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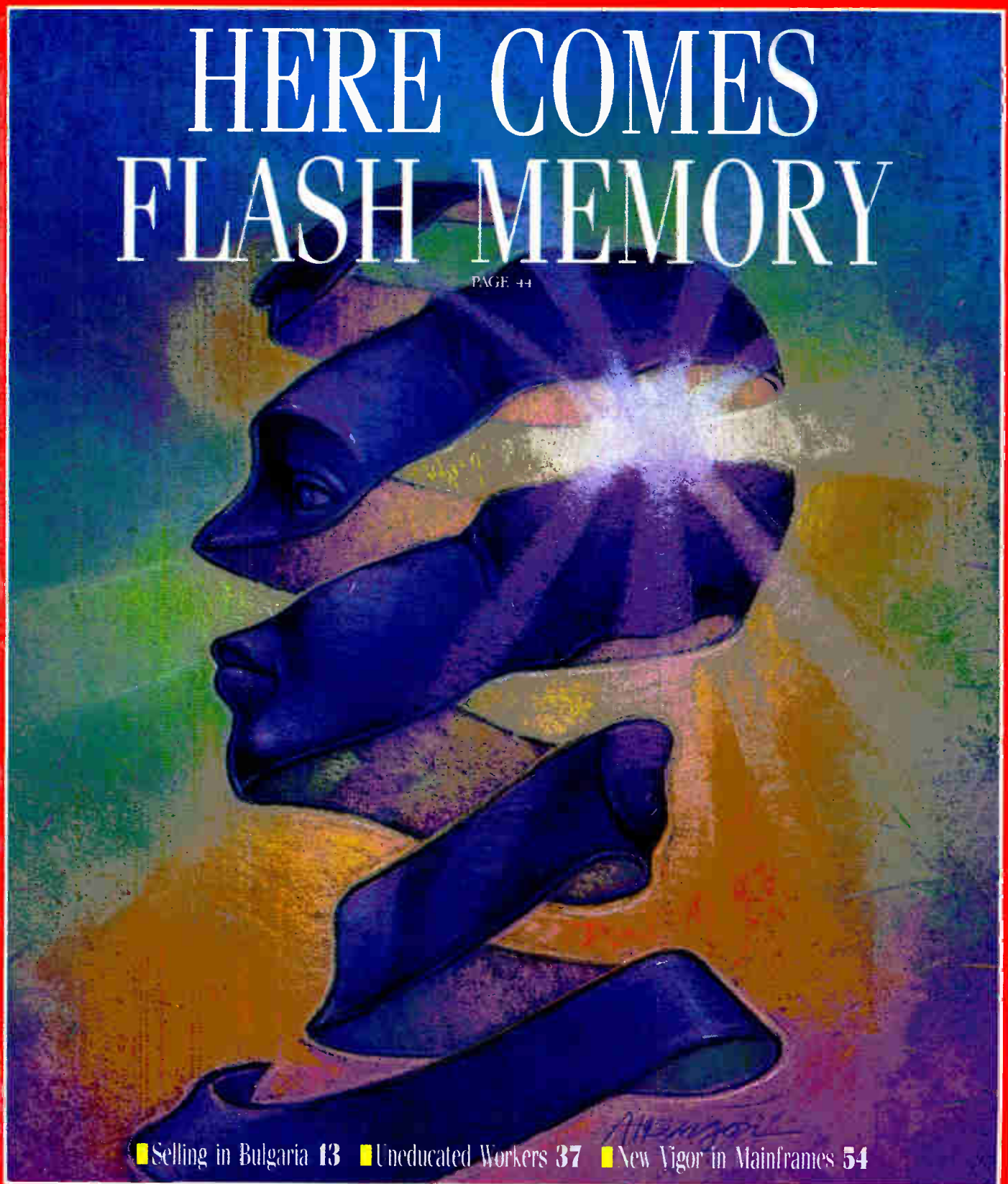
Electronics

FIRST MAGAZINE OF GLOBAL ELECTRONICS MANAGEMENT

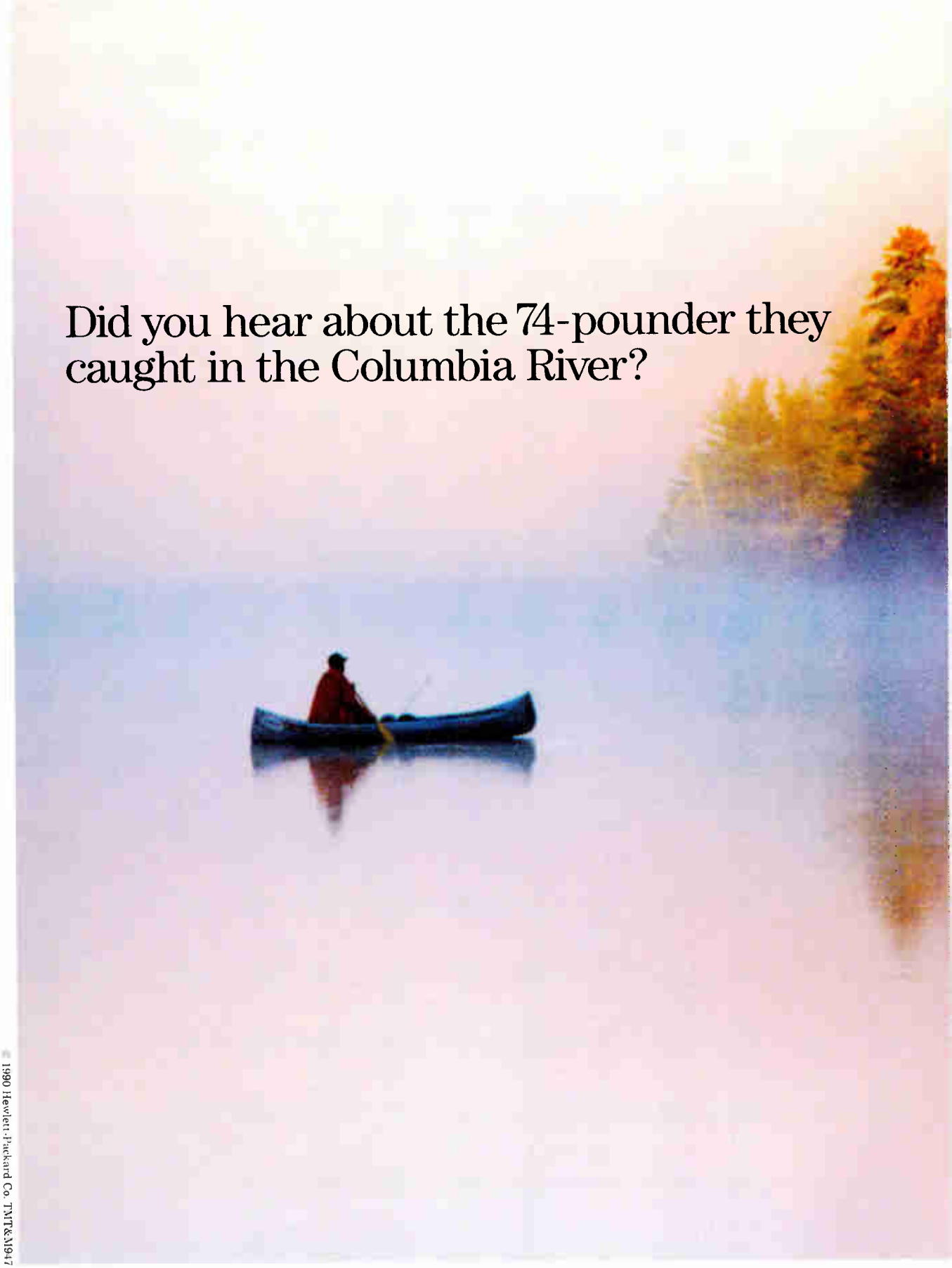
WHAT'S HOT ELECTRONICA? PAGE 57

HERE COMES FLASH MEMORY

PAGE 44



Did you hear about the 74-pounder they caught in the Columbia River?



It worked without a snag.

This is a story about the one that got away. And then came back as reliably as ever.

In 1987, bandits stole four HP signal generators from a truck in Spokane, Washington. Luckily, police managed to recover three of them. But the last one disappeared without a trace.

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HEWLETT PACKARD

CIRCLE 201

Electronics

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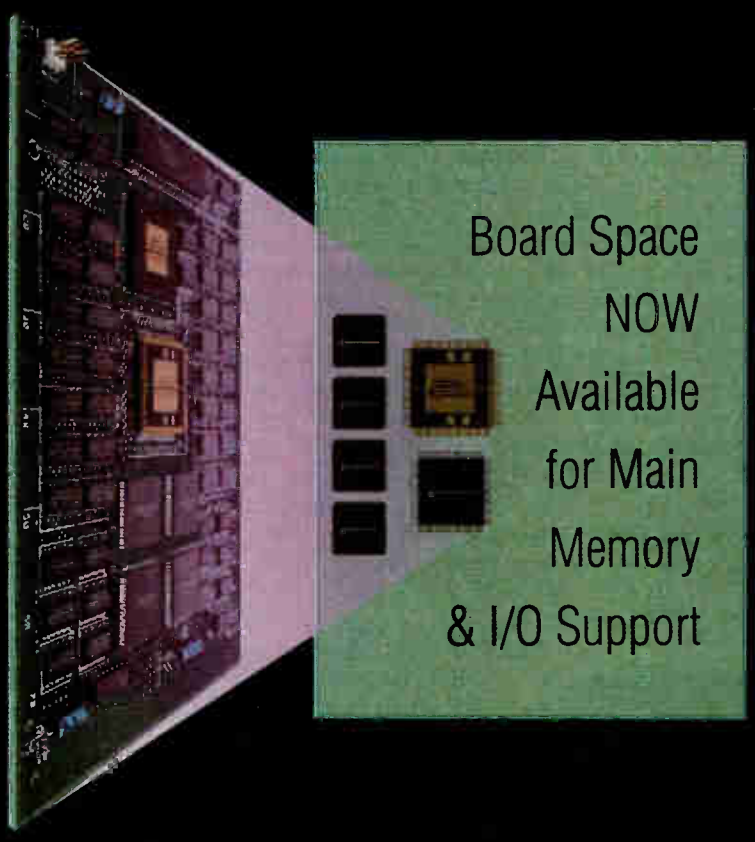

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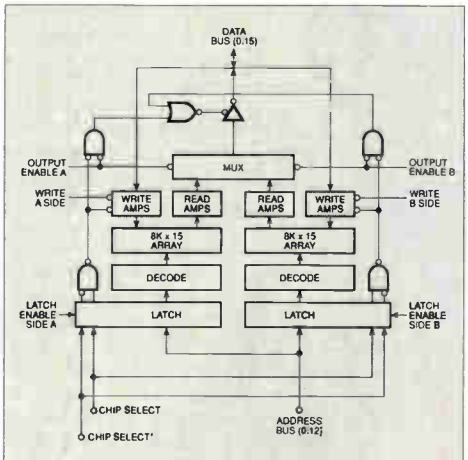

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CIRCLE 189

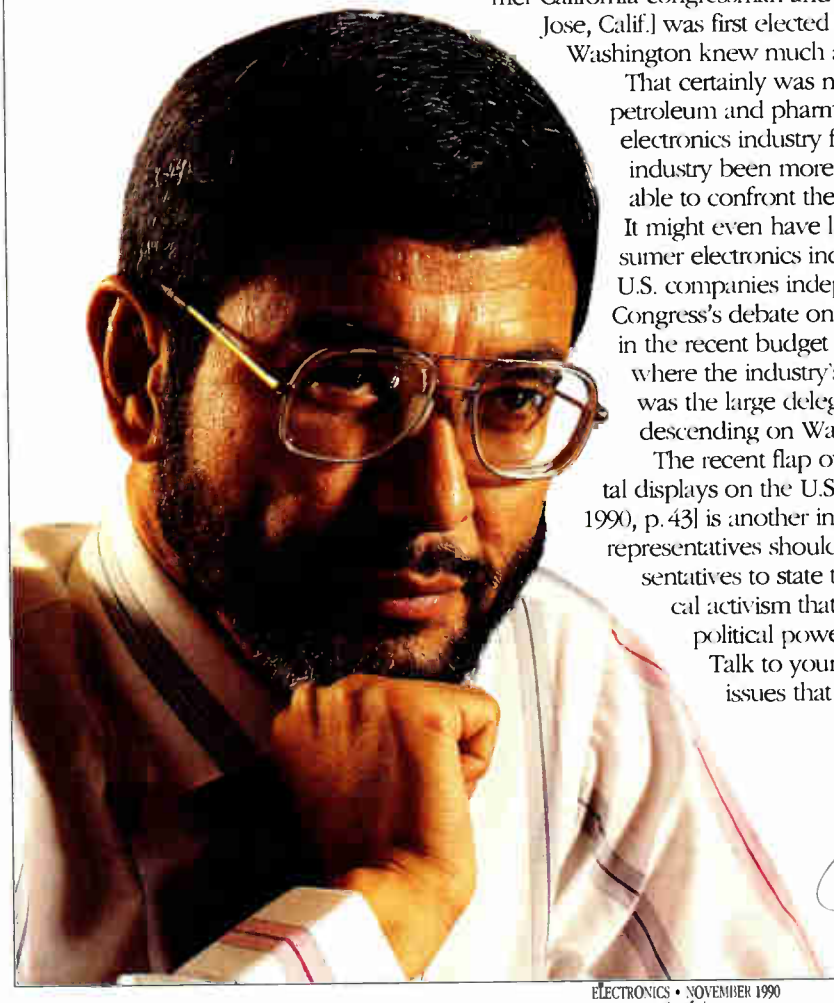
LET'S MIX OIL AND WATER

Like oil and water, politics and electronics have tended not to mix. That's been one reason why U.S. electronics companies have not fared well on trade issues, government support, favorable tax policies, and so on. Perhaps that's because electronics companies are largely entrepreneurial enterprises headed by engineers, who avoided politics as avidly as they did the liberal arts and social sciences—not to mention political science—in college.

But technical innovation and marketing skills alone are not sufficient to survive in an increasingly politicized industry. Industry leaders faced with this realization have become more politically active. However, the dawn of political awareness in the electronics industry is coming at a bad time. The industry as a whole is strapped for cash. It has hardly enough to afford sufficient investment in R&D, let alone fund a first-rate lobbying campaign in Washington. Nevertheless, it is incumbent upon these U.S. companies to take just such a course.

Just as on all other fronts, international competitors have not been idle. Japanese electronics companies, especially, have acquired great wealth and all the advantages that come with it. Nowhere is that advantage more obvious than in the field of political lobbying. One case in point is that of Toshiba Corp. Caught red-handed selling sensitive machine technology to the Soviet Union in May 1987, the company got off with what critics call a "mild rebuke" from the U.S. government. The reason for the kid-glove treatment, critics say, was the massive lobbying campaign Toshiba launched in Washington using the best lobbyists money could buy. Many of them were ex-government officials intimately familiar with the strings of power and how these strings are pulled.

By contrast, "The U.S. electronics industry has made ineffectual use of the political process in furthering its aim," says Wilf Corrigan, chief executive officer of LSI Logic Corp. "When Ed Zschau [a former California congressman and now CEO of Censtor Corp. in San Jose, Calif.] was first elected to the House in 1982, no one in Washington knew much about the electronics industry."



That certainly was not true of other industries, such as petroleum and pharmaceuticals. And shame on the U.S. electronics industry for its lack of political savvy. Had the industry been more politically active, it might have been able to confront the dumping of RAMs much earlier on. It might even have been able to save the lucrative consumer electronics industry had action been taken before U.S. companies independently chose to exit the business. Congress's debate on lowering the investment tax credit in the recent budget fracas presented an ideal instance where the industry's interests were at stake. But where was the large delegation of industry representatives descending on Washington?

The recent flap over Japanese dumping of liquid-crystal displays on the U.S. market [*Electronics*, September 1990, p. 43] is another instance where electronics industry representatives should be petitioning their elected representatives to state their views. This is the kind of political activism that U.S. companies need to engage in if political power is ever to be wielded in their favor. Talk to your congressman. Speak out on the vital issues that affect your industry. E

JONAH McLEOD
EDITOR

Many designers have hot, high-performance designs. Literally.

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Electronics

60 YEARS OF GLOBAL LEADERSHIP

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FEATURES

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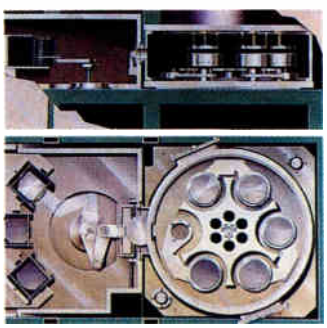

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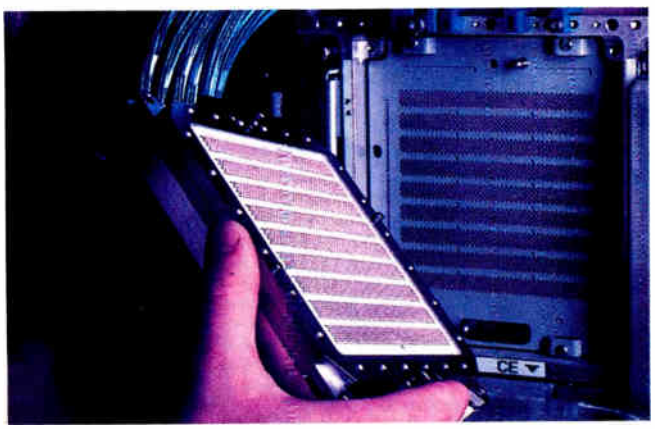

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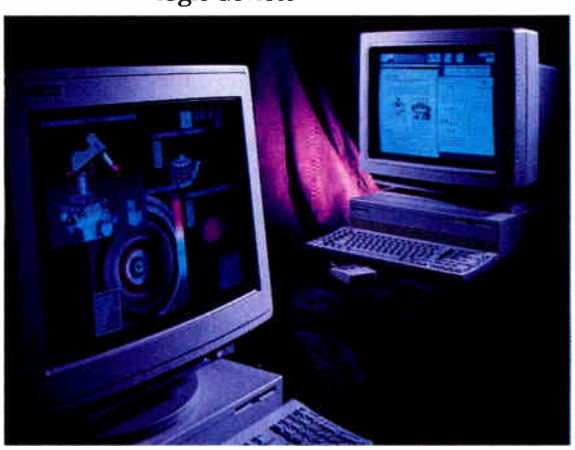

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DEPARTMENTS

NEWS ROUNDUP

WORLDWIDE NEWS

EXECUTIVE BRIEFING

Companies covered in this issue, indexed to the first page of the article in which each is mentioned.

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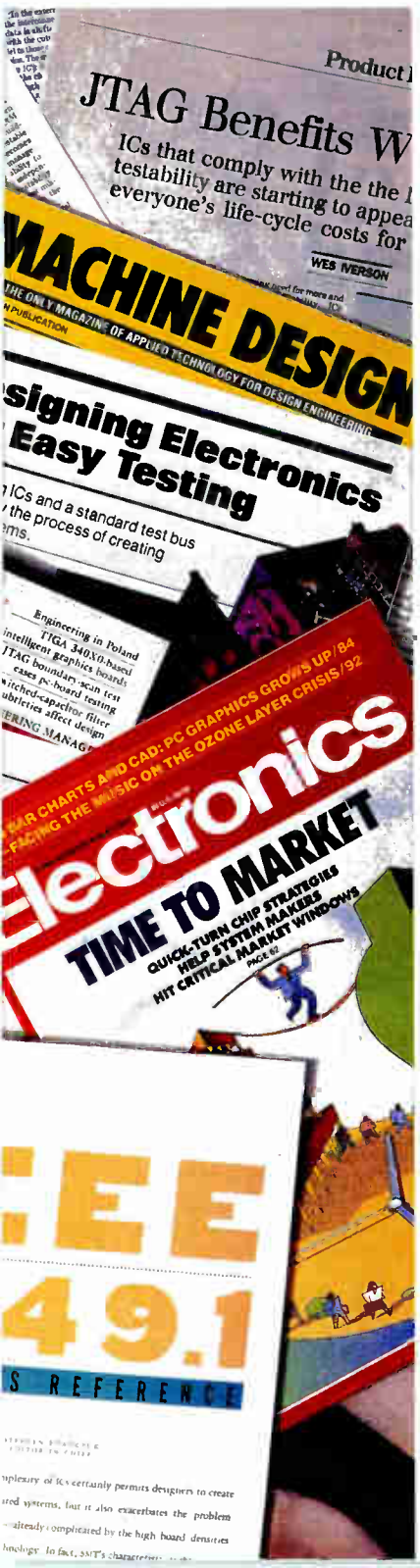
IN THE ERA OF MegaChip™ TECHNOLOGIES

A lot has been said about
company is doing a lot about

testability, but only one it. Texas Instruments.



You've seen the headlines and read the stories. Design-for-test (DFT) is a challenge but one that's now easier to live with. The reason: Texas Instruments is the first to develop products for implementing the JTAG/IEEE 1149.1 testability standard quickly and effectively.

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We are in for the long haul

As a member of the Joint Test Action Group (JTAG), we contributed to the formulation of the IEEE 1149.1 standard and wholeheartedly support it. We are committed to growing our SCOPE family of products so that designing to the IEEE 1149.1 standard will be like second nature.

Your future competitiveness depends upon an engineering methodology where design teams bear the burden of testability, manufacturability, and reliability. The demands of concurrent engineering will be met in part by the extended capabilities accessed via the IEEE standard — from embedded system information that allows realtime availability of data throughout the design cycle to emulation and realtime system analyses capabilities built right into the silicon.

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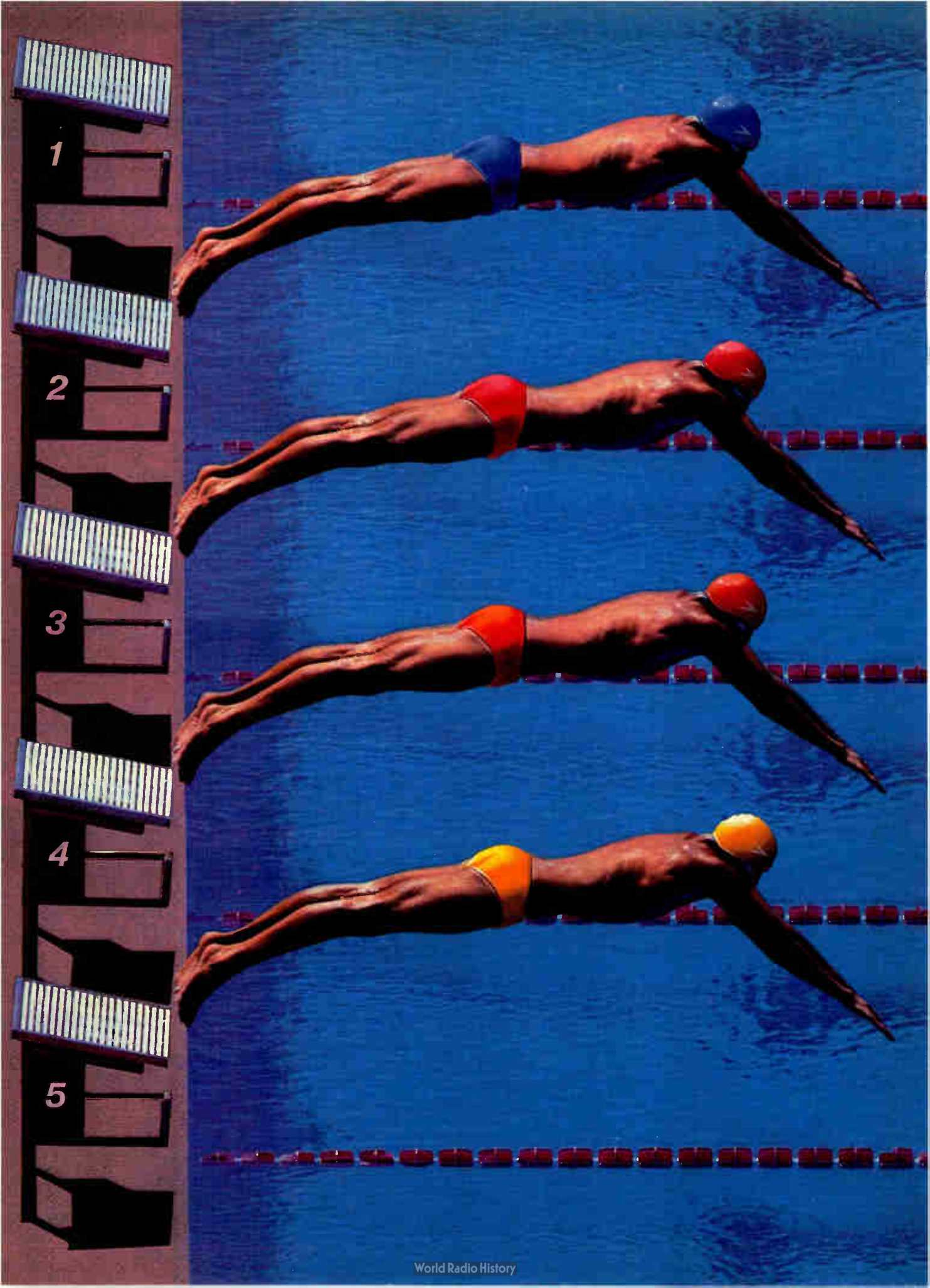
You will continue to read headlines about DFT. We intend to make many of them.

TEXAS INSTRUMENTS

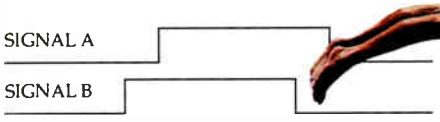


A Precision Start, Every Time.

Motorola's Low-Skew Clock Drivers for Precision Control and Timing of High Speed RISC and CISC Designs

Record setting performance for high speed processor designs depends on perfect timing, perfect control from start to finish.

If your high speed CISC or RISC processor flies off the blocks at 25MHz, 33 MHz or faster, clock signal skew from ordinary clock drivers can result in false starts for devices in close proximity. And, you may also require very exact 50% duty cycle waveforms.



Skew is like lining up starting blocks unevenly—nobody starts at exactly the same time.

Either way, without precise operation, performance suffers. Worst case? You blow your race to production and the entire design could be disqualified.

A Precision Start

To get all of your board's devices off to a precision start for critical events, Motorola's low-skew clock drivers are setting the target pace.

Offering 200% to 300% less output skew than ordinary clock drivers, typical delay skews are as low as 0.1 nS in ECL and 0.5 nS for TTL or 0.5 nS for CMOS outputs.

When you design with low-skew clock drivers, you don't need to handicap your high speed circuits with delay chips that compromise power and speed. And you can avoid trial and error tests with other high speed logic devices you had hoped would sooner or later work.

Instead, Motorola's line of low skew clock drivers let you design for optimum speed control from the beginning, with high performance dependability part-to-part and tight clock duty cycles.

Programmable Time Delays

For really difficult timing requirements, your design can also incorporate Motorola's Programmable Time Delays. Along with Low Skews, MC10E/100E195 (20 pS steps) or 196 (80 pS steps) ECL input delays provide you with more design options when board layout dictates.

Part #	Input Levels	Output Skew (nS)	Output/Input Freq. Ratio	Max. Input Freq. (MHz)	Output Levels
F803	TTL	1	+2	70	TTL
H640	TTL or ECL	0.5	+2 and +4	135	TTL
H641	ECL	0.5	1X	100	TTL
H642	TTL or ECL	0.5	+2 and +4	135	TTL
H643	ECL	0.5	1X	100	TTL
E111	ECL	0.1	1X	1000	ECL
MC88913	TTL	1	+2	110	CMOS
MC88914	TTL	1	+2	110	CMOS
MC88915	TTL	0.5	1X, 2X, and 4X	70MHz*	CMOS

*MC88915 is a PLL Clock Driver, therefore 70MHz is the maximum output frequency.

CMOS Skews of 0.5-1 nS and Phase-Locked Loop Capability

For multiple synchronous outputs, the MC88913 Clock Driver (skew 1.0 nS) and MC88914 CMOS Clock Driver with Reset (1.0 nS skew) provide high speed, low power hex divide by two capability. The MC88915 Low-Skew Phase-Locked Loop Clock Driver locks output frequency and phase into the input reference clock — and can synchronize several boards. It also functions as a frequency multiplier that can double or quadruple the input frequency. Skew is 0.5 nS.

FAST Schottky TTL Low-Skew Clock Drivers

For quad D-type flip-flop applications requiring matched propagation delays, the MC74F803 Clock Driver provides 1.0 nS skew.

68030/040 0.5 nS Skew ECL/TTL Clock Driver

Motorola's MC10H640 series Clock Drivers generate clock output for 68030/040 and are warranted to meet all clock specs required by these microprocessors.

ECL Clock Driver with 9 Differential Outputs

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LETTER FROM

SOFIA

$10.2 BILLION IN DEBT, BUT IT HAS A CHIP AND COMPUTER INDUSTRY

BULGARIA: THE BEST AND THE WORST

BY ANDREW ROSENBAUM

NOW THAT THE INITIAL hubbub about the opening up of Eastern Europe is quieting down, businessmen in the West and the East are beginning to realize that capitalism is not going to arrive in these countries overnight. The transition to a market economy will be a long one in most Eastern European countries, and they lack the hard currency needed to buy Western goods. But businessmen who work there agree that the right operation can earn real profits.

Bulgaria provides an extreme example of the problems and the potential, especially for electronics manufacturers, because it has a highly developed electronics industry and no lack of skilled workers. But the things that the Bulgarians lack are not trivial: money, good products, and markets.

Last November, when Bulgaria was transformed into a Western-style democracy, it found that it was $10.2 billion in debt, and had no means to earn enough hard currency to pay the interest. Electronics was one of the main culprits; millions had been borrowed to set up a full-scale computer and semiconductor industry.

According to George Zahariev, Bulgarian country manager for Britain's ICL Ltd., both operations are first-rate. The semiconductor plant in Botevgrad, near the capitl, Sofia, can turn out 16-Kbit and 64-Kbit DRAMs that compare with those in the West. And the computer-manufacturing operation at Pravetz can make a competitive, 80286-based PC within the limitations that had been imposed by Cocom.

"Bulgaria had set up these expensive manufacturing operations because the USSR was importing virtually 100% of its electronics production," says Oliver Dziggel, a consultant with Bethesda, Md.-based Enterprise Development International who specializes in Eastern Europe. The Soviets were buying all the computers, despite a 42% failure rate. There were even small producers who bought cheap components in the Far East, assembled them in Bulgaria, and pawned them off on the USSR.

Then last year the USSR cut its imports from Eastern Europe to the bone, so Bulgarian electronics manufacturers suddenly had to discover marketing. But, says Dziggel, "Thanks to the Soviets, basic marketing concepts and pricing concepts are not well-known in Bulgaria. Because they have always had a captive market, they have never worried about selling. They have never had to ask: 'Does anybody need or want this product?' "

Now the pressure of the $10 billion debt is forcing subsidized firms to become productive. The new Bulgarian democracy allows them to keep 50% of their hard currency. New laws allow business to offer real incentives to motivate workers. And, with the move to a market economy pushing up prices, people have a real need to earn more money.

All of which provides real possibilities for Western entrepreneurs. Westerners can use cheap Bulgarian labor to assemble products. Assembly in Bulgaria provides clear short-term advantages, but a joint venture with a Bulgarian firm can offer an entry into all the East European markets.

Curtis Instruments, a Mount Kisco, N.Y., maker of dashboard devices for forklift trucks, bought 51% of a joint venture with Bulgaria's Balkancar, Europe's largest producer of forklifts. Curtis supplies the materials to the joint venture, called Curtis-Balkan, to produce its electric forklift truck battery gage and controller. "With the help of [Curtis], we are beginning to reach markets in the other East European countries," says Christov Prodonov, who manages the joint venture. "As the joint venture reaches new markets, it will begin earning hard currency, and could become profitable."

But working in countries like Bulgaria means getting to know the terrain well. "Despite the way the government has run the economy, there are actually some good companies in Bulgaria that earn hard currency with their exports," says ICL country manager Zahariev. "By concentrating your activity on those companies, you can develop a limited, but lucrative market."

ICL is planning to assemble its TX-3000 electronic telexes in Sofia, through its joint venture with the Bulgarian Academy of Sciences. Telephones don't work in any East European country, so telex service still provides the only sure means of communication, and capitalism should increase demand. "ICL hopes to be positioned to serve the rising demand that these successful companies are creating," says Zahariev.

Companies like Curtis and ICL can count on reinforced guarantees for their operations in Bulgaria. Profits can now be exported, whether they are in the local currency or in foreign currency, according to Neo Neov, chief aide to the finance minister. "We have already changed our legislation to free foreign companies from the threat of nationalization," says Neov.

Yet, with all these positive changes, certain oddities are likely to last beyond economic reform. Rank Xerox Ltd., for example, barters with large Bulgarian state companies. "Sales generally depend on what's available and whether we can use it," says country manager John Moore. "So, until Bulgaria has a real market economy and a convertible currency, working there will be different for Westerners."

BUSINESS IN BULGARIA

Bulgaria has a highly developed electronics industry and skilled workers—but lacks money, quality products, and markets.

For the short term, assembly operations are the ticket. But for the long run, think joint venture.

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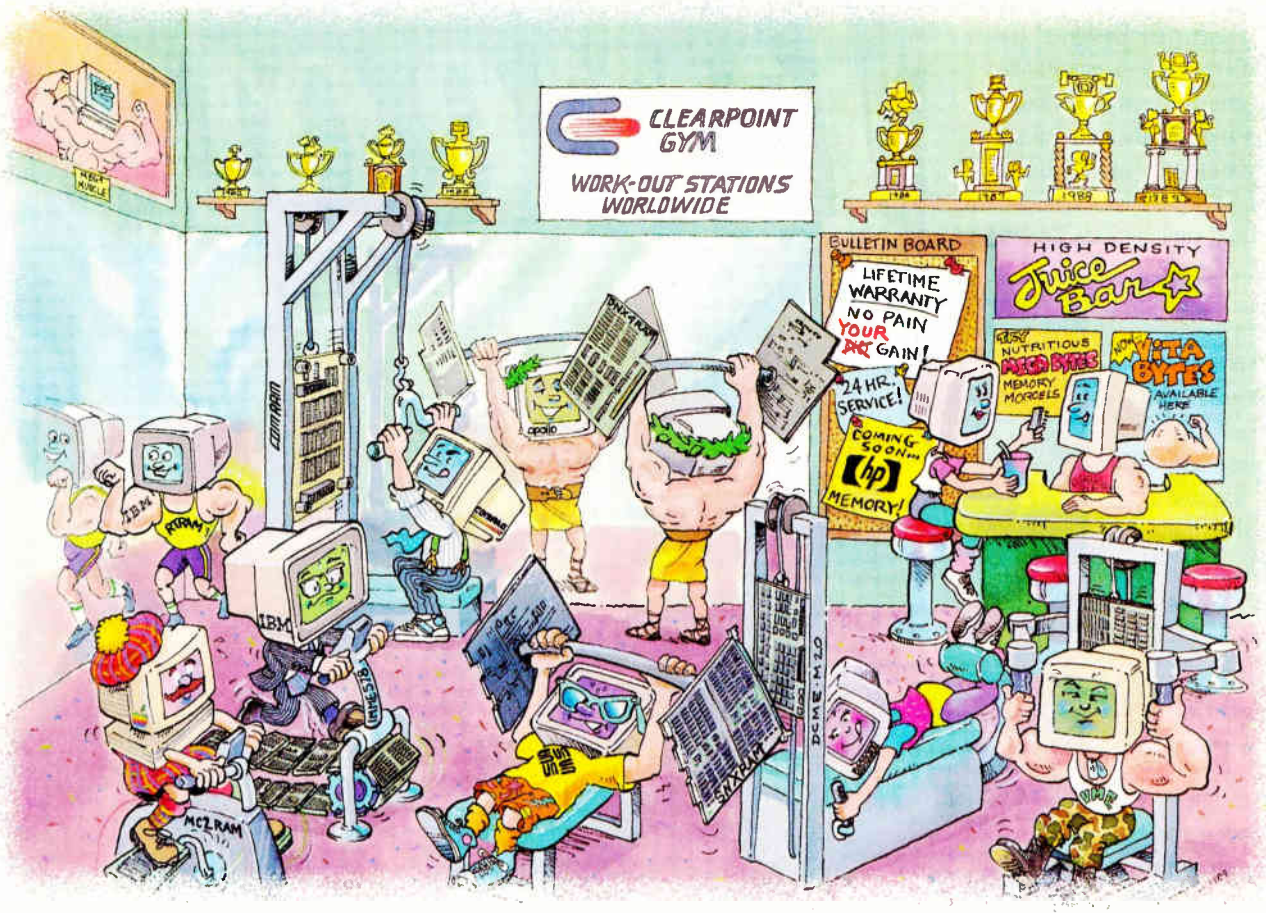

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CIRCLE 236

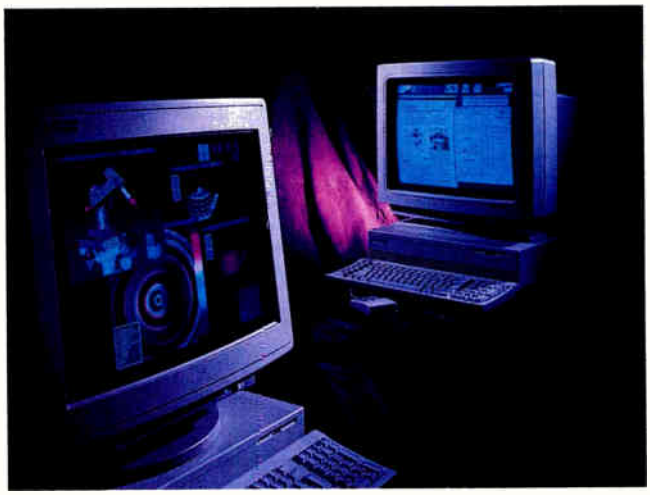
TO WATCH

SOLBOURNE SINKS ITS TEETH IN PEX

With the unveiling of its low-end S4000 Sparc-based workstation, Solbourne Computer Inc. has become a full-line workstation vendor and jumped into a leadership position on the X Window user interface.

Priced at $9,000, the 25.5 million-instruction/s S4000 is the industry's first 64-bit Sparc desktop, says the Longmont, Colo., company. As Solbourne's first workstation for less than $10,000, it also satisfies low-end requirements and makes the company more attractive to resellers and other distribution channels. Other Solbourne products are priced up to $200,000.

Solbourne also demonstrated its commitment to the X Window System standard by announcing it will provide X-compatible, standard 3-d graphics on all its products. The so-called PEX implementation (for Phigs extension to X) has been adopted by the Window Consortium as a means of providing the Programmers High-level Graphical Standard language for color 3-d graphics capability. Solbourne accelerates PEX with its Sbus Graphics Accelerator on the S4000. E



Solbourne's SBus-based desktop can be purchased with a 19-in. monochrome or 16-in. and 19-in. color monitors.

COMPAQ'S 386SX NOTEBOOK HAS VGA

Compaq Computer Corp. has combined an Intel 20-MHz 386SX microprocessor, 2 Mbytes of memory, a cache, 60 Mbytes of hard-disk storage and a Video Graphics Array display all in a notebook computer called the Compaq LTE 386s/20.

The Houston firm says the 8.5-by-11-in. PC provides 50% faster processing than notebook computers using a 16-MHz 386SX processor. The 60-Mbyte model provides more storage than any other notebook computer, and costs $6,999. Model 30, with 30 Mbytes, sells for $6,499.

Either model can plug into a $1,499 expansion base, which provides space for additional mass storage, expansion boards, and connection to an external monitor and keyboard. The 9-in., 80-character, 25-line display is the first VGA for a notebook PC. E

INTEL AIMS AT NOTEBOOK PCs WITH ITS 386 SL TWO-CHIP SET

It may not be a motherboard on a chip, but Intel Corp.'s new SL SuperSet is the next best thing: a 386 solution for notebook computers in just two ICs. The Santa Clara, Calif., microprocessor giant has crammed all the logic functions needed to build a 386 PC into a special version of the microprocessor, the 386 SL, and accompanying 82360 I/O chip.

Intel designed the SuperSet specifically for notebook and palmtop PCs, a fact it underlined by making the SuperSet announcement in Tokyo, home of the Japanese vendors that dominate the portable PC market. The company says it expects to see machines based on the chip set before the end of the year.

The SuperSet will reduce the weight of notebook computers while giving them all the clout of the 386 microprocessor and access to the powerful software that has been written for desktop 386 machines.

The chip set was designed for power conservation, a big concern in portable PCs: the 32-bit 386 SL, which runs at 20 MHz, has a programmable clock that shuts off automatically when not in use, and the 82360 has additional programmable facilities to manage power and lengthen battery life.

Both chips are fabricated in Intel's 1.0-μm CHMOS-IV technology. They are priced at $221, a cost that Intel expects to fall sharply as production ramps up. The company also unveiled supporting ICs such as keyboard and floppy-disk controllers and a modem chip set. E

INSTRUMENT CONTROLLER INCLUDES SCPI

A powerful new board from IOtech Inc. brings a new level of instrument control to personal computers controlling IEEE 488.2-based systems.

The Power488 16-bit AT-compatible board and accompanying software conforms 100% to the recently revised 488.2 standard, and adds many functions that are programmable using the new SCPI (standard commands for programmable instruments) command standard, says the Cleveland company.

SCPI's command set and syntax protocols make it possible to interchange the instruments in a system not only within a product line, but between instruments from different manufacturers.

Power488, including IEEE 488 hardware, digital I/O hardware, and Driver 488 software with serial I/O support costs $495. Power 488CT adds counter/time capability and costs $595. E

TO WATCH

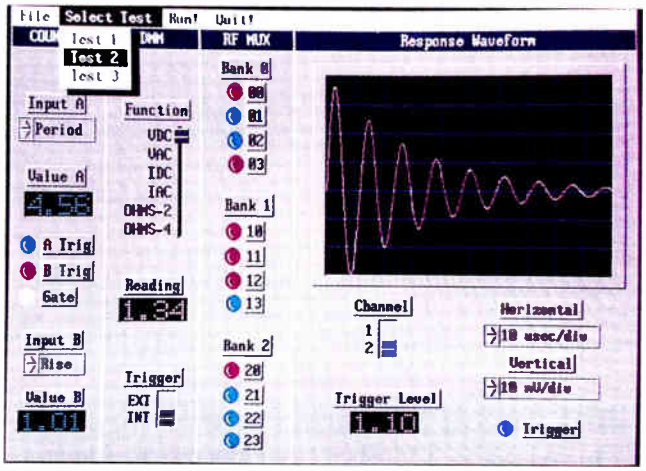
NATIONAL EXPANDS LABWINDOWS' ADDRESS MEMORY TO 16 MBYTES

Look for National Instruments Corp. to pack lots more functionality into its popular LabWindows development system for instrumentation programs when Wescon/90 convenes in Anaheim, Calif., later this month.

The most significant enhancement frees LabWindows from the 640-Kbyte memory restriction imposed by the MS-DOS operating system. To address the growing number of instrumentation programs that exceed 640 Kbytes, the Austin, Texas, company has integrated Rational Systems Inc.'s DOS/16M DOS Extender into LabWindows 2.0.

Besides being able to address up to 16 Mbytes of system memory, LabWindows 2.0 will also be able to address virtual memory residing in expanded memory and hard-disk drives. This means it will still be able to handle 16-Mbyte programs with even only 2 Mbytes of memory in the IBM-compatible PC.

Extending memory capability also allows National to implement a user-interface library that lets programmers create a graphical user interface that operates as a front end to the data-acquisition, analysis, and presentation functions. E



Developers of instrumentation programs on PCs can now enjoy an expanded library of graphics functions.

ALTERA'S MAX 7000 ARCHITECTURE DELIVERS 20,000 GATES, 70 MHz

Altera Corp.'s new family of electrically programmable logic devices sets new standards for the EPLD industry, including a specification of just 15-ns logic delays across the entire device, and a 70-MHz global clock rate.

The Multiple Array Matrix family of 0.8-µm CMOS EPLDs ranges in density from 1,500 to 20,000 gates, a mark that doubles the densities now available in existing high-density PLD and field-programmable gate-array devices. Consisting of eight devices, the MAX 7000 family will come in packages from 44 to 280 pins.

They are the first PLDs to support a programmable speed/power tradeoff. The "power-saver" feature allows the devices to support both quarter-power and half-power operation across the entire device or on selected signal paths.

In an architectural breakthrough, the San Jose, Calif., company has implemented a scheme that provides high device-logic utilization while introducing negligible interconnect delay. Because of the low delays, the logic can operate at 70 MHz. E

PLESSEY'S 8-BIT DAC RUNS AT 450 MHz

Building high-end video, instrumentation, and satellite communications systems just got easier thanks to the new Plessey Semiconductor Corp. 8-bit digital-to-analog converter and its 450-MHz clock frequency.

Fabricated in Plessey's bipolar process, the SP98608 is claimed to be the fastest such device on the market by the Scotts Valley, Calif., company. Its speed does not come at the cost of resolution performance. The device has settling times of 2.2 ns ± one-half least-significant bit.

In the video arena, the SP98608 provides solutions for graphics displays requiring up to 2K-by-2K-pixel resolution. In applications such as waveform synthesis, frequency-agile radio and high-speed modems, the Plessey chip provides an easy migration path to higher speeds and resolution.

Available now, the SP98608 costs $50 in 1,000-unit purchases. E

AT&T TAILORS MULTIMEDIA DSP

The first digital-signal processor expressly designed for personal-computer and workstation multimedia applications has been announced by AT&T Microelectronics.

Based on the Berkeley Heights, N.J., company's popular 32-bit WE DSP32, the DSP3210 will integrate logic to allow it to interface directly with both Intel Corp. and Motorola Corp. 32-bit microprocessor buses. Its support of bus-error and request/relinquish/retry protocols means it can also operate as a busmaster to greatly increase multimedia system performance.

AT&T has also provided an optimizing C compliler, assembly-language tools, and a real-time operating system for the DSP3210. E

BURR-BROWN'S DACs CUT DSP GLUE LOGIC

Designers of systems based on popular digital-signal processing chips from Analog Devices, AT&T, Motorola, and Texas Instruments can throw away their glue-logic manuals.

The new single-channel DSP201 and dual-channel DSP202 from Burr-Brown Corp. include all the glue logic needed for the DSP interface, and they update analog output voltages at rates up to 500 KHz, says the Tucson, Ariz., company.

Packaged in 28-pin dual, in-line packages, the chips will cost $25 each in small quantities. They are available now. E

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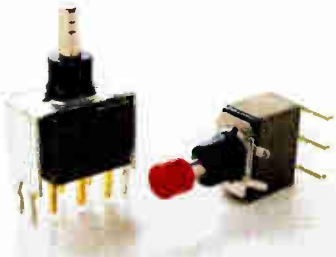


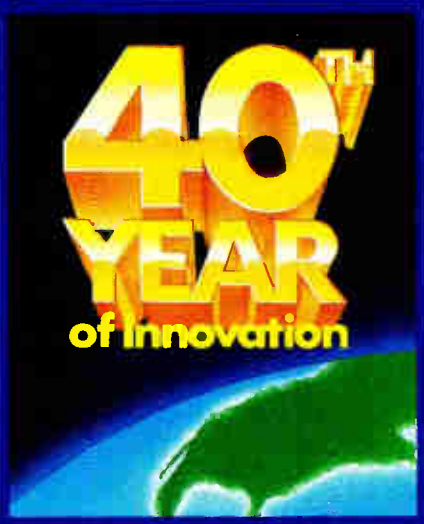
Washable M2B subminiature pushbuttons feature very-light-touch, snap-acting contacts. Straight, right angle, vertical PC terminals.

ULTRA-MINI

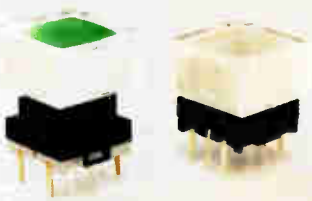
New ND switch is half the size of ordinary binary coded DIP rotaries. Washable and universal footprint pattern.

LEGENDARY

New compact, industrial-grade NB snap-in LED pushbutton with split legend up to 4 ways. Built-in resistor. Numerous options.



WORTH A MILLION



Million operations from unique LED illuminated JB keypad switch. Red, green or yellow LED options.

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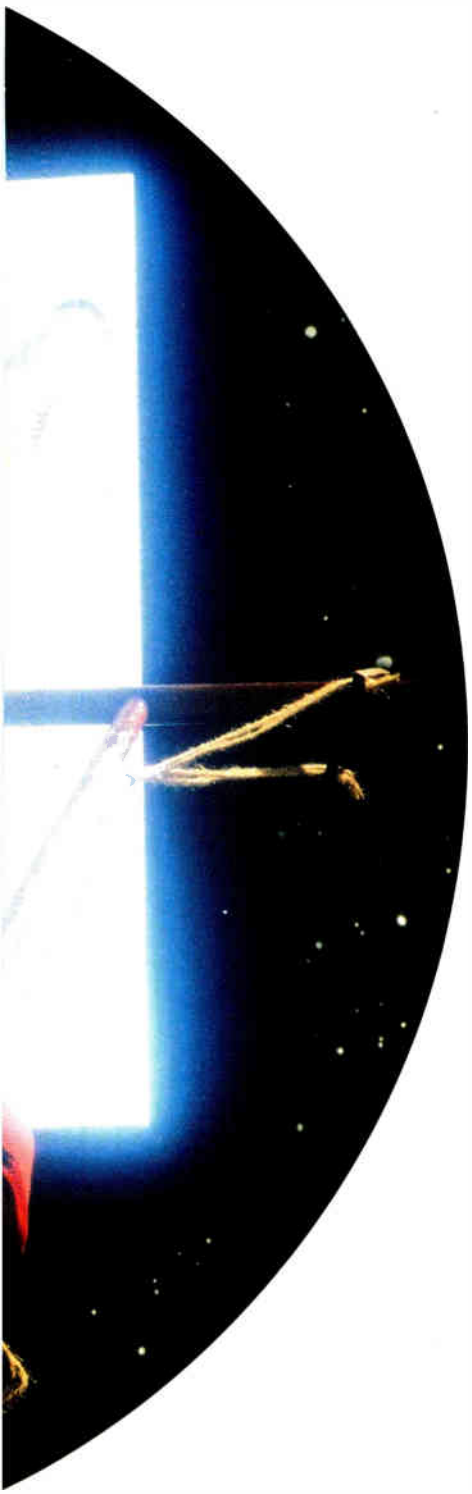
YB pushbutton yields literally 100,000+ part numbers with variations in mounting, illumination, circuitry and color.

CIRCLE 175



Pursuing Light's Speed in a Powdered Wig

Light travels so incredibly fast that people once thought it infinite and unmeasurable.

Then one perceptive Danish astronomer, Ole Rømer, thought about the slight variation in the observed revolutions of Jupiter's moons. He correctly reasoned that it is caused by the varying distance between the Earth and Jupiter as we move around the Sun.

The longer cycles include the time it takes the light to travel the longer distance when the two planets are far apart. Based on this he made the first calculation of the speed of light.

Though Rømer was nowhere near today's accuracy, he proved in the process that light's speed is finite and measureable.

Serving current needs in measurement

Just as Rømer sought light's speed, today Anritsu presses forward with advanced test equipment for optical communications systems.

Anritsu specializes in measuring modern telecommunications systems with extreme accuracy, for R&D or daily maintenance. These instruments cover not only optical, but wire and radio systems as well with an outstanding reputation for accuracy and reliability.

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CIRCLE 211

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25ns Fast!

Our 1-megabit monolithic 128Kx8 SRAMs clock in at 25 and 35ns. Very fast. They're ideal for microprocessor applications where fast access times are a must to avoid wait states: workstations, supercomputers, image processing, telecommunications switches, and radar/sonar systems. Packages include DIPs, CSOJs, and flatpacks for commercial/industrial/military applications.

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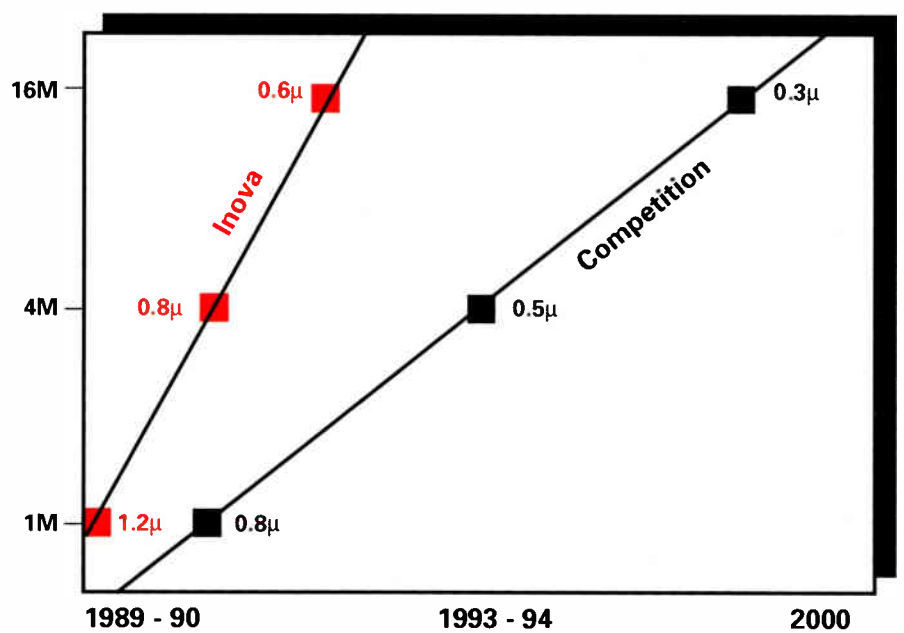
Inova was first to ship 1-megabit monolithic SRAMs, and we've been shipping them since 1988. We've established a reputation for on-time delivery — even during the memory crunch of 1988 and '89. Like our delivery, our high-speed, high-density monolithic devices are getting faster all the time. Inova has devices with access times ranging from 100ns to 25ns in stock now.



Inova lets you upgrade to the next generation of density without waiting for the next generation of process technology.

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Inova makes the only monolithic 1-megabit SRAM specified on DESC drawing #5962-89598. Both our 1-megabit and 256K devices are DESC listed. Inova 64Kx16 devices are listed on DESC drawing # 5962-90858. All our military grade devices are MIL-STD-883C compliant.

The first and only 64Kx16 monolithic SRAM

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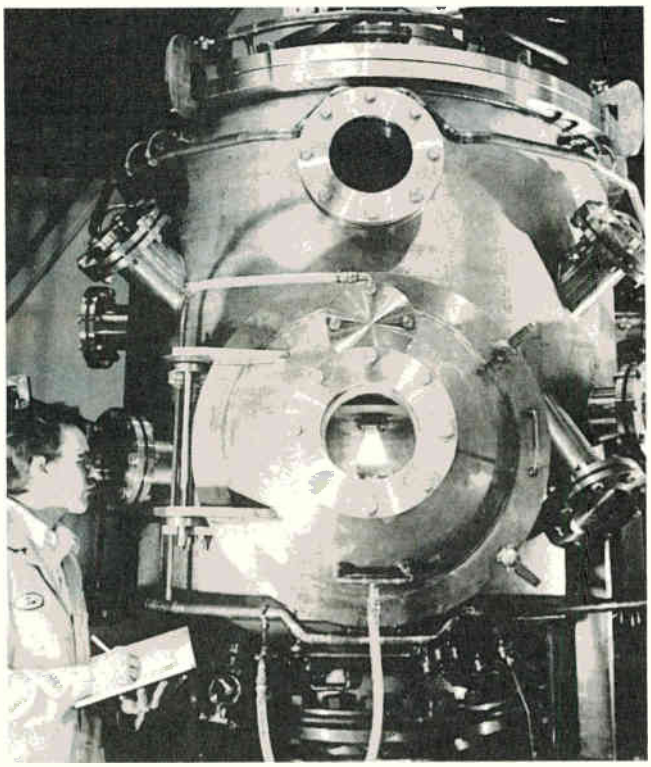
CIRCLE 174

NORTON CLAIMS IT'S NO. 1 IN DIAMOND

Synthetic diamond sports higher thermal conductivity than any other material. It also boasts tremendous electrical resistance, is radiation proof and chemically inert, and has the same physical characteristics as Teflon. So why isn't it being used as a substrate?

The problem is that the material is difficult to synthesize, particularly in the sizes needed for semiconductor wafers.

But Norton Co. of Northboro, Mass., may be changing that. It has emerged from a five-year R&D effort costing tens of millions of dollars with a plasma-assisted chemical-vapor-deposition process that it says yields product size, shape, deposition rate, and quality that have eluded hundreds of other diamond film developers worldwide. So the materials company, already a world leader in abrasives, now claims worldwide leadership in diamond film, leapfrogging not only U.S. rivals like General Electric Co., but Japanese companies of the rank of Asahi, Kobe Steel, and Sumitomo. All told, say Norton executives, more than 100 academic labs—70 in Japan alone—have been working on scaling up diamonds.



Diamond film being synthesized, using a chemical-vapor-deposition process in a furnace at Norton Co.

The key is diamond's usefulness in thermal management. It is such a good conductor that heat is quickly spread evenly over the film's total area. Immediate applications could be in laser diode heat sinks or large substrates for thermal management of multichip modules, or in dense advanced computer circuits. One estimate of the eventual market: $4 billion to $7 billion a year. E

LITIGATION SCOREBOARD: AMD, INTEL SPLIT; BROOKTREE WINS

The chip industry's autumn litigation season is moving right along, with Advanced Micro Devices Inc., recording one split decision to go with one defeat. The split decision came in a dispute with Intel Corp.; the defeat was in a lawsuit filed against it by Brooktree Corp.

The AMD-Intel arbitration concerns AMD's right to produce and sell the 80386, which AMD claims under the terms of a 1982 contract between the companies. But Intel says AMD had not lived up to a contract provision requiring it to deliver chips equal in value to Intel's microprocessors.

The arbitrator found that Intel indeed had blocked AMD's access to the 386, but that AMD had not delivered its chips. Will AMD get the 386? Stay tuned.

The suit won by Brooktree, the San Diego, Calif., maker of imaging ICs, charged AMD with violating three of its patents. E

MORE PROCESS WORK FOR SEMATECH?

Will Sematech place special emphasis on process-control technology now that William J. Spencer has signed on as the chip-making consortium's president and CEO? Spencer, most recently Xerox Corp.'s chief technical officer, says, "As an engineer, I believe we could have real leadership in manufacturing processes" based on U.S. knowhow.

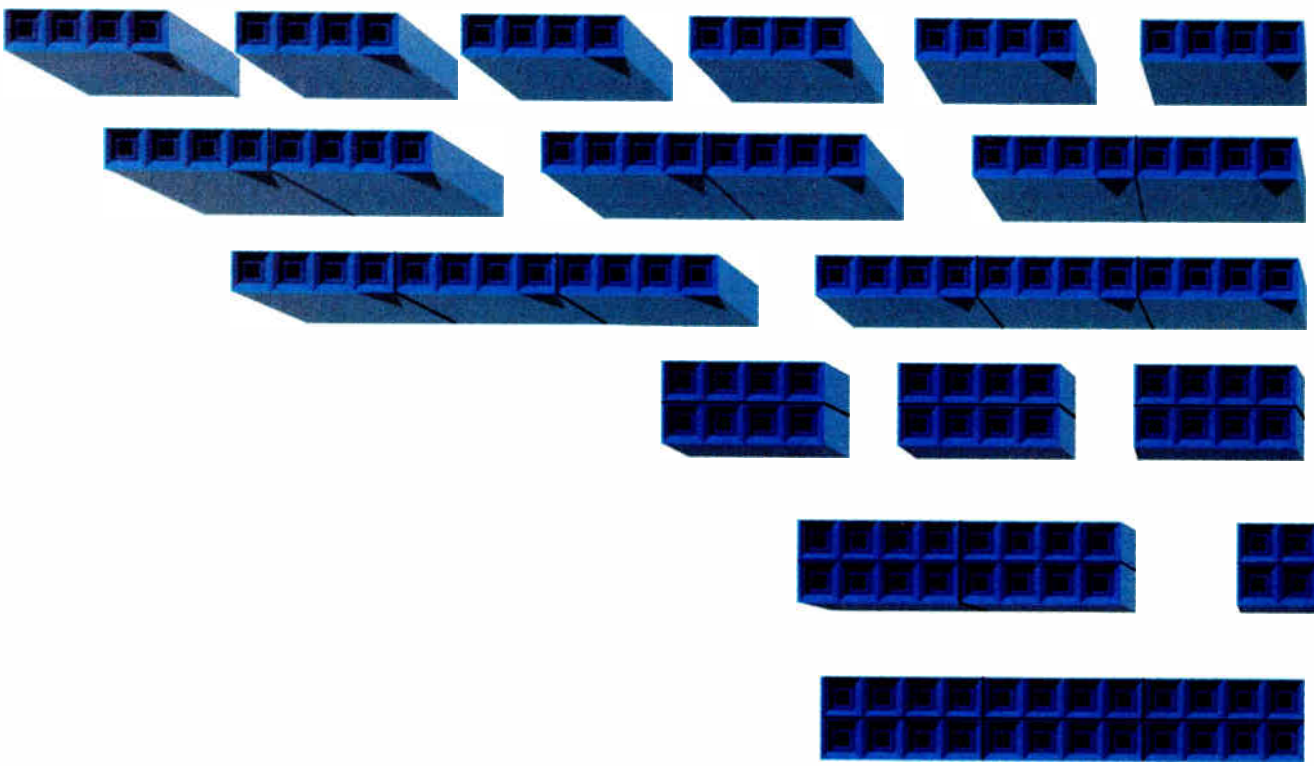
But whatever influence he brings to the development work of Sematech, Spencer, who succeeds the late Robert N. Noyce, promises "to interface with the Washington scene," in effect taking up the lobbying role that was filled by Noyce. In that function, he says, he favors Sematech's opposition of the sale of critical high-tech companies to foreign firms. Right now, the group is fighting the purchase of SemiGas Systems by Japan's Nippon Sanso. E

INTERACT SIGNS UP CAE TOOL MAKERS

Interact Corp., a three-year-old provider of framework software for integrating CAE software, has signed nine tool and application manufacturers whose software will be encapsulated in the framework. The agreement includes joint development and marketing of the encapsulations.

Interact is owned by IBM, Advanced Computer Techniques, and Prutech R&D Funding (itself an affiliate of Prudential-Bache Securities).

The nine: CAD Language Systems, Carberry Technology, Data I/O's Futurenet Division, Interleaf, Meta-Software, Source III, Test Systems Strategies, and Zycad. E



Enough

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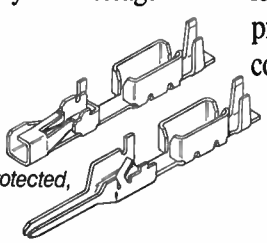
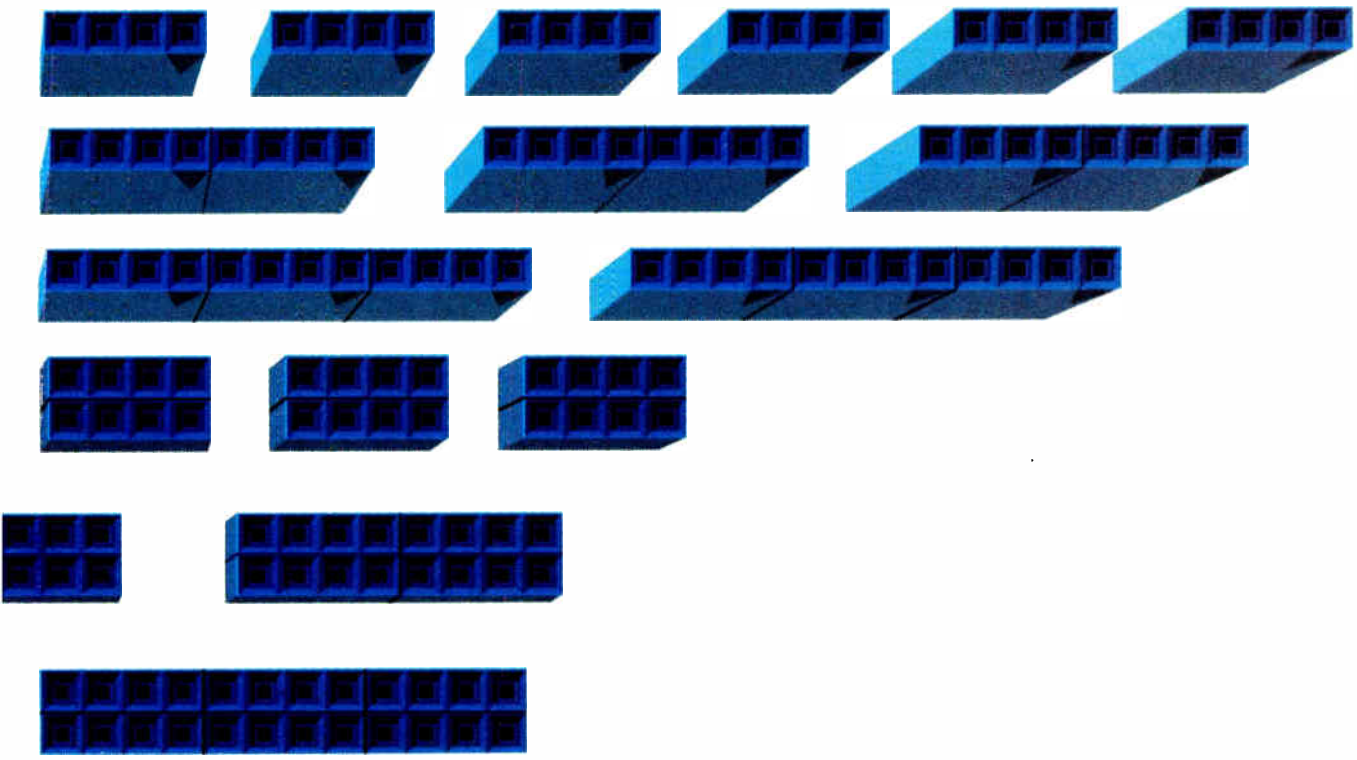


Dual-beam contacts are over-stress-protected, and feature post stops to protect wire on wrap type posts.



said.

row coupling shrouds.

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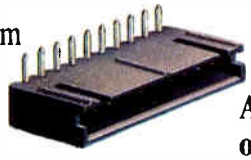

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WHEN RELIABILITY IS IMPERATIVE.™

CIRCLE 222

MOTOROLA'S 18-GHz MICROCELLULAR LAN USES GaAs CHIPS FROM THE MIMIC PROGRAM

A WIRELESS OFFICE

BY JACK SHANDLE

THE MARCH TOWARD A wireless office—one where companies do not incur major rewiring costs whenever furniture is moved around—has taken an important leap forward with Motorola Inc.'s introduction of a microcellular technology that operates in the 18-GHz band.

Although Motorola's Wireless In-Building Network will inevitably be compared with the spread-spectrum wireless local-area networks unveiled last year by Agilis Corp. and O'Neill Communications Inc., it is quite different in both its basic technology and in the business opportunities it represents. Whereas spread-spectrum LANs—which operate in the 900-MHz band—do not require an operating license from the Federal Communications Commission, Motorola's WIN does. Motorola holds some of the licenses and intends to ensure that setting up and operating a WIN is as easy as using a cellular phone, says Glen Kephart, manager of strategic operations for Motorola's Radio Telephone Systems Group in Arlington Heights, Ill.

"A couple of other companies have also filed for licenses," says Kephart, "but they have to actually use the band within 18 months to hold onto the license. So they are betting that we will be marketing products before then."

The chances that anyone but Motorola will come up with an 18-GHz wireless LAN anytime soon are not very strong. Motorola's highly sophisticated system includes gallium arsenide chips derived from the Department of Defense's Monolithic Microwave Integrated Circuit program (known as Mimic); a high-performance rf digital-signal processor that ensures 15-Mbit/s data rates; an intelligent six-sector microwave antenna to solve the multipath-distortion problem; and a high-speed data-handling architecture that combines circuit switching with conventional packet and fast-packet switching for transparent operation.

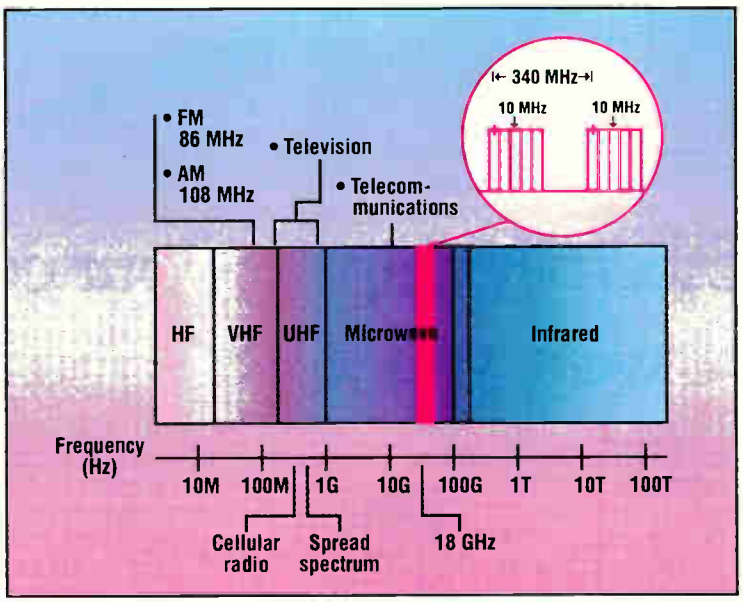
Kephart insists that the Mimic chip included in WIN will eventually become cost-competitive with wired solutions. "Initially, we will install where the environment is most difficult for wire," he says, "but as we come down the cost curve, we will evolve into the general marketplace."

Operationally, an 18-GHz wireless LAN using time-division duplex (TDD) multiplexing offers several advantages. Although the FCC's allocation of the 18.82-to-18.87-GHz spectrum allows room enough for only ten 10-MHz channels, microwave radiation attenuates quickly, which means the available spectrum can be reused by another system within 120 ft. On the other hand, 18-GHz signals can squeeze through the tiniest crack, says Kephart, so most walls will not impede the network. What's more, the WIN system will not interfere with even the fastest ICs, says Tom Freeburg, senior member of the Radio-Telephone Systems Group's technical staff. Security will not be an issue for most users. "We encapsulate the frames," says Freeburg. "We put a header on them, scramble them, and skip them across the path."

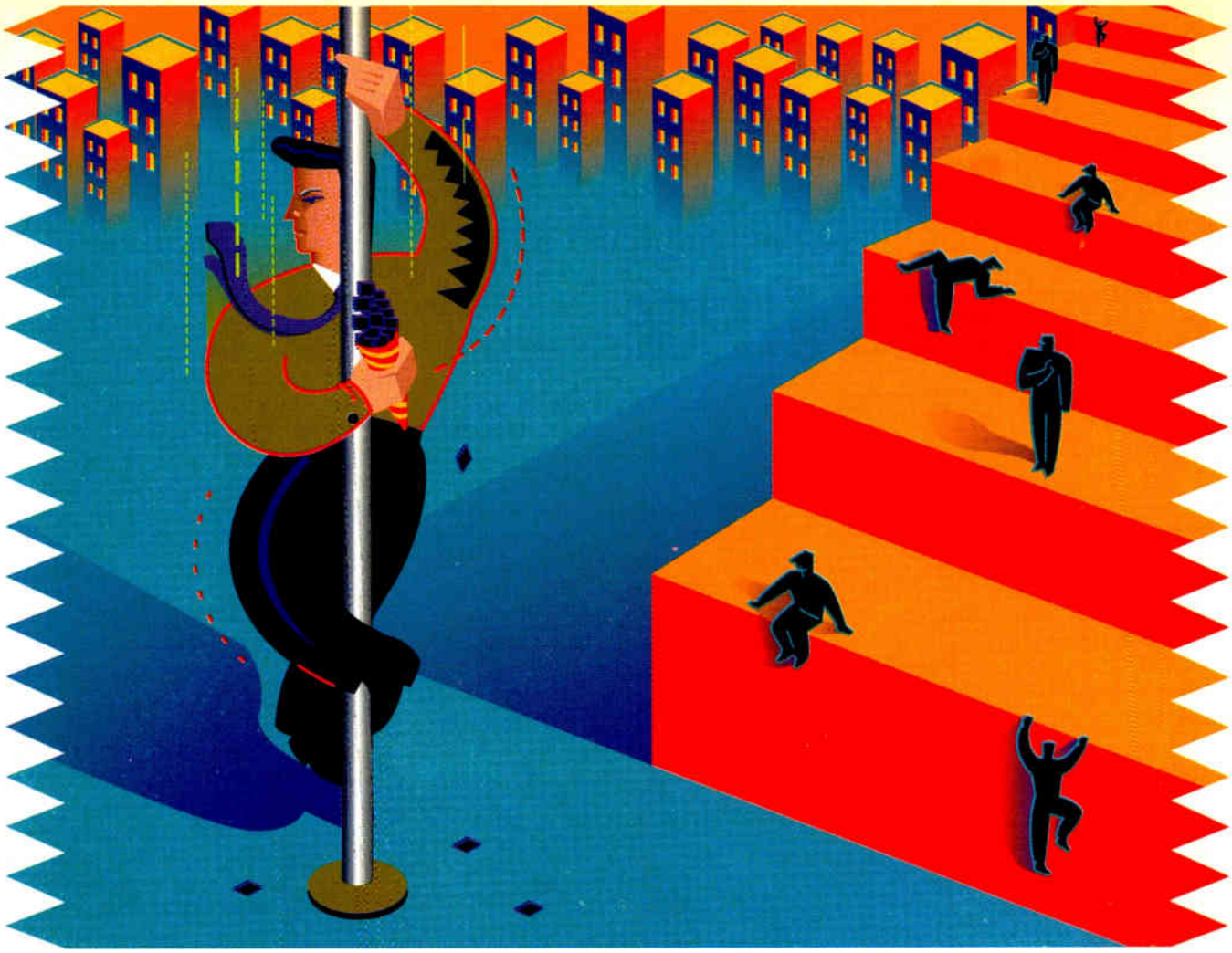
Finding that path for each transmission is the major technological challenge Freeburg's group overcame. They did it by matching a three-level switching architecture with a six-sector antenna. Using various kinds of switching—circuit, fast-packet, and true-packet—digitized information is divided and encoded into component data packets, which are transmitted independently using TDD multiplexing to an assigned destination. Once received, the packets are reassembled. The routing function is accomplished using a CMOS gate-array chip. Transmission slots are dynamically selected.

Each transmission of data will take the best of numerous paths made possible by the six-sector antenna. The antenna consists of six 60° directional antennas that can be used to transmit and receive. Multiple path options are helpful in maintaining maximum signal gain and minimizing multipath distortion, because of filing cabinets, walls, and other reflective or absorbive objects.

During operation, the receiving antenna samples the incoming signal from the six transmitting antennas for each of its six receiving sectors—for a total of 36 combinations. Identities of the transmitting sectors are encoded in the signals, so the receiving antenna can block out duplicate signals from other sectors.



Motorola's wireless network uses TDD to provide ten 10-MHz channels in the new spectrum allocation.



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The shortest route to market begins with our three-chip set — the EtherStar™ controller, encoder/decoder, and transceiver — from Fujitsu's Advanced Products Division.

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EtherStar's unique buffer manager automatically controls buffer memory access and allocation, making application software easier to develop. And EtherStar handles many functions usually performed by the software driver in hardware — boosting system performance. No wonder official *Novell certification tests performed by independent consultants show that products based on our chip set have higher data-transfer rates.

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*Novell certification applies to the EtherStar LAN adapter which incorporates the Fujitsu chip set.

CIRCLE 210

APPLIED MATERIALS AND NOVELLUS CHASE GENUS IN A RAPIDLY GROWING MARKET

THE TUNGSTEN BATTLE

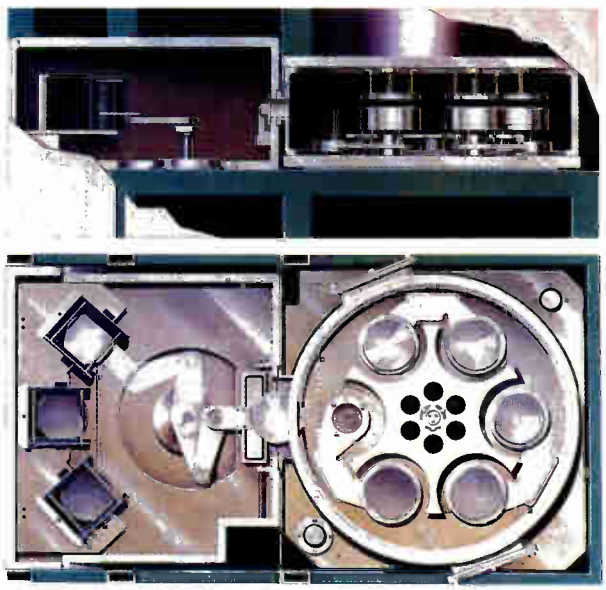
BY JONAH McLEOD

A SEGMENT OF THE MARket for semiconductor production equipment is on the verge of explosive growth, and three companies are slugging it out for domination. The prize is the tungsten chemical-vapor-deposition segment; it will grow 34% through 1994, figures VLSI Research Inc., a San Jose, Calif., market-research firm. The three that would be king:

- Genus Inc. of Mountain View, Calif., progenitor of the technology in 1984. Genus leads, with 40% of the market, says VLSI Research;
- Applied Materials Inc. of Santa Clara, Calif., a competitor since September 1989 with its Precision 5000. It has 15% of the market;
- Novellus Systems Inc. of San Jose, the latest to enter the fray, in August. Novellus claims to have cured all the ills of the others' machines.

Until recently, semiconductor manufacturers wired hundreds of thousands of transistors on a device using aluminum. In manufacturing, a sputtering technique applies the interconnect aluminum on the layer as well as between metal layers. Though aluminum is still used to connect transistors on each layer, it is inadequate for connections between layers of today's devices with their geometries narrower than 1.2 μm. That's because sputtering is less able to fill the via, or hole between layers, which is also narrower. The solution: tungsten, which fills the vias more uniformly.

To deposit tungsten, tungsten hexafluoride gas enters a chamber containing one or more heated wafers. The gas reacts with the heated surface and in the vias. Etch back removes the surface tungsten, leaving it in the vias.



Novellus's Concept One-W uses five wafer trays for deposition, one for loading and unloading.

Being first, Genus has become the target of all subsequent competitors. The company's 8200 system batch-processes six wafers at a time and has no etching capability. "Our customers wanted the CVD and etch processes in the same machine," says Clark Fuhs, product manager. "We addressed this problem in the newer System 6000."

To do it, Genus teamed with Plasma-Therm Inc. of Voorhees, N.J., integrating Plasma-Therm's dual-chamber 2800 Plasma Etch system to the input and output of the 6000. In one chamber, wafers en route to the CVD chamber are pre-etched, says Robert Ward, director of marketing for Plasma-Therm. In the other, wafers

from the CVD system go through the etch-back process.

But Applied Materials says that throughput is hurt by the need to frequently clean the larger chamber of built-up tungsten. Its answer, the Precision 5000, does one wafer at a time but combines CVD and plasma-etch capability. "By processing a single wafer at a time we achieve much better control and throughput," says Julio Aranovich, director of business development.

Applied also claims to have addressed the cleaning problem. "CVD produces a buildup of material, tungsten especially, on the inside of the deposition chamber," says Aranovich. Having CVD and etch capability in the same chamber, the system etches the buildup inside the chamber at selected intervals. It is thoroughly cleaned off line at 1,000-wafer intervals.

Meanwhile, the newest system—Novellus's Concept One-W—combines batch and wafer-at-a-time processing. In a six-wafer chamber, five are used for deposition and one for loading and unloading wafers on a rotating carousel that moves each wafer past each deposition station.

To create uniform wafers cost-effectively, says Robert F. Graham, Novellus's president, the system deposits a portion of the tungsten needed to fill the vias at each of the five stations. The gas dispenser is beneath the wafer, making optimum use of the gas, and the averaging of the five stages ensures uniform coverage. The chamber is periodically cleaned in situ for tungsten buildup.

RESEARCH

GERMANS SET SPEED RECORDS FOR SILICON AND FOR FIBER-OPTIC TRANSMISSION

THE FASTEST YET

BY JOHN GOSCH

GERMAN RESEARCH LABORatories set two records in components speed recently, considerably advancing electronics technology and promising a major impact on systems performance. One is a 20-Gbit/s data rate for a silicon device and the other a data-transmission rate of, again, 20 Gbits/s over a glass fiber 71 miles long.

Scored at the Ruhr University in Bochum and at Standard Elektrik Lorenz AG, the Stuttgart-based subsidiary of France's Alcatel NV, the two records are all the more significant since they were achieved simply by exploiting today's technologies. The Bochum and Stuttgart researchers did not resort to any fancy and expensive techniques, nor did they rely on sophisticated and unconventional methods.

In effect, the Bochum group, headed by Professor Hans-Martin Rein of the university's Faculty of Electrotechnology, has given silicon a new lease on life as a material for high-speed circuits. In making the device from this conventional and inexpensive material, the group got a helping hand from Hewlett-Packard Co. in Palo Alto, Calif.

The 20-Gbit/s switching speed is the highest ever achieved with a monolithic integrated circuit, Rein says. It is even one third higher than the 15-Gbit/s speed obtained with gallium arsenide, a material much more expensive and more difficult to process than silicon. The highest measured speed for a silicon chip before this was 14 Gbits/s, according to the researchers.

The new device is a time multiplexer designed, optimized, and tested by Jürgen Hauenschild, one of Rein's colleagues. Using silicon bipolar technology, HP fabricated the device in Palo Alto. Once perfected, it could find applications in fiber-optic transmission systems operating at extremely high data rates and in fast measuring equipment.

The Bochum device demonstrates that today's silicon technologies can achieve data rates at, and possibly above, 20 Gbits/s, as Rein predicted some time ago in earlier publications. Prerequisites for the high speed, he says, "are a careful circuit design cou-

pled with up-to-date technologies as well as individually optimized transistors in the circuit."

The other record—the 20-Gbit/s transmission rate that Standard Elektrik achieved over a dispersion-shifted optical fiber—corresponds to some 300,000 voice channels. To obtain this result, the Stuttgart researchers did not use new and rather expensive coherent techniques such as superheterodyne methods that are being tried out at other laboratories. Instead, they combined a number of relatively conventional and inexpensive technologies that SEL has developed recently.

Among these technologies are time multiplexing with silicon bipolar components operating at up to 10 Gbits/s and the use of a high-speed laser, also working at up to 10 Gbits/s. Then there's an optical multiplexing method to obtain 20 Gbits/s from two optical signals (each 10 Gbits/s).

SEL also optically amplified the 20-Gbit/s data stream at the transmitter output and added more amplification after a 63-km length of the transmission line. Yet another key was compression of the optical pulses by way of pre-emphasis adapted to the chromatic dispersion of the optical fiber. A fast p-i-n photodiode detects the 20-Gbit/s signal at the receiver.

So far, the SEL researchers have achieved a gain of up to 30 dB and a bandwidth of about 5,000 GHz. The components used can be employed not only for digital point-to-point transmissions as they are in the experiments. They are also good for multichannel, amplitude-modulated TV-signal transmissions, which may be used soon.

SEL's work exemplifies the company's strategy in optical high-speed transmission systems. For data rates up to 10 Gbits/s, electronic signal processing is used—a technique that is reliable and can be implemented at low cost with silicon bipolar technology. Higher speeds, however, are best achieved with such optical signal-processing techniques as multiplexing, pulse compression, and, particularly, amplification.

COMPUTERS

SESSIONS AT COMDEX COULD HELP END CONFUSION ABOUT TECHNOLOGIES

CLEAR DAYS IN VEGAS

BY LAWRENCE CURRAN

IF YOU ARE CONFUSED about how your organization might benefit from fast-moving developments in technologies such as imaging, local-area networks, and multimedia systems, maybe you should catch Comdex/Fall '90 Nov. 12–16 in Las Vegas. More than 1,800 exhibitors will play to an expected 120,000 show-goers at the 12th annual extravaganza centered around small computers and their distribution.

This fall, Comdex is spread over nine locations, with the exhibits concentrated mainly in the Sands Expo and Convention Center and the Las Vegas Convention Center and its West Hall. The 48-session conference program features topics that should help sort out technology and market trends in some of the most talked-about segments of the business, including document-imaging, communications servers and software, and multimedia.

John Dykeman, imaging systems session chair, sees a lot of confusion about what constitutes imaging. The Comdex sessions will define it as document imaging in an office environment, covering those image-management systems involving transactions that produce a record but excluding applications such as real-time visual inspection or medical imaging using real-time video. Dykeman is associate publisher and editorial director of *Modern Office Technology* magazine, a Penton publication in Cleveland.

Besides defining imaging for the office, a session chaired by Amy Wohl,

president of Wohl Associates, a market research firm in Bala Cynwyd, Pa., will provide a review of imaging technology. The session will also feature a panel discussion of barriers to greater acceptance of image-management systems as well as examples of how those barriers are being overcome in some applications.

One of these sessions will be headed by Roger Sullivan, vice president for image-management systems at BIS CAP International, a Norwell, Mass., market research firm. While the session is devoted primarily to the sales challenges faced by vendors and value-added resellers, Sullivan is an authority with a good grasp of growth trends. He estimates that document-imaging systems are growing from $360 million in 1989 revenues to $540 million this year, and will soar to $1.96 billion by 1993.

For his part, Frank Dzubeck's goal in his sessions on communications is to help define a new model for network computing. Dzubeck is president of Communications Network Architects Inc., a Washington consulting firm. "We're trying to bring network computing into the market as a new paradigm," he says. "Communications is becoming the thread that binds instead of being the baggage that went along with information systems."

The increasing emphasis placed on network computing by all major computer and workstation vendors suggests that these sessions are quite timely. Dzubeck foresees communications as the vehicle that will bring data, voice, video, and other information to the desktop in the future.

"Users will neither know nor care where the information comes from when they seek it," Dzubeck says. "It will be gathered transparently from multiple sources located in the next room or thousands of miles away and presented at a user's fingertips."

His own session will cover communications systems, focusing on LAN connectivity and interoperability. Another session will cover software for integrating various computer platforms into LANs, and two more sessions are devoted to communications servers for LANs—the hardware and operating system considerations.

It won't be long before those LANs include increasing numbers of multimedia platforms—computers that can present full-motion, real-time video, graphics, data, and voice from a variety of media, including broadcast transmissions, CD-ROMs, video, and magnetic disks. Tim Bajarin, executive vice president of Creative Strategies International Inc., Santa Clara, Calif., has assembled a group of sessions he hopes will realistically assess the size of the multimedia market, which is projected to be in the multibillions of dollars in the next five years.

More importantly, however, part of his motivation in organizing the sessions was the need "to come to grips with the standards that will be needed fairly soon" so that standards don't become the pacing item in multimedia market growth. "We spend a lot of time sorting out the standards in the computer industry these days," Bajarin points out, "and we hope these sessions bring about a better understanding of what's needed in standards for both development systems and end-user systems."

While Comdex historically has been a PC/value-added reseller stronghold, workstations are working their way onto the show floor and into the conference because they've penetrated the VAR market. "Workstations: The New Kids on the Block," a session in a group dedicated to buyer-seller issues, acknowledges that fact.

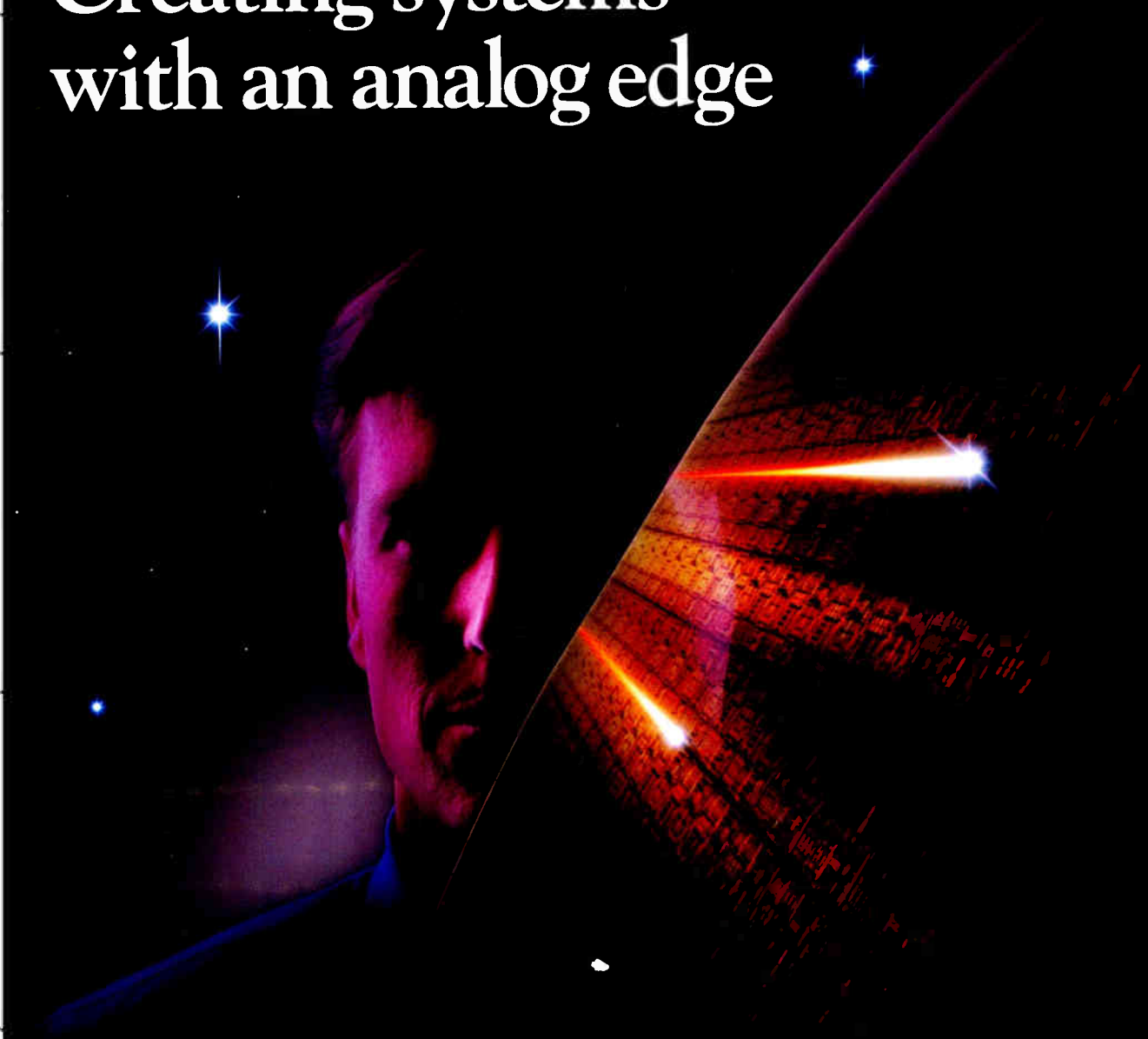
Chairman Egil Juliussen says that lower prices for both workstations and their software are making these platforms formidable competitors in the PC arena. Juliussen is president of a directory service in Incline Village, Nev., that publishes the *Computer Industry Almanac*. He says high-performance reduced-instruction-set-computing workstations selling for less than $10,000—along with low-cost shrink-wrapped application software—will continue to blur the distinctions between technical workstations and PCs.

But the performance of PCs continues to improve, adding to the confusion. Their lower-than-worksation prices make them attractive in technical workstation applications such as computer-aided-design automation. Juliussen's session may help clarify some of the confusion while suggesting that workstations will be a billion-dollar VAR business by 1995.

TEXAS INSTRUMENTS

A PERSPECTIVE ON DESIGN ISSUES:

Creating systems with an analog edge



IN THE ERA OF

MegaChip TECHNOLOGIES

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A leadership family of analog circuits from Texas Instruments is helping designers meet difficult design challenges.

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TI's new analog devices are enabling design engineers to link digital brains to analog worlds more effectively and efficiently than ever before. Some offer new standards of accuracy or speed while others are highly integrated devices combining analog and digital functions on a single chip. The result is superior system performance and design flexibility.

These Advanced Linear functions are the result of leadership process technologies that we at TI firmly believe are the key to the advanced analog devices your future applications will demand.

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Designers in the automotive industry face a tough challenge: Handle high reverse voltages and achieve rapid load turnoff while providing fault protection, detection, and reporting and efficient load management. To provide the needed intelligent power devices, we developed one of our newest process technologies, Multi-EPI Bipolar. It is unique because it can combine rugged power transistors with intelligent control functions.

The resulting circuits are now providing reliable, cost-efficient control of solenoids and valves in such automotive applications as antiskid braking systems, electronic transmission controls, and active suspension systems.

Other industry segments are also benefiting from TI's Advanced Linear process technologies. Here are a few of the winning designs to which we have helped add an analog edge:

Toledo Scale

Challenge: Improve the accuracy of point-of-purchase scales by eliminating drift over time and temperature.
Solution: The TI TLC2654 Chopper op amp. Our Advanced LinCMOS™ process makes possible chopping frequencies as high as 10 kHz, reducing noise to the lowest in the industry.

Pulsecom

Challenge: Develop a linecard capable of driving low-impedance loads with greater precision.
Solution: Our TLE206X family of JFET-input, low-power, precision operational amplifiers. These devices offer outstanding output drive capability, low power consumption, excellent dc precision, and wide bandwidth. Fabricated in our Excalibur process, they remain stable over time and temperature.

Leitch Video

Challenge: Design a compact, cost-efficient direct broadcast satellite TV descrambler for consumer use.
Solution: TI's TLC5602 8-bit Video DAC. Our LinEPIC™ process combines one-micron CMOS with precision analog to satisfy the demands of the application for video speeds and low-power operation.

U.S. Robotics

Challenge: Build a modem for high-speed data transmission between computers; allow flexible operation and minimize data errors.
Solution: Our TLC32040 Analog Interface Circuit (AIC). A product of our Advanced LinCMOS process, the AIC combines programmable filtering, equalization, and 14-bit A/D and D/A converters with such digital functions as control circuitry, program registers, and a DSP interface.

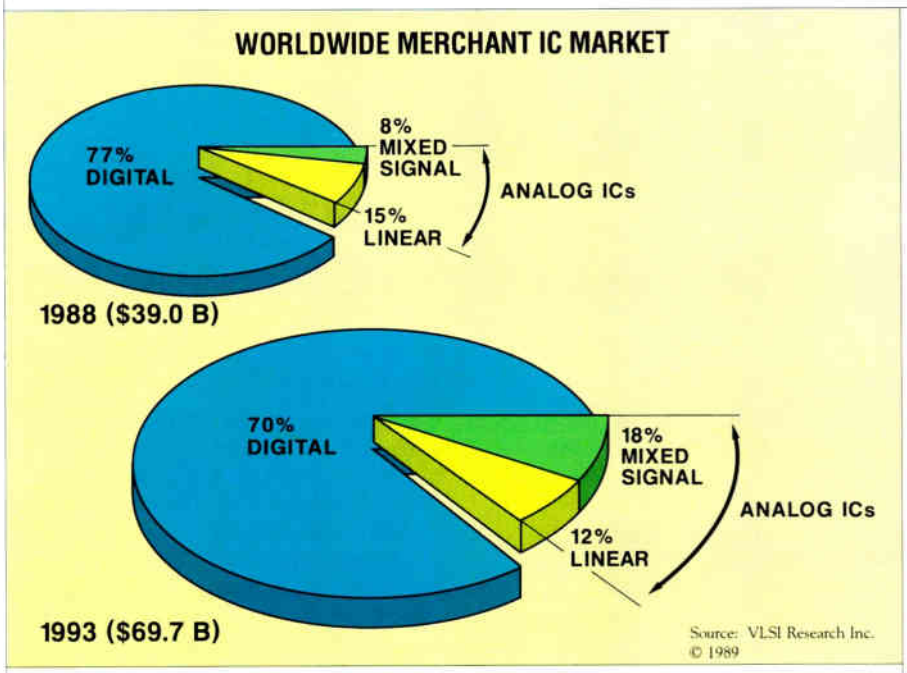
Xerox

Challenge: Cut component count and cost of copier systems while boosting reliability.
Solution: Our TPIC2406, a top-performance peripheral driver in a standard DIP package that is capable of driving heavy loads. It is fabricated using our Power BIDFET™ process which permits greater circuit density and incorporates CMOS technology for low total power dissipation.

Mr. Coffee

Challenge: Design an intelligent coffee maker that brews faster, maintains optimum temperature, shuts off automatically, and has a built-in cleaning cycle.
Solution: Our LinASIC™/LinBiCMOS™ capability permits us to combine both analog and digital library cells with custom analog cells. This results in cost-efficient integration of temperature monitoring, timing, and high-current outputs on a single control chip.

All of these examples point to one conclusion: TI's Advanced Linear functions are adding an analog edge to many system designs. They are contributing significantly to the enhanced system performance that marks a market winner.



Helping you implement your designs in a changing world.

An increasing share of the total analog market is being captured by mixed-signal devices. As they gain more widespread acceptance, they are driving the expansion of the overall analog market (*see above*).

Changes such as this are the order of the day in the IC marketplace. Texas Instruments continues to provide not only the high-performance circuits you need but also the depth of experience, support, and service fundamental to successful completion of your designs.

Experience: Building on three decades in ICs

We at TI can successfully meet your requirements for mixed-signal devices because we have acquired the necessary knowledge from 30 years of experience in developing both analog and digital functions. We have also drawn upon our digital ASIC strengths in developing our LinASIC capabilities.

Support: Speeding our chips to you

The faster we move new products through our design cycles, the faster you can get through yours. We employ a wide variety of design-automation tools and sophisticated software to speed our development process.

Service: Providing a surety of supply

However advanced our circuits may be, they are of little value if they are inaccessible to you. TI operates on the principle of global coverage, local service. We manufacture semiconductors in 13 countries and operate support centers in 22. We have product and applications specialists, designers, and technicians around the world. They are linked by one of the world's largest privately owned communications networks so that we can bring you our best — circuits and support — from wherever they may be to wherever you are.

Keeping our communications open

The relationship between you as customer and us as vendor is vital: You are our chief source for firsthand information that can help guide us in developing the circuits you will need for your future designs. We at TI welcome your comments and your suggestions.

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LinBiCMOS — Combines Advanced LinCMOS, digital ASIC CMOS, and up to 30-V bipolar technologies to allow the integration of digital and analog standard cells and handcrafted analog components on a monolithic chip.

LinEPIC — One-micron CMOS double-level metal, double-level polysilicon technology, which adds highly integrated, high-speed analog devices to the high-performance digital EPIC process.

Advanced LinCMOS — An N-well, silicon-gate, double-level polysilicon process featuring improved resistor and capacitor structures and having three-micron minimum feature sizes.

Power BIDFET — Merges standard linear bipolar, CMOS, and DMOS processes and allows integration of digital control circuitry and high-power outputs on one chip. Primarily used for circuits handling more than 100 V at currents up to 10 A.

Multi-EPI Bipolar — A very cost-effective technology that utilizes multiple epitaxial layers instead of multiple diffusion steps to reduce mask steps by more than 40%. Used to produce intelligent power devices that can handle loads as high as 20 A and voltages in excess of 100 V.

Excalibur — A true, single-level poly, single-level metal, junction-isolated, complementary bipolar process developed for high-speed, high-precision analog circuits providing the most stable op amp performance available today.

If you would like a more detailed explanation of our Advanced Linear process technologies, please call **1-800-336-5236, ext. 3423.** Ask for a copy of our *Advanced Linear Circuits* brochure.

TEXAS INSTRUMENTS

A BEVY OF NEW CHIPS AIM AT DISPLACING THE 68000 FROM LASER-PRINTER APPLICATIONS

RISC GOES EMBEDDED

BY JONAH McLEOD

THE STRUGGLE BETWEEN reduced- and complex-instruction-set microprocessors has moved onto yet another battleground: embedded applications. These applications use microprocessors as compute engines buried within such equipment as laser printers. The engine of choice for most laser printers has been the Motorola Inc. 68000, a CISC machine, because of its relatively high power and sub-$10 cost. However, with the advent of more demanding desktop-printing applications, the 68000 is beginning to run out of gas.

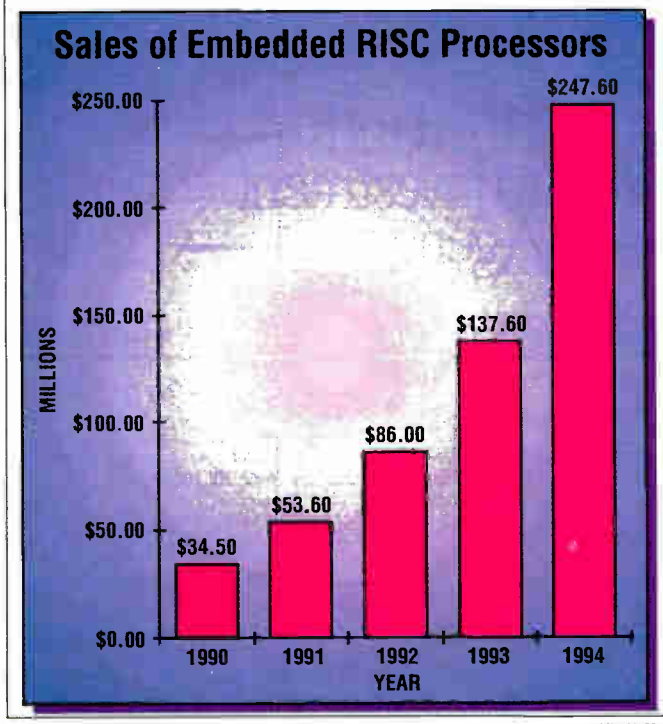
RISC vendors now see an opportunity to begin displacing CISC in these very high-volume applications. Until now, though, RISC chips have been too expensive for the mass market; they have also lacked the level of integration and functionality needed to adequately serve as embedded processors. But that began to change this fall, when a number of vendors announced embedded RISC processors to be priced under $100. They include Fujitsu, Hitachi, Integrated Device Technology, and LSI Logic. The aggressive pricing is the result of new 0.8-μm technology, which is being implemented in full-custom and cell-based designs—less costly approaches than the traditional gate arrays.

Also, the parts will have the on-chip functions that embedded applications need. These include sophisticated on-board cache, support for low-cost DRAMs, and high-speed multiply and divide for floating-point emulation. Some offerings will also have counter-timers.

The market for embedded RISC processors is on the verge of explosive growth, says Jack Quinn, senior analyst at market research firm In-Stat Inc. of Scottsdale, Ariz. "Embedded applications include anything that needs high-speed screen or print graphics," Quinn says. "The laser printer, especially, will gradually shift from CISC-based compute engines to RISC."

The newest chip offering is Fujitsu Microelectronics Inc.'s Sparclite processor, which the San Jose, Calif., company is rolling out this month. It comes a month after LSI Logic Corp. of Milpitas, Calif., unveiled its LR33000 processor, a version of the MIPS Computer Systems Inc. R3000 CPU containing features for the embedded market.

In the middle of September, IDT of Santa Clara, Calif., took the wraps off the IDTR3051/2, two versions of the MIPS RISC chip likewise customized for embedded control. For its part, Hitachi Ltd. says it will soon have an embedded version of Hewlett-Packard Co.'s Precision Architecture RISC processor.



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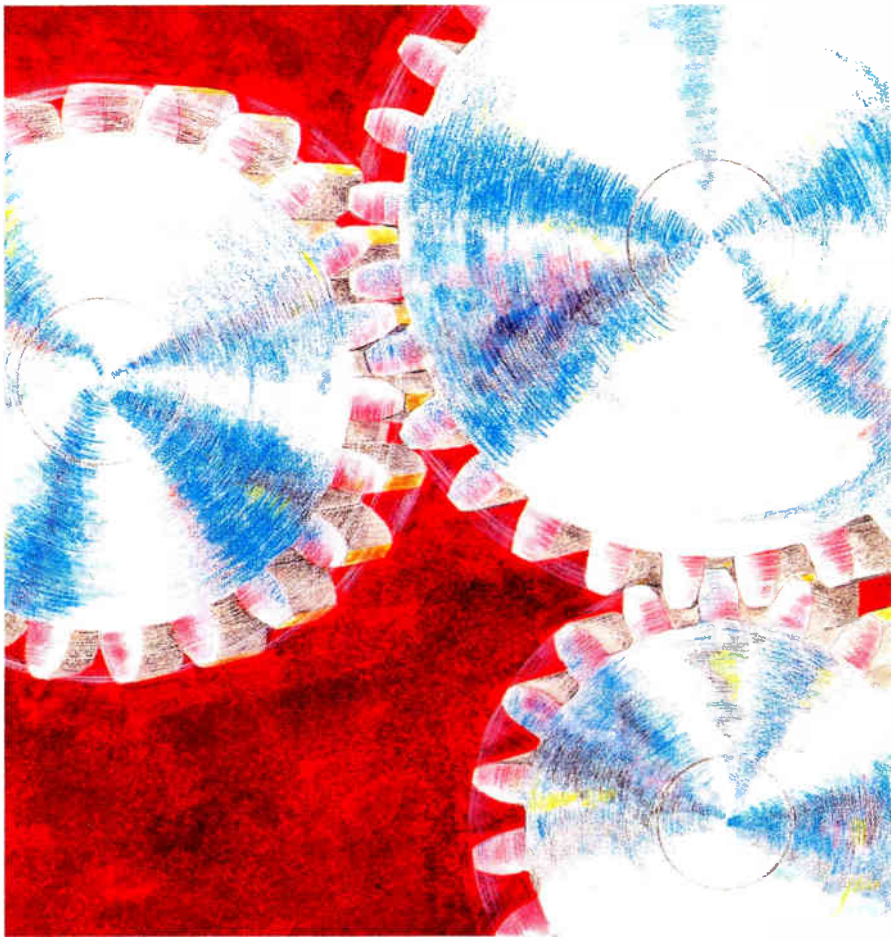

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HIT THE GROUND RUNNING

CIRCLE 205

A LANDMARK FOR THE GERMANS

In what industry observers consider a landmark decision, Germany's Ministry of Research and Technology has for the first time appropriated development money to a U.S.-owned semiconductor producer. The multimillion-dollar contract is to the ITT Semiconductor Group to develop key components for Europe's future high-definition TV system.

Acting through its lead house, Intermetall GmbH in Freiburg, Germany, the ITT group has long been offering its expertise in circuit design to the research ministry, hoping for government funding for certain projects. Obviously, the ministry believes ITT Semiconductor can make valuable contributions to HDTV system components.

Europe's HDTV project, designated Eureka 95, entered its second phase in July. This phase encompasses system implementation as well as the development of strategic components. The development money ITT Semiconductor is getting amounts to about $7.5 million spread over the 1991 to 1993 period. E

SIEMENS NIXDORF OPENS FOR BUSINESS

Now that Siemens AG has formally taken over financially troubled Nixdorf Computer AG—the acquisition became effective Oct. 1—Germany's largest data-processing equipment maker is busy trying to squelch speculation that it's poised to buy up other European computer makers. The rumors had Siemens casting eyes on, for example, Germany's Mannesmann Kienzle and France's Bull.

But before any new acquisition moves will be made, the company wants to complete the process of fusing Nixdorf's activities with its own computer business in the newly formed group, Siemens Nixdorf Information Systems AG, and "that process certainly won't end so soon," officials say.

Siemens Nixdorf, with 50,000 employees and sales expected to reach $8.4 billion during fiscal 1990-91 (which ends Sept. 30 next year), brings together Siemens's highly profitable computer business and Nixdorf's loss-ridden activities in the field. Sales at the Siemens Data Processing Division increased about 25% this year over the previous year's level, and business has consistently been profitable since 1985. Nixdorf, by contrast, lost approximately $650 million in 1989, managing to reduce that by only one half this year.

The new company aims to grow into a strongly sales- and marketing-oriented group, with Europe as the prime field of operations, and thus wants to become a truly European company. With a product range encompassing everything from PCs to supercomputers, Siemens Nixdorf will emphasize network computing in the 1990s, banking on Siemens's own BS2000 operating system as well as on Unix. As for the market in the former East Germany, the new company expects sales of $129 million in that region this year. This could "possibly grow to $320 million in 1991," the company's executives declare. E

EAST EUROPE CONTINUES TO ATTRACT WESTERN PARTNERS

Anticipating eventually lucrative markets in East Europe, electronics companies in the West keep striking cooperative deals there. Targeting Czechoslovakia as one such market are two German companies—Robert Bosch GmbH and Philips Kommunikations Industrie AG, which is a subsidiary of Philips International NV of the Netherlands.

Bosch, the Stuttgart-based auto accessories maker, and Czechoslovakia's government-owned ZVS have agreed to cooperate in antiskid and slip-control systems for commercial vehicles. The deal provides for ZVS to manufacture the systems under license using Bosch know-how, and for the German firm to buy braking system components and other automotive parts from ZVS.

For its part, Nuremberg-based Philips Kommunikations has struck a deal with Tesla of Prague to work together in cable-based telecommunications and help expand the country's public networks. Cooperation will center on digital signal transmission gear and on systems such as pulse-code-modulation equipment, multiplexers, and line terminals that can also be used for 140-Mbit/s transmissions over optical fibers. The two aim to set up a joint venture. E

Czechoslovakia List

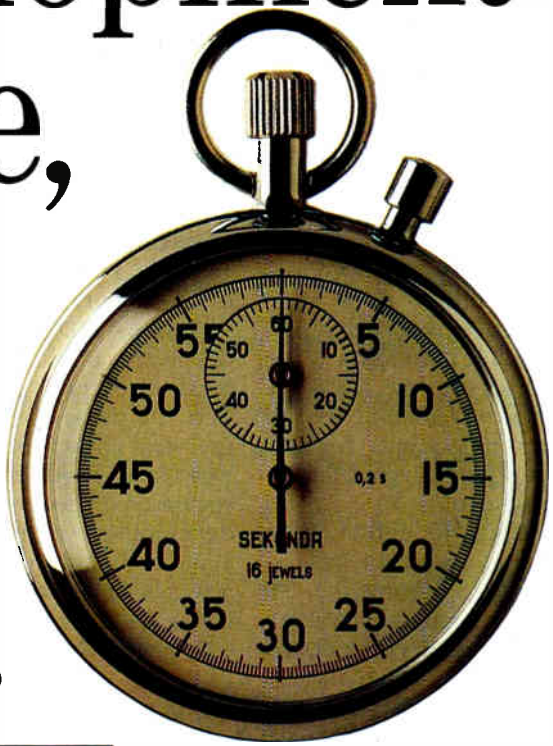
Company	Partner	Products
Robert Bosch	ZVS	Antiskid brake systems
Philips Kommunikations Industrie	Tesla	Telecom; public nets

AT ELECTRONICA, A 2.5-V EEPROM FROM SGS-THOMSON

SGS-Thomson Microelectronics will show off at the Electronica show in Munich Nov. 6-10 an EEPROM that not only can handle more than 1 million write/erase cycles but operates with supply voltages as low as 2.5 V. Called the ST93CS57B1, it is a 2-Kbit part with a 128-by-16-bit organization, a programmable memory-write protection feature, and a serial input/output interface.

The device combines SGS-Thomson's advanced CMOS F3 process with circuit-design techniques that considerably improve the performance of the on-chip voltage multiplier. The part is particularly suited for portable consumer applications, the firm says. E

If you're in video development chances are, you're wasting your time.



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CIRCLE 188

EDUCATION

CONCERNED ABOUT TOMORROW'S WORK FORCE, ELECTRONICS FIRMS GO BACK TO SCHOOL

START WITH THE ABCs

BY JACQUELINE DAMIAN

IN THE MIDDLE OF A HOT, steamy day last August, Mike Rice found himself walking down the streets of a run-down neighborhood in South Dallas with 52 balloon-carrying four-year-olds, their mothers, assorted aunts, grandmothers, and smaller children, and two clowns. It was unusual company for Texas Instruments Inc.'s vice president of corporate communications and marketing.

But Rice is also president of the TI Foundation, and the children were the first graduates of the organization's model Head Start program. They were making the long two-block march between the Head Start site and the Julia C. Frazier Elementary School, where principal Rubye Snow and her teachers were waiting to enroll them in kindergarten.

The TI program may be unique in addressing this young an age group, but it's far from the only effort among U. S. electronics companies to make an impact on American education. All across the country, high-tech firms have launched scores of programs at all grade levels designed, ultimately, to improve the quality of the students who will go on to become the next generation of employees.

The corporate commitment is substantial, at least at the top rung of electronics manufacturers. TI, for example, spent $7.2 million on education last year, while the TI Foundation—a separate entity set up to fund civic endeavors—kicked in another $576,000. That's just about the cost of a state-of-the-art wafer fab. Of that total, $288,000 went to install the Head Start program, the only corporate project of its type in the U. S.

Although the majority of companies spend a great deal less, a few are spending vastly more. Hewlett-Packard Co. and IBM Corp. vie for top honors as the biggest corporate educational boosters in the nation. In 1989, HP spent $65.3 million on a variety of programs spanning kindergarten through college; IBM's contribution for an equally broad swath of projects was $58.1 million (including loaned staff time).

In this effort, the elec-

Companies are allocating big bucks to school programs at every grade level—a long-range investment in the next generation of employees.

tronics sector "is in the forefront" of a wave of corporate involvement in education, says Leonard Lund, program director for business/education research at the Conference Board, a New York–based research organization. "It has the capability because of its technology to provide the educational improvement," he says. It also has, arguably, the most to gain. As the nation's largest manufacturing industry, electronics producers "realize that the products of the schools are not adequate for the work force needs," says Lund. Or as TI's Rice puts it: "The pool of available workers the company draws from is deteriorating, and the jobs are getting a lot harder. It's just going in the wrong direction."

The now familiar litany of statistics on U. S. students' poor grasp of math and science—in one international test, high school seniors ranked 14th among 15 nations surveyed in math—are alarming enough. How that translates into tomorrow's work force is even more sobering.

Of any 100 ninth graders, only five will go on to graduate from college, says Ken Lay, the IBM director of international education. Of those five, less than one will get a technical degree. "By the end of the century, the U. S. will be short 750,000 scientists and engineers," Lay says. "IBM is the third-largest employer of engineers in the U. S.," so efforts to turn the situation around are "not just altruistic," he says.

Still, surveys, test scores, and long-range projections are abstractions until the problems start showing up on the shop floor. Mark Rosenker, vice president of public affairs for the Electronic Industries Association, tells of one high-tech company's discovery that a valued quality-control employee charged with calibrating highly sophisticated equipment could neither read nor write. The company sent him to remedial courses, "but it cost them money to do this. And this is not just one case," he says.

Indeed, the Conference Board in a recent survey of 1,600 companies found that 14% traced work delays or stoppages to functionally illiterate workers. "Plant workers unable to read manuals maintain machinery inadequately, causing breakdowns. Production workers incorrectly measure raw materials because of an inability to read, and these errors result in production waste," says the report.

With the electronics industry heavily invested in quality as the key to competitiveness, it can't afford borderline employees any more than it can afford borderline parts or borderline customer service. But in the U. S., "half of every high school cohort is unemployable," says Lay of IBM. "One of four drops out, another one in four graduates with less than sixth-grade skills. We're wasting too much human resource."

The recognition of these harsh realities has made bedfellows of U. S. business and U. S. schools on a scale never seen before. "Business says, 'Look at us, we're losing our edge competitively,'" says Roger Morton, editor of *School and College* magazine in Cleveland. In the past five years, he says, business has responded in a big way by mobilizing resources on two fronts: "first, to train people [in order] to keep themselves alive right now; second, to upgrade the local schools so they won't face the same

problem in the future."

Few companies are as energetic at the front end of that equation—employee training—as Motorola Inc. Hand in hand with its ambitious quality program [*Electronics*, July 1990, p. 54] has come a massive employee assessment and training thrust, culminating in the creation of an in-house university—Motorola U., with campuses at corporate headquarters in Schaumburg, Ill., and in Mesa, Ariz. The company spends an estimated $60 million a year on employee training.

At the division level, training efforts grow out of an immediate need. For example, when technological changes swept the Mesa plant three years ago, bringing new equipment and new procedures, "the manager sensed that his people didn't have the skills necessary to move into some areas of operation," says Lionel Goddu, manager of selection and assessment for Motorola's Semiconductor Sector in Phoenix. Testing proved him right: "About 30% needed some kind of remedial help," Goddu says.

They got it, and so have other factory-floor employees throughout the Semiconductor Sector—some 2,000 people in all so far, Goddu says. They attend two-hour classes, on-site, on company time, three to four days a week, depending on need. The result? "We have noted significant productivity improvements: cycle time has gone down and the cost of manufacturing has gone down," Goddu says.

ON A LEVEL MORE DIFFICULT to measure, "The evidence is mostly anecdotal—I don't have any hard numbers to go by. But the people feel great about themselves. The supervisors say that people for the first time are taking the initiative, offering suggestions," giving feedback to the process engineer when something goes wrong on the line, communicating with one another, and intervening more actively when problems crop up. "The work force is just a higher-powered work force," Goddu concludes.

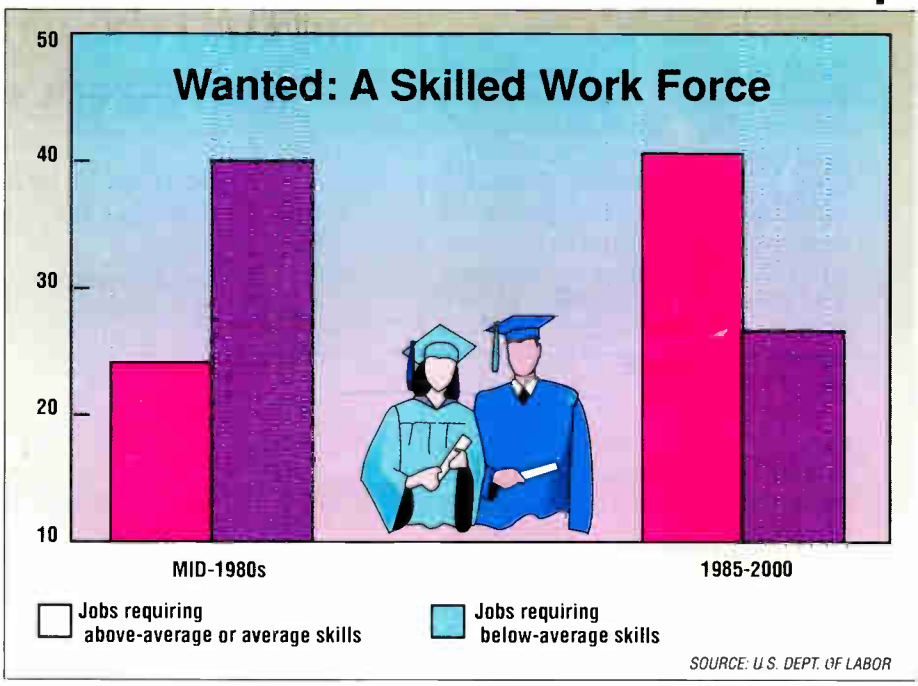
As companies discover that it takes time and money to bring today's employees up to snuff, they're also butting up against the longer-range outlook. It's what Gail Niedernhofer, director of the federal Office of Corporate and Community Liaison, calls "the spill-down effect." Corporations find themselves struggling to compensate for the deficits in community college educa-

tion (an especially acute concern in high-tech areas, where vocational training has not kept pace with the real world). The colleges, meanwhile, have to make up for deficiencies in the high schools, and so on down the line all the way to the elementary school.

The result, Niedernhofer says, is a blossoming of "partnerships"—as these school-business linkages are called—in the younger grades. Where once corporate involvement was mainly at the college level, today more companies are broadening out into K–12.

Besides the increasing focus on younger children, Niedernhofer sees another trend in corporate educational endeavors. "Partnerships got a bad name for a while—businesses were in effect throwing money at a school and saying, 'Here, fix it.' But at this point, dollars are the last thing on the list of priorities for a corporation to give."

Companies are now rolling up their sleeves and getting involved in the process, she says, whether by setting up employee-student mentor programs, lending a hand in curriculum development, funding "magnet schools" in science and math, or loaning computer expertise—not just equipment. Beyond the classroom level, businesses stage workshops on technology or management for teachers and administrators, help define teachers'-college curricula, and participate at the public-policy level.



There's even a case or two where a high-tech company—notably, Digital Equipment Corp.—is encouraging engineers to leave the firm and become teachers. Launched this year, Engineers into Education helps DEC engineers make a full-fledged career change with the aid of a generous financial package, including a salary and benefits "bridge" and tuition reimbursement. Twenty-six Digital employees recently graduated from the pilot program, and another 35 are enrolled for the second round.

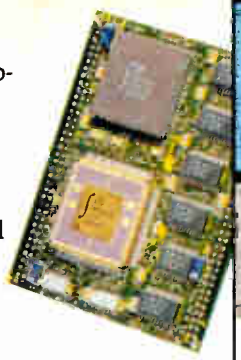
"The logic is pretty straightforward," says Sam Fuller, vice president for research and development at Digital. "Three to four years ago, when we began to look at the educational pipeline, we realized the real crisis is in K–12. It's a sufficiently big problem that for a while we were baffled as to what to do. Our conclusion was that our principal resource was our people." Sending well-informed technical people out into the trenches to teach science, math, and computers "to us was the one way to begin getting some real leverage," Fuller says. The company estimates that within five years, each of the new teachers will have influenced more than 500 students.

Fuller, who says the program was inspired by a similar project at Eastman Kodak Co., reports that enthusiasm is high among schools in DEC communities and among employees: there are two applicants for every program slot.

(Continued on p. 43)

R3000 RISC SubSystem™ Modules

The IDT7RS101 and IDT7RS102 SubSystems are available in 12-, 16-, 20- and 25 MHz versions. They feature 64 KBytes and 16 KBytes each of instruction and data cache, respectively, an optional floating-point, and read and write buffers.



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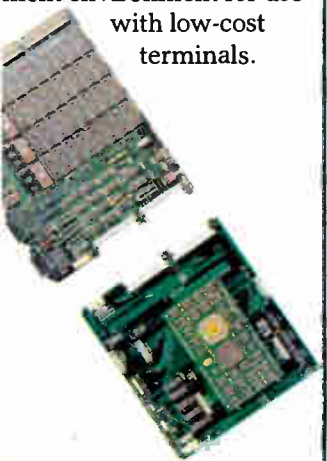

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A New Way of Thinking

CIRCLE 185

(Continued from p. 40)

Many of them, he says, are midcareer engineers who now "want to mentor and give back to society, rather than climb higher on the corporate ladder." In the end, he says, "I think we'll get back more than we put in. If another 50 corporations will do the same thing, we'll get our fair share of the better-educated kids going through K–12."

Like Digital, all the corporations embarking on educational efforts want to ensure that their dollars are well-spent—that they're getting the most bang for the buck, so to speak. And also like Digital, many of the biggest high-tech spenders are taking stock of their educational grabbag to determine which programs are the most effective and where future dollars should go.

That's the case at Hewlett-Packard, which a year ago created a new corporate position: K–12 education relations manager. "Our employees, in a survey that was conducted, expressed a strong interest in the challenges and issues facing education," says Bess Stephens, a 10-year HP veteran and former science teacher who was appointed to the new post. "And we already had a groundswell of participation [in local schools] by HP people around the country—it's part of our corporate culture."

It was time, HP decided, "to provide some corporate management of that whole process." Ultimately, says Stephens, "we apply the same techniques to this program that we do in our own company [overall]. Using our good business instincts, we're going to look carefully at our dollars and where we're going to put them."

Of scores of programs at virtually every HP manufacturing and business site across the country, Stephens singles out a San Jose, Calif., experiment in setting up magnet schools "to encourage kids into the technical pipeline." More than 100 HP employees participate, mostly as one-on-one mentors to the students, who are from the low-to-midlevel ranks academically. HP's San Jose general manager sits on the board that administers the program, and the company recruits students for part-time jobs and for full-time employment upon graduation.

"The results have been quite impressive," Stephens says. The students showed "significant improvements" in a number of measures, including dropout rate, grade-point average, and attendance. At least two of last year's graduates are now working for HP.

HP has discovered that in its dealings with the schools, "The process and the approach—the entry point for the business—can be a key factor in the success of the program," Stephens says. "Whatever our contribution is going to be, we have taken the time and effort to ensure it's needed by that district and becomes an integral part of that school district. That's a different emphasis than 'we know what's best for your schools.' "

In the end, by addressing education corporations are serving not just their own interests but the interests of the communities in which they do business.

"This is our city," says TI's Mike Rice in describing why the TI Foundation set up its Head Start program. "And we have an enormous problem in this city with people who are not receiving the proper education becoming the outcasts of society. The quality of the city is going down because we're not providing the kind of education we need. I've lived here all my life—I don't want my city to go toes up and die." E

LOOK OUT EPROMs, HERE COMES FLASH

AS THE LAPTOP BOOM SPARKS MEGAGROWTH IN NONVOLATILE MEMORY, THE PLAYERS ARE LINING UP AT BAT

BY SAMUEL WEBER

MEMORIES

IN THE WORLD OF NONVOLatile memory, flash is where the action is. As technology advances and densities push higher and costs lower, memory vendors are anticipating an explosion of applications for this versatile device. They are casting covetous eyes at the current $3 billion market for the venerable ultraviolet-erasable EPROM and the high-density segments of the more sophisticated full-featured electrically erasable PROM (EEPROM). Some even speculate that as speeds get better than 100 ns, some RAM applications may fall to flash as well.

The potential market size and growth rate are so attractive that old-line semiconductor vendors like Advanced Micro Devices, Hitachi, Mitsubishi, Signetics, and Texas Instruments are mounting big efforts with first-time flash products to join battle with companies already in the market. These include market leader Intel Corp., along with smaller but experienced flash suppliers like Atmel, Catalyst, and Seeq. Exel, NEC, and Waferscale are also expected to launch products soon.

One factor driving the growth of flash is the boom in portable, laptop, and palm-size computers, expected to grow fivefold to 11 million units by 1994. They offer a big opportunity to suppliers of an all-solid-state substitute for floppy and hard disks (see p. 52). In this market, flash offers distinct gains in size, power dissipation, reliability, and speed.

"At the 4-meg level," says Robert Tabone, Hitachi Ltd.'s product marketing manager for static RAMs in Brisbane, Calif., "suddenly we will have memory cards with the density to rival a hard disk. While the cost won't be at parity then, by 1994 we expect that to occur. With the explosion of laptop and notebook computers and many applications requiring high density, this technology is absolutely going through the roof."

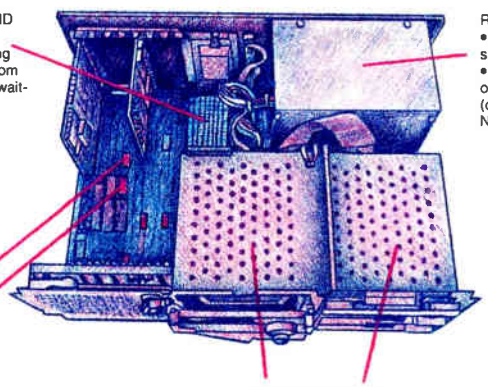
There are literally thousands of applications for low-cost, high-density electrically reprogrammable memory in automotive, telecom, point of sale, computer peripheral, industrial control, instrumentation, military, medical, and many other areas where large numbers of sockets await. All this means that flash sales will swell from a small base of $37 million this year to $134 million in 1991 and $1 billion by 1994, says Mary Olsson, industry analyst for Dataquest Inc., the San Jose, Calif., market research firm.

This growth largely stems from the industry's need for an in-system programming solution, says Krish Panu, vice president of marketing and sales for Catalyst Semiconductor Inc. of Santa Clara, Calif. "Time to market is getting critical and system life cycles are getting shorter. Having in-system reprogrammability makes it easy to upgrade and modify products quickly and reliably," he says.

And flash is quick: a device can be erased and reprogrammed in less than 5 s, about half the time it takes for a full-featured EEPROM. And erasure can be done without removing the device from its socket, unlike EPROMs, which erase in about 20 min. Thus, code changes in prototypes can be made in seconds, and board updates can be done without disassembly. These are just two simple examples of the possibilities flash offers to system designers.

At this incipient stage, there are several

How Flash Enhances Systems



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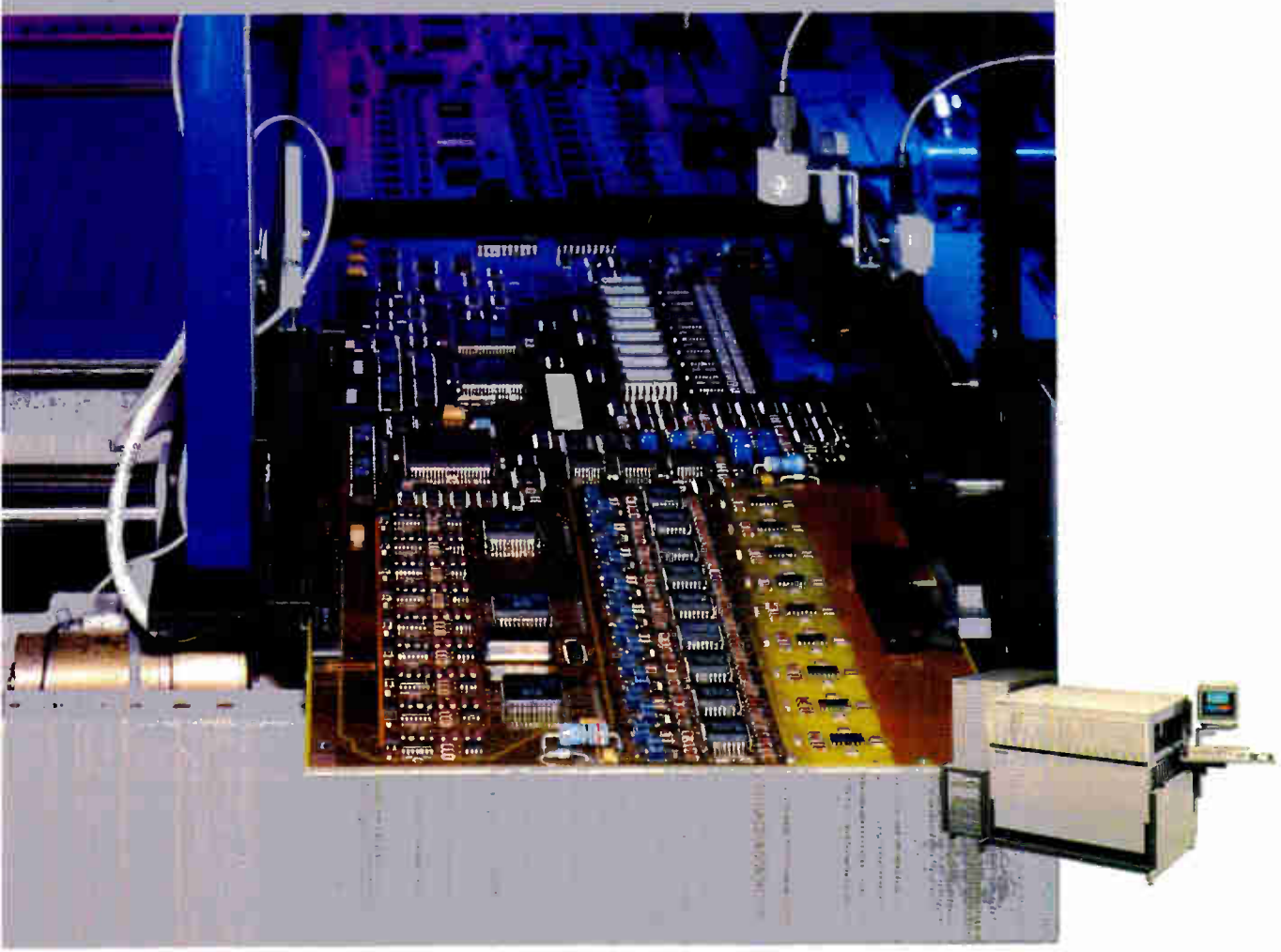

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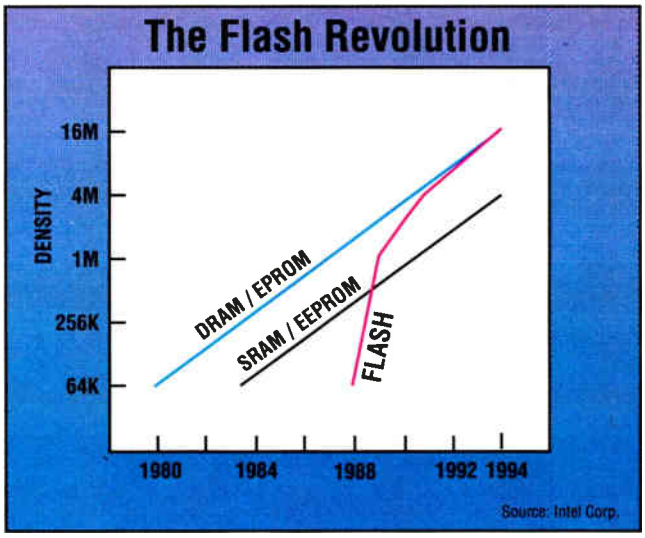
approaches to flash technology and a lack of standards, although one may be emerging in at least de facto form. Right now, chip makers follow different roads in cell size and design, method of writing and erasing, power-supply requirements, and endurance (the number of write/erase cycles that can be performed before deterioration of the gate oxide).

Each variation has advantages and disadvantages, a situation that can be confusing to potential users. Also confusing is just where flash fits in the hierarchy of nonvolatile memory options available (EPROMs, full-featured EEPROMS, battery-backed RAMs, and nonvolatile RAMS of different types). Invariably, the choice boils down to cost and system requirements. The system designer must consider such questions as frequency of writing or erasing, whether byte, page, sector, or bulk alterability is required, the density needed, power-supply availability, and price.

The multifarious designs sort themselves into two basic approaches, distinguished by whether they require one or two voltage supplies. Both can trace their lineage to EPROM technology, using a floating-gate structure but with a thinner gate oxide. But they differ in their cell structure—whether they require one or several transistors per cell. In general, the one-transistor cell requires a 12-V supply for programming and a 5-V supply for read, but yields a small cell size. This results in higher density, smaller chip size, and lower cost than the 5-V-only approach.

Intel's self-aligned stacked-gate cell, based on its proprietary ETOX (EPROM tunnel-oxide) technology, is the paradigm for the one-transistor school. At midyear, the Santa Clara firm announced the highest-density flash part currently available, the 2-Mbit 28F020. The competition either has or will shortly introduce 1-Mbit parts, and most have 4-Mbit flash devices in development. These should start to appear in late 1991.

The Intel approach received validation in the September announcement by Advanced Micro Devices Inc. of a 1-Mbit flash memory compatible with Intel's 12-V memory pinout and software-programming routines. AMD is committed to "establishing a de facto standard" for flash, says Steve Grossman, director of marketing for memory products at the Sunnyvale, Calif., company. Catalyst also follows the Intel pinout and algorithm lead in its 1-Mbit, 120-ns part, the CAT28F010, now being offered as samples. Exel, Hitachi, Mitsubishi, and Toshiba also opt for Intel compatibility.



One problem with the single-transistor cell is the possibility of overerasure and consequent current leakage, resulting in false data readings. This occurs when a cell in the zero state receives an erase pulse, whereby it can be driven into the depletion mode. The column-sense amplifier can read this leakage current falsely as an erased cell. Intel and its emulators overcome this with a programming algorithm that first programs up all the cells on a chip to 1 before erasing.

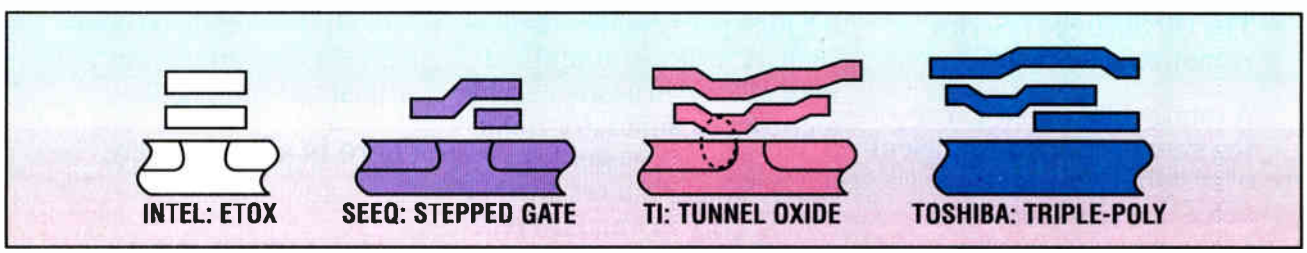
Seeq Technology Inc., a major competitor of Intel's, overcomes this problem by means of a different cell structure. Its split-gate cell employs what amounts to a two-transistor architecture, but exacts only a small premium in cell area. Through a diffusion process, the split gate creates a "phantom transistor" that looks like a series transistor, says Richard Norris, marketing manager for Seeq's Memory Division in San Jose. "This allows us to isolate the cell from others in a column. The series transistor acts like a valve, and even if you overerase the cell and it gets leaky, if you don't select the transistor the leakage doesn't reach the column."

Another difference from Intel is the ability of the Seeq parts to erase a sector or small portion of the memory. With the Intel device, the entire chip must be erased before writing in new data. "We have sector-erase," says Norris. "There are 128 columns and you can erase and reprogram any one of those without altering any of the others."

Norris insists that the 15% premium on cell size and 10% on overall chip size is worth it for the advantages Seeq offers. "Furthermore, in our next-generation part, cell sizes will be within 5 mil² of [Intel's], because Intel adds a lot more external circuitry to prevent that overerase from happening." Seeq now produces two parts, the 512-Kbit 48F512 and the 1-Mbit 48F010.

The dual-power-supply requirements of most of today's flash EEPROMS add cost and space penalties for system design, and for this reason, some vendors are developing single-supply flash technology. Both Texas Instruments Inc. in Dallas and Atmel Corp. of San Jose have introduced 256-Kbit products of this

(Continued on p. 50)



VARIATIONS ON A THEME

Chip makers are taking many routes to flash, including these, but all the designs trace their lineage to EPROM technology, using a floating-gate structure but with a thinner gate oxide.

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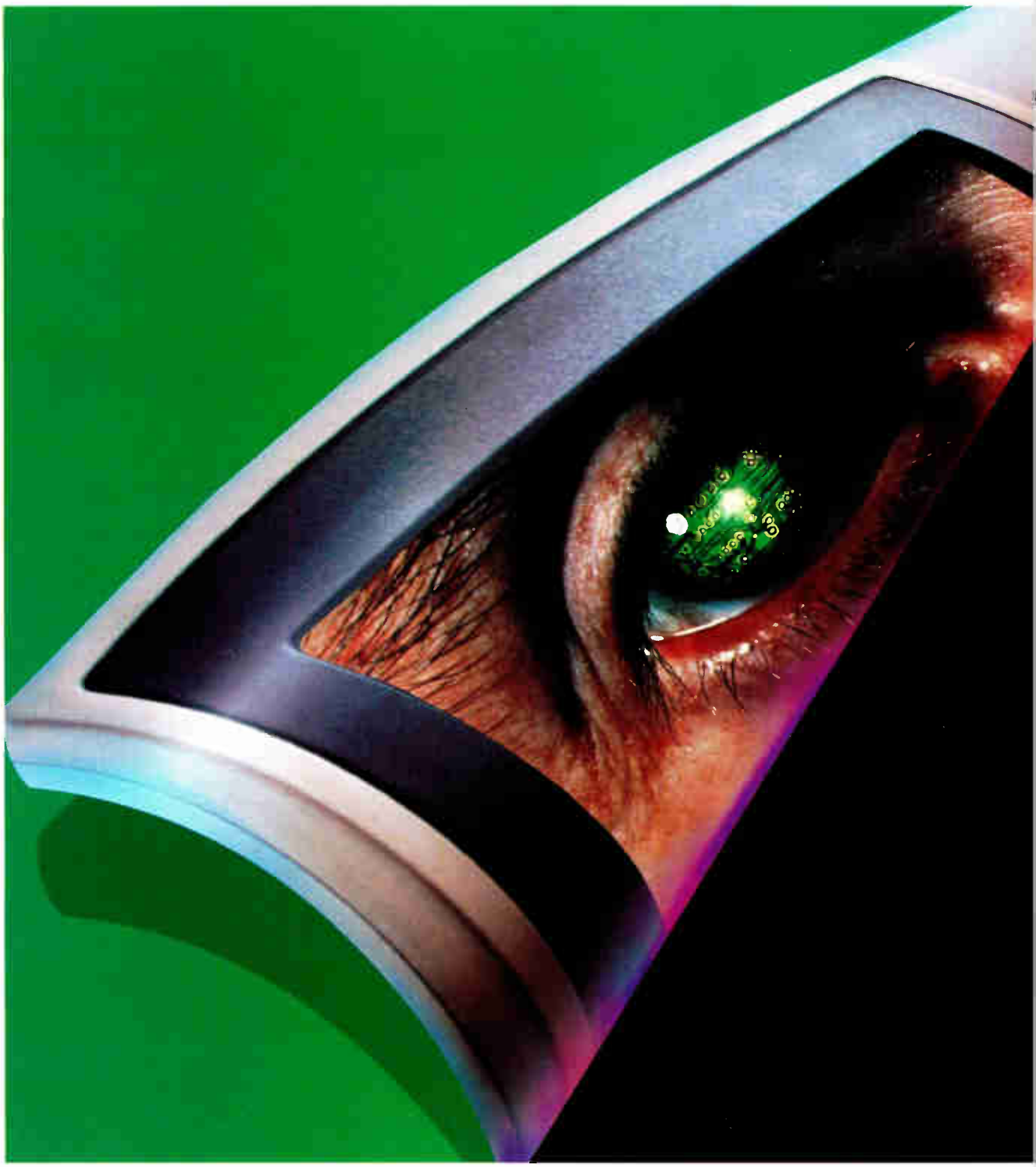

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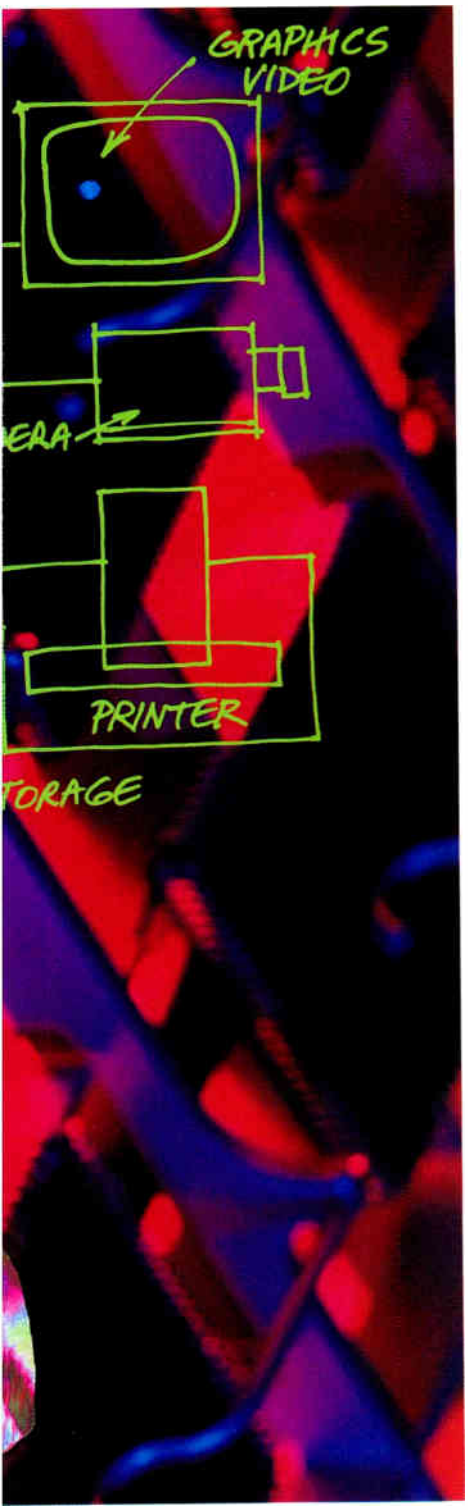

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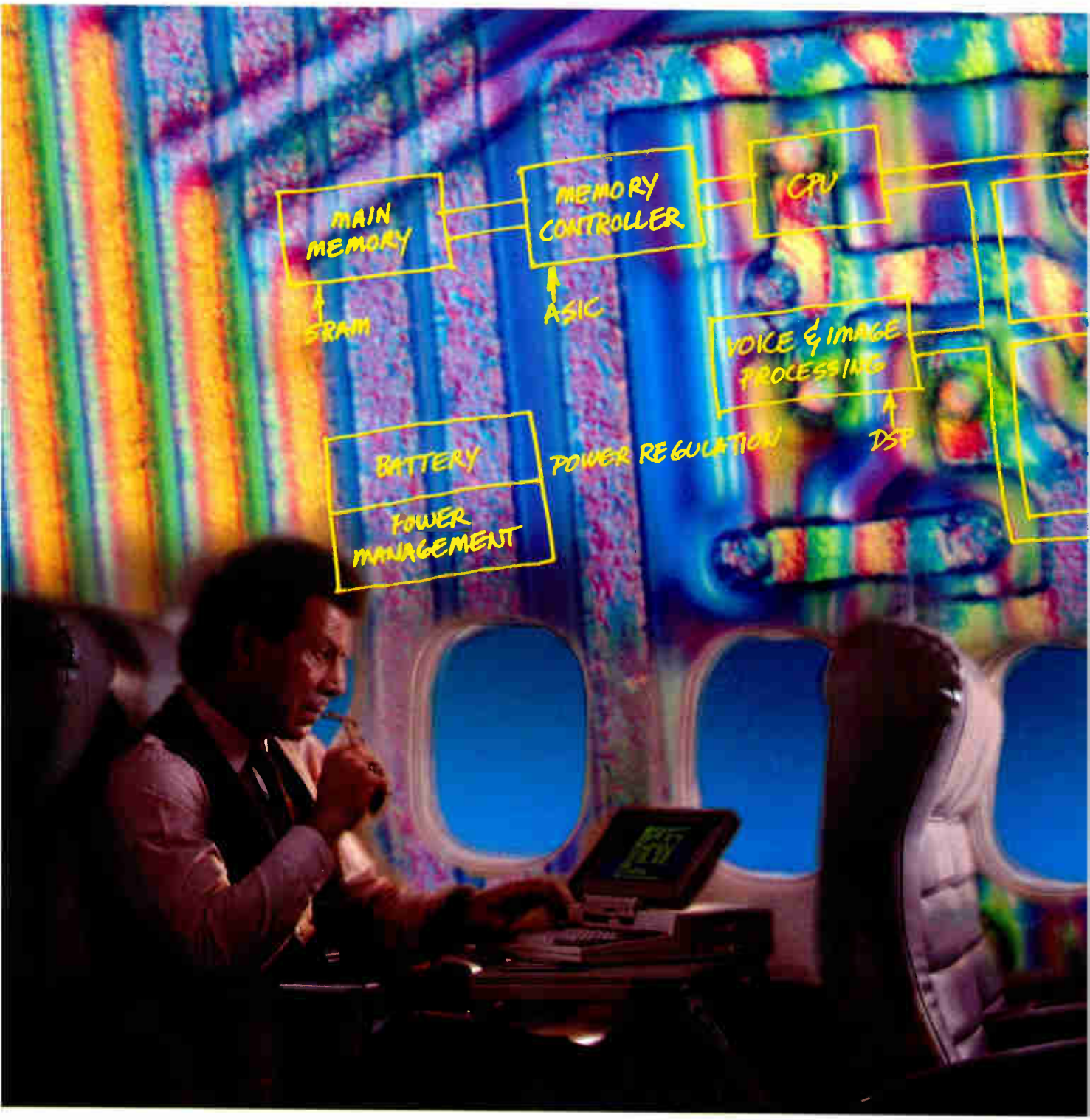

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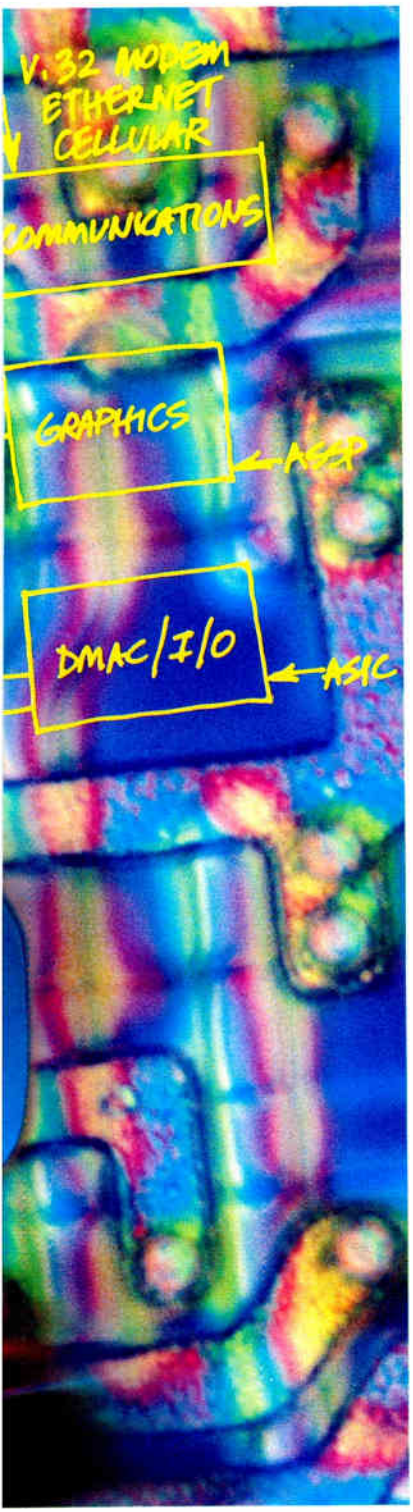

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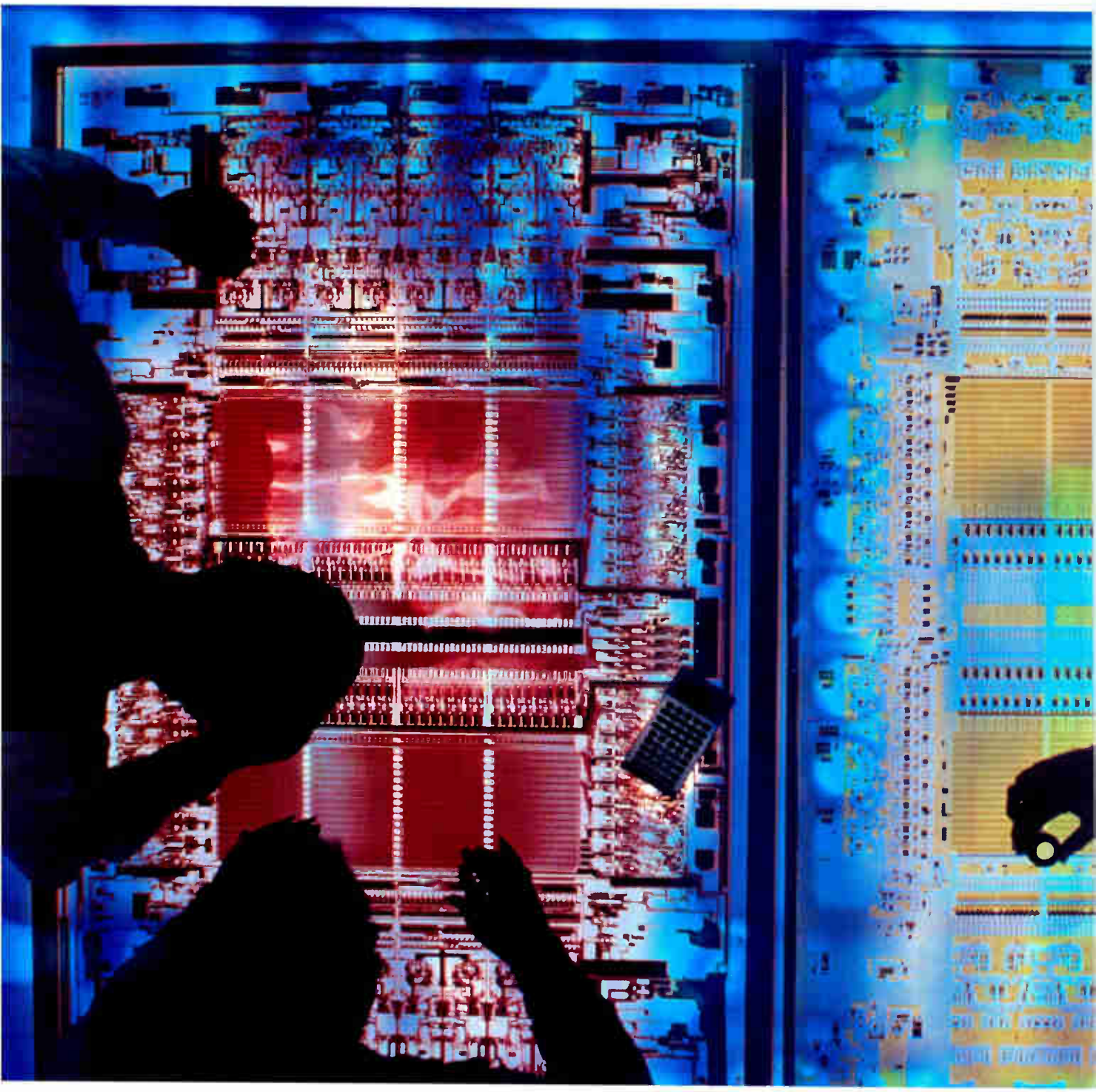

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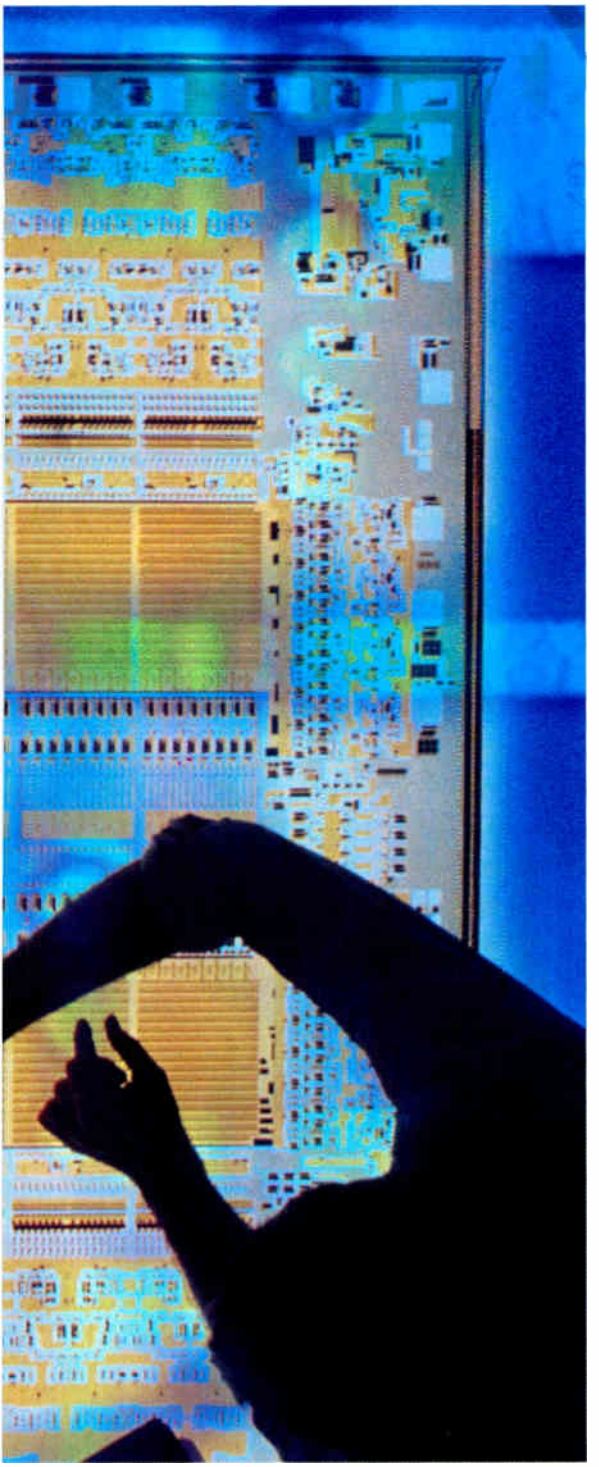

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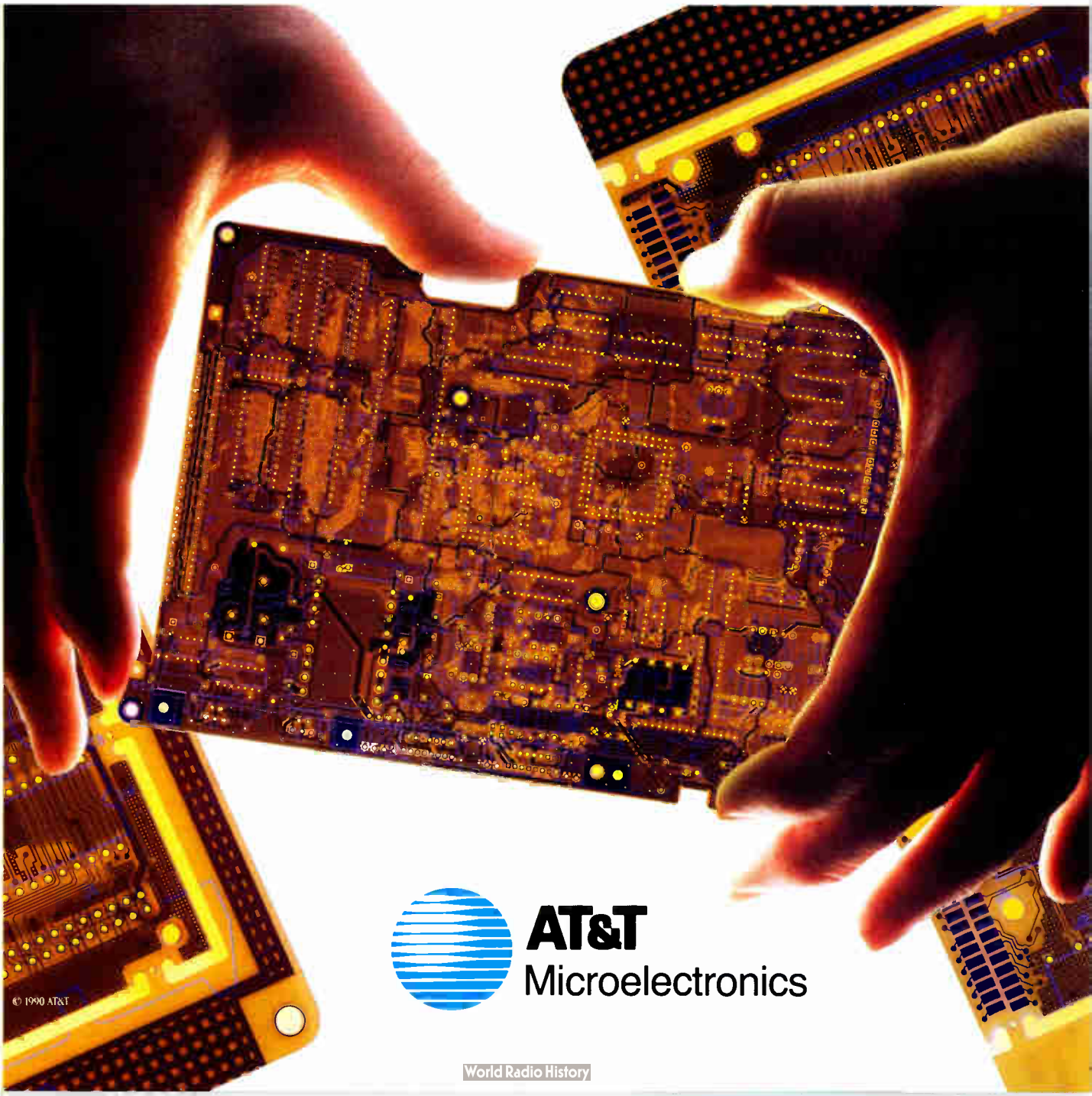

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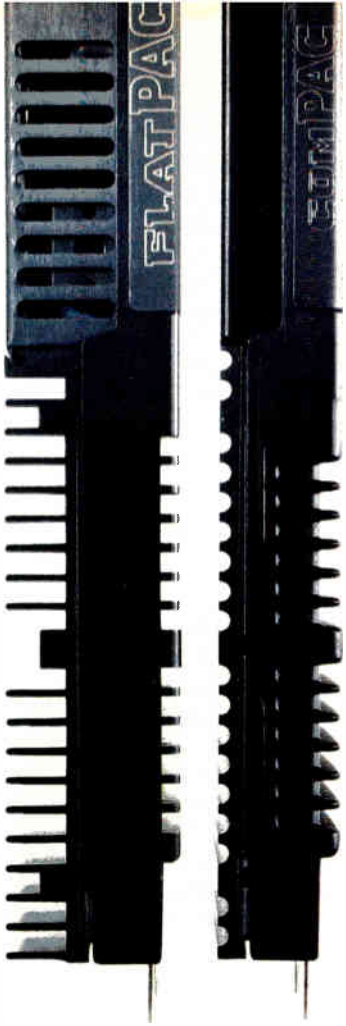

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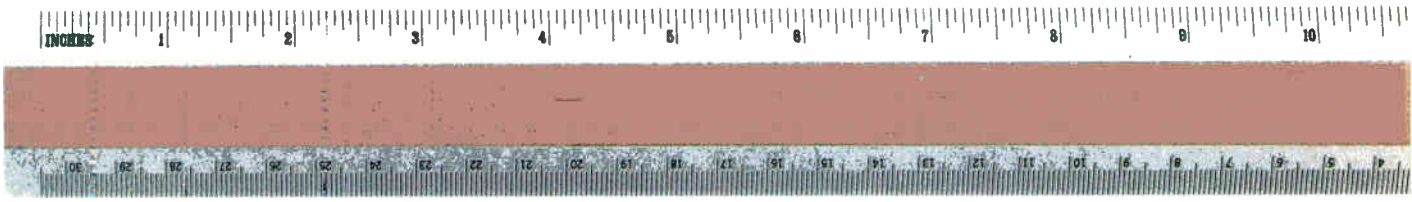

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CIRCLE 204

EMBEDDED GROWTH

THE POTENTIAL POWER of embedded flash in microcontroller applications is spurring development of new devices. The embedded market could grow to $1 billion by 1992 or '93, says Bruce McCormick, vice president of marketing at Intel Corp.'s flash memory operation. A big chunk of that will be automotive, says Greg Armstrong, manager of application-specific memories at Texas Instruments Inc.'s Semiconductor Group in Dallas. Here, Armstrong says, programmable memories that now employ EPROMs for storage codes, lookup tables, and engine and transmission parameters will go flash by the end of the 1990s. This trend will be accompanied by the use of larger amounts of flash memory on automotive microcontrollers for greater system-level integration.

A case in point: at the recent Convergence Conference in Detroit, Chrysler Corp. demonstrated its Ultradrive trans-axle electronic control system. With TI flash devices and microcontrollers, it keeps the shift quality consistent throughout the life of the transmission, monitors system performance, and provides diagnostics at the assembly line and dealership.

TI is also merging its flash technology with the emerging boundary-scan JTAG (IEEE 1149.1) test standard to provide a unique device for automatically and permanently maintaining system or board history. Dubbed a testability-ported diary memory, the TMS29F816 can store diagnostic information in the on-board 5-V, 16-K flash memory.

Also recognizing the potential of this embedded market, Intel is about to introduce the 88F51FC, a CHMOS single-chip 8-bit controller with 32 Kbytes of on-chip user-programmable flash.

The Inmos Division of SGS-Thomson Microelectronics in Phoenix is taking the module approach to embedded flash by combining a 16-bit IMS T222 Transputer with 256 Kbytes of flash in a credit-card-sized module, the IMS B418 ROM TRAM. Unlike Intel's entry, the device can be block-erased in 4 Kbytes.—*S. W.*

(Continued from p. 46)

genre, using very similar technologies. In fact, Atmel hints that the two companies are discussing mutual cooperation.

Atmel's device, which it calls a PEROM (for programmable erasable ROM) cell, uses two transistors. This eliminates the need for a high-voltage programming process because it isolates the cells being programmed from the other cells. The AT29C256 can be erased or programmed in 64- or 128-byte sectors (if desired, a bulk full-chip erase is available). The device has 160-ns read-access time and write time of 10 ms for 64 bytes (5 s full chip).

TI's TMS29F256 is based on a 1.5-transistor cell fabricated in the company's ACEE (advanced contactless EPROM) technology. For writing and erasing, it uses a tunnel diode in the channel region of the transistor cell rather than the conventional Fowler-Nordheim floating-gate structure. With access times of 170 ns, the device can be programmed 1 byte at a time or in the page mode from 2 to 64 bytes at a time. At the 256K level, TI is using a 1.5-μm ACEE process and will scale down to 1.0-μm for the 1-Mbit part. TI's 4-Mbit prototype uses 0.8-μm technology.

While flash device vendors refine device technology and tussle over the right approach, they are also taking hard aim at those beckoning sockets. Last month, Intel introduced the first flash-memory-based IC card in 1- and 4-Mbyte sizes aimed at laptop, notebook, and palm-top computers. Card densities should converge rapidly toward those of hard disks and greatly exceed those of floppy disks in the late 1990s, the company says.

The Intel cards are intended for applications in updatable application code, application-code and data-file storage, and data acquisition. They will be competing with existing memory-card technology, which includes expensive battery-backed RAM cards, unalterable ROM cards, and one-time-programmable EPROM cards. They are unsurpassed as a disk replacement in portable PCs, says Jim Weisenstein, Intel's flash-memory-card manager in Folsom, Calif. Reduced power consumption, resistance to shock, a doubling in write speed, and 3.5 times faster read time are among the benefits he cites.

Meanwhile, Microsoft Corp. of Redmond, Wash., has issued a Flash File System that runs as a software driver under MS-DOS. It effectively makes the flash-card memory behave like a disk, reacting to familiar DOS commands and storing data files sequentially.

On another front, Western Digital Corp. of Irvine, Calif., is working on a solid-state disk using flash technology with partners SunDisk Corp. of Santa Clara and AT&T Co. in Allentown, Pa. Details were scant at press time, but Ilene Graney, Western Digital's director of marketing for storage products, says the company has been involved in the project for two years. The device is not intended for general EPROM replacement but can be used for this application. It will be a 4-Mbit chip, Graney says, capable of assembly in 10-, 20-, and 40-Mbyte disk replacements potentially equivalent to a 1.6-in. disk. Access time will be under 2 ms.

Packaging is an issue in flash, and increasingly the 1-Mbit-and-higher chips are being produced in the new TSOP (thin small-outline) packages. Its small form factor of 20 by 8 by 1.2 mm makes TSOP ideal for the flash-card market as well as other embedded applications. It also is desirable for surface-mounted boards. Another possibility comes from White Technology Inc. The Phoenix company's WF1024KB-150 is an 8-Mbit flash-memory module packaged in a 34-pin, hermetically sealed metal package. It is built with eight 1-Mbit flash chips, organized as 1 Mbyte by 8, and assembled on a thick-film substrate. Each of its eight pages can be erased a page at a time. The device is guaranteed for 10,000 erase/program cycles.

Meanwhile, cell sizes for flash memories are shrinking rapidly under the assault of new approaches to cell-structure design. Intel radically trims size with a new contactless single-transistor cell. At the upcoming International Electron Devices Meeting, company researchers will describe their Flash Array Contactless EPROM (FACE) technology, which reduces the area of the ETOX cell by 55% to 8.4 μm^2. That reduction is based on 1.0-μm design rules. At 0.8-μm, the cell can be almost halved again to 2.48 μm^2.

Also at IEDM, Toshiba Corp. will show a NAND-structured memory cell of only 2.3 μm^2 (0.6-μm design rules). The cell can achieve 16-Mbit and larger flash memories, Toshiba says. Mitsubishi Corp. has achieved a single-transistor, stacked-gate cell of only 3.6 μm^2 in a 16-Mbit flash. It uses 0.6-μm design rules and achieves 5-V-only programming and erasure by a unique negative-gate-biasing erasing condition.

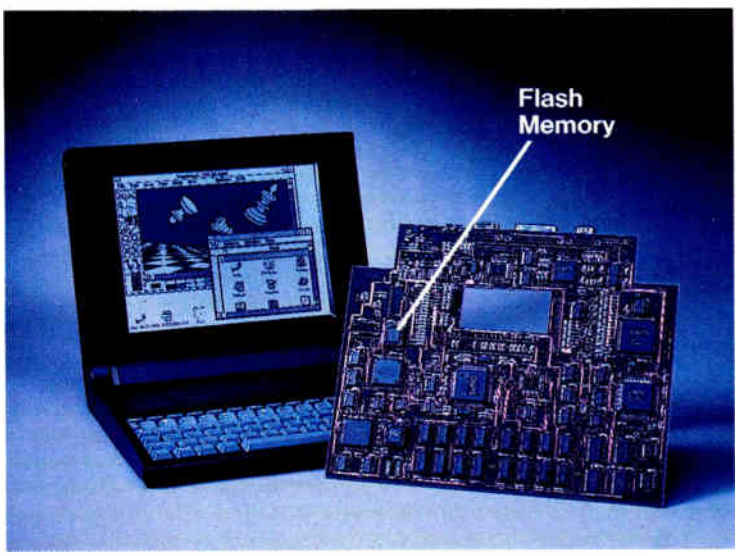
LAPTOP VENDORS JOIN THE FLASH BANDWAGON

AIRIS'S VH-286 USES FLASH TO STORE BIOS, BUT THAT'S JUST THE BEGINNING OF THE APPLICATION POSSIBILITIES

BY JACK SHANDLE

MEMORIES

WHEN THE founders of Airis Computer Corp. left Zenith Data Systems in 1988 to start a new notebook-computer firm, they knew, as all entrepreneurs must, that their product strategy had to stand out in a crowd. Flash memory technology (see p. 44) will play a major role in Airis's strategy when the first VH-286 computers start rolling off the production line this month. But Airis is unlikely to be alone for long.



INSTANT UPDATES

The BIOS in Airis's laptops is stored in a bank of flash memory. With TeleROM, BIOS can be updated by modem.

Flash is versatile—it lets clever systems houses such as Airis play with innovative marketing techniques as well as advanced technology. For Chicago-based Airis, the bright idea is TeleROM, says Steve Valentor, engineering vice president. All Airis computers have built-in modems, and by combining that capability with a bank of flash memory that stores system BIOS, Airis can offer users a highly desired feature: instantly updatable BIOS. Simply by dialing into Airis's bulletin board, users will be able to update their BIOS for a nominal charge.

Software-updatable BIOS ensures compatibility with the latest features and software. There are, for example, undocumented features in IBM Corp.'s VGA graphics specification, says Valentor. As these are revealed and utilized in new applications software, Airis users will stay compatible with a phone call.

Airis dedicated 128 Kbytes of flash to BIOS updating: 32 for system BIOS, 32 for video BIOS, and 64 to a program to update the BIOS. Patents have been requested for the updating scheme. In particular, provisions must be made for the possibility that system power may be lost during the BIOS update. "You have to be sure you have enough BIOS available at all times to boot the system," Valentor says. Airis purchases its flash chips from Seeq Technology Inc., San Jose, Calif., because they offer a sector-erase feature that helps implement the fail-safe updating procedure.

Storing BIOS is just the beginning for flash applications. John Wharton, a contributing editor to the *Microprocessor Report*, a Sebastapol, Calif.-based newsletter, says there is more to come. Conventional PC-memory systems are organized on three-levels: rotating mass storage, dynamic random-access memory, and static RAM cache, he says. Each level adds expense in the form of control logic, interconnects, access time, and reliability. "If executable programs and data are all already on-line in moderately fast memory," he says, "why copy them to an intermediate DRAM first? As larger caches migrate into the central processing unit, the performance characteristics of external memory become less critical." Several companies are hard at work leveling the conventional three-tier memory architecture by means of flash-based "silicon disks."

Among them is Psion Inc. The Watertown, Conn., company employs small flash-based modules as replacements for floppy disks. And at least one company—SunDisk Corp. of Santa Clara, Calif.—is building a flash-based storage system to replace Winchester drives. Flash could even be used to store applications software, but cost and reliability in massive read/erase/write environments continue to be inhibitors to widespread acceptance.

Besides the advantages to laptop and notebook end-users, flash offers considerable advantages in manufacturing, says John Wagner, manager of Zenith Data Systems' Portable Products Development Group, Mt. Prospect, Ill. Although Zenith has not yet implemented flash, it is studying the technology closely in part because of manufacturing issues. "Producing a machine requires several stages of firmware development," he says, "and using flash memory would let us implement the latest version in the final stages of manufacturing. You can also include the latest BIOS and system configuration on a floppy."

Psion is already using flash as a floppy-drive stand-in. Its Flash Packs use 1

Mbyte of Intel Corp. flash chips and measure about 1 by 2 in., says Brian James, marketing support manager. Flash Packs can be used as rewritable storage or as a medium for applications programs. Right now, users must download applications programs from a desktop PC to the Psion notebook computer, but licensing agreements with major software houses should be in place by 1991 that will make memory-card versions of popular MS-DOS software available. Price is high: $650 for a 1-Mbyte card.

The most controversial application for flash is mass storage. Whether it will one day supplant Winchesters depends on the balance of the technology's strengths and weaknesses. For notebooks, laptops, and portables, flash will save valuable real estate, says Zenith's Wagner. But just as important is its form-factor flexibility.

"Flash devices can fit into unusual space configurations within the cabinet. You don't have to lock up space for a drive early in the design cycle," he says. They are also immune to the read/write-head failures of rotating media, he says, and are at least 10 times faster than rotating media.

FLASH'S BIG DRAWBACK IS cost: a 20-Mbyte flash-based storage device would cost an outrageous $4,800 at today's prices, says Airis's Valentor. That compares with an OEM price of $300 for a 2.5-in Winchester. But Valentor points out that the access-time differential between silicon and rotating media must be traded off against the cost differential.

"Using data-compression techniques, you can reduce the number of chips needed to store a given amount of data and still deliver performance better than or equal to hard-disk storage," he says. "In the next two years, we could start to see flash drives at about twice the cost of rotating memory, and that will make flash's form-factor and performance advantages more attractive."

Flash's advantage in power consumption speaks directly to the concerns of portable PCs. Somewhat surprisingly, power consumption is "about a wash in access mode," says Wagner, but in nonaccess mode, the disk continues to spin while flash goes to near zero. "You have to look at the peak voltage [12- or 5-V erase, depending on vendor] and how many times you use it," Wagner says. "Changing BIOS does not happen often, so it is not an issue there, but in mass storage, erases happen much more frequently."

Though the biggest market inhibitor is cost, flash also has a reliability issue to deal with, and Airis is taking a wait-and-see posture on mass storage. "At this point in time," says Valentor, "I do not believe the parts have the number of reprogramming cycles needed for a hard-disk replacement, but there is not a fundamental inhibitor to longer life, and I expect to see their longevity improve." Intel's chips lead the pack with 100,000 erase and reprogram cycles, but Valentor points out that a portable or laptop running a spreadsheet program, for example, reads and writes to the same portion of the disk. This means that in a flash-based device some chips would be used much more than others.

NEW VIGOR IN THE MAINFRAME SECTOR

IBM PROTECTS ITS CORE BUSINESS BUT FACES FORMIDABLE CHALLENGES FROM FUJITSU AND AMDAHL

BY LAWRENCE CURRAN

COMPUTERS

A SPATE OF RECENT BIG-system introductions has riveted the industry's attention on a computer-market sector often overshadowed by its smaller, flashier brethren: mainframes. Included is the biggest mainframe broadside from IBM Corp. in many a moon, serving notice that Big Blue intends to protect its core business, which had slowed in recent years.

The System/390, the first new mainframe family from IBM in more than five years, includes the firm's most powerful processors yet. A six-processor model more than doubles the performance of the previous best—the ES/3090. Besides rolling out 18 new processors, IBM also bolstered its ability to integrate multivendor computers into enterprise-wide networks, unveiled new versions of its Enterprise Systems Architecture operating systems, and introduced high-speed fiber-optic communications to the mainframe family.

But IBM doesn't have the mainframe spotlight all to itself. Fujitsu Ltd. and Amdahl Corp. bracketed the IBM broadside with mainframe volleys of their own, further indications of renewed vigor in the mainframe business.

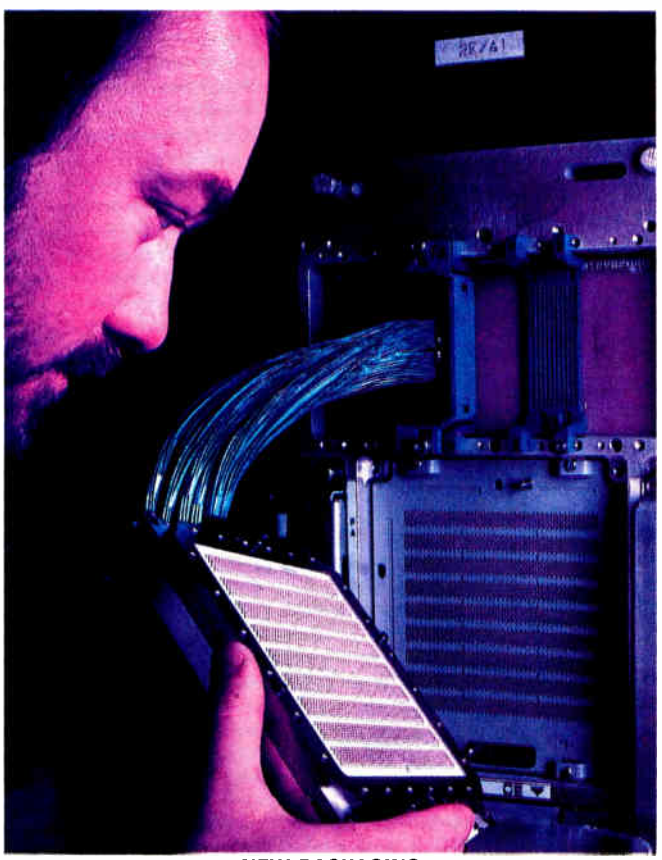
And it's a business in which IBM has a big stake to protect. International Data Corp., the Framingham, Mass., market research organization, estimates that the company had 62% ($17.8 billion) of last year's $29 billion in mainframe revenues worldwide. Hefty as that is, it's not what it used to be. Peter Burris, director of IDC's IBM and Digital Equipment Corp. advisory services, points out that IBM's share has slipped in the last five years. He sees the System/390 introduction as "a major move by IBM to stanch this erosion."

For his part, IBM's Robert Budnick views the entirety of the System/390 announcement as "a further demonstration of our ongoing commitment to the mainframe market." Budnick is manager of data systems marketing plans in the U. S. Marketing and Services Group, White Plains, N. Y. While he declined to compare the new family to the new systems from Amdahl and Fujitsu by name, Budnick characterizes the System/390 entries as being "very competitive with anything that's on the market or has been announced."

ES/9000 is the name given to the central processors in the family—18 of them in all—which span a hundredfold performance-range increase from the smallest uniprocessor model to the six-processor, water-cooled ES/9000 model 900, which can be delivered now. Delivery schedules for the other processors in the family range from now into 1991.

The model 900, designed for scientific and technical supercomputing, is expected to pack 2 to 2.8 times more clout than the highest-performance earlier ES/3090 machine, the model 600J. IBM doesn't rate processors in mips, but industry analysts put the model 900 in the range of 210–250 million instructions per second.

That falls short of the fastest machine among 10 models in the 5995 series introduced by Amdahl, the $2.1 billion Sunnyvale, Calif., firm that derives most of its revenue from IBM plug-compatible mainframes. Like IBM, Amdahl declines mips ratings, but market analysts have estimated the eight-processor 5995-8650M model at about 350 mips. That model offers almost three times the throughput of any previous



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UNITED MICROELECTRONICS CORPORATION

CIRCLE 191

Amdahl mainframe, says Henry Cassel, director of processor system marketing.

Cassel says the four new members of the 5995 series, deliveries of which will begin next year, are important because they show customers a growth path from today's high-end 5990 series mainframes, six of which are being absorbed into the 5995 family as the A models. The new M models "provide a clear path [for customers] of how to get from here to there," he says.

Amdahl would have waited to introduce the new processors until they were closer to being deliverable, Cassel says, but it had to respond to IBM's move.

"Quite frankly, we didn't want to announce the M models yet, but IBM put considerable pressure on the market when it announced," he says. "I think they announced sooner than they wanted to because the 3090 backlog was so low and they weren't selling machines."

Amdahl's M models get their 7-ns cycle times (compared with 10 ns for the A models) from semiconductor technology, including high-speed logic and static random-access memory devices, and combined logic/RAM—all implemented in emitter-coupled logic. The devices are jointly designed by Amdahl and Fujitsu and fabricated by Fujitsu, which owns about a 45% stake in Amdahl.

Both the A and M models will run the new versions of the MVS/ESA and VM/ESA operating systems that IBM introduced with the System/390, as well as UTS, which is Amdahl's version of Unix System V. Amdahl will also support the fiber-optic communications architecture that was included in IBM's announcement.

Meanwhile, Fujitsu's major mainframe debut encompasses five models in a new M-1800 group, in which the highest-performance eight-processor machine is believed to top 300 mips. Although not a vendor of IBM plug-compatible mainframes, the Tokyo-based giant's own mainframe line is formidable competition for Big Blue. Fujitsu looms even larger as an IBM competitor because of its stake in Amdahl and its recent purchase of 80% of the UK's largest mainframe manufacturer, International Computers Ltd.

The M-1800 line, deliveries of which will begin in the second quarter of 1991, serves notice that the Japanese firm will protect its home market, which IBM has penetrated in recent years. And Fujitsu is "getting more ambitious on a worldwide scale," says Burris of IDC.

The company "didn't make a move" recently when it had a chance to purchase some more Amdahl stock, but that option could be exercised in the future, Burris notes. "And their acquisition of ICL, which is a major mainframe supplier to Europe, could turn into a pan-European move in time."

Burris regards the scope of the System/390 announcement as "IBM attempting to assert its leadership in a business where it controls the architecture and has the lion's share of the installed base." But it hasn't been easy to integrate networks that include non-IBM computers into that installed base. The System/390 debut includes communications controllers and software to overcome that obstacle.

One new interconnect controller attaches multiple local-area networks to multiple host computers running more than one operating system. Another controller implements the Fiber Distributed Data Interface standard, enabling data transmission over networks at 100 Mbits/s. Both controllers support both IBM's own Systems Network Architecture and the Open Systems Interconnection international standard, which enables users to link computers from different manufacturers.

In addition to the controller enhancements, IBM also updated its Virtual Telecommunications Access Method software with two new versions that provide networking services between mainframes and workstations. VTAM version 3 release 3 is for the new VSE/ESA and VM/ESA operating systems; VTAM version 3 release 4 is for MVS/ESA, VM/ESA, and VM/SP.

IBM's Budnick believes these and other elements of the System/390 fill some holes in IBM's networking tool kit, acknowledging that "a major part of the announcement is a set of hardware and software that allows us to play much better in a multivendor computing environment."

That comment also covers products unveiled at the System/390 debut that are intended to ease client-server computing in a multivendor network. Included are programs to simplify software distribution between hosts and workstations, and to provide more flexible LAN-to-LAN connections. All of them come from IBM's Client/Server Computing Organization, established in May 1989 to provide a better understanding of how customers define client-server computing.

Both innovative packaging and enhancements in IBM's own semiconductor technology are major contributors to ES/9000 processor speed in the two highest-performance models: the multiprocessor 820 and 900. IBM calls the ultradense packaging concept TCM, for thermal conduction modules.

A 63-layer crystallized-glass ceramic module made of alpha cordierite instead of alumina permits a near doubling of substrate layers compared with the ES/3090, greatly increasing the wiring density. The new module material also has a lower dielectric constant than the earlier alumina, says Evan Davidson, manager of high-performance technology at IBM's East Fishkill, N. Y., facility. This reduces propagation delays between devices so that signal velocity is increased by 33%.

The water-cooled models 820 and 900 also benefit from the East Fishkill facility's latest semiconductor advancements. The logic in those processors is from IBM's advanced transistor technology family, called ATX, which includes both ECL and differential current-switched logic. The density of the 1.0-μm ECL used in the two machines is twice that of earlier devices, enabling a 30% improvement in circuit speed.

IBM says the ECL SRAM chip employed in the cache memories of those two models is the fastest yet in a mainframe cache. "At 64 Kbits and a 2.5-ns access time, it's twice the density and a full nanosecond faster" than the fastest previous SRAM, used in the ES/3090, Davidson says.

MOVEMENT IN MAINFRAMES

System/390 is seen as a major stride to extend IBM's leadership in its core business.

Fujitsu anticipates Big Blue with a new family that may shore up the home market in Japan.

And Amdahl keeps pace with an IBM-compatible mainframe series that may top 300 mips.

PHOTO: COURTESY GERMAN NATIONAL TOURIST OFFICE

Munich means Electronica

For the components and assembly businesses, November is special. That's when Electronica takes place every other year in Munich, and the show keeps getting bigger. This year some 2,500 companies will be represented, serving as magnets for 120,000 visitors.

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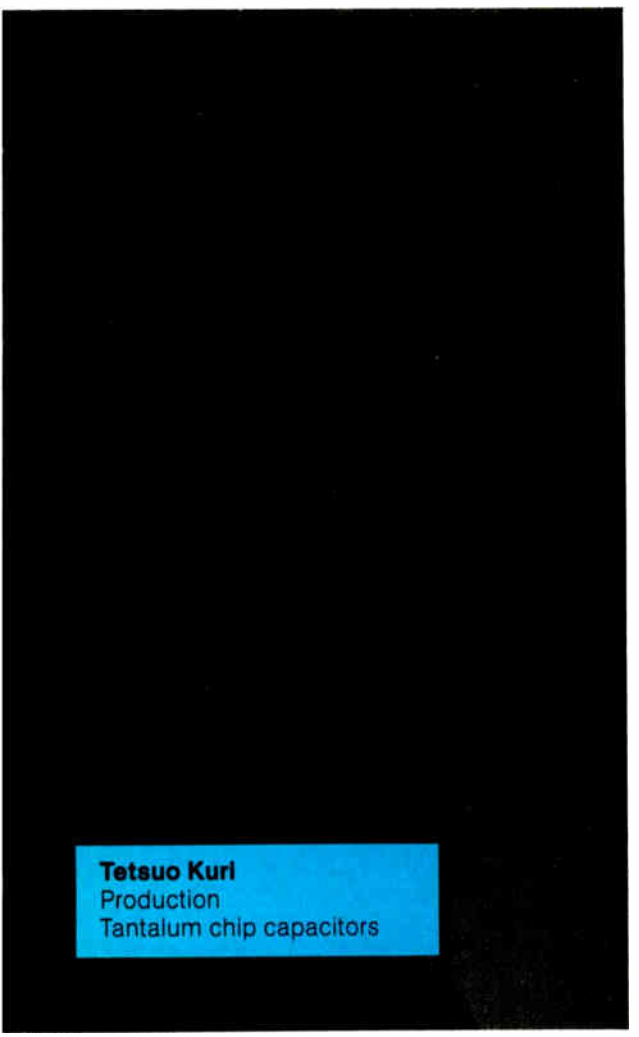

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CIRCLE 193

Electronica 90: Bigger and better than ever

The Munich show lives up to its reputation as the best and the brightest in components

INTRODUCTION

Once again it's Electronica time. That's the moment in every other November when Munich plays host to one of the world's great electronics shows and, for a few days, becomes the mecca for people keen on components and electronic assemblies. This year's Electronica, the 14th since the event began in 1964, will be held Nov. 6 to 10. And true to form, it will again be bigger than its predecessor, both in terms of visitors and exhibitors.

At latest count, Electronica 90 will draw nearly 2,000 exhibiting companies to the Bavarian capital, about 10% more than in 1988. Besides their own wares, these "direct" exhibitors will show the products of 530 other firms. So in all, components and assemblies from about 2,500 companies will be on view.

Crowding the 16 halls—the total floor space is nearly a million square feet—will be an estimated 120,000 visitors, 12% more than in 1988. This year too, Munich's sprawling fairgrounds will pull 30% more visitors from East European countries, "a result of the opening of the borders between East and West," says Gerd vom Hövel, managing director of the Munich Trade Fair Corp., the show's host. Vom Hövel's aim is to strengthen Electronica's seminars and enhance its workshop character.

Also of note is Electronica's international character. Of the 2,000 or so directly exhibiting firms, almost 900 will be from outside Germany, carrying the flags of 39 different countries in East and West. The biggest foreign contingent will be the 223 companies from the United States; and on their stands they will be showing products from an additional 183 American firms. Following the U. S. will be the UK with 125 direct exhibitors and France with 85. Eastern countries are represented in greater numbers than ever before this year.

But perhaps more important to the show's organizers than attendance records is the quality of Electronica. The exhibition serves as a forum for new product announcements and as a showcase for innovations from all over the world. As for the visitors, they are truly specialists in their fields, active in components-consuming industries and thus potential customers of the products they spot on the stands. Few, if any, are mere sightseers.

Electronica is also valued because of the concurrently held seminars, speeches, and discussions relating to components and their markets. This year, on Nov. 6, the board chairman of the Joint European Submicron Silicon Initiative, Raimondo Paletto, will critically review Jessi's organization, projects, and goals (see p. 61). Moderated by Klaus Knapp, Jessi's spokesman, the half-day conference will also feature speeches on Jessi's four subprograms: technology, equipment and materials, applications, and basic research.

An effort that is involving all the nations in Western Europe, Jessi is shaping up as the biggest microelectronics initiative that has ever been launched on the continent. It was started in 1989 as an answer to the fear of Europeans that technology from the U. S. and Japan would increasingly dominate and drive European companies out of business.

The initiative is scheduled to run until 1996, and it calls for no less than 21,400 engineering manhours during the eight-year period. The total cost of all this work is budgeted at more than $5 billion. That's a considerable expenditure, so the cost is being spread widely. Half the sum is coming from the European semiconductor industry, with the remainder—one quarter each—being put up by the governments of the nations involved and the European Commission, which is the executive arm of the 12-nation European Community.

Also on Nov. 6 is an international press forum titled "The World Microelectronics Market—Is The Focus Shifting?" On the podium will be such industry leaders as Jerry Sanders of Advanced Micro Devices, Jürgen Knorr of Siemens, SGS-Thomson Microelectronics' Pasquale Pistorio, Philips International's Heinz Hagmeister, Toshiba's Hideharu Egawa, and Tomihiro Matsumura of Nippon Electric. The forum will be moderated by Roland Ackermann, editor-in-chief of the German trade magazine *Markt & Technik*.

Supporting specialists' seminars on the following days will be held on miniaturization of plug-in connectors, test-cost optimization, power electronics, microelectronic sensors, producers' liability, electromagnetic compatibility, microsystem technology, and quality.

Electronica 90 will take place at a decisive phase in Europe's politi-

cal, economic, and technological history, vom Hövel says. In addition to the great thaw in East-West relations, there's the Single Market that will see the European Community without trade barriers, a free flow of capital across national borders, and common technical standards by the beginning of 1993.

Both events will profoundly affect the industry Electronica serves. The opening of East-West borders will create new opportunities for component makers and the Single Market will foster concentration and cooperation in the industry.

Already, cooperation among European semiconductor makers is in full swing, be it within the pan-European Jessi initiative or on a bilateral basis. "The reason for this is that firms are not only trying to recapture part of their own European market, which at present is dominated by U. S. and Japanese companies," vom Hövel says. Cooperation is also being pursued to achieve greater economy of scale and thus to bolster the European companies' competitive positions on world markets.

Statistics show that the chances to recapture domestic markets and play a bigger role elsewhere are good. According to market researcher Dataquest Inc., the three leading European semiconductor manufacturers—Philips International of the Netherlands, Germany's Siemens, and the Italian-French semiconductor combine SGS-Thomson Microelectronics—together chalked up sales in Europe of $2.66 billion in 1989.

That's about as much as the five leading U. S. manufacturers (Motorola, Texas Instruments, Intel, National Semiconductor, and AMD). The five top Japanese vendors (NEC, Toshiba, Hitachi, Fujitsu, and Matsushita) grossed only $1.5 billion on the European market last year, according to the San Jose, Calif., market research organization.

Despite the growing strength of Europe's leading producers, cooperation is necessary, even vital, given the high cost of research and development and production facilities, and in view of the short innovation cycles in semiconductors. Today, a modern production facility cannot be built for less than $600 million or so, and after six years it's already obsolete.

To sum up, Electronica is not just a giant display of components. It's also a place where component markets are assessed, the factors affecting these markets are discussed, and views on the industry's future are aired.—*John Gosch*

Jessi's progress is a hot topic at the show

Pan-European project is aimed at developing technologies, not products, for future devices

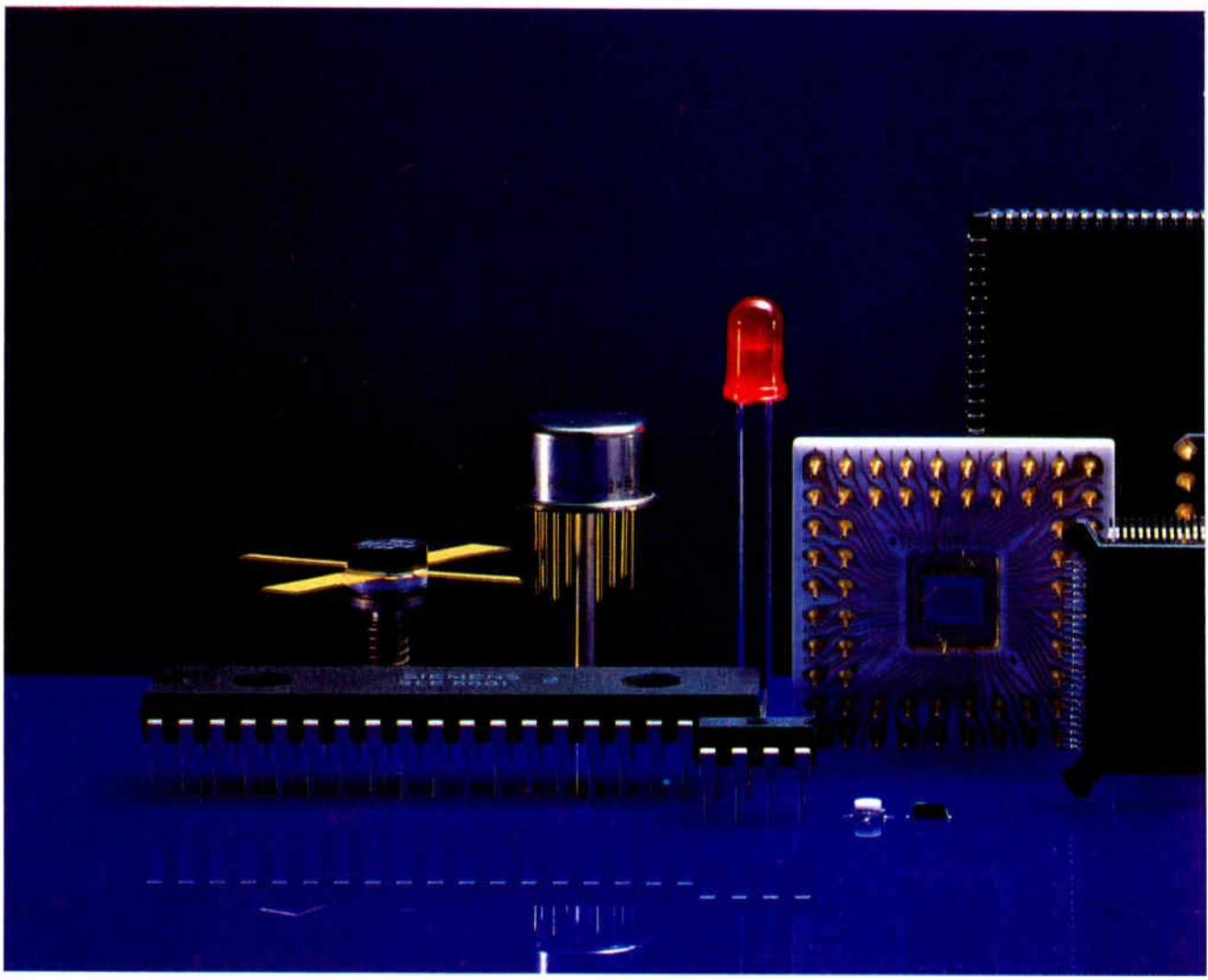
A major topic at Electronica 90, both on the stands and at the conferences, will be the Joint European Submicron Silicon Initiative. And no less a figure in European electronics than Raimondo Paletto, chairman of Jessi's board of management, will tell an audience on Nov. 6 what this project is all about and where it is headed.

A pan-European effort, Jessi is the biggest project the old continent has ever launched in microelectronics. Started in 1989 and running until 1996, it calls for 21,400 engineering man-hours during the eight-year period and an expenditure of more than $5 billion. Half of this sum is coming from the European semiconductor industry. The remainder—one quarter each—is from national governments and the European Commission, which is the executive arm of the 12-nation European Community.

Jessi is different from the $2 billion Mega project, the five-year program aimed at developing a high-density dynamic and static random-access memory that was jointly run by Siemens AG of Germany and Philips International NV of the Netherlands. Mega, which ended in 1988, was product-oriented. For example, a 4-Mbit DRAM from Munich-based Siemens is a "European child" in that it's based on technology developed as part of the Mega memory project, which both partners rate as a big success. On the other hand, Jessi is a precompetitive effort. Jessi carries device development only to the prototype stage. Its aim is the acquisition of technology and know-how: the goal is not a product but the development of technologies and tools needed to build, for example, 64-Mbit DRAMs. In fact, this memory type is Jessi's technology driver. The intention is that the know-how gained through Jessi will enable Europe's semiconductor in-

CONSORTIA

SIEMENS



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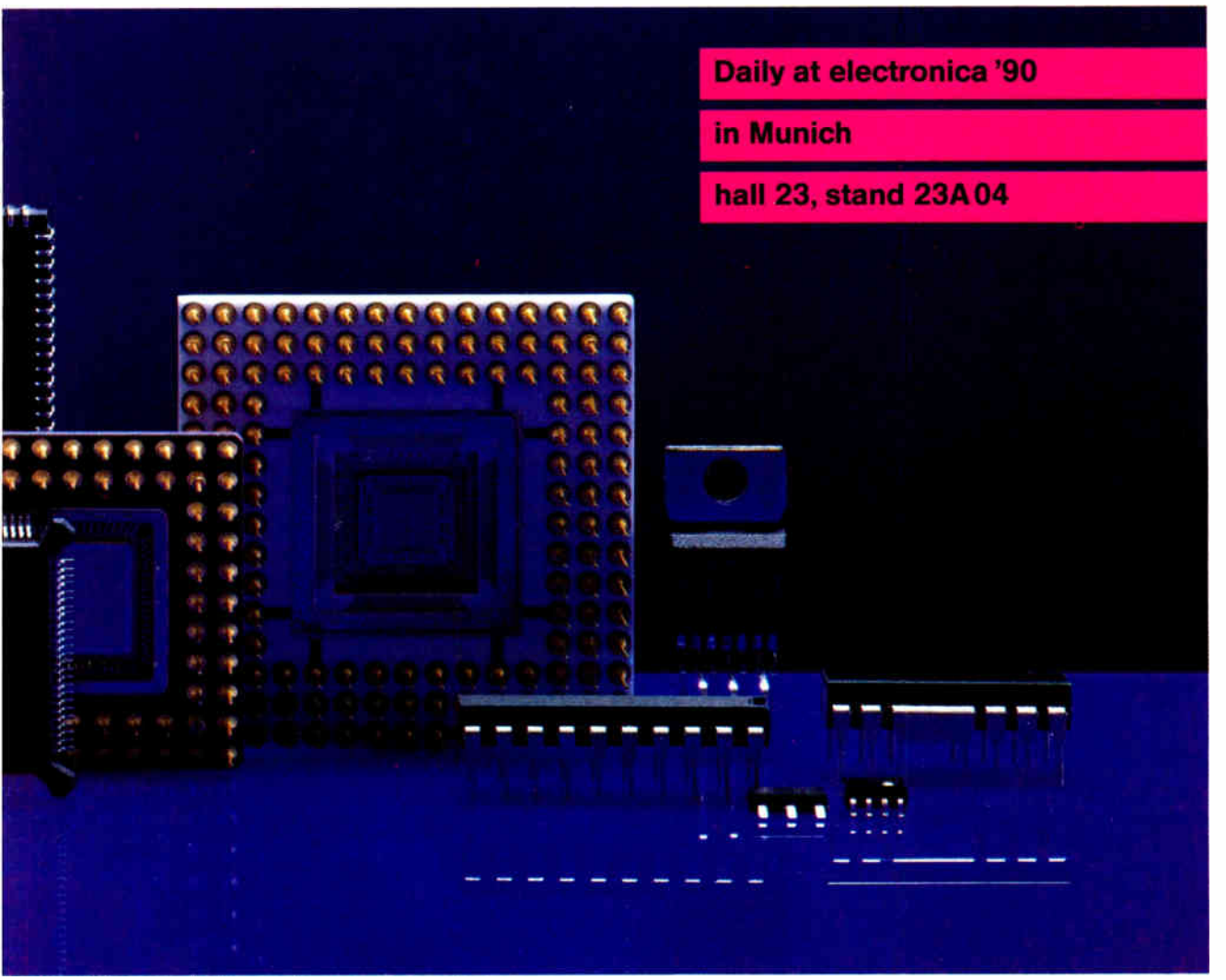


dustry to produce not only the memories but also the highly complex logic devices envisioned for the 1990s. Another anticipated result is to make it possible for equipment manufacturers to build the machines needed for submicron line production and help systems makers develop applications for the devices.

Thus Jessi is also geared toward closing the applications gap that exists in Europe, a gap resulting from the reluctance of many traditional industries to use the latest microelectronic devices.

"Ultimately, Jessi is to guarantee Europe's capabilities in microelectronics and the independence of its key industries, such as the automobile, machine building, and other sectors vital to its economy," says Klaus Knapp, Jessi's spokesman. "All of these industries build upon strength in microelectronics."

Given its broad scope, Jessi doesn't quite compare with the U. S. Sematech effort, which stresses production technology, equipment, and, to some extent, materials. The European endeavor is much more broad-ranging in that it's based on four subprograms: basic research, technology, applications, and equipment and materials. At latest count, Jessi encompasses 53 projects with companies from nine countries participating.

Such differences, however, do not exclude cooperation between Jessi and Sematech. In fact, the two consortia have penned agreements to work together in competitive analysis and in seeking common standards. At present, U. S. and European officials are discussing possible cooperation in other fields as well.

Reflecting Jessi's multifaceted aspect is the nature of the participating firms. In addition to Europe's big three in semiconductors—Philips, Siemens, and SGS-Thomson Microelectronics—members include big device users such as France's Alcatel and Matra, Italy's Olivetti, and Germany's Robert Bosch and Daimler-Benz (the Mercedes car producer). And there are scores of others, including chemical manufacturers and machine builders. There are 120 in all so far.

Although a European effort, Jessi is not restricted to European firms. "If a foreign company has R&D facilities here and sells on European markets—and if it proposes a worthwhile work project—it qualifies as a participant," Knapp says. A strong candidate would be IBM Corp. Adds Knapp, "Jessi is not against anybody. It's for Europe."

The consortium received a big jolt recently when Philips withdrew from Jessi's Joint Memory Project, for reasons of costs and internal restructuring measures. However, the Dutch company still heads or participates in more than 20 other work projects among Jessi's four subprograms.

Except for delays on the part of some governments in approving funds, Jessi is on schedule, Knapp says. Ongoing now is the startup phase, which runs from mid-1989 to the end of 1991. Work on most projects is well under way, Jessi executives report.

Following the startup phase will be the execution phase, which is to end in 1995. Finally, there will be a one-year conclusion phase.

Jessi will reach some important milestones during the next half decade, including engineering samples of 0.5-μm devices by mid-1991 and their pilot production by the end of that year; and first silicon of 0.3-μm parts by mid-1993 with engineering samples by mid-1994. Such 0.3-μm parts are scheduled to be ready for pilot production by the end of 1995.—*John Gosch*

In Europe, the odds are good in semiconductors

Europe is coming on strong, says a noted industry player, and should hold or up its share

Too many visitors, Electronica isn't just a showcase for what's new in components design. The Munich fair is also a forum where, during round-table discussions and after-hour shop talk, company managers review past market performance, take stock of current scenarios, and assess the future, predicting where their markets are headed.

Taking a longer-term view of what lies ahead and looking at

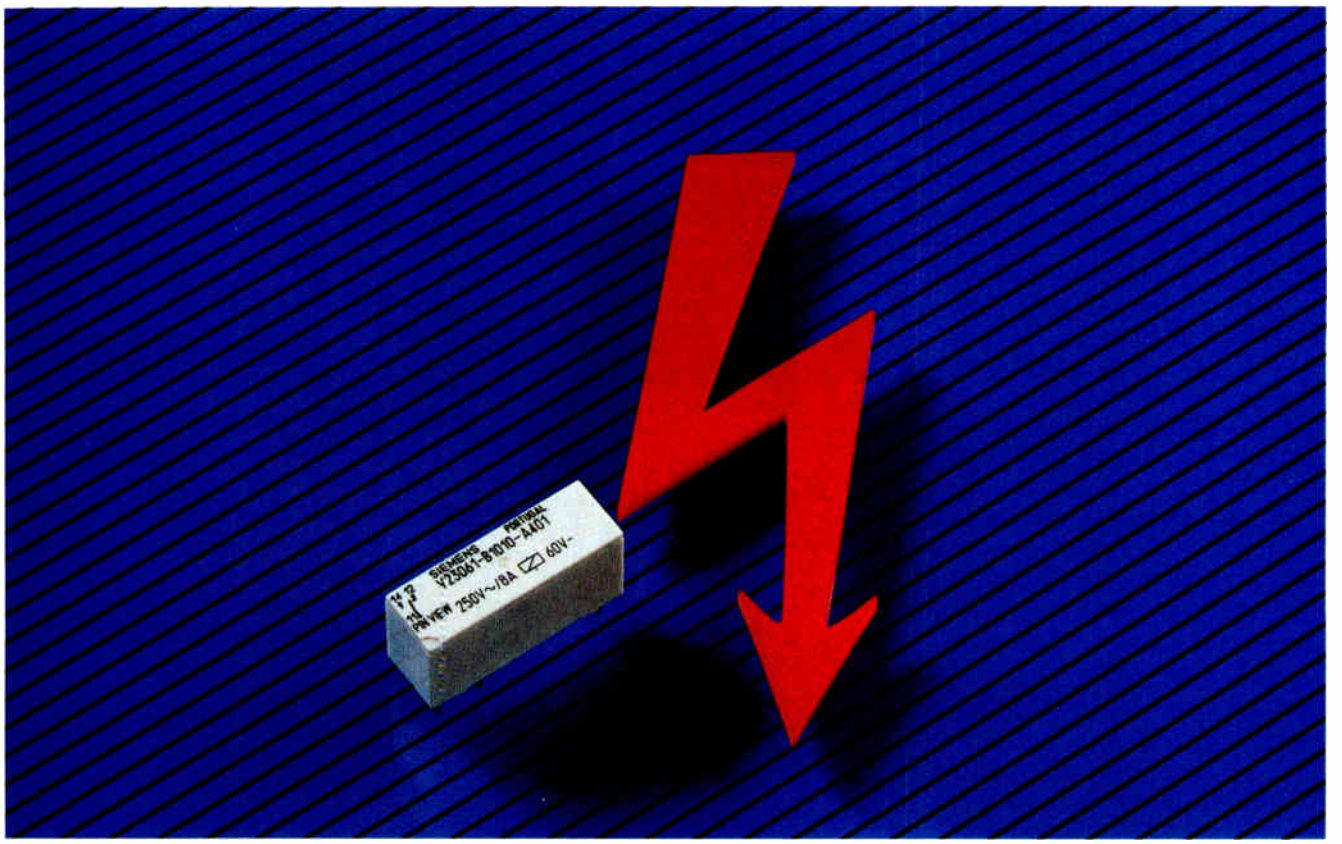
SEMICONDUCTORS

Western Europe as one of the world's three major electronics regions—the U. S. and Japan are the others—is Jürgen Knorr, president of the Brussels-based European Electronic Components Manufacturers Association (EECA). In Knorr's judgment, the chances for Europe to remain a major player in semiconductors and even improve its competitive position are good.

Europe has a lot going for it,

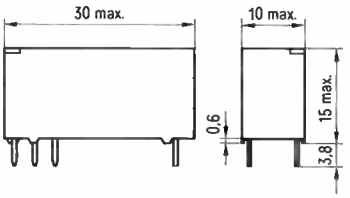
SIEMENS

Little in size but big in performance



A19100-G3-Z6-X-7600

The miniature power relay MSR from Siemens.



Dimensions of the MSR with changeover contact.

The trend in development of electromechanical components is clear: the same or even higher performance in a smaller package.

The best example of this is the new MSR universal miniature power relay from Siemens. Its extreme miniaturization makes possible far higher packing densities in modern circuits than were previously possible. Despite the amazingly low volume of only 4.5 cm^3, this relay is capable of achieving at least the same high power ratings as comparable relays which are twice the size.

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CIRCLE 195

says Knorr, who is also a member of the management board of Germany's Siemens AG and head of the Munich company's Semiconductor Division. If the worldwide semiconductor market is predicted to grow an average 13% to 15% annually through the year 2000, Europe will participate in that growth in equal measure, Knorr says.

Furthermore, Europe will keep its share—around 18%—of the global semiconductor market, Knorr says. That, by itself, is considered no mean success in view of the U. S.'s dwindling share, which is expected to drop from the current one third to less than 30% by 2000. The U. S. dip stems from several factors, among them the virtually nonexistent production of entertainment electronics gear in America and the less than robust state of the once flourishing computer market.

Also encouraging is Europe's position in components-related research and development. "Here, we've already pulled even with our competitors," Knorr says. As evidence, he points to the successes European companies have had in developing high-density memories, notably through the Philips-Siemens Mega project and also through the pan-European Jessi consortium.

For example, Siemens has first silicon of 16-Mbit dynamic random-access memories, while SGS-Thomson Microelectronics, the Italian-French semiconductor combine, has made its mark in other types of high-density memories, especially EPROMs and other nonvolatile devices.

Knorr concedes that a gap still exists in making components on a large industrial scale; given the 18% share of the global semiconductor market, an economy of scale just hasn't been reached.

But Europe's continuing efforts in cooperative deals and the ongoing concentration in the industry should bring about greater production units, Knorr says. Rumors abound that more semiconductor makers in Europe will join forces in turning out components or even merge the production of certain device categories. A case in point: industry watchers believe Siemens and SGS-Thomson may team up on DRAMs.

JURGEN KNORR
President, EECA

Excellence in R&D and the economy of scale that the concentration in the industry will afford are among the prerequisites for helping Europe in its drive to right the production imbalance vis-a-vis Japan and the U. S. While Europe consumes 30% of integrated circuits sold to end users worldwide, it produces only 10% of them. By contrast, the U. S. and Japan account for 35% and 50%, respectively, of global semiconductor production.

"We want to correct this imbalance so as to reduce the dependence on foreign suppliers and prevent our markets from being manipulable by others," Knorr says. Such manipulation could take the form of controlling the flow of chips to specific European industries so that competing industries would gain market advantages. This is a scenario Europe cannot allow to happen, Knorr declares, pointing out how the well-being of a good number of industries depends on the ready availability of the latest-technology chips.

In Germany, for example, the 1988 market for microchips accounted for slightly more than 0.1% of the country's gross national product. But these chips had a direct bearing on the performance of nearly $400 billion worth of equipment in five important export-intensive industrial branches. These are the electrotechnical sector, machine building, automotives, precision mechanics and optics, and office equipment.

Europe's drive toward independence does not mean the continent is striving for self-sufficiency in semiconductors—not even the U. S. and Japan are fully self-supporting. But too great a dependence on foreign suppliers, Knorr says, could adversely affect the industries that are vital to Europe's survival—not to mention growth—as a major industrial base in the coming decade.

Knorr's views are summed up in the EECA's Semiconductor Industry Principles, which are important elements in the organization's strategy for the 1990s. The strategy revolves around two main points:

- Recognition that the industrialized society of each major region of the world needs its own autonomous semiconductor industry.
- Acknowledgement that each region will defend its independence in semiconductors.

Friction in semiconductor trade, Knorr says, "can be avoided if the trade behavior is based on these two points."

Will the much-discussed single-market, barriers-free Europe, which is to become a reality by the end of 1992, affect the semiconductor business? Knorr doesn't think it will. His reasoning: the industry already is operating on a single-market, continent-wide, and even world-wide basis. With production, marketing, and distribution centers across Europe as well as in America and the Far

East, virtually all semiconductor producers are positioned for doing business on a global scale, Knorr points out.

Another question often asked is whether the new Europe will foster the establishment of Silicon Valley-style startups in semiconductors. Not necessarily, Knorr says. Rather, he envisions the big European companies getting even bigger, "because the need for capital to manufacture high-tech-intensive devices will rise much beyond the levels that small companies can cope with."

Already, the development of a new generation of high-density memories calls for expenditures between $300 million and $500 million. On top of that massive investment comes some $800 million to put up a state-of-the-art factory for volume fabrication of, say, 16-Mbit DRAMs. "Only the giants in semiconductors can foot these bills," Knorr says.

Among other problems facing the industry, Knorr mentions the financial risks involved in device development and doing business. These risks, he believes, can be reduced if companies team up to work together.

Yet another problem is overcapacity. In the 1985–86 period, the losses due to the uncontrolled expansion of production capacity worldwide came to some $6 billion, Knorr says. So one of the big challenges facing all semiconductor manufacturers is to cut their production capacity to reasonable limits for upcoming generations of devices.—*John Gosch.*

Where does Europe stand in memories?

Siemens is gaining fast in DRAMs as SGS-Thomson moves ahead in EPROMs

MEMORIES

Memories may be the most common electronic components around—they account for between 20% and 25% of global semiconductor sales, and their share is rising—yet they provide much excitement in the marketplace and in the technological race among the world's three major electronics regions, Japan, Europe, and the U. S. Little wonder, then, that memories will be much in the limelight at Electronica this year.

At conferences and panel discussions during the five-day Munich show, visitors will hear how the Europeans are faring in that race, while sharp-eyed show-goers will find evidence of their ranking on exhibitors' stands.

Until a few months ago, there were three big memory makers in Europe: Philips International NV of the Netherlands, Germany's Siemens AG, and SGS-Thomson Microelectronics, the Italian-French semiconductor producer. Each engaged in one of the three prime device categories—static or dynamic random-access memories and EPROMs. But Philips's recent withdrawal from SRAMs leaves just Siemens with DRAMs and SGS-Thomson with EPROMs as major vendors of such devices. Both are respectable contenders in the memory race.

For its part, Siemens, which has a 30% share of the European, and a 5% share of the worldwide, DRAM market, now has working samples of 16-Mbit devices. It is currently developing 64-Mbit versions with IBM Corp. in East Fishkill, N. Y.

"There are good reasons for us as the only European DRAM producer to take part in this strategic market," says Hans-Jörg Penzel, executive director and head of the standard products section in Siemens's Munich-based Semiconductor Group. The worldwide DRAM market is valued at approximately $7.1 billion and enjoys one of the highest growth rates in the industry.

As for SGS-Thomson, the Milan- and Paris-based chip maker rates among the world's top three EPROM manufacturers. "Our product strategy aims at world leadership in the nonvolatile memory area," says Carlo Ottaviani, vice president of communications in Milan.

New generations of DRAMs with four times the capacity of their predecessors continue to come along at Siemens about every three years. Now that 256-K types are being phased out at the company's facilities in Villach, Austria, production of 1-Mbit versions is in full swing. After the first such devices were delivered in 1987, fabrication was cranked up to reach 20 million units in 1989 and about 50 million this year. In 1991 Penzel expects output to climb around 40% over the 1990 level.

It was primarily the high output of 1-Mbit DRAMs last year that pushed Siemens to the No. 2 spot (after Philips) among European semiconductor makers, says market researcher Dataquest Inc. And the company made money too. But as is true for most producers,

RAMPING UP

Siemens AG has begun production of 4-Mbit DRAMs at this plant in Regensburg and another in Munich.

that will not be the case this year as 1-Mbit memory prices dropped about half—to currently $5—since the beginning of 1990.

Meanwhile, Siemens has started production of 4-Mbit DRAMs at plants in Regensburg and Munich. But the company does not seem eager to tie up its production lines with 4-Mbit chips because its plants are going full blast with 1-Mbit parts. Besides, the market "was a difficult one in 1990 because the PC industry, the prime customer, performed weakly and because the increasing value of the deutsche mark vis-a-vis the U. S. dollar and the yen affected earnings," Penzel says.

What's ahead? "Our experience with memory chips is a good basis for entering the fields of embedded memory products and application-specific memories," Penzel declares. The first of these products, combining both DRAM and logic functions on one chip, will be video DRAMs for use in digital TV sets and high-resolution graphics systems.

Turning to new standard DRAMs, Penzel says that next year will see the production of the third generation of 1-Mbit chips. At 38 mm^2, these will be the smallest 1-Mbit types on world markets. As for 4-Mbit parts, a second version will soon be available in a 300-mil package. Next year, too, will see customer samples of 16-Mbit parts.

All told, where does Siemens stand in DRAMs vis-a-vis the Japanese, the world leaders? When the company started producing 256-K types in volume in 1983, the lag was about three years. With the start of production in 1988 of 1-Mbit devices, the lag had narrowed to one year.

The lag again narrowed—to around six months—with the start of 4-Mbit device production in 1989. Finally, when volume fabrication of 16-Mbit types gets under way in 1992, "we will have pulled even with the competition in the Far East, excepting any surprise moves by Pacific Rim countries," says Horst Fischer, member of the board of Siemens's Semiconductor Group.

SGS-Thomson's strength clearly lies in EPROMs. Ranking among the world's top three in the field, it has a broad spectrum of CMOS and n-MOS versions ranging from 16-K to 4-Mbit parts. The latter use 0.8-μm CMOS technology and access in 100 ns, making them one of the fastest 4-Mbit EPROMs on the market.

Striving for world leadership in the nonvolatile memory business, SGS-Thomson is expanding its product range upward to include flash EPROMs, EEPROMs, and application-specific memories. At the same time, the company is extending downward toward lower-cost devices such as one-time programmable parts and small ROMs for computer applications.

For all its involvement in EPROMs, SGS-Thomson hasn't let the SRAM sector slide. For fast SRAMs the center of excellence is at Inmos Ltd. in Bristol, UK, which rates as the West's No. 1 supplier of such devices (globally it ranks No. 9 behind seven Japanese firms and one South Korean).

For standard-speed static memories, activity is centered in Carrollton, Texas, which will put out a 1-Mbit part before the end of this year. Also from the Carrollton facilities come FIFO BiPORT memories as well as two families of the SRAM/SRAM&CLOCK variety with built-in battery backup.

While SGS-Thomson uses EPROMs as a technology driver, "we have always acknowledged the importance of standard DRAMs for future growth," Ottaviani says. And indeed the company has widely publicized its preference for a DRAM partner—possibly Siemens—and its intention to enter the market, alone if necessary, in early 1991. That's when the DRAM market, currently in a slump, should pick up again.

Actually, SGS-Thomson has never lost contact with DRAM development—it had 1-Mbit prototypes in 1988 and is working on 4-Mbit parts. The Carrollton facility is now delivering the first commercial devices. "This, to be sure, is not a major step into the DRAM market, as volumes are not huge," he says. "But it is a move to fine-tune our manufacturing for the new product line," if only to ensure it would enter DRAMs from a solid base.

The next step is setting up a plant to turn out the many millions of devices annually that are needed to rate as an important supplier, he adds. "It's the risk of this investment that we would like to share with a partner."—*John Gosch*

WHAT'S THE ONE RISC WORTH TAKING?

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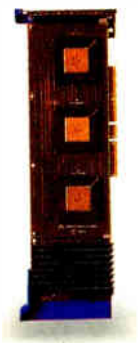

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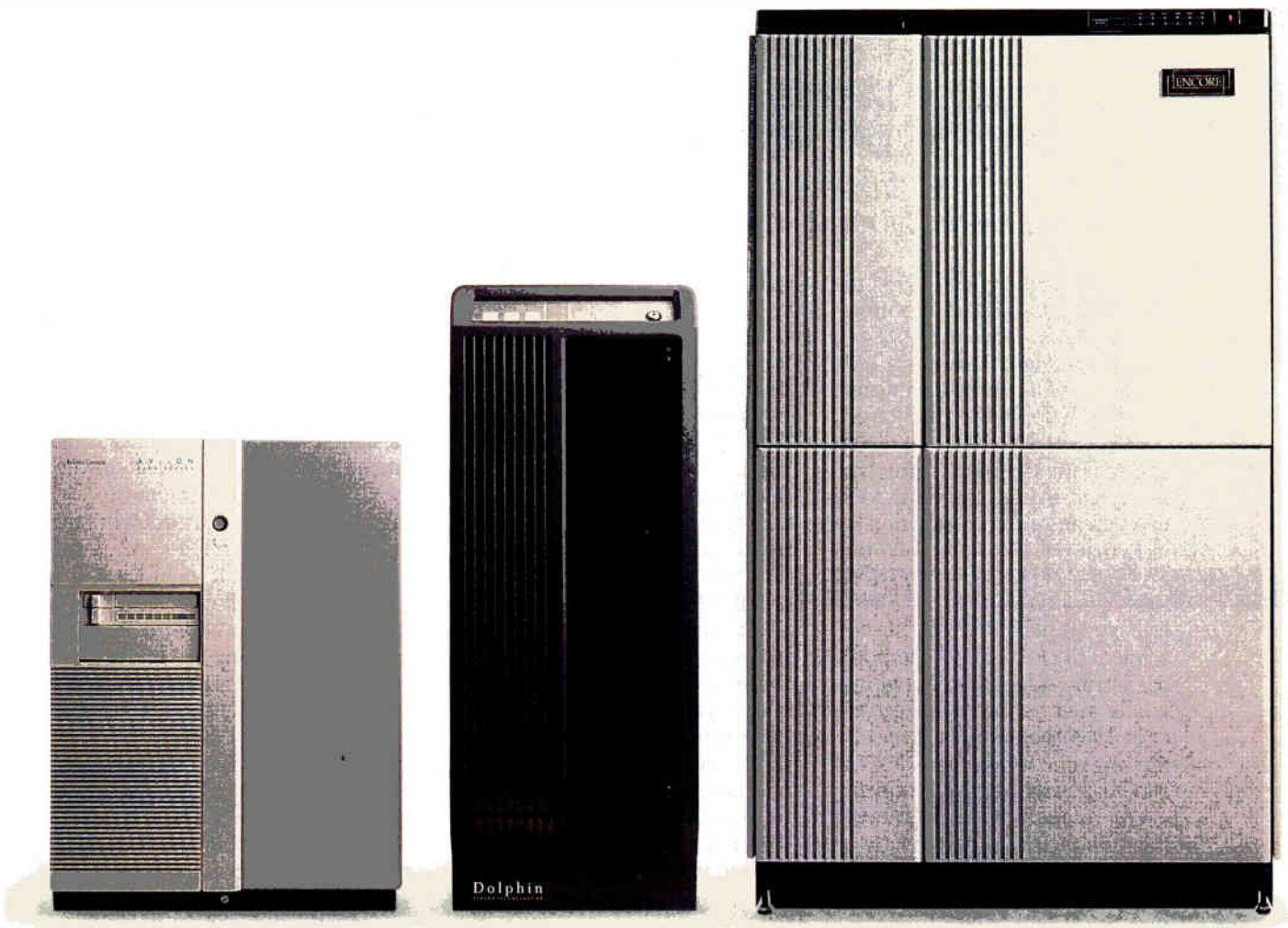

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What's more, the 88000 is the only RISC architecture with a published and adopted binary compatibility standard—and the first RISC architecture with an Application Binary Interface (ABI) for UNIX V.4. Which means that hardware vendors in the 88open, a consortium of over 50 companies in virtually every category of computing, can continue building innovative products and still protect their customers' software investments.

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MOTOROLA

MUNICH '90

From Motorola, a wide range of new products

With 25 years in Europe, the company is putting its best foot forward

SEMICONDUCTORS

The European market is a mosaic of opportunities. The advent of a unified Europe in 1992 will present electronics suppliers with a target of 320 million consumers. And the opening of Eastern Europe to market forces provides even greater opportunity in a region that could number 500 million consumers by 2000. But for semiconductor makers the potential is truly staggering: a region where sales probably were greater in 1989 than anywhere else, the first time in two decades Europe has exhibited such power.

For companies like Motorola Inc., the picture is particularly bright. Established in Europe for a quarter century, its Semiconductor Sector already has three manufacturing plants and five major facilities on the continent. So Motorola is well positioned to serve the potential burgeoning market in Germany and Eastern countries that will be participating in the Western market in the near future. At Electronica '90, Motorola is exhibiting a significant array of new products.

For high-performance embedded-control applications, Motorola will display the newly developed MC68EC030 controller, capable of up to 10 mips' (million instructions/s) performance. The 68EC030 features a newly optimized layout, with no programmable memory management unit on board, to provide high performance capability. It is fully functioned and pin compatible with the widely used MC68030 microprocessor.

Being introduced is an advanced digital signal processor designed for digital telephone and high-speed data network control. Called the DSP56116, this new unit features a clock rate of 80 MHz (25-ns instruction cycle) and is one of the fastest 16-bit signal processors in the world. The unit is based on Motorola's widely designed-in DSP56001 and has been extended by an 8-Kbyte random-access memory, two serial interfaces, a 16-bit timer, and an on-chip emulator.

On display for the first time in Europe will be the newly introduced MC68340 microcontroller, which was announced around the world in September. Motorola's 340 is designed for fast data movement and is aimed at the Compact Disc Interactive (CDI) market. The 340 is based on Motorola's core 68020 processor and integrates on-chip timers, system integration modules, and serial communications channels connected through an intermodule bus.

A 32-bit dual channel direct memory access (DMA) controller on-chip can move data between the compact disc and memory at 32 Mbytes/s. Motorola worked with NV Philips Interactive Media Systems Group to define the specs for its new controller.

For controller applications, Motorola will also feature its MC68331 controller—a low-cost version of the MC68332 engine controller for the automotive market. The stripped-down 331 features an improved HC11 timer instead of the lavish timer processor unit used in the 332. The 331 also provides 2-K less RAM capabilty, which lowers the cost. Both the 331 and 332 controllers are built around the same CPU32 core, which is similar to the one used on the popular MC68020 microprocessor. Both units are fully compatible with the M68000 family of processors-controllers. The new 331 was especially developed for the embedded-control applications.

To assist the microcontroller designer, Motorola has introduced the CDS32 low-cost "Jewelbox" development system designed to assist engineers who are using Motorola's 68331/332 32-bit microcontrollers. It includes a compact in-circuit emulator, bus state analyzer, and control station unit for debugging the hardware and software during the development of a system. The CDS32 is a portable unit that can debug a system in the actual environment in which the system is used.

At Electronica '90, Motorola will exhibit two high-performance additions to its popular 8-bit 68HC11 microcontroller family. The 68HC11K4 and 68HC711K4 double the bus speed of the original HC11 family members and feature a variety of memory configurations and on-chip peripherals to bring the highest level of integration and performance to 8-bit microcontroller applications.

The increased bus speeds allow the HC11K devices to challenge many existing 16-bit microcontrollers.

For the first time, Motorola is showing a new 16-bit microcontroller that is a fully compatible upgrade from its popular 8-bit HC11 product line. Called the MC68HC16, the new unit lets Motorola customers move smoothly

from 8-bit designs to 16-bit designs utilizing their current knowledge of the HC11 architecture. The HC16 is source-code compatible with the 8-bit HC11 family.

During the show, Motorola is holding a press conference to introduce worldwide a new family of gate arrays offering a complexity of 317,000 gates. Called the H4C family, the new arrays use a submicron HSMOS technology and three-layer metalization to achieve a silicon chip area utilization typically 70% or better.

Visitors to Motorola's booth in Hall 18 DO8 at Electronica will be able to view a panoply of world-class technology from an established European producer. ■

Meet Gerd vom Hovel, the man behind Electronica

The organizer's 'clear line' strategy has made this one of the industry's premier events

Gerd vom Hövel is a very methodical man. Everything the managing director of the Munich Trade Fair Corp. does seems to follow a grand design, a well-defined strategy. The "clear line"—*die klare Linie*, as he likes to say—is what has made Electronica one of the electronics industry's most successful shows.

PEOPLE

Not that vom Hövel is the father of Electronica—its originator back in 1964 was a group of U. S. businessmen joined in the International Electronics Working Group, which initiated an electronics show separate from Germany's giant Industrial Fair in Hanover. But it was vom Hövel who, when he became managing director in 1974, transformed Electronica from a hodgepodge of different technologies into a well-ordered fair devoted to components and related products.

"We embarked on a new fair policy," vom Hövel says. Its aim was a show focusing on a narrow spectrum of electronics and catering to the specialist: "We wanted to create a relationship of confidence between the industry, science, and customers." In keeping with vom Hövel's clear-line strategy, any firm that's not in the business of components and electronic assemblies is barred from displaying its wares at Electronica. This components-only quality ensures that the show is a forum for the specialist.

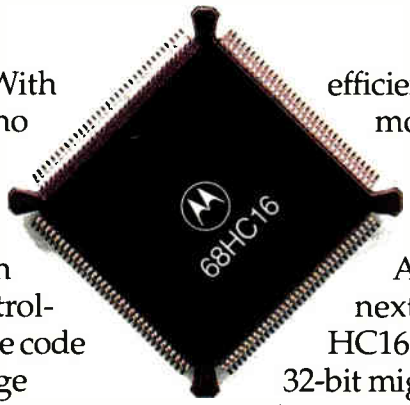
Electronica's narrow focus and its supernational character—44% of the exhibiting firms will come from outside Germany this year—have helped make the show not only the biggest but also the most significant in components. The presence of truly innovative firms, both big and small, from around the world has also helped. They often pick Electronica to make new product announcements or important statements. And among the dignitaries are well-know industry leaders from the U. S., Japan, and Europe. In fact, the fair has become a trademark for Munich and has earned vom Hövel the sobriquet of Mr. Electronica.

GERO VOM HOVEL
Managing director

To him, the show is more than just a display of bits and pieces. It's a "forum for information exchange" among people with components as the common denominator, he says. That exchange is between device users and producers, semiconductor physicists and designers, salespeople and customers, engineering students and companies—and between the trade press and readers.

Bringing these groups together are not only the exhibits but also the seminars. They cover commercial and technical aspects and new trends in devices ranging from microproces-

ASSURED MIGRATION TO 16-BIT ARCHITECTURE. THE TRUE TEST OF A DESIGN THAT FLIES.



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The 68HC16 not only makes upward migration easier than ever. It also sends 16-bit performance soaring into a whole new realm. This incredible device averages over eight times faster than the fastest member of our HC11 Family. And its powerful control-oriented DSP instructions push the limits of 16-bit performance.

OUR 68HC16 TAKES YOU IN THE RIGHT DIRECTION.

With our 68HC16 Family's modular design, your flight to the future is fast. And efficient. The HC16 can use any inter-module bus peripheral from our rapidly expanding 68300 Family. So the 68HC16 Family can grow quickly to meet your needs. And when you're ready to take the next step up, you can apply your HC16 knowledge directly toward your 32-bit migration.

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THE PATHWAY TO PERFORMANCE.

MOTOROLA

sors to electromechanical parts. Other seminars are on software, applications, and quality control.

Much to the credit of vom Hövel and his staff is that Electronica has become a tool in many companies' global sales and marketing strategies. On this strategy level, the show represents something different to executives from different regions. For U. S. and Japanese groups it's primarily a springboard into new markets and business opportunities. To the West Europeans, the show is a forum for ordering the kinds of devices that will help them remain the leaders in industrial sectors such as machine tools, motor vehicles, chemical processing systems, and metal-finishing equipment. And to East Europe and the Soviet Union, Electronica is a showcase for the components this region needs to make its industries more competitive.

For his job as a fair organizer, vom Hövel has just the right credentials. Armed with a master's degree in business administration with emphasis on marketing, the 60-year-old executive joined one of Germany's largest fuel-supply companies to set up new sales channels in Europe. In 1965 he left to sign on with the Munich Trade Fair Corp., where he became managing director in 1974. He has been honored by local, state, and both German and foreign governments for the services he has rendered in the interest of trade.

Described by some as the quintessential trade-fair organizer, vom Hövel has initiated a number of other high-tech shows in Munich, applying the same clear-line strategy to them. Among these shows—which, like Electronica, take place every other year—are Systec (computer-integrated manufacturing), Laser (optoelectronics), Analytica (biochemical analysis), Productronica (electronic parts production), and Systems (communications.)

During a two-year schedule cycle, these shows bring together some 400,000 visitors from 70 countries, as well as 6,000 firms from 30 countries. Clearly, vom Hövel has done his share to make Munich Germany's high-tech capital.—*John Gosch*

From Intermetall, a supercomputer on a chip

The Datawave video processor can crunch 4 billion multiplications and additions/s

SUPERCOMPUTERS

The supercomputer on a chip. That's how Intermetall GmbH, lead house of the ITT Semiconductors Group in Freiburg, Germany, bills a video processor it will present at Electronica. Using 0.8-μm CMOS technology, the Datawave processor—so called because data transmission through the device resembles the propagation of a wave—incorporates 1.2 million transistors on a 150 mil^2 chip and boasts a computational power of a staggering 4 billion multiplications and additions per second. Such performance is needed for real-time digital picture processing in consumer and industrial applications.

Conventionally, designers use dedicated, hardwired components for real-time picture processing. With the programmable Datawave processor, however, software techniques handle the job. By cascading several processors, complex processing systems can be built up. And since new software can be loaded into them at any time, the Intermetall processors can be configured to suit new applications without changing the hardware.

This flexibility comes in handy especially for future high-definition TV systems, whose standards are likely to be different in Europe, the U. S., and Japan. The Datawave processors copes with all standards. But also for today's TV standards such as PAL, NTSC, Secam, and satellite TV norms like D2MAC, the processor provides an "all-in-one" solution.

The processor's high performance of 4 billion operations/s (giga-ops) arises from a high clock frequency—125 MHz—and the use of parallel computing techniques. The processor consists of 16 identical and individually programmable cells arranged in a 4 by 4 array.

Each cell has two parallel operating computing networks for multiplication, addition, and subtraction, and, using pipeline methods, processes 12-bit numbers. A cell interconnects with its four neighboring cells by 12-bit-wide, bidirectional buses. Through these buses, up to 1 million data words can be exchanged between neighboring cells.

The Datawave processor exploits the new data-flow principle: the parallel program runs in the cells, which are decentrally controlled by local data streams, and not by a global clock. Such decentralized control makes programming parallel systems a lot easier, Intermetall says.—*John Gosch*

CAN PC LANs SURVIVE THE MEDIA BLITZ?

EXOTIC DATA TYPES WILL DEMAND NEW SOLUTIONS TO UNCLOG THE SOFTWARE-DRIVER BOTTLENECK

BY JACK SHANDLE

NETWORKING

BIG CHANGES ARE IN THE works for local-area networks, and they are not going to be evolutionary. Instead of numerical and text-based data, even pedestrian business LANs will be carrying exotic data types during the 1990s.

"As we move into graphics, voice, animation, and video, there will be a greater and greater demand not just for bandwidth, but for the ability to execute larger transactions," says Leon Adams, open systems marketing manager for Texas Instruments Inc. in Houston. "To get close to the full potential of the chips, you have to get above 1.5-Kbyte packets and tune your drivers."

Why is a chip maker like TI interested in software issues such as transactions, packet size, and drivers?

In 1989, Adams and TI learned the hard way that faster LAN-chip architectures such as TI's 16-Mbit/s Token Ring are only the first step toward a solution to the coming deluge of media types. In September of that year, a leading PC publication used a standard test suite to benchmark Ethernet, Arcnet, and two versions of Token Ring. Ethernet placed first, even though its 10-Mbit/s theoretical maximum throughput is significantly less than the 16-Mbit/s Token Ring. In fact, the 16-Mbit/s version barely outperformed the older version, rated at 4 Mbits/s.

The problem lay not in the silicon but in the complex—and mostly hidden—interaction of network operating systems such as Novell Inc.'s Netware and Microcsoft Corp.'s LAN Manager with the software drivers on the LAN adapter cards. The standard test suites, which were created for slower networks, made some key assumptions about frame size and board architecture. None was good for Token Ring.

In effect, says Adams, silicon merely sets an upper limit on speed. Data throughput can be throttled down to a trickle unless the equipment manufacturer or system integrator "tunes for performance."

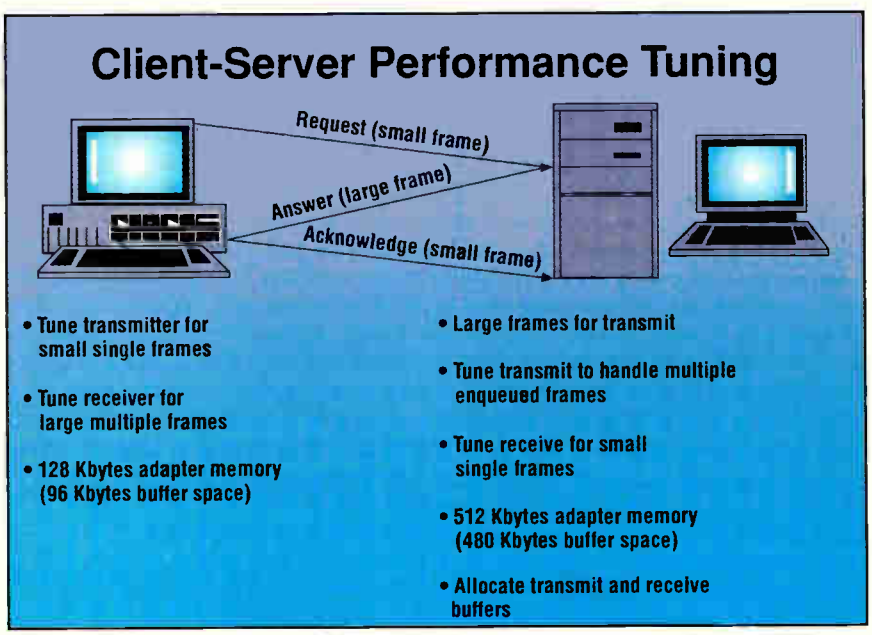
In fact, a quick look under the hood of a LAN reveals a multitude of combinations that affect performance: the architectures of the adapter cards, the network operating system, and software drivers are only three of the most important. The 1990s will see fundamental changes in all these elements.

Tuned LANs deliver much higher throughput. Although the test TI would like to forget clocked 16-Mbit/s Token Ring throughput at about 3 Mbits/s, Proteon Inc. of Westboro, Mass., delivers 12 Mbits/s. Proteon doubled performance simply by rewriting its 16-bit drivers for Netware, says Carl Blume, networking products manager. Proteon also opted for a bus-master architecture that uses a direct-memory-access controller to direct activity on the adapter card. Part of that activity—the pipelining of the data packets—also helps.

Proteon's RapiDrivers are among the first wave of turbo drivers. Network Interface Corp., Lenexa, Kan., has developed Arcnet drivers that deliver a 70% speed boost, and similar developments are taking place in the Ethernet world.

Tuning for performance in a client-server LAN model has three main aspects, says Phil Campbell, TI's strategic markets manager for LANs. They are frame size, buffer management, and list management. "Server tuning is the key to performance," he says. "You can run into problems when the maximum frame size is initialized at 512 bytes and you want to transmit a 4-Kbyte frame, because you have to chop it up into pieces and transmit protocol-overhead bits with each of those frames." Managing the buffers on the adapter card also contributes to tuning.

In Token Ring networks, improper setting of either buffer size or the num-



ber of buffers allocated to the transmitter and receiver functions can reduce performance by up to 70%. Buffers on the server's receive side should be tuned for small, single frames because the server receives many requests from clients. Transmit buffers, on the other hand, should be large because the server typically sends out large blocks of data. Over and above buffer size, the number of buffers for transmitting is critical because this allows for pipelining—the queuing of frames for bursting over the network without intervention from the host processor.

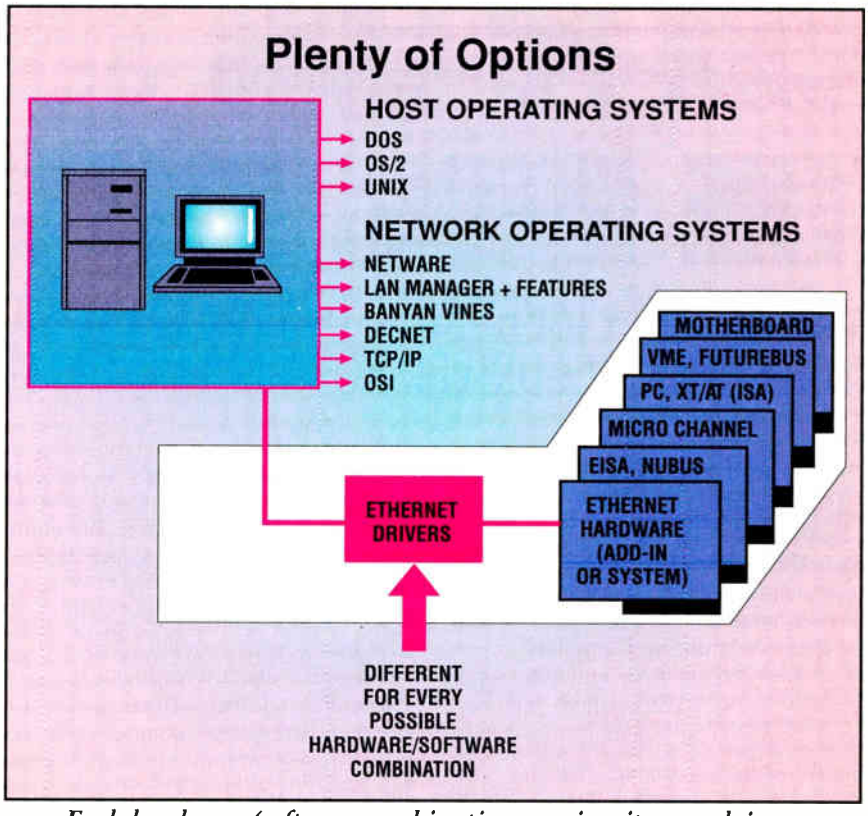
List management is the third performance-tuning knob. "The idea," says Campbell, "is to keep the pipeline full with a minimum of overhead." This is a fairly arcane task that involves how data is queued for transfer between host system and adapter card. Two techniques can be used: valid chaining and odd forward-pointer (OFP) chaining.

Valid chaining prechains all the internal list registers and can reduce performance by 30% during peak demand on the server, says Campbell. OFP chaining links lists at run time and processes them until there is a change (to odd) in the forward pointer. So valid chaining is more appropriate for nonpipelined applications and OFP runs faster for pipelined applications.

In Ethernet, the performance issues are the same as in Token Ring. "It is how fast the card and driver can get information from the cable onto the network operating system," explains Larry Wakeman, application manager for National Semiconductor Corp.'s LAN Business Group, Santa Clara, Calif.

Of necessity, drivers must do certain bookkeeping activities, but performance goes up as the hardware on the card takes over transmit-and-receive tasks from the software. Ethernet drivers still must be written to take advantage of the hardware. Every combination of host operating system, network operating system, and bus architecture can be tuned to optimum performance with the right drivers, says Wakeman.

Three generic architectures dominate adapter-card technology. Historically, they have developed in this order: input/output port, shared-buffer memory, and bus master. Each successively puts more intelligence on the card, delivers higher throughput, and costs more. In Ethernet, the I/O-port architecture had been the conventional choice, but it's falling from favor. Buffers on the card hold data in temporary storage while the host processor and adapter-card controller negotiate a protocol and pass information over a fixed-width I/O port, copying it from the card buffer into system memory.



Each hardware/software combination requires its own driver.

Shared-buffer memory improves on this situation by using dual-port RAM, which allows both the host CPU and the card's controller access to the same physical memory on the card. This still involves temporary storage, says Wakeman, while the bus-master approach avoids that entirely.

IN THE BUS-MASTER ARCHITECTURE, the controller is smart enough to directly read or write to system memory. When enough information is in the controller's first-in, first-out memory, the controller takes charge of the bus. Performance can be further enhanced by pipelining. Testing at National shows that going from an I/O-mapped to a shared-memory architecture can deliver a 10% performance improvement, says Wakeman. Bus mastering delivers about a 40% improvement over shared memory, all other things being equal.

Arcnet LANs enjoyed great popularity in the 1980s. As an early LAN architecture that delivered reliable service at a low price per node, Arcnet was the original topography chosen by Novell for its Netware. In fact, Netware appears to be tuned for Arcnet's standard 256-byte frame.

But that size is now a performance inhibitor, and innovative companies are finding ways around it. Custom drivers are the quickest way. NCR Microelectronics has developed a turbo driver for Arcnet, says Tony Parker, the company's communications products manager in Ft. Collins, Colo. "The turbo driver basically fakes out Netware to make it think four nodes are transmitting instead of just one. That way, we can pump more data into the cable with less overhead."

Performance is also degraded by protocol generation. When a user running an application at one node wants to send the information generated to an application running on another PC, he sets in motion a complicated chain of events. Using the International Standards Organization's seven-layer protocol stack as a model, Parker points out that protocols must be generated to pass the basic information down the stack at the sending node—from Application Layer 7 to Physical Layer 1—and then back up the stack at the other node. "An enormous amount of code has to be executed, and this is usually done by the host micro-

Analog Devices delivers mixed-signal technology that meets today's most demanding specifications.

ANALOG DEVICES

processor. But an intelligent adapter card with a bus-master chip on it can do up to Layer 3."

The next step up from bus mastering, says Parker, is the implementation of IBM Corp.'s Subsystem Control Block architecture. It allows peripheral boards to communicate with one another without intervention. "A Small Computer Systems Interface board can talk directly to an Ethernet board, for example, or even another system that supports SBC," says Parker.

This development separates vertically integrated systems houses from board-level network vendors by commingling network and the host's internal bus. "The board companies may not be able to take advantage of it," he says, "because you have to have control over the system architecture. When you power up, you have to set up pipes between the different boards."

The Fiber Distributed Data Interface is no different than other networks in its need for tuning at the driver level. "The integration of a network into a host's operating system is one of the key areas where performance can be gained or lost," says Russ Sharer, director of marketing at CMC Inc., Santa Barbara, Calif. FDDI's theoretical maximum of 100 Mbits/s means the "chip sets are quick right out of the chute," he says. "But you have to be sure your interface with the system is set up to efficiently handle data chunks with as few transfers as possible." Another challenge is to process the buffers quickly enough so the stacks do not overflow. This is a critical requirement for the CPU, which has to respond much faster with FDDI.

To help the processor keep the pace, FDDI has implemented more data handling in hardware. Putting incoming information into buffers is handled by the network chip set itself. CMC has done two things with its software to support that capability. One is scatter-gather support, says Sharer. "This lets us take an address from one place in memory and data from another and send it over the network."

A second area is in minimizing the number of interrupts generated during pipelining. If, for example, three buffers arrive from the network in rapid succession, the conventional way to process them would be for the FDDI chip set to interrupt the host processor to announce each buffer's arrival. The host would generate an interrupt when it finished reading the buffer. In this way, six interrupts would be generated for three buffers.

BORN TO RUN

Performance tuning of software drivers can double LAN performance; turbo drivers will be the next marketing wave.

Bus masters for LAN adapter cards are becoming the first choice for high-performance applications.

IBM's Subsystem Control Block architecture may give systems houses a leg up on LAN board makers.

CMC's drivers support buffer chaining, says Sharer. After the first interrupt is generated, the host processor keeps reading until it finds an empty buffer. When it does, it generates another interrupt. The net result is to generate just two interrupts instead of six.

In addition to working on the drivers, FDDI can achieve impressive throughput if the host system's memory allocations are tuned to the right size. Computer systems allocate from 64 bytes to 1 Kbyte for network information. Enlarging that block from 128 bytes to 1 Kbyte on a Sun workstation boosts network performance threefold.

Although much can be done to optimize FDDI network performance, one problem it does not share with Ethernet, Token Ring, and Arcnet is an interface with network operating systems such as Netware or LAN Manager. "I don't know of anybody who has written an NOS that runs at 100 Mbits/s," says Sharer. A generic network operating system is, in fact, not necessary at this point because FDDI is being used in three primary applications: as a backbone, where the Ethernet or Token Ring packet is encapsulated; on workstations, where the NOS is proprietary; and in CAD and medical imaging, where it is also proprietary.

FDDI specifies the bottom two layers of the seven-layer OSI protocol stack, and FDDI vendors typically supply some of the upper layers by adapting the TCP/IP (Transport Communications Protocol/Internetworking Protocol). But these applications are really being designed one at a time, says Sharer. A more generic operating system for distributed computing is in the cards, he says, but it will be incorporated in the workstation operating system. Unix, for example, will pick up some of the distributed capabilities.

Connecting varying LANs over a wide-area network presents a whole new set of problems that make more software tuning essential. In general, these problems are solved with bridges and routers, particularly if they are running under TCP/IP, says Nancy Connor, chairman of the board of FTP Software Corp., a Wakefield, Mass., specialist in TCP/IP on personal computers.

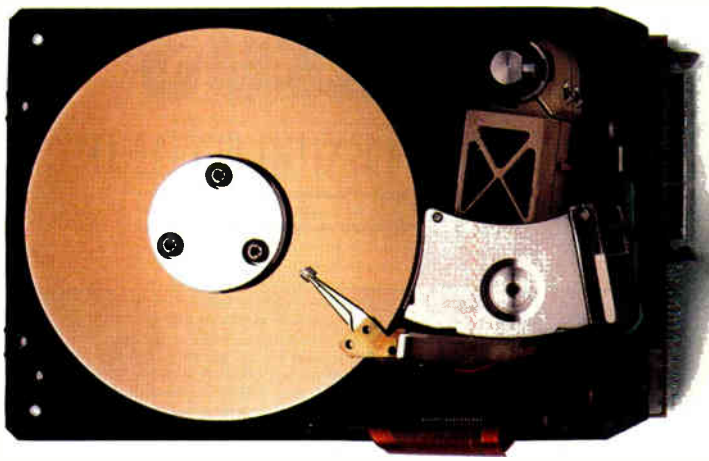
TCP/IP's big advantage over proprietary network-operating-system protocols is its scalability. Dynamic-backoff protocol algorithms embedded in the TCP/IP protocol work with software drivers to keep the internetwork from choking down to the lowest performance point, she says. FTP intentionally uses a complex in-house network to test its products. The internetwork consists of four LANs: a 4- and a 16-Mbit/s Token Ring, a 10-Mbit/s Ethernet running on thin-wire coaxial-cable, and a 10-Mbit/s 10 Base T Ethernet running on twisted-pair telephone wire. The LANs are connected by bridges, routers, and a microwave link.

NETWARE, LAN MANAGER, and other proprietary network operating systems do not have the same scaling capability, says Conner. But all is not lost if the software in the router conforms to one of several data-interchange standard specifications. "If you write a driver to one of these specs," she says, "it will accept a packet and decide where to send it—to a Netware stack or a TCP stack, for example." While TCP/IP offers advantages in scalability, the proprietary systems are better solutions for LANs because they are transparent to users who simply want to share files or printers, she says.

Performance tuning in internetworking does not stop with bit-rate scaling, says Steve Knowles, FTP's vice president of engineering. One method is to write drivers that dynamically tune the timers that control when a node concludes a data packet has been lost in the network and asks for it to be retransmitted. The timer is set based on how long it has taken to receive an acknowledgement in the past. "This means you do not retransmit gratuitously," he says.

Another optimization technique calls on the drivers to keep track of the time for two nodes to complete transactions. "If the round-trip time gets shorter," he says, "you tighten the timer." E

Faster.



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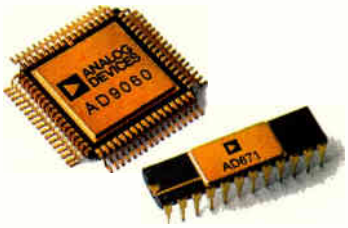

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ANALOG DEVICES

CIRCLE 217

TESTER CAN GROW WITH CUSTOMER NEEDS

TERADYNE'S MODULAR APPROACH COMBINES FLEXIBILITY AND POWER TO TEST ADVANCED LOGIC DEVICES

BY LAWRENCE CURRAN

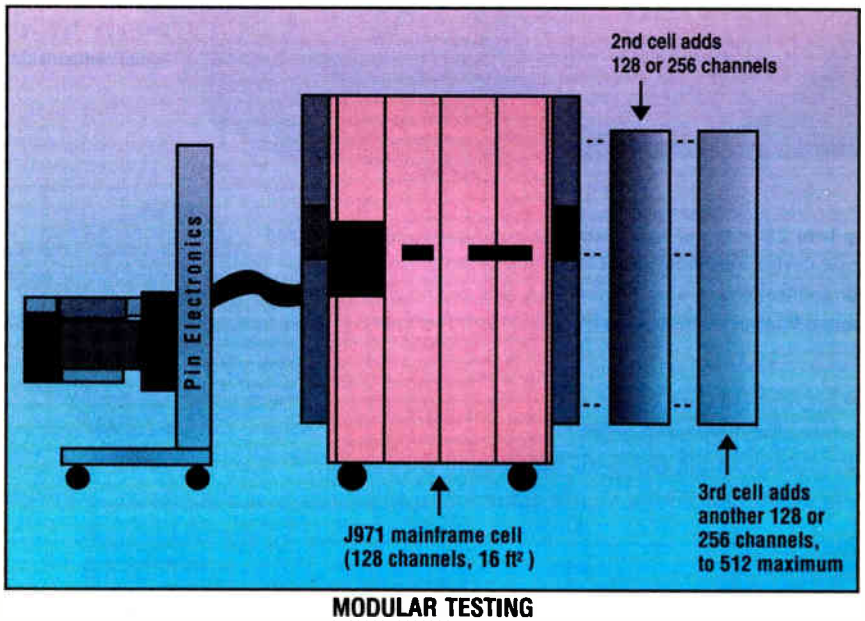
ATE

PROBLEM: YOUR DESIGNers need to test high-performance logic devices with as many as 512 pins at up to 200 MHz. But that would be overkill for the production line, where 192 pins and 50 MHz could do the job. Teradyne Inc. says it has a test solution for you. The J971 series addresses both ends of that range without forcing customers at the low end to pay for high-end performance.

Teradyne partitions the new J971 tester into "cells" that allow users to buy only as much test capability as they need. They can add cells later, working their way up to the maximum to test a range of devices from high-end microprocessors to advanced ASICs. Other innovations include a blend of emitter-coupled logic and CMOS in the timing and formatting circuitry as well as the system software's graphical user interface.

The company says the J971 bucks the trend to take care of low-end needs first and then attempt the difficult scale-up to more demanding test requirements. Although other test vendors offer upgradability, often "the only machines they can ship are limited in pin count, frequency, accuracy, or in other ways," says Ed Rogas, vice president and general manager of Teradyne's Semiconductor Test Division, Agoura Hills, Calif. But Teradyne, he says, has "full-capability systems today, so the technological risk is zero."

A minimum of overhead is built into the J971 to cover future expansion. In earlier systems, including Teradyne's own J953, customers had to buy the same size system chassis (52 ft²) no matter how many channels it had to accommodate. What's more, that chassis was sold with the maximum number of power supplies, backplane sections, card cages, and cables to handle the highest channel count the unit would hold if it were to be upgraded.



MODULAR TESTING

With Teradyne's J971, users buy only as much test capability as they need. Mainframe cells can be added later to boost capacity.

The J971 reflects a different approach. A single system cell of approximately 16 ft², along with the accompanying test station, holds only the pin-electronics cards, backplane segments, and cables needed for 128 channels. To upgrade, a user installs a kit containing the elements needed for the number of channels desired, to 512 maximum.

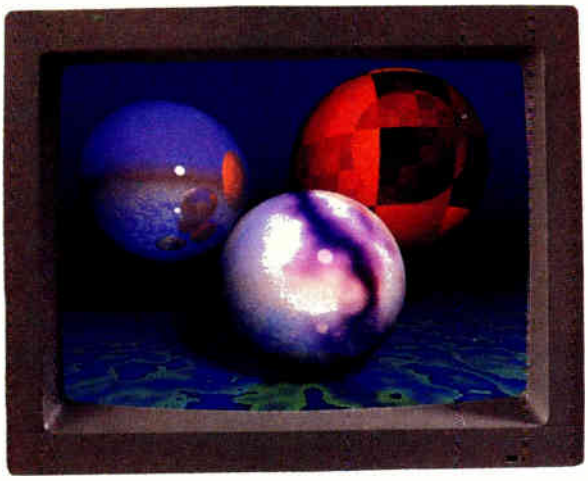
The J971 also breaks new ground in its so-called E/MOS technology, which is a proprietary mix of ECL and CMOS. Use of ECL in the tester's timing and formatting section is essential for the 200-MHz test frequency, but ECL is expensive and power-hungry. That prompted a design that mixes custom ECL and CMOS gate arrays. Some 90% of the timing and formatting circuitry is this "dual-bus CMOS," says Wayne Ponik, product manager for VLSI systems.

The J971's data-state generation, digital timing generators, and error-processing circuitry—all of which are built with ECL in the J953—are implemented in CMOS. "We have developed a way to process timing signals quickly and accurately in CMOS for most of the timing circuitry," Ponik says. The pattern and waveform generators, and edge-generation and waveform-capture circuitry, are ECL.

On the software side, the tester uses the IG900+, the second generation of the data-base-oriented system software introduced with the J953. An important enhancement is the X11 Window System standard with the Open Look graphical user interface. Thanks to X11, J971 users can employ any terminal that complies with that standard.

Teradyne says that more than 1,000 J971 variations are possible by combining system cells for varying test needs. Prices run from about $600,000 to $4 million; shipments begin next month.

Better.



Picture this – a PC monitor that offers the same color and clarity as a high-end engineering workstation costing as much as 20 times more. Our pin-compatible RAM-DAC is literally redefining the low end of the PC monitor market.

Marball. Original image courtesy of University of California, Davis.

ADSP-2111 – Better integration on the best architecture in the industry. Adds an 8/16-bit host port to the two serial ports, timer, hardware companding and memory already on the ADSP-2101. And like all our DSPs, it's got fast, flexible arithmetic, wide dynamic range and a single cycle fetch of two operands (on- or off-chip). Plus it's code-compatible with the rest of our DSP family, so what's written today will be useful tomorrow.

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CIRCLE 217

INDEX

RECESSION WINDS ARE STARTING TO BLOW STRONGER

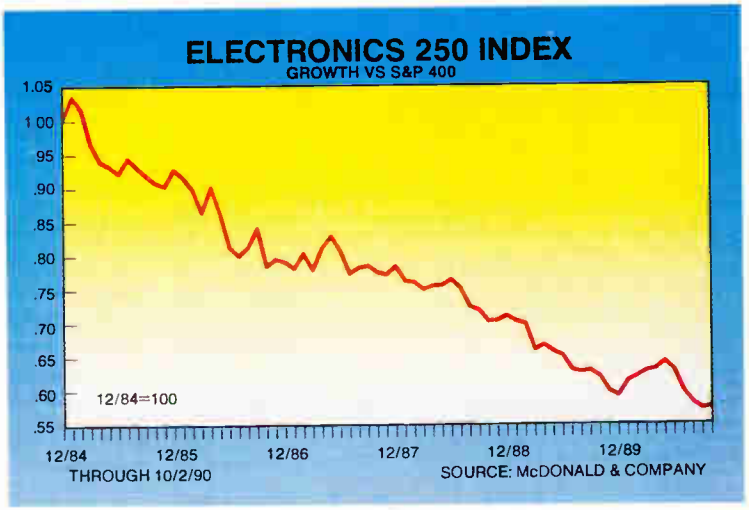
The probability of a moderate to severe recession early next year has increased significantly. The signs are there: domestic order patterns deteriorated significantly in September for OEM suppliers. The period of transition to next-generation mainframes will add further downward pressure to computer shipment patterns over the next six to nine months.

The primary problem this time is likely to be weakness in the financial sector. The lack of capital availability is beginning to slow capital spending and is affect new-business formations. Industrial production has been deteriorating since early in 1988, increasing general pricing pressures. The chance that a there would be no recession, or a mild one, is diminished by an increasingly progressive tax structure and less federal spending restraint than is needed. Also, the Japanese stock market decline may be signaling weaker Far Eastern growth.

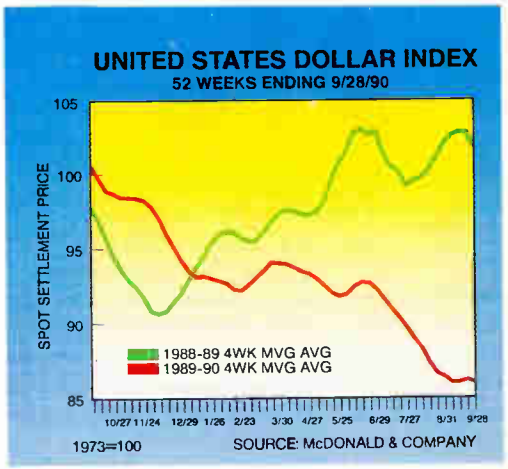
Although inputs from numerous companies confirm the existence of a broad order slowdown in September, August data from the Commerce Department also indicates signs of weakness. On a trailing 12-month basis, computer and office-equipment order growth still looks robust, but orders have been virtually flat over the past three months and declined more than 12% in August. Shipment activity is likewise very weak.

Component orders still look reasonably good due to strength in automotive and communications demand. Inventory patterns are holding up well, and backlog trends in general remain fairly stable. Currency-translation effects are offsetting weaker demand thus far, but not for much longer if current trends persist.

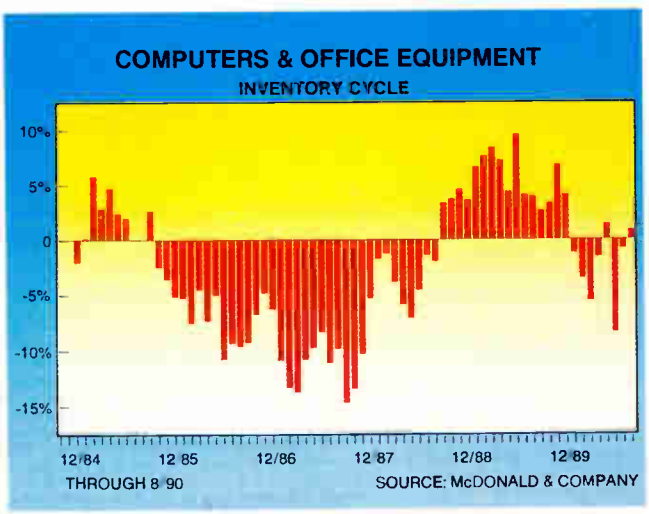
By Mark Parr, McDonald Securities Inc., Cleveland (216-443-2379)



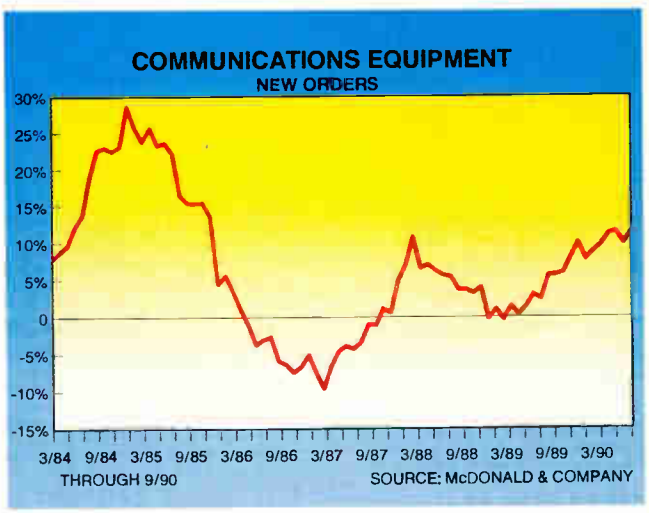
With recession looking more likely, the growth rate of the Electronics 250 declined as compared with Standard & Poor's 400.



The dollar index was relatively stable after a decline that has lasted a year.



Though the computer market still looks healthy, orders have been about flat over the last three months.



Strength in demand for communications equipment is helping to keep orders for components at a good level.

Cheaper.

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CIRCLE 217

MEIKO SCIENTIFIC INC.

PARALLEL SYSTEM USES MIX-AND-MATCH CPUs

UK FIRM SHIFTS BASE TO MASSACHUSETTS

BY LAWRENCE CURRAN

THAT MASSACHUSETTS MIRacle that Michael Dukakis proclaimed loudly during his unsuccessful 1988 presidential campaign has collapsed, but that hasn't daunted Meiko Scientific Inc. In a step that may help revive the Boston area's depressed Route 128, the five-year-old firm has moved its headquarters from Bristol, England, to Waltham, Mass., and simultaneously introduced two new parallel-processing systems.

Meiko calls its core product the Computing Surface, which embodies an expandable architecture that's probably unique in its ability to combine the Sun Sparc, Intel i860, and Inmos Transputer microprocessors in one Unix-based parallel-processing platform. Several nodes can be linked to deliver from 10 million floating-point operations/s to more than 5 gigaflops.

Meiko isn't well known in the U. S., but it has installed nearly 300 systems in the UK and Europe and 25 in America, says Robert Gardner, vice president for marketing and sales in Waltham. Meiko has derived more than $40 million in revenues since spinning off from Transputer-developer Inmos Ltd. in 1985, Gardner says, and it expects 1989 revenues of about $10 million to double this year.

That expectation may be unrealistic, says Charles Casale, president of the Aberdeen Group, a Boston market research house. "You can't even grow 15% to 20% in today's market without outside capital. And few people have heard of Meiko. But [president] Dick Bloch is well known in the computer business—and they have an intriguing system." The concept is something the industry has been looking for, he says. "It's almost

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like the Holy Grail because of the ability to mix and match processors." Casale says he knows of no other system that supports different microprocessors in one chassis.

Meiko's president, Richard M. Bloch, holds the patent for parity checking, a technique to examine computer data for errors, which he invented when he was general manager of Raytheon Co.'s Computer Division. He also patented the basic bar-code technology while he was vice president of technical operations at Honeywell Inc. Further, Bloch and computer pioneer John von Neumann are co-holders of a patent for a mathematical method of determining the blast effect of nuclear explosions.

More recently, Bloch was chairman, president, and chief executive officer of AI Corp. in Waltham, one of the few successful companies specializing in artificial intelligence.

There are two versions of the Meiko system—an Engineer's Computing Surface and an Embedded Real-Time Computing Surface. The engineer's model uses any combination of the T800 Transputer, i860, or Sparc chip in the same chassis. Users assign each of these reduced-instruction-set computing chips to the task it does best.

For example, Gardner says that a 64-processor engineer's version can be partitioned into one 32-processor T800-based subsystem to run a large numerical application, a 24-processor i860-based section to run smaller programs, and two three-processor Sparc-based subsystems, all of which execute different programs simultaneously.

An entry-level 10-megaflops engineer's system—including a Sun Microsystems Inc. Sparcstation host, four T800s, and Meiko's Surfaceware software environment—sells for about $50,000. Applications include high-performance engineering and scientific tasks, such as simulation, modeling, and design automation. The embedded version starts at about $30,000.

Bloch says most design and manufacturing will remain in England for now, although some of the most advanced systems are already being designed and built in Waltham. Eventually, he says, "We expect to increase the amount of engineering and manufacturing we do in the United States, but we believe that splitting product development between the U. S. and England helps keep people up to date on emerging technologies." E

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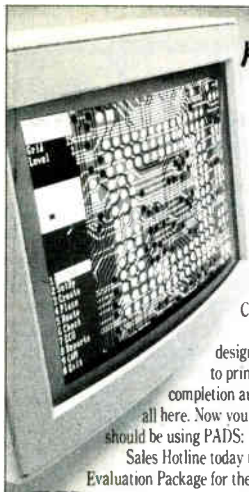

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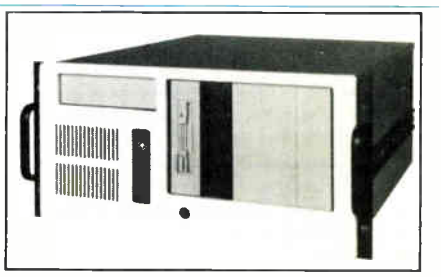

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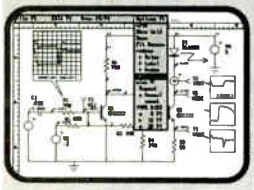

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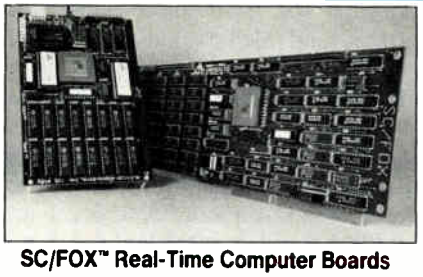

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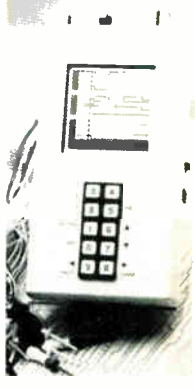

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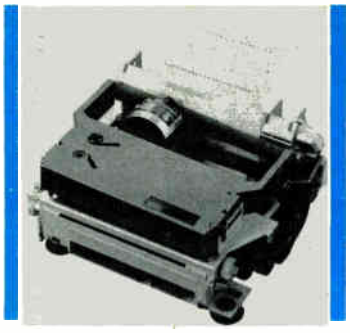

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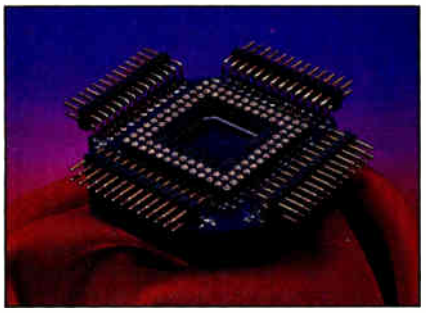

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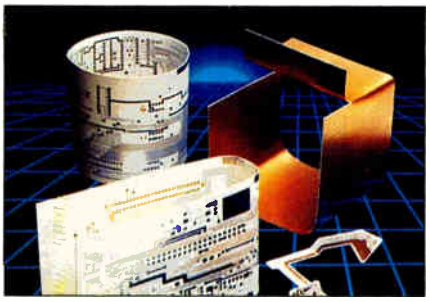

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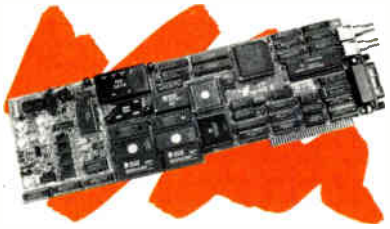

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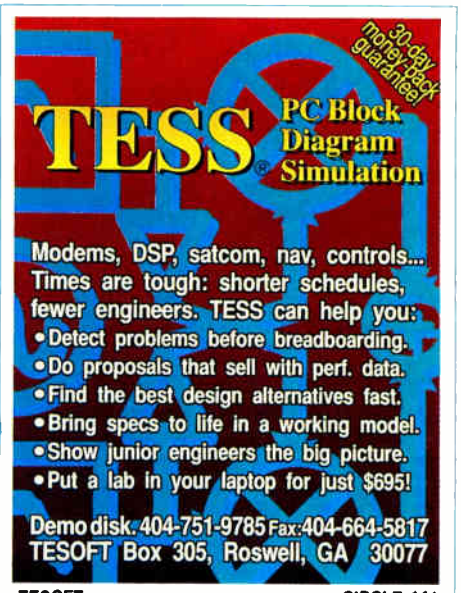

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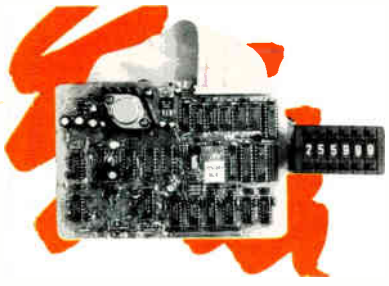

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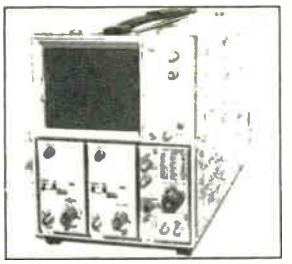

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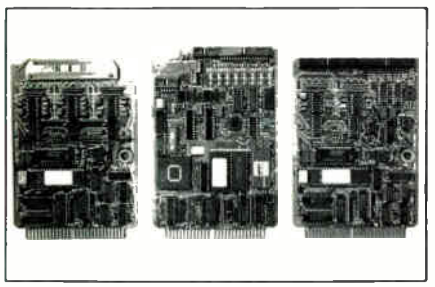

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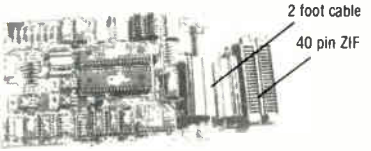

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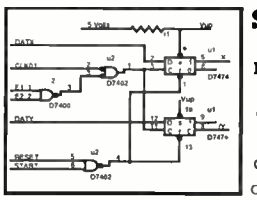

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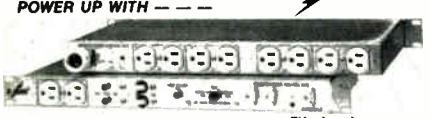

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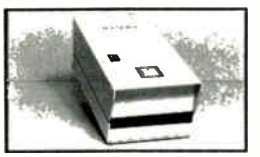

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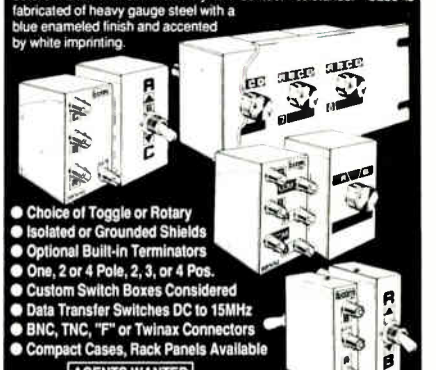

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