing chip designers to try higher integration levels.

"The advantage of all this digital circuitry is you have more control, interfaces, and adaptive features," Callahan continues. "The disadvantage in chip design is that the more you have digitally, the greater your chances of disrupting or corrupting some of the analog low-level circuitry." The critical hurdles his company faces are on the analog side, he says—"including testing problems."

BEYOND SIMULATION. Crystal's designers use conventional simulation tools provided by digital design-automation packages. Over the past year, Crystal tailored a number of computer-aided engineering packages, adding some of its own analog design tools. But "the boundary between the two regions still has opportunities for imperfect simulations. That is where the skill of our design engineers comes into play," adds Callahan.

Crystal is preparing to introduce later this year a token-ring network transceiver, dubbed CSC 80257, which contains an on-chip decision-feedback equalizer. The equalizer digitally processes an algorithm to fine-tune the transceiver's signal detection.

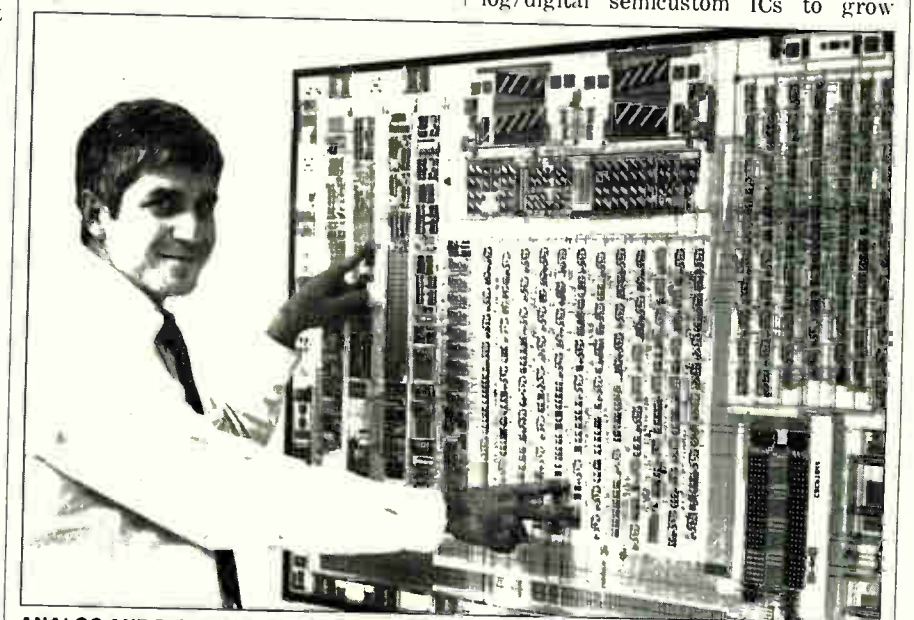
The company also plans to introduce a T-1 telecom transceiver, the CSC 61544, in April. The 1.544-Mb/s pulse-code-modulation IC carries logic that allows the user to adapt it to specific transmission-line lengths.

Crystal's future family of analog-to-digital and digital-to-analog converters will have integrated self-calibration random-access memory and logic. The goal is to achieve 12- to 16-bit accuracy through self-adjustment circuits.

Scattered around many of Crystal's analog circuits are 1-, 2-, and 4-bit digital signal processors. Embedded DSP blocks are used on the CSC 7008 universal filter chip to offer 2^{72} different filtering possibilities. The digitally programmable 8-pole filter has a patented architecture that greatly reduces the die area required for a wide range of implementations. Crystal plans to offer filter-development software for personal computers, which, along with add-on hardware, will let users try out coefficients in a matter of minutes.

"In the analog world we are approaching the same place where we were in the microprocessor world five or six years ago," believes T. Allan Hamilton, vice president of marketing. "One of the levels of expertise that we have been able to cultivate is systems knowledge," he adds, referring to Crystal's team of analog-chip designers, which includes seven who came from AT&T Bell Laboratories.

Crystal will start introducing standard products during the second quarter. In addition, it plans to market semicustom application-specific ICs using a cell library compiled while building up its core of standard products. Crystal expects the total market for mixed analog/digital semicustom ICs to grow



ANALOG AND DIGITAL. Crystal Semiconductor's Callahan says his company's analog CMOS ICs will carry large amounts of digital circuitry for interfacing, control, and self-calibration.

from $55 million a year now to $640 million in the next five years.

The startup, funded with an initial round of $4.5 million in venture capital in October 1984, is aiming its digitally enhanced analog ICs at emerging market niches in telecommunications, data communications, instrumentation, and industrial automation. Its six-year plan sets a revenue goal of $100 million. Its investors include former Mostek Corp. executives Berry Cash and L. J. Sevin.

Crystal is forming a network of strategic partnerships with chip makers operating wafer-fabrication lines and assembly plants. The pacts are intended to guarantee plenty of 3-μm CMOS capacity. Product exchanges are also likely as Crystal expands its product line, adds Hamilton. *–J. Robert Lineback*

PERIPHERALS

FLOPPY DISK VERTICALLY STORES 4 MEGABYTES

KAWASAKI, JAPAN

As other floppy-disk drive manufacturers line up behind a new generation of 3½-in. disks with unformatted capacities of 1.6 and 2.0 megabytes, Toshiba Corp. is moving boldly to even greater densities. The company is offering samples of 4-megabyte drives that use vertical recording on disks with a novel barium ferrite magnetic coating.

The Kawasaki company's approach saves money over longitudinal recording because the drive mechanism is similar to that of earlier products with 80 tracks per side at 135 tracks/in., but four times as much information is recorded in each track. It was necessary to design a special—though fairly conventional—record/playback head for the medium. This head is much simpler than those required for earlier vertical-recording techniques.

The combination of vertical recording and the BaFe medium increases maximum recording density from 8.7 to 35 kb/in., and quadruples the data-transfer rate. The BaFe itself is in the form of ultrafine hexagonal platelets that measure only 0.05 μm across facets. The platelets are thin with respect to this dimension (see figure). The axis along which magnetization occurs easily is perpendicular to the platelets, making them ideal for high-density vertical recording.

Vertical recording yields high density because adjacent perpendicular domains do not tend to demagnetize each other, in contrast to the commonly used longitudinal techniques. Standard floppy disks use a cobalt-doped ferrite coating consisting of relatively long, rod-shaped particles that are most easily magnetized in the longitudinal direction.

In earlier demonstrations of vertical recording, Shun-ichi Iwasaki of Tohoku University, Sendai, and others used two layers of sputtered metal. Toshiba also experimented with sputtered metal media [*Electronics*, Oct. 6, 1982, p. 68]. Besides being expensive to apply, though, metal films often are nonuniform, prone to defects, and have short lives.

Key to increased density is coating of barium ferrite

Now Toshiba has turned to a conventional process with magnetic particles in an organic binder. The unconventional magnetic material is the key.

Another problem with earlier attempts at making vertical recording practical was the complex head required. For example, the head developed by Iwasaki's group is mechanically inconvenient because its two halves are on opposite sides of the disk. But Toshiba has been able to use a far more conventional ring-type recording head. Though the field in the gap of such a head is longitudinal, leakage flux provides a sufficiently strong perpendicular component for vertical recording and playback.

In longitudinal recording, the ring heads cannot achieve the same data density. To do so, the medium's coercivity would have to be about 1,400 Oe to prevent demagnetization, which would cause head saturation. The BaFe used in the prototype disks has a coercivity of 750 Oe, but BaFe coatings can be designed with any value from 400 to 1,400 Oe, Toshiba says.

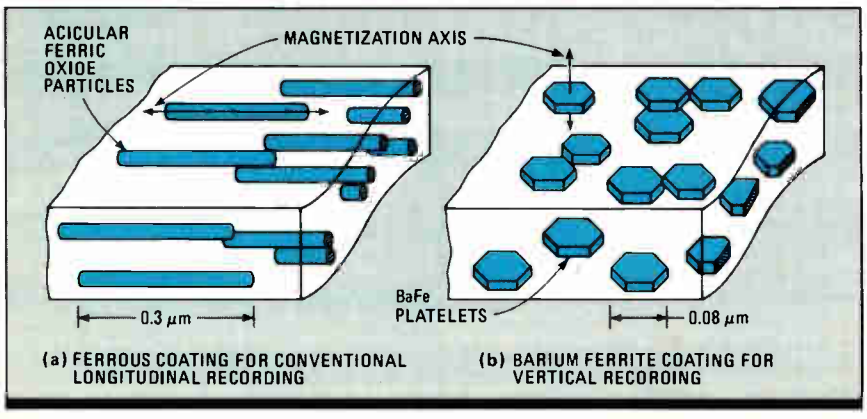
Coated disks and standard ring-type heads present problems of their own, however. Coating thicknesses under 1 μm for the BaFe medium sacrifice reliability, Toshiba says, and it is thus impractical to use the standard recording method in which a single head writes data to a new disk and overwrites data on a previously used one.

In Toshiba's drive, the magnetic field from the 0.35-μm-gap heads extends only part way through the coating. This is acceptable for reading on and writing to new disks. But because recording depth depends on both gap length and head current, the field during a successive write operation might not extend as deeply, causing incomplete erasure of previous data. Thus residual magnetization from an earlier write, especially if the data was written by another drive, could corrupt data. Disk interchangeability would be impaired.

Toshiba's engineers solved the problem by mounting a dedicated erase head with a 2.5-μm gap 200 μm in front of the recording head. This longer gap creates a magnetic field that extends into the base film and completely erases old data. The head's gap is wider than the recording head, so the old track is completely erased and a new one can be recorded even if the positioning of old and new tracks is not identical.

The method in some respects reverses normal practice. With conventional tunnel recording, as it is called, the recording head has a gap somewhat wider than the specified track width. The recording head is followed by two narrow erase heads that straddle the track to trim the recorded strip to a specified width and create an unrecorded guard band between tracks.

It appears likely that another disk medium, cobalt-doped gamma ferrite, will beat Toshiba's BaFe floppy disks to the market. A number of vendors—among them Hitachi Maxell, Matsushita, Mitsubishi Electric, NEC, Sony, and TDK—are planning to offer 1.6- and 2.0-megabyte (unformatted) 3½-in. disks and drives of this type. *–Charles L. Cohen*



MAGNETIC. The particles used for most longitudinal magnetic recording (a) are relatively long compared with the BaFe platelets of Toshiba's high-density vertical-recording medium (b).

LASER MAY FIT IC PROCESSING ON DESK

SANTA CLARA, CALIF.

Laser pantography could eventually make possible a desk-top integrated-circuit prototyping facility. That day is still far off, but the technology, in which a laser is used to control a thermally driven chemical reaction at the surface of a semiconductor wafer, could easily grow into a $250 million business by 1990, according to Burns Research Corp.

First use: writing metal lines on gate-array ICs

In a report released late last year, Art Elsea and coauthor Otto Draper of the Santa Clara company point out that controlling chemical-vapor-deposition or etching reactions with a laser beam opens up the possibility of directly writing a pattern on a wafer without the usual lithography steps of spinning on a resist, baking, exposing, and so on. Elsea, manager of process physics at Burns, predicts that the first generation of commercial laser-pantography equipment will be announced within the year. Several companies are rushing to produce the first commercial machine that performs this type of IC processing.

At the same time, laser-pantography technology is being developed in government-funded work at Lawrence Livermore National Laboratory and at Columbia University. Prototypes are being worked on now that will be aimed at the semicustom gate-array field, he says. These units will write lines of metal or polysilicon interconnection and etch vias on gate-array wafers. Laser-pantography machines with more extensive wafer-processing capabilities may be only a few years down the road.

Laser pantography is typically done in a chamber slightly larger than a wafer's diameter and about 2 to 3 cm deep. The chamber has a fused-quartz window on its top for the laser to pass through and orifices in its sides for introducing gas.

LOCAL REACTION. To write metal interconnection patterns, organometallic gases containing nickel, aluminum, or gold are used. Once a process gas has been introduced into the chamber, heat to drive the reaction is generated locally by a laser impinging on the wafer. With a narrow laser beam, the reaction can be localized to an area 1 μm in diameter.

The laser is scanned by means of an optical column and movement of the chamber's table. This process writes a pattern on the wafer. The laser, a continuous-wave argon-ion type, typically delivers power in the range of hundreds of milliwatts to the wafer's surface. It heats the localized surface to a point in the range from 500°C to 1,100°C, depending on the process.

Many market researchers have already predicted that the market for application-specific ICs will boom in the next five years. Laser pantography, with its very fast turnaround time for small numbers of chips, lends itself well to the ASIC market, particularly in the customizing of gate arrays.

But laser pantography can do more than wire gate arrays. A second generation of machines now in the laboratory stage will fabricate the active devices underneath the interconnections. Elsea doesn't see this as becoming practical for several more years. But it is conceivable that a laser-pantography machine will be able to complete an entire IC from scratch, starting with a raw silicon wafer and data tapes. This type of system will be able to do doping, etching, and interconnect wiring.

Laser pantography is only one of many ways the laser is making itself felt in the world of IC processing [*Electronics*, Jan. 6, 1986, p. 70]. The market for laser-based IC-processing equipment is expected to grow from $1.2 billion in 1985 to some $3.5 billion in 1990. Most will come from mask- and wafer-inspection systems and for wafer-stepper applications. But as IC features shrink, applications such as laser pantography, photo CVD, micromachining, and doping will increase. *–Jerry Lyman*

A NEW WAY TO MEASURE MAY SPEED IC SHRINKING

CONCORD, MASS.

A marriage of optical microscopes and imaging technology could speed the next generation of semiconductor devices. This union of technologies—known as digital microscopy—gives semiconductor makers a crucial ability: to measure features smaller than a single micron in real time.

IVS Inc. of Concord is demonstrating equipment it says can repeat measurements of features as small as 0.5 μm to within 0.002 μm for a broad range of targets. Soon, the company expects, it will be joined by others. "I think we have a technology lead of 9 months to 15 months," says Rene Verhaagen, director of marketing and sales.

The front end of the IVS system is a high-quality optical microscope attached to a vidicon-based high-resolution video camera. Images from the camera are transmitted to an image processor, where they are digitized and can be stored in one of three frame buffers in the system. Each buffer can store images with resolutions of 512 × 480 × 8 bits, yielding 256 shades of gray. Or two buffers working in tandem can provide 16-bit results.

The hardware and software provide for a variety of image-enhancement techniques and filter out optical imperfections. But where IVS believes it moves technology substantially forward is in software algorithms for edge detection. "The issue was, 'How can you make measurements that go beyond the limits of optical resolution?' We are extracting information that in the optical image is obscured by noise," says Eutimio Saporetti, IVS vice president of engineering.

FEATURED IN 3-D. The IVS system features an image-shearing function that gives 3-d effects to irregularities.

Other attempts to measure lines heretofore have concentrated on distinguishing single points on either side of the feature for reference. Such algorithms, which are incorporated in the IVS system, work well down to about 1.5 μm but are inadequate for finer measurement.

To get below a micron, IVS found it necessary to examine the image of the entire line profile. "When you have a single point, you have a

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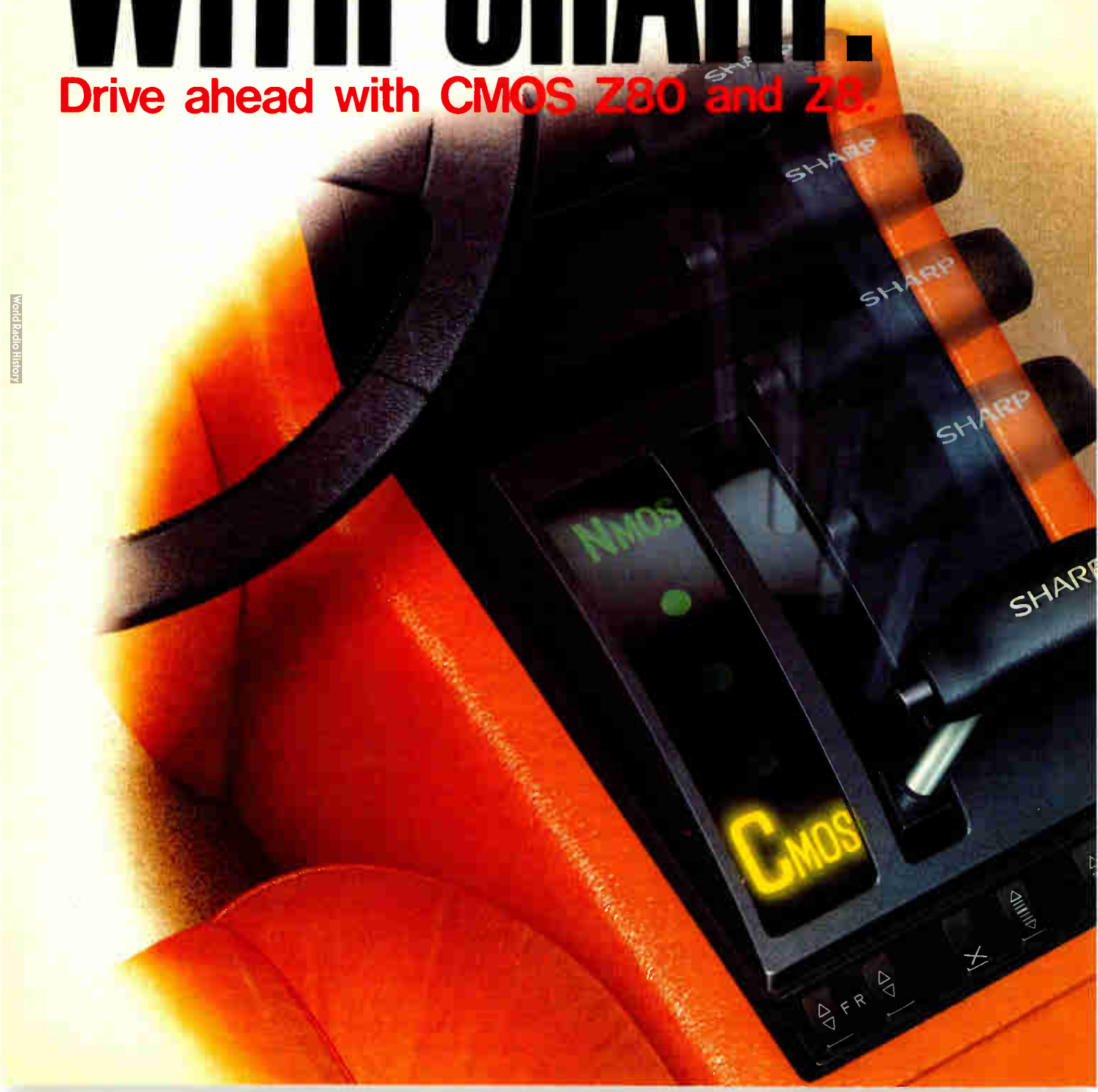

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Z80 CMOS Family (8-Bit CMOS Microcomputers)

Type No.	Description	Features	Package
LH5080 LH5080M LH5080A LH5080AM	Central processing unit	●8-bit microprocessor compatible with LH0080 (Z80 CPU) of NMOS process. ●Fully static operation. ●10mA (TYP.) supply current. ●2.5MHz (MAX.) clock frequency. (LH5080, LH5080M) ●4.0MHz (MAX.) clock frequency. (LH5080A, LH5080AM)	40 DIP 44 QFP
LH5080L LH5080LM LH5080AL LH5080ALM		●Equivalent to LH5080. ●Power-save mode with the execution of HALT instruction. ●50μA (TYP.) in power-save mode.	
LH5081 LH5081M LH5081A LH5081AM	Parallel I/O controller	●Compatible with LH0081 (Z80 PIO) of NMOS process. ●Fully static operation. ●2mA (TYP.) supply current.	40 DIP 44 QFP
LH5081L LH5081LM LH5081AL LH5081ALM		●Equivalent to LH5081. ●Power-save mode with the execution of HALT instruction. ●50μA (TYP.) in power-save mode.	
LH5082 LH5082M LH5082A LH5082AM	Counter timer circuit	●Counter/timer device which is compatible with LH0082 (Z80 CTC) of NMOS process. ●Fully static operation. ●2.5mA (TYP.) supply current.	28 DIP 44 QFP
LH5082L LH5082LM LH5082AL LH5082ALM		●Equivalent to LH5082. ●Power-save mode with the execution of HALT instruction. ●50μA (TYP.) in power-save mode.	

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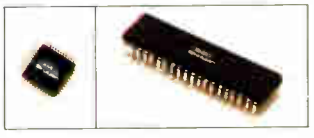

Z8 CMOS Family (8-Bit CMOS 1-Chip Microcomputers)

Type No.	Cycle time MIN. (μS)	Supply voltage (V)	Current consumption TYP. (mA)	No. of inputs/outputs	ROM (bit)	RAM (bit)	Subroutine nesting level	Package	Remarks
SM803	2.2	5	24	32	4096x8	144x8	Uses RAM area	40DIP 44QFP	Z8 CMOS type (pin compatible to NMOS Z8)
LU800V1	2.2	5	12	32		128x8	Uses RAM area	40DIP 44QFP	For development of SM803 For pilot production

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noisy result," says Saporetti. Besides, he adds, the line edge is not a single point but a series of points. "By looking at the whole line profile, and in particular at the peaks and valleys [diffraction lobes] at the base of the line as well as the top of the line and taking into account the system transfer function, the end result is more repeatable than looking at a single point."

The most edge information is found at the highest spatial frequencies. But it is at those frequencies that the system's signal-to-noise ratio is reduced. To increase the ratio, IVS employs the system's imaging hardware and, Saporetti says, "we get a lot of mileage out of time integration."

System performs highly repeatable submicron checks

While boosting the S/N ratio, IVS also uses special proprietary algorithms to correct for video and electronic distortion of the image. Both processes occur in 2 to 6 seconds. Using the edge-contrast algorithm, software can then perform a width measurement by first inspecting the diffraction lobes and edge profile to determine where the edge slope begins and ends. The user selects a percentage of that distance to determine where the line begins. An alternate algorithm can automatically select this position.

Applying the algorithms to the entire profile of the line, says Saporetti, results in a three- to five-magnitude improvement over single-threshold algorithms in measuring submicron features. "For 0.5-μm developed photoresist on chrome, we can achieve repeatability of 0.002 to 0.003 μm."

To calibrate the machine, IVS digitizes a target image, superimposes it over a standard, and then counts the pixels per unit.

An autofocus routine selects an optimum focus for a particular structure, from which operators can offset for examining other wafer layers. But for the problem of distinguishing between layers, the IVS system relies primarily on selective focus by the operator. "We don't have magic," says Saporetti. "In some cases, it's very easy; in other cases, it's impossible." *–Craig D. Rose*

TELEVISION

TWO-CHANNEL BROADCAST GIVES HIGH-QUALITY 3-D TV

MUNICH

A new way to broadcast three-dimensional color TV using only two channels has been developed by researchers at the Institut für Rundfunktechnik (IRT)—the Institute for Broadcast Engineering. The research and development arm of West Germany's two national TV networks, ARD and ZDF, has produced the sharpest picture and best depth perception yet obtained in 3-d TV, agree German and Japanese researchers in the field.

Broadcast of 3-d programs using the technique is not practical in the near future, however, because of the need for two broadcast channels and for modification of present TVs. So IRT researchers are also toying with the idea of combining the two channels into one special high-quality channel that could be broadcast using high-definition TV schemes. The technique, which uses ordinary TV signals, requires additional studio equipment. In addition, viewers must wear polarized glasses, though future plans call for development of a special lenticular raster system to eliminate this need.

Japanese engineers investigating 3-d color TV who have seen IRT showings "concede they have not obtained the picture crispness and depth quality that we have," says Rüdiger Sand, head of the Munich institute's TV-display technology department.

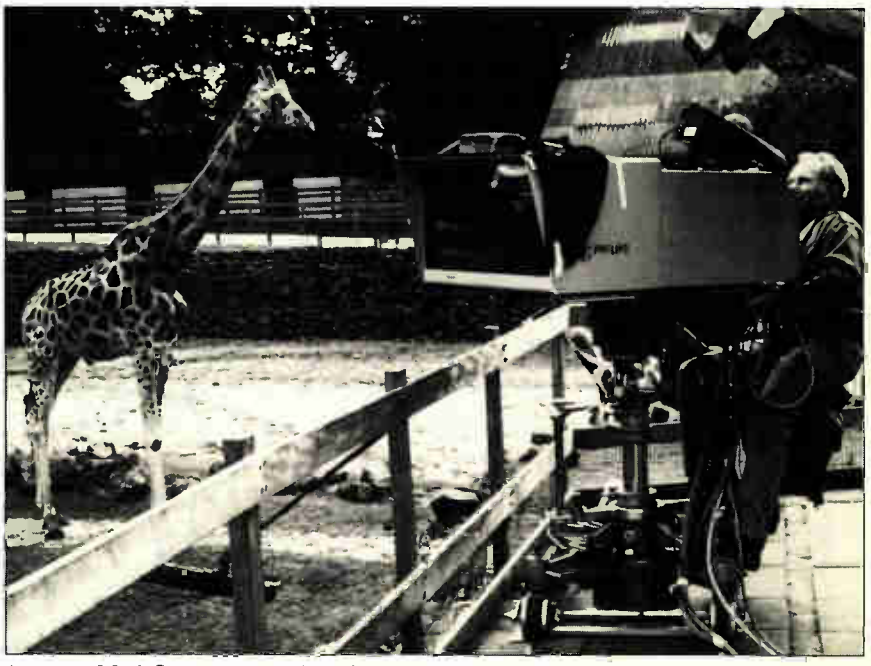
In a closed-circuit, cable-based application, the two-channel concept uses identical hardware in each channel: there are two camera systems, two synchronized tape recorders, and two projectors that focus two pictures on a screen.

The two-channel technique, which is also being pursued in Japan, is a big improvement over the anaglyphic method that made news in Germany and elsewhere a few years ago [*Electronics*, Feb. 10, 1982, p. 71]. This older method relies on the transmission of the pictures for each eye by means of the color signals of a conventional single-channel TV system. The viewer must wear red-and-green filtered glasses to separate the signals.

COLOR FIDELITY. Most who tried it found it irritating to wear glasses with different color filters for each eye. And with anaglyphic methods, the 3-d image comes at the expense of color fidelity—a drawback that viewers would not accept. Such methods proved to be a dead-end technology; as one expert puts it, "it turned out to be a gag."

Despite the IRT technique's advantages of true 3-d imaging, high sharpness, color fidelity, and lack of jitter and noise, Sand has no illusions about 3-d TV being publicly introduced for regular broadcasts in the near future. Given the limited channel capacity for terrestrial—and even for satellite—broadcasts, network operators are not soon likely to set aside the two channels needed.

A way out of this dilemma could be high-capacity cable TV. But station operators would still need double the amount of studio equipment for one 3-d program than for regular single-channel-transmitted programs. Financially strapped as many of them are—at least



AT THE ZOO. A German crew takes pictures for use with IRT's 3-d TV system at a Dutch zoo, using a camera system that was developed at Philips's lab in Eindhoven, the Netherlands.

in West Germany—TV stations may be reluctant to invest in more equipment.

The biggest roadblock, however, is the receiver. A new breed of TV set would be needed, one that uses two channels per program. But the industry will certainly not build such sets until two-channel transmissions take place. All told, Sand does not expect 3-d TV for public broadcasts to come about for another decade or so. "If any country comes along sooner, it will probably be Japan, where the industry is bolder than elsewhere."

HDTV, with its six-times greater bandwidth and twice the line numbers of standard TV, provides an excellent means of transmitting both pictures of 3-d TV. To make it possible to exploit HDTV's potential, the IRT team will start development this year of a universal color receiver which, besides standard pictures, will allow pickup and display of either HDTV or 3-d TV images.

If not for public broadcasts, 3-d TV is a near-term possibility for closed-circuit applications. Here it could serve, for example, as an attractive advertising medium in department stores, for demonstration purposes at trade fairs, and as an educational aid in schools.

For these applications, the heart of IRT's two-channel scheme is a stereo recording system developed at the Research Laboratories of electronics giant Philips Industries, Eindhoven, the Netherlands. Resembling human vision as closely as possible, the system consists of two cameras mounted on a base plate, each camera recording pictures for one eye of the viewer.

For optimum depth perception, Sand says, it would be desirable that the inter-axis distance between the cameras be variable down to a few centimeters, that is, to the interaxial distance—typically 6.5 cm—between the human eyes. That, however, is not possible because the cameras, although slim, still have too wide a lateral dimension for best results. Too large a distance between the cameras would cause a somewhat exaggerated perspective of some scenes.

DONE WITH MIRRORS. To get around that problem, the Philips designers hit upon an optical arrangement using a prism and a semi-transparent mirror, an arrangement similar to that employed in 3-d cinematography. One camera records the picture through the mirror, which is mounted at a 45° angle relative to that camera's light path. The mirror also deflects the image by 90° to a prism, which redirects it to the other camera.

By varying the position of one camera, it is possible to narrow the distance between the image centers of the cameras to the point where the two pictures merge. This variability to practically zero allows the Philips system to record 3-d images of insects with considerable sharpness.

The two-camera system is designed for all recording functions, such as zoom and close-up. All mechanical operations are servo-controlled. Eventually a microprocessor will handle control functions.

The signals for the left and right pictures are recorded with two coupled studio-type 1-in. B-format magnetic recording machines from Darmstadt's Robert Bosch GmbH. Reproduction is with two color-TV projectors from the Belgian company Barco Electronic NV. Each projector has three projection tubes, one each for red, green, and blue. These focus the pictures onto a metalized screen with a 2.5-meter diagonal. *–John Gosch*

INTERNATIONAL TRADE

JAPANESE EASE ENTRY TO MOBILE-RADIO MARKETS

TOKYO

A new U. S.-Japan agreement simplifying equipment-approval procedures and technical standards and allowing foreign companies to operate third-party radio services in Japan will create the "level playing field" that American companies have been pushing for. "We now have essential parity in radio market service procedures," says Richard C. Beaird, director of strategic planning for the U. S. Commerce Department's National Telecommunications Information Division.

The radio services agreement concluded the telecommunications portion of the four-sector U. S.-Japan trade negotiations. Last year, other agreements liberalized the overall telecommunications market, allowing the entry of foreign companies into previously regulated markets such as satellite communications. Negotiators also agreed on standards and certifications for terminal equipment last year.

The talks concluded earlier this month with three key concessions from the Japanese. First, they will toss out all but one of their 10 technical standards for approving market entry of radio receivers. Second, they will base equipment approval procedures on the same simplified criteria agreed to in the telecommunications-terminal negotiations concluded last spring.

'Agreement will open important markets for U. S.'

Third, the Ministry of Posts and Telecommunications (MPT) will amend its Radio Wave Law to allow foreign companies to obtain station licenses and offer all types of land mobile services. The law could change as early as this spring or as late as December, depending on how quickly the Japanese Diet acts, says chief U. S. negotiator Clyde V. Prestowitz, counselor to the Secretary of Commerce.

It is not known how much U. S. radio equipment will be sold in Japan in this more open market. Industry sources say that although Nippon Telegraph & Telephone Corp., which now dominates the car radio business, will face real competition for the first time, it will be close to two years before any new ventures begin marketing services.

Nonetheless, one U. S. executive says, "this agreement, if it's enforced, will definitely open up some very important markets for us." There are only an estimated 40,000 to 50,000 car-telephone subscribers in Japan, however, and the market for portable data terminals is pure potential—it doesn't yet exist.

Opportunities arise not only from this month's 11-point agreement, but from earlier approval by an MPT advisory group of the Advanced Mobile Phone Service system now in use in the U. S. The decision to allow the U. S. system, which uses a 12-kHz bandwidth, to coexist with the 5-kHz NTT system cleared the way for manufacturing tie-ups between U. S. makers and Japanese customers, and for direct marketing by U. S. vendors.

Several new Japanese ventures, including Daini Denden Inc., Tokyo, have announced their intention to enter the car radio market and their interest in U. S. equipment. The major U. S. beneficiary figures to be Motorola Corp.'s subsidiary, Nippon Motorola Co.

Nippon Motorola of Tokyo, with manufacturing contracts under which it builds gear to NTT specifications, sold only about $14 million worth of pagers and $3 million worth of mobile phones to NTT last year. The new agreements clear the way for Motorola to market its own products and sell them to NTT competitors such as Daini Denden.

Daini Denden expects to receive its radio-services license from the MPT this summer, and hopes to offer services by early 1988. First, however, Nippon Motorola and Daini Denden must make the modifications necessary for the new service to interface with the NTT telephone system. *–Michael Berger*

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LSI Logic Counts on Sandfort to make its Mark in Europe
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NEC Fashions New Fab Process
Olivetti's Viti Directs ET Designs that Marry Bus & Art
German Startup's Success Surprises Europeans
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OBI Rains on IBM's Parade
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NEC's CPU Leapfrogs IBM
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May

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Singapore Casts Lot with Software
Philips' Eurom Chip Finally Debuts
Sagging Prices Sting Japanese Producers
British Telecom Spreads Its Wings with Mitel
South Korean IC Maker Seeks World Markets

June

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INSIDE TECHNOLOGY

STORAGE/LOGIC ARRAYS FINALLY GET PRACTICAL

SILICON COMPILER SPEEDS SLA DESIGNS AS DENSE AS FULL-CUSTOM ICs

Suhas Patil excited a good many chip designers in 1979 when he invented the storage/logic array. One reason: this technology promised chip densities two or three times greater than either gate arrays or standard cells—even densities approaching those of full-custom, or handcrafted, design. But their enthusiasm quickly cooled when designers found out how difficult it was to design complex application-specific integrated circuits with this technology.

Little was written or done about storage/logic arrays and the design was rarely used. What people were waiting for was for someone to develop a computer-aided design system for SLAs that would make it easier to design ASICs. Patil to the rescue. The founder and vice president of research and development at Cirrus Logic Inc. has coupled the SLA with a powerful double-level silicon compiler to design highly complex ASICs. Now the Milpitas, Calif., company is gearing up to produce 24-MHz hard-disk controllers and other custom microprocessor peripheral circuits at turnaround times of only three to six months (see "Cirrus Logic keeps it simple for the customer, p. 32). These designs promise the small chip size and high performance of handcrafted VLSI circuits that take a year or more to develop with conventional logic circuitry.

The primary difference between the SLA and a conventional gate array and standard cell is that the SLA uses both localized and distributed gates. The distributed gates perform both logic and interconnection functions. So, unlike gate arrays and standard cells, there is no need to set aside wide channels for SLA interconnections. This significantly improves density and gate-utilization efficiency.

Conceptually, an SLA is a distributed logic system made up of a plane of AND gates interleaved with a plane of OR gates, which are supplemented by flip-flop storage elements. This is in contrast to a programmable logic array, in which AND and OR gates occupy separate planes. Physically, a PLA is a transistor array, with flip-flops, comparators, state detectors, inverters, and buffers scattered throughout. These are interconnected by a superimposed X-Y wiring matrix that requires a myriad of breakpoints to define the logic functions and modules.

The SLA is a variation of the traditional PLA used in many handcrafted and semicustom standard-cell designs in that the AND and OR arrays are folded together so that input and output lines alternate within a single array (Fig. 1). This has two important effects. First, many more flip-flops can be added without the need for additional I/O space. Second, rows of the array (conjunction signals) can be subdivided into multiple independent segments that can represent independent variables over smaller portions of the array. As a result, more flip-flops can be added at intervals along the columns of the array, so that the columns can also be subdivided into segments carrying independent variables with localized access.

An important benefit of this capability is that, unlike traditional PLA structures, portions of an SLA can be used for independent tasks. This permits much denser packaging of logic into an array and execution of much more complex functions on a single chip. In an SLA, the AND conditions of the input signals are formed on the rows of the array and the OR conditions on the columns. Complex cells other than those needed to form the AND/OR products of a function can be inserted into the grid at arbitrary locations. The AND/OR cells are of unit size, one row high and one column wide, but the complex cells are multiples of the rows and columns. The row and column wires that connect the cells can be interrupted at any cell boundary. Thus, in contrast to a PLA, the columns and rows in an SLA can be divided into any number of segments required. Discrete modules such as memory, as well as combinatorial logic, can be placed anywhere in the grid and segmented from the other modules by row and column breaks.

As a logic element, the SLA has other characteristics. First,

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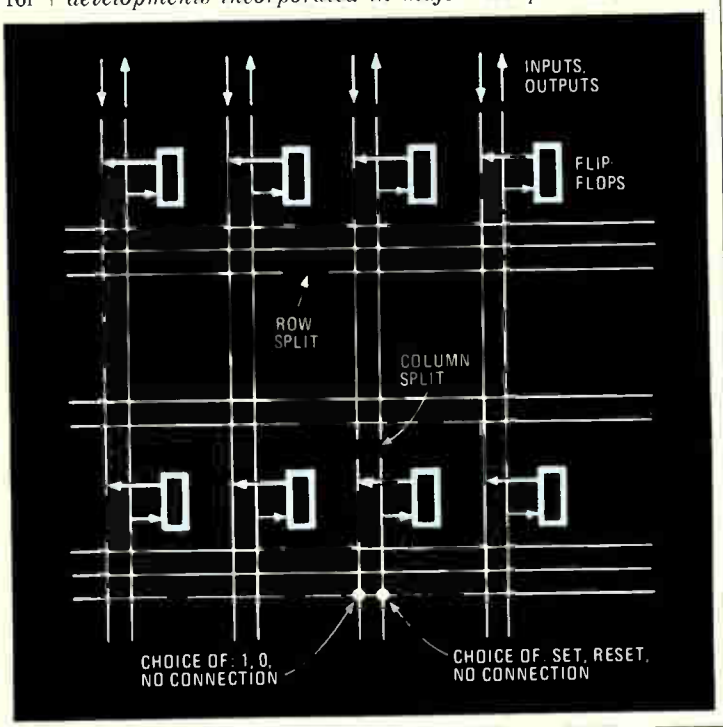


1. SLA STRUCTURE. The storage/logic array owes its density advantages to the fact that, unlike a programmable logic array, the AND and OR arrays are folded together so that input and output lines are alternated within a single array.

each logical column can act as a stored binary variable or perform the logical OR function of the row inputs. When the column segment represents a stored variable, the values can be set and reset by the rows. Second, each row is a conjunction or product term over the selected column variables; a column input may be either the column value or its complement, or there may be no connections from the column to that row. These variables are ANDed to form the row value.

Similar to a PLA, the AND array in an SLA forms selected conjunction, or product, terms based on input data, and the OR array combines these product terms to form the correct sum-of-product output. As in a PLA, an SLA is programmed by selecting, through make/break connections, whether a conjunction or product term line is gated by a 1, a 0, or neither on each input, and whether an output line responds to a product term line.

Contributing to the increased densities is the fact that SLAs allow the designer to achieve an architecture that is well matched to the design at hand. The SLA method does not force a particular architecture on the designer, freeing him to pick the one best suited to his needs, according to company president Michael Hackworth. This is because circuit design is performed by placing logic symbols on a grid, which is the physical representation of the actual chip. In this way, the designer can visualize the logical description of the system in terms of the actual physical layout of the IC.

With an SLA, 200,000 transistors fit on a 400-mil² chip

As a result, chip densities with SLAs already approach those possible with a full-custom, handcrafted design, says Hackworth. For example, in a 250-mil² chip, densities as high as 50,000 to 75,000 transistors are possible—roughly two to three times the density of gate arrays or standard cells. In a chip of about 400 mils², densities approaching 200,000 transistors should be possible—roughly four times those of standard cells and gate arrays.

Because of its density advantages, the SLA methodology initially did get the attention of a number of companies after it was invented. Intel Corp. used an SLA for interrupt control in the iAPX432 micro-mainframe's interface processor, General Instrument Corp. developed an SLA-based video-game processor, and Boeing Aerospace Co. has designed circuits for the military. Boeing researched SLA design methods for the U.S. Air Force's Very High-Speed Integrated Circuits program.

CAD TO THE RESCUE

But most semiconductor companies shied away from the technology because designing large SLAs becomes very difficult without a special CAD system. Cirrus Logic's answer to the problem—the two-level, interactive silicon-compiler—runs the software for the first level on a network of Apollo Computer Inc. color-graphics work stations. Software for the second level runs on a Digital Equipment Corp. VAX-11/750 minicomputer that also compiles the SLA circuit elements. The two systems are linked in such a way that each designer can use the two interactively on the same Apollo work station.

During design, the system designers never see a conventional gate-level layout, as with other CAD systems, much less the actual transistors. Design begins at the architectural and block-diagram level with a high-level design language called Glide that defines the logic functions and enables the CAD system to generate a chip floor plan for the second level.

Complex functions are generally performed by combinatorial logic arrays with functions selected and sequenced by small state machines. The logic circuits that actually perform the functions defined with Glide are designed by the CAD system and then optimized by the circuit designer to meet performance targets and reduce chip size.

Optimization is done at the second level with a symbolic editor called Stride that enables the designer to improve the circuit's performance and adjust the chip floor plan to reduce the silicon area of the compiled array. In effect, the design cycle is analogous to writing a computer program in a high-level computer language and optimizing inefficient routines in assembly language. A computer's compiler and assembler handle the machine-coding details but must follow the programmer's design. Similarly, with Cirrus Logic's system, the software that actually compiles the SLA elements and generates the wafer-fabrication masks is forced to adhere to the adjusted floor plan.

Conventional circuits can also be designed quickly with conventional silicon compilers. However, the chips are generally 30% to 50% larger than handcrafted designs because the CAD system rather than the designer controls the chip layout, as Hackworth notes. Design starts with standardized bus structures, the designer arranges building blocks in predetermined data paths, and then the silicon compiler lays out the chip automatically. "So whatever the computer lays out is what you get," Hackworth says. "And if it doesn't meet the performance target, the designer must try different architectures or semiconductor technologies." Standard-cell circuits and gate arrays are also based on predetermined structure and also require extra chip area for interconnection wiring channels, he adds.

In contrast, the Stride/Glide approach takes advantage of the fact that an SLA's active elements and interconnections generally occupy the same chip area because even bus structures can be incorporated in the superimposed X-Y wiring grid. If the circuit contains random-access and read-only memories, conventional RAM and ROM arrays must be added to the array, but these are also very dense.

The design process starts in the silicon compiler's Glide mode after the ASIC specification based on a previously developed generic design is customized. The system designer assigned to the project first uses an Apollo work station to modify the generic design's architecture with the Glide graphics and linguistics. The result is a block diagram that is both a functional specification and the circuit's initial floor plan (Fig. 2, top). The diagram includes block-to-block connections, register sizes, and the like. With the high-level language, the functions of each block are entered in three forms: a state-machine language consisting of "when... do" statements that specify how the control logic should react to particular conditions; truth tables for combinatorial logic; or "when... then" statements, also for combinatorial logic functions, that contain Boolean logic equations. If a function is already an industry standard in the CAD software library—such as a standard microprocessor bus—the designer simply types in the function's name. The designer can also position and specify conventional memory arrays.

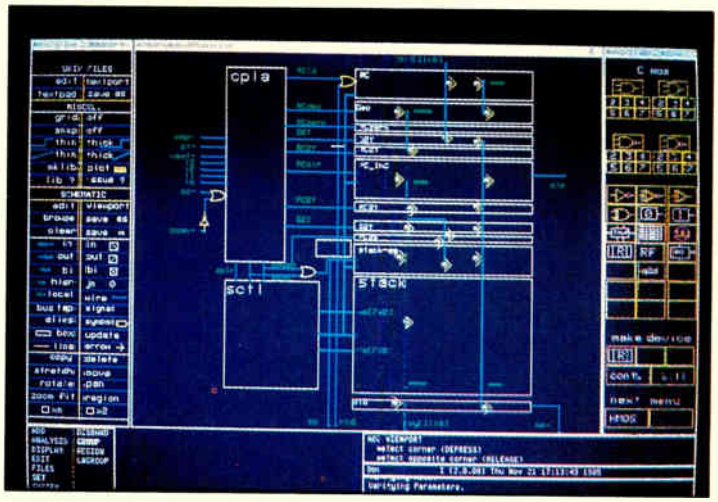
GLIDING THROUGH DESIGN

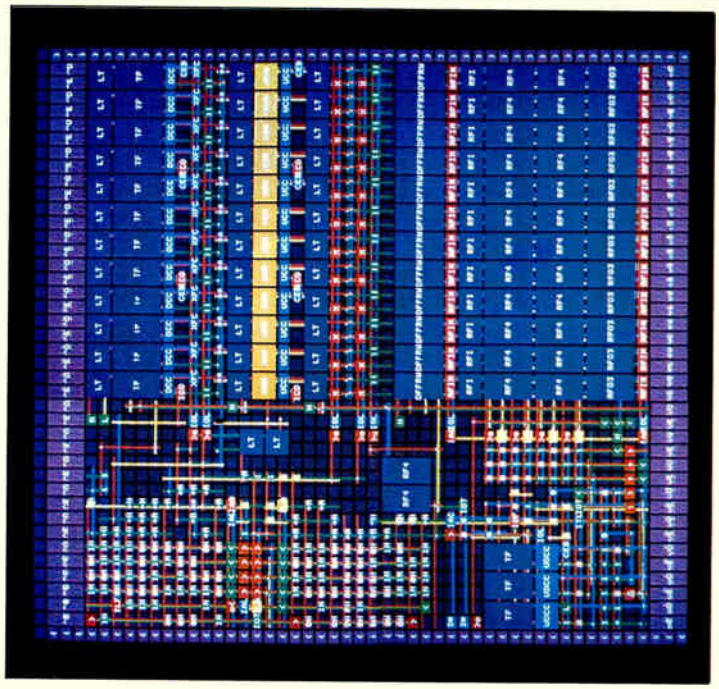
At this point, the Glide software synthesizes the logic of each block hierarchically down to the gate level. The synthesis permits simulation of the circuit's operation at the gate-level detail needed to detect and correct any design errors and verify the design's functionality. Because the circuit designer does not need to create a detailed logic schematic, this step alone can save several weeks of design work.

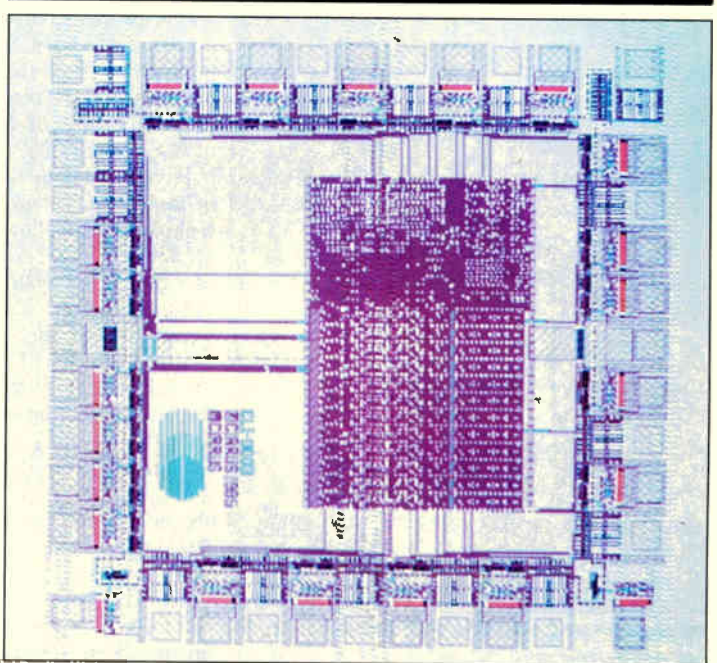
A designer using a conventional silicon-compilation system would also route the interconnections at this stage in the design cycle. Also, with a conventional silicon compiler, the designer works only at a high level, so the layout is the compiler's best effort. With the two-level, interactive CAD technique, however, detailed implementation of the floor plan is supported by Stride software. This level allows the designer to optimize the floor plan and ensures that the compiled array structures will be laid out efficiently by the CAD system.

The Stride system displays the floor plan, with labels that define the modules' functions, in a multicolor X-Y grid, on the

2. BENCHMARK TEST. To compare the density of SLAs and handcrafted circuits, Cirrus Logic designed an SLA version of the 29C10 controller. The block diagram (top) was created with the Glide high-level design language; the floor plan (middle) was developed with the Stride symbolic editor; the third step (bottom) formed the chip-metalization pattern.







designer's Apollo work station (Fig. 2, middle). Next to the floor plan, the system displays a 30-character alphabet. Each character is a symbol or letter representing a type of SLA microelement, which ranges from very fine-grained structures, such as Boolean elements 1 and 0, to D-type flip-flops. There are also symbols for specifying whether the flip-flops should read, read and write, be changed to a Q-type, and so forth.

Symbols are selected from the alphabet and positioned in the floor plan with a mouse, much like painting by numbers. For instance, if a module's functions are defined by a truth table, the designer fills in the X-Y grid with 1's, 0's, and +'s. The compiler software will later configure that section of the array to perform the specified combinatorial logic functions. In the Stride display, what looks like X-Y wiring is actually a symbolic grid containing truth tables. As another example, if the floor plan calls for an 8-bit register, the designer places a row of eight D symbols in the block.

Because the entire floor plan is only a symbolic representation of the functions to be performed by the actual array, the designer can modify the floor plan in any way needed to optimize the design. It can be massaged, for example, to squeeze blocks into vacant areas of the array and thereby reduce the size of the actual array and the chip. These operations do not affect the integrity of the design. To catch logic or timing errors, the designer again simulates circuit operation.

At the Stride level, the CAD system synthesizes the SLA design down to the transistor level. Circuit timing is then simulated, analyzed, and corrected. Although the array has not yet been compiled, timing is simulated with real circuit parameters. Because the variety of array elements is so small—the same as the 30-character alphabet—each has been characterized on test chips in combination with elements that will be next to it in the array. Most timing errors can be corrected at the Stride level by inserting buffer symbols in slow data paths or by changing the positions of modules at the Glide level. Occasionally, a problem might require an architectural change.

After logic and timing are verified, the CAD system automatically compiles the array in the arrangement indicated by the detailed floor plan. The resulting circuit (Fig. 2, bottom) is correct by construction because the CAD system's layout software must follow the verified floor plan and because the design rules required to implement the actual array are contained in the CAD software. As the final step, the CAD system produces the tapes for generating the wafer-fabrication masks.

Designs can be modified at any time up to wafer fabrication. The floor-plan X-Y grid can be opened to insert more functions (symbols), or closed after functions have been deleted without affecting the integrity of other functions. Even major architectural changes, such as expanding a bus's width, can be accomplished within hours. Also, considerable modification is possible by changing the metalization masks because the functions of many array elements depend on how the elements are wired.

Cirrus Logic's system now compiles designs based on three semiconductor technologies: 3-μm n-MOS, 3-μm CMOS, and 1.6-μm CMOS with two metal layers. The next upgrade is expected to be 1-μm CMOS with two metal layers. □

CIRRUS LOGIC KEEPS IT SIMPLE FOR THE CUSTOMER

Cirrus Logic Inc.'s powerful compiler for designing storage/logic arrays is more than just a way to speed up the designer's job of creating complex very large-scale integrated circuits without sacrificing performance. It is also how the company takes a distinctive approach to the application-specific IC market.

For example, the nature of Cirrus Logic's arrangement with the customer is unique. In gate arrays, the user normally has to supply either a working breadboard of the design to be implemented or a network listing (net list). Then the vendor works with the system designer to develop the final mask sets (which customize the last few layers of the gate array) on in-house computer-aided design tools.

In the standard-cell approach, all layers are customized and the user must take even greater responsibility. Using either his own CAD tools or those supplied by the vendor, he must design a completely customized circuit, using standard-cell and megacell building blocks. The vendor then performs additional operations on this design, such as logic and circuit verification and simulation; finally, working with the user, the vendor fabricates a circuit in which all layers are customized to the particular application.

In Cirrus Logic's generic approach using predefined silicon templates of particular functions, the customer modifies a preexisting design using one of the company's "concept specs." No breadboard or net list is required; the customer needs to supply only the basic functions, the input and output signals, and the basic dc and ac parameters.

FIXED PRICE. The company intends to offer product lines at fixed prices per chip based on silicon templates of generic circuits aimed at specific market and application niches. The fixed prices will cover engineering, manufacturing, and any redesign needed after the prototypes are tried out in the customer's system, even if the customer's specifications were faulty.

Because Cirrus Logic is initially specializing in microprocessor peripheral circuits, its product line of generic silicon template designs will consist of storage controllers, display controllers, and data-communications circuits for microprocessor systems. However, the SLA-based silicon compiler will remain proprietary—or, as company president Michael Hackworth puts it, "we will only sell the product, not the recipe."

The customer simply modifies existing generic designs

Cirrus Logic had the inside track in SLA compiler development because it is the commercial follow-on to Patil Systems Inc., a research group headed by Suhas Patil, the SLA's inventor and now Cirrus Logic's vice president of research and development. He became interested in structured logic design while he was a professor and associate director of Project MAC, an experimental time-sharing computer system at the Massachusetts Institute of Technology in the early 1970s.

Patil turned to development of an asynchronous logic array technique that allowed the relatively straightforward design of circuits and systems that do not require a clock. Out of this work evolved all the present features of the SLA, he says. "But in the early to mid-1970s, the engineers and companies I showed my ideas to were not as interested in the asynchronous features as they were in the ability to combine AND/OR logic, memory elements, and standard logic blocks into circuits approaching handcrafted designs in density." In response, Patil evolved the present synchronous logic form of the array, which retains many of the "correct by construction" elements of the asynchronous form, especially at the chip-layout level.

He subsequently formed the VLSI Group at the University of Utah and started up Patil Systems Inc. in Salt Lake City. Patil Systems moved to Sunnyvale, Calif., and became Cirrus Logic in 1984. Moving the company and key members of the design team from Utah to California, Patil and Kamran Elahian, Cirrus Logic's senior vice president, obtained $7.5 million in first-round funding from venture capital investors and began building a management and engineering team.

One of the first executives approached was Hackworth, then vice president of the MOS Products Division at Signetics Corp., Sunnyvale, Calif. "Normally, in such a position you get at least an offer a week from a new startup looking for executive talent," says Hackworth. "Usually, it is easy to say no. This time it wasn't." As it happened, he says, he was already familiar with the SLA approach, having come across it while investigating advanced VLSI design-automation methodologies for Signetics. "Of them all, including Seattle Silicon, Silicon Compilers, and so on, the SLA approach appears to be the most powerful."

Patil recruited Kenyon Mei to be engineering vice president; he was general manager of Intel Corp.'s OEM Commu-

PRESIDENT HACKWORTH. He'll sell only the product, not the recipe.

R&D VP PATIL. He invented storage/logic arrays and founded Cirrus Logic.

nications Operation and previously held microprocessor engineering management positions at Intel and National Semiconductor Corp. Patil also tapped Michael Canning, formerly president of Teledyne Semiconductor, to be manufacturing vice president.

If there was any one reason why many of the engineers and top management at Cirrus Logic joined the new company, it was their frustration with current approaches to circuit design and design automation. For example, Elahian was president of CAE Systems Inc., a design-automation company that was recently acquired by Tektronix Inc., when Patil approached him with the idea of developing a design-automation software package based on SLA techniques. "I was impressed with the power and sophistication of his methodology," says Elahian. "But my engineers and designers felt it was too far outside the mainstream of their experience in circuit design."

But Elahian was convinced. When his company was acquired in 1984, he visited Patil in Utah and developed a new approach to marketing the SLA: "rather than trying to sell the methodology as a piece of software, or the expertise, sell the results, in the form of VLSI-density semicustom circuits that can be turned around in weeks rather than months."

Cirrus Logic's generic silicon templates are not chips; they are sets of quickly customizable designs for modular interface and control functions. Moreover, the modules are not standard cells; they are circuit designs that can all be organized, customized, and optimized quickly with the company's Glide—a high-level design language—and Stride, a symbolic editor.

The first product is a disk controller being developed with 1.6-μm CMOS technology. This design is an ASIC version of a generic design called the disk-controller chip (DCC). The DCC operates at data rates up to 24 MHz without interleaving, supports a cache memory, resides in either a host system or a drive, and accommodates all generally used bus and disk interfaces. Any of these functions can be customized.

Hackworth points out that VLSI disk controllers must be ASICs because of the great variety of interface and control combinations used throughout the industry. A large family of standard circuits would be needed to cover industry requirements, even though each class of industry-standard interface—microprocessor bus, peripheral bus, and drive interface—requires a relatively small number of options. Therefore, the generic DCC design offers the various industry-standard interfaces as options, but also accommodates custom interfaces and command sets as complex as the Small Computer System Interface from the American National Standards Institute, as well as drive-specific interfaces on the disk side of the controller.

The company is the commercial follow-on to Patil Systems

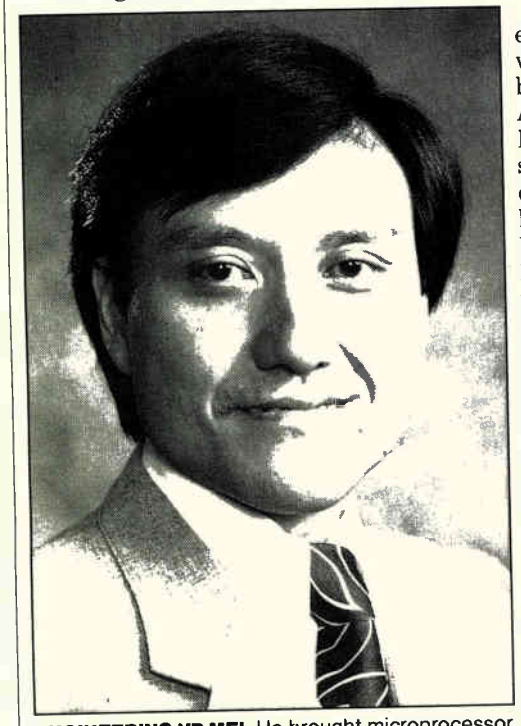
With VLSI controllers, the equipment maker's proprietary variations should be provided by a single ASIC chip or by an ASIC and a microprocessor, Hackworth says. Even high-speed functions that previously demanded bipolar devices can be incorporated in a CMOS VLSI device. For instance, the DCC is specified for data rates up to 24 MHz, but that's actually conservative—some designs could hit 40 MHz. So, the high-speed functions can now be integrated with slower but more complex functions such as error detection and correction, formatting, data management, and interface-bus management.

Hackworth and his coworkers are so confident of the capabilities of the SLA approach that they have arranged an unusual benchmark test with the help of Advanced Micro Devices Inc., Sunnyvale, Calif., to illustrate the technology's chip-shrinking capabilities. Cirrus Logic previously had developed SLA ASICs at LSI complexities that were denser than handcrafted standard circuits, according to Hackworth. However, because the ASIC and handcrafted designs were not the same, some AMD executives called those "apples and oranges" comparisons and challenged Cirrus Logic to an "apple versus apple" contest.

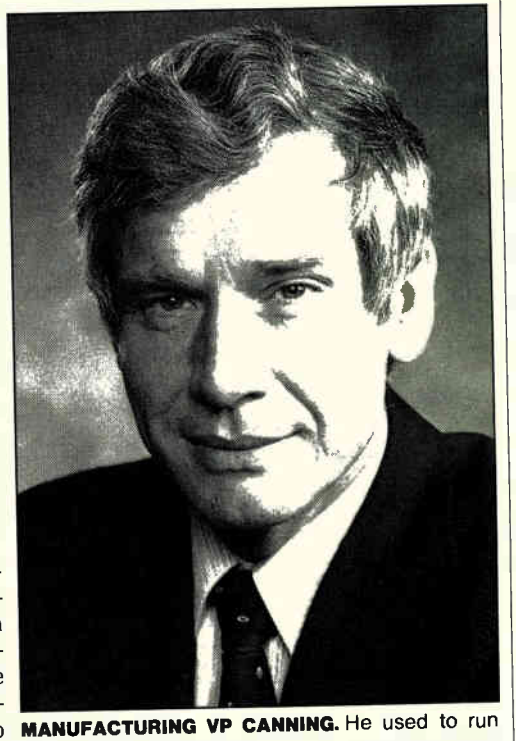
As the benchmark, AMD selected the 29C10, a new CMOS microprogrammable controller for the 2900 processor family. Although the 29C10 is an LSI device, AMD produces the controller with VLSI-density CMOS technology and handcrafts the circuit to achieve maximum efficiency.

FUNCTIONALLY EQUIVALENT. After incorporating AMD's process technology into its CAD software, Cirrus Logic designed a functionally equivalent SLA in only eight man-weeks. The chips are the same size because their overall dimensions are dictated by the bonding-pad ring; the SLA core—the actual circuit—is slightly smaller than the handcrafted core. Timing simulations indicate that the SLA version's speed will be at least as good as the handcrafted design's speed. However, "we won't see first silicon until early 1986," says Hackworth.

Both versions were based on AMD's 1.6-μm CMOS technology, which features an effective transistor gate length—the dimension generally used today to indicate functional density—of 1.6 μm and the double-metalization-layer processes needed to produce very dense SLA arrays. □



ENGINEERING VP MEI. He brought microprocessor know-how from Intel.



MANUFACTURING VP CANNING. He used to run Teledyne Semiconductor.

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Executive Outlook

WHAT'S WORRYING INDUSTRY LEADERS

The business outlook, trade, and increased competition head their concerns

In good times, the flood of business tends to "paper over" many of the problems that an electronics company may be experiencing. Corporate managers are so busy then that they never seem to have the time to deal with their problems. But in bad times, problems get the most meticulous scrutiny. That's what's happening now.

Times are tough and the corporate leaders interviewed for this year's Executive Outlook, more than ever, worry about their problems. The high-flying industry is slowing down, frustrating executives who are long used to soaring growth rates that often continued even when the economy ebbed. Those contracyclical days could be over: most of the electronics industry's markets slowed down in growth last year despite a recovery in many of the world economies.

Industry leaders think the slump in their markets will end sometime this year, but each seems to have a different timetable. Taking on new importance is the trade deficit that the U.S. electronics industry is running with Japan, an imbalance that has been growing for several years as U.S. and Japanese companies scramble for pieces of the world's largest electronics markets. Protection for these U.S. markets and products this year could move from discussion to execution, some U.S. executives predict with relief. Others worry about the backlash of protectionism.

Dealing with increasing foreign competition is a major concern of managers throughout the U.S. electronics industry. Many of them believe that more should be done to help train the engineers needed to come up with the innovations to fuel growth. Technological developments this year will be evolutionary, rather than revolutionary, as the industry digests the new products and processes that have emerged from the laboratories and turns them into products. But there'll be plenty of them.

These are the topics, concerns, worries, and views of a cross section of leading executives in the electronics industry. These international business leaders—from both large and small

'It'll get better next year, but I don't see any great surge to indicate it yet'

EDSON W. SPENCER
Chairman and Chief Executive Officer
Honeywell Inc.

companies in the U. S., Japan, and Europe—were surveyed by the staff of *Electronics* and asked to respond to a series of questions.

The main worry is when exactly an upturn will occur. Most executives believe that business will improve this year, but they are divided on just when it will get better. Some think during the second quarter, some in the second half of this year. Others think recovery might take longer, though a few say it has already started. But they have no concrete evidence of an upturn.

If business leaders are divided on when an upturn will occur, they are equally divided on how to deal with what could be the most sensitive issue in the industry—the U. S. trade deficit. Many U. S. executives, while professing to be ardent believers in free trade, argue that the U. S. government must protect the electronics industry from the inroads made by foreign competitors—mainly Japanese—who, these businessmen think, operate unfairly. Restrictions should consist of import quotas, tariffs, or merely more rigorous enforcement of antidumping provisions of U. S. law.

On the other hand, some U. S. executives think protectionism should be avoided at all cost by the U. S., arguing that it would hurt the domestic electronics industry more than it would help. U. S. access to foreign components would be curtailed; innovation could suffer; and—most important—other countries would retaliate by protecting their domestic markets from U. S. goods. Japanese and European businessmen think protectionism would also be the wrong step for the U. S. to take.

Another worry that U. S. businessmen have is how to compete with their foreign counterparts. Other concerns are ensuring a steady stream of innovative products and getting the U. S. government to deal with its ballooning budget deficit, which keeps the dollar high compared with foreign currencies and hurts U. S. exports.

Around the world, engineering schools are turning out more—and better trained—graduates to meet the needs of the electronics industry. But there are never enough skilled workers, executives say, and graduates are sometimes taught the wrong skills. Schools need more engineering faculty, and more young people have to be enticed into joining engineering's ranks.

These problems and concerns facing industry leaders most certainly will not all be resolved this year. What is certain, though, is that executives will be tested more than ever during the coming year, and the lights will burn far into the night in corporate suites as managers try to cope with these tough times.

When will an upturn occur?

Some executives think the recovery in the electronics industry has already started. Others believe that it won't start for another three to six months. Still others don't expect it to occur until after that.

What's certain, say company chiefs in the U. S., Europe, and Japan, is that the recovery will start in U. S. electronic equipment, the market that acts as a stimulant or a depressant for other markets. After that will come an increase in component business, with Japan, and then Europe, falling into place with stronger growth.

The downturn spared several industry segments, such as computer-aided design and application-specific integrated circuits, some executives point out. The business end of the personal computer market has also stayed strong, but growth rates will slow as the industry gets bigger.

For the rest of the electronics industry, most executives believe that business will improve within the next six months, but they can't pin down their reasons. "I think it'll get better next year," says Edson W. Spencer, chairman and chief executive officer of Honeywell Inc., Minneapolis. "But I don't see any great surge to indicate that yet. Some things, like anything related to defense, are obviously strong. I just hope that things like computers and components have about bottomed out." But he won't venture a guess on how much better business will get.

"Speaking strictly from our standpoint, we don't see any particular milestone for a business turnaround, but we do hope that after the first of the year, things will start picking up," says John H. Krehbiel, chairman of component-maker Molex Inc., Lisle, Ill. "But this is built strictly on hope. We don't have anything that's so reassuring that we can say it is going to start at a certain time."

"I'd like to qualify this as a hope, not something I've come about by scientific calculation—I think we'll see signs of improvement by the second calendar quarter," says John Fluke Jr., chairman of John Fluke Manufacturing Co., a test-equipment maker in Everett, Wash. "My opinion is that we're at the bottom of the recession. It isn't any worse, and we get the occasional sign that things might get a little better. But it won't be clear until the first or second quarter of 1986. It's hard to say how vigorous the recovery will be. Maybe it will be more solid because of the inherent caution that company management takes as the upward spiral begins. They'll take a wait-and-see attitude about any dramatic increase in capital spending."

The overriding questions are more fundamental than the industry's business cycle or the downturn for Lester (Buck) Hill, vice president and general manager of TRW Inc.'s Electronic Components Group, El Segundo, Calif. Hill wants to know why levels of business in the electronics industries are so low, given the general economy worldwide in which countries' gross national products are floating up.

Hill also wonders whether these conditions are temporary or permanent. "We need to get perspective, to understand the dynamic forces that caused the electronics industry to disconnect with the general economy, to under-

'The predictability has seeped out of the system in the past five years'

EARL WANTLAND
President and Chief Executive Officer
Tektronix Inc.

stand the drivers." The oft-quoted reasons for the industry's decline, such as the debacle in personal computer markets and a glut in semiconductor supplies, don't hold the answer, he believes. "My sense is this is a period of fundamental change, and the people who sense it first, find the advantages."

Sensing those fundamental changes is getting more difficult for industry executives, because "the predictability has seeped out of the system in the past five years," says Earl Wantland, president of Tektronix Inc., Beaverton, Ore. He has "absolutely no feel for a major upturn. There is a rationale for why things have bottomed out and will probably get somewhat better, but there is no strong rationale for why it's going to get a lot better. We just need to stay loose for 1986."

The upturn is already under way, "but it's a slow upturn and we don't expect any rapid increases," says Joseph C. Ross Jr., president of Micro Mask Inc., the Sunnyvale, Calif., maker of photolithography masks. The same is true for the semiconductor and components industry as a whole, he says. No new chip-using consumer products—such as digital watches, citizens' band radios, video games, or personal computers—have been introduced to fuel a buyer, and thus an industry, upturn.

Another executive who believes the industry has already turned the corner is Charles E. Exley Jr., president of NCR Corp. "If our order situation is an indicator, I would say that the upturn is at hand now." His company had a "very strong order picture" for the fourth quarter. "Whether that is characteristic of the industry or not, I'm not sure."

Orders have increased across the board for the Dayton, Ohio, company, though Exley can't quantify it. "We're entering 1986 from a very different situation from the situation in 1985, when we began the year with backlogs considerably below those envisioned in our plan for the year, largely because we had a weak fourth quarter," he says. "But as we enter 1986, our backlogs are going to be in a far better position than that of a year ago. So at this point 1986 looks like an encouraging picture to us."

Texas Instruments Inc. is also "seeing some additional signs of a recovery, particularly from some small firms, end-user equipment customers, and also from distributors," says William P. (Pat) Weber, executive vice president and corporate development officer for the Dallas company. But inventory is still being reduced. "We have not seen any large and sustained purchasing yet, so we are still cautiously optimistic."

Another somewhat optimistic chip executive is Alfred J. Stein, president of VLSI Technology Inc., San Jose, Calif., a leading maker of application-specific integrated circuits. He says his business is performing well. "But overall in semiconductors, my general outlook is that it's not nearly as strong in the short term as some of the public literature that's being generated" suggests. For the first half of 1986, he says, "there will be gradual improvement, but it will be much more solid during the second half of the year. I estimate the U.S. chip market will be up about 10% from last year, which is not as robust as the 25% forecast projected by the Semiconductor Industry Association."

Stein thinks 1987 "will be a good year also" for the semiconductor industry, but he's casting a wary eye on that year. "Obviously, economists are shouting that the economy will be in a recession year," he says. Since semiconductors have moved into just about all types of equipment, "if there is a recession, we'll no doubt feel the effects." On the whole, though, Stein believes "semiconductors should have a relatively good year in 1987 as compared to 1986. The same holds true for the electronics industry as a whole."

A "very optimistic" belief in a rebound for the electronics industry comes from Aryeh Finegold, president of Daisy Systems Corp., Sunnyvale. "I think the problems we see today are just being highlighted by the economic cycle. In bad times, only the guys who really shine come through. Good times tend to cover up all their sins."

When the recovery does come, "it will probably be caused by the various economic effects we are seeing now, in particular the lowering of interest rates." says Robert J. Paluck, president of Convex Computer Corp., Richardson, Texas. That action "is combining with a change of attitudes of planning for 1986, and generally there is an emerging attitude of optimism."

That optimism appears to be spreading quickly in the electronics industry. At a recent American Electronics Association meeting in Phoenix, Ariz., "it was surprising how strongly people felt that they were getting upticks in their business," notes John A. Rollwagen, chief executive officer of Cray Research Inc., Minneapolis.

"The one exception was the component suppliers, who have not yet felt it. But in terms of systems and equipment suppliers, there was a definite sign of better things to come, because their order books are beginning to fill up again." That contrasts strongly with his impression at a similar meeting three months ago, when most were "cautiously optimistic at the very best."

Still, there are some nay-sayers. "An upturn will never happen in the way people mean when they ask about it," says Kenneth Olsen, president of Digital Equipment Corp., Maynard, Mass. "I don't see an upturn for a while partly because people overbought computers and didn't know what to do with them afterward . . . but also because manufacturing is going overseas."

Olsen doesn't foresee a recovery in

MOST EXPECT UPTURN TO COME THIS YEAR

UNCERTAIN EXECUTIVES SAY THE RECOVERY WILL START IN:

- The second half of 1986
- The second quarter of 1986
- The first quarter of 1986
- The third quarter of 1986

Listed in order of number of responses

'There's no such thing as free trade when it's one-sided'

KENNETH OLSEN
President and Chief Executive Officer
Digital Equipment Corp.

the U. S. until the Reagan administration comes up with a plan to help the business community. "All they're interested in is consumer spending, and they said that will build up business. The thing they forgot was, if you give consumers money, they'll spend it, but they'll spend it on Japanese TV sets."

That's what Japanese companies, such as Toshiba Corp., are hoping. "We depend so much on the U. S. economy that any upturn here in Japan must be linked to one in the U. S.," says Jun Kobayashi, senior managing director of Toshiba's Industrial Electronics Sector. "And we don't see any significant upturn in the U. S. until the second half of 1986."

Last year's downturn hurt the Tokyo company's components business more than its industrial electronics sector, which includes information systems, telecommunications, defense, and medical electronics, he says. This sector does about 40% of its business overseas, with 70% of that business in the U. S. "Still, after 22% growth in 1984, we're only going to have 9% growth in 1985 and about the same in 1986."

Japan's recovery "should start in February or March, with the recession ending by spring," predicts Hiroshi Asano, executive vice president in charge of nonconsumer electronic products at Hitachi Ltd., Tokyo. But that recovery will be slow for two reasons, both of which do not bode well for U. S. manufacturers: Japan's electronics industry has excess manufacturing capacity, and "the American market won't grow that fast," he says. When the recovery comes, "initially it will be profitless 'busy-ness,'" which also means bad news for U. S. producers and also those in Europe.

As always, the European market is reacting with a delay of around six months, says Hermann H. Franz, executive vice president at Siemens AG of Munich and head of its Components Group. "Hence we do not expect a change for the better in Europe before mid-1986."

"We have the feeling that the depletion of components by the major users in the industry is done. There are already more new orders coming in." That's the word from Henk Bodt, senior managing director of the Electronic Components and Materials Division (Elcoma) of Philips, Eindhoven, the Netherlands. Prices are firming, which will lead to a more balanced situation this year compared with last, Bodt says. "Equipment makers may be up against a gradual extension of lead times and further stiffening of the component price level due to increased demand."

Growth in the electronics industry this year in Europe will range from 7% to 10%, says Pasquale Pistorio, chief executive officer of SGS Microelettronica SpA, Agrate, Italy. "This is certainly not spectacular, but we will experience a shortage of certain strategic products, and the current price-erosion phenomenon will come to an end," Pistorio predicts. "Recent firming in memory prices is just a first indication of this new tendency. Italy, as the rest of Europe, will be a little delayed in the recovery, just as it was in the downturn."

How do executives feel about protectionism and free trade?

Executives in the U. S. are divided about it; Japanese and European executives are against it. This conflict shows that the most sensitive political issue facing the electronics industry today is protectionism.

Most U. S. executives recognize that something must be done to help their industry rebound from its trading slump, to return to the days when the U. S. dominated world markets and chalked up trade surpluses. While the U. S. continues to maintain a trade surplus with most of its major trading partners, it has racked up huge trade deficits with Japan in recent years. Executives want to correct this situation, but sentiment is mixed on how to go about it. Most U. S. executives surveyed profess to be free-traders in philosophy. But some of them think the U. S. government should step in and place import restrictions, quotas, or tariffs on electronic goods imported from Japan.

Others believe that concerted action to bring down the value of the U. S. dollar—and spur U. S. exports—is what's needed. A minority thinks the industry should not—and indeed cannot—rely on governmental action at all, but should take matters into its own hands to boost productivity and quality and gain a competitive edge on Japan. Some say that the problem will develop with countries other than Japan, although trade with the island nation is the major hurdle at present.

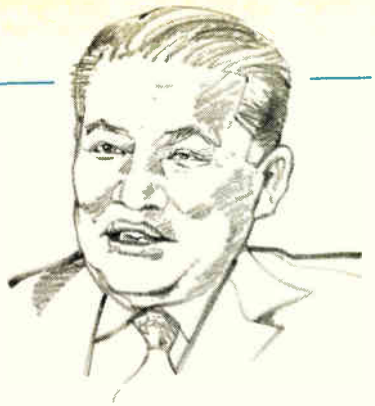
Japanese executives don't know what to do about the trade problem, though they are willing to increase their manufacturing operations in the U. S. and Europe. And in the background hover executives from Europe. They fear that any trade restrictions imposed by the U. S. government may curb the flow of their wares across the Atlantic.

Nearly all the U. S. executives surveyed emphasized that they were, in theory, free-traders who believe no restrictions should be put on anyone doing business. Still, "there's no such thing as free trade when it's one-sided," says Olsen of Digital Equipment.

Though free trade is fine in theory, corporate leaders say it is not being practiced by all U. S. trading partners. "Free and fair trade is preferable to protectionism," says Ross of Micro Mask. "But the government has to take steps so that the Japanese government and industry play by the same rules that the U. S. government and industry play by."

"I am against putting up arbitrary trade barriers—that would start a trade war and hurt industry. On the other hand, we do have to put some teeth in our trade policy," adds Thomas H. Bruggere, president of Mentor Graphics Corp., Beaverton, Ore.

'Protectionist laws would result in higher prices for the consumer'



JUN KOBAYASHI
Senior Managing Director, Toshiba Corp.,
Industrial Electronics Sector

But putting more of a bite in the U. S. trade policies in the form of barriers could backfire. "I think if protectionism is applied, it would be a disaster for the U. S. as well as for the entire world," says T. Z. Chu, president of Finnigan Corp., a San Jose maker of analytical equipment. "All markets would be closed. Everyone would have their own industry, and world trade would come to a halt. And everyone's economies would go into a tank. I think it would hurt every industry in the U. S."

Another voice in the antiprotectionist chorus belongs to John Lewis, chairman of Amdahl Corp., Sunnyvale. "Our industry would be put at a great disadvantage if protectionism were to arise throughout the world." Protectionist measures would effectively bar many people in the electronics industry from buying products that are technically attractive from foreign companies, Lewis says. Besides, other countries would probably retaliate, he adds, which would put goods made in the U. S. at a disadvantage. "It doesn't help anybody. I assume they would do the same thing to us that we're doing to them."

Exports represent only about 14% of the U. S. gross national product, according to Lewis, "but in many other countries, it's 30% to 40% to 50%. I don't think the U. S. should institute trade barriers, and I don't think anyone else should do it, either. I prefer free trade."

Micro Mask's Ross says, "Beyond personal philosophy and politics our view is that any protectionism that is potentially beneficial in the short term creates a situation for American industry to not strain as hard and spend less capital. This results in a disadvantage for consumers in terms of price and quality, and it limits industry's ability to export overseas against lower-cost higher-quality products."

That's hogwash, says Gordon Moore, Intel Corp.'s outspoken chairman. If protectionist measures are put in place, Moore says, they will probably make a bit more money available within the industry for investment but won't cause the industry to rest on its laurels. "This industry has never been complacent," he says. "Before the Japanese could even spell semiconductor, we were the most competitive industry . . . and I can assure you it will be every bit as competitive in the U. S. without the Japanese. I cannot imagine anyone imagining us becoming complacent and stopping investments and lowering costs."

Trade imbalances aren't limited to Japan, or at least they won't be in the future, says Edson W. Spencer, chairman of Honeywell Inc. "We've got to keep the pressure on all of those competitive countries—particularly Taiwan and Korea, which tend to protect their own industries and limit investment—and do all the things the Japanese did so effectively for so long to keep us out while they're building market share."

VARIETY OF REMEDIES IS FAVORED FOR TRADE WOES

TO CORRECT TRADE IMBALANCE, THE U. S. SHOULD:

- Put in place import duties and surcharges
- Limit imports through quotas
- Reduce the value of the dollar
- Enforce antidumping laws
- Lower tax rates
- Do nothing

Listed in order of number of responses

On the other hand, any action taken to limit imports from countries other than Japan "can have the immediate effect of damaging our ability to do business with lesser-developed countries," according to Fluke of John Fluke Manufacturing. "I know it would impinge negatively on our business if not on the U. S. as a whole. What's most important to understand is how all this attention on getting Japan to open its markets to us has taken away tension from the question, 'How do we stack up against our Japanese competitors in such countries as Australia, Germany, and Brazil?' We have to pay much more attention to that."

Will the Reagan administration actually institute trade restrictions? "They would much rather negotiate something that would involve some other issues as well," says Moore of Intel. "But there is such a strong feeling in Washington that U. S. industry needs protection that the government is likely to do something. Any restrictions on trade will have to be very carefully conceived so they don't hurt the overall competitiveness of U. S. manufacturers. That is a very narrow line, which the people putting in those restrictions will have to walk."

A vocal minority believes that relying on the U. S. government for help is a bad idea. "No matter how much we're hurting, we'd better pull up our socks and learn to compete rather than pull up the drawbridge and hope that the competition goes away," says Earl Wantland of Tektronix.

Fluke agrees. "The electronics industry ought not to run and hide behind protectionist measures the federal government would put in place. That would only put us to sleep and make us pay a much bigger price later."

Industry must work to get the government to lower tax rates and take action against flagrant trade violations, Fluke says. "Where there are no violations of the law, where Japan has just managed to outdo us, the last thing the industry should do is spend money on getting protectionist legislation." Instead, companies should spend that money on "making sure that they get themselves back into a competitive position."

Exley of NCR adds that "the most important single thing we can do to help trade has already been done. And that is to get a more realistic foreign exchange value for the U. S. dollar." This dramatic change has "absolutely" had a positive effect already on business overseas.

Protectionism carries another risk, points out E. Oran Brigham, chairman and president of Avantek Inc., Santa Clara, Calif. "How far can you drive the Japanese? If you totally cut off trade with them, since their economy must

'The protectionist sentiments in Congress are justified'

RAYMOND E. JACOBSON
Chairman and President
Anderson Jacobson Inc.

trade to survive, do we drive them to the Soviet Union? Can we accept the increase in the Soviet military complex that would result from their access to Japanese technology? The question is—how big a bully can you be?"

While the U. S. pressures Japan, "they will have to find a market for their products, so they will be more competitive in Europe. As the center of world economy, we must have a balanced hand in both Europe and Japan."

Japanese executives appear perplexed by what they call "trade friction." They want to keep dialogue open on the problem, but they are—understandably—against trade restrictions. "I am surprised that more Americans don't realize that protectionist legislation will hurt U. S. firms, too, even including giants such as IBM and DEC, who depend on Japanese suppliers for so many components and peripheral products," says Kobayashi of Toshiba. The Tokyo company has raised its prices because of the increase in the value of the yen, he notes. Trade restrictions, such as import surcharges, would boost prices further.

U. S. manufacturers "will continue to rely on Japanese producers, because they know we deliver quality products, and on time," Kobayashi says. "The net result of protectionist laws would be higher prices for the consumer. This is bad for everyone in the computer business, which already is stagnant."

Hitachi's Asano believes that "there is not much we can do about trade-related problems now that the issues have become politicized. It is difficult to find a good solution but we must strongly persevere in trying to achieve a dialogue. The one bright spot is that electronics has good growth potential. With the advent of the information society, the pie has become large so there should be some solution that everybody can live with."

Many Japanese executives believe that the way to solve the trade problem is not necessarily to open up their home market to increased imports but to move their production offshore, to the U. S. and Europe. "It is the obligation of Japanese enterprises to rectify extreme trade imbalances by increasing local manufacturing or promotion of imports," says Takuma Yamamoto, president of Fujitsu Ltd., Kawasaki. "Our firm has started various steps, including building a hard-disk-drive plant in Oregon and establishing Fujitsu Trading, and other firms can be seen to be taking similar actions."

In Europe, executives are against protectionist measures, but they are aware of the problem and the need to do something about it. "We try to sell into the U. S. market, so naturally we are very concerned about protectionist moves," says Derek Alun-Jones, managing director of Ferranti plc, Chadderton, UK.

The real problem remains Japan, he says. "It is not possible for Japan to take so much of other people's manufacturing without giving anything in return. The Japanese must be forced to recognize the problem. Premier Nakasone has recognized the problem with his remark, 'You don't play mah-jongg with a fellow who wants to win all the time,' " says Alun-Jones, but that recognition must be translated into effective action. "Japan must negotiate."

That advice, however, rules out protectionism by the U. S. for the same reasons cited by its opponents in the U. S. "In the end, protectionism has only negative consequences for all involved," says Siemens's Franz. "Those trying to protect themselves will be, at least to a certain extent, isolated. And their opponents lose market opportunities. Therefore, I am against protectionism."

"There are really three trading zones in the world—the U. S., the Far East, and Europe—and ideally there would be no protectionism," says Jacques Bouyer, vice president of RTC-Compélec, Suresnes Cedex, France. "That seems out of the question, but if we were to look at the world as three protected zones, each with its needs in terms of both production and consumption, it would probably be far easier to manage international trade. In a more limited sense, in Europe I think we should try to be just as open as Japan is, no more and no less."

Alain Gomez, president of Thomson SA, Paris, predicts that "it is probable that there will be some kind of protectionist move in the U. S., particularly in semiconductors, and that will aid American manufacturers." However, he says, "such a move could put European competitors in an even more difficult situation. The problem is that there is such an overcapacity in Japan in terms of domestic consumption and, if the U. S. market becomes more difficult for the Japanese to attack, they'll be left with only Europe as a major market on which to concentrate," Gomez reasons.

According to Frank-Dieter Maier, general manager of Telefunken electronic GmbH, Heilbronn, West Germany, "Japan should try in earnest to tear down the existing de facto trade barriers to allow U. S. and, of course, European, producers to do business on the Japanese market." American protectionism "would hurt us here in Germany in two ways," he says. For one thing, sales to

EUROPEANS DON'T WANT RADICAL SOLUTIONS

EUROPEAN EXECUTIVES WANT THE U. S. TO:

- Enforce present legislation
- Negotiate with the Japanese

Listed in order of number of responses

JAPANESE WANT TALKS ON TRADE

IN JAPAN, THE ANSWERS ARE:

- Achieve a dialogue with the U. S.
- Assemble and manufacture abroad
- Build new plants in the U. S.
- Promote imports from U. S.

Listed in order of number of responses

'U. S. industry is outmanufactured, outmarketed, and outmaneuvered'

CHARLES E. SPORCK
President and Chief Executive Officer
National Semiconductor Corp.

the U. S. would suffer. For another, the Japanese, in seeking new outlets for their products, would turn with greater force "to our open market." That would trigger political and trade-related events whose outcome is difficult to predict.

What the U. S. needs is selective protection, says Raymond E. Jacobson, president of Anderson Jacobson Inc., a San Jose maker of terminal and data-communications equipment. "The protectionist sentiments in Congress are very justified with respect to the Far East." U. S. equipment markets should have protection from the Far East, "but not from the rest of the world." U. S. industry needs protection from Japanese and Far East competitors until it can catch up with other countries' performance.

The U. S. can deal with its trade problem and avoid protectionism by copying the Japanese way of doing things, he says. "We tend to have a consumer economy in the U. S., where we get the lowest possible prices for consumers, whereas in Japan it's a business-type economy. In Japan, they may pay 25% more than in the U. S. for consumer goods, but everybody has a job. It comes down to a question of low prices or a job. So I would like to see the U. S. become more business-oriented."

Some American executives vehemently oppose government help in the form of new barriers. One such opponent is Rollwagen of Cray Research. The cry from U. S. manufacturers for help from the government reflects frustration at losing business to offshore manufacturers and is not necessarily a reaction to unfair practices, he says. "I'm really a free-trader, and I don't understand exactly what unfair trade is. If Fujitsu can supply us parts for less money and higher quality, I don't consider that unfair, no matter how it came about." The trade situation is "a very powerful signal to us that we've got a job to do to restore the competitiveness of U. S. industry," Rollwagen says.

But those who seek trade barriers won't find a champion in President Reagan, who opposes protectionism. "It appears to me that very little will be done during the present administration," says Paul Montrone, executive vice president for finance and administration at Allied-Signal Corp., Morristown, N. J.

Montrone finds a parallel in the U. S. auto industry. If the political muscle of the United Auto Workers and the car manufacturers in the U. S. auto industry can't force protectionist measures, the electronics industry has little chance to pull it off, he points out. Some economists have argued that auto-import quotas on Japanese suppliers actually weakened U. S. producers because it lessened competition in the American market. "Erecting a barrier to provide protection for electronics suppliers that are weak won't make them stronger," says Rollwagen. "It will make them weaker."

WHAT OTHER IMPORTANT CONCERNS FACE THE INDUSTRY?

Though industry executives worry most about an upturn and protectionism, that's not all they are concerned about. Other big worries are the shift to overseas manufacturing by U. S. companies, the ballooning U. S. budget deficit, and maintaining an edge in product innovation. And in the U. S., an influx of foreign-born workers is changing the make-up of the work force, but most executives think the threat of unionization will not grow.

"We clearly are losing to international competitors, both from the standpoint of market share and from long-term financial strength and technological edge," says Chu of Finnigan. "If we are not internationally competitive, our technological edge will disappear."

Other countries have increased their share of the U. S. electronics market, and they have generated more money to reinvest in research and development than have their U. S. counterparts, Chu notes. In addition, foreign shareholders don't expect quick returns on their investments. "If you keep piling on advantages like this year after year, you're bound to get ahead on technology," Chu says. "People in the business world always talk about long and short term, but that is inaccurate. The whole thing is expectation of return on investment. There is no simple solution—it requires the commitment of the whole country."

It also requires educating the political leaders of the U. S. on the importance of the electronics industry to the country's economic well-being, says John Rowley, chairman of software developer Digital Research Inc., Pacific Grove, Calif. "The U. S. needs substantial improvement in its government support for high-tech industry. We have no government incentives in place for the U. S. to keep up with Japan, where they operate as a nation-state instead of individual companies."

Says Robert J. Paluck, president and chief executive of Convex Computer Corp., Richardson, Texas, "Without a concerted strategy in the U. S., it is very difficult for us to be as efficient with our R&D dollars. So what is really needed is a global U. S. strategy. However, that runs contrary to the U. S. business attitude of not wanting government meddling. So there is a dichotomy. To succeed, we need to unite and form a strong strategy. But on the other hand, we would not like to see the government tell us what to do in developing new products and new technology."

TI's Weber points out that "the electronics industry is one of the big five industries" in the U. S. For strategic reasons and for the health of the economy, "I think it is fundamentally important that the U. S. maintain a strong electronics base and in particular a semiconductor technology base. This is important for both commercial and military end-equipment."

Getting governmental support may take some doing, though. "People in national politics have no idea of the implications of these technologies," Rowley says. "They are very fundamental in

'Workers aren't unionized because unions haven't done a good job'

CHARLES E. McEWAN
President and Chief Executive Officer
Ramtek Corp.

general economic areas, because the amount of national economic product that comes through high-tech is phenomenal."

Maintaining a competitive edge on foreign manufacturers—especially companies in Japan and the Far East—transcends the domestic electronics industry, believes Tektronix' Wantland. "The issue is broader than just the electronics industry—electronics has permeated all industries, so the vitality of all American industries is being affected by how well they can compete," he says. "That's going to take renewed attention to how you organize and how sharply focused you are and how many bad habits you can get rid of and how fast you can improve quality."

Complicating the situation, Wantland notes, is the fact that "the world has truly become an international market. And I don't think we have, as management, fully assimilated that fact."

Particularly thorny is what Wantland calls "the terrible migration taking place away from the shores of the U. S." Jobs are flowing rapidly out of the U.S. as aggressive foreign competition batters such U. S. industries as steel, textile, automobile, and consumer electronics.

U. S. industry has been "outmanufactured, outmarketed, and outmaneuvered" by foreign competitors, declares Charles E. Sporck of National Semiconductor Corp., Santa Clara. As a result, the U. S. manufacturing base is eroding to nothing, and the U. S. economy is increasingly based on services that cannot be exported, he says. "What bothers me is the assumption that industrial companies can exist in a service economy. I don't think that's possible. We are facing some major dangers and I don't think we recognize it as a society."

"I truly think the industrial base of the U. S. could be wiped out," he says. "People get excited about a new Toyota plant in Kentucky that will create 2,000 jobs. Those are 2,000 grunt jobs, for unskilled labor. All the R&D and the complex engineering will be done in Japan. Is that what we want? We are in danger of becoming an underdeveloped country: you make use of the labor; you don't make use of the brains."

In solving its competitive problem, the U. S. has to draw on its strengths. "It requires a lot of attention to competitive manufacturing in the U. S. We just have to take advantage of the assets we have, such as proximity to markets and an educated work force, in order to really be competitive," says Gordon Moore of Intel. The move to offshore manufacturing will likely continue, he says, although if the dollar continues to weaken in comparison with other currencies, some of the pressure will ease and make U. S. products more competitive.

European companies must also find new ways to compete against both the Japanese and U. S. companies in their home markets. One way that Groupe Bull plans to do this is through the development of industrial, technical, and commercial cooperations and alliances. These ventures will give the company a broad range of the most advanced products necessary to respond to customers' needs and help it to acquire new technologies and know-how to bring them to the market faster, says Jacques Stern, president of the French company. This will permit the company to concentrate in-house expertise on priority developments while sharing research and development expenses and developing a broad catalog of applications running on Bull hardware.

THE BIGGEST WORRY IS HOT GLOBAL COMPETITION

THE MAIN CONCERNS FOR U. S. EXECUTIVES ARE:

- Dealing with increased international competition
- Loss of manufacturing by U. S. industry
- Loss of market share by U. S. vendors
- How to manage slower growth
- Lack of product innovation and getting fresh ideas
- U. S. budget deficit and health of the economy

Listed in order of number of responses

The best way to compete against the Japanese is to "out-innovate, particularly in areas where foreign competitors will come in and copy," maintains Bruggere of Mentor Graphics. "Innovation will drive dollars our way."

"The problem is that the market needs fresh ideas—and more than fresh ideas, fresh product," says Finegold of Daisy Systems. But the dollars flowing to innovative companies are shrinking. How managers will react to this is another concern, believes Ross of Micro Mask. "People who manage the electronics industry are oriented to go-go-go growth—everyone loves that 25% compounded annual growth figure."

"I'm not sure the CEOs in this industry can adjust to an economy, longer term, that may be slower growing but healthier than the roller coaster we've been on for the last 10 years. So I think we're going to overreact to the upturn again. We all talk like we won't, but when push comes to shove, we do."

Of lesser concern is the issue of unionization. Most executives believe that unions have only a slight chance to to gain entry to their worker ranks. "Unionization is not an issue in our industry, and I don't believe it will be because generally our industry treats employees fairly, and the union offers them nothing," says Brigham of Avantek.

But at least one executive thinks the issue of unionization could flare up. "I used to say that unions were absolutely no worry in our business," says Charles E. McEwan, president of terminal maker Ramtek Corp., Santa Clara. "But we didn't have quite as many foreign employees then as we have now." He notes that Ramtek's manufacturing work force includes about 30% Hispanic and 25% Oriental immigrants from Viet Nam, Hong Kong, and Taiwan. "They may be more susceptible to union issues than our older employees, who

'We don't have enough engineers, but we are reconciled to this'

HIROSHI ASANO
Executive Vice President
Hitachi Ltd.

were almost antiunion."

Unions haven't worked their way into the electronics industry because union leaders have taken the wrong tack, he says. "I think the only reason workers haven't been unionized is because unions haven't done a good job. If they went for what people really worry about, which is job security, or if nothing else, seniority," then unions might succeed in signing up workers in the industry.

How can engineering education help industry solve its problems?

The race for technology is heating up around the world, and the need for engineers is growing steadily. The new crop of engineering graduates is more highly skilled than ever, executives say, but even more expertise is necessary to keep up. And the crop has to be bigger.

To improve the quality of tomorrow's engineers, executives suggest adding faculty to engineering schools, publicizing engineering careers, and offering students different types of training for specialty areas in the electronics industry.

"There are never enough engineers, but it's a lot better," says Spencer of Honeywell. "There's been a lot of attention paid to this." He says trade organizations and corporations have worked hard to help colleges and universities with facilities, scholarships, teaching funds, professorships, and so on. "I think that's going to have a long-term, very significant impact over where we were 10 years ago, when science and engineering were not as favored by the undergraduates."

Depending on the products their companies make, however, many executives think the work aimed at improving education could be shifted around. "When it comes to computer science, we get more very well-educated people—which is so different from just a few years ago, when people were self-taught," says Olsen of Digital Equipment. "The negative part is that at the same time they've often lost a feeling for physics and electrical engineering." Olsen thinks the engineering schools "teach too many things about today's products rather than basic things about physics. In trying to be general they end up being narrow."

Donald W. Brooks, president of Fairchild Semiconductor Corp., Cupertino, Calif., thinks that one deterrent to developing technology is a lack of mechanical engineers to work on manufacturing processes. This shortage could be alleviated, he suggests, by "changing engineering curriculums to involve more manufacturing courses from statistical process control to computer-integrated manufacturing." He believes that "would influence more students to do manufacturing as a way of life."

John H. Krehbiel of Molex thinks schools should put more emphasis on giving students hands-on experience. "We don't get good drafting from new college graduates, and we don't get people who know shop practices," he says, adding that graduates also seem to be generally lacking in practical computer-aided-design and -manufacturing skills.

"We aren't spending enough time in manufacturing engineering," states Ross of Micro Mask. "When I was first in school, industrial engineering was considered a very important talent, and many engineers were trained to go into that. Time went on, and then everybody got enamored with design and semiconductors and physics, and manufacturing became the low man on the totem pole. We can't get graduate engineers to go into manufacturing."

Executives who clamor for increased—and more varied—educational skills may be asking too much of a student, however. "You can always debate that students need new and different skills, but we're already asking these students to absorb a lot of information in four to four and a half years," says Brigham of Avantek. "Industry has to pick up on continuing education, and only ask the university system to provide the fundamentals. It's to the point now that a bachelor's student gets out in five years rather than four."

Besides overloading students' ability to learn, new programs could overload the system itself. As Stein of VLSI Technology points out, one problem facing the educational system is a lack of qualified teachers. "We have a major shortage of professors who can teach in all the related fields, such as electrical engineering and computer science. This is affecting the industry overall. We need more engineers, but we really need more and better teachers."

Even in Japan, whose engineering schools produce more engineers per capita than those in the U. S., there aren't enough to meet the need as seen by industry executives. "We don't have enough engineers, but we are reconciled to living with the situation," says Asano of Hitachi.

Adds Toshiba's Kobayashi, "The real shortage is not so much for really top-rate engineers, but mid-level engineers, especially for software projects." Toshiba's way around this is to "take graduates of law or business faculties, for example, and retrain them as software engineers. We're also using many young women for this purpose. We have no complaints about the level of education—we prefer to do the retraining in-house."

Nor is the problem limited to the U. S.

IMPROVE SCHOOLS TO IMPROVE ENGINEERS

TOP EXECUTIVES WOULD LIKE:

- More faculty for engineering schools
- Education of the general public about engineering careers
- More training offered to students in a variety of specialty areas

Listed in order of number of responses

'No revolutionary technology in 1986, but many evolutionary gains'

GORDON MOORE
Chairman and Chief Executive Officer
Intel Corp.

and Japan. "There are too few people going into this industry in the United Kingdom," says Derek Alun-Jones of Ferranti. "I think it is a society problem. Also, there are too few engineers in government." He notes that about one government policymaker in 30 has engineering qualifications. The educational system, he believes, still produces engineers in the wrong disciplines while trade unions turn out too many craft apprentices and too few technicians.

A better understanding of economic trends would guide careers in the right direction. "We in Germany did not perceive early enough how important electronics is to our future industrial development," concedes Franz of Siemens. "Despite a high rate of unemployment, we are faced with a considerable lack of engineers, technicians, and other qualified personnel."

WHAT TECHNICAL DEVELOPMENTS DO MANAGERS EXPECT THIS YEAR?

Technical developments this year will be "more of the same" as last year, says Moore of Intel. Products will make more use of artificial intelligence, and surface-mounted technology will increasingly come into play. What's more, the move to smaller chip geometries will gather steam; low-power CMOS will team up with fast bipolar architectures; and application-specific integrated circuits will continue to make inroads.

"I doubt we'll see any revolutionary technology, but there will be many evolutionary improvements," Moore says. One is "applying AI to our products as well as to the way we manage our business," says Chu of Finnigan. "We're seeing signs of it now. AI could materially ease operation and maintenance."

The proliferation of AI is creating a "highly developing, emerging market that will find applications in many areas but will probably be a $3 billion market by the early 1990s," agrees Weber of TI.

The big news this year will be "the emergence of very high-speed integrated circuits, the ever-reduced geometry and increased capacity of ICs," says Spencer of Honeywell. ICs from Phase 1 of the Defense Department's VHSIC program "are now beginning to be inserted into products, and that opens up a whole new range of opportunity for the electronics industries."

A technology that will make even bigger strides in the new year is CMOS, which is "moving faster and faster to the center of all IC activities," says Franz of Siemens. "The combination of CMOS and bipolar technologies offers the chance to design faster devices that consume less power."

Two major events are shaping up in the chip industry, says Stein of VLSI Technology Inc. "First and foremost is the advancement in software to do chip designs. The application-specific IC revolution is for real. Last year was the year of its recognition. We have just begun to exploit what can be done by utilizing the computer for complex chip design. That's the one place we have true leadership in the international arena."

Second, "everything is CMOS, and state of the art is 1-μm" geometries and lower, Stein says. Though submicron technology won't make its way into the manufacturing process this year, it will reach the lab, and, by 1988, it will be part of the manufacturing process. "But we'll get down to 1 and 1.2 μm in 1986 and 1987, though under 1 μm is still three to five years away."

Some developments to watch this year are better use of optical technologies, more use of custom VLSI circuits, and a speedup in the move to 32-bit systems, says Elserino Piol, executive vice president at Italy's Ing. C. Olivetti & C. Further, "an important area of progress will be in the software area for the work station, in an attempt to provide an even friendlier user interface."

"Surface-mount technology is certainly going to become more and more prominent," says Krehbiel of Molex. "The technology is getting a heck of a lot better known, and more people understand it now and what you can and can't do with it."

The other big news is "the ongoing evolution of design tools in CAE," says Fluke of John Fluke Manufacturing. Computer-aided engineering, he says, is an "opportunity rather than a threat. It offers the possibility of a standard environment on every engineer's desk. They are also the authors of documentation—which opens up a new class of software products to make it easier to program production test equipment."

The diverse evolutionary or revolutionary technologies that take hold of the electronics industry this year should have one thing in common—the goal of helping the user, says Wantland of Tektronix. "I think the critical issue here is how well you assimilate the present technology and realize it for the benefit of the customer."

EXISTING TECHNOLOGY CONTINUES TO EVOLVE

COMPANY OFFICIALS EXPECT:

- Artificial intelligence to be used in more existing products
- Use of surface-mount technology to increase
- Semiconductor geometries to continue to shrink
- More combinations of bipolar and CMOS technologies
- Application-specific ICs will continue to make inroads

Listed in order of number of responses

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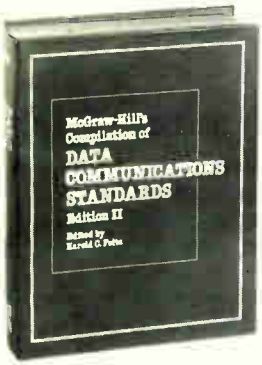

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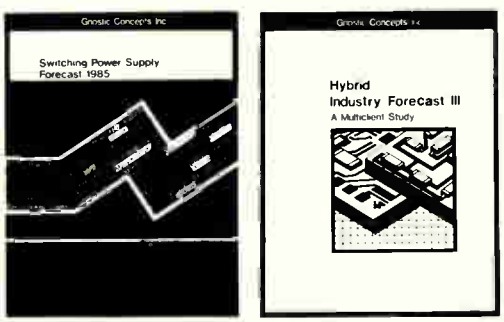

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PROBING THE NEWS

WILL THE FCC FREE 'THE BELL OPERATING COMPANY SEVEN'?

COMPUTER INQUIRY III MAY LOOSEN REINS ON LOCAL PHONE MONOPOLIES

by George Leopold

WASHINGTON

An attorney representing Ameritech was seeking a waiver of federal restrictions last August so that the Bell operating company could offer a cellular telephone service independent of its monopoly network. He argued that a waiver would be consistent with previous rulings; the court immediately disagreed.

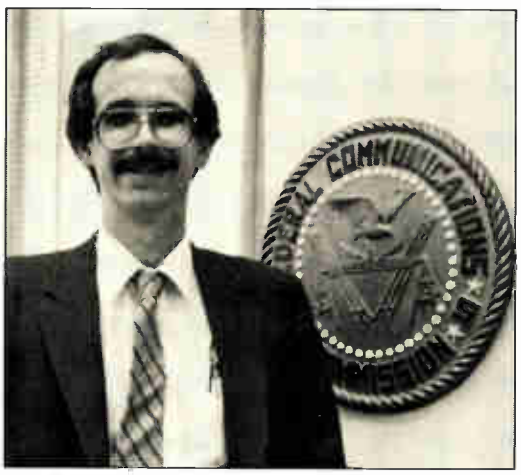
"AT&T is in a completely different world" from the Bell operating companies, explained U. S. District Judge Harold H. Greene, who presided over the breakup of the Bell system. "When the breakup occurred, it was made quite clear that AT&T could go into information service and they could go into selling hamburgers and everything else—and you couldn't, because you continue to be a monopoly and have a stranglehold on the local service."

But that distinction may be dropped. The Federal Communications Commission seems about ready to change its rules. The commission's review, initiated several weeks after that August hearing by Judge Greene, focuses on information services by AT&T and the seven BOCs (see "What the regionals can and can't do"). Better known as Computer Inquiry III, the study will reevaluate the rules for separating competitive ventures, such as information services, from the monopoly phone networks.

KEEPING UP. The FCC, citing what it considers the denial of these services to customers over an emerging intelligent network, has proposed loosening the requirements for structural separation. "We're seeing a trend across the industry to recognize a market for a package of information and communications services," maintains Albert Halprin, chief of the FCC's Common Carrier Bureau. "The technology is much farther along than the service availability."

The major issue is the FCC's idea of merging regulated network services with unregulated information services, a concern hot enough to generate some 4,000 pages of comments by 112 respondents. The proposals have received mixed reviews—falling pretty much along partisan lines—as have other proposals for promoting equivalent interconnections to an intelligent network.

AT&T and the BOCs are eager to see an end to the requirements that they set up separate subsidiaries to do business in enhanced services. But major competitors—notably IBM Corp., GTE Corp., and equipment vendors—oppose relaxation of those rules, which were established after Computer Inquiry II.



COMPETITION COMING. FCC's Halprin says an open net would bring many players into the BOCs' game.

Completed in 1980, Computer II also mandated a boundary between regulated (basic) and unregulated (enhanced) services. Predivestiture AT&T was also freed to offer these enhanced services, but the commission imposed separate-subsidiary requirements to protect ratepayers from bankrolling the services.

But the overall picture was changing rapidly. The Bell system breakup in 1984 spawned the regional BOCs. That, plus mergers such as IBM's acquisition of equipment-maker Rolm Corp. and partial acquisition of MCI Communications Corp. [*Electronics*, July 1, 1985, p. 11], as well as rapid technological advances in telecommunications since Computer II, have generated intense pressure both within the FCC and on Capitol Hill to loosen structural-separation rules. Several bills designed to "free the BOC seven" have recently been introduced in Congress.

It now appears inevitable that the rule stating that enhanced services must be provided by a separate subsidiary will be scrapped, perhaps as soon as this spring. Replacing it will be nonstructural safeguards such as accounting controls and a concept the FCC calls "comparably efficient interconnection." As a result, code and protocol conversion for packet-switched transmission, voice and data storage, call forwarding, and other enhanced services eventually could be integrated directly into a network closely resembling AT&T's planned integrated services digital network.

The commission also proposed what has emerged as an unpopular regulatory framework that adds a new category to Computer Inquiry II's basic/enhanced dichotomy, called "ancillary to communications." This new classification includes services now considered enhanced as well as customer-premises equipment. The proposed classification would be used if ancillary services are provided by a dominant carrier, and if the service is not subject to "effective competition." IBM argued in its comments to the FCC that the basic/enhanced boundary "remains viable and should be upheld and supported by the commission."

To determine the potential competitiveness of enhanced services, the FCC has proposed a market test that "seeks to improve the economic efficiency of the industry while maintaining protection against abuse of market power, by using accounting distinctions among classes of products rather than separate subsidiaries." But like other parts of the commission's new regulatory framework, the market test has come in for widespread criticism.

In their comments, GTE, the Computer

and Business Equipment Manufacturers Association, and others warned that such a formula is unnecessarily complex and that the enhanced-services market is already highly competitive. "We're concerned that the FCC will create even more ad hoc decisions," says Susan G. Stuebing, CBEMA's director of telcommunications programs. Instead, Stuebing says, "we prefer a fine-tuning of Computer II" or the adoption of adequate safeguards against cross-subsidization before structural separation is lifted or a new regulatory framework is adopted.

Others have doubts about the so-called nonstructural safeguards. "I'm not sure Computer III is the vehicle we want to use to hammer out the accounting issues," says George M. Shea, director of telecommunications industry marketing for Digital Equipment Corp., Maynard, Mass. Herbert Marks, an attorney representing the Independent Data Communications Manufacturers Association, agrees. "There's still an immense amount of work before these accounting controls are real," Marks says.

At the same time, several potential technical solutions for providing equal access to intelligent networks have also emerged from BOC comments. US West Inc.'s open network architecture and Ameritech's feature node/service interface (FN/SI) might offer the "comparably efficient interconnection" cited by the commission as a means of replacing structural separation while allowing third-party vendors to compete in the enhanced-services market.

The Justice Department's Antitrust Division backs the "open architecture" strategy. Indeed, an open network that ensures equivalent connections is viewed by many as the price the BOCs must pay to offer enhanced services without structural separation. The FCC's Halprin acknowledges that if the BOCs go to the trouble and expense of engineering an open network, the payoff is likely to be participation by many players "in these new and potentially tremendous markets."

US West's open-architecture approach is based on two concepts: unbundled network services and flexible access tailored to all network users' requirements. The open architecture would also make available to all users and vendors the necessary carrier switching and transport services.

Unveiled last February, Ameritech's FN/SI would provide enhanced services through vendor-owned devices called feature nodes. These nodes could be used by vendors to gain network access to their voice-storage equipment, host computers, and reference data bases. The service interface is a point of interconnection between the service vendors and the telephone network.

Despite the FCC's professed desire to provide equal access to an intelligent network, some observers worry that the commission is moving too quickly to merge regulated and unregulated services. "We think the FCC and Justice should get off the notion that destructive competition is healthy," says Edwin B. Spievack, president of the North American Telecommunications Association. Spievack, whose Washington trade association represents telecommunications-

'The technology is farther along than the service availability'

equipment makers, thinks the FCC isn't taking sufficient time to consider the implications of the Computer III changes.

Not surprisingly, NATA is critical of the FCC proposals to lift structural separation, and it has called for retention of the basic/enhanced regulatory framework. In addition, NATA and other trade groups argue that innovation will be stifled if the network becomes the sole repository for new technology.

In 1985 alone, NATA estimates, manufacturers saw nearly $500 million worth of business in the private-branch-exchange market go to Centrex, the BOC business switching service. The commission's Computer III proposals will mean enhancement of Centrex and further losses of business for PBX manufacturers such as Rolm, GTE, and Northern Telecom, says George Dellinger, who follows telecommunications for Washington Analysis Corp.

As NATA opens a counteroffensive intended to block further BOC requests to the FCC for structural-separation waivers, other trade groups have opposed a Computer III proposal to add network channel termination equipment (NCTE) to the network. NCTE is considered customer-premises equipment under Computer II, so AT&T and the BOCs can furnish it only under structural separation. The FCC now says that decision has proven too costly, however, and customers have experienced delays because carriers could not provide it.

With the likely addition to the network of enhanced services such as protocol conversion and the lifting of structural separation, two critical issues remain unresolved. The first, explains Washington telecommunications attorney R. Michael Senkowski, is how the FCC will respond to criticism of its proposed regulatory framework. Halprin hints that the FCC may be willing to compromise, emphasizing that its initial Computer III proposals are "not locked in stone."

CONFLICTS. The remaining issue concerns potential conflicts between Computer Inquiry III and the 1982 consent decree that ended the Justice Department's antitrust suit against AT&T. The department is conducting a study of the telecommunications industry to determine whether changes in the decree are necessary.

"We will not fall into the trap of enforcing fixed rules and regulations beyond their useful life," says Antitrust Division head Douglas Ginsburg. Halprin says he is optimistic that the Justice Department "is looking in exactly the same direction that we are." □

WHAT THE REGIONALS CAN AND CAN'T DO

The first two computer inquiries and the agreement that settled the Justice Department's antitrust suit against AT&T Co. formed the basis of current telecommunications industry regulations. In its Computer I order, released in March 1971, the Federal Communications Commission adopted a distinction between unregulated data-processing services and communications. It also determined that carriers other than AT&T could offer these services through a separate subsidiary.

Computer II, besides creating the basic/enhanced dichotomy, freed AT&T to offer enhanced services and customer premises equipment—telephones and private branch exchanges—competitively through separate subsidiaries. It also deregulated that equipment and lifted structural-separation requirements imposed on independent telephone companies.

The 1984 breakup of the Bell system into AT&T Co. and the regional Bell operating companies meant more modifications. AT&T retained its long-distance, customer-premises, and enhanced-services businesses, and its manufacturing arm. The spun-off regional BOCs retained local exchange service and the sale of phones and switches through separate units, but were prohibited from making equipment.

Currently, the regional BOCs must obtain permission from U.S. District Court Judge Harold H. Greene to enter new lines of business and continue to offer them through a separate subsidiary. Meanwhile, the FCC has recently granted the regional BOCs two structural-separation waivers to offer enhanced services while dropping restrictions that barred AT&T from offering enhanced services to business customers [*Electronics*, Nov. 4, 1985, p. 15]. –*G. L.*

POT STARTS BOILING IN MIL-STD-1750A CHIP SETS

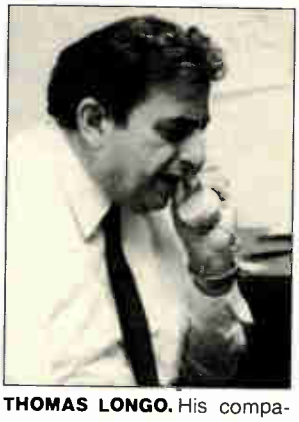
SEVEN PRODUCERS RUSH INTO NEW MARKET STARTED BY AIR FORCE

by Jerry Lyman

A small crowd of integrated-circuit producers is jostling for position in a promising new market niche that was created by the U.S. Air Force. The gold rush revolves around MIL-STD-1750A, the Air Force's standard instruction-set architecture for 16-bit processors.

The other armed services apparently will follow the Air Force's lead and require that contractors for all their programs use the processor in existing products and all new designs. Their decision, coupled with the boom in defense electronics and the potential fallout in nonmilitary graphics applications, has spurred the likes of McDonnell Douglas, Fairchild Semiconductor, Performance Semiconductor, Texas Instruments, RCA, TRW, and Harris to design 1750A chip sets. All of them foresee a fast-growing market, but no one yet has a firm estimate of its eventual size.

So far, only McDonnell Douglas Corp. and Fairchild Semiconductor Corp. have hardware in production (only McDonnell Douglas's part is fully certified). Soon to join them, however, is Performance Semiconductor Corp., the Sunnyvale, Calif., company started a little over a year ago by former Fairchild chief scientist Thomas A. Longo. It is developing a set whose first versions are being designed to meet commercial specifications. The other developers are working under insertion contracts from Phase 1 of the Defense Department's Very High Speed Integrated Circuits program that may eventually produce 1750A hardware.



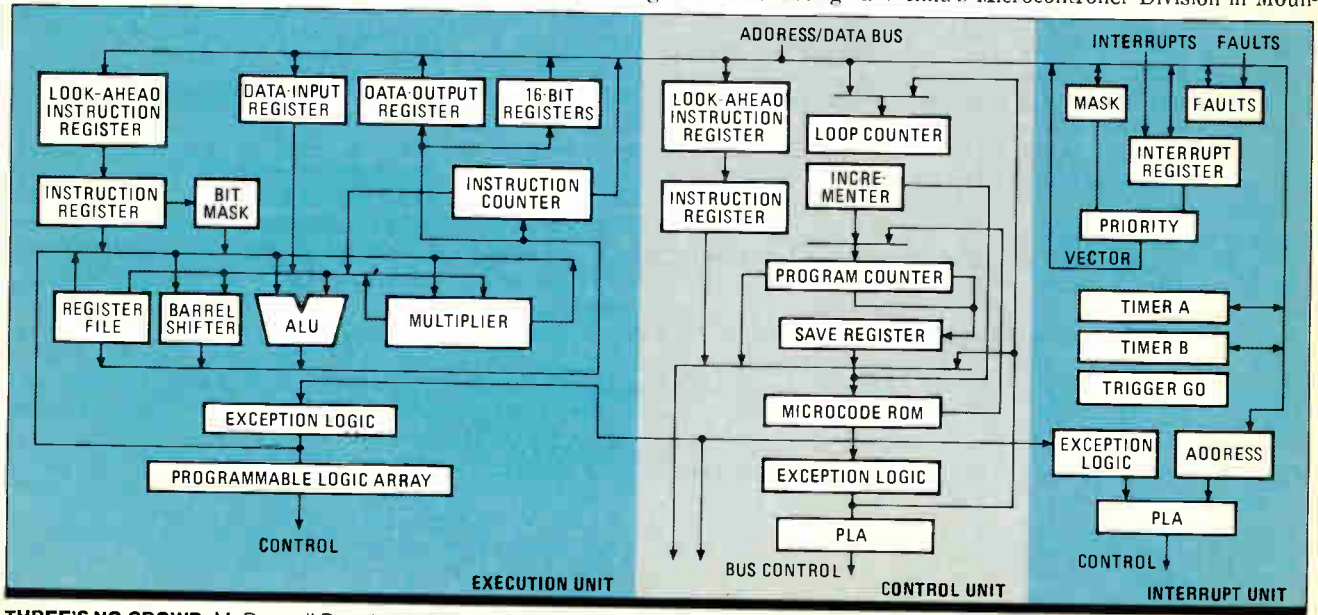
THOMAS LONGO. His company is moving fast.

As for nonmilitary fallout, this new family of high-speed 16-bit processors seems particularly suited for graphics applications in work stations and the like. The processor can shift data around very quickly, and it implements floating-point solutions on a single chip. Fairchild says it has several customers using its processor, the F9450, in commercial equipment. In addition, Longo notes that this type of chip, which doesn't require a coprocessor because it supports multitasking, has potential for robotics and other high-performance control applications.

McDonnell Douglas is marketing a three-chip set, the MDC281, that consists of an execution unit, a control unit, and an interrupt unit (diagram). The chips come mounted in three 64-pad leadless ceramic chip carriers that in turn are surface-mounted on a small ceramic substrate with either straight or gull-wing leads. The chip technology is a 4-μm CMOS-on-sapphire radiation-hardened process developed at the McDonnell Douglas Microelectronics Center in St. Louis.

The three chips form a basic central processing unit that can directly address instructions and data with 64-K words of memory. The chip set performs at 30 MHz across the military temperature range of −65° to +125°C and dissipates less than 2 W. The MDC281 has a throughput of 940,000 instructions per second when running the Digital Avionics Instruction Set, which includes 16-bit integer and 32- and 48-bit floating-point operations.

McDonnell's main rival so far is Fairchild's Microcontroller Division in Moun-



THREE'S NO CROWD. McDonnell Douglas split its 1750A processor into three chips—an execution unit, a control unit, and an interrupt unit.

tain View, Calif., which has the only one-chip implementation of the 1750A architecture. Fairchild's F9450 is based on a 3-μm bipolar isoplanar integrated-injection-logic process and is packaged in either a ceramic dual in-line or a gull-wing package, each having 64 leads.

The processor, which Fairchild expects will be certified by the end of the second quarter, fully implements the instruction-set architecture of MIL-STD-1750A. The processor will run on Jovial software (under MIL-STD-1589) and Ada (under MIL-STD-1815).

Fairchild is supplying a commercial-grade (0° to 70°C) version that runs at 15 MHz (700,000 instructions per second) and should be shipping a Mil Spec version early this quarter. A 20-MHz version is expected in late 1986.

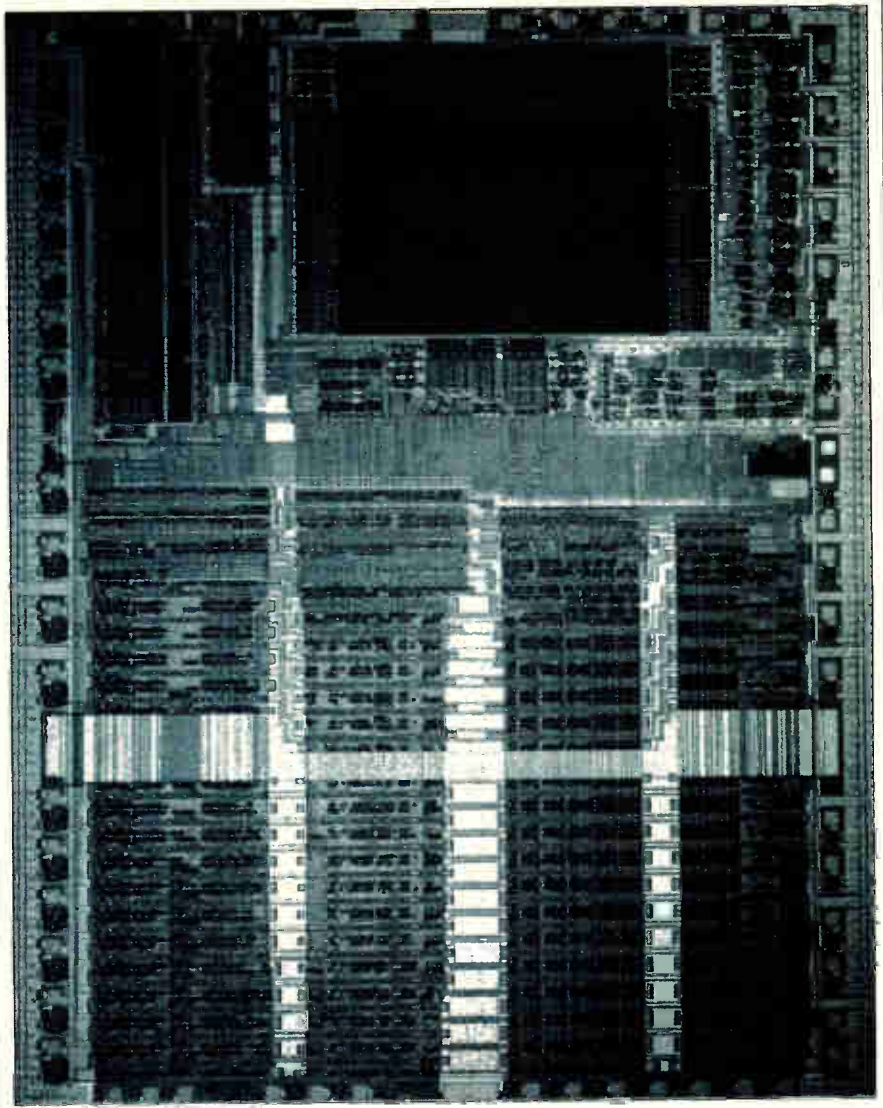
Fairchild has already delivered more than 1,000 of its 9450 processors, which many makers of military avionics systems are planning to use. For example, Simmonds Precision Instrument Corp.'s Systems Division in Vergennes, Vt., has developed a new computerized fuel-management system for a future jet fighter based on a MIL-STD-1750A architecture and implemented by the F9450 and Jovial software.

MORE TO COME. Also based on the F9450 is an advanced color display system developed for a variety of military aircraft requirements by the Allied Bendix Flight Systems Division in Teterboro, N.J. It is the first of its type to use a MIL-STD-1750A processor, and it is programmed in the Jovial high-level language.

Though Fairchild and McDonnell Douglas are leading the 1750A pack, they could have serious competition in about six months. Coming up fast is Performance Semiconductor, which plans to come out with a high-performance CMOS MIL-STD-1750A processor that will be pin-for-pin compatible with the Fairchild F9450.

Interestingly, it was Performance Semiconductor's Longo who was directing research and development at Fairchild when the company won the Air Force contract to develop a one-chip 1750A processor that resulted in the 9450. "When I started the new company, I had three objectives," Longo says. "The first was to concentrate on CMOS, since it seemed the IC process of the future. Second, I wanted our initial part to have a good market despite a coming recession. Third, I wanted to position our first product so that it would be relatively insensitive to Japanese competition."

A CMOS 1750A processor met all these objectives, and the new company's designers selected it as one of their first products. The new unit, called the PACE (performance advanced CMOS engineered) 1750A, whose design has just been completed, will run at 1 million instructions per second and will dissipate less than 2 W—one less than the Fairchild isoplanar I^2L version. First finished wafers should be ready in the next few months, and units that perform to commercial temperature specifications will be available in the second half of the year. A full military version will be out by the end of the year, and a radiation-hardened version is planned.



ONE CHIPPER. The Fairchild F9450 is a single-chip isoplanar I^2L implementation of the MIL-STD-1750A architecture. It is packaged in a 64-pin ceramic DIP with leads on 50-mil centers.

IMPROVING PERFORMANCE. The Defense Department's VHSIC Phase 1 insertion program has several projects aimed at fabricating higher-speed and radiation-hardened chip sets for MIL-STD-1750A processors. TI is the most advanced in this work and has already demonstrated a fully functional brassboard built around its 1.25-μm bipolar three-chip set for a 25-MHz processor. The TI set is capable of 3.3 mips over the full temperature range.

RCA Corp. and Harris Inc., both experienced producers of radiation-hardened CMOS circuits, are engaged in projects to produce improved hardened processors for military and space applications. RCA is developing a hardened CMOS-on-sapphire test chip and a 1750A architecture implementation with 1.25-μm double-level-metal processing for a hardened space-applications 1750A processor.

In a similar project, a team consisting of Harris Corp. (the prime contractor), Melbourne, Fla., and the Singer Co.'s Kearfott Division, Little Falls, N.J., is developing a VHSIC computer chip set that will be significantly smaller than competing sets, yet will meet the requirements of MIL-STD-1750A in a radiation-hardened design. The design goal is better than 4 mips processing power. A third team—TRW Inc. in Redondo Beach, Calif., and General Motors Corp.'s Delco Division, Kokomo, Ind.—is working to deliver an advanced high-speed processor to the Air Force by 1987. None of the companies will reveal further details about their chips. □

BRIDGE'S GROWTH MEANS BIG ROLE IN NETWORKS

FOUR-YEAR-OLD COMPANY CLAIMS IT SOLD MORE ETHERNET NETWORKS THAN ANY COMPETITOR DID LAST YEAR

SUCCESS. Bridge founders Carrico (left) and Estrin think software is the key to their business.

MOUNTAIN VIEW, CALIF.

While many electronics companies found it difficult to grow last year, Bridge Communications Inc. managed better than 100% growth. Important as this performance may be for the company's balance sheet, its significance goes beyond the bottom line or the return on investment. The big thing is that Bridge has most likely locked up a major role in the local-area-network business.

Industry watchers think the four-year-old company is now in a good position to share in the future growth of the entire LAN market. But for other potential suppliers, "the window of opportunity for this market has closed," believes Louise Herndon Wells, a telecommunications analyst with Dataquest Inc., the San Jose, Calif.. market researcher.

While the LAN market's sheer size—Dataquest estimates it hit the $1 billion mark early last year (see chart)—could still tempt some young hopefuls, Wells thinks it's too late. In all likelihood, she believes, all the major LAN players are already in the running. And it will be these companies that absorb most of the market's growth.

In addition, large general-purpose computer and information-processing equipment vendors, such as IBM, DEC, and Wang, now have significant LAN products of their own, and they can build sales from their base of installed equipment.

The opportunity for the existing LAN companies is enormous. Market forecasts indicate continued good health and expansion at an annual compound growth rate of almost 30% through 1990. Bridge ranked fifth among all LAN suppliers last year in terms of revenue. "In 1985, Bridge sold more baseband Ethernet LANs than anybody," Wells says, and it is a close second to Ungermann-Bass Inc., Santa Clara, Calif., in total LAN connections.

"The only real competition we have is Ungermann-Bass," claims Bridge president William Carrico. "That's good news," since only two companies are vying in a market that is far from saturated. Carrico doesn't doubt the growth rate will be sustained because "LANs leverage the value of the installed base—you get more value out of the equipment that you've already bought. Often, a company will buy a LAN instead of buying more equipment."

Bridge's revenue has increased from about $13 million in 1984 to an estimated $30 million for 1985, while profits rose from $519,000 in 1984 to an estimated $2.7 million in 1985 (see chart). Carrico aims to maintain that revenue rate as Bridge grows, keeping it at about the current level of $175,000 in revenue per employee.

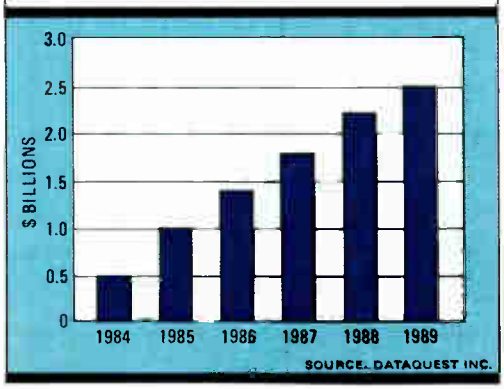
SISTER SPIN-OFFS. Surprisingly, both Bridge and Ungermann-Bass were spun off from the same company: Zilog Inc. Ungermann-Bass was founded by alumni of the Campbell, Calif., microprocessor maker in 1979. In 1981, Carrico, executive vice president Judith Estrin, and two others left Zilog to start Bridge.

"We felt we could add something by focusing on modularity and Ethernet," Carrico recalls. Unfortunately, just when the budding entrepreneurs were looking for their initial financing, an industry research company issued a negative report on Ethernet's prospects as a viable player in the LAN market. Carrico says that report delayed the closing of their financing by two months.

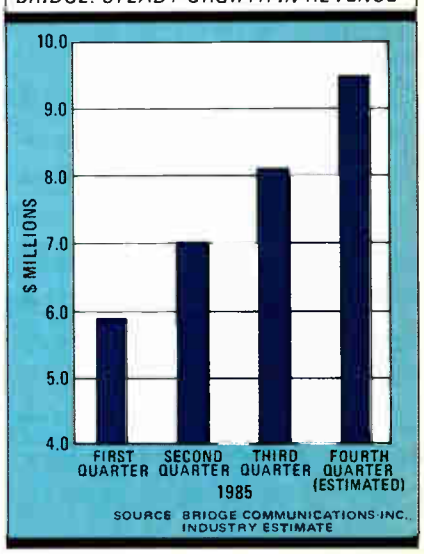
"They were in the very early stage of an emerging market and there were a lot of opinions around about what the market would be," says Bridge investor and board member Robert J. Loarie, who is also a general partner of Weiss Peck & Greer Venture Partners LP, a San Francisco investment firm. "We came to the conclusion that Bill Carrico and Judy Estrin were right. There is very little certainty in our business. The decision to invest in them was a combination of our liking to participate very early on in a rapidly emerging market and the right people."

"We invested about $1 million and it was considered a big risk then," recalls fellow board member and investor James C. Anderson, a general partner

STEADY GROWTH AHEAD FOR U.S. LAN MARKET



BRIDGE: STEADY GROWTH IN REVENUE



of Merrill Pickard Anderson & Eyre, another San Francisco investment firm. "Bill was 31 and Judy was 27, and that's pretty damn young to start a company."

The investments turned into "the most precisely executed of any business plan I have seen executed," Loarie says. Adds Anderson: "They are one of the 3% or 4% of our portfolio that did what they said they were going to do. Their execution is the key to their success."

Bridge builds network-system products and internetworking equipment, marketing it directly to users. It also has contracts with major resellers, such as Honeywell Communication Networks division, Dallas, and TRW Information Networks division, Torrance, Calif. All Bridge products meet the IEEE 802.3 local-net specification, but they accommodate a wide variety of equipment and network cabling schemes.

CUSTOMER-INTENSIVE. Carrico puts his company's goal simply as "to network whatever our customer has." He says the business is very customer-intensive, adding that 75% of orders come from existing clients in any given month. In 1985, Bridge added 25 new customers per quarter and finished the year with a total of about 400.

This month, the company is bringing out a system called CS/200, which connects asynchronous devices to a Bridge IEEE 802.3 LAN running the Xerox Network System protocols. The CS/200 makes connections at under $450 per port when teamed with the company's Ivecs (integrated VAX Ethernet communications server), a plug-in board for Digital Equipment Corp.'s VAX line that emulates input/output controller cards while providing a direct attachment to an IEEE 802.3 LAN.

Later this year, Bridge will introduce communications device servers and gateway servers that will link IEEE 802.3 communications to an emerging standard, IBM Corp.'s token-ring LAN.

Bridge's customers range greatly in size and application. The company's largest single customer is Southwestern Bell, St. Louis, whose 3,000 users communicate on an Ethernet LAN maintained by 330 Bridge servers over 18 miles of fiber-optic cabling. Its smallest customer may be Hunan University, whose purchase of one server marks the company's first sale to the People's Republic of China.

Though the hardware is what customers see, it is the software that does the job. "We've written in the neighborhood of 1 million lines of C code," Carrico boasts. Estrin says that Bridge has been able to maintain this output by "consistently hiring software engineers that are in the top 10%." Their 24 software engineers outnumber hardware engineers by 4:1. *–Eve Bennett*

BOTTOM LINES

HYPRES, IBM SPIN-OFF, RAISES $6.4 MILLION

Hypres Inc. says it has raised $6.4 million in a second round of venture financing. The company, founded in May 1983 by IBM Corp. scientist and superconducting expert Sadeg M. Faris, is developing what it calls ultrahigh-performance test and measurement instrumentation products based on Josephson junction technology. IBM granted the Elmsford, N. Y., company a license to use its superconducting technology, which Hypres says it will pair with its own proprietary process improvements to develop superconducting small-scale integrated circuits for use in high-speed test equipment and "certain military electronic systems." Eventually, it plans to use the technology in high-speed digital data-processing applications. The new funding brings to $8.6 million the amount raised by the startup.

CONVEX TURNS FIRST PROFIT

Convex Computer Corp., which ushered in the minisupercomputer era by introducing its $500,000 64-bit C-1 in October 1984, ended last year on a profitable note. Robert J. Paluck, president of the privately owned company, says it had planned to be profitable by the end of 1985. The three-year-old Richardson, Texas, company earned a profit of several hundred thousand dollars during the fourth quarter—a little over a year after shipping its first product. Convex shipped 11 C-1 supercomputers in the three-month period, bringing the total systems in the field to 25, reports Paluck. "We are basically running at about $30 million annualized sales rate right now."

RCA SETS MEETING TO VOTE ON GE DEAL

RCA Corp. has called a special meeting of shareholders, to be held on Feb. 13, to consider and vote on its agreement to merge with General Electric Co. The deal is expected to be approved by shareholders. Under terms of the transaction, GE will pay $66.50 for each share of RCA stock.

EXEL TO OPERATE AS EXAR SUBSIDIARY

Exar Corp., Sunnyvale, Calif., has completed a definitive agreement to acquire Exel Microelectronics Inc., a privately held semiconductor maker in San Jose, Calif. Under terms of the agreement, Exar will exchange about $5.7 million worth of new shares of its stock for all Exel Microelectronics common and preferred stock. Exel, it said, will operate as a wholly owned Exar subsidiary. Exar makes semicustom and standard linear and digital semiconductors; Exel makes electrically erasable programmable memories and chips for data-communications applications.

HARRIS, 3M COMPLETE JOINT VENTURE

Harris Corp., Melbourne, Fla., and 3M Co., St. Paul, Minn., have completed the formation of a new joint company to market copiers and facsimile equipment. The new company, called Harris/3M Document Products Inc. and based in Atlanta, is equally owned by the two and combines 3M's copying and facsimile businesses with the operations of Harris's Lanier Image Processing division, the two parents said. They point out that Lanier, which merged with Harris in 1983, was the largest distributor of 3M's copier products in the U. S. The two partners estimate the new company's sales base will exceed $400 million in its first year of operation.

DIGITAL TRANSMISSION RAISES $3.5 MILLION

Digital Transmission Systems Inc. says it has completed a $3.5 million second round of venture financing. The Norcross, Ga., company, which makes telecommunications products, said the funds will be used to expand production and marketing operations.

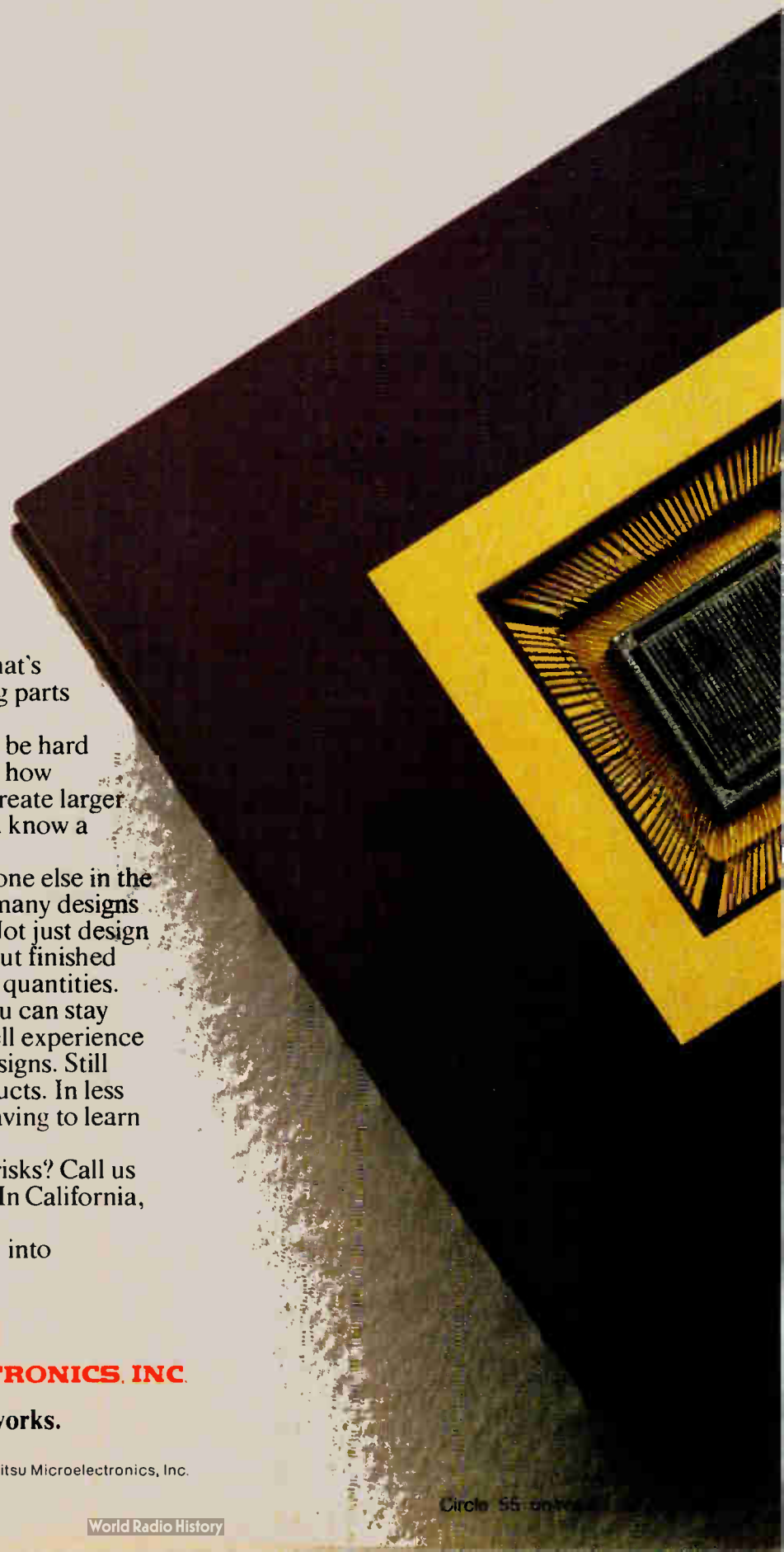
POWERTEC COMPLETES ACQUISITION

Powertec Inc., Chatsworth, Calif., has completed the acquisition of Semiconductor Circuits Inc., a privately held company in Windham, N. H. Terms of the transaction were not disclosed. Powertec, which makes switching-mode ac/dc power supplies, said Semiconductor Circuits makes encapsulated dc-to-dc converters and low-power ac/dc power supplies.

FIRST SOFTWARE GETS INTERIM FUNDING

First Software Corp., a Lawrence, Mass., distributor of microcomputer software and accessories, says it has received a financing commitment of $25 million from Heller Financial Inc. The company said the interim funding "will enable us to continue our tremendous growth until we secure additional equity financing."

Only one ASIC company has gone to such extremes.



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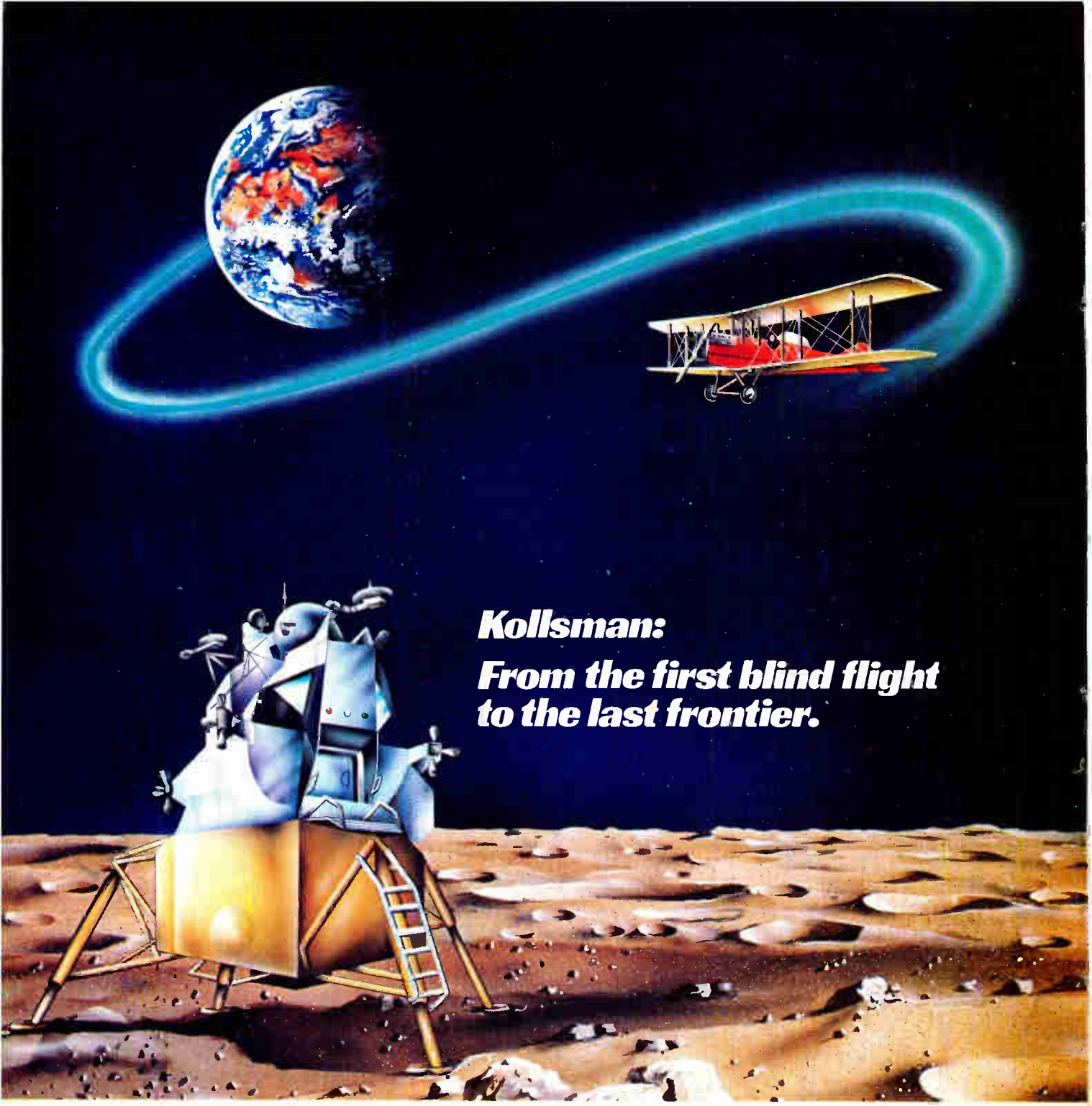

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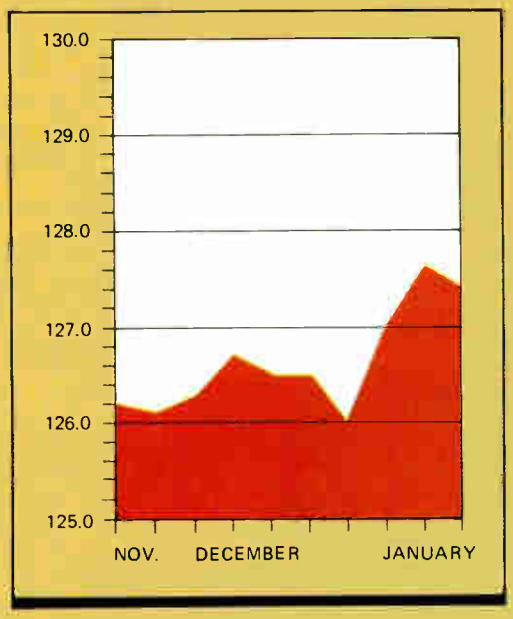
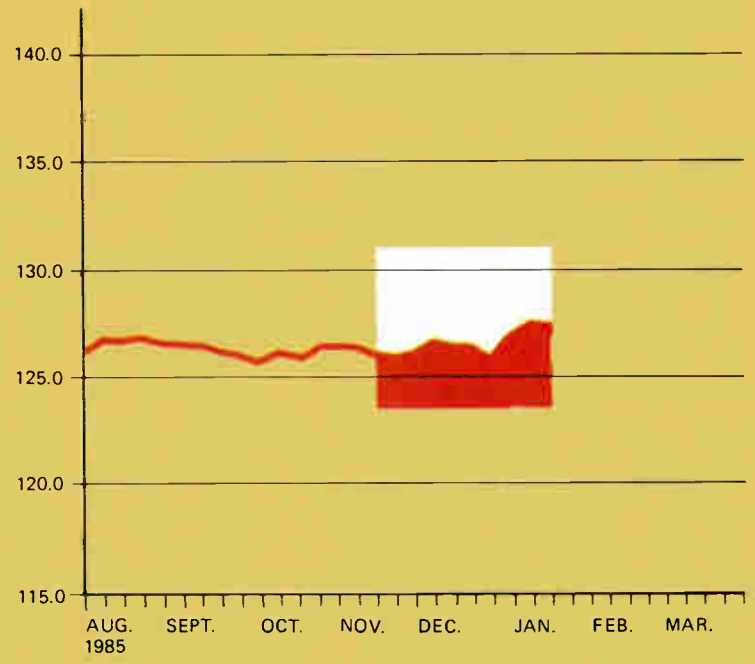
ELECTRONICS INDEX





THIS WEEK	= 127.4
LAST WEEK	= 127.6
YEAR AGO	= 129.6
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. IMPORTS & EXPORTS ($ MILLIONS)

	IMPORTS			EXPORTS		
	November 1985	October 1985	November 1984	November 1985	October 1985	November 1984
Accounting, computing, and data-processing machines	372.609	378.722	238.209	544.488	573.346	633.175
Calculators	44.551	42.697	42.268	5.498	6.499	8.727
Parts for data-processing machines and office calculators	356.478	337.154	347.427	527.378	564.618	585.386
Telecommunications, sound-recording, and sound-reproducing equipment	1,690.449	1,515.266	1,383.118	343.802	325.446	364.040
Electronic or electric instruments	152.221	138.159	123.007	507.524	542.922	564.196
Printed-circuit boards	26.033	24.815	21.400	24.713	28.728	25.027
Integrated circuits, diodes and other semiconductors, tubes, piezoelectric crystals, parts	450.288	450.432	636.257	351.440	343.362	533.539
Fixed and variable resistors	17.758	17.925	23.714	11.297	12.528	17.279

An expansion in the U. S. electronics industry's trade deficit knocked the *Electronics* Index down a few notches last week. With imports of electronic goods rising by 7.1% in November and exports slipping 3.4%, the domestic industry's trade deficit grew to $795 million from just over $500 million the month before.

Trade balances often worsen a bit after a fall in exchange rates because of the time it takes for old contracts to expire and new ones incorporating updated exchange rates to come into effect. So November's trade developments might not be so disheartening.

One bright side to the trade story comes in components. Semiconductor imports held steady at October's level, while exports actually increased 2.4%. But on the equipment side, every segment of the U. S. electronics industry saw its overseas market postings contract, with the exception of telecommunications equipment. That sector reported a 5.6% increase in exports in November over October 1985, but exports in this sector are still down 5.6% from their level in November 1984. Exports of data-processing equipment slipped 5% in November from the previous month, and are off 14% from November of 1984.

WELLAND PREPARES FOR DISK SHAKEOUT

LAS VEGAS

Mark Welland calls 1985 "the year of the shakeup, and 1986 the year of the shakeout" for the floppy-disk business. The 39-year-old sales manager for computer products at Maxell Corp. says that selling floppy disks is now a lot more like selling razor blades—giving away the razor to sell the blades. And those vendors lacking the marketing savvy or financial clout to promote sales of their products through mass-merchandise outlets will disappear, he predicts.

The shakeout will be speedy as far as Welland is concerned. "There are 80 brands in the floppy-disk business right now. But by the end of 1986, there will be only about two handfuls left," he predicts, "and one of those handfuls will dominate the whole market."

For Welland, a 1969 graduate of Rutgers University with a bachelor's degree in business and marketing, the market shift plays right to his strength. Before joining Maxell, Moonachie, N. J., in early 1978 to develop new businesses for the company in floppy disks and batteries, he had already garnered several years of consumer marketing and promotion experience with Barclay Industries and Johnson & Johnson Inc., selling products as diverse as building materials and adhesive tapes.

NEW CAMPAIGNS. At the Winter Consumer Electronics Show last week, Welland oversaw the rollout of new promotional and advertising campaigns designed to move Maxell products off the racks and shelves of supermarkets, drug stores, and department stores. "Half of our business is now flowing through the mass merchandisers," he notes. That's up from nearly nothing three years ago, when most sales were through computer specialty stores. By contrast, audio tape followed the same path out of audio specialty outlets, but it then took six to seven years to reach the mass-market penetration.

Much of the shift in the floppy-disk business occurred in just the last year, Welland says, when single- and double-sided disks began to emerge as convenience purchase items. Some major chains saw five- to six-fold sales increases within the last 6 to 12 months, he says.

"We can't put a finger on who's buying in the mass merchandise outlets. I don't think it's the home computer owners because that market's too small. I've got a feeling it's the small businesses, where the doctor or the lawyer is sending his secretary out to pick up some disks over the lunch hour."

BIG CHANGE. Maxell's Welland sees a shift to mass merchandising.

Added promotional and advertising costs that are now necessary to compete in the floppy-disk business will lead to this year's shakeout, Welland says. The disk's emergence as a mass merchandise item "begins to separate those vendors that have the funds to support these kinds of programs from those that don't. We're not just in a technology race anymore. It's also financial."

Depending on whose market figures are used, Maxell ranks either first or second among floppy-disk suppliers, with a 25% to 30% market share, Welland says. The other big player is 3M Co., of St. Paul, Minn. When asked to predict which vendors will thrive in the new era, Welland provides a short list. "Maxell, 3M, and Sony will survive, and Fuji will hang in there. But for the rest, they're going to have to speak for themselves."

Regardless, the Maxell official expects the slugging to get heavy this year as leading floppy-disk vendors react to the change with various promotions to fight for the convenience buyer's attention. At the consumer show, a number of other floppy-disk vendors including Fuji, Polaroid, 3M, and Verbatim were talking up new advertising and promotional programs offering everything from rebates to free rolls of photo film to head-cleaning products tied to the pur-

PEOPLE ON THE MOVE

RICHARD K. KRUSE

☐ NCR Corp. has named Richard K. Kruse vice president of corporate quality assurance. Kruse, 47, is a 20-year NCR veteran who moves into the slot after five years as vice president of the Dayton, Ohio, company's Retail Systems Development and Production division. Kruse has been a line manager in various engineering and manufacturing positions since joining NCR in 1965.

JERRY KELLENBENZ

☐ Internet Systems Corp., Sunrise, Fla., has appointed Jerry Kellenbenz vice president of product development. He has spent 28 years in the computer industry, 23 of them at Sperry Corp., where he played a key role in the specification of the company's distributed communications architecture. Most recently, as Sperry's director of advanced connection development, Kellenbenz managed the design of high-performance computer connection products.

FRED W. O'GREEN

☐ Litton Industries has named a replacement for chairman Charles B. Thornton, who died last November. Fred W. O'Green, the new chairman and chief executive officer, joined Litton in 1962 as a general manager of the Guidance and Control Systems division. He rose through the Defense and Space Systems and Components groups to become president and chief operating officer in 1972. Prior to joining Litton, O'Green was technical director of all space programs and assistant general manager at Lockheed's Space division.

MICHEL JOUBERT

☐ CIT-Alcatel Inc., a U. S. subsidiary of CIT-Alcatel of France, has promoted Michel Joubert to director of software development. Joubert will be responsible for the development of call processing, administration, maintenance, and diagnostic software for the company's E10-FIVE switching system. Joubert, who has worked for the Reston, Va., company for five years, was charged with developing software for the E10-FIVE Remote Switching Unit.

HAL YANG

☐ The new vice president of product operations for MIPS Computer Systems is Hal Yang. Yang, 44, will be responsible for product manufacturing and engineering, including boards, development systems, and software. He joins the Mountain View, Calif., company from KLA Instruments Corp., where he had various vice presidential assignments.

If the cards below have already been used, you may obtain the needed information by writing directly to the manufacturer, or by sending your name and address, plus the Reader Service card number and issue date, to Electronics Reader Service Department, P.O. Box 2713, Clinton, Iowa 52735.

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Estimate number of employees (at this location): **1.** ☐ under 20 **2.** ☐ 20-99 **3.** ☐ 100-999 **4.** ☐ over 1000

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chase of their disks.

For his part, Welland says Maxell will increase its advertising budget significantly in 1986 to more than $5 million. This year's spending will include the company's first-ever series of TV commercials touting its floppy-disk products, scheduled to run at midyear. And on the promotional front, Welland hopes that the three programs unveiled at the consumer show will boost Maxell's product brand awareness with consumers.

All three efforts aim to provide purchase incentives by including an extra disk packaged in specially marked 10-packs of Maxell MD-2 5¼-in. disks. The 11th disk will be free with the 10-packs, which retail for $16.95 to $19.95.

One promotion will offer a trial disk of a new Computerized World Atlas program developed by Software Concepts Inc., Stamford, Conn. The Atlas provides a three-dimensional representation of the globe that can be rotated in all directions and enlarged or shrunk as desired. By entering one of 2,500 city names, the user can bring up the appropriate point on the globe and can also get a variety of information about the city and the country.

Maxell disk packs will include promotional software

Codes built into the Atlas program will allow the customer to use the software for three 40-minute trials before the program automatically locks up, preventing further use. The customer can then purchase the program by credit card for $69.95 by dialing a toll-free number, receiving an unlocking code that frees the Atlas for unlimited use. Alternatively, the disk can be reformatted for other use.

DEMOS OFFERED. Unlike the Atlas trial program, the other two Maxell promotions will offer 11th disks containing demonstration programs for available computer services. One offers a sample of the Dow-Jones News/Retrieval online business news and information service. The other, to be offered only in New Jersey and the New York metropolitan area, will provide a demonstration of direct-access banking services offered by Citibank.

Welland says the current efforts are only the first of a series of similar promotions planned by Maxell over the next several months. These efforts won't come free. By providing an 11th disk, "it costs us 10% on whatever goes out the door," not to mention such other costs as a 56-page documentation booklet that is also provided with the Atlas program. *–Wesley R. Iversen*

NEW PRODUCTS

TURNING A PERSONAL COMPUTER INTO AN ARRAY PROCESSOR

TWO-CARD PRODUCT SPEEDS UP AN IBM PC AT TO 20 MEGAFLOPS

Powerful array processors can now be added to the growing list of tools that have been domesticated for use on personal computers. A two-board array processor that is capable of executing 20 million single-precision or 10 million double-precision floating-point operations per second will soon be available for the IBM Corp. Personal Computer AT from Sky Computers Inc.

Among the keys to the performance of this array processor, which is called the Vortex and performs vector and scalar operations, are two very large-scale integrated circuits from Analog Devices Inc. The boards use both Analog Devices' 3210 arithmetic logic chip and its 3220 multiplier [*Electronics*, Jan. 13, 1986, p. 72]. Other VLSI chips on board are a sequencer from Analog Devices and an Advanced Micro Devices 2901 bit-slice microprocessor. Sky Computers says the boards will perform scalar operations up to 10 times faster than Intel Corp.'s 80287 processor.

TWO CARDS. Sky Computers' array processor will ship in March for a price of $9,900.

The Vortex has 1 megabyte of dual-ported RAM, which the PC AT can access as its own data memory. Thus the personal computer and the Vortex can work on the same data, eliminating the overhead required for transfers.

"In one sense, we avoid the whole issue [of data transfer]," says John Carbone, vice president of sales and marketing. "In another sense, the data has to come from somewhere. If the reading is from the disk, it can be read directly into the Vortex memory because that memory looks like system memory to the AT and the disk controller doesn't know the difference. In normal cases, there is no transfer from PC memory to Vortex memory."

BRAINS AND BRAWN. The processor's raw power is complemented by intelligent software designed to reduce the hassles associated with array processors. In a conventional array processor, programmers must plow through the job at hand to determine where the processor's subroutines can be used. The Vortex has a preprocessor called VEX that does much of this work.

VEX examines standard Fortran programs to seek out vector operations, then automatically converts those sections of code into code that triggers the Vortex to perform the operations. After the vectoring is completed, VEX seeks out scalar operations and feeds them to the array processor for execution. Scalar operations take 2.8 μs.

"VEX doesn't require the user to do any rewriting," says Carbone. "Basically, a recompile is done to use VEX." The processor's scalar performance efficiency is maximized because 32-bit commands trigger the Vortex for scalar, as well as vector, operations. Those 32-bit commands in turn contain pointers to data descriptors set for scalar or vector operations.

COMMAND WORD. "The biggest challenge of the design was to achieve a single 32-bit command word which contained all the necessary information," says Carbone. "To do that, we had to generate several data-support structures that are referenced by the command word but reside in the Vortex."

Further reducing overhead, VEX lumps 32-bit scalar commands under a single name, stores it in the Vortex, and then executes the collection with a single 32-bit command. VEX can also call array-processor subroutines from the host, as traditional array processors do.

The company points out that the machine's theoretical maximum of 20 megaflops would be executed in the form of 10 million additions and 10 million multiplications.

Sky Computers expects such areas as geophysics and finite-element analysis to be major applications for the Vortex. The boards will ship in March for a unit price of $9,900. *–Craig D. Rose*

Sky Computers Inc., Foot of John St., Lowell, Mass. 01852. Phone (617) 454-6200 [Circle reader service number 338]

SENSOR MEASURES POWER FOR MACHINE CONTROL

Now a sensor called Power Cell has been developed that accurately measures a variable-frequency drive's power output. Load controls that sense power using current and watt sensors are available and widely used in machine tools, chemical processes, and material-handling applications. But they don't work on variable-frequency sources.

Built by Load Controls Inc., in Sturbridge, Mass., Power Cell uses Hall-effect sensors to take readings in an unconventional approach—from the power rather than the current of the drive, for measuring both pulse-amplitude-modulation (six-step) and pulse-width-modulation drives. The sensor, which measures power at both low and high frequencies, is fast and immune to noise.

INSTANTANEOUS. Current sensors are effective for power lines and large motors, where the current is high, but they do not work well at low current-input levels, says William A. McClurg, president of Load Controls. "We're looking at taking an instantaneous reading of

the level of power for rapid control of machine movement."

Unlike Power Cell, McClurg says, watt transducers won't work on the output of a variable-frequency drive. This is for two reasons. First, typical waveforms from a pwm or six-step drive are "too dirty" for the watt transducer to sense the zero crossing of sinusoidal voltage and current for power-factor calculation.

Second, many watt transducers use a current-sensing toroid or a lamination transformer, and both are unreliable at low frequencies.

POWERS THAT BE. Load Controls' Power Cell measures the power output of variable-frequency drives for control devices.

Although small, when the Hall voltage is amplified, it becomes a supple tool for digital- and linear-output measurement. Power Cell is sensitive even at low load levels, and its capacity can be changed in the field to maximize sensitivity. It is also fast—response time is 15 ms, due to a multistep filtering circuit, as opposed to a typical response time of 250 to 500 ms for watt transducers.

A CLEAR SIGNAL. In a system, the Power Cell fits between the variable-frequency drive and the variable-speed ac or dc motor. It senses the variable-frequency or dc power, then sends a clean, unambiguous signal to a load control. The load control then uses this power signal as feedback for machine control and protection, by detecting overloads. These take the form of adjusting feed rates as sizes or materials change, signaling that the tool has reached the workpiece, and protecting both the machine and the tools by sensing overload or loss of load.

The Power Cell costs $500. A series of plug-in resistor-capacitor networks are used to adjust the gain of the Power Cell for various currents from of 4 to 20 mA or 0 to 1 mA and voltages from 0 to 5 V or 0 to 10 V. *-Ann Jacobs*

Load Controls Inc., Rte. 131, Sturbridge, Mass., 01566.
Phone (617) 347-2606 [Circle 343]

WAVEFORM SYNTHESIZER SIMPLIFIES TESTING

Hewlett-Packard Co.'s arbitrary-waveform synthesizer replaces a rack of instruments to satisfy a wide range of test and measurement scenarios. The HP 8770S system consists of the HP 8770A arbitrary-waveform synthesizer and the HP 11775A Waveform Generation Language software package, which makes the generator easy to use.

This modest lineup of equipment generates a precise working waveform, which the engineer then assaults with noise, glitches, and any other defects that imagination and experience can devise for the application under test. All this is possible thanks to the new HP language, a terse rule set that employs the same technique HP used in its language for the popular HP-41CX programmable calculator.

The synthesizer, which works with either the HP 9836A or 9816A computer, is a versatile arbitrary signal source for general-purpose automatic test systems—one generator might replace four or more typical pulse and function generators. Other possible test scenarios include signal-stress testing to probe for the marginal performance of devices and systems. Such tests include video simulation for TV design, hard-disk-drive testing and read-head waveform simulation, high-frequency receiver testing, electromagnetic pulse simulation, and voice synthesis—any signal that spectrally fits into the unit's 50-MHz bandwidth. "This puts the user right in the middle of read-head simulations and also covers the intermediate frequency range of microwave systems," says John L. Minck, advertising manager of HP's Stanford Division.

MENU. Users create waveforms on HP's 8770S generator by picking elements like ramps or random noise from a menu.

BEYOND BASIC. Waveform Generation Language is more versatile and concise than Basic, enabling operations on arguments such as a starting ramp to create a sine wave, for example. Where Basic would require looping and delays, the HP language just creates the sine wave. The user can build very complex waveforms with very few lines of code.

There are three basic building blocks in the HP language—ramps, noise, and constants—and four ways to use them. The user can manipulate a menu of the three building blocks or write the mathematical description of the desired waveform directly. The user also can set up a personal repertory of often-used waves into a menu area that's on call, while the fourth mode creates a waveform from data input by means of a graphics tablet or from captured data obtained by an oscilloscope.

The HP language has more than 180 commands in its vocabulary but requires only 17 to perform a disk read-head test. For this purpose, the language allows creation of a missing bit or an extra bit, and the operator can modulate the signal envelope to simulate disk wobble or other mechanical anomaly. The software can add interference glitches at random times.

The HP 8770A waveform synthesizer performs parallel processing from eight 16-K by 12-bit memory banks to achieve a 125-megasample/s rate with an amplitude resolution of 12 bits. The 9836A or 9816A computer serves as both the instrument panel and the interactive interface.

The 12-bit data stream from the multiplexer forms the input for the digital-to-analog converter, the heart of the system. The DAC provides a new analog level every 8 ns, at distortion lower than -60 dBc. Its amplitude range is 72 dB, which means identical repeatability, and it offers a high standard of spectral puri-

ty and signal fidelity.

When a plot of the output waveform is superimposed on its mathematical model to check accuracy of replication—the integrated cumulative differences between the two signals—the average deviation is typically 0.2%.

The price of the synthesizer is $24,000 and the software goes for $5,000. Delivery takes about 16 weeks. *–Ann Jacobs*

Hewlett-Packard Co., Inquiries Manager, 1820 Embarcadero Rd., Palo Alto, Calif. 94303 Circle 339]

A CORE MEMORY THAT CAN TAKE THE HEAT

Magnetic core memories can survive the semiconductor onslaught only by finding niche applications that can take advantage of such properties as nonvolatility. Now Controlex Corp. is delivering a core memory that reads and writes at temperatures up to 200°C, a capability that the Van Nuys, Calif., company believes will widen the niche.

Controlex's offering, dubbed the Hot T because of its pc board's shape, stores 64 8-bit words. And because it is designed for operation with a separate electronics package, the memory array is removable for data recovery outside of the host equipment.

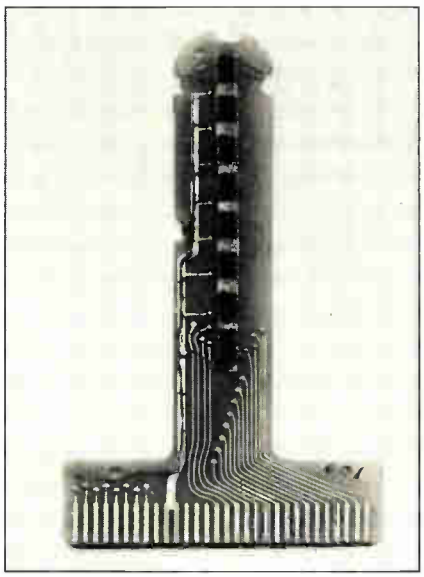
Controlex says it has developed techniques that enable the nonvolatile core memory to operate within microseconds at temperatures far in excess of those previously possible. Until now, the maximum operating temperature has been about 100°C.

NEW NICHE. High-speed read and write operations in nonvolatile memory can be important in data gathering and control systems for logging data deep inside oil wells and for "measure-while-drilling" gear—operations that routinely encounter elevated temperatures. The Hot T's high-temperature capability suits it for such down-hole applications as oil exploration, well operation and management, and for geothermal systems.

The Hot T can handle these temperatures thanks to a special class of ferrite memory cores, which have high Curie temperatures—the point above which magnetic properties disappear. The Hot T memories retain their square loop properties well past the specified 200°C operating temperature. In addition, Controlex uses special pc boards made of polyimide and silver-doped solders that can withstand the high temperatures.

Customized memories based on the Hot T design technique can range from storage capacities of a few hundred bits to hundreds of kilobits. Hot T memories also can be radiation hardened, making them suitable for military applications.

Because the memories are custom built, prices and delivery information are unavailable. The Hot T pictured



DOWN UNDER. Controlex's core memory can operate at 200°C, suiting it for use in oil wells.

costs about $250 each in lots of 100 pieces, without electronic circuitry. Delivery takes 60 to 90 days. *–Steve Zollo*

Controlex Corp., 16005 Sherman Way, Van Nuys, Calif. 91406.
Phone (818) 780-8877 [Circle 342]

LOCAL AREA NET IS $25 PER DEVICE

EM Gerätebau GmbH, a small West German company, has come up with an alternative to the high costs of connecting single-chip microcomputer-based gear to local-area networks such as Ethernet and Arcnet: a low-cost, low-speed LAN called 1Chipnet. With it, as many as 255 personal computers or process controllers can communicate.

Networks can extend over distances of up to 2 km without repeaters and transmit data at a rate of 100 kb/s. Compared with Ethernets, which have a typical per-device connection cost of $695, 1Chipnet's connection cost is as little as $25 per device on a fully configured network.

The 1Chipnet LAN is intended for industrial measuring and control applications in factories and hospitals to tie together single-chip process controllers, personal computers, and other small pieces of data-processing equipment. A connected station's regular computing functions can be interrupted by software so that these stations can take on the additional job of network controller for the 1Chipnet.

For example, each of four single-chip stations controls three axes of a 12-axis machine-tool positioning system. The device's memory usually has enough spare capacity—about 1-K byte—for storing protocol, security, and collision-control data so that the station can act as a network controller.

LINE DRIVERS ONLY. Thus, with network controllers already on hand, all the hardware the customer needs to buy is one line driver for each connected station. That is what keeps the 1Chipnet's cost low, says Siegfried Schwarz, EM Gerätebau's deputy general manager. A line driver sells for as little as $20 each. The required network-control software package, which supports up to 255 connections, goes for $1,200. Cabling is usually provided by the customer to suit his own needs.

At such a low cost, however, the 1Chipnet supports only data transfers; it does not support file or peripheral sharing because single-chip computers usually have no file-management capability.

The 1Chipnet can link a number of popular single-chip computers from different manufacturers—the 8-bit 8031, 8051, 8052, and 6500/11, and the 16-bit 8096 and 68200—because the protocol is independent of the computer. The serial interfaces of these devices connect to the EM Gerätebau line driver.

The baseband LAN uses the carrier-sense multiple access with collision detection and answer transmission method. If a station has accessed the network without collision, that station has priority over all others for as long as it takes to send the message. Optimum data transmission is over a two-wire shielded twin-axial cable with 110-Ω termination resistors.

The line driver drives the cable with 6 V peak to peak, which allows bridging the 2,000 m without a repeater. The delivery time for the 1Chipnet is about six weeks. *–John Gosch*

Interface Data Inc., 18 Assembly Square Dr., Somerville, Mass. 02145.
Phone (617) 646-5580 [Circle 340]
EM Gerätebau GmbH, D-6800 Mannheim, P. O. Box 509, West Germany [Circle 341]

PRESSURE ACTIVATES THICK-FILM RESISTOR

Interlink's Force Sensing Resistors conduct electricity as a function of pressure and can serve as a switch. A system employing such parts can be controlled by simply pressing harder or softer. The FSR is a sandwich formed by a conductive polymer between two flat conductive surfaces. The thick-film resistors are available in almost any shape and size for applications ranging from appliance controls for ovens and dishwashers to tactile sensors for robotics and sensors for prosthetic devices.

Resistance at force saturation can be tailored from 100 Ω to 100 kΩ. Repetition rates go from 2 to 5 ms. The company will send a data sheet with a free sample of the FSR, and a sample kit with device formats in five resistance ranges is available for $34.

Interlink Electronics Inc., 331 Palm Ave., Santa Barbara, Calif. 93101.
Phone (805) 965-5155 [Circle 350]

CHIP CAPACITORS HAVE WIDE RANGE

The DA4400 series of metal-silicon nitride chip capacitors come in a capacitance range of 4.7 to 470 pF with tolerances of 20% or 10%. They are suitable for use in thin- or thick-film circuits as coupling-decoupling devices, or as dc break capacitors in filters, oscillators, and matching networks.

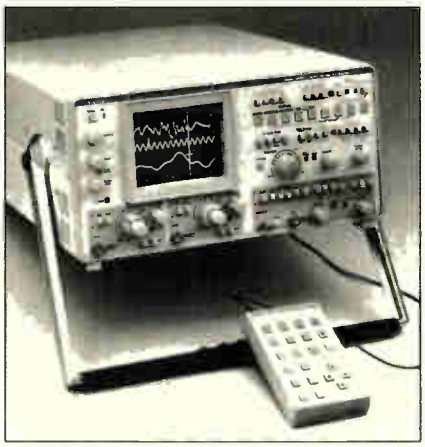
The customer can specify capacitance value, capacitance tolerance, and chip dimensions. Both pads are gold-metalized and chips are 100% tested to twice the stated maximum working voltage. Depending on capacitance, the price for quantities of 1,000 ranges from under $1 to around $4. Delivery time now takes six weeks but will drop to two weeks when these capacitors, which are manufactured by Marconi, are available from its U. S. distributor.

Epsilon Lambda Electronics Corp., 427 Steven St., Geneva, Ill. 60134.
Phone (312) 232-9611 [Circle 352]

SCOPE STORES FIVE TRACES

The model 4050 digital storage oscilloscope offers dual 100-MHz analog-to-digital converters, 1 K-byte of memory per channel, and five-trace nonvolatile RAM storage for general-purpose use. The instrument also functions as a dual-channel analog oscilloscope, with a bandwidth capability up to 35 MHz.

A signal-averaging feature takes up to 256 events and averages them using double-precision math to eliminate rounding errors. Vertical resolution is 8 bits, and two independent cursors are located on-screen. In autoplot mode, the scope automatically captures random transients for recording on an oscillograph, strip chart, or X-Y recorder. Output to a computer is also possible over the IEEE-488 interface; because the interface is bidirectional, the user can program the scope.



The complete 4050 system costs $7,950 and will be delivered in 60 days. The price without the optional keypad is $7,290.

Gould Inc., Recording Systems Division, 3631 Perkins Ave., Cleveland, Ohio 44114.
Phone (216) 361-3315 [Circle 360]

FIFO RAM CONTROLLER DOES DEEP BUFFERING

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The RAM-based architecture of the 674219 has no fall-through time, which suits it for digital signal-processing systems. Other applications for the IC are printers and data-communications links, where word depth is critical. The chip operates at up to 24 MHz and draws a maximum of 350 mA.

Available now in a 40-pin ceramic DIP, the 674219 FIFO RAM controller costs $28.35 in 100-piece quantities.

Monolithic Memories Inc., 2175 Mission College Blvd., Santa Clara, Calif. 95054.
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ELECTRONICS WEEK

ELECTRONICS JOBS DOWN 2.3% IN 1985

Declines in employment at components and computer manufacturers led to a 2.3% decrease in the U. S. electronics industry labor force in 1985, says the American Electronics Association. Components manufacturers cut 55,000 employees—8% of their work force—while computer and office equipment makers, likewise down 8%, lost nearly 42,000. Increased employment in the communications and programming fields helped offset those losses, leaving a total of 60,000 workers displaced. At Silicon Valley's heart, Santa Clara electronics manufacturing employment fell by about 6% overall last year, with the component manufacturing sector accounting for most of the 12,500 jobs lost. Intel Corp. closed fiscal 1985 with a net income of $2 million, a 99% decrease from 1984, and a 16% drop in revenue. As a result, 700 employees—3% of the total—were laid off.

HBO SCRAMBLES ITS SIGNALS

Home Box Office has ended clear-channel broadcasting, and with it the movies that the 1.5 million owners of satellite dishes have been receiving for free. Fourteen other broadcasters are expected to follow HBO's lead later this year. To receive scrambled broadcasts, dish owners will need a decoder (about $400) and will have to pay a monthly fee—expected to generate upward of $1 billion in additional revenue for the broadcasters. Dish makers are challenging HBO's move in court, and Congress has proposed a two-year moratorium on scrambling.

PENNEY MOVES INTO COMMUNICATIONS

J. C. Penney Co. is setting up a communications subsidiary to market video-conferencing, direct-broadcast-satellite, and a range of other services. The new company arises from a communications department Penney began seven years ago to produce in-house video tapes for sales instruction, which has grown since to include a DBS television network, three New York studios, full-motion video conferencing between New York, Atlanta, Dallas, and Pittsburgh, and a variety of other services. Called J. C. Penney Communications Inc., the subsidiary will be based at Penney's New York headquarters.

TAIWAN SEEKS VLSI PARTNERS

The Taiwan government is seeking investors to join a proposed $207 million project to manufacture very large-scale integrated circuits. The project is being coordinated by the government-supported Industrial Technology Research Institute, whose president, Morris Chang, was formerly president of General Instrument Corp. and vice president of Texas Instruments Inc. in the U. S. So far, Matsushita, Philips, and TI have held discussions with the institute. A joint-venture company could be established in the first half of this year and begin production as early as the fourth quarter by leasing a pilot line already set up by ITRI. Construction of its own plant could be completed about a year later.

FCC CONDITIONALLY OKs FINANSAT

Another player in the growing international satellite business joined the roster on Jan. 10 when the Federal Communications Commission conditionally authorized Financial Satellite Corp. to build and operate a private communications satellite system that will span the Atlantic and Pacific oceans. The approval means additional competition for the International Telecommunications Satellite Organization, which held a virtual monopoly on international telephone and television transmissions until the FCC approved limited competition last July. Finansat says it will sell or lease all its transponders for several financial and corporate digital data network services.

FRENCH FIRM BUYS INTO U.S. SOFTWARE

With the stroke of a pen, France's largest software and consulting group has increased its U. S. role. Cap Gemini Sogeti SA, Grenoble, signed an agreement to purchase the professional services activities of CGA Computers Inc., a U. S. software house with sales of some $80 million. The purchase, which corresponds to two thirds of CGA's activities, will increase Cap Gemini Sogeti's U. S. turnover in 1986 to some $125 million, just under one third of the group's worldwide sales. The company created by the merger of the French company's current U. S. activities with those of CGA will do business under the name Cap Gemini of America.

OSHMAN RESIGNS ROLM PRESIDENCY

M. Kenneth Oshman, who founded Rolm Corp. in 1969 with three associates and presided over its sale to IBM Corp. in November 1984, has resigned as president and as an IBM vice president. He says he is leaving Rolm for new—and unspecified—ventures, presumably startups. He will continue to serve the Santa Clara, Calif., company and IBM as a consultant and has been elected to the board of directors of IBM World Trade Europe/Middle East/Africa Corp. Dennis D. Paboojian, vice president of Rolm's Systems Development Group, will succeed Oshman as president of Rolm.

U. S. CO-OP BUYS NEC SUPERCOMPUTER

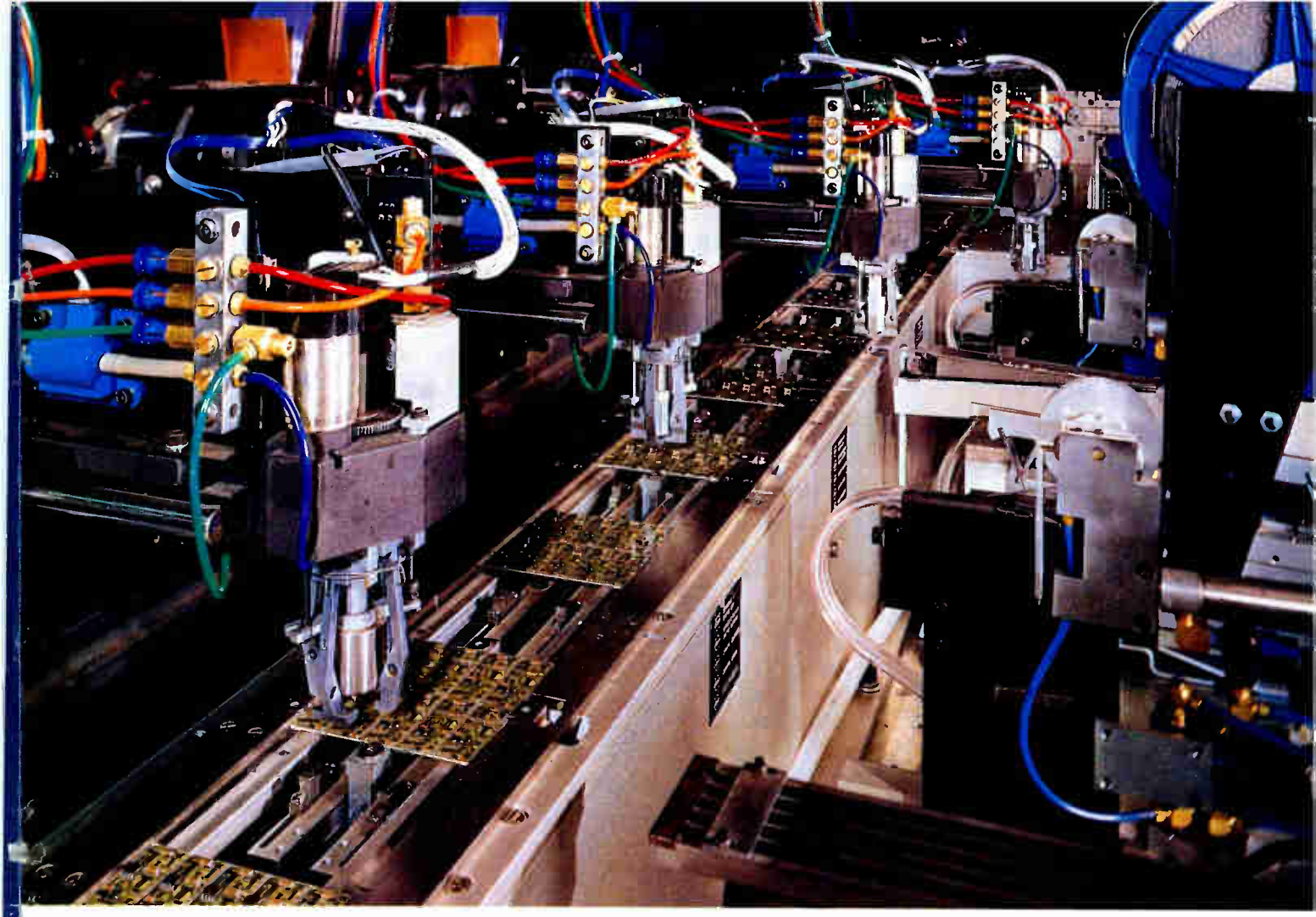
The month-long pending sale of the first Japanese supercomputer to be installed in the U. S. has been completed, according to a research and development cooperative of Texas universities in Houston. The Houston Area Research Center and NEC Information Systems Inc. have formed a cooperative relationship that includes the sale of an NEC SX2 supercomputer to the center. The system, which will be installed in nine months, is capable of 1.3 billion floating-point operations per second and costs $20 million.

NATIONAL DROPS OPTOELECTRONICS

National Semiconductor Corp. has sold its optoelectronics unit in Troy, N. Y., to a new company called III-V Semiconductor Inc., in Phoenix, Ariz., for an undisclosed amount. "The technology and product line do not fit into our long-range plans," says Charles E. Sporck, president of the Santa Clara, Calif., company. The optoelectronics line represented less than 1% of National's revenue. III-V Semiconductor's founder, president, and chief executive officer is Frank Shroff, former head of the unit National just sold.

SOFTWARE HOUSE EXPANDS OVERSEAS

Software Publishing Corp., purveyor of two best-selling lines of business software—pfs: and the Harvard project-management series for Apple Computer Inc. and IBM Corp. personal computers—has opened its first overseas office, in London. The Mountain View, Calif., company says it has been shipping products to Europe since 1981—but all its competitors, including Ashton-Tate, Lotus Development, and Microsoft have offices overseas.



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SMC standardization will result in the increased use of surface mounted components. However, use of insertion mounted components also will grow. Except for some extremely high volume consumer electronics applications, industry experts project that use of DIPs and SIPs will grow substantially through this decade, and use of insertion mounted discrete components will not taper off during the next decade. Therefore, new PC board assembly facilities need to be planned with the flexibility to handle changing mixes of both surface mounted and insertion mounted components. Only Universal can provide a full range of compatible assembly systems for both types of components.

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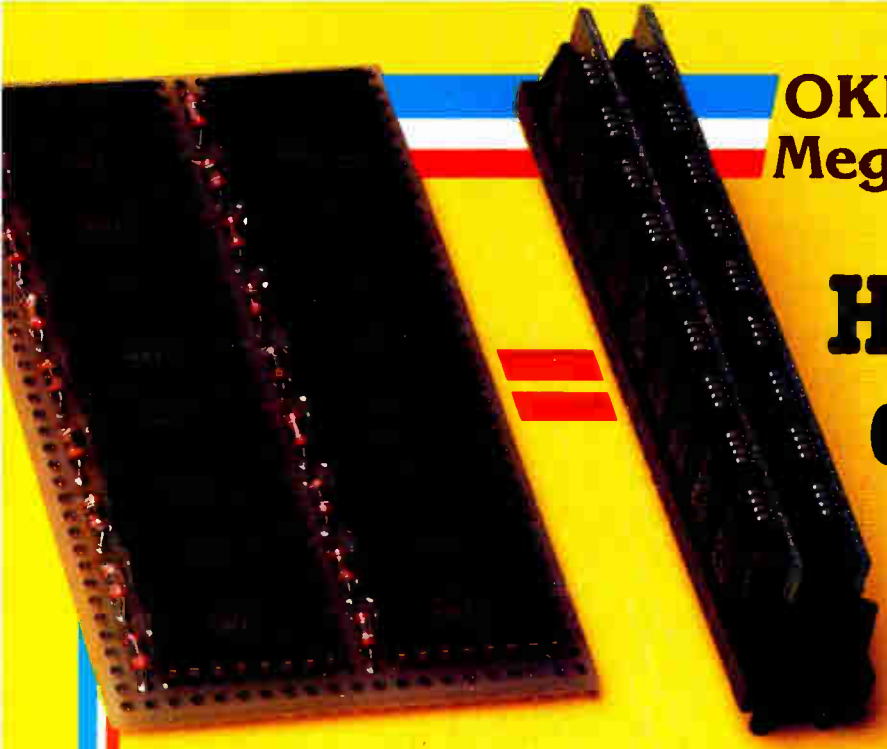

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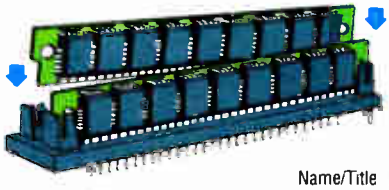

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