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MARCH 1990

# Electronics

FIRST MAGAZINE OF GLOBAL ELECTRONICS MANAGEMENT

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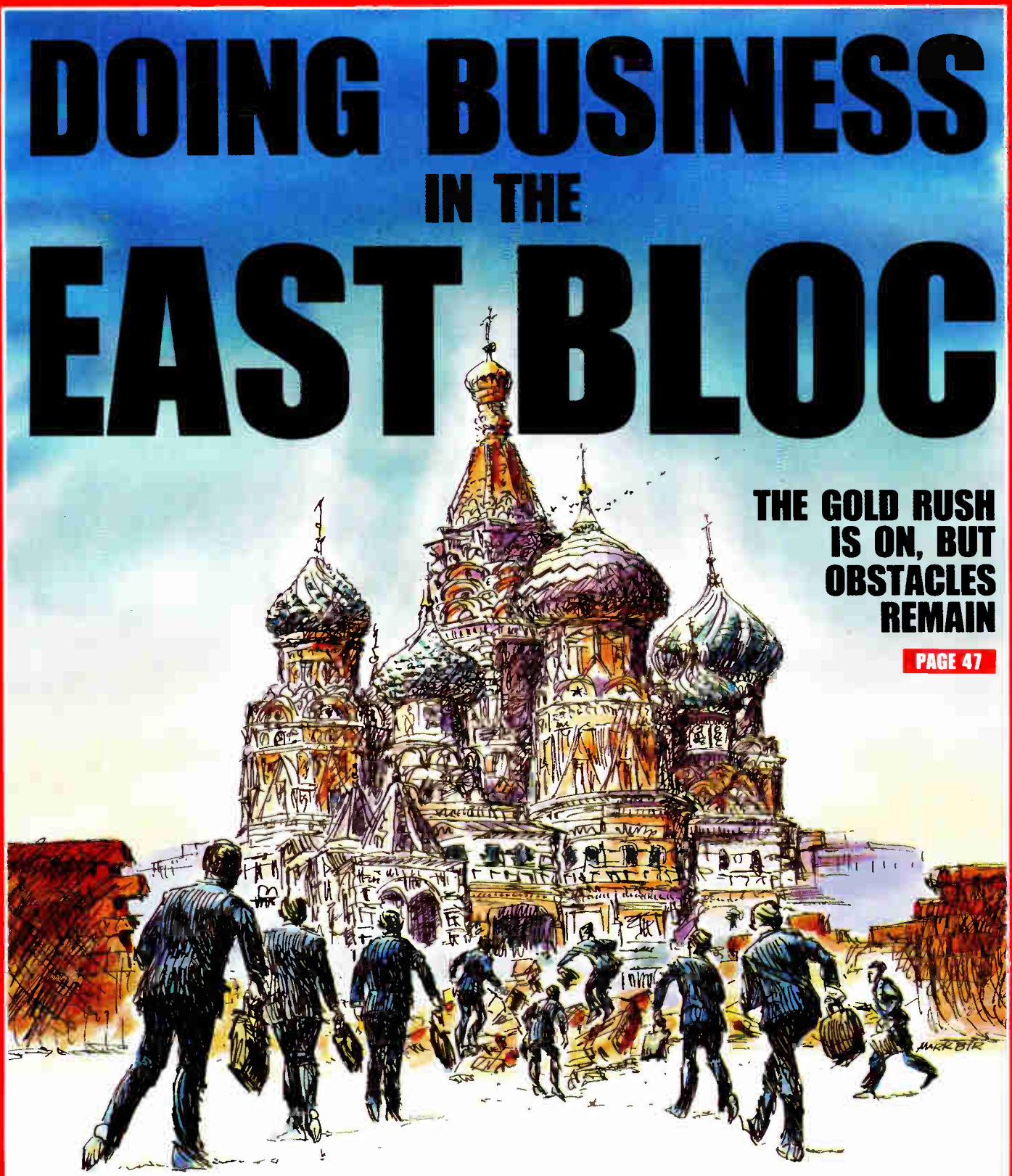

## THE GOLD RUSH IS ON, BUT OBSTACLES REMAIN

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**Electronics**

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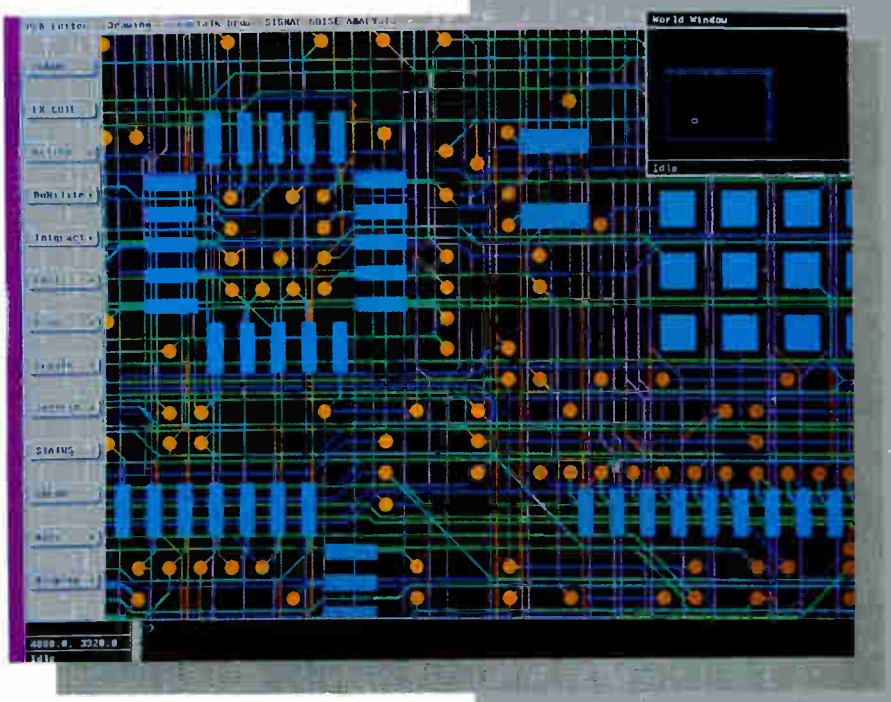

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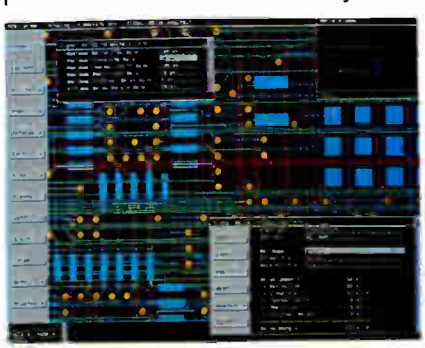

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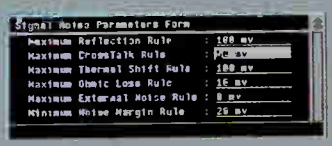


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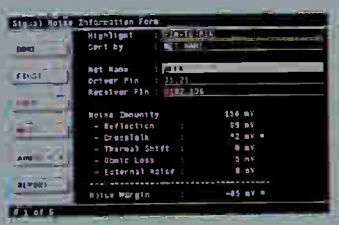


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# MANUFACTURE OR DIE

Let's face it, the U. S. electronics industry is losing its lead position in the world. Dataquest Inc., the San Jose, Calif., research company, predicts that by 1992 U. S. manufacturers will produce $332 billion worth of the $1.074 trillion in electronic goods produced worldwide, while those in Japan will turn out $360 billion worth. One reason the U. S. industry is in such a state is that American electronics manufacturers and government policymakers have overlooked the importance of manufacturing superiority. Japan hasn't. If the U. S. is to return to its premier position, it must regain world-class manufacturing capability. The inherent strength of the U. S. electronics industry is its ability to innovate new products quickly. What it lacks overall is the ability to make them in high volume, with consistently high quality, at a cost-effective price.

There are bright spots. One industry segment that has not lost its manufacturing edge is the Winchester disk-drive business. According to Disk/Trend Inc., a Mountain View, Calif., research house, 31 of the 58 competitors in this market are U. S. companies. They develop new products with higher capacity and performance quickly and bring them out through very narrow market windows. But more important, these companies make the drives in the U. S., and they get high yields—and world-class quality. One such company is Quantum Corp. of San Jose. In the early 1980s Quantum struck a deal with Matsushita Kotobuki Electronics to manufacture a product called Hardcard. Steve Berkley, chairman and chief executive officer of Quantum, says the company learned a great deal about manufacturing from its Japanese partner. He recalls that when Hardcard initially went into production at Kotobuki, the line started off by producing a yield of more than 90%. Quantum's delighted U. S. engineers went off to celebrate, while the Japanese scratched their heads in dismay at the "low" yield. This is a work ethic that places great value on the highest production efficiencies. Berkley says the experience left a lasting impression on Quantum, one that is reflected in the high profit margins the company now enjoys: in excess of 30%, as compared with 20% for its rivals.

One result of its effective manufacturing capability is in the amount of revenue each employee in the company produces—total revenue divided by total number of employees. "The disk-drive industry average is roughly $50,000," says Berkley. "Quantum's 500 employees alone produce $400,000 each." Another measure is capital invested per dollar of income. "Quantum has just under $4 of revenue for every dollar of investment," he continues. "The industry average is $1.25 to $1. So large a ratio of revenue dollar to investment dollar provides the company large operating leverage."

Quantum is not alone in being a world-class U. S. manufacturing company. That list would have to include Digital Equipment, Hewlett-Packard, and IBM. However, there are few domestic companies still producing consumer electronics or semiconductor production equipment in the U. S. If this industry is to dominate once more, it must rededicate itself to manufacturing high-yielding, good-quality products that the world markets want to buy. E

Jonah McLeod

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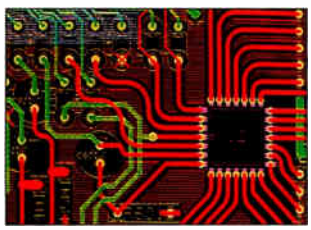

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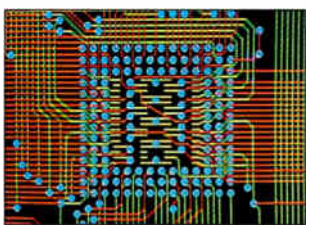

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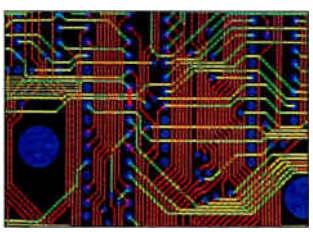

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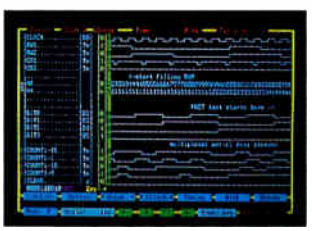

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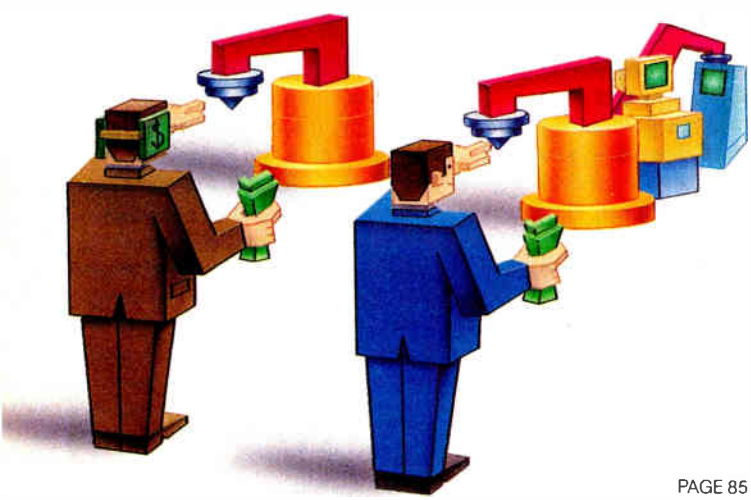

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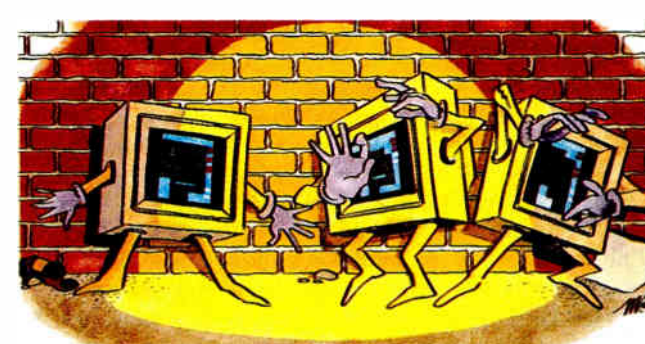

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## DEPARTMENTS



## NEWS ROUNDUP



## WORLDWIDE NEWS



## NEWSMAKERS



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

## IN EAST EUROPE, TODAY'S OFFICIAL MAY BE TOMORROW'S HAS-BEEN

# THE BEST STRATEGY? TRY WAITING

BY JOHN GOSCH

AS EASTERN EUROPE opens up economically, many U. S. and West European electronics firms are preparing to charge into that technology-starved region, hoping to sell equipment or enter business deals there (see p. 47). But there's a lot more involved than getting the appropriate visa.

"Hold your horses," warns Horst Jenisch, an executive at ITT Semiconductors in Freiburg, West Germany. "Most East European countries are still in political turmoil, and you'll hardly find an official there who's in charge, willing to take on responsibility, and with whom you can negotiate a deal."

To illustrate his point, Jenisch tells this story: last December he met an East-bloc industry minister in Munich and struck an agreement to cooperate on some business. Four days after the meeting the minister was sacked, presumably because of his affiliation with the "wrong" political party. The ITT man's advice: wait till the elections that will be held in many East European countries this spring before making any long-term agreements.

By this spring, too, the East Europeans will have hammered out details on how joint ventures with Western concerns may be structured. The current policy—except in nonaligned Yugoslavia—is to retain majority control in any venture a Western firm enters with an East European enterprise. Companies in the West may not be pleased with such an arrangement.

Jenisch also warns against counting on any quick results from a business deal in the East. "It is and will remain for some time a long-term market, one that won't fulfill the West's expectations overnight," he says. To be sure, short-term results can be expected from a venture whereby an East European firm manufactures Western products for sale on Eastern or Third World markets. "But generally, patience is the order of the day."

One thing Western businesses are certain to find is that their potential customers and partners in the East are eager to acquire advanced technology. What has so far prevented this is, among other things, the tough restrictions on sales of high-tech items as spelled out by the Cocom international-trade regulations.

"Cocom is really hurting us," says the director of an East German electronics equipment producer. "We must reinvent many parts, and that is tying up much of our research-and-development capacity." While a U. S. or West European firm can pick a vendor to supply the parts it needs, and thus use its R&D capacity more efficiently, an Eastern firm must develop the parts from scratch.

American and West European electronics executives will be dealing with a different breed of people in the East these days. Before the reforms, during the era of tight government planning and control over all industry activities, Western firms negotiated deals with industry ministries or foreign trade monopolies, which in large part were staffed by bureaucrats with only a few technical people advising them. "Things are done in a bureaucratic way," with negotiations taking place "sort of at the ambassador level, as it is for a diplomatic summit conference," says Data General Corp.'s chairman, Edson de Castro, speaking of his experience in the Soviet Union (see p. 50).

Now that reforms are loosening the governments' grip and giving companies more flexibility and self-responsibility, Western business people will be negotiating directly with end users—namely, a company's technical director, sales manager, or financial expert. While these executives may be technically competent, they lack negotiating skills, an executive at West Germany's Siemens AG says.

"They are still unsure of themselves, since they have previously never been called upon to work out deals with Western firms," he says. With a few exceptions, managers of a company or a small manufacturing unit within a larger company are afraid to make decisions. "They are still used to taking orders from above."

Hungarian negotiators are different, Western observers agree. Having progressed the most in implementing economic reforms and tolerating many elements of capitalism, Hungary stands out in the East bloc. There, "negotiators come down to the point and make decisions fast," ITT's Jenisch says.

Given their nations' lack of hard cash, East European executives often propose compensation deals to their Western counterparts, deals whereby, instead of money, they offer products in return for technology. "Even today, Soviet industry officials may offer caviar or Crimean champagne in exchange for Western technology and products," says a manager at a U. S. publishing

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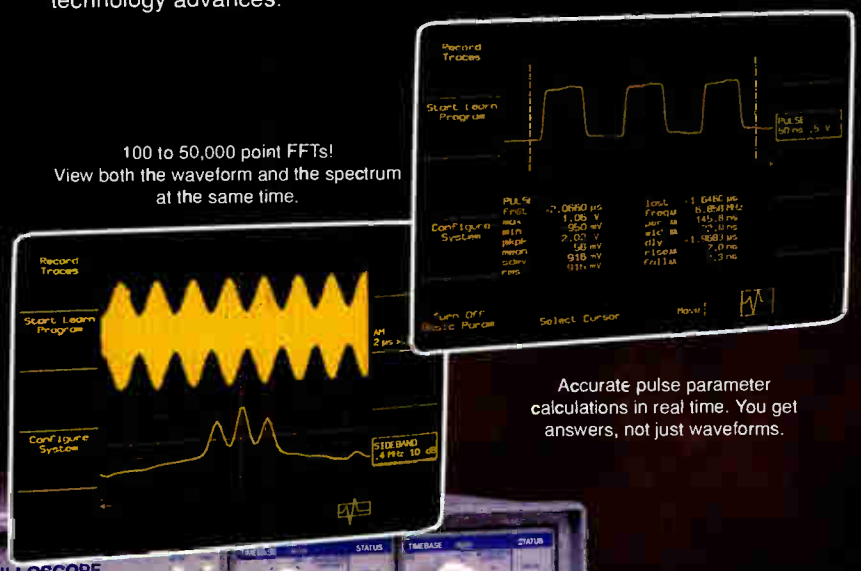


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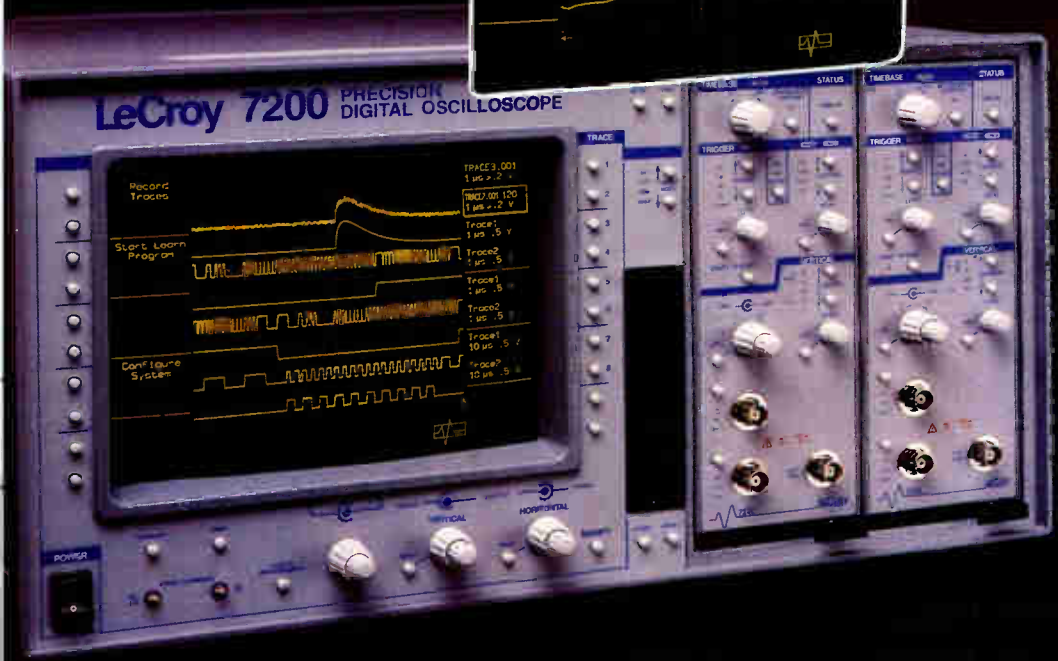


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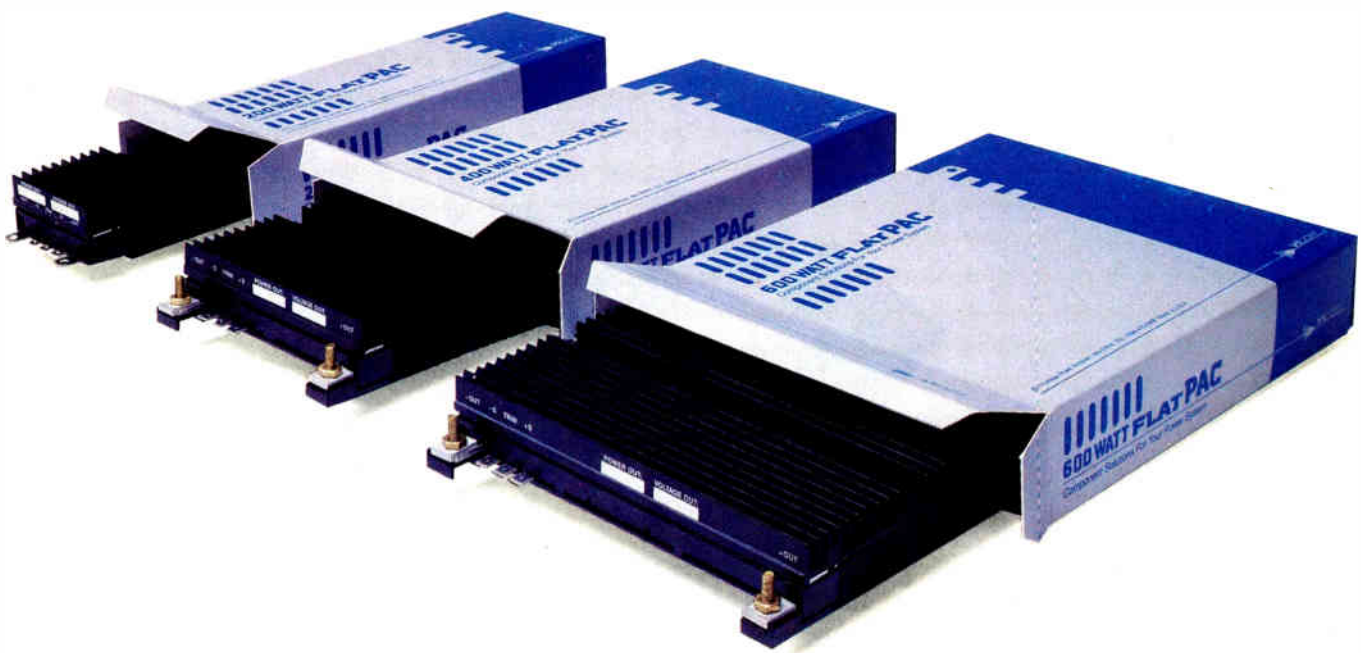


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firm in Frankfurt, West Germany. The response from most Western companies to such offers has so far been a resounding no.

Language shouldn't be much of a problem for business people from the Anglo-Saxon world. Although English is not as widely spoken in the East as in Scandinavia, the Netherlands, and West Germany, it is still the language for electronics. Many engineers, particularly the younger ones, in East Germany, Hungary, and Czechoslovakia, have a fairly good command of it. The story is different in the Soviet Union. There, interpreter and translation services are generally needed.

**HUNGARY, WITH ITS OWN FORM OF 'GOULASH COMMUNISM,' IS THE MOST AMENABLE TO WESTERN BUSINESSES**

What is a problem, though, is communications that don't happen face to face. In fact, getting in touch with companies in the East can be an exasperating experience. Phone callers in Frankfurt may have to wait hours before getting a line to Moscow, and it may take up to 10 hours to establish a connection in the other direction. Facsimile is not much better, because the terminal on the Eastern end may be a considerable distance away from the wanted party. West German business people generally find telex the best means of communications, although even this mode isn't all that efficient.

SLOWLY AND SPOTTILY, communications links are starting to improve. Phone service between West and East Germany has gotten considerably better in recent months as postal authorities have added more lines to the 1,200 or so that existed until now. But the best service is to Czechoslovakia and Hungary.

Hungary stands out in still other ways. The more liberal form of communism that has evolved there during the past decade has led to what observers call goulash communism. This finds expression in well-stocked shops, bustling traffic, and smartly dressed people, especially in Budapest, the nation's capital. Because it has the appearance of a West European country and offers a favorable climate for doing business, Hungary has become one of the most attractive places in the East for foreign companies to set up joint ventures.

Yugoslavia, too, has worked out many of the business difficulties that stand between East and West. Westerners can take 99% of a joint venture in Yugoslavia, or start up a wholly owned subsidiary there. A series of new laws makes running a company in Belgrade not too different from running one in Boston. And the recent decision to make the currency convertible—it is fixed to the Deutschemark at a rate of 7 to 1—means that it is relatively easy to get profits out. Most of all, technology-starved Yugoslavia is willing to offer big advantages to Western firms.

Yet despite the big changes, the political situation bears watching. Reforms promulgated by current Prime Minister Ante Marcovitch could fall apart in the next few months. It would be wise to see if all six states of this federation accept those reforms before making any long-term arrangements. If Serbia—the largest and least developed republic—decides against the reforms, or if Slovenia—the most developed—secedes from the federation, a deal cut in Belgrade may not be worth much.

Some Western observers bemoan what they see as a dearth of skilled labor in the East bloc, but others say that technical professionals there are highly trained. "They do not need technical training," says Clifford Hardcastle, chairman of Densitron Ltd. in the UK, which has a joint computer venture in Hungary. "In many ways Hungarian design and production engineers have advantages over their Western counterparts. Lack of spare parts has made them more resourceful in squeezing the best out of obsolete production machinery."

More urgently needed is business training. "Under centrally planned economies, industrial concerns get used to making a limited number of products to order," says Hardcastle. "They are not used to researching a market need, developing a product to meet that need, and actively going out to sell it in the face of competition." E

*Additional reporting by Lawrence Curran, Peter Fletcher, and Andrew Rosenbaum*

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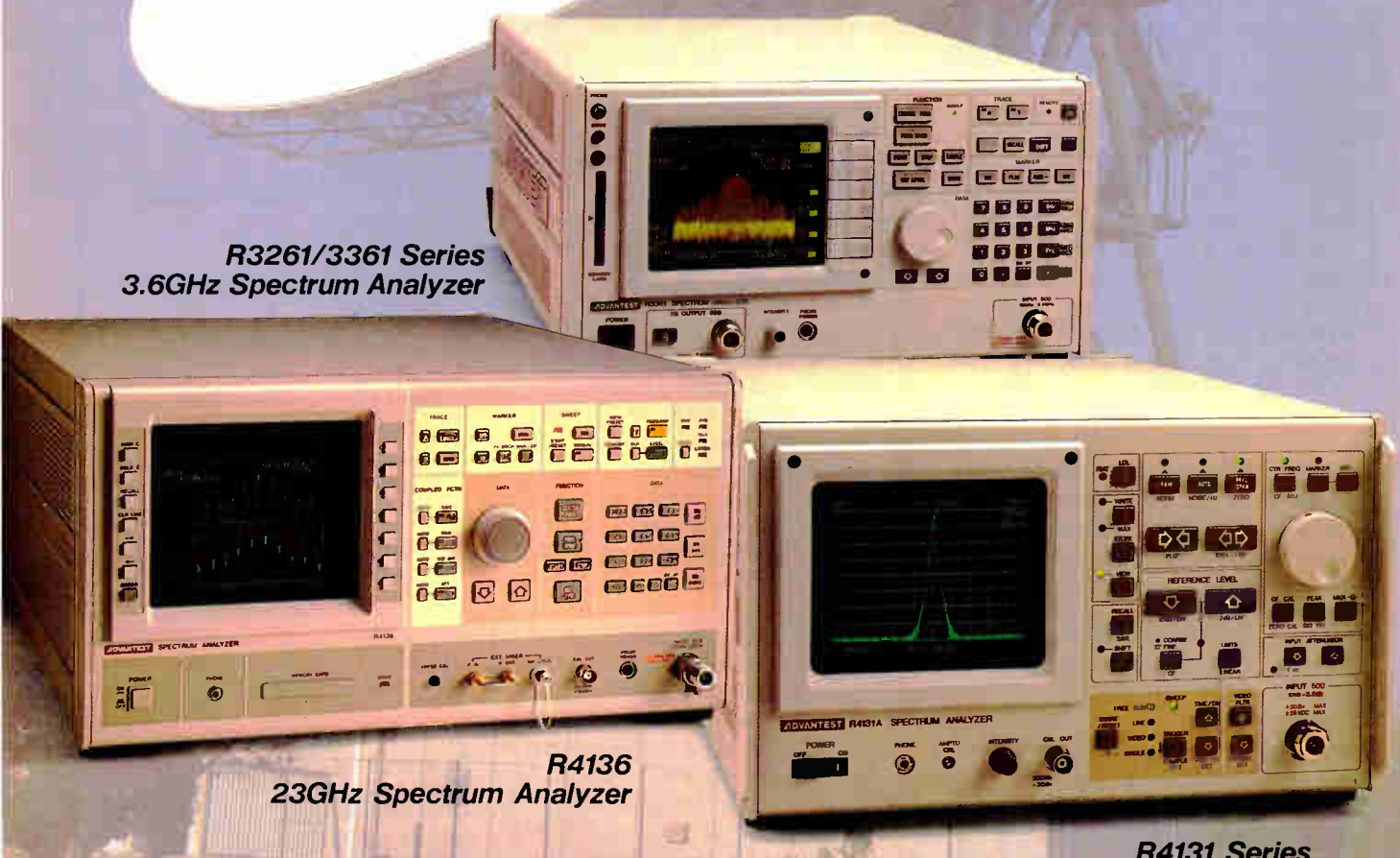
At ADVANTEST, the goal is to develop and deliver spectrum analyzers as general tools for measuring virtually any quantity or phenomenon that can be viewed in the frequency domain. The key to high spectrum purity is in-house developed YIG (yttrium-iron-garnet) technology. And ADVANTEST spectrum analyzers offer much more than just spectrum analysis. They feature such convenient functions as frequency counting, direct-reading field strength measurement, interference noise measurement, occupied bandwidth measurement, and automatic measurement of adjacent channel leakage power. The use of a built-in tracking generator enables wide-dynamic-range measurement of the frequency response of filters and amplifiers. In addition, phase and group delay measurements provide not only highly accurate data, but enable a multifaceted approach to the measurement task as well, thereby improving the reliability of measurement results. The bottom line for the user is a powerful arsenal of frequency-analysis tools that provide the right answers, in a highly usable form.



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*3.6GHz Spectrum Analyzer*

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*23GHz Spectrum Analyzer*

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CIRCLE 200

# *CAE Technology Report*

Vol. 2, No. 3 March 1990

## CAE Technology Will Lead the U.S. Industry to Higher Competitiveness

Some U.S. industries have had major setbacks because they woke up too late to the fact that they were in a global economy. How well a company is doing in the global economy depends to a large extent on how well it anticipates technology changes and takes full advantage of new opportunities. Since new CAE tools can cut development time by a ratio of four to five times as well as provide superior quality products, and since the U.S. companies are the largest CAE users in the world, they stand a good chance of getting on top of their foreign competition.

## New Schematics Will Automatically Warn Users of Design Problems

Despite big advances in the CAE field, most hardware designers still shy away from CAE tools because they are too complex and software oriented. What designers need is a simple integrated package that allows them to draw schematics and simulate at the same time. Designers have been demanding that design errors be shown as they are made, not hours or even days later. Such systems are coming quickly to fruition in a cooperative effort between leading international CAE vendors and ALDEC, Inc. (Newbury Park, California) which has developed a real-time simulator that back annotates simulation results directly into the schematic. This allows the user to analyze the behavior of each connected part on the schematic in real-time. **CIRCLE 102**

## 1990 Is Seen As the Year of Major CAE Changes

The year 1990 will be dominated by Active Schematics and Concurrent Design Environment Release 8.0 from Mentor Graphics, Inc. Release 8.0 will allow concurrent observations of the behavioral, electrical and mechanical design aspects, but it may be very expensive. On the other hand, Active Schematics from a number of CAE vendors will allow direct, real-time schematic changes and concurrent simulation at a very low cost. With fully automated real-time design validation and simple user interface that is similar to hardware breadboarding, the CAE vendors will receive a lot of attention from users looking for low cost, practical engineering solutions. **CIRCLE 103**

## Why VHDL Will Be a Standard on PCs and Workstations

While there is some criticism that the VHDL language does not take into account the vagaries of electronic components, it is quickly becoming the new CAE modeling language standard. According to Keith McCann of ITEX Corp. (805-499-6860), two things favor VHDL: superior quality and accuracy of IC models and low cost model development. For example, VHDL-SHORTHAND™* users need not be concerned with the internal IC structure because the VHDL compiler does the entire model design automatically. **CIRCLE 105**

## VHDL Source Code for IC Models is Free

To stimulate IC model development, ALDEC has decided to release the source code of its key IC libraries. This will allow designers to learn about writing their own IC models more quickly and efficiently. The source codes will be available in June, 1990 from ITEX, Corp. which licenses ALDEC VHDL tools. **CIRCLE 104**

*VHDL-SHORTHAND is a product of ALDEC, Inc. (805) 499-6867.

# Tiny Glitches Lead to Giant Wobbles

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

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

Hipparchus

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

## Stabilizing Today's Communications

The slightest deviations can be extremely important. In high-speed communications, tiny errors can garble the whole message.

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CIRCLE 279

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THE LEADER IN VIDEO MICROTECHNOLOGY

CIRCLE 210

# BELL LABS IS OUT TO MAKE A POINT

Inside AT&T Bell Laboratories, the first-ever optical computer represents more than just another technological coup for the research-and-development giant. The delicate assembly of semiconductors, masks, and lenses is also being viewed inside the sprawling, 5,000-employee facility as proof that U. S. global competitiveness is alive and well and living in Holmdel, N. J.

The processor architecture came into being only because Bell Labs' executives would settle for nothing less than the most solid technology, says Alan Huang, head of the Optical Computing Research Department at the labs.

The terms "scalable" and "expandable" don't do the architecture justice. While just 48 of the core devices—symmetric self-electro-optic-effect devices, or S-SEEDs—are operating in each stage of the demonstration processor, gallium arsenide/gallium aluminum chips have already been fabricated with 8,000-device arrays. And though the S-SEEDs are now driven at 1 MHz, they have been tested at 1 GHz, says Huang. Similarly, the four stages can be expanded indefinitely.

Huang is confident that a monolithic implementation lies on the horizon—and it will be based primarily on existing semiconductor technology. Planar holograms will take the place of the conventional lenses used in the demonstration. Also, the masks that turn on and off to create node-to-node connections for the processor can be electronically driven. Huang envisions a 6-by-8-in. quartz plate, silvered on the bottom, top-etched with electronic and laser devices, and implanted with holographic lenses.

In the larger picture of global competition, Huang sees his optical computer as disrupting the "complacent" plateau of present-day electronics technology. "What does America do best?" he asks. "It take risks. I'm trying to get electronics back into that free-running mode again."

**Alan Huang believes monolithic implementation of the processor is just around the corner.**

## LOOK OUT COMPAQ, TOSHIBA'S GOT A NOTEBOOK COMPUTER TOO

Toshiba America Inc. is throwing down the gauntlet to Compaq Computer Corp. and its hot-selling notebook-size, hard-disk-equipped personal computer [*Electronics*, November 1989, p. 44]. The Irvine, Calif., company has introduced its own version—doing it at a big media event in Compaq's hometown of Houston. What's more, Toshiba has priced its machine below the Compaq unit.

Toshiba's timing couldn't be better for rolling out the T1000XE and T1200XE machines, which should start shipping this month. Demand for Compaq's LTE/286, which has a 40-Mbyte hard disk and was introduced last October, has outstripped supply. But Compaq says it will catch up with demand by the end of the first quarter.

The notebook models offering full-travel keyboards, sidelit liquid-crystal-display screens, and 20- or 40-Mbyte hard disks are selling briskly in a portable PC market worth $2.3 billion last year, says market researcher Dataquest Inc. of San Jose, Calif.

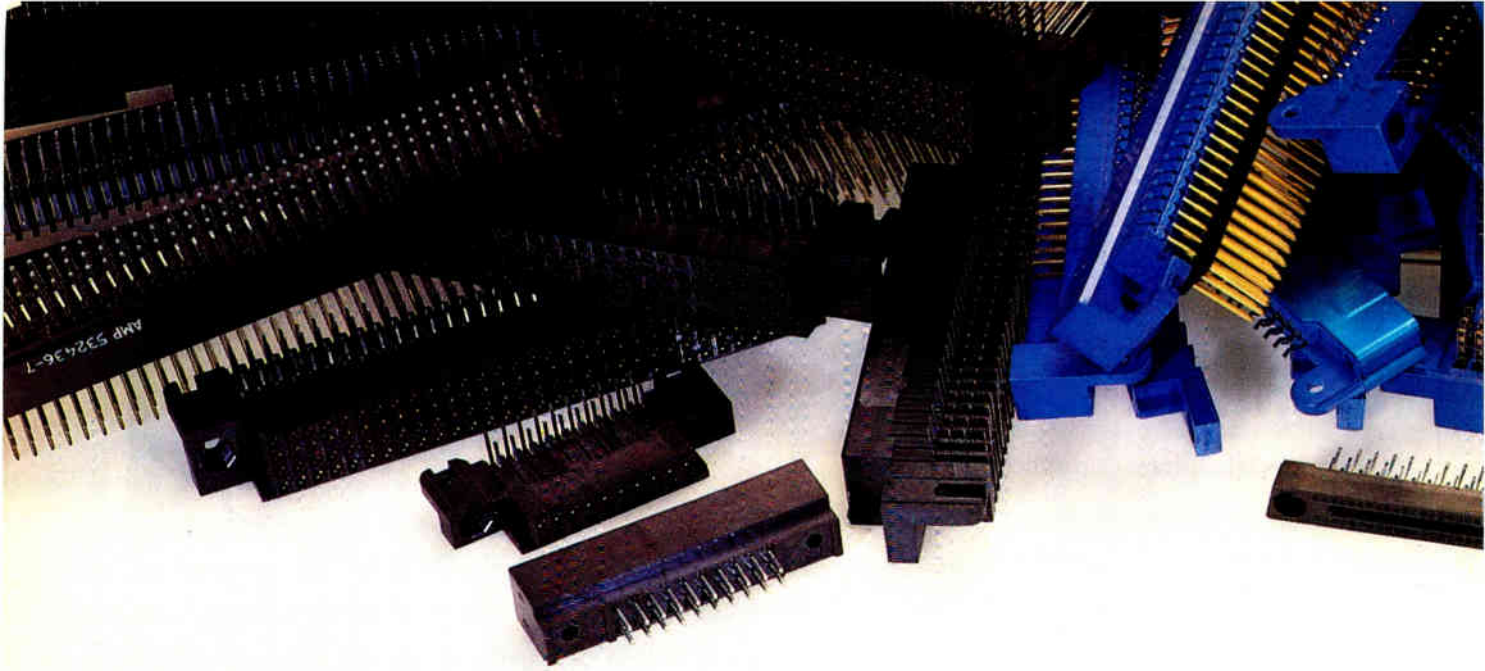
Toshiba's low-end unit, the T1000XE, is built around an 80C86 processor and has a 20-Mbyte hard disk. It sells for $2,699, some $300 less than the rival Compaq LTE. The T1200XE, built around an 80C826 processor, lists for $3,999, which is $500 less than Compaq's LTE/286 model 20.

## FINAL LINK FORGED FOR FDDI: STATION MANAGEMENT SOFTWARE

Look for the final link in the Fiber Distributed Data Interface standard to arrive before the end of the first quarter. The Station Management (SMT) software—the intelligent framework that unifies all attachments to an FDDI LAN—was shown running on two FDDI chip sets at last month's Comnet show in Washington.

Called Component SMT by developer Synernetics Inc. of North Billerica, Mass., the software distributes network-management capability to all attachments on an FDDI LAN, regardless of equipment type, vendor, or data protocols employed. At Comnet, it ran on computers using both PC/DOS and the VxWorks operating systems.

An Intel 80286-based PC used at the show also represented the first public demonstration of an FDDI chip set from National Semiconductor Corp., which joins Advanced Micro Devices Inc. as an FDDI silicon vendor. Synernetics president R. Bruce McClure expects SMT to be approved as a standard this spring.



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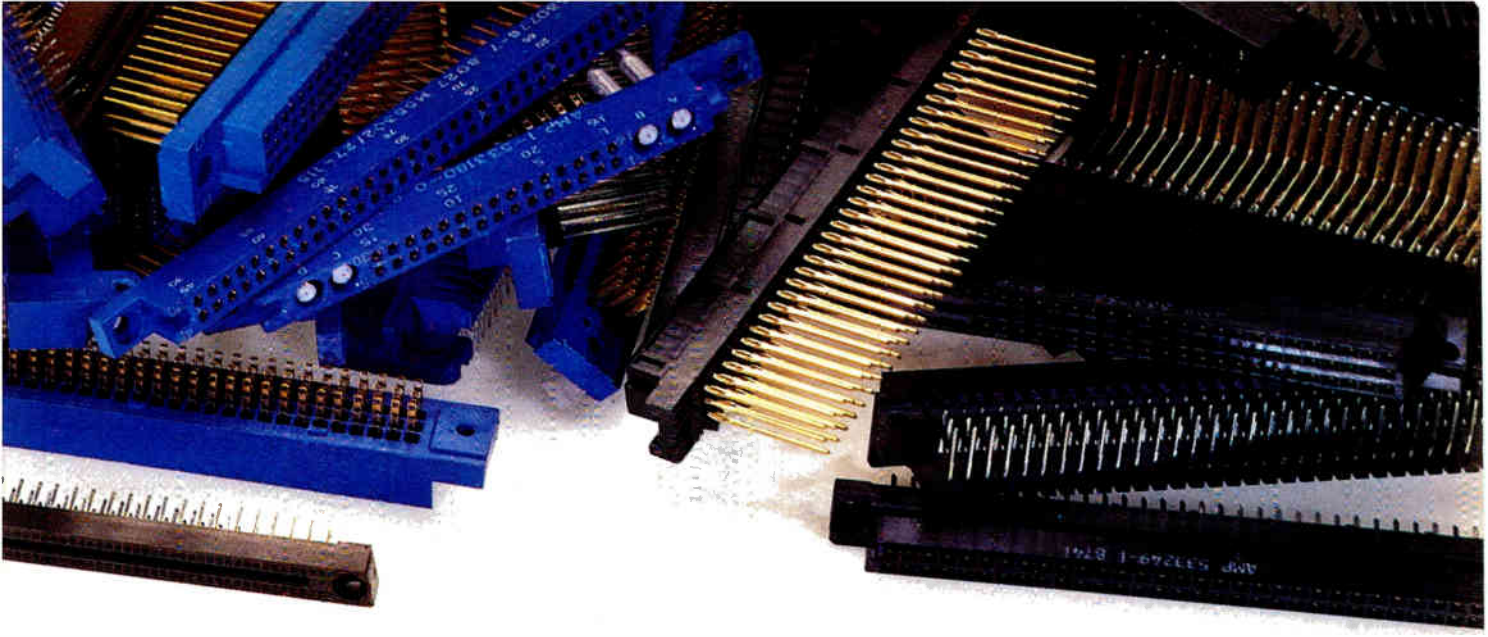
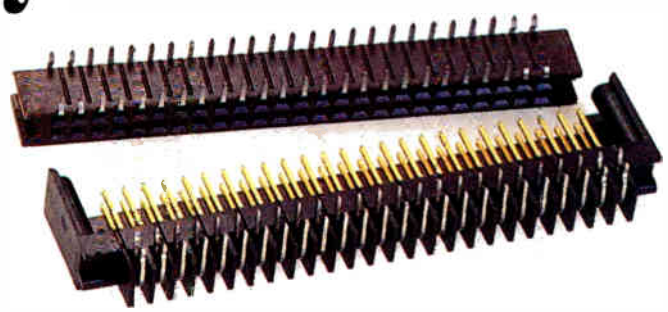


# the pair you need.



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**AMP Interconnecting ideas**

CIRCLE 263

## NEW HDTV CONSORTIUM LOOKS AT 1995—AND NOT JUST BROADCAST

Digital high-definition TV is closer to reality as a result of the research consortium that was formed last month by the National Broadcasting Co., Thomson Consumer Electronics, and Philips Consumer Electronics. But the main target of the group isn't just broadcast TV. Executives in the research arms of Philips and Thomson have confirmed that digital HDTV is a key goal of the alliance—and that broadcast transmission is only part of a much bigger picture.

The simulcast approach developed for Thomson by the David Sarnoff Research Center in Princeton, N.J., should be easier to convert to a digital implementation than Philips' augmentation approach, says James Tietjen, president at Sarnoff—and that may be part of the reason that Philips decided to make the switch to his lab's technique.

**An NBC camera operator tests Sarnoff's wide-screen fixed camera at a recent AFC playoff game at Mile High Stadium in Denver.**

A Philips executive explains further that video cassette recorders could easily adopt a digital Advanced Compatible TV—or even HDTV—format as early as 1995, and that cable and fiber delivery media will also loom very large in the future of the HDTV business. Broadcast delivery is not out of the question, the executive points out. However, he adds, "it makes a lot of sense to consider digital delivery on other media in the interim." E

## MENTOR BUILDS A FRAMEWORK TO CHALLENGE CADENCE IN CAD ARENA...

With the recent announcement of its System 8.0 software release and its earlier acquisition of Silicon Compiler Systems Corp. [*Electronics*, February 1990, p. 15], Mentor Graphics Corp. of Beaverton, Ore., not only appears out to dominate the design-automation market but to change its image as a company whose software is closed to third-party design tools. It also threatens the open-system framework monopoly of Cadence Design Systems Inc. of San Jose, Calif., as well as Cadence's image as leader of the effort to establish a common framework via the ad hoc CAD Framework Initiative group.

All this has come about because System 8.0 contains Mentor's open-system Falcon Framework. A framework provides software hooks that third-party tool vendors can use to connect their programs into an existing design system. With Falcon, Mentor is positioning itself as an open-system supplier of design-automation tools, says Ron Collette, senior market analyst at Dataquest Inc., the San Jose market-research company.

When the System 8.0 ships later this year, Falcon will have an installed base to rival that of Cadence: Mentor will offer the new software version as a free system upgrade to all customers currently on maintenance. Collette thinks Mentor will push Falcon as the de facto industry framework.

Not only is Mentor seeking to sell itself as the industry's open system supplier, it is also rolling out new tools to rival current third-party tool supplier offerings. For example, the company's new Quicksim II mixed-level simulator is being positioned against Verilog from Gateway Design Automation Corp. of Lowell, Mass. E

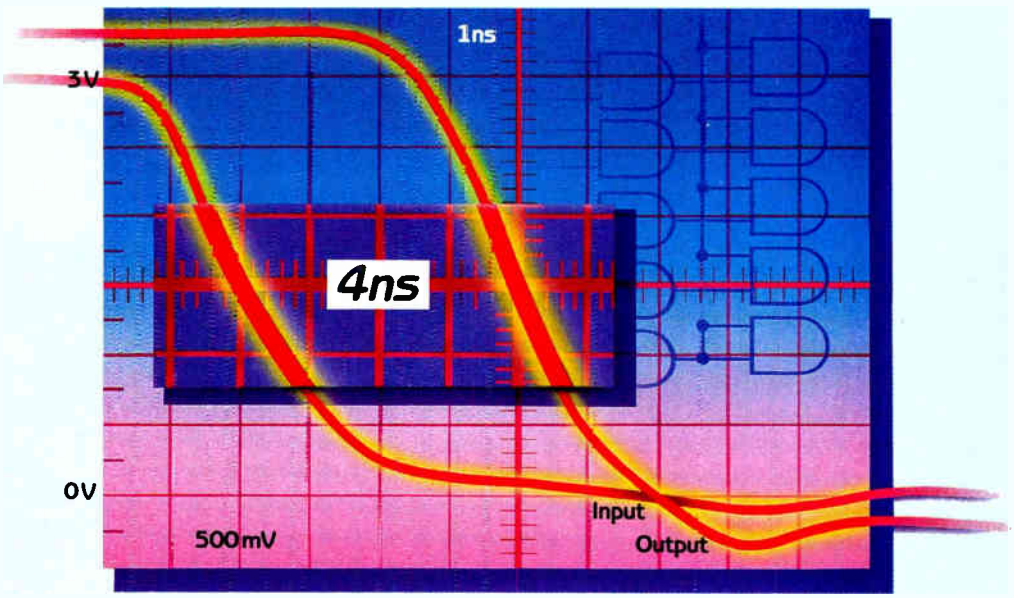
## ...AND DEC FLEXES ITS NEW MUSCLES IN THE CAD MARKET

Expect Digital Equipment Corp. to become aggressive in computer-aided design now that the Maynard, Mass., computer giant has acquired PowerFrame, a software framework for CAD management of electronic products, from EDA Systems Inc. of Santa Clara, Calif. DEC has assumed ownership of PowerFrame, including support of current EDA customers and development of the popular product. DEC helped develop PowerFrame as part of a 1988 agreement with EDA, which also gave DEC the right to sell the software.

Along with the acquisition of PowerFrame, DEC announced an expanded push in CAD for electronic products, embodied in the DECframe product, which builds on PowerFrame. The DECframe/Electronics framework is a design environment that's tailored to a customer's site to provide integrated software products and services. The framework will run initially on DEC's reduced-instruction-set-computing work stations.

In another development, DEC moved to broaden its office appeal by providing links between its software applications and AT&T Definity and System 85 PBXs. The link permits the All-in-1 System for Customer Services and DECVoice Response System on VAX computers to be accessed through the AT&T PBXs. E

# FCT-T Logic Fast and Friendly

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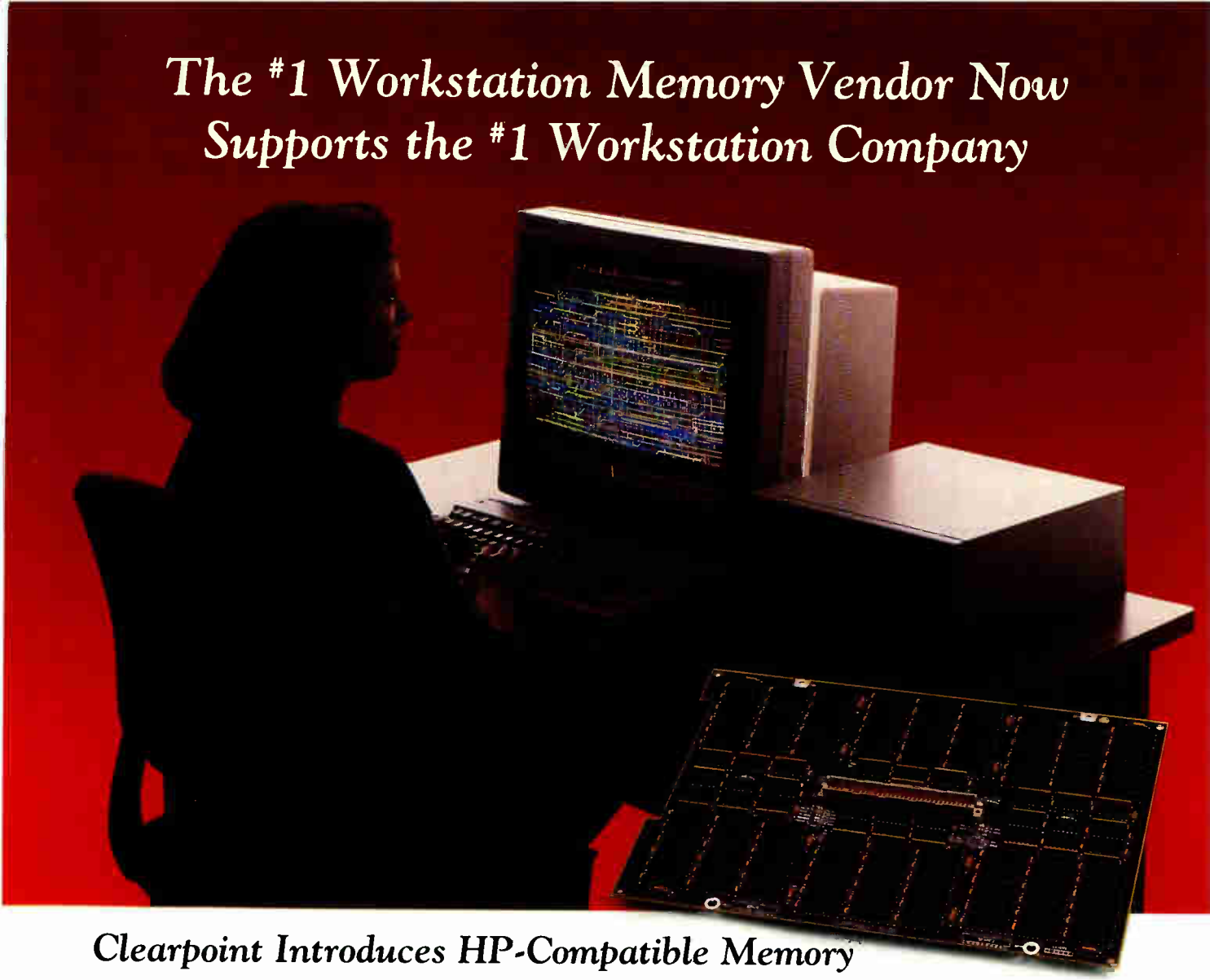
CIRCLE 276

# The #1 Workstation Memory Vendor Now Supports the #1 Workstation Company



## Clearpoint Introduces HP-Compatible Memory

**Clearpoint, the only manufacturer of memory for both Hewlett-Packard and Apollo systems, now offers memory 100% compatible with the HP 9000 Series 350/370 workstations. The HPME-93P is backed by Clearpoint's comprehensive support program:**

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The HPME-93P array board is available in both 4 MB and 12 MB configurations. Using 1 MB DIP technology, the array board brings your system to its full 16 MB/slot capacity.

The HPME-93P is user-installable; no jumper configuration is needed. The HP 9000 Series 350/370 includes built-in diagnostic testing to insure easy installation and a high-speed bus for no-wait state processing.

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**CIRCLE 236**

# INTERGRAPH ADDS GRAPHICS PUNCH

By teaming a second-generation Clipper C300 microprocessor with a digital-signal-processor graphics engine, Intergraph Corp. has come up with a family of Unix-based work stations that have as much clout as the firm's 3000 Series at substantially lower prices.

Machines in the new 6000 Series weigh in at 10 or 14 million instructions/s, depending on which version of the Clipper reduced-instruction-set microprocessor they use. Prices start at $30,000, half the cost of some of the 13-mips 3000 Series units [*Electronics*, November 1988, p. 105]. The family aims at the full range of historic Intergraph applications, including computer-aided design, mapping, and desktop publishing.

The Huntsville, Ala., CAD/CAM giant has souped up the graphics performance of the new line by adding an Extensible Display Geometry Engine (EDGE)—a 34-megaflops graphics processor with drawing rates of 400,000 two-dimensional and 350,000 three-dimensional vectors/s in the most sophisticated version. That configuration is called EDGE II, and it employs three Texas Instruments Inc. DSPs delivering more than 100 megaflops of floating-point performance. EDGE II configurations can perform realistic rendering with Gouraud shading at 25,000 100-pixel shaded triangles/s.

At the low end, the 10-mips InterPro 6040 sells for $29,900, including EDGE I graphics, 16 Mbytes of main memory, and a 355-Mbyte hard-disk drive. That performance puts it in a class with the Sun 3/30 and the HP 834.

## NORTHERN TELECOM'S MERIDIAN 1 PBX TALKS TO MORE COMPUTERS

The seamless coupling of telecommunications and computers has taken another step forward with Northern Telecom Corp.'s support for two more industry-standard data protocols—and more are on the way.

Its recently announced Meridian 1 digital PBX family adds IBM Corp.'s 3270 SNA and the CCITT X.25 packet-switching protocols to the previously available LAP-B protocol, says John Spindler, manager of Meridian Link products.

Meridan Link is an intelligent interface that integrates the Meridian 1's call-processing capability with the data-processing power of computers. The Nashville, Tenn., company is also developing interfaces for IBM's LU 6.2 protocol, Ethernet, Token Ring, and both the primary and basic rates for the integrated services digital network, says Spindler.

On the business side, Northern Telecom is already shifting gears in its quest for applications software that takes advantage of Meridian Link. Although it will add a few more major strategic alliances with big computer vendors to supplement deals with Digital Equipment Corp. and Hewlett-Packard Co., a broader-based approach is gaining favor.

Using its Corporate Networks Organization, Northern Telecom will this year launch a tactical drive to work closely with third-party software vendors. A major marketing investment will go into this program, says Rick Faletti, general manager of Meridian Communications Systems.

Meanwhile, negotiations for an industry-standard switch-to-computer interface are entering a critical stage and could be final by the end of 1991, says Spindler.

## U.S.-ITALIAN COMBO FILLS OUT ISDN LINE WITH U INTERFACE

National Semiconductor Corp. and SGS-Thomson Microelectronics have put in place the last building block of their chip sets for the integrated services digital network.

Jointly developed by the Santa Clara, Calif., and Agrate Brianza, Italy, companies, the TP3410/ST5410 U-interface transceiver combines analog and digital technologies on the same chip. The device, which connects phone company line cards and subscriber offices, is the last to be settled by international standards bodies.

Other companies, including AT&T Microelectronics, Motorola, and Siemens have U-interface chips, but the National/SGS-Thomson entry is a particularly elegant solution. A technical paper describing it was presented at the 1990 International Solid-State Circuits Conference.

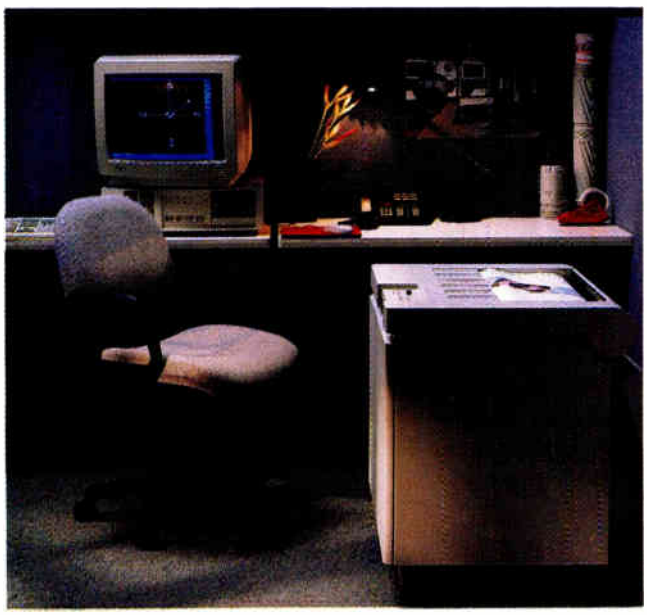
The chip features selectable modes for chip-to-chip interface formats including National's Microwire and the European General Circuit Interface. Samples are available now.

## RASTER GRAPHICS' NEW PLOTTER GIVES COLOR OUTPUT

The ColorStation D from Raster Graphics Inc. is the first electrostatic plotter to offer full-color output for D-sized (22 by 34 in.) plots, says the Sunnyvale, Calif., company.

Priced at $18,500, the ColorStation D will be introduced at the National Computer Graphics Association Show in Anaheim, Calif., March 19–22. Besides the upgrade on paper size, the product also includes a number of features formerly available only on plotters selling for more than $20,000.

For example, its writing head lets users put in full color at a speed of 2 in./s for each printing pass. As a result, the machine produces plots in minutes that pen plotters would require hours to create. Designed specifically for use with work stations, the plotter features line definitions down to 0.005 in. and has complete shading and solid-fill capability. It writes in 200 or 400 dots/in.



Software compatibility is extended to most major environments, including Hewlett-Packard's HP-GL, AutoDesk's AutoDesk and AutoShade, and AT&T's Targa Files. The paper transport through the plotter is based on a proprietary technology that cuts the paper and vacuums it into place for high-quality registration and accuracy. Plots are ejected into the paper catch tray so that they can be easily accessed by users who may be sharing the plotter on a network.

## LSI LOGIC WILL JUMP INTO IMAGING WITH THREE CHIPS

Look for LSI Logic Corp. to enliven the race to supply chips to the fast-growing electronic imaging market sometime this summer.

The Milpitas, Calif., company's lineup will serve the needs of such apparently diverse applications as CCITT Group IV color facsimile, video telephone transmission, and both still-photo and live-video compression and expansion.

The chips can also be problem solvers for multimedia applications. Since the same core algorithms can handle many image-manipulation and transmission applications, LSI Logic has segregated the problem into three mix-and-match chips: the L64720 motion-estimation processor, the L64730 discrete-cosine transform processor, and the L64740 quantization processor.

## SOFTWARE DOES AWAY WITH DATA-ACQUISITION PROGRAMMING

Engineers with few programming skills should welcome Global Lab, a software package from Data Translation Inc. for the company's data-acquisition boards. It's the first menu-driven software that allows the Marlboro, Mass., company's customers to perform data gathering and storage to disk at the highest speeds available with the company's family of boards—250 KHz.

Instead of setting jumpers or doing any programming, users simply progress through Global Lab's menu to call into play various attributes of the hardware, such as a dual direct-memory-access mode, simultaneous sample and hold, or DMA digital-to-analog conversion. Setup menus recognize which data-acquisition board is installed in a system, making it simple to specify sampling rate, channel sequence to be used, gain, trigger, and clock sources employed.

Global Lab supports up to 20 Mbytes of expanded memory and 15 Mbytes of extended memory, allowing storage of all points acquired in an operation in one continuous stream. The program works with DT2801, DT2821, and DT2901 series boards for the IBM PC/AT, XT, and PS/2 computers. It sells for $995 and is available now.

## CADENCE'S ROUTING TOOL HANDLES MORE INTERCONNECT LEVELS

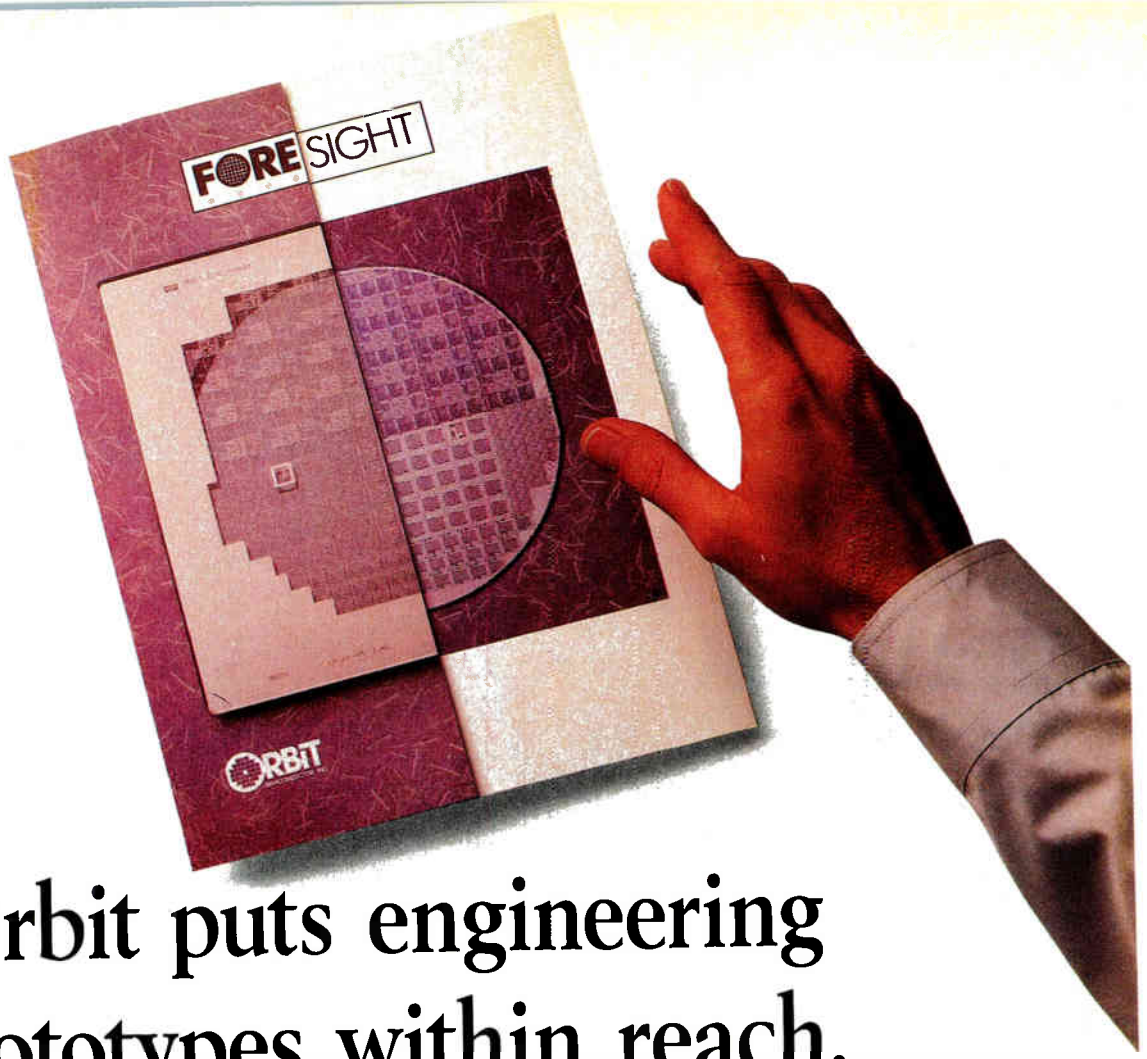
Cadence Design Systems Inc.'s automated, chip-level place-and-route system for cell-based designs supports three or more levels of metal interconnect.

The Cell3 Ensemble is the first to support that many levels, says the San Jose, Calif., company. With it, designers can take advantage of system improvements such as unrestricted over-the-cell routing and channel-based routing algorithms.

Cadence claims Cell3 Ensemble can reduce die area by nearly 45% and increase performance by over six times compared with double-metal-interconnect solutions.

Other key features include placement tools that support three-level-metal top-down and bottom-up hierarchical design. When sophisticated global routing algorithms are used with Cell3 Ensemble, average wire lengths result that are within 10% of the optimum.

The tool is available now. Pricing starts at $100,000 per license depending on which work station is chosen as the platform.

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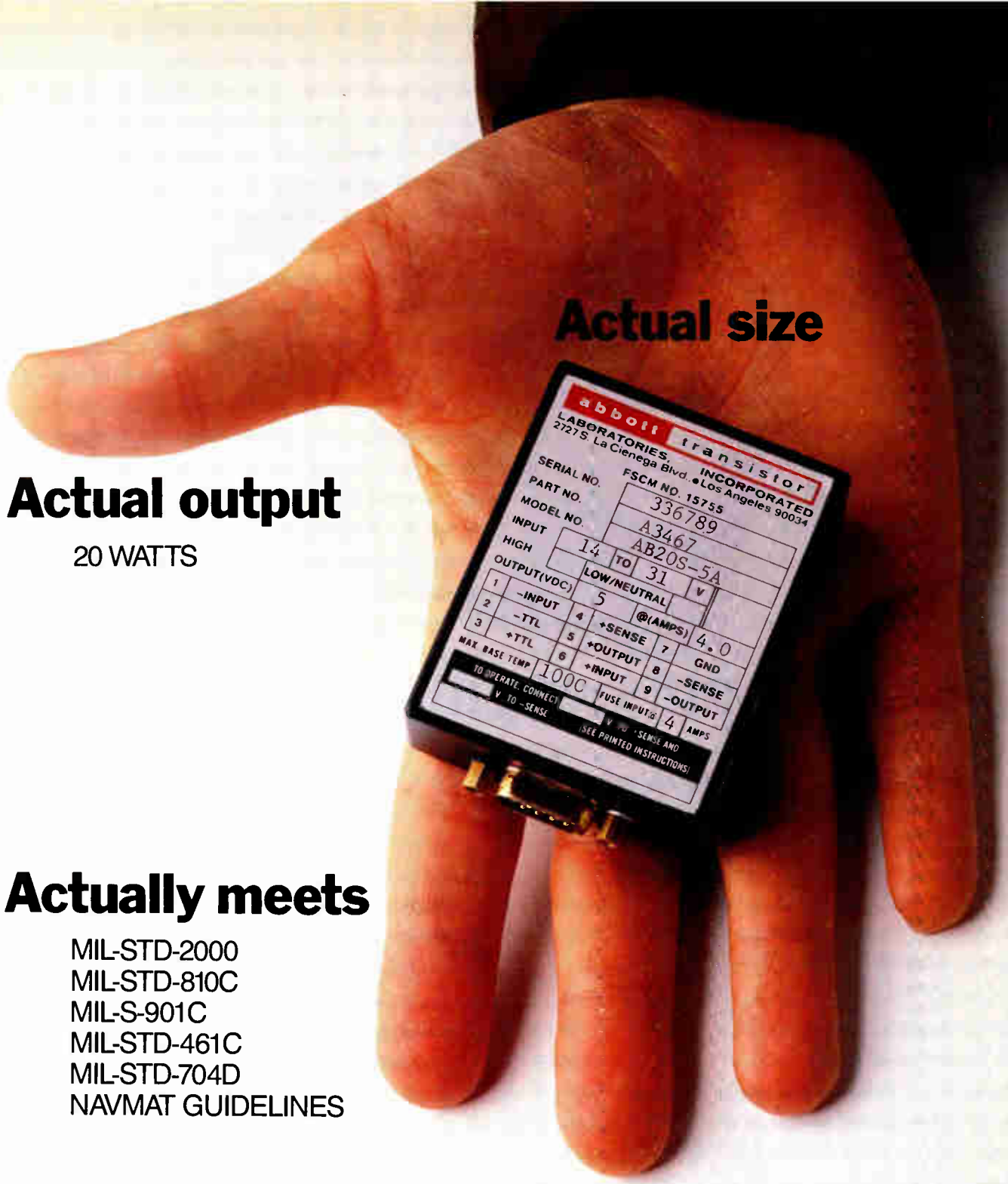
**CIRCLE 225**

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CIRCLE 205

## THE FIRST OFF-THE-SHELF MULTIPROCESSOR CHIP SET FEATURES A DIFFERENT ARCHITECTURE

# A NEW PC DESIGN PATH

BY BERNARD C. COLE

IT LOOKS AS IF GORDON Campbell, Morris Jones, and their gang of merry chipsters have pulled off another one. This time it's the first off-the-shelf chip set for multiprocessing. Featuring a new architecture, the set could well change the way that engineers design and build not only personal computers but work stations and minicomputers as well.

"What Chips & Technologies has done—again—is redefine the computer business as it relates to personal computers and work stations," says Michael Slater, editor of the industry newsletter *Microprocessor Report*. "And in the process, it has moved itself out of a marketplace full of copycat clone-chip makers and into a totally new market segment in which it has defined the ground rules and in which it has at least a year or so before it has any significant competition." At the same time, Chips has vaulted out of the category of just another chip-set supplier. "Now, they can rightly claim to be a company with a leading-edge technology," says Slater.

The product behind all the excitement is a new chip set introduced last month by the Milpitas, Calif., company. Chips managed to attract the attention of engineers from around the world with the announcement of its CS8239 multiprocessor architecture extension—dubbed MPAX—chip set. Indicative of its brash and aggressive approach to marketing its products, Chips guaranteed that the eyes of the world's technical and financial communities would be on it by announcing the new offering at the St. Francis Hotel a few blocks away from the San Francisco Hilton, where several thousand engineers were attending the 1990 International Solid State Circuits Conference.

It all started more than a year ago, says Campbell, who is founder and president of the company. He and Jones—cofounder and vice president of technology—along with a small group of engineers began looking at the PC and work station market. They came to the conclusion, Jones says, that current approaches dependent on particular processors, buses, or chip sets were too limiting, in both performance and flexibility. "It was inevitable that some sort of new architecture that moved beyond the current ISA, EISA, and even MicroChannel architectures was needed," he says. "Somebody had to take the risk. Why not us?"

MORRIS JONES

GORDON CAMPBELL

**The Chips & Technologies team decided that current approaches to designing PCs and work stations were too limiting. The result: a chip set with a new architecture.**

The result is the five-chip MPAX architecture, scheduled to be available in sample quantities in June. Included are the 82C390 cache-directory comparator, the 82C392 system-control unit, the 82C393 direct-memory-access controller, the 82C395 processor data switch, and the 82C397 cache-control unit. In a typical processor module, two processor-data-switch chips are required along with a single cache-control unit and cache directory comparator, as well as fast static memory.

Handling the high-speed communication channels to the outside world, the direct-memory-access controller serves as a high-speed byte-serial controller for multiple DMA channels. Such channels might be used for tying the system into peripherals based on the Small Computer Systems Interface standard, or network adapter cards, image scanners, or even video digitizers. They might also support such new applications as multimedia computing [*Electronics*, February 1990, p. 48].

A processor module based on the 80486 and the chip set can run at clock rates of 33 to eventually 50 MHz as faster central processing units become available, says Jones. The 128-bit-wide multiprocessor interface bus has a sustained bandwidth of 128 Mbytes/s, four times the peak burst rate of either the MicroChannel or the Extended Industry Standard Architecture buses for current chip-set implementations, the company says.

With a single system-control unit, from 4 to 256 Mbytes can be addressed in main memory. A second unit ups the address range to 512 Mbytes. According to Jones, typical system implementations range from a simple single-processor configuration with considerably improved input/output response on up to six processor modules. And work is under way, he says, on new chips that will further increase the number of processors available.

The significance of the Chips introduction is that until now there has been no off-the-shelf hardware solution for designers to build multiprocessor systems, although a number of systems houses have attempted to do so on their own, says Slater. Among them are Compaq, Corallary, and Santa Cruz

Operations; and similar systems come from Zenith Data Systems and Mitac Corp. Industry watchers say there also have been attempts at 386- or 486-based multiprocessor systems by Wyse Technology as well as by Intel itself.

And what should make designers of systems using competitive complex- and reduced-instruction-set processors take notice, says Campbell, is the fact that though the initial version is optimized for the 486, with some minor glue logic, the MPAX architecture can support virtually any CPU. "And if there is a large enough market, we will also be there with extensions to the chip set to support particular architectures," he says.

The set should bring joy also to the low end of the PC market, because of its connectability to existing PC system buses. These are designed to synthesize the 80386 processor's protocol to access the PC's I/O resources. E

CONSORTIA

## THE END OF U. S. MEMORIES IS ONLY THE START OF WHAT COULD BE A LONG BATTLE

# ARE CONSORTIA DEAD?

BY JACK SHANDLE

IN THE TWO MONTHS since the U. S. Memories Inc. consortium died, it has become obvious that no one was betting the farm on America's first attempt at cooperatively manufacturing dynamic random-access memories. Less obvious—but just as true—is the fact that U. S. Memories was only one round in a fight that will last through the decade to establish manufacturing consortia.

Within a few weeks of U. S. Memories' demise, two of its founding members announced DRAM deals with an international flavor. Intel Corp. got together with Japan's NMB Semiconductor Co. in an exclusive sales agreement, and IBM Corp. signed on with Siemens AG of West Germany to develop 64-Mbit DRAM technology.

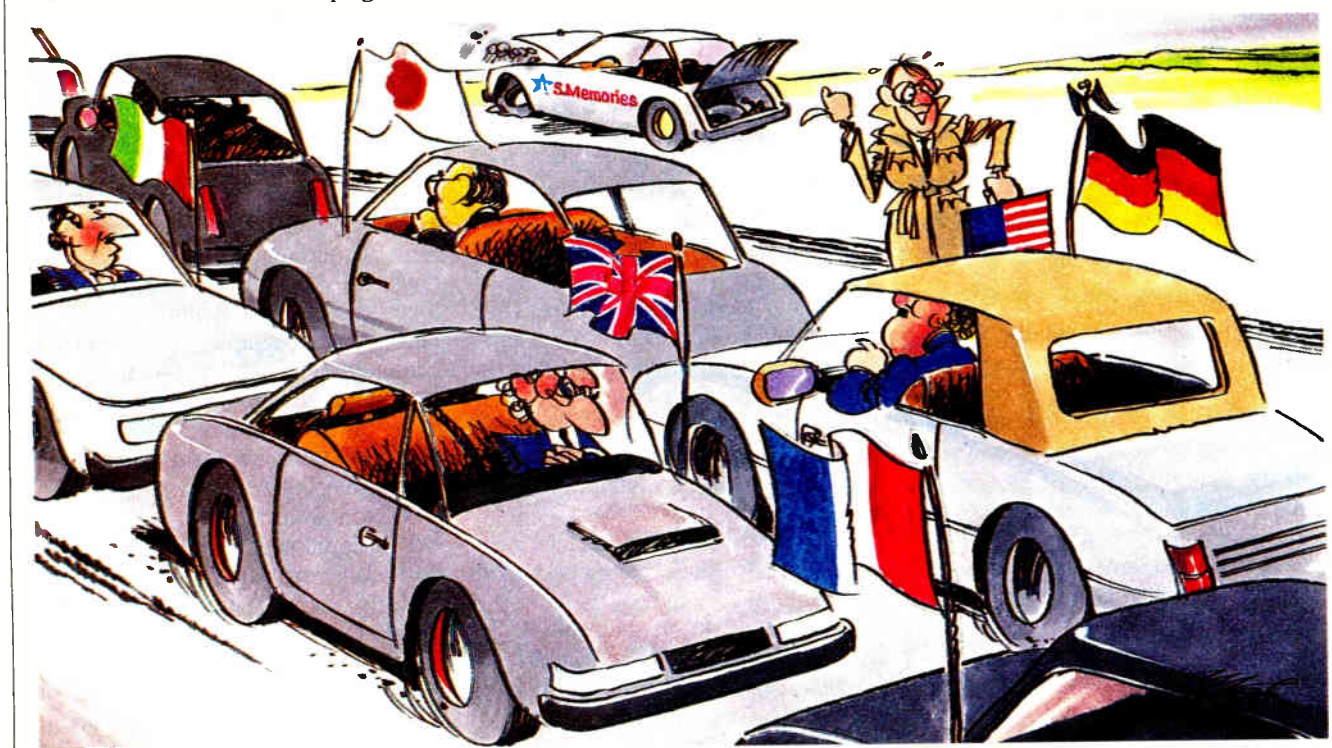
High-ranking executives at both U. S. companies say the NMB and Siemens deals were part of broad corporate strategies and would have gone on regardless of U. S. Memories' fate. In the same breath, they call for renewed American cooperation to preserve the domestic semiconductor industry.

"There are two perspectives," says Gordon Moore, chairman of the board of Intel. "A company tries to make itself as independent as possible by putting plants in other countries and making strategic alliances. But that doesn't necessarily coincide with the interests of the U. S. or our standard of living in this country."

Patrick Toole, senior vice president of IBM's Technology Products Division in Somers, N. Y., agrees that focusing simply on DRAM supplies clouds the issue. "For IBM to succeed in semiconductors, we need world-class tools and materials," he says.

EXPERTISE IN THOSE AREAS and in manufacturing capability is quickly migrating overseas, especially to Japan. That worries IBM, says Toole. Moreover, the U. S. needs chip-manufacturing capability to support a healthy tools and advanced materials industry, he adds.

Which brings the argument back to chips and fabs. The consensus in the pro-cooperation camp is that capital is just too costly, too scarce—and the investment community too impatient—to supply the megabucks needed to build

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CIRCLE 271

fabs or similar facilities, except as cooperative ventures. Dick Iverson, president of the American Electronics Association, thinks U. S. high-definition TV technology will have to be consortium-based in order to survive. Iverson uses as an example Toshiba Corp.'s decision to build a $300 million plant to manufacture active-matrix, flat-panel displays. "That line has no prospect of making money for four to five years," he says. "No single U. S. company can do that."

The question of capital's cost, availability, and "patience" is too big to be solved by the semiconductor and computer industries, says Iverson. So getting the government involved is another common theme in the post-U. S. Memories era. But Iverson sees that as more of a problem now. "The people in government look at this with wonder in their eyes," he says. U. S. Memories had everything going for it—a handful of America's largest and most successful companies and IBM's DRAM technology, he says. And still it could not get off the ground. "This has had a negative effect in Washington."

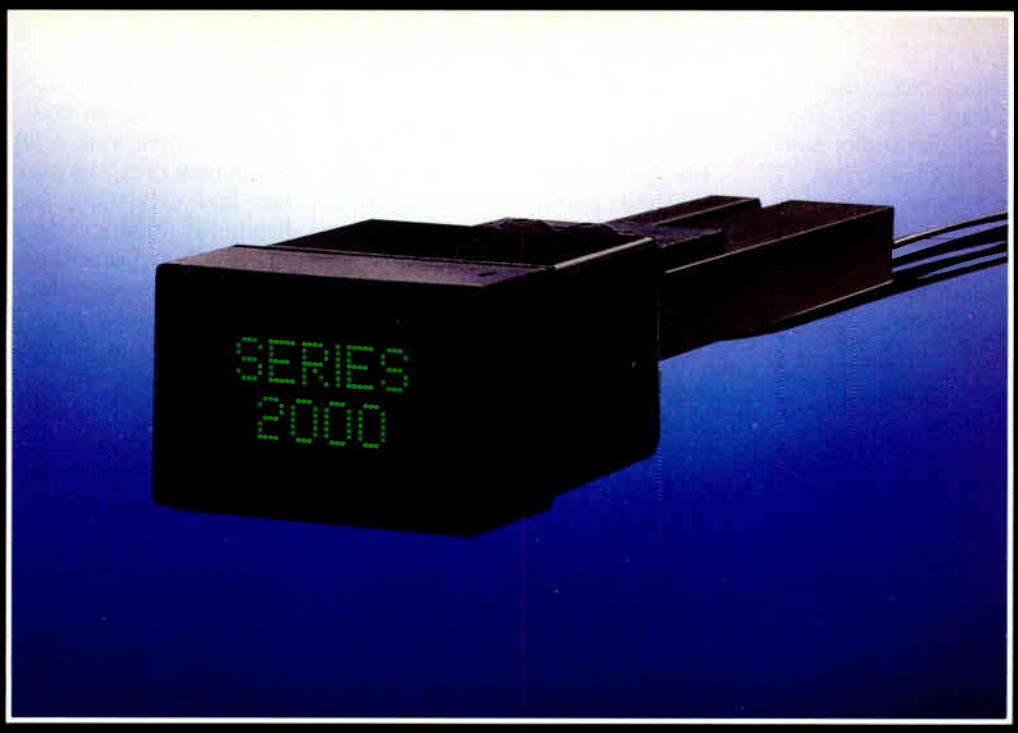
Congressman Tom Campbell, (R., Calif.) concurs that confusion reigns in Washington. The prevailing view in the Congress, says Campbell, holds that America's technology lead is eroding, "and that translates into a willingness to help. But a selling job is needed to win Congress over to the idea that DRAMs are a critical technology."

Campbell is considering introducing legislation in the next few months that would at least start to nibble away at the cost-of-capital problem.

The bill would have two main elements. First, the U. S. would designate a "short list" of strategic technologies through a mechanism that would include panels from the National Academy of Science and the National Academy of Engineering. The list might include HDTV, semiconductors, advanced materials, artificial intelligence, fiber optics and microbiology, he says.

Then a user tax would be imposed on current technologies in those areas. For example, conventional TVs could be taxed to support research and development in HDTV.

**THERE ARE TWO PERSPECTIVES, AND SOMETIMES A COMPANY'S BEST INTERESTS DON'T MATCH THOSE OF THE NATION, SAYS INTEL'S MOORE**

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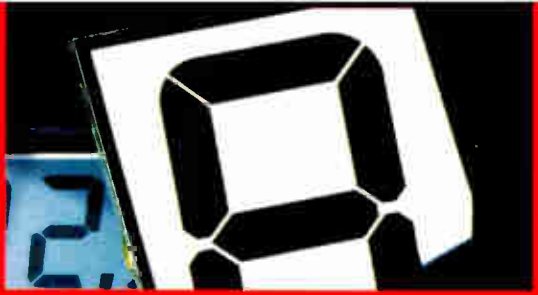
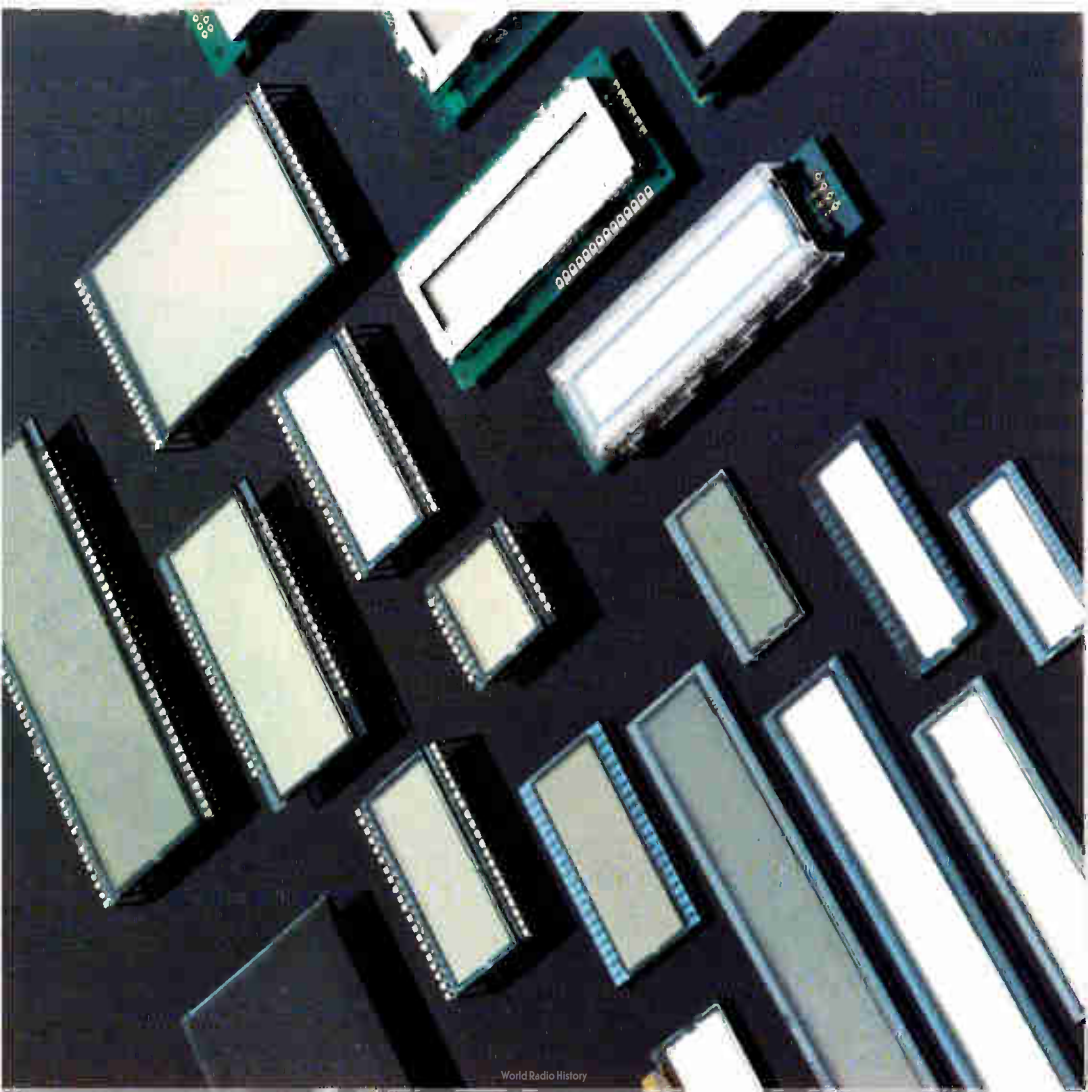


# Take an inside look at Philips LCDs



## Philips ...and the future of LCDs

■ Liquid crystal displays were first developed to meet a demand for greater design flexibility and lower power consumption than could be achieved with LED displays. But it wasn't long before other benefits of LCDs became apparent. Benefits like their low cost, intrinsic reliability and superior legibility. And with new LCD technologies, such as double super-twisted nematic (DSTN) crystals and active dot-matrix displays, improvement in LCD characteristics is guaranteed.

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Philips has the staying power and the resources to offer you a long-term partnership. Resources such as the largest privately-funded research organization in the world and our new $100 million LCD facility in The Netherlands, providing unsurpassed LCD development, complemented by mastery of mass production. The result is a line of standard/custom LCD cells and modules for segment, character and dot-matrix display, including types with fully integrated driver ICs implemented in chip-on-foil and chip-on-glass technology. Separate driver ICs are available in SMD and tape-automated bonded (TAB) packages.

Philips — setting the pace for the future of LCDs. ■

*Development sample of a semi-custom chip-on-glass LCD module in which the driver chip is bonded to the LCD cell*

# LCD design flexibility

■ Philips already provides a host of LCDs for application in a variety of industries. Recent advances in the technology have extended legibility, information content and temperature range, leading to applications in the demanding environments of telecommunications, computers and the automotive industry.

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Philips — flexibility to satisfy all your LCD design needs. ■

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Philips — production experience built into every LCD.

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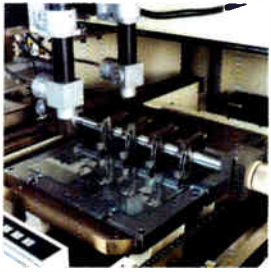
*2. Printing*

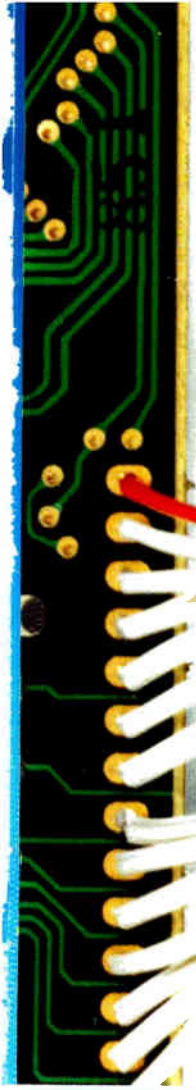


*3. Cutting*

*1. The first major production stage — sputtering glass plates with thin layers of silicon dioxide and indium/tin*

*2. Offset printing of polyimide layer to orientate the liquid crystal molecules*

*3. Cutting matched plates into strips, each of which may contain many individual cells, before filling these with liquid crystal under vacuum*



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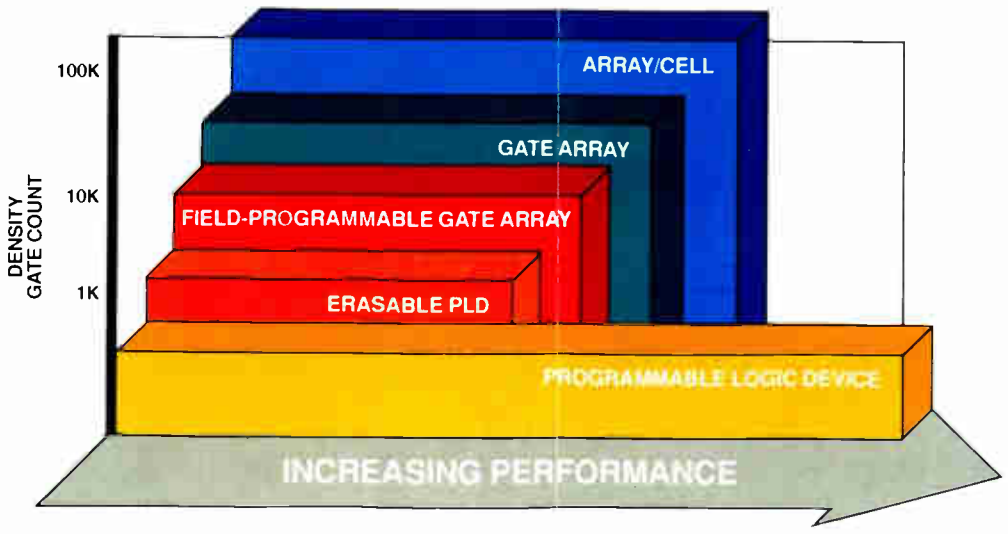
## TI's ASIC PRODUCT SPECTRUM

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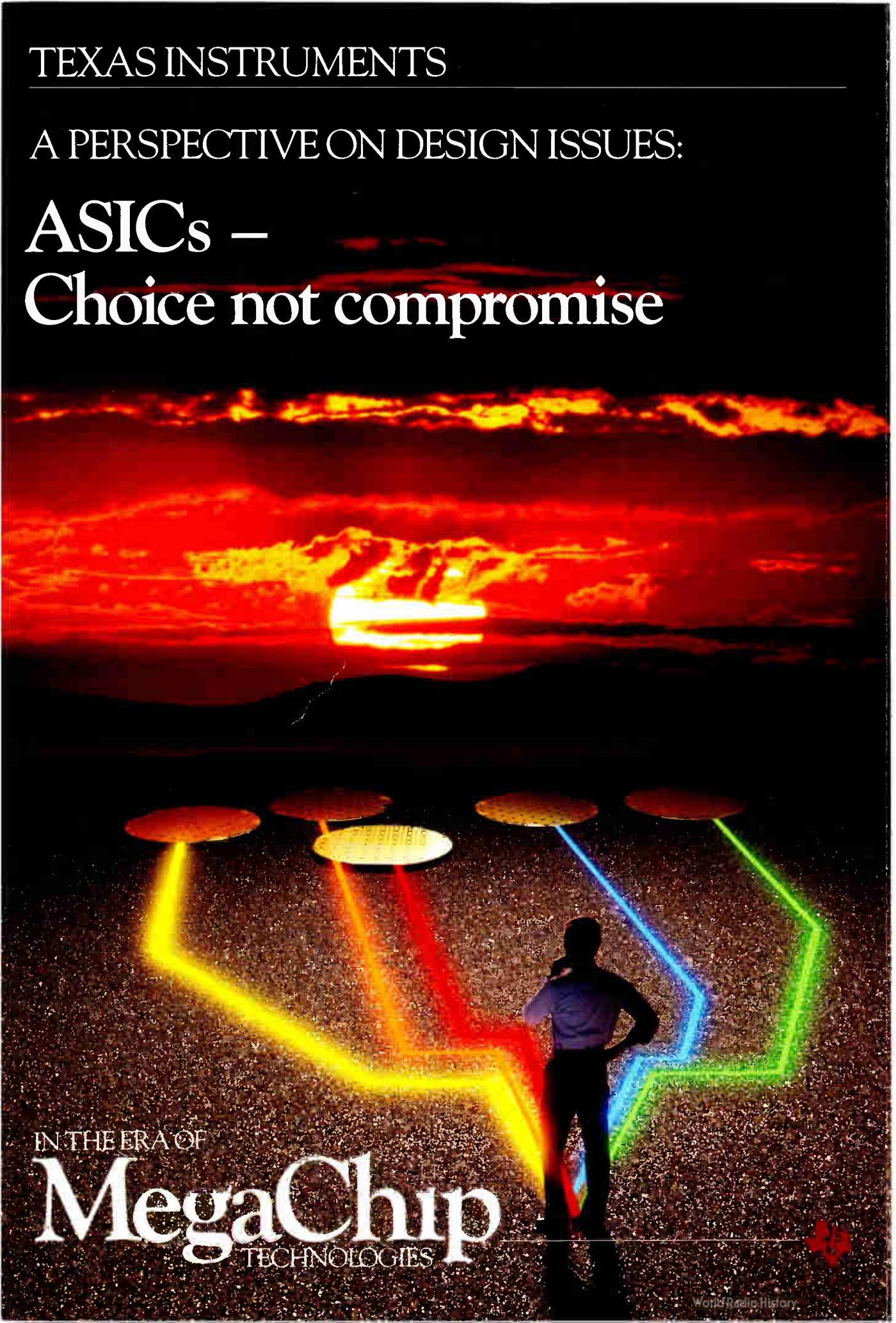
TEXAS INSTRUMENTS

A PERSPECTIVE ON DESIGN ISSUES:

# ASICs – Choice not compromise

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"An ASIC solution is more than a choice of silicon. To keep you from compromising on a square peg for a round hole, an ASIC solution involves many considerations: Your performance needs. How much control you want to exercise. The amount of support you require. What you can spend. How narrow your market window is. It's the result of you and your supplier weighing all the choices and reaching a balanced decision. At Texas Instruments, that's the way we like to work.

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"We are looking to future solutions. For example, we are developing submicron CMOS and BiCMOS gate arrays and standard cells with densities over 100K gates. We are extending our support by developing software that migrates FPGA designs to mask-programmed gate arrays.

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"At TI, we invite you to experience the difference between compromise and choice — the difference between an ASIC device and an ASIC solution."

Walden C. Rhines, Ph.D.
Executive Vice President, Semiconductor Group
Texas Instruments Incorporated

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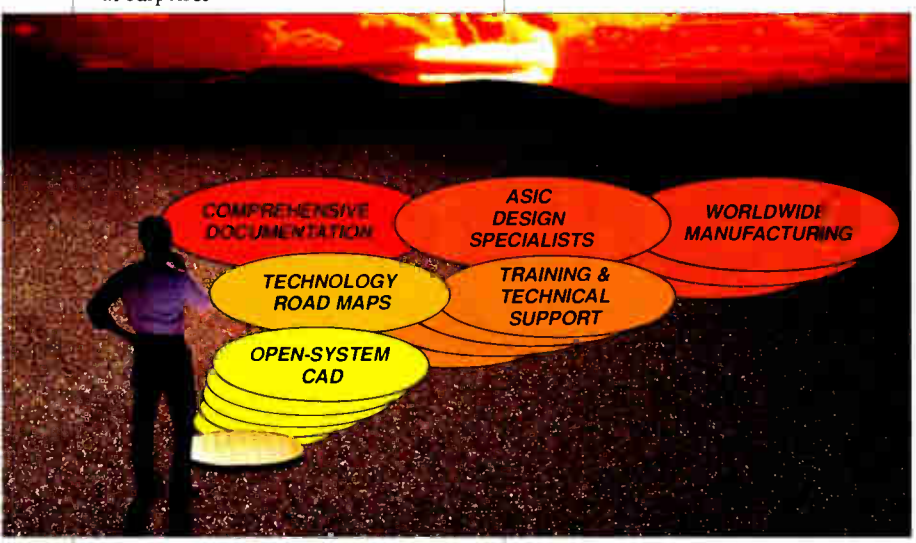


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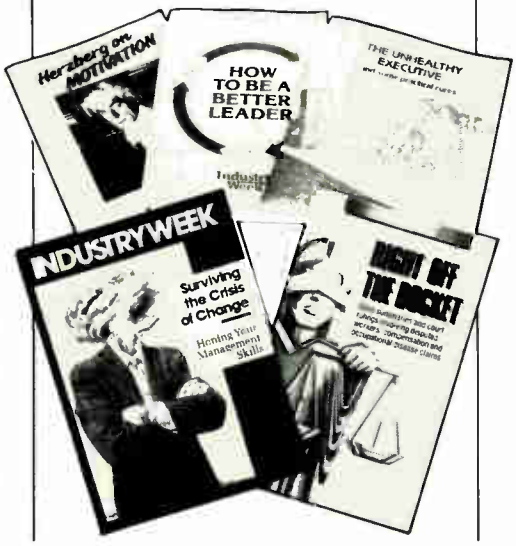


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SEMICONDUCTORS

# BiCMOS SWEEPS ARE ON OUT OF THE NICHE

BY BERNARD C. COLE

THE BiCMOS SWEEPSTAKES are on, and there's more at stake than the short-term profit possibilities of high-speed emitter-coupled logic and TTL logic and memory. With a few notable exceptions, every major and minor semiconductor company has come to the conclusion that biCMOS's time has come. By the mid-1990s, it is generally agreed, biCMOS will move out of its niche as a high-performance process and into the mainstream for everything from application-specific integrated circuits to dynamic random-access memories.

One of the newest players is Philips Components-Signetics of Sunnyvale, Calif., which last month announced its intention to jump into this already crowded arena with a range of digital logic products, including gate arrays, memories, programmable logic devices, and bus controllers as well as analog and mixed-mode circuits.

Signetics is betting on a horse called QUBiC, a 1.3-GHz biCMOS process that has been three years in development and features bipolar gate delays of less than 70 ps. "With this process we'll be able to build an entirely new class of low-power products that perform at supercomputing speeds," says company president James Dykes, who terms QUBiC Signetics' strategic technology for the 1990s.

The first QUBiC products are three bus-interface chips: a 3.5-ns octal inverting buffer, a 2.8-ns octal transceiver with direction pin, and a 4-ns octal d-type transparent latch. Where competing parts require supply currents as high as 10 to 100 mA, the QUBic devices use just 50 μA. "By midyear we expect to be introducing an average of one new biCMOS logic product per month," says George Conner, manager of biCMOS technology development.

The key to the 20-mask biCMOS process, he says, is the merging of the company's 1.0-μm CMOS process with ultrafast bipolar transistors that allow

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construction of gates with delay times as low as 70 ps. The key is the use of a single polysilicon layer to form the emitter of the pivotal npn transistors. N+ and p+ buried layers are formed on the base wafer prior to epitaxial silicon deposition to create the npn subcollector for the bipolar structure and the retrograde n- and p-well structures for the CMOS.

A RICH PROCESS, QUBiC also offers pnp transistors, Schottky diodes, polysilicon resistors, lateral fuses, and three layers of aluminum-copper global interconnect, as well as titanium tungsten for use as local interconnect within the transistors. The result is transistors with operating frequencies as high as 13 GHz, with 17-GHz parts in development. In the next few months the company expects to roll out gate arrays, memory products, telecom circuits, and PLDs.

Impressive as the Signetics offering is, it's not the only entry. For example, National Semiconductor Corp. of Santa Clara, Calif., will soon ship samples of a 1-Mbit biCMOS static RAM and this month expands its biCMOS memory offerings to include the first in a family of application-specific SRAMs. The 2-Kbit-by-9-bit advanced self-timed part boasts access times as fast as 5 to 10 ns. National is also developing a second-generation biCMOS process running at 10 to 12 GHz.

Aspen Semiconductor in San Jose, Calif., is using its 10-GHz biCMOS Star process to build a new family of 64-Kbit TTL SRAMs. In the works are PLDs and higher-density SRAMs as well as a newer 15-GHz process. And engineers at Texas Instruments Inc. in Dallas are putting finishing touches on 256-Kbit and 1-Mbit SRAMs built with TI's 7-GHz process.

BiCMOS is a critical technology for any semiconductor house that expects to play in the high-performance market, says Naushik Desai, strategic marketing manager for biCMOS at Aspen. "As CMOS transistors move to half-micron dimensions, some way has got to be found to give them enough drive capability," he says. "Adding bipolar structures at this point seems to be the only practical solution." E

LAN SERVERS

## MARKET BOOM IS HERE

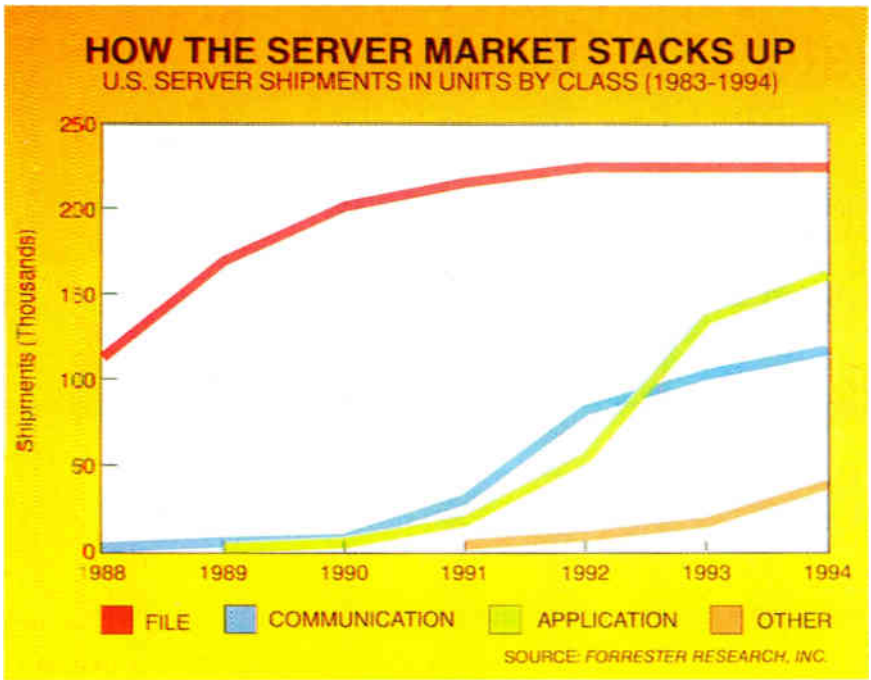
# NEW BREED OF SERVER

BY WESLEY R. IVERSEN

LIKE GAS SURGING TO FILL a vacuum, a flock of fledgling computer companies is rushing into what they think could be an exploding market opportunity for a brand-new class of network computers in the early part of the 1990s.

A case in point is the latest entrant, Tricord Systems Inc., a Plymouth, Minn., startup. The two-year-old company this month will begin shipping an example of what many market watchers are calling a new generation of local-area-network servers.

Tricord calls its line Powerframe,




multiprocessor LAN servers based on the 80386 and 80486 processors from Intel Corp. Displayed for the first time last month at the Networld show in Boston, the new servers will not only offer more number-crunching power for computationally intensive jobs like data-base serving, but they will also up the ante in input/output processing power needed to serve the ever expanding numbers of desktops. "In the emerging server market, depending on the application, there is a requirement to move data that is equally important as, if not more important than, the requirement of processing data," says John McCarthy, director of research at Forrester Research Inc. in Cambridge, Mass. "Network I/Os per second and the ability to move information as well as process it is what will separate the men from the boys in this game," he declares.

ON THAT COUNT, SOME think the background of the Tricord management team—in supercomputers, mainframes, and special-purpose architectures—could provide a design edge for the Minnesota firm. Tricord was founded by Larry D. Ingwerson, founder of Star Technologies, and the current Tricord team includes former employes of Sperry and Control Data, including the defunct ETA Systems supercomputer unit. Tricord's chief executive officer is James D. Edwards, previously senior vice president of AT&T Computer Systems, whose

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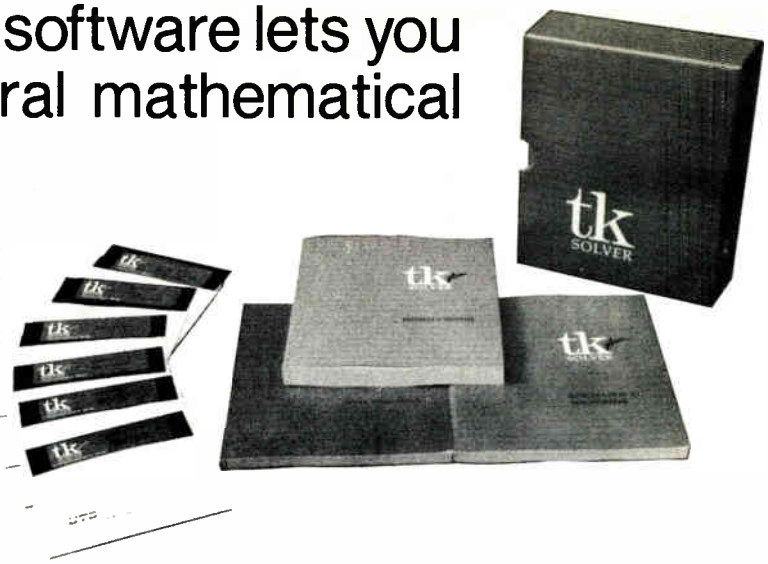


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"For a nice Midwest company, they've got a pretty good roster," says industry watcher Gary Smaby, president of the Smaby Group Inc. in Minneapolis. "They seem to have a very good understanding of what it takes to compete at the high end of the [network server] market."

Still, with the Powerframe Tricord faces a strong and growing list of competitors that are also targeting the dedicated server market. At least eight other start-ups, mostly in the Silicon Valley, are in various stages of design and production of machines with architectures similar to Powerframe's. These include names like Auspex Systems, Netframe Systems, Omni Solutions, and Parallax. And even big-name players like Compaq Computer Corp. are getting into the game. The Houston-based personal computer powerhouse introduced its multiprocessor 386/486 Systempro line last November for use in network server and multiuser host applications.

**THE NEW SERVERS GIVE MORE POWER FOR NUMBER CRUNCHING AND OFFER THE I/O THAT IS DEMANDED BY THE GROWING NUMBER OF PCs**

All of the activity grows out of the burgeoning popularity of LANs and the rise of so-called client/server computing. That's where one machine on a LAN provides services for the desktop machines (or clients) linked on the net. For example, file servers allow LAN-linked PC or work station users to share and back up files centrally, while communications servers may take over protocol processing and link managing for communication with other LANs and wide-area networks.

Increasingly, servers are also being called upon to handle more processing-intensive tasks, such as data-base or facsimile/image serving.

Today, about 80% of all servers sold for use on PC-based networks are actually standard-platform PCs that have been outfitted to act as servers, says Rick Villars, manager of computer network systems and strategies for market researcher International Data Corp. in Framingham, Mass. But as LANs expand—and as desktop machines become more powerful and server applications more complex—this approach is proving unsatisfactory. The machines can't handle the traffic and keep running into I/O bottlenecks.

Until now, the primary alternative for LAN users has been the use of more powerful minicomputer or mainframe server platforms from the likes of Digital Equipment, Hewlett-Packard, or IBM. But the new breed of dedicated LAN servers will deliver new price/performance points that fall between traditional PC and workstation-based servers, and the higher-end mini- or mainframe solutions.

As a result, some analysts expect the new generation of machines to carve out big chunks of a fast-growing server market.

For example, Forrester Research sees the U. S. market for all kinds of servers jumping from just over $3 billion last year to $11.7 billion by 1994. And McCarthy, for his part, predicts that "at least 50%" of that business will be captured by server-specific architectures such as those currently emerging from Auspex, Compaq, Netframe, Tricord, and other companies.

That's a $5.9 billion market. And though most market watchers expect a shakeout somewhere down the line, some believe that at least one and perhaps more of the new network computer startups will emerge as new fast-growth computer-industry darlings. Big-name players like Compaq, DEC, IBM, HP, and Sun are to varying degrees all expected to be in the game with dedicated server machines of their own, says McCarthy.

"But there are also prospects here for a new Sun, a new Apple, a new DEC, or whatever you want to call it, to emerge," he allows.

At Tricord, CEO Edwards says the goal is to become a $100 million company by 1993. "One danger for us would be to get misled by all the in-

dustry enthusiasm that mainframes and minis are dead, and that servers are going to get all the business, which isn't true," he says.

But Edwards notes that at prices ranging from $24,000 to $50,000, Tricord's high-end Powerframe Model 40 will offer server performance comparable to that of minicomputers such as the IBM AS/400, DEC's VAX 6000, or the HP Spectrum—at about a tenth of the cost. At the same time, the low-end Powerframe Model 30, starting at around $16,000, will run rings around traditional servers that are based on standard or customized PC or work-station platforms, according to Edwards.

Tricord's primary target is the PC LAN market, not the Unix work station LAN segment. The Powerframe maintains binary compatibility with DOS or OS/2 applications, and the company is emphasizing an open-systems architecture based on PC industry standards. Powerframe I/O subsystems include a set of seven 32-bit Extended Industry Standard Architecture cards slots, an 8-bit XT bus, and a high-speed disk subsystem that is controlled by a dedicated 386 processor.

**LAN SERVERS WILL OCCUPY A LARGE CHUNK OF THE MARKET BETWEEN PC-BASED AND MINI/MAINFRAME SOLUTIONS**

The system can accommodate up to 17 Gbytes of disk storage, which can be configured as mirrored disk sets for fail-safe operation. An SCSI-2 controller option also is also offered for faster speeds using disk-array technology.

The Powerframe is the first of the new network servers to be offered with a RISC coprocessing option; the Model 40 can be outfitted with either two Intel 486 processors, or with a single 486 and an Intel 80680 reduced-instruction-set-computing machine. These processors are tied to each other and to the I/O subsystems over a high-speed, 67-Mbyte/s internal bus.

In about a year, Tricord plans to introduce a higher-end version of the field-upgradable Powerframe line that will accommodate up to eight Intel processor chips, Edwards says. But for now, Powerframe performance will range from about 12 million to 45 million instructions/s peak throughput. Use of the 860 option will provide 20 million floating-point operations/s sustained performance for certain compute-intensive applications, such as communications gateway problems.

IN SOME SERVER SEGMENTS, the Powerframe is likely to go head to head with Compaq's Systempro, which can perform 8 million to 40 million instructions/s and costs $16,000 to $26,000.

But according to Edwards, a more telling measure will be how many transactions per second a system can perform. And on that count, he says, Tricord will have the edge thanks to the Powerframe's high-speed internal bus and other architectural features. Based on one popular benchmark, "We think our high-end model has a 50% to 70% performance advantage over Compaq's high-end machine," says Edwards.

Specsmanship aside, Edwards says that given access to the same chips and standards, most server vendors will ultimately match up well on technology, offering comparable price/performance levels. As a result, he says, "I think distribution channels will be the key differentiator for the server market." On that front, vendors like Compaq and Netframe that rely primarily on retail distribution channels could be at a disadvantage, Edwards figures.

Tricord instead has opted to sell through systems integrators and value-added resellers, a group "who are more experienced in installing LANs and the servers that go with them," Edwards says.

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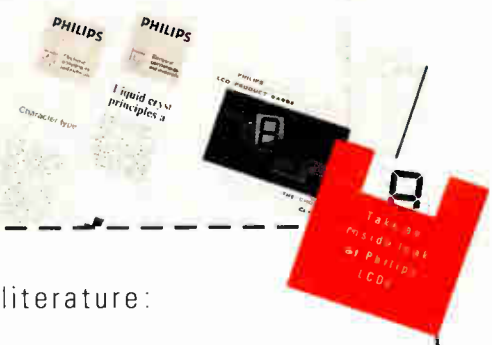


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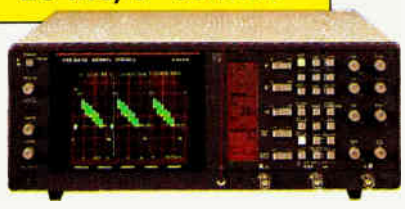

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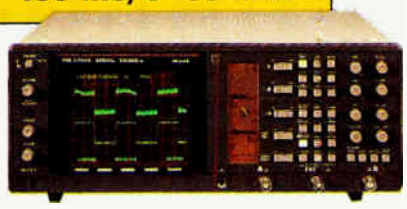

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■ ***PM 3365A*** *100 MS/s sampling simultaneously on both channels, plus repetitive sampling at up to 100 MHz, 100 MHz analog bandwidth, 4 memory registers, extra signal - processing modes, Digitally Delayed Timebase, GPIB/IEEE - 488 or RS232 - C interface options.*

**250 MS/s - 60 MHz**

■ ***PM 3355*** *Fast 250 MS/s sampling simultaneously on both channels, 60 MHz analog bandwidth, 4 memory registers, fast - action 'intelligent cursors', Digitally Delayed Timebase, GPIB/IEEE - 488 or RS232 - C interface options.*

**250 MS/s - 100 MHz**

■ ***PM 3375*** *Fast 250 MS/s sampling simultaneously on both channels, plus repetitive sampling at up to 100 MHz, 100 MHz analog bandwidth, 4 memory registers, fast - action 'intelligent cursors', Digitally Delayed Timebase, GPIB/IEEE - 488 or RS232 - C interface options.*

*For further information, call your local supplier:*
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*For countries not listed, write to: Philips I&E, T&M Department, Building TQ III-1, 5600 MD Eindhoven, The Netherlands.*

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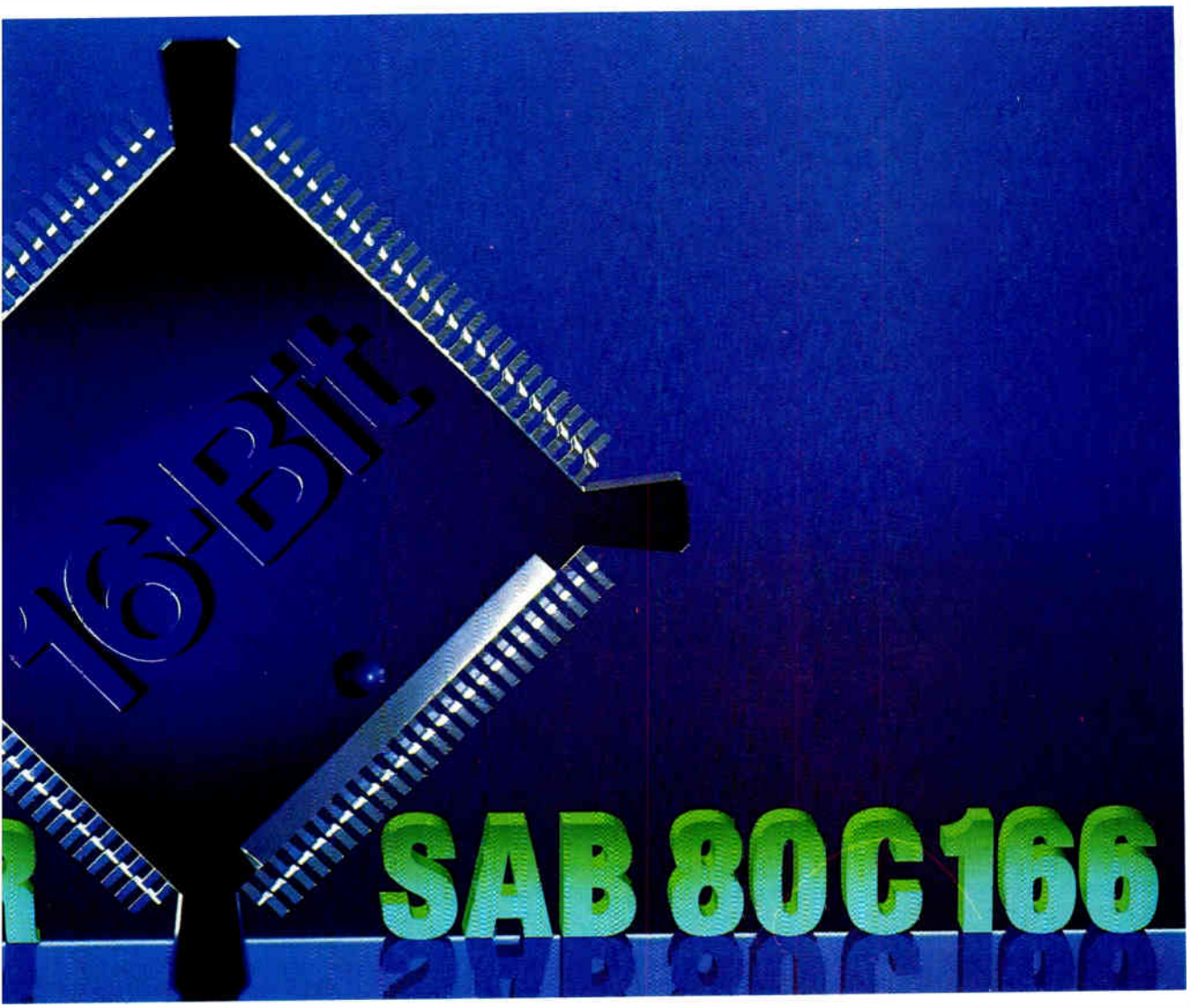
# The New Reference Class




A19100-HL5818-X-7600 MC&D

The SAB 80C166 integrates the best from today's new processors & advanced microcontrollers: the processing speed and data throughput of the micro processors plus the fast response and peripheral integration of the micro controllers.

The 16-bit SAB 80C166 microcontroller is tailored to high-speed real-time processing, satisfying all the demands of modern embedded-control systems. In other words it is just as much at home in the complex control world of automobiles as it is in fast data terminals or time-critical industrial control systems.

Here's a taste of how this new 16-bit controller performs: instruction cycle time 100 ns, processes 90% of all instructions in one cycle (that's typical RISC performance), interrupt response 400 ns (worstcase!), complete task switch 100 ns.
If that goes down well and you want to find out more, contact your local Siemens office or just write to:

Europe:
Siemens AG, Infoservice HL 5818,
Postfach 2348, D-8510 Fürth
USA:
Siemens Semiconductor Group,
2191 Laurelwood Road,
Santa Clara,
CA 95054
Quoting: „SAB 80C166".

**TopTech Semiconductors Siemens**

CIRCLE 228

# News from Philips

THE COMPLETE COMPONENT COMPANY

Philips Components
5600 MD Eindhoven
The Netherlands

## Philips enters SRAM market with ultra-low-power 64-kbit CMOS SRAMs

Philips Components is entering the byte-wide SRAM market with a high performance 8kx8 CMOS device offering ultra low-power consumption down to 1 µA both in 5 V standby and in the battery backup mode ($V_{dd}$ = 3 V). Access times range from 55 ns to 70 ns. The 8kx8 CMOS SRAM is fully pin-compatible with devices presently on the market.

*Philips Components' 64 kbit SRAMs suit many demanding applications.*

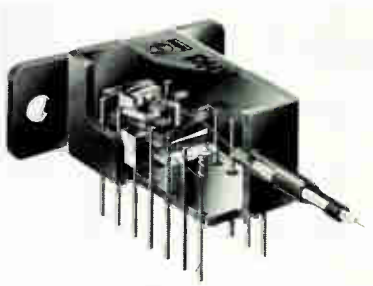
The new devices are manufactured in MOS-3, Europe's most advanced wafer fab based in Nijmegen, the Netherlands. The 1.2 µm, double-metal technology together with the full-CMOS six-transistor cell design account for the very low power consumption, very low sensitivity to alpha particles and wide operating temperature range. The FCB61C65 operates from a single 5 V supply; inputs and outputs are directly TTL- and CMOS-compatible. Two chip-enable pins are provided for maximum flexibility, easy memory expansion and controlling the standby mode. The address activated devices feature combined data input and output interfaces and can also be three-state controlled with a separate output enable pin.

The FCB61C65 normal and low power devices with an access time of 70 ns are available now in a 600 mil 28-pin DIL package and will be available in a 330 mil SO28XL package early 1990. The 55 ns part and the ultra low-power part will be offered in the near future.

**Circle 800**

## InGaAsp laser diode for high bit-rate fibre-optic communications

Philips Components is introducing an ultra-fast DIL-pacakged InGaAsP laser diode for extremely high bit-rate fibre-optic communications. The CQF60 incorporates internal electrical compensation that allows operation at up to 2.4 GBits/s, a unique feature for a DIL-packaged laser diode. The LC compensation network counteracts the effects of the inductance and capacitance of the encapsulation and feed-through connections, provides perfect 50-Ω line impedance matching, and avoids electrical reflections.



*1.3 and 1.55 µm wavelength lasers in user-friendly DIL package.*

The 14-pin DIL package is both cost-effective and user friendly.

The CQF60 forms part of a new and comprehensive range of DIL-packaged InGaAsP lasers which covers the 1.3 µm and 1.55 µm wavelengths.

**Circle 801**

## New ferrite helps lift SMPS operating frequency

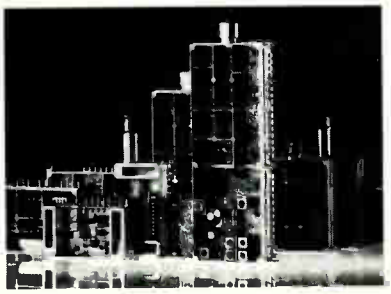
Philips Components' 3F3 ferrite helps boost the operating frequency of switched-mode power supplies to 1 MHz, thus making the supplies smaller and lighter. The new ferrite will be attractive for EDP, aerospace, and telecom equipment, where size and weight are at a premium. It will work particularly well in new resonant-converter designs, which can furter reduce switching losses, increase operating frequencies, and cut EMI.

By reducing high-frequency losses, the ferrite reduces the core size without sacrificing power throughput. Replacing a conventional core with a 3F3 and simultaneously increasing the operating frequency from 50 kHz to 500 kHz leads to a threefold reduction in core volume and weight, and a tenfold reduction in the size of the output choke and capacitor.

**Circle 802**

## TV tuners incorporate PLL tuning system

Philips Components has added two new series of TV tuners with built-in phase-locked loop (PLL) tuning systems to their range of VHF/UHF TV tuners. The UV-800 and UV-900 TV tuner series' advanced PLL tuning system contains all channel and function information necessary to control the tuner. In this way, a sizeable portion of external circuitry is made redundant, making CTV design both simpler and cheaper.



*These PLL TV tuners make CTV design simpler and cheaper.*

The PLL tuning system takes instructions from a microcomputer via the I²C Bus. The new ranges share the pinning and electrical configuration of the established Philips UV-600 and UV-700 series TV tuners, thus guaranteeing total compatibility throughout the range.

These tuners. They cover the entire TV broadcast spectrum in just three bands (VHF high, VHF low and UHF) in place of the four required for earlier tuner designs (VHF1, VHF3, Hyperband and UHF).

To further simplify system design, Philips also produces complete front-end modules. Housed in screened boxes slightly larger than those used for the tuners, these front-ends contain a tuner plus IF amplification and demodulation circuits, providing baseband video output with either quasi-split stereo or demodulated mono sound.

**Circle 803**

## Clock-timer IC has low power consumption

The compact PCF8583 CMOS clock/timer/static RAM IC provides a wide range of timing functions, including a real-time clock with alarm functions, a calendar, and a timer or event counter.

Drawing typically just 10 µA from a 2.5 V to 6 V supply, the device is particularly attractive for normal telephones as well as for battery-operated and portable equipment such as pagers, remote handsets, and cordless telephones. A programmable timer or alarm interrupt allows the PCF8583 to reduce system power consumption by waking a processor from an idle mode at pre-programmed intervals.

With a resolution of 0.01 s, the PCF8583 works as a real-time 12- or 24-hour clock/calendar, keeping track of the year (with compensation for leap years), month, date, day of week, hour, minute, and second. As a timer, the PCF8583 provides elapsed time information in either days, minutes, seconds, or hundredths of a second.


*The low power PCF8583 provides a wide variety of timing functions.*

The PCF8583 also has an on-chip 256-byte SRAM to store alarm, status or time information as well as telephone numbers, access codes, and other application-related information. The IC can connect to any microprocessor, and is controlled via the two-line I²C-bus. Its operating temperature range is −40 °C to +85 °C. Naked-chip versions are available, as well as versions in small outline and DIL packages.

**Circle 804**

# Twice the printer in half the space.


## Fujitsu's new 2-ply thermal printer

For fast, quiet, high-resolution receipt printing, nothing can match a thermal printer. But what if you need to print two copies – one customer receipt and one journal receipt? Until now, you'd need two printers. Fujitsu's new FTP-421UCL002 printer prints two copies at once – on 2-ply thermal paper. And the second copy is just as sharp, clear and easy to read as the first.

## Saves space, saves cost

If you design POS systems, ATMs or other systems that require multicopy printing, imagine the space and cost you'll save by replacing the printers you're now using with one fast, quiet, reliable 2-ply thermal printer from Fujitsu.

A 2-inch (60mm) model is available now and a 4-inch (120mm) model will be available soon. For complete information, please call Fujitsu Mikroelektronik GmbH at 49-69-66320.

**HIGH SPEED, 2-PLY THERMAL PRINTER FTP-421UCL002**

| | | |
|---|---|---|
| Printing Method | | Thermal sensitive dot method |
| Dot Matrix | | 320 dots/line |
| Effective Print Width | | 52.8mm (2.079 in.) |
| Dot Pitch | Vertical | 0.165mm (0.00650 in.) |
| | Horizontal | 0.165mm (0.00650 in.) |
| Printing Speed | | Approx. 358 char./sec. (standard characters) |
| Paper Width | | 60(+0/–1)mm (2.36[+0/–0.039] in.) |
| Specified Paper | | FTP-020P7111 (2 PLY paper) |
| Mechanism Dimensions | | 110(W)×60(D)×40(H)mm (4.331×2.362×1.575 in.) |
| Interface Dimensions | | 89(W)×140(D)×15(H)mm (3.504×5.512×0.591in.) |
| Mechanism Weight | | Approx. 300g |

FUJITSU

**FUJITSU MIKROELEKTRONIK GmbH:** Lyoner Straße 44-48, Arabella Center 9. OG/A, D-6000 Frankfurt Niederrad 71, F.R. Germany Phone: 069-66320 Telex: 0411963 Fax: 069-6632122
**FUJITSU COMPONENT OF AMERICA, INC.:** 3330 Scott Blvd., Santa Clara California 95054-3197, U.S.A. Phone: 408-562-1000 Telex: 910-338-0190 Fax: 408-727-0355
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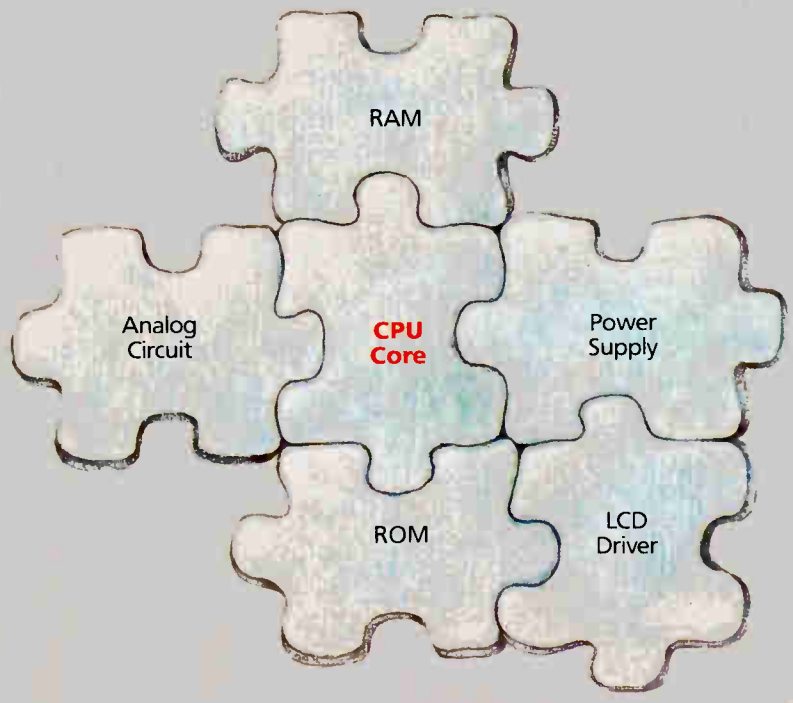
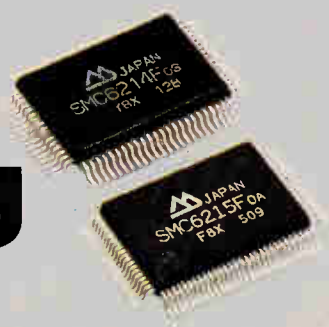
CIRCLE 240

**SMC62** Family: CMOS 4-Bit Single Chip Microcomputers.



# Powerful Core CPU

## plus flexible architecture.

The SMC62 family architecture uses a building block approach to circuit design. This highly flexible, yet modularized system gives you the freedom to add or tune circuit features to match the needs of the application at hand.

Built around the SMC6200, Seiko Epson's powerful 4-bit CMOS Core CPU, SMC62 family members provide a wide choice of ROM and RAM sizes, I/O port types and numbers, on-chip LCD drivers and other high-performance peripheral circuits. All devices feature Seiko Epson's power-saving, low-voltage (1,5/3/5 V) CMOS technology.

Seiko Epson provides customers with powerful development support software and add-on hardware for use with low-cost 16-bit personal computers to help you develop SMC62 family applications rapidly and efficiently.

| Family SMC62... | | | 14 | 15 | 31 | L31 | 34 | L34 | A34 |
|---|---|---|---|---|---|---|---|---|---|
| Supply Voltage | | V | 3 | | | 1.5 | 3 | 1.5 | 3 |
| Power Consumption | *Operating* | µA | 150 | | 2.5 | 5 | | | |
| | *Clock mode* | | 4 | | 4 | 2 | 4.8 | 1.5 | 3 |
| Clock Frequency | | kHz typ. | 32.768/455 | | 32.768 | | | | 32.768/500 |
| Memory | *ROM* | bits x12 | 4096 | | 1024 | | 4096 | | |
| | *RAM* | x4 | 208 | 488 | 80 | | 480 | | |
| I/O Ports | *Input* | bits | 8 | | 5 | | 8 | | |
| | *Output* | | 8 | | 8 | | 8 | | |
| | *In/Output* | | 4 | 8 | 4 | | 8 | | |
| Instructions | | | 100 | 106 | 100 | | 106 | | |
| Interrupts | *External* | | 2 | | | | 2 | | |
| | *Internal* | | 2 | 3 | 2 | | | | |
| LCD Drivers | *Common drivers* | | 3/4 | | 3 | | 3/4 | | |
| | *Segments* | | 32 | 50 | 32 | | 48 | | |
| Package | | ...QFP | 80 | 100 | 80 | | 100 | | |

State-of-the-art technology and low-cost development environment.

EPSON

*Where everything is possible.*

CIRCLE 222

**EPSON Semiconductor GmbH**

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# Digital oscilloscope DL-series

## Oscilloscopes With Personality.

Offering "fast rate", "high resolution", and "four channels" with a large memory function.
YOKOGAWA's digital oscilloscope DL-series.

The DL-series consists of powerful programmable digital oscilloscopes designed to catch single shot and unstationary signals. The DL-series provides "fast rate", "high resolution", and "four channels", in three oscilloscopes, each with their own personality. Naturally, "large memory" is incorporated into each oscilloscope to shorten the analysis time. This enables a close detailed look at phenomena of long duration. The design of the DL-series digital oscilloscopes incorporates all these features to meet the needs of those in the field!

- four 100 MHz individual input channels for advanced measurement analysis
- high speed sampling of up to 100 MSample/s
- strong trigger and waveform calculation capabilities for automatic measurements
- large memory capacity of 128k Word in this unique portable instrument
- memory card and built-in printer are optional

**DL1200**

- 200MSample/s and large memory of 128k Word/ch
- 300 MHz bandwidth with 2+2 channels
- Enhanced Trigger Set provides versatile triggering modes, such as pattern, sequential, multigate, and glitch
- 32-bit RISC signal processor for high speed computation and signal processing functions
- memory card and built-in printer are optional

**DL2100**

- 25MSample/s and 12-bit for high vertical resolution, large memory of 256k Word/ch (512k Word/one channel)
- complex waveforms can easily be captured using the Enhanced Trigger Set
- high sensitive differential inputs for measuring very small signals
- FFT function is added to the existing computation functions
- memory card and built-in printer are optional

**DL3100**

Call for complete information:

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Telex: 79118, Telefax: (033) 631.202

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## For active or passive needs, a change to CLS can boost productivity.

If you're ready for another laser trim system and want to increase productivity and decrease problems, the system to add is the CLS-37S. Built for high-volume, high throughput demands, the CLS-37S is more affordable to purchase and more cost-effective to operate.

Even if you currently operate another manufacturer's trimmers, adding a CLS-37S can help you trim costs and enhance capabilities. Its many benefits can be applied to passive trims, or active trimming to ac and dc voltage or time parameters. It can even handle capacitance trimming; and an IEEE-488 bus interface module is available. An air-bearing step and repeat handler and a new cartridge feed stack loader are also optional.

In addition, the CLS-37S is trimmer in size than other systems, Its advanced design has made it smaller and less complex than the older generation of trim systems sold by others.

Designed as "the smart laser trim system," the CLS-37S is backed by the industry's most intelligent software operating system. So easy to use, unskilled workers can learn to program the system in just days.

For lower operating costs, Chicago Laser has taken extensive measures to minimize the chance of downtime. That process begins with well-proven designs and rigid quality-control standards. Chances of downtime are further reduced by the system's modular construction and advanced diagnostic programs,

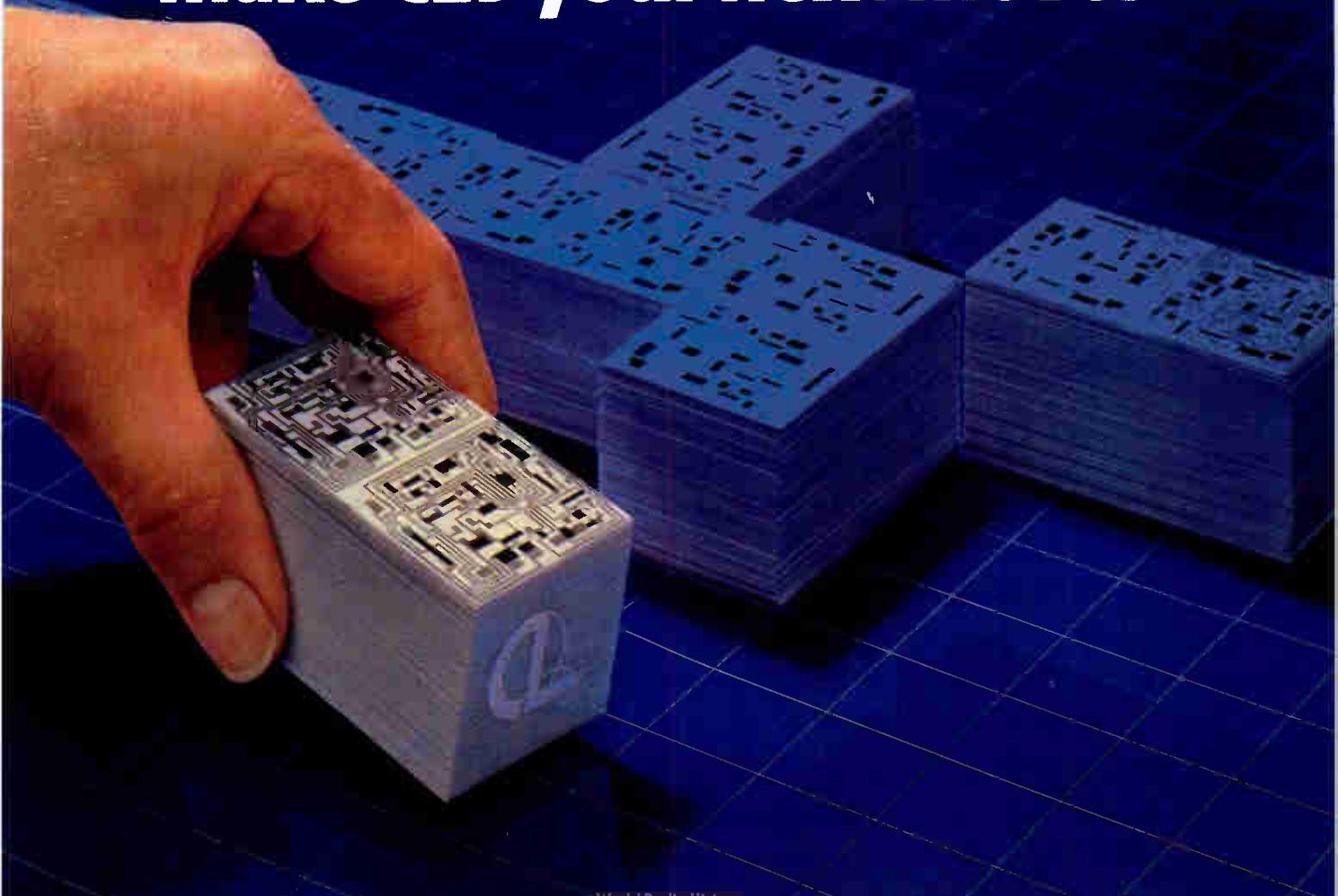
For a detailed appraisal of how the CLS-37S can fill your needs, contact Chicago Laser Systems.

**Chicago Laser Systems Inc.**

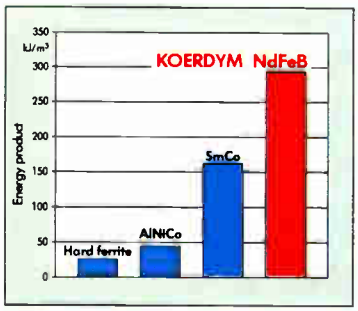
4034 N. Rockwell Ave., Chicago, IL 60634 • Phone 312 • 282-2710 Telex 071-1269

CIRCLE 301

# For lower-cost laser trimming, make CLS your next move.




# KOERDYM® from KRUPP WIDIA, for a new dimension in permanent magnet performance.




KOERDYM: registered trade name of KRUPP WIDIA GMBH
Licensor Sumitomo Special Metals

KOERDYM is a new neodymium-iron-boron material that opens up new opportunities in permanent magnet applications. Thanks to its unparalleled energy product, miniature magnets can now be made even smaller or a lot more powerful. An abundant supply of raw materials is another point in KOERDYM's favour.

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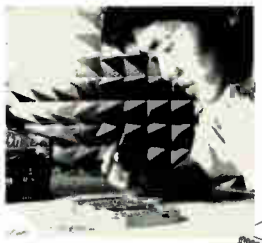
**KRUPP WIDIA**
**Magnet Engineering**

CIRCLE 248

SMD & SMT EMC MICROWAVE

Crossing the technical barrier with Murata's human technology. Vol.6.



Noise countermeasures using Chip EMI Suppression Filters are being studied in this unechoic chambre.
At present, noise countermeasures on a PC board can be realized only by Chip EMI Suppression Filter.
Close attention should be paid to handling of chips.

# EVER SMALLER AND BETTER MONOLITHIC CHIP EMI SUPPRESSION FILTER

## Continuous technological innovations for ever changing Market needs. — Murata.

The number of noise suppression components per set has increased sharply due to stricter noise regulations. At the same time, the market demands more compact and lighter set. Production of chip components for noise suppression has been strongly needed to realize the pcb compactness. Murata has been producing surface mounting EMI Suppression Filters to meet this demand.
In this article, Mr. Kaneko of Murata's EMI Suppression Division discusses this point.

**Q: Have making components for noise suppression into chips been behind of capacitors and resistors?**

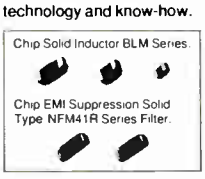
A: Yes. We firmly decided to make components into chips about ten years ago. It was just about five years ago that we came to obtain their outline since we started their development.

**Q: Did you foresee the need for chips at the time you first began their development?**

A: Yes. As a matter of fact, circuit boards themselves serve as antennas to collect noise; so circuit board must be made small. Accordingly, components must be small. Making components for noise suppression into chips has been needed for both factors.

**Q: How have you tackled this problem?**

A: We aimed at making all components for noise suppression into chips from the very beginning. We produce components making full use of Murata's excellent technology and know-how.




**Q: Have you produced entire components by yourselves?**

A: We developed materials for them. In addition to making chips compact. we have provided them with additional excellent functions unattained by conventional leaded components. Therefore, we make monolithic types which realize further compactness.

**Q: Is the term "monolithic" a key to compactness?**

A: The monolithic type which is made into a chip through the processing and integral firing at the stage of materials can realize more excellent characteristics than through the mere soldering of collected materials. Technologically, highly advanced techniques are required; however, we succeeded in developing them making use of the know-how we have accumulated through the development of other components.

**Q: Could excellent functions be produced by making components into chips?**

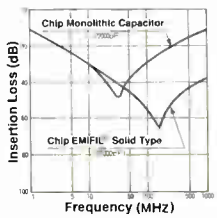
A: Yes. Efforts have been made to reduce residual inductance as much as possible. Therefore, in addition to space merit, noise suppressing effect at high frequencies has improved greatly.

**Q: Are these common characteristics reflected in the products?**

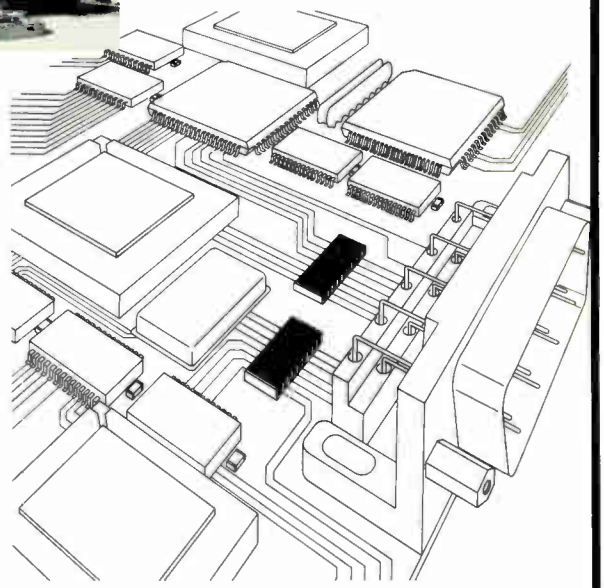
A: Yes. The products are: Chip Solid Inductor with its volume ratio below 1/20 to a conventional bead inductor, Chip Solid EMI Suppression Filter effective for radiation noise countermeasures, and Chip Tube EMI Suppression Filter which has attained rated current of 2A for DC power lines. At present, only these chip components can eliminate noise on a PC board.

**Q: What are your future aspirations?**

A: Chip components are becoming more co...pact. With the monolithic type, logically we can produce Chip EMI Suppression Filters with a size of 1/20 compared with conventional one's. Since we started with this, we have determined to realize ever better and more functional products.




■ Insertion Loss Characteristics (Compared with Chip monolithic Capacitors of the same capacitance.)



Chip Solid EMIFIL Array
Pursuit of compactness will, realize such components like this one which has eight elements per chip and corresponds to high density mounting. This is suitable for noise countermeasures in the I/O cable for electronic equipment such as computers. Excellent IL characteristics can be attained even in high frequency.

(For further information, contact

muRata

MURATA MFG.CO,LTD.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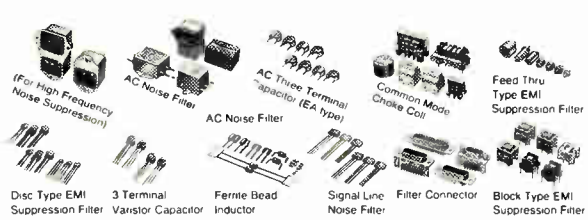


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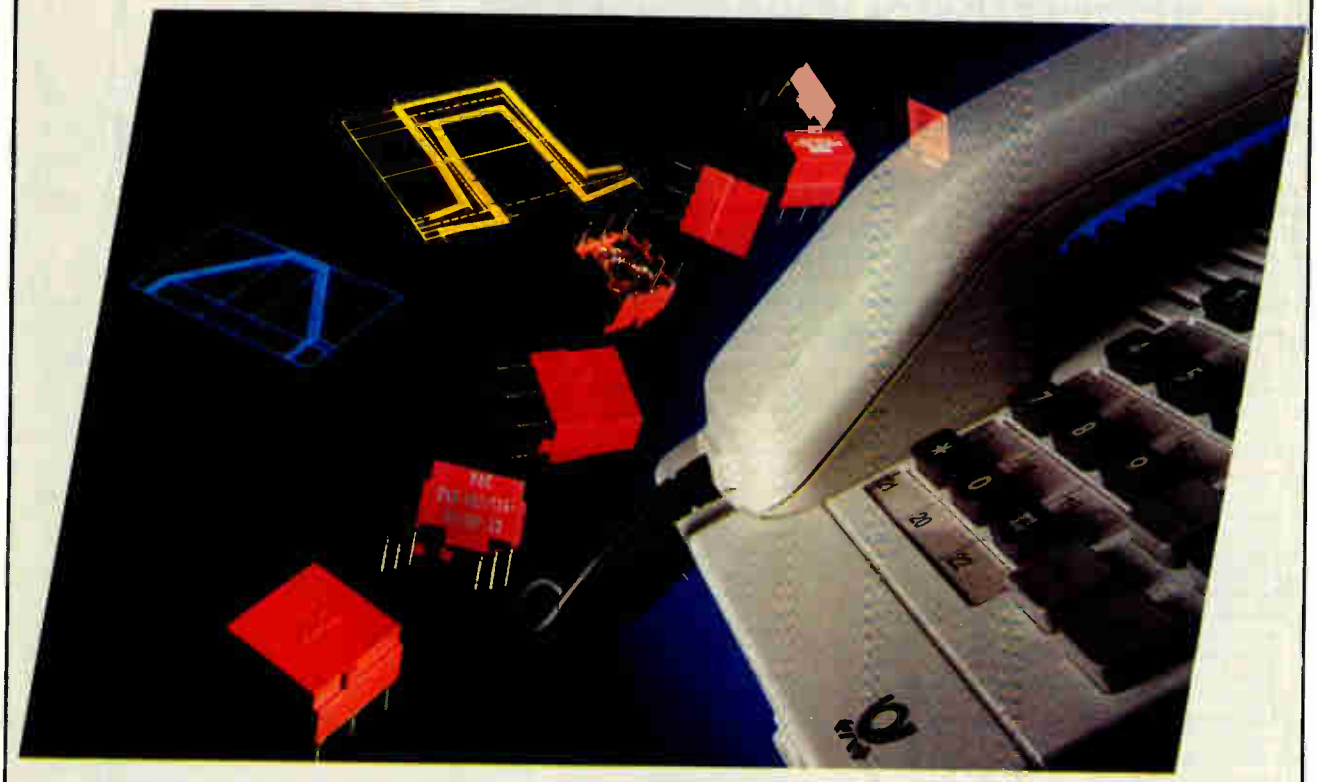

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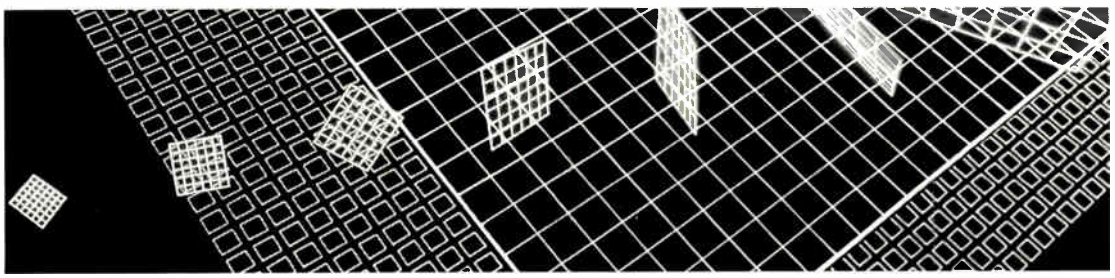

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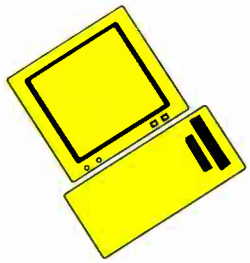

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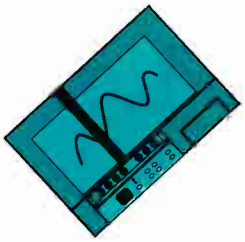

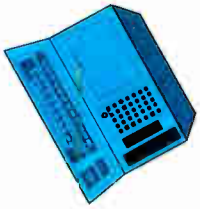

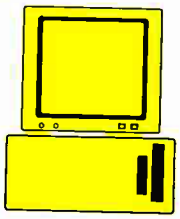

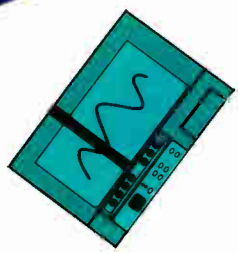

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# IBM-SIEMENS PACT TO BOOST JESSI?

The agreement between IBM Corp. of Armonk, N. Y., and West Germany's Siemens AG to cooperate in developing 64-Mbit dynamic random-access memories—a project whose cost industry insiders peg at $450 million by the mid-1990s—could help the goals and timetable of the Joint European Submicron Silicon Initiative, or Jessi, a group that IBM wants to join. One of Jessi's targets is the implementation of the technologies needed to produce 64-Mbit DRAMs by 1996.

With Munich-based Siemens one of the prime participants in the $4 billion Jessi effort, the know-how it will gain from the partnership with IBM could prove beneficial to the pan-European consortium. Since innovation cycles in memories are around three and a half years per generation, a speedup in development that the IBM-Siemens cooperative deal could bring may move up the market introduction of


future memory chips.

Meanwhile, the Jessi management board has invited IBM Europe to contribute engineering know-how to selected projects of the European initiative and to forward proposals. IBM Europe hasn't responded as yet, but according to usually reliable sources, the company has set up a working group at its Böblingen, West Germany, facilities that is looking at possible forms of cooperation with the Europeans. Among the areas it is said to be exploring is technology for semiconductor production equipment. E

## PHILIPS POINTS THE WAY TO A GIANT STEP IN DATA DENSITY

Would you believe data media 10,000 times denser than today's compact disk? It sounds incredible, but that possibility has emerged from experiments that researchers Evert van Loenen and Dick Dijkkamp are conducting at the Philips Research Laboratories in Eindhoven, the Netherlands.

Central to their investigations is the use of a tungsten needle in a vacuum to prick tiny pits in silicon with a heretofore unattained density. The work of the two scientists could ultimately lead to higher-precision operations on technologically important chip materials such as silicon, according to the Philips researchers.

The possibility of pricking pits with a tungsten needle in silicon was discovered during experiments with a scanning tunneling microscope, an instrument whose key element is a sharp needle held in a vacuum at several atomic spacings, or around half a nanometer, above a surface. Electrons tunneling through the vacuum barrier between the needle tip and the silicon surface, the researchers found, can prick ultraminute pits in the material.

With this method, van Loenen and Dijkkamp created pits with a diameter of about 10 nm and a depth of 0.6 nm without any appreciable distance between the pits. "It would be possible to fit 10,000 pits into the space taken up by one pit in today's compact disk," van Loenen says.

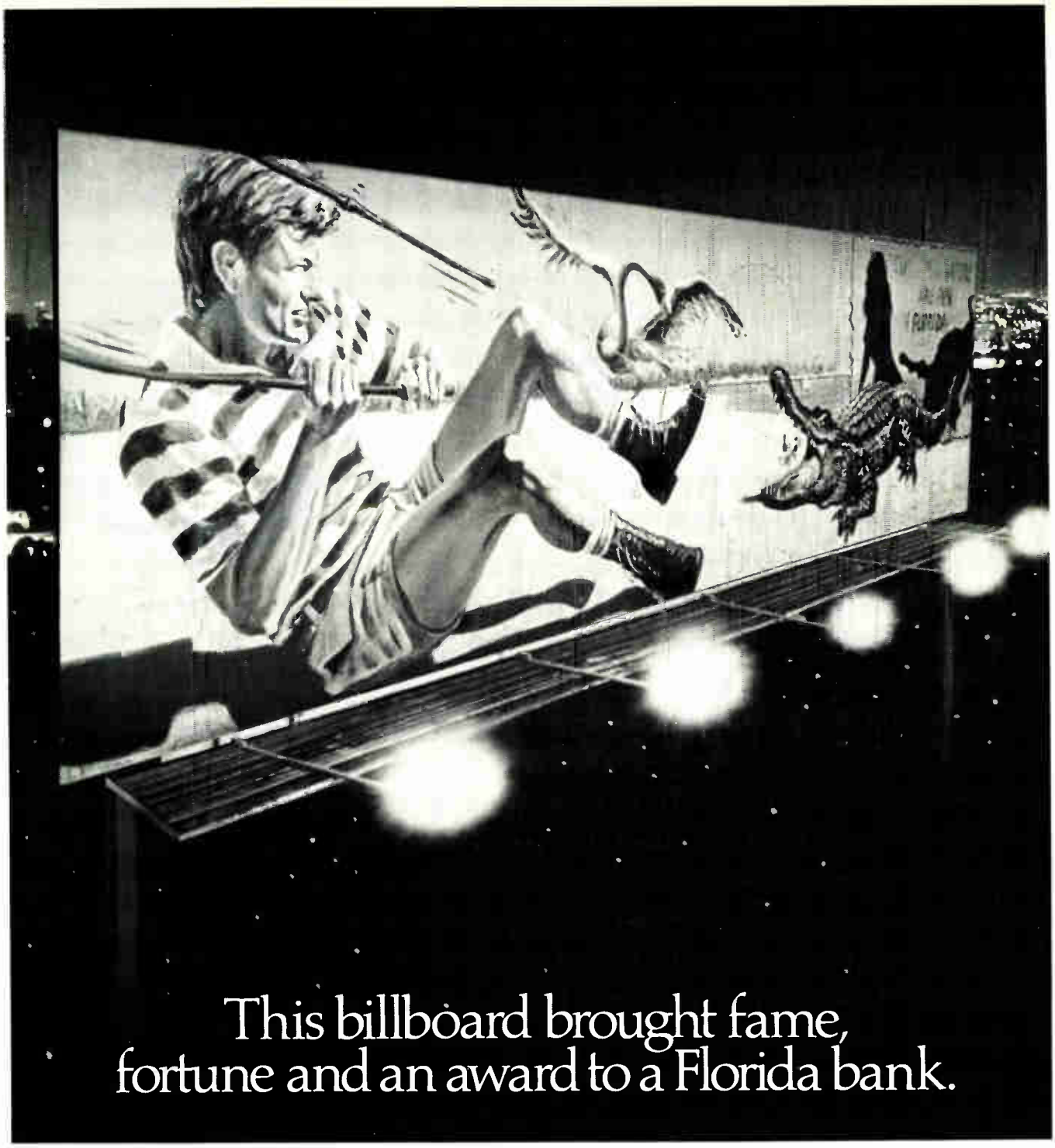
By overlapping the pin pricks, it's possible to make tracks to produce, for example, extremely fine line structures. E

## SIEMENS SCORES BIG IN SEMICONDUCTORS WITH 65% RISE

Champagne corks were popping at Siemens AG. The reason: the latest figures from market researcher Dataquest Inc. show that the company's 1989 semiconductor sales had jumped a whopping 64.9% over the previous year's—from $569 million to $938 million. That catapulted the Munich company from the No. 5 spot on the European semiconductor charts to No. 2—past Motorola and SGS-Thomson Microelectronics to just $29 million behind Philips. Worldwide, it moved up from No. 20 to No. 15.

Siemens attributes its growth spurt to healthy business with dynamic random-access memories. Last year it sold more than 50 million 256-Kbit, 1-Mbit, and 4-Mbit parts, the majority of them—around 45 million—1-Mbit types. DRAMs now account for about 37% of the Semiconductor Division's sales, up from 18% in 1988. With the 1-Mbit versions going strong, Siemens is gradually phasing out 256-Kbit devices and is increasing the output of 4-Mbit units, which it started shipping late last year.

Meanwhile, The French-Italian SGS-Thomson Microelectronics, although sliding from No. 2 to No. 3, still enjoyed an impressive 15.2% sales gain over the preceding year. This, analysts say, shows that the company's purchase of the UK's Inmos Ltd., and access to that company's static RAM and Transputer microprocessor technology, is paying off. E



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# EAST EUROPE: THE NEXT ECONOMIC MIRACLE?

## WESTERN ELECTRONICS FIRMS ARE LINING UP AT THE BORDER, BUT MAJOR ROADBLOCKS REMAIN

BY JACQUELINE DAMIAN

ON JAN. 17, THE CHAIRman of France's Groupe Bull cut short a New York City press conference to dash to Kennedy Airport and the Concorde. Francis Lorentz, who had just been outlining the company's strategy in acquiring Zenith Data Systems, was jetting back to Paris to join French President François Mitterand for a trade mission to Hungary the next day.

The trip was part of a French economic blitzkrieg to hammer out new business in Eastern Europe, and in this pursuit Lorentz is not alone. As the world watched dramatic events unfold in the Soviet-bloc nations over the past few months, businessmen in Europe, the U. S., and Japan sensed an important and huge new market opening up.

Indeed, countries such as Poland, Hungary, Czechoslovakia, and East Germany are actively seeking advanced high-technology products to modernize their economies, and the Western nations have been quick to respond. Even the U. S., which historically has taken a hard line on exporting technology to the Warsaw Pact countries, is softening its stance. The Bush administration recently announced its support for a far-reaching liberalization of export restrictions on advanced computers, telecommunications gear, and machine tools—though perhaps not as sweeping a reform as its Western European allies would like. The NATO countries, Japan, and Australia were to meet in Paris in mid-February to hammer out details.

TRADE

For his part, Lorentz says that Bull has begun a joint venture with the Hungarian company Videoton—which, at $400 million, is that nation's largest electronics producer—to develop Hungary's information-processing industry. (Videoton, based in Budapest, is involved in another computer deal with the UK's Densitron Ltd. and with West Germany's Standard Elektrik Lorenz AG on a telecommunications project.) "There

# FOR COCOM NATIONS, CONSENSUS IS HARD TO COME BY

THE DOOR TO TRADE with Eastern Europe may open wider for U. S. electronics companies, but only after the considerable weight of export restrictions on strategic technologies is eased.

The streamlining has already begun for computers, telecommunications gear, and machine tools. A broad-based relaxation depends heavily on the safeguards East-bloc countries are willing to implement to prevent transshipment of sensitive equipment into the Soviet Union.

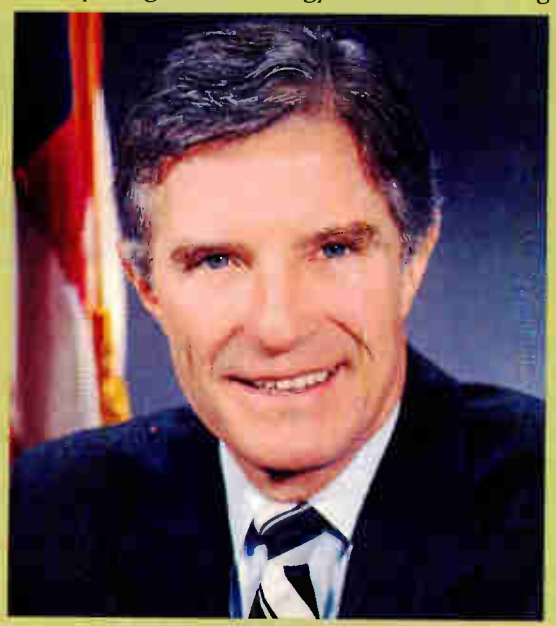
For more than 40 years, the Coordination Committee for Multilateral Export Control—better known as Cocom—has been the international nerve center for strategic exports. Based in Paris, Cocom operates by consensus. Each member nation—the NATO allies plus Japan and Australia—implements Cocom agreements independently. There are no treaties to break or formal sanctions to be imposed if a nation goes beyond the consensus.

But consensus has been harder to come by since Eastern Europe started splitting away from the Soviet Union. Sensing market opportunities that can only grow over the next decade, trade missions from Cocom nations have been breaching what used to be called the Iron Curtain in unprecedented numbers.

Since the U. S. has been the leader for many technologies, in the past its opinion has weighed heavily in determining Cocom policy. Now the U. S. is advocating a phased approach, says Bob Price, director of the Office of Cocom Affairs in the U. S. State Department. But "we don't know if our position will be acceptable in the minds of our Cocom partners."

On the one hand, there is pressure within Cocom to decontrol off-the-shelf commodities readily available in the West. On the other hand, Western European nations seem particularly skeptical of Eastern Europe's ability to implement functional safeguards against the Soviet Union, says Price. "This raises the question of whether Eastern Europe and the Soviet Union should be treated differently [in terms of easing trade]," he says. "We are basically suggesting that we do something for Eastern Europe now."

Safeguards against transshipment are not unexplored territory for Cocom. Non-Cocom nations are required to set up security systems and, in many instances, the company exporting the technology must also be involved in tracking its use. Most likely, Eastern European countries would be asked to set up export control systems like those already in force in non-Cocom nations that trade in strategic technologies. Poland and Hungary, which the State Department considers the top two East-bloc prospects, have "offered to put a set of safeguards in place," says Price, "but some of our allies may have a different view on that idea."



**EASING OFF**

*It's futile to restrict the export of off-the-shelf technologies, says Commerce's Mosbacher.*

The State Department has based its reformulated Cocom policy on four goals: support for political reform in Eastern Europe; strengthened protection for truly strategic technologies; rapid modernization of current control lists; and decontrol of off-the-shelf products. Price expects an architecture for implementing this set of goals to emege in early spring following the completion of a presidential review of export controls.

Even inside the U. S., Cocom policy is a matter of consensus. The export of any product or technology that could have strategic implications is jointly decided by the Departments of Commerce, Defense, and State, says Price. "Companies should touch base with all three in advance to see how to discuss and structure their requests," says Price. "We talk to many businesses on a regular basis." While large companies often go it alone, smaller firms with technologies for export will often turn to trade associations for help.

Within this governmental triad, Commerce Secretary Robert A. Mosbacher has been the most ardent advocate of relaxing restrictions. Mosbacher has generally argued that it is futile for the U. S. and Cocom nations to restrict the export of off-the-shelf technologies when Eastern European countries can readily acquire them from Taiwan or South Korea.

Mosbacher believes that the time is right for businesses to go into Poland and Hungary. Both nations have expressed a willingness to facilitate foreign investment, he says, but there are other incentives as well, including a pool of cheap labor in Poland. Also, "it is a great geographic spot to ship into the USSR and make that next jump when the time is right," he says.

After two tours of Eastern Europe last year, Mosbacher formulated Commerce policy guidelines. He tied the pace of increased trade to a corresponding progress in human rights and increased openness on the part of East-bloc nations. In particular, Mosbacher wants potential trading partners to supply more information about their domestic markets.

Besides those issues, Mosbacher believes it is best for trade to proceed only on a sound commercial basis. This includes joint ventures, which must make good business sense. He also called for an independent banking system in Eastern European countries so capital and interest rates are set upon principles like those in the West. "Privatization of state-owned enterprises by itself will not result in increased international competitiveness," he says, "if these enterprises do not face competition in the domestic marketplace. Even joint ventures with foreign owners will try to create monopolistic safe havens."—*Jack Shandle*

is a very big market opportunity in Eastern Europe," Lorentz says. "They don't have a computer industry, and if they want to liberalize their economy and their political system they will have to build one."

That holds true for more than just computers. "Throughout Eastern Europe, there's a pent-up demand in all electronic sectors—telecommunications, factory automation, medical electronics, railroad signaling equipment, and consumer products," says Friedrich Remplik, coordinator for trade with Czechoslovakia and East Germany at Siemens AG in Munich.

WEST GERMAN ECONOmists say that East Germany alone—a country about the size of Kentucky and with 16.5 million people—needs more than $760 billion worth of goods and services to bring its economy, infrastructure, and standard of living to the level that prosperous West Germany now enjoys. On a per-capita basis, it would take 20 to 25 times that sum for all of Eastern Europe to catch up.

With such vast potential, it's no wonder electronics companies are lining up at the border. A sprinkling have already consummated deals, usually in the form of joint ventures; still others are cutting deals in the Soviet Union (see p. 50). "In the end, all countries with high technology to offer will get into the act, with the AT&Ts, IBMs, and Alcatels sure to play a major role," says Eberhard Posner, spokesman for economic affairs at Siemens.

Still, Western observers note that some formidable obstacles must be overcome if East Europe is to become the next economic miracle. Among the problems East-bloc countries face are:

- international trade agreements that forbid the NATO allies and Japan from exporting advanced or sensitive equipment to the East (see opposite);
- a scarcity of hard cash coupled with currencies that are not yet convertible;
- the lack of technology and economic infrastructures;
- political and economic uncertainties as the newly emerging nations hold elections and attempt to strike out on their own;
- and cultural problems that can interfere with business as usual in the Western sense.

The money shortage and the technology lag go hand in hand. Simply put, a nation needs a solid technology base from which to bring innovative products to market in exchange for hard cash. Without that cash, there's no way for East-bloc countries to buy equipment, since their own money is not yet convertible on world markets.

Some world governments—notably, the Japanese—are considering multibillion-dollar credits to some East European countries, presumably in an effort to get a foot in the door. That's a tactic that U. S. Commerce Secretary Robert A. Mosbacher has vetoed. Mosbacher says the U. S. will not support a massive lending program or subsidized credit to encourage what he calls "artificial growth" of East-West trade.

With or without government subsidies, East European countries may find help at Western banks. East Germany did, when its Polygraph Export-Import Co. borrowed from a Munich bank to become the first Eastern-bloc company to buy outright a U. S. concern. The high-tech printing combine purchased Royal Zenith Inc. of Great Neck, N. Y., in late January.

In addition, banks in West Germany figured in the Standard Electrik Lorenz agreement with Hungary, as did two regional West German governments. Signed last October, before the political uproar began, the agreement lets SEL and Videoton jointly build some $82 million worth of SEL System 12 digital switches for 300,000 subscriber lines. Financing is guaranteed largely by a $275 million credit from the West German states of Baden-Württemberg and Bavaria. But banks also played a major role, and two of them—the Hungarian Postbank and the West German Landeskreditbank Baden-Württemberg—now own 3% apiece.

Typically, though, a Western company setting up shop in Eastern Europe will have few such guarantees. No longer are trade deals being made with the governments, which may have been slow payers but at least were unlikely to go broke. Instead they're being done with newly "commercial" firms whose solvency is unproven.

IN BRITAIN, THAT HAS made the UK's insurance organization, the Export Credit Guarantee Department (ECGD), wary. Currently, the agency considers Poland and Romania the highest risks, since both are extremely short of currency.

"We are in a very delicate situation," says Peter Jackson, electronics specialist at the ECGD. "We want to encourage trade, but dare not underestimate the commercial risks involved. The biggest problem is that everything is changing so quickly that it's difficult to know exactly what is going on there." The

## INTERESTED? HERE'S HOW TO BEGIN

THE EASTERN EUROPEAN Business Information Center is the central clearinghouse for information on opportunities in Eastern Europe and on U. S. government programs supporting private enterprise, trade, and investment there.

Opened Jan. 23, the center will also be the key agency for companies that want to develop proposals for the new Polish-American and Hungarian-American Enterprise Funds. Congress last year allocated $240 million to the Polish initiative and $60 million to the Hungarian fund to support the Polish and Hungarian joint-venture partners of U. S. firms. (Contact: Eastern Europe Business Information Center, Room H-6043, U. S. Department of Commerce, Washington, D. C. 20230; phone 202-377-2645.)

Other government programs of longer standing will also prove helpful to the neophyte in overseas trade. The Commerce Department's International Trade Administration offers a portfolio of services that include foreign-market research through its Commerical Information Management System. It electronically links the department's worldwide data base of marketing information and tailors information packages for specific businesses or technologies.

The ITA can also identify foreign distributors, importers, manufacturers, and government trading offices by name and telex number. Still another program that will eventually be extended to Eastern European countries is the Commerce Department's Matchmaker Program. Government officials accompany trade delegations overseas and arrange a full schedule of appointments with distributors, agents, and potential customers.

Usually, the initial contact with the Commerce Department can be made locally. Counseling services with trade specialists are free.—*Jack Shandle*

currency shortage holds even for East Germany, which Western analysts consider the most advanced electronics producer in the region. Bound by the directives of the Comecon (the East's equivalent to Western Europe's Common Market), East Germany has been forced to sell most of its electronic equipment to its Communist partners, primarily the Soviet Union.

"Selling to the less demanding and less quality-conscious customers in the East is hardly a stimulant for an industry to develop the high-tech products that can compete on the tough markets of the West," a West German executive declares. "They also need to have trained people to make efficient use of the equipment [they import], and that is an important obstacle to growth as well," says Bull's Lorentz.

Moreover, countries that change overnight from centrally controlled economies to a more capitalist environment do not have the economic infrastructure for international trade. Banking systems are unable to cope—fundamental tools such as letters of credit and checking accounts do not exist as the West knows them—and communications systems are not equal to the task. A case in point is a Polish businessman who told Commerce Secretary Mosbacher that he drives more than 200 miles to Warsaw twice a week to discuss his business with government authorities. The reason: he can't get a phone call through.

A related hurdle is a lack of management skills—indeed, an understandable failure to grasp the facts of capitalist life. This is all too clear to executives at Bull HN, a Waltham, Mass.-based Groupe Bull subsidiary that has been manufacturing its DPS 6000 minicomputers in the Yugoslavian town of Nis since 1979. Its joint venture there, Elektronska Industrie-Bull HN, has never made much of a profit.

"The managers don't seem to be aware that profit making is important," says Salvatore Nicoli, vice director of the Yugoslav operation. "They are imbued with the idea that the [government's] central planners request production of a certain number of machines, and that they provide them no matter what. The connection between production and the market eludes them completely."

Ensuring regularity of supply is no easy matter, even in nonaligned Yugoslavia, which is not a Warsaw Pact nation and not part of Comecon. The Bull venture imports about 60% of its materials from the West, generally the more advanced components, like chips. But it regularly experiences production delays because the locally supplied parts—boards, power supplies, cables, and the like—are unavailable.

Then too, "Factory foremen have every incentive to cheat in their production reports to the planners," Nicoli says. "The more they say they are producing, the happier everyone is." It

## 'THE GOLD RUSH IS ON'

IS EASTERN EUROPE becoming a boom town for Western businesses? The former U. S. Ambassador to Hungary thinks so.

R. Mark Palmer has just resigned his diplomatic post to run a new consortium of North American financiers investing in communications, commercial real estate, and tourism in Hungary. The Central European Development Corp.'s first deal: the $10 million purchase of half interest in the General Banking and Trust Company, one of prewar Hungary's most eminent financial institutions.

"The gold rush is on in Hungary," Palmer told *The New York Times*. "If you stand in the lobby of the Forum Hotel, you are lucky not to get knocked down." Fax machines at that Budapest hotel are backed up for hours by businessmen making deals.

So far, Western European companies are the major players in Hungary and elsewhere in the Eastern bloc as well as in the Soviet Union. Michael J. Shade, president of Budapest's newly formed American Chamber of Commerce branch, estimates that West German and Austrian concerns outnumber U. S. companies there 10 to 1.

The reason? "Eastern Europe is too new for anyone [in the U. S.] to have any good intelligence on it," says Steven Crummey, senior vice president for worldwide sales and support at Lotus Development Corp., the Cambridge, Mass., software house. "Everything that's been happening in the last 90 days couldn't have been predicted, so it isn't realistic to expect anyone to have a game plan in place." Only recently have U. S. companies begun earnestly pursuing trade in the Soviet Union, where some European competitors have long been active.

Japanese companies have so far been cautious in these new markets, although Sony Corp. says it wants to expand in East Germany. Prime Minister Toshiki Kaifu has proposed a $2 billion aid package to Eastern Europe, but the Japanese as yet have little presence in the region. Some Japanese businessmen question whether they should make massive investments there or concentrate instead on China and Southeast Asia.

### WESTERN EUROPE

Generally, West German firms consider themselves particularly well positioned for the coming battle for East-bloc market share, geographically and otherwise.

To begin with, they have a running start: for almost all East European countries, West Germany ranks as the largest trading partner in the West. Its electrical/electronics exports to the East totaled $1.1 billion in 1988 (a drop in the bucket compared with the $23 billion in such equipment that West Germany sold to Common Market countries that year).

Siemens AG has been keeping tabs on Eastern markets for many years and has in place a group of some 20 experts to coordinate Eastern trade and aid the firm's 15 divisions in negotiating contracts and selling goods.

The Munich-based electronics giant has signed a declaration of intent with the Soviet Union's Ministry of Posts and Telecommunications to cooperate in expanding that country's communications network. Negotiations could soon lead to an agreement to use Siemens' EWSD digital switches in large exchanges and for long-distance communications.

Siemens is also involved in a telecom venture with the big Yugoslav equipment maker Iskra, which is headquartered in Ljubljana. Called Iskratel and established last May, the new company will introduce Siemens' EWSD to the Yugoslav market and also sell the Iskra-developed SI2000, a switch for

may become virtually impossible for a manager to know how much his factory is turning out—especially since bookkeeping procedures are often inscrutable to Western accountants.

Finally, distribution is difficult. The Bull venture sells almost all its production directly to its Yugoslav partner. "There are a few outlets for computers now in the more developed states of Slovenia and Croatia," says Nicoli. "We sell most of our minis to banks and financial-service organizations. Now that the new laws require these businesses to compete, the demand for networking should rise and we should sell more."

And yet, despite all these impediments, the Eastern nations pronounce themselves ready, willing, and able to do business. "We simply must discard ideology and turn into a market-driven economy where performance counts," says Jürgen Apitz, director general of East Germany's VEB Kombinat Nachrichtenelektronik, the country's combine for communications electronics headquartered in East Berlin.

**FUNDAMENTAL ECONOMIC TOOLS, SUCH AS LETTERS OF CREDIT AND CHECKING ACCOUNTS, DO NOT EXIST**

Coming across as a hard-nosed U. S.-style businessman, Apitz is determined to make his combine profitable, and he sees cooperation with Western firms as one of the keys. That will happen on three levels, he says. On the lowest, the outfit would function as a supplier of parts to communications equipment houses in the West. At the middle rung, it would embark on partnerships with Western firms in third markets. And at the upper end, it would put together research-and-development ventures with Western companies to develop products for global markets.

Apitz says his group can contribute research know-how along with service networks in East European and Third World countries, where it has been active for some time. He says he is already talking with potential partners, among them Ascom of Switzerland, Nokia of Finland, Telindus of Belgium, and SEL, which is a subsidiary of France's Alcatel.

If this type of entrepreneurial flair is evidence of a new order in the East, then Western electronics producers may be on to something.

*Additional reporting by Peter Fletcher, John Gosch, Andrew Rosenbaum, and Jack Shandle*

small and medium-size public exchanges and private branch exchanges. By the early 1990s, Iskratel hopes to be doing about $100 million worth of business a year.

Stuttgart-based Standard Elektrik Lorenz AG, the West German subsidiary of France's Alcatel NV, is keeping a high profile in East Europe. Besides its Hungarian telecom deal (see p. 47), SEL has signed on to help modernize East Germany's telephone network with its System-12 digital switch. A 2,000-subscriber switch went into service in December.

Also involved is Holland's Philips International NV, which set up a components application and design-in center in Minsk last year in conjunction with Soviet partner Gorizont, a TV manufacturer in that city. With test and measuring equipment installed, the Minsk facility is now designing Philips components—including bipolar and MOS circuits—into audio and video equipment, primarily TV sets. Philips says it is looking into other ventures in the East.

So are British manufacturers. Some of the larger companies have already concluded deals, among them GEC Plessey Telecommunications Ltd.—it has a joint venture to set up pay phones in the Moscow area. And for the past five years, the company has been negotiating with Bulgaria for the sale of its System X digital public central-office telecom switch. Some smaller firms are already involved in selling personal computers to the East.

## THE U. S.

American electronics manufacturers have fewer deals to their credit. The biggest to date is US West's multimillion-dollar pact with Hungary to set up the Eastern bloc's first cellular-telephone service in Budapest. If the Denver-based Regional Bell Operating Company obtains an export license, it will sign on the dotted line with Magyar Posta, the government's telecommunications agency. US West is also negotiating to install a $500 million, 6,000-mile fiber-optic line in the Soviet Union.

Data General Corp. last December became the first major U. S. computer maker to forge an agreement with the Soviet Union [*Electronics*, January 1990, p. 17]. With one Russian and two Austrian partners, the Westboro, Mass., company will focus on computers for industrial automation.

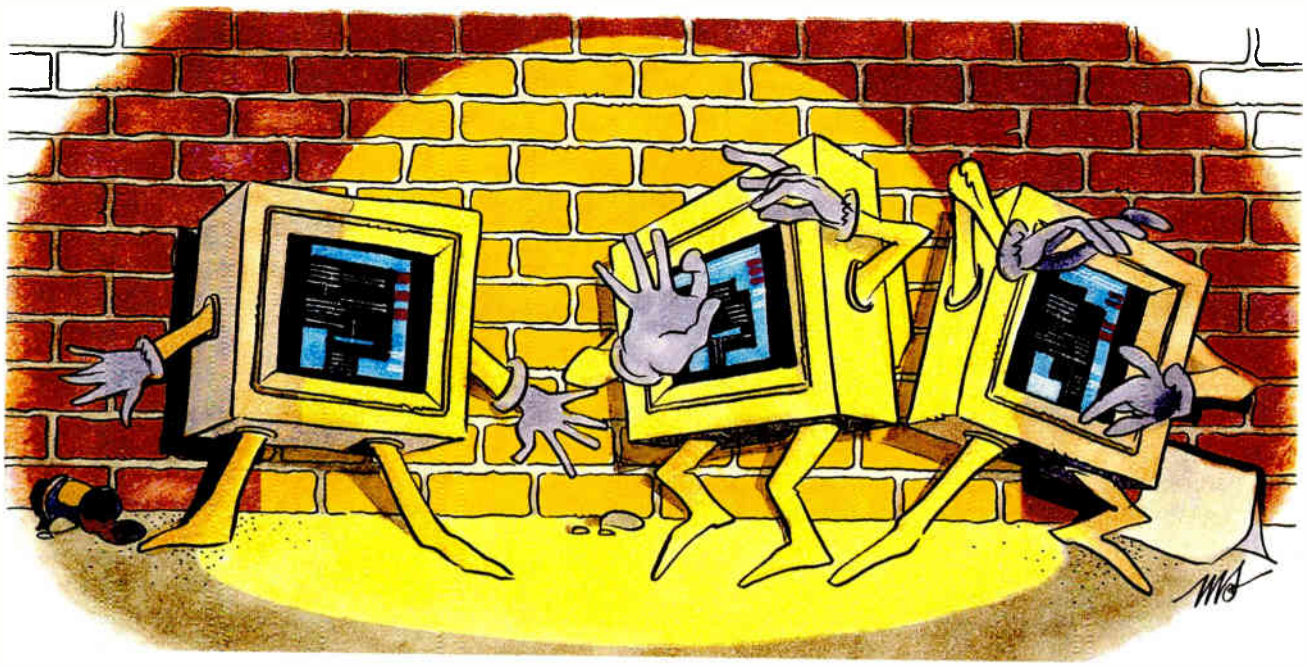
To date, Data General has U. S. government approval to offer the Soviets the MV/2000, a small computer with a rating of just under 1 million instructions/s, through the joint venture. It has applied for an export license for the MV/7800, which runs at about 1.2 mips.

It took two years to complete the deal, and that time frame is not unusual for East-West pacts. Eastman Kodak Co. has been angling for that long to get several projects off the ground in Russia, including a deal to make and sell floppy disks through its Verbatim Corp. subsidiary.

The Rochester, N. Y., company is working under the auspices of the American Trade Consortium, a nonprofit New York-based group exploring trade possibilities with Moscow. However, "there's been no news since March of last year," says Kodak spokesman Paul Allen.

Lotus is looking eastward, too. About a year ago, it set in motion a small task force to explore business opportunities in the Soviet Union, where "the potential for personal computers is incredibly large," Crummey says. The company has developed a version of its ubiquitous 1-2-3 spreadsheet that runs in both English and Cyrillic. "We'd like to make something happen before the end of this year," Crummey says—assuming that Lotus can find an appropriate Soviet partner.

*Reporting by Lawrence Curran, Jacqueline Damian, Peter Fletcher, and John Gosch*



# IN PC-BOARD CAD, BACKS ARE AGAINST THE WALL

## NOBODY HAS EVEN A 20% MARKET SHARE, SO THE RACE IS ON TO DEVELOP BREAKTHROUGH PRODUCTS

BY JONAH McLEOD

CAD/CAE

IN A MARATHON RACE FOR market share, the major runners in the printed-circuit-board computer-aided-design market are in a dead heat. The nine or so contestants are clustered together near the lead, with no one commanding even 20% of the market. In recent months, several have lunged forward with new tool offerings that they hope will pull them ahead of the pack.

These competitors are tempting buyers with layout tools that accept component-placement and routing annotations from front-end designers to maintain high routing speed while reducing heat and noise emissions.

Several are hawking gridless routers to dispatch boards with high-pin-count pin-grid arrays and surface-mounted devices connected with thin traces and narrow spacing between traces. Others are entreating customers with tools that automatically make boards more manufacturable and, in some cases, more testable.

At stake is a market for pc-board CAD tools worth $500 million this year, according to the Technology Research Group Inc. in Boston. Growth should climb in the double digits to $895 million in 1993, the research house says. The diverse market runs the gamut from $1,000 shrink-wrapped software sold in high volume for personal computers to programs costing tens of thousands of dollars that run on networked work stations. The contest for front-runner is at the high end, and the players include Calay Systems, Dazix, Intergraph, Mentor Graphics, Racal-Redac, Schlumberger Technologies, Scientific Calculations, Valid Logic, and Zukin.

Not one of these nine holds more than 18% of the market, says David Marini, vice president of marketing for Scientific Calculations, a division of Harris Corp. in Fishers, N. Y. Scientific Calculations was once a leader with its Sciccards, a product just out in its 25th release, and is fighting back from its current spot with only a 6% share.

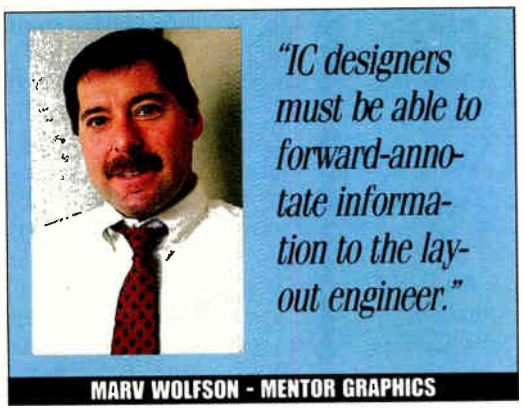
High-end CAD tools sell to sites that already have older technology tools. "There are 40,000 systems worldwide purchased before 1980, of which many

are manual drafting systems," estimates Marv Wolfson, product group vice president at Mentor Graphics Corp. in Beaverton, Ore. "Departments have evolved around these existing tools, which have limited support for analysis, SMDs, high-speed logic, and so on."

Up to now, benchmarks on how fast a tool routes a board have been the way to win business, says Joe Prang, vice president of marketing and sales at Valid Logic Systems Inc. of San Jose, Calif. But now the customer has to look at the larger picture, he says.

Citing figures from the Technology Research Group, Prang says that 50% of all pc-board designs last year had a clock frequency of 20 MHz or more. In high-speed designs, the placement and routing of board components is not left to the layout engineer because moving the components around can affect performance.

"Before, pc-board layout was performed separately from circuit design," says Wolfson. "Now designers need to be concerned with trace lengths, routing angles, heat dissipation, and crosstalk between signal paths." As a result, circuit designers are increasingly becoming involved with the layout of the board. "Circuit designers must be able to forward-annotate information to the layout engineer on where to place components, the maximum length of circuit traces, and so on," he says.

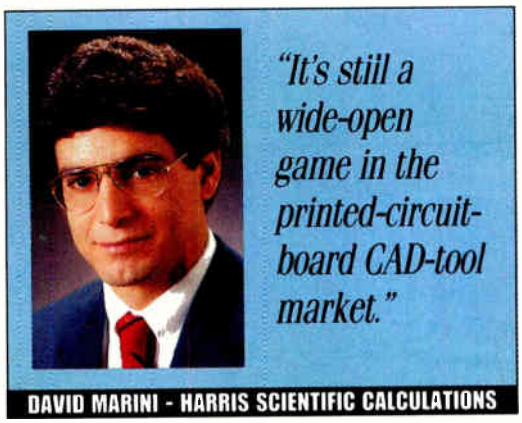



THIS TREND BODES WELL for tool suppliers that offer front-end design tools along with back-end CAD layout software and a data base that serves them both. Suppliers offering only CAD layout tools, such as Scientific Calculations, are tightly integrating with front-end tools by means of a framework, which is a software infrastructure providing a comon operating environment for a variety of design automation tools. For example, Scientific Calculations is linking Sciccards with Workview from Viewlogic Systems Inc. of Marlboro, Mass.

In handling high-speed designs, the designer must be able to describe to the layout engineer critical paths and critical networks on the board, says Richard Moulé, product marketing manager at P-CAD in San Jose. The designer also needs the ability to specify net lengths for routing CMOS devices, says Cathy Gambino, director of marketing at the PC Division of Valid Logic. In one case, the designer might need to specify that all bus lines be routed together in parallel and specify their length.

Then too, designers must be able to specify trace widths and ensure a maximum impedance load and clearance between traces, says Doug Spice, Scientific Calculations' director of marketing. "For example, the designer might want to limit clock traces to a certain layer of the board," he says. This capability is not available on all high-end tools yet, though it is on some mid-range tools, such as P-CAD's Master Designer.

In addition, "the plethora of different devices—surface-mounted and pin-grid-array packages—with different numbers and spacing of pins makes it impossible to develop a floor plan for an entire board," says Prang of Valid Logic. "You need to be able to partition the board and address different placement and routing strategies in each section." Valid's Allegro CAD software offers this capability, he says.




So does the new Visula 5.0 from Racal-Redac Inc., a unit of Racal Electronics plc in Westford, Mass. Visula's placement algorithms, controlled by a rules-driven data base, automatically group and place technology-related components.

With older, slower board designs, a designer created his design and provided a file to the layout engineer. Using an automatic tool, the engineer placed and routed the board without regard for where individual components ended up. Once the board was laid out, it was checked in its enclosure. Fans and shields were added if the board created too much heat or generated too much electromechanical interference.

BUT IN HIGH-SPEED DEsigns, temperature and electromechanical interference are side effects that come even with CMOS designs. By analyzing the board before it has been laid out, the designer can rearrange components that run hot to distribute the heat more evenly or shield components that generate too much electromechanical noise.

Wolfson of Mentor Graphics contends that with reduced design cycles, time to market suffers if thermal and electromechanical analysis is performed after a board has been laid out. "This analysis must be performed as part of the front-end design to reduce a time-consuming design iteration," he says.

Prang says Valid was the first to integrate a thermal-analysis package into a layout tool. Thermo-Stats, part of Valid's Allegro, first performs a rough placement of components. Using data on the heat each component produces, it then creates a temperature profile of the board with hot spots represented by white and cooler spots by blue. Gambino says the package lets the designer see the effects of adding convection, conduction, and radiation cooling to the board.

Last December, Racal-Redac

rolled out a package called Visula Thermal in its Visula 5.0 release that uses a mainframe modeling technique called difference modeling. Its main attraction is speed; it's an order of magnitude faster than other tools and achieves a thermal profile of a board that is within 10% of the actual measured temperature.

Mentor also offers an integrated thermal-analysis package based on an expert system developed in conjunction with Sandia Labs. "It is 30% to 60% faster than what's on the market," says Wolfson. Algorithms in the thermal package can also perform other types of analysis applicable to high-speed design.

Some competitors still get their analysis packages by means of OEM deals, buying the likes of PCB Thermal from Pacific Numerix Corp. of La Jolla, Calif. Other tools—such as Greenfield from Quantic Laboratories Inc. of Winnipeg, Canada—provide the same kinds of analysis for electromagnetic emissions.

Heat and noise aren't the only wild cards in pc-board design. The diversity of device types also increases routing complexity, and addressing this problem takes variable-grid or gridless routers. Laying out boards with a variable-grid router "requires maintaining millions of points in memory," explains says John Dawson, engineering manager at Teradyne EDA Inc. in Sunnyvale, Calif. "An irregular repeating grid that does not have a uniform step size is a better solution," he contends. Teradyne's Vanguard tool creates a special grid for pin-grid arrays with 200 to 300 pins in a regular structure and associated components surrounding the part.

Solutions from Racal-Redac, Intergraph, and, as of last month, Scientific Calculations in its Version 25 software release have championed the gridless router. Such a router is not limited to placing components on a grid. Rather, it can place them anywhere on the surface of a board for area optimization.

With Version 25, Scientific Calculations plans to get back into the fight for leadership in the pc-board CAD market, says Marini. Version 25 is a clearance-based router that runs traces relative to other traces, pads, and vias already on the board. The tool is powerful—it is able to push other traces aside. It can also plow through ground and power planes to complete a hard-to-route trace.

## A FRAGMENTED MARKET

**I**n hopes of breaking out ahead of the pack, vendors are luring buyers with routers that link with front-end design;

**W**ith gridless routers to handle boards with high-pin-count ICs and surface-mounted devices;

**A**nd with features easing manufacturability and test.

In the Tiger II gridless router from Intergraph Corp. of Huntsville, Ala., software partitions the task into manageable pieces. Tiger II recognizes congested areas of a pc board, such as around pin-grid arrays and SMDs or edge connectors, says Jim Thompson, executive manager for electronic products at Intergraph. These areas are routed first, followed by less congested areas.

Besides demanding the feature sets to place and route complex boards, layout designers still fret about the time it takes to complete these routes. In some cases hours or days of computer time are required. In the past, companies such as Daisy/Cadnetix Inc. made handsome profits selling route engines to speed the process. However, the rapid pace of work station performance has diminished the need for dedicated hardware. The accelerator market is declining, says Victoria Hinder, director of research at the Technology Research Group, from $8 million this year to $6 million in 1991.

Nevertheless, Dazix believes there's still a market for dedicated accelerators among its installed customer base, and has just introduced a new product, the Voodoo Router, to serve it. The router offers an order of magnitude higher performance than work-station-based software (see p. 56).

Just as the circuit designer has given his two cents' worth to the place-and-route function, so too have the test engineer and industrial designer. Boards crammed on both sides with SMDs and pin-grid arrays, and with very narrow traces packed into every inch of space, present manufacturing and testing problems. Thus, layout tools now observe design rules that ensure manufacturability and test.

For example, Intergraph's Tiger II router automatically examines where test points must be added on a board to ensure access by a bed-of-nails tester. With Valid's Allegro, the designer specifies a test strategy, such as test points on a 100-mil grid or testing from the bottom or from both sides, says Gambino. The tool automatically adds test points to meet the specification. In fact, it can even specify how to build the test fixture.

Testability analysis is not available on all tools yet, but most address manufacturability. Virtually all the high-end place-and-route tools on the market today offer some capability to clean up a board after it has been routed so it is more manufacturable.

Sciccards Version 25, for example, expands traces to fill up unused area on the board and provide more spacing between traces. It also eliminates unused vias. Racal-Redac's Visula will shorten some routing paths (see p. 72), converting stair-step traces to straight lines and ensuring that traces do not connect to a pad at a 45° angle. (This angle traps solder and acids during wave soldering.)

With capability for accommodating test and manufacturing coupled with strong links to the front-end design, the entire pc-board development process has become automated. Now the front-runners must continue providing capability to handle each successive generation of boards. "It's still a wide-open game in the pc-board CAD-tool market," says Marini.

*"You need to be able to partition the board and address different strategies in each section."*

JOE PRANG - VALID LOGIC


# Electronics

The magazine that gives its readers the best perspective on vital issues and trends is also the place to communicate every month with engineers who manage their companies.

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# CAN A NEW ROUTER WORK SOME VOODOO?

## DAZIX HOPES A POWERHOUSE PRODUCT CAN HELP IT RISE ABOVE THE FINANCIAL MIRE

BY SAMUEL WEBER

BESET BY FINANCIAL WOES and dogged by competitors eagerly nipping at its customer base, Daisy/Cadnetix Inc. is struggling to regain its once lofty position in the computer-aided-design marketplace by developing products for its installed base that offer performance and features unavailable elsewhere.

One product on which the company—dually based in Mountain View, Calif., and Boulder, Colo.—is pinning high hopes is the Voodoo Router, a new dedicated routing engine for printed-circuit boards that the company claims is 5 to 20 times faster than conventional routers, while routing boards to 100% completion. Analysts applaud the router but question whether it can pull Dazix, as the company is known, out of the doldrums.

CAD/CAE

To get this kind of performance, Dazix turned to advanced concepts in hardware design and system architecture, and also incorporated expert-system elements in a new algorithm that is the first in the industry to exploit parallel processing.

For speed, the hardware is designed around a pair of Intel Corp. i860 reduced-instruction-set-computing processors, each running at 40 MHz. Each microprocessor has its own dedicated zero-wait-state 512-Kbyte coherent cache memory and its own dedicated 8-Mbyte local dynamic random-access memory. Additionally, each processor board has 32 Mbytes of shared DRAM that can be accessed by all processors in the system.

To further enhance speed, the system utilizes a dual-bus setup. The VME-bus serves input/output traffic while shared-memory and control-processor accesses are made over a 64-bit bus conforming to recently released Futurebus+ specifications [*Electronics*, February 1990, p. 29].

Depending on the complexity of the board solution sought, a Voodoo system can be expanded from one processor board to five, for a total of 10 i860s. Up to four memory boards holding up to 96 Mbytes can be added to serve a full complement of five processor boards. The configuration is managed by the central-processing-unit board of a Sun Microsystems Inc. Sparcstation 1 running at 12.5 million instructions/s. The CPU board provides networking and memory access, synchronizes the i860s, and does data-base conversion. All the software algorithms come built in.

The Voodoo Router can be accessed from any node in a work-station environment on a Dazix high-speed Ethernet network. Routing jobs can be offloaded and scheduled for unattended batch processing.

The router derives much of its power from an intelligent algorithm called Strategist, says Bob Anastasi, Dazix's

**WHO DO THAT VOODOO?**

*Dazix's new Voodoo Router routes pc boards to 100% completion 5 to 20 times faster than conventional routers.*

vice president of CAD/CAM systems marketing. Strategist evaluates the board criteria the designer feeds to the system—for example, board size, number of layers, and the design rules—and then decides how to divide the problem among the several processors.

"While the routing is going on, Strategist evaluates the problem," Anastasi says, "and dynamically assigns tasks to, and chooses optional methodologies for, each processor individually or all working together."

## IN A NUTSHELL

**P**c-board routing engine is the first to use a parallel-processing algorithm.

**U**p to 10 i860 processors and 96 Mbytes of memory can be applied to routing problems.

**B**ut industry observers wonder if customers will look past Dazix's shaky financial condition.

**NEW HIGHS IN ROUTING** speed are becoming critically important because of the mounting complexity of today's many-layer pc boards. Such features as surface-mount technology, high-speed gate arrays, emitter-coupled logic, and hybrid designs make great demands on the degree of automation and the speed that most routers can deliver.

A conventional router can take as long as four or five days, thus greatly slowing a product's time to market. The Voodoo Router can trim that time, says Anastasi.

Dazix has been a leader in routing technology with its dedicated routers for some years, but the company gradually began feeling pressure from general-purpose routers as the work stations for which they are designed became faster. With comparable performance available, says Anastasi, customers would opt for a general-purpose piece of equipment.

But the demands of today's complex boards have forced vendors of general-purpose routers to load their algorithms with special functions and features that slow them severely, despite the increased hardware speed.

"Our customers told us that if we could give them a significant improvement in performance, they would have no problem buying a dedicated piece of hardware," Anastasi says. "Many of the customers for our routers are running them seven days a week all the time. It's not possible to get the kind of performance they needed for today's boards when routing on a general-purpose computer because of insufficient memory bandwidth." Voodoo Router's support of extensive coherent cache memory overcomes this limitation.

Base price of the Voodoo Router is $99,000, for which buyers will get the box, the Sun control board, one Voodoo board with two i860s, and 48 Mbytes of RAM. This basic configuration will handle almost any medium-size board in the range of 300 to 400 equivalent integrated circuits.

"If you want more than that," says Anastasi, "say, 5-mil lines or 24 layers or very large boards, you need more memory. If you need more speed, you can add more boards." The speed of the Strategist algorithm increases incrementally by a factor of 1.8 with the addition of another board.

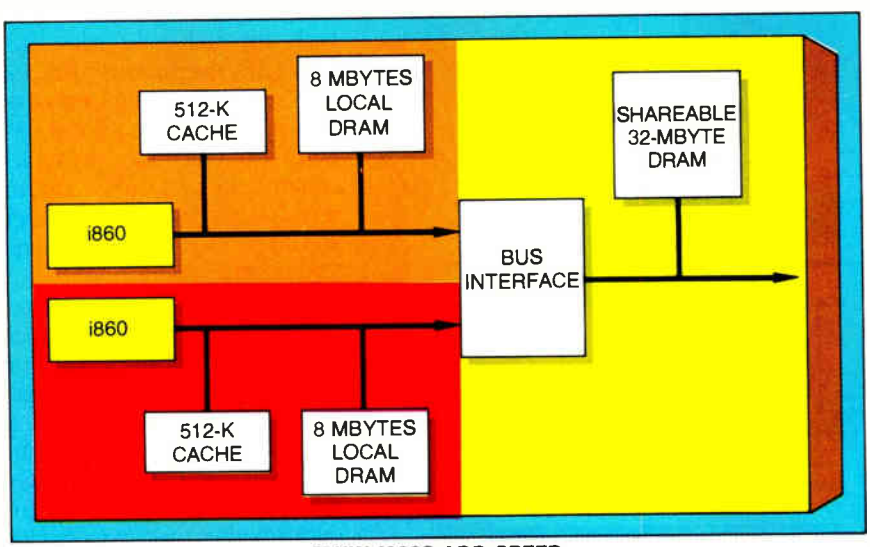
The Voodoo Router retains all the functionality of its predecessor in the Dazix product line, the Route Engine III, including 100% rip-up and reroute, sub-mil resolution, support for SMT design with blind and buried vias, and ability to handle boards up to 44 in. long with 10,000 components. In addition, the new product permits 45° routing and can handle up to 32 layers simultaneously using layer-specific design rules.

**CAN THE NEW PRODUCT** save Dazix? Despite the Voodoo Router's impressive qualities, industry analysts are not sanguine about its ability to pull the company out of the financial mire in which it finds itself. Its precarious position came about as a result of last year's unfriendly takeover of Cadnetix Inc. by Daisy Inc., a buy-out that was leveraged by heavy borrowing at high interest rates [*Electronics*, July 1989, p. 95]. The merged company is having difficulty servicing its heavy debt and recently brought in a new management team in an effort to turn the situation around.

"Candidly, if you're facing bankruptcy, a lot of customers refuse to buy your products," says Robert Herwick, senior technology analyst for Hambrecht & Quist Inc. in New York. "They've gotten into such financial difficulty that the overriding issue is money, not product availability."

Indeed, "there's no way a new company looking for CAD tools would go to [Dazix]," says Ron Collett, an analyst at Dataquest Inc. in San Jose, Calif. New advanced products such as the Voodoo Router might hold some of the firm's installed base of customers who are looking to upgrade, but the shaky financial picture will scare off most if not all new buyers, he says.

But Collett believes Dazix is making a good effort. "They have to produce significantly better products just to stay abreast, and that they seem to be doing. They have a very good understanding of market needs. What they don't have is money."




**TWIN i860S ADD SPEED**

*The hardware is designed around a pair of 40-MHz i860 processors, each with its own 512-Kbyte cache memory and 8-Mbyte DRAM.*

# NONIMPACT PRINTERS TRANSFORM THE OFFICE

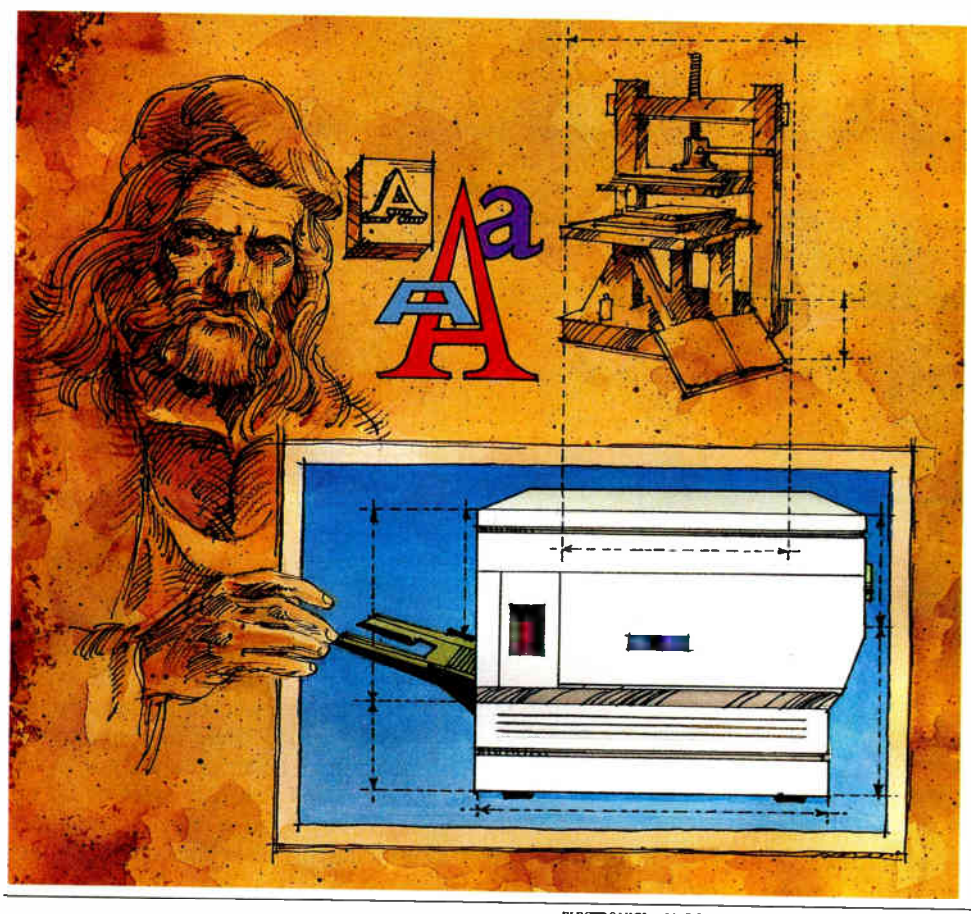
## AND THAT'S GOOD NEWS FOR CHIP MAKERS SUPPLYING THEM WITH MEMORIES AND MICROPROCESSORS

BY BERNARD C. COLE

A HARD-COPY REVOLUTION is upon us. Driven in part by the pervasiveness of the personal computer and in part by the low cost of printers, users both within and without the corporation are shifting from impact-based machines such as the typewriter and the daisy-wheel and dot-matrix printers to higher-quality, higher-resolution nonimpact techniques, be they laser, ink-jet, or other approaches. And they are doing so with a rapidity that Gutenberg—and the monks his invention of movable type displaced 540 years ago—might appreciate. But where Gutenberg's invention led eventually to the decline of the bright, detailed manuscripts that medieval monks copied by hand and embellished, the hard-copy revolution is allowing users to create letters and documents with a variety of typefaces and a level of detail and sophistication that would make a calligrapher jealous. This has led to an increasing enthusiasm for desktop publishing in the most unexpected places. Within corporations, simple business letters are brightened not only with the precise images on paper that the laser produces, but with a variety of flourishes.

SEMICONDUCTORS

With the flexibility offered by new printer languages from the likes of Hewlett-Packard Co., Adobe Systems Inc., and others, users are finding it easy to add graphics and even photos to illustrate their letters. And reports, instead of being done in the same old 8-by-10-in. format, are being transformed into newsletters.

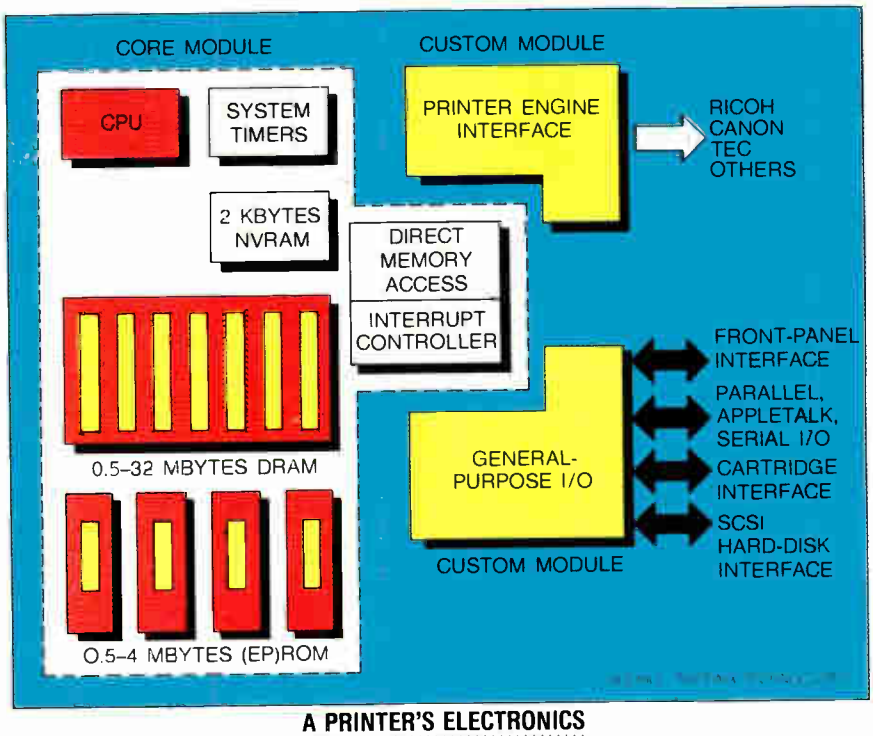


Although impact-based printers still dominate, the nonimpact units are coming on strong in both unit and dollar sales, says BIS CAP International Inc. of Norwell, Mass. Shipments of nonimpact printers totaled 2 million last year, the market-research house says, against 900,000 in 1985. The number should double by 1993, accounting for $9.2 billion in sales.

Driving this revolution and benefiting from it are four groups of companies: two or three makers of the basic electromechanical engine for printers, a half dozen or so suppliers of various fonts and printer and page-description languages, semiconductor houses making memories and programmable logic, and, most recently, at least eight or nine makers of advanced micro-

processors and coprocessors. These companies are trying to break the stranglehold that Motorola Inc. has on the market with its 68000 processor.

The boon to semiconductor manufacturers could amount to as much as $1 billion in sales this year, says Kevin Landis, printer-industry analyst at Dataquest Inc. of San Jose, Calif. About 80% of that will be for high-density dynamic random-access memories and erasable programmable read-only memories for storage of type-font information. The rest will go to processors and peripheral logic circuitry.




**A PRINTER'S ELECTRONICS**

*Printer manufacturers will spend some $1 billion this year on chips—DRAMs, EPROMs, and processors—to power their machines.*

MORE THAN ANYTHING else, the rapid growth of this market comes because laser printers have been able to crack the critical $1,000 barrier by making use of the same electromechanical engine as plain-paper copiers, says Robert Auster, director of BIS CAP's Intelligent Copier/Printer Service. This lets manufacturers take advantage of the economies of scale in the first market to drive down cost in the second.

Accounting for no more than 10% to 15% of the total cost of a $1,000 unit, the laser imaging and printer system is a virtual clone of that used in copying machines. An electrostatic charge is evenly applied to the surface of a rotating, photosensitive drum. Then a laser beam is modulated on and off in response to electronic signals representing text or image data.

This beam is directed onto the surface of the drum, leaving a trail of dots when the static charge has been removed, eventually producing a complete electrostatic image of the page. The drum is then exposed to toner, which is attracted only to the areas where the static charge has been removed. As paper is fed through the copier or printer, it is exposed to a charge that is opposite to that on the toner on the drum, causing it to be transferred to the paper. A high-intensity lamp then fuses the tiny dots together, resulting in clear, continuous images.

Suppliers of electromechanical engines such as Canon, Ricoh, and Tokyo Electric are finding a rich new market in more than 50 laser-printer manufacturers that have burst upon the scene in the last two to three years—some two dozen within the last 18 months.

Apple Computer Inc. and Hewlett-Packard dominate the low end, with 80% to 90% of the market for systems that produce 4 to 16 pages per minute. As a result, many of the new players, such as QMS Inc. of Mobile, Ala., see their opportunity in the mid-to-high-end laser printers where performance requirements range from 16 ppm on up to 80 or 100 ppm.

Many are gambling on two technological developments to give them an edge in this segment. One is the growing popularity of sophisticated page-description languages such as Adobe's Postscript and its clones. The second is a reliance on advanced high-speed processors and coprocessors to handle the more complex algorithms required by such languages. These devices offer throughputs not possible with present 68000-based systems.

LASER PRINTERS FIRST BEgan their road to widespread popularity with the 1984 introduction of HP's original LaserJet printer, built around the Canon engine, a 68000-based controller, and a simple character-based printer-control language called PCL-1. "HP has set the standard for producing complex documents with clear, crisp text on personal computers," says Landis of Dataquest. "And HP is the one everyone has to beat. To this day, no other laser printer has attracted so large a share of the market."

A printer-control language is relatively simple. Its focus is the generation of characters, either individually or line by line, controlled by a very basic set of commands. Typically, these commands might be represented in the form of control characters, but since different applications require different control characters, software programs called printer drivers are used to take the output of an applications program and turn it into a protocol that the printer controller understands.

Printer drivers reside in the host computer and must be tailored to the specifics of the machine and the applications it runs. But they are short, easily produced, and take up little memory space. HP's PCL represented an incremental step forward since, besides standard character-printing capabilities, it incorporated some font variations and scaling and some very basic graphics, such as straight lines.

The advantage of the protocol is that it simplifies considerably the design of the controller, says Richard Belluzzo, general manager of HP's Printer Division in Boise, Idaho. It also allows relatively high print speeds by limiting the realm of what may be printed.

Page-description languages, such as Postscript from Adobe in Mountain View, Calif., take a giant step beyond PCL-type implementations by taking on not just characters or a line of charac-

ters, but an entire page of characters, graphics, or both.

The idea behind a page-description language is to represent the contents of a printed page as a set of instructions on how to "draw" the page, not as a series of 0s and 1s that indicate the absence or presence of an ink dot, says Barbara Nelson, printer business manager at Weitek Corp. of Sunnyvale, Calif. A language such as Postscript treats images and alphanumeric text figures alike as independent graphic entities that can be expressed mathematically and manipulated at will. In such a language, fonts and graphics are stored as abstract mathematical representations independent of any particular resolution or orientation.

This approach gained considerable credibility in 1985 when Cupertino, Calif.-based Apple adopted Postscript for its line of laser printers. Even so, Postscript has had an uphill fight to reach parity with the simpler PCL approach for two reasons. One is Adobe's virtual monopoly on Postscript controller software and font libraries. Anyone who desires a Postscript-based printer has to license the design from Adobe. At the low end, especially, this is a significant amount of a printer's final price, since such licenses can add anywhere from $100 to $400 to the cost of a single printer.

NOW A NUMBER OF ALternatives have emerged that bid to lower this cost. While Adobe, due to its past connections with Apple, has been the only truly successful vendor of such languages, several companies have developed their own versions, including Xerox Corp. with its Interpress and QMS with Imagen. In addition, a number of companies, including Pheonix Technologies Ltd. of Cambridge, Mass., have come out with Postscript clones that are available for a fraction of Adobe's licensing fee. But for vendors of Postscript-based laser printers, this choice presents something of a dilemma, says Brent Wientjes, director of marketing for graphics products at Cirrus Logic Inc. of Milpitas, Calif.

All things being equal, a printer running Postscript is usually slower than one running PCL because of the much heavier processing requirements associated with page composition. Postscript printers are, in fact, notoriously slow, especially where multiple fonts, fancy layouts, or detailed graphics are involved. It sometimes takes half an hour to print a single complex page. And when multiple users share a common printer on a network, the problems are compounded. This occurs even though 95% of the printing time for a typical Postscript machine is devoted to page processing and only 5% to actually running the print engine. The result, says Nelson of Weitek, is that Postscript printers run at only a fraction of their peak engine speeds.

It is in this dilemma that many of the chip vendors see their opportunity for significant sales of processors and coprocessors. Currently leading the pack in developing this market are Intel Corp.'s Chandler, Ariz., operation and National Semiconductor Corp. of Santa Clara, Calif. National is taking the complex-instruction-set-computing road, while Intel is setting out along the reduced-instruction-set path.

With two CISC-based central processing units—the 32CG16, targeted at 4-to-8-ppm applications, and the 32GX32, aimed at the midrange of 8 to 20 ppm—National has achieved design wins at Canon, Everex Systems, GVC, and Mannesman Tally. Intel's RISC-like 80960 will be used in controllers at Destiny, Eicon, GVC, Hanzon, Newgen Nissho, and RIPS, and as a high-end implementation at Canon. In addition to introducing standard versions of ever higher throughput and higher integration, Intel also plans to introduce this year special laser-printer application-specific products that will reduce the component count in a typical system to as few as 7 to 10 chips.

Also targeting this market are Advanced Micro Devices Inc. of Santa Clara with its general-purpose 32-bit 290000 RISC machine, and Weitek with its Postscript-specific family of 32-bit XL-8200 Hyperscript processors. In addition, says Dataquest's Landis, a number of RISC vendors—among them Integrated Device Technology Corp. of Santa Clara and Inmos Corp., of Colorado Springs, Colo.—have also come up with solutions.

HOWEVER, MOTOROLA'S 68000 is a hard processor to beat, "even though it is not enough for many Postscript applications," says Landis. For starters, it's cheap—just $5 apiece in high volumes. "At that price, printer manufacturers can afford to implement gate arrays to boost throughput, reduce component count, or optimize their design for Postscript," he says.

Hoping to attract customers that would normally go to an application-specific integrated circuit solution, Cirrus Logic is finding a brisk business for its family of 16- and 32-bit coprocessors optimized for Postscript, says Wientjes.

But Motorola itself has a handle on this market, says Murray Goldman, senior vice president and general manager of the company's Microprocessor Products Group in Austin, Texas. At the high end, he says, its new 40-MHz 68030 and 20-MHz 68040 offer more than enough performance for those tempted to go to a RISC solution, he says.

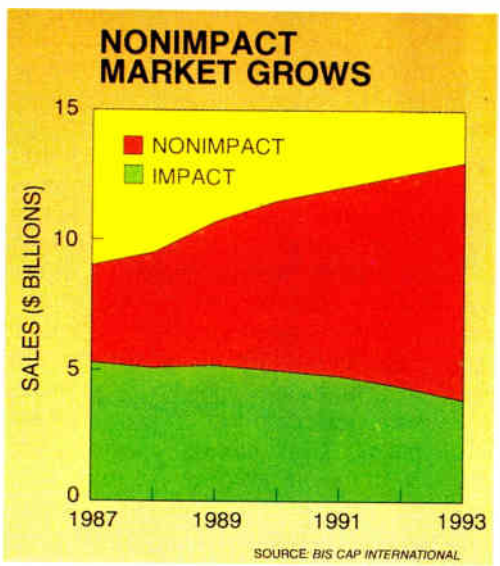
And at the low end, the company is at work on an ASIC variation of its 68030 family that reduces chip count and cost. "This is not a market that we will easily give up," Goldman says.

## WHERE'S THE BUSINESS?

**W**ith two or three makers of the basic electromechanical engine for printers;

**S**ix suppliers of printer languages;

**A**nd chip makers supplying DRAMs, EPROMs, PLDs, and—most recently—advanced processors and coprocessors looking to knock the 68000 from the catbird seat.



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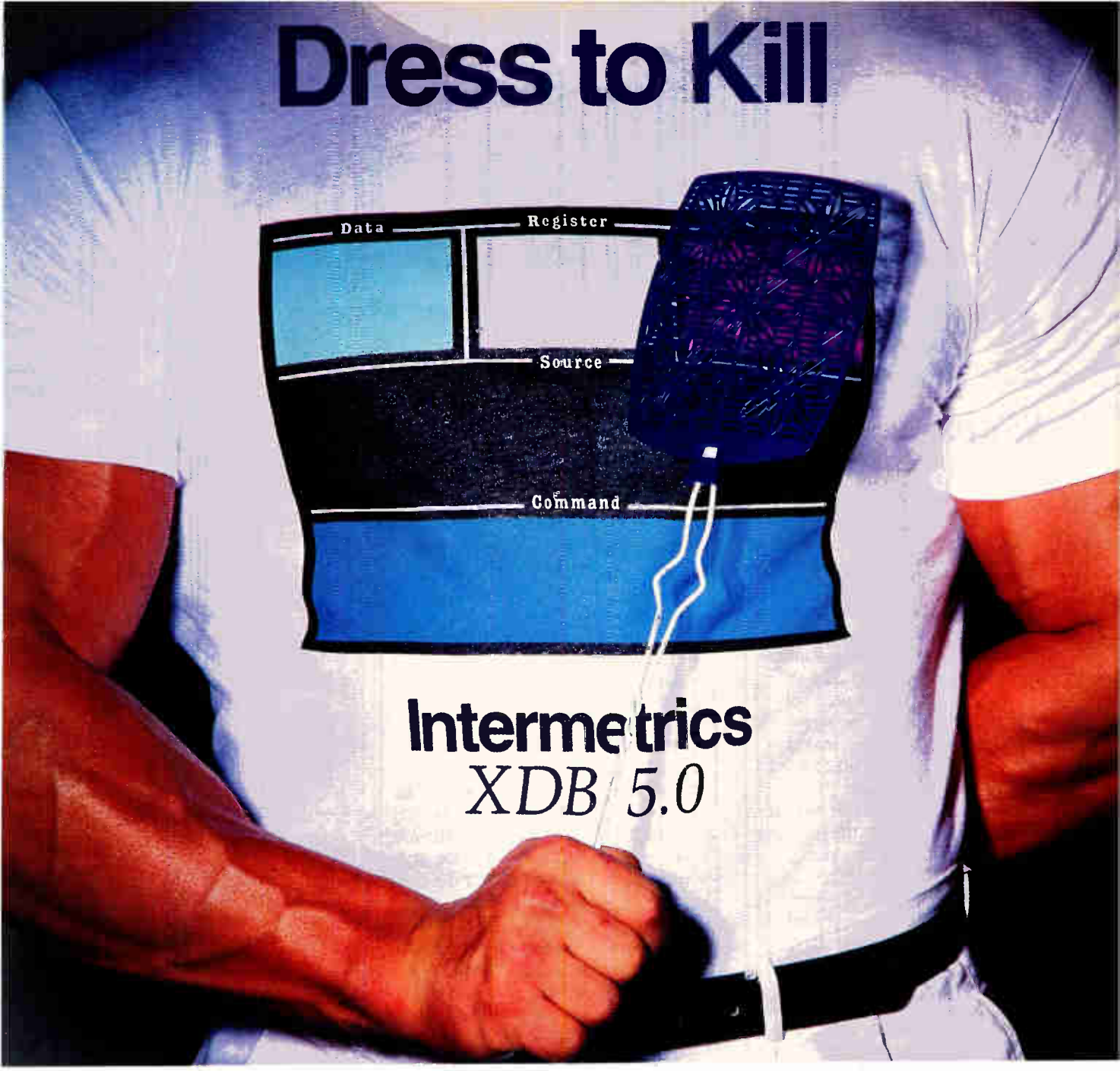


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# ARCHIVING GETS A SHOT IN THE ARM

## DAT DRIVES AND REWRITABLE OPTICAL DISKS CAN PACK AWAY MEGABYTE AFTER MEGABYTE

BY SHERRIE VAN TYLE

STORAGE

AS THE '90S OPEN, THE paperless office remains a mirage. But a slew of companies, among them Hewlett-Packard Co. and Sony Corp., are building low-cost, 4-mm digital-audio-tape drives that will archive data for cents per megabyte. And makers of quarter-inch cartridges are working hard to counter the inroads of 4- and 8-mm DAT drives on their turf by beefing up tape capacity.

Meanwhile, the erasable optical-disk drive is poised to serve the high end of the archiving spectrum—direct-access, secondary storage—where archived files must be recalled in seconds. Because optical disks are removable, they can pack away gigabytes of data in disk libraries, or jukeboxes. Since this option is more costly than tape, tape-drive vendors are counting on technological breakthroughs that improve quality and speed to give them a toehold at the high end.

"If your hot button is access time, use [rewritable optical] disk. If your hot button is cost, use tape," says Tom Balue, product manager for Honeywell Inc.'s Test Instrument Division in Denver, Colo.

Although optical-disk drives and tape overlap for some archiving tasks, in the long run they will serve different markets and thus are complementary. "If you need to retrieve archival data, look at it, and update it, then you should use optical. But if you rarely look at archival data, then tape would be very suitable," says Bo Larsson, marketing manager for Sony America's Digital Data Storage Division in San Jose, Calif.

Another hot button for users is capacity—the more the better. In tape cartridges, the fastest-moving products are those with the highest capacity, according to Peripheral Strategies Inc., a market research firm in Santa Barbara, Calif. Products storing 1.35 Gbytes and beyond will fuel growth of 5.25-in. data-cartridge drives well into the 1990s, says Robert Abraham, vice president at market researcher Freeman Associates, Santa Barbara. About 25 companies intend to jump into the 4-mm DAT fray, with about half ready to ship drives, Abraham says.

Overall, sales of data-cartridge and data-cassette tapes last year hit 1.5 million units and $517 million, Abraham says. By 1993, sales are expected to grow to 2.1 million units and $633 million, he estimates. For growth to stay strong, however, quarter-inch tape drives will have to meet the challenge posed by DAT. DAT relies on the helical-scan technology developed for 8-mm videotape and 4-mm consumer products, which affords higher bit densities than 0.25-in. tape.

In helical-scan recording, data is stored on tracks running diagonally from top to bottom past a rotating read/write head. This technique affords higher density than conventional tape, in which tracks run lengthwise. DAT's big advantage, though, is cost: some 40 times less than the cost of optical disks for archiving tasks.

Shipments of 4-mm DAT units should hit 71,000 units this year and 623,000 in 1994. OEM prices are expected to drop from $2,000 per unit last year to $1,360 this year, Abraham says. On the 8-mm front, 92,000 units will ship this year and 144,000 in 1992, with the average OEM price per unit

dropping from $1,560 last year to $1,420 this year, he says.

For the near future, capacity won't propel growth in erasable optical drives, since most makers of 5.25-in. erasable drives are conforming to standards set by the American National Standards Institute and the International Standards Organization for magneto-optical disks—325 Mbytes per side. Companies in the standard 5.25-in. market or about to jump in include Hitachi, Maxoptix, Mitsubishi, Panasonic, Ricoh, Sharp, Sony, and Toshiba. The exception is an optical drive from Canon U.S.A. of Lake Success, N.Y., whose disk stores 256 Mbytes per side. Maxoptix's Tahiti I drive has a second mode that puts 500 Mbytes on each side.

The erasable optical market hasn't hit its stride yet: drives arrived on the market only a year and a half ago. Still, sales should nearly triple to 173,000 units this year and 761,000 in 1992, predicts market researcher Disk/Trend Inc., Mountain View Calif.

ERASABLE OPTICAL "IS A 1991 high-volume product. And 1990 is where all the development work is going to be done—the pioneering efforts in software and demonstrations to the various industrial channels," says John Freeman, vice president of marketing for drive maker Maxoptix Corp., San Jose.

Beyond archiving data, rewritable optical holds considerable promise as primary storage because it offers random access to files. But before it can challenge Winchester disks for storing data on line, key improvements in optical technology are needed (see p. 64).

"A significant share of our rewritable optical applications are archival. Rewritable optical as primary storage is still in the delicatessen section of the marketplace," says Bob Mueller, vice president of Sony America's Rewritable Optical Products Division, Park Ridge, N.J.

Compared with tape cartridges of any format, optical media remains expensive: a 650-Mbyte optical disk costs about $250. With volume production, media prices will drop to $25 to $50, which would compare favorably in cost per Mbyte with tape, but this probably won't happen for several years. OEM prices for drives range from $2,000 to $3,000. The end-user price is two to three times that.

In the meantime, tape leads the way in archiving for less. "Tape will continue to be viable for a long time. Low-end users have a need for archiving that can be done easily," says Ed Harper, vice president of marketing at Colorado Memory Systems Inc. in Loveland, Colo. Tape costs range from 10 to 20 cents per Mbyte compared with 20 to 40 cents for optical drives.

At the high end for tape storage, where half-inch tape cartridges are replacing tape reels, "demand for high-end cartridge drives will more than double by 1994, the only bright spot in a sagging market for half-inch tape devices," says Abraham of Freeman Associates. IBM Corp.'s 3490 cartridge-tape subsystem stores 200 Mbytes per cartridge and offers 9- or 18-track recording and a data-transfer rate of 4.5 Mbytes/s. He points to the growing importance of low-cost subsystems from such manufacturers as Fujitsu, Laser Magnetic Storage, and Storage Technology, which can read and write tapes compatible with IBM 3480/3490 subsystems.

Not intended to replace mainframe drives, "these new devices will extend the use of parallel-recorded half-inch cartridges to smaller systems and stimulate use of the cartridges for data interchange," Abraham says. These products, he points out, will enjoy an annual growth rate of 105%.

Aiming at users of desktop systems who need to access tape libraries, the model 3410 from Qualstar of Chatsworth, Calif., comes in a 5.25-in enclosure and stores 250 Mbytes.

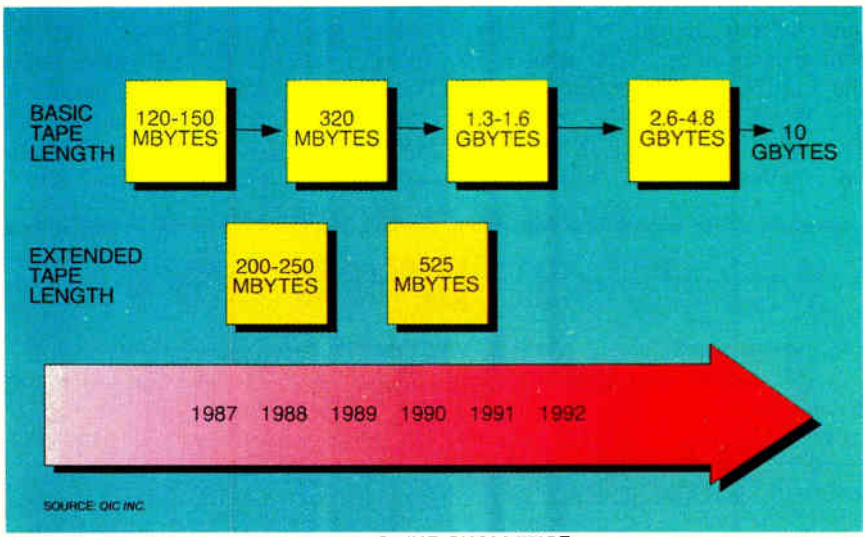
In the 0.25-in.-tape realm, manufacturers are responding to DAT's challenge and boosting capacity by lengthening the tape, applying data compression, and improving recording heads and media. The MT2ST/F data-cassette drive from Teac America Inc.'s Data Storage Products Division stores 600 Mbytes in a 3.5- or 5.25-in. cabinet. The unit's 14 Mbytes/min transfer rate is nearly double that of other 0.25-in. drives, the Montebello, Calif., company says.

Rather than compress data on the tape, Teac uses a special read/write head to handle narrower track widths. The number of recording tracks increases from 17 to 21; recording density increases from 16,000 flux transitions/in. to 48,000.

Depending on applications and type of data being stored, compression can double data-transfer speed and capacity. For example, Tallgrass Technologies of Overland Park, Kan., packs 500 Mbytes onto an ordinary 150-Mbyte cartridge. The Filesecure 150's data rate is 6.75 Mbytes/min. The unit's quick file-access feature offers recall in less than 40 s.

Colorado Memory Systems' Turbo Compression boards plug into the expansion slot of an IBM PC AT. The TC-02 board boosts the capacity of the company's QIC-150 drive to 500 Mbytes using extended-length tape; the data-transfer rate rose from 4.5 Mbytes/min without compression to 8.2 Mbytes/min with compression.

But even with the advances in tape, many see DAT as the one to watch for archival applications. Of the companies




**MEETING THE CHALLENGE**

***To match digital-audio-tape drives, quarter-inch tape cartridges are increasing in capacity by compressing data and using longer tape.***

making DAT units, some, such as Archive and Wangtek, have a foot in both 4-mm DAT and 0.25-in. tape camps. Sony expects to start shipping its 4-mm DAT drive this month. There are two recording formats in 4-mm DAT: DDS, being promoted by Sony and Hewlett-Packard, and DATA/DAT, being pushed by Hitachi [*Electronics*, September 1989, p. 82].

BOTH FORMATS ARE UNder consideration by ANSI's X3B5 committee, which could choose one or the other or bless both. It's too soon to tell which will win in the marketplace, Abraham says: "Often the market preempts or precludes the standardization committee and its work."

DDS units are hitting the market now, and this format has an edge because of the strength of the players behind it, Abraham says. Besides HP and Sony, Archive, Laser Magnetic Storage, WangDAT, Wangtek, and others have lined up behind DDS. DATA/DAT counts among its adherents Fujitsu, JVC, Sharp, Teac, and Toshiba, but no DATA/DAT drives have arrived yet. Hitachi is expected to introduce one by the fourth quarter.

The formats differ in several ways. Both offer the ability to randomly read files, but DATA/DAT is aiming for primary storage tasks because it has random-write access for updating files in place and another level of C3 error correction, says Richard Young, director of marketing for Hitachi Ltd.'s System Development Division in Costa Mesa, Calif. Moreover, for faster file access, DATA/DAT allows for 254 partitions in the tape's data area while DDS allows for just two.

In the DAT/DDS arena, WangDAT Inc. of Costa Mesa, Calif., packs 1.3 Gbytes onto standard 4-mm DAT cassettes. The half-height model 1300, which transfers 183 Kbytes/s, can replace 150-Mbyte QIC-150 drives without system software or hardware changes. Also tossing its hat into the DDS ring is Tecmar. The Solo, Ohio, company's 1.3-Gbyte Datavault drive has 10 times faster search speed than 8-mm tape, says Gene Della Toree, product marketing director. With data compression, cartridges can squeeze in 2.6 Gbytes. Another DDS drive is the model 6130FS from Wangtek Inc., Simi Valley, Calif. It transfers 183 Kbytes/s and stores 1.3 Gbytes.

Having shipped 60,000 8-mm digital tape drives, Exabyte Corp. of Boulder, Colo., doubles previous capacity in its EXB-8500 tape subsystem, which stores 5 Gbytes. Transfer rate is 500 Kbytes/s. Among the system integrators using Exabyte's drive is Emerald Systems Corp. with its VAST device. The San Diego, Calif., company is building around a 4-mm DAT/DDS drive for release late this month.

Storing tens or hundreds of gigabytes brings on the need for tape or disk libraries. Such systems are a natural for storing aircraft or weapons documentation and maintenance manuals. Robotics assemblies, which automatically locate and load tapes or disks into drives, make it possible to access a file

# WILL ERASABLE OPTICAL DISKS REPLACE HARD DISKS?

THE INTRODUCTION OF the Next Computer with a Canon Inc. 5.25-in. erasable optical drive as its primary storage surprised many. Erasable optical disks are still two to six times slower than hard disks for most tasks, and Next Computer Inc. has added a 40-Mbyte "accelerator" hard-disk drive to speed things up. Even Next concedes that faster optical drives are needed if optical is to be used as primary storage, although the Redwood City, Calif., company plans to stick for now with the Canon unit.

To challenge hard disks in desktop and file-server machines, rewritable optical technologies must leap several hurdles. One is eliminating "two-pass" writing, in which the drive must perform two passes over the disk—first to erase by writing 0s where the new data will go and then 1s to represent the data. Achieving what is called direct overwrite and shrinking the weight of the read/write head will boost speed. Also, "we need to spin the disk faster, push the data through the [input/output] channel faster, and put both sides on line," says Jay Bretzmann, senior market analyst at International Data Corp., Framingham, Mass.

"Five years from now we'll see new types of direct-overwrite materials—either magneto optical or phase change," says Gordon Knight, vice president of engineering at Maxoptix, San Jose, Calif. Phase change, an alternative erasable optical technology, still lacks infinite erasability, Knight points out. Rather than rely on magnetics to record bits, in phase change the writing laser heats spots on a metal layer in the disk, changing them from an amorphous to a crystalline state and back again.

"Erasable optical can't compete with Winchesters until the mid-1990s," concurs Barry Donahue, vice president of Toshiba America's Disk Product Division in Irvine, Calif. "Two-pass erasable is niche-market-oriented, and on-pass rewritable is three years away." He says the company is working with two other technologies, but declines to say what they are.

Besides undergoing technological changes, optical drives are headed for smaller sizes. Several companies, IBM Corp. and Sony Corp. among them, are working on one-sided 3.5-in. units. The disks, which hold about 120 Mbytes, seemed aimed squarely at the desktop.

Notwithstanding the obstacles, drive makers and system manufacturers are optimistic about optical's prospects. "Within the next five years, rewritable optical will meet or exceed the performance of today's hard disks," says Bob Mueller, vice president of Sony America Corp.'s Rewritable Optical Products Division in Park Ridge, N. J. For one thing, hard disks are close to reaching the upper limits of their capacity in terms of density, and optical is not.

To users, optical offers the lure of potentially huge capacity and ease of use for archiving, imaging, and other tasks. "Some studies show that 97% of all the information in the world is off line on either microfiche or paper," says Bill Boles, product manager for Hewlett-Packard Co.'s Greeley Storage Division in Greeley, Colo. "There's a huge opportunity for keeping that data on line in an optical storage medium."—*S. V. T.*

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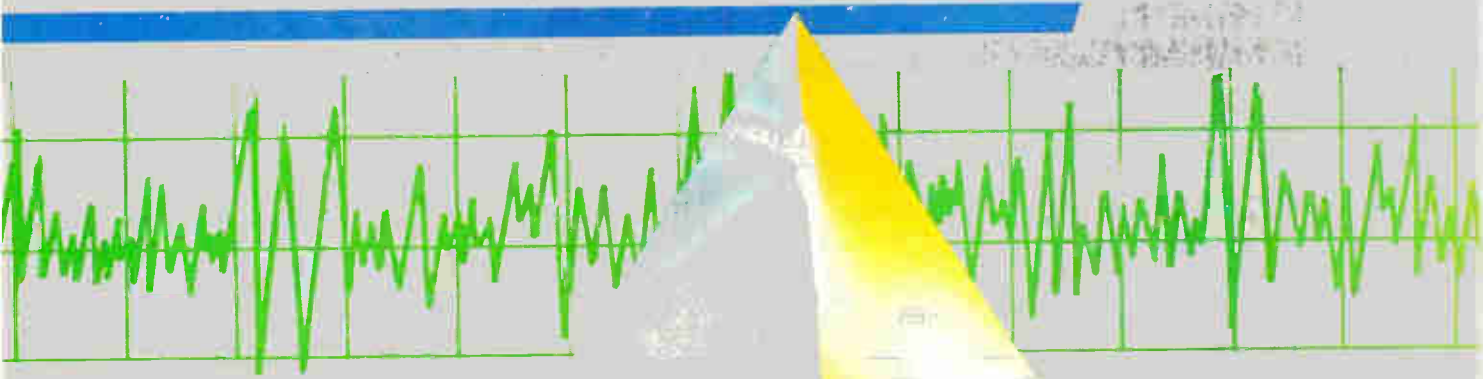

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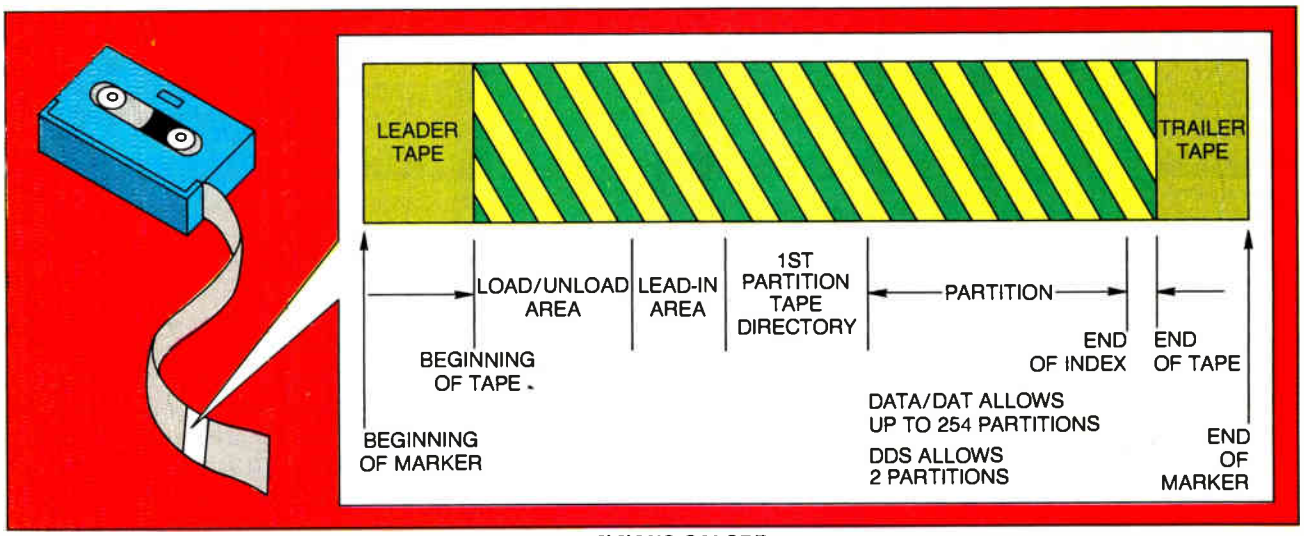


**PARTITIONS GALORE**

***The host system to a DATA/DAT drive sees each of up to 254 partitions as a tape. DATA/DAT proponents say this gives the format an edge over DDS drives in retrieving archived files fast.***

anywhere in a library within seconds. For instance, Exabyte's EXB-120 cartridge-handling system stores 580 Gbytes—roughly the amount stored on 3,200 reels of nine-track tape—in less than 4 $ft^2$. Any tape is delivered to any drive in an average of 16.5 s.

Along similar lines, the 4400 Automated Cartridge System Library from Storage Technology of Louisville, Colo., can store 6,000 18-track cartridges and loads them in 11 s. Total storage is 1.2 terabytes.

Honeywell's Test Instruments Division turns to video cassettes to archive terabytes of data. The Very Large Archive system can store 3 terabytes of data on 600 T-120 video cassettes—the library enclosure is about the size of an office desk. At the heart of the system is a VLDS drive that can store 5.2 Gbytes on one T-120 video cassette with a sustained data-transfer rate of 4 Mbytes/s. The drive works with a robotics assembly and a VME controller to store and retrieve 600 cassettes with access time of under 8 s.

Optical disks also lend themselves to automated libraries or jukeboxes. HP, first on the scene among computer companies to offer an optical jukebox for its products, is ramping up its optical-disk-drive operations with the purchase of patents and equipment from Optotech Inc., a Colorado Springs pioneer in optical technology. HP's Greeley, Colo., Storage Division will manage these assets. In the HP series 6300 model 20GB/A library system, an HP-designed autochanger can load any one of 32 cartridges in an average of 7 s. Total storage is 20.8 Gbytes.

The number of players offering optical jukeboxes is growing. Among the entries is Hitachi America Ltd.'s OL 112 library, which holds up to 48 disks for 30 Gbytes of storage. Cartridges load and unload in about 8 s. Aiming at work station networks in engineering and scientific areas, Epoch Systems Ltd. of Westborough, Mass., builds its Epoch-I Infinite Storage jukebox around Hitachi's drive and library.

System integrator Alphatronix Inc., Research Triangle Park, N. C., builds a 55-cartridge Inspire jukebox for Digital Equipment Corp. VAX and MicroVAX computers that stores 35.8 Gbytes. The company also offers a 25-cartridge jukebox system for Sun Microsystems Inc. work stations, IBM PCs, and Macintosh computers. With Bypass software, users can share optical-disk files across unlike file systems.

The only jukebox certified for Novell networks comes from Advanced Graphics Applications, says Stanley Marder, president of the New York City company. The 56-cartridge unit stores 38 Gbytes, with a worst-case cartridge-exchange rate of 2.5 s. Also a part of the growing optical subsystem market, AGA has shipped 5,000 units so far.

Another subystem builder, Xyxis Corp. of Eden Prarie, Minn., bases its XY600RW erasable optical system on Ricoh's optical drives. The subsystem links to IBM PC AT, PS/2, Sun, and Macintosh computers. Apart from optical's archival uses, "we were attracted by the graphics and imaging possibilities of the market," says Tom Lohse, vice president of engineering.

If big players like IBM and DEC introduce computers or work stations built around erasable optical drives, the market will change rapidly, with IBM setting the standard for optical drives, says Jay Bretzmann, senior market analyst at International Data Corp., Framingham, Mass.

But the emergence of optical drives as a primary storage medium isn't likely to diminish, and may even increase, the need for tape. "Tape is the best backup," Sony's Larsson asserts. And tape capacities in all formats are increasing to keep pace with bigger archiving tasks. Quarter-inch data cartridges are expected to store 4 Gbytes by 1993, says the tape industry's standards association, QIC. The Santa Barbara group points to an installed base of more than 3 million quarter-inch cartridge drives worldwide. Larsson predicts that longer DAT/DDS tapes will someday store 10 Gbytes.

## NEW DEVELOPMENTS

**E**rasable optical-disk drives and jukeboxes store gigabytes of data and let users recall files in seconds.

**R**esponding to DAT's challenge, 0.25-in. drives are packing away increasing amounts of data.

**I**n DAT, DDS units are hitting the market first, but DATA/DAT has random-write capability.

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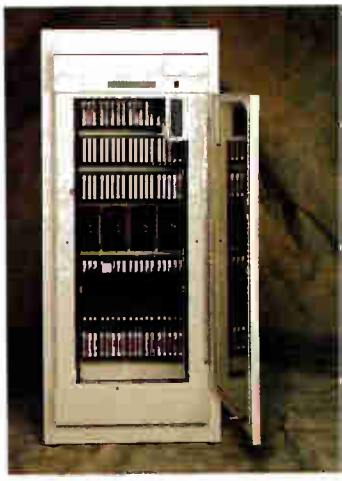

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# REAL-TIME SIMULATION SPEEDS HDTV DESIGNS

## PRINCETON ENGINE COMBINES PARALLEL PROCESSING WITH GRAPHICAL PROGRAMMING INTERFACE

BY JACK SHANDLE

VISITORS TO THE DAVID Sarnoff Research Center in Princeton, N. J., can experience firsthand the benefits that massively parallel supercomputing may bring to the lowly consumer.

Before their eyes, the many imperfections of commercial TV broadcasts are cleaned up into crisp moving images with excellent color saturation. The correction algorithms are executed continuously in real time. By moving into a split-screen mode, chief project engineer Danny Chen can display the results of two image-enhancing algorithms side by side for comparison by the human eye. This is real time—not a frame-store operation that reruns the same few seconds again and again.

Humming in a room nearby, the Princeton Engine, a massively parallel video supercomputer, executes the algorithms at a rate of 28.6 billion instructions/s. Based on a processor-per-pixel architecture and implemented in banks of proprietary gate arrays, the engine supports data rates up to 224 Mbytes/s. Its basic hardware architecture falls into the single-instruction, multiple-data category of parallel computers with configurations of up to 2,048 processors available.

But as impressive as the hardware platform is, it is more than matched by the programming environment for creating corrective video algorithms. In short, it cuts months off development time for high-definition TV systems or any other signal-processing research-and-development project that depends on digital-signal-processing algorithms.

Although it is difficult to gauge productivity gains across the board, Stan Knight, head of Sarnoff's Parallel Computing Research Group, says design time for an image-processing chip or board-level system could be cut by a factor of 10 and cost by a factor of five or more. In one recent example, three engineers who had come to Sarnoff from another company to be trained on the engine completed in 12 hours a project that would have taken weeks without real-time simulation.

HDTV

The project was an improved-definition TV system that included field-progressive scan, noise reduction, and signal proocessing for both luminance and chrominance.

Since the graphical programming environment runs on a Mentor Graphics Corp. work station, users can begin the graphical-level design of a signal-processing chip, says Knight, and later provide video simulations of the functionality of chip designs created with standard computer-aided-design software. Combined with the power of the Princeton Engine, the graphical programming environment puts Sarnoff's sponsor in the project—Thomson Consumer Electronics Inc. of Indianapolis—a big step ahead in the race for a high-quality HDTV system and the interim product, Advanced Compatible TV.

**SOMEDAY THE ENGINE WILL GO COMMERCIAL; IN THE MEANTIME, IT'S AVAILABLE ON A TIME-SHARE BASIS**

The engine's programming environment includes a library of functions such as finite-impulse-response filters, arithmetic-logic units, modulators and demodulators that matches up well with similar macrocells in leading CAD packages. Once a graphical design proves out through real-time simulations on the Princeton Engine, it can be passed to a chip designer who substitutes the corresponding macros in his CAD package.

In general, the designer will also make changes to accommodate practical concerns such as testability, says Knight. After logic simulation using the CAD package, the design can be reconverted back to the engine's graphical programming environment and simulated again to see if any video artifacts cropped up as a result of the changes. In one instance, a client saved $50,000 by using this final simulation before releasing the master tape of the chip design to the foundry.

The graphical programming environment lets engineers implement algorithms at a high level of abstraction without having to consider details such as code generation. It differs from other graphical programming environments in its ability to handle the high degree of parallelism inherent in the engine's configurations of up to 2,048 processors.

Four major components define the

environment. The Graphical Program Composer includes a robust library of processing functions keyed upon user-selected video standards, including NTSC, SECAM, PAL, and digital TV. When a particular digital-signal-processing primitive module does not exist, it can be created using the Graphical Programming Editor. Engineers use the GPE to create new algorithms by routing data between source and destination points within a pseudo processor representative of the thousand or more parallel processors that comprise the engine. The GPE generates code from the graphical representation of the system being designed. Data paths are selected by moving the cursor to icons representing a mathematical operator or register within the processor.

ONCE A SYSTEM HAS BEEN designed, it can be debugged and simulated by the Concurrent System Simulator and Debugger while still on the host computer. The CSSD is a Lisp-based object-oriented software simulation of the engine in which each processor is treated as an object. At any time during the simulation, users can examine internal registers or status.

When the time finally arrives to run the designed system on the engine, the Graphical Control Environment comes into play. It allows users to change control parameters for the algorithm. Once a simulation is complete, small changes can be made to the design using the GCE, and the code can be recompiled and resimulated.

## THE ENGINE AT A GLANCE

**M**assively parallel supercomputer executes video algorithms in real time.

**G**raphical programming environment generates code from library macros.

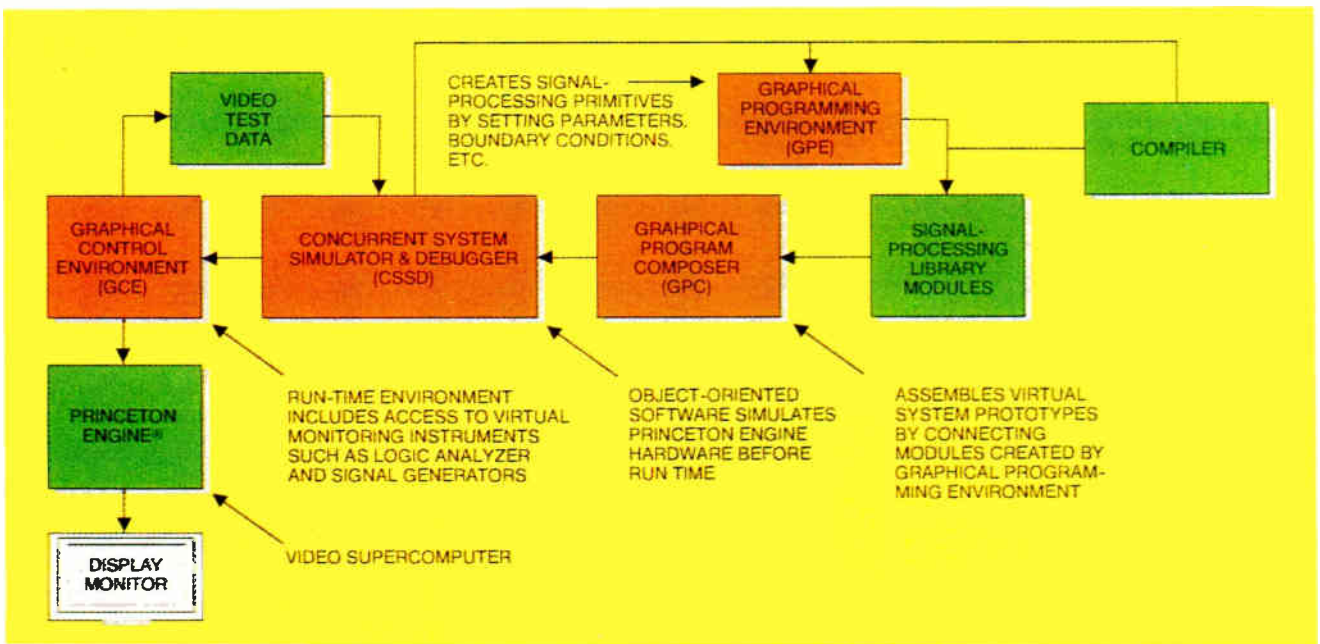
**T**raining sessions are available with financial terms determined by negotiation.

The first Princeton Engine to go into service outside Sarnoff Labs is slated for delivery in the fourth quarter to the National Institute of Standards and Technology in Washington, courtesy of the Defense Advanced Research Projects Agency. Darpa, the Pentagon's R&D arm, is funding research into high-definition imaging. It will use the Princeton Engine's real-time video-processing capability to evaluate competing high-definition video signal-processing and compression algorithms.

Darpa had previously selected two companies—Adams Russell Electronics of Waltham, Mass., and Qualcomm Inc. of San Diego, Calif.—to develop advanced compression technology for high-definition moving images. Although commercial HDTV development will eventually benefit from Darpa-funded research, the Pentagon has a more immediate goal. "There are many pressing requirements for these technologies in command and control, advanced weapons systems, and logistics," says Lt. Col. Mark Pullen, deputy director of Darpa's Information Science and Technology Office.

Ultimately, Sarnoff wants to turn the Princeton Engine into a commercial product, says Curtis Carlson, director of Sarnoff's Information Systems Research Laboratory. In the meantime, it's making the computer available on a time-share basis. Since the major financial backing came from Thomson, access to the engine will be denied to competing consumer electronics companies, says Carlson. But companies developing nonconsumer signal-processing products such as radar, sonar, image processing, and supercomputer visualization can contract with the lab for run time.

"Users get roughly one week of training," says Knight, "and it is best to have a familiarity with a Mentor work station. At the end of the week, they know how to program, but not necessarily how to map their problem on the work station. We'll help with that until they get a feel for how to visualize their problem." E




**FAST PROTOTYPING**

*The Princeton Engine's graphical interface cuts design time by a factor of 10. Systems are defined graphically and converted to run-time code automatically.*

# TOMORROW'S TESTER IS HERE TODAY

## MEGATEST'S POLARIS HITS 100 MHz WITH TESTER-PER-PIN ARCHITECTURE

BY SAMUEL WEBER

KEEPING UP WITH THE rapid strides in semiconductor technology, much less trying to keep ahead, is a major challenge for vendors of automatic test equipment. Each advance in chip performance and complexity puts new strains on ATE gear. But bringing a new tester to market is a two-year, multimillion-dollar effort, so vendors must introduce new products with exquisite timing, keeping an eye on both the needs of today's market and what will be required years down the road.

A case in point is the Polaris 100, a new high-performance VLSI logic tester just introduced by Megatest Corp. of San Jose, Calif. This machine represents the company's recognition of the advent of the "superchip"—devices with operating frequencies of 80 MHz or more and with hundreds of package pins, says Craig Foster, vice president of marketing. "We were seeing more and more of our customers stretching the last-generation machines to the limit," he says, to accommodate the new breed of reduced-instruction-set-computing devices, high-performance complex-instruction-set chips, and application-specific circuits.

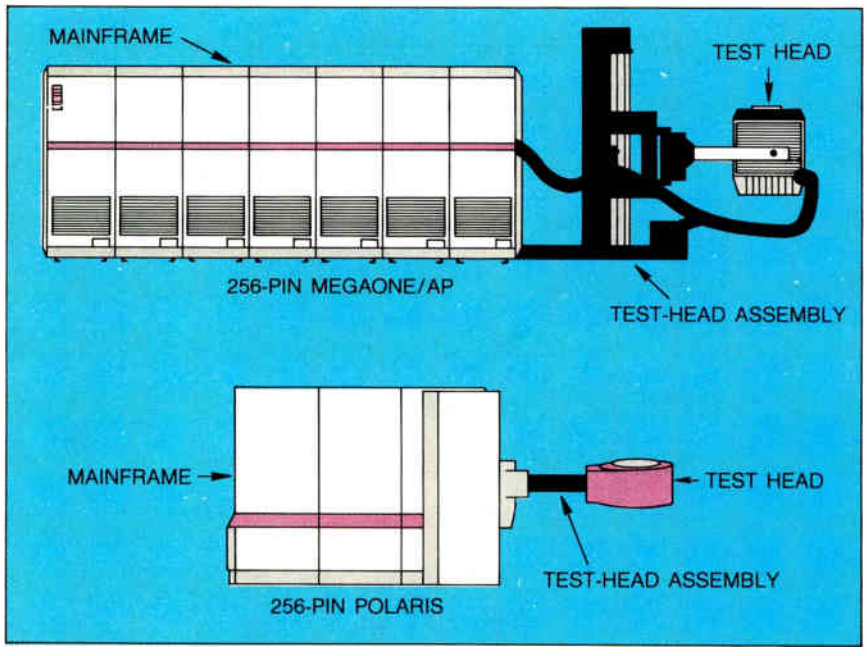
The Polaris is aimed squarely at these leading-edge devices. It's capable of operating at 100 MHz, has an 8-million-vector memory, and handles up to 384 pins, and it can be expanded to accommodate future semiconductor developments. It is the first tester that TEST offers both performance at this level and tester-per-pin architecture, a concept Megatest pioneered with its MegaOne, introduced in 1985.

A tester-per-pin architecture is one that applies an independent timing generator on each pin. This permits a unique test function simultaneously on each pin of the device under test, giving the test engineer a high degree of flexibility. By contrast, on a shared-resource machine, pins are subjected to the same test in groups, which often results in compromising the quality of the test, Foster says.

Up to now, Japanese firms such as Ando and Advantest have dominated the high-performance end of the ATE market with shared-resource testers. "They lead in terms of pin count and high speed," says Foster, "but they have chosen to do it with the shared-resource approach. Given a choice between high-performance testers with shared-resource and tester-per-pin, we are confident users will prefer the latter."

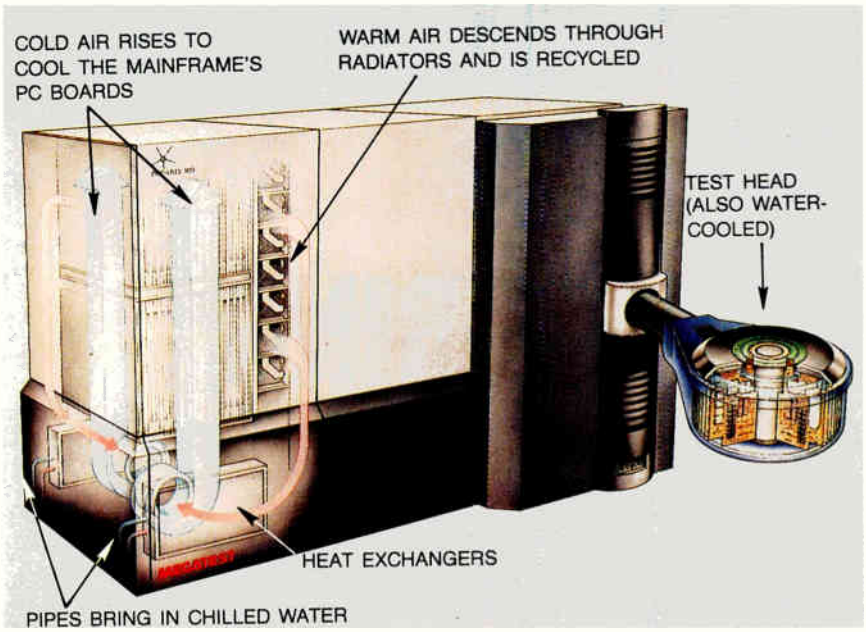
Megatest developed Polaris in partnership with a customer that the company will describe only as a very large U. S. captive semiconductor producer. "This represents such a large investment for us that we had to make sure it was very well targeted," Foster says. "Our partner helped us with the design and funded some of the R&D." The customer will take delivery of the first machine, which is already in production, and has ordered more, he adds.

Polaris may be well positioned to




**SMALLER FOOTPRINT**

*Polaris is half the size of its predecessor, the MegaOne/AP. Since test-floor footage is expensive, this lowers a factory's facility cost.*




**A NOVEL COOLING SYSTEM**

***A chilled-water setup drops internal temperature 20°C; heat exchangers extract warm air from the mainframe and cooling rings chill the test head.***

take a healthy share of the approximately $200 million high-end tester market, says Carolyn Rogers, a technology analyst at Hambrecht and Quist Inc. in San Francisco. Most U. S. competitors don't have the resources to develop next-generation tester-per-pin equipment, she says, and the Japanese have ignored this arena. "Their testers have raw strength and high speed, but people are looking for more flexible systems for use with complex logic." Rogers says Schlumberger Technologies is the only other competitor that could give Megatest a run for its money. The San Jose company is known to be working on a machine of this type, though no product announcement has yet been made.

POLARIS'S 8-MILLION-VECtor memory is an eightfold improvement over previous-generation machines and can be expanded to 32 million vectors. The depth of the vector memory affects the size of the truth table the machine can execute.

The tester runs off Sun Microsystems Inc. 3/60 and SPARCstation work stations with a graphical user interface and complete off-line software-development ability. Polaris overcomes the timing restrictions of previous testers by allowing edge placement over four cycles (as opposed a typical 1.5 in earlier machines) with ±150-ps edge accuracy. This means simulator outputs can be directly applied to the tester.

In addition to the enhanced electronics, Megatest engineers have taken unique approaches to the physical and mechanical aspects of Polaris's design. For starters, the unit is half the size of its predecessor. "The smaller footprint has lots of advantages," Foster says. "The footprint directly affects the facility cost when these machines are installed in a factory, particularly here in Silicon Valley where footage on the test floor is very expensive. The small footprint also yields advantages in performance when you're dealing with these frequencies and accuracy specifications."

The greatly reduced footprint forced the Megatest designers to take a radical departure from conventional cooling to overcome the inherently higher power dissipation and improve reliability and lifetime. The approach entailed an unusual hybrid system of air and water cooling. For the mainframe, chilled water is circulated through two heat exchangers in the base, then blown between the printed-circuit boards. The boards are covered by fiberglass impingement plates through which the air flows to uniformly cool the component to 20°C below ambient. The warm air is then recirculated back through the radiators so that no ambient air is exhausted into the test facility. Thus Polaris can be installed in a clean room without disturbing it.

A DIFFERENT TECHNIQUE is used to cool the test head, where most of the dissipated power is from the gate arrays that control the logic and the hybrid-circuit analog receivers and drivers. Heat pipes attached to the heat sinks on these components connect into doughnut-shaped cold walls that surround the test head and circulate cold water. Heat from the component is drawn out by the heat sink and efficiently carried through the heat pipe to the cold wall in the form of water vapor. The vapor condenses and returns as cooled water through capillaries in the heat pipe.

A typical configuration of Polaris at 128 pins is priced at $1.4 million. It is available with configurations ranging from 32 to 384 pins upgradable in 16-pin increments. Even higher pin counts are contemplated. The system can support up to three test heads for simultaneous testing by three engineers.

Although there is a slowdown in the semiconductor industry right now, Megatest management is confident that Polaris is hitting the window at an opportune time. According to Foster, customers are looking at this machine for the next generation of devices, which are important to their future growth.

"They're not slowing the development of these devices despite the slackening of volume in the market right now," he says. "We believe our timing is right to get our foot in the door when these new products will turn into future business."

The company already has $17 million worth of backlog orders for Polaris. It promises delivery within six months.

## TESTING SUPERCHIPS

**R**unning at 100 MHz, Polaris has an 8-million-vector memory and handles 384 pins in a tester-per-pin architecture.

**I**t's packaged in half the footprint of its predecessor, which yields cost and performance advantages.

**A**nalysts say it may nab a good chunk of the $200 million high-end tester market.

# MELDING DESIGN AND MANUFACTURING

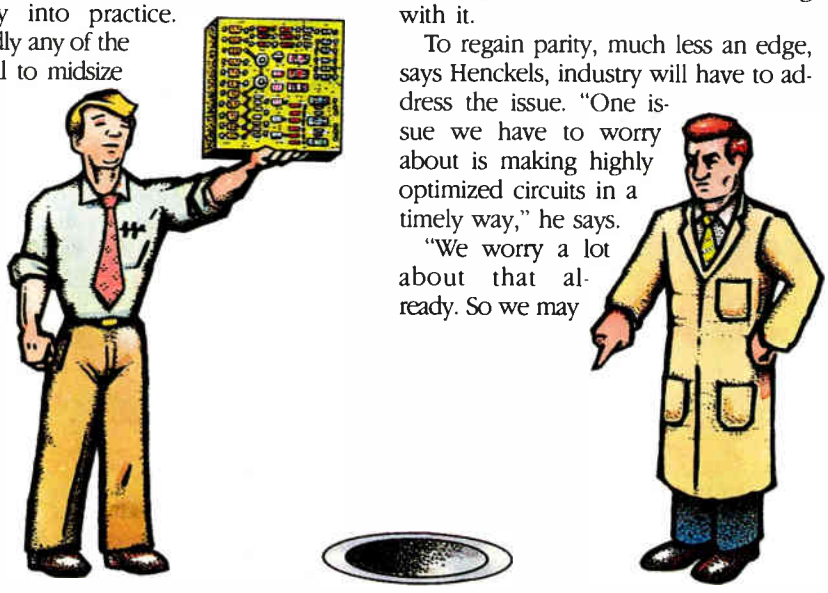
## THE IDEA HAS BEEN KICKING AROUND FOR A WHILE; IS ANYBODY OUT THERE LISTENING?

BY SUSAN LEVI WALLACH

EVERY YEAR OR SO, A NEW Great White Hope springs upon the manufacturing scene. A few years ago, the hot topic was flexible manufacturing.

Now it is design for manufacturability, a concept that marries new-product specification to the capabilities of a company's manufacturing arm. The goal is to ensure more efficient production and faster time to market along with more reliable and more cost-effective products.

As a concept, design for manufacturability isn't new, though given its spotty implementation, it may seem to be [*Electronics*, January 1990, p. 111]. Despite what industry analysts proclaim as its sound logic, only a few major U. S. manufacturers—Apple, Ford, General Motors, IBM, and Xerox, for example—have put design for manufacturability into practice. Hardly any of the small to midsize companies have joined them.



In fact, say analysts, the only real problem with design for manufacturability is that it is just not being pushed enough by Americans—certainly not with the fervor of the Japanese, for whom the concept has become standard operating procedure.

MANUFACTURING

In the U. S., optimizing a design means to tweak it for speed or power, not for ease of manufacture. "We always talk about the magic wall," says Lutz Henckels, president of U. S. operations for Racal-Redac Inc. in Mahwah, N. J. "In the U. S., we are extremely creative regarding functionality and optimization. But we don't worry about how a design is going to be manufactured. When a design is done, we just throw it over the wall." And toss away chances for a competitive advantage in the world market along with it.

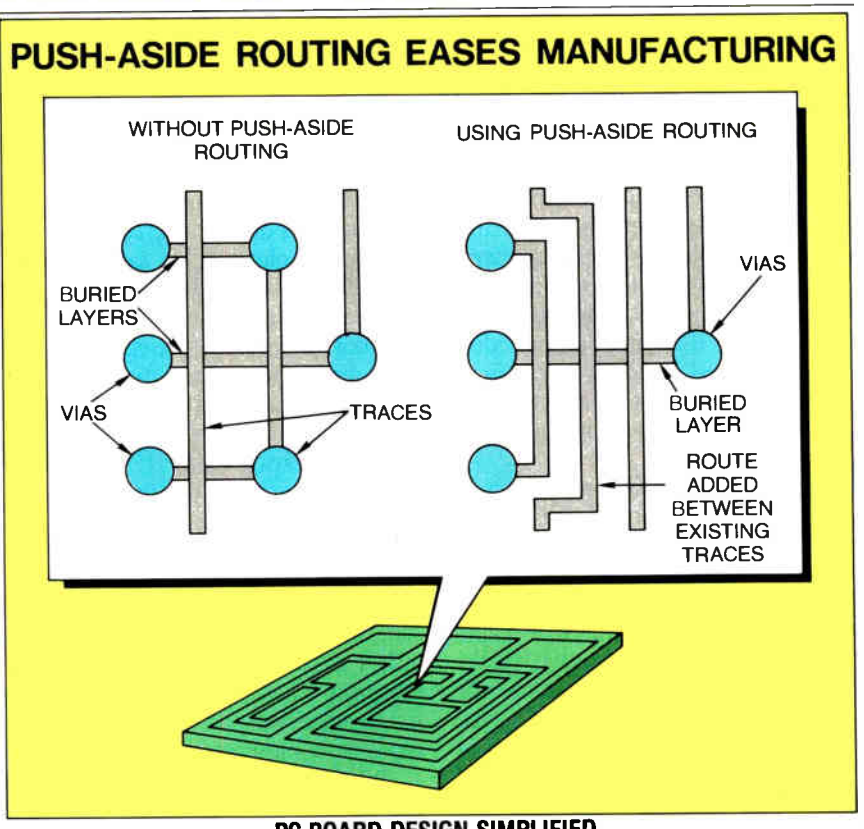
To regain parity, much less an edge, says Henckels, industry will have to address the issue. "One issue we have to worry about is making highly optimized circuits in a timely way," he says.

"We worry a lot about that already. So we may have created the densest, fastest circuits, but we bloody hell don't try to make one. We have to optimize the circuits for manufacturability as well."

Which is where design for manufacturability comes in. Design for manufacturability is a close cousin to concurrent, or simultaneous, engineering, in which the product, its process, maintenance, and life cycle are designed at the same time, as opposed to going about it piecemeal. "What you have to do is match up the product requirement with an understanding of manufacturing capabilities," says Mark Brown, program manager at The Industrial Technology Institute in Ann Arbor, Mich. "Those manufacturing capabilities typically consist of process capabilities, system capabilities, scheduling capabilities, inspection capabilities, and so on," Brown says. "So you are trying to balance the product and the realities of what it is going to take to make that product."

In addition, says Winston Chen, president of Solectron Corp. in San Jose, Calif., the product should be designed with an eye toward testability. "If you don't design enough test points on a [printed-circuit] board, then you don't know whether the board is good or bad until you go to final assembly," he says. "The designer has to think about how in the manufacturing process the board is going to be tested."

And, adds Richard Germuska, program director at Booz, Allen, Hamilton in Cleveland, it means taking into consideration the total supply chain, standardizing design elements, and streamlining resources wherever possible. "For example, using a lot of different materi-




*In Racal-Redac's Visula layout software, a push-aside algorithm moves existing board traces so that another route can be completed.*

als often just adds cost without adding value," says Germuska. "I worked with an automotive company that used 27 different plastic materials and color variations to make basically the same sort of part. We got them down to four. That eliminated a lot of the setups and changeovers we had to do."

Engineers must attempt a number of things when designing a product, Germuska says. "Use the same materials, go to the same suppliers, use the same fasteners. If you don't think about the total supply chain, you may choose a new fastener because it is perfect for this design. It may give you some incremental benefit." But, he says, "when you look at the total system, it may cost you more to get that benefit than it is worth."

The overriding goals of implementing design for manufacturability are higher yields at lower cost, because the product is designed to suit the process, rather than the other way around. For the same reason, products get to market faster. Though there are many ways to approach implementation, most strategies have two elements in common—organized information flow and a data base.

A VISION HAS TO FLOW from the top—you can't establish this concept without the very highest levels of authority being involved," says Robert George, an analyst in the computer-integrated-manufacturing group at market researcher Dataquest Inc. in San Jose. "And the practical information has to flow from the bottom up. The guy on the shop floor has to have as equal a say as possible vis-à-vis the design engineer who is doing the conceptual work."

Many of the constraints that design for manufacturability seems to impose on the designer are not real constraints, says Henckels. "These are more things that design engineers have no awareness of. It's a matter of the information not existing before," he says. "By incorporating the information into a data base, suddenly it exists."

Much of the shop floor's input is contained in the data base, which, says George, ideally is object-oriented. In an object-oriented data base, entities have qualities that in a design-for-manufacturability application can be inherited by or transferred to either subassemblies or final assemblies. Thus any constraint that pertained to the subassemblies would also pertain to the final assembly and vice versa.

Adds Henckels, "Many of these issues as they relate to manufacturability are issues of detail, because there are many details that manufacturing has to concern itself with."

If God is in the details, then a number of companies heavily involved in pc-board manufacture are starting to get religion where design for manufacturability is concemed. At Unisys Corp. in San Jose, where pc boards are designed and manufactured in-house, Al Conte, the company's advanced manufacturing systems manager, introduced design for manufacturability two years ago.

"In terms of simplifying the process, we're putting restrictions on the design people upstairs," Conte says. "For example, we've developed a way that allows us to reflow adequately with small quantities of through-hole parts without doing another setup to run through our wave-solder machine. I might ask them to change some of the artwork so I could reflow through-hole parts, instead of wave-soldering and then coming back and reflowing the surface-mount parts. This way, we don't have to run multiple processes on a board."

The result, says Conte, is that one of the company's product lines has 15% more margin, thanks to simplification of existing designs. "By spending some money and changing the designs, we got rid of five or six process steps. That equaled a day and a half of cycle time," he says. "Nobody has a leg up in terms of performance of one product over another. The big issue now is who can deliver the product fastest at the lowest price."

At Solectron, a manufacturing subcontractor for pc boards, Chen says the key issues in design for manufacturability are pad size, geometry, and suppliers. To ensure that pad size and geometry are optimal, customers are given a detailed set of design guidelines within which to work.

"We have a formal document," says Chen. "That has all the details—the recommended pad size, relationships between via holes and the pad, orientation of the components. From the design standpoint, the issue is you can spend the same amount of money on design but come up with something that will cost a lot less in manufacture. If the solder-pad size isn't right, for

example, you have surface-tension problems and our yield in the process can go from 95% down to 70%."

To ensure that components are of high quality, Solectron maintains a data base listing the failure rates and manufacturing problems of components from different suppliers along with their costs. Whereas large customers such as Apple, IBM, and Sun provide a list of preferred vendors, says Chen, Solectron often refers to its own data base to recommend suppliers to its smaller customers.

Despite impressive improvements in productivity, design for manufacturability has caught on slowly in the U. S. outside a handful of major companies. What seems to be holding it back is, ironically, one of the things that makes it so attractive in the first place. Implementation of design for manufacturability depends far more on changing the way people look at the relationship of design and manufacture than on capital investment.

IT'S A MATTER OF CHANGing the way design and manufacture are done, not a matter of changing equipment, says George. "It is probably one of the cheapest things you can do to increase your productivity, because it is so human-intensive," he says. "It's a way of thinking about the problem more than anything else. What design for manufacturability does is say, 'What have I got down on the shop floor, what are the capabilities of this stuff, what do people want out in the marketplace, and how can I provide what they want given the resources I have?' "

In this sense, it is the antithesis of flexible manufacturing. Says Germuska, "Design for manufacturing addresses the inherent cost of the product and reduces that. When you put in a flexible manufacturing system, you're trying to make up for those inherent complexities, which you probably don't need, by adding cost to the total manufacturing system. What you want to do is eliminate the requirements for the flexible manufacturing system."

In his view, U. S. companies "use technology as a crutch to cover up a problem, instead of identifying the problem's root cause and eliminating it." However, getting people to revamp long-used practices is difficult. "Typically, in a business like this, the design-function people are graded by the cost of their design," says Conte, "not by manufacturing cost. So when they are working toward their reviews, they aren't focusing on the cost of manufacturing, unless it's outrageous. They're thinking, 'If I do this, my cost is less.' "

Conte's solution, he says, was to "educate the managers that manufacturing has to live with this thing day in and day out. It could cost us $10 or $15 more per board because you didn't spend an extra day on designing some trace links a little differently, and that's a recurring cost."

George says that the university programs aren't teaching design for manufacturability outright but at least they are graduating students who accept it as a standard practice. Still, it is back to the university that Germuska traces the concept's slow progress.

"We tend to teach engineers to think of the high-tech revolutionary solutions, instead of looking at all the evolutionary change that can be done incrementally," he says. "So they come up with a whole new manufacturing system for this product while we are still making the old one."

The solution at Unisys is to bring the design engineers onto the shop floor for a week. "They may not particularly like being there," Conte says, "but they all come away with an awareness that some of their designs aren't very good for manufacturing."

**U. S. COMPANIES ARE NOT PUSHING THE CONCEPT WITH THE FERVOR OF THE JAPANESE, FOR WHOM IT HAS BECOME STANDARD OPERATING PROCEDURE**

At Racal-Redac, an intelligent tool set automates the manufacturability of the design. The Visula tools for pc-board layout bring design for manufacturability within the province of computer-aided design through use of a relational data base; the tool set can take into account 256 relations per object, including design rules that are critical to manufacturing.

In essence, says Henckels, "You want to take these concerns away from the designer as much as possible. The electronics engineer does not want to concern himself with this issue. To say that I'm going to totally change his way of thinking is unlikely. So the tool has to think about these issues for him." With the tool, "I can optimize the circuit automatically and I can automatically generate the test without having to worry about ruining that optimization," he says.

"We can specify relationships that then are captured by the algorithms and as the algorithms come to that object it recognizes that. By knowing the relationships in the data base as they relate to manufacturing, we automatically take care of all that, so the user doesn't have to concern himself," he says.

Whichever approach to design for manufacturability a company takes, says Chen, the critical issue is that it be implemented—but not in a vacuum. It has to be part of a whole strategy aimed at building muscle in world markets. To Chen, this strategy must address four other issues as well.

After design for manufacturability, he says, the first issue is "how do we improve the quality by using statistical process control and quality control. Without that, design for manufacturability alone won't do it. You can't compete with the Japanese."

The second issue is managing the logistics by implementing just-in-time and continuous-flow manufacturing. "Reducing the cycle time is the secret—you can have lower inventory and lower work-in-process," Chen says.

The third issue is automation, preferably in its total form—computer-integrated manufacturing so that information can be processed quickly. Finally comes what Chen calls proactive procurement, in which "you have the buyers work with the design and manufacturing people, so when they select components they have the right lead time, the right quality, the right pricing.

That happens way ahead, before problems occur. We have to implement all these factors to gain world-class manufacturing competitiveness again." E

# AMD UPS THE ANTE IN THE PLD WAR

## A NEW CMOS FAMILY AIMS TO HEAD OFF THE COMPETITION IN SPEED AND DENSITY

BY BERNARD C. COLE

IN THE FACE OF INCREASing competition on all sides in programmable logic, Advanced Micro Devices Inc. has charged into the new year with an aggressive campaign to regain lost ground.

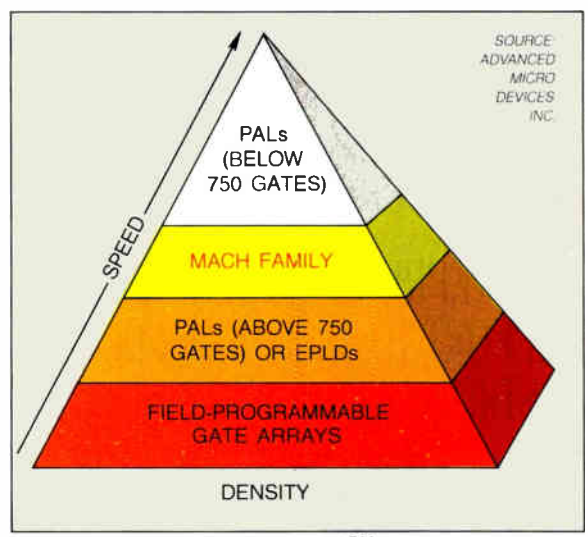
Long dominant in the PLD marketplace, the Sunnyvale, Calif., company by its own admission recently got caught with its assumptions down: about market size, which is expected to grow from $600 million this year to almost $1.5 billion by 1993; about the popularity of CMOS, which is expected to beat out bipolar by 1991; and about the number of players, of which there are now at least two dozen.

Although still ahead in bipolar PLDs with about 60% market share, the firm lags in CMOS. To catch up, AMD a year ago shifted to a new 0.8-μm double-metal CMOS process and invested $10 million in new fab capacity. It is targeting key device types that Andy Robin, its PLD marketing director, estimates make up half the industry's CMOS PLD shipments. From a No. 9 spot three years ago, AMD now ranks No. 4 in volume shipments, he says, "and 1990 will be the year we move ahead."

Amid a barrage of 1990 product announcements is AMD's most direct challenge yet. This month the company will unveil a competitor to Altera Corp.'s high-density MAX series of erasable PLDs. Designated the MACH family, the electrically erasable devices will range from 900 to 3,600 gates and boast 15-ns propagation delays. AMD will offer two versions, Robin says: three medium-density MACH 1 devices for input/output-intensive applications and three high-density MACH 2 parts targeted for address logic.

PLDs

The MACH 1 series inlcudes the 110, with 32 macrocells and 44 pins; the 120, with 48 macrocells and 68 pins; and the 130, with 64 macrocells and 84 pins. The MACH 2 family will offer double the number of macrocells with the same number of pins.



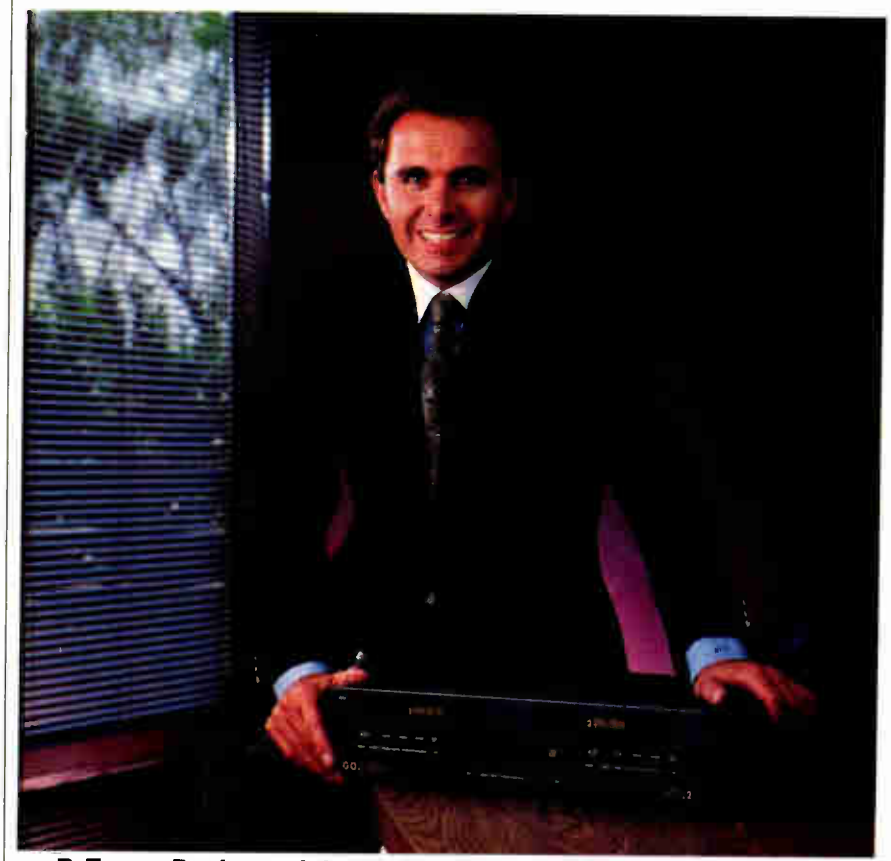

**MAKING A NICHE**

*In both speed and density, the MACH family fills a gap at the middle of the PLD hierarchy.*

Like other EPLDs, the chips consist of multiple programmable-array logic blocks connected by a high-speed switch matrix. "The significant architectural innovations are inside the blocks and the switch-matrix structure," Robin says. For example, the PAL blocks are half the size of those in competitive devices. Also, the matrix is optimized for speed and predictable gate delays, and the macrocells are uncoupled from both the product-term array and the I/O pins to insure maximum silicon efficiency. Finally, where the Altera parts are UV erasable, the MACH devices are erased electrically, so they are easier to program and also to test.

AMD is not the only company announcing new PLDs. Altera, based in Santa Clara, Calif., has completed filling in the MAX family's midrange, pushing propagation delays down to 15 ns. Now it's working on a 6,000-gate addition. Xilinx Inc. of San Jose, Calif., is about to introduce a SRAM-based family of 20,000-gate field-programmable gate arrays. And there's a new kid on the block: Texas Instruments Inc., which has just announced volume production on its antifuse-based ACT-1 one-time programmable gate arrays, which it is producing with Actel Corp. of Santa Clara.

"The pressure is still on," says Al Graff, PLD marketing manager at Cypress Semiconductor Corp. in San Jose, which is second-sourcing Altera's MAX family and pushing the speed limit on its own high-performance, application-specific CY7C300-series PLDs to 125 MHz. "The marketplace is moving very fast, and AMD is going to be hard pressed to gain even a fraction of the market share it enjoys in the declining bipolar segment."



R. Terren Dunlap and the world's first commercial dual-deck VCR.

DUNLAP OF GO-VIDEO

## THE LAWYER-TURNED-ENTREPRENEUR HAS WON SOME BATTLES IN HIS EFFORT TO SELL DOUBLE-DECK VCR DESPITE STRONG OPPOSITION

# CAN DUNLAP WIN HIS WAR?

BY WESLEY R. IVERSEN

YOU SAY IT'S TOO LATE for an American startup to gain a foothold in the $5 billion U.S. market for consumer video cassette recorders? Don't tell that to R. Terren Dunlap, the controversial, Japan-bashing chairman at tiny Go-Video Inc. in Scottsdale, Ariz. "The fact is that we don't have to sit back, as American companies, and be kicked around any more by the Japanese," Dunlap declares.

Go-Video's war is far from over. But during the past five years, Dunlap, 45, and his publicly held firm have gained increasing notoriety for successfully battling against heavyweight Japanese and Korean consumer industry interests, as well as facing off against the powerful U.S. motion picture industry. The issue: Go-Video's plans to market a dual-deck VCR.

If all goes as expected, Go-Video's VCR-2 machine will finally hit store shelves before midyear priced at $995. It will be the first double-deck VCR ever offered to U.S. consumers. But for Dunlap and company, getting this far has been anything but easy.

Dunlap got the idea for such a machine in 1984, after he and a partner founded Go-Video to provide mobile video-production van services. As the pair struggled to edit and copy tapes by awkwardly cabling two single-deck VCRs together, the need quickly became obvious.

By September 1984, Go-Video had filed for a basic patent on a dual-deck VCR system, which has since been granted, Dunlap says. But in 1985, when the company began looking for someone to manufacture the machine, the trouble started.

Go-Video couldn't find an American company to do the job. "We've got a lot of spineless manufacturers here in the U.S., who have let the Japanese run over us," Dunlap says.

And when he turned to traditional foreign manufacturing sources of consumer electronics, he ran into a brick wall. Essentially, Dunlap claims that top Japanese consumer companies that control the VCR market conspired not to make the double-deck unit, and not to sell key components that would allow others to do so.

Dunlap—whose background includes a law degree and experience as a trial attorney—knew what to do. He hired a top antitrust lawyer and slapped a multibillion-dollar, treble-damages lawsuit on 28 defendants, including top Japanese and Korean VCR makers and the Motion Picture Association of America. The suit claimed an illegal conspiracy to block Go-Video from marketing a dual-deck VCR.

Go-Video has since settled its differences with the MPAA by agreeing to build an anticopy chip into its VCR-2 that will prevent illegal reproduction of specially encoded prerecorded movies and other copyrighted tapes. Most of the other defendants have also entered

monetary or other settlements, producing almost $2 million in settlement fees for Go-Video to date, Dunlap says.

What's more, as part of its settlement in early 1989, Korea's Samsung Electronics Co. Ltd. agreed to a manufacturing deal to build the VCR-2 for Go-Video. Samsung will supply 30,000 units during the first six months, with initial deliveries expected in late March. And Go-Video will purchase an additional minimum of 5,000 units per month for the following year.

Go-Video signed up a distributor last May in D&H Distributing Co., Savage, Md., which has committed to take the first 30,000 units. Demand for the machine is strong, reports James G. Schwab, D&H director of sales. "The real problem is, we have people who want far more than we can begin to supply," Schwab says.

The VCR-2 is essentially two VHS-format VCRs in one 20.25-by-4.25-by-16.5-in. cabinet, controlled by an Intel Corp. microprocessor and equipped with proprietary Go-Video software for easy operation. Video camcorder users can employ the two-headed unit for tape-to-tape editing, while video nuts can record two TV programs at once, or record one program while watching another from a tape.

THE CENTER OF THE storm surrounding the VCR-2 is the machine's ability to make high-quality copies of unprotected prerecorded tapes. Dual-deck machines have long been opposed by the MPAA, which views the primary use to be what it calls "illegal copying of American motion pictures."

MPAA opposition has been enough to keep the Japanese out of the dual-deck market, industry watchers say. Sharp Corp. marketed a double-deck machine briefly in 1985 in Saudi Arabia, and Samsung showed a prototype in the U. S. in 1986 that was never brought to market. Other big consumer vendors have likewise been scared off by the MPAA, says David Lachenbruch, editorial director at *TV Digest*, a New York industry newsletter.

For its part, the MPAA is resigned to the VCR-2. "We perceived its primary use being to make copies of prerecorded video cassettes, and we still do," says an MPAA spokesperson. But when Go-Video agreed to the anticopy chip, "we dropped our opposition."

Using an easy, one-touch-of-a-button format, the VCR-2 will produce high-quality copies for up to five generations. Current techniques using two cabled single-deck units typically lose quality in the first copy, Dunlap says.

For the stockholders of Go-Video, it's been a wild ride. Since going public in July 1986, Go-Video's NASDAQ stock price has gyrated, from a low of 62.5 cents to a high of $24.13. Along the way, Dunlap has blamed some of the volatility on rumors spread by short sellers looking to profit from the stock's decline, and he's also had to fight off a dissident stockholder group looking to take over the company.

"He [Dunlap] has really made a lot of progress against insurmountable odds," says Douglas Pritchard, a vice president who trades in Go-Video stock at Minneapolis brokerage firm Craig-Hallum Inc. "I think with the big

short position in the stock a year or so ago, that people were betting he wouldn't be able to find a manufacturer, that with the Japanese as the adversaries, that there wasn't much of a chance." But on that issue and others, Dunlap has so far proved the nay-sayers wrong, Pritchard notes.

But while Dunlap seems to be doing a lot of things right, some snipe at the VCR-2's high retail price tag in a market where single-deck machines typically sell for $200. "There's no question in my mind that at $1,000, he will instantly sell out the 30,000 units he's going to get initially," says Bob Gerson, editor of *Twice*, a New York industry newspaper.

The first wave of sales will come from pent-up demand at commercial users such as ad agencies, schools, and others, Gerson predicts. But many believe the price will have to drop if the product is to catch on among consumers. And if the VCR-2 does succeed, some expect a Japanese assault on the consumer dual-deck market, leading to quickly falling prices and competition that Go-Video could find tough to meet. As Gerson puts it, "Should this product take off, you've got to believe that the Japanese are going to say, 'Screw it, let's do it. Why are we leaving this to him? What has he ever done for us besides sue us?' "

For Go-Video's part, Dunlap claims that anyone entering the business will have to pay it royalties. "We have a very sound, broad patent, and we will defend it and prosecute any infringers very vigorously," he says.

In the meantime, Dunlap is aggressively pressing the attack in Go-Video's antitrust conspiracy case against the remaining six Japanese defendants. It's a group that Dunlap refers to as "the ringleaders." And in late January, Go-Video slapped a second, much more sweeping antitrust and trademark-violations lawsuit on the group and two of its U. S. subsidiaries.

Named in the latest suit filed in federal court in Phoenix are JVC, Matsushita and its Panasonic division, NEC, Sanyo, Sharp, and Sony.

THE SUIT REPEATS THE EARlier charges of a dual-deck conspiracy and claims further that the defendants have engaged in a worldwide conspiracy and cartel to monopolize consumer electronics products in general, including single-deck VCRs, digital-audio-tape equipment, and high-definition TV.

Shortly after the filing, a Matsushita spokesman in Secaucus, N. J., said the company was withholding comment until it had time to study the case. "But obviously, we don't think we're liable for anything," the spokesman said.

Go-Video claimed a landmark victory in the initial case last September when the Ninth Circuit U. S. District Court ruled that it could properly sue the Japanese in a U. S. court.

"As far as I know, we're the only company that has ever taken depositions of these top executives in Japan, in their home territory, and have the right to bring it back here into the U. S. and use that as evidence in a U. S. federal district court," Dunlap says. "We are changing history," Dunlap declares. "We're not going to stand for it anymore." E

ORBIT SEMICONDUCTOR

## CHIP FOUNDRY FINDS WELCOME AT COMPANIES WITH PROPRIETARY PROCESSES—AND THERE'S A MONEY-BACK GUARANTEE ON DELIVERY

# SPEED AND ACCURACY KEY ORBIT'S SUCCESS

BY HOWARD WOLFF

WHAT HAS NO PRODUCTS, total 1989 revenues of $24 million, and offers a 30% discount if it delivers late? The answer: Orbit Semiconductor Inc., a Sunnyvale, Calif., chip-fabrication foundry that just might be the only productless semiconductor manufacturer around.

The outfit has made something of a specialty of serving a generally ignored sector: small to medium-size companies that need reliable processes fast. The result of Orbit's emphasis on accuracy and speedy service is that it has seen revenue grow 30% a year since it turned profitable in 1986.

But while appealing to that sector, Orbit has become the answer to the needs of companies on both ends of the size spectrum. These range from startups like Dallas Semiconductor to aerospace giants like Hughes and Rockwell. It has also carved out something of a profitable niche for itself in high-reliability chips for the medical and military markets; a total of 25% of its volume is in devices for medical applications such as pacemakers, and another 19% is in high-reliability manufacturing for military and aerospace use.

To the man who runs the company, acceptance on two such seemingly disparate levels is easy to understand. "That's probably because we deliver on time and are 90% accurate," says president Gary P. Kennedy, a veteran of 20 years in the business with the likes of Raytheon, Signetics, and Synertek. "What we are really selling is manufacturing capability."

That includes an array of CMOS silicon-gate chip-making processes that can handle design features ranging from 4.0 and 5.0 μm to 1.2 μm as well as n-MOS and H-MOS in 2.0, 3.0, 4.0, and 5.0 μm. "We guaranteed five-day delivery in the old n-channel days." Now, with more complex processes, the guaranteed turnaround is 15 to 20 days. But perhaps the single most valuable service that this foundry offers is its custom process development.

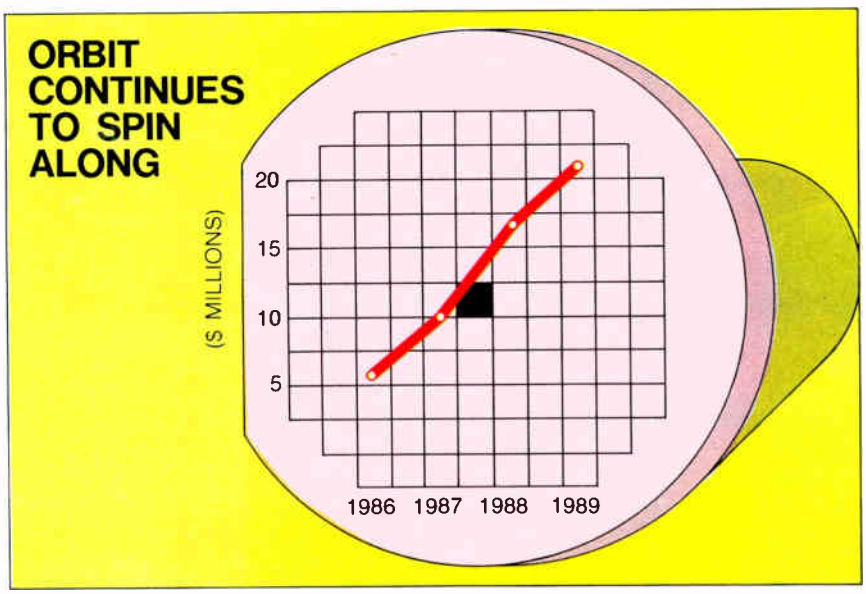
"With startups, this means that they don't have to give away their proprietary technologies to a potential competitor. We work with them to see if the process happens, then Orbit can function as a noncompetitive second source," says Kennedy. And the company also provides computer-aided design.

An equally powerful argument, says Kennedy, is that by working with Orbit a startup can find out quickly and economically if a circuit works for a quarter of the cost of doing the job itself. "If it doesn't work, they're out $15,000 or so rather than $50,000 or $60,000," he says. A case in point is Dallas Semiconductor Corp. "We did all their prototypes until they bought their own fab area," says Kennedy. On the other end of the size range, a half dozen divisions of Hughes Aircraft Co. use Orbit and account for 19% of its business.

WHY WOULD A COMPANY the size of Hughes, which is not only a producer of sophisticated systems for the military but a high-volume chip maker in its own right, go to Orbit? "We have a good technical interface," replies Kennedy, "and it's cheaper for them than using their own fab lines. If they do the job themselves internally, it takes four times longer to process a run than it does at Orbit. And they can develop processes with our equipment rather than tying up their lines and labs."

Orbit also offers a service it calls Foresight multiproject wafer processing, which is another way for companies trying new processes or technologies to see the results of their work quickly. The company was involved for several years in the government's Mosis chip-fabrication project, and Foresight is an outgrowth of that experience. It can significantly reduce engineering costs by running numerous projects on a single wafer according to a monthly project-start schedule.

Orbit has been on a fast-service track since it opened its doors. Actually a division of Orbit Instruments, it was purchased, along with the instruments company, from Comdial Semiconductor 10 years ago. "Our first customer was Atari," recalls Kennedy. "They got their data base to us and 10 days later we delivered packaged products." E



NELSON OF FLUENT MACHINES

## COFOUNDER OF PRIME AND APOLLO EYES INTEGRATED VIDEO, SOUND

# NELSON WORKS ON MULTIMEDIA

BY LAWRENCE CURRAN

THIS FOUNDER needs little introduction to close followers of the computer industry: David L. Nelson, cofounder of both Prime Computer Inc. and Apollo Computer Inc. But make note of the new company's name: Fluent Machines Inc. of Framingham, Mass. It just might become a household word in the multimedia business of the coming decade.

**Not just another systems company, says Nelson.**

Nelson founded Fluent in his home, has personally bankrolled the company until venture capital comes in, and serves as president and chief executive officer. He says commitments from venture backers are imminent, as is Fluent's first product introduction, which may come as early as next month.

Until that time, he isn't discussing product details but is willing to say that Fluent will become "a supplier of enabling technology for full-motion video and sound to the computer industry." Nelson aims to make that technology as easy to integrate with networked personal computers and work stations as spreadsheets are today.

The other product clues he offers are that Fluent's technology will be delivered on a standard type of work station—probably using an Intel 80X86 or i860 processor. In addition, says Nelson, the technology will run in standard software environments, most likely the OS/2 operating system with Windows.

Nelson got the idea for a new company while at Apollo, where he was vice president and chief technical officer. The Chelmsford, Mass., work station pioneer was a major early backer of the Open Software Foundation, and Nelson worked with OSF to evaluate the responses the organization received to its request for technology proposals to develop a standardized Unix user interface.

That was in the fall of 1988, and the effort resulted in OSF/Motif. But at the time, Nelson says he saw little conceptual innovation in the more than 20 company proposals OSF received. "This was before any of the media hype had begun about multimedia," Nelson recalls. "It was food for

thought for me that so many of the proposals seemed to be variations of the same thing. They were all basically reimplementations of the Xerox PARC/Apple Macintosh user environment showing relatively little innovation." By that time, adds Nelson, he was becoming more and more convinced that full-motion video and sound were "the next major innovation in the computer user environment."

Nelson resigned from Apollo in January of last year, before its acquisition by Hewlett-Packard Co., and announced formation of Fluent Machines at the same time. He was in no hurry at the outset, however, because he was looking to recruit people immersed in the key disciplines needed for full-motion video and sound: analog video and data compression.

"We're not building just another computer-systems company," Nelson explains. "We expect to be world-class experts in compression algorithms." To fill that need, he's recruited David Backer, who got his doctorate from the Massachusetts Institute of Technology's Media Laboratory in Cambridge, Mass., as one of his heads of engineering. The other recruit is Marcus Julian, an analog video authority who came from a private consulting company.

NELSON POINTS OUT that the Media Lab has made fundamental contributions in compression algorithms, although Fluent is not licensing Media Lab technology. "We're developing technology in our own right," he says. And that technology revolves around a set of algorithms "that can accommodate the uncertain or varying resources that exist in an interactive, networked computer system," Nelson says.

Fluent is using a technique called sub-band coding, which Nelson maintains is more suitable than region coding in an interactive computer system. Intel Corp. uses region coding in its Digital Video Interactive multimedia approach [*Electronics*, February 1990, p. 48].

Nelson points out that "full-motion video and sound is a real-time problem that would normally require dedicated bandwidth if existing compression algorithms were used." He calls sub-band coding "the next generation because of its adaptability to systems that can't deliver real-time dedicated bandwidth," which is difficult to do in an interactive system.

But how does a user benefit from all that technology? For one thing, full-motion video and sound mean that the user has the ability "to pop up a window [on a work station] and see Peter Jennings live on the evening news," Nelson says. Or it permits a user to experience a complex medical procedure via videotape, such as the suturing of an artery during open-heart surgery.

Nelson believes it's too early to tell how far multimedia technology will go. "I truly believe that this is generational—a major push for the '90s and not just another tweak of computer technology. This is a technology that will become ubiquitous and commonplace in five to eight years," he concludes. However, he cautions, "trying to understand in 1990 all the applications for it is like trying to project the applications of the Macintosh user interface in 1982." E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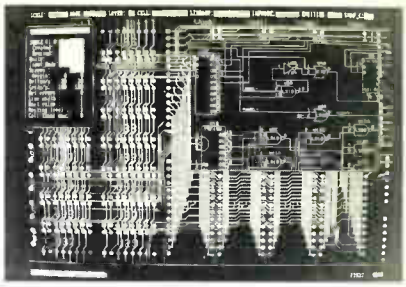

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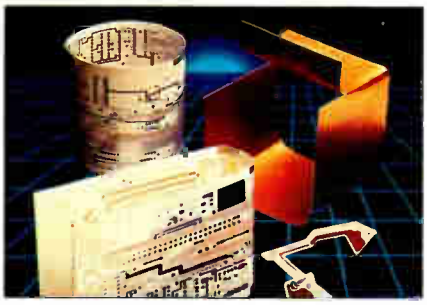

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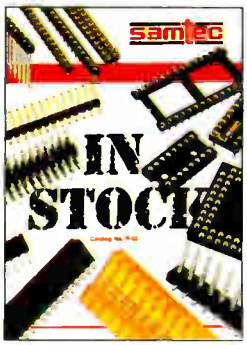


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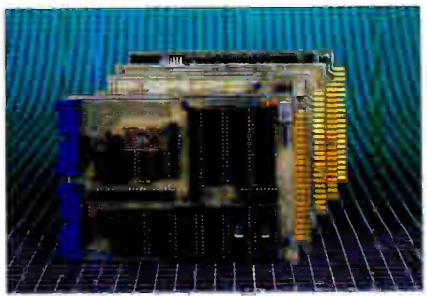

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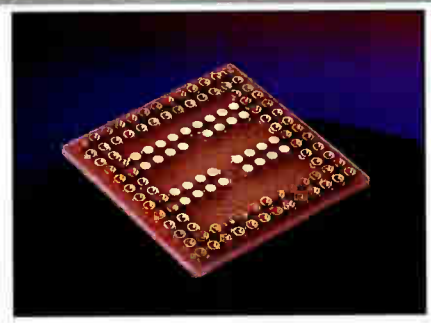

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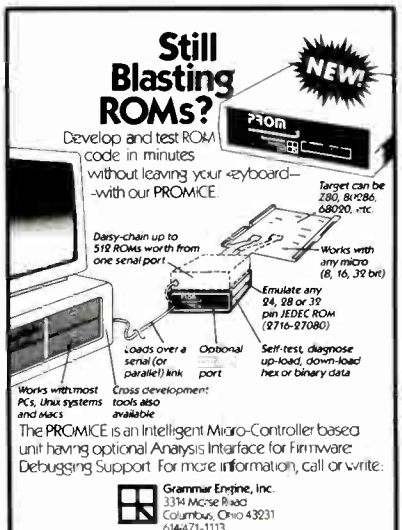


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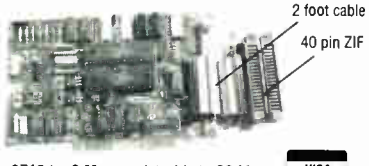


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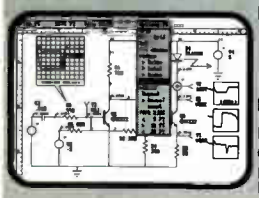

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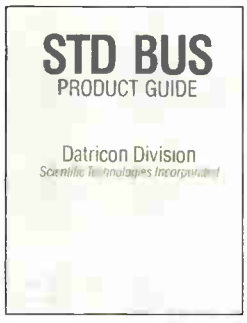


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# THINK OF STRATEGY, NOT JUST DOLLARS

BY SUSAN LEVI WALLACH

## THAT'S HOW TO DETERMINE THE VALUE OF NEW MANUFACTURING EQUIPMENT

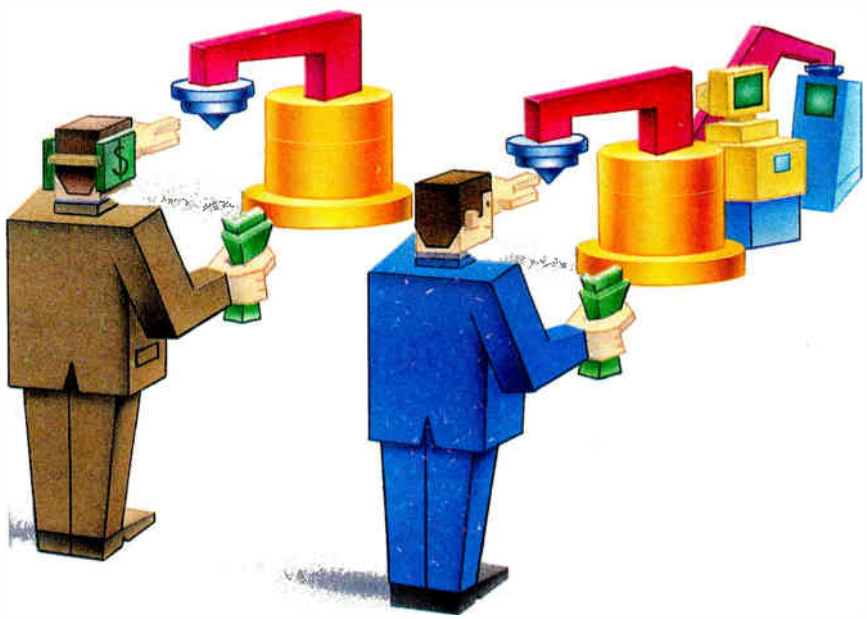
HOW DO YOU FIGURE the value of new manufacturing technology? When Michael Burstein hears the term "cost justification," he gets nervous. To Burstein, one of the developers of an entirely different approach to planning investments in manufacturing technology, that's far too myopic a way to gauge the worth of new advanced equipment in the factory. And manufacturers who persist in using it and other time-honored but shopworn means of costing out investment, such as replacement analysis, wind up with a skewed vision of what the addition of high technology will mean to their operations.

What Burstein would rather hear is best summed up as "strategic justification," a theory by which the value of new advanced technology—be it on the soft side, such as just-in-time manufacturing, or on the hard, such as robotics—is judged systemically.

"To capture the benefits of advanced technology, you have to look at the overall manufacturing system," says Burstein, because "you're changing the ability of that system to meet competitive requirements. The traditional analysis of introducing a machine assumes you're dealing with a mature environment and all you're doing is replacing one machine with another of the same capacity and capabilities. That is in tremendous contrast to the impact of technology today." The company that doesn't think in terms of integrating higher capabilities to boost system performance loses out.

Though his focus is the machinery and processes involved in actual manufacture, Burstein also works with the business plan from bottom up, beginning with the customers the company is trying to court and ending with the goals at the corporation's top levels. In linking up with the business plan, he explains, "you know what is expected of you in manufacturing."

The point of doing things Burstein's way is to connect the acquisition of technology with the requirements of competitiveness. "The idea is that the first thing on the agenda is to figure out what you have to do to be competitive," Burstein says, "which means what the customer wants versus how good you are at providing it versus the competition," instead of aiming only to do things more cheaply. In fact, adds Burstein, "the revenue side is a major part of our approach. Here is where you begin to get a sense of strategy—where you feel the market's influence."

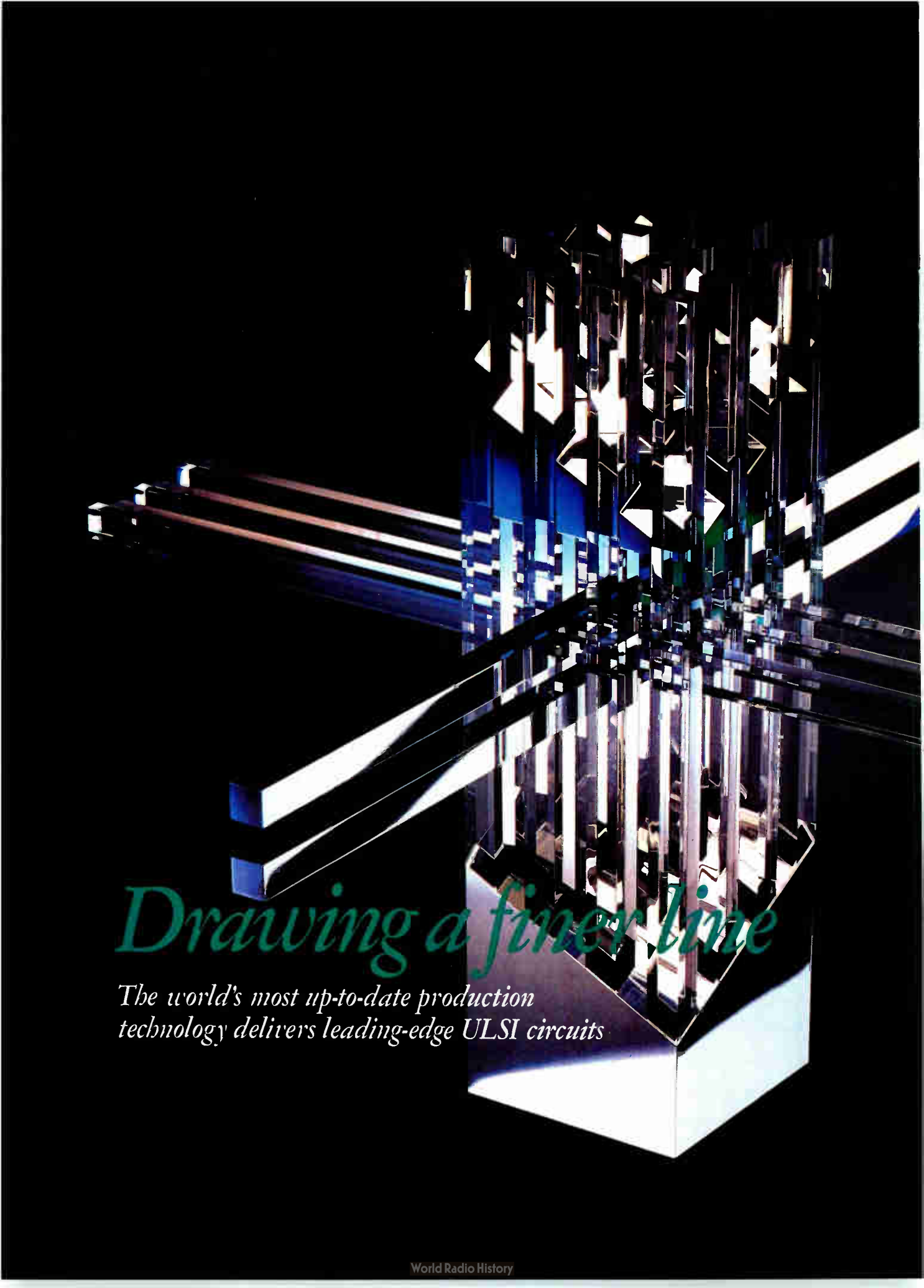


JAPANESE COMPANIES have long taken what Burstein terms this holistic approach. "They've always said that the whole point was to give the customer value" and that "it's what the customer is willing to pay for a product that determines the value added."

Digital Equipment Corp., for one, is putting Burstein's theory to use. "What we're trying to do is keep away from the piecemeal approach, away from point solutions, and look at solutions that are integrated across the functional unit and across the whole enterprise," says Irving Winter, a management consultant in DEC's Enterprise Integration Services Division in Landover, Md.

"We approach strategic planning from an enterprise-wide perspective. You basically first look at what business purposes are driving the company, before you focus on specific application technology. And you look at how clear the company is on plans to implement technology," he says. "There has to be very good communication of what the top-level strategy is conceived to be, because no matter what strategy is conceived at the top, it has to be implemented from the ground up."

There's a twist, of course, Burstein adds. The plan has to be based not so much on the market as it is but on as it might be, because "by the time you make your move it's going to be a couple of years down the way."



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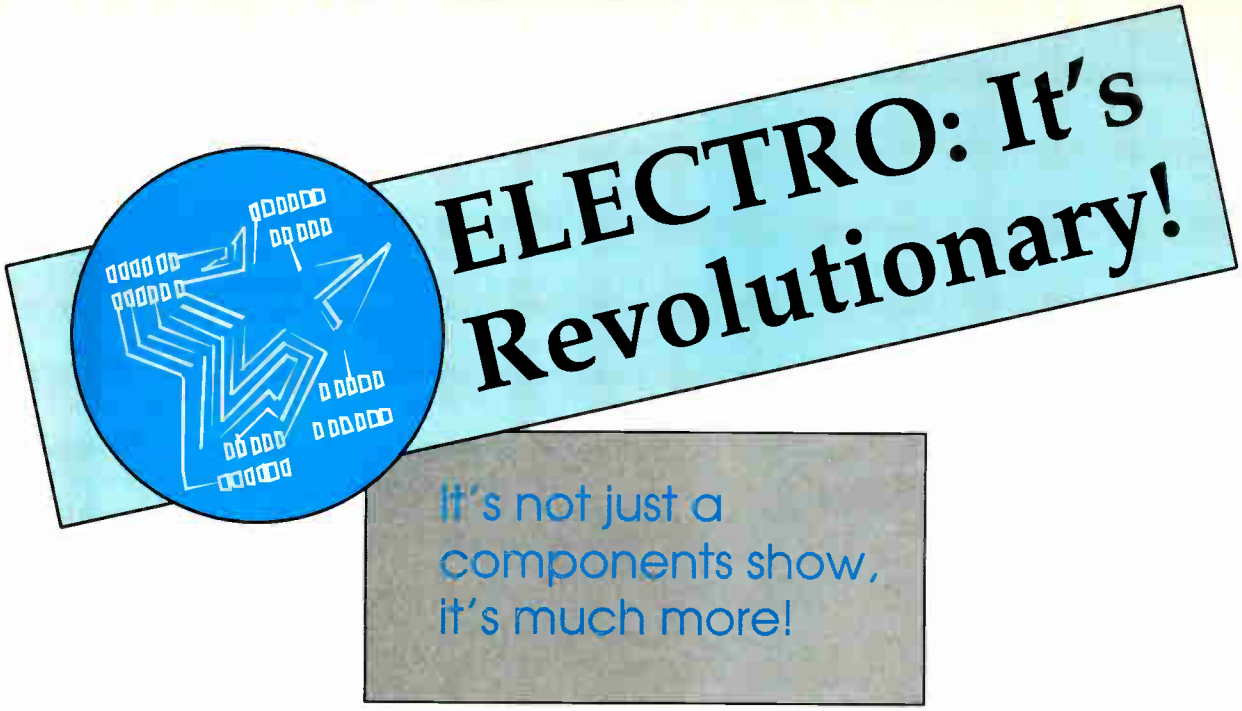


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# THE SOFT LANDING MAY TURN OUT TO HURT A BIT

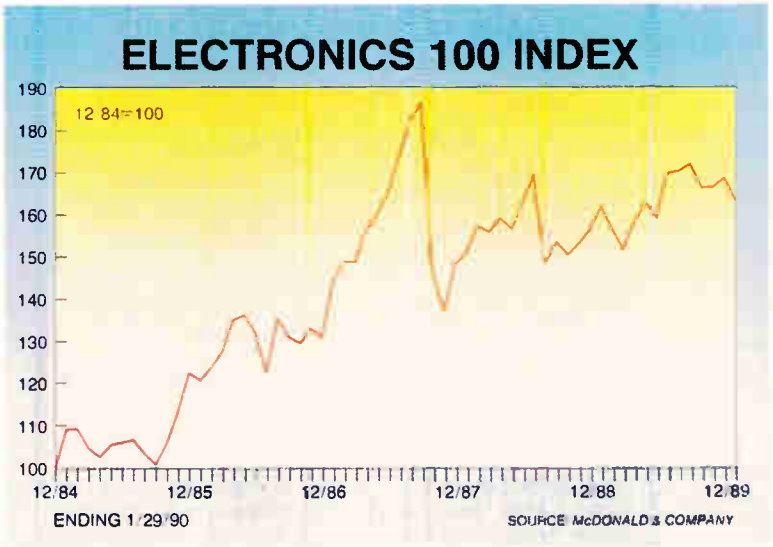
WE CONTINUE TO SEE EVIDENCE of a mild seasonal upturn, but recent economic news is worrisome.

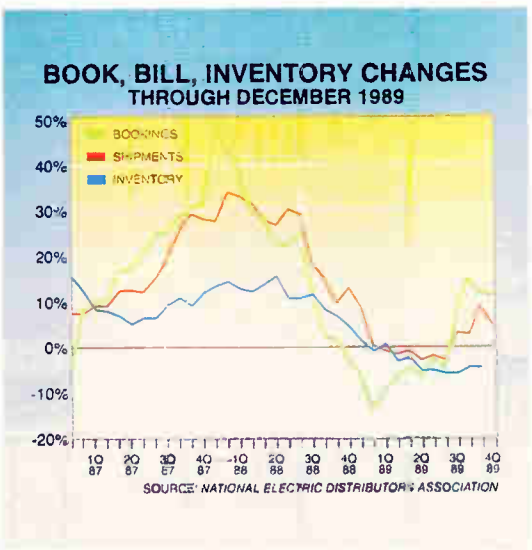
Economists and business planners had assured us that after some modest pain in the first half, things would look better by the third quarter. Their scenario went like this: the Federal Reserve Bank would gradually reduce interest rates this winter to gently stimulate the economy by summertime. Consumer spending patterns, after about a year of moderate restraint, would begin to accelerate by fall. The beginning of a modest upward trend in electronics orders would gradually result in better shipment patterns by the end of 1990, with a brightening 1991 outlook.

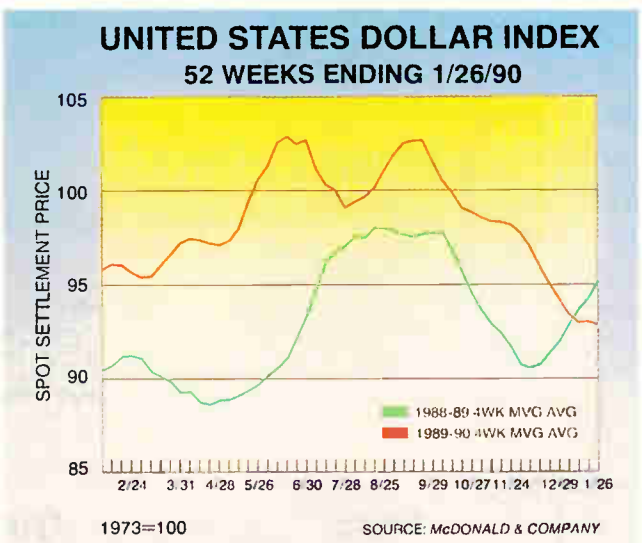
But bad news has a habit of hanging around a while, and recent events strongly threaten that soft landing scenario. Japanese interest rates have skyrocketed to unprecedented levels. This has reduced the premium, or "spread," between U.S. and Japanese rates to the point that Japanese investors would prefer to own their own debt. As a result, U.S. rates have also risen sharply. This is putting a damper on the Federal Reserve's ability to stimulate domestic growth through lower interest rates.

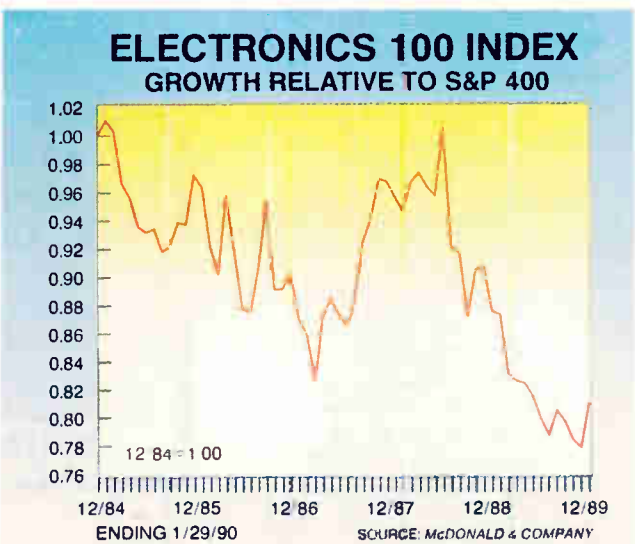
Consumer confidence is beginning to wane. By some measures, confidence levels are low enough to suggest recession, not slow growth. Fourth quarter GNP, up only 0.5%, reflected more inventory accumulation than growth in demand. Capacity utilization is declining faster, reducing the need for growth in capital equipment spending. In sum, though the leading economic indicators haven't signaled a recession yet, other early warning signs strongly urge caution. E

*The index is prepared especially for* Electronics *by Mark Parr of McDonald & Co., Cleveland.*



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**101 - Aldec**—Real-time CAE tools that allow instant design guidance and on-the-fly modifications. **102 - VHDL**-based Susie 6.0, a real-time, incremental design-development tool. **103 - Gazelle's HOT ROD** rides at 1-Gbit. **104 - ITEX** looks for IC model developers and ICs to model.
**105 - Services** key to CAE penetration.
**301 - Chicago Laser Systems**—For active or passive needs, a change to CLS can boost productivity.

### COMMUNICATIONS

**286 - Vacuumschmelze**—Inductive components for ISDN.

### COMPONENTS

**418 - Hirose Electric**—The right high-density connectors.
**489 - Ferranti Venus**—Active airborne ECM power management.
**435 - Pico Electronics**—Ultra-miniature power inductors.

### COMPUTER BOARDS

**210 - Matrox**—Flexible image processing on the PC with new capabilities and enhanced price/performance numbers.

### COMPUTER I/O DEVICES

**471 - Itac Systems**—Mouse-Trak: accurate and precise cursor control; user-definable keys.

### COMPUTER REPAIRS

**445 - Tech Serv**—If you are servicing electronic equipment, computer repair can double your income.

### CONNECTORS & SOCKETS

**263 - AMP**—Reliability, quality, and availability in two-piece connectors.

### DISPLAY DEVICES

**83 - Aerospace Optics**—Introducing Vivisun Series 2000, the programmable display push-button system.
**498 - Hewlett-Packard**—Commitment to meeting your needs in optoelectronics, optical communications, and microwave technology.
**309 - Philips**—When it comes to LCDs, Philips sees things your way.

### LOGIC ICs

**276 - Integrated Device Technology**—FACT-T Logic offers CMOS power at TTL levels in a fast logic family.

### MATERIALS

**401 - Conap**—Cut potting and encapsulating costs with Conathane.
**406 - Daicel Chemical Industries**—Recording materials for optical and magneto-optical disks.
**248 - Krupp Widia**—Koerdym, a new neodymium-iron-boron material, opens doors in permanent magnet applications.
**526 - Nippon Chemi-Con**—Products to help miniaturization, low cost, high reliability and performance.

### MEMORY ICs

**800 - Philips**-Philips enters SRAM market with ultralow-power 64-Kbit CMOS parts.
**474/475 - Vitelic**—Vitelic has a lead in integrated cache memory. Circle 474 for literature, 475 for sales contact.

### MICROCONTROLLERS

**228 - Siemens**—The SAB 80C166 combines the best of today's microprocessors and microcontrollers.

### MICROPROCESSORS

**222 - Epson Semiconductor**—The SM62 family provides a powerful core CPU plus flexible architecture.

### MICROWAVE COMPONENTS

**260 - Murata**—Smaller and better monolithic chip EMI suppression filter.

### OSCILLOSCOPES

**115/120 - LeCroy**—The 1 GS/sec digital scope with many features. Circle 115 for literature; 120 for a demonstration.

### PC BOARD LAYOUT

**242 - P-CAD**—Master Designer for PCB designers can handle boards of up to 2,500 components, 4,000 nets.
**252 - Valid**—Allegro catches hidden problems before prototypes are made.

### POWER SUPPLIES

**205 - Abbott**—Mil/Pac high-density military power supplies.
**802 - Philips**—New ferrite lifts switched-mode power supplies' operating frequency.
**435 - Pico**—AC-DC power supplies with lowest profile, up to 55 W.
**291 - Vicor**—FlatPAC takes the uncertainty out of power development.

### PRINTERS/PLOTTERS

**240 - Fujitsu**—For high-resolution receipts, a two-ply thermal printer.

### PROCESS CONTROLLERS

**218 - Rohde & Schwarz**—AT-compatible system solutions from a single source.

### SEMICONDUCTORS

**217 - Oki**—The Miyagi plant has recently begun production of 4-Mbit DRAMs.
**801 - Philips**—InGaAsP laser diode for high-bit-rate fiber-optic communications.
**804 - Philips**—Clock-timer IC has low power consumption.

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**225 - Orbit Semiconductor**—Foresight, a multiproject wafer-processing service.

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**236 - Clearpoint**—HP-compatible memory products.
**475 - T-Cubed Systems**—Reliability prediction software.

### TEST INSTRUMENTS

**200 - Advantest**—Spectrum analyzers that deliver on-the-mark signal-analysis accuracy.
**279 - Anritsu**—The highest levels of test accuracy for all types of communications.
**Frequency Devices**—The model 9002 dual-channel filter.
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**428 - Rental Electronics**—The rental source for all your T&M needs.
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| 6 | 31 | 56 | 81 | 106 | 131 | 156 | 181 | 206 | 231 | 256 | 281 | 306 | 331 | 356 | 381 | 406 | 431 | 456 | 481 | 506 | 531 | 556 | 806 | 831 |
| 7 | 32 | 57 | 82 | 107 | 132 | 157 | 182 | 207 | 232 | 257 | 282 | 307 | 332 | 357 | 382 | 407 | 432 | 457 | 482 | 507 | 532 | 557 | 807 | 832 |
| 8 | 33 | 58 | 83 | 108 | 133 | 158 | 183 | 208 | 233 | 258 | 283 | 308 | 333 | 358 | 383 | 408 | 433 | 458 | 483 | 508 | 533 | 558 | 808 | 833 |
| 9 | 34 | 59 | 84 | 109 | 134 | 159 | 184 | 209 | 234 | 259 | 284 | 309 | 334 | 359 | 384 | 409 | 434 | 459 | 484 | 509 | 534 | 559 | 809 | 834 |
| 10 | 35 | 60 | 85 | 110 | 135 | 160 | 185 | 210 | 235 | 260 | 285 | 310 | 335 | 360 | 385 | 410 | 435 | 460 | 485 | 510 | 535 | 560 | 810 | 835 |
| 11 | 36 | 61 | 86 | 111 | 136 | 161 | 186 | 211 | 236 | 261 | 286 | 311 | 336 | 361 | 386 | 411 | 436 | 461 | 486 | 511 | 536 | 561 | 811 | 836 |
| 12 | 37 | 62 | 87 | 112 | 137 | 162 | 187 | 212 | 237 | 262 | 287 | 312 | 337 | 362 | 387 | 412 | 437 | 462 | 487 | 512 | 537 | 562 | 812 | 837 |
| 13 | 38 | 63 | 88 | 113 | 138 | 163 | 188 | 213 | 238 | 263 | 288 | 313 | 338 | 363 | 388 | 413 | 438 | 463 | 488 | 513 | 538 | 563 | 813 | 838 |
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| 15 | 40 | 65 | 90 | 115 | 140 | 165 | 190 | 215 | 240 | 265 | 290 | 315 | 340 | 365 | 390 | 415 | 440 | 465 | 490 | 515 | 540 | 565 | 815 | 840 |
| 16 | 41 | 66 | 91 | 116 | 141 | 166 | 191 | 216 | 241 | 266 | 291 | 316 | 341 | 366 | 391 | 416 | 441 | 466 | 491 | 516 | 541 | 566 | 816 | 841 |
| 17 | 42 | 67 | 92 | 117 | 142 | 167 | 192 | 217 | 242 | 267 | 292 | 317 | 342 | 367 | 392 | 417 | 442 | 467 | 492 | 517 | 542 | 567 | 817 | 842 |
| 18 | 43 | 68 | 93 | 118 | 143 | 168 | 193 | 218 | 243 | 268 | 293 | 318 | 343 | 368 | 393 | 418 | 443 | 468 | 493 | 518 | 543 | 568 | 818 | 843 |
| 19 | 44 | 69 | 94 | 119 | 144 | 169 | 194 | 219 | 244 | 269 | 294 | 319 | 344 | 369 | 394 | 419 | 444 | 469 | 494 | 519 | 544 | 569 | 819 | 844 |
| 20 | 45 | 70 | 95 | 120 | 145 | 170 | 195 | 220 | 245 | 270 | 295 | 320 | 345 | 370 | 395 | 420 | 445 | 470 | 495 | 520 | 545 | 570 | 820 | 845 |
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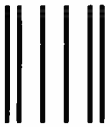

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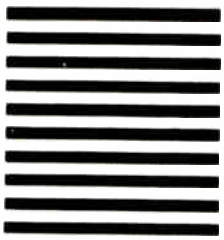

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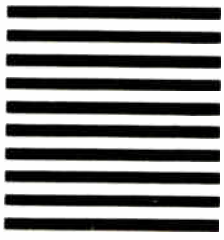

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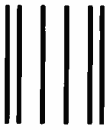

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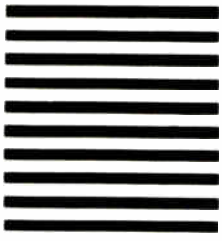

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**1.** ☐ **Your principal job function: (Insert one code only)**

**COMPANY MANAGEMENT**
- **01.** Corporate & Operating Management (non-engineering)
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- **04.** Purchasing/Procurement Management (VP, director, manager)
- **05.** Marketing Management (VP, director, manager)
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**ENGINEERING MANAGEMENT**
- **07.** Design & Development Management (circuits, components, equipment, systems)
- **08.** Engineering Services Management (evaluation, quality control, reliability, standards, test)
- **09.** Manufacturing & Production Engineering Management
- **10.** Research & Development Management
- **11.** Executive & Operating Management (engineering/technical)

**ENGINEERING**
- **12.** Design & Development (circuits, components, equipment, systems)
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- **14.** Manufacturing & Production Engineering
- **15.** Research & Development

**STAFF**
- **16.** Consultant
- **17.** Engineering Support (draftsman, lab assistant, technician/applications)
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**2.** ☐ **What is the PRIMARY end product or service performed at this location? (Insert one code only)**

01. Computers & computer systems
02. Computer peripherals: disk drives, terminals, printers/plotters
03. CAE/CAD/CAM systems
04. Software manufacturer/developer
05. Computer systems integrator
06. Office & business machines
07. Communications systems & equipment
08. Industrial controls, systems, equipment & robotics
09. Electronic instruments, ATE systems, design/test equipment
10. Medical electronic equipment
11. Avionics, marine, space & military electronics
12. Government/military
13. Automotive and other ground vehicles
14. Consumer electronics & appliances
15. IC's & semiconductors
16. Other components, materials, hardware & supplies
17. Electronic sub-assemblies (boards, modules, hybrids and power supplies)
18. Other manufacturers incorporating electronic equipment in their end product not described above
19. Independent/academic R&D laboratory
20. Technical/engineering consulting firms
21. Industrial users of electronic equipment
22. Commercial users of electronic equipment
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**3.** ☐ **Please indicate TOTAL number of employees in your entire company/ organization, including corporate headquarters, subsidiaries, divisions, branch offices and conglomerate affiliates. (Insert one code only)**

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

**4.a.** **Is your company at this location involved in government or military electronics?**
1. ☐ YES 2. ☐ NO

**4.b.** **Are you personally involved in government or military electronics?**
1. ☐ YES 2. ☐ NO

**5.a.** **Are you regularly involved in the selection of vendors or in the purchase of products?**
1. ☐ YES
2. ☐ NO

**5.b.** **If YES, what roles do you play in the purchasing/specification process. (check all codes that apply):**
1. ☐ Determine the need to buy a product or select a vendor.
2. ☐ Establish the product specifications.
3. ☐ Evaluate products.
4. ☐ Specify products.
5. ☐ Evaluate vendors.
6. ☐ Negotiate prices, terms, and availability.
7. ☐ Approve vendor.
8. ☐ Approve purchase.

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