THE TALK OF SEMICON PAGE 32A

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APRIL 1991

Electronics®

FIRST MAGAZINE OF GLOBAL ELECTRONICS MANAGEMENT

THE WORKSTATION RACE HEATS UP

PAGE 43

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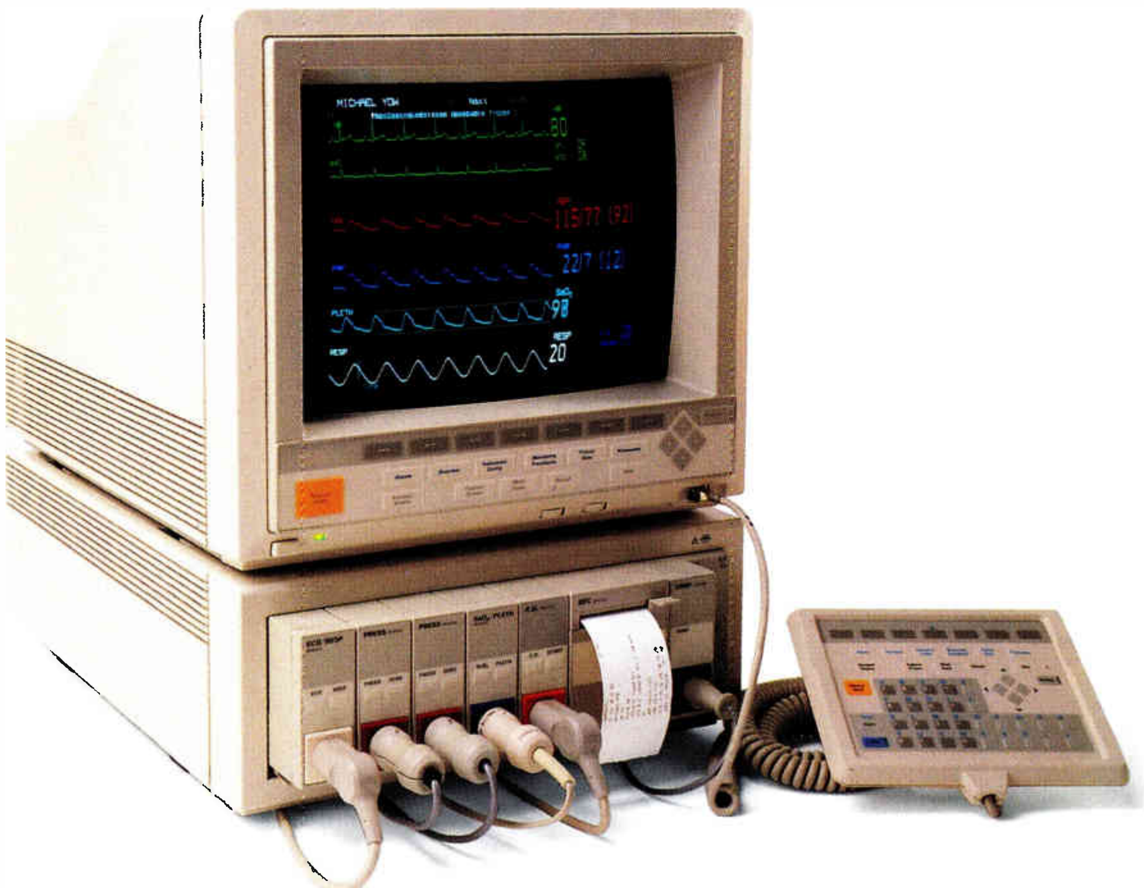

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408-441-0551

April 1991 Volume 64, Number 4

Electronics (ISSN 0883-4989) is published monthly by Penton Publishing, Inc., 1100 Superior Ave., Cleveland, OH 44114-2543. Second class postage paid at Cleveland, OH, and additional mailing offices.

Editorial and advertising addresses: Electronics, 611 Route #46 West, Hasbrouck Heights, NJ 07604. Telephone (201) 393-6060. Facsimile (201) 393-0204. San Jose, Calif.: Telephone (408) 441-0550. Circulation (1100 Superior Ave., Cleveland, OH 44114-2543): (216) 696-7000.

Microfilm of issues or articles can be ordered from University Microfilms, Ann Arbor, Mich. 48103. Telephone: (313) 761-4700.

Subscriptions free to qualified managers. All others: $60 for one year in the U.S.; $70 in Canada; $136 in all other countries. For subscriber change of address and subscription inquiries, call 216-696-7000.

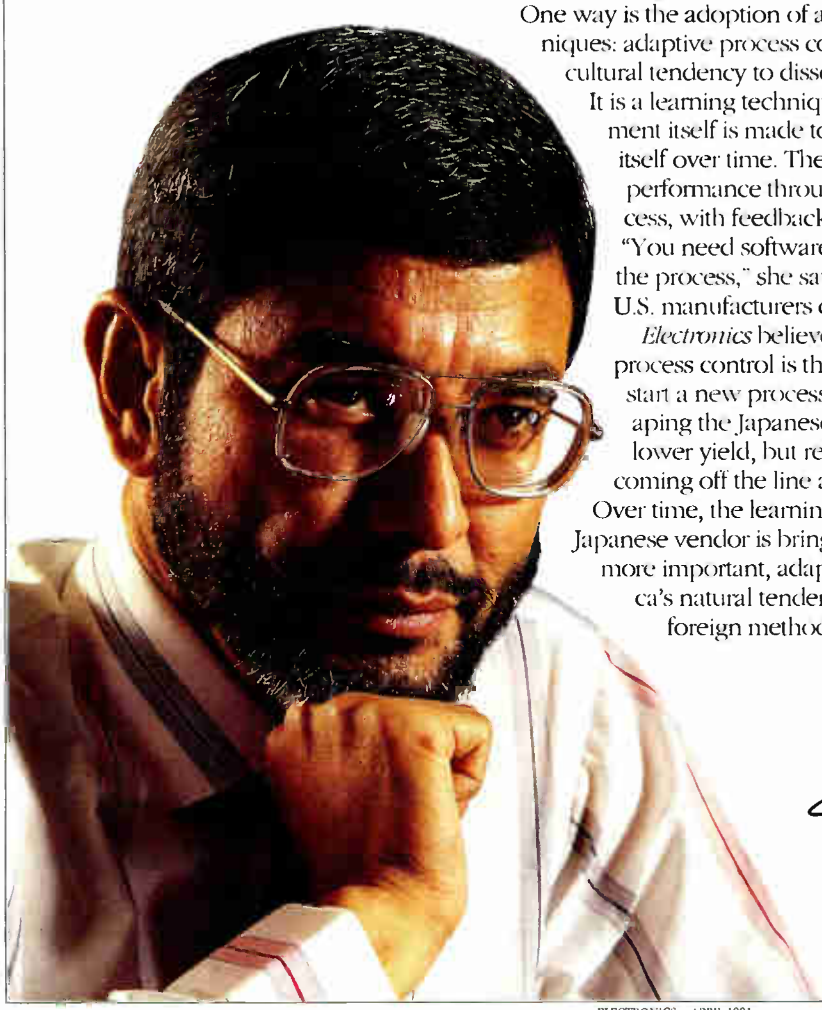
POSTMASTER: Please send change of address to ELECTRONICS, Penton Publishing, Inc., 1100 Superior Ave., Cleveland, OH 44114-2543.

LET EACH PLAY TO ITS STRENGTHS

One observer—G. Dan Hutcheson, president of VLSI Research Inc., a San Jose, Calif., market research house—makes note of one decided difference between the U.S. and the Japanese psyche. He generalizes that the Japanese tend to synthesize diverse elements into a singular whole, whereas Americans are much more analytical—they tend to dissect a larger body into its constituent parts. These disparate cultural traits speak to a major difference in the way each culture approaches the concept of manufacturing in the electronics industry.

In building a semiconductor-manufacturing line, the Japanese conceive of a yield they wish to achieve, explains Sue Billat, president of Benchmark Strategies Inc., a Palo Alto, Calif., manufacturing-consulting firm. "They then characterize every variable in the process with the goal of achieving this level of yield." Only after painstakingly developing process equipment that achieves the desired level is the line put into production. In Japan, it takes six months to build a high-yield line. Thereafter, each step is monitored using statistical process-control techniques to ensure that it remains within optimum performance tolerances. The upside: "In Japan you build yield into the process before it gets into production," says Billat. The downside: it can take longer to get the line running.

Until recently, U.S. companies have been making a tremendous effort to duplicate the Japanese approach to manufacturing. "This came about as a result of U.S. companies cross-licensing Japanese companies' processes," says Billat. "They discovered that Japanese companies were getting incredible process performance from old equipment. U.S. electronics managers have attempted to duplicate the yield, but they have realized that extracting high yield from old equipment requires a fundamental change in the way they view the entire process." How does an analytical mind duplicate the results of a process that has been synthesized to achieve high yield?



One way is the adoption of a new breed of manufacturing techniques: adaptive process control. This concept plays to America's cultural tendency to dissect a process into its component parts. It is a learning technique, Billat says, in which the equipment itself is made to "learn" what's wrong and improve itself over time. The machinery is educated about its own performance through measurements placed in the process, with feedback loops to incorporate the learning. "You need software to make the measurements and tune the process," she says, but software is another strength U.S. manufacturers can play to.

Electronics believes the long-term benefit of adaptive process control is that it allows a U.S. manufacturer to start a new process line much faster than he can by aping the Japanese method. In doing so, he accepts lower yield, but receives a premium for the product coming off the line ahead of his Japanese counterpart. Over time, the learning loop improves the yields just as the Japanese vendor is bringing production capacity on-line. But more important, adaptive process control plays to America's natural tendency rather than forcing it to adopt a foreign methodology—and mind set. ❑

JONAH McLEOD
EDITOR

advertisement

CAE Technology Report

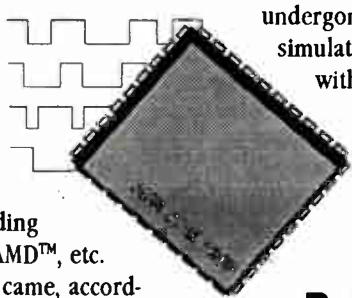
April 1991
Vol. 3, No. 4

Standard Universal Simulator

SUSIE is an acronym for Standard Universal Simulator for Improved Engineering, the world's only real-time simulator that allows concurrent design and test vector modifications while simulating. It took ALDEC only three years to promote SUSIE as a new logic simulation standard on PCs. Today, judging by the number of OEM vendors who have standardized on the SUSIE simulator, it clearly dominates the market. SUSIE is resold by CADAM/P-CAD™, Racal-Redac™, CAD Software™, Omation™, Phase Three Logic™, Accel™, and many other CAE vendors. To further increase SUSIE's international presence, ALDEC is working with four new European and two Japaneese CAE vendors who want to port SUSIE to their CAE environments.

VHDL Takes Over

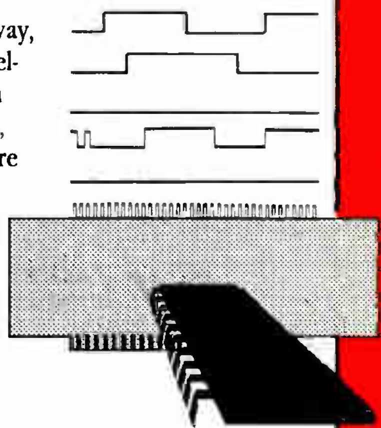
While many pundits still debate the merits of the VHDL standard, the leader in logic simulation on PCs, ALDEC Company (Newbury Park, CA) has already converted all its logic simulators to VHDL. According to Harry Tosado, Director of Sales at ALDEC, all IC models since March 1990 have been written in VHDL. The new SUSIE 6.0 simulator has exclusively VHDL IC models and supports most PLDs and FPGAs, including parts from Xilinx™, Altera™, Actel™, AMD™, etc. ALDEC's strong commitment to VHDL came, according to Mr. Tosado, as a result of superior VHDL model reliability and easy cloning of new parts by the user.



Easy Cloning of IC Models

Perceiving that IC modeling could be a major stumbling block to wider use of simulators, ALDEC has released ICMaker™ which allows for instant cloning of VHDL IC models. Since each of ALDEC's VHDL IC models is driven by a timing table that looks like an IC catalog sheet, the user can instantly create a new IC model just by changing timing data in this table. The method is so easy and simple that IC modeling with ICMaker has become a trivial task. The majority of CAE vendors have already standardized on ALDEC's SUSIE logic simulator because of its performance, ease of use, large IC libraries and superior IC modeling tools. **CIRCLE 101**

Simulators Replace Breadboarding



Simulators are replacing breadboarding in a big way, by cutting costs and development time to less than 20% in most cases. First, breadboarding in software takes only seconds but produces a perfect product. Second, the new simulators operate in real-time and behave like real hardware. The users can toggle switches, move jumpers, replace ICs, change JEDECs, etc., all within a fraction of a second. Some simulators such as SUSIE allow the user to move back in the simulation process, change design and test vectors and instantly analyze the effect of the latest changes. Also, IC modeling has undergone major improvements and the newest simulators allow for cloning of IC models within seconds. CAE tools are advancing at such a rate that they are catching up with the progress in silicon technologies. **CIRCLE 102**

Xilinx Leadership Reinforced

Good field programmable gate array (FPGA) architecture helps in getting user attention. However, since FPGAs are often used on small production runs, lowering development costs is a critical issue. Since Xilinx has worked closely with leading CAE vendors, its FPGAs have superior software support and designers can now test and modify multiple Xilinx FPGAs in real-time. For example, a designer can change a single cell in one FPGA and instantly see how this change affects another cell in a different FPGA. As design complexity grows, Xilinx leadership will be reinforced by the excellence of their support tools. **CIRCLE 105.**

* ***SUSIE*** and ***ICMaker*** are trademarks of ALDEC Co., Inc. Newbury Park, California, USA. TEL: (805)499-6867 FAX: (805)498-7945. **To obtain a free working model of these tools please contact ALDEC.**

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Electronics

60 YEARS OF GLOBAL LEADERSHIP.

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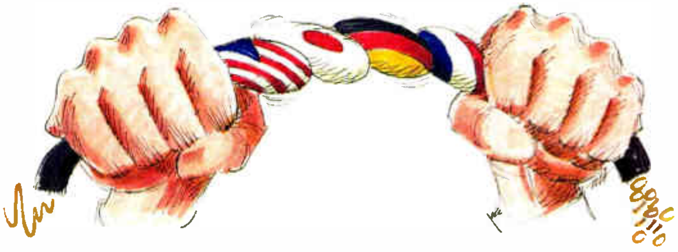

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Jesse H. Neal
Editorial Achievement Awards

1956 Merit, 1965 First
1975 Merit, 1976 Merit
1977 First, 1978 First
1988 Merit, 1990 Merit

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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.

57 MIPS/$12K

(Grayscale $12K. Color $19K)

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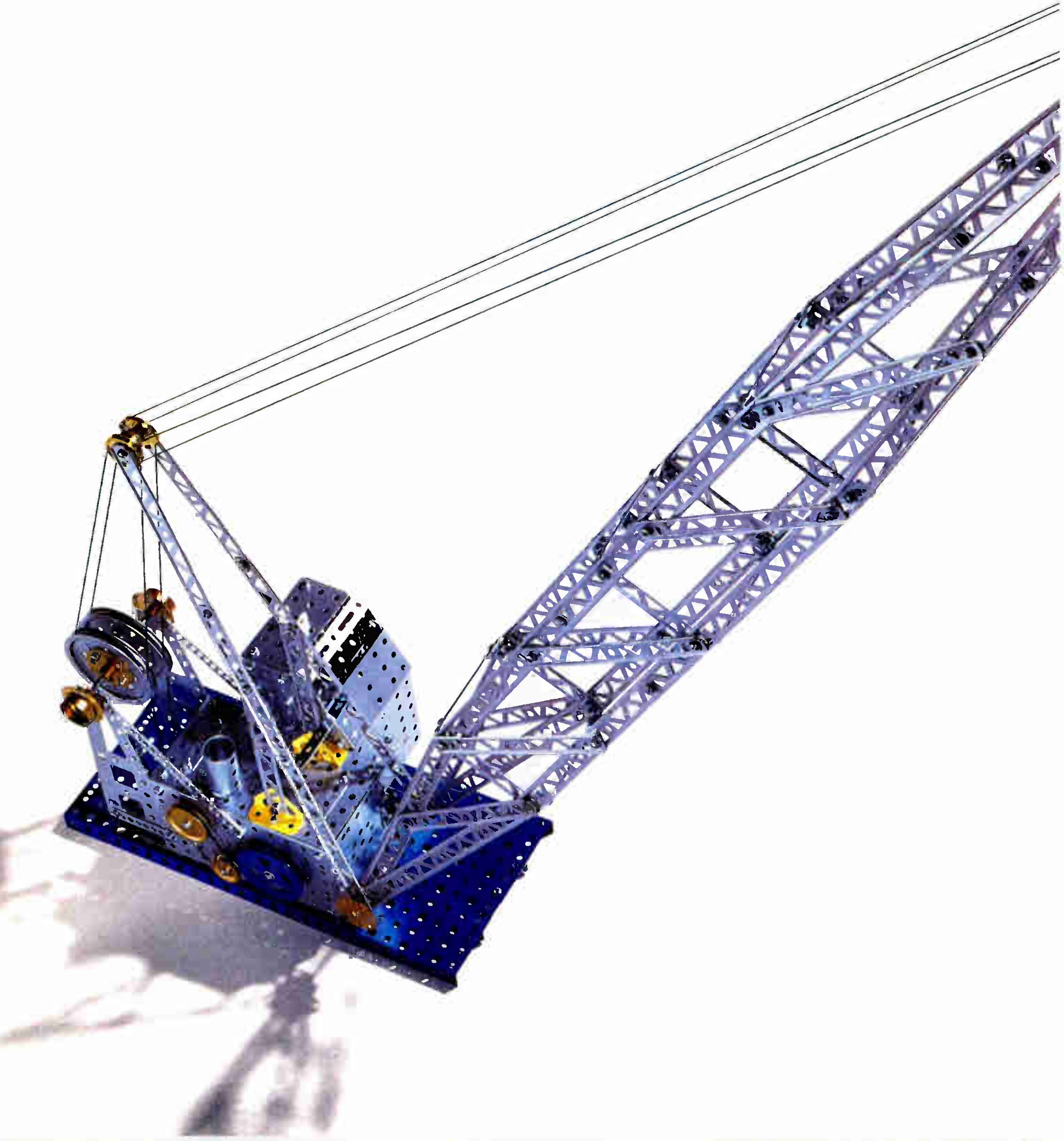

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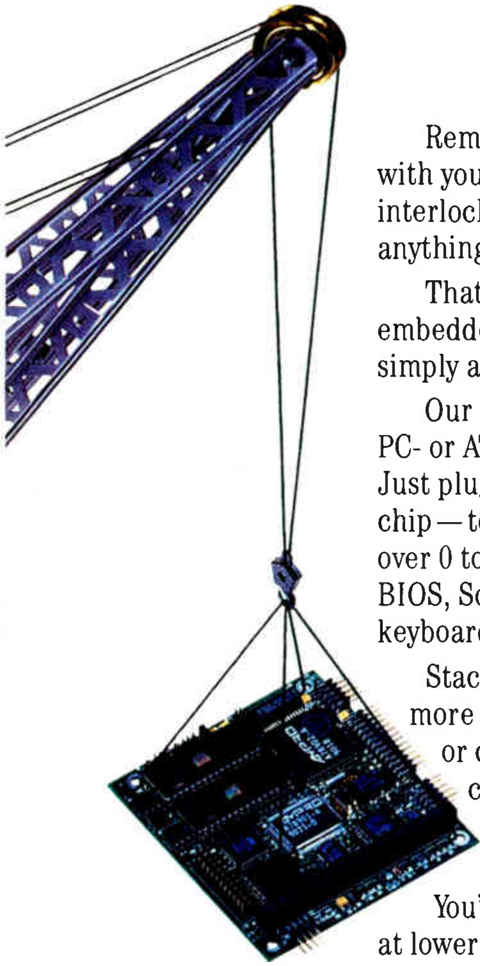

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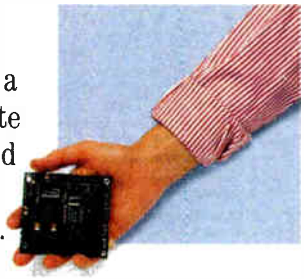

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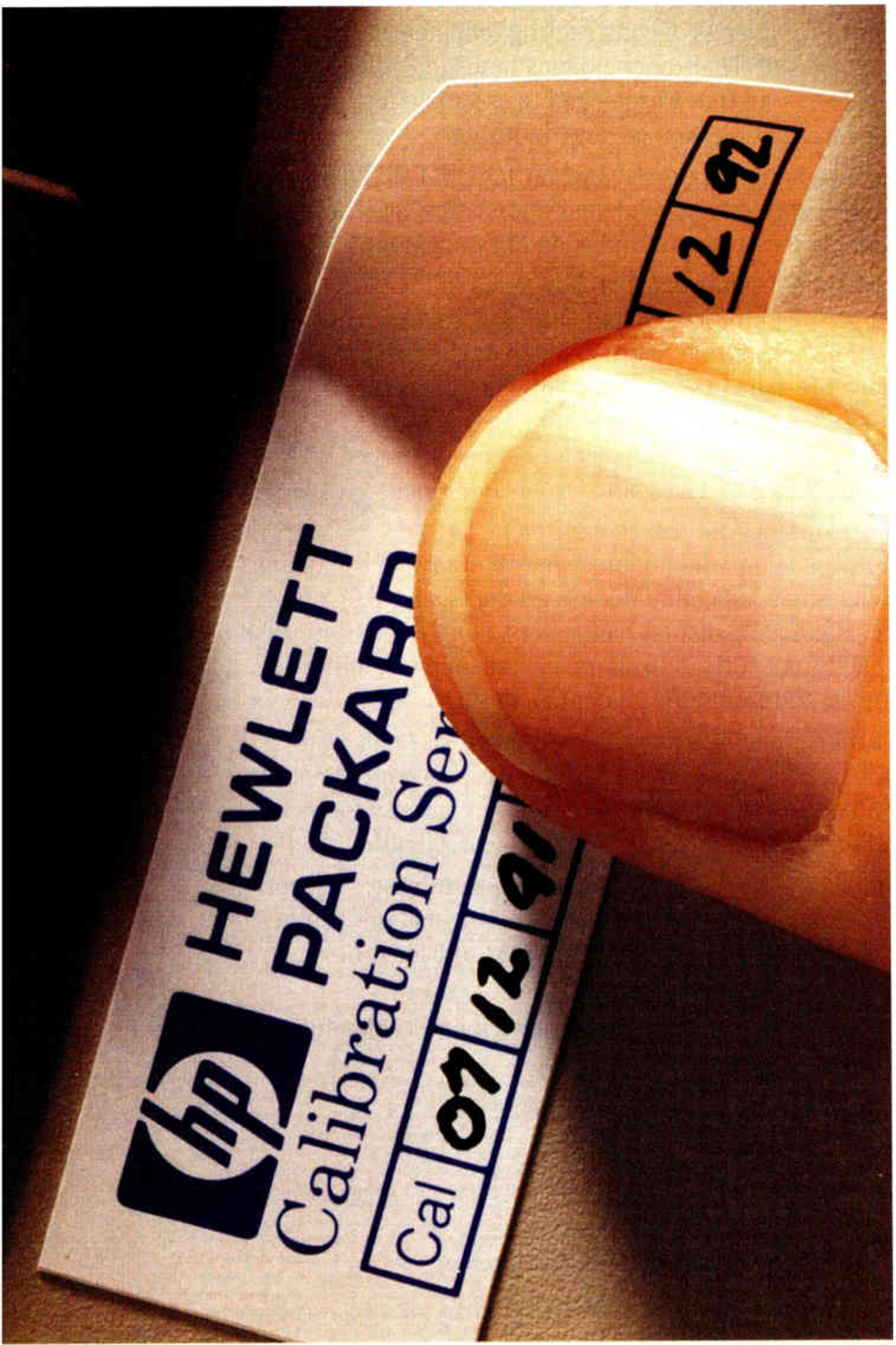

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AMID SUNTAN LOTION AND BEACHWEAR SIT DEC AND IBM

A HEAVENLY SPOT FOR ELECTRONICS

BY ANDREW ROSENBAUM

Working in Sophia Antipolis is almost like working in heaven. The blue waters of the French Riviera, only 6 miles away, are easily visible from the hills in which the technology park is nestled, and even in winter being there feels like a vacation. You can't actually watch the topless bathers at nearby Cap d'Antibes from the windows of an office at Sophia Antipolis, but you can see the water, and there are little shops that sell suntan lotion and beachwear in the arcades outside the company buildings.

Sophia Antipolis—the name is Greek and means literally "city of wisdom near Antibes"—hosts a unique concentration of electronics companies, and is becoming an increasingly popular site for American electronics producers seeking a foothold in fortress Europe before 1992. Digital Equipment Corp. has just established its worldwide Telecommunications Business Group in the park; IBM Corp. has its most important European telecommunications laboratory nearby; Texas Instruments Inc., which has just created a holding for its European operations, is moving its newly elected board members there.

Sophia won't accept large-scale manufacturers; general manager Gerard Passera says the park recently turned down offers from two Japanese consumer electronics makers to build factories there. Sophia successfully attracts research and development, telecommunications, software, and specialized manufacturing. "This is a good place to get away from the day-to-day operations and do some thinking," says Stan Smits, group development manager for telecom engineering at DEC.

About 100 companies a year agree with Smits and move to the technology park, despite the relatively low level of regional aids available. For example, Ireland will pay an electronics company $30,000 per job created to bring its operations to the region; the area in which Sophia is located pays a mere $6,000. Nevertheless, Sophia continues to grow about twice as fast as the Western Irish seaboard. The low price for office space—about $6.50/ft²—obviously is attractive as well.

"And it's no problem recruiting executives, even in a country with a severe shortage of engineers," says Yves Saboret, software support manager of VLSI Technology Inc.'s European research center at Sophia. That is extraordinary given that housing costs are among the highest in France. In fact, going out for a pizza at Sophia costs a couple $50. "Life is not cheap on the Cote d'Azur," complains DEC spokesman Jean-Pierre Bourbon, "but that doesn't keep people away." The University of Nice has grown with the technology park, and its engineering department is now located there.

Small electronics manufacturers find good logistics and good support at Sophia, though they say the site is not without its drawbacks. Bruno Pagliuca started the European operations at Sophia four years ago for Poquet Computer International, the California-based maker of a 1-lb, battery-operated portable PC. "Being at Sophia was very important for logistical reasons," says Pagliuca. "I was able to find the support I needed, and it was easy to establish a rapport with engineers at the other companies located here." Pagliuca says that he started a joint venture with DEC, which was crucial to the development of Poquet in Europe, during occasional meetings with engineers at that company's Sophia headquarters.

But Pagliuca, like many others at Sophia, complains that there is not enough communication among the various companies. "Our first clients were not found here," he says. "Companies at Sophia don't interact very much." Philippe Noel, technical director of Nouvelle Technologies Industrielles, an eight-person producer of hybrid components, agrees. "We do a lot of work for Thomson [of France], but not the one located in the park," he says. "We don't even talk to the Thomson office here." But both say that the potential for making contacts is considerable.

Telecommunications has been the prinicipal motor driving Sophia Antipolis. "Since the war, IBM has preferred

Starting from the hill in the foreground, that's the Texas Instruments plant, Cap d'Antibes, and the bright, blue Mediterranean.

SMallTalk.

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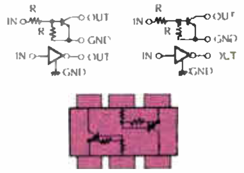

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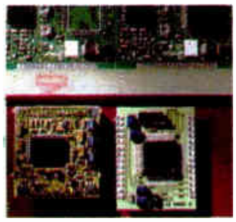

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CIRCLE 178

France for its telecom research, because the field is highly developed here," explains IBM laboratory director Maurice Lacombe. In 1962, the government obliged many large companies to locate away from Paris to develop other regions. IBM picked a tiny town on a hilltop overlooking the Mediterranean called La Gaude for its telecom laboratory. It is now about 6 miles from Sophia.

"We needed a site that was willing to upgrade its public network to a level we could work with," says Lacombe (at the time France did not have the modern network it has today). The area was willing to make the investment. "And we needed a site close to a full-size international airport." Thanks to its tourist trade, Nice offered that as well.

Today the IBM laboratory develops communications controllers and networking technology at La Gaude, employing about 200 people. Big Blue also helped to build up the area, working with the University of Nice in engineering, and attracting satellite companies. Lacombe says about 150 small companies do work for the telecom lab today.

> **THE TELECOM AND NEARBY INTERNATIONAL AIRPORT ARE WHAT ATTRACTED TI AND IBM TO THE SOPHIA ANTIPOLIS AREA**

The international airport and the good telecommunications also attracted TI to the site, at about the same time and for the same reasons as IBM. TI still makes chips outside Nice, but the decision to locate the new European holding at Villeneuve Loubet, about 3 miles from Sophia, had a lot to do with the technology park. "There is a good climate here for electronics," is how a TI spokesman sums it up.

Despite the climate, one thing everyone complains about at Sophia is the traffic. The technology park has grown so rapidly that the region has not been able to improve the infrastructure quickly enough. "There are tremendous traffic jams every morning when people come to work," says DEC's Smits. And at the IBM laboratory, which is reached via a mountain road barely wide enough to allow two goats to pass, traffic backs up right to the highway. Competing tourist traffic doesn't help.

But most executives who work there seem willing to accept these drawbacks. It seems that although it's not a major city, there's never any problem luring clients to Sophia to look at products. ❑

Zilog's contributions

To the editor: "The 82532: a chip for all seasons" (February 1991, p. 58) inaccurately characterizes Zilog's notable contributions to the data communications industry with its 8530 SCC and 16C30 USC families of serial controllers. It also implies that a competitive 10-Mbit/s serial communications controller is a new achievement when it is a late arrival, following Zilog's introduction of the 16C30 in 1989.

Zilog designed, licensed, and developed the market for the industry-standard SCC 8530 10 years ago. It then licensed alternative sources such as AMD, Intel, SGS-Thomson, and Sharp. The industry has also seen the introduction of several copies of the Zilog SCC that use the same register-level architecture base.

Zilog has developed the broadest range of serial communication controllers in the industry; the latest offers 10-to-20 Mbit/s performance.

Siemens's 82532, far from leading the industry, will compete against the Zilog 16C30, which has won many followers in the last two years. In the 16C30 there are [many] features that are not surpassed by the Siemens 82532. And Zilog has been shipping for two years while samples of the Siemens part are just now available.

Michael B. Hulme
Director
Datacom Product Line
Zilog Inc.

A BOOST FOR HARD CARDS?

What's needed to light a fire under the smart card market is the right 8-bit microcontroller, one that's loaded with programmable read-only memory. That's what the people at the Semiconductor & IC Division of Hitachi America Ltd. believe, and they are also convinced that they have just what the market ordered.

They're not exactly attacking a virgin territory: there are about 30 suppliers. In 1989, Hitachi shipped 460 million units worldwide worth $1.9 billion. The leader by far is Motorola Inc., followed by NEC, Intel, and Mitsubishi. Hitachi ranks fifth.

So the Hitachi division, based in Brisbane, Calif., knew it needed a pretty good mousetrap if it hopes to create a traffic jam at its door. Enter the H8/310, a member of the new H8/300 family. Hitachi bills its 8 Kbytes of on-board EEPROM as the most in the industry, and points also to its write/erase inhibit function, which guards against accidental writing or erasing. Also, to protect against unauthorized ROM access, all memory, CPU, and peripheral functions are integrated on a single chip.

The other members of the H8/300 family are the 350 servo-positioning controller; the 320 and 330 series of general-purpose controllers; and the 310 smart-card controller. Besides real-time jobs, the controllers are aimed at office automation and mobile communication. ❑

THE TOP 10 IN 8-BIT MICROCONTROLLERS

Motorola	Philips
NEC	Signetics
Intel	SGS-Thomson
Mitsubishi	Siemens
Hitachi	Matsushita

SOURCE: DATAQUEST INC.

HUNTING A WAVE? HERE COME PCNs

For all you budding entrepreneurs, one expert's advice is to take a long, hard look at the prospects for wireless personal communications networks, or PCNs.

According to venture capitalist John W. Bayless of SRB Management Co. in Dallas, "Wireless personal communications networks, and the mobility and speed that they offer, will be the next technological wave, although that wave is still four or five years away."

What's holding things up, says Bayless, is a lack of standards and frequencies. "However," he adds, 'it's encouraging to see that there will be an allocation in the 200-MHz portion, with 2 MHz taken from hams and given to PCN."

Bayless believes that first meaningful activity in the PCN marketplace will be in wireless private branch exchanges and then the technology will percolate downward from there. ❑

CHALK UP ONE APIECE IN THE CMOS-BICMOS CONTEST

The battle for technology supremacy between CMOS and BiCMOS heated up as LSI Logic Inc. in San Jose, Calif., rolled out its CMOS LCA200K Compacted Array Turbo, Cypress Semiconductor Corp. of San Jose unveiled four biCMOS programmable logic devices, and Texas Instruments Inc. of Dallas announced availability of its latest BiCMOS gate array.

LSI Logic has opted to stay with CMOS and push for the next level of process technology in its newest LCA200K family of gate arrays. Not only is the device denser—20,000 to 200,000 usable gates out of a maximum of 307,000—but it is fast, says John Daane, product line manager. The device provides a 25% to 30% performance boost over LSI's LCA100K.

The Cypress quartet of address-decoder PLDs are intended for high-speed systems with clock rates up to 50 MHz. Sporting 12 inputs and eight outputs, the single-chip devices propagate in 6 or 7 ns; in contrast, designers up to now have been forced to use 10-to-12-ns two-chip solutions. Even the fastest general-purpose field-programmable model of equal complexity—also from Cypress—has a propagation delay of 7.5 ns.

The TI TGB1000 family, which numbers seven parts, includes a 150,000-gate device with 75% utilization [*Electronics*, December 1990, p.48]. It uses 0.8-µm features and is made with a triple-layer-metal process. ❑

DATA GENERAL: BLACK INK AND BRIGHTER DAYS

There's light at the end of the tunnel for Data General Corp. The Westboro, Mass., computer manufacturer, one of the industry pioneers, has turned a quarterly profit for the first time in ages, and is looking to some impressive new systems to contribute more black ink.

After five unprofitable years [*Electronics*, February 1991, p. 19], Data General broke into the black in the first quarter of fiscal 1991, with net income of $12.4 million on revenues of some $312 million. That compares with a loss of $21 million on revenues of $290 million in last year's first quarter.

The new products are high-end Aviion family members unveiled in mid-March. They extend those reduced-instruction-set-computing systems from a $3,995 desktop workstation that delivers 17 million instructions/s to a level of 117 mips at about $105,000 for one of the new machines.

The AV 7000 and 8000 use a new central processor board housing four 25-MHz Motorola 88100 RISC chips—a board that's also available as an upgrade to the users of existing AV 5000 and 6000 systems. ❑

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intel

CIRCLE 185

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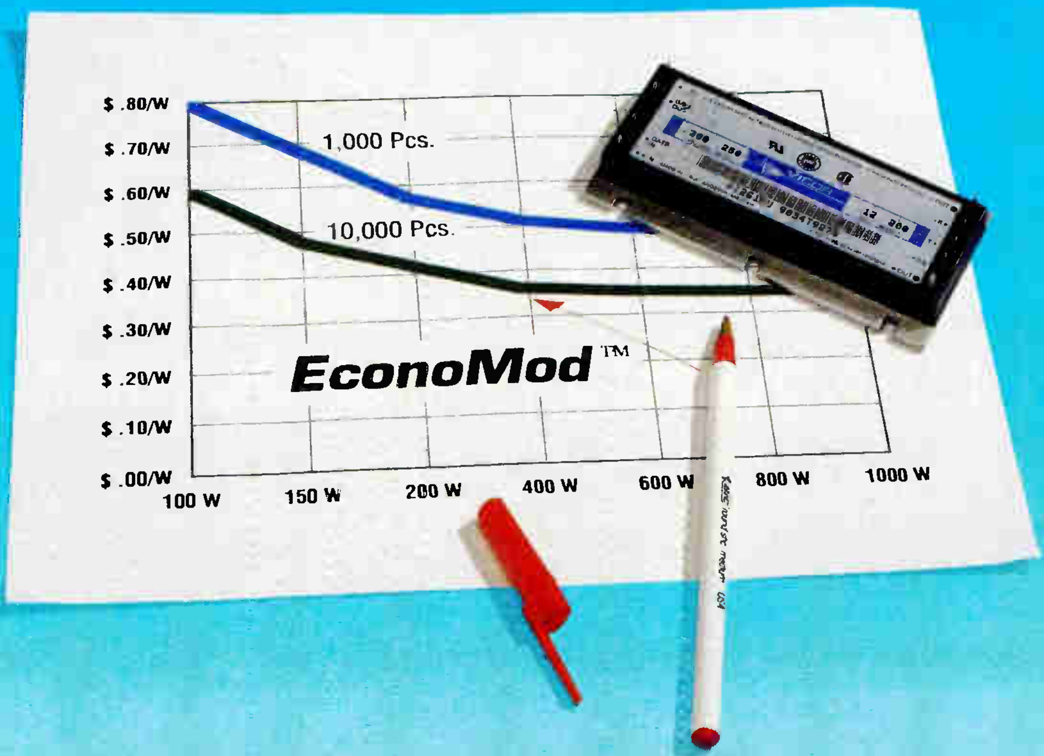

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Component Solutions For Your Power System

CIRCLE 175

IBM CLAIMS DESKTOP GRAPHICS LEAD

The latest news on IBM Corp.'s RISC System/6000 workstation line leaves little doubt that Big Blue is dead serious about taking the market-share lead in workstations by 1993.

For starters, IBM is claiming the price/performance lead in desktop 3-d graphics. By enhancing its PowerStation 320 with the PowerGraphics GTO accelerator, the 320 delivers 990,000 three-dimensional vectors/s for $53,152. That's double the performance of a comparably priced Sun Microsystems product, says the Armonk, N.Y., company. Until last month, PowerGraphics GTO was available only on the RS/6000's 5XX series deskside machines.

The RS/6000 model 320 desktop workstation now renders 3-d graphics at a rate of almost 1 million vectors/s.

IBM has also beefed up the 320 with a 25-MHz processor. At the high end, the rack-mountable PowerServer 950 gets a 41-MHz processor.

Providing granularity for the RS/6000 is a key to IBM's workstation strategy (see p. 43). At the low end, for example, maximum memory has gone from 32 to 126 Mbytes since 1990 while storage has jumped from 640 to 800 Mbytes. Similar leaps are true for rack-mounted platforms, which grew to 512 Mbytes memory and 25.2 megaflops performance. ❑

MOTOROLA'S FDDI CHIP SET CUTS THE GLUE-LOGIC CHIP COUNT

Motorola Inc.'s long-awaited chip set implementing the Fiber Distributed Data Interface has landed, sporting more functionality than the competition and a low price.

Besides just executing the FDDI protocols, Motorola's four-chip set includes circuit modules that deliver lower part counts in key applications, say executives at the company's Austin, Texas, design facility. For example, an embedded pulse-code-modulation state machine cuts the glue logic needed to design a concentrator. Similarly, an on-chip stripping algorithm for reverse bit ordering of addresses makes implementing a bridge less costly.

Station management software codeveloped by Digital Equipment Corp. is also available. The chip set costs $300 in 100-unit purchases. ❑

AMD'S 40-MHz 386 INCLUDES SLEEP MODE

Advanced Micro Devices Inc. has now begun volume shipments of a 40-MHz version of its Am386 microprocessor family.

A low-power version of the Sunnyvale, Calif., company's chip—the Am386DXL—is aimed at the notebook computer market. In sleep mode, the device consumes less than 1 mA, compared with the current minimum of 133 mA for Intel Corp.'s chip.

The Am386DXL comes in four clock speeds: 20, 25, 33, and 40 MHz. The companion Am386DX, which does not include sleep-mode circuitry, comes in 20-, 25-, and 33-MHz versions.

The 40-MHz Am386DXL is priced at $306 each in 100-unit quantities. The other chips are available only to original equipment manufacturers and do not have published pricing. ❑

MATROX DELIVERS MORE CAD PUNCH ON PCs

A new graphics controller board from Matrox Electronic Systems Ltd. brings workstation performance to personal computers used in CAD applications.

The Dorval, Canada, company's board uses two Matrox-designed ASICs and a Texas Instruments Inc. TMS320C30 DSP to draw 250,000 two-dimensional vectors/s (150,000 in 3-d) or 20,000 3-d Gouraud-shaded polygons/s for AutoCAD and other design packages. Matrox says the nearest competitor's $5,700 board draws 10,000 polygons/s. The Matrox MG-3D Ultra for the EISA is priced at $5,995; the MG-3D (PC/AT) is $3,495. ❑

EXPERT SOFTWARE CHECKS QUOTES

System integrators who set up process or manufacturing control systems can get a leg up on the competition with an expert system program from Allen-Bradley Co.

The Abecos program helps prepare quotes for systems built around the Milwaukee company's line of programmable controllers. Running on an IBM Corp. personal computer, the package graphically builds a system from a data base of input/output modules, processors, racks, and related components. It is smart enough to warn users when they are specifying I/O, for example, that exceeds the physical limits of the chassis or the electrical current capabilities of the selected power supply. It also helps match the response time of the control system to design requirements. Users can export results to CAD programs. ❑

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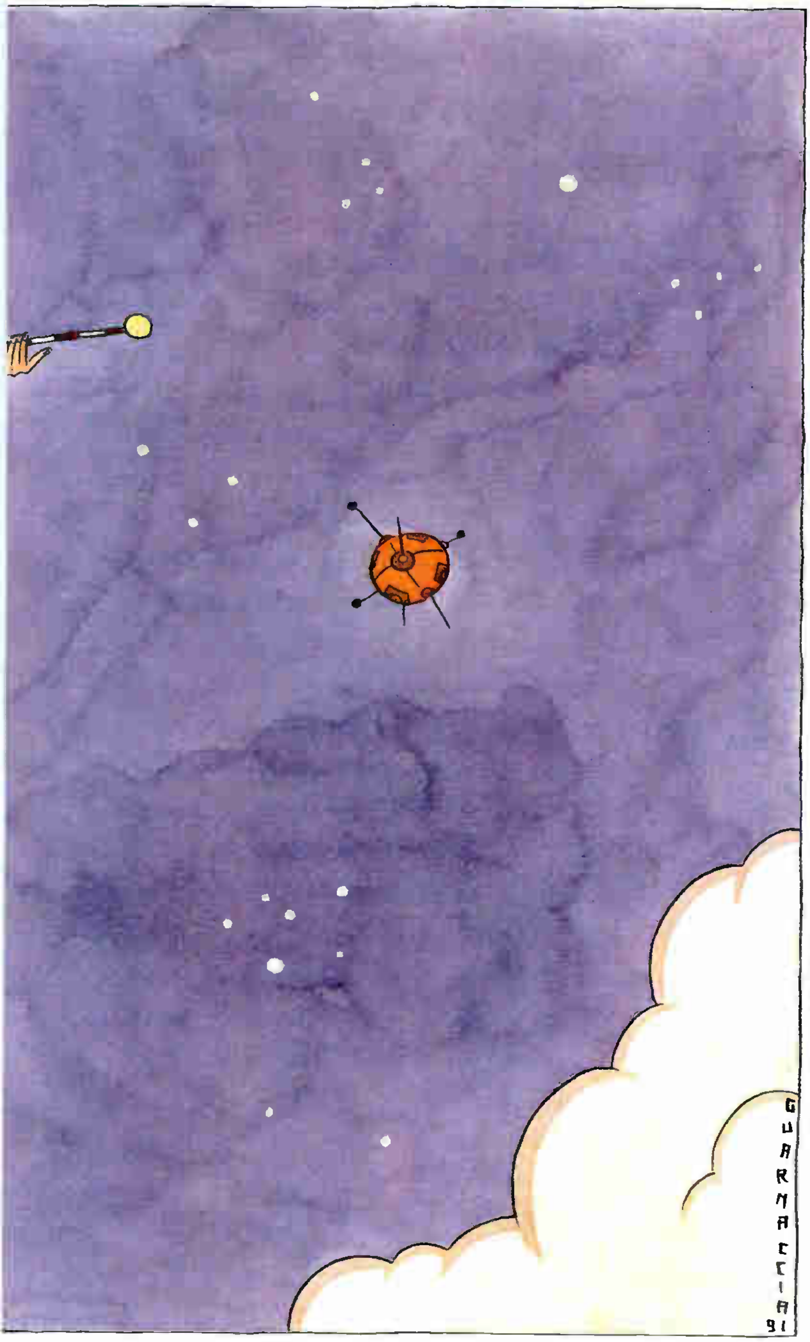

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CIRCLE 219

SHRINKING A POWER-LINE COMMUNICATIONS MODULE OPENS A VAST NEW MARKET

METER-READING SOLUTION

BY LAWRENCE CURRAN

DATACOM

Utility companies have long yearned for the day when computers could read their meters remotely and automatically. But the high cost of technology and little interest on the part of a regulated AT&T slowed progress. Now, however, with regional Bell operating companies looking for new income and the cost of the electronics dropping, component makers are paying more attention to the market.

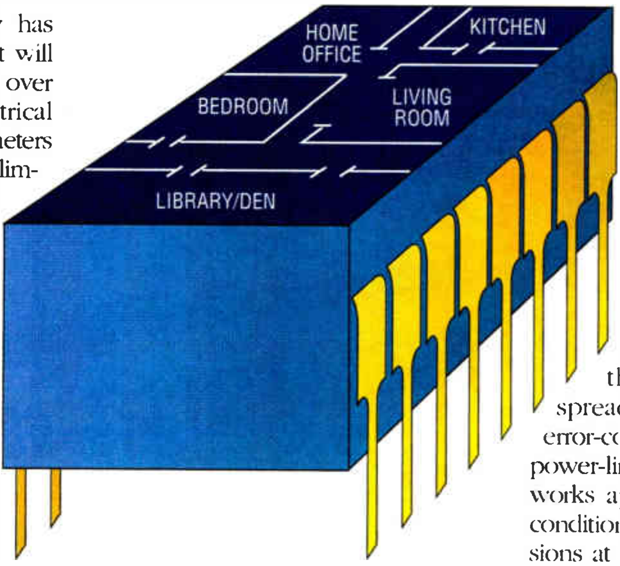
Now a Boston-area company has come up with a two-chip set that will make the idea of moving signals over existing alternating-current electrical wiring more attractive for use in meters and other equipment where space limitations and economy are pressing requirements.

Adaptive Networks Inc. is replacing dozens of components in its present power-line-network communications module with the two CMOS devices—a processor that handles the International Standards Organization's physical layer, and a combined data-link-layer and application processor. Thanks to the chips, Adaptive Networks will be able to shrink the module and crack a lucrative market in electric utility meters that by itself could result in sales of hundreds of thousands of chip sets per year, says company president Michael Propp.

The meter application presents tight space restrictions that prompted Adaptive Networks to undertake development of the chip set, with the help of two design houses; two separate foundries are fabricating the devices. Propp expects to see first silicon in May or June, followed by customer samples in July or August.

One customer that's already counting on the chips is Domestic Automation Co. of San Carlos, Calif., which supplies electronic data registers used by manufacturers of standard watt-hour meters for time-of-use metering and load management. The company will use the chips to collect data over standard building wiring on the home side of the distribution transformer, then transmit it long distance on demand to the electric utility.

Larsh Johnson, vice president of product development at Domestic Automation, foresees a rich potential for the chip set. His company has installed more than 140,000 data registers in meters to date. But about 5 million meters are installed each year in the U.S., and some 110 million are in use overall—all of them candidates for retrofitting with time-of-use data monitors.



Meters aren't the only application Adaptive Networks is serving. Propp says power-line communication has also caught on in security systems for buildings, industrial data acquisition and control, networked point-of-sale systems, and shipboard communications.

Adaptive Networks is supplying its current AN192 module, which it will continue to manufacture, for several of these markets. For example, in January of last year, the firm's technology was selected as an ISO standard for remote condition monitoring of refrigerated freight containers. The first installation of this system was made last August on two Chiquita Brands banana ships. Propp says that Adaptive Networks this year will ship 3,000 modules to the company in Denmark that provides refrigeration controllers to Chiquita's container manufacturer.

The circuitry for the 3-by-5-in. AN192 module includes a transmitter/receiver, analog signal-processing section, and digital signal-processing/network section. The two signal-processing sections are separate in the AN192 but are being integrated into one chip in the new set—the physical-layer processor. In fact, the analog section alone in the AN192 comprises some 12 integrated circuits, along with about 60 discrete components.

The chip set will implement the same features as the module. That concept uses spread-spectrum techniques to transmit low-wattage signals over existing 120-V ac lines in homes or offices, or 460-V ac power bars in industrial buildings. To do so, Propp developed a worst-case model of the power-line environment, then designed proprietary spread-spectrum modulation and error-control coding to compensate for power-line noise. The Adaptive Networks approach adapts to power-line conditions, concentrating data transmissions at those frequencies between 50 and 450 KHz that are momentarily free of noise.

Propp says the physical-layer processor will perform the spread-spectrum modulation and demodulation, plus the required adaptive synchronization and equalization. The data-link-layer processor, which includes a 65CO2 central processor plus random-access and read-only memory, provides noise immunity. In addition, the processor accommodates the token-passing protocol employed in the Adaptive Networks approach.

Propp says the chip set will sell in a range from "single-digit numbers in large-volume consumer applications to perhaps $50 in lower volumes." ❑

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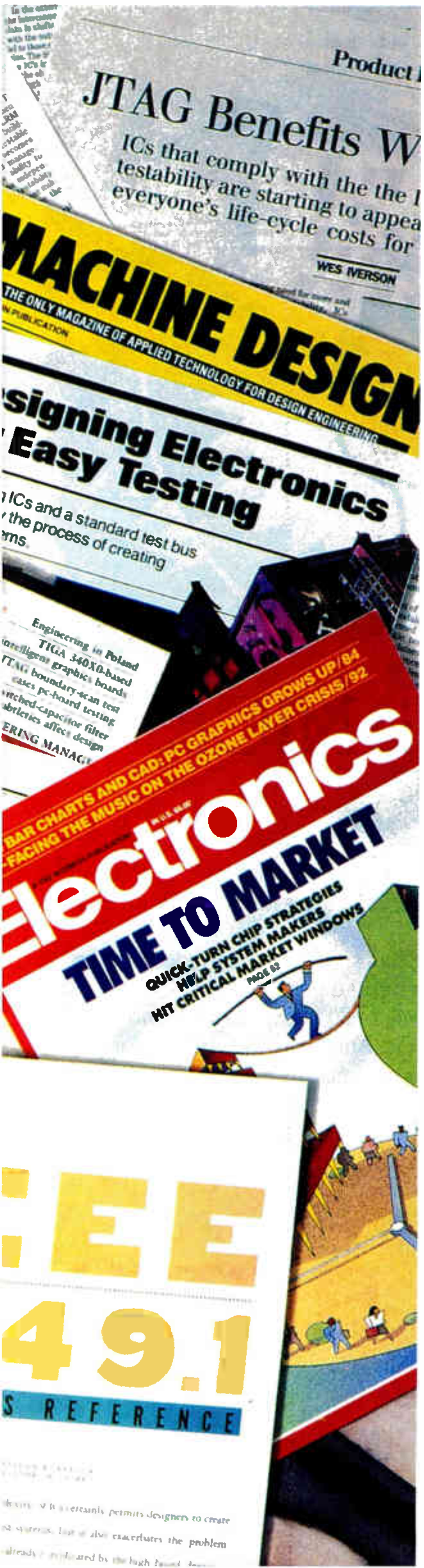

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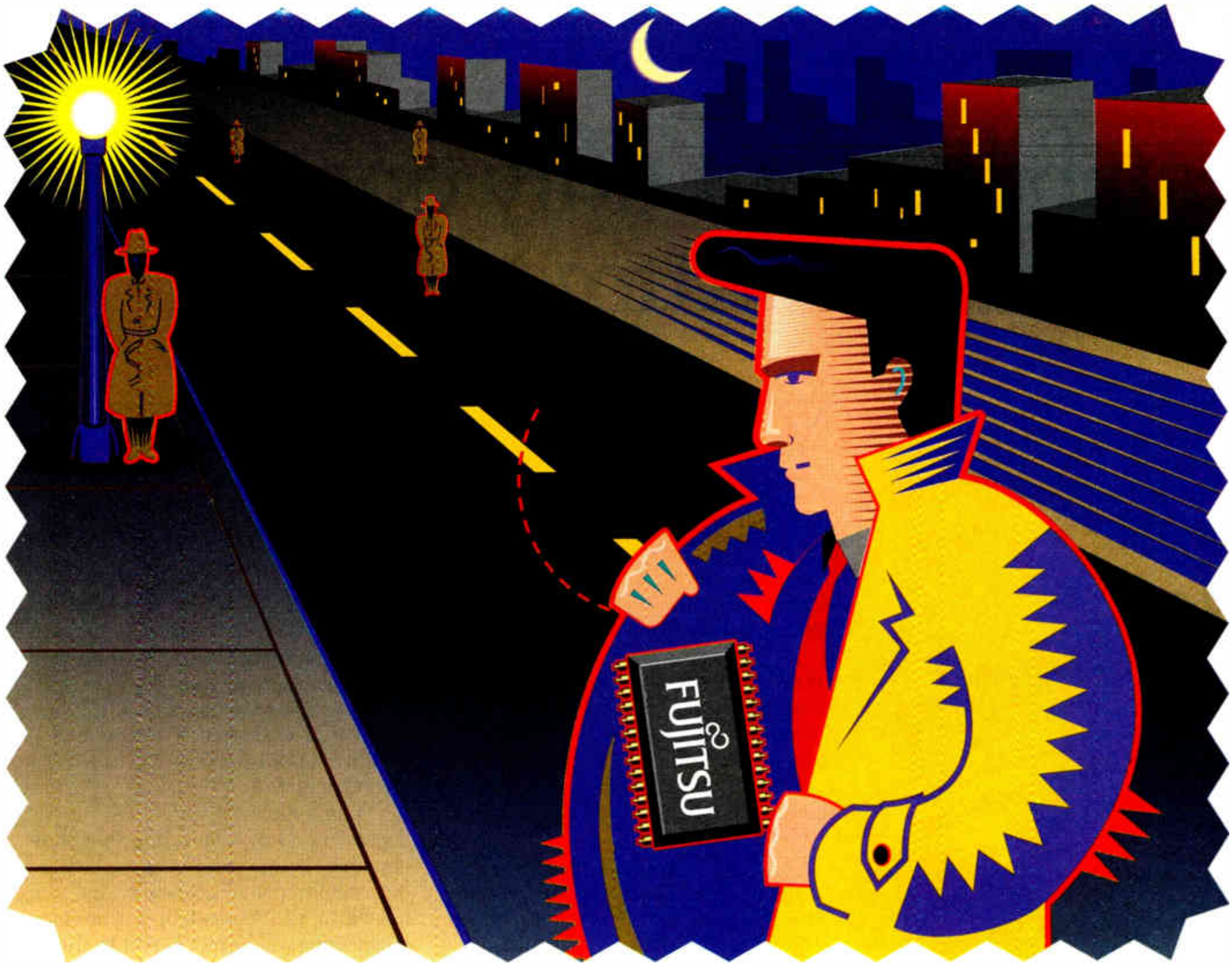

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TO BEAT ITS COMPETITORS TO THE PUNCH, ANALOG DEVICES SUPPLANTS A STANDARD

STAYING ON TOP

DATA CONVERTERS

BY LAWRENCE CURRAN

How do you protect your turf when your product is the standard in its field and your company still does a thriving business with that component? If you're management at Analog Devices Inc., you market a successor to that part before any competitor can, locking up a leading market share well into the future. The new product is the AD1674, a 12-bit analog-to-digital converter that will supplant the Norwood, Mass., firm's industry standard AD574 and later AD674, which have been second-sourced by at least nine other companies since the 574 appeared in 1980.

The new device, unveiled in mid-March, is pin-compatible with its predecessor, but it's faster and cheaper. That will prompt many customers to choose it instead of the older unit, which means it will effectively curtail the product life of the 574.

And that's precisely what Analog Devices wants. William Riedel, product marketing manager for high-resolution ADCs, says that the new converter "no doubt will take some of that [574/674] business away—from us and from other companies." However, he adds, "It was just a matter of time before someone came along with something like the 1674, so it just makes a lot of sense for us to do it first to maintain our market leadership."

For his part, Gary Grandbois says the 1674 "may indeed become the new industry standard." Grandbois is senior industry analyst for analog ICs at Dataquest Inc., the San Jose, Calif., market research firm. Analog Devices "has to be pretty excited" about the converter, he says. "They've been the leaders in data converters and they obviously want to stay ahead of the competition. They're not resting on their laurels, and that's a good strategy."

Riedel says the new device is the only 12-bit converter with this 28-pin footprint that includes an integrated wide-bandwidth sample-and-hold amplifier (SHA). That feature alone eliminates the need for a separate SHA, which is often placed ahead of the ADC in a system. Even with the SHA, the 1674 still is guaranteed to deliver 100,000 samples per second at a 10-µs conversion rate.

The patented SHA design overcomes problems associated with earlier attempts to include a sampling input, Riedel maintains. Those were either limited-performance capacitive designs or complex approaches that made them too costly. This one has a fully functioning sampling input with an acquisition time of 1 µs and a 1-MHz bandwidth.

Riedel says that makes the unit as much as four times faster than the nonsampling converters it replaces when comparing it to some versions of the 574 that have a 35-µs conversion time, than adding 2 to 5 µs for the SHA function associated with those parts. A plastic-packaged version of the 1674 will sell for $18 each in quantities of 100. The lowest price being quoted for a plastic-housed AD674B is $26 each in hundreds of units.

Products such as the 1674 have caused Analog Devices to alter its marketing approach for new devices. Instead of its design engineers talking only to a customer's design engineers to find out what's needed in a new part, the contact also includes conversations with the customer's engineering-management and purchasing-management teams to learn their needs.

Says Riedel, "We don't design in a vacuum to add performance now. We ask what the additional performance will do to the customer's business." For example, "Our sales engineers may visit the customer's production line and purchasing department to find out how a new part can help the customer standardize," Riedel says. In the case of the 1674, which sells for less than both the 574 and 674, its availability "may allow customers to stock one part instead of two because many of them use both" of the earlier parts, Riedel says. ❑

AUTOMATION THE KEY TO COMPETITIVENESS

ITT STAYS ONSHORE

BY JOHN GOSCH

COMPONENTS

If a company makes such lowly devices as diodes in a high-wage country, competes against cheap imports from the Far East, and still generates profits, it must be doing something special. That's the case with the ITT Semiconductors Group in Freiburg, Germany; and its strategy is simply—you guessed it—automation.

Automating production processes is standard in the industry. But at ITT, it's an article of faith, a production philosophy carried to its extreme.

Diodes are the latest products to get the all-out automation treatment. At ITT's plant in Colmar, France, each of three parallel production lines puts out 100,000 to 200,000 units/hr, depending on type. Each is manned by only seven people, who perform mainly supervisory functions. That, says Günter Schmitt, director for discrete semiconductors, is "among the industry's most productive."

But volume without quality is unacceptable, so production and test equipment made in house ensures high average quality and optimum performance characteristics, as well as offering statistical control at each process step. This means optimum reproducibility—parameters, quality, and performance are the same for device after device.

ITT's policy of making its wares at home, rather than offshore, runs counter to what most semiconductor firms are doing. Highly efficient production cancels out the low-salary advantage of offshore plants, logistics costs are low—Colmar, just across the German-French border, is only a few miles from headquarters in Freiburg. Furthermore, the parts are made where they are needed most: in Europe, close to ITT's biggest customers.

The result of all this is that ITT is Europe's biggest—and, according to

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CIRCLE 208

Schmitt, most profitable—diode manufacturer, turning out 3 billion such devices a year. Globally, it ranks No. 2, behind Japan's Rohm. As for types of diodes, ITT is among the world's top three producers of glass-encapsulated versions. In ITT's device lineup are zener diodes, Schottky diodes, tuner diodes, and many others. Each family in turn encompasses devices with different sets of parameters.

Production equipment is made in house because suitable machines are not available or do not meet ITT's throughput and quality requirements. The Colmar plant uses wafers from the Freiburg facilities. In a class-1000 clean room, the diodes are assembled and then, for encapsulation, put through one of four furnaces, each with a capacity of 200,000 units/hr. ITT plans to install a fifth furnace that will have twice that capacity.

After cleaning and tinning, the diodes are transported to what the company calls the "turbo machine," a system that is the basis for the automatic handling, testing, marking, and finishing operations. In the turbo machine, all parameters are checked out on 100 diodes at a time, a process that takes only a few seconds. Finally, the diodes are put in 15,000-unit boxes. ❑

EUROPEANS SHOPPING AWAY FROM HOME

A WINDOW FOR THE U.S.

BY ANDREW ROSENBAUM

SYSTEMS INTEGRATION

Computer purchasers in Europe are finally starting to get smart about suppliers—they are discovering systems integration. And that is creating an opportunity for Americans.

Computer customers in most European countries traditionally have turned to their national supplier when they needed a computer system. But now customers are starting to realize that after Europe forms a single internal market at the end of next year, these so-called national champions—such as Olivetti in Italy, Bull in France, or Siemens in Germany—no longer offer the sole solution. Nor do they feel obliged to turn to IBM Corp. as the only alternative.

The result: the systems integration business is growing at an incredible clip in Europe. It is fueled by a demand for computers that is growing far faster than that of the U.S. Clients are actively looking for the best deals their money can buy, rather than going straight to the traditional national supplier.

The good news for U.S. competitors is that even as systems integration is the fastest-growing area in European information technology, it is also the market most open to foreign competition.

"The systems integration market was worth about $4 billion in 1988," says Dennis Exton, a computer industry analyst with the Merrill Lynch stock brokerage in London. "I expect it to be at about $25 billion in the mid-1990s."

Exton says, there is room for foreign competitors. "This may be one of the last areas where foreigners still have a chance," he says. That's because a systems integrator looks for the best equipment and software available to perform a specific function—no matter who makes it "A systems integrator has to supply more service value than hardware value," says Gareth Cadwallader, managing director of the Paris-based International Computer Group BV, Europe's largest integration specialist. "The big companies supply their own boxes, and set up the system. We supply the boxes that we feel the company needs, and set up the system."

Systems integrators say that they supply more than 50% of know-how in a given system, more than the value of the hardware supplied. "Less than that is just hardware and installation," says Cadwallader, "and more than that puts you in Arthur Andersen country," speaking of the leading consultant for major corporations.

As their business grows, systems integrators are also building up clout with computer manufacturers. ICG now supplies about 17% of all the IBM machines sold in France, by furnishing either full-scale facilities management or just the initial work. The company has been growing at about 20% a year, and now boasts about $2 billion in annual sales. It can count on three or four more years of fast growth, analysts say.

European companies have a greater need for systems integration than U.S. firms. "Firstly, there is a greater need to improve systems supplied by the European 'national champion.'" Exton explains. "Now European companies want to take advantage of a wider range of applications. The systems integrator can provide them."

But labor costs are an equally important factor. "There is no clearly defined career path for the person who runs the computer system in Europe," Cadwallader points out. "It is much harder to move from one company to another here. These people lose their motivation, and are known to become a burden for European companies."

The systems integrator solves both of these problems. It has no ties with the national supplier, and thus can provide the customer with the necessary solutions, regardless of the supplier. And the integrator works under contract, so the client is not saddled with the heavy European labor costs that it would face if it hired a manager.

While this new market is open to foreigners, analysts say, success depends on the ability to provide highly specialized advice. This is why European sytems integrators tend to evolve out of a number of specialized companies. ICG was formed in 1989 from an alliance of the UK's leading systems integrator, Computacenter, CompuNet Computer AG in Germany, and Random France SA.

Another highly successful systems integrator, the Stockholm-based Group Enator, united more than 20 specialized consulting firms in every business field, "from insurance to machine tools," as the group spokesman puts it. Enator has built up $500 million in sales with clients throughout Scandinavia. Like other systems integrators, Enator can draw on its varied expertise to provide the package the client is looking for. "That is the ideal strength of a systems integrator," says Exton, "to provide the client with the best-defined solution."

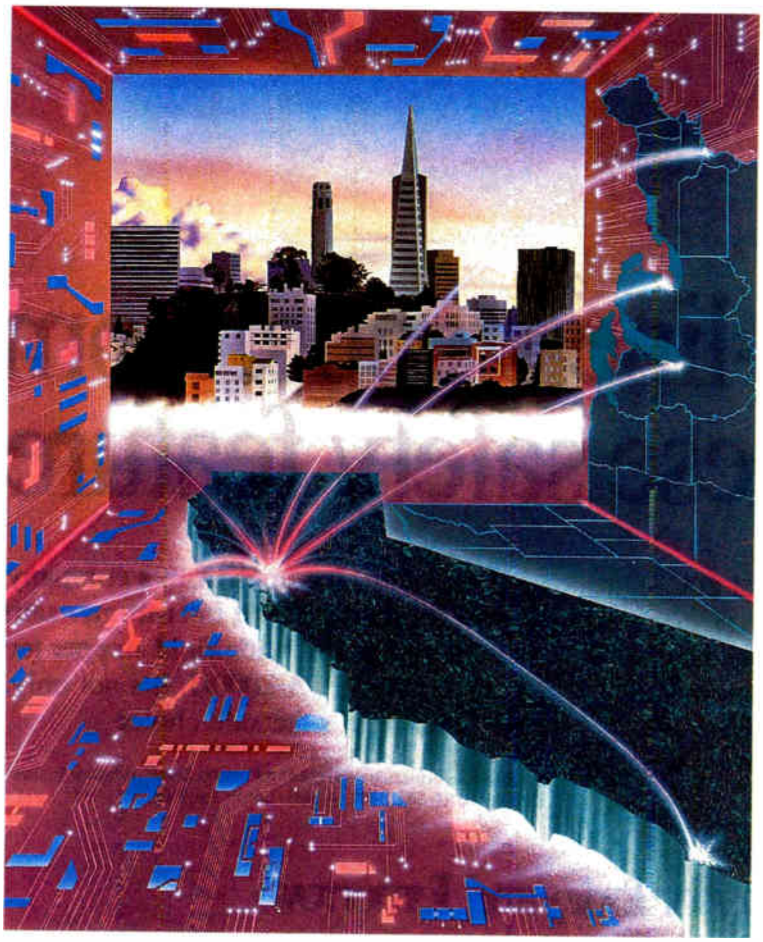
Enator, like ICG, places about 20% of the IBM boxes sold in Scandinavia. Also like ICG, it is basing its strategy on full-scale facilities management. "This provides an additional responsibility to systems integrators," comments Exton. "Companies that provide facilities management are wholly answerable for the operation of the system. You have to be prepared to put in a lot of time for facilities management," Exton adds.

ICG manager Cadwallader admits that there are limits to the possible growth of a systems integrator in Europe. "Because of the high degree of specialization in the field, you reach the largest client base in a relatively short period. We are probably already working with most of our potential clients, and that means that we expect growth to fall to reach a mean level of about 10% in the next five years."

All of which means that the field is open for competitors with different kinds of specialization. "The main thing is to be able to enter the market and compete," says Exton. ❑

SEMICON 1991

- BUILDING SUCCESS ON AUTOMATION AND SERVICE
- FORGING GLOBAL PARTNERSHIPS
- NOVEL SOLUTIONS TO TECHNICAL TOUGH NUTS



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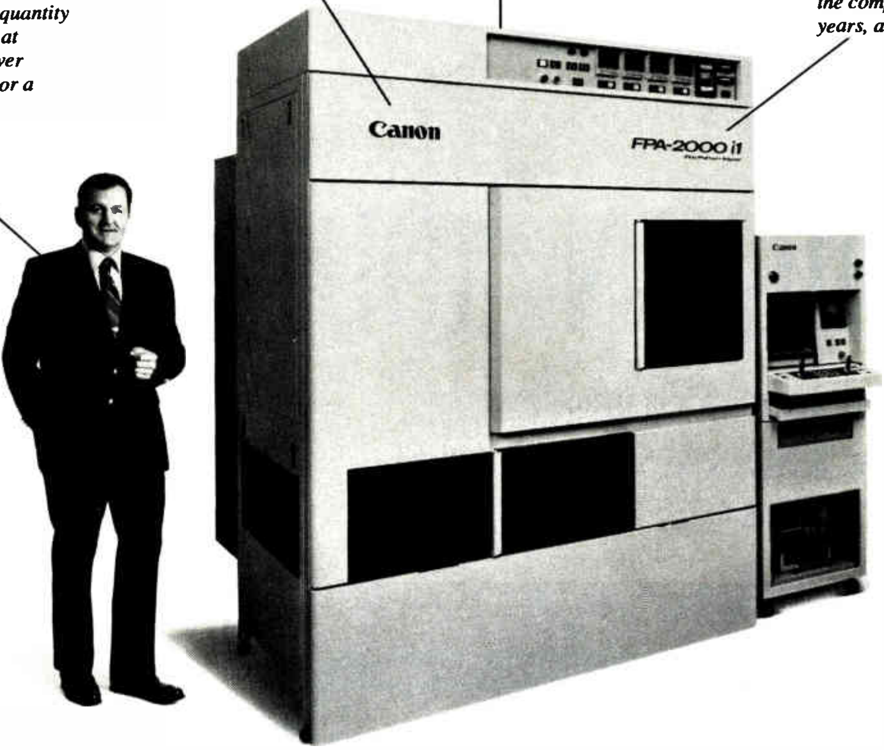

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CIRCLE 187

Keys to Success: Automation and Service

Equipment vendors seek a cluster-tool standard and a new definition of customer service

Vendors of semiconductor production equipment are preoccupied these days with two significant trends that are making a big impact on this $20 billion-a-year industry: the drive toward a greater degree of automation and the effort to improve customer service. The potential benefits of automation include higher productivity, lower cost per wafer, and improved quality. Customer service improvements lead directly to greater market share and more directed product development.

STANDARDS

In automation, a major thrust is toward environmentally isolated cluster, or modular, tools. The Semiconductor Equipment and Materials International (SEMI), with headquarters in Mountain View, Calif., is working on an approach to cluster tools through its Modular Equipment Standards Architecture.

MESA's goal is to let users tie together equipment from various manufacturers under a single central handler in an isolated environment. The idea is to provide more than one in-line process in a single station. The result should be higher quality, since wafers never leave the isolated environment during the multiple processing steps.

Cluster tools have been in existence for some time. Applied Materials of Santa Clara, Calif., pioneered the concept with a proprietary closed system. MESA is aiming at an open system using a standard interface among tools from multiple vendors.

MESA work began two years ago, says Robert Graham, president and CEO of Novellus Systems Inc. of San Jose, Calif., when five company presidents acknowledged that to link equipment in a single cluster required a standard interface. "We decided we had to make that interface nonproprietary," says Graham. "We would compete on the wafer or equipment produced and not take advantage of the interface." At the invitation of William Reed, president of SEMI, the MESA concept was brought into the organization under SEMI's Modular Equipment Standards Committee.

The biggest problem in developing a MESA standard is a common software interface. "The central handler is the easiest part. It's a fairly straightforward mechanical system," Graham says. "What's needed is the software transfer protocol. The most difficult challenge is getting the various chambers to talk to the central handler, and the central handler to talk to the fab."

Despite widespread MESA development activity, some doubt whether the concept will ever really fly. "Standards are very nice as long as there is some benefit to the customer," says Arnon Gat, president of AG Associates, a Sunnyvale, Calif., manufacturer of rapid-thermal-processing equipment. He regards AG's investment in MESA as a speculative proposition.

"Standards don't stand alone just because they are common," Gat contends. "Vendors will

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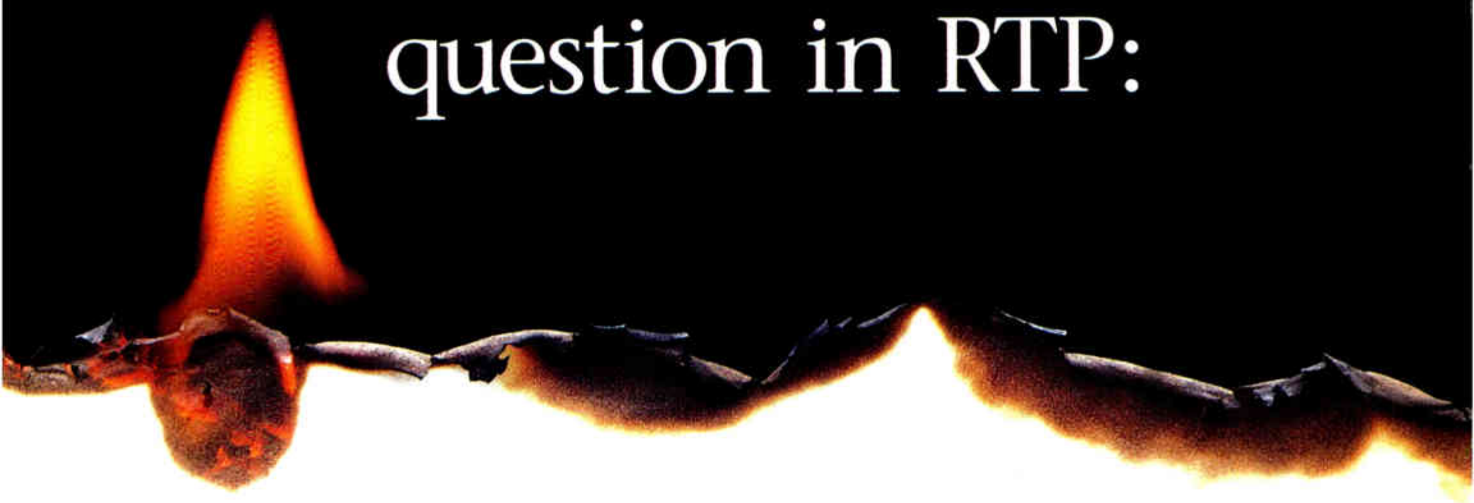

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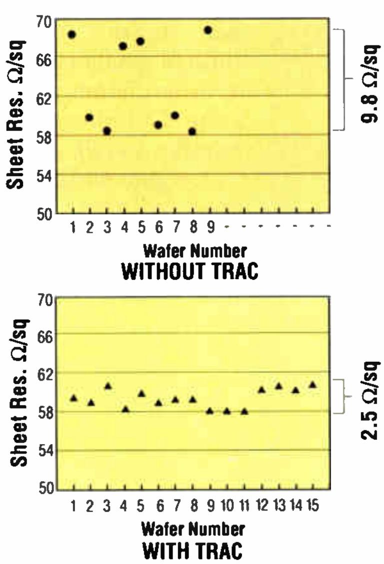
SHEET RESISTIVITY VS. VARYING NITRIDE THICKNESS



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AG Associates

CIRCLE 199

have to guarantee customers substantial benefits from hooking up systems in the complicated way the standard requires. And they'll need to spend more money for a system that works with not only one set of designs but four or five. You're talking about a $2 million tool before you even start, for one station that would do four steps."

The cluster tool raises another controversial issue. "If you build the central robot," asks Scott Young, technology manager for SEMI's standards staff, "and add chambers from other companies to it, who owns the tool? Who does the maintenance on it?"

Novellus's Graham says his company's recent partnership with Lam Research Corp., a manufacturer of dry-etching equipment, is a precursor of how that issue might be addressed. The two will supply equipment combining Lam's etch process with Novellus's tungsten chemical vapor-deposition system to Cypress Semiconductor Corp. in San Jose. "We tell Cypress that if either piece of equipment has a problem, either one of us can be called," says Graham. "Both of us will provide service."

SEMI president Reed says the advent of MESA and other standards could promote more such partnerships in an industry not noted for mutual cooperation. And partnering could boost the competitive capability of the small companies that make up the bulk of the U.S. semiconductor equipment industry.

Partnering could also boost the competitive capability of the small companies that make up the bulk of the U.S. semiconductor equipment industry. "If you look at the Japanese and U.S. equipment industries," Reed says, "they're very different. The U.S. industry is composed mainly of small companies—$25 million and under—while the Japanese competitors all have major parents."

Cluster tools give U.S. vendors the opportunity to do what they do best—build a single chamber—without having to build a whole piece of equipment. The advantage is in spending R&D capital only for their proprietary part of the process.

In addition to environmentally isolated clusters, a group of device manufacturers is working under the auspices of SEMI to develop descriptions of models to aid in the automation of fab facilities. This seven-member task force is looking for a way to take existing automation standards—there are 15—and define a subset of requirements for automating their factories.

Another thrust is in communications standards. SEMI has done an excellent job in this arena, says Sue Billat, president of Benchmark Strategies, a Palo Alto, Calif., firm that offers technical assessment and litigation support. "The Semiconductor Equipment Communications Standards—known as SECS I and II—are standards everyone loves to hate, because they were difficult to put together," she says. "But now many companies offer a SECS interface?"

There are some marked changes in the view equipment companies have of service. "The classical wisdom is to view service as a profit center," says Scott Scholler, executive vice president at Ateq Corp. of Beaverton, Ore., a supplier of mask- and reticle-making equipment. However, Ateq, among others, has made service an integral part of the equipment.

Other companies are addressing the service issue from many angles. For example, Gus Pinto, director of customer service at Peak Systems Inc. in Fremont, Calif., believes today's vendor-supplier relationships are too one-sided. He says a standard service contract means unlimited liability for the supplier. So the supplier must charge a large amount to minimize that liability.

Peak has developed an alternative, the Customer Partnership Agreement. Instead of a service contract for each piece of equipment, the customer buys a book of coupons good on any type of service: repair, preventive maintenance, training, and so on.

—SAMUEL WEBER, WITH ADDITIONAL REPORTING BY JONAH MCLEOD

Matchmaker, Matchmaker

SEMI helps its members forge international partnerships via the annual Partners Conference

Electronics is a truly borderless industry, with strategic agreements, partnerships, and every other kind of intercompany cooperative endeavor imaginable crisscrossing among countries and continents.

PARTNERSHIPS

Perhaps nowhere is that trend stronger than in the semiconductor equipment industry.

Here global partnerships are vital, for two reasons. First, the high cost of development and manufacturing makes the industry capital hungry, and linking up with offshore giants is an efficient way to get cash quickly. For another, such liaisons open the door to the international sales and marketing efforts that are keys to market leadership.

"Partnering is the lifeblood between customers and suppliers," says Tim Stultz, president of Peak Systems Inc. in Fremont, Calif., and a member of the board of the Semiconductor Materials and Equipment International trade association, "particularly because the marketing relationship goes beyond selling a machine—training and service are equally important."

How does one find a partner? An uncommonly effective answer is provided by SEMI, which draws its 1,350 corporate members from around the world. The Mountain View, Calif., group each fall holds an International Trade Partners Conference in Hawaii. "You meet with your Japanese counterparts in an informal atmosphere and build personal relationships; you loosen up," says John Osborne, senior vice president at Lam Research Corp. in Fremont.

Since it started sending people to the meetings, Lam's revenue from Japan has increased from 2% to 15% of total sales, he says, though part of that rise can be traced to a Japanese partnership with Sumitomo Metals. In Hawaii, says Colin Tierney, operations vice president, "the Japanese customers who work with Sumitomo can get to know the [Lam] people; it helps to cement relationships."

For Peak's Stultz, Hawaii is an ideal spot for the conference, not only for its obvious charms but also because "there is no place to do business there. If the meeting were held in Japan or the continental U.S., the executives would be running off to see customers. So the casual environment plus the lack of an opportunity to do business gives you access to people."

How the meetings worked for Peak is typical. "Aktis Corp., Peak's wholly owned subsidiary, makes process equipment for the flat-panel industry," says Stultz. "That industry is 90% in Japan, so we needed a Japanese partner. Through the people we met at Trade Partners, we established a joint venture with Mitsubishi Corp., which has invested in the multimillions and is now our development and business partner."

But what about potential partners in Europe for which a trip halfway around the world is prohibitive? Says Stultz, "Right now Europe is a relatively small market—most chips and chip equipment come from the U.S. and Japan. But [SEMI] considers every year trying to get European companies. Maybe the answer is two conferences."

—*HOWARD WOLFF*

A Push For Standards

The worldwide semiconductor industry faces unparalleled challenges and opportunities as it enters the 1990s. Major challenges include increasing productivity, controlling costs, and improving industry-wide communications. New opportunities are being found in emerging technologies, their evolving applications, and the concomitant expansion of marketing. But perhaps none of those is as important as standards.

One of the vital underpinnings of any major global industry is a set of rigorous standards and a dynamic program for establishing and constantly upgrading them. This is one of the most important functions of Semiconductor Equipment and Materials International (SEMI), the industry association for companies that supply the equipment, materials, and services used to manufacture semiconductors. The Mountain View, Calif., organization's International Standards Program draws participants from among SEMI's 1,350 corporate and 400 individual members along with their customers, the device manufacturers. Membership is now at 3,000.

While a major objective of the standard-setting process is to develop documentation, another important aspect is providing a forum for users and suppliers to communicate with each other. Customer service is the name of the game. "Establishing relationships with customers, and understanding their needs before and after the sale, is just as important as the document," says Scott Young, technology manager for SEMI's standards staff.

"We have 26 volunteer committees working on standards, and one of the requirements is that they must be balanced with 50% vendor and 50% user participation," Young says. "In terms of customer service, That's the part of the system that helps the industry understand what a customer's needs and problems are, and how he works."

SEMI began developing standards initially in the mid-1970s to address a silicon shortage that existed at that time. Contributing to that shortage was the fact that a wide variety of wafer sizes was in use. That also created a problem for equipment manufacturers that had to accommodate a multiplicity of different-size wafers. From that start, the program has since expanded to include standards for automation hardware and software as well as chemicals and gases, packaging, materials, facilities and safety, and micropatterning.

—*SAMUEL WEBER*

A Dazzling Array of Technology

To handle the complexities of chip making today, equipment suppliers solve some technical tough nuts

EQUIPMENT

Equipment makers are coming up with some novel ways of handling the complexities of today's chip making. For example, Novellus Systems Inc. weighs in with the Concept One-W chemical vapor-deposition (CVD) system for depositing blank tungsten metal films. The unit offers extraordinary uniformity and excellent step coverage. In addition, vacuum clamping combined with a gas-exclusion technique solves a particle problem caused by unwanted backside deposition of tungsten. Wafers are processed sequentially at five deposition stations in a single chamber, receiving one fifth of the total film thickness at each stop. This approach reduces surface and wafer-to-wafer variations.

AG Associates of Sunnyvale, Calif., a leader in rapid thermal processing (RTP), offers the Heatpulse RTP systems, ranging from benchtop to automated high-volume production units. Basically, they are quartz processing chambers heated by banks of tungsten halogen lamps that heat wafers to 1,300°C at a maximum rate of 250°C/s. With Heatpulse 4100, a three-axis robot handles up to 150 four-to-six-inch wafers per hour.

THREE IN ONE

In Lam Research's Integrity CVD system, film deposition, flow, and anneal occur within a single chamber.

The Rainbow 4500i from Lam Research Corp. of Fremont, Calif., is an oxide etcher with an integrated isotropic etch capability, meaning both isotropic and anisotropic oxide profiles can be etched in parallel. This improves aluminum step coverage, thereby boosting device yields.

It's also economical: users save valuable clean-room floor space and minimize wafer-breakage particulates through reduced wafer handling.

Ultratech Stepper's high-throughput M2000 stepper can be intermixed with g and i-h line reduction steppers to give users a low-cost alternative for noncritical layers. The Santa Clara, Calif., company's machine employs a linear motor wafer stage that cuts step and settle times by a factor of two. The cast-iron platform is supported by a dynamic isolation system, a combination that protects against floor and acoustic vibration.

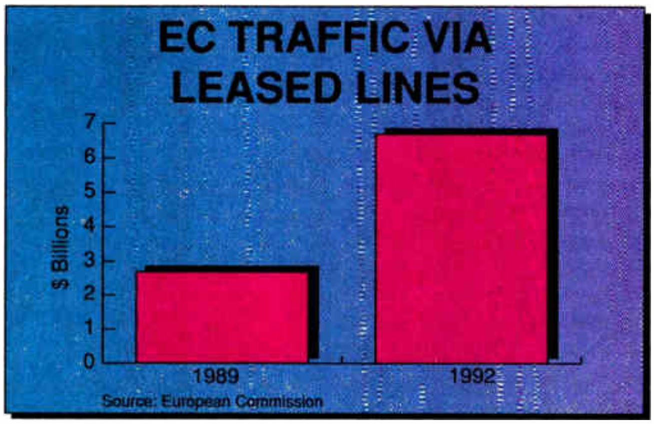
The Model ALP 8520 vacuum-compatible RTP system from Peak Systems Inc. of Fremont processes 200-mm wafers and features Peak's "silicon-specific" lamp technology and cold-wall process chamber. A gas box handles up to eight mass flow-controlled gas loops.

The Model 20-S high-sensitivity particle-monitoring system from HYT of Mountain View, Calif., keeps track of minute particles within the loadlock of CVD systems. It can detect particles as small as 0.2 µm and control shifts in particle levels before they result in what can become costly yield losses.

From the Silicon Valley Group Inc. of San Jose, the new Series 7000 vertical thermal-reactor line builds upon the Series 6000 VTR. It delivers heightened film quality for sophisticated process requirements and boasts a quartz tube-removal system that dramatically speeds tube replacement: the procedure takes less than an hour.—*SAMUEL WEBER*

EASING LEASED-LINE USE

Companies based in the 12-nation European Community area may soon find it easier to lease data communication lines from government-run telecom authorities. In an effort to further liberalize and harmonize communications markets, the Brussels-based EC Commission has proposed a plan that provides for open access to networks for users and suppliers of information services. Among other things, the so-called Open Network Provision specifies that prices and any price changes be made generally known.



What's more, the EC proposal spells out the rules that should govern leased lines. For example, users who exchange data regularly with someone overseas should be billed on the basis of annual rates rather than number of connections established.

Also, in the interest of harmonization, the proposal calls for common standards and tariffs for leased lines in the 12 EC countries. ❑

THE GERMAN PC MARKET LOOKS AT A STAGNANT FUTURE

After years of stormy growth, Germany's market for personal computers is now leveling off and will eventually face a period of stagnation. That's the word from experts at Diebold Deutschland GmbH in Eschborn, near Frankfurt, a management and technology consulting firm. The reservoir of new customers, says analyst Thomas Centner, will be exhausted in the next two to three years while sales of replacement PCs will drop.

The trend matches those in the U.S. and the UK, points out the Diebold expert. The result is further concentration in the industry, as small and medium-sized firms are gobbled up by the giants. In Centner's view, only five to six large companies active on the German market will grab the lion's share of PC sales. The small ones will have to look for niches.

After PC sales in Germany rose 15% in 1990 to reach $5 billion, this year's market in the former West Germany, will level off to between 5% and 10% growth. Only in the five new eastern states will there still be a 15% rise in sales in 1991, this because of the enormous demand for PCs in that region. For the whole of Germany, however, the longer-term PC future is anything but bright. ❑

CHINESE TO BUILD PBXs FROM SIEMENS

The popular Hicom 300 private branch exchange system from Siemens AG will be built under license at two factories in China. An agreement that the German company recently made with China Great Wall Industry Corp. provides for each factory to ramp up production to 100,000 subscriber lines annually within four years.

The first phase, which just started, calls for the assembly of subsystems and racks from Siemens into complete systems as well as final functional tests. During the next phase, to begin in mid-1991, Chinese technicians will put together the subsystems. To prepare, about 50 workers underwent a nine-month training course at Siemens.

The Beijing-based China Great Wall Industry Corp. is the trading organization of the country's Ministry of Astronautics and Aerospace. It handled the commercial part of the German-Chinese cooperative deal. Two licensing partners will build and market the Hicom 300 switch: the 1,500-employee facility of Xin Guang Telecommunications Factory in Shanghai and the Xiang Dong Machinery Factory in Beijing. ❑

SIEMENS MOUNTS MAJOR INITIATIVE IN FUZZY LOGIC

Determined not to leave the field to Japanese producers, Germany's Siemens AG is launching a long-term, multimillion-dollar effort in fuzzy-logic technology. The company's Task Force Fuzzy project aims at research and development in fuzzy controller hardware and software, and in this sector "we want to be No. 1 in Europe in three to five years," says Michael Reinfrank, who heads the project.

While most European companies have assigned just one or two people to watch over the fuzzy-logic scene, Siemens is going all out. Starting from zero a few months ago, the company is doubling its staff to about 10.

R&D will emphasize automation, medical diagnostics, household appliances, environmental control, image processing, character recognition, and related areas. In many of these applications, no exact programs can be set up for certain processes to allow the use of conventional logic methods. Fuzzy logic overcomes this problem and offers a better solution with lower hardware and software development costs. ▸

What should help Siemens is that it can draw on the know-how its various groups and divisions—those engaged in automation, communications, medical electronics, power engineering, instrumentation, and the like—have in measuring and control technology. On the other hand, the need these divisions have for fuzzy controllers translates into a big in-house demand. ❑

Before the A500 started testing Motorola's mixed-

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Manager, Advanced Test Technology

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TERADYNE

CIRCLE 194

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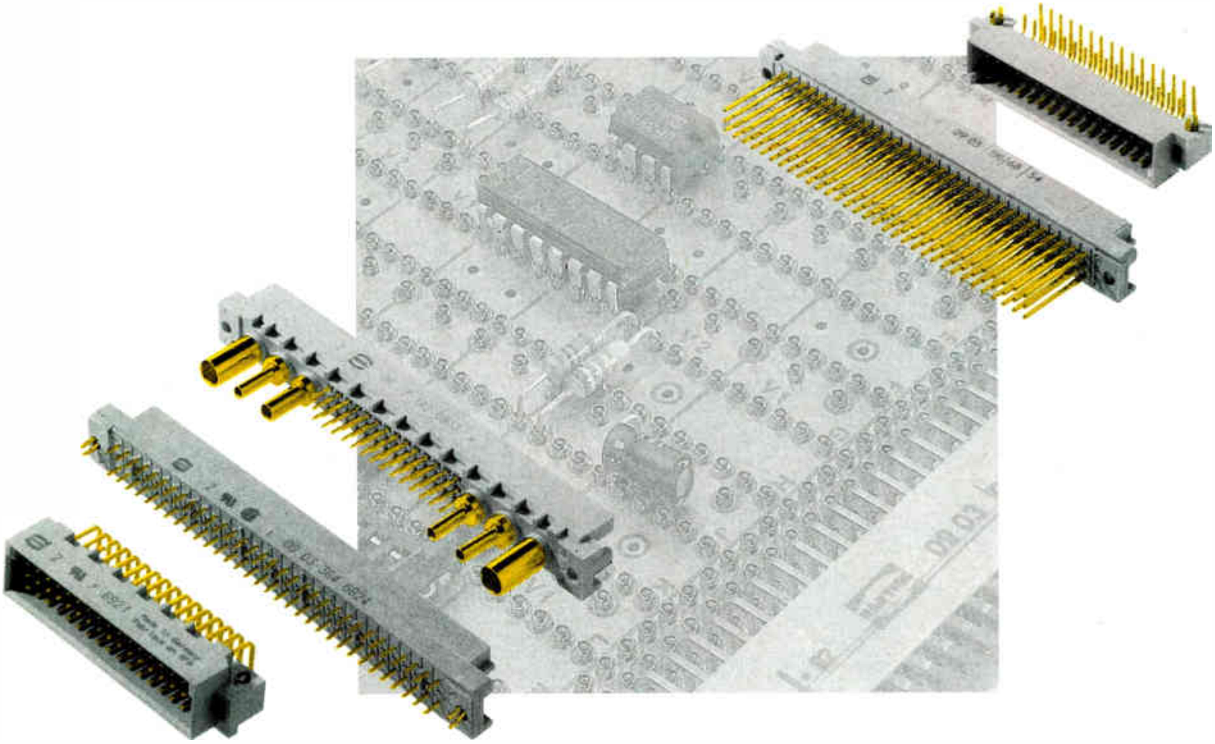

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CIRCLE 171

RESEARCH

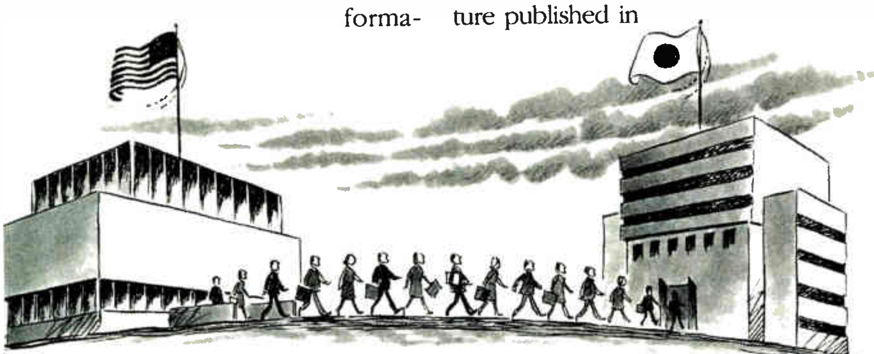
THE U.S. RESEARCH COMMUNITY LOOKS ASKANCE AT THE NEW JAPANESE 'BASIC SCIENCE' LABS

THE BRAIN DRAIN

BY JACQUELINE DAMIAN

When Matsushita decided to set up a basic-science research lab in the U.S., the Japanese firm originally eyed the Palo Alto, Calif., region as the site. But the giant electronics company had pinpointed the person it most wanted on board, and he was on the East Coast. So when Richard J. Lipton, one of the stars of the American computer-science galaxy, signed on, Matsushita duly settled on Princeton, N.J.—Lipton's home turf—for its facility.

"That's a very amazing accommodation on the part of the Japanese," says Ram Gnanadesikan, assistant vice president of research in information sciences and technologies at Bellcore in Morristown, N.J. "It's like the mountain going to Mohammed. They will go where the human resources are."



Those human resources, it seems, are often in the U.S., and to meet their goal of closing the basic-science gap between the two nations, Japanese companies have begun building research centers in America. Offering sky-high salaries, spanking-new facilities and equipment, and a great deal of scientific freedom in terms of research topics, these labs exert a powerful pull on U.S. university and industrial scientists.

"The best people are being wooed away," says Gnanadesikan. "There is a lot of discussion within the professional societies about what should be done." The Japanese, he says, are offering salaries as much as 100% or 150% higher than what American labs can offer (others say the differential is more like 50%). "People in my own lab have been approached by these firms with unbelievable offers," Gnanadesikan adds, although Bellcore—the research and development arm of the Bell operating companies—hasn't yet lost anyone to the Japanese.

It's a new arena of competition for the U.S., which has long held sway as the preeminent center of research in "pure" or "fundamental" science. America's dominance can be seen by the fact that U.S. researchers contributed 35.6% of all the scientific and technical literature published in 1986, against just 7.7% for the Japanese, according to the National Science Foundation. The new labs are part of a Japanese effort to redress that balance.

Whether the glass is half empty or half full depends on who you talk to. Some in the electronics community avow that the more research that's going on in the U.S. the better, no matter who's footing the bill. "You want to stimulate R&D, create high-value-added jobs," says Pete McCloskey, president of the Electronic Industries Association in Washington. "If it's a bona fide operation, how can it hurt us?"

Those who see cause for concern point to the loss of talent as one glaring disadvantage. The other revolves around how the scientific advances generated in the new labs will be translated into products. As patents begin to flow out of their work, the cream of the U.S. research crop may be giving the Japanese a competitive boost in producing the next generation of computers and other electronic innovations.

The oldest of the Japanese facilities is NEC Corp.'s research institute in Princeton, open less than three years. Matsushita Electric Industrial Co. has joined NEC in Princeton with an information-sciences lab headed by Lipton, a Princeton University professor. A second, more comprehensive lab is planned nearby. Canon is considering opening a lab in Palo Alto and Mitsubishi one in Cambridge, near the Massachusetts Institute of Technology. And Fujitsu and Ricoh are said to be considering starting up labs as well.

Based on those plans, "it will be the equivalent of creating two or three more basic-research institutions of the Bell Labs and IBM variety," says C. Kumar N. Patel, executive director of research in materials science, engineering, and academic affairs at AT&T Bell Labs in Murray Hill, N.J. Each of those massive labs employs thousands of people.

"It is a topic of discussion and it is a matter of some concern," Patel says. "It represents an expansion of choices the scientists have. Either [the U.S.] will need more scientists and engineers [to fill all the research slots], or in the short term it will make it difficult for us to attract the best people."

Scientific research is, of course, free currency and nondenominational: whatever their nationality, scientists publish their findings in international journals and make their results available to colleagues around the world. But research also produces wealth for the nation or institution that sponsors it. Frank Press, president of the National Academy of Sciences, says that money spent on fundamental research has a rate of return of 28% a year.

In a report prepared recently for the Commission for U.S.-Japan Relations for the 21st Century, Press exhorts the Japanese to share their research, most of which is concentrated in industry. In America, by contrast, the bulk of scientific research is university-based. "It is appropriate to ask more from nations, such as Japan, which have benefited

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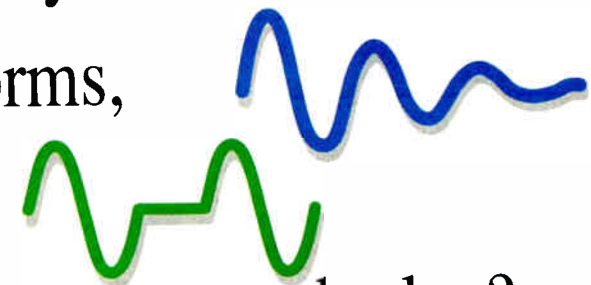

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from free access to scientific knowledge but have so far contributed less research than might be expected, given the size of their economies," Press says.

But some observers say that sharing research isn't the point—no one interviewed believed researchers at the new Japanese labs will fail to publish. Rather, the problem for the U.S. lies in the ease with which Japanese companies seem to translate scientific findings into commercial technology—and the difficulty U.S. firms seem to encounter.

"The fact that the Japanese have exploited a lot of our technology is our fault, not theirs, because we don't manufacture anything anymore," says Gordon Bell, an outspoken computer industry consultant who is also chief scientist at Stardent Computer Inc., Newton, Mass. Once a university researcher himself, Bell says he was approached to run a lab by a Japanese company he declines to name. He believes it will be easy for the Japanese to lure away disenchanted university researchers who are tired of "grubbing for grants. As long as [the researchers] aren't uptight about who 'owns' them, their value systems may tell them it doesn't matter who they work for."

CITATION RATES

(U.S. and Japanese shares of world scientific publications)

Japan	**1973**	**1983**
% of all papers	5.01%	7.34%
% of all citations	3.62%	6.37%
U.S.		
% of all papers	38.95%	37.03%
% of all citations	53.47%	50.36%

SOURCE: COMMISSION ON U.S. - JAPAN RELATIONS FOR THE 21ST CENTURY

But the ownership issue cuts another way—in manufacturing—which does concern Bell. "The guy who's making the physical goods ends up owning the technology and the revenues that flow from it. And the way things are going," he says, "I can't figure out how the Japanese aren't going to end up owning everything. We don't make anything in the U.S. anymore. That's an exaggeration, but nobody seems to care about making anything."

In fact, it will be interesting to see how Japan solves the technology-transfer problem, says Patel of Bell Labs. "The problem of transferring knowledge and know-how from basic research to development and manufacturing is not trivial," he says. "One of the significant barriers is the distance." At big corporate labs, "you can rely on not just what's been published, but you also have the guy in house to discuss it with," Patel says. "How will the Japanese deal with this when the designers and developers and manufacturing brains are 10,000 miles away?"

However, Gnanadesikan of Bellcore believes the Japanese are grappling with this issue. "The interesting thing I hear about the NEC lab at Princeton is that it's not just basic research but more development-oriented," he says. Gnanadesikan fully expects the Japanese to put in place a mechanism "to translate [U.S.-based] research into products." ❑

Additional reporting by Laurence Curran

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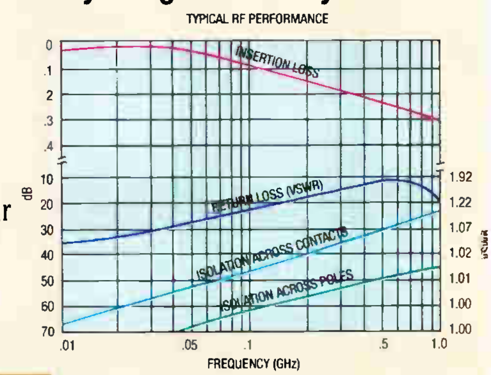

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Coil Operating Power at Nominal Voltage (Milliwatts)		405	360	440
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HP SPEEDS UP THE WORKSTATION RACE

ITS NEW RISC LAUNCH REVIVES A LAGGING ENTRY AS SUN STAYS NO. 1 AND DIGITAL GETS A YELLOW FLAG

BY LAWRENCE CURRAN

WORKSTATIONS

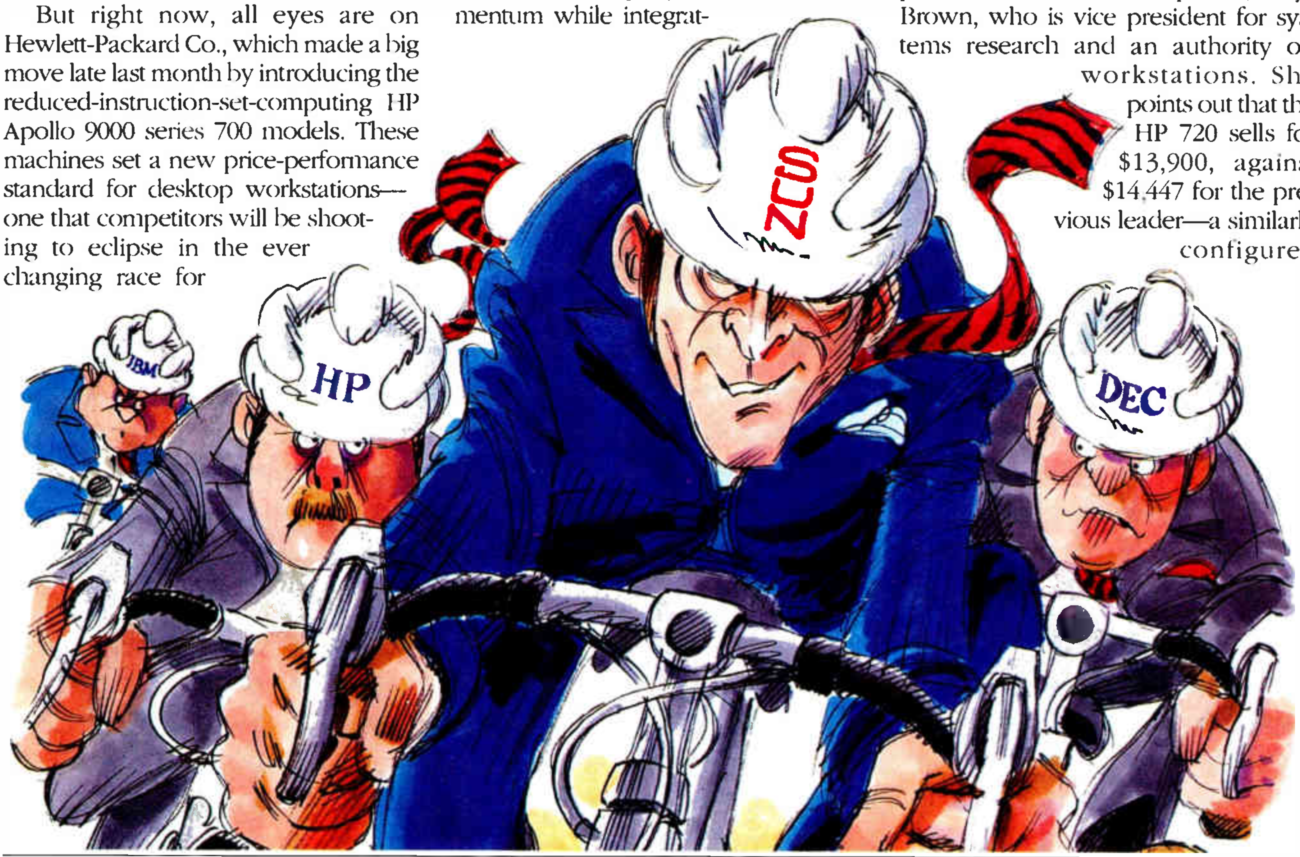
Sun Microsystems Inc. still leads the pack in the workstation race, but developments at Hewlett-Packard, Digital Equipment, and IBM have workstation watchers buzzing. Digital and HP switched positions in the rankings last year, with Digital dropping from second to third place in workstation revenues. And don't look now, but IBM Corp., which broke late from the gate, is moving up fast on the outside. Although still a distant fourth, IBM zoomed ahead of Intergraph Corp. to round out the top five 1990 workstation vendors, according to International Data Corp., the Framingham, Mass., market research firm.

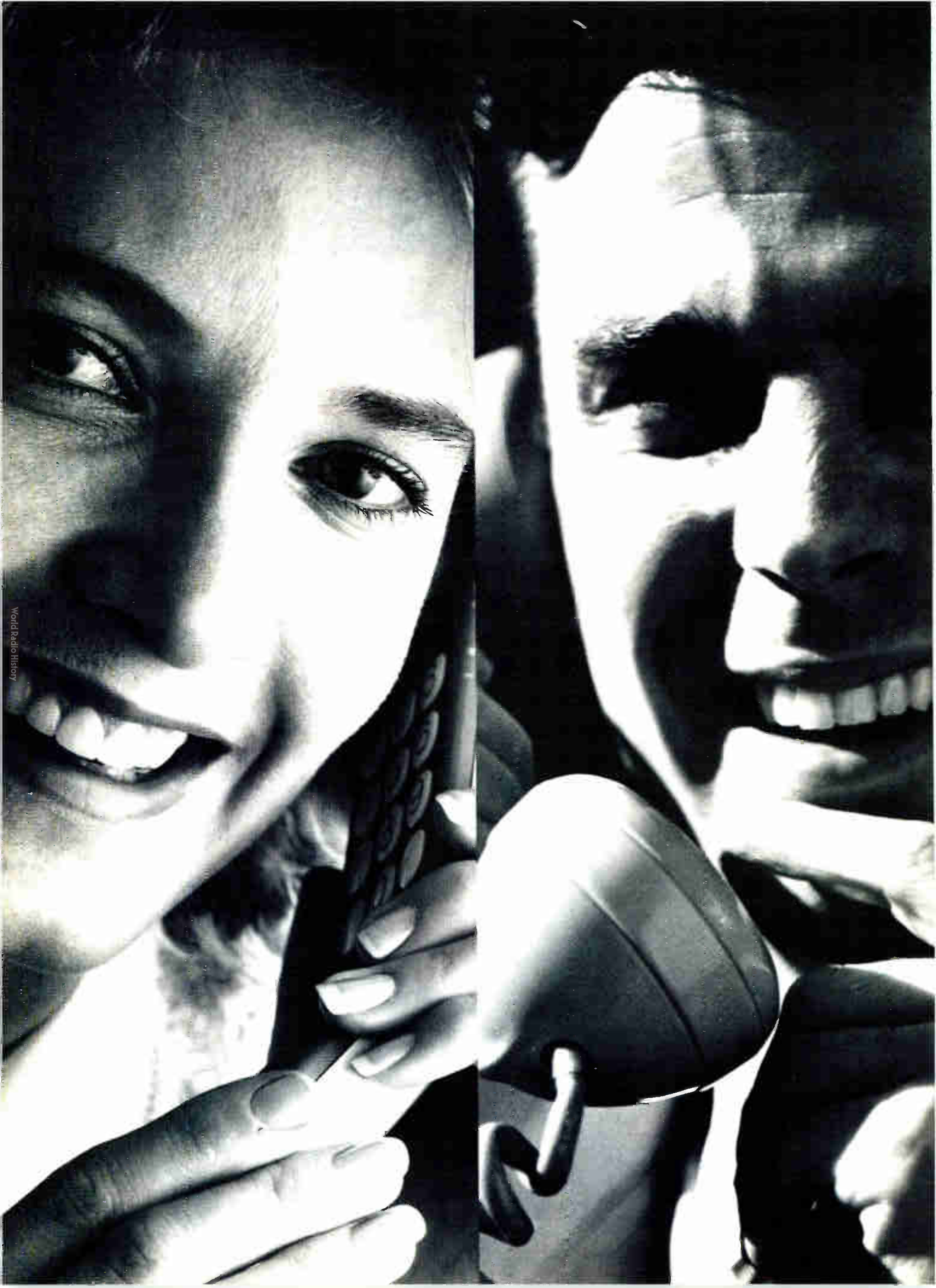
But right now, all eyes are on Hewlett-Packard Co., which made a big move late last month by introducing the reduced-instruction-set-computing HP Apollo 9000 series 700 models. These machines set a new price-performance standard for desktop workstations—one that competitors will be shooting to eclipse in the ever changing race for performance leadership in the market. The jockeying all adds up to more mips and megaflops per buck—and probably better deals—for corporate and engineering department managers who are shopping for desktop machines.

HP's introduction came close on the heels of an earlier March move by IBM to flesh out both the low and high ends of the RISC System/6000 family with new models (see p. 19)—an announcement that was reportedly hastened to steal some of HP's thunder.

The bold thrust embodied in the three new models from HP Apollo rejuvenates a company that had lost momentum while integrating and sorting out overlapping product lines and design teams after HP acquired Apollo, based in Chelmsford, Mass., in April 1989. "They've leapfrogged the industry by about a year," says Chuck Casale, president of the Aberdeen Group, a Boston market research firm. "Where 1990 was the year of the IBM RISC System/6000, 1991 may go down as the year of the HP 700," he says.

IDC's Vicki Brown is also impressed. The introduction "doesn't just establish HP as the price-performance leader in workstations, it has them just about doubling the performance at the same price as the nearest competitor," says Brown, who is vice president for systems research and an authority on workstations. She points out that the HP 720 sells for $13,900, against $14,447 for the previous leader—a similarly configured





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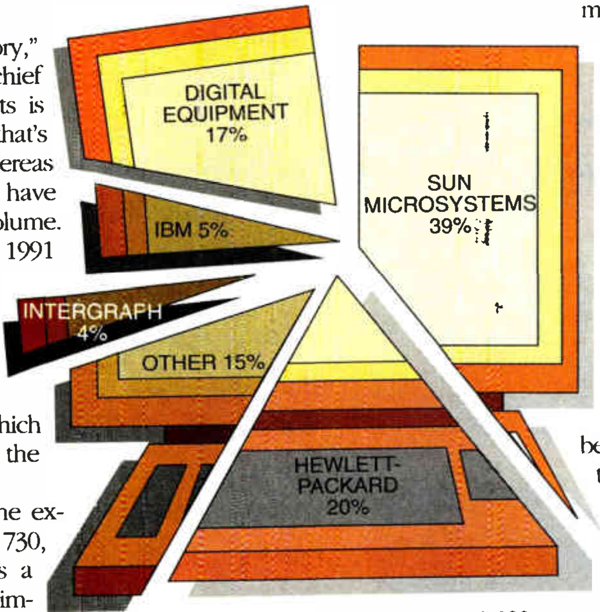
WORKSTATION SHIPMENTS WORLDWIDE



TOTAL UNITS SHIPPED (1990): 370,800

SOURCE: INTERNATIONAL DATA CORP.

A. WHITE

IBM RS/6000 model 320. And the HP 720 has about twice the speed and main memory, with substantially more mass storage.

"It's a pretty compelling story," Brown says, adding that her chief concern about the HP products is that there isn't a RISC model that's priced below $10,000 yet, whereas Sun has two such machines that have contributed substantially to its volume. She cautions further that for HP, 1991 will be a transition year in workstations. It may be difficult for the company to move customers from its earlier Motorola-based complex-instruction-set-computing architecture, which HP continues to develop, to the newer RISC models.

The HP machines stirring the excitement are the models 720, 730, and 750. The low-end 720 is a diskless model that provides impressive performance for $11,900: 55.5 Specmarks, 57 million instructions/s, and 17 million floating-point operations/s in double-precision floating-point operations. The price includes 16 Mbytes of random-access memory, HP's GRX X-Window graphics option, and a 19-in. monitor. That performance puts the 720 well ahead of any current Digital, IBM, or Sun workstation, and at a price that's lower by $1,000 to $3,000, says HP's John Thompson, manager of next-generation systems at the Apollo Systems Division.

For example, the Sun Sparcstation 2 is rated at 21 Specmarks, 28.5 mips, and 4.2 megaflops for a double-precision Linpack operation. The comparable numbers for the DECstation 5000 are 18.5 Specmarks, 24 mips, and 3.7 megaflops. For the IBM RS/6000 model 320, they're 24.6 Specmarks, 29.5 mips, and 8.5 megaflops. The new products, says Thompson, "give us 1992-class performance in early '91 and increase our market-share potential substantially."

All three models use a CMOS three-chip set fabricated by HP that implements the company's five-year-old RISC concept, the HP Precision Architecture (HP/PA): a central processor, floating-point unit, and memory input/output controller. The higher-performance 730 and 750 use a 66-MHz version of the processor, versus 50 MHz in the 720.

Also impressive is the series' graphics performance, says Laura Segervall, workstation industry analyst at Dataquest Inc., the San Jose, Calif., research firm. The HP systems can draw more than 1 million two- and three-dimensional vectors per second, probably the industry's fastest rate to date, and "paint" windows three to seven times faster than competing workstations, HP says.

"The price-performance comparison with the [Sun] Sparcstation 2, in terms of dollars per Specmarks, shows that HP gets twice the performance for the same dollar," Segervall says. "This is what HP needs, because they were starting to fall behind" both Sun and, more recently, IBM, she adds. "IBM did extremely well with the RS/6000 line last year," says Segervall, who checked into Big Blue's claim to have delivered 25,000 workstations and finds it credible. She says some older PC/RT systems may be counted in the total, but about 23,000 of that number were probably RS/6000s.

For his part, Sun's Doug Kaewert, director of systems product marketing in Mountain View, Calif., has learned not to be surprised by major leaps ahead in the price-performance ratio.

He points out that "everybody is working on faster chips—IBM, HP, ourselves, and Sparc chip vendors. We're all on fundamentally the same technology curve, so we'll continue to see vendors leapfrogging each other every six months. It's pick your horse and sooner or later it will come out ahead—and then drop back again."

As for Sun, Kaewert says, "you can expect us to continue to gain market share versus our competitors in 1991. Both IDC and Dataquest in their 1990 recaps showed that we gained share against HP and DEC," he adds. "IBM gained market share [with the RS/6000] because they had virtually none before 1990."

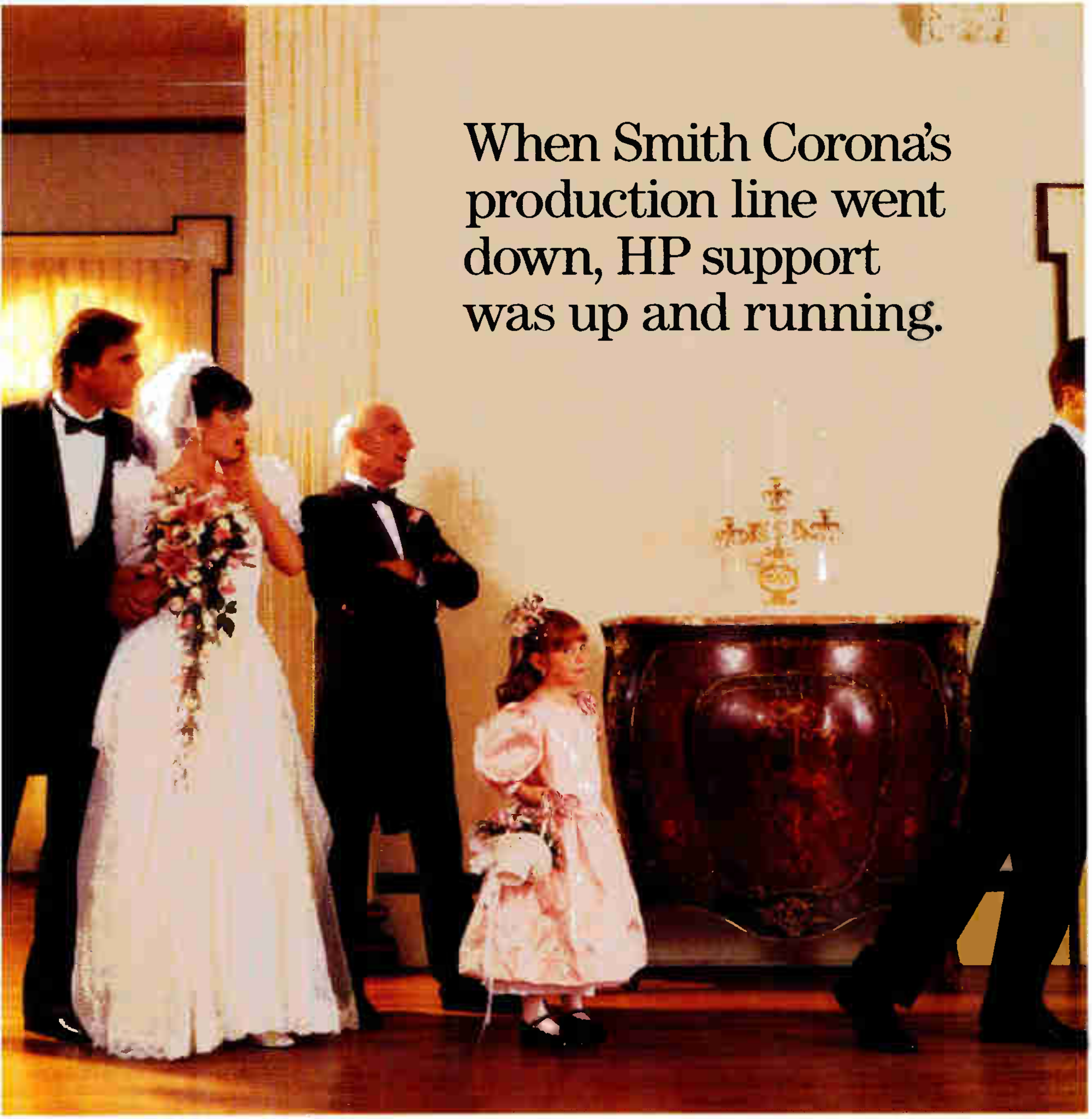
Ultimately, breadth of application-software support becomes the differentiator in the competition for sales, in Kaewert's view. "IBM seems to be emphasizing 'hot boxes,'" he says. "They have two times the mips we have, but our machines are selling much faster because of all the application software that's available [for Suns]."

Back at Dataquest, Segervall emphasizes that "HP had to do something like the new models," in part because the company had to bridge the gap between its lower-end 680X0-based workstations and its RISC machines. She says that HP Apollo customers using the Motorola-based products may have sensed those systems were running out of gas for their applications—and may have been eyeing other vendors. "Now they may consider HP first" for new workstations.

No competitor, however, is likely to dislodge Sun from the top spot because of the dominance of the Sun-pioneered Sparc architecture, which has attracted at least 24 clones to date. "Sun shipped 146,000 systems last year," Segervall says, "and that in itself is pretty spectacular." But she says HP appears to be well positioned to play the leapfrog performance game: "HP is well aware of the nature of the business, and they have a 100-MHz processor in the lab" to use in succeeding rounds of the race.

As for Digital Equipment Corp.'s reported sluggish performance in workstations last year, Eric Jaeger, product marketing manager for the DECstation 5000 RISC family in Palo Alto, Calif., acknowledges a slowdown that he says has since picked up. But he's quick to point out that slow growth didn't stretch across the board. Although he won't provide numbers, he says that "our RISC workstation experience last year was spectacular. The DECstation 5000 has been very well received, and sales are growing faster than expected."

Jaeger says, however, that Digital's growth curve in the CISC VAX worksta-



It happened on a freezing Saturday in February.

Joe Reiley, a Hewlett-Packard test and measurement support engineer, was at a wedding in Pottstown, Pennsylvania. The office was the furthest thing from his mind, when suddenly his beeper went off.

In minutes, Joe was on the phone to Travis Field, the support engineer for Smith Corona in Cortland, New York. An HP test system crucial to Smith Corona's production line had gone down. Suddenly, Joe's thoughts turned to figuring out how to get Smith Corona's production line back up. Joe bid the other guests goodbye and ran to his car.

After driving through a blinding snow storm over icy mountain roads, Joe pulled into Smith Corona at 10:30 pm. A thorough analysis of the problem made it clear they needed extra parts, so Joe called another HP support engineer, Pete Nahrgang, in Valley Forge. Working through the early morning, Pete took parts from a back-up HP system, then flew them to Cortland by special courier. By Sunday afternoon, just 24 hours after Joe's beeper first went off, Smith Corona's production line was up again.

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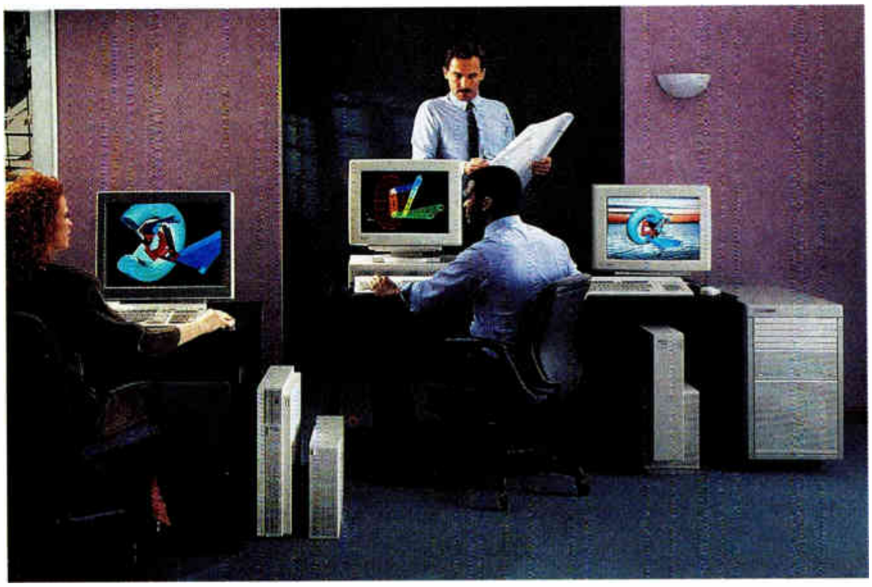


TOPS IN PRICE/PERFORMANCE

The HP Apollo models 720, 730, and 750 offer more megaglops, mips, and memory for $1,000 to $3,000 less than competing machines.

tion family "was a little better than flat because of a product trough" that developed between the older VAXstation 3100 models 38 and 40 and the model 76, which was introduced last October. "Since then, there's been a pickup, and we're certainly not done developing the VAXstation family," Jaeger adds.

Nor does Jaeger believe IBM's RS/6000 rush has cost Digital market share. As he sees it, Big Blue's RISC line has made its mark primarily among the vast numbers of companies that are already IBM customers for larger systems, but that don't have many workstations. "That large installed base of MIS departments has been looking first at the 6000" to fill its workstation needs, Jaeger claims. "It isn't a case of them selling into the installed bases of other vendors."

Digital undoubtedly has been delayed in getting newer RISC DECstations to market because of slippage in availability of the MIPS 64-bit R4000 processor, which MIPS Computer Systems Inc. has said will be available "later this year" from its five CMOS semiconductor partners. But Digital has no plans to back an alternative architecture.

"We've specifically designed our platform architectures to accommodate the R4000," Jaeger says. "There will be a number of sources for the chip and we're confident we'll get volume shipments." Further, Jaeger points out that in the all-important software category, more than 1,700 application programs are already running on the MIPS architecture, with some 300 others coming soon. Regarding the debut of R4000-based DECstations, however, Jaeger wouldn't commit to 1991 deliveries.

Meanwhile, relative newcomer IBM "wants to have a full range of Unix-based products—in workstations and commercial systems," says Phil Hester, director of the engineering center for the Advanced Workstation Division in Austin, Texas. The initial RS/6000 introductions in February 1990 were just the first volley, he says. "We intend to extend the family both down and up" in performance. The first follow-on move was at the high end, with last October's debut of the model 550. That system delivers more than 25 megaflops—almost double the 13-megaflops rating of the model 540, Hester says. "Performance is doubling in the industry every 12 to 18 months," he points out, and "we intend to be on that curve."

In fact, IBM is well ahead of that curve in that the doubling in floating-point performance between the 540 and 550 took just eight months. It came about through process evolution that allowed the Austin operation to boost speed by taking advantage of a shrink from 1.0-µm to 0.5-µm effective gate length in the CMOS process at IBM's General Technology Division. That's the silicon foundry in Burlington, Vt.

"One of the messages here is that we're doing a lot of work inside IBM between the General Technology Division and the product groups to apply advanced technology quickly," Hester says. He says the semiconductor technology will also cover the need at the low end. "We have to do an entry-level system—lower than the current low end—and the technology is clearly there to do that," he says. Today's low end is the model 320, which delivers 27 mips and 7 megaflops and sells for $12,995 in its minimal configuration.

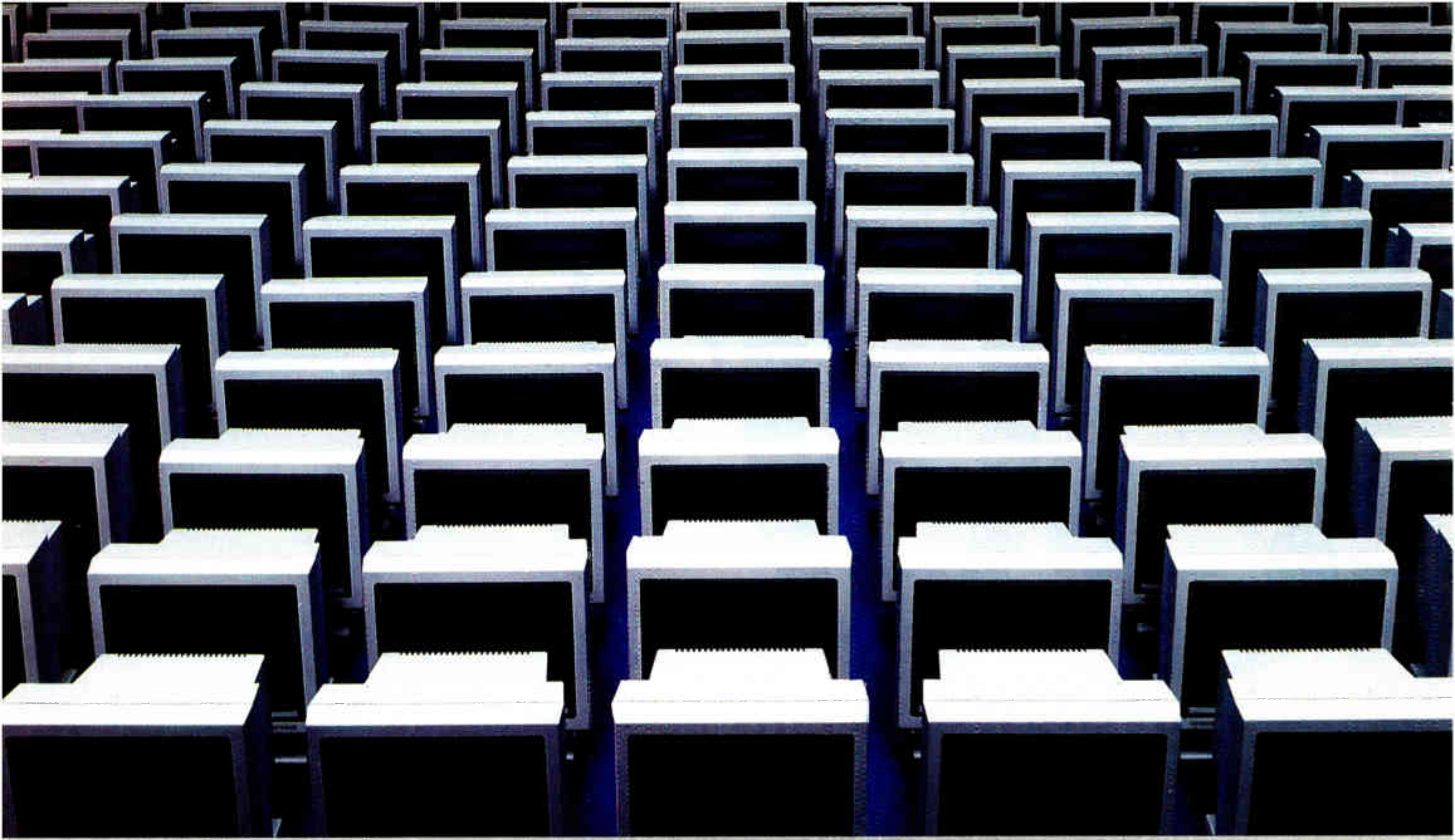
Back at the Aberdeen Group, Casale assesses the scramble for workstation leadership from his perspective as a former securities analyst. He's intrigued about how company fortunes have shifted in recent years. For example, where IBM was perceived as a huge corporation with too much fat, "now they're lean and mean, and they keep smiling and hinting that there's more to come in the RS/6000 line.

"Sun has always been lean and mean," Casale continues, "but they've grown very fast. And the faster you grow, the more cash you need." He says that Sun has probably used the cash injection provided by AT&T Co.'s earlier investment, leaving "Sun needing to figure out where to get cash for growth. They can't get much leaner. They've also lost some of the luster they had earlier as the 'darling culture company' in workstations." Casale says that stems in part from Sun having lost its "unsullied image on standards. A lot of people are saying that the Sun OS operating system [a variation of Unix] isn't really an open standard."

Casale regards HP as "a fine company, one with a very positive stance going in" as it unveils these new workstations. "Their operating margins have gradually declined, but those haven't been erratic, as Digital's have been."

It's Casale's view that Digital hasn't yet bitten the bullet on downsizing, even though the company has experienced the first layoffs in its history [*Electronics*, February 1991, p. 19]. "Digital hasn't yet fully assimilated that to get better they have to get leaner. They don't really believe that, and they're not in fighting trim."

As the 1991 workstation scene unfolds, Casale offers this scenario: "Sun, although needing cash, is okay; IBM will do well and Digital is still sweating out how to slim down." As for HP in the aftermath of the series 700 introduction, the company "won't gain a lot of market share this year, but they're positioned to do so in 1992." ❑



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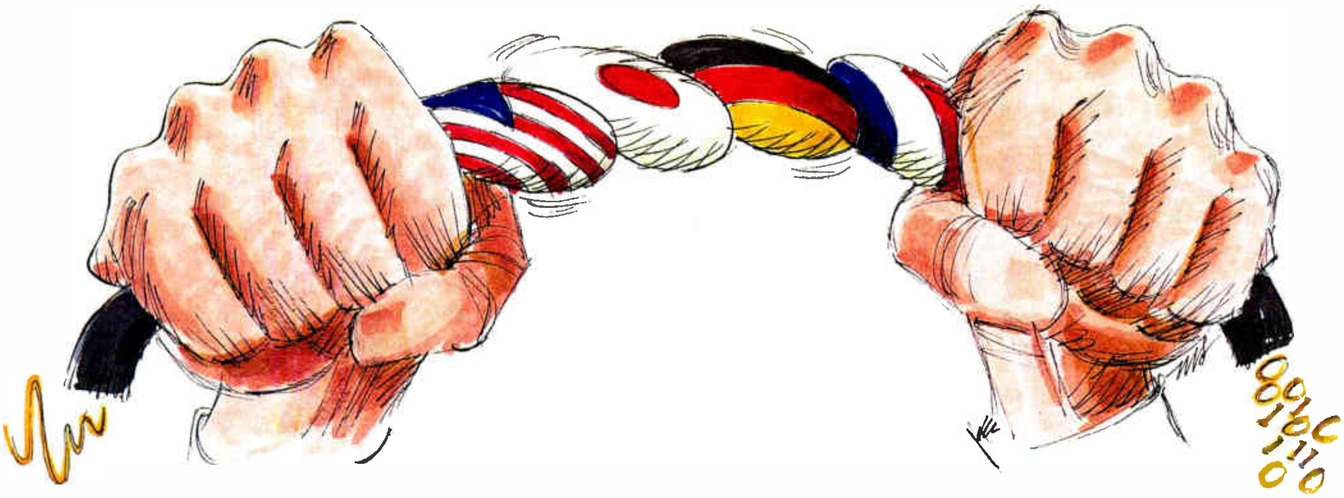


WRINGING OUT THE BITS: ANALOG OR DIGITAL HDTV?

THE U.S. TAKES THE TECHNOLOGY HIGH GROUND, BUT NO ONE KNOWS FOR SURE IF DIGITAL SCHEMES WILL WORK

BY JACK SHANDLE

HDTV

Hype surrounding the all-digital systems now vying to be the U.S. high-definition TV standard has obscured an important fact. Nothing similar to the digital compression schemes that aspire to shape America's future viewing has ever been field tested for terrestrial broadcasting.

With the all-digital proponents out on a technology limb, the only contestant still using a traditional analog approach is NHK Corp., Japan's national broadcaster. "If digital transmission proves impractical," says one HDTV expert, "then the winner could be NHK, which would be bad for the U.S." A compromise scenario has all-digital systems pushing back the standards process while bugs are worked out.

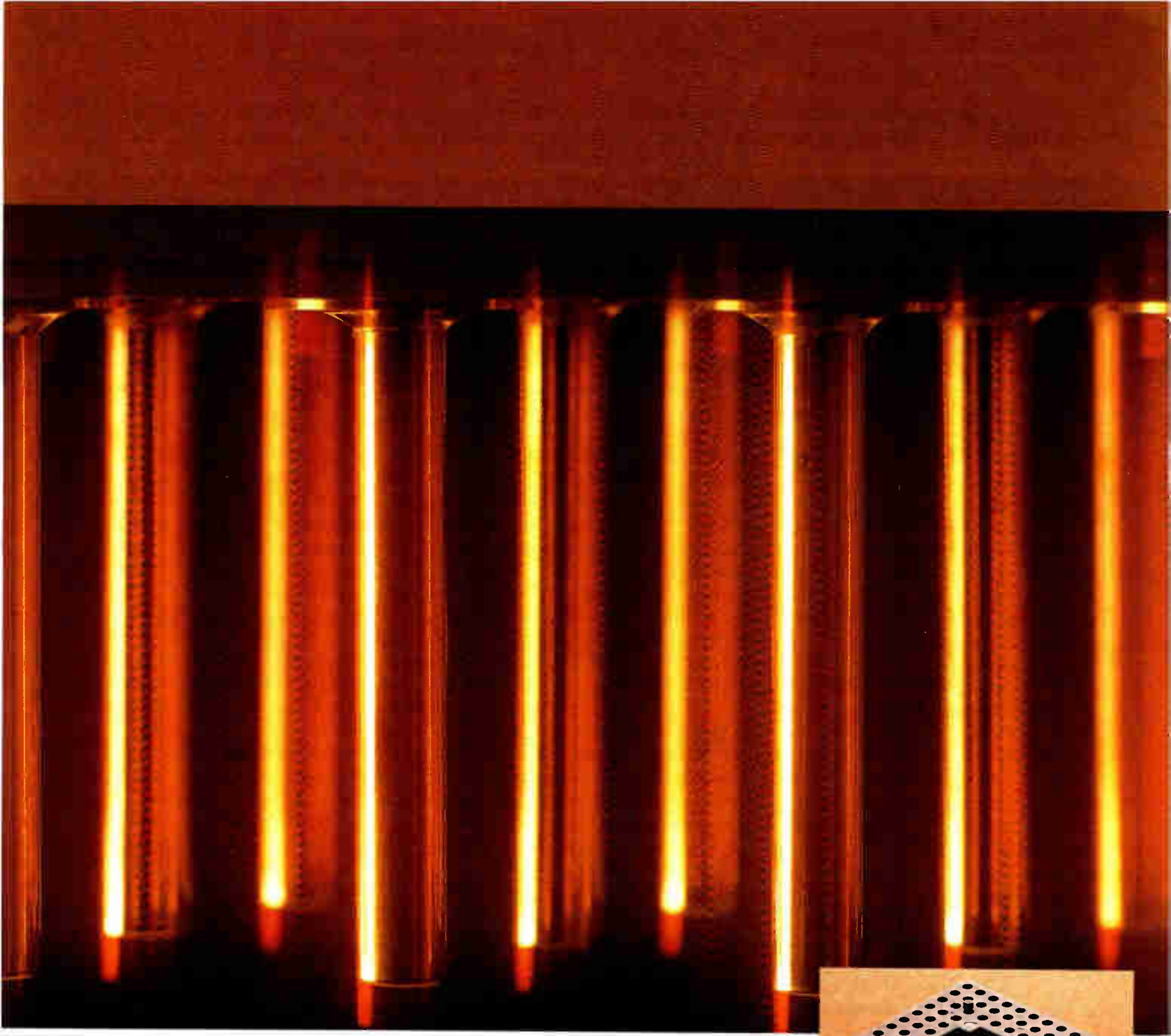
"There is doubt about all-digital systems, especially for terrestrial transmissions," says Sai Naimpally, vice president of Panasonic Corp.'s Advanced Television Laboratory in Burlington, N.J. But Naimpally is convinced that all-digital transmission is the wave of the future. It "looks beyond the next three or four years into the 21st century," he says. "There will have to be some serious rethinking in Japan and Europe."

Simulation testing is set to begin this month at the Advanced TV Test Center's laboratories in Alexandria, Va. Field testing of one or two of the systems will follow, says ATTC program officer Ben Crutchfield. All testing is to be completed by the end of 1992 to meet the Federal Communications Commission's schedule for adopting a standard in early 1993.

Since Japan and Europe are well into the process of deploying analog systems, the U.S. has a de facto lead in the digital TV technology. In Europe, work on digital HDTV is still in an embryonic stage in research institutes. Industry officials and project leaders for the Eureka 95 HDTV consortium agree that digital HDTV is coming, but almost certainly not by the 1995 deadline set for HDTV transmission in Europe.

"We must follow digital HDTV," says Eureka's chief, Peter Bögels. "But at this point, it's still a bird in the sky." Sönke Mehrgardt, technical director at the ITT Semiconductors Group in Freiburg, Germany, agrees. "Work on Eureka 95 and the HD-MAC standard has gathered such momentum by now that it cannot be stopped to pursue another approach," he says. Some of the early work on digital HDTV is being done as part of Eureka 95. Also studying the subject are a handful of other groups, including, in the UK, National Transcommunications Ltd. The company's program is to compress broadcast TV plus stereo sound by a ratio of 1:18 so that a broadband HDTV signal will fit into the 8-MHz bandwidth used for conventional TV broadcasting in Britain.

Systems in Europe, the U.S., and Japan have the same fundamental problem: coping with a noisy transmission channel. Over-the-air broadcasting is notorious for its peculiar channel impairments such as ghosts and airplane flutter, and these channel-related problems compound the challenge for the compression algorithms that must squeeze a full-bandwidth 800-Mbit/s signal into the 20 Mbits/s required by the 6-MHz TV channel. One difficulty arises from variable-length coding tech-



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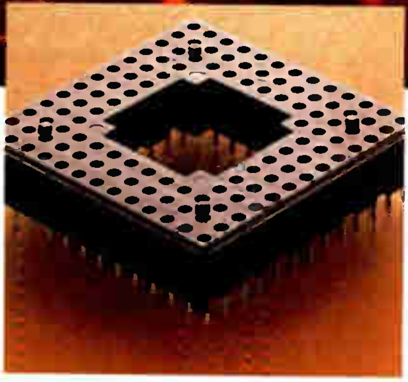


Dual-beam contact LIF PGA

AMP

CIRCLE 174

niques, which compress data by deleting redundancy, says Dimitris Anastassiou, codirector of the Image and Advanced TV Laboratory at Columbia University in New York.

The video bit stream is reconstructed at the receiver as directed by the algorithm, but every algorithm is subject to some data loss, he says. Picture reconstruction is assisted by error-correction techniques, but if they fail, the picture can degrade quite rapidly—and completely—because one wrong bit in variable-length coding can propagate errors throughout the picture, literally leaving no picture at all. This is in marked contrast to the slowly degrading picture of today's analog NTSC broadcasts. The key to a successful digital HDTV, says Anastassiou, will be "graceful degradation"—the ability to move from an excellent picture to a good one to a bad-but-viewable one as distance from the transmitter increases.

This is no simple matter when the pictures are moving and the 40:1 compression must occur in real time. All the proponents claim to have solved this problem with robust algorithms. Interestingly, their approaches appear to be quite different. But they all offer some commonality with the compression hierarchy adopted by the International Standards Organization's Motion Picture Experts Group [*Electronics*, December 1990, p. 53].

This is good news for the computer community, since until now MPEG has mostly been mentioned in the context of multimedia and video conferencing. Another hopeful sign for computer makers is the Zenith/AT&T consortium's provision for "square pixels" and progressive—instead of interlaced—line scanning. By making the horizontal and vertical distance between pixels equal, the Zenith/AT&T proposal eases the job of integrating computer-generated graphics on the screen. Similarly, progressive scanning is the mode used in computer displays.

Zenith and AT&T have company: the system proposed by the Massachusetts Institute of Technology on behalf of the the American Television Alliance (General Instruments and MIT) also offers progressive scan and square pixels. Although the proposal from the Advanced Television Research Consortium (Sarnoff Research Center, NBC, Philips, and Thomson) uses interlaced scanning, the ATRC claims it is flexible enough to be converted to progressive scanning.

Proponents say there is good reason to go digital despite the channel-impairment challenge. "Many entertainment appliances in the home are going digital," says Ralph Cerbone, advanced TV project director at AT&T Microelectronics, Berkeley Heights, N.J. Among the associated applications mentioned for HDTV are compact-disc sound, computer graphics, multimedia libraries, and high-fidelity digital video recordings. Cerbone estimates that the additional cost for signal processing in an HDTV receiver will be $700, compared with the cost of an NTSC receiver with the same size screen.

Not coincidentally, the all-digital TV proposals come at a time when MPEG is preparing to move to higher picture quality by detailing a second-generation coding scheme. MPEG-2 will deal with roughly the same compression as HDTV in a 6-MHz channel when it starts its bake-out testing this summer. The goal of initial MPEG-2 tests will be to compress a standard-size screen into either 4 or 9 Mbits/s (compared with MPEG-1's bandwidth of 1.5 Mbits/s). HDTV compresses a screen that's four times larger 20 at Mbits/s.

The system description the ATRC has submitted to the FCC follows MPEG so closely that ATRC calls it MPEG++. It is "quite likely" that the algorithm will be submitted to the MPEG-2 committee later this year, says Glenn Reitmeier, director of high-definition imaging and computing at the Sarnoff Labs in Princeton, N.J. The joint proposals of General Instruments and MIT also follow MPEG generally. The Zenith/AT&T proposal is least related to MPEG. It uses technologies developed at Bell Labs, including adaptive quantization techniques based on what the human eye can—and cannot—discern in a moving picture.

Assuming at least one of the proponents can pull it off, the all-digital systems offer a much better economic deal for broadcasters. TV station managers choked when a $40 million price tag for converting a studio to HDTV started circulating last year. Although only partially true [*Electronics*, June 1990, p. 66], the rumors banished HDTV to an appendix in some broadcasters' strategic plans. The same FCC advisory committee's Working Party on Economic Assessment that developed last year's figures now points out that digital systems could lower costs significantly. They operate at lower power, which means less expensive transmitters and antennas.

In fact, the operating budget for power would be much lower than for an NTSC system, and this is digital HDTV's largest single boon to broadcasters, says William Schreiber, a Cambridge, Mass., consultant and former MIT professor. Production costs will be about the same for any HDTV system, says Sarnoff's Reitmeier. Digital systems could benefit from economies of scale by using computer technologies such as memory and compression engines, he adds.

Not everyone is happy with the all-digital approach. One of the most vocal critics is Schreiber, who masterminded MIT's hybrid analog/digital system, which was displaced by the all-digital proposal. "For the same cost of receivers, there is no way to get the robustness from an all-digital system," he says. "You have to get ghosting down to a much lower level."

Schreiber also contends that a hybrid ap-

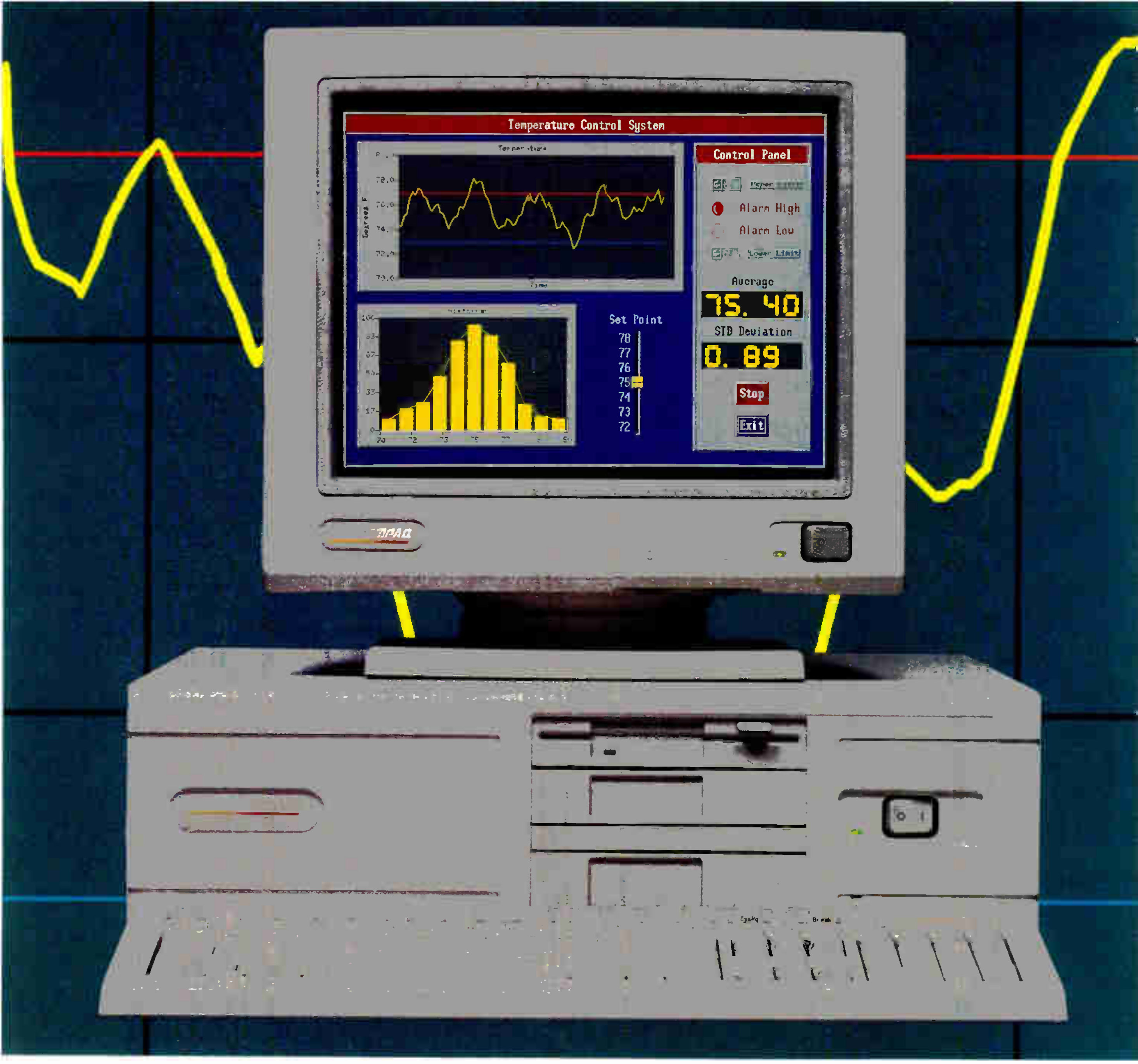
HOW THEY DIFFER

	Bidirectional Coding Mode	Progressive Scan	Square Pixels	Graceful Degradation
Zenith/AT&T	N	Y	Y	N
Advanced TV Research Consortium (1)	Y	N	N	Y
American Television Alliance (2)	N	Y	Y	N

Notes: 1. The ATRC includes Sarnoff Labs, NBC, Thomson, and Philips.

2. The ATA is a joint effort of General Instruments and the Massachusetts Institute of Technology. Each will submit a separate proposal.

SOURCE: *Electronics*



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CIRCLE 176

proach delivers better spectrum efficiency. Instead of using the entire 6 MHz in a TV channel, MIT's hybrid system transmits 5 Mbits/s and 5 million analog samples/s in 3 MHz. The remaining 3 MHz in the channel can be used for cellular radio, an application crying out for more spectrum, he says.

On the receiver side, digital systems should not add much cost to the price of a TV set, since the picture tube—or projection system—will make up the lion's share of overall cost. Panasonic's Naimpally believes technology and production volume will intersect at a cost-effective display in about five years. This time line gives the FCC a little breathing room in creating a digital standard, and the digital proponents might need it to fine-tune their algorithms.

Another plus for digital systems is that they offer set manufacturers more flexibility to hook into computers and other peripherals. There are, however, limits to the set makers' interest in an open architecture, says Naimpally. Cost considerations limit the set to just one field-scanning and one line-scanning rate. Otherwise, they can be programmable. Accepting varying resolutions and multiple video sources will help in marketing HDTV sets, he says, because it will take time to ramp up production for HDTV programming.

This view dovetails with the most likely scenario for migrating broadcasters to HDTV. Initially, local broadcasters will need only enough equipment to "pass through" network programming to the consumer. The last programs to switch over will be local news production.

But broadcasters may have to balance the benefits of digital systems against broadcasting to a smaller viewing area than they now serve with NTSC. "Broadcasters have to be concerned about their coverage from two points of view," says Merrill Weiss, managing director of advanced TV systems at NBC in New York. "First is the amount of interference from neighboring stations using the same channel. Second, they have to be concerned about the fact that digital transmission tends to fail abruptly, which would give them trouble in fringe areas. Nothing would be more disconcerting for viewers than to have their picture and sound switched on and off when they are trying to watch a show."

Since all the digital proponents have error correction, they can all claim their systems will degrade gracefully, says Columbia's Anastassiou. But from initial review of the FCC submissions, only the ATRC proposal specifically provides for stepwise degradation, he adds.

HDTV images can be thought of as having various levels of detail, and the data in each level can be given various degrees of protection. The engineering trade-off balances the number of "overhead" bits allocated to error correction against the number of data bits that actually constitute the picture. A picture with near-perfect error protection, for example, will still be low in quality because relatively few bits are left for coding the picture itself.

But data can also be protected by using modulation schemes, says Martin Vetterli, codirector of Columbia's TV lab. He draws the analogy of sending high-priority information at a lower bit rate than lower-priority information, but more sophisticated modulation schemes are also possible.

The Zenith/AT&T proposal takes more of an all-or-nothing approach than ATRC's. "It does not make any sense at all to talk about a smaller service area than the broadcasters have now," says Wayne Luplow, executive director of research and development for Zenith Electronic Systems in Glenview, Ill. Luplow acknowledges that at some point his system will go from "a perfect picture to no picture at all," but contends it will transmit 60 miles—farther than the competition, regardless of their provisions for graceful degradation.

Only through field testing will a winner's strategic decision on graceful degradation be confirmed. In the meantime, the digital proponents have been working feverishly on their algorithms using supercomputer simulations. "None of the digital proponents have hardware in a complete system," says Luplow. "We have pieces, but we will not have a complete system until our test slot comes up in October."

The flip side of picture integrity is picture quality, an important consideration that sometimes gets lost in the debate over transmission strategies. Using the MPEG coding hierarchy as a guide, three types of frames—video still pictures, roughly speaking—can be defined.

The first is Intra-frames, or I-Frames. These involve intensive coding of an entire image and serve as references or anchors for the other two frame types, which compensate for motion. The simplest form of motion-compensation frames, P-Frames, predict motion forward in time. A P-Frame can be predicted from an I-Frame or another P-Frame. The third type of frame is a bidirectionally predicted frame, or B-Frame. It takes into account both the frames that go before it and the frames that follow. To do this, a few frames must be stored in video memory so comparisons can be made before the frame is displayed.

Digital proponents are keeping their ever changing plans close to the vest, so details on some proposals are sparse, says Columbia's Anastassiou. But it appears that only the ATRC plan currently incorporates B-Frame coding. "The bidirectional mode gives a significant improvement in picture quality," says Sarnoff's Reitmeier. "We believe that it is worth the additional cost of signal processing, which itself is a small part of the entire receiver cost."

Specific technology comparisons aside, the U.S. seems to have almost unwittingly stumbled into the lead in HDTV. It will most certainly be behind Japan and Europe in deployment, but as Panasonic's Naimpally says, digital systems look beyond the next four or five years into the 21st century.

"The NTSC standard has been around for 50 years," says Sarnoff's Reitmeier, "and one of the primary motivating factors for our system was to make it a standard that could live for 50 years" as well. By changing the fundamental rules of the game, the U.S. might still come up smelling like roses in terms of licensing technology and algorithms abroad. ❑

Additional reporting by Peter Fletcher and John Gosch

HDTV'S NEW LOOK

Field testing will make or break digital HDTV systems for terrestrial broadcasting.

Graceful degradation for digital systems could mean a shrinking service area for broadcasters.

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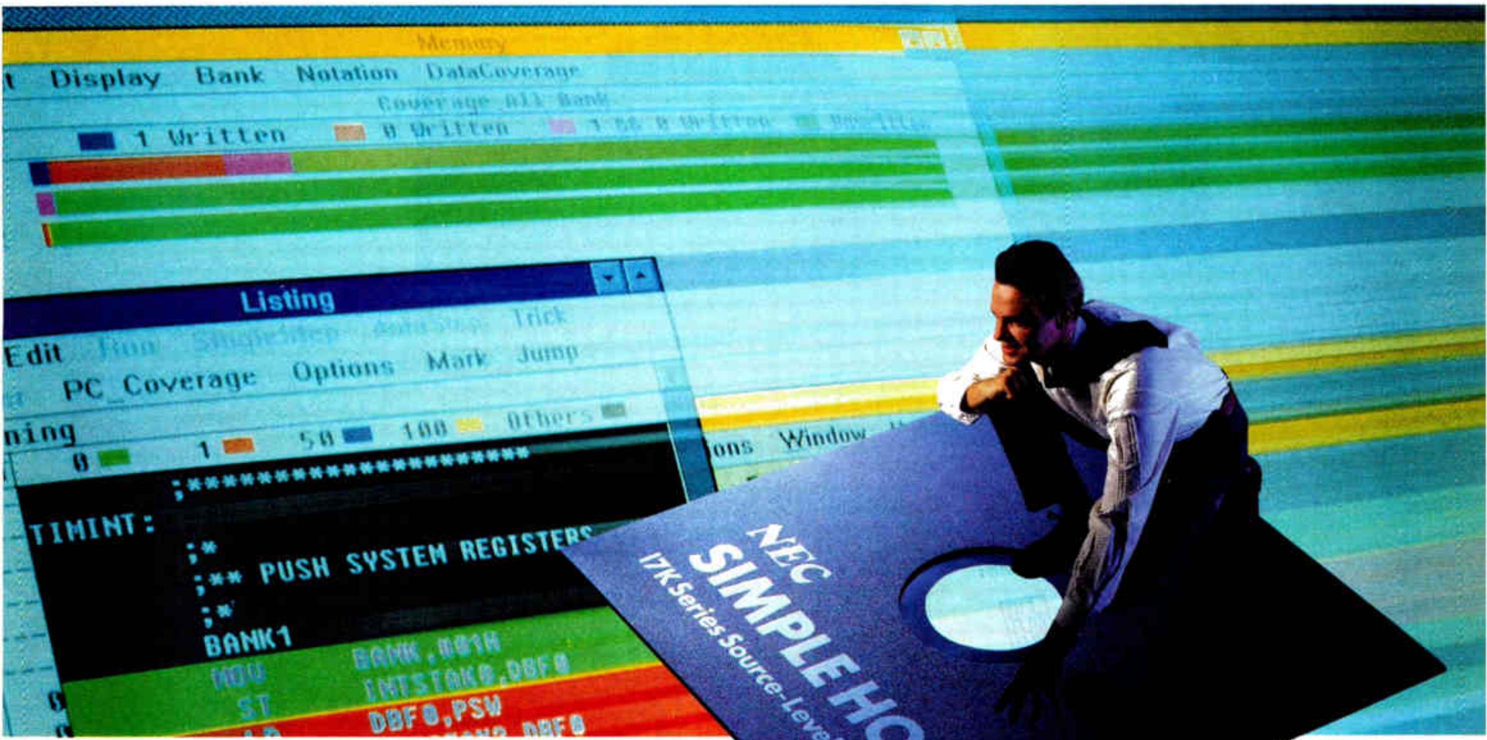

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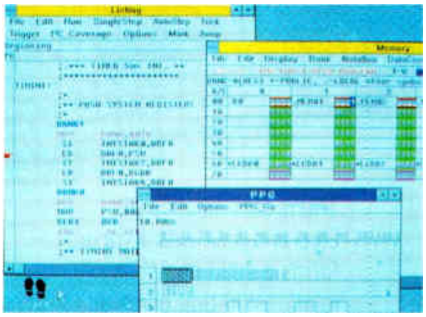

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CIRCLE 183

The Japanese found a powerful ally in U.S. computer makers, who testified against the small display vendors.

THE TECHNOLOGY THAT GOT AWAY

AN ANTIDUMPING SUIT IN FLAT PANELS RAISES BIGGER QUESTIONS ABOUT U.S. COMPETITIVENESS

BY JACQUELINE DAMIAN

DISPLAYS

Monday morning quarterbacks are still trying to decide who won. Both sides were claiming some measure of victory in the first round of an antidumping suit leveled by a handful of small U.S. producers of flat-panel displays against eight large Japanese manufacturers. The complainants found consolation in the Commerce Department's initial ruling in mid-February that the Japanese had, in fact, been dumping screens in the U.S.; the Japanese and their allies in the U.S. computer industry were pleased, in their turn, that the dumping margins were found to be minuscule.

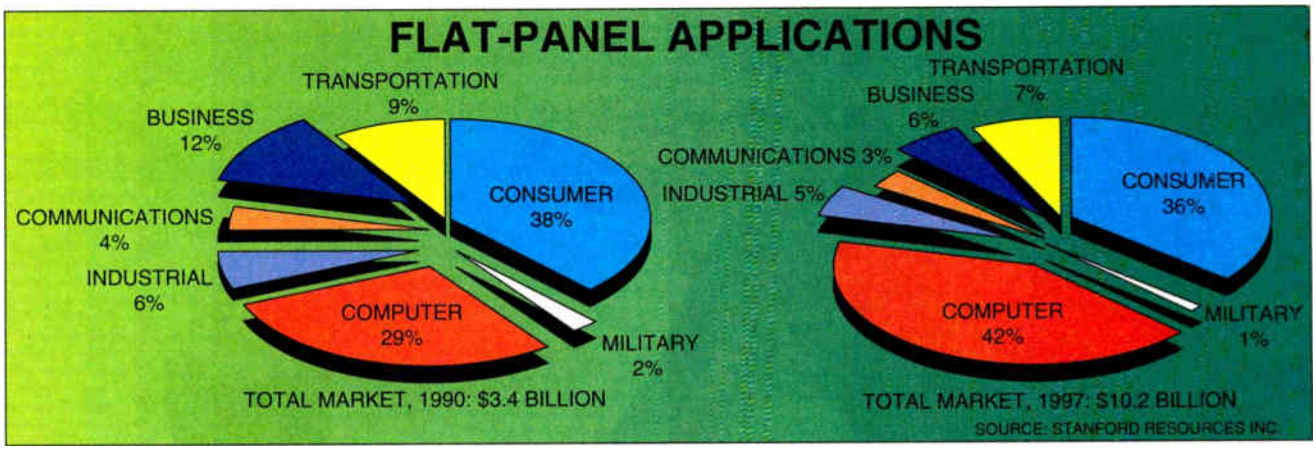
The Commerce Department is due to issue a final ruling by July 8 following on-site investigations in Japan to cull detailed cost-of-production figures from the companies involved. But whatever the outcome, this controversial suit has galvanized U.S. attention around flat-panel technology, a crucial link in the next generation of electronic systems. The question is whether it will spark a renewed American effort to ensure a domestic supply or become a memento mori for the technology that got away.

"This technology essentially fell through the cracks," says Richard Florida, a management professor at Carnegie Mellon University in Pittsburgh and co-author, with Martin Kenney, of *The Breakthrough Illusion: Corporate America's Failure to Move From Innovation to Mass Production* (Basic Books). "The U.S. basically made the pioneering breakthroughs [in flat panels] roughly 30 years ago. This is a case of having a breakthrough but not investing in it."

Because of that lapse, the U.S. display industry today consists of a dozen or so small entrepreneurial vendors serving niche markets with electroluminescent, plasma, and liquid-crystal displays. Not one U.S. company has high-volume manufacturing capability in flat panels of any type. Of today's $4 billion market, Japan owns fully 98%, according to Electronic Trend Publications in Saratoga, Calif.

The loss of this industry is a bitter pill for many in the U.S. electronics community, given market figures and technological trends that point toward meteoric growth for flat panels in the decade ahead. "The new electronic markets will revolve around display technology," says Florida of Carnegie Mellon. As these thin, lightweight screens find their way into more and more products, the worldwide market will zoom to $10.1 billion in 1997, according to Stanford Resources Inc., a San Jose, Calif., research house.

On the consumer side, flat panels will loom large—literally—in the coming age of high-definition TV. The Japanese goal is to have, by 1996, flat screens measuring 1 meter diagonally for TVs that may hang on a wall or be used in corporate video conferencing. On the computer end, the fast-growing laptop, notebook, and palmtop market will live or die by the quality, light weight, and low power consumption of its displays. Desktop machines will no doubt feature flat panels, too, once the price meets that of today's bulky cathode-ray tubes. Other uses are in auto-dashboard displays, computers that ac-



Analysts project meteoric growth for flat panels as these thin, lightweight screens find their way into the next generation of laptop and palmtop computers, HDTV sets, and other applications.

cept stylus-input "handwriting," medical and industrial systems, and avionics.

Moreover, the displays are vastly more sophisticated than CRTs and thus more central to system design. In fact, some observers go so far as to say that in the future, much of a system's circuitry may be etched onto the glass of the display—essentially, the display becomes the system.

"Displays can integrate a lot of system functionality—they're not a commodity component you can buy out of a catalog," says James M. Hurd, president and chief executive officer of Planar Systems Inc. in Beaverton, Ore., and spokesman for the Advanced Display Manufacturers of America (ADMA), the group that brought the dumping complaint. In the early 1980s, says Hurd, "The Japanese saw this and set flat panels as a strategic technology," investing hundreds of millions of dollars in research and manufacturing. By contrast, "many of the U.S. companies felt that the flat-panel display was a simple component like a CRT—something they're used to buying foreign, off the shelf."

The fact that LCDs are key to the burgeoning laptop market is what turned the dumping complaint from a U.S.-Japan struggle into an internecine battle within the American electronics industry. True, behemoths like Hitachi, Matsushita, and Toshiba stand accused of selling their LCDs below cost. But if the International Trade Commission imposes stiff duties on imports, these firms will suffer less than their customers in the U.S. computer industry.

The repercussions of a major price hike could be disastrous for the American vendors, who are jockeying for laptop market share, ironically enough, with the same vertically integrated Japanese giants that make the LCDs. That's why companies like Apple Computer Inc., Compaq Computer Corp., and others testified against the U.S. display makers at the ITC last summer, when the dumping complaint was originally filed. "In my experience, this was probably the most active presentation [by U.S. manufacturers] against U.S. manufacturers," says Lawrence Walders of the Graham & James law firm in Washington, co-counsel for the Japanese producers.

In the heat of the combat, the doomsayers painted an apocalyptic scenario whereby U.S. companies, unable to afford imported LCDs and lacking a domestic source, would exit the laptop business altogether or move production offshore. And no wonder: the ADMA complaint asked for margins of 70% to 300% on some displays. A 300% tariff would send the cost of a typical laptop LCD from $200 or so to a head-spinning $800; since displays account for about 40% of the cost of producing a computer, the price of an American laptop would catapult out of sight.

In the initial ruling, however, the Commerce Department imposed margins vastly lower than this: 4.6% for Sharp, 1.46% for Toshiba, nothing at all for Hosiden and Matsushita, and 2.33% for the rest. The computer industry heaved a collective sigh of relief, but ADMA's Hurd believes the final margins could be much higher once the data detailing price versus cost of materials, research, and return on investment are in from Japan. Indeed, "the verification is a very objective process," says Commerce spokeswoman Cydney Louth. "Those margins could change; they could go up, they could go down. I've seen margins go any which way."

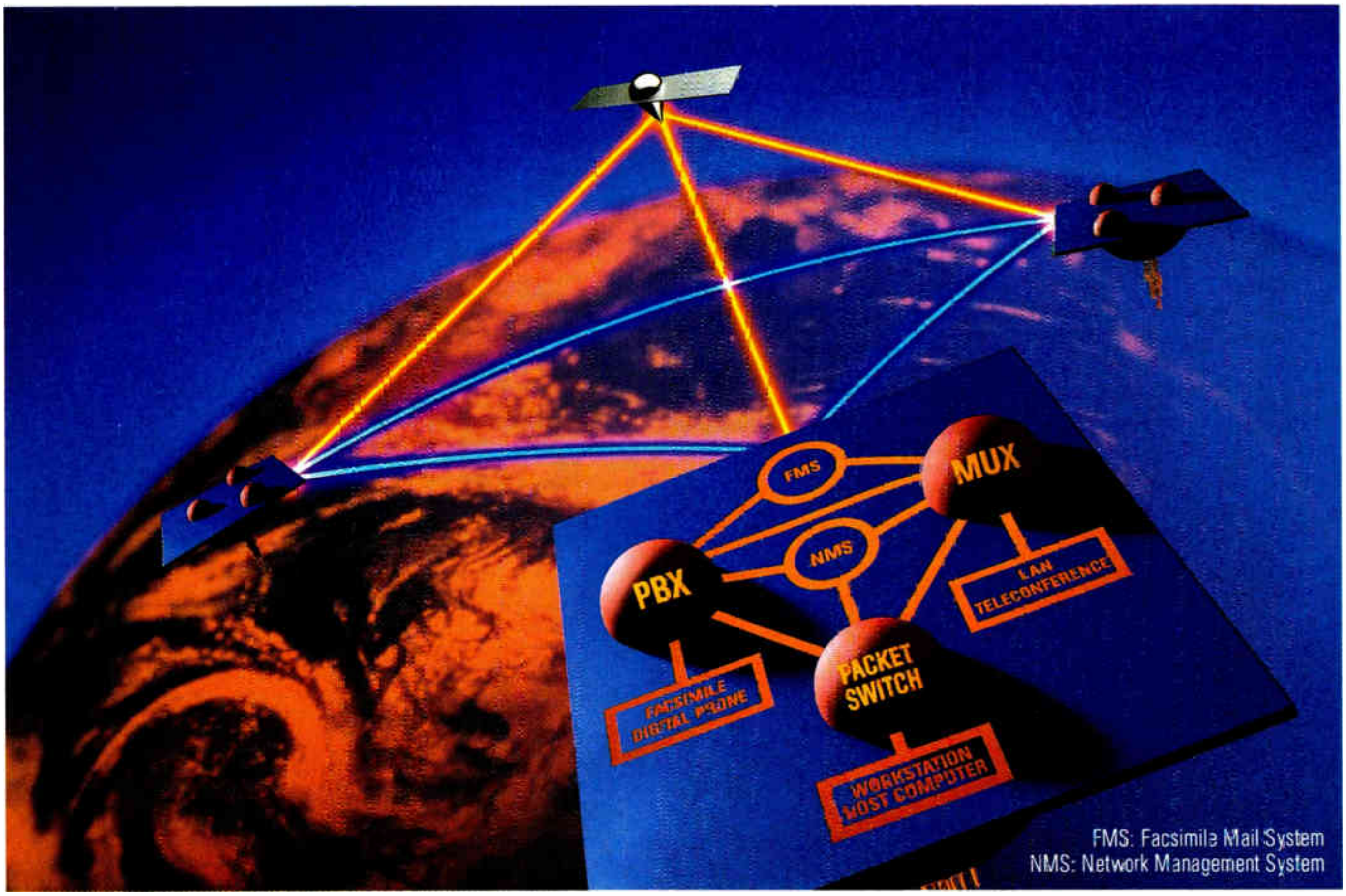
All ADMA wants, says Hurd, is "a level playing field" upon which U.S. technology won't be dismissed out of hand on the basis of price. Asked to describe the best-case scenario, ADMA member James L. Kehoe says: "As future display requirements come up for U.S. systems manufacturers, given the fair and legal pricing now required by the Japanese we would be better positioned to compete."

For their part, the computer makers understand ADMA's frustration but hold that tariffs aren't the solution. "Duties would not help them one iota," says James M. Burger, Apple's chief counsel-government. "There are some systemic problems here we need to look at. We [the U.S.] do not have in place anything to help the high-tech infrastructure. This case reflects a little corner of that frustration." The computer makers have frustrations of their own. Burger took pains in his ITC testimony to outline the efforts the Cupertino, Calif.-based company made to find a domestic supplier when it was planning the Macintosh Portable in 1987-88.

At the time, he says, only one U.S. vendor was making active-matrix LCDs, the type Apple needed to implement the Mac's distinctive user interface and crisp black-on-white screen. Although most laptops employ passive-matrix displays, the active-matrix variety is fast becoming the LCD of choice for its rich color and fast response time.

"The prices they gave us were ridiculous," Burger says. "We couldn't sell a portable at that cost." To get the volumes needed to bring down cost, he adds, "they said you'd have to invest in

NEC NEWSCOPE



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a plant for us. We said give us a business plan. They never got back to us."

The attitude that the computer makers should foot the bill is common in the U.S. display industry, says Steve Hix, a former manager at Planar Systems who now runs his own company, In Focus Systems Inc. in Tualatin, Ore. For example, says Hix, Compaq was interested in Planar's EL technology back in the mid-1980s, "but Planar didn't want the business unless Compaq wanted to fund the whole thing."

In Hix's opinion, that's not good business practice. "They say, 'you've got to pay us X amount to develop [a product],'" says Hix, who believes the R&D background of many in the U.S. display industry is a handicap when it comes to striking business deals. By contrast, "The Japanese come in and say, 'here's a product, here are the specs, we can do it.' Which one would you buy?"

It doesn't help that the cost of manufacturing flat panels is steep. "It's very similar to setting up a wafer fab," says Kehoe, who is president and CEO of Plasmaco Inc. in Highland, N.Y. To produce 250,000 displays a year would take an investment of "$100 million or more," he says. Adds Hurd: "That's not the level of risk the U.S. financial community is comfortable with. Venture capitalists prefer to seed a few million here and there. For flat panels, you need tens of millions up front."

What's more, the displays are difficult to manufacture. A 10-in. active-matrix LCD, for example, might contain a million thin-film transistors (TFTs), each controlling a pixel and each formed on a fragile glass substrate much in the manner of a huge integrated circuit. Sharpness, contrast, and color are daunting technical hurdles, and the task becomes ever more perplexing as the screen size increases. The Japanese have had serious delays and low yields in bringing this technology to market.

The cost and complexity of manufacturing, along with the unavailability of sufficient capital, are the factors that led companies that pioneered flat-panel displays in the 1960s and '70s, like Westinghouse Electric Corp., to give up on the technology [*Electronics*, September 1990, p. 43]. But the Japanese had a structure in place that allowed them to persevere, says Carnegie Mellon's Florida.

"Japanese companies are very good at process innovation. They get the shop-floor workers involved. They consider the factory itself to be a living laboratory," he says. So as flat panels emerge from the research lab, factory workers can "actively implement a process" and continually tweak it for efficiency, he says, working hand in glove with the researchers for optimal results. This patient approach to manufacturing "dovetails with their long-term investment horizons and their long-term strategic interests."

FLAT-PANEL DEBATE

The antidumping suit has pitted U.S. display manufacturers against the U.S. computer industry, which buys its displays from the Japanese vendors named in the complaint.

The bigger issue: is it a good idea for American laptop makers to rely on offshore competitors for a crucial component? And is there a way for the U.S. to regain some footing in the flat-panel market?

Florida is just one observer who would like to see the U.S. regain domestic control of flat-planel technology. With the supply offshore, he says, "American firms continue to be at the mercy of their main competitors. In this situation, the risk of price-gouging, supply shortage, and cutoff are inordinately high."

Apple's Burger agrees: "We would like, for selfish reasons, to have a whole variety of production here," he says. "A plant next door to our [portables] plant in Fremont making flat-panel displays" would be ideal. "But it has to be competitively priced."

How to get there is another question. Every so often talk is heard of forming a consortium much as chip makers did with U.S. Memories. Most recently, Harris, NCR, Sun Microsystems, and the David Sarnoff Research Center, an HDTV leader, were said to be considering such a move. Some see hope in the fact that Xerox Corp., which developed active-matrix LCD technology for its printers and scanners, is looking for partners to commercialize the technology. The company's Palo Alto Research Center, in a joint venture with Standish Industries of Lake Mills, Wis., is developing a prototype suitable for HDTV.

Meanwhile, buoyed by a larger research allotment in the new federal budget, a consortium of ADMA members has just nabbed a $1.25 million federal grant under Commerce's new Advanced Technology Program. The 10 consortium members, which have pledged another $7.6 million to the project, will jointly explore precompetitive research into such generic technologies as drivers and interconnect schemes as well as test and repair.

Direct investment by the computer industry is yet another option. "You need to have an attitude by the Apples and Compaqs that they're willing to invest in some of the companies that are out there," says consultant Mark Duncan, author of the report "Computer Industry: Critical Trends for the 1990s" for Electronic Trend Publications.

Investment, along with a commitment to buy products, would help attract additional capital and get domestic production humming, Duncan says. He points to Digital Equipment Corp.'s choice of a Planar Systems EL display for its MicroVAX workstations—a deal that included some development funding—as a step in the right direction.

In lieu of a broad-based domestic supply, some computer makers are turning to strategic partnerships with the Japanese, such as IBM Corp.'s LCD joint venture with Toshiba Corp. The Japan-based venture, Display Technologies Inc., aims to introduce 10-in. color active-matrix LCDs this spring. At the other end of the size scale, some flat-panel outfits are turning in the same direction: for example, startup FPD Technology Inc. of Wayland, Mass., is looking for a big Japanese backer for its ladder-logic magnetic switch, which could replace TFTs in LCD manufacture [*Electronics*, March 1990, p. 16].

Ultimately, says Florida, "if we fail to do it [ourselves], Japan will do it for us." Indeed, Sharp Corp. has just announced it will build a $30 million plant in Camas, Wash., to manufacture passive-matrix LCDs. And Hix of In Focus Systems reports that on a recent trip to Japan, he heard a number of other LCD makers, stung by the dumping suit, talk of setting up shop in the U.S. "This whole discussion," Hix says, "should have taken place 15 years ago."

With steel and autos, says Florida, "Japan rebuilt those industries for us right in our backyards." They may well do the same with flat-panel displays. ❑

READY OR NOT, HERE COME XGA GRAPHICS

IBM OFFERS A STANDARD FOR NEW-AGE PC GRAPHICS AS VENDORS PUSH THE LIMITS ON SUPER VGA

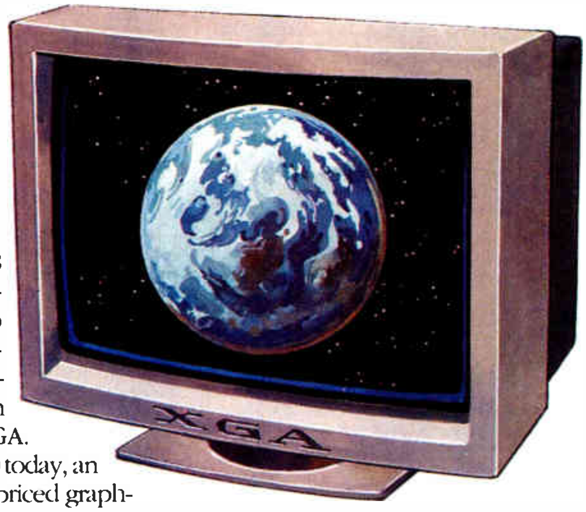
BY JONAH McLEOD

SEMICONDUCTORS

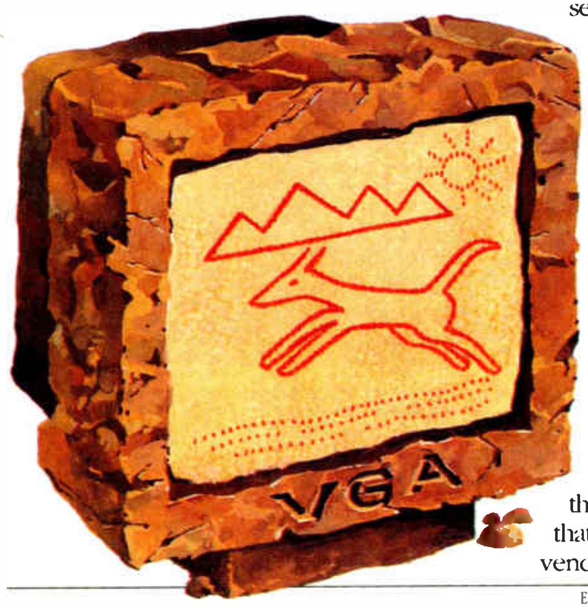
The advent of graphical user interfaces, primarily Windows 3.0, is driving the demand for personal computer graphics with higher resolution and more colors than ever before. As the number of pixels on a screen increases and the variety of colors possible on each pixel explodes, the compute power of graphics controllers must take a quantum leap forward. Graphical user interfaces are straining existing VGA controller chips.

The ultimate solution is the extended VGA, or XGA, standard announced by IBM Corp. late last October. XGA provides resolution of 1,024 by 780 pixels, against 640 by 480 in Big Blue's venerable Video Graphics Array, and 64,000 colors per pixel, compared with just 16 for VGA. The new standard replaces IBM's previous contender for the high-resolution crown, the 8514/A, which belly flopped with the industry.

The market for XGA is ripe—in an industry hungry for high-performance graphics, graphic-chip shipments are growing nearly 30% annually, analysts say. What's more, XGA promises to bring standardization and intelligent graphics coprocessing to a market lacking both. But it may take 18 months or so for a groundswell of XGA solutions to appear, and in the meantime chip makers are pushing the performance of an interim standard, Super VGA.



That's because at $1,000 today, an XGA board is a very high-priced graphics solution. By contrast, Super VGA boards, with resolution of 800 by 600 pixels, typically cost $200. Suppliers are wondering how long to milk the Super VGA market. The trick is determining how rapidly the price of XGA will fall below $500, the mark that throws a product into the millions-of-units-a-year category. Industry watchers expect to see XGA solutions from others besides IBM as early as the Fall Comdex show. Prices should start dropping within 18 months, according to the market model for graphics-standards migration: it took 18 months to two years for VGA to displace the earlier CGA as the de facto standard and become a mass-market item.



If XGA follows this model, it will bring some much needed standardization to the marketplace. In their effort to devise solutions that go beyond VGA quality, vendors have come up with a host of proprietary schemes, says Bob Brummer, product manager for high-resolution graphics at Chips & Technologies Inc. in San Jose, Calif. This proliferation of so-called Super VGA chips adds better resolution and more colors to the basic VGA spec, he says. But each chip requires its own unique software drivers and interacts with the host central processing unit in its own way.

For example, Microsoft Windows ships only with software drivers for Headland Technology Inc.'s Super VGA chip. All other chip makers provide software drivers for their own implementations, which the user must load into the operating system. With XGA, by contrast, only one software driver is needed for all chips and all application software.

There is no doubt that XGA will become an industry standard; IBM is actively lobbying the Video Electronics Standard Association, an ad hoc group, to adopt XGA. Moreover, the company is backing off its VGA strategy of keeping that standard's specifications under wraps, forcing chip designers to reverse-engineer the devices. Instead, IBM has been aggressive in providing all the information needed to build XGA-compatible chips.

One important capability XGA brings to PC graphics is intelligence. Borrowing from the concept of a graphics coprocessor, a staple of workstation design, an XGA coprocessor, not the CPU, draws the image, thus freeing the CPU for other computing tasks.

"In [VGA and] Super VGA, the host 80386 does all the line drawings," says Brummer of Chips & Technologies. That's why VGA chips are considered dumb input/output devices, says Brian Herbert at NCR Microelectronics Inc. in Colorado Springs, Colo. They simply draw a pixel map that the CPU then builds on screen. By contrast, "XGA can execute line-drawing and bitblt [bit-boundary block transfer] commands," says Brummer. A few Super VGA chips approach the coprocessor concept. For example, in NCR's 77C22, the CPU sends a monochrome pattern and the 77C22 expands it into full color, says Herbert. "Sending the less complex monochrome image cuts the amount of bus traffic, so you can move more information over the bus with fewer bytes."

The only company to date with an XGA solution is, of course, IBM, which late last year rolled out an XGA add-in board for the Personal System/2. "IBM has a two-chip architecture," says Bill Knapp, director of advanced products at Cirrus Logic Inc. in Fremont, Calif. "They put the RAM-DAC [random-access memory plus digital-to-analog converter] onto the graphics controller chip." IBM chose a high-priced RAM-DAC, he says; hence the high price tag of its solution.

A few graphics chip makers may follow IBM's lead, but not many have the analog expertise to pull it off. One that does is SMOS Systems Inc. in San Jose. The company's Dragon chip set, a six-chip solution aimed at laptop PCs, contains an integral RAM-DAC, says Robert Wong, director of standard products. Otherwise, vendors will be looking to RAM-DAC suppliers to roll out units suitable for XGA.

Two companies in the business of building RAM-DACs are Brooktree Corp. of San Diego and Sierra Semiconductor Corp. of San Jose. Brooktree's BT471, BT476, and BT478 contain 8-bit DACs that provide 256-color capability per pixel in many of today's Super VGA chip solutions. Sierra in late 1990 began offering its SC11481, 486, and 488 chips, which were designed to work with the Tseng Labs Inc. ET4000 Super VGA controller. Last month, it rolled out the SC11475/SC11477 RAM-DACs, which interface with most other Super VGA controllers. Since they provide 32,000 colors per pixel, the chips can approximate the IBM RAM-DAC. The only problem is that the higher number of colors takes so much computing power that the resolution must drop if the controller is to paint the screen every frame.

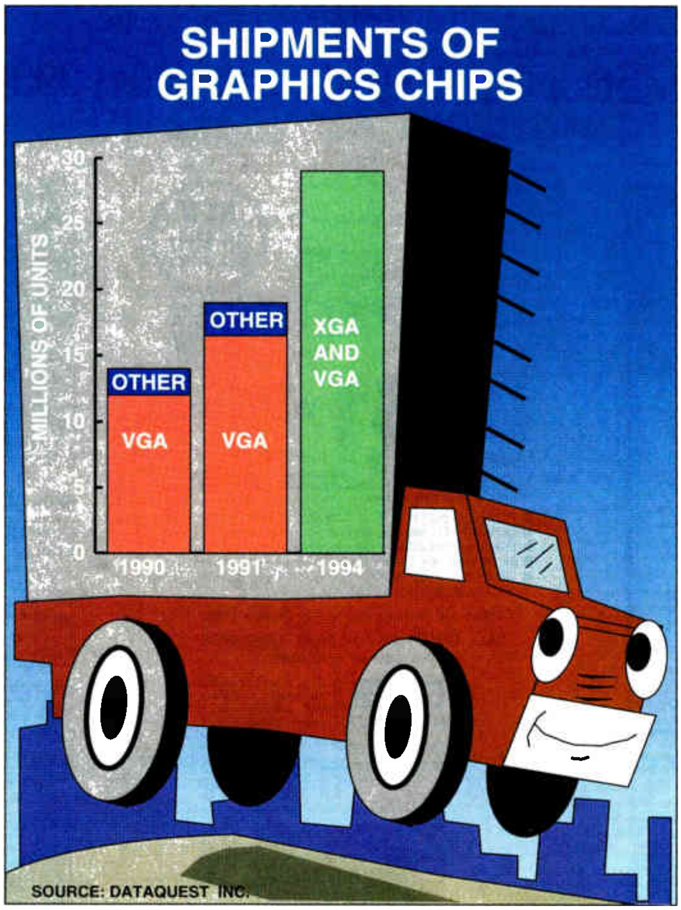
Sierra's RAM-DAC is just one way that Super VGA vendors are reaching for XGA-level performance. One of the latest to gain XGA's resolution and colors is Western Digital Corp.'s WD90C3X. The chip is implemented in 0.9-µm technology, which means its processing speed is sufficient for 1,024 by 768 pixels and 256 colors, says Chris Chang, product manager for the family at the Irvine, Calif., company. If the user is willing to swap resolution for color, the chip will drive 640 by 480 pixels and 64,000 colors.

In the quest to further the life of Super VGA, PC makers are experimenting with putting the graphics controller on the local bus, which runs between the CPU and the dynamic RAM. In most PC systems, the graphics controller is a plug-in card added to the AT bus, which means performance is hamstrung by the low AT bus speed. IBM built XGA on the much higher-speed MicroChannel bus. However, cost dictates the AT bus for the mass of the PC market, so using the local bus for graphics is one solution.

Headland Technology has tied its product strategy to the local bus. "Our HT216 chip is the local bus chip for the motherboard," says Jim Anderson, director of product marketing at the Fremont company. "The PC maker gets coprocessor performance at VGA price." NCR also plans to move its Super VGA chip onto the local bus.

But Brummer at Chips & Technologies is skeptical that this method necessarily affords a performance boost. "There is memory overhead in moving data from host processor to the display memory," he says. A more attractive solution, he says, is to build the Super VGA controller board using video RAM memory. Brummer points out that prices of 1-Mbit VRAMs have now been halved to $10 or $12. That's still a premium over DRAMs, but it's within the price range of a low-cost board.

While every graphics-chip vendor pushes its Super VGA chip closer to XGA performance, all are simultaneously working feverishly on an XGA solution. The market opportunity for the chip vendor with little Super VGA market share lies in leapfrogging the pack and being first with XGA. ❑



In 1994, vendors will ship 29 million graphics ICs; XGA's portion depends on how fast the price drops.

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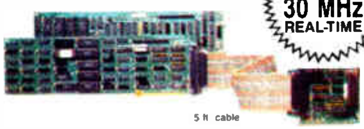

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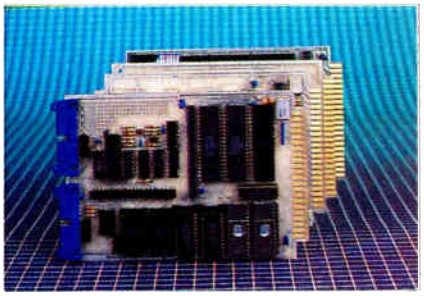

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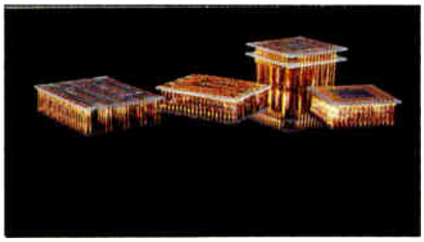

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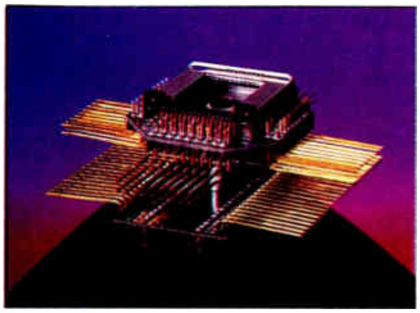

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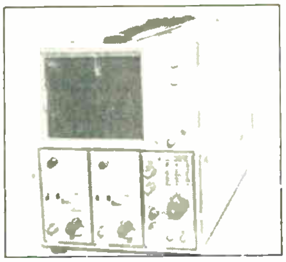

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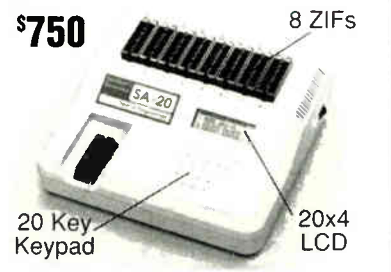

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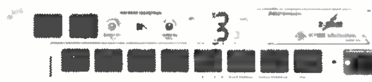

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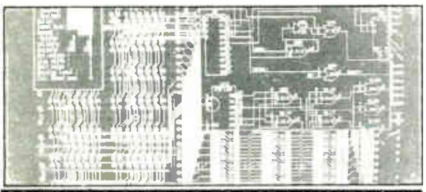

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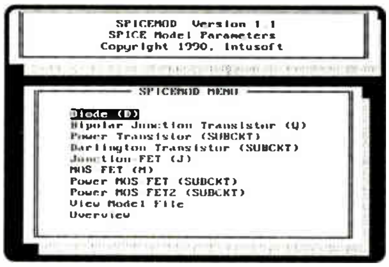

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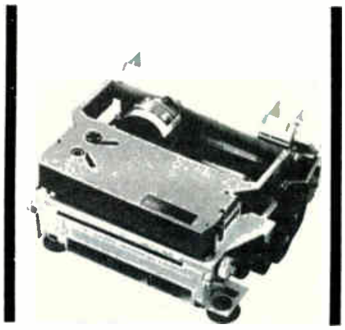

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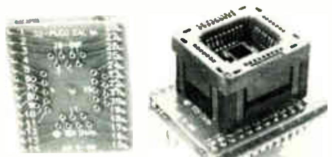

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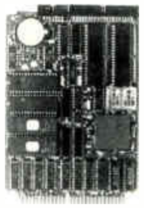

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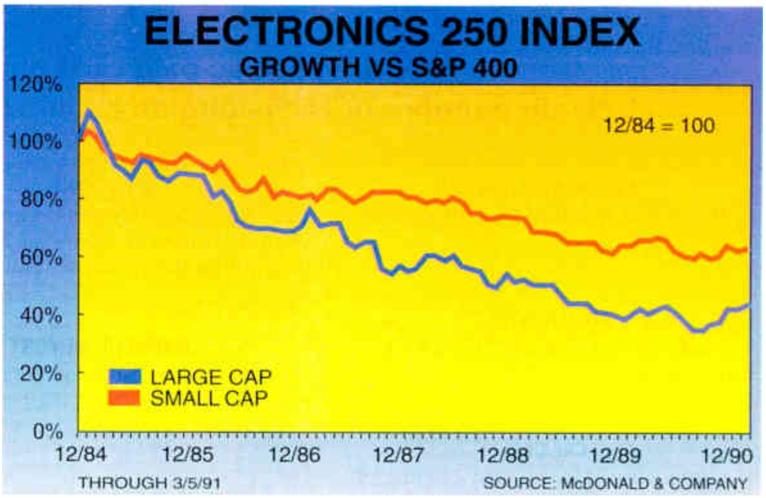
THE RECOVERY ISN'T GOING TO BE THAT EASY

This is not going to be an easy recovery though electronics, as usual, will do better than the rest of the economy. Even as industry demand begins to recover and corporate planners start to loosen their purse strings, seasonal inventory building and order strength look much more constrained than usual.

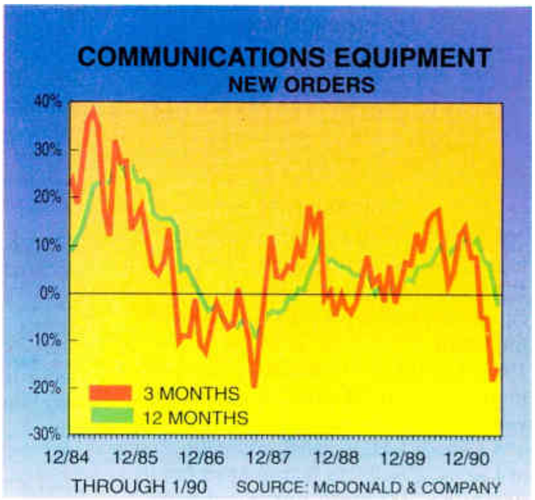
In general, order patterns remain very weak. The recession continues to depress new business formations, increase business failures, and delay all but the most essential capital appropriations. And the government, burdened with enormous debt, will not spend the economy out of recession this time. Consumers face higher taxes, increased health-care costs, well-above-average debt burdens, and weaker housing values. Europe's growth continues to slow, limiting its ability to take the pressure off weak domestic demand. New capital demands from Kuwait, Saudi Arabia, Germany, and the Soviet Union will at best limit the Fed's ability to lower long-term interest rates. Electronics companies will need to focus more than ever on the basics, excelling at listening to their customers, improving quality, and increasing productivity.

Communications orders remained weak in January, while computer orders may be showing some modest improvement after a disastrous December. Component orders are still showing low single-digit growth. February trends showed little improvement from January, while preliminary comments on activity in March suggest only modest recovery. Auto and truck demand shows no sign of improvement, as Big Three production plans for the second quarter are down 14% from last year. Aerospace demand is also weakening, but huge backlogs could help alleviate pressure on suppliers. Inventory productivity remains excellent. ❑

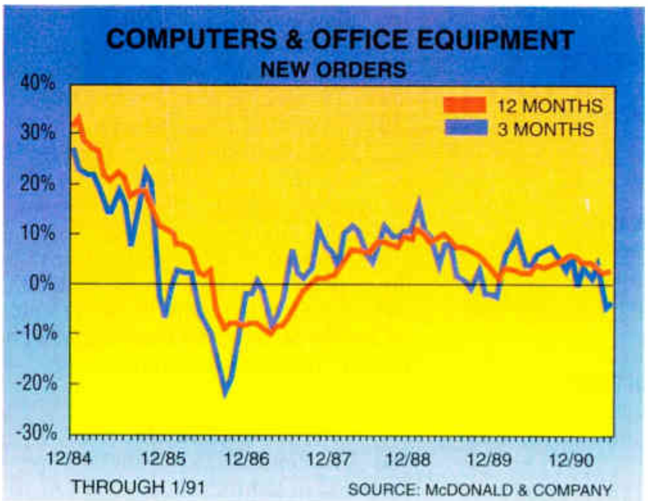
By Mark Parr, McDonald & Co. Securities, Cleveland (216-443-2379)



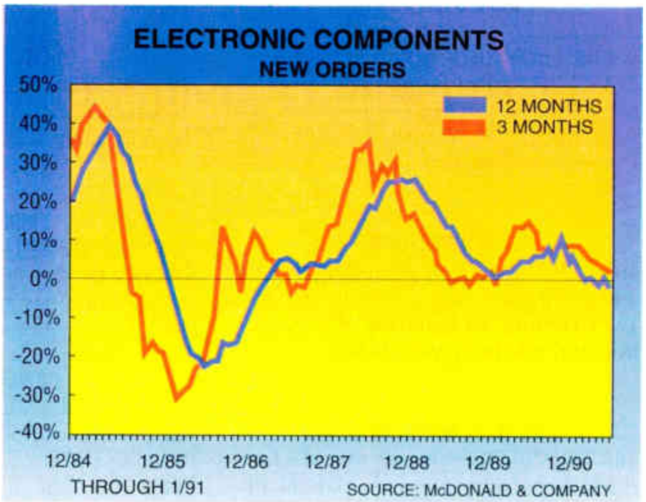
First-quarter earnings are likely to disappoint, and the second quarter's preliminary outlook leaves a lot to be desired.



Orders for communications equipment showed no signs of reversing their downward trend.



December was a disastrous month for the computer business, with any improvement since then only modest.



The components business may recover slightly in March from slow growth pattern of January and February.

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Check your one principal job function.

- 01 ☐ Corporate & Operating Mgt.
- 07 ☐ Engineering Mgt.
- 03 ☐ Manufacturing Mgr.
- 04 ☐ Purchasing Mgt.
- 05 ☐ Marketing & Sales Mgt.

How many people are employed in your entire organization?

- 1 ☐ 10,000 or more
- 2 ☐ 1,000-9,999
- 3 ☐ 100-999
- 4 ☐ Less than 100

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