E CHASES SPEED PAGE 67

A PENTON PUBLICATION SEPTEMBER 1990

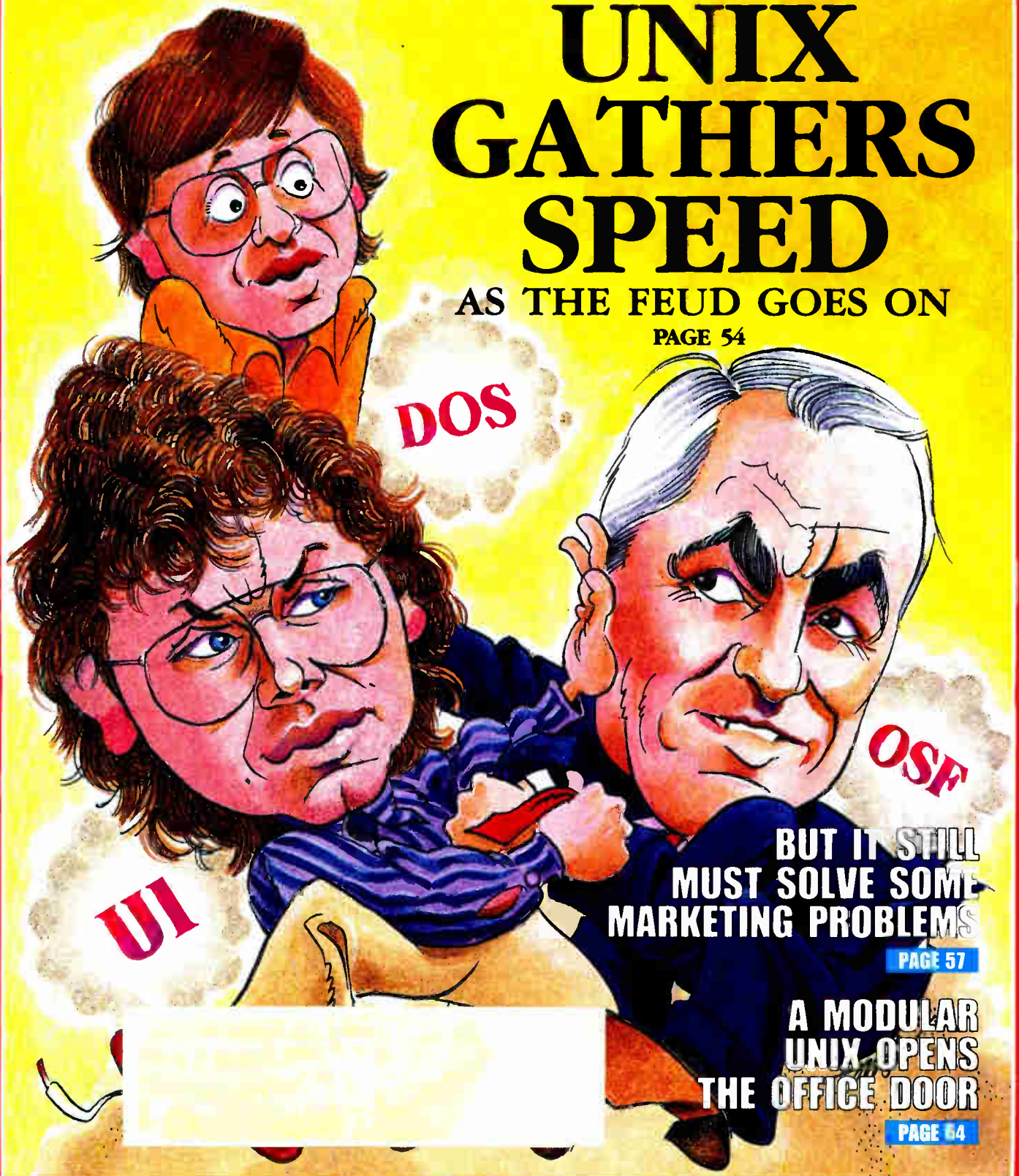
Electronics

FIRST MAGAZINE OF GLOBAL ELECTRONICS MANAGEMENT

UNIX GATHERS SPEED

AS THE FEUD GOES ON

PAGE 54



BUT IT STILL MUST SOLVE SOME MARKETING PROBLEMS

PAGE 57

A MODULAR UNIX OPENS THE OFFICE DOOR

PAGE 64

Looking
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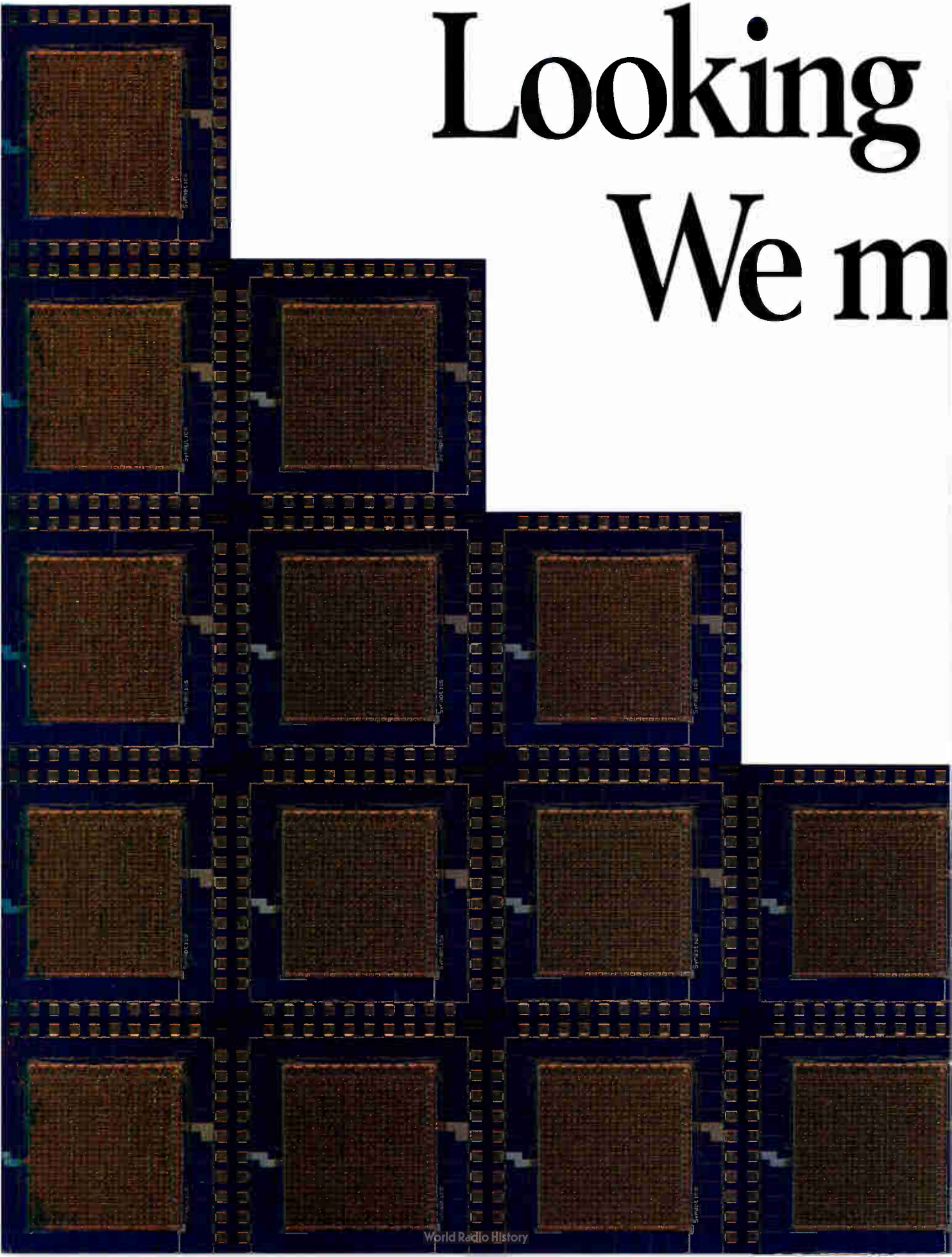

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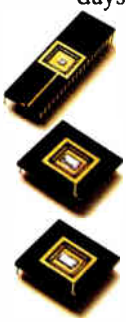

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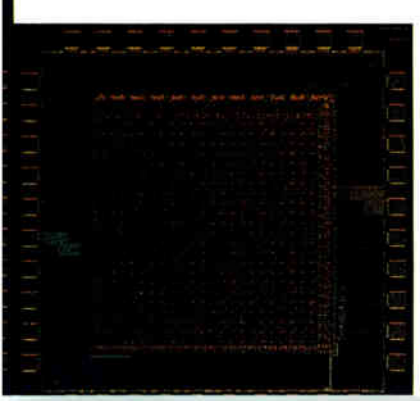

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CIRCLE 207

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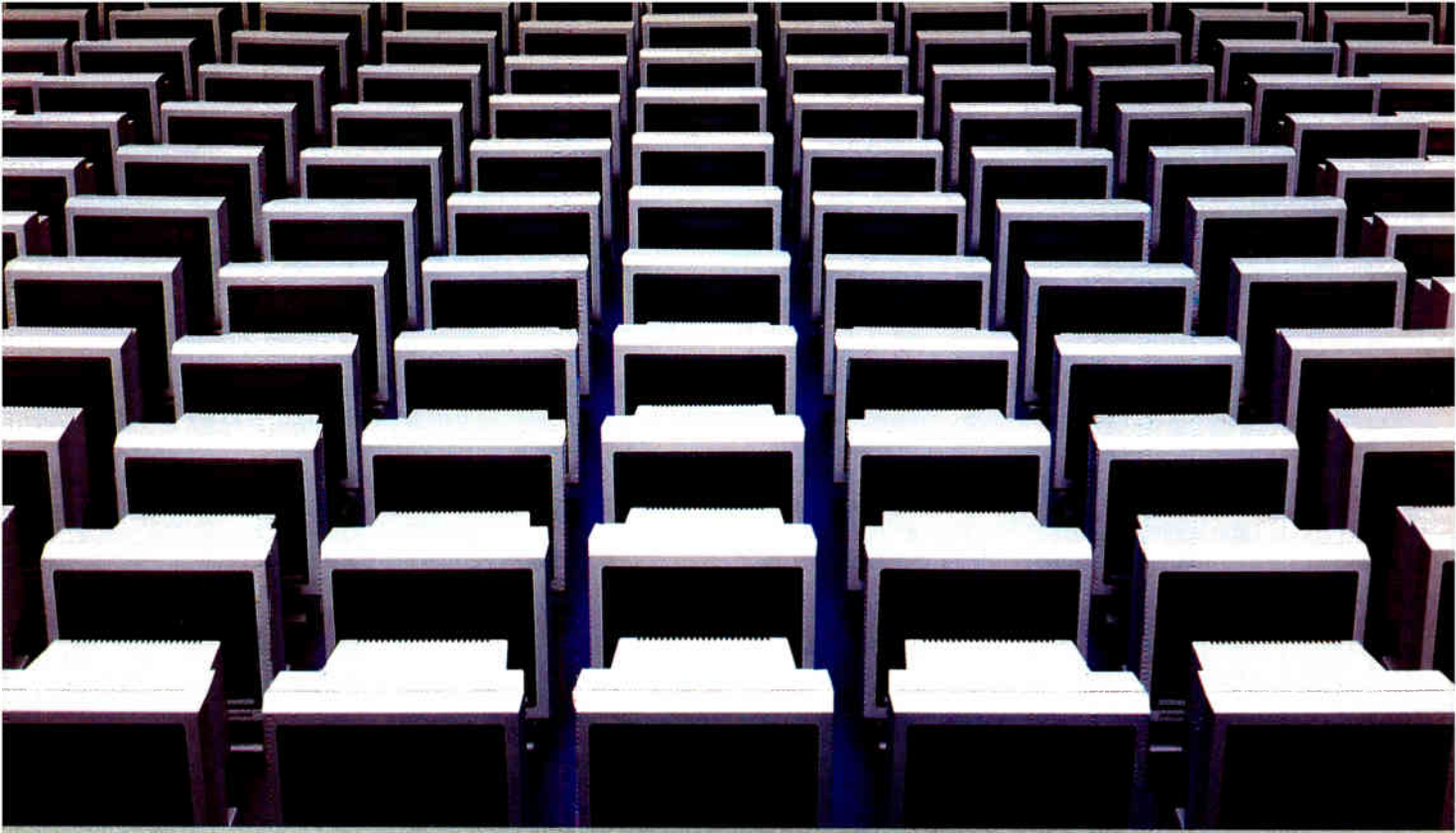

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CIRCLE 212 FOR SALES CALL

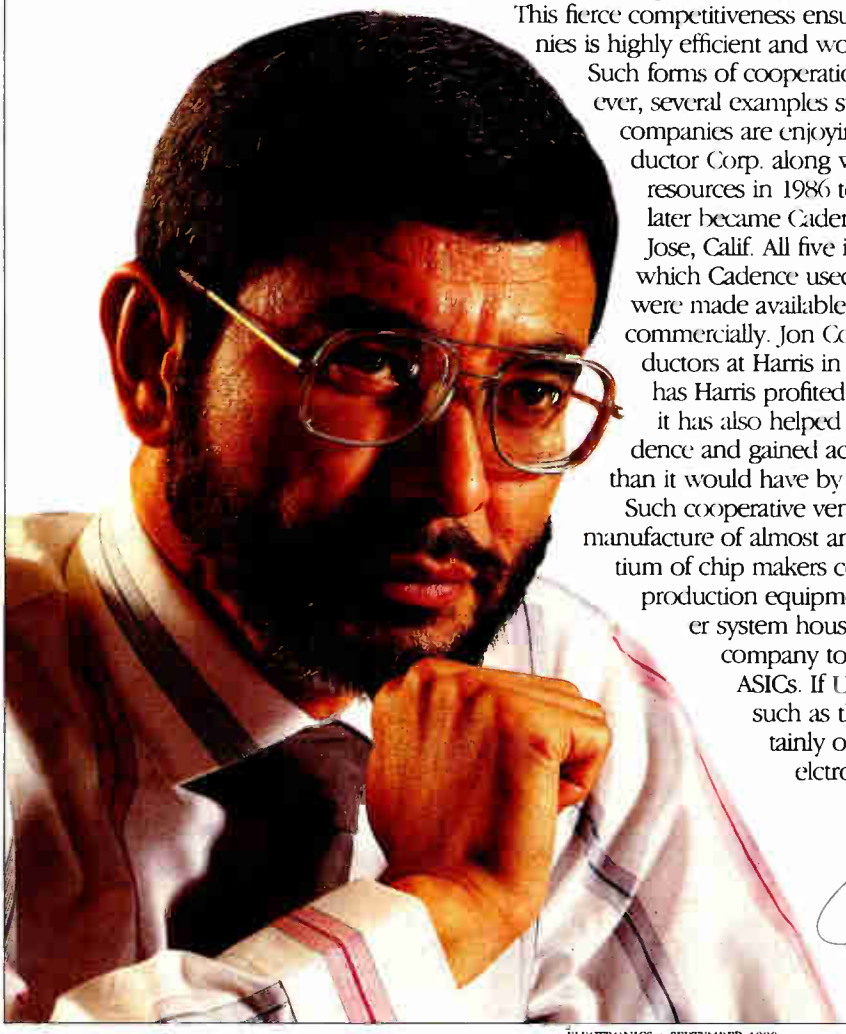
CIRCLE 213 FOR LITERATURE

DOES 'KEIRETSU' WORK?

In their dazzling push to the top of international markets, Japanese electronics companies have had the advantage of government sanctions that nourish the large *keiretsu*—societies of business. The keiretsu are groups of diverse companies with common interests that pool resources and cooperate to win market share. Detractors claim such government involvement wouldn't work in the U. S.—that it would simply transfer public funds into the hands of large, inefficient companies already well entrenched in the industry. The real key to success is unfettered market competition, they say. But the reality as practiced by the Japanese makes room for both.

In the July–August issue of the *Harvard Business Review*, Charles H. Ferguson, research associate at the Massachusetts Institute of Technology, explains that a keiretsu is usually built around a central company, typically a bank or supply company, that resembles the U. S. conglomerate of the 1960s and 1970s—a central holding company such as ITT that controlled a number of companies in other industries. Members of the keiretsu have ownership in one another and interlocking directorates, so top management cooperates for mutual benefit. Thus keiretsu can minimize risk and develop strategic technologies for the long term. Through mutual ownership, member companies have access to capital, complementary technology, and guaranteed markets. For example, Ando Electric, 51.2% owned by NEC Corp., sells its test equipment to the NEC keiretsu.

Conventional wisdom would suggest that the keiretsu would be self-defeating, that member companies assured of long-term financing and a guaranteed customer base would grow complacent. What keeps this from occurring is that one keiretsu competes with several others: Ferguson points out that nine companies and their associated keiretsu compete in the semiconductor and electronics markets. This fierce competitiveness ensures that each enclave of companies is highly efficient and world-class competitive.



Such forms of cooperation are anathema in the U. S. However, several examples suggest ways that U. S. electronics companies are enjoying similar synergy. Harris Semiconductor Corp. along with four other companies pooled resources in 1986 to jointly fund the company that later became Cadence Designs Systems Inc. of San Jose, Calif. All five investors contributed technology, which Cadence used to develop new products that were made available to the investors and also sold commercially. Jon Cornell, vice president of semiconductors at Harris in Melbourne, Fla., says that not only has Harris profited handsomely from the investment, it has also helped direct tool development at Cadence and gained access to these tools much sooner than it would have by developing them in-house.

Such cooperative ventures can also be applied to the manufacture of almost any product. For example, a consortium of chip makers could invest in a semiconductor production equipment company. A group of computer system houses could invest in a semiconductor company to produce RAM memory and ASICs. If U. S. companies do not take actions such as these, the keiretsu of Japan will certainly outperform them in every aspect of elctronics, from systems to chips. E

Jonah McLeod

JONAH McLEOD
EDITOR

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Electronics

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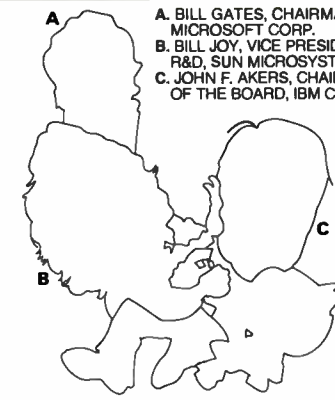

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DEPARTMENTS

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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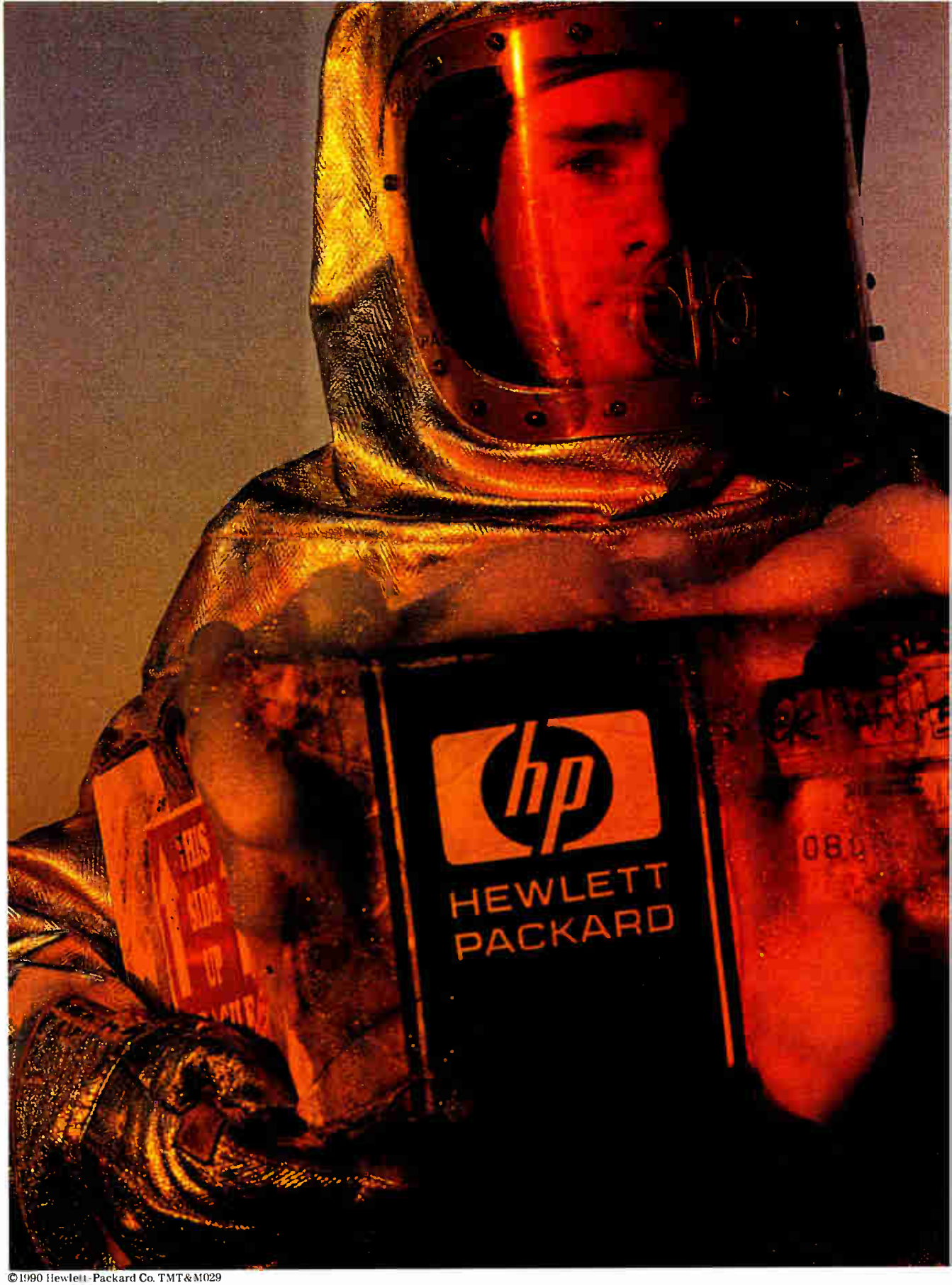
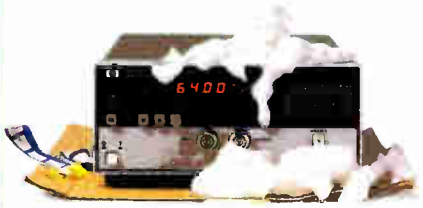


Did you hear about the optical attenuator that fell from the sky?



It hit the ground running.

"Roger, Falcon 20, you're cleared for landing. Braking action advisory. Ice on the runway." The veteran pilot of the cargo plane had landed at Link Field before, but the tower's report was a cold reminder that the airstrip ended in a 75-foot cliff.

On touchdown, the jet skidded out of control. Within seconds, it shot off the cliff like a ski jumper and tumbled down the steep embankment, cargo flying in all directions.

Minutes later, rescue teams were helping the pilot and co-pilot from the wreckage. The pungent smell of jet fuel filled the air, so crews sprayed fire-retardant foam on everything. Including an HP optical attenuator which was on its way to a customer.

Two days later, our customer received the instrument. Fostering little hope, their engineers ran routine tests anyway. The optical attenuator not only survived, it passed all specifications.

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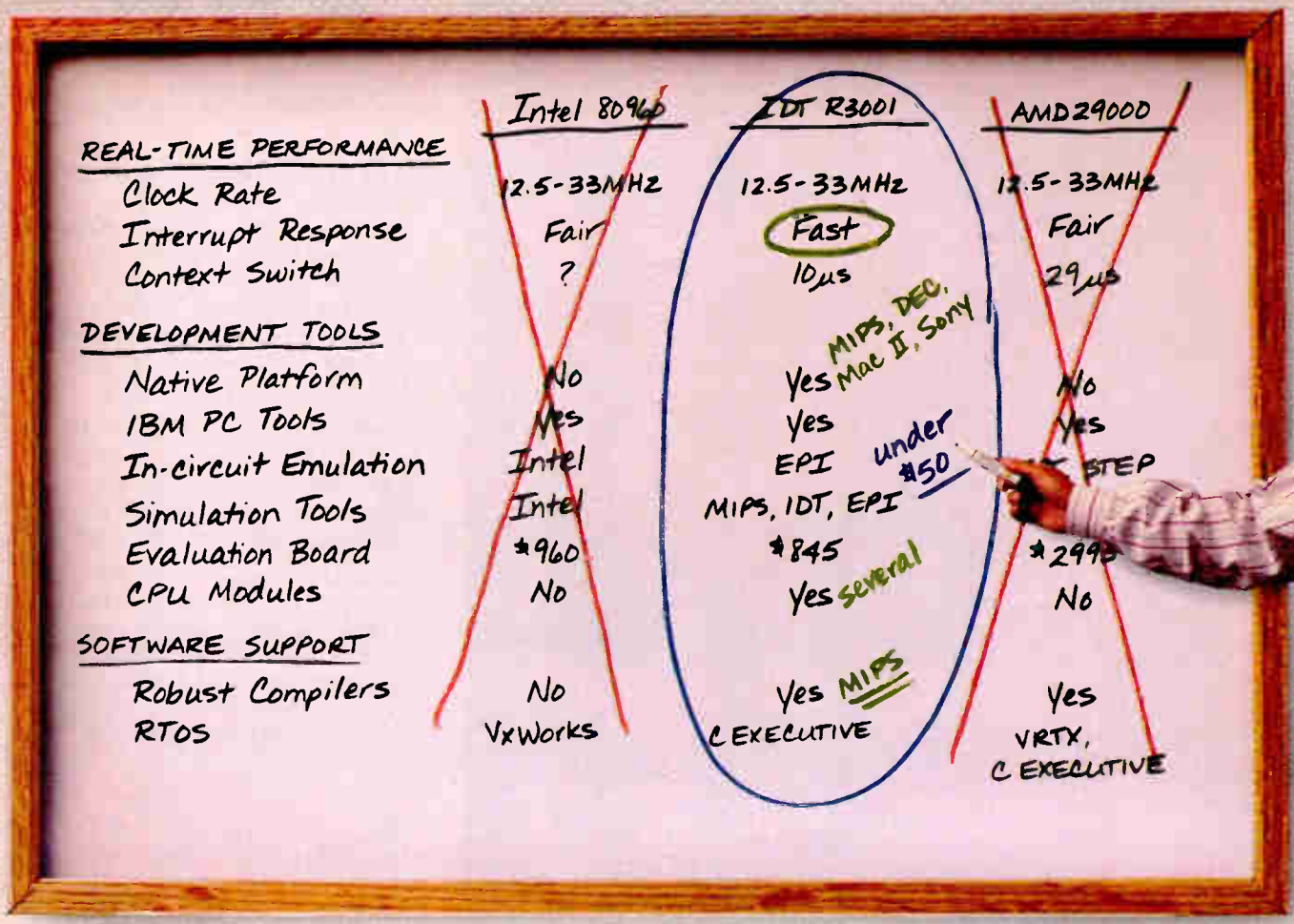
CIRCLE 199

Embedded RISC

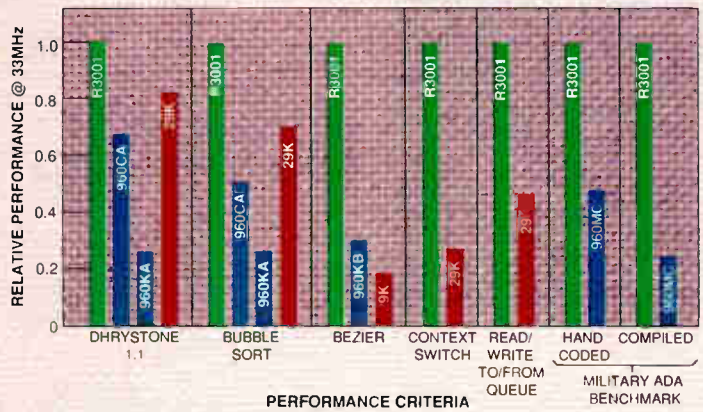


Get the Facts

When evaluating RISC processors for embedded applications, you need real benchmark data from independent sources. The *R3001 Performance Comparison Report* is a collection of the original third-party data used in the graph below.

Benchmark Your Code

Of course, we know that published data can't give you all the information. You'd prefer to perform benchmarks for your specific application, and our six technology centers are equipped to do just that — bring us your code and we'll run your benchmarks!



Sources: *Electronic Engineering* Magazine, *High-Performance Systems* Magazine, *Microprocessor Forum* Conference Fall 1989, *Independent Assessment Benchmark Report* Atlantic Research Corporation

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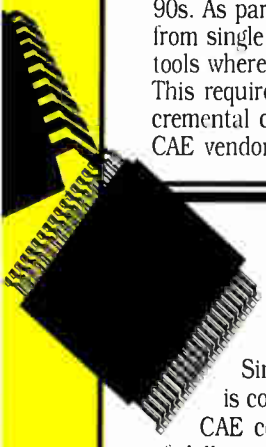
CIRCLE 175

CAE Technology Report

September 1990
Vol. 2 No. 7

CAE Industry Undergoing Major Changes

The leader of the CAE industry, Mentor Graphics™, has projected a drop in revenue for the second quarter of 1990. Inasmuch as this has concerned some analysts, it is only a reflection of the transition to a new generation of CAE tools required by the technologies of the 90s. As part of this transition, CAE tools are evolving from single operation programs to concurrent design tools where several tasks can be worked on in parallel. This requires a shift from batch compilation to incremental compilation—a major undertaking for any CAE vendor.



Concurrent Design—Fad or Reality?

Since many technologies have come and gone, is concurrent design yet another fad? Leading CAE companies are committing tens of millions of dollars to the development of such tools which are expected to dominate the CAE industry within a few years. Concurrent design tools will typically sell for $100,000 and more. However, ALDEC, Inc. of Newbury Park, CA offers the VHDL-based SUSIE* Concurrent Designer™ for under $10,000. SUSIE allows concurrent design and simulation of logic designs that include PGAs, PLDs, etc. The 386 PC-based SUSIE converts any schematic into an exact electronic breadboard in a matter of seconds. SUSIE is fully interactive; you can toggle switches, move jumpers, load JEDEC fuse maps, etc. like real hardware. SUSIE is sold in turn-key packages with most installations ranging between $6,000 and $10,000.

Circle 102

Now XILINX™ Parts Are Easier to Use

Nobody could envision a few years ago that field programmable gate arrays (FPGAs) would do away with discrete logic so quickly. However, FPGAs offer major advantages: easy system level design, quick modifications and large PC board space savings. The most widely used FPGAs are XILINX parts.

XILINX development tools have been recently complimented by the powerful SUSIE/PGA ($1,995) from ALDEC which allows simulation of XILINX parts in real-time. SUSIE is closely integrated with XILINX development tools and allows concurrent cell editing and simulation and instantly emulates new cell placement. **Circle 105**

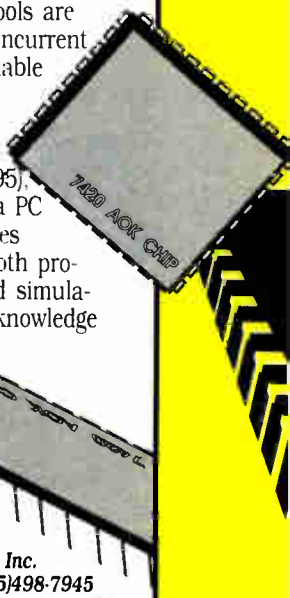
IC Modelling Becomes More Reliable

Most CAE vendors are making a strong commitment to the VHDL standard. With this and because VHDL compilers are less prone to human error, the new generation of IC models should be much more reliable than their predecessors. ITEX™ (805-499-6860) is specializing in selling VHDL IC modelling tools and IC models for the SUSIE logic simulator. ITEX contracts modelling work to independent developers, then verifies models and resells them over its own BBS network. This process will result in an abundance of IC models for users of the SUSIE logic simulator. **Circle 104**

ACTEL™ Programmable Gate Arrays Grow Stronger

ACTEL's market share will grow quickly now that new and easy-to-use design development tools are available. Two VHDL-based products for concurrent design and simulation of ACTEL programmable gate arrays have been released by ALDEC. SUSIE/ACT ($1,995) is a turn-key system for single chip development and simulation. The second product, ACT Library ($995), allows for development of ACTEL parts in a PC board environment. The ACT Library requires SUSIE-CD ($5,990). The major feature of both products is concurrent design modification and simulation without any compilation. No software knowledge is required to use either product.

Circle 103



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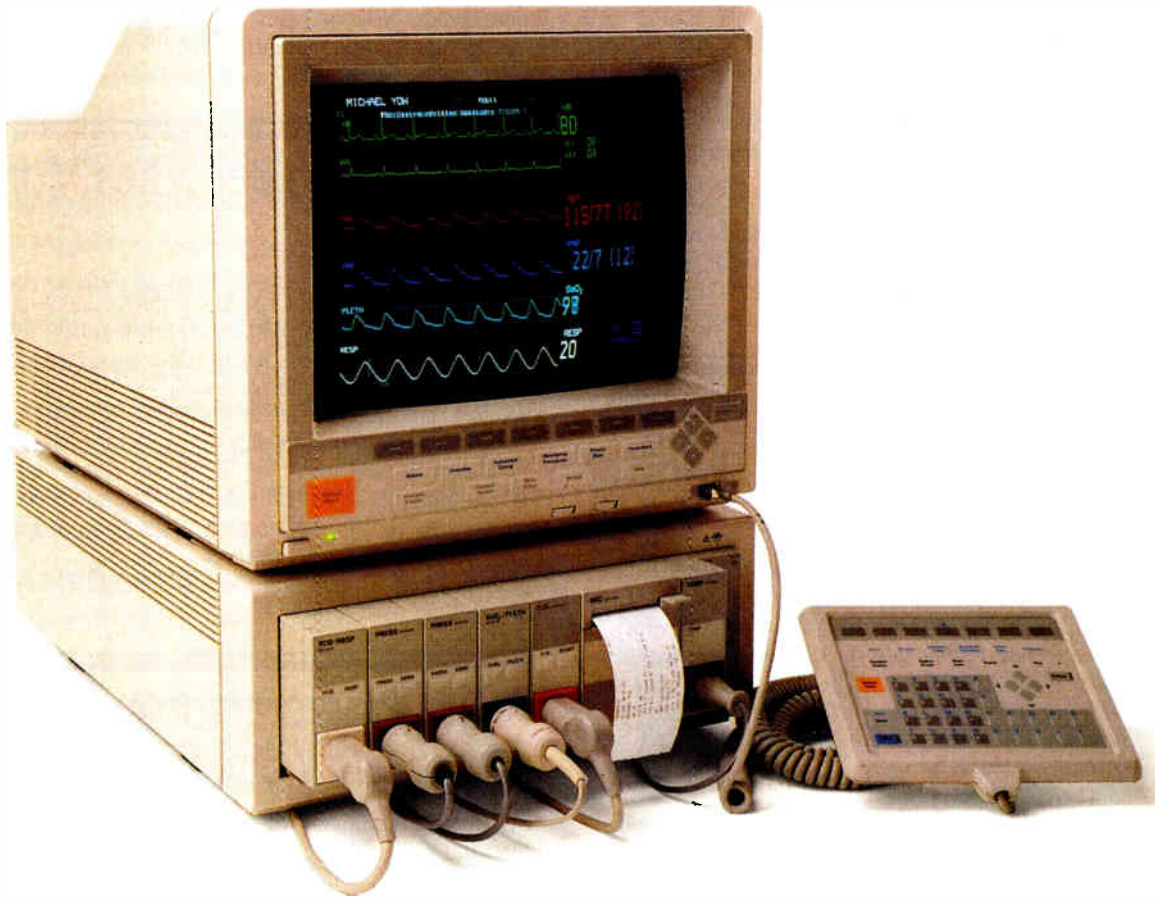

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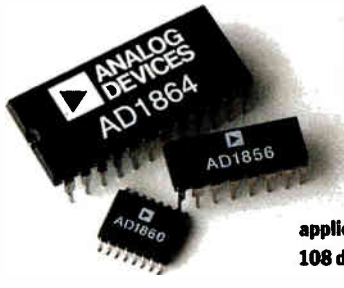

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CIRCLE 216

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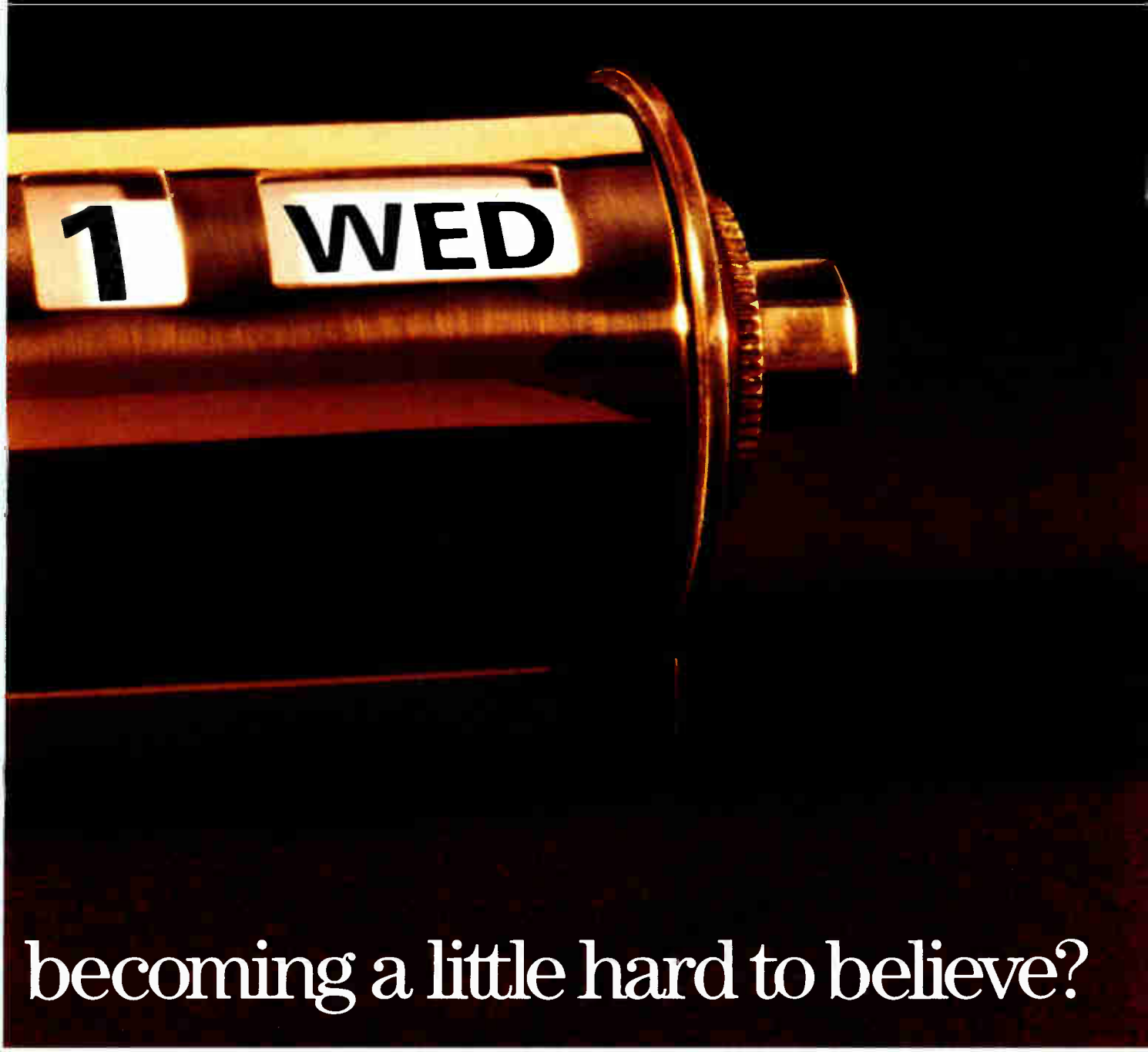

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CIRCLE 218

LETTER FROM

COLORADO

ON SILICON MOUNTAIN, DATA STORAGE IS THE KEY

NEW OPTIMISM IN THE ROCKIES

BY FRANCIS LAVOIE

BUSINESS HASN'T BEEN great among the high-tech companies in the Colorado Springs, Colo., area. Defense cutbacks have hurt, and there are scores of stories about engineers arriving in the area full of hope, only to find jobs driving cabs or waiting tables.

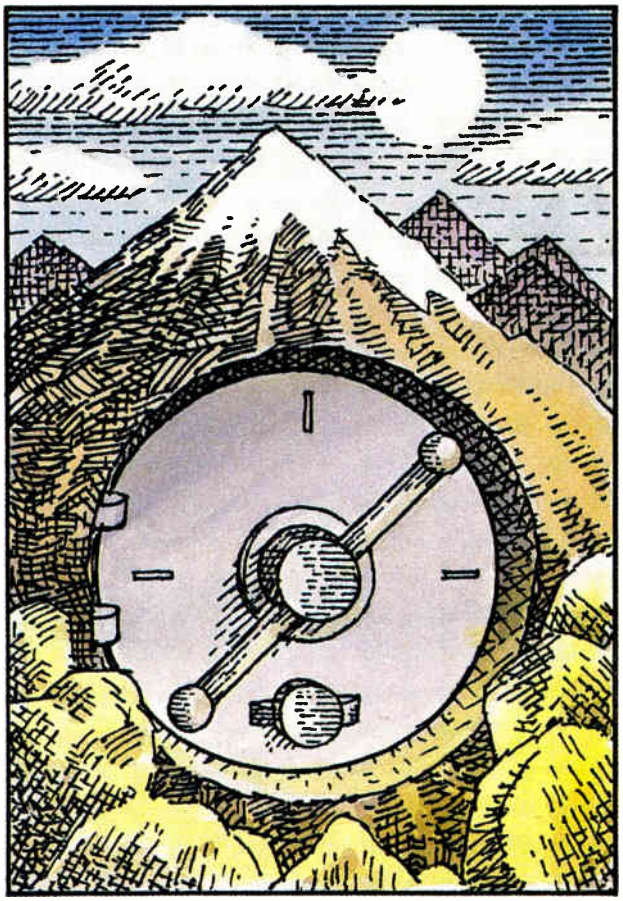
Still, there is a new feeling of optimism in the area these days. Nowhere was it more evident than at the fifth Silicon Mountain Symposium, an annual gathering designed to burnish the images of the electronics companies clustered there. Much of the good feeling can be traced to the promise of a bright future for the data-storage business, and for Colorado's part in it.

At the symposium, representatives of a dozen or so companies came mostly from Colorado Springs and its environs, but they brought a breadth of expertise that was global in scope. And they provided a grand tour of the state of the art in semiconductor memory technology.

Perhaps the most interesting—and significant—discussions centered around the future of nonvolatile memories. Most of the speakers agreed with Simtek Corp. president Richard Petritz that nonvolatility "is the next dimension in semiconductor memory." But if that was the general agreement, there was no such consensus on how best to achieve it. Some manufacturers are adapting established technology, aiming to solve some of the limitations of current nonvolatile memories. For example, Simtek is relying on its proprietary Novcel technology to lower cost and raise reliability.

Perhaps the most interesting—and, some say, promising—technology discussed at the symposium was the use of ferroelectric materials. One champion of ferroelectronics is Ramtron Corp. of Colorado Springs (see p. 23).

Although much of the symposium was devoted to semiconductor memory, magnetic-disk and tape memory came in for their share of attention. According to Dataquest Inc.'s Phil Devin, associate director of the San Jose, Calif., market researcher's computer storage industry service, both markets are still growing. In the case of tape drives, that growth will take place in the 8-mm, 4-mm, and DC-2000 sectors.



One company that has tied its wagon to the 8-mm tape star is Exabyte Inc. of Boulder. Founded in 1985, Exabyte has already seen its revenues grow to $89 million in 1989, with $175 million forecast for 1990.

In magnetic disks, although the 5.25- and 3.5-in. sizes are expected to dominate in the near term, there's considerable interest in the 2.5-in. size. Prairietek Inc., a four-year-old Longmont company, is one that believes in the future of the 2.5-in. disk. Its 20-Mbyte, 60-oz. Prairie 120, the first 2.5-in. disk drive, was designed for notebook and laptop computers.

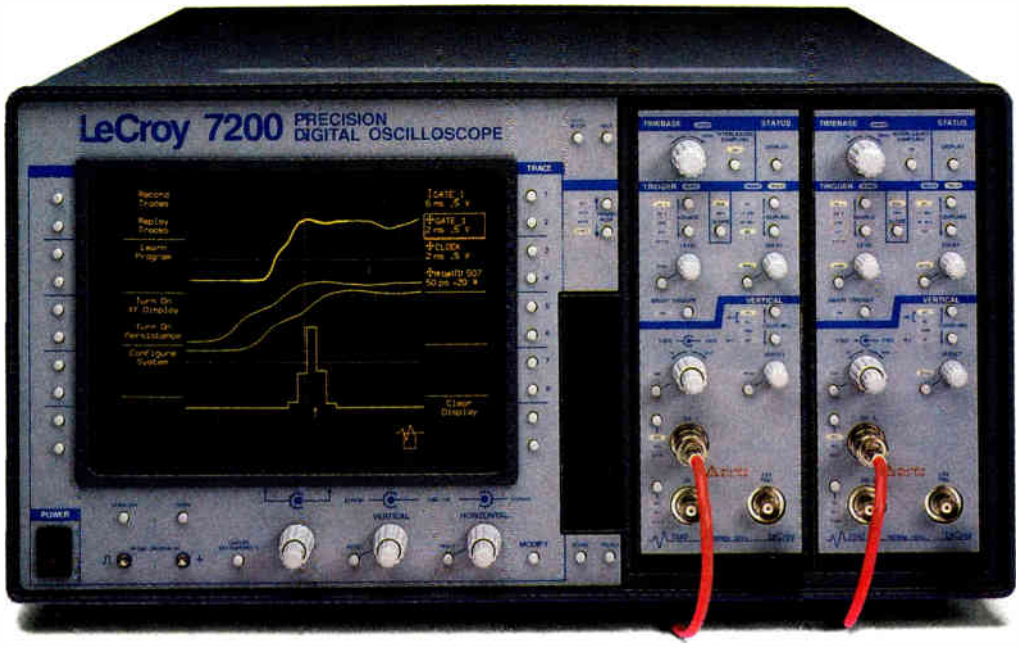
Devin offers a few caveats in the face of his generally optimistic outlook. He feels that there is confusion in the marketplace, with too many vendors competing. This will lead to a shakeout, says Devin, with the survivors being the service-oriented vendors. Also, there is the threat of competing technologies, mainly optical.

According to Devin, the rewritable optical-disk business will continue to expand, with the 5.25-in. size growing from about 30,000 shipped in 1989 to more than 600,000 in 1994. By then, the 3.5 in. will have reached 250,000 units.

The "bright and shining star" in optical-disk drives is the CD-ROM, which, says Devin, will acount for some 40 million units by the end of the decade. Today, most optical disks are WORM drives—write-once, read-many. These disks are widely used to provide nonvolatile, high-density storage. But with WORM drives, the user cannot erase and rewrite data.

So manufacturers three years ago introduced rewriteable optical drives based on magneto-optic technology, and the battle was joined between the two approaches, with each having its unique advantages and limitations. Now, says Al McDowell of Laser Magnetic International Co., Colorado Springs, there is a third option—LMI's new Laser Drive 520, a 5.25-in. optical drive that combines both write-once and rewriteable capabilities. The multifunction drive was introduced at the symposium.

2 GIGS-A-CHANNEL!



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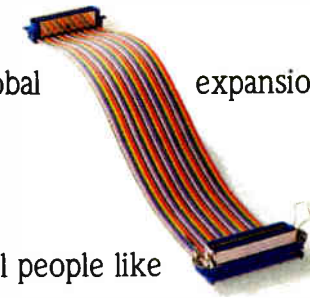
Some big names in electronics are  making big plans for global  expansion.

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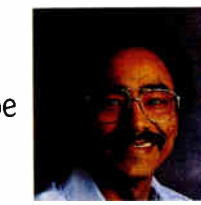
In most cases, we're right next door to major customers. So no matter how far away you go,  people like Efrain and Normand won't be  far away. That's what makes us a world class connector  manufacturer, and second to none when it comes to customer service.

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CIRCLE 227

Tiny Glitches Lead to Giant Wobbles

We take it for granted that the Earth rotates stably on its axis and that the stars are fixed in the sky above us.

Yet, Hipparchus discovered more than two millennia ago that there were very slight discrepancies in the measured positions of stars over the years. Compelled to look further, he found the difference to be greater than what could be attributed to error and analyzed it.

Hipparchus

Hipparchus realized that the position of the stars was actually shifting at a constant rate, year after year. This was later shown to be caused by the Earth slowly wobbling like a top as it turned on its axis.

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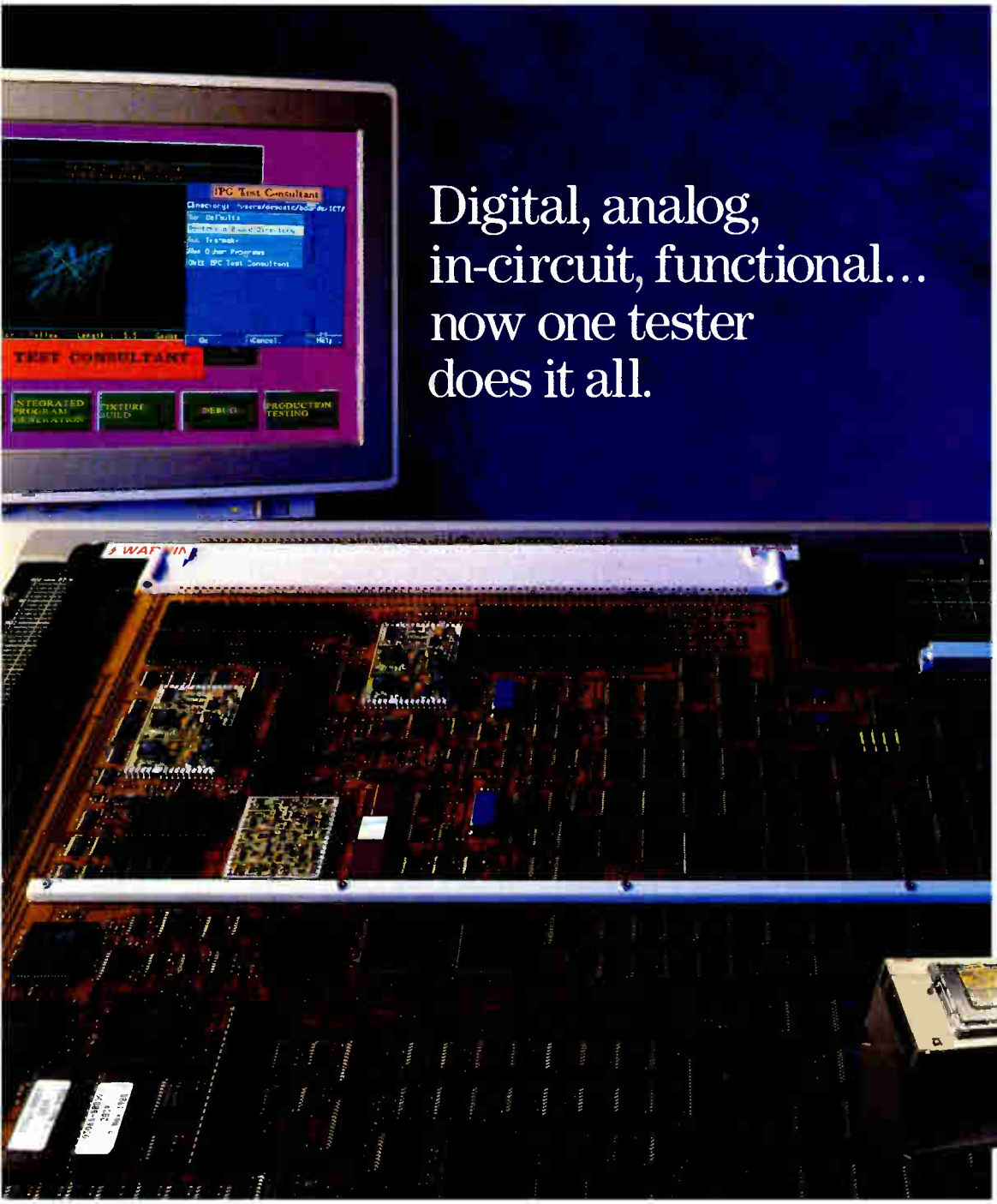
CIRCLE 171



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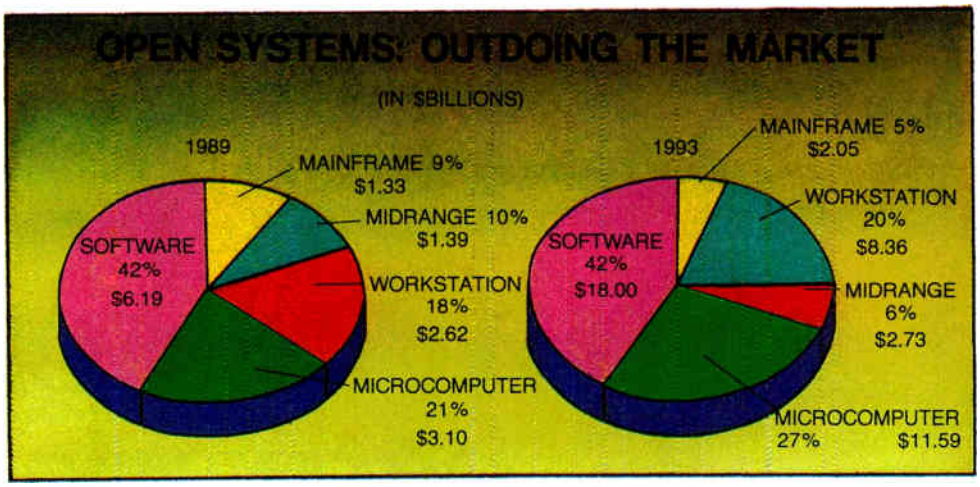
FUTURE BRIGHT FOR OPEN SYSTEMS

Illustrating the truth of the adage that if you build a better mousetrap the world will beat a path to your door, the players in the market for open computer systems can contemplate a future of unalloyed growth. That's the word from Electronic Trend Publications, the Saratoga, Calif., market-research company.

In fact, the report, "Open Systems' Impact on the Computer Industry," forecasts growth for open systems hardware and software that will outstrip that of the total computer market. By 1993, open systems' growth will be from $14.6 billion to $42.7 billion, a compound annual rate of nearly 31%, says the study. At the same time, open systems' share of the market will swell from 15% to 31%.



Greatest growth will be in the smallest computers, says the report. Sales of micros will zoom 275% in the period; workstations, 220%; midrange units (those selling for more than $50,000 to commercial and engineering users), nearly double; and mainframes and supercomputers, 54%. The largest computers will be slowest to open because proprietary firms dominate.

FERROELECTRIC MEMORY MAKER GETS A NEW HOME

If there still are any doubts about the staying power of ferroelectric memories, they should be dispelled by the opening of the first plant built especially to make the nonvolatile devices. Ramtron Corp.'s 69,000-ft² facility in Colorado Springs, Colo., can turn out 6,500 6-in. wafers a month and is equipped for pilot production of memories up to 4 Mbits with submicron features and boasts a Class 1 clean room. In addition, the new headquarters building can house up to 220 employees, more than double today's staff of 90.

Ramtron, which was founded in 1984, is currently turning out 256-Kbit memories in its ferroelectric family. It has dubbed the parts FRAM, for ferroelectronic random access memory.

SIEMENS, SGS-THOMSON ARE STILL TALKING MERGER

Those rumors of a merger between Siemens and SGS-Thomson Microelectronics have surfaced again, this time in a weekly trade tabloid. Here's the story: Siemens AG confirms that it has been talking to a number of potential partners, among them SGS-Thomson Microelectronics. The idea is to make Europe stronger in semiconductors, "something more immediate and substantial than Jessi," according to company insiders. Jessi is the European Community-sponsored Joint European Submicron Silicon Initiative.

For Siemens, two models of cooperation with SGS-Thomson are feasible. First, efforts to work together in specific fields, as is already being done in microcontrollers [*Electronics*, May 1990, p. 54], may be intensified and extended to encompass other semiconductor devices such as memories. SGS-Thomson is said to be interested in getting into the market for dynamic random-access memories; Siemens is already there. Second, cooperation could widen across the board in semiconductors or even an outright merger of the two firms' activities in the field.

Meanwhile, Europeans, despite rosy forecasts, worry about the future of their chip industry. A Siemens official declares, "It must be Europe's goal to concentrate its forces. Something must be done."

SILICON-ON-INSULATOR ICs GO COMMERCIAL

What are believed to be the first commercially available high-performance ICs made with a silicon-on-insulator material have reached the market in the form of two diode arrays manufactured by Silicon General Semiconductor Inc., Garden Grove, Calif. The devices are fabricated on SOI wafers made by Kopin Corp., Taunton, Mass., and are the first SOI-based components to receive the Joint Army-Navy MIL-S-19500/474 qualification from the Defense Electronics Supply Center.

Because of their sturdy insulation layers, SOI substrates allow much higher voltage, higher density, and better radiation resistance in the active devices fabricated in them than are possible with conventional silicon substrates. Kopin grows a thermal oxide on silicon, deposits a polycrystalline layer, then recrystallizes the poly layer into a single-crystal silicon thin film.

FDDI.
From deskwork to network.

Good news for networks!

The X3T9.5 Task Group, under the procedures of ANSI Accredited Standards Committee X3, has reaffirmed approval of the Media Interface Connector (MIC) for the proposed FDDI (Fiber Distributed Data Interface) Physical Layer Medium Dependent (PMD) document.

More good news! AMP has the complete fiber optic interconnection system—the AMP OPTIMATE Fixed Shroud Duplex System—that meets all FDDI PMD requirements. And includes all the physical components you need to make your fiber optic network a reality.

Of special note: the transceiver is capable of operating at data rates up to 125 Mb/s. Available in standard or raised (+5v) ECL logic, it gives you a compact, board-mount data link in an industry-standard 22-pin package. Reliable duplex mating and electro-optic conversion are now easier than ever.

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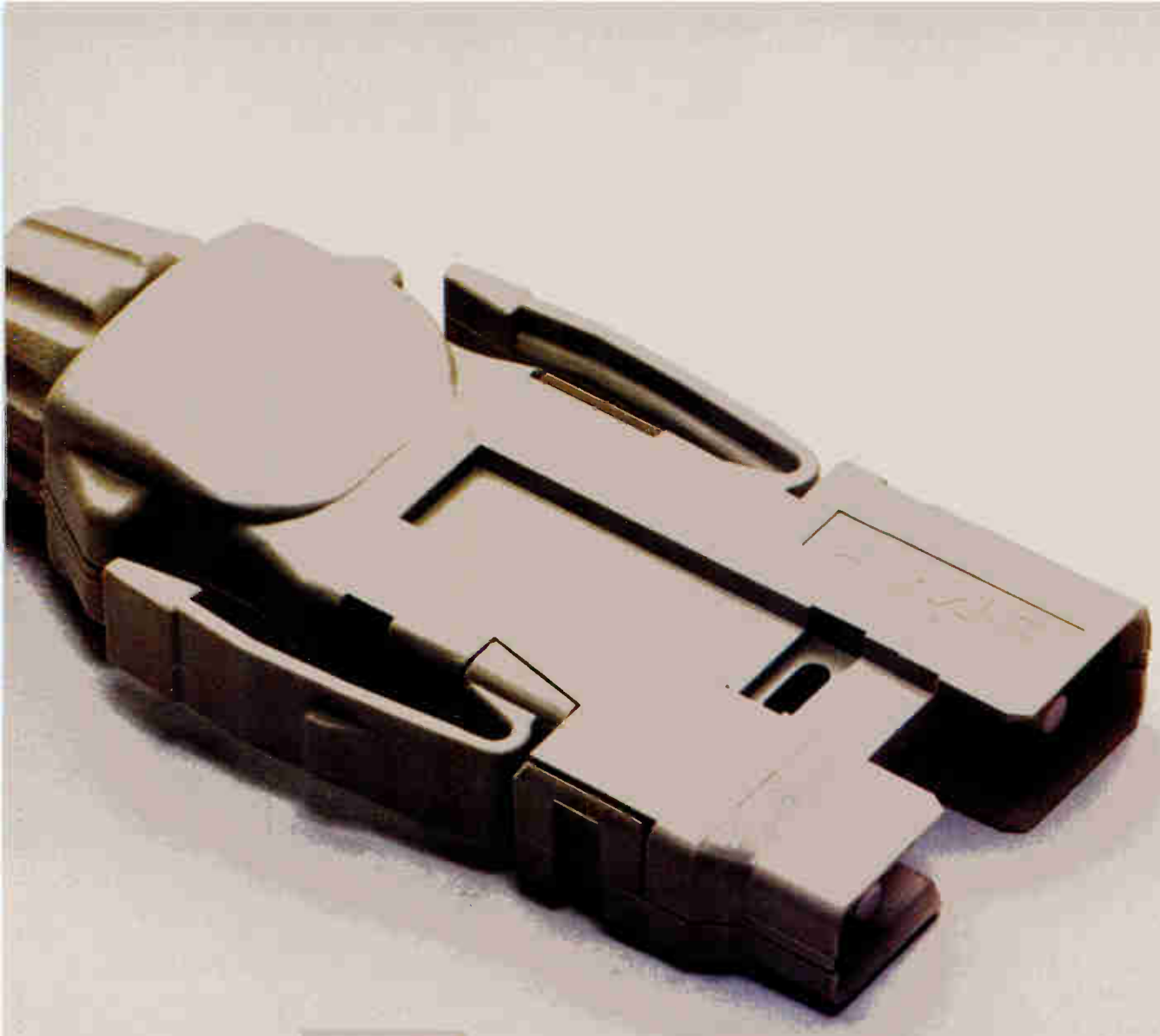
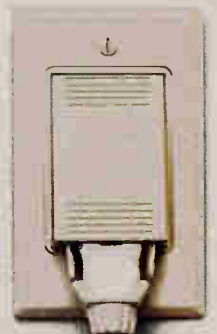
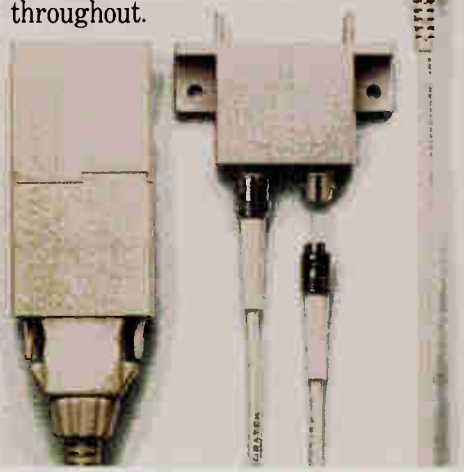


All system components, in fact, are easy to install and reconfigure. Our field termination kit makes short work of attaching duplex connectors to fiber cable. And because all interconnections use a floating interface, you get consistent, low-loss mating (0.6 dB typical) throughout.





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CIRCLE 172

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CIRCLE 193

TO WATCH

RADIUS ADDS TV TO THE MAC

The convergence of the computer and the TV has won another convert: San Jose, Calif-based Radius Inc., a leading manufacturer of high-res display monitors and software.

Using Apple Computer Inc.'s Macintosh II as its platform, the RadiusTV System lets users display broadcast TV, videotape, or videodisk signals in a window. Digitized video resolution is 640 by 480 pixels, while the audio component is handled through the Mac's sound system.

Video images can be saved and manipulated with 15 special effects. Lingo, a multimedia authoring language from Macromind Inc., San Francisco, Calif., provides overall system control. Available now, RadiusTV prices start at $3,000 including software.

By integrating video and audio into a single system, Radius makes multimedia development easier.

ACCULIN IC OUTRUNS SAMPLE-AND-HOLD CHIPS AND HYBRIDS

Acculin Inc.'s monolithic, 12-bit sample-and-hold amplifier's 7.5-ns acquisition time for 8-bit samples establishes a new performance standard, claims the Natick, Mass., startup.

The closest monolithic IC competitor runs at just 25 ns, while the closest hybrid competitor offers 20 ns, says Acculin. At 8-bit accuracy, the chip delivers 100 megasamples/s. At 12-bit accuracy, it handles 50 megasamples/s.

Fabricated in a complementary bipolar process, the AL1220 targets high-speed flash analog-to-digital converters in data-acquisition systems for radar and intermediate-frequency imaging.

The price for commercial-grade devices will be $95 each in quantities of hundreds when production volumes become available later this month.

MATROX DOES WINDOWS—WITH GUSTO!

Personal computers running graphical applications under X Windows or Microsoft Corp.'s Windows 3.0 or Presentation Manager can boost display speed, as well as color and resolution performance with Matrox Electronic Systems Ltd.'s M-WIN Series of graphics boards.

The accelerator boards basically offload window manipulation from the host microprocessor for any standard-architecture IBM-compatible microcomputer. Matrox has developed state-of-the-art software drivers for each of the three windowing environments.

The hardware is built around Western Digital Corp.'s 8514/A chip set. The M-WIN 1280 displays up to 256 screen colors from a palette of 16.7 million colors and contains a 2-Kbyte-by-2-Kbyte frame buffer for on-board storage of fonts, icons, and cursor bit maps.

Applications compatible with IBM Corp.'s 8514A standard—such as Lotus 1-2-3 and WordPerfect—can display screens at a resolution of 1,024 by 768 pixels and still execute much faster than if the host had to perform windows rendering.

Matrox has included driver switches that can boost the resolution to 1,280 by 1,024 pixels. The Dorval, Canada, firm says that, priced at $2,495, the board offers performance similar to that of products based on the Texas Instruments Inc.'s popular 34020 graphics chip at about half the cost.

ROCKWELL MODEM ICs CALL ON EUROPE

The latest version of Rockwell International Inc.'s innovative 2,400-bit/s modem chips adds European call-progress and blacklisting to the Newport Beach, Calif., company's chips with CCITT-endorsed data compression and error detection.

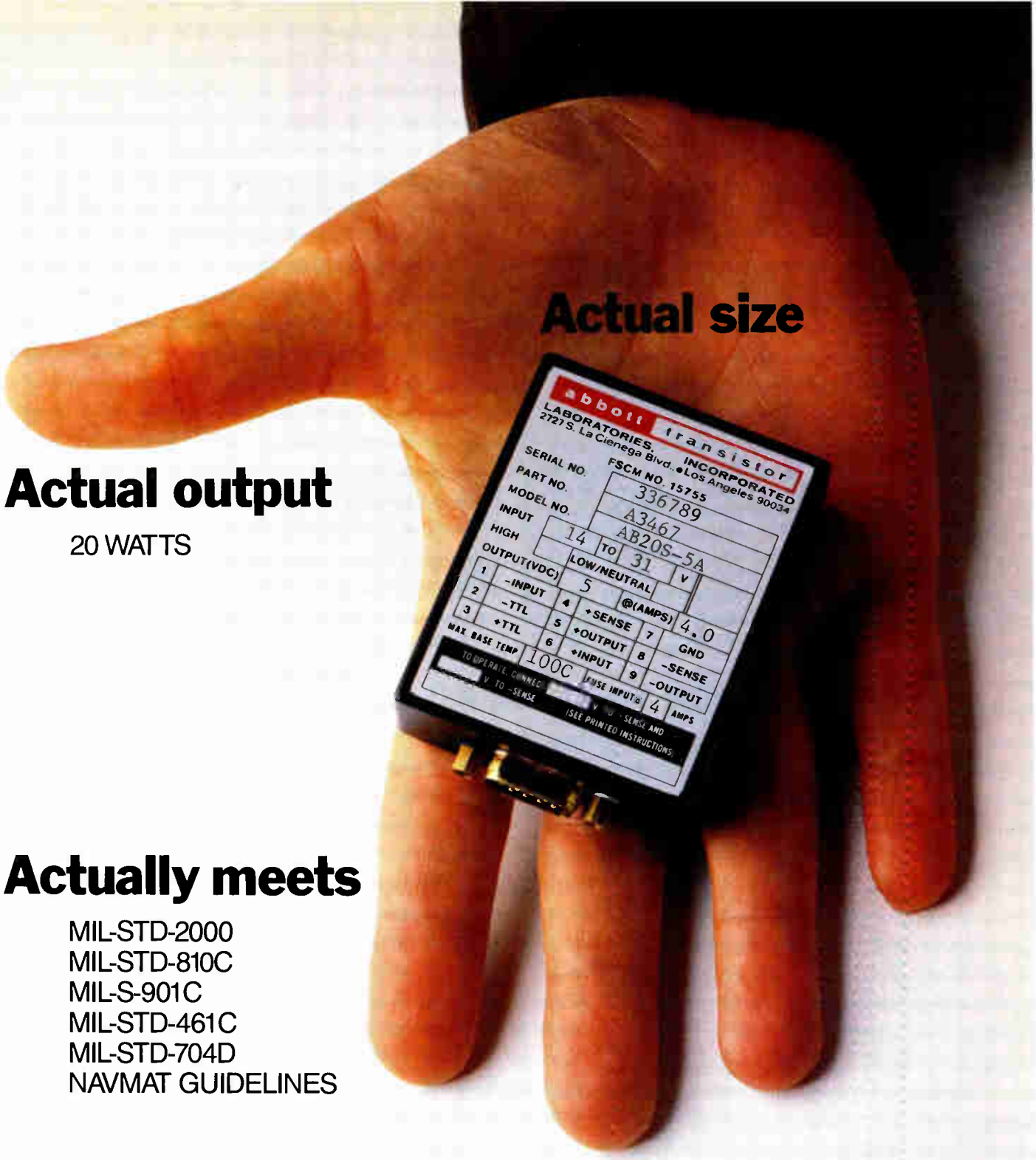
The RC2324AC-E complies with the CCITT V.42bis standard and provides effective speeds up to 9,600 bits/s. Samples are available.

AT&T PACKS SIX DSPs ON A VMEBUS BOARD

AT&T Microelectronics has teamed six of its WE DSP32C floating-point digital-signal processor chips on a board to create a development system to simulate leading-edge processing applications in graphics, imaging, audio, and other real-time uses.

Together, the DSPs can achieve 150 million floating-point operations/s. The board's architecture calls for a VMEbus interface. Sun Microsystems Inc. Sun 3 or Sun 4 workstations are the development platforms.

The VMEbus board costs $9,998. DSP support software—including a C compiler, source-code debugger, and host file server—for the Sun 3 or Sun 4 workstations costs $3,800 and a standard library of application programs costs $1,000.



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CIRCLE 194

TI AND MIT SHOW PROTOTYPES OF SYSTEMS THAT TAKE DIFFERENT APPROACHES

IT'S HERE! REAL 3-D!

BY JACK SHANDLE

THE TECHNOLOGY OF true three-dimensional displays—not simply 2-d images viewed with special eyeglasses—has now advanced beyond the laboratory and is looking for applications developers.

Three 3-d systems that display computer-aided-design data—but use radically different technologies—made news last month. Texas Instruments Inc. is seeking business partners to develop the OmniView system it demonstrated as a prototype during the Siggraph show in Dallas. Also in Dallas, Dimension Technologies Inc. of Rochester, N. Y., showed a more conventional autostereoscopic monitor.

Meanwhile, in Cambridge, Mass., Massachusetts Institute of Technology researchers unveiled the prototype of a real-time holography system that they have constructed from existing optical and electronic technologies. TI is already developing custom prototypes of its system for military clients, says R. Don Williams, a development engineer in TI's Computer Systems Laboratory in Dallas. Other opportunities exist in medical imaging, CAD, and entertainment, he says, as well as niche markets where TI would need a partner to supply applications expertise. "We are delivering prototypes to specs now," says Williams, "and we will be fielding [completely operational] systems in the next two years at the latest."

At MIT's Media Lab in Cambridge, Mass., the system being developed by a team headed by Prof. Stephen Benton is still in the research phase, says team member Mark Lucente.

MIT links classical holography techniques with a Connection Machine supercomputer from Thinking Machines Inc. to produce images that measure about 1.5 in. on each side. The Connection Machine is needed to create real-time images from CAD data because each point in the image has a theoretical relationship with every other point. To simplify the calculations, the hologram accounts only for horizontal parallax—viewers lose the 3-d effect if they shift their angle of vision in the horizontal plane.

TI's OmniView offers several advantages but also suffers at least one defect. The 3-d volume is created by rotating a translucent disk around an axis perpendicular to the disk's center at 600 revolutions/min. A low-power laser beam modulated 10,000 times/s creates points of light on the disk. The persistence of the light source in the viewer's eye fuses the points into an image, says Williams. By contouring the disk's surface in the shape of a double helix—instead of a simple plane—the TI engineers have managed to double the refresh rate.

Although the system prototype has a bandwidth of 3,000 points, that limitation is placed on it by computer system memory and can easily be scaled up. Red, green, and blue lasers can be mixed to produce a full-color display, and the display volume can be varied by the size and shape of the rotating disk. The prototype is 21 in. in diameter and 4 in. high. "We could use very large disks," says Williams. "People are already building centrifuges that rotate much faster."

Unlike the MIT system, TI's OmniView is not compute-intensive. The data is generated by a Sun Microsystems Inc. workstation. The prototype has about a 1-s delay now but real-time performance is easily obtainable. OmniView also lives up to its name by letting a number of viewers see the image simultaneously from any vertical or horizontal angle, and there is no loss of the 3-d effect. But this advantage also means that one side of the object does not occlude the other. In other words, the objects appear to be made of glass.

"We are looking for applications in which transparency is not a disadvantage," says Williams. In some applications, such as medical imaging, transparency is actually a desired characteristic, he notes.

An ideal application is air-traffic control. The system could show several controllers the positions of aircraft relative to one another and to ground-based reference points. Color coding could identify protected airspace and provide an index of altitude levels. A controller might use a laser pointer to select a plane for radio contact.

TI is looking for business partners to develop the prototype OmniView 3-d CAD system.

WHAT ACCELERATES A SUN?

TRADE

WHEN DOING BUSINESS WITH THE RUSSIANS, YOU HAVE TO COME UP WITH SOME UNUSUAL PLANS

IN THE USSR, WING IT

BY MARTIN BANKS

ARE YOU READY TO DO business in the USSR? Then you had also better be ready to wing it. "There is a definite need for creativity in doing business with the Russians, and it will be those with the best business deal that will win, not the best products. To some extent, the technology is irrelevant for the moment," says K. Philip Hwang, chairman and CEO of Televideo Inc. of San Jose, Calif.

Hwang was one of a large contingent representing U. S. and European computer systems and software suppliers that made the journey this summer to Moscow's huge VDNH Exhibition Park for the first PC World Forum conference and exhibition. They ranged from IBM Corp. to software companies on their first visit trying to establish formal business links with the well-established Soviet user groups.

Into this category fell the producer of data-management and analysis software, SAS Institute of Cary, N. C. "The exhibition has been very useful for us," says the company's European vice president, Art Cooke. "We now know that the street price of the PC SAS system is up to the 10,000-ruble mark. Now we need to establish ways of formalizing business with these people." At the official exchange rate, 10,000 rubles is about $15,000; on the black market, it is about $600.

"It is a problem marketing product in a command-led, layered organizational structure," says Harrijs Buss, the Latvian chairman of one of the unofficial Soviet user groups. "There is good communication across the country within each layer—for example, data-processing people or scientists—but little communication between the layers. It is also a problem dealing in hard currency, but legal distribution of the SAS system also means payment."

At present, Cooke favors the idea of dealing with the Soviet market as a separate entity and in the local currency. This has some problems because bank accounts in the USSR can only be opened by Soviet nationals. "However, we have had discussions with the Lithuanian authorities," he says, "and we have been told it will be legal for us to open an account there. We are still investigating the situation."

This was just one type of creative business thinking evident at much of the exhibition. Televideo, for example, has three joint ventures running, and two of them have led CEO Hwang into

Spectators at the Moscow fair check out the U. S. pavilion. American companies are finding innovative ways to do business.

some interesting deals, especially for a computer company.

"One is a partnership venture in a leather-producing factory with the Ministry of Agriculture," he says. "This should have a maximum production capacity of 300,000 skins per month. There is a strong market in the West for leather, which this factory aims to service, for hard currency earnings." Those earnings would then be used to buy Televideo products. The same arrangement applies to work with the Moscow City Council on the construction of a hotel.

The U. S. pavilion at the show included both the largest and the smallest from the U. S. computer business. That included IBM, which has had a Moscow office since 1974. It was, however, left to the special marketing group based at Boca Raton, Fla., with manager Robert Lohman in charge, to represent the company.

"I am cautiously optimistic about the Russian market," he says, "though the situation is still highly fluid. IBM trades in dollars, like most others, and accepts that this can't be the way to do business in the long run."

A surprising find at the show was Western Digital Corp. of Irvine, Calif. The company's disk controller, disk drive, and video controller chips are normally sold into the aftermarket for PC users as well as to PC manufacturers and assemblers. But according to Ken Larsen, the company's vice president of operations for Eastern Europe, based in Epsom, England, it is trying to work with other suppliers and manufacturers looking to set up factory installations in the USSR.

"We are trying to become involved with other manufacturers that have ex-

isting relationships here," he says. "In particular, we are looking to work with some of the Korean companies, which are starting to do good business." One reason for this, he suggests, is that they are large conglomerate companies that can trade Soviet raw materials such as timber for equipment, rather than deal directly in hard currency.

The need for flexibility in creating business opportunities in the USSR is well demonstrated by PC-compatible manufacturer Tandon Corp. The company is exploiting its facility in the Andheri free trade zone of Bombay, India, as its route into the Soviet marketplace.

"There is a bilateral trade agreement between India and the Soviet Union," says Shrikant H. Joshi, Tandon's general manager of business development in Bombay, "and this has established a rate of exchange between the ruble and the rupee. There is currently an imbalance of trade between the two countries, and our ability to provide PCs, paid for in rupees, is an opportunity for the Soviets to redress this balance. With the recent relaxation of the Cocom rules, it also means that our full range of systems can be made available to them."

The Apple Macintosh is starting to see some penetration of the Soviet market, partly because its user interface makes it easier to work with for those with limited English [*Electronics*, August 1990, p. 12]. A full Cyrillic version of the Mac interface was displayed.

Although the majority of exhibitors was American or European, perestroika is having its effects on the development of indigenous businesses. Not only are there Soviet companies growing and forming partnerships and ventures with Western companies, but totally local businesses are starting to appear as well.

Software is their obvious target and one of the first such companies is the BIS cooperative, based in Donetsk in the Ukraine. Founded in 1988, it has now produced a wide range of applications and utilities, with most of the emphasis being on the latter. According to the co-op's marketing manager, Valery Lukashin, some of its biggest sellers are antivirus and copy-protection programs.

Acknowledging the ironic necessity, given the way the Soviet software market has developed, Lukashin says that the co-op copy-protects all its products. "The copy-protection program is also one of our best sellers," he says. It is outsold only by its networking package, BISLAN 2.03, which is a combined hardware and software product using a three-wire bus, RS-232C connections, and a 115-Kbaud transmission rate.

BIS is looking to start exporting its software products, and has therefore published a price list of its offerings in dollars. The comparisons with local pricing are quite striking. For example, BISLAN 2.03 costs 1,990 rubles, but just $79. The copy protector, more likely to be an individual purchase, costs 390 rubles—but the export price is just $49.

As well as exporting its products, BIS is seeking import opportunities, and Lukashin feels it could offer Western software companies a specific advantage. "We can apply our copy protection package to any software product," he says, "so we can offer this service to Western software companies. We can sell their products in the Soviet Union protected by our package."

Software generally is a strong suit for the Soviet Union. Copris, for example, is a Moscow company that not only acts as distributor-agent for hardware companies such as Rasterex and Houston Instruments, but also specializes in CAD applications software that exploits these hardware products.

Perhaps one of the best-known Soviet-American joint ventures is JV Dialogue, which now has Microsoft Corp. of Redmond, Wash., as a leading business partner. It has recently launched Version 4.01 of MS-DOS, which is a complete rewrite of the package in Russian that was carried out by JV Dialogue under the direction of Nikolay D. Lioubovniy.

"This is already selling well," Lioubovniy says, "and we hope to have a Russian version of Microsoft Works Version 2 available later this year." More long term, he is also considering the potential of Windows 3.0 as a target for conversion.

JV Dialogue is also moving strongly into the manufacture of its own hardware, says Alexander I. Berest, distribution group manager. "We have so far produced only AT- and XT-compatible machines," he says. "We have a 12-MHz 286 machine, and a 16-MHz version just coming." E

TEXAS INSTRUMENTS

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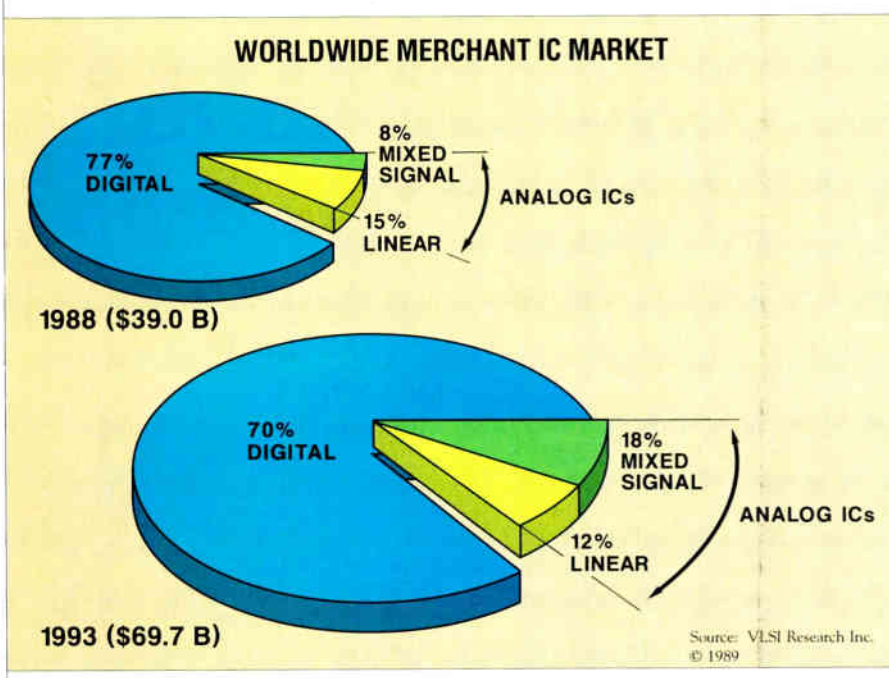

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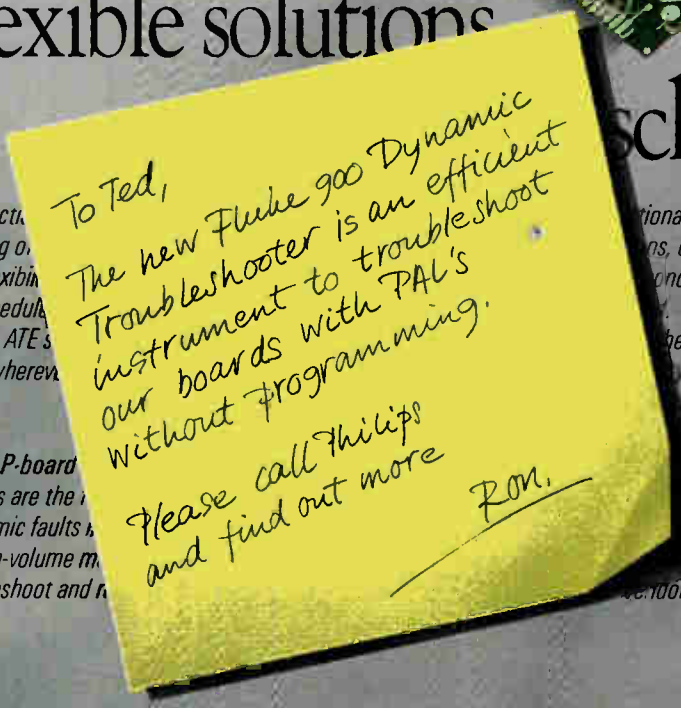

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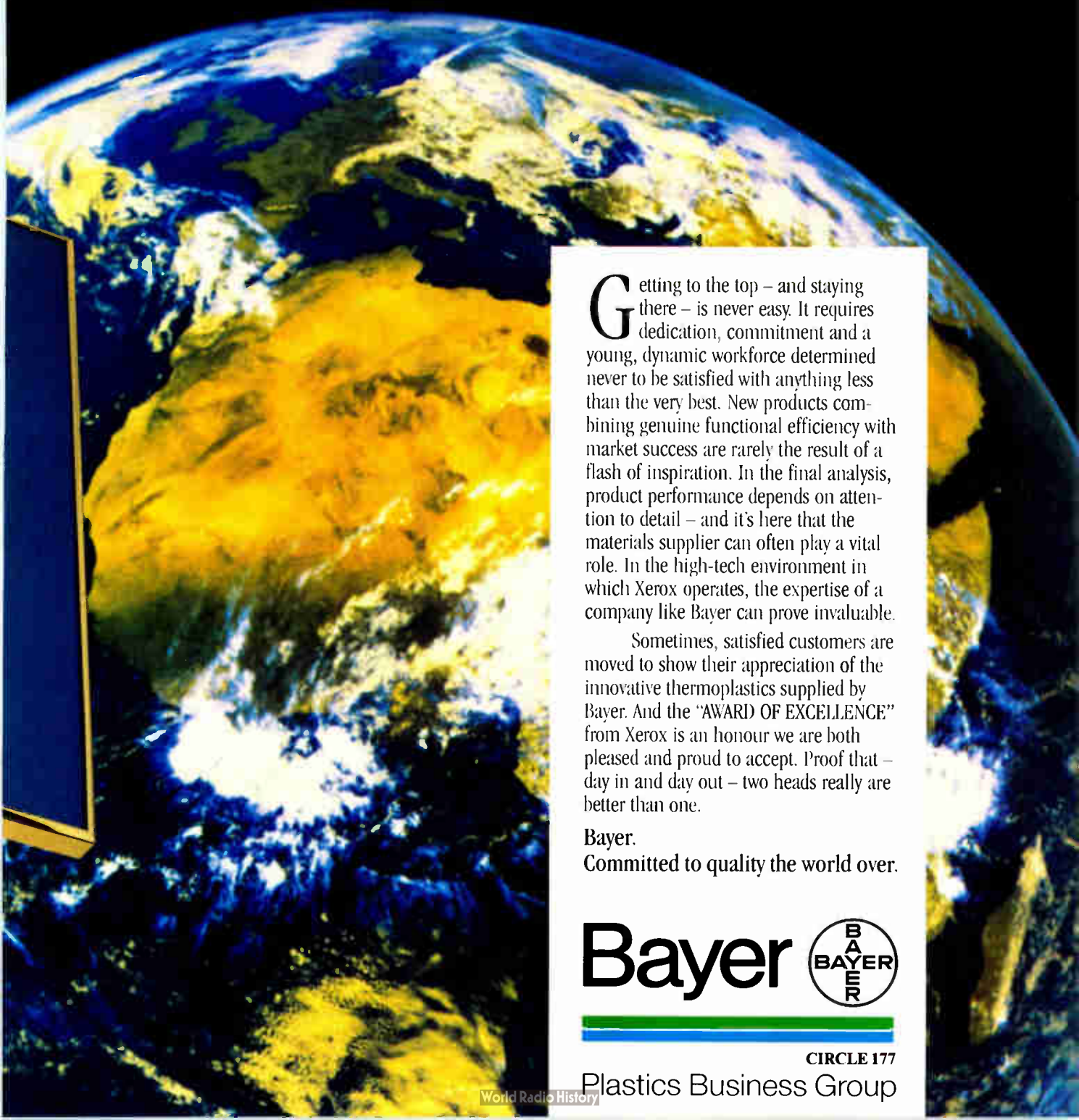

Getting to the top – and staying there – is never easy. It requires dedication, commitment and a young, dynamic workforce determined never to be satisfied with anything less than the very best. New products combining genuine functional efficiency with market success are rarely the result of a flash of inspiration. In the final analysis, product performance depends on attention to detail – and it's here that the materials supplier can often play a vital role. In the high-tech environment in which Xerox operates, the expertise of a company like Bayer can prove invaluable.

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CIRCLE 177

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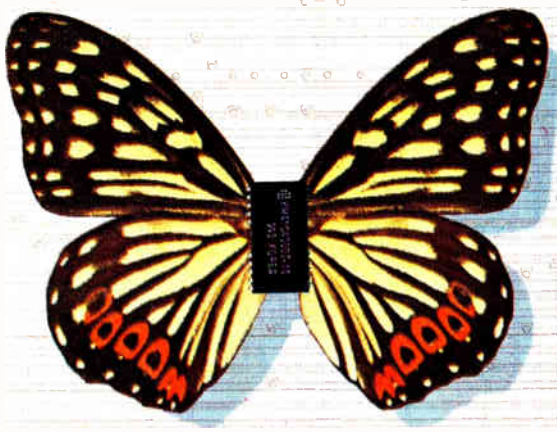

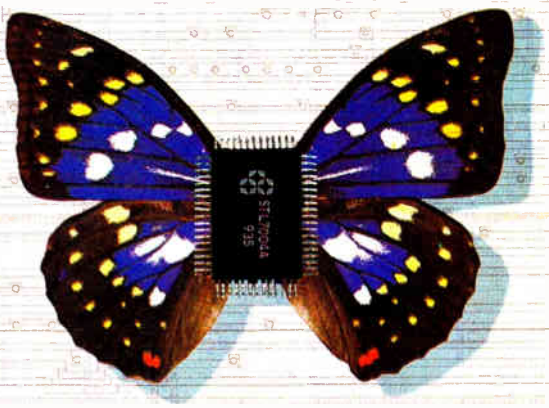

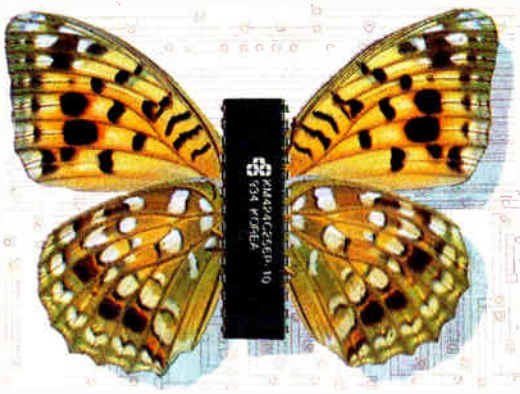

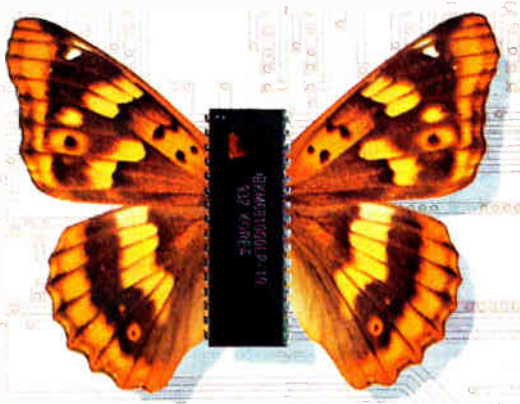

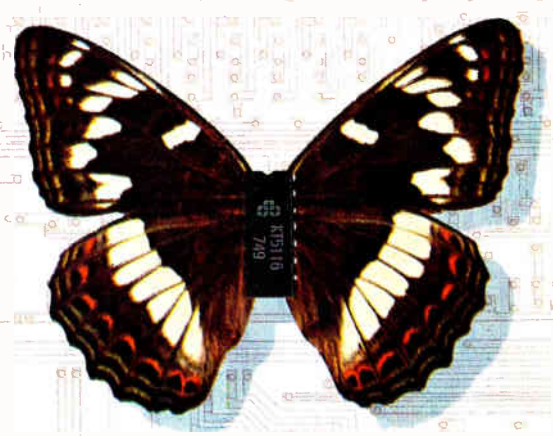

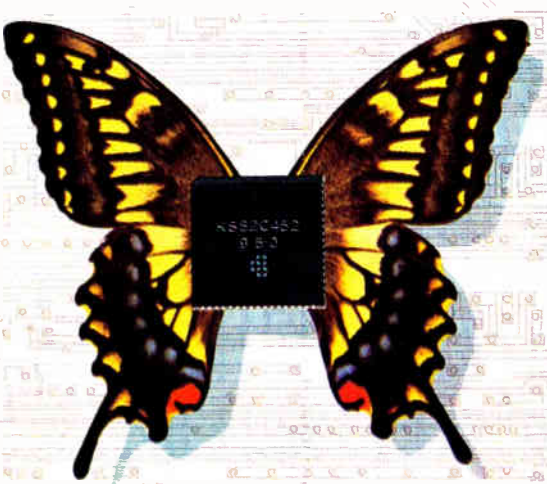

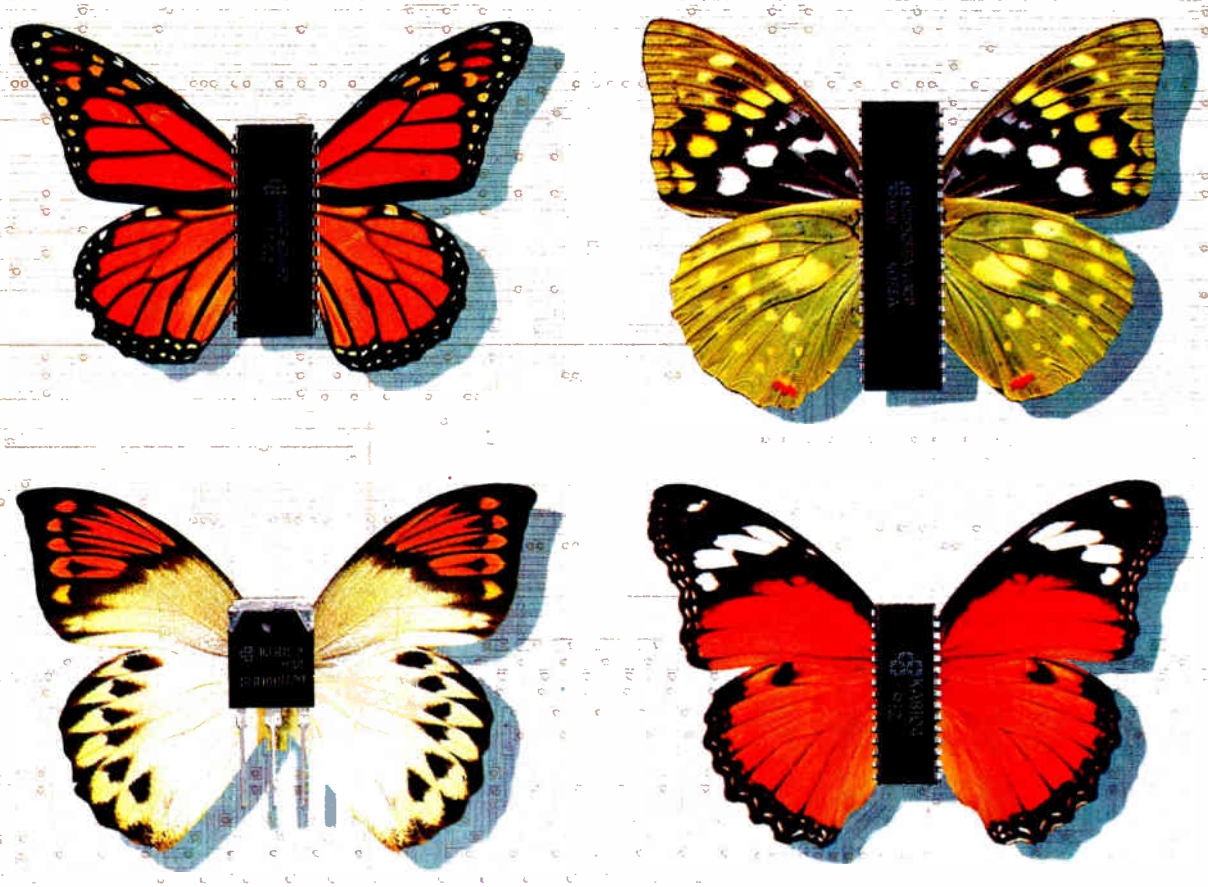

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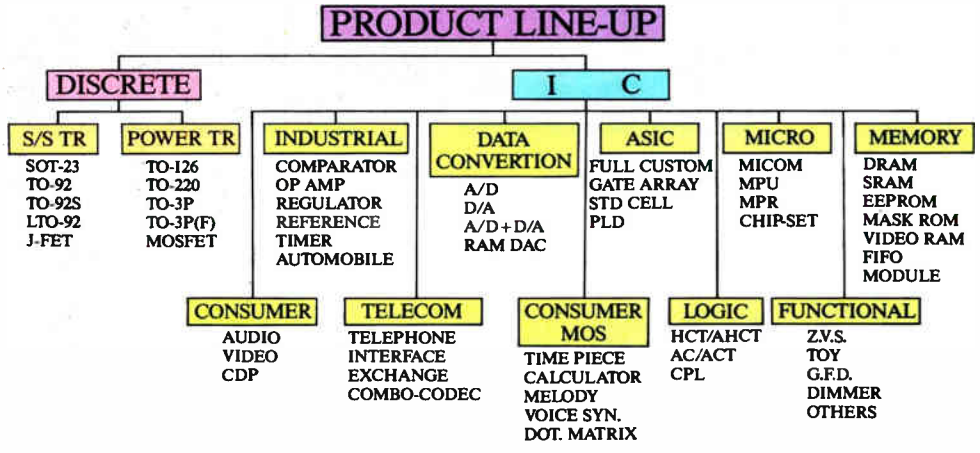

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CIRCLE 197

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CIRCLE 174

RAM DAC ALSO INCLUDES DSP ELEMENTS

VGA PLUS AT A BARGAIN

BY LAWRENCE CURRAN

IBM CORP.'S WIDELY used Video Graphics Array standard that governs personal computer displays had hardly become entrenched before PC users started pushing for screen resolution greater than VGA's 640 by 480 pixels and 256 colors [*Electronics*, July 1989, p. 66].

Now two Boston-area companies have teamed to develop a CMOS VLSI device that delivers an apparent resolution of 1,600 by 1,280 pixels and 792,000 colors on a standard VGA monitor.

Two simple and inexpensive system changes are all that is required to upgrade and extend the life of perhaps millions of these low-end monitors: replace the conventional random-access memory/digital-to-analog converter (RAM DAC) on the VGA controller board with the pin-compatible new component, and modify the driver software so that the display data can be prepared in a slightly different format.

The unique device is a CEG RAM DAC monolithic integrated circuit that also includes a digital signal processor. CEG stands for continuous-edge graphics, a technique that eliminates the jagged edges typical of computer-generated images. CEG enables the eye to perceive much higher resolution and smoother color gradations than are possible using a conventional VGA graphics board.

Graphics controller add-in boards are often retrofitted to a PC system after it's sold. One market-research organization estimates that of the total of some 16.2 million video DACs to be sold this year, more than 5 million will go onto such add-in boards—a nice market even if only half of those sockets are candidates for the new CEG RAM DAC.

The CEG feature is made possible by an algorithm developed by Edsun Laboratories Inc., Waltham, Mass., and the chip is fabricated by Analog Devices Inc., Norwood, Mass. Analog Devices is the exclusive licensee for Edsun's CEG algorithm. Both companies will sell the chip, which might add about $100 to the price of a VGA board—a minimal increment when it is compared with the $2,000-to-$3,000 cost of a high-resolution monitor.

Besides the algorithm, Edsun, a startup graphics firm, also worked out the device's system-level architecture and provides application software driver expertise. To date, only drivers for Lotus Development Corp.'s 1-2-3 spreadsheet and Autodesk Inc.'s AutoCad computer-aided design programs are available with the chip; others are now being developed.

Analog Devices designed the mixed-

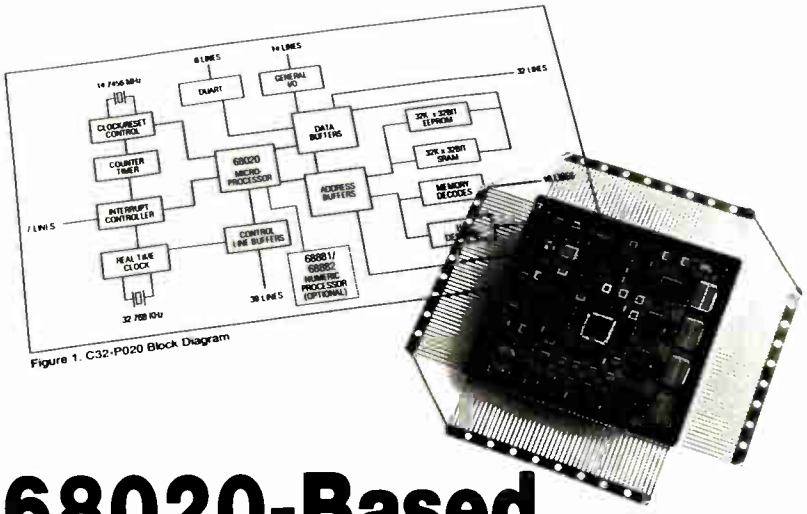
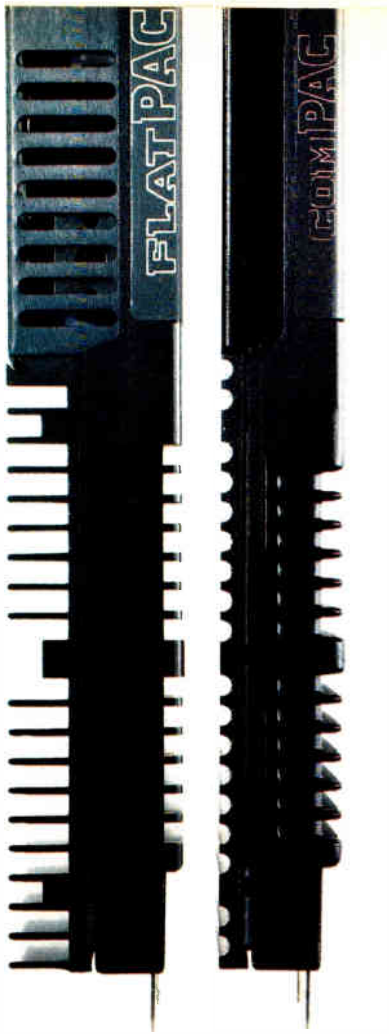


Figure 1. C32-P020 Block Diagram



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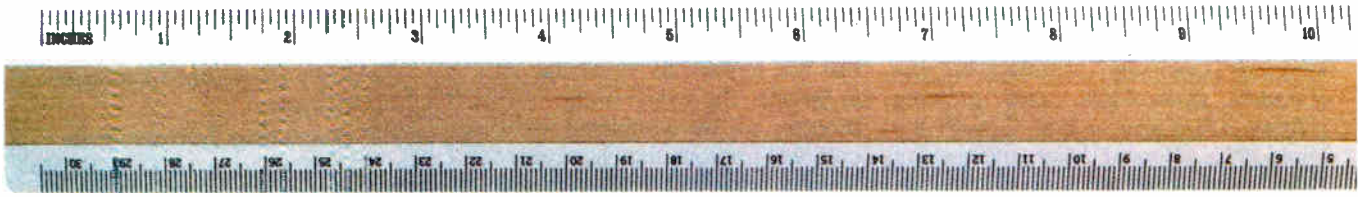

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2 to 95 VDC	Output Voltages	2 to 95 VDC
Up to 600 Watts	Output Power	Up to 600 Watts
1.37"	Height	1"
FCC Part 15, Class A VDE 0871, Class A IEEE Std 587-1980	Applicable Specifications	Bellcore (24/48 V) British Telecom (24/48 V) FCC/VDE, Class A (300 V) MIL-STD-461 C (28/270 V) MIL-STD-704A

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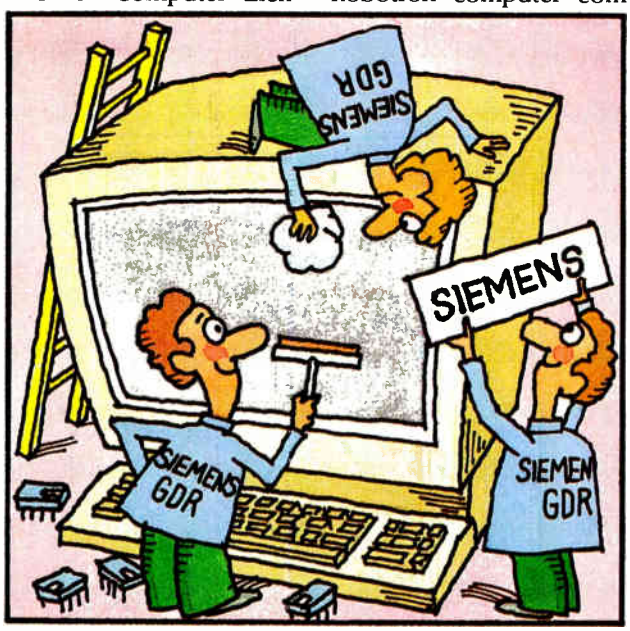
CIRCLE 204

EAST GERMANY TO MAKE COMPUTERS

While many companies in the West see East European countries simply as markets, West Germany's Siemens AG is one of the few that actually seem to want to manufacture equipment in that technology-starved region. In line with this action plan, Siemens's Data and Information Systems Division will cooperate with the newly founded Computer Elektronik Dresden GmbH in Dresden, East Germany, in the development of hardware as well as production.

The effect will be not only to create jobs in East Germany's fragile and hard-pressed economy, but also, through technology transfer, to raise that country's high-tech national product.

As for Computer Elektronik Dresden, an offshoot of the formerly state-owned Robotron computer combine, it will turn out $250 million worth of equipment annually by 1992. It has already received its first development contracts from Siemens and will start building Unix- and MS-DOS-based systems in October.



Included in the Dresden company's product output will be personal computers, multiuser Unix systems, and medium-performance central-processing units—with a Cocom-allowed computing power of up to 20 mips. Deliveries of the first systems to come off the line, within East Germany as well as to other East European countries including the Soviet Union, will start before yearend. E

SIEMENS AND BOSCH STRENGTHEN NORTH AMERICAN AUTO BUSINESS

Two West German electronics powers that want to harvest larger shares of the lush North American markets for automotive systems and mobile telecommunications equipment have purchased Canadian companies. Munich-based Siemens AG has acquired the Maci Industries Group in London, Ont., and Robert Bosch GmbH of Stuttgart has purchased a 50% share of Novatel Communications Ltd. in Calgary, Alta.

With the addition of Maci, whose 1,200 workers produce fractional horsepower motors and related components for the Canadian and U. S. auto industries, Siemens now has over 3,000 persons, out of 11,000 worldwide, working in the auto market in North America. Siemens did nearly $900 million in auto business during the first nine months of the fiscal year ending Sept. 30.

Bosch wants to strengthen its position as one of the world's leading suppliers of mobile communication systems and prepare for activities in integrated navigation, communication, and entertainment systems in vehicles. Novatel, in Canada as well as in the U. S., the UK, and Norway, employs about 1,600 people with sales of $250 million last year. E

PHILIPS TO THIN OUT ITS IC RANGE

In an effort to nudge its loss-ridden Components Division back on the road to profitability, Philips NV of the Netherlands will take measures more drastic than many industry observers originally anticipated. For starters, in restructuring its components activities, the company will reconsider the extent of the division's involvement in ICs.

Details are hard to come by, but top management has decided to cut back the IC business and concentrate on selected product lines, emphasizing parts related to Philips's consumer and professional equipment.

In addition, expenditures for chip-related research and development will be curtailed. Further, to get better returns on its R&D investments, the Dutch company will keep seeking strategic alliances with other IC makers.

Still a matter for speculation among industry watchers: will the cut in IC spending mean that Philips might also cut back its role in Jessi, the Joint European Submicron Silicon Initiative? E

AEG COMES TO THE RESCUE OF SILICONIX

One of Silicon Valley's oldest semiconductor firms, Siliconix Inc., which has sought protection from creditors under Chapter XI of the bankruptcy laws, has found a financial rescuer: the West German electronics giant AEG AG, which has offered to waive some $2 million owed it by Siliconix, inject a further $13 million in cash, and wind up owning 80.1% of the firm.

Now AEG has to submit its plans for the restructuring of the company to the U. S. Bankruptcy Court for confirmation by Oct. 31. AEG has also agreed, at Siliconix's option, to provide either a $6 million loan for working capital, or, at the least, a guarantee that funds for day-to-day operations can be secured from a third party. E

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64K	UM6164	8K x 8	20/25
64K	UM6188	2 x (4K x 8)	25/35/45
64K	UM61164	4K x 16	25/35/45
64K	UM61165	2 x (2K x 16)	25/35/45
64K	UM6264AL	8K x 8	70/100/120
128K	UM61168	8K x 16	25/35/45
256K	UM62256AL	32K x 8	70/100/120
1Mb	UM621024	128K x 8	70/85/100

SRAMs include DIPs, SDIPs, and SOs. 1Mb available 4th qtr.

UMC

UNITED MICROELECTRONICS CORPORATION

CIRCLE 190

LCDs

TWO U. S. INNOVATORS STRUGGLE AGAINST THE TIDE AS JAPAN TAKES OVER IN LCDs

KILLED BY ACCOUNTING

BY WESLEY R. IVERSEN

MANY SEE ACTIVE-MATRIX liquid-crystal displays as a classic case of another key American-born technology frittered away through shortsightedness. T. Peter Brody is one of them.

"The Japanese don't do discounted cash-flow analyses and then kill out their really important projects because the numbers don't come out right," says Brody, an active-matrix pioneer whose startup company, Magnascreen Corp., is at work on a new "tiled" approach to the technology. "When they have an important new product, they will develop it and put money into it until it's capable of standing on its own two feet. We don't do that. We get all these ideas killed by the accountants."

Brody speaks from first hand. The Hungarian-born, English-educated physicist headed the design team at Westinghouse Electric Corp. that conceived and demonstrated the first active-matrix flat-panel displays in the late 1960s and 1970s, only to see the technology taken over by Japan in the 1980s. "Westinghouse decided to drop the technology in 1979 because it wasn't the right product for them, and I can't quarrel with that," says the 70-year-old Brody today. "But I do quarrel with the rest of U. S. industry for not recognizing that this was going to become a very important technology."

In some ways, Thomas S. Buzak today finds himself in the same spot that Brody was in 10 years ago. Buzak, 37, is the inventor of a new "plasma-addressing" scheme for flat-panel displays that some think has potential to one day supplant the active-matrix methods pioneered by Brody's crew, especially for larger screen sizes. But like Brody in 1979, Buzak faces the fact that his employer—Tektronix Inc.—has no current plans to put up the big investment needed to commercialize his technology. "We don't do high-volume manufacturing. That's not our bag," says Buzak, who is principal scientist and manager of the advanced display technology group at Tektronix Laboratories in Beaverton, Ore.

Instead, Tektronix a few months ago began looking for a partner or partners with volume distribution and manufacturing experience to pursue the plasma-addressing technology. And so far, among those that have expressed interest, "the largest companies, and the companies with the most resources, are all Japanese," Buzak says. Unlike Brody, who professes an aversion to seeking out Japanese funding for his projects, Buzak says neither he nor Tektronix would have a problem with a Japanese partner. But Buzak does see some similarities between his situation and that of Brody 10 years ago. "Has anything really changed? Maybe not. I just don't know," Buzak muses.

There's no doubt about one thing. After a decade of research and infrastructure development, Japan today dominates flat-panel, active-matrix LCD technology. Japan's vertically integrated electronics giants regard control of color flat-panel displays as a strategic key to leadership in a range of 1990s systems products. This includes a potentially huge market in portable computers and small desktop machines, military and avionics displays, and later markets for wall-size high-definition TV and computer displays. And unlike their U. S. counterparts, Japanese firms have been willing to make the big, long-term investments needed to gain the upper hand.

In the late 1980s, Japanese firms created a new market for hand-held color TVs based on high-quality 2-to-5-in.-diagonal active-matrix LCD flat screens. Now the action is shifting to 10-in. screen sizes and larger. And the Japanese are spending enormous amounts of money to keep the momentum going.

Since last October alone, Japanese companies have announced plans to invest some $2 billion in new active-matrix LCD manufacturing plants, says Larry Tannas, an Orange, Calif., consul-

With Darpa funding, T. Peter Brody (inset) is developing at Magnascreen Corp. a modular active-matrix LCD scheme.

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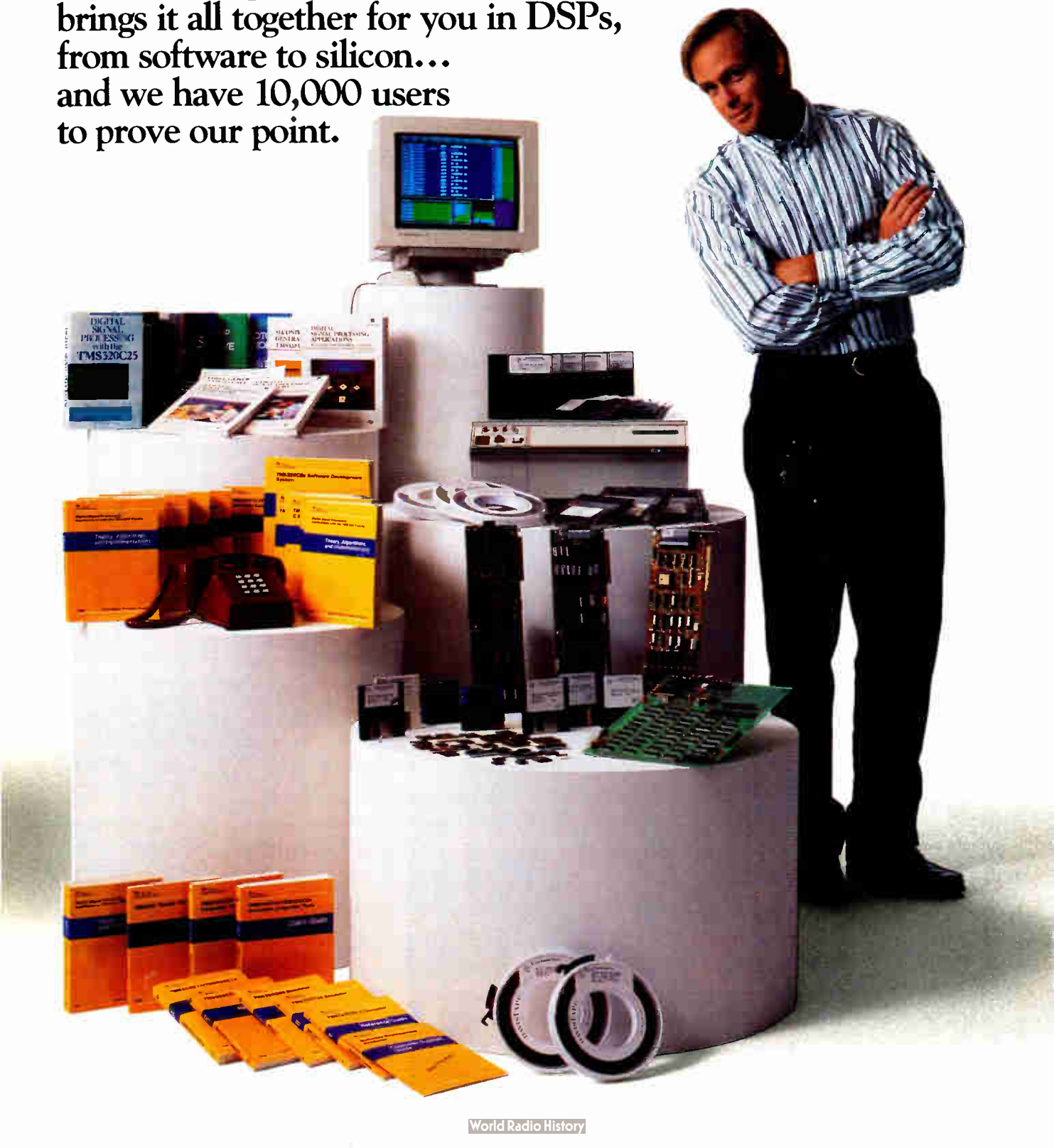

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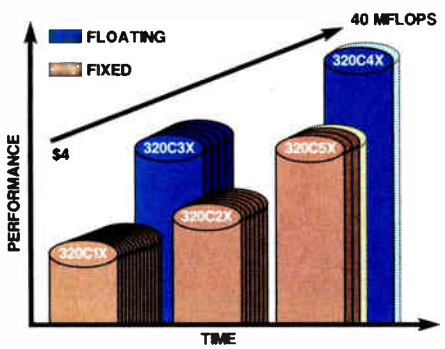

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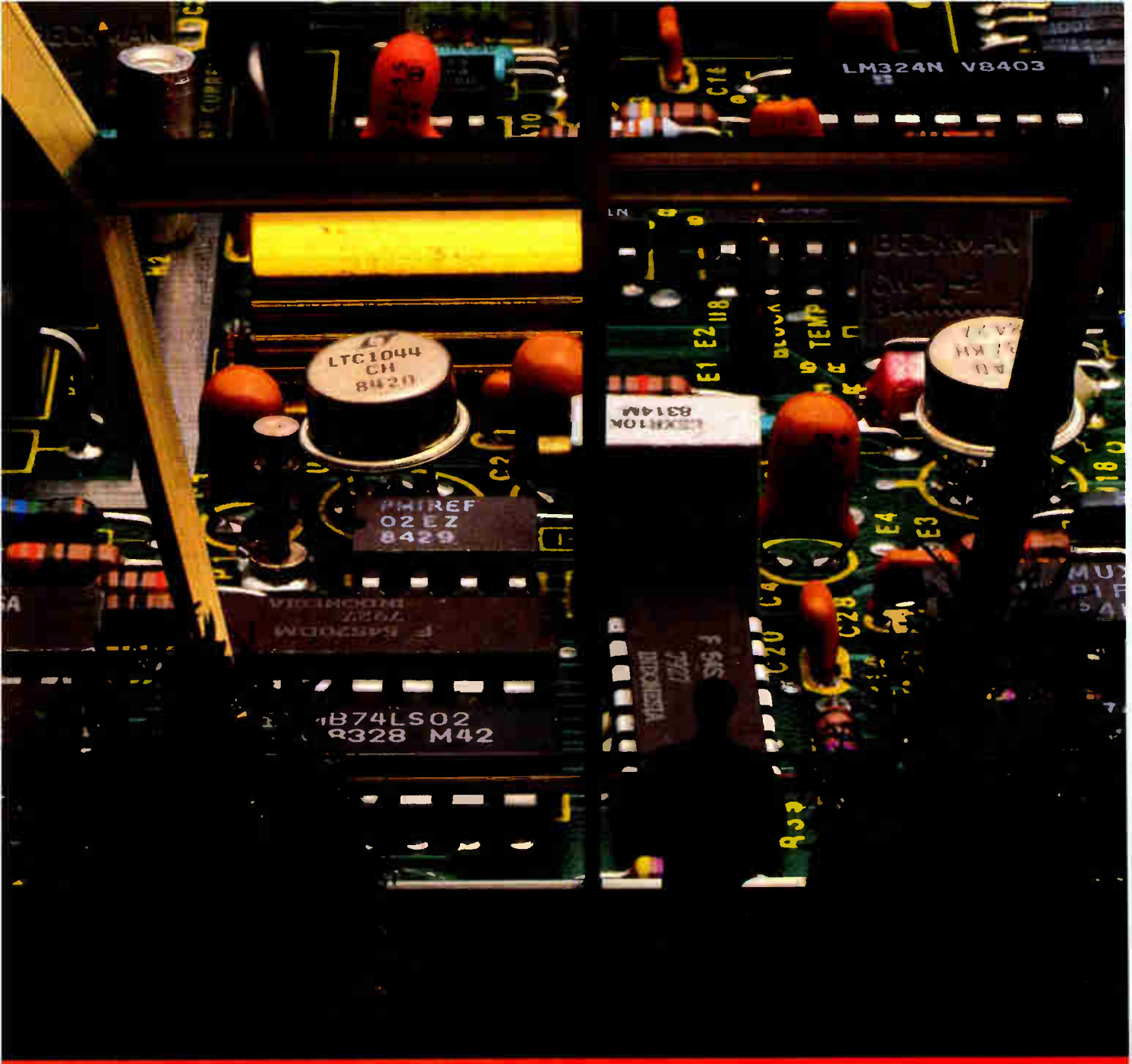

Electronics

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tant and immediate past president of the Society for Information Display. And in a project launched this year, Japan's Giant Electronics Technology Corp. aims to develop by the end of 1996 the manufacturing techniques needed to build active-matrix LCD flat panels up to 1 meter diagonal in size. That project is sponsored by the Ministry of International Trade and Industry, with 17 companies participating.

In the U. S., by contrast, not a single high-volume active-matrix LCD factory exists. Some groups recently have proposed raising money for such a plant from among U. S. computer makers, who would receive an assured source of LCD supply for their investment. But such an effort would require $100 million or more, and many around the industry doubt the money can be found.

AS PART OF AN EFFORT to stem the Japanese tide, Magnascreen joined recently with a group of U. S. makers of flat panels to file a dumping complaint against Japanese manufacturers. The complaint, filed with the International Trade Administration and the International Trade Commission, covers a variety of flat-panel types, including active-matrix LCD, electroluminescent, and conventional plasma displays, and cites specific instances of alleged U. S. sales of flat panels by Japanese firms at unreasonably low prices.

Although he denies any dumping in terms of price cuts—"the evidence just doesn't support it"—an executive at one of the Japanese firms named in the complaint concedes that the U. S. companies have a legitimate gripe in the question of "material retardation." That means, simply put, that the Japanese have such a head start in LCD technology, production, and R&D that it's all but impossible for a U. S. firm to catch up. "It's as if you wanted to build Hondas in your garage and got $1 million in venture capital to do it; it would cost you $100,000 per car," says the executive.

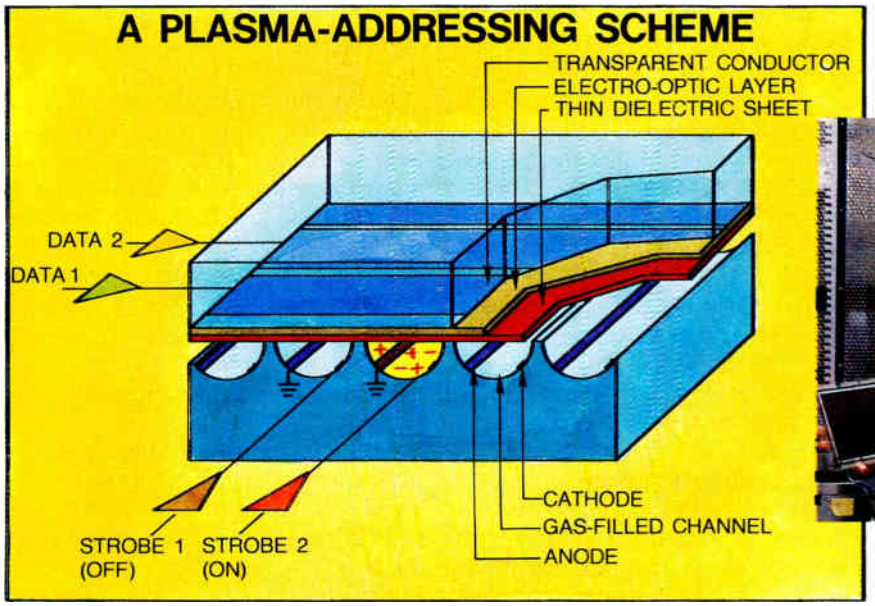
However, he adds, the U. S. industry must consider the long-term repercussions of a dumping surcharge on imported LCDs. The advanced-technology color LCD used in a laptop computer represents 40% of the machine's materials cost, he says. A surcharge will either send computer prices skyrocketing or force systems houses to assemble their machines offshore to avoid the added cost—with a loss of American jobs.

For Tektronix's part, Tom Long, technology group vice president and general manager, says his firm has neither the high-volume manufacturing experience nor the consumer distribution channels to go it alone in bringing Buzak's invention to market. Unlike Westinghouse with active matrix, however, Tektronix has no plans to drop plasma-addressing technology. "We consider this development to be pretty important," says Long. "So we're going to bring some partners and some know-how to the table that will accelerate the program, as opposed to letting it come at its own pace."

Recent financial problems at Tektronix played a role in the decision to look for partners, Long concedes. But if the company is unable to cut the kind of deal that it wants, Tektronix would consider commercializing the technology itself, he says. "If this thing works out the way I think it will, and plasma addressing is the technology for large-scale panels, we may very well prove that the Westinghouse people were right," he adds.

After Westinghouse dropped active-matrix technology in 1979, Brody secured a license on the key patents and set out on his own to commercialize the concepts. But he ended up spending much of the 1980s scrambling unsuccessfully for money. Brody's first company, Panelvision Corp., was founded in 1981 and ultimately attracted about $13.5 million in funding. But Panelvision was sold by investors in 1985 after Brody was unable to raise an additional $5 million needed for capacity expansion. Some 70 U. S. companies and investment groups turned him down, he says.

"We started the world's first commerical company. We had customers. We had products," Brody relates. "But we didn't have enough capacity, and we just couldn't raise the money in 1985 to build up to a break-even level of sales. So when the Japanese started



Tektronix Inc. is looking for partners to commercialize the plasma-addressing approach invented by Thomas S. Buzak (inset).

moving in, my investors bailed out as quickly as they could."

But Brody didn't give up. By 1988, he had scraped together about $650,000 in seed money to start another company, Magnascreen, in Pittsburgh. The company has since raised an additional $1.4 million in equity investment, including some money from Apple Computer Inc.'s president and chief executive officer, John Sculley. And in January, Magnascreen won a $1 million contract from the Defense Advanced Research Projects Agency to pursue some new ideas Brody has for so-called tiled active-matrix LCDs.

Brody sees current Japanese active-matrix LCD technology extendable up to 20-in.-diagonal screen sizes. That will be big enough to find enormous markets in computers, workstations, and entertainment systems, he figures. "But we ourselves feel that you cannot just extend the technology linearly up to 40-to-50-in. sizes." Thus the tiled approach. "Simply put, we have developed a way of making a large display out of modules that fit together seamlessly, so that you will not see a gap between the partial images. And we can do this at quite high resolution," Brody says. Under the Darpa contract, Magnascreen will develop a small "proof of concept" panel by the middle of next year. If additional Darpa money is forthcoming, the company will develop manufacturable 40- and 50-in. sizes by 1992.

Active-matrix display technology relies on arrays of thin-film transistors (TFTs) formed on a glass substrate to drive display pixels or subpixels directly on a one-on-one basis. Brody's team at Westinghouse worked with cadmium selenide, but mainstream Japanese displays today are built with amorphous silicon TFTs. When employed in LCDs, direct TFT addressing produces rich colors, wide viewing angles, and smear-free video-rate imaging that rivals the performance of cathode-ray tubes.

But as active-matrix LCDs are made larger, yield and cost hurdles go up disproportionately, since the TFTs must be deposited over increasingly large glass display substrates. It may take a million transistors or more for a 10-to-14-in.-diagonal display, for example. And since a bad transistor means a

dead pixel, defect-free panels are few and far between. The manufacturing challenges will only get worse for larger screens. What's more, lithography equipment for handling glass substrates larger than 18-in. diagonal is not currently available.

While Brody would attack the problem with tiled displays built from smaller, higher-yielding LCD modules, Buzak is proposing an entirely new scheme that relies on the properties of an ionized gas to address liquid-crystal pixels directly while eliminating the need for large arrays of TFTs. "We aren't trying to do this wafer-scale type of integration on a large piece of glass like all the TFT guys are trying to do, so we think our approach has some inherent manufacturability advantages," Buzak says. "I can have the same functionality as a piece of glass with a million TFTs on it without having to fabricate a single transistor," he says, "and without having to use any integrated-circuit-type processes whatsoever."

Buzak's plasma-addressing method works by replacing each row of TFTs found in a conventional active-matrix array with an etched channel in a glass substrate. The channel is used to contain a plasma, such as helium or neon. In its ionized state, the gas is conducting, but when deionized it's nonconducting and controllable with an electrical strobe. "Since the plasma that resides in each of these lines is capable of changing between a conducting and a nonconducting state, we can effectively make it act like an array of switches," Buzak explains.

Buzak first disclosed the plasma-addressing scheme at last May's SID show in Las Vegas, where he demonstrated a working, full-color 150-by-150-pixel LCD built with the technology. The next step is to sign up a development partner to produce a product prototype—a 16-in.-diagonal, 640-by-480-pixel, full-color unit, for example. Such an effort might take about two years, Buzak figures, after which point the technology could be ready to move to production.

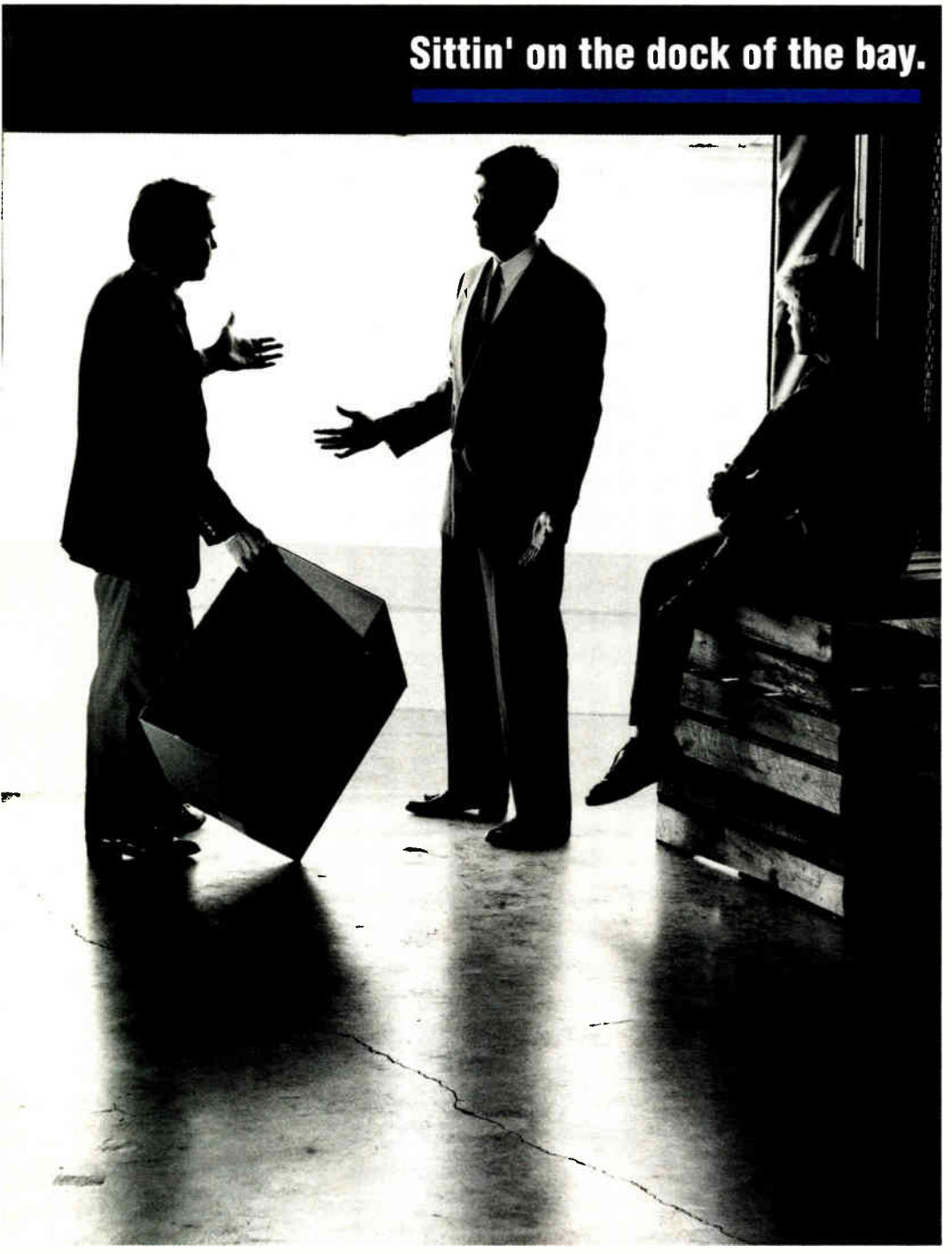
AS AN ALTERNATIVE TO TFT-based LCDs, plasma addressing probably won't offer big benefits in capital investment or materials cost, says Buzak. But it has clear advantages in high yield, and the ability to make displays in very large sizes.

Many industry watchers give Buzak high marks for inventiveness. But they caution against too much optimism. If Tektronix does find development partners, they will probably be Japanese, says Joseph Castellano, president of Stanford Resources Inc., a San Jose, Calif., market research firm. "The Japanese have the competence and expertise to take something like this and make it into a production process," he notes. "But whether they have the desire to do that now that they've put all this other money into TFTs, I don't know."

Tannas, the former SID chief, agrees. "Buzak's activity is important from a research standpoint. But it is so minuscule in the context of the active-matrix LCD activity going on in Japan," he says. "Americans have this John Wayne attitude where they think some inventor is going to invent something in the garage and it's going to turn into Ford Motor Company," Tannas says. "But the world is too complicated now. You have to have teams of hundreds of people working for tens of years before you make significant things. And the Japanese have already done that."

Brody, for his part, is impressed with the Buzak invention. "I really think it's an excellent idea. Even though it is ostensibly produced to make my active-matrix technology obsolete, I don't think it's going to do that. But I do think it should be developed further."

Like others, Brody is generally downhearted about prospects for U. S. high-technology competitiveness in the 1990s. "I blame the [Bush] administration for generating an atmosphere that totally discourages the private investors. And I am really quite bitter about that," Brody says. "We need to protect our basic high-technology infrastructure, which is all going to go away, and we will become a Japanese colony. It's happening before our noses, bit by little bit, and the administration refuses to see it, because it doesn't agree with their ideology of complete, unfettered world free trade." E



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CIRCLE 188

THERE'S A LOT OF LIFE LEFT IN THE 4-BIT CONTROLLER, AS EUROSIL'S FAMILY PROVES

STILL HOPPING

BY JOHN GOSCH

WITH THE TREND IN microprocessor technology going from 16- to 32-bit devices, you might think that 8-bit versions are on their way out and 4-bit parts are already museum pieces. Far from it. According to Dataquest Inc., 4-bit microcontrollers are still enjoying substantial growth. Some estimates put the world's consumption of such controllers at more than 300 million units for this year, with applications especially in fields where requirements for device intelligence and computing performance are not too stringent—telephones, household appliances, timers, and the like.

It's at these markets that West Germany's Eurosil Electronic GmbH is aiming a new family of 4-bit applications-oriented microcontrollers. Combining the flexibility of standard cells with the best features of a microprocessor, the MARC4, Eurosil says, is the first low-power single-chip CMOS microcomputer programmable in the high-level language Forth. "Its systems performance compares well with that of most 8-bit microcontrollers on the market," says Gerhard Göttle, leader of the MARC4 development group.

In the new family, Eurosil employs a building-block approach for integrating modular components to suit customers' needs. Furthermore, a stack-oriented architecture, together with the modular Forth programming language, yields a device that is ideal for real-time applications in low-power environments.

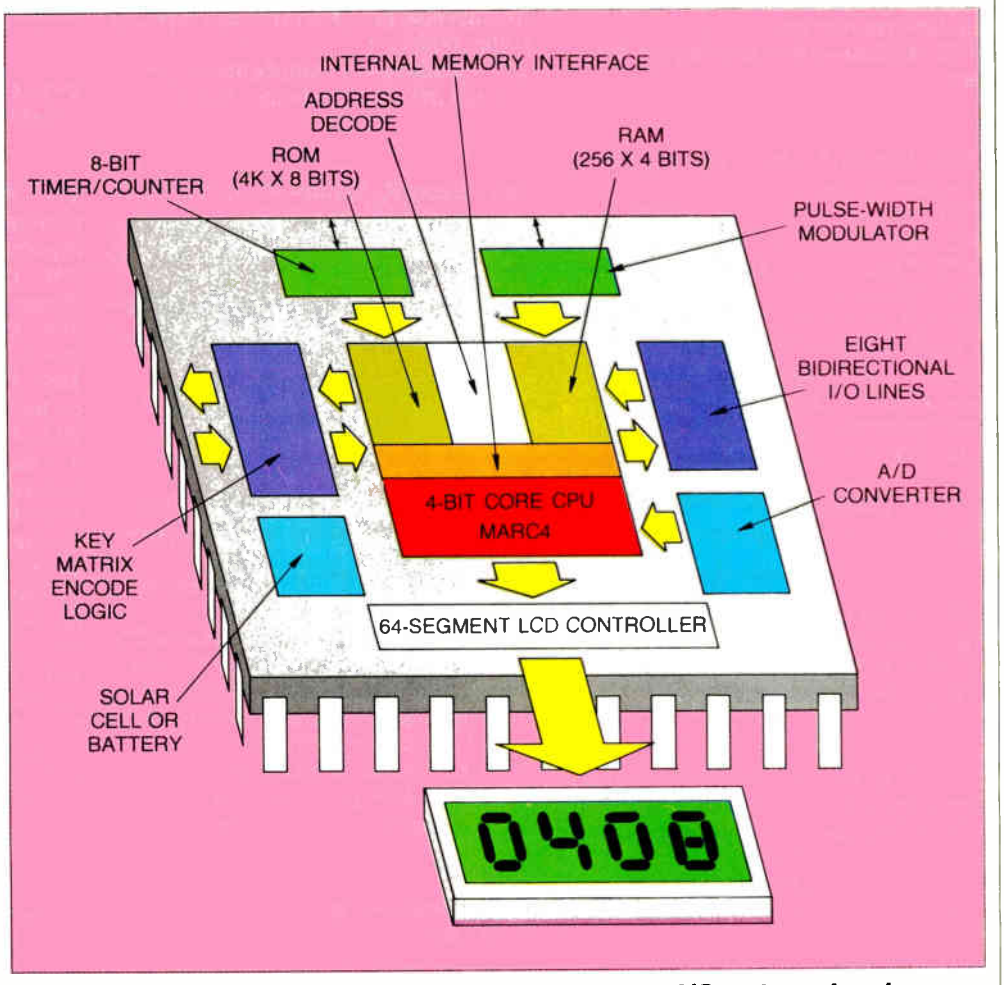
Forth compares with C or Pascal, but Eurosil has optimized the language so it can be used in real-time embedded-control applications. The language is easy to learn and, because of its modularity, suited for structured programs. "Using Forth means more programming efficiency compared with assembler programs normally employed with 4- and 8-bit microprocessors and microcontrollers," says Heinrich Storz, who is responsible for software development for the device.

Of particular note is the MARC4's low power requirements. After the device has performed all its tasks, it automatically switches to its Sleep mode. Current consumption then drops to typically 3 μA for a 1.5-V supply. That, Göttle says, makes the MARC4 one of the least power-hungry 4-bit microcontrollers of its class: it has an average instruction cycle time of 4 μs at 1.5 V.

With its MARC4, Eurosil, with headquarters in Eching, near Munich, continues its decades-long tradition of developing low-power CMOS parts. The firm—a subsidiary of Telefunken Electronic GmbH (which, in turn, belongs to the Frankfurt-based AEG AG group)—has 30% of the world market and 60% of the European market for low-power ICs for clocks and watches.

The MARC4 is already available in Western Europe. "What appeals to us is the high clock frequencies—500 MHz and more—the MARC4 delivers at low voltage levels," says Manfred Schubert, an engineering manager at the Institute for Time Measuring Technology in Stuttgart, West Germany. "In addition to the combination of speed and device features, there's the low power consump-

(Continued on page 53)



MARC4 holds a CPU, program and data memory, I/O ports, and such peripherals as LCD drivers; a system can be configured on a single chip.

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15	35	55	75	95	115	135	155	175	195	215	235	255	275	295	315	335	820
16	36	56	76	96	116	136	156	176	196	216	236	256	276	296	316	801	821
17	37	57	77	97	117	137	157	177	197	217	237	257	277	297	317	802	822
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(Continued from page 51)
tion that makes the controller an attractive buy." The family is now being introduced into the U. S., with AEG Corp. in Somerville, N. J., responsible for sales and distribution. The device will sell for $1 to $4, depending on supply-voltage range, package, and volume ordered.

The MARC4—the name stands for modular architecture 4-bit microcontroller—is a true computing system on a chip, comprising a central processing unit, program memory, data memory, and input/output ports, as well as peripherals such as liquid-crystal-display driver, counter/timer, and similar modules. They are all integrated on a single chip so that a complete system can be configured without any added components.

The CPU divides up into four functional blocks: the program read-only memory, data random-access memory, arithmetic logic unit, and microprogrammed control logic. The CPU is based on the Harvard architecture, which means that the ROM and RAM are physically separate and are addressed independently. A major advantage of this architecture is that both memory areas can be accessed at the same time. This way, the next instruction can be prefetched from ROM while the current one is being executed.

A separate peripheral interface bus is used so that peripheral components such as LCD driver, counter/timer, analog-to-digital converter, and EEPROM modules can easily be integrated on-chip. Right from the start, Eurosil has developed various processor versions that differ from one another in the number of I/O lines, interrupts, prescalers, and timers. One version, Göttle says, is designed to control LCDs with up to 80 segments.

HOW POWERFUL IS THE controller? Considering that it's a complete computer system with all necessary components on-chip—and also taking into account the fast instruction cycles—the MARC4 stands up to an 8-bit CPU and costs less. The CPU's instruction cycle time, which is derived from the internal resistance-capacitance oscillator clock frequency, varies with the supply voltage. It is about 2 μs at 3 V and 8 μs at 1.2 V.

The CPU is built around a stack-oriented processor core. One advantage of a stack is its dynamic properties. This makes efficient use of the memory space and supports the MARC4's multilevel preemptive interrupt capability.

Because the Forth language is implemented with the MARC4 hardware, it is possible to generate highly optimized code without any loss of efficiency. A software simulator simulates individual program modules, while an emulator tests the complete program under real-time conditions. The menu-driven software-development system—which also includes an editor and a Forth compiler—runs on IBM PC or compatible.

The MARC4 was originally designed for Eurosil's 3.0-μm p-well CMOS process for 1.5-V applications. Last year, the technology was altered to a 1.5-μm n-well CMOS process. The basic MARC4 core was converted also into Telefunken's n-well biCMOS technology.

All told, Eurosil's MARC4 is a 4-bit microcontroller that can operate with minimal currents from a single 1.5-V battery. The device, Eurosil predicts, has a great future in many applications.

UNIX MAKES GOOD ON ITS PROMISE

THE AT&T-DEVELOPED OPERATING SYSTEM NOW PENETRATES ALL CLASSES OF COMPUTERS—AND IT'S GROWING FAST

BY LAWRENCE CURRAN

COMPUTING

LIKE A BASEBALL PLAYER who has outgrown a reputation for unfulfilled potential, Unix is coming into its own. The operating system developed more than 20 years ago at AT&T Co. is becoming pervasive in all classes of computers and applications. Hardware running Unix now accounts for more than 10% of the value of worldwide computer shipments annually—a figure that will more than double by 1994.

Once regarded as almost exclusively suited for technical and scientific computing, Unix's broader success is built on several factors. Chief among them is that Unix has achieved the status of a de facto standard in the computer industry's swelling push for open systems, in part because it readily accommodates networking in enterprise-wide client-server computing.

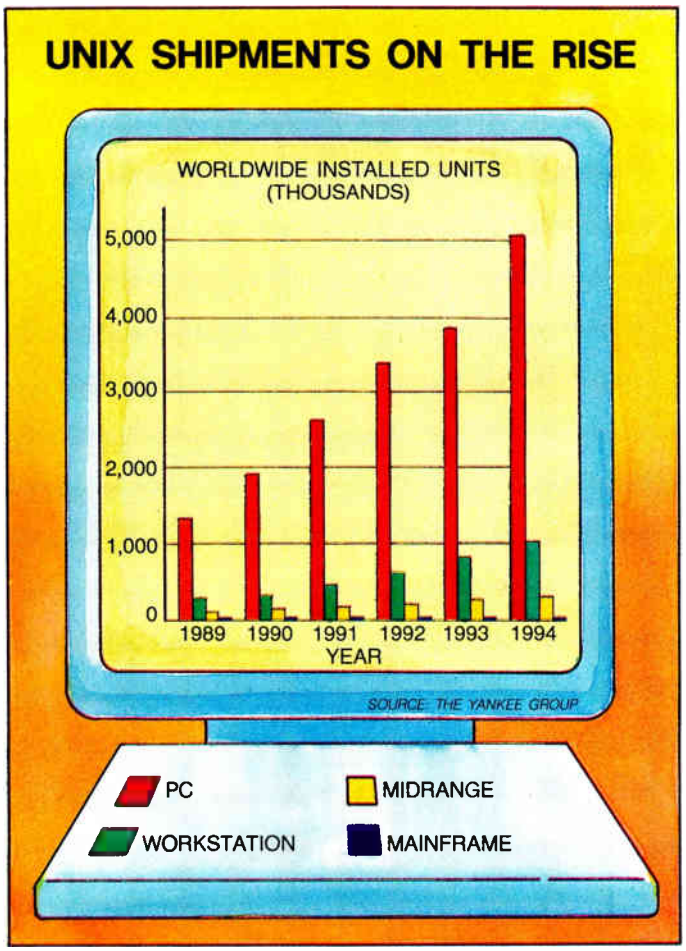
Another plus is that Unix has found a home on workstations—the fastest-growing computer market segment—and it matches up naturally with reduced-instruction-set-computing workstations, which are catching on fast.

Further, new graphical user interfaces, which make Unix easier to use by presenting menus and/or function icons on the screen, make the operating system less intimidating for nontechnical personal computer users.

As a result, Unix is finding its way into an increasing number of low-end systems (see p. 57). Two of the leading graphical user interfaces are the Open Software Foundation's Motif and Sun Microsystems Inc.'s Open Look.

In fact, although Unix will continue to face competition on PCs from MS-DOS, OS/2, and the Apple Macintosh operating system, its strong move downward to smaller platforms is one of the most convincing testimonials to its widespread acceptance. Some 45% of the Unix-based single-user systems shipped by U. S. vendors in 1989 were PCs, while 55% were workstations, according to International Data Corp. of Framingham, Mass. And in a June report, the Yankee Group projects that the largest number of Unix-based computer shipments through 1994 will be PCs. The Boston-based market research and consulting organization forecasts that the installed base of PCs running Unix will zoom from 1.3 million last year to more than 5 million in 1994.

Importantly, that burgeoning PC base is a relatively new market for Unix, which also continues to thrive on engineering workstations, its historic stronghold. The Yankee Group estimates that the greatest compound annual growth rate for Unix on any class of computer—36%—will continue to be in workstations, which will soar from an installed base of 225,000 last year to 1.03 million in 1994. By then, 80% of all installed workstations will run Unix, up from 50% last year, Yankee reports.



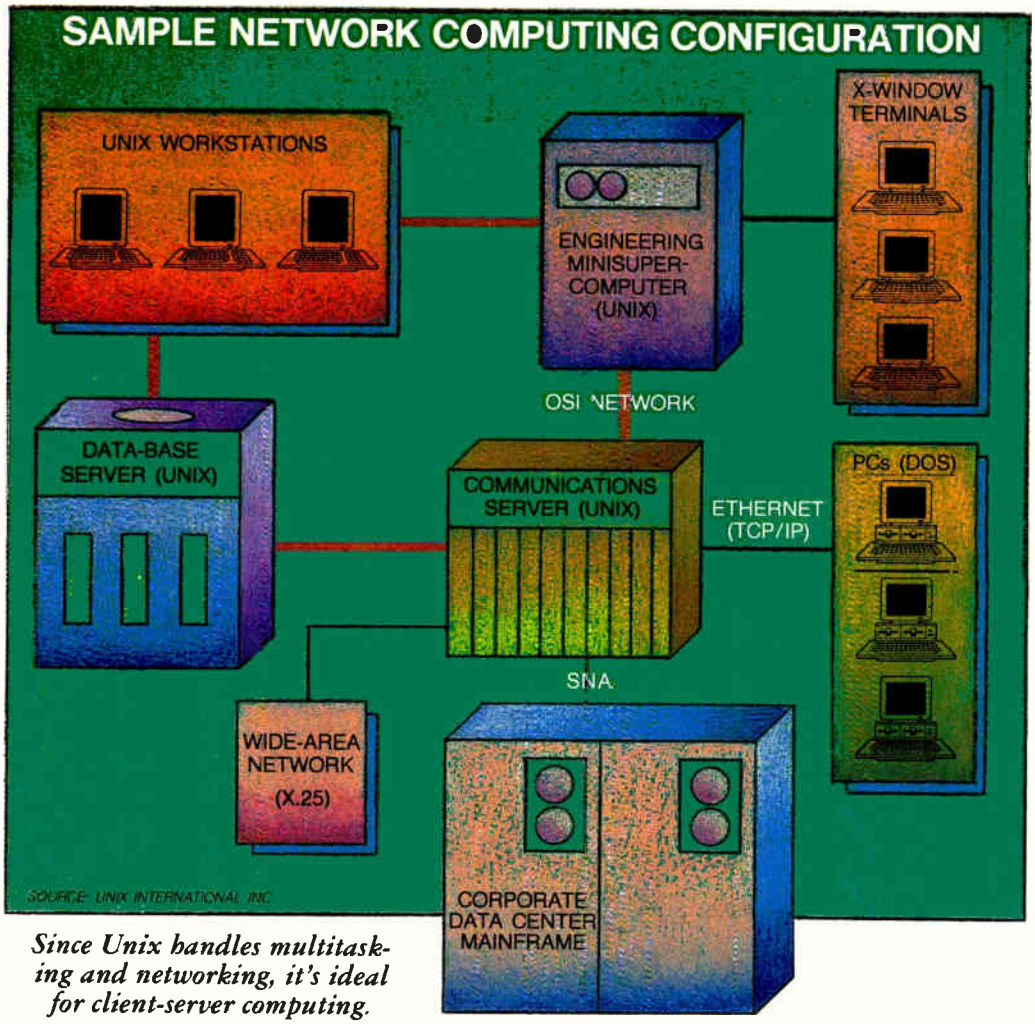
At Dataquest Inc., the San Jose, Calif., market research organization, analyst Paul Cubbage says the value of Unix-based machines shipped last year grew about 50%—to some 820,000 units worth $14 billion. "That's a step function in growth," Cubbage says, and a trend that will continue. By 1994, he estimates that Unix-based shipments will reach 2.8 billion units and $47 billion.

"Unix is beginning to dominate certain segments," Cubbage adds. "The supercomputer market is almost totally Unix. The workstation market is all Unix plus [Digital Equipment Corp.'s] VAX. The small-to-medium

minicomputer segment is becoming dominated by Unix systems, starting with SCO Xenix on 386 boxes and working up from there. That leaves mainframes and PCs not dominated by Unix," Cubbage concludes. (Xenix is the Microsoft Corp. version of Unix for 8086/80286/80386-based PCs that's sold under license by the Santa Cruz Operation, Santa Cruz, Calif.)

This voracious demand for Unix is coming despite the ongoing hassle between Unix International Inc. and the Open Software Foundation, the two main bodies backing different versions of the operating system. UI touts AT&T's System V Release 4; OSF champions OSF/1, which is derived from the Mach operating system from Carnegie Mellon University in Pittsburgh (see p. 59).

In their push for open systems—networked hardware and software from various vendors that must work together—computer users have forced vendors away from sole reliance on proprietary hardware architectures and operating systems. No longer are users voiceless while computer giants like IBM Corp. and Digital Equipment offer only proprietary designs that couldn't communicate with one another in multivendor environments.



Since Unix handles multitasking and networking, it's ideal for client-server computing.

"The real key to openness is to provide interoperability between systems, regardless of their heritage or technological underpinnings," says Paul Zagaeski, senior analyst for distributed systems at the Yankee Group. "This is what users have begun to demand, and operating systems are only one part of this call for standards," he says. "Unix is, however, the core of open-systems technology."

In fact, "I know of no company entering the business in the last few years that is building an operating system of its own, with the exception of PCs and IBM mainframe clones," declares Mike DeFazio, vice president for Unix System V software at AT&T's Unix Systems Laboratories in Morristown, N. J., where Unix was spawned.

Another push for open systems comes from the U. S. government, says David Sandel, vice president for marketing at Unix International in Parsippany, N. J. "The government has been telling vendors for the past few years that it doesn't want to be tied to a specific hardware vendor." That push, he says, has led to Posix—portable operating system interfaces, in which portability is achieved through application programming interface guidelines. Those guidelines are now being generated by the IEEE. Posix, says Sandel, is the core of Unix and the key to its broad compatibility. "Vendors, seeing tens of billions of dollars of [government] procurements per year, are concluding they have to have a Unix implementation," he says.

Nor is there much question about the open-system status of Unix in the United Kingdom. The word is synonymous with open systems in the minds of UK information-systems managers, says consultant Caroline Weinstein of BIS Mackintosh Ltd., a market analysis firm in Luton, England. "And they like the open-systems concept because it gives them power over their suppliers," she maintains. Most of them, she adds, have worked with IBM-compatible PCs and know the benefits that a standardized operating system such as MS-DOS can bring. "These people regard Unix as a more sophisticated equivalent to MS-DOS," she says.

BIS Mackintosh estimates that the value of Unix-based systems shipped in the UK will jump from $600 million last year to $2.5 billion by 1994—an average annual growth rate of 32%. That compares with a predicted growth rate of 10% for the same period for the entire UK computer market.

Back in the U. S., however, IBM—which bid its own Unix variant, AIX, to the Open Software Foundation for incorporation into OSF/1 before Mach was chosen—isn't ready to acknowledge Unix as the alpha and omega of open systems. "We don't regard Unix as a four-letter word, and we're very strong behind it, with AIX as a strong part of our product line," says Bill Filip, assistant general manager of marketing for personal systems and advanced workstations at IBM in Somers, N. Y. "But we're

looking to achieve interoperability and application portability with other operating systems as well."

Filip points out that the IEEE's definition of open systems, which will be proposed to the International Standards Organization as the U.S. position, leaves room for more than one operating system. The IEEE under Posix defines an open-systems environment as one that "supports a comprehensive and consistent set of international information-technology standards and functional standards profiles that specify interfaces, services, and supporting formats to accomplish interoperability and portability of applications, data, and people."

Filip acknowledges that Unix fits that definition. But, he says, so will several other operating systems, including DOS, OS/2, VMS, MVS, and VM, because of their developers' stated intentions to have them comply with the Posix push.

The client-server computing model that will dominate the 1990s forces vendors to provide computers and software that will communicate readily over a worldwide network linking the desktop with the data center, and every computing resource in between. That's an environment in which Unix thrives, because it accommodates multitasking, network communications, and application software transportability.

PUSH COMES TO SHOVE

Once seen as an operating system for technical computing only, Unix will account for about a quarter of the value of all computers shipped by 1993.

The push is fueled by the industry's demand for open-systems computing, Unix's forte.

Another plus: Unix has found a home on workstations and in RISC.

"Networking is one of Unix's strongest features," says AT&T's DeFazio, "especially in relation to DOS, OS/2, and proprietary systems. Its NFS [Network File System] file-sharing capability is a natural for networking." Indeed, "Unix system users can run all their DOS applications on the network in a distributed computer system under Unix, even though the original DOS idea is of a stand-alone machine," says Sri Rajeev, Sun/OS product manager at Sun Microsystems in Mountain View, Calif. (Sun/OS is Sun's version of Unix System V.)

The communications features of Unix are also attractive to Joe Menard, marketing manager for Digital Equipment's Unix variant, Ultrix, in Nashua, N.H. But Unix has a lot more going for it than that, he says. "You get a lot of functionality with Unix—multitasking, multiprocessing, and advanced memory support, as well as a solid communications interface."

And now, with a good graphical user interface, such as OSF's Motif, "Unix will catch on in PCs, because you can run both it and DOS in a 386-based machine."

As for the apparent domination of Unix on RISC architectures, some industry observers see the two as mutually supportive, and most agree that RISC workstations have become a prime Unix market driver. Rajeev at Sun maintains that the operating system's portability "is an excellent reason Unix and RISC are so closely tied. Unix is so portable that you need only port the C compiler, because Unix is machine-independent." In fact, Rajeev says flatly that today's Sparc and MIPS RISC chips "wouldn't have become a market nearly as fast as they have without Unix."

Digital's Menard seconds the view that the portability of Unix made it simple to move to RISC machines, mainly because the operating system is written in C. "Unix was ported quickly because of its design; it's written in a high-level language and is therefore easy to port to a new platform." But Menard is also quick to point out that Digital continues to sell "a significant number" of workstations that run the company's proprietary VMS operating system.

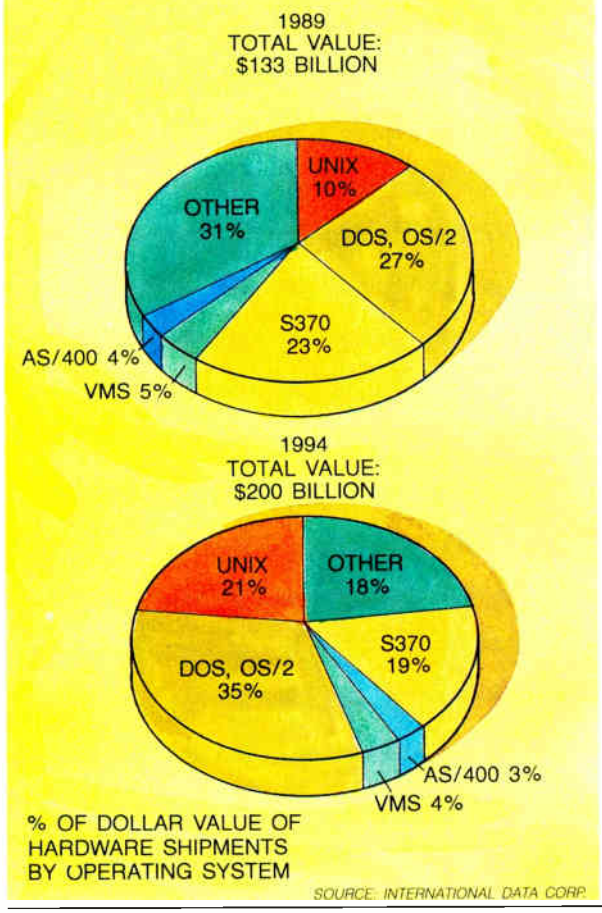
Nor will IBM rely solely on AIX/Unix for its RISC products, although Filip too sees a natural tie between RISC and Unix. "One of the things that's been driving the popularity of Unix in the last few years is the trend toward exploiting RISC architectures, but both IBM and Microsoft have said that OS/2 is likely to be important" on future RISC platforms, he says.

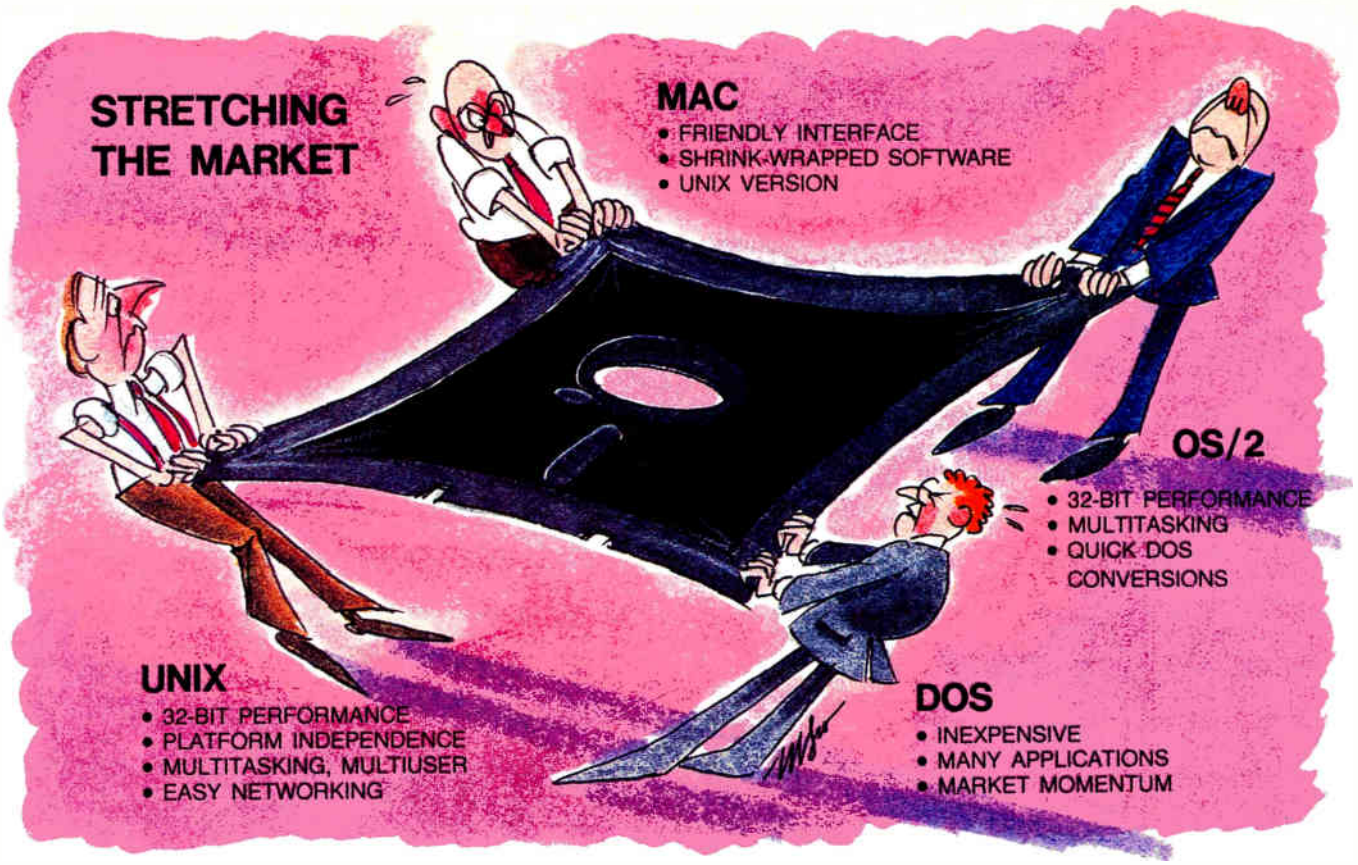
While the success of Unix has forced most major vendors to add Unix-based systems to their proprietary product offerings, the operating system still needs more features. "When Unix International was formed," says UI's Sandel, "we developed a five-year plan for the evolution of open systems, with System V, Release 4 as anchor." And while non-UI members may not support AT&T's System V, few would argue with the functions Sandel says are lacking, but coming.

First among those is security. "If Unix is to be used in the banking industry," Sandel says, "it needs better security features." The other important features he lists are better provision for multiprocessing, real-time transaction processing for mission-critical applications, and distributed system administration and network management. "I think you will see them all—but not too quickly."

Additional reporting by Peter Fletcher, Jack Shandle, and Samuel Weber

A BIGGER PIECE OF THE PIE





Unix wants to conquer more of the PC market, but entrenched operating systems and OS/2 have the inside track.

UNIX TAKES A HAND IN THE PC TUG-OF-WAR

MARKET SHARE WILL ELUDE THE UP-AND-COMING OS UNTIL IT SOLVES SOME MUNDANE MARKETING PROBLEMS

BY JACK SHANDLE

THE PENETRATION OF UNIX into the world of personal computers now dominated by the DOS and Macintosh operating systems could be described as a daisy chain of "ifs."

If mission-critical applications move to networked PCs, and if shrink-wrapped Unix software really takes off, and if Microsoft Corp.'s OS/2 languishes, then Unix will gain significant market share in the desktop market.

Many industry watchers would readily change the "ifs" into "whens" and suggest that the real question is how much Unix will displace the entrenched PC operating systems from Microsoft and Apple Computer Inc. But for the time being, at least, many PC companies have opted for the wait-and-see mode. Their problem is familiar enough: keeping all technology bases covered while still maximizing profit at the end of each quarter. So far, that means watching Unix closely but not embracing it. "We look at Unix as a strategic element—not as a strong market presence now," says Greg Young, systems marketing manager at AST Research Inc., a leading PC vendor based in Irvine, Calif.

COMPUTING

Young estimates that the penetration of Unix on AST platforms is roughly proportional to the company's sales of 32-bit platforms—anywhere from 6% to 10%. AST's estimates fall in the same ballpark as Compaq Computer Corp.'s, according to Lorie Strong, director of product marketing for the Houston-based PC giant.

But although these percentages seem small, they are far from insignificant in unit numbers: a mere 10% or less of the PC market accounts for the largest percentage of units shipped in

the much smaller Unix market. That's why Unix software companies are salivating over the PC world's growing interest in the operating system. "Compaq alone sells more machines in a month than [workstation heavyweight] Sun sells in a year," says Pat Bellamah, OS/2 product manager at Microsoft in Redmond, Wash. The Yankee Group confirms that the largest number of Unix unit shipments in coming years will occur in the PC market. The Boston market analyst forecasts an installed base of 5 million PC/Unix systems by 1994—up from 1.3 million in 1989 (see p. 54).

Even as sales grow, market analysts offer diverse opinions as to just how much Unix will penetrate the PC market, running either on a stand-alone PC or as part and parcel of a low-end workstation. Weighing in on the bullish side is San Jose, Calif.-based Dataquest Inc. Analyst Paul Cubbage sees the price/performance ratios of Unix workstations making them strong candidates to displace PCs for corporate desktop computing. "You can run PC applications on certain Unix workstations as fast as you can on a PC," he says.

But for the non-power user, there is a big question: why purchase a $700 operating system when DOS seems to be working just fine? "There is no big advantage in running Unix on a stand-alone PC," says consultant Caroline Weinstein of the London market research house BIS Mackintosh Ltd.

Underlying the arguments on both sides is an unstated assessment of Unix's strengths versus DOS, OS/2, and the Mac. But a straightforward technology assessment does not tell the whole story, says Microsoft's Bellamah. Unix on a PC platform is sold overwhelmingly as a multiuser system—typically two or three terminals running on a 386 PC. Microsoft's strategy, on the other hand, keeps the PC on the desktop running OS/2 with data or task calls to the server. "OS/2 is still outselling Unix on PC platforms by a substantial margin," she says. "We know, because PC Unix licenses go through Microsoft to AT&T Co."

The migration of mission-critical applications such as payroll, inventory, and financial data from mainframes and minicomputers to distributed computing environments could be a boon to Unix. Such applications could simply outgrow a DOS network, says Maury Domengeaux, a product marketing manager at Interactive Systems Corp. Based in Santa Monica, Calif., Interactive Systems is a leading vendor of AT&T Unix for PCs.

Platform independence provides another reason for migrating to Unix. Applications written for mainframes or minicomputers can move to local-area networks with little recoding, says AST's Young. Platform independence also makes for cost-effective program development on PCs for applications that will eventually run on mainframes.

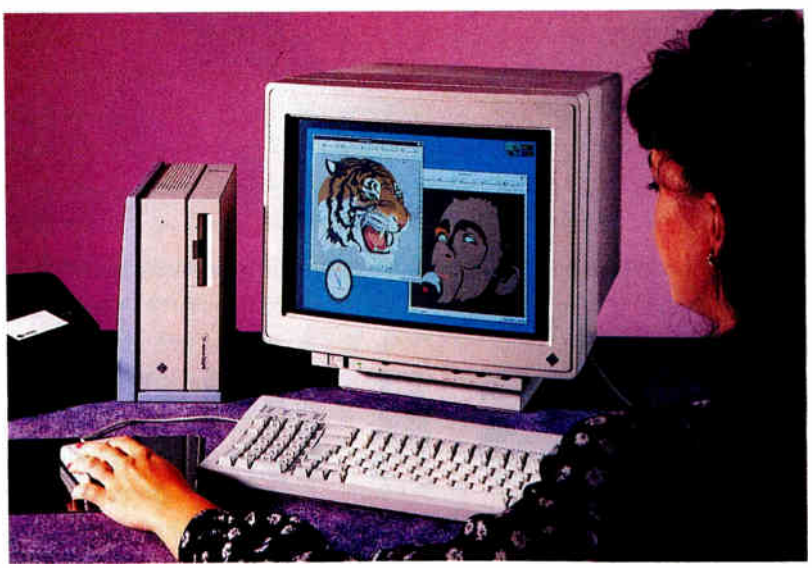
Two other features that have long helped the Mac and the PC—and that have been lacking in Unix—are readily available software in shrink-wrapped packaging and a friendly user interface. Unix is fighting back on both fronts. The Open Software Foundation's Motif and Sun Microsystems Inc.'s Open Look are gaining ground as graphical user interfaces. And great strides are being made in the availablity of commercial—rather than scientific/engineering—software. "One important phenomenon with Unix today is the advent of shrink-wrapped software," says David I. Sandel, vice president of marketing for Unix International Inc., Parsippany, N.J. "It will be a major market opportunity over the next few years for independent software vendors."

Meanwhile, software companies specializing in Unix—such as Interactive Systems and the Santa Cruz Operation in Santa Cruz, Calif.—have steadily added to the list of applications. SCO's catalog lists over 3,000 applications, 90% of them of the commercial variety, such as spreadsheets, word processors, and data-base programs, says Charles Watkins, SCO's Unix product manager.

For the most part, PC makers have little at risk from Unix running on their platforms. But a separate and distinct Unix challenge to the desktop is the low-end Unix workstation—machines like Sun's new Sparcstation IPC, which is built around the reduced-instruction-set Sparc chip instead of an Intel Corp. or Motorola Inc. microprocessor. Priced at $9,995 and offering performance of 15.8 million instructions/s, the IPC is being positioned as offering better performance at a lower price than many full-function PCs with color monitors. And while the IPC can handle technical applications such as computer-aided design, the Mountain View, Calif., company expects strong demand from the financial community, where analysts could use it to execute complex financial modeling and portfolio management programs. The IPC also runs traditional PC personal productivity applications, including spreadsheets, data-base management, word processing, and desktop publishing.

Interactive Systems' Domengeaux does not see the IPC as a direct competitor to Unix running on PCs. Since it has a RISC processor, he says, the IPC's performance slumps when it runs DOS applications. "It is really geared to the engineering market," he says. "It is Sun's answer to the IBM System/6000 and Hewlett-Packard's low-end workstations." E

Additional reporting by Lawrence Curran and Peter Fletcher



A PC KILLER?

Priced at PC level, Unix workstations like Sun's Sparcstation IPC target the high-end PC's office niche.

A SINGLE UNIX? DON'T HOLD YOUR BREATH

THERE'S OSF AND THERE'S UI, AND THE PUNDITS PREDICT THAT NEVER THE TWAIN SHALL MEET

BY LAWRENCE CURRAN

Unix support has divided into two primary camps: the Open Software Foundation and Unix International Inc., each with a host of member companies. Here we sample the views of some of them regarding the ongoing Unix debate. On the following two pages, senior OSF and UI executives offer their opinions on the merits of the two groups' respective versions of Unix.

IF YOU'RE A DEVELOPER OF application software for the Unix operating system, don't hold your breath waiting for one "standard" Unix to emerge. It looks like the parallel paths on which the Open Software Foundation and Unix International Inc. are traveling will not converge in the foreseeable future.

OSF, based in Cambridge, Mass., was spawned in early 1988, in part as a hedge by its members against the possibility of Unix being shaped too closely to the proprietary wishes of developer AT&T Co. and Sun Microsystems Inc. AT&T invested in Sun, which has backed AT&T's Unix System V since its inception. Then, in December 1988, Unix International sprang up, settling in Parsippany, N. J., with a mission to direct the evolution of Unix System V in response to member recommendations.

Since their inception, the two groups have held occasional meetings aimed at resolving their differences, leading to expectations that the organizations would merge and a true U. S. standard Unix would result. This phantom Unix, industry watchers hoped, would embody the best features of System V and the soon-to-be-released OSF/1. But the latest talks fizzled last April, leaving two main versions of the operating system.

Still, two beats 200: many in the computer industry regard today's situation as far better than in the pre-OSF days, when more than 200 Unix variations caused considerable confusion in the marketplace. "Just about all the MIS managers in the U. S. now know that they need Unix. Furthermore, there are now two versions instead of more than 250," says Sri Rajeev, product marketing manager for Sun Microsystems' SunOS version of Unix. What's more, he says, the lively debate between OSF and UI "has focused attention wonderfully on Unix." At the same time, he allows, the lack of agreement between the two bodies "buys more time for proprietary operating systems."

Dueling Standards

	Open Software Foundation	Unix International Inc.
Founded:	5/88	12/88
Location:	Cambridge, Mass.	Parsippany, N. J.
Number of members:	200	160
Key members:	DEC, Hewlett-Packard, IBM	AT&T, Sun, Intel
Kernel:	Carnegie Mellon Mach	AT&T System V Release 4
Status of operating system:	To be released 11/90	Released 11/89
User interface:	Motif	X Windows

But the two Unixes are unlikely to merge in the next few years simply because their backers are too heavily committed to their respective directions. That's the realistic view of Jan Silverman, manager of system software and communications at the Apollo Systems Division of Hewlett-Packard Co., Chelmsford, Mass., which backs OSF.

"From a business point of view, a number of vendors have crystallized behind one of the two camps and have a significant investment" in one version of Unix, Silverman points out. "If there were a merger between the two tomorrow," he adds, "the backer of the 'losing technology' would be one or two years behind. I see no such merger in this generation of products."

Caroline Weinstein, a consultant with BIS Mackintosh Ltd., a market analysis and forecasting firm in Luton, UK, thought the recent discussions between the two bodies "might lead somewhere, but the likelihood of there being one Unix is remote at present. But at least two Unixes are better than all the proprietary systems."

The industry appears divided over whether the brouhaha is good or bad for the computer industry. Like Sun's Rajeev, Cory Devor, Bull HN Information Systems' director of marketing for open systems and Unix, believes the debate is healthy because it focuses attention on Unix and rejuvenates sharper competition than was typical in the days when proprietary systems were dominant. "A perfect world would run on 110-V power," Devor says.

For his part, senior analyst Paul Zagaeski of the Yankee Group, a Boston market research firm, is not so sure. Zagaeski doesn't see the OSF-UI debate as healthy for the computer industry over the short haul, although he believes competition between the two may have long-term positive results. For now, however, "it's draining ener-

gy away from the merger of technologies that is needed for truly open systems," Zagaeski says. "These guys are really serious about their disagreements, and they're not going to be glossed over easily."

Even more vocal is Charles Watkins, Unix product manager at the Santa Cruz Operation, a leading supplier of Xenix and Unix system software for personal computers in Santa Cruz, Calif. "I'm mad as hell at these guys for conducting their little war," Watkins snorts. "They're not telling customers about the commonality [between the two versions]. Customers sense that there are two distinctly different versions when in fact they both have a lot of similarity, including similar kernels," Watkins says. Both versions, he notes, offer the Transmission Control Proto-

OSF/1: BLENDING INNOVATION AND COMPATIBILITY

COMMENTARY

THE OSF/1 OPERATING system offers the innovative operating-system technology that the industry requires today while preserving the industry's previous investment in existing software. The innovations that are found in OSF/1 meet the needs for high-performance, high-reliability computing in networked and multiprocessing environments. At the same time, OSF/1 is compatible with standards and existing operating-system implementations, thus preserving application portability and interoperability with other systems.

Three sources contribute to the innovation of OSF/1.

First, OSF/1 uses Mach, a next-generation operating system developed at Carnegie Mellon University, as its base kernel technology. Today, thousands of Mach-based systems have been shipped by a number of commercial suppliers. Mach has been thoroughly tested over the past five years by university, commercial, and industrial research centers. The OSF/1 operating system combines this Mach base with OSF enhancements, Berkeley Software Distribution Unix, System V Unix, and compliance with all relevant industry standards.

Mach gives OSF/1 symmetric multiprocessing; demonstrated portability to diverse hardware architectures; a versatile memory-management subsystem; "threads" that allow multiple instruction streams to run concurrently in a single address space; and a fully compatible path to a simplified microkernel that can provide a trusted computing base for higher security levels.

Second, OSF/1 draws upon leading-edge Unix implementations from industry and universities. This includes contributions from IBM Corp.'s AIX operating system, Encore Computer Corp.'s implementation of Mach, security features from SecureWare, and the latest Berkeley Unix.

- AIX provides, among other features, a logical volume manager that lets storage volumes span multiple physical media (hard disks, for example) and also supports disk mirroring. The logical volume manager is essential for applications, such as data-base management systems, that create large files which exceed the capacity of a single external storage device.
- Encore's implementation of Mach, along with joint Encore and OSF development, provides full parallelization of many key features of the operating system, including the file system and networking code.
- The Berkeley 4.4 release provides a newly designed network file system compatible with NFS from Sun Microsystems Inc. This release also provides a framework for the addition of other file systems by means of its virtual file-system switch.
- OSF's advanced, highly extensible program loader operates in user space. It supports position-independent shared libraries and dynamic linking, and enables the loading of new or existing object-file formats.

'OSF/1 will support diverse hardware architectures and applications yet preserve software investments.'

GRACE PEREZ

The third source of innovation is an industry-wide open process that merges the best new technology into the OSF/1 environment. The process demonstrated its value with the selection of the OSF graphical user interface, OSF/Motif. In less than one year, OSF/Motif has become a de facto industry standard.

OSF/1 is compliant with applicable standards and specifications such as Posix and X/Open Portability Guide, issue 3 (XPG-3). What's more, OSF/1 is compatible with the existing Unix implementations. Through incorporation of portions of AIX, it merges the Berkeley and System V command sets. Users familiar with either system will have no trouble making the transition to OSF/1. In addition, the extensible nature of OSF/1 enables vendors to provide binary compatibility for their existing Unix applications. This backward compatibility provides a migration path for users and independent software vendors moving to an OSF/1 base while preserving previous software investments.

The combination of software innovation and broad standards compatibility makes OSF/1 uniquely valuable. For system vendors, it presents a lower-cost, more functional, and more extensible platform for meeting all their customers' needs. For software vendors, it supplies innovation, standards compliance, backward compatibility, and new application-building tools. For end users, it provides the right foundation for computing in the 1990s. The OSF/1 operating system combines the innovative features required to support diverse hardware architectures and business applications, along with the compatibility required for preservation of current software investments.—*Grace Perez, business area manager, the Open Software Foundation*

col Internet Protocol for communications, the Network File System for networking, and compliance with Posix. "This is a disaster in the industry and plays right into the hands of proprietary system vendors, such as IBM and Microsoft."

IBM Corp.'s Bill Filip voices the hopes of many about the OSF–UI conflict. Neither group is a standards body, notes Filip, the assistant general manager of marketing for personal systems and advanced workstations in Somers, N.Y. Rather, "they're both sources of standards-based technology for the vendor community. We'd like the source to be vendor-neutral, but we're not uncomfortable with two versions of Unix," he says. "We hope the debate takes a low profile—and our ears are always open to a merger of the two." E

SYSTEM V, RELEASE 4: A CLEAR ROAD TO THE FUTURE

COMMENTARY

AN OPERATING SYSTEM is a foundation product for the information-technology business. A well-constructed operating system can serve as the basis not merely for interesting and important products, but as the cornerstone for a business—indeed, for entire industries. Witness the growth in DOS-based applications in the 1980s and the consequences in terms of desktop computing.

The world of the '90s is very different than that of the '80s, both in technology and in the structure of business. Thus, while assessing an operating system today may start with the code itself—the product's technical excellence—the assessment must extend far beyond that narrow focus. In the open-systems market, an operating system must meet five key criteria.

- The product must incorporate advanced technology that meets the needs of the information-technology market of today and tomorrow. The industry's requirements keep changing, mandating the constant development of new releases.
- It must be proven technology, backed by an experienced development organization with a track record of shipping "industrial-strength" products and the ability to maintain an aggressive development program.
- It must help foster the success of users, who create the demand for the underlying operating system. In the open-systems market, this means protecting the installed base of some 10 million Unix System V users through full forward binary compatibility.
- It must provide a clear path to the future so that product-development planners and corporate strategists can make informed decisions.
- And it must be under the control of the industry at large, not a small group of vendors. Otherwise the majority of the companies committed to that operating system will be hostage to the needs and whims of the few.

In terms of the product, System V, Release 4 in many ways represents a "merger release," providing full binary compatibility for software written for the major Unix system variants while incorporating highly advanced features unique to each of these products. These are expanded by features specifically developed for System V, Release 4. Moreover, the operating system complies with important internationally accepted standards. Among its key features are:

- Source portability, establishing a common computing environment across multivendor systems.
- An application binary interface defining the set of interfaces that allow application software to be ported in binary form across different vendors' systems that share a specific processor architecture.
- An enhanced set of networking services to support the development of distributed applications, along with a well-defined plan for the creation of a mature distributed computing environment in future releases.
- The "Streams" input/output capabilities, which offer unprecedented modularity and portability for all I/O processing done inside the kernel.
- A third-generation virtual file system that lets several different types of file systems exist simultaneously.
- An advanced memory-management architecture that lets processes access files and devices as ranges of bytes within the virtual address space of the process.
- Real-time enhancements such as user-controlled process scheduling, higher-resolution timers, and enhanced memory locking to facilitate process-control and OLTP applications.
- Advanced internationalization features, such as support for multibyte characters (required for alphabets such as Japanese kanji).

'This is a product on which users can rely and continue to build their businesses.'

DAVID I. SANDEL

In developing the latest version of System V, one fundamental, unalterable principle was to maintain full binary compatibility with the installed base of System V, Xenix, SunOS, and BSD users. This was no simple task, but those users represent some 80% of the more than 10 million System V users worldwide and had to be protected. At the same time, System V, Release 4 represents a bridge to the technologies of the future—fully distributed computing, multiprocessing, and so on.

It was not so long ago than an examination of Unix focused on whether it might ever break out of its status as a niche product, one doomed to running only technical applications. Today the discussion points to the fact that in the commercial environment as much as anywhere else, Unix is a winning proposition. System V, Release 4—its robust features and its clear road to future operating-system technologies—make it a product on which users can rely and can continue to build their businesses.—*David I. Sandel, vice president of worldwide marketing, Unix International Inc.*

MERGING REAL-TIME PROCESSING AND UNIX V

NIXDORF'S HYBRID SYSTEM LETS UNIX RUN CONCURRENTLY WITH ITS REAL-TIME NICOS ON THE SAME CHIP

BY JOHN GOSCH

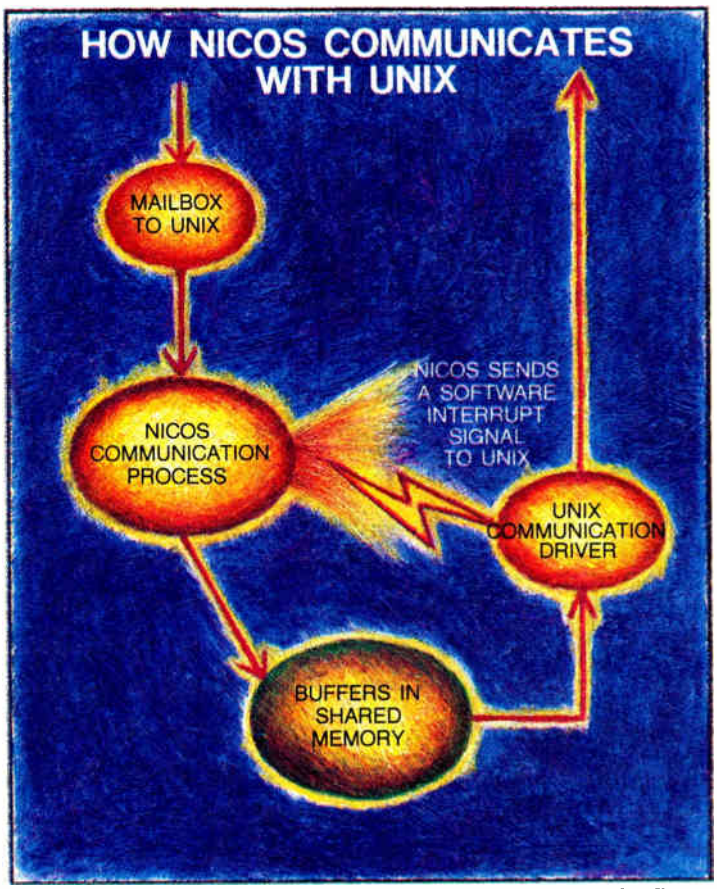
COMPUTING

SUPPLIERS OF EMBEDDED systems such as telecom switches face a dilemma. On the one hand, they need a powerful real-time operating system to handle the switching tasks. At the same time, they must provide the services of a standard operating system—filing input/output to back up programs or traffic data, for example. Until now, all the solutions devised to handle this problem have had drawbacks. But Nixdorf Computer AG has come up with an alternative: the West German equipment maker has developed a way to run Unix concurrently on the same chip with a real-time operating system, Nixdorf's Nicos.

Traditionally, designers have navigated around the real-time problem with three basic solutions.

First, you can use a pure real-time operating system with basic and extended I/O—such as Intel Corp.'s iRMX or Ready Systems' VRTX—gaining a dedicated real-time operating system with its functions tailored for efficient real-time processing. The disadvantage: the real-time OS remains embedded and can't be used to access standard commercial software.

Second, you can use a standard operating system that also fulfills real-time requirements, as does Concurrent Computer Corp.'s RTU Real Time Unix. This choice provides access to standard software and to real-time processing. However, with such a solution, the real-time software cannot easily be transferred to a pure real-time environment. That's because the standard operating system's memory requirements as regards the target hardware are too extensive.



To send a message to Unix, Nicos copies data into a buffer in shared memory and also sends an interrupt signal.

The third alternative is putting the two operating systems on different processors, connected by hardware and software links. This allows real-time processing as well as the use of standard software. But since the operating systems reside in different hardware units, system cost goes up.

"For our requirements, none of these solutions was satisfactory," says Clemens Schmidt, basic software development manager at Nixdorf, the Paderborn-based data-processing and communications equipment maker. To meet the needs of the equipment's embedded part, the company had to develop its own real-time OS family—called Nicos, for Nixdorf Communication Operating System. "But we also wanted to use Unix," Schmidt says. Running the two on separate processors would have worked "if it weren't for the added hardware, which is a big cost factor, especially when you're building small equipment."

As a way out of this bind, Nixdorf developed its so-called Hybrid System, which permits Unix V.3 to run concurrently with Nicos on the same processor, an Intel 80386. This solution offers a host of advantages:

- The complete application software available for Unix V can be accessed in a real-time environment.
- A native, high-end real-time OS allows real-time processing without compromises originating in the standard OS.
- Software that was developed for a pure real-time environment can be transferred to the Hybrid System's microprocessor.
- By employing the facilities for communications between the two operating systems, Unix features can be

used to extend the real-time OS. This offers an efficient way to equip existing Unix V machines with powerful real-time capabilities.

• Cost-effective systems can be built in cases where a two-processor solution is too expensive.

"These advantages enhance the technical and economic possibilities of present and future applications," says Schmidt. "Indeed, software designers no longer need to care about possible repercussions of the standard OS on real-time software and vice versa."

Nixdorf will use its Hybrid System in a private telecom switch the company is now developing for up to 10,000 subscriber lines. Depending on its acceptance by the industry, the company may make the system available as a commercial product. Nixdorf has applied for patents nationally and internationally, including in the U. S. and Japan, for its implementation, which runs on an 80386 processor board.

A TYPICAL APPLICATION under Nicos is event-driven. It consists of interrupt handlers, interrupt tasks, and application processes. Most of the time the processes are waiting for an external event to occur. As soon as a signal arrives, the associated interrupt handler starts, handles processing, and signals the event to the waiting interrupt task.

The interrupt task finishes the event handling, sends a response, and waits for the next event. Processing the event is time-critical, which means it must be accomplished in a predefined time period. If there is no event, Nicos schedules the Nicos idle task.

"In our Hybrid System, a real-time Nicos process must respond to an event in the same way as in a stand-alone Nicos system," says Gerd Friedrich, system software development manager at Nixdorf. "Therefore, Nicos must be able to preempt Unix at any time." The Unix kernel, however, is designed as nonre-entrant code; so as long as a Unix process executes in the Unix-kernel mode, no scheduling can take place.

These considerations led to the idea of handling the Unix system as the idle task of Nicos, which means that Unix controls the central processing unit only when no Nicos process is ready to run. This ensures that the real-time capabilities of Nicos in the Hybrid System are maintained, along with an acceptable Unix response time.

When Unix is running while a Nicos interrupt occurs, the Nicos scheduler switches from Unix to this interrupt task. But as soon as event processing under Nicos is finished, Nicos switches back to its idle task. When Nicos is executing, Unix-related events are still served by the Unix interrupt handler. But in contrast to the stand-alone Unix system, no Unix scheduling may take place at the end of interrupt handling.

The main memory in Nixdorf's Hybrid System divides into three parts: Unix memory, Nicos memory, and shared memory. Unix memory is managed by Unix, and neither Nicos nor any Nicos application can access it. Nicos memory, which is managed by Nicos, is allocated under Unix as I/O space and is accessible by both operating systems. Unix does not touch this memory after the allocation, and Unix applications cannot access it.

UNIX GETS REAL

Nixdorf's Hybrid System lets Unix V.3 run on a 386 CPU with the real-time Nicos operating system.

This eliminates the expense of the dual-processor setup for merging real-time capability with Unix.

The system is now being built into a private telecom switch and may one day become a commercial product.

The shared memory is also allocated under Unix. It is accessible by both operating systems and is used for code—common prologs and epilogs, for example—and for data (such as the interrupt descriptor table), which must be readable and writable in both contexts and is used for synchronization and communication between Unix and Nicos. While the physical memory in the Hybrid System is shared between Unix and Nicos, each OS has its own virtual memory space.

Hardware-interrupt handling under Unix is in a fully procedural manner. It is performed in the context of the interrupted application by calling procedures according to the interrupt. On return from the interrupt handler, all handling is completed. One of the called procedures could be the Unix scheduler.

Nicos provides the usual two-stage handling for interrupts. The time-critical part is performed by the interrupt handler, which executes in the context of the running process. The remaining handling is done by an interrupt task that is scheduled according to its priority.

In its Hybrid System, Nixdorf solved this problem as follows: first, the priorities of the hardware-interrupt entries are partitioned in such a way that all interrupt entries assigned to Nicos have a higher priority than any Unix interrupt. Because Unix only masks interrupt entries assigned to devices managed by Unix, real-time response of Nicos is guaranteed. Second, the Unix interrupt epilog is designed so that it does not call the Unix scheduler at the end of the interrupt handler. The call is delayed till the next switch to Unix.

Another problem in a hybrid system is the execution context. Nixdorf's solution to this is a common prolog in front of any interrupt handler and a common epilog at the end. The common prolog analyzes the event, switches to the needed context, and finally calls the original interrupt handler. The common epilog is responsible for restoring the initial situation at the end of interrupt handling.

"A major feature of the Hybrid System is the support it gives to message exchange between Unix and Nicos processes via the shared memory," Friedrich says. Under Unix, a communication driver copies messages from Unix processes into the shared memory and vice versa. Under Nicos, copying is done by a communication handler and a communication process.

IF A NICOS PROCESS SENDS a message to a Unix process, the Nicos communication process requests a buffer in the shared memory, copies the data into the buffer, and sends a software interrupt signal to Unix. The latter's interrupt handler copies the data into the user space and transfers the message to the target process.

If, on the other hand, a Unix process sends a message to a Nicos process, the Unix communication driver first requests a shared-memory buffer from Nicos by a software interrupt signal. Nicos manages the shared-memory's message buffers. After receiving a message buffer, it copies the data into the buffer and signals a communication request to Nicos. Now the Nicos communication process copies the data into a new buffer and delivers the message to the appropriate application process.

A MODULAR UNIX OPENS THE OFFICE DOOR

CHORUS MAKES ON-LINE TRANSACTION PROCESSING EASY WITHOUT A PROPRIETARY OPERATING SYSTEM

BY JONAH McLEOD

COMPUTING

UNIX HAS SPENT A long time in the cloistered world of scientific and engineering applications. And while MIS people are starting to look favorably at Unix platforms, system vendors have their work cut out for them trying to push Unix into the fast lane of continuous processing systems. That's because business lives or dies on on-line transaction processing—with uninterrupted, instantaneous data-base updates an absolute prerequisite—and Unix does not.

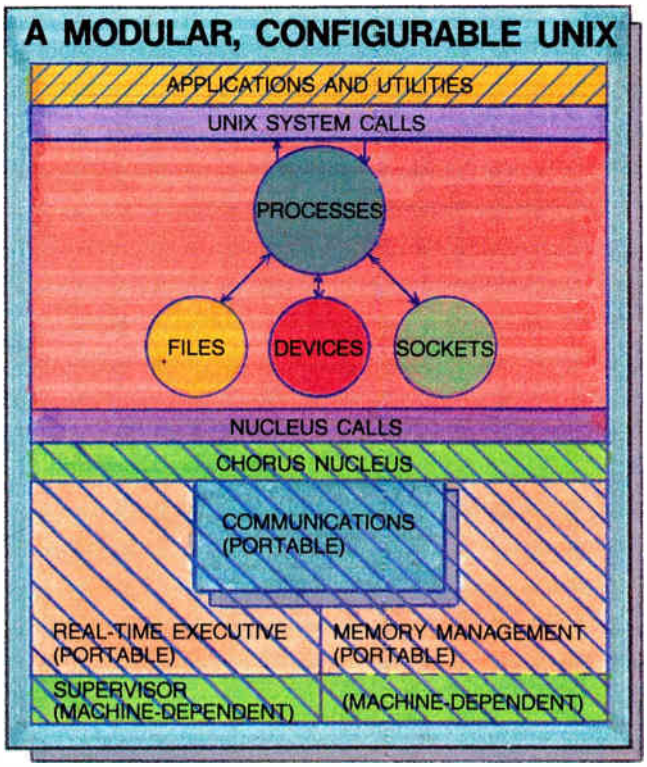
Computer-system OEMs can build OLTP capability into their own versions of Unix, but the operating system becomes nonstandard in the process. However, Chorus Systems Inc. of Portland, Ore., now offers a solution that considerably simplifies the task of adding non-Unix functions while maintaining standardization. The company's Chorus MIX product splits Unix into modules that communicate by passing messages, an architecture that has two big benefits: it inherently supports symmetric multiprocessing and it lets the OEM add commercial functions by simply adding modules.

Unix is "one large, monolithic body of code, and that makes it difficult to add new functionality," says Marc Guillemont, director of product development at Chorus. Thus, when the OEM modifies the code for the new functionality, he is strapped with support headaches of changing his proprietary code with each new Unix release.

Chorus gets around this problem by breaking Unix up into modules, which communicate with one another via a message-passing protocol. A small, efficient microkernel—the Chorus nucleus—provides communications, memory management, and real-time event processing. The rest of the operating system is Unix System V version 3.2; a version 4 is in the works.

When Chorus MIX boots to memory, the System V kernel is replaced by the Chorus microkernel, says Michel Gien, general manager for R&D and cofounder of Chorus. The microkernel can be configured for different types of systems. For example, an OLTP system would require the full implementation of both the real-time executive and the file manager.

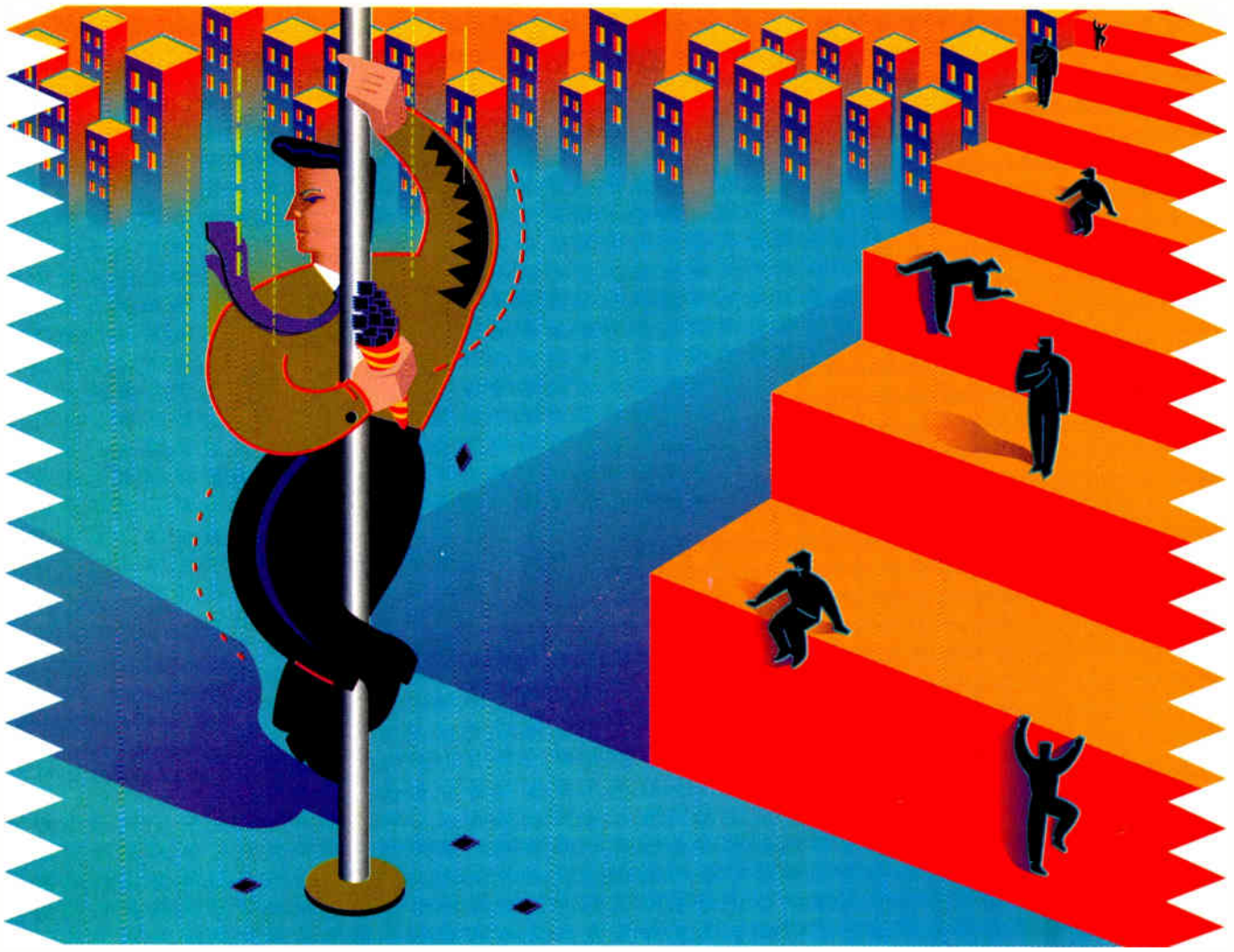
Chorus MIX contains a set of independent programs—modules, servers, or applications programs—that can be physically located on different hardware platforms. Computing platforms can be connected by network or, for a multiprocessor system, by backplane—or both. A microkernel on each platform provides local and global services over all hardware within a system. Message passing is handled by an interprocess communications manager (IPC), which juggles remote or local procedure calls, depending on system configuration.



Chorus Mix's independent programs can be physically located on different hardware platforms.

If a process running on one platform requires service from a process running on another, a message is created and sent to the distant process in a remote procedure call. Since the routines are executing on different hardware, a context switch creates a message and physically passes it over the network to the distant routine. If, however, both processes are running on a single processor, then the Chorus message passing takes advantage of virtual memory. Instead of a full context switch, the sending process simply passes a pointer to the receiving process via a high-speed register transfer. The pointer directs the receiving process to the appropriate memory location, so no data is physically moved. This is a local procedure call.

The benefit of this approach applies to a multiprocessor system in which several processors on the same backplane share a common memory. A process on one processor calls a process on another by passing a pointer to where the message resides in common memory.



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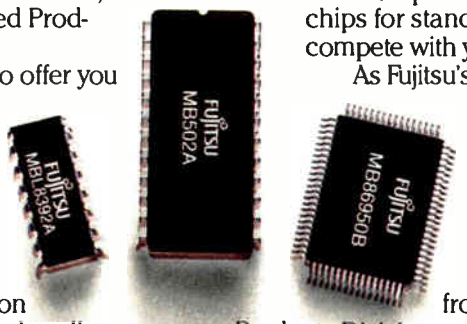

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FAST, FASTER, FASTEST: ATE CHASES SPEED

WITH TIME TO MARKET THE CHIP MAKERS' BATTLE CRY, THE BURDEN IS TO SLASH TEST TIME

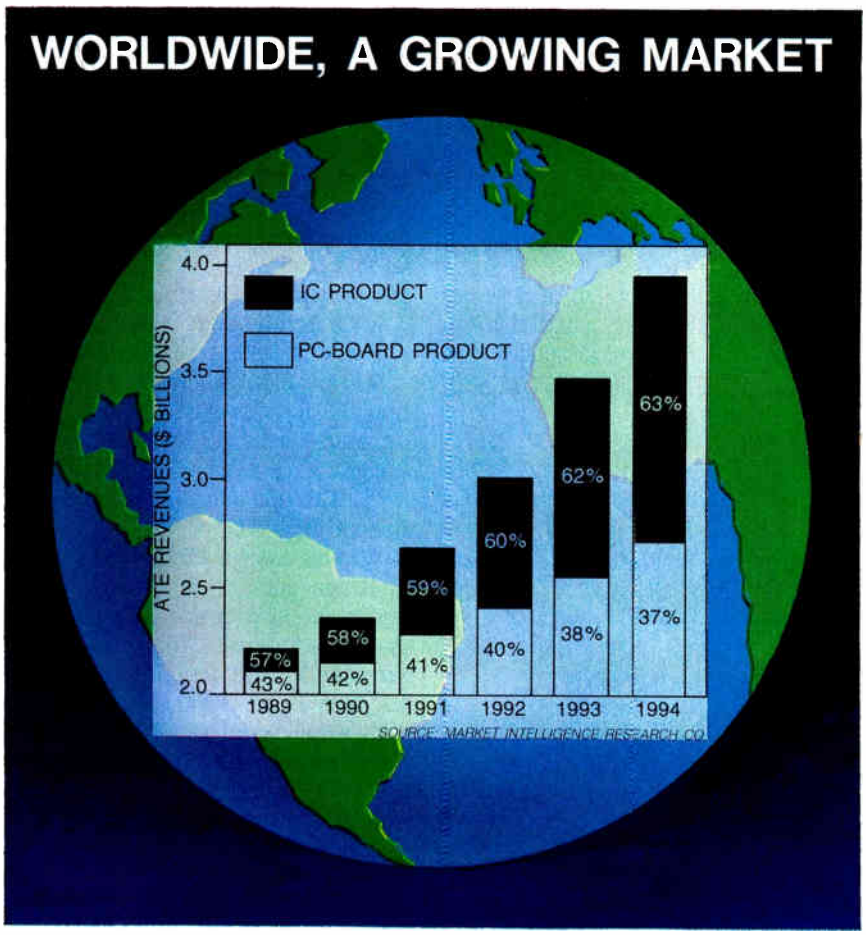
BY JONAH McLEOD

IN THE PELL-MELL RUSH TO shrink time to market, component and board manufacturers have put the onus on suppliers of automatic test equipment to reduce test-development and test time. The sluggish market for some ATE vendors and boom time for others is indicative of who has responded. Suppliers have tightened links to design systems and offered software that slashes test programming time. In addition, they have developed testers that cut test time even as chip and board complexity increases.

The outlook for ATE equipment makers is the subject of debate among analysts. At venture-capital firm Hambrecht & Quist in San Francisco, senior market analyst Caroline Rodgers calls the market depressed. "But there are signs that orders for new ATE purchases are on the rise," she declares.

However, the Market Intelligence Research Co. in Mountain View, Calif., takes a rosier view, projecting an 11% rise in ATE sales this year and continued growth ahead. Analyst Andrea Dace expects a total ATE market of $1.4 billion in 1990, growing to $3.96 billion in 1994. Of this year's total, 58% of the revenue will be in integrated-circuit test systems, with the remaining 42% derived from testers for printed-circuit boards. By 1994, IC testers will represent an even larger 63%.

If there is a malaise in the IC test business right now, it comes from chip makers' uncertainty about future business prospects, says Hiroji Agata, national sales manager and general manager for Advantest in Lincolnshire, Ill. "Captive semiconductor manufacturers are reluctant to make major capital investments because of weakness in their end products—personal computers, office equipment, telecom systems, and so on," he says. "But merchant IC manufacturers are more bullish."



As the ATE market shoots ahead 11% this year, the percentage of revenues from IC testers is steadily rising.

And demand should snowball once new products, such as reduced-instruction-set and digital signal processors, start going into volume production, says Ed Rogas, general manager at Teradyne Inc. in Agoura Hills, Calif. "When these parts get designed in, the demand for test systems should pick up," Rogas says, counterbalancing a firming in the demand for logic and memory ATE systems. Rogas expects that ATE vendors with systems already installed at component vendors will get large orders: suppliers that don't have a foot in the door will have to fight for the next-generation high-volume component.

In board testers, growth will hover at 9% to 10% for the next five years, according to analyst Dace. Board makers using statistical process control and designing boards for manufacturability

will increase spending on in-circuit testers that check for manufacturing defects, not board function. Computer, communications, and aerospace companies still needing to perform functional test will continue demanding combinational testers.

The key to winning the business in ATE is solving the test-programming and test-throughput problems that chip and board manufacturers see as the major bottlenecks in getting products to market. ATE vendors have responded with tighter links between design and test systems as well as a plethora of new software offerings.

"The design-to-test link used to be a netlist to the tester from the design system," says Rudi Egger, European marketing specialist at GenRad Inc. in Concord, Mass. "Now it includes the board-layout information needed to build test fixtures and parametric data on components to ensure that correct power is applied during testing, among other things."

Nowhere is the problem of developing test fixtures more acute than in testing mixed analog and digital ICs. In the past, the designer of mixed-signal devices had to cobble together a complex apparatus that combined digital and analog test systems. "The test development time was longer than the initial design of the mixed-signal IC itself," says George d'Arbeloff, the vice president at Teradyne in Boston.

A number of companies are addressing this problem, among them Teradyne. Its A500 analog VLSI test-system family eliminates the engineer's hardware-development time. It contains, on a high-speed test bus, digital and analog test systems that are synchronized with each other. "It changed the problem from developing a hardware fixture that coordinated operation of digital and analog testers to developing a test program," d'Arbeloff says.

Another time saver is the test simulator, a workstation that simulates the A500 operation. It can be used to debug the test program. "Half a mixed-signal test system's time is spent debugging test programs," d'Arbeloff says. "The test simulator is a big attraction of the A500."

With its System HiLo simulator used in design automation, GenRad has expertise in using design data in test-program development. "You need the same simulator in both design system and tester," says Egger. "One of our customers with a full board simulation wanted a tester that used their simulation environment. GenRad integrated the customer's simulator on its tester. It took us four hours to develop a test for a complex board," Eggers says, a task that once took three to six months.

However, test systems that share tester resources, especially for testing ICs, cannot use all the vectors a simulator produces. Test Systems Strategies Inc. of Beaverton, Ore., a company with products that turn simulator outputs into usable tester waveforms, has a new product called Wavemaker that eases the job of adding more waveforms.

Analysts believe today's tester-per-pin architectures are the way ATE vendors will speed test-program development. Among the manufacturers fielding next-generation logic testers with this architecture is Megatest Corp. of San Jose, Calif., with its new Polaris 100 [*Electronics*, March 1990, p. 70]. Tektronix Inc. in Beaverton also provides tester-per-pin capability with its Vista Series.

And Schlumberger Technologies in San Jose takes the tester-per-pin architecture to its next level with the ITS 9000, to be unveiled this month (see p. 71). With its radical new sequencer-per-pin architecture, says Schlumberger, this system can accept and execute all the test vectors any simulator can produce.

Many analysts call Advantest the leader in logic testing, thanks to its systems' high test speed—100 MHz—and high pin count—500 pins. The company does not currently have a system with tester-per-pin architecture, but industry watchers believe that one is in the works. Teradyne, too, is said to be working on a next-generation, tester-per-pin unit.

Ron Johnson, product marketing manager at Hewlett-Packard Co.'s Manufacturing Test Division in Loveland, Colo., believes that to shorten the time it takes to generate a test program, the emphasis should be on developing the test program concurrent with the design. HP and computer-aided-design heavyweight Mentor Graphics Corp. "have a joint development effort on concurrent design and test," he says.

ATE systems must also test boards or chips fast. "If you control your process and are making good products, you want high throughput to get them out," says Tom Coughlin, director of tactical marketing at GenRad. Johnson says HP addresses this problem in the tester's architecture. "In the HP3070, there are four synchronously operating test modules," he says. "The modules can operate independently to improve throughput," each testing different board sections concurrently.

At GenRad, the controller behind the test pins has been improved on the current generation 2286 in-circuit tester. Coughlin claims it's five to ten times faster than the company's earlier 2276. "The problem is the boards are 10 times more complex," Coughlin says, so it still takes on the order of 15 seconds to test a board.

EASING THE BOTTLENECK

ATE suppliers have tightened links to computer-aided-design systems, developed software that eases test programming, and introduced faster testers as part of their push to reduce the test cycle.

Demand for fast testers should rise as new products like RISC chips and DSPs go into volume production and get designed into products.

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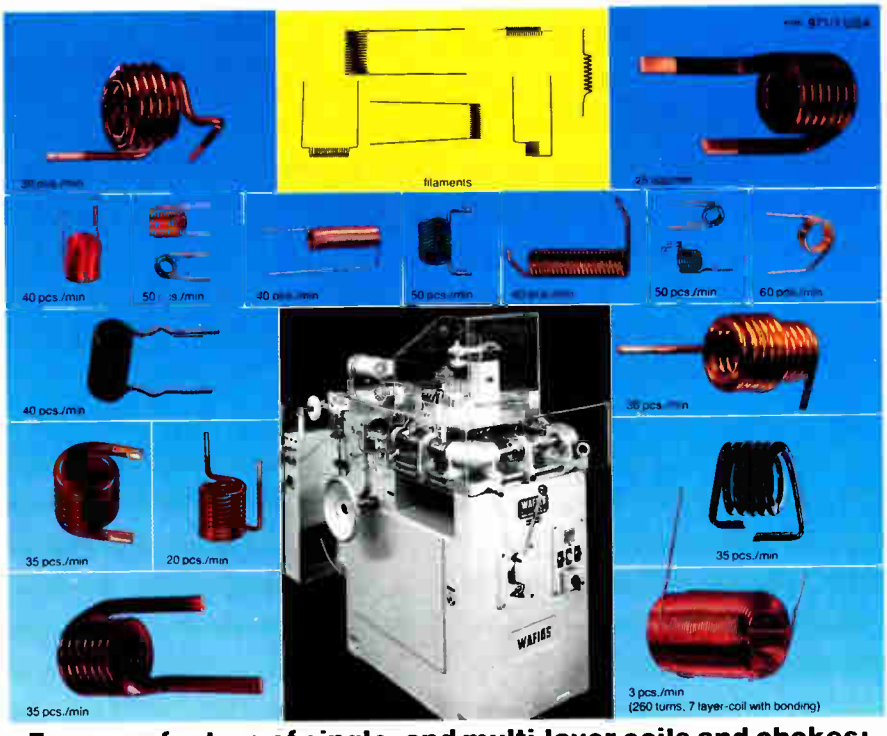

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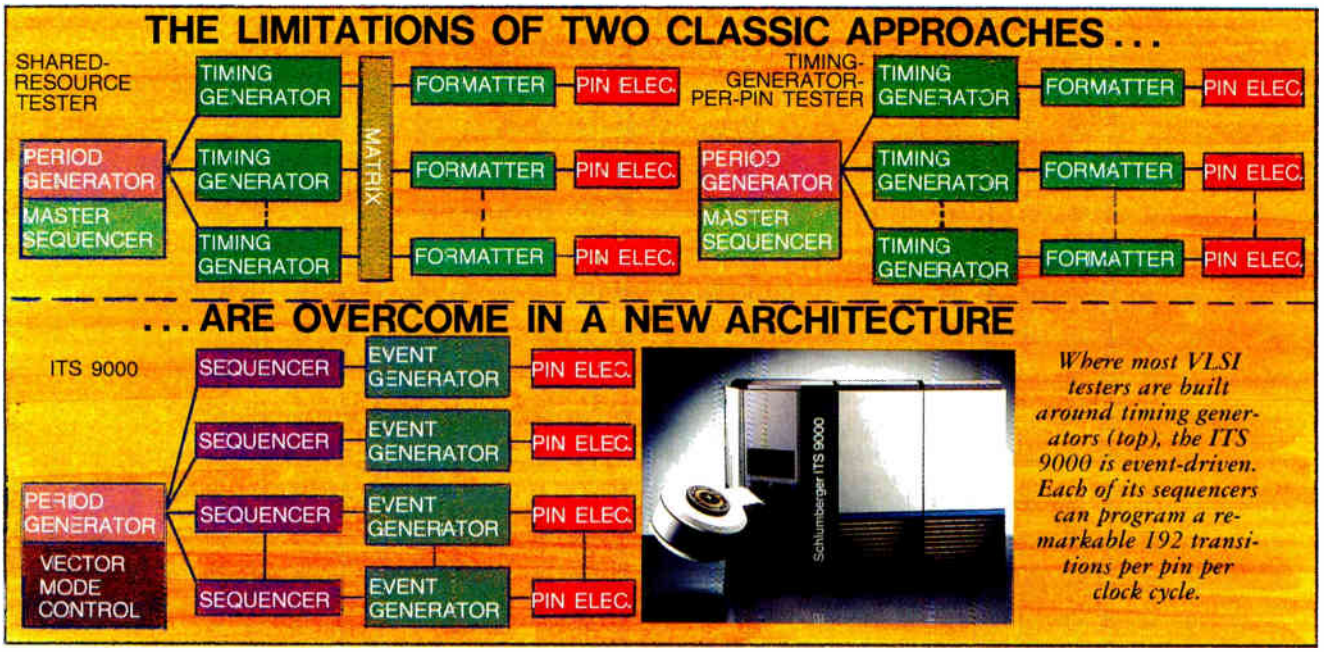

A RADICAL ARCHITECTURE TRIMS TEST TIME

SCHLUMBERGER'S NEW UNIT OFFERS VAST FLEXIBILITY AND DIRECT LINKS WITH SIMULATION DATA

BY SAMUEL WEBER

COMPUTER-AIDED DESIGN tools shrink the design cycle for complex ICs, but there's still a hangup in getting those chips to market fast: test. Test engineers yearn for the same cutbacks in test-development time that design engineers have enjoyed since the advent of CAD.

A radical new test-system architecture from the ATE Division of Schlumberger Technologies may be just what they've been waiting for. The ITS 9000 family overcomes the deficiencies of previous generations of test-system architectures while giving the engineer tools to rapidly generate test programs that fully utilize test vectors and timing information derived from logic simulation.

The San Jose, Calif., company calls this new concept the sequencer-per-pin, or SPP, architecture. SPP furnishes the test engineer with a degree of flexibility and accuracy never before available, says Nadim Ahmad, product marketing manager. The 9000 brings "two important things to the party," he says: resources to handle application-specific designs, and multifunctionality—the ability to test devices with mixed analog and digital functions, chips that also contain some memory and a processor, and so on.

Such mixed-mode chips require a variety of stimuli. By virtue of optional resources, such as an algorithmic pattern generator, the Schlumberger tester can be configured to accommodate these multifunctional designs. It can also be set up to handle ASIC designs that contain analog or memory cells, and it can perform scan testing with the built-in scan generator.

The 9000 family, which will debut at the International Test Conference, Sept. 10–14 in Washington, is the latest of four leading-edge products that Schlumberger has rolled out recently in an effort to reestablish itself as an ATE heavyweight. Industry watchers had pretty much written off the former Fairchild Sentry Test Systems, complaining that the subsidiary of multinational mega-company Schlumberger Ltd. had lost its technology edge and was out of touch with its customer base.

ATE

But now the company is enjoying a turnaround. Its initial strategy was to upgrade the existing systems, improving their productivity and helping the customer wring more performance and throughput from them. "We kept at it until we had convinced that customer we were serious about wanting his business," says Irving Pfister, the division's vice president and general manager.

Then, starting in 1987, came the wave

of innovative new products: the IDS 5000, an electron-beam diagnostic system for malfunctioning prototypes; the S1650, codeveloped with Motorola Inc., which uses built-in testability circuits to aid in testing; and the UL5000, a top-of-the line verification system codeveloped with Japan's NTT Corp. "The e-beam diagnostic system gave Schlumberger back its technology edge," says Caroline Rodgers, senior analyst at Hambrecht & Quist in San Francisco. And the company hopes the ITS 9000 will do the same in logic testing.

Schlumberger offers the tester's SPP architecture as an alternative to the two approaches most widely used in VLSI digital logic testers: a shared-resource system and a timing-generator-per-pin architecture.

In the shared-resource architecture, a limited number of timing generators are multiplexed through a switching matrix to the pin electronics. Format logic in the pin electronics combines the timing with functional data stored in a pattern memory to generate formatted waveforms for application to the device under test. However, the number of transitions per cycle per pin is severely constrained, as is the number of formats. This is especially true as the speed and complexity of the device under test rises.

As the name implies, the timing-generator-per-pin architecture provides an independent timing generator for each pin, thereby improving on the shared approach. This type of architecture also furnishes more formats than a shared-resource tester. But like the other architecture, it remains limited to only three or four transitions per cycle per pin.

By contrast, the Schlumberger unit is built around sequence generators instead of timing generators. Because the sequencers are tied into the memory, each can program up to 192 transitions per pin per each cycle of the main clock, offering unlimited flexibility in duplicating waveforms coming out of the simulator.

The Schlumberger tester rises above previous systems in another important way as well: its ability to link with simulation data. Semiconductor manufacturers use the data from simulation of their complex ICs to generate timing information and test vectors for test programs. But accessing this data is no easy task. That's because conventional testers are state-driven in nature and allow only a limited number of transitions in a cycle for each pin. Simulators, on the other hand, are event-driven and can produce an unlimited number of transitions.

To make the event-driven outputs of a simulator compatible with a state-driven tester with fixed timing resources and edge or format restrictions, the test engineer must manually modify the simulation waveforms. These modifications take time and reduce test accuracy, since the test pattern may differ from the intent of the simulation.

A major advantage of the SPP architecture is that by defining timing in the form of events as opposed to state transitions, it allows direct generation of test patterns from the simulation data. This trims the time it takes to create a test program without compromising the simulation vectors during testing. If modification is required to increase fault coverage, this can be done easily, Ahmad says. "The tester itself is event-driven, and now looks like an extension of the simulator," he says, "where the output of the simulator is directly mapped onto the tester. That lets the device be tested the way it was meant to be tested."

The basic core of the ITS 9000 is the event sequencer, which generates sequences of events for device stimulus or response. Each event is defined by an event type and an event time. There are three event sequencers per pin, each capable of storing 64 events in its associated sequence memory, permitting a total of 192 events in any sequence for any pin. Up to 13 types of events can be programmed to occur in any order any number of times in a sequence. Also, unlike other testers, sequences of events can be repeated without going back to memory. Edge-placement accuracy ranges from ±375 ps to ±175 ps, and edge resolution ranges from 100 to 12.5 ps.

TESTER FOR ALL SEASONS

The ITS 9000 is built around sequence generators, each of which can program an unparalleled 192 transitions per pin per each cycle of the main clock.

Since it's event-driven, it uses data directly from the logic simulator, with no manual modifications necessary.

It handles ASICs, mixed-signal ICs.

The ITS 9000 family at present comprises two members: the FX, capable of test rates to 200 MHz and aimed at high-end ASICs and 32-bit RISC microprocessors; and the MX, with test rates up to 80 MHz and aimed at midrange ASICs, microprocessors, and mixed-signal devices.

An important aspect of the 9000 family that stems from the SPP scheme is a feature called dynamic pin mapping. According to Ahmad, a major problem for the test engineer is the fact that the same devices are often available in a variety of packages with different pinouts. "As a result, the companies that have to test these devices must maintain enormous libraries that allow testing of devices with different pinouts," he says. "It's a nightmare."

With SPP, however, timing, edges, and functional patterns are available behind each pin, so it's a simple matter to "scramble" pins in a manner appropriate to a specific package type. "The pin groups and pin definitions for each package type are stored; when you do the program installation you call out the type of package and it automatically assigns the pins to that pattern," says Ahmad. Thus only one test program is required for any device.

For the software, Schlumberger has developed an object-oriented environment called ASAP, for advanced symbolic ATE programming. This is a powerful set of tools for developing test programs seamlessly from simulation to test, says Ahmad, all aimed at greatly increasing programming productivity. "The test engineer doesn't have to write a single line of code," he says. "He just has to click and drag icons."

The first of the ASAP tools is FlowTool, which presents a set of icons from which the engineer selects a test program. With LevelTool, the engineer chooses input levels and sets resolution by moving a cursor. With PinTool, the engineer sets up the appropriate pin designations, while TimingTool establishes the edges and waveform formats.

The front end of the ITS 9000 is a Sun Microsystems Inc. Sparcstation running Unix and X Windows. The 9000's fluid-cooled mainframe is built around a Motorola Inc. 68030 processor. Initial shipments will begin in the fourth quarter. Prices range from $1.8 million to $2.8 million for a 256-pin configuration, and from $3.1 million to $4.8 million for a 512-pin system. ■

Additional reporting by Jonah McLeod

SPECIAL EDITORIAL FEATURE

JAPAN

ELECTRONICS 1990

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2705	AC	Transistor	80	50 to 300	40	4-pin SOP
Dial-pulse generation circuits						
2532	DC	Darlington Transistor	80	1500 to 6500	300	4-pin DIP/SMD
2533	DC	Darlington Transistor	80	1500 to 6500	350	4-pin DIP/SMD
263X	DC	Darlington Transistor	80	1000 to 15000	300	6-pin DIP/SMD
Line supervisory circuits						
262X	DC/AC	Transistor	150	20 to 50	80	6-pin DIP/SMD

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JAPAN

A SPECIAL EDITORIAL FEATURE

The flowering of Japanese technology

The continuous investment in research carried out by Japanese electronics firms has finally begun to bear fruit. Profitability is up in spite of obstacles such as Super 301 and the U. S. semiconductor sanctions, and the companies are beginning to hold their own in R&D. Westerners have replaced their accusations of the Japanese being technological copycats with a close attention to their every move.

The Japanese semiconductor industry now is the world leader in every regard: quality, quantity, and production technology. Stronger management has learned how to keep the impact of the silicon cycle to a minimum. Semiconductor manufacturers are racing forward in making investments for both 4- and 16-Mbit products, ahead of Western manufacturers.

The big news in computers is how the Japanese are beating the Americans to the punch in announcing and delivering the next-generation mainframe. Whereas in the past, it was common for Japanese mainframe makers to announce competitive products a full year after IBM Corp.'s announcements, this time the product announcements preceded the expected announcement of IBM's next-generation mainframe, the Summit. And the performance of these machines was astonishing, proving that Japan has reached parity with the U. S. in terms of hardware expertise.

Japanese advances in portable computers serve as an impetus for electronic component manufacturers: Japan virtually owns the market for liquid-crystal displays, the critical components used in portables, and vendors are making capital investments on the order of $700 million per company.

In hard-disk drives as well, where U. S. firms now hold an overwhelming competitive position, Japan is continuing research in an effort to grab some share. This, too, is thanks to the new market arising from the portable computer. Unlike the 5.25- and 3.5-in. disk markets, where Japan never ran a strong race, this time both the U. S. and Japan are standing at the same starting line.

In the home electronics field, the hot topic is high-definition TV. As the possibility of a common standard for the U. S., Europe, and Japan recedes into the distance, Japan, the first to start development of HDTV, continues to stay the course. As the VCR market becomes saturated, the multimedia market is being looked to as a way to fill in the gap until HDTV takes off. Japan is especially good at finding new ways to use audiovisual devices, such as *karaoke* sing-along machines, game computers, and portable equipment.

The big news in communications is the explosive growth in the market for radio devices, including cellular and cordless telephones. Cellular phones are exhibiting year-on-year growth rates of 200%, while cordless phones now account for a full 50% of the Japanese telephone market.

This report is provided by Nomura Research Institute in Yokohama, Japan. Its preparation was supervised by Yasuhiko Arai, who also handled the computer section. Shin Kusonoki is responsible for the section on disk drives, Kazuhiko Ota for semiconductors, Hiroshi Fukui for telecommunications, Norihiko Naono for LCDs, Masaki Asano for multimedia, Ken Katayama for HDTV, and Masaki Ichikawa for test and measurement. ■

EDITORIAL FEATURE

From mainframes to PCs, Japan is on a roll

Technical advances in hardware stir an expanding market

COMPUTERS

The Japanese computer market expanded rapidly in 1989 for the first time in five years. Especially noteworthy was growth in the personal computer segment. PCs are now becoming truly established in Japan. In addition, it is clear that the PC market is undergoing major changes in terms of both volume and product structure. On the technological front, there is remarkable activity in advanced new product development ranging from PCs to mainframes, reflecting the vigorous R&D activities of Japanese firms.

The hot topic in mainframes is the announcement by Hitachi Ltd. and NEC Corp. of fast next-generation machines. Both vendors' new offerings are highly meaningful for the mainframe market.

Hitachi's new product, its M-880, was developed to go up against IBM Corp.'s upcoming Summit, which it precedes in the marketplace. The top-of-the-line model uses a four-way processor approach and can address up to 16 terabytes of memory. It easily surpasses existing machines in terms of memory expandability and connectivity. Another special feature is a dedicated data-base processor to accelerate relational data-base processing. As the first new mainframe announced by a Japanese manufacturer prior to an IBM generation, the Hitachi product demonstrates clearly that Japan has caught up with the U. S. in hardware technology.

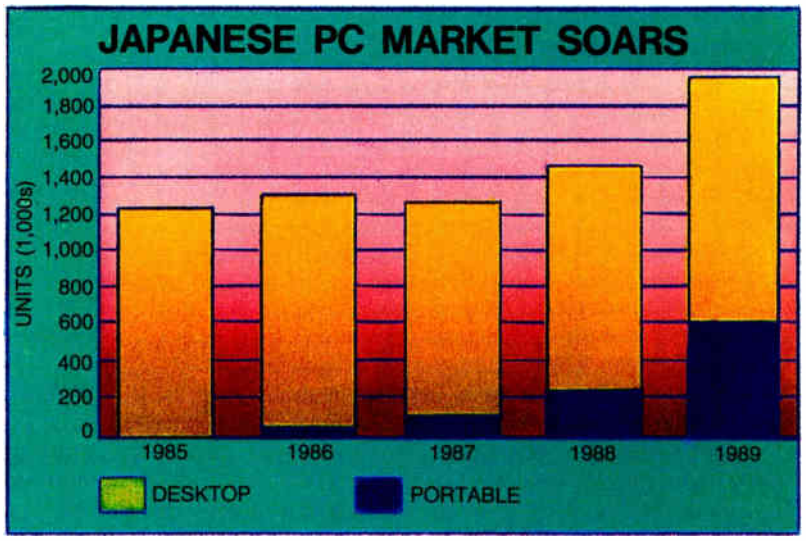
Only a month after Hitachi made its new product announcement, NEC announced the world's fastest mainframe. Known as the ACOS System 3800, the machine is distinguished by processing speeds ranging to 500 million instructions/s. A configuration of up to six processors is possible, and the 3800's extended data address space accommodates up to 128 terabytes. It is expected that it will take other manufacturers some time to catch up to this high-speed performance.

In Japan, the products corresponding to minicomputers and superminicomputers are known as office processors, with Fujitsu, NEC, Toshiba, and IBM the key players among many other computer vendors. IBM's entry is the AS/400 minicomputer. A distinguishing characteristic of all these systems is their closed architectures.

This segment has been expanding in Japan for the last several years. Japanese manufacturers have been able to drive up sales of their closed-architecture systems thanks to their strength in putting entire systems together. This is important due to the prevalence of custom software solutions, which in turn springs from the dearth of software packages in Japan.

Now the fashion is using systems integration (SI) to provide multiple office processors in place of one mainframe, and this trend is contributing to further growth in the office processor segment. But it will be interesting to see what new products come out in light of the expected competition from Unix-based open systems and LAN-based systems.

The Japanese workstation market continues to exhibit strong growth, with unit shipments up 80% from 1988 to 1989, pushing the segment to the 78,000-unit level. Although the likes of Sun Mi-



crosystems Inc. and Hewlett-Packard Co. have garnered large shares in Japan, the domestic manufacturers are also increasing their shares. The growth at the low end of the segment is particularly noteworthy; this trend should accelerate with the spread of X terminals.

One event worthy of note in the Japanese workstation market is the advent of laptop workstations, with two vendors—Sony Corp. and Toshiba Corp.—currently in the market. As its name implies, Toshiba's Sparc-LT employs the RISC-type Sparc processor. Toshiba's goal is to achieve significant market share of up to 50% by 1995 in the Sun-and-compatibles workstation market.

Considering the high potential demand for laptop workstations for personal use, this market represents a highly promising one for the Japanese manufacturers, with their mastery of high-density mounting technology. And as operating systems and user interfaces move towards standardization, there will be all the more opportunity for Japanese computer manufacturers to exploit their strengths in semiconductor technology in the world markets.

After a five-year lull, the Japanese personal computer market is now entering a second growth phase. PCs, a small market to date given Japan's economic might and population, are now truly poised to enter the mainstream. Whereas 1988 PC unit shipments in Japan were only 1.5 million, the total hit 1.95 million units in 1989 and should exceed 2.4 million units in 1990. Japan's PC

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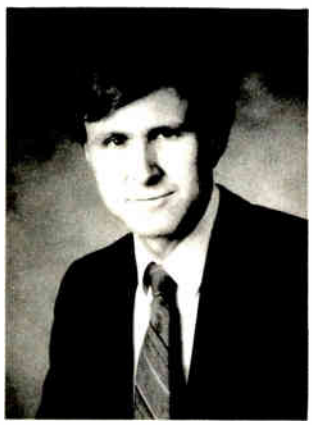

Sheffield Eaton is the president of United Memories
a memory design and development company jointly owned by NMB Semiconductor of Japan and Ramtron Corporation of Colorado Springs, Co.
The company is currently focused on the development of advanced 4Mb and 16Mb DRAM Products.
At Ramtron Corp, from 1986 through June of 1990,
he was inolved in the development of nonvolatile ferroelectric memories, and later in the design of high-performance 1Mb and 4Mb DRAM's.

Sheffield Eaton
President of United Memories

Doug Butler is currently responsible for Process Technology Development at United Memories.
Mr.Butler was with Ramtron Corporation for four years where he was responsible for process development for Ferroelectric Memories until he assumed resposiblility for process architecture and device design for a cooperative 4Mb DRAM with NMB Semiconductor of Japan.

Doug Butler
Vice President of Technology of United Memories

United Memories is a new joint venture company owned by NMB Semiconductor Co., Ltd. and Ramtron Corporation with respective shares of 55% and 45%.
The new company, which capitalizes on the strengths of each partner, researches, designs and develops dynamic random access memories with densities of 16-Megabits and above, as well as other speciality memory products.
The actual production will be conducted at NMBS's plant.
This makes it uniquely suited to provide systems companies with the high-performance, high-density memory required in the next-generation products.
The company began operations on July 1, 1990 with 25 employees, all former NMBS and Ramtron personnel with Sheffield Eaton as president and Shosuke Shinoda as chairman of the board.

Production of High-Speed DRAM, Market through International Cooperation.

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Bird's eye view of NMBS's Tateyama plant (The front shows plant Module I & II and back shows new plant Module III)

NMB Semiconductor Co., Ltd. (NMBS) is one of the world's leading semiconductor manufacturers specializing in high-speed DRAM's.
NMBS is currently producing and marketing dynamic random access memories with densities ranging from 256K bits to 1 and 4-M bit DRAM.
NMBS and Ramtron have jointly developed 4-Megabit DRAM with an access time at least as fast as 40ns and are currently under production at NMBS's new $300 million wafer fabrication facility in Tateyama plant starting September 1990.
NMBS's Tateyama plant is the most advanced very-large-scale integration CMOS production facility in Japan.
The plant boasts class 1 clean rooms which makes extensive use of robotics, and is capable of wafer fabrication of circuits with sub-micron geometry.

Takumi Tamura
President of NMB Semiconductor Co., Ltd.

Shosuke Shinoda
Executive Vice President of NMB Semiconductor Co., Ltd.
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Tomorrow's Mainframes Today

	Hitachi				NEC						
System	Hitac M-880				ACOS System 3800						
Model	210	310	220	420	8	10	20	30	40	50	60
Number of processors	2	3	2	4	1	1	2	3	4	5	6
Main memory capacity (Megabytes)	128 – 2,048		256 – 2,048		512		512 – 1,024	1,024			
Extended memory	256 – 4,096		256 – 8,192		8,000						
Max. number of channels	128		256		256		512	512			
Total channel speed (Gigabytes/s)	1.1		2.2		1		1/2	2			

market has been characterized by the high percentage of laptops. In 1989, the market for the even smaller notebook-type PCs took off like wildfire.

Nearly all PC vendors have set their sights on this market and are either selling or planning products. Although there are cases where a customer may buy notebook-type PCs in bulk due to their easy portability, their low price makes it more common to see them bought for personal use. And since there are really no longer any performance differences between laptops and notebook PCs, some growth in the segment is coming from replacement demand for laptops.

Laptops are thus starting to attempt to differentiate themselves through high performance—notably by moving to color displays. Major Japanese vendors have announced laptops with color LCDs.

Another trend worth noting in the Japanese PC market is the entry of U. S. vendors: both AST Research Inc. and Compaq Computer Corp. have announced plans to sell in Japan.

AST is entering the market with a new product that promises compatibility with both NEC's PC-9801 Series—the de facto standard in Japan—and the IBM PC/AT. With the help of the U. S. Department of Commerce, AST plans to devel-

NMBS: Moving ahead in DRAM density

NMB Semiconductor Co. Ltd. (NMBS) was founded in May 1984 for the development and production of ultrahigh-speed 256-Kbit, 1- and 4-Mbit dynamic random-access memories. At our highly automated CMOS production facility in Tateyama, Module I can produce 20,000 five-inch wafers a month; Module II can produce 12,000 six-inch wafers a month; and the highly automated Module III, which begins operations this month, has a capacity of 12,000 six-inch wafers a month.

On June 18, NMBS and Ramtron Corp. formed a new joint venture (at 55% and 45% respectively), with an aim to unite unique design and process technologies. The new company, which capitalizes on the strengths of each partner, researches, designs, and develops DRAMs with densities of 16 Mbits and above, along with other specialty memory products. The actual production will be conducted by NMBS. This is a natural evolution following the codevelopment agreement for the production of 4-Mbit DRAMs signed in September 1988 with the Colorado-based Ramtron.

TAKUMI TAMURA
President

Some of the unique features of the 4-Mbit DRAM are:

- the use of the stacked-in trench method in the construction of memory storage capacity;
- operation at 50-ns access time, with future performance at 40 ns;
- and a wide product range in order to gain the largest market share.

NMBS has begun sample production and expects to produce 2 million chips a month by mid-1991.

Regarding financing activities, on Aug. 29, 1989, NMBS made an initial successful public offering of $17,313 per share of stock on the OTC market, making it possible to raise additional funds directly from the debt-equity market. In this environment, NMBS will consider building a plant in the U. S., and hopes to bring a new generation of memory technology to the market. ■

op its business in Japan mainly through the OEM route: as of press time, however, no OEM relationships had been finalized.

Compaq, on the other hand, has not yet decided on its strategy for supporting Japanese language processing, preventing analysts from judging what sort of impact its entry is likely to have.

The local-area-network market has finally emerged from its long period of gestation in the early 1980s and is starting to try its wings. LAN sales are currently growing at an annual rate of 150%, with 40,000 new PCs connected via LAN during 1989. The product that first cracked open the Japanese market was Ungermann-Bass's Net/One, the first to provide Japanese language support. Succeeding products have almost all been from the U. S.

Novell's Netware, with the largest worldwide share, is also growing rapidly in Japan and is expected to become the standard LAN in the near future. Novell has set up a Japanese subsidiary, Nihon Novell, a joint venture with a number of PC vendors and software houses. With so many firms pushing LANs, there is little doubt the market will maintain its strong growth in the future. ■

Chip makers plow $4.6 billion into 4-Mbit DRAMs

After 1989's downturn, semiconductor sales are on the rise, with 15% growth expected next year

The Japanese semiconductor industry suffered a slowdown in the third quarter of 1989 but is headed for a pickup after the first quarter of this year. The size of the Japanese market in 1990 is estimated at nearly $18 billion. Estimated growth for 1991 and beyond is 14.6% annually, leading to a market in excess of $66 billion in the year 2000.

Segments with the highest individual annual growth rates include MOS memories at 20% and MOS logic components at 17.4%. Growth in gate arrays and standard cells is especially brisk at 22%; these market segments will account for about 50% of the overall MOS logic market by the end of the decade.

Semiconductor manufacturers are now making the capital investments required for the next generation of 16-Mbit dynamic random-access memories. The total investment in 1990 by the "Big 10" will amount to more than $4.6 billion, about the same as last year. All companies are increasingly concerned about U. S.–Japan semiconductor friction and criticism of huge capital investments; for this reason, Japanese firms are acting with prudence.

The response of the individual manufacturers to the current slowdown differed from that in 1985. The main factor behind the 1985 downturn was overproduction of 256-Kbit DRAMs. The oversupply was due to capital investment on the part of the semiconductor manufacturers bordering on the insane. The resulting production increases caused prices for 256-Kbit DRAMs to fall to as low as $2, pushing the whole industry into a recession.

This time, although there was some excess production of 1-Mbit DRAMs, chip makers acted more intelligently. Starting at the end of 1989, they began cutting production by about 10%. As a result, 1-Mbit DRAM prices remained stable, and a more serious recession was averted. Today, 1-Mbit DRAMs show firm growth, and production increases should continue until a peak is reached in 1992. Currently, the major vendors are continuing production at a monthly rate of 5 million to 8 million parts each.

Full-fledged 4-Mbit DRAM production will start in the latter part of this year. At the head of the pack is Hitachi Ltd., which lost out to Toshiba Corp. in the 1-Mbit competition. Hitachi is planning monthly production runs of 2 million parts by the end of the year. Toshiba plans to hit that level by the first quarter of next year, and NEC Corp. has similar plans.

Hitachi, NEC, and Toshiba actually began producing 4-Mbit DRAMs in the latter part of 1989, but the market has been relatively stagnant. Production levels at each company are hovering at around 500,000 pieces. Reasons for this lack of immediate growth include the still high prices and the narrowness of the product line. More efforts are required to meet user needs for power consumption, packaging, and op-

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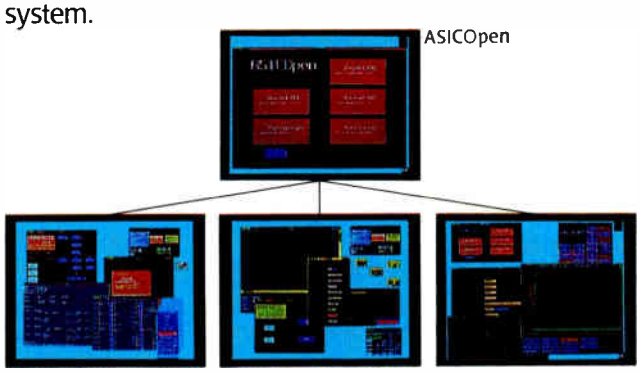

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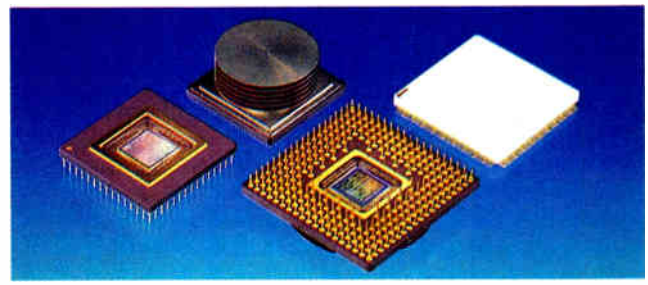

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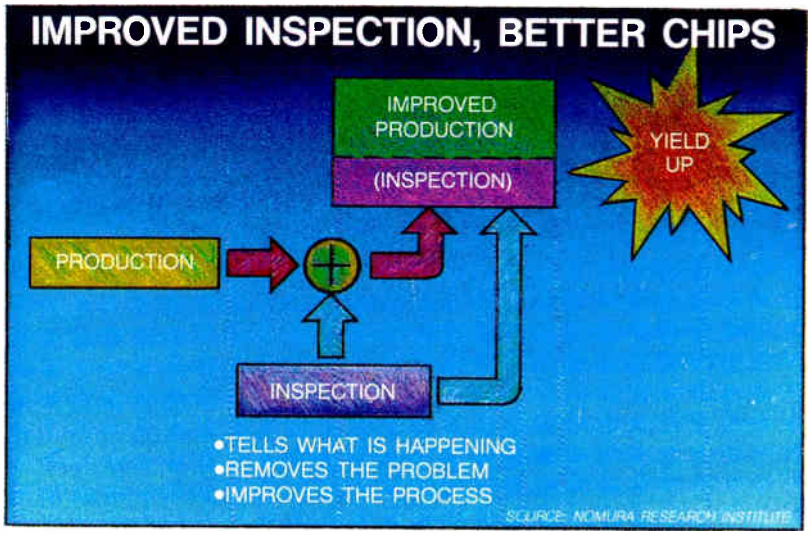

erating speed. Toshiba and NEC are using trench structures in their 4 Mbit DRAM designs, while Hitachi, Fujitsu, and others are using stack structures. The key point is that each manufacturer is developing its own proprietary technology, not working in tandem.

All the major manufacturers are rushing to set up production facilities overseas to help ease U. S.–Japan trade friction and prepare for the 1992 Single Market in Europe. NEC is pursuing the construction of a second factory in the U. S., while Hitachi (in Dallas) and Mitsubishi in (Durham, N. C.) are both establishing integrated production facilities. Even Toshiba, which in the past has not been interested in overseas production, is setting up integrated facilities in the U. S. to produce application-specific integrated circuits.

Japanese manufacturers are also building factories in Europe, in anticipation of the local-content restrictions to come into force after 1992. The manufacturers are scurrying to meet the local-content requirements to avoid the high customs that will be slapped on products not produced from the upstream stages within the European Community. As of now, however, the only operating factory is the NEC plant in Scotland. Fujitsu is building an integrated factory in northern England; that facility is scheduled to go online at the end of this year. Both Hitachi and Mitsubishi are planning to enter Germany.

ICs entered the submicron era around the time that 1-Mbit DRAMs came to the fore. As line widths continue to shrink, requirements for production devices grow increasingly stringent. The key requirements are reliable microlithography, high throughput, ultraclean technology, and maximum automation.

Production equipment falls into two categories: equipment that is directly production-related, such as steppers; and inspection devices, such as mask-defect inspection systems and film pressure meters. Recently, the role of the inspection devices has assumed additional importance.

In the past, inspection was not generally regarded as an important part of the semiconductor production process. For chip makers, in fact, the ideal was a manufacturing process without inspection. Such attitudes led to insufficient advance study of the necessary inspection requirements for the pro-

duction process. As a result, in many cases problems were identified too late.

With the advent of submicron technology, inspection plays a vital role in the production process. The past practice of producing first and inspecting second is not conducive to high yields. More important is to raise the quality of the production line itself. To do this requires treating inspection not as a separate step, but rather to understand which types of inspection are required and build them into the production process.

This approach of building quality into the process is not alien to Japanese chip makers. Japanese companies have a tradition of building in quality to their systems, leading them almost unconsciously to pursue the ultimate in yield performance. The spirit is the wellspring of Japanese industrial might. ■

and tomorrow

tomer's community. In Japan we are a Japanese company, but in Europe we are a European company and in the U. S., a U. S. company.

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Looking ahead to technology improvements

Japanese manufacturers are pouring research money into better displays

From the standpoint of both device technology and end products, flat-panel displays may easily become one of the most important technologies for the communications, information, and electronics industries in the 1990s. For flat-panel technology to achieve its promise, however, major improvements must be made.

Flat-panel displays have widespread applications, including computers, camera viewfinders, and projection TVs. For such applications, high screen quality, low price, and compact size are absolute requirements. Up to now, however, flat-panel technology has not been able to meet these needs; as a result, development has been slow.

Japanese companies are setting the pace in mass production of flat-panel liquid-crystal displays. The Japanese LCD market will reach about $1.4 billion this year and is projected to reach the $6.6 billion mark by 1995. Japanese manufacturers have established true mass production for the large supertwisted-nematic (STN) panels used in many laptop computers, as well as the five-color thin-film-transistor (TFT) panels used in pockets TVs. The TFT LCD used in Apple Computer Inc.'s Macintosh Portable, for instance, is provided by Hoshi Electronics. Several companies, led by Sharp Electronics Corp., plan to begin mass production of larger TFT color panels within a year.

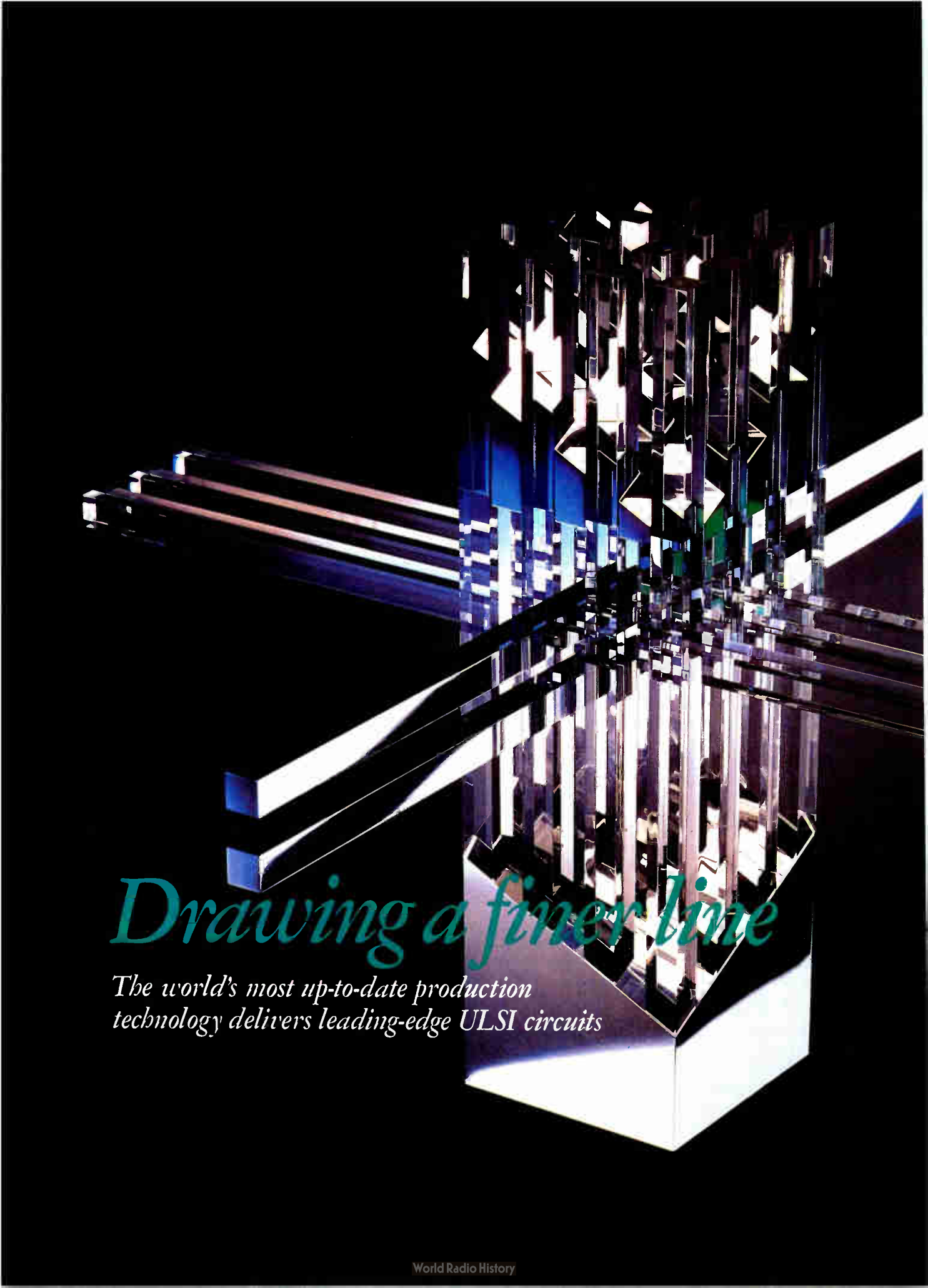
Twisted nematic (TN) LCDs, primarily used in calculators and watches, account for over 90% of flat-panel production. Due to their extremely low prices—less than $1 for the panels themselves and no more than a few dollars for a panel equipped with a driver—large manufacturers are already starting to direct their sights elsewhere. Hitachi Ltd., for instance, has moved half of its TN LCD production to Taiwan. Other LCD manufacturers are gradually increasing domestic production of large, multiplexing-type LCD panels. STN technology

LCDs

is used for medium- and large-size multiplexing LCDs that do not use active-matrix technology. Production in 1989 was about 3 million units. Toshiba Corp.'s popular notebook-style J-3100SS computer, known as the T-1300 in the U. S., uses an STN display.

Although more than half the STNs in existence are monochrome (blue mode), the black-and-white double layer and film types should become more popular in the future. The color filters used in STN color panels have reached a technological impasse, limiting their use almost entirely to pocket-size video games.

TFT LCDs based on amorphous silicon (a-Si) technology are now receiving the most attention in



Drawing a finer line

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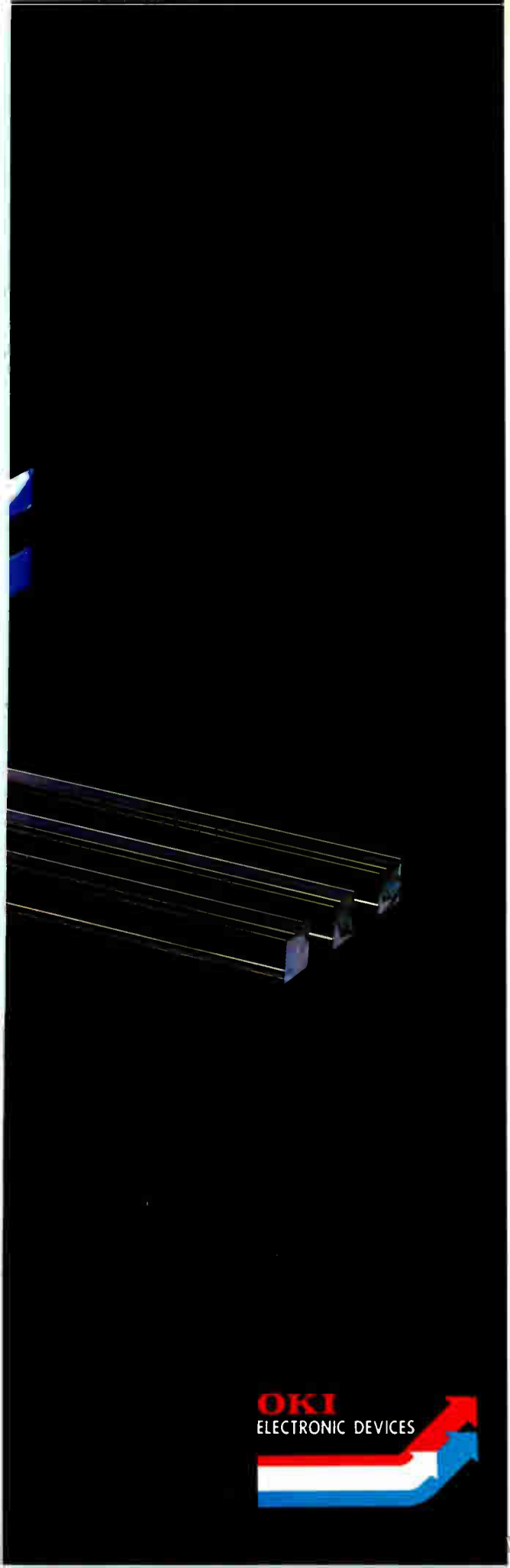

Sub-micron production in full swing, bringing the new age of 4M DRAMs

Oki's Miyagi Plant, benefitting from the latest advances in the company's system technology, has already reached mass production and shipment of 1M-bit memories and has recently begun quantity production of 4M DRAMs. At the Miyagi Plant, broad utilization of ultra-fine process technology and state-of-the-art automation combine to assure the high quality of these products. Oki is already well underway with technological innovation enabling production of 16M-bit memories.

High-level automation with ultra-fine process production

Oki's 0.8μ process technology used in its second-generation 1M-and 4M-bit memories has been integrated into one of the world's most advanced production lines for reliable mass production of over 20,000 6-inch wafers per month.

In 1988 Oki led the world with the first facility dedicated for production of sub-micron devices. Today that lead is being extended with the latest advances in automated manufacturing, such as sophisticated wafer tracking systems for improved quality and production control monitoring.

From the transportation system, driven by linear motors, to individual production equipment in each process machine group, all are computer controlled. To assure products of extremely stable quality, automation and every detail of the production environment are maintained at the world's highest levels.

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CIRCLE 192

electronics circles. Last year, a-Si TFTs accounted for $130 million, or about 10%, of the overall LCD device market. Currently, a-Si TFTs are used in 3- to 5-in. portable TVs, a fairly limited market. But if more powerful color TFTs can be supplied at a price competitive with CRTs, they will gain access to the immense CRT replacement market. Panel makers such as Sharp, Hitachi, and Toshiba are now planning to start full-fledged mass production of color a-Si TFTs in the latter part of this year; by 1995, prices may fall below $350 for display and driver. If these vendors are successful, the market could reach $4.6 billion by then. This enormous potential is driving large Japanese electronics manufacturers to make huge capital investments in a-Si TFT technology.

Meanwhile, TFT LCDs based on polysilicon (poly-Si) technology are the subject of much research, but only Epson Ltd. and Matsushita have moved to mass production, with volumes still negligible compared with a-Si. Applications for poly-Si TFTs range from viewfinders for video cameras to projection TVs. Larger panels are still in the prototype stage.

The major technological obstacle that must be overcome is the high process temperature, which requires the use of an extremely expensive quartz substrate. Epson, Matsushita, and Sony Corp. have announced plans to enter the market with a quartz-substrate high-temperature process and are now constructing a poly-Si TFT LCD production line exploiting their respective semiconductor process technologies.

The rapid growth of markets for LCDs have made this a much-watched segment. But there are many technological alternatives, making it sometimes difficult to discern the best match of technology and application. There is also some doubt about whether the large-scale investment strategy being followed by the electronics manufacturers will really pay off. ■

The growth spurt in T&M equipment begins to flag

As chip makers grow more cautious in capital investments, test vendors' markets slow

TEST & MEASUREMENT

Japan's test and measurement industry hit a two-year lull beginning in 1985, when unfavorable exchange rates triggered cuts in capital spending and domestic demand. But the industry came back with a vengeance in 1988, recording production growth of 18.9%, to top the $2 billion mark.

Particularly noteworthy was the growth in integrated circuit and LSI testers, which jumped 52.8%, to $600 million. Two major developments fueled this high growth rate: the increase in demand for highly integrated devices, such as 1- and 4-Mbit dynamic random-access memories, and advances in application-specific ICs, such as one-chip microprocessors and gate arrays. The performance of the board-tester segment is also growing at a healthy rate. This segment grew 22% in 1989, to nearly $37 million.

The high growth trend exhibited by the T&M industry in 1988 lost some of its steam last year, with growth slowing to 11%, putting the total market at just over $2.2 billion. The slowdown can be attributed to the caution being exercised by semiconductor manufacturers with regard to capital investment, while the industry was in one of its valleys in the silicon cycle. Makers of IC testers responded to market conditions by

T&M Sales: A Mixed Picture

	Revenues ($ millions)		
	1987	1988	1989
Semiconductor fabrication			
Optical measurement	12	20	22
Flatness measurement	12	13	13
Thickness measurement	8.7	15	15
Wafer particle detection	20	37	45
Wafer pattern defect detection	4	9	9.5
Mask/reticle defect detection	17	35	34
Electrical testing			
Digital multimeters	56	57	71
Oscilloscopes	114	134	143
Spectrum analyzers	55	52	60
Distortion testers	43	37	30
Logic analyzers	17	23	22
MPU development support systems	55	55	52
Measuring systems for AV equipment etc.	80	75	72
IC/LSI testers	393	600	671
Board testers	13	30	34

switching to LSI testers to be used in areas in which new demand could be expected, such as reduced-instruction-set computing processors, ASICs, and analog IC testers, which are not subject to the vagaries of the silicon cycle.

Production of digital multimeters (DMMs), on the other hand, showed strong growth of 26.4% in 1989, to top $70 million. This growth stemmed from an increase in the personal-use market attributable to greater reliability and lower prices stemming from custom LSIs used in the hand-held testers that account for the lion's share of DMM production.

Growth in the oscilloscope segment was 6.4% in 1989. The current focus is on digital storage oscilloscopes, demand for which is being driven by advances in IC technology, and the development of portable-type oscilloscopes using liquid-crystal displays. The main suppliers of oscilloscopes are Iwasaki Electric, Sony/Tektronix, Hitachi DECO, and others.

Logic analyzers, used as analysis tools for microprocessors, are expected to generate high demand due to the shift from 16- to 32-bit architectures and the advent of high-speed logical elements, such as GaAs technology.

Greater IC functionality and higher densities pushed production of semiconductor testing devices up 53.8%, to $1.14 billion in 1988. Last year, growth slowed to only 4.5%, putting the market near $1.2 billion.

Flatness testers—devices that are used to test wafer flatness—have moved from manual techniques using visual inspection based on interference bands to automatic devices. In 1988, automatic devices accounted for 80% of the market. Nidek Co. Ltd. and GCA (Sumitomo Electronic Systems) have entered the market, with the former holding the top share in manual devices and the latter in automatic devices. In the market for optical super-fine measurement devices, Nikon Corp. and Ryokosha Co. Ltd. together hold half the market.

With capital investment at a peak, no great growth should be expected in the electrical measurement device market for this year. But firm demand should continue due to further technical innovations. ■

EDITORIAL FEATURE

Computers, radio remake telecom

ISDN is gathering steam in Japan as deregulation takes hold

TELECOM

Results of the July 1989 U. S.–Japan communications trade negotiations made apparent the exclusive, fixed nature of the Japanese communications industry, and the problems inherent in the radio-frequency policies of the Ministry of Post and Communications. Motorola Inc., which was allocated frequencies for its cellular telephone service only in the western and northeastern regions of the main island Honshu, along with the island of Hokkaido, was finally awarded the bandwidth to allow it to compete with IDO Communications, already providing service in the most important and profitable Kanto and Tokai areas. As a silver lining in a dark cloud, this development means that Motorola's MicroTac, the most portable of all the current cellular offerings, will now be able to operate throughout Japan.

As a player in the newly freed-up electronic communications market, NCC has realized astoundingly high profits. In particular, NCC's performance in the long-range and mobile communications areas has been so strong as to gain the attention of Nippon Telephone & Telegraph (NTT). In fact, NCC's success has led the Ministry of Post and Communications to delay any moves to break up NTT, and particularly not to separate the mobile communications market until the capital investment in digital systems is complete. At the same time, no consensus has been reached on break-

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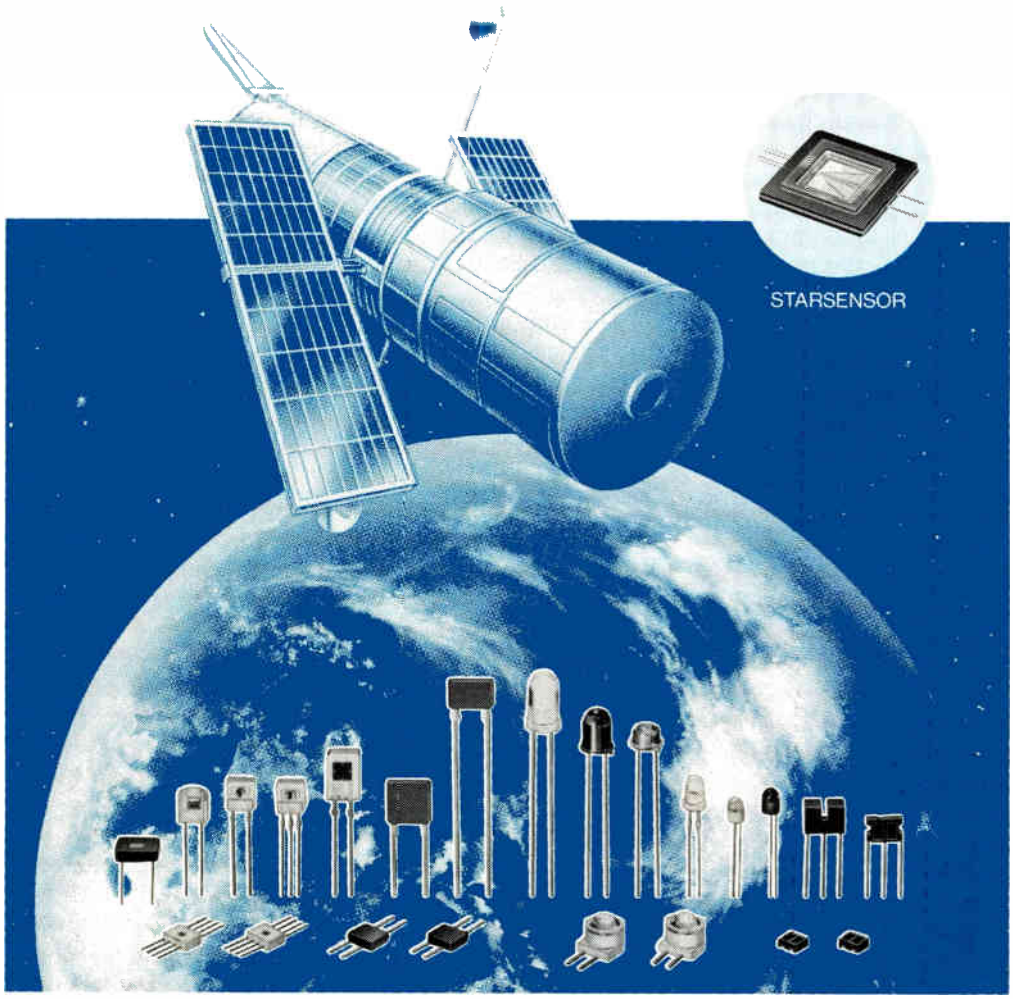

When the planetary exploration satellite was launched in 1990, Kodenshi's STARSENSOR was an important part of the mission. Thanks to its outstanding accuracy and reliability, STARSENSOR was regarded as a crucial component of the satellite's attitude control system.

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CIRCLE 208

ing up the communications giant on a regional basis.

Radio and computer technologies are remaking communications. Radio technology has given us cordless and portable phones, resulting in entirely new forms of service; wireless private branch exchanges and mobile satellite communications systems are expected in the near future. With regard to ground-based systems, ground stations with entirely new cost and performance specs are coming.

Computers are increasing the sophistication of devices and networks. By linking computers and switches, a menu of custom services can be automatically provided, allowing customer response systems, telemarketing systems, and the like to be configured. The unique DialQ service introduces the value-added concept to telephone rates, which until now were a mere function of distance and time, allowing networks to be configured and providing a means for value-added resellers to reduce the labor involved in collecting fees.

The diffusion of integrated services digital network capability—the infrastructure required for new functionality in data communications—has been picking up speed and momentum. NTT is increasing the rate at which it is installing digital switches in its local offices, preparing the way for ISDN. NTT had contracted for some 6,600 INS Net 64 lines by March of this year, with 117 lines contracted for INS Net 1500. In particular, the fact that PBXs have come to be delivered with ISDN interfaces as part of the standard package and the launching of ISDN packet-switching services in April have contributed to the increasing demand.

The cutting loose of the telephone handset from NTT's monopoly grip has led to a flurry of new product introductions. This spurt in technology has fostered a growth rate of 130% in the Japanese market. The expansion in cordless telephone sales has been

Japan's Communications Market

Shipments of telecommunications equipment ($ millions)

	1985	1986	1987	1988	1989	CAGR (85-89)
Telephone	732	746	812	1,142	1,468	18.99%
Standard	373	279	232	197	159	-19.25%
Multifunction	172	212	288	388	423	25.15%
Wireless	0	0	0	257	516	
Others	187	255	292	300	370	18.66%
Telephone-related units	1,939	1,817	1,456	1,223	1,307	-9.39%
Key telephone	1,495	1,330	1,009	897	899	-11.95%
Telephone recorder	153	234	200	114	134	-3.33%
Others	291	253	247	213	275	-1.43%
Transmission terminals	2,393	2,320	2,771	3,504	3,585	10.64%
Facsimile	2,286	2,213	2,663	3,401	3,489	11.15%
Very high speed	0	0	0	21	31	
High speed	2,286	2,213	2,663	3,142	3,220	8.94%
Medium speed	0	0	0	238	238	
Others	107	107	108	103	97	-2.39%
Telephone and data switching	2,168	2,384	2,865	3,355	3,371	11.67%
Public	1,276	1,319	1,755	2,090	1,997	11.86%
Private	601	745	756	878	860	9.40%
Others	291	320	353	387	513	15.20%
Transmission equipment	2,449	2,507	3,472	3,717	3,143	6.44%
Coded data	856	777	1,616	1,665	1,430	13.68%
Broadband terminal	450	488	458	504	348	-6.21%
Modern	319	314	502	602	553	14.74%
Others	824	928	896	946	812	-0.36%
Broadcast equipment	539	488	443	509	541	0.13%
Wireless communication equipment	2,738	2,822	3,246	3,652	4,017	10.06%
Fixed station	1,465	1,518	1,596	1,596	1,825	5.65%
Mobile station	1,101	1,140	1,400	1,734	1,800	13.06%
--Automobile	603	620	737	987	913	10.94%
--Portable	277	292	422	500	611	21.82%
--Others	221	228	241	247	276	5.67%
Personal station	172	164	250	322	393	23.00%
Wireless related units	1,386	1,535	1,704	1,871	1,708	5.36%
Total	14,344	14,618	16,769	18,974	19,141	7.48%

SOURCE: MITI

particularly remarkable, accounting for nearly 50% of the total value of sales in 1989. The trend to replace traditional telephones with cordless phones is continuing. More than 30 manufacturers—including Sharp, Kenwood, JVC, Matsushita, and a host of others—have entered the fray. The hottest sellers are cordless telephones with built-in answering machines.

The cordless telephone is very interesting, in terms of technology, digitization, ISDN capability, and integration with mobile telephones. The technological specifications for cordless phones, which make use of the radio bandwidth regulated in the public trust, are established by the Ministry of Post and Communications. The current models are treated by the law regulating use of radio bandwidth as ultralow-power radio stations or as low-power cordless telephone stations; they use analog frequency modulation for their transmission.

The number of installed facsimile machines has topped 3.5 million units, making fax the most widely used communications terminal after the telephone handset. The Japanese facsimile market has already evolved into a mature market; Ricoh, Matsushita Electric Industries, and others are now focusing their efforts on high-end facsimile products.

The highest class of fax machine, the G4 facsimile, has been plagued by paper-jamming problems, leading to thermal techniques as the most popular printing method. Some new market entrants have introduced niche products, such as portable faxes and faxes for installation in automobiles. The position that Japanese companies have, with their nearly monopolistic hold on the world fax market, is not expected to change appreciably during the coming year.

In the PBX market, the four largest manufacturers—NEC, Fujitsu, Hitachi, and Oki—continue to hold nearly 90% of the Japanese market. But the past year has seen Toshiba and Mitsubishi increasing their shares, leading to more intense competition. The latter two companies offer the ordinary office user equipment that combines voice and data lines and integrates ISDN capability.

Each of the top PBX suppliers is a computer manufacturer, and they use their strength in user applications to appeal to the customer. Currently, there is a need for PBXs that link telephones and data bases to allow for the creation of applications for broadcast stations, telemarketing companies, and sales offices, and to integrate voice and data for the computers those users have. Another important trend is to bring cordless telephones into the office.

At present, there are two incompatible mobile telephone systems coexisting in the Japanese market: NTT's system, which is used by NTT and Japan Mobile Communications, and TACS, with service offered by the Cellular Automobile Telephone Group. Japan Mobile Communications also has begun offering TACS service in addition to its NTT service. Equipment for communications bases is supplied by NEC and Japan Wireless, while that for mobile stations is provided by Matsushita Communications Industries, NEC, and Oki.

The number of mobile phones in operation in January 1990 was 410,000, a twofold increase over the number from the preceding January. The number of units that can be used while walking (including portable and luggable models) has passed 100,000, for a 25% share of the market segment. Research on a digital system, based on the three-channel method using the 1.5-GHz band (a system also used in the U. S.), is proceeding. This technology is needed to deal with the extremely crowded situation in Tokyo and its environs. Service is expected to begin in 1992 or 1993. ■

Multimedia needs a solid base and broader market

The integration of audiovisual and computer technologies presents a new set of problems

MULTIMEDIA

Multimedia has become the focus of attention in many fields, as an effective, efficient, and interactive means of accessing information in our ever more information-oriented society. High-density storage devices, such as CD-ROM and optical disks, as well as personal computers to control these devices, have begun to penetrate into many areas of society. Multimedia applications using these systems as platforms will follow, introducing major changes as we

approach the next century.

Interest in multimedia technology continues to grow. The International CD-ROM Conference and Exposition, held under the leadership of Microsoft Corp., completed its fifth meeting recently. Japan's First International Conference on Multimedia was held at the end of 1989, under the leadership of ASCII Corp., which is building a multimedia research facility and media laboratory.

The ASCII facility, which is expected to be completed next year, will house efforts to research multimedia technology and establish audiovisual facilities; a ground station using a communications satellite transponder is also being planned. ASCII is hoping that its media technology laboratory will be a resource not only for Japan but also for multimedia industries in America and Europe as well.

One of the most important devices for multimedia may be the CD-ROM. Several computers now contain a CD-ROM in their standard configuration, including the FM-Towns from Fujitsu Ltd. and the PC8801MC and PC-Engine from NEC Corp.

The PC-Engine is a game machine whose core concept is expandability. It was designed for the ease of connecting various peripherals. The PC-Engine's CD-ROM drive accomplishes the low cost required in a game machine by sacrificing error correction and other features included in previous CD-ROM drives. As a result, the PC-Engine has sold 2.1 million units since hitting the shelves this past July.

Not only games (the leading edge of the multimedia wave) but also *karaoke* and other types of entertainment applications are being marketed. The PC-Engine can be connected to the NEC 8801MC, which also incorporates a CD-ROM drive. However, the connectability reaches only to the hardware level—there is no software compatibility.

NEC, with its PC9801 Series, controls about half of the personal computer market in Japan. For this reason, all eyes are on NEC, waiting to see in which direction it will throw its considerable weight within the multimedia market. NEC has recently contributed an NESA (New Extended Standard Architecture), high-end version of its PC9801 Series PCs. The NESA is a 32-bit bus architecture, widely touted as the standard for multimedia. NEC is also at work on developing CD-ROMs that can be used by both the PC9801 Series and the PC8801 Series computers.

The Fujitsu FM-Towns, a 32-bit personal computer, was announced in April 1989. The FM-Towns was the first Japanese PC to include a CD-ROM drive, and it was expected to develop into a hardware platform for multimedia. But sales figures so far have been disappointing. Fujitsu sold only 60,000 FM-Towns units last year, less than one-tenth the volume for the PC9801 Series.

Sony Corp. also has released a personal computer incorporating a CD-ROM in its standard configuration, the QuaterL (C Model). The QuaterL is being marketed to businesses, with a view to connect to POS systems and to develop sales-monitoring and order-monitoring systems. Besides the C Model, Sony is expected to release an X Model to support the CD-ROM XA standard.

Fujitsu and Sony are developing a common library of CD-ROM XA applications. At this point, a single standard has been established for the data portion of CD-ROM XA, but the program portion, which actually controls the computer, has not been standardized. A common procedure for software development will have to be established in order to obviate the need to modify the software for each type of computer on which the multimedia is to be used. The library is expected to be made available at no charge to other hardware manufacturers, software companies, and publishers later this year.

Manufacturers of facsimile machines are also getting into the act. Canon Ltd.'s G3/G4 facsimile can operate on a local-area network. This fax incorporates an Ethernet interface and LAN Manager, allowing it to send and receive faxes and documents from workstations and to input documents from image scanners. Canon is focusing on developing the multimedia market by way of office automation products.

Last year, Apple Computer Inc., which hopes to expand its share of the Japanese PC market, began selling its Apple CD SC, which can be used with the Macintosh and Apple II GS machines. Apple's share of the Japanese PC market by the end of 1989 was said to be approximately 3%. However, figures for the first quarter of 1990 are up 80% over the same period last year. Apple is determined to strengthen its Japanese position even further, with a goal of reaching 10% market share this year. As Apple increases its share, the Apple Media Control Architecture, which integrates multimedia, will become a major force in multimedia in Japan.

Japan's computer manufacturers possess world-class technology and are capable of imparting enormous influence on the world's computer industry. However, with regard to multimedia, it is clear that Japan is far behind the level achieved in the U. S. In particular, there is an unsatisfied demand for rich multimedia application software.

This need cannot be met unless software developers are joined by producers and musicians who can create professional-quality multimedia. As hardware penetration increases, analysts expect applications, currently sold by hardware manufacturers, to become available through bookstores, computer stores, and toy stores. ■

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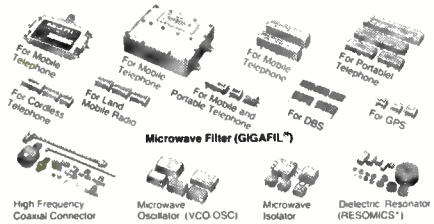

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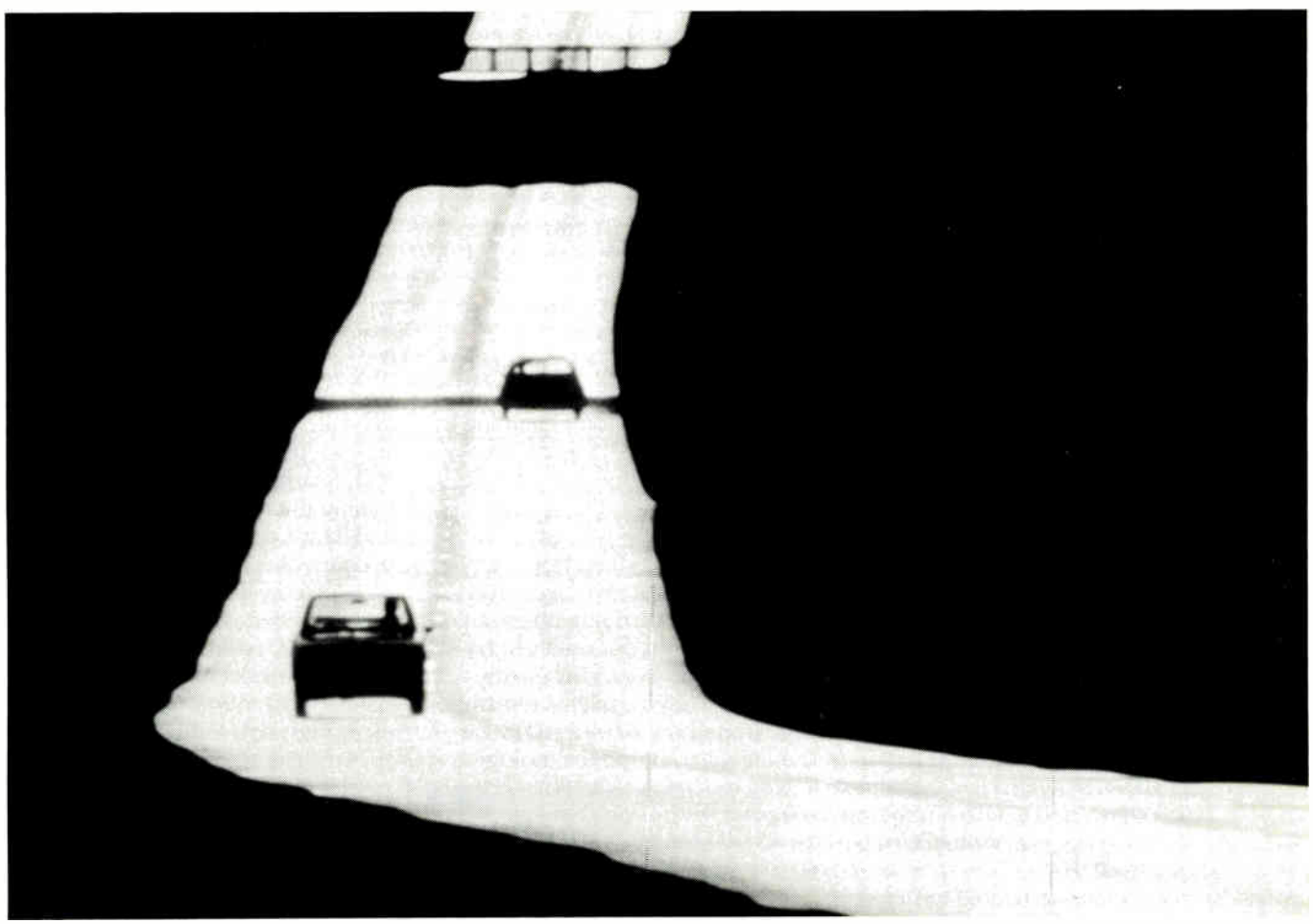

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CIRCLE 226

EDITORIAL FEATURE

HDTV technology pushes ahead in many areas

Development is proceeding on many fronts, but can show production fill the hours allotted?

HDTV

High-definition TV, the next generation of television, is indeed a revolutionary technology. HDTV was originally developed as a broadcast medium; problems surrounding standardization efforts have made worldwide news. In the electronics industry, attention also is focused on the construction of broadcast satellites and fiber-optic networks as carriers of HDTV signals, and on the development of decoders.

The International Telephone and Telegraph Consultative Committee (CCITT), at its general meeting this past May, was unable to agree on the four most important specifications of HDTV—including number of scan lines—and left them for determination by member country. Japan has adopted the HiVision as its HDTV standard. Japan's Ministry of Post and Communications' standard for HDTV broadcast is due by 1991.

Japan was scheduled to launch its BS 3A broadcast satellite (expected to operate for seven years) on Aug. 24. This will add one frequecy to the two NHK is already broadcasting. The BS-3A contains three transponders with output levels of 120 W, allowing for the use of small (45-cm) parabolic dishes. These small dishes mean that use by automobiles and trains will be feasible; meanwhile improvements in flat microstrip antennas are also proceeding.

A fourth transponder, although low in power (at just over 20 W), covers a very wide area. Proposals are currently being considered to use this transponder for HDTV transmission for corporate and other applications.

The backup BS-3B satellite is scheduled for launch next summer, with operation beginning in the fall. The BS-3H, with three 200-W transponders and an expected operating life of eight years, is scheduled for launch in spring of 1991. If all three satellites operate as expected, HDTV broadcast—currently one hour, one day per week on a test basis—will be expanded greatly.

Still, many problems remain to be ironed out before HDTV becomes a common technology.

Homes Receiving NHK Satellite Broadcasts

1990	2.3 million
1991	3.3 million
1992	5.7 million

% of homes with NHK contracts: 7% (as of March 1990)

SOURCE: NHK

These problems include the paucity of video software currently available in HDTV format and the small fees collected by NHK, restricted due to its status as a public corporation.

Production by NHK, the British Broadcasting Co., Italy's RAI, and others has led to Japan's HiVision HDTV standard having the largest available software library today. But it still is not adequate to fill large blocks of programming time. The high cost of HiVision equipment (which can range into the millions of dollars) and the lack of experienced operators contribute to the shortage.

However, devices for converting film to HDTV are being developed, and the CBS Sony Group has begun general marketing of HDTV software. In addition to production of dramatic films for broadcast, applications in screen composition, special effects, and computer graphics are being pursued. Prototype development of HDTV decoders was done principally by NHK. But Toshiba Corp. developed the moving-region-extraction chip and NEC Corp. built dedicated memory devices. Matsushita handled signal processing, with Sharp, Sony, and Hitachi joining the team later. Mitsubishi and Sanyo did not participate in decoder development, but they have prototyped HDTV-to-NTSC down-converters.

As HDTV approaches practical use, semiconductor manufacturers are most interested in the field memories, devices that have great applicability to other equipment as well. Sony, with its overall corporate emphasis on video, is focusing on the logic circuits, to strengthen the integration within its production group.

Charge-coupled devices, the key technology for HDTV cameras, must be capable of processing at least 2 million pixels, making them equivalent to 64-Mbit dynamic random-access memories. Sony sees the new CCDs as a

strategic product and is putting all its strength into development. NEC, Matsushita, Toshiba, and other Japanese corporations, as well as Texas Instruments Inc. and other overseas manufacturers, are also developing CCDs.

CRT-based HDTV displays have already been announced by several manufacturers. Research and development is also proceeding apace on flat-panel displays, considered to have the most product potential for extra-large screens. Liquid-crystal direct-view displays, which apparently have the brightest future, are currently difficult to manufacture in large formats due to yield problems. However, Sharp and other major investors in LCD technology are leveraging R&D in front-projection TVs to get a leg up on the technology. And in rear-screen projection, Sony, Hitachi, Pioneer, NEC Home Electronics, and other companies are commercializing products now.

The videotape recorder is indispensable as a recording device for HDTV. Sony and Hitachi have released 1-in. digital VTRs for professional use; these cost well over $300,000. Under NHK's leadership, 10 manufacturers have joined to develop a device conforming to the UniHi standard. Matsushita and Toshiba have announced products in the $130,000 price range, while Sony has developed a very small unit. JVC Corp. and Hitachi are also developing products.

To reduce chip counts and thereby make models that are affordable to home users, NHK's Giken laboratory has developed a prototype VCR that increases recording density by using metalized tape. Meanwhile, Pioneer has developed an HDTV video-disk player that operates by distributing the HDTV signal onto three optical video disks and replaying them in synchronization.

Possible HDTV applications are not restricted to broadcast use. Experiments are being done with corporate video and still-picture data bases, while practical systems for manufacturing, medical applications, printing, publishing, and museums are under consideration or in the process of implementation. The HiVision Gallery installed by the Gifu Prefecture Museum of Art in April of 1989 has drawn many visitors as well as a great deal of attention in the art world. Other art museums and photo galleries are moving to introduce similar systems. To some extent, this reflects the aggressive attitude of local government bodies toward an early introduction of HDTV, as well as the general appeal of anything new.

Optical fiber and package media are under consideration as delivery media for HDTV broadcasts, but in the near term, satellite broadcast is the only practical option available. Receivers for HDTV broadcasts are increasing, particularly internal satel-

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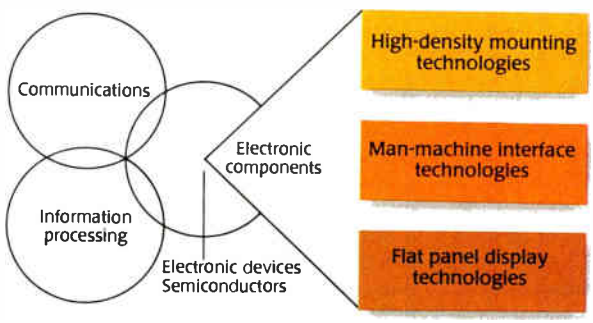

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lite broadcast receivers built into TV sets and VCRs. And of course, the growth of antennas continues unabated. In spite of preventive measures, Japanese satellite broadcasts do spill over into Taiwan and Korea. The Taiwanese government in particular was vexed by the number of illegal receivers, and finally moved in 1989 to legalize them.

At this point, all Japanese firms will be investing their developmental energies into second-generation HDTV equipment, that intended for production in large volumes for home use.

In particular, the manufacturers expect to ride the current worldwide boom in demand for large-screen TVs, increasing the performance of large CRTs and projection-style TVs.

The large LSI part count in current Muse decoders and half-inch VCRs can be reduced greatly through design improvements, leading to fast price drops. ■

NDK: meeting the

Nihon Dempa Kogyo Co. Ltd. is one of the world's top manufacturers of crystal units and their application products. The demand for crystal is growing considerably for three reasons: the rapid proliferation of car telephones and the miniaturization of hand-held phones; expansion of the laptop computer market; and the demand for new products in the field of audiovisual equipment, such as video cameras.

NDK is attempting to accommodate this demand by establishing new production facilities within Japan as well as by strengthening our production affiliate in Malaysia. In particular, Hakodate NDK, in Hokkaido, specializes in the production of crystal application products such as TCXO (temperature-compensated crystal oscillators), which are used in hand-held phones, and in crystal filters and SAW devices.

NDK currently has five sales bases in Japan and three overseas

Japan sets its sights on 2.5-in. disk industry

After being squeezed out of earlier generations, vendors look to the new units

At one time, Singapore was called "the Island of Disks," referring to the large number of disk-drive assembly factories established there by Seagate Technology and other U. S. disk-drive manufacturers. During one period, more than half the hard drives in the world were coming out of Singapore. In the past year or two, Singapore has lost some of its domination of the hard-disk business, primarily because of Seagate's shift of production facilities to Thailand. However, the rapid growth of hard-drive production in Japan is an additional factor that cannot be ignored.

Production of 3 1/2-in. hard drives is concentrated primarily in Singapore and Japan, but the trend is for high-end products to be produced in Japan rather than in Singapore. In the extreme price competition that rules the market for low-end hard drives, Japan is at a competitive disadvantage, with cheaper labor available in Southeast Asian countries.

As one president of a Japanese hard-disk components supplier recounted, Japan was knocked cold in the 5 1/4-in. hard-disk market. In the 3 1/2-in. market, Japan lost by a decision. The 2 1/2-in. drive will represent Japan's third attempt at the hard-drive title.

Among Japanese firms girding to develop 2 1/2-in. capacity, this kind of thinking is quite common. There are those who say

DISKS

that Japan's tradition of high-volume production of small products will be telling in the emerging market. To get back on their feet in the low-end markets, Japanese manufacturers will have to use the 2 1/2-in. market to catch up with overseas manufacturers.

Three firms—PrairieTek, Conner Peripherals, and JVC Corp.—have taken the early lead in the 2 1/2-in. market. Conner is moving ahead with plans to open production facilities in Singapore, but PrairieTek, also an American company, has contracted its first offshore production to the Japanese firm Alps Electronics. In addition to JVC and Alps, nearly every Japanese hard-disk supplier is developing 2 1/2-in. facilities. Fujitsu Ltd., second in the high-end hard-disk market only to IBM, is developing 2 1/2-in. hard drives at its American subsidiary, Intellistore. And it's not only hard disks.

Optical drives are not to be ignored, either. Combined Japanese investment in R&D for optical disks (including rewritable and write-once disks) has already topped $1 billion. The major play-

growing demand for crystal

(in the U. S., London, and Singapore). Ten years have passed since we first established our U. S. affiliate, allowing us to gain the vast trust and confidence of major users in the areas of computers and automobiles. One example of these products is our crystal clock oscillators for computers.

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Although the crystal industry continues to demonstrate favorable growth overall, one problem must be overcome: the international restrictions on the use of freon. NDK will completely eliminate the use of freon by the end of 1992. This is the result of our basic philosophy of making every possible effort to contribute to society. ■

ers have laid out as much as $200 million each, and it is said that investments of less than $100 million will not be enough to survive in the market.

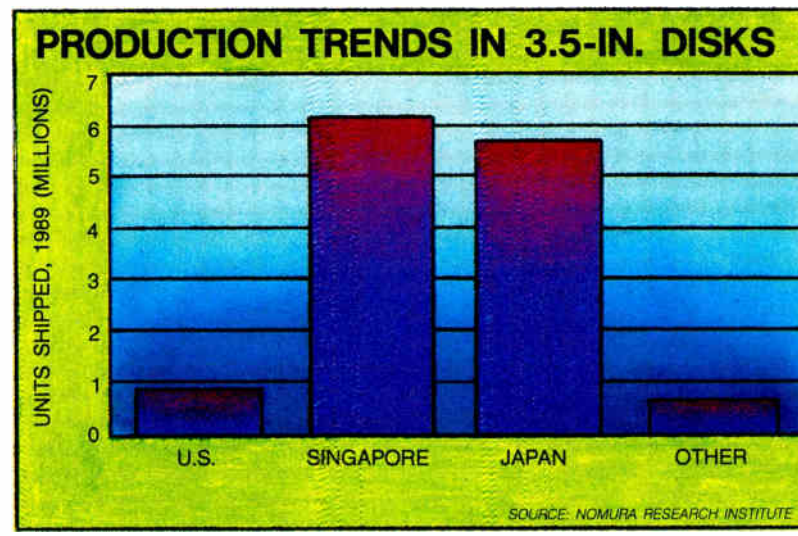
Such high capital requirements practically guarantee that nearly all the survivors in optical drives will be Japanese firms. Several American companies are continuing their development efforts, but in each case, the development is proceeding in cooperation with a Japanese partner.

Where optical disks are concerned, there has been no dearth of topics for discussion of late. Write-once disks have been the mainstream, but with acceptance of the ISO standard for rewritable disks, a host of manufacturers are commencing with sales of rewritable products.

Pioneer, Ricoh, and Matsushita have all announced 5 1/4-in. multifunction drives that can use either write-once or rewritable media. The Pioneer and Ricoh products use magneto-optical disks as the rewritable media, while Matsushita's product uses the new phase-change technology for rewritable media. Phase-change media may allow the rewrite operation to be carried out in one-third the time required for magneto-optical media.

If optical disks come to be used with personal computers in place of floppy disks, the inconvenience of having to supply both hard and floppy drives with PCs will disappear. The race is on to develop 3 1/2-in. magneto-optical disk drives with the potential to be used in high volume in PCs. No manufacturer has yet announced such a product for commercial applications, but all the major players are at work behind the scenes promoting their as yet unannounced products.

At the same time, the 3 1/2-in. magneto-optical disk ISO standard is approaching completion, and should be out by the end of this year. With the standard in place, 3 1/2-in. drives packing 120 Mbytes should hit the market at the beginning of next year.



The fate of the optical-drive market is tied directly to the direction of the personal computer market. Will personal computers include optical drives? A PC with a 120-Mbyte 3 1/2-in. optical disk would be a powerful platform for multimedia applications. However, from the PC viewpoint, optical disks are not a necessity. Everyone is extolling the virtues of multimedia, but there is as yet a great dearth of interesting software. And there are still a number of technical problems regarding optical technology.

Taking all these factors into account, Nomura Research analysts came up with two predictions for the optical-disk market. If everything goes well, the market could reach 1 million units by 1992. However, if some of these problems are not resolved, it is entirely possible that the market will be less than half of that.

What does this all mean for Japanese disk production? While Japanese firms virtually control the floppy-disk market, they have continued to battle in the 5 1/4-, 3 1/2-, and 2 1/2-in. hard-disk markets, where American firms remain in the lead, and to introduce new products in the optical-disk market. There are more than 20 Japanese players in these markets that have collectively invested several billion dollars in research and development. Now and for the foreseeable future, for better or worse, Japan will continue to be the true "Island of Disks." ■

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CIRCLE 221

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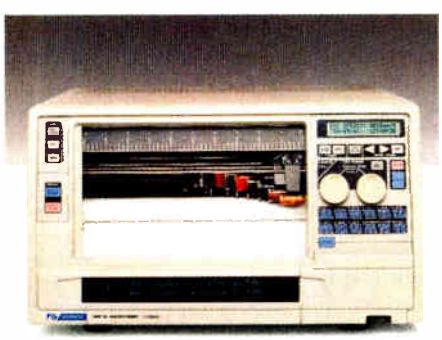

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MIDEAST CRISIS COULD SLOW THE INDUSTRY RECOVERY

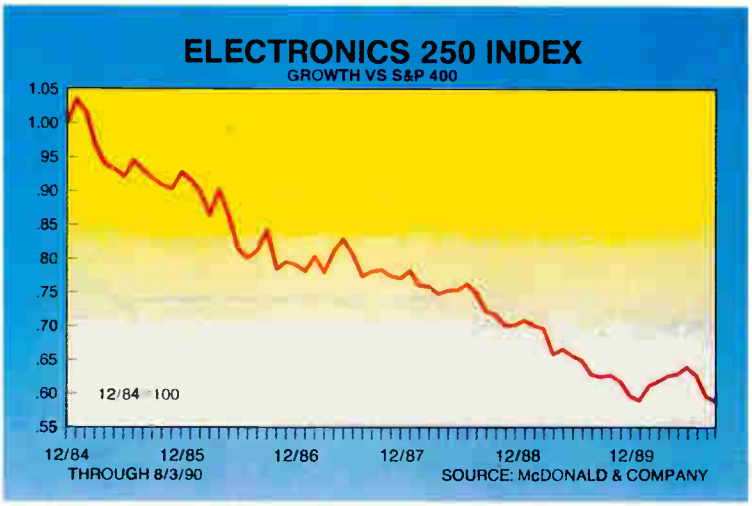
IF HIGHER OIL PRICES MEAN THAT the U. S. economy is headed for recession, what are the implications for electronics? An oil-induced recession would likely hurt the Far East a lot more than the U. S., but economies there are much stronger. Electronics demand has shown increasing sensitivity to general economic patterns, and the maturation of the computer hardware market has accelerated this trend in recent years.

To the extent that a potential war in the Mideast increases uncertainty, the recovery in domestic electronics demand may slow for a while. Caution has begun to creep into many companies' planning horizons, but overall patterns thus far seem far from disaster. Further, the outlook for defense electronics spending has improved somewhat.

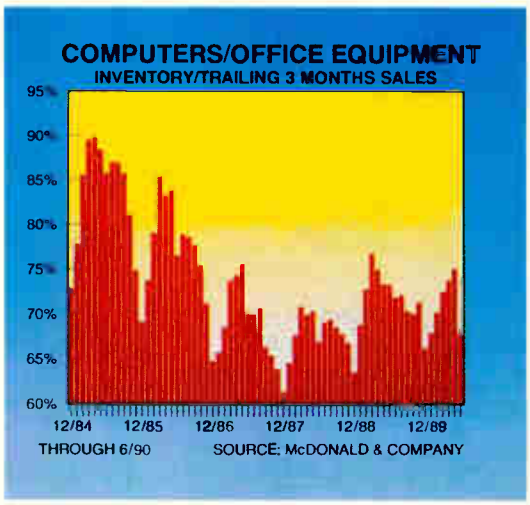
The painful lessons of 1985 and the increasingly global nature of the market have resulted in much leaner cost structures, stronger balance sheets, and a more conservative approach to expansion. Companies that meet this profile may witness some modest slowing until tensions ease a bit, but should easily weather the storm.

June order patterns for computers and office equipment were weaker than in previous months, but long-term momentum suggests about 5% growth at current run rates. Inventory productivity in this sector improved dramatically in June, which probably contributed to weakness in component orders. However, component inventory trends remain positive; 7% to 9% growth is indicated given current order momentum. Communications equipment patterns continue to look very strong and growth is continuing to accelerate. Electrical equipment trends continue to slow as does industrial growth, but they may be stabilizing. E

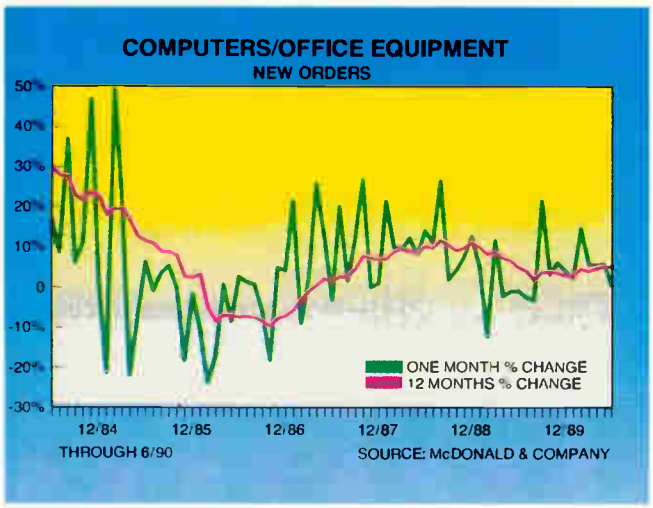
By Mark Parr, McDonald Securities Inc., Cleveland (216-443-2379)



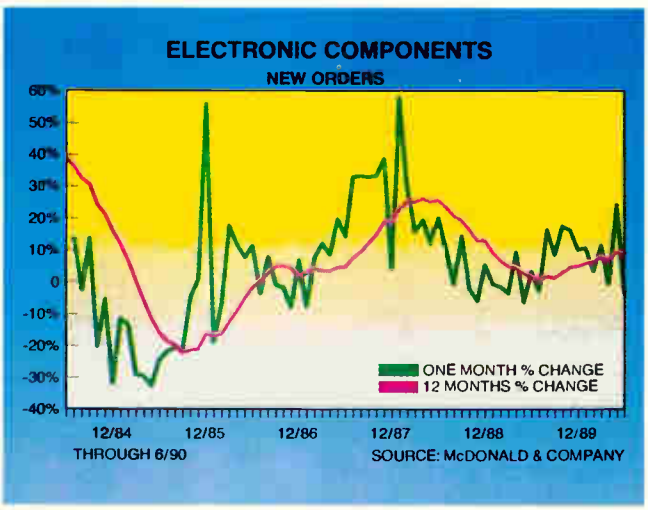
Potential war in the Mideast may increase uncertainty, slowing any comeback.



Inventory productivity for computers has improved.



Orders in June for computers and office equipment were weaker.



Inventory strength in computers helped weaken component orders.

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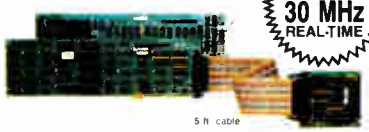

8051

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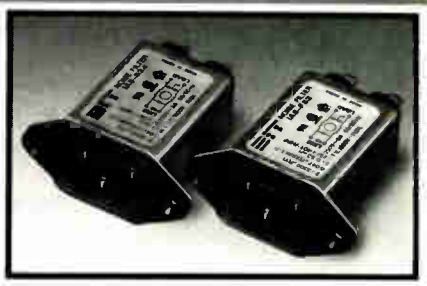

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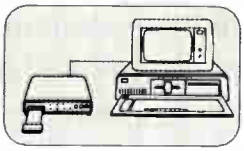

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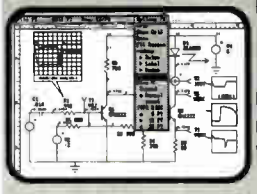

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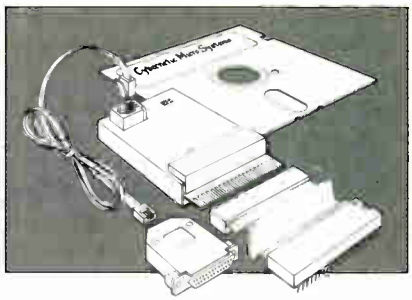

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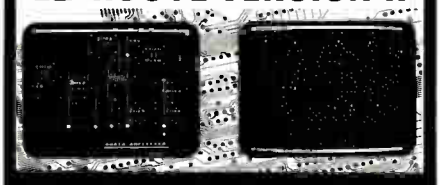

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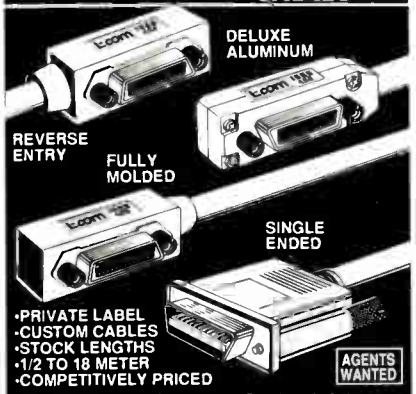

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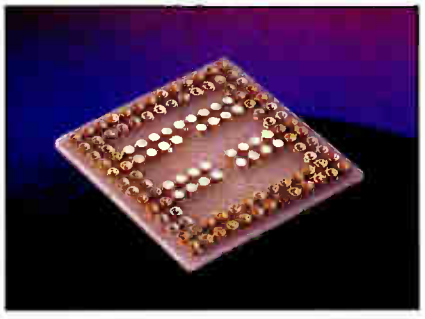

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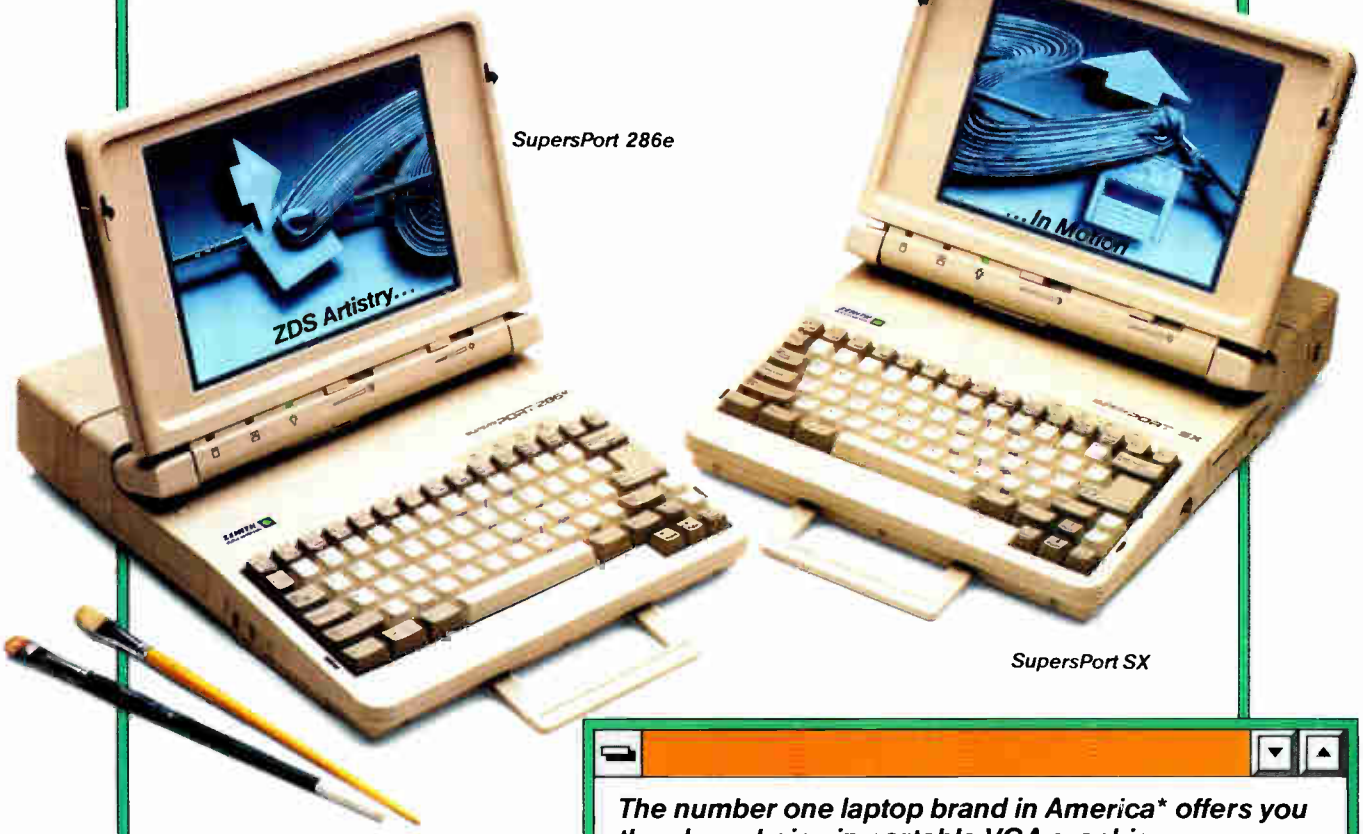

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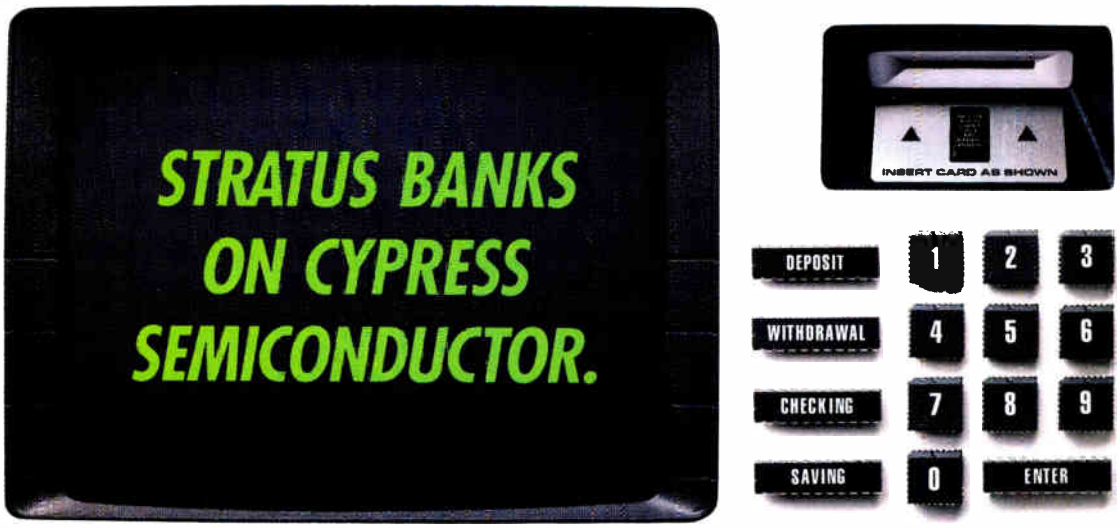

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