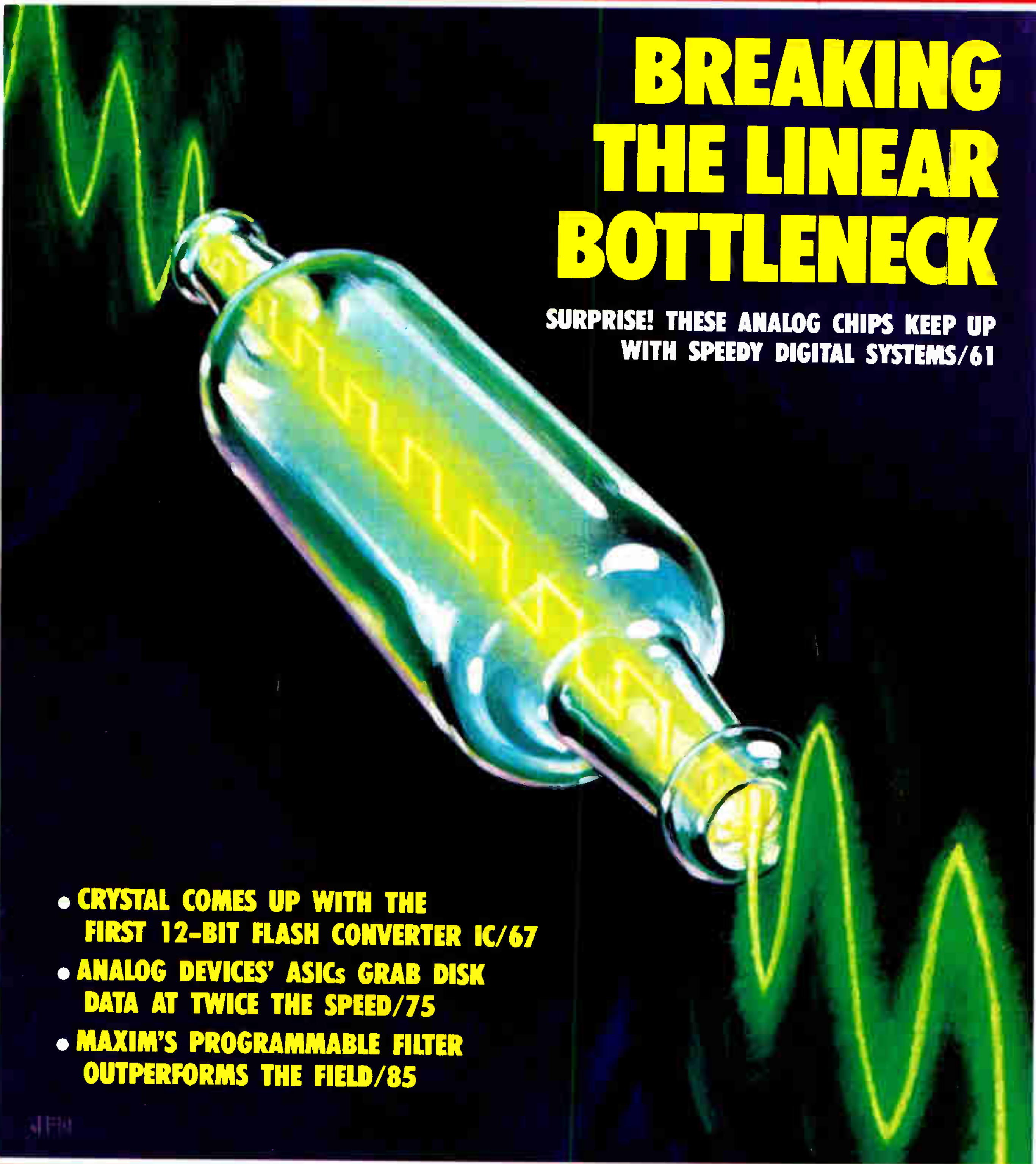
EXECUTIVE OUTLOOK: CRASH ISN'T CHANGING PLANS—YET/91

AT ISSCC, LOOK FOR HOT DEVELOPMENTS EVERYWHERE/103

A McGRAW-HILL PUBLICATION SIX DOLLARS DECEMBER 17, 1987

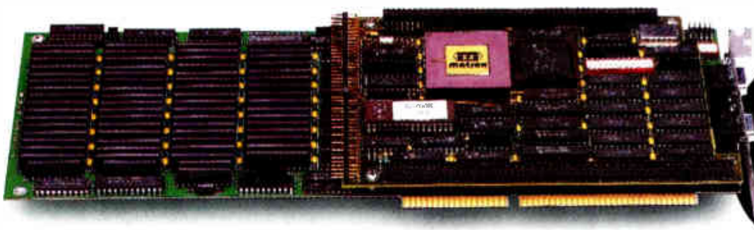
Electronics®



BREAKING THE LINEAR BOTTLENECK

SURPRISE! THESE ANALOG CHIPS KEEP UP WITH SPEEDY DIGITAL SYSTEMS/61

- CRYSTAL COMES UP WITH THE FIRST 12-BIT FLASH CONVERTER IC/67
- ANALOG DEVICES' ASICs GRAB DISK DATA AT TWICE THE SPEED/75
- MAXIM'S PROGRAMMABLE FILTER OUTPERFORMS THE FIELD/85

Fast.
Faster.

est.

PG-1281 virtually redefines "high performance". With this new Matrox color display processor at the heart of an IBM PC AT, 386 PC, or compatible, a true professional workstation is born. Enhanced by four custom gate arrays, the PG-1281 is the fastest TMS34010-based board in the world today... and you have all the power of high-priced workstations at a fraction of the price!

▪ 1280 × 1024 resolution ▪ Full 64-bit bandwidth ▪ 65,000 vectors/second ▪ 100 million bits/second BITBLT ▪ Up to 1.5Mb on-board RAM ▪ Downloadable user code for easy application development ▪ Optimized drivers for major CAD packages ▪ Compatibility with all current graphics standards: Windows, X Windows, CGA, VDI, PGA, and more... ▪ Optional high-speed 3D coprocessor and EGA/VGA add-on modules.

If you need the best graphics performance available today, you need the PG-1281. For more details call us – fast!

IVT 1-800-361-4903

A LEADER IN VIDEO MICROTECHNOLOGY

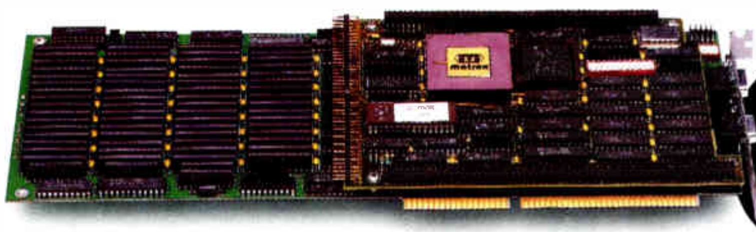
matrox

In Canada, call (514) 685-2630. IBM and IBM AT are registered trademarks of International Business Machines Corporation. Windows is a trademark of Microsoft Corporation.

1281-ELEC

Circle 900 on reader service card

Fast. Faster.



Fastest.

PG-1281 virtually redefines "high performance". With this new Matrox color display processor at the heart of an IBM PC AT, 386 PC, or compatible, a true professional workstation is born. Enhanced by four custom gate arrays, the PG-1281 is the fastest TMS34010-based board in the world today... and you have all the power of high-priced workstations at a fraction of the price!

▪ 1280 × 1024 resolution ▪ Full 64-bit bandwidth ▪ 65,000 vectors/second ▪ 100 million bits/second BITBLT ▪ Up to 1.5Mb on-board RAM ▪ Downloadable user code for easy application development ▪ Optimized drivers for major CAD packages ▪ Compatibility with all current graphics standards: Windows, X Windows, CGA, VDI, PGA, and more... ▪ Optional high-speed 3D coprocessor and EGA/VGA add-on modules.

If you need the best graphics performance available today, you need the PG-1281. For more details call us – fast!

IVT 1-800-361-4903

A LEADER IN VIDEO MICROTECHNOLOGY

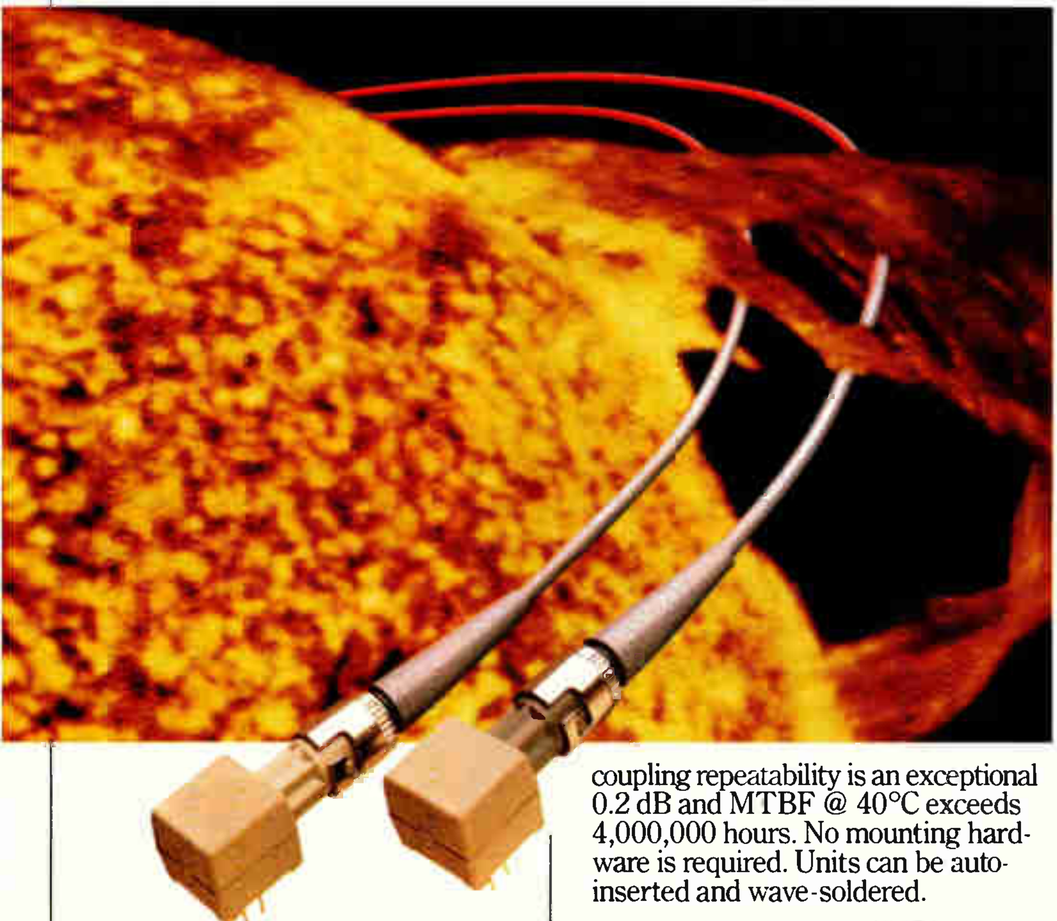
matrox

In Canada, call (514) 685-2630. IBM and IBM AT are registered trademarks of International Business Machines Corporation. Windows is a trademark of Microsoft Corporation.

1281·ELEC

Circle 900 on reader service card

Hot performance. Cool pricing. Easy mounting. Complete your ST links with HP's sizzling new transmitters and receivers.*



Have you been looking for the convenience of the ST Connector, HP quality and affordable pricing? Look no more. The DC to 50 MBaud performance, uniquely efficient optics and 4 km range of Hewlett-Packard's fiber optic transmitters and receivers have already made them a designer's favorite. Now they are available for use with the popular spring-loaded, quick-twist ST Connectors at extremely competitive prices: as low as $12.50 in quantities of 1,000.‡

HP's ST transmitters and companion ST receivers are completely specified with 62.5/125, 100/140 and 50/125 μm fiber sizes. For transmitters, coupling repeatability is an exceptional 0.2 dB and MTBF @ 40°C exceeds 4,000,000 hours. No mounting hardware is required. Units can be auto-inserted and wave-soldered.

Fire-you-up sale: 90 days only!

Save 80% off the regular evaluation kit price! For the next 90 days order the complete HFBR-0410 kit** for just $10.00. (One to a customer, please!) Make checks payable to Hewlett-Packard Company and send with this coupon *and your business card* to Monte Smith, Hewlett-Packard Components Group, 370 West Trimble Road, Mail Stop 91-1G, San Jose, CA 95131.

☐ I'd prefer an SMA connector evaluation kit for $10 instead.

**Kit includes an HFBR-1412 Transmitter, HFBR-2412 5 megabaud TTL receiver, and 3 metres of AT&T's 62.5/125 μm fiber optic cable with plastic ST ferrules. CG08705 EL 12/17/87

For more information, call the Hewlett-Packard sales office listed in your telephone directory white pages and ask for the Components Department. To order, contact your nearest HP distributor. In the U.S.; Almac Electronics, Hall-Mark, Hamilton/Avnet, or Schweber. In Canada: Hamilton/Avnet or Zentronics Ltd.

"ST" is a registered trademark of AT&T for Lightguide Cable Connectors. ‡U.S. list price. CG08705

hp HEWLETT PACKARD

Electronics

As the business of designing electronics gets more sophisticated, technical managers and engineers struggling to stay abreast of the latest technology often find that they are not keeping up with the latest developments in the basic tools of their work, the components that make up the systems. To help close that gap, we are launching in the next issue our new monthly Technology Series.

MATTERA: Keeping track of the critical design basics.

The editor of the series will be Lucinda Mattera, who is one of the most highly respected editors in the electronics trade press. She will be returning to the *Electronics* family—she was our Components Editor back in 1978—after serving as editor-in-chief and publisher of *Electronic Design*. Lucinda's years as an industry observer have enabled her to build a network of solid contacts and sources from coast to coast and overseas.

The emphasis in our Technology Series will be on fundamentals. It will cover each of three key areas—analog and power, components and interconnections, and test and measurement—four times a year.

"Fundamental technologies, like components and instruments, are the ones that the senior designers and technical managers must deal with most often," Lucinda says. "Yet surprisingly, finding information about these important subjects is frequently difficult. So our special sections will be tuned to their principal technical information needs in these critical areas."

The topics to be treated have been carefully selected, and range from data converters to function generators, operational amplifiers to digital multimeters, and surface-mount passives to oscilloscopes. "The reason we are focusing on these topics," says Lucinda, "is that they are so critical to the everyday aspects of a design project. When an engineer undertakes a design, the particular power supplies or interconnections that he is going to use are generally the last things in his mind. Instead, he is occupied trying to select the microprocessor, or the graphics processor, or the operating system—and the coverage of these areas in *Electronics* is already topnotch. So we're going to put on the table exactly what he needs to make the basic decisions."

We recognize that the technical managers and engineers who read *Electronics* have special information needs when it comes to traditional technology areas. The series will provide technical interpretation, perspective, and assessments that can move them faster to their goal—speeding up time-to-market with the right product.

"The articles will be different from the typical how-to design article found in other industry publications," notes Lucinda. "They will be geared for the *Electronics* reader, the high-level technical manager. Thus, they will deal with technical issues, examine trends, and unravel complex technology topics."

Lucinda adds, "Since we announced the series, we have been getting a very positive reception. In speaking to company officials, I find a lot of enthusiasm. Many of them have been calling me with ideas for articles."

December 17, 1987 Volume 60, Number 25
152,975 copies of this issue printed

Electronics (ISSN 0883-4989). Published biweekly by McGraw-Hill Inc. Publication office: 1221 Avenue of the Americas, N.Y., N.Y. 10020; second class postage paid at New York, New York and additional mailing offices. Postage paid at Montreal, P.Q. Registration Number 9034.

Executive, editorial, circulation, and advertising addresses: Electronics, McGraw-Hill Building, 1221 Avenue of the Americas, New York, N.Y. 10020. Telephone (212) 512-2000. Teletype 12-7960 TWX 710-581-4879. Cable address: M C G R A W H I L L N E W Y O R K.

Officers of McGraw-Hill Information Systems Company: President: Richard B. Miller, Executive Vice Presidents: Frederick P. Jannot, Construction Information Group, Russell C. White, Computers and Communications Information Group; J. Thomas Ryan, Marketing and International. Senior Vice Presidents-Publishers: Laurence Altman, Electronics; Harry L. Brown, BYTE; David J.McGrath, Engineering News-Record. Group Vice President: Peter B. McCuen, Communications Information. Vice Presidents: Robert D. Daleo, Controller; Fred O. Jensen, Planning and Development; Michael J. Koeller, Human Resources; Talat M. Sadig, Systems Planning and Technology.

Officers of McGraw-Hill Inc.: Harold W. McGraw Jr., Chairman; Joseph L. Dionne, President and Chief Executive Officer; Robert N. Landes, Executive Vice President, General Counsel and Secretary; Walter D. Serwatka, Executive Vice President and Chief Financial Officer; Shel F. Asen, Senior Vice President, Manufacturing; Robert J. Bahash, Senior Vice President, Finance and Manufacturing; Frank D. Penglase, Senior Vice President, Treasury Operations; Ralph R. Schulz, Senior Vice President, Editorial; George R. Elsinger, Vice President, Circulation.

Editorial department phones: Administration (212) 512-2645, News and New Products (212) 512-2685, Technology (212) 512-2666. Bureaus: Boston (617) 262-1160, Chicago (312) 751-3811, Dallas (214) 644-1111, Los Angeles (213) 480-5234, New York (212) 512-3322, San Francisco/San Mateo (415) 349-4100, Washington (202) 463-1650, Frankfurt 72-5566, London 493-1451, Paris 42-89-03-80, Tokyo 581-9816. **Business departments:** (212) 512-6435 (Business departments follow the Advertisers' Index).

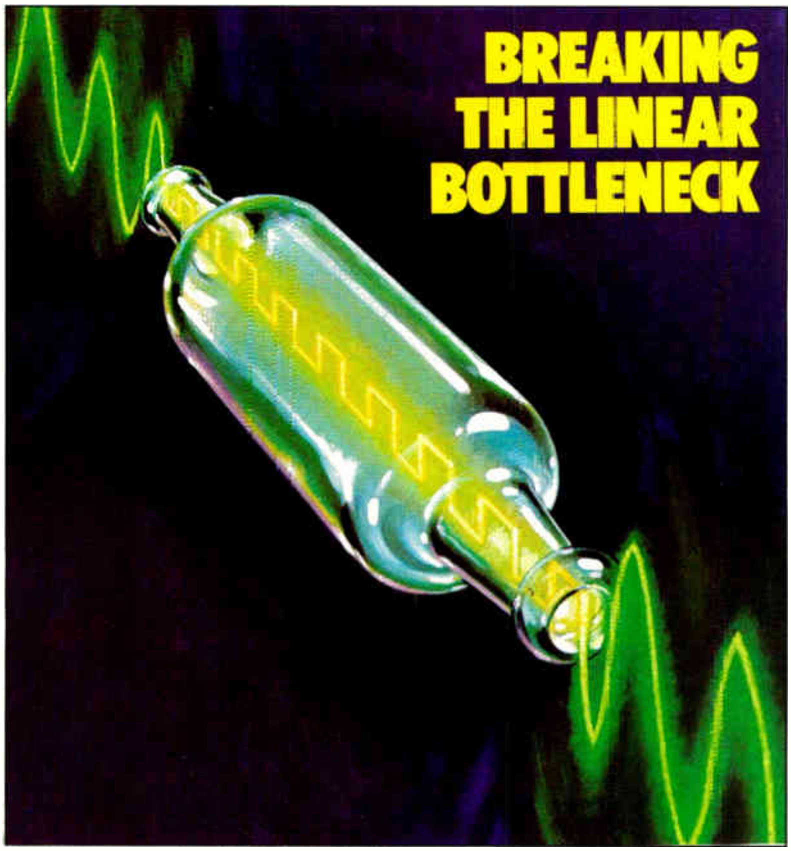
Electronics

YEAR-END DOUBLE ISSUE

NEWS

INSIDE TECHNOLOGY

COVER: JOEL NAPRSTEK



PAGE 61

NEW PRODUCTS

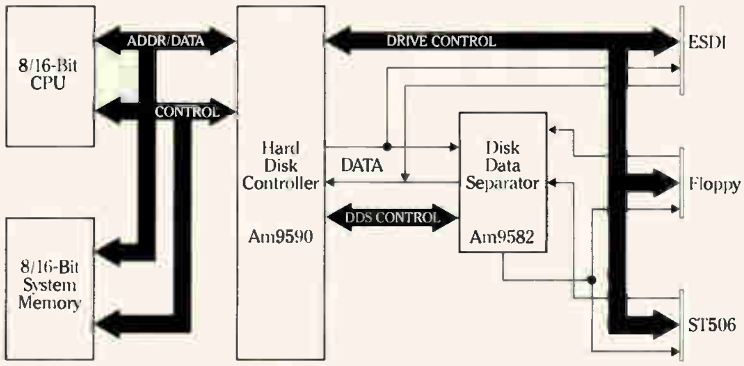
DEPARTMENTS

Narrow your horizons.

Put your hard disk controller on a single chip.

Twenty chips and a board is too much hardware for a hard disk controller. Any engineer would agree. So we focused our attention on turning all that into a single chip: the Am9590 Hard Disk Controller.

The Am9590 can control up to 4 drives allowing for any mix of hard and floppy drives. It supports ESDI, ST506/412 or standard double density floppy disk interfaces. Use the Am9590 with its companion chip the Am9582 Disk Data Separator to design your current ST506 system and you've got an easy upgrade to ESDI system performance for the next generation. Or you could always start that next generation now with the Am9590 as a stand alone.



On-chip DMA with data mapping.

We gave the Am9590 on-chip DMA with data mapping (which will come in handy when you're working with UNIX). Then we added dual on-board sector buffers to allow for Zero Sector Interleave. This simple way of organizing sectors means that access time is bounded by drive capabilities—not controller limitations. And it leaves the CPU free to do the things it does best.

On-board EDC.

The Am9590 even has on-board EDC. Select an error detection code (CRC-CCITT) or one of two error correction codes (Single or Double Burst Reed-Solomon). Or if you prefer, the Am9590 provides handshake interface to your own external ECC circuitry. All this adds up to maximum data integrity.

And it's easy to use. A comprehensive high level command set (with command chaining) allows for independent operation without constant CPU intervention.

You can even shorten your design cycle with an evaluation board, development software and a BIOS driver.

If all this sounds interesting, get in touch with us for more information. Once you've used the Am9590 Hard Disk Controller, you'll understand why the narrower view can be very broadening.

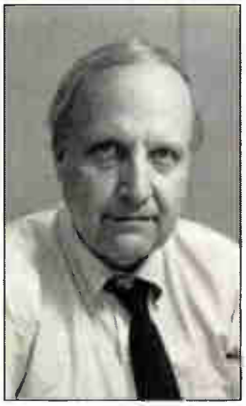
Advanced Micro Devices

901 Thompson Place, P.O. Box 3453, Sunnyvale, CA 94088
Call toll-free (800) 538-8450 ext. 5000; inside California call (408) 749-5000.

Circle 7 on reader service card

FYI

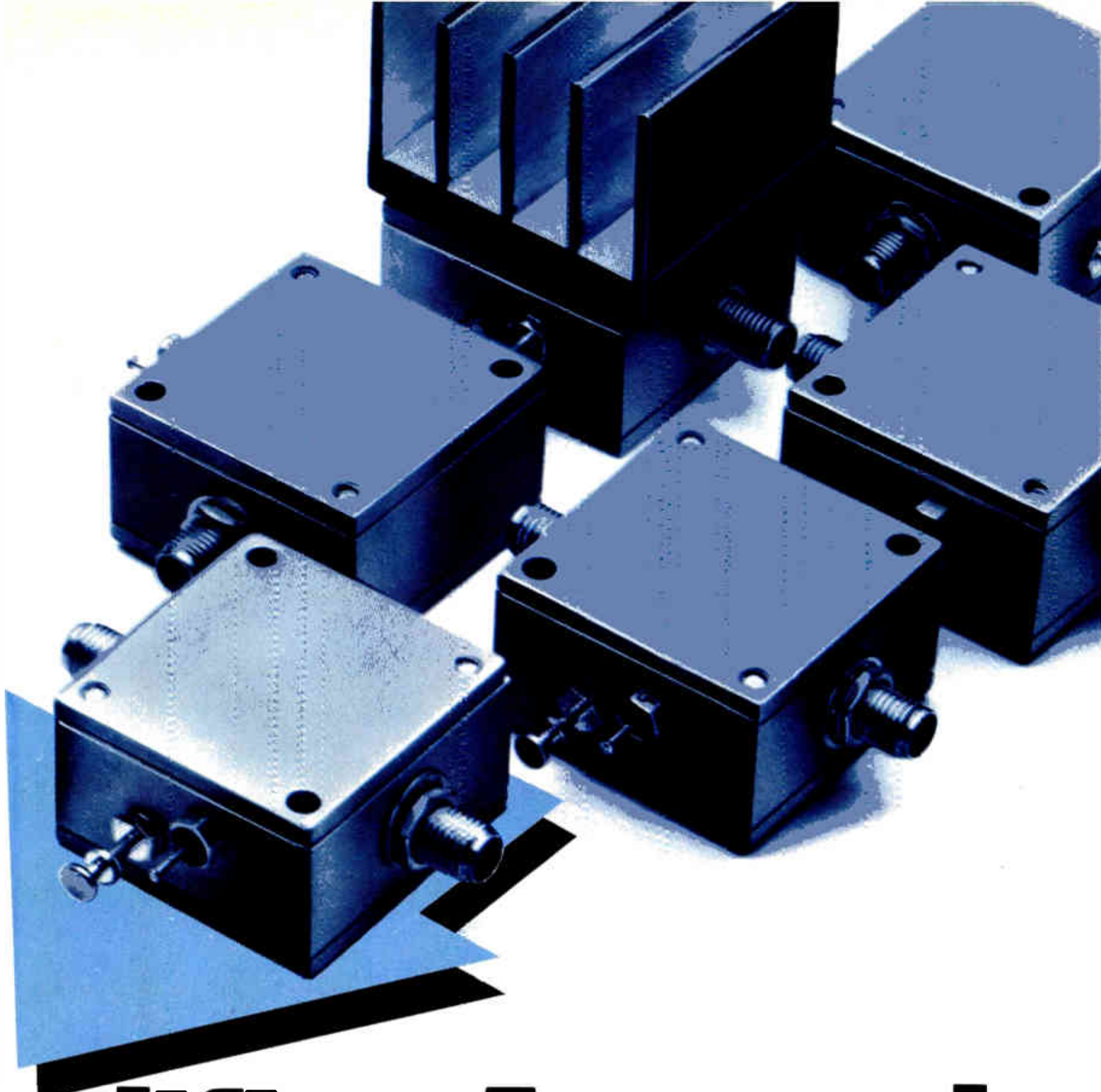
Keep a close eye on Apple Computer International: it's already beginning to look like the company that its U.S. parent aims to be in the 1990s



I'm going to let you in on another little secret. It's about Apple Computer. I know, I know. You already know all there is to know about the legendary personal computer maker. First it was founder Steve Jobs who stared out at you from all those magazine covers; recently it's been John Sculley, the former "sugared water" salesman who molded an out-of-control entrepreneurial company into a more professional organization. So much has been written about Apple, you say, that there can't be any secrets left. But there are. *Fortune* magazine may have published six long pages on the PC maker last month, but it didn't print word one about Apple *outside* the U. S. And that's the real secret: Apple Computer International is the tail wagging the corporate dog.

Keep a close eye on Apple International: it's already beginning to look like the company that its U. S. parent aims to be in the 1990s. It's moving into business markets at a very rapid clip, faster than its domestic parent. It's interested in making acquisitions: system-house integrators for the multivendor environment, for example. It has its own dedicated flexible manufacturing, a world-class plant in Cork, Ireland, that builds 27 products on one line. Apple is also growing faster overseas than it is in the U. S. "There has been an acceleration of our growth," says Michael H. Spindler, International president and resident genius behind Apple's overseas success. "Two years ago, we accounted for 20% of Apple's business; now we're 30% of the corporation," he declares. In those two years, overseas profits doubled because International was faster in switching over to the Macintosh.

In 1981, International did only $98 million. But since then, it has shot up at a 40% compound annual rate, to $743 million in fiscal 1987. Says Spindler: "We think we can grow 35% annually over the next few years, hitting $1 billion long before this decade is over." Some experts expect him to account for more than one-third of Apple revenues by 1990, growth that would make Apple more successful overseas than any U. S. computer maker but IBM. To keep up this momentum, International has just moved into phase two in Europe: "Our goal is to make us into a European company, so that we look and feel like a European enterprise," Mike says. This means an operation as self-contained as possible, sourcing almost entirely locally. And it will do its own R&D, with software and communications efforts located in Paris. **ROBERT W. HENKEL**



Amplifier Arsenal

50KHz—2000MHz, Low Noise 100mW output Gain Controlled from **$69.95**

Our ZFL-2000 miniature wideband amplifier hit a bulls-eye when we introduced it last year. Now we've added more models to offer you a competitive edge in the continuing battle for systems improvement.

The ZFL-2000, flat from 10 to 2000MHz, delivers +17dBm output and is priced at only $219.

Need more output? Our ZFL-1000H, flat from 10 to 1000MHz, delivers +20dBm output.

Is low noise a critical factor: Our ZFL-500LN and 1000LN boast a 2.9dB NF.

Variable gain important? Our ZFL-1000G, flat from 10 to 1000MHz, delivers +3dBm output with 30dB gain control while maintaining constant input/output impedance.

Searching for a high-quality, low-cost amplifier? Our ZFL-500 flat from 50KHz to 500MHz, delivers +10dBm output for the unbelievable low price of only $69.95. Need to go higher in frequency? Consider the ZFL-750, from 0.2 to 750MHz, for only $74.95. Or the $79.95 ZFL-1000, spanning 0.1 to 1000 MHz.

One week delivery...one year guarantee.

SPECIFICATIONS

MODEL	FREQUENCY MHz	GAIN, dB (min.)	MAX. POWER OUTPUT dBm(typ)	NF dB(typ)	PRICE $ Ea.	Qty.
ZFL-500	0.05-500	20	+9	5.3	69.95	1-24
ZFL-500LN	0.1-500	24	+5	2.9	79.95	1-24
ZFL-750	0.2-750	18	+9	6.0	74.95	1-24
ZFL-1000	0.1-1000	17	+9	6.0	79.95	1-24
ZFL-1000G*	10-1000	17	+3	12.0	199.00	1-9
ZFL-1000H	10-1000	28	+20	5.0	219.00	1-9
ZFL-1000LN	0.1-1000	20	+3	2.9	89.95	1-24
ZFL-2000	10-2000	20	+17**	7.0	219.00	1-9

* 30dB gain control **+15dBm below 1000MHz

finding new ways ...
setting higher standards

Mini-Circuits

A Division of Scientific Components Corporation
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500
Fax (718) 332-4661 Domestic and International Telexes: 6852844 or 620156

C101 REV.C

National Semiconductor

Finally, graphics to match your imagination...now more than ever.

INTRODUCING THE FIRST EFFECTIVELY PARTITIONED VLSI ARCHITECTURE FOR TRULY FLEXIBLE GRAPHICS SYSTEMS DESIGN

Imagine a graphics architecture so powerful, you can achieve 16K-by-16K resolution. So effective, you can add virtually unlimited planes of color without degrading performance. So flexible, you can integrate it into an existing design or use it to build an entire range of new systems.

That's the Advanced Graphics Chip Set from National Semiconductor.

By using a multiple-chip, modular approach, the Advanced Graphics Chip Set avoids the design compromises and limitations of single-chip solutions.

That gives you two unprecedented benefits: *performance* and *flexibility.*

Which means you can design exactly the type of system you need with exactly the level of performance your application demands.

For example, you can integrate part of the chip set with an existing general-purpose microprocessor for a low-end display.

Or you can utilize the chip set's full capabilities for a high-end, high-performance, high-resolution CAE/CAD workstation or laser printer — with virtually unlimited planes of color. Yet with the same high-speed performance as a black-and-white application.

In fact, you can design an entire range of graphics systems without having to "reinvent the wheel" each time, by using the same hardware building blocks and the same central software in each of the systems.

THE ADVANCED GRAPHICS CHIP SET

Now expanded for even more design flexibility and freedom.

2 BitBlt Processing Units (BPUs). 20-MHz devices that control data movements within their own dedicated memory planes or between those planes and other memory planes in multi-color systems. AVAILABLE NOW.

4 Video Clock Generators (VCGs). Timing and control generators providing all the synchronization signals needed by a graphics system. Pin-programmable pixel frequencies for both low-frequency (125 MHz) and high-frequency (225 MHz) applications. AVAILABLE NOW.

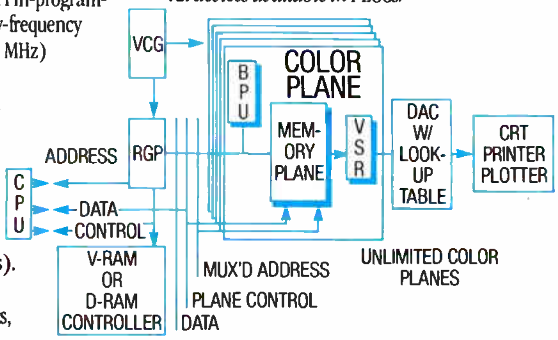
2 Video Shift Registers (VSRs). Parallel-to-serial shift registers capable of serial-output rates up to 225 MHz. Compatible with 10K ECL outputs or with 100K ECL outputs. AVAILABLE NOW.

3 Video RAM Controllers (VRCs). Memory-array controllers for dual-port video RAMs from 256K to 4 Mbits, including dual-access arbitration logic for multiple-CPU applications. AVAILABLE NOW.

A total of 11 chips — all introduced in a single year between Siggraph 1986 and Siggraph 1987. An unmatched commitment to graphics system design.

And soon another family member, now in beta-site testing: **Raster Graphics Processor (RGP).** A fully programmable, high-performance microprocessor specially tuned for graphics applications.

All devices available in PLCCs.



THE MULTIPLE-CHIP SECRET

The secret to all this flexibility and performance is our unique multiple-chip, modular approach. Rather than trying to squeeze all the important graphics functions onto a single chip — which would require some significant design and performance compromises — we've partitioned appropriate functions onto individual building-block ICs. This allows us to optimize the design of each chip, and allows you to optimize your own design for your particular application.

GRAPHICS WITHOUT LIMITS

What matters most about the Advanced Graphics Chip Set, of course, is what it does for *you.* And that answer is clear when you consider its high performance, its modular approach, its open architecture, and its programmability: It gives you graphics without limits. It gives you true design freedom. It gives you the opportunity, for the first time, to design a graphics system "custom fit" to your exact specifications.

So what are you waiting for? If you're tired of those limited single-chip solutions bogging down your designs, take a look at the Advanced Graphics Chip Set. And learn how you can design a graphics system to match your needs . . . as well as your imagination.

For more information and availabilities, just contact your local National Semiconductor Sales Engineer or write:

National Semiconductor
Advanced Graphics, MS 23-200
P.O. Box 58090
Santa Clara, CA 95052-8090

National Semiconductor

Circle 11 on reader service card

0.7μ CMOS 64K SRAMS

This blazing 64K SRAM, with 12ns address access time, is twice as fast as any non-Performance 64K. It joins our family of 64K architectures—all with 6 transistor storage cells to optimize for performance, margins, temperature range, and supply tolerances.

		Com'l	Mil
P4C187	64K x 1	12ns	15ns
P4C188	16K x 4*	17ns	25ns
P4C164	8K x 8	20ns	25ns

*Also available: Common I/O with output enable and separate I/O.

For optimal packing density, our standard 64K SRAMs are delivered in the popular 0.3″ package widths, in either hermetic or plastic.

But that's not all. While others are still trying to catch up to the pace set by our 0.8 micron channel lengths and 2.75 micron metal pitch, we have pushed the frontiers of technology out even further. Now Performance's PACE Technology™ features 0.7 micron effective channel lengths, and 2.25 micron metal pitch. (As we've said before, metal pitch is the design rule that separates the men from the boys in VLSI technology.)

All of our chips are made here in our Sunnyvale facility for six-inch wafers, which has now attained Class 1 status.

Memory technology with the highest speed and greatest density gives you faster systems at a lower cost. So don't be left behind. Call the company that is ready to deliver the performance your system needs.

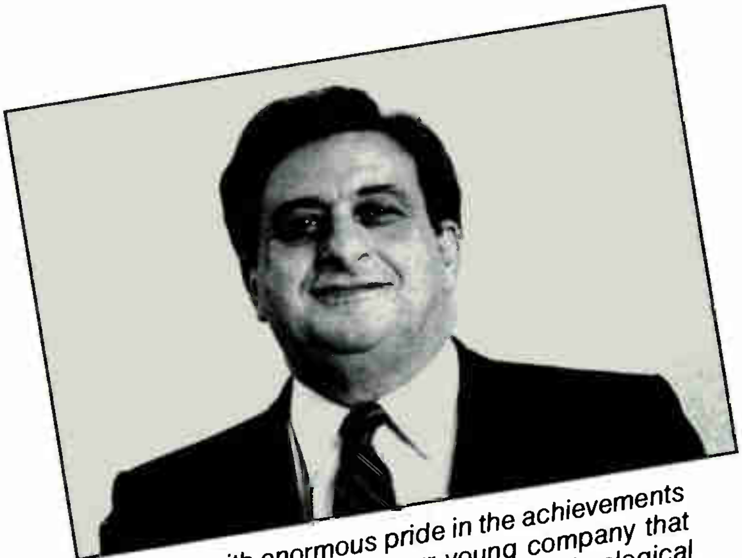
Performance Semiconductor
610 E. Weddell Drive
Sunnyvale, CA 94089
Telephone: 408-734-9000
Telex: 6502715784
FAX: 408-734-0258

Circle 19 on reader service card

12NS

PERFORMANCE SEMICONDUCTOR SHATTERS THE SPEED BARRIER

with a new CMOS 64K x 1 SRAM



"It is with enormous pride in the achievements of the employees of our young company that we are able to announce that our technological pace is accelerating. Our engineers and scientists are smart, dedicated, and focused. New levels of technical productivity are being established every month. We are at the tip of the technology vector into the future and we intend to stay there."

Tom Longo
President

PERFORMANCE
SEMICONDUCTOR CORPORATION

I want a faster system! Please send me detailed information on your SRAMs.

NAME ______________________

TITLE ______________________

COMPANY ______________________

ADDRESS ______________________

CITY/ST/ZIP ______________________

PHONE ______________________

ELECTRONICS NEWSLETTER

HP AND TI PROMISE SUBMICRON BICMOS PROCESSES

While biCMOS processes have attracted a stronger following, many designers worry that submicron geometries could restrict biCMOS performance because they would limit the drive capabilities of the on-chip devices. That's not so, however, according to a group of Hewlett-Packard Co. researchers who described work on an experimental 0.5-μm process at the International Electron Devices Meeting in Washington last week. Testing the process in various ring oscillators, the Palo Alto researchers achieved delay times of 406 ps—two-thirds that of a pure 0.5-μm circuit. What's more, the process yielded relatively high-performance bipolar devices with cutoff frequencies of 7.5 GHz at 1.5 mA. HP was not alone in singing the praises of sub-micron biCMOS. A group from Texas Instruments Inc. unveiled details of its 0.8-μm process, calling it the "next generation of very high-performance, low-power logic and memory products." The TI group showed details of a 16-Kbit ECL/CMOS static random-access memory, with a six-transistor cell of only 118 μm^2. That kind of density could yield a 256-Kbit SRAM of 90,000 $mils^2$, which could fit in a 400-mil package and boast an access speed of just 7 ns. □

AT&T DEVELOPS A BETTER WAY TO PROBE VLSI CHIPS

Probing, characterizing, and timing VLSI circuits has always been daunting, but now a researcher at AT&T Co.'s Bell Laboratories has found a way to do the job quickly and nondestructively. Janis Valdmanis's technique can resolve timing signals down to 0.3 ps—100 times better than conventional electronic measurement systems. The entirely external technique can be used on any kind of material including silicon, gallium arsenide, ceramics, or hybrid circuits, and requires no specially designed test circuit on the chip itself. The probe used is a pyramid-shaped crystal of lithium tantalate attached to a quartz rod. Sampling and triggering pulses from two laser beams are focused into the tip, which can be placed close to any point on the chip using an X-Y-Z table for accuracy. Local electric fields at any node affect the birefringence of the crystal, and the effect on the intensity of the pulses can be measured. □

U. S. CHIP BUSINESS IS FORECAST TO GROW 17 TO 20% IN 1988 . . .

Most semiconductor experts are cautious about the prospects for 1988 but one notable exception is Charles Clough, president of Wyle Laboratories, a leading chip distributor. He's predicting strong 17% to 20% growth for the U. S. industry. Clough's upbeat view is based on the lean inventories of his customers, he says. "They are buying for consumption, not to stockpile," he explains. "If anything, inventories are lower than a year ago." Other developments in addition to healthy inventories point to a "year of good, digestible growth," he adds. These factors include continuing strong demand for Intel Corp.'s 80386 microprocessor and the growing role of integrated-circuit technology in automobiles. □

. . . AND NEW PRODUCT-CYCLES MAY FEND OFF ANY COMPUTER RECESSION

Outstanding performances by the leading computer makers will help fend off an industry-wide recession in 1988, say computer analysts at Sanford C. Bernstein & Co., a New York investment, research, and management firm. The firm predicts earnings growth between 25% and 50% for Compaq, Hewlett Packard, IBM, and Sun Microsystems, all of which are in the early or middle stages of new product cycles. Strong 15% to 25% growth is also expected from Digital Equipment, Control Data, Cray, Honeywell-Bull, and Wang Laboratories. The company says that growth in the computer industry is more closely tied to product cycles than to overall capital spending, the indicator of industry health that is watched most closely. □

It's the same old story. Static RAM suppliers come out with new claims base on, what else, speed. And with everybody touting speed, they all start looking alike. Until you look at reliability.

That's where INMOS breaks the mold.

At INMOS we've developed SRAMs that give you high performance without compromising reliability.

We've achieved that reliability with innovations like using layered refractory metals to reduce electromigration and eliminate stress voiding, interlevel shorts and to reduce contaminates.

At the transistor level we use lightly doped drains to inhibit hot electron effects, yielding transistors that will last more than a century.

So if you're tired of the same old line about the same old stuff, call INMOS. Our 25ns, 64K SRAMs will make you look at chips in a whole new way.

RELIABLE 64K CMOS SRAMs

inmos

INMOS, Colorado Springs, Colorado, Tel. (303) 630-4000; Bristol, England, Tel. (0454) 616616;
Paris, France, Tel. (1) 46 87 22.01, Munich, Germany, Tel. (089) 319 10 28, Tokyo, Japan, Tel. 03-505-2840.

Circle 23 on reader service card

PRODUCTS NEWSLETTER

GRAPHICS BOARD KIT IS COMPATIBLE WITH IBM's VGA STANDARD

Add-on board makers itching to field a graphics card 100% compatible with IBM Corp.'s Video Graphics Adapter standard can get a two-to-four-month jump on the competition and save $40,000 to $80,000 in development costs with Award Software Inc.'s AVGA Manufacturer's Kit. The kit includes everything from schematics, a netlist, and prototype boards, right down to FCC registration. Award, a Los Gatos, Calif.-based leader in Basic-input/output-system software, developed the kit with Cirrus Logic Inc., an integrated-circuit maker in Milpitas, Calif. Not surprisingly, the kit specifies Award's VGA BIOS and Cirrus's VGA chip set. Production boards will offer 640-by-480-pixel resolution, 16 colors, and will be compatible with all other IBM graphics standards. The $5,000 kit will be available in mid-January. Samples of Award's VGA BIOS chips cost $15; Cirrus's VGA chip set costs $45. □

PEREX'S 150-MBYTE STREAMER CUTS TAPE BACKUP TIME IN HALF

System integrators can cut tape-backup time for their computer products in half with a 150-Mbyte, dual-speed streaming drive from Perex Ltd. Designed for ¼-in., Small-Computer-Systems-Interface-compatible systems, the Peristream 150 in its 90 in./s mode loads data at 10 Mbytes/min, compared to 5 Mbytes/min for the competition. It gets its performance primarily by running the tape faster than the standard 72 in./s. Control problems are solved by a design with a complex application-specific integrated circuit chip at its heart. The drive also offers a 72-in./s mode and an electrical tape-loading system similar to those used in VCRs, instead of the mechanical systems of other makers, says the Reading, UK, company. Shinwa Corp., Tokyo, developed the loader and will market the system in Japan. U. S. sales will be handled through Naichimen Corp., Los Angeles. Available now, the Peristream will cost original-equipment manufacturers between $500 and $600. □

TI CHIP MATCHES IDT's FIFO ON SPEED AND USES LESS POWER

Look for Texas Instruments Inc. to provide International Device Technology Inc. with some strong competition in the fast first-in, first-out memory business with a 1-μm CMOS product that is just as fast but offers an active-mode power rating of 440 mW—20% lower than IDT's IDT7202. TI's 1K-by-9-bit SN74ACT7202 is miserly on power mostly because of the Dallas company's highly efficient EPIC 1-μm CMOS, twin-well, silicon-gate technology. Pin-compatible with the IDT7202, the new FIFO offers similar maximum access speeds of 35 and 50 ns. In standby mode, it beats the Santa Clara, Calif., competition by 47%—44 mW compared to 83 mW—and in an ultra low power-down mode it dissipates 3 mW instead of 28 mW for the IDT7202. Available now in 1,000-piece lots, the FIFO costs $31.25 each for the 35-ns grade and $22.50 for the 50-ns parts housed in plastic dual in-line packages. □

INTEL OFFERS ADA LANGUAGE TOOLS FOR THE 80386

Military applications developers using the Ada programming language with Intel Corp.'s 80386 microprocessor can now go one-stop shopping with the Ada-386 Cross-Compilation Package from Intel's Development Tools Operation, Hillsboro, Ore. The package includes chips, board products, and software tools needed to develop embedded real-time 386 applications on a Digital Equipment Corp. VAX terminal. Tools include a VAX/VMS compiler, symbolic debugger, a global optimizer, and an Ada runtime system for various hardware environments. The boards are compatible with Multibus I and II and have 1 Mbyte of dynamic random-access memory. Price varies with the VAX host; a MicroVAX version sells for $36,000 and will be ready in the first quarter. □

Chip, Chip, Array!

For High Speed with Low Power.

AMCC has the chips worth cheering about. When you need the versatility of high speed with low power in a bipolar array, our Q5000 Series Logic Arrays are the answer. They're designed for logic applications requiring speed/power efficiency. And they deliver.

Today's hi-rel commercial and military semicustom applications need high performance and proven reliability. And, our Q5000 Series gives you both—without paying the power penalty.

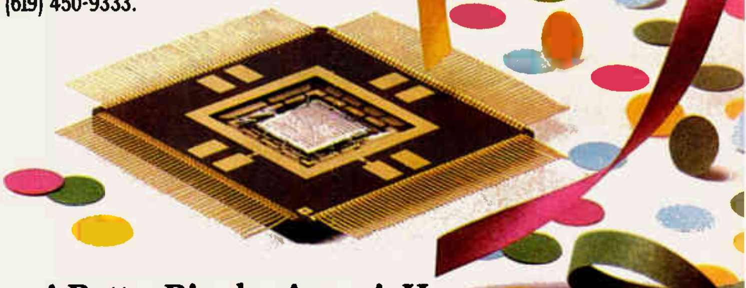
Our newest bipolar series is comprised of five arrays. All feature 4 levels of speed/power programmable macros and over 600 MHz I/O capability. One comes with 1280 bits of configurable RAM.

Q5000 Series Key Features

Equivalent Gate Delay:	210-545ps
Flip/Flop Frequency:	>600 MHz
Power Per Gate:	1mW
Speed/Power Product:	0.5pj
Equivalent Gates:	1300-5000
I/O Pads:	76-160
Operating Temperature Range:	−55°C to +125°C

AMCC Bipolar Logic Arrays have been designed with other flexible performance features in mind, too. Mixed ECL/TTL I/O compatibility. Your choice of packaging. Full military screening. AMCC's MacroMatrix® design tools. And, unrivaled customer support.

To talk with an applications engineer about your specific needs, in the U.S., **call toll free (800) 262-8830.** In Europe, call AMCC (U.K.) 44-256-468186. Or write, Applied MicroCircuits Corporation, 6195 Lusk Blvd., San Diego, CA 92121. (619) 450-9333.

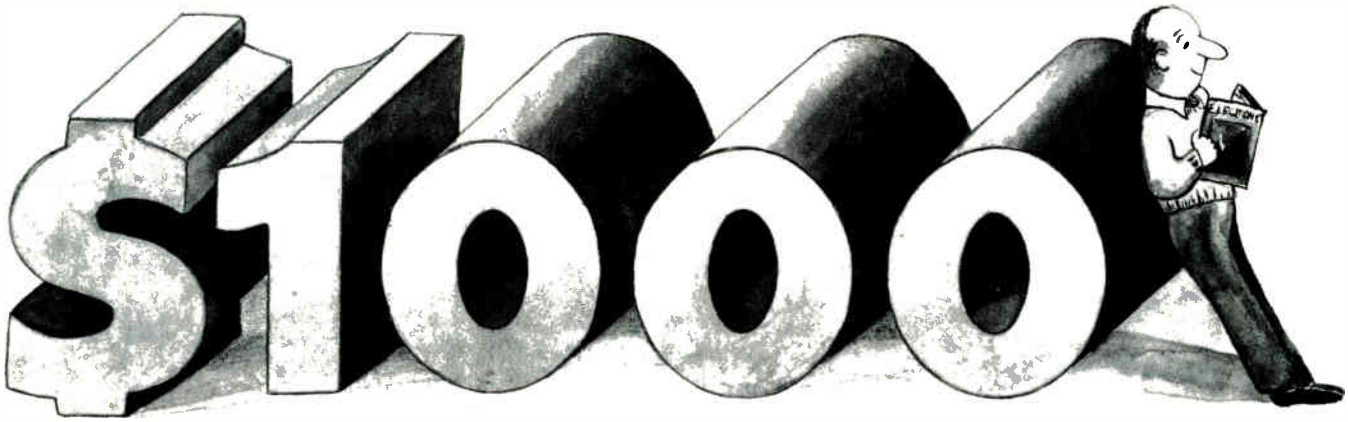


A Better Bipolar Array is Here.

AMCC

Circle 27 on reader service card

Win $1,000 Cash In *Electronics'* Annual Advertiser Audit Contest!



Watch for more details and complete contest rules in the January 7, 1988 issue.

It's easy to enter, and fun to win! Simply select the 10 ads in the January 7, 1988 issue of *Electronics* that you think will be best-read by your peers. List your selections on the entry card bound in the issue, or a reasonable facsimile. Whoever comes closest to selecting the 10 winning ads collects $1,000 cash!

Electronics

Attention Advertisers: You can win $1,000 too!

All advertising and marketing personnel in companies and agencies are invited to participate along with our readers by filling out a Special Advertiser's Ballot included in the January 7, 1988 issue. Whoever comes closest to picking the 10 winning ads in this special advertiser's contest will receive an award acknowledging their skill in evaluating advertising, plus a free ad for their company—and $1,000 cash!

FCC CISPR VDE

EMI Noise Sensor catches the source of EMI.

In this electronics age, troubles of electronic equipments by EMI tend to increase in various fields of industry. In order to solve this problem, it is necessary to take the following two measures simultaneously:
One is to enhance the noise immunity of electronic equipment itself for preventing malfunction, and the other is to suppress the source of EMI which may be produced from electric and electronic equipments.

The EMI Noise Sensor is designed to search for the source of interfering electro-magnetic wave and to indicate its intensity by LED bar graphs approximately according to each frequency band classified based on the FCC, CISPR, VDE standards, so you can monitor the effectiveness of noise countermeasures you have taken in your products.

Compact design and lightweight construction allow you to take the most effective countermeasures at any time and anywhere.

Before testing your products in a large-scale open site, thoroughly study the effective countermeasures for EMI in your factory. The EMI Noise Sensor sharply cuts the time and cost required for passing the approval test.

<FEATURES>

- **FVC-1000 indicates the intensity of interfering electro-magnetic wave approximately according to each frequency band classified based on the FCC, CISPR, VDE standards.**
- **No necessity for a shielding room or RF anechoic chamber.**

NOISE LABORATORY CO., LTD.

2662-1, NOBORITO, TAMA-KU, KAWASAKI CITY, KANAGAWA PREF, 214 JAPAN
TEL(044)933-4311 TELEX 3842777 NOISEL FAX(044)932-4511

NOISE®
NOISE LABORATORY CO., LTD.

Ordering Information Remittance to our account No.77-062-114878 with The Dai-ichi Kangyo Bank, Ltd., Shinjuku-nishiguchi Branch, Tokyo, for U.S. Dollars 1,850.00 (FOB Japan, Air freight collect)

Circle 30 on reader service card

Electronics

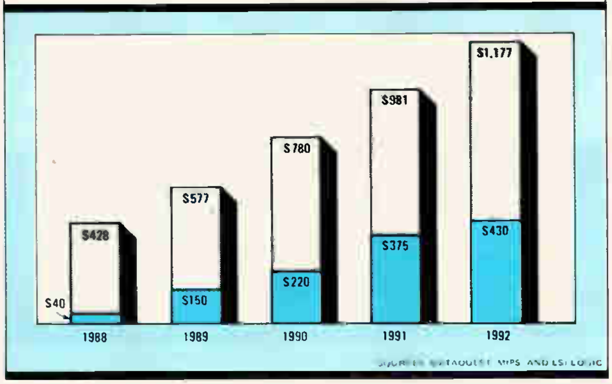
MOTOROLA CONFIRMS RISC EFFORT AS PRESSURE ON 68000 BUILDS

CHIP MAKER IS SPENDING UP TO $20 MILLION A YEAR ON DEVELOPMENT

AUSTIN, TEXAS

Motorola Inc. has ended the suspense. The big semiconductor maker, pushed by its customers and moving to counter threatening new alliances formed by feisty young silicon merchants, has finally decided to enter the emerging market for 32-bit microprocessors based on reduced-instruction-set architecture. And the other big U. S. 32-bit chip makers, National Semiconductor Corp. and Intel Corp., are taking their own routes.

RISC SHARE OF WORLDWIDE 32-BIT MARKET SOARS (IN $ MILLION)



The industry has been abuzz for more than a year with rumors about a Motorola RISC project, called the 78000, but the company would not discuss it. Meanwhile, Sun Microsystems signed up Fujitsu, Cypress Semiconductor, and Bipolar Integrated Technology to build its Sparc architecture [*Electronics*, Aug. 6, 1987, p. 126]. Then, last month, another trio—LSI Logic, Integrated Device Technology, and Performance Semiconductor—enlisted to back the RISC chip set of work station-maker MIPS Computer Systems. That did it: the multipronged attack on its complex-instruction-set 68000 processors as well as growing customer approval of RISC forced Motorola to go public.

Motorola officials emphasize that though they have been working on RISC for several years, they are unconvinced that the technology will replace CISC. While Sun and MIPS claim higher performance and lower cost for RISC, the Motorola counterclaim is that CISC can match or outperform RISC, and that it can cost less because of higher sales volume. However, the officials acknowledge that RISC can cut design time and serve customers that are enthusiastic about the architecture.

Competitors and some market analysts say what Motorola faces in RISC is spelled r-i-s-k because of incompatibility with the 68020, the new 68030, and the planned 68040. Motorola managers strongly disagree, saying they can set separate standards. They also argue that CISC-based processors will continue to dominate the 32-bit markets, though Motorola officials hint that the future 68040 will have more RISC-like features mixed in with its CISC-based design.

Motorola's RISC project is separate from its 68000 work, says Murray A. Goldman, senior vice president and general manager of the Microprocessor Products Group in Austin. Goldman says Motorola is spending at a rate of $10 million to $20 million per year on the work. The chip will be in CMOS, operate under Unix, and is expected to be ready early in the year, though Goldman won't confirm that.

In the MIPS alliance, the three chip houses will apply their fast CMOS technologies to the R2000 central-processing unit and R2010 floating-point accelerator, starting out at common speeds of 12.5 and 16.7 MHz. Around mid-1988, IDT, LSI Logic, and Performance Semiconductor will start revving up their own CMOS processes in an all-out race to provide the fastest and lowest-cost parts. The three are also planning to design and produce peripherals independently.

IDT, which is considering a future biCMOS MIPS design, is planning a line of peripherals for the RISC architecture likely to include a graphics coprocessor and digital signal filter. The first will appear in the second half of 1988.

LSI Logic was attracted to the MIPS design by its small size, which makes it easier to include in a semicustom design library, says Rob Walker, vice president and chief engineering officer. After the initial 1.5-μm core, LSI Logic plans a 1.2-μm CMOS design to offer performance of 25 million instructions per second. In 1989, a submicron CMOS process will be used to push performance to 40 mips.

Performance, already selling 16-bit 1750A processors to the military, will use the MIPS design to expand those offerings and enter the 32-bit commercial business. It is also planning peripheral chips, starting with a set of high-speed write buffers.

MIPS will participate in the design of future generations of the core chip set and act as judge on conformance to its software base, says Robert C. Miller, MIPS's chairman and chief executive officer. Miller also says MIPS might not be finished signing up chip-producing sources yet—the company is also interested in emitter-coupled logic and even gallium arsenide.

GOOD YEAR. The MIPS and Motorola developments serve as a fitting finale to a big year for RISC. The technology built up steam through 1987, partly led by engineering work-station houses seeking more power than than they can get from commodity microprocessors, and partly fueled by general discontent over sole-source supplies of 32-bit chips from Motorola and Intel, Santa Clara, Calif.

In addition to the MIPS and Sun teams, the RISC scorecard now lists Advanced Micro Devices Inc., with its AM29000 Streamlined Instruction Processor [*Electronics*, March 19, 1987, p. 61], as well as Intergraph Corp. Intergraph acquired rights to the first- and second-generation Clipper [*Electronics*, Nov. 12, 1987, p. 85] from Fairchild Semiconductor Corp.

The MIPS camp is aiming for 1,000 design wins during the next three years, and estimates that the RISC segment of the 32-bit microprocessor business could reach $430 million of a total world market that hits $1.177 billion (see figure). However, at market researchers Dataquest Inc., analyst Alice Leeper estimates the RISC portion to be about half that. "We feel the largest part of the market is in established applications," she says, but adds that more RISC announcements can be expected.

Such as one from National Semiconductor Corp. The Santa Clara, Calif., company will announce early next year that it is working on a RISC-oriented next generation of its CISC-based 32-bit 32532. President Charles E. Sporck adds that no RISC processor will be introduced unless it is compatible with the existing 32000 microprocessor line. Intel, also rumored to have a RISC chip in design for embedded control applications, is also considering RISC-like operations for its future 80486.

"We will use RISC technology on the 486 to do RISC-level instructions in single-clock cycles, but the bigger application is in embedded control. I'm not ready to announce any products, however," says Dave House, senior vice president and general manager of Intel's Microcomputer Group in Santa Clara. *–J. Robert Lineback*

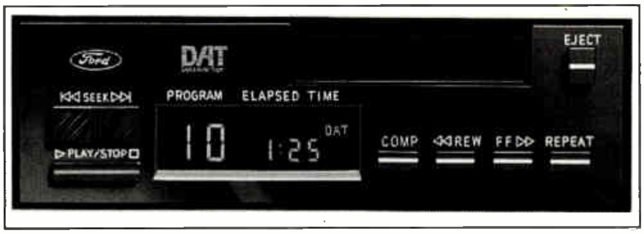
CONSUMER

DIGITAL AUDIO TAPE GETS CLOSER IN U. S.

DEARBORN, MICH.

There are growing signs that consumer digital audio tape may finally be able to establish a beachhead in the U. S., despite the political controversy that has so far blocked the entry of the new technology here.

Ford Motor Co. is the latest to join those vowing to test the waters next year. With hardware supplied by Sony Corp., the automaker announced plans this month to offer DAT players as an option for the Lincoln Continental in limited markets beginning in June. What's more, at least three consumer audio vendors say they'll announce 1988 U. S. price and delivery schedules for DAT hardware at next month's Winter Consumer Electronics Show in Las Vegas after one of them, Marantz Co. of Chatsworth, Calif., said last summer that its introduction would come in October. Likewise, at least one independent record producer plans to announce immediate U. S. availability of prerecorded music on DAT, with others contemplating similar moves.



DAT DRIVE. As manufacturers await word on the DAT software-protection controversy, Ford plans to offer a player in 1988.

COPYRIGHT DISPUTE. DAT backers are hoping that these initiatives and possibly others will help break the logjam. At least a dozen manufacturers showed DAT prototypes at last January's show [*Electronics*, Jan. 22, 1987, p. 30]. But the dispute with the record industry over software copyright issues has so far prevented big-name suppliers from marketing consumer DAT home hardware here.

For its part, the Recording Industry Association of America, which represents major record producers, is continuing to push for federal legislation that would mandate the use of a circuit in all DAT recorder/players to prevent the copying of prerecorded materials containing a special code. The record industry is concerned about lost revenues because DAT can produce high-quality digital copies of records, analog tapes, and perhaps compact disks. Until the issue is resolved, the major record labels are boycotting DAT, while major hardware makers sit on the fence. But DAT hardware is being sold in Japan, and is also entering the European market despite similar copyright disputes.

Progress on the U. S. legislative front could come in late January or February. That's when the National Bureau of Standards is expected to deliver results of a test of the proposed DAT copy-code system, which was devised by CBS Inc.

The Ford system is play-only, so it won't run afoul of any legislation affecting play/record equipment. The same is true for the Audia 7000 car DAT player which Clarion Corp. of America, Lawndale, Calif., plans to introduce in Las Vegas for U. S. delivery in April. But given the boycott by major labels, will buyers of play-only equipment have anything to listen to?

"We feel confident there will be prerecorded software available by next summer," says Don Duncan, marketing manager for Ford Audio Systems, a unit of the company's Electrical and Electronics Division in Dearborn, Mich. "If not, we'll provide a sample tape for customers, and we'll also give them information on where they can order [DAT titles] directly from suppliers."

Indeed, at least one independent software house says it's ready. "We'll have immediate availability on 45 titles," says Jerome Stine, marketing director for Delta Music Inc., Los Angeles. Like the hardware, initial DAT software releases won't come cheap. "Our price to dealers will be $19.40 each," says Stine. On the hardware side, car DAT players will retail for over $1,000. DAT player/recorders for home use are expected to cost $1,500 to $2,000.

Despite the likely software shortage and the threat of restrictive legislation, at least two vendors say they plan to go ahead now with play/record DAT hardware here that will not include a copy-code chip. Casio Inc., Fairfield, N. J., says it will start test-marketing its $1,099 DAT-1 portable player/recorder in the U. S. beginning in April.

And Marantz, which last June declared its intention to market its DT-84 home deck in October [*Electronics*, June 11, 1987, p. 24] but didn't, is now vowing to proceed next year. What stymied the company, explains president James Twerdahl, was the unwillingness of its Japanese suppliers to provide component parts for the unit—for fear of balance-of-trade repercussions—and other issues. *–Wesley R. Iversen*

THE IEEE

IEEE'S NEW VOTE RULES WEAKEN 'THIRD PARTIES'

NEW YORK

Petition candidates are effectively being closed out of the Institute of Electrical and Electronics Engineers elections. The IEEE is switching next fall to a new process, approval plurality voting, that effectively prevents "third-party" candidates from winning an election when two or more other candidates split the establishment vote. Under the new rules, members can vote for as many candidates as they choose.

Jack Nagel, an associate professor of political science at the University of Pennsylvania and a leading proponent of approval voting, puts it succinctly: "Approval voting helps prevent a splintering of the majority."

IEEE executives say the new method is an answer to their prayers after three years of trying to improve the organization's electoral process. Approval pluarlity voting was developed in the mid-1970s by a group of academics, but has not won much success, particularly for electing government officials. The IEEE, with 280,000 members, is the biggest organization to back it so far.

That's exactly why the institute's most outspoken critic, Irwin Feerst, who has lost five races for IEEE president as a petition candidate, says the change is unfair. The move was taken solely to keep "the academics and corporate executives" in charge and himself out of contention, Feerst charges. "I am the target of this change," he says. "They're trying to keep the dissidents down."

Henry L. Bachman, the current IEEE president, says that is not the case. "In elections where we have multiple candidates running for a single seat, we've generally had an even split," he says.

For example, the 1975 IEEE election pitted Feerst against the IEEE's board of directors' candidate, Joe Dillard, in a two-man race; Feerst drew 37.6% of the vote—respectable, but still far short of Dillard's 61.5% share. But 11 years later, Feerst went up against two board-nominated candidates, Russell Drew and Merlin Smith, and almost won, even though he captured only 34.3% of the votes. Feerst came within half a percentage point of beating Drew, the winner. Feerst almost succeeded because the so-called mainstream voters had been forced to choose between two candidates. Together, Drew and Smith garnered 64.8% of the vote.

Anticipating another Feerst candidacy, the IEEE board nominated only Emerson Pugh in 1987. But this time Feerst held off, pushing instead for a constitutional amendment requiring the board to nominate a minimum of two candidates. His aim was to wait a year and try to split the vote again.

FELL SHORT. The amendment was approved by a majority—but not the two-thirds majority it needed to pass. And although the board promised in November to name at least two nominees in the future, it now has acted to foil Feerst's strategy by switching over to approval voting. Now, since mainstream voters no longer must choose between two acceptable candidates, they can vote for each. Such a scenario would make it difficult for Feerst to mount a strong challenge. *–Tobias Naegele*

INTEGRATED CIRCUITS

SMART POWER GOES OFF-THE-SHELF

LOS ANGELES

Power integrated circuits, until now mostly custom chips for a few major automotive customers, are becoming standard products. The big-name suppliers, Motorola Inc. and Siemens AG, are pitching their first off-the-shelf power ICs to industrial-equipment makers. And several competitors, including a division of General Electric Co. looking to stage a comeback, are polishing their own standards for introduction in early 1988.

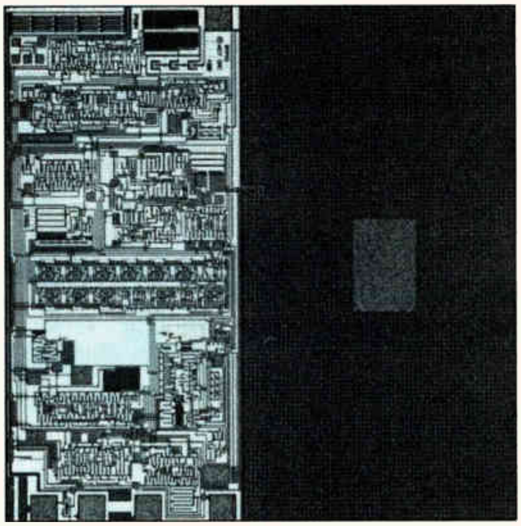
The strategy, to develop high-volume momentum to drive down prices, foreshadows the emergence of power ICs as an important business. The chips are attractive because they combine logic circuitry and a power switching element—at least several amps worth of power and upwards of 25 V—in the same monolithic device. A sensing function is also required. Their compactness and performance permits power ICs to replace entire boards of discrete components in interfacing microprocessors to all types of equipment.

DAUNTING TASK. The chips are complex, however, and low yields make them more than three times as expensive as discrete solutions. In addition, providing what is expected of standard parts has proved daunting. For example, isolating the power from logic economically and protecting chips from real-world conditions such as overvoltage surges and extreme temperatures have been difficult. Also, the most sophisticated chips need up to 15 mask levels, compared to fewer than half that for logic ICs.

"It is a lot tougher than people expected, including us," says Donald Neill, marketing manager for General Electric Co.'s Integrated Power Systems Department. GE bid for leadership in the power IC industry several years ago but recently has kept a low profile. Its power IC facility in Research Triangle Park, N. C., has spent seven years and some $100 million to date. The company, though, considers power ICs "only at the early development stage, where customers are still trying to figure out the payoff," Neill says.

Despite the new-product activity, knowledgeable industry observers say it will take until 1990 or 1991—when the first car models using them extensively will appear—for power ICs to become major factors. Observers also expect better computer-aided-design tools by then, which will make possible application-specific power ICs and provide a boost in other markets.

In fact, the move to standard power ICs helps power ASICs, in the view of Motorola's Daniel Artusi. "The standard products then become cells which can be used from our expanded smartpower library," says Artusi, director of marketing, power, and transistors for Motorola's Discrete Products Group in Phoenix.



POWER PACKED. In a typical power IC from Motorola, CMOS power cells are separated from the logic block.

Motorola and Siemens appear to have a step up on the rest of the field with their chips, called high-side switches, designed for auto use. The Motorola Smartpower MPC 1510 and Siemens Smart Sipmos BTS 412A operate at up to 35 V with a 12-A rating and are intended, under microprocessor control, to switch solenoids and other inductive loads between the power source and the ground. This suits them for myriad industrial tasks, including robotics and program control.

Other power IC makers are not far behind with products in sample quantities and volume production promised shortly. GE, in particular, is preparing to unveil expanded lines. They include power-conversion devices in the GS/600 family with ratings up to 500 V and smart input/output modules with increased functionality in the GS/200 group. "You'll see us recognized as the leader again," GE's Neill predicts.

Siliconix Inc. in Santa Clara, Calif., intends to carve out a niche in battery-powered equipment such as intelligent telephones. The company is adding to its SI9100 Smartpower family, which provides dc-to-dc power conversion. Ixys Corp. of San Jose, Calif., is addressing the auto market, where a manufacturing partner is funding a program aimed at producing millions of devices. In the meantime, the privately held company has a line of modules planned that will switch up to 1,000 V.

At International Rectifier Corp. in El Segundo, Calif., two of the earliest power ICs, the Chipswitch and photovoltaic relay, have sold steadily to the tune of $1 million a year. But these still are not truly volume products, says Derek Lidow, executive vice president for marketing. The company plans two more high-powered entries in the spring, along with power ICs developed jointly with National Semiconductor Corp. *–Larry Waller*

DESIGN AUTOMATION

HERE'S YOUR COFFEE—AND YOUR FINISHED PLD DESIGN

SANTA CLARA, CALIF.

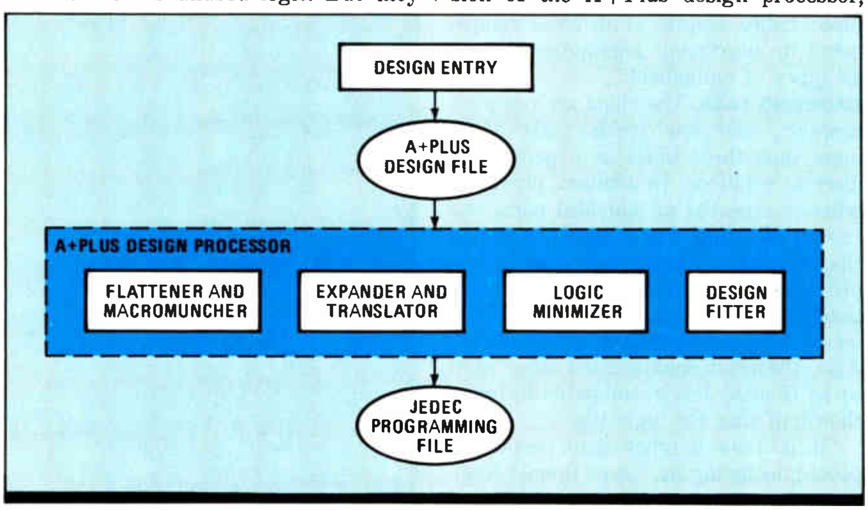
In about the time it takes an engineer to grab a cup of coffee, fast new compiler software for CMOS erasable programmable logic devices can convert design descriptions into finished EPLD programming patterns. That reduction—down to minutes from a half hour—promises not only to keep engineers productive during the iterative process of system design, but also to slim down development operations for competitive equipment markets.

The software is from Altera Corp., a Santa Clara, Calif., producer of EPLDs. The company is incorporating the speedy intelligence-laden compiler into the new version 5.0 of its A+Plus design processor software. It becomes available this month for IBM Corp. PC ATs and compatibles. At the same time, Altera is joining a handful of competitors in unveiling faster EPLDs. The one-two punch of fast-turnaround development software and quick CMOS chips is intended to deepen penetration of semicustom markets now served by mask-programmed gate arrays and bipolar PLDs by Altera's EPLDs.

For the development software (see figure), Altera engineers didn't touch the flattener and macromuncher portion of the design processor, which substitutes logic descriptions for TTL symbols and then trims unused logic. But they sped up the expander section which scans for errors, and rewrote the logic minimizer portion to include knowledge-based, general-consensus algorithms that take a specific engineering tack in reducing the size of product tables. Programmers also embedded heuristic strategies into the compiler's design fitter, which now employs artificial-intelligence-like algorithms to quickly determine if a particular approach to putting logic in an EPLD chip will be successful.

Smart fitter programs are becoming necesssary in EPLD programming because of the growing densities of the CMOS parts, says Clive McCarthy, vice president of software development. "It is becoming the kind of computing task that cannot be solved strictly by brute force," says McCarthy, referring to approaches that try all combinations of logic placement before giving up on a design that might not fit.

Altera managers believe the speedup of the A+Plus software has pushed compilation times to their maximum beneficial point. "A designer can now very quickly do 10 or a dozen designs within a day, iterating a system design through changes," says McCarthy. Key design changes during prototyping can be made while fixes are fresh on the mind of a designer, says David A. Laws, marketing vice president. The 5.0 version of the A+Plus design processor,



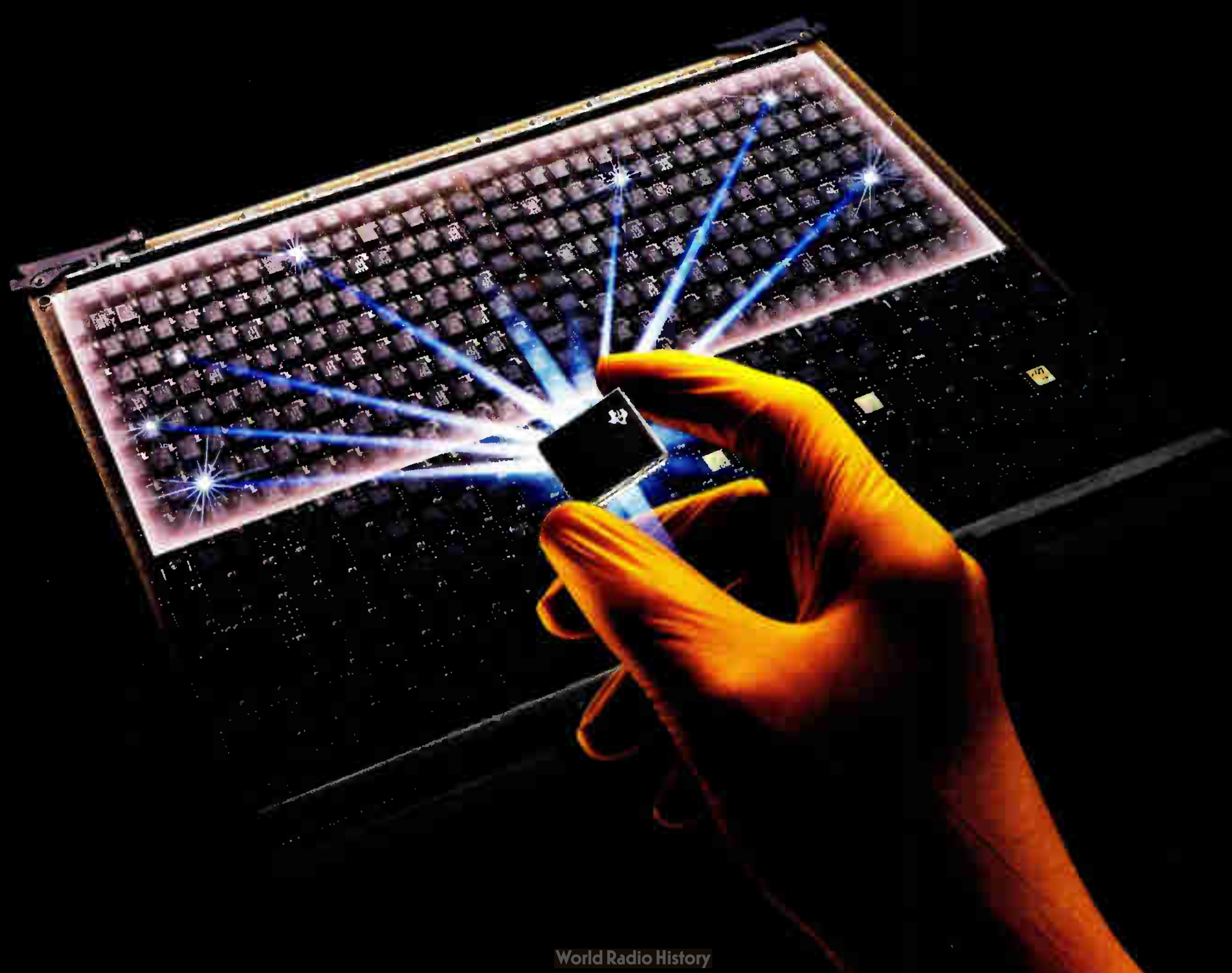
KEY IMPROVEMENTS. Altera has sped up the expander, rewritten the logic minimizer, and added AI-like algorithms to the design fitter portions of its EPLD design processor.

TEXAS INSTRUMENTS REPORTS ON

MEMORY MANAGEMENT

IN THE ERA OF

MegaChip TECHNOLOGIES



Texas Instruments can help processor speeds.

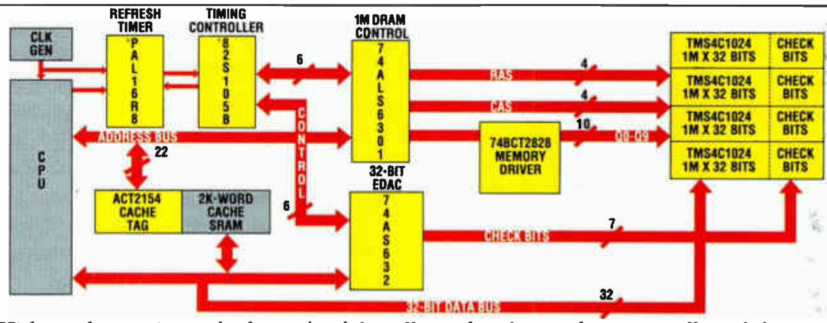
A universal architecture enables these TI devices to work with — and enhance — virtually any high-speed microprocessor or bus structure, even custom engines.

In addition, your component count is cut because these are single-chip VLSI circuits. Your design time and effort are shorter and easier because of TI's comprehensive Memory Management Design Kit *(see page 4)*.

TI addresses your major memory-design concerns

To immediately improve memory-access time, use both main and cache memories, as shown in the block diagram. This approach can produce up to a 3X increase in system performance.

Frequently accessed data and instructions are stored in a few high-speed static random-access memories and "tagged" by a TI industry-standard cache controller (SN74ACT2151/4). These CMOS controllers are the fastest available and can support deep cache architectures of 16K or even 32K.



High-speed memories can be designed with less effort and implemented more cost-effectively by using TI's family of universal memory-management ICs. These devices, all of which are contained in TI's Memory Management Design Kit, will work with and enhance almost any high-speed processor.

This scheme is cost-effective because slower, less expensive dynamic random-access memories (DRAMs) can be used for main memory.

When you must assure system integrity, use of an error-detection-and-correction (EDAC) circuit can improve system reliability 500-fold. Since this approach is necessary with memory arrays larger than half a million bits, TI offers its leadership 32-bit EDAC.

The SN74AS632 detects dual-bit errors and detects and corrects single-bit errors while avoiding processor wait states. It is the fastest EDAC available: 25 ns for error detect, 32 ns for correct.

Interfacing between processor and main memory gets tougher as speeds increase. But TI has the SN74ALS6301 DRAM timing controller. It can handle any DRAM up to 1 Mbit and incorporates only the essential functions on chip to improve flexibility and speed and to allow for custom timing routines. This controller supports nibble- and page-mode access and scrubbing-mode refresh to increase memory output.

Soon to come: An ASIC (application-specific integrated circuit) solution.

Reducing over/undershoot is accomplished by TI's 2000 Series buffers and drivers — 25-ohm series-damping resistors on the output prevent false reads at DRAM input. For example, the SN74BCT2828 driver can reduce undershoot by 40% compared to traditional approaches. TI's 2000 Series has a high-drive current suitable for VME and MULTIBUS® II bus structures.

You can use any or all of TI's memory-management ICs to obtain the superior performance that marks a market winner. And there's no design rule that says your memory-management chips and your CPU have to come from the same supplier.

TI's MegaChip Technologies

Our emphasis on volume manufacturing of high-density circuits is the catalyst for ongoing advances in how we design, process, and manufacture semiconductors and in how we serve our customers. These are our MegaChip™ Technologies. They are the means by which we can help you and your company get to market faster with better, more competitive products.

▶ *Turn page for more information.*

The tools you need to design a high-performance memory-management system are between these covers:

At $149, the value of TI's Design Kit far outweighs its cost. In one compact file, we've included just about everything you'll need to bring your memory array up to speed. Everything, that is, except your imagination in creating your own unique product differentiators. Here's what you get:

- All necessary high-performance ICs, including
  - —SN74ACT2154 2K X 8 Cache Address Comparator
  - —SN74AS632 32-bit EDAC
  - —SN74ALS6301 16K to 1 Mbit DRAM Controller
  - —SN74BCT2828 10-bit Buffer/ Driver with series-damping resistor
  - —TIBPAL16R8-10 and TIB82S105B High-speed Programmable-logic Devices for user-defined timing control
  - —TMS4464 256K DRAM
- *Memory Management Applications Handbook* containing applications reports and briefs that supply valuable insights into memory-management system design.
- Data sheets on TI circuits designed for efficient memory management.
- Memory-management-product software graphic-symbol libraries and supporting documentation for use with Futurenet™ or Mentor Graphics™ CAE systems.

For more information on TI's Memory Management Design Kit, call 1-800-232-3200, ext. 3203, or contact your nearest TI field sales office or authorized distributor.

Texas Instruments Incorporated SDVØ63EC8ØØC
P.O. Box 809066
Dallas, Texas 75380-9066

YES, please send me more details on TI's universal memory-management ICs.

NAME ______________________

TITLE ______________________

COMPANY ______________________

ADDRESS ______________________

CITY ______________ STATE ______ ZIP ______

AREA CODE ______ TELEPHONE ______________ EXT. ______

™MegaChip is a trademark of Texas Instruments Incorporated.
Futurenet is a trademark of Futurenet Corporation.
Mentor Graphics is a trademark of Mentor Graphics Corporation.
®MULTIBUS is a registered trademark of Intel Corporation.

27-4510

TEXAS INSTRUMENTS

with a compiler that is 10 to 20 times faster than the previous release, sells for $1,750.

On the device front, faster chips are coming not only from Altera but also from Intel, Lattice, and Cypress. Altera says its additions to the EP600 and 900 series, designated the 610 and the 910, are more than 40% faster than present parts. Laws says that the speed of the two newcomers will enable them to muscle into the territory of high-power-dissipating bipolar parts, which cannot be reprogrammed like the ultraviolet-light-erasable CMOS devices. The 610, which has more than 600 equivalent gates, improves propagation delay to 25 ns from 45 ns; the 910, with more than 1,000 gates, will clip along at 30 ns versus 45 ns. The 610 and 910 have price tags of $12 and $21.50 in 100-piece lots, respectively.

Intel Corp., Santa Clara, Calif., now offers parts equal to Altera's slower ones and is aiming for 25 ns at 35.7 MHz with its new 1-μm 5AC312 EPLD [*Electronics*, Sept. 17, 1987, p. 65]. Lattice Semiconductor Corp. in Beaverton, Ore., has 15-ns parts now among its electrically erasable PLDs, which it calls generic array logic, or GAL. But with a submicron CMOS process next year, it plans to ship 12-ns EEPLDs in the first half and 10-ns parts in the last half, says Paul Kollar, vice president of sales and marketing. "We may soon beat the TTL boys at the 24-pin level."

Cypress Semiconductor Corp. in San Jose, Calif., is fitting its entire EPLD product line for a new 0.8-μm drawn-gate, double-level metal CMOS process. It will wring 15 and 12 ns out of 25-ns parts starting in the second quarter. "This will allow us to replace all but the 10-ns bioplar parts, which are still not in volume production. We expect to be able to select some 10-ns parts and have a high yield at 12 ns," says Al Graf, the company's PLD product marketing manager. *–J. Robert Lineback*

SOLID STATE

A NEW BREED OF FAST, LOW-POWER BIPOLAR

BÖBLINGEN, WEST GERMANY

A new breed of bipolar chip is now being developed that may blaze a trail for bipolar design into VLSI for consumer products, where low power is the ticket, and for data processing, where speed is crucial. Researchers at IBM Laboratories in Böblingen report power dissipation of 50 μW and a speed of 800 ps in experimental devices, but say that is just the beginning.

There are some proprietary bipolar processes—such as those from Bipolar Integrated Technology Inc. of Beaverton, Ore., and Integrated Device Technology Inc. of Santa Clara, Calif.—that produce low-power functions. However, these do not get down to CMOS levels; neither can they be considered generic low-power processes, as is CMOS.

The new complementary-transistor-logic circuit, instead of operating on a well-defined base current like standard bipolar logic circuits, uses minority carrier charges to generate the currents for switching the output transistors. Hence its name: charge-buffered logic. And since only low dc currents flow in standby, the average power consumption is reduced to CMOS values. In fact, CBL is to bipolar what CMOS is to MOS: both are complementary circuits, with CBL using pnp and npn transistors, and MOS relying on p-channel and n-channel transistors.

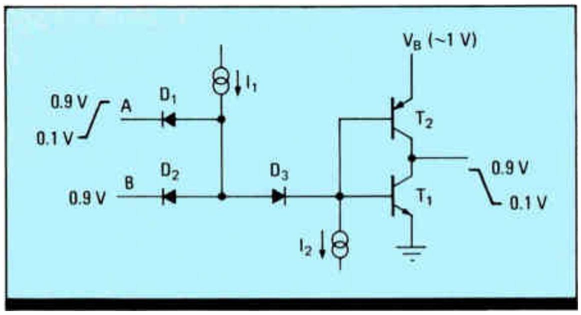
To get to the 800 ps-50 μW level, the IBM team uses conventional 2.2-μm technology and a 200-MHz switching transistor. But computer calculations show that the circuit—described at the International Electron Device Meeting earlier this month in Washington—can reach 300 ps and less than 10 μW if 1.2-μm features and a 1.5-GHz pnp are used instead. A circuit boasting such speed but using so little power would set records for bipolar design, says IBM Fellow Siegfried Wiedmann, head of a VLSI design team at Böblingen. A fast pnp transistor is a prerequisite for high-speed switching.

But even those values are not the limit, says Wiedmann. CBLs using 1-μm technologies, trench isolation, and other novel process techniques as well as pnp transistors higher in the gigahertz range should top 100 ps, he says.

Up to now, designers around the world have hardly explored bipolar complementary-transistor logic. The reason: the current-controlled bipolar transistor, in contrast to the voltage-controlled MOS-type, is ill-suited for complementary logic applications. After switching, current continues to flow, which causes fairly high static power dissipation.

The solution would seem to be CMOS-like bipolar complementary-transistor logic in which bipolar transistors replace MOS types. But it is difficult to implement such logic with bipolar structures, even with advanced processing techniques. What's more, the relatively large saturation time constants of presently investigated transistor structures severely limits the speed.

These shortcomings eventually led Wiedmann, who was also one of the developers of integrated-injection logic, to the charge-controlled logic device. The challenge during the three years of CBL development work, Wiedmann says, was finding a way to feed a large controlled charge into the base of a transistor without generating the large continuous currents that conventional bipolar transistors require. By keeping such currents as low as possible, the standby power could be considerably reduced.



CBL. In a NAND configuration, D_1, D_2, and D_3 are the charge-storage diodes, and T_1 and T_2 are low-current push-pull drivers.

The basic CBL circuit consists of three diodes and a pnp/npn transistor pair at the output (see figure). It thus looks like a diode-transistor logic gate; indeed, the logic functions and static signals are similar to those in DTL.

Storing the charge are two input diodes. This minority carrier charge is rapidly transferred between these diodes and the third, the level-shift diode, during each switching transition.

The oppositely biased input diodes have a large time constant and can store a large charge, which is typically 0.1 pC, so during the switching period the input diodes act as a low series resistance. So just as with CMOS devices,

MORE MULTIPROCESSOR MUSCLE. MORE RAW PERFORMANCE.

When you're out in the trenches fighting it out with ordinary microprocessors, running out of muscle is all too easy. That's why you should look to the new T800 Transputer from INMOS.

The T800 is the fastest 32-bit, single chip, floating-point microprocessor available today. A quick glance at its statistics will show why nothing else is in its league...

32-bit enhanced RISC processor...64-bit on-chip IEEE floating-point processor...4K Bytes on-chip 50ns static RAM...Four 20 MBits/sec interprocessor communication links...Eight independent DMA engines. All on a single chip capable of sustained 1.5 MFLOPS...and 4.6M Whetstones!

And, if that's not enough raw power, the T800's links allow multiprocessor systems to be constructed quickly and easily – giving you 6 MFLOPS with four T800's...30 MFLOPS with 20...150 MFLOPS with 100...In fact, there's no limit to the number of Transputers you can use!

Programming Transputers couldn't be easier, with compilers for C, Fortran and Pascal, and the world's first concurrent programming language OCCAM.

Want to turbocharge your current system? No problem. Our exclusive Link Adaptor IC's allow Transputers to be connected to other microprocessors or peripherals.

Other team members include the pin compatible T414 Transputer, offering lower cost, 10 MIP performance and 0.75M Whetstones. Lined-up to provide all the I/O processing you need, the T212 16-bit Transputer is the ideal high performance controller and the M212 Disk Processor combines disk controller hardware and a Transputer on a single chip, supporting both Winchester and floppy disks. And the C004 Link Switch makes the design of software reconfigurable multiprocessor systems as easy as kicking an extra point.

Whatever field you're in – from real-time distributed systems to high-performance graphics, from fault-tolerant systems to robotics, Transputer technology can give you scalable performance at a cost you can afford.

Transputers are manufactured using an advanced 1.5 micron CMOS process which keeps the power consumption under one watt. So your system stays cool while under fire.

Transputers to MIL-STD 883C will be available in the first half of 1988.

If this all sounds like your kind of game, put the ball in play by contacting your local INMOS sales office today. And get ready to score.

DESCRIPTION			PERFORMANCE		AVAILABILITY		PACKAGE
Part No.	Word Length	Clock MHz	Integer Drystones	Floating Point Whetstones	Commercial	Military	
IMS T800-20	32-Bit	20	9500	4.6 Million	Now	Q2 88	84 PGA
IMS T414-20	32-Bit	20	9500	0.75 Million	Now	Q2 88	84 PGA
IMS T212-17	16-Bit	17	8000	–	Now	Q2 88	68 PGA
IMS T212-20	16-Bit	20	9500	–	Now	Q2 88	68 PGA
IMS M212-17	16-Bit	17	8000	–	Now	–	68 PGA

NETWORK SUPPORT PRODUCTS			AVAILABILITY		PACKAGE
Part No.	Description	Communication Speed	Commercial	Military	
IMS C004	Software configurable 32 way link switch	10 + 20 MBits/sec	Now	Q2 88	84 PGA
IMS C011	Link to system bus	10 + 20 MBits/sec	Now	–	24 Pin DIP
IMS C012	Link to system bus	10 + 20 MBits/Sec	Now	Q2 88	24 Pin DIP

THE TRANSPUTER TEAM

inmos®

INMOS, Colorado Springs, Colorado 80935. Tel. (303) 630-4000.

Orange County – 714-957-6018
Santa Clara – 408-727-7771
Denver – 303-252-4100
Minneapolis – 612-932-7121
Dallas – 214-490-9522
Boston – 617-366-4020
Baltimore – 301-995-6952
Atlanta – 404-242-7444

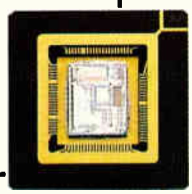
☐ Send me information on the Transputer Team. ☐ Send me the Transputer White Pages, a listing of third-party manufacturers' transputer-based products and services.
☐ Please have a Field Applications Engineer call. ☐ Please have a salesman call.

Name ______________ Title ______________

Company ______________ Address ______________

______________ Zip ________ Tel ________

EL12/17/87



Circle 45 on reader service card

a large current flows only during that period.

In their standby mode, the input diodes constitute a high resistance. That limits the current and therefore the power dissipation to levels that are virtually negligible. The dynamic power, on the other hand, is lower than that of CMOS because CBL uses smaller voltage swings. *– John Gosch*

MILITARY

COMING: EMBEDDED TRAINING SYSTEMS

WASHINGTON

Embedded training systems for the military were little more than an idea until recent advances in microprocessors and memory technology. The Department of Defense now thinks the time is ripe for integrating training functions directly into weapons, aircraft, or ship systems, and it has started developing a set of guidelines to speed things along. However, the big stumbling block still is deciding when and how integration should be done.

Traditionally, weapons and training systems have been designed and built by different contractors, under separate contracts and with little interaction. But the growing complexity of modern weapons systems and the high cost of dedicated trainers spurred interest in alternatives. Advocates say the embedded approach saves money, provides better hands-on training, and permits users to practice and refresh skills without having to leave the weapons unit.

FLEXIBLE. The Army took the lead last spring by mandating that embedded training must be evaluated as the first training option. But there is still some flexibility, says Dorothy Finley, a team leader at the Army Research Institute, and the director of a four-year effort to define the concept. "You don't have to have embedded training," Finley says, "but if you don't, you better have a pretty good reason for it."

One obvious reason is whether it's worth the trouble; not all weapons and vehicles may need embedded training. Other considerations include the effect a training system might have on the lifespan and cost of its host system. Key to the success of any implementation is an early decision, says J. Thomas Roth, staff scientist at Applied Science Associates. "The initial decision has to be made in the concept stages of a program."

"Embedded training must be viewed as only a component of your training system. It is not going to do all things for you," Finley says. "If you don't always remember that, you can end up

doing too much or too little."

To guard against that threat, a 10-volume set of procedures and guidelines is being developed by the Army institute, with three contractors—Applied Science Associates Inc. of Butler, Pa.; Vector Research Inc. of Ann Arbor, Mich.; and Hi-tech Systems Inc. of Columbus, Ga. The guidelines, aimed at program managers as well as prime contractors and subcontractors, cover all of the issues, documentation, requirements, and other factors that must be considered at each phase in program development. Finley says drafts of six volumes are already complete, and the rest should be completed by next June.

One result of the new Army policy is bound to be closer cooperation between the prime contractor and the training system contractor. "Designing the embedded training system component is similar to designing a stand-alone system," Roth says. "But there's a much stronger need for interaction between the systems designer and the training developer."

Embedded training may save money and permit better hands-on practice

For example, aircraft have tight space and weight limitations. That means training-system designers cannot add much in the way of computer hardware and must implement their systems in software that will run on the computers in the host equipment. That's where recent improvements in microprocessors and memory technology come in handy to support the additional software.

"Most of it can be done in software. That's the saving grace of it," says Henry C. Okraski, deputy technical director at the Naval Training Systems Center in Orlando, Fla. The center is the focal point for most of the DOD's training-system needs.

Okraski says the center is overseeing development of two embedded training systems "that look very promising." He expects one, which involves the SPA-256 radar, to be installed in 5,000 Navy systems. He also acknowledges that "we are making some inputs" for the SS-N-21 submarine. Code-named the Sea Wolf, the SS-N-21 is planned as the next generation of attack-class submarine.

Submarines are ideally suited to embedded training technology, Okraski says. They spend up to six months or more between ports, so the crew can test the systems whenever they have time, to make sure they stay sharp. "Embedded training has a tremendous payoff in areas where there are perishable skills," he says. *–Tobias Naegele*

In Costa Rica, we run rings around illiteracy.

Our belief in education is so strong in Costa Rica, we have a literacy rate of 93 percent—the highest in Latin America. That's why our work-force is without equal in the Caribbean.

It's also part of the reason why Costa Rica is the unequalled offshore location for U.S. manufacturers.

Our workers are well-educated, thanks to mandatory education to age 15 and numerous vocational and technical schools. There's even a Harvard Business School affiliate among our six universities. And they're willing, too, with the longest regular work week—48 hours—in the area. All of which means a manufacturer gets a high return on his labor investment.

And he gets it in the safest, most stable country in the Caribbean—a country that's had regularly scheduled, free and fair elections every four years for nearly four decades.

And all those willing workers work in an established, affordable infrastructure featuring abundant energy, transportation and tele-communications; with companies receiving generous incentives and tax holidays, including tax-free export earnings; and under a govern-ment that insists private industry help set public business policy.

When it comes to offshore manufacturing, Costa Rica has the ring of success. For more information, contact the nearest Costa Rican Investment Promotion Office.

COSTA RICA
The Right Business Climate

Northeast: 36 Hunting Lane, Suite A-1, Stamford, CT 06902 • (203) 968-1448. □ Midwest: 221 N. LaSalle Street, Suite 1808, Chicago, IL 60601 • (312) 346-0626.
Southeast: 235 Peachtree Street, Suite 1617, Atlanta, GA 30303 • (404) 223-5708. □ West Coast: 17910 Sky Park Circle, Suite 101, Irvine, CA 92714 • (714) 250-0146.

Circle 49 on reader service card

MAKE LAMBDA YOUR PARTNER IN MANAGING YOUR POWER SUPPLY INVENTORY.

Let Lambda be part of your power supply MRP/JIT system. We understand that your production schedules change in order to meet your customers needs. So you either end up with too much or too little inventory.

That's why Lambda maintains a worldwide stock of power supplies. We assure at least 90% of our catalog models are always on the shelf. Our on-line order entry system enables us to meet all your power supply needs. We have the flexibility to provide fast, one-day delivery or react to your changing scheduling requirements.

That way, your MRP/JIT system can operate the way it should. You'll save substantially in warehousing and inventory costs—and be able to respond quickly to the needs of your customers.

When it comes to profitable power supply inventory management, you've got a partner with Lambda.

LAMBDA ELECTRONICS

DIVISION of Veeco® INSTRUMENTS INC.

515 BROAD HOLLOW RD., MELVILLE, L.I., NEW YORK 11747 (516) 694-4200

Circle 51 on reader service card

OUR GROWTH IS A MEASURE OF OUR DEDICATION TO OUR CUSTOMERS

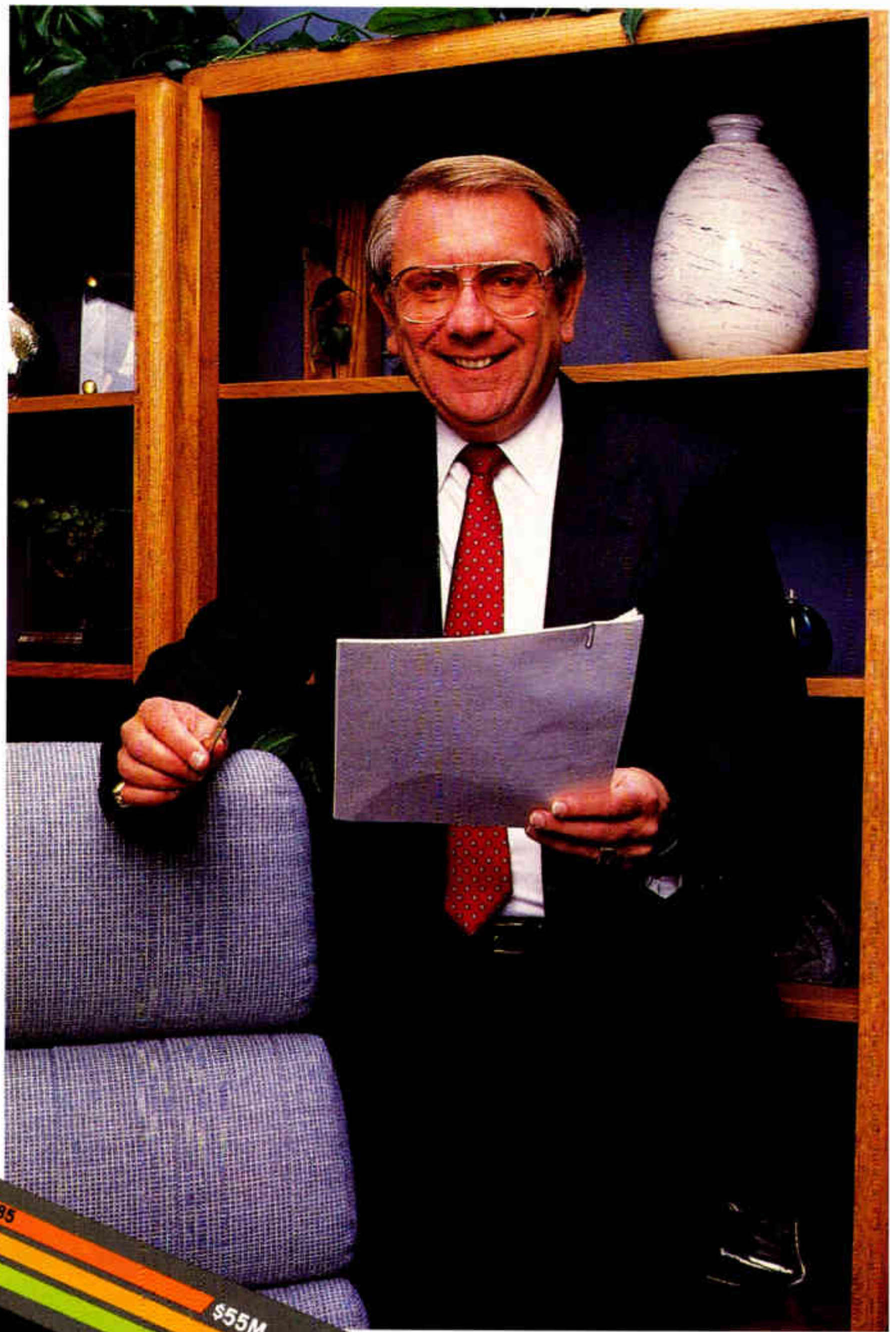
A company can only grow with the confidence and support of its customers—and that must be earned by dedicated service. At Silicon Systems, we are proud of our growth record over the past few years. To achieve that growth we have studied our customers' specific application requirements and have developed families of products to meet those requirements.

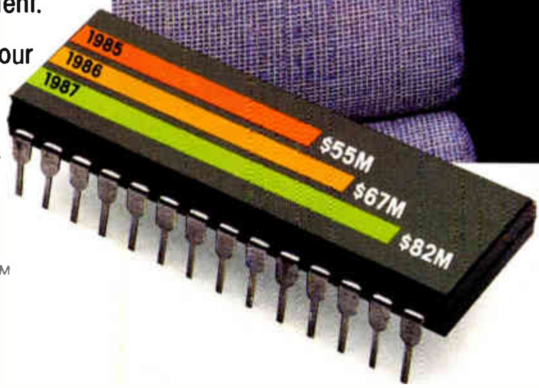
Although in the volatile semiconductor industry profitability does not always keep pace with revenue growth, in the long run the successful companies are those that concentrate their resources on serving their customers and their markets. And in the end, the rewards follow good business management and policies. That's why the management of Silicon Systems is equally dedicated to three constituents: its shareholders, its customers, and its employees.

Our fiscal year 1987 was marked not only by a substantial gain in revenues and profits, but also an overall strengthening of our balance sheet and a broadening of both our customer and product portfolios. We successfully completed a major reorganization and launched the company toward even more vigorous growth objectives for the future.

Starting the new year with orders up by more than 20% and a backlog 25% higher than the year previous, we look forward to fiscal 1988 as a year challenging us to post record high revenues with proportionate profitability. But we can only hope to achieve that goal by providing our customers with continued offerings of innovative products and dedicated service. That is our commitment.

For information on our company, our products, or our capabilities, contact: **Silicon Systems** 14351 Myford Road, Tustin, CA 92680, Phone: (714) 731-7110.





CARMELO J. SANTORO
Chairman, President, and CEO

silicon systems™
INNOVATORS IN INTEGRATION

"Where we design to your applications."

Circle 52 For Product Information

Circle 153 For Career Information

INTERNATIONAL NEWSLETTER

A FIRST: MATSUSHITA AND TOSHIBA TO EXPORT U. S.-MADE APPLIANCES TO JAPAN

Next year, two Japanese electronics manufacturers will start importing finished consumer products they build in the U. S. for sale in Japan—marking the first time Japanese electric-appliance makers have ever made such a decision. The recent steep rise in the value of the yen, which is making American-built products cheaper in Japan, spurred Toshiba Corp., Tokyo, and Matsushita Electric Industrial Co., Osaka, to make the move. Toshiba will start importing low-end microwave ovens manufactured at Toshiba America's Lebanon, Tenn., plant next March. The company is also considering importing color TVs made in the Lebanon plant, which is putting out 500,000 microwave ovens and 800,000 color TVs a year. Matsushita will import large-screen color TVs made by Matsushita Industrial Co., Franklin Park, Ill., starting in the middle of next year. The Illinois factory builds 1 million color TVs a year. □

SIEMENS SETS JOINT VENTURE WITH CHINESE TO BUILD ITS DIGITAL SWITCH

The Chinese have been having a tough time getting the kinds of technology-transfer agreements they prefer over simple hardware imports, but one such agreement has been reached with Siemens AG. Siemens and the Chinese government will set up a joint venture to manufacture the Munich-based company's digital telephone-exchange system, EWSD, and to start microelectronics production in China. Siemens will also work with the Beijing Technological Exchange Center, construction of which is scheduled to begin next spring, by training some 500 Chinese engineers a year at the center. The deal was reached through negotiations between Siemens's chief executive officer Karlheinz Kaske and prime minister Li Peng and general secretary of the communist party Zhao Ziyang. □

NIKON TO MARKET HALF-MICRON STEPPER . . .

The first Japanese stepper manufacturer to start marketing an excimer-laser photolithographic system for fabrication of chips with feature sizes below 0.5 μm will be Nihon Kogaku K.K. (Nikon). The NSR-1505EX stepper can be used initially for development of 16-Mbit dynamic random-access memories, and will be suitable for mass production later on, the Tokyo company says. The resolution of better than 0.5 μm is made possible by a krypton fluoride excimer-laser light source operating at a 258-nm wavelength. The NSR-1505EX provides 5:1 reduction of the reticle pattern for lithography of an area measuring up to 15 by 15 mm per shot. The $2.3 million stepper will be available 10 to 12 months after receipt of order, and Nikon will start accepting orders from Japanese customers in January. Matsushita Electric Industrial Co., Osaka, and Canon Inc., Tokyo, are expected to announce competing products soon. □

. . . AS IT AND CANON PLAN TO BUILD 30% MORE STEPPERS NEXT YEAR

Stepper production is accelerating in Japan. Two leading stepper manufacturers, Nippon Kogaku K.K. (Nikon), Tokyo, and Canon Inc., Tokyo, will increase production of stepper photolithography systems to meet the rapidly increasing worldwide demand for semiconductor production capacity, they say. Nikon, which exports around 30% of its steppers, has just revised upwards its shipment estimates for steppers for fiscal 1987, which will end on March 31, 1988, by 30% to 260 units, and the company expects to sell more than 300 units in fiscal 1988. Canon says that the annual shipments of its steppers will top the 100-unit mark for the first time by December 31. Canon also says it will boost its production rate to 20 units a month from the current 15 units by next spring. □

Numbers

That set the standard for high performance programmable ICs:

The company that brought you
CMOS programmable devices
with bipolar performance
now introduces the next logical step:
CMOS programmable devices that
surpass bipolar in speed, and in density.

1. Bigger PROM, faster.

Nothing this big ever went this fast with so little power.

16,384 words by 8 bits, with address-to-valid-output in 45 nanoseconds!

Isn't new technology wonderful?

Here's PROM with the speed and density to keep up with microprocessors running at 20MHz and beyond.

128K PROM
45ns. 100mA. 600 mil package.
Bipolar pin compatible. Reprogrammable.
(Military: 55ns, 120mA)
Actual size!

High performance PROM for program and table storage with the density and low power you need for cooler, smaller designs.

Beyond speed: CMOS advantages that make bipolar obsolete:

There are no viable bipolar PROM suppliers supporting this density.

A density that lets you design bigger systems with fewer devices.

Devices that, in turn, need less power.

100mA Active.

Two 64K bipolar parts would require nearly four times the power!

And bipolar PROM can't match our standby power-down features for lowest system power requirements.

30mA Standby Power, with no sacrifice in speed!

128K PROM
45ns. 100mA. 30mA Standby.
300 mil package.
Three fast chip selects.
Power-down chip enable.
Reprogrammable.
(Military: 55ns, 120mA, 35mA Standby.)
Actual size!

2. Small PROM, faster.

16K Registered PROM
18ns Set-up. 12ns tCO. 120mA.
Pipeline accelerator.
Reprogrammable.
(Military: 25ns Set-up.
15ns tCO. 120mA)

16K PROM
25ns. 120mA.
Reprogrammable.
(Military: 30ns, 120mA)

Prom II is here! Speed records tumble!

Sub-micron fabrication (0.8 micron, to be exact) means our newest 16K delivers record setting performance:

Clock-to-output of 12ns for the registered CY7C245A, 18ns set-up.

And access time of 25ns for the unregistered CY7C291A and CY7C293A.

The 25ns CY7C293A also offers unprecedented low standby power: Only 20mA, and with no loss in performance!

Plus a wide range of 4K, 8K, and 16K PROM

In registered and non-registered versions. Some with windows. And all with the key Cypress Semiconductor CMOS PROM Technology Advantages.

16K Power-down PROM
25ns. 120mA. 20mA Standby.
Reprogrammable.
(Military: 30ns, 120mA, 30mA Standby.)

3. Midsize PROM, faster.

64K Performance PROM: Choices.

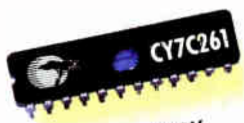
For highest performance, lowest power 64K PROM devices, you have little choice but Cypress Semiconductor. We give you the fastest low power parts in the industry. And we give you plenty of options:

Registered versions. Registered diagnostic versions. Reprogrammable versions. Power-down versions.

More *choices,* so you have more ways to configure the best system.

64K PROM
35ns. 100mA.
Reprogrammable.
(Military: 45ns, 120mA)

64K Registered Diagnostic PROM
40ns Set-up. 20ns tCO. 100mA.
28-pin, 300 mil package.
Reprogrammable.
(Military: 50ns, 120mA)



64K Power-down PROM
35ns. 100mA. 30mA Standby.
Reprogrammable.
(Military: 45ns, 120mA, 30mA Standby.)

64K PROM
35ns. 100mA.
Reprogrammable.
(Military: 45ns, 120mA)

4. Innovative PROM, faster.

64K Registered Diagnostic PROM
40ns Set-up. 20ns tCO. 100mA.
32-pin, SSR™ Compatible. Full Diagnostics.
Reprogrammable.
(Military: 50ns, 120mA)

First bytewide diagnostic PROM: 64K. Registered. 20ns.

Widely accepted in military applications, diagnostic PROM is now gaining in popularity for commercial applications.

Two new innovations should accelerate that acceptance: Our CY7C268 and our CY7C269.

Both function in the normal pipeline mode, with high performance.

Or, when selected, the Diagnostic Register can be loaded with the data on the bus, or the data in the Pipeline Register. Conversely, the system can load the contents of the Diagnostic Register into the Pipeline Register.

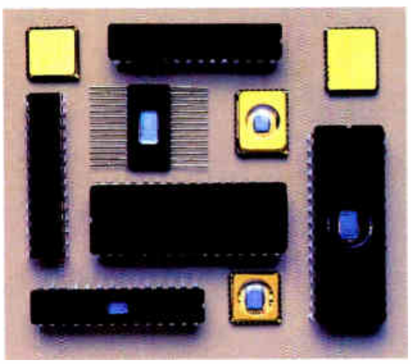
If board space is at a premium, the designer can select the 300-mil, 28-pin CY7C269.

The CY7C268 offers full compatibility with the SSR Diagnostic Standard, but with the important addition of bytewide capabilities.

Either way, the designer has powerful tools for system diagnostics.

Who uses diagnostics?

Designers of state machines. Controllers. Bit-slice machines. Debugging systems. Anyone who needs to step through programs.



And, you can specify these packages. Our robotic assembly makes your package requirements easy to satisfy.

How innovation gives you better, more reliable technology. With every Cypress PROM or PLD:

Speed: As we continue to exploit the capabilities of CMOS, you see CMOS surpassing bipolar performance, delivering the highest speed available.

Low Power: A fraction of the power of bipolar, in fact. Invaluable for today's highest performance systems. With power-down features that let you create the lowest overall system power possible.

Reliability: First, because our floating gate cell technology can be erased, we are able to test and erase every cell in every product prior to shipment, to assure you of the highest possible programming yields.

Second, our engineers have created designs that have the highest tolerance to static discharge and voltage fluctuation. Translation:

Tolerates 2001V Static Discharge.

Tolerates ±10% voltage fluctuation.

5. Innovative PLD, faster.

Second Generation Programmable Logic: Our best seller.

The Cypress 22V10 difference.

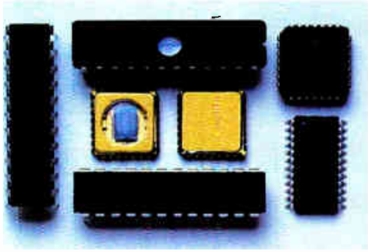
It is fast, 25ns with 15ns set-up time, and it is shipping in quantity.

It sips power. It is available in reprogrammable versions, to simplify your development cycle.

And our 22V10 features Programmable Macro Cells, which lets you define the architecture of each output, individually. Options include registered operation, combinatorial operation, selectable output polarity, and array-configurable output-enable; you have up to 22 input terms and 10 outputs at your disposal. These options let you configure the part to your system needs like no other PLD.

Our Variable Product Term architecture allows you the functions you need for most applications without burdening the performance of the part.

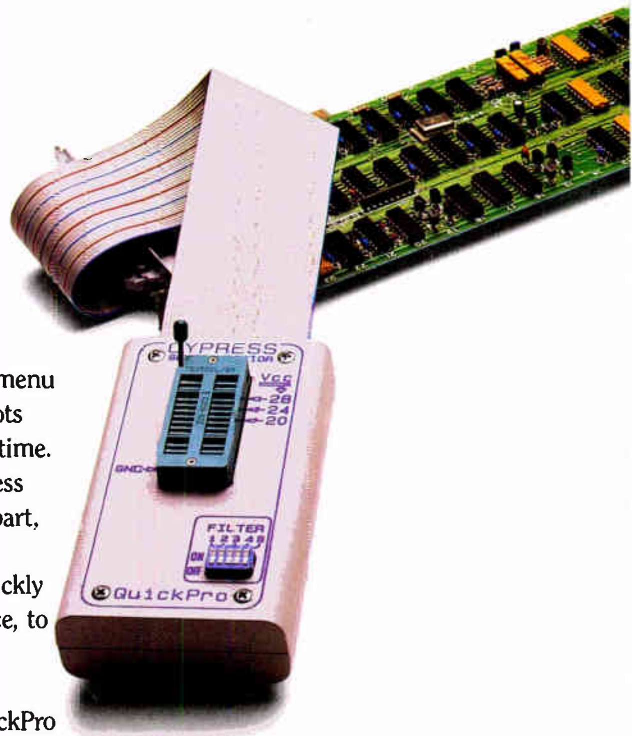
Finally, there is an array of enhanced test features to accelerate development. Not to mention our handy QuickPro™ for easy programming and diagnostics right on your PC-compatible.



The 22V10 is also available in these packages. Our robotic assembly means we can supply the package that's best for your system.

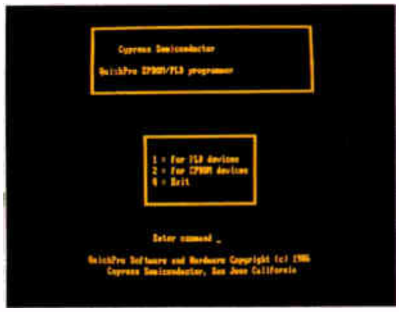
25ns. 33MHz. 55mA "L". 90mA Standard. 300 mil package. Reprogrammable. (Military: 25ns, 25MHz, 100mA)

6. Tools for design, faster.



QuickPro: PROM and PLD programming and diagnostics right now, right from your PC-compatible.

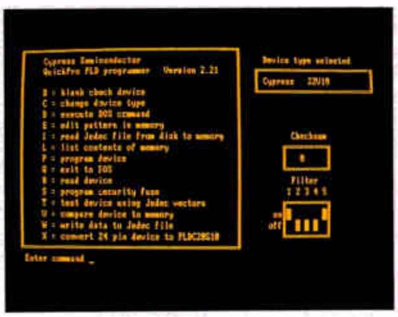
QuickPro is fast becoming an essential complement to the PROM programmer in the development lab.



Menu-driven: PROM and PLD options are easily selected through hierarchical menus. Help screens make the system easy to learn and use.

Here's why:

1. You have the software updates you need to use the latest Cypress PROM and PLD releases quickly—typically several months before the updates are released by PROM Programmer vendors. Because the QuickPro is software driven, updates are simple floppy disk files; the system is future proof.



Powerful options: You select from a broad array of programming and debugging tools for both PLD (shown) and PROM.

2. You have an easy, screen and menu oriented system that gives you lots of options, and saves you lots of time.

3. You can program any Cypress Semiconductor programmable part, on PC-compatibles.

4. As you can see, you can quickly display the contents of any device, to speed debugging.

5. Using the JEDEC standard, (PC-DOS™ binary for PROM) QuickPro is compatible with the output of all the popular PLD programming tools, including CUPL,™ ABEL™ and PALASM.™

Memory display/editing: You can display the contents of PROM (shown) and PLD parts, for simplified debugging. You can also edit the contents of memory, and reprogram easily. Result: Faster development, more productive 'what-ifs'.

6. You can read the contents of virtually any 20- to 32-pin PLD or PROM. This allows you to copy your parts easily to Cypress devices, for comparative evaluations.

Get the CMOS good book, faster.

High speed SRAM.
High speed PROM.
High speed PLD.
High speed Logic.

Over 600 pages.

Including every data sheet on every Cypress Semiconductor product. Plus preliminary data sheets on devices in progress. Plus full information on our military capabilities. Design-in information. Application Briefs. And much more.

Data Book Hotline:
1-800-952-6300, ask for Dept.
1-800-423-4440 (In CA), ask for Dept.
(32) 2-672-2220 (In Europe)
(416) 475-3922 (In Canada)

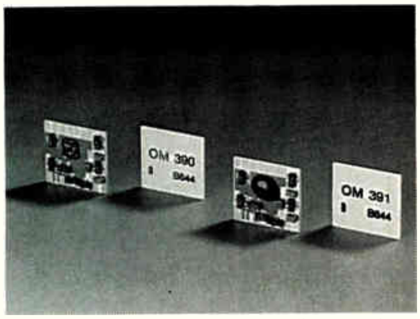
Cypress Semiconductor 3901 North First Street, San Jose, CA 95134. Phone (408) 943-2666 Telex 821032 CYPRESS SNJ UD, TWX 910-997-0753.
Cypress Semiconductor International, 51 Rue Du Moulin A Papier, BTE 11, 1160 Brussels, Belgium. Phone (32) 2-672-2220.
Cypress Semiconductor and QuickPro are trademarks of Cypress Semiconductor Corporation. CUPL is a trademark of Assisted Technology. PAL and PALASM are trademarks of Monolithic Memories, Inc. ABEL is a trademark of Data I/O Corporation. SSR is a trademark of Advanced Micro Devices. PC-DOS is a registered trademark of International Business Machines Corporation.

Circle 164 on reader service card

THE COMPLETE COMPONENT COMPANY

Philips Electronic Components and Materials Division, 5600 MD Eindhoven, The Netherlands

Smaller hybrid circuits dramatically reduce the length of proximity detectors



Two new hybrid ICs are small enough to mount transversely in proximity detectors having coils 20 mm in diameter or larger, and therefore dramatically cut the length of these detectors. The OM390 and OM391 measure just 14 by 14 by 1.7 mm and produce a proximity detection operating distance of between 2 and 5 mm, depending on the coil.

The OM390 and OM391 are for such application areas as positioning of machine tools, limit switches, component detection during assembly, and detection of coins in slot machines. By allowing manufacturers to use a shorter tube, the devices open up the possibility of new application areas where space is a critical factor and in addition reduce manufacturing costs.

Each circuit consists of a voltage regulator, an oscillator, a rectifier stage, a Schmitt trigger, and an output stage. They have protection circuits against short-circuit and overload, voltage transients, and reverse-polarity connection. When actuated, the circuit passes an output current up to 250 mA through the load (such as the coil of an electromagnetic relay, an LED, or a photocoupler); two extra terminals connect to an optional indicator LED.

The thin-film circuits fit in M18 hollow-stud assemblies (when they are mounted longitudinally) or M30 (for transverse mounting). They accept a supply voltage between +10 and +30 V (OM390) or −10 and −30 V (OM391), and consume typically 0.4 W from a 24 V supply.

CIRCLE 173

Image intensifier offers third-generation features at a second-generation price

With a price tag of US$ 4500, the Philips XX1610 'second-generation super' proximity-focused image intensifier offers third-generation night vision performance at a second-generation price. The new device suits night-viewing systems for military and security surveillance applications.

The new image intensifier has a sensitivity and signal-to-noise ratio double those of currently available second-generation types and works right down to starlit or clouded moon conditions, still producing an illuminance of 10^{-4} lux. In addition, it has an operational lifetime three times that of other second-generation intensifiers. It operates with the objective lenses and other accessories of second- and third-generation image intensifiers.

Minimum sensitivity is 500 μA/lm, compared with the 240 μA/lm of other second-generation devices. Although third-generation intensifiers have a higher sensitivity of 1000 μA/lm, they cost more than twice as much as the XX1610, and will anyway not be generally available until 1990. Furthermore the XX1610 has a signal-to-noise ratio of 15.5 which matches that of third-generation types.

Light entering the intensifier is collected through a clear-glass anti-veiling glare input window, onto an S20R red-extended photocathode. The electrons generated by this photocathode are multiplied by a microchannel plate which incorporates a proprietary treatment that gives a long 3500 hour operational life – again matching third-generation intensifiers.

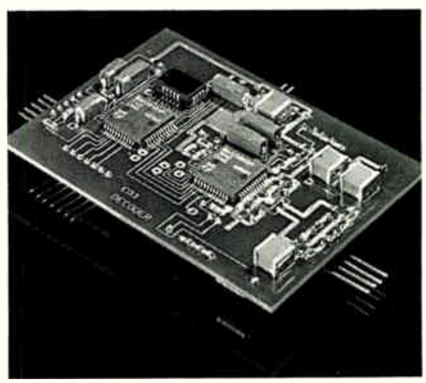
CIRCLE 174

Compact Disc decoding circuits halve IC parts count, use less power, extend temperature range

We are unveiling a pair of third generation Compact Disc ICs for high-performance low-cost systems that forms a complete stereo CD decoding system – instead of the four ICs previously required – with very few other components. Particularly attractive to portable equipment, the CMOS SAA7310 and SAA7320 have a much lower power consumption – typically 475 mW combined – than second generation NMOS ICs, and allow the whole decoding system to be run from a single +5 V supply. The devices also operate over a wider temperature range of −40 to +85 °C which is of great importance in automobile applications.

The SAA7310 decoder incorporates all the functions available on the well-known SAA7210, such as demodulation, error correction and basic interpolation. In addition there are extra functions: a special mode for non-digital audio applications – for example CDROM and CD Interactive – prevents data from being interpolated (and thus corrupted), a strong requirement for such applications; and improved playability for applications where mechanical shock is likely to occur, such as portable players and in-car systems.

The SAA7310 and SAA7320 are both available in a 44-pin quad flat-pack. In addition, the SAA7310 is also available in a 40-pin DIL which can be used as a replacement for the SAA7210.



CIRCLE 175

PHILIPS

INTERNATIONAL WEEK

NMB TO MAKE 1-MBIT MEMORIES FOR TI

Texas Instruments Inc., in full production of 1-Mbit memories in Japan and ramping up output in Dallas, is turning to an outside supplier for help in meeting demand. NMB Semiconductor Co., Chiba, will manufacture 1-Mbit TV frame memory and 1-Mbit dynamic random-access memory for TI. The products will be marketed in both Japan and the U.S. under TI's brand name. NMB will initially supply 50,000 frame memory chips and 100,000 DRAMs a month. The monthly production rate for the 1-Mbit DRAM is expected to be increased up to 1 million units by next March.

U.S.-SINGAPORE CHIP MAKER FORMED

The government-owned Singapore Technology Corp. is teaming up with two U.S. companies, Sierra Semiconductor Corp. of San Jose, Calif., and National Semiconductor Corp. of Santa Clara, Calif., to build a state-of-the-art $40 million plant for making customized computer chips. The joint venture, called Chartered Semiconductor Pte Ltd., will start producing 5,000 six-inch wafers per month in early 1989. That will double over the course of five years. Sierra and National Semiconductor are committed to buying more than 50% of the company's total production. The rest will be sold in the Asia-Pacific region.

KDD LOSES ITS TELECOM MONOPOLY

Two Japanese international telecommunication planning firms are going to give Tokyo's Kokusai Denshin Denwa Co. some competition for the Japanese international telecommunications market. The two Tokyo firms, International Digital Communications Inc. and International Telecom Japan Inc. have received permission from the Ministry of Posts and Telecommunications to enter the market, despite MPT's fears of excessive supply [*Electronics*, Feb. 19, 1987, p. 46]. However, MPT will not initially permit IDT and its partner to fully utilize their planned 11,000-channel cable. The two firms will be allowed at first to use only the equivalent of 1,260 circuits.

NEC EXPANDS DRAM FACILITY

NEC Corp. will expand manufacturing lines for 1-Mbit dynamic random-access memories at its manufacturing subsidiary, NEC Yamaguchi Ltd., in reaction to the current worldwide 1-Mbit DRAM deficit. NEC Yamaguchi will start building the new production lines next spring with an investment of 14 billion yen and expects to complete them by the end of 1988. The new lines will double the subsidiary's current manufacturing capacity of about 6 million chips including memories and microprocessors. NEC says that the new lines will also be used to fabricate 4-Mbit DRAMs, which are slated for sampling in mid-1988.

U.S. BUYS ISRAELI SIMULATORS

Israel's Elbit Computers Ltd. of Haifa has signed an agreement with the U.S. army to supply simulators for its conduct of fire-control training programs for tank crews. The first stage involves the sale of 16 simulators for $12.5 million. The project is a joint program between Elbit and its American subsidiary, Inframetrics. Elbit officials say that the contract eventually could be increased to $100 million worth of simulators.

CHINA IMPORTS TO GROW SHARPLY

China's fast-growing electronics industry, targeted to grow 16% yearly to a level of $17.4 billion by 1990, could turn out to be a major export customer for producers of components in Japan, other Asian countries, and the U.S. Components imports by Chinese equipment makers totaled $740 million in 1985 and could jump to $1 billion by the end of the decade, reports the Chicago consultants A.T. Kearney Inc. Japan is the dominant supplier, but Kearney suggests U.S. firms stand a good chance to break into the market with large- and ultra-large-scale integrated circuits.

AT&T TO SELL CHIPS IN JAPAN

AT&T International (Japan) Ltd., Tokyo, says that AT&T will market semiconductors in Japan starting in January 1988. An AT&T Japan spokesman says that its parent firm will initially sell MOS integrated circuits for integrated services digital networks, linear ICs, and digital signal processors through several leading Japanese semiconductor trade firms, including Tokyo's Tomen Electronics Corp. and Marubeni Hytech Co. AT&T Japan will cooperate with these trade firms in sales promotion. AT&T will also set up a design center in Tokyo next fall for marketing its application-specific ICs including 1-μm full custom and standard cell ICs.

PHILIPS INVESTS IN CHINA CRT PLANT . . .

Philips signed an agreement with officials of China's Jiangsu province last month providing for a joint venture for making color TV tubes and deflection units. The partners in the $180 million venture will be the Chinese picture-tube maker Huadong and a Hong Kong investment firm, which will have 45% and 25% shares in the venture, respectively. The Dutch firm, which is supplying its flat-and-square tube technology, will own the remaining 30%. The Jiangsu plant will have an annual capacity of 1.6 million tubes.

. . . AND OPENS A CRT PLANT IN UK

Philips has started production of high-resolution color monitor tubes in Durham, England. The Dutch firm says the plant is Europe's largest manufacturing facility for such tubes—and one of the world's most advanced. Production at the $27 million plant will concentrate initially on 90-degree, 14-inch tubes, with a goal of about a quarter of a million units a year by the end of 1988. Philips sees the world market for color monitor tubes growing some 25% a year—from six million in 1986 to 13 million by 1990.

GERMANS TO BOOST COMMUNICATIONS

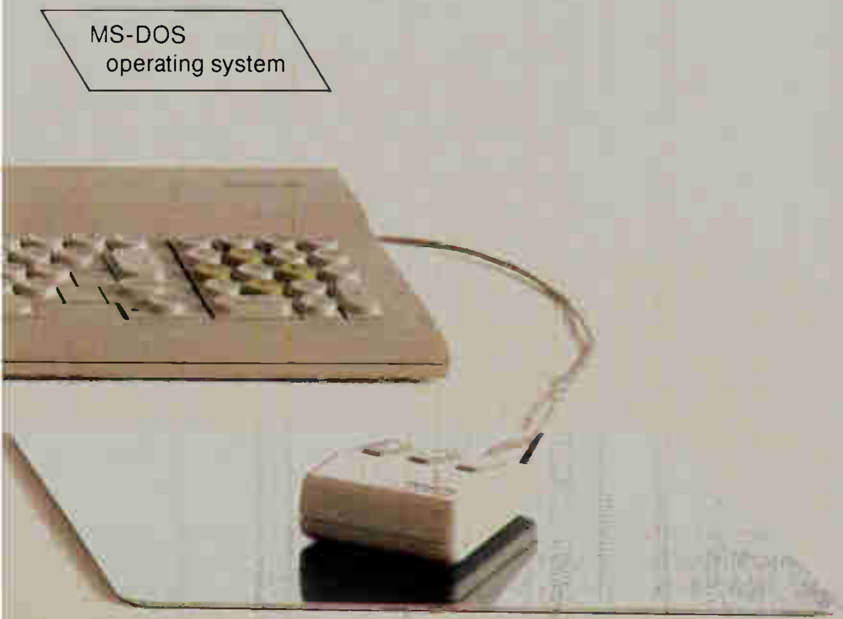
West Germany's $12.7 billion investment package designed to support the economy—something the U.S. has long urged the Bonn government to do—provides for a $900 million increase in spending by the Bundespost, the country's telecommunications agency. That raises the agency's investments next year from $11.2 billion to $12.1 billion, the bulk of them for communications hardware.

SEL CHURNS OUT MONOMODE FIBERS

With an eye towards Europe's optical fiber-based broadband integrated services digital networks of the 1990's, West Germany's Standard Elektrik Lorenz AG, a member of France's Alcatel Group, has started production of monomode optical fibers in a new factory. Initial production, which began last month at the $24 million, 1,000 square-meter plant in Stuttgart, West Germany, will be 50,000 kilometers of fiber a year, but its annual capacity may be raised to 120,000 km by 1990.

SIEMENS

Why don't these new measurement instruments have any control elements?



Now, you can skip unweldy operating procedures when using measurement instruments. Why? Because Siemens has developed new measurement instruments that cooperate with personal computers over an IEEE 488 bus.
And that eliminates, for example, your reliance on cumbersome keys and dials when using transient recorders.
Adjusting parameters, ranges, and functions is easier than ever... with the PC keyboard and mouse.

What's more, our standard software accepts only instrument-specific and logically-structured entry data. So that you get top quality results every time. And since each instrument includes pre-programmed operating instructions, there's no more flipping through time-consuming manuals to get to the point. Whenever you're uncertain about how to proceed, the instrument itself provides the plaintext answer. A click of the mouse is enough... for calling up instructions or executing commands that put you firmly in control of up to 15 measurement instruments. From function/pulse generator to digital multimeter.

All this adds up to less routine, more attention to what really counts – and better results. The kind of convenience that's fast becoming the hallmark of advanced measurement technology. From Siemens.

Measurement's never been easier.
With PC instruments from Siemens.

Want to know more about our PC instruments? Just contact your local Siemens office or drop a line to:

Siemens AG
Infoservice 213-Z027eE
Postfach 2348, D-8510 Fürth
Federal Republic of Germany

A19100-E686-Z4-V1-7600

Circle 167 on reader service card

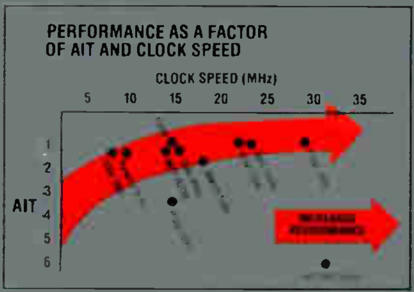
68000™ FAMILY UPDATE NO. 3

"CISC VS. RISC" DEBATE IGNORES KEY ISSUES OF SYSTEM SOFTWARE AND ON-GOING SUPPORT COSTS

The continuing debate over whether CISC or RISC technology is the answer to boosting computer performance levels tends to focus on machine speed, often ignoring an equally important issue: architectural compatibility. Computer manufacturer's with 68000-based CISC architectures considering a move to RISC technology for their high-end product offering need to recognize the enormous costs they face. Current systems software must be adapted and supported on different architectures. Two different operating systems as well as diagnostics have to be ported and supported. Compilers for high level languages need to be developed. And these are just a few of the obstacles.

The EDGE 2000 Series VME board set recently introduced by Edge Computer proves that a 68000-compatible CISC system can operate with RISC-like efficiency. But performance is only one side of the coin. Value and the ability to leverage your investment in existing 68000-based software are equally important. By driving costs to approximately $1K per MIPS in OEM quantities, while maintaining 68000-compatibility, Edge makes CISC a more attractive option than other implementations of CISC or RISC. 68000-based manufacturers can stay with CISC and forego a sizeable portion of software porting costs, as well as the on-going expense of supporting and maintaining two different architectures.

In the industry's continuing quest for improved machine performance, Edge has set the pace by achieving faster clock speeds and reducing cycles per instruction. At 1.4 cycles per instruction, the EDGE 2000's AIT (Average Instruction Time) is already lower than most products on the market today.



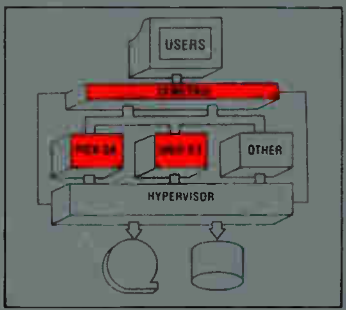
Nonetheless, the CISC/RISC debate will continue. But for 68000-based manufacturers faced with the need to expand their product lines and bring high-performance 68000-compatible products to market economically and on time, the EDGE 2000 is a clear winner.

SYMETRIX UNITES PICK, UNIX V.2 OTHER OPERATING SYSTEMS TO FOLLOW

Edge Computer now offers SYMETRIX™, a concurrent operating system environment, on its line of high performance computer systems.

SYMETRIX provides an architecture that allows multiple standard operating systems to operate at the same time on the same system.

The first implementation of SYMETRIX integrates the solutions and applications oriented environment of the PICK* Open Architecture with the programming and systems environment of UNIX V.2†.



SYMETRIX provides a seamless, menu-driven PICK/UNIX interface that allows transparent access to PICK and UNIX. The end-user literally never need know which operating system is being used.

SYMETRIX is undergoing further enhancements that will allow transparent interfacing of as many as three, four or more popular operating systems.

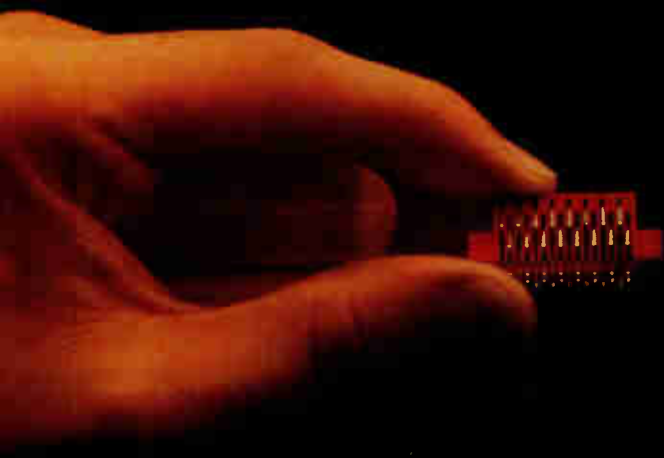
EDGE COMPUTER

Compatible With Your Future

For more information, contact Pamela Mayer, Edge Computer Corporation, 7273 E. Butherus Drive, Scottsdale, AZ 85260, 602/951-2020. European Operations contact, Heiner Krapp, 5 Avenue des Jordils CH 1000 Lausanne Switzerland, 41-21-275315.

*PICK is a trademark of PICK Systems. † UNIX V.2 is a trademark of AT&T Bell Laboratories. SYMETRIX and HYPERVISOR are trademarks of Edge Computer Corporation. 68000 is a trademark of Motorola Corporation.

Circle 55 on reader service card



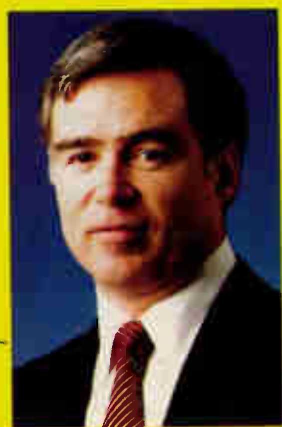
The RN "Partners in Quality Team" delivered a state-of-the-art connector in 16 weeks!

RN offers a wide variety of DIN Connectors. Half-size, standard and high density DIN connectors—120 or 150 positions. Completely repairable solderless FLEX PRESS™ contacts in male and female styles. Custom Early Mate/Late Break grounding pin location. Available in "better than gold" ROBEX® plating. Write for complete catalog.

Circle 183 on reader service card

"The RN 'P/Q TEAM' concept brings all of our design, engineering and production skills to bear on *your* unique socket/connector problems. We work closely with your people to create solutions that are delivered on-time and defect-free. *You have my personal guarantee on it.*"

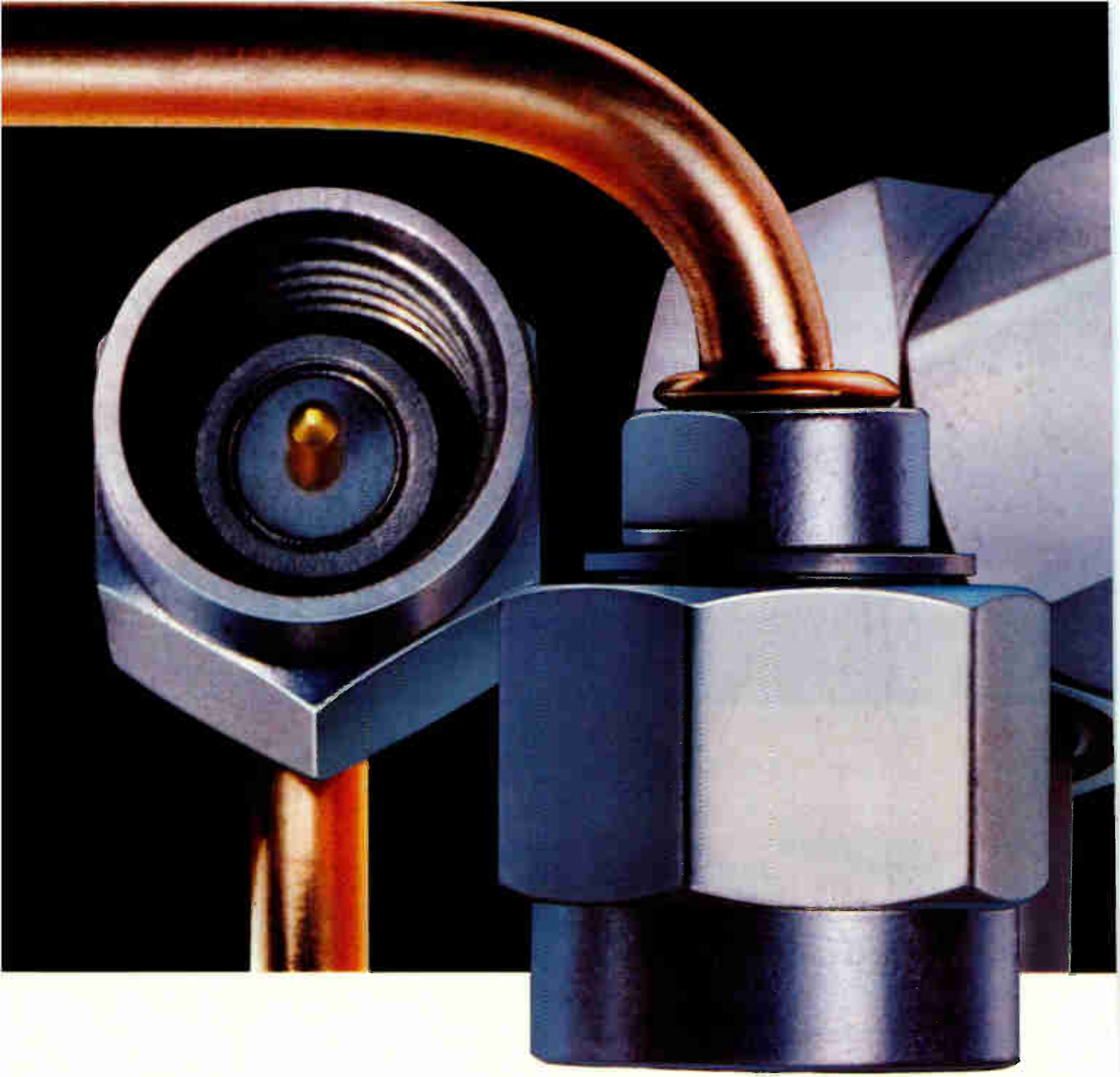
R. A. Lindenmuth
President/CEO



Write or call today for the comprehensive new brochure: *"The RN P/Q Team in Action".* You'll learn how smart companies are putting the brains, resources and experience of RN engineers to work to solve tough interconnection problems with speed and efficiency.

Circle 57 on reader service card

The RN "P/Q TEAM"...your Partners in Quality



Crimp performance story. 26 GHz, and economy too.

INSIDE TECHNOLOGY

THESE CHIPS ARE BREAKING THE LINEAR BOTTLENECK

The action in linear is exploding; firms ready monolithic solutions for analog filtering, analog-to-digital conversion, disk-drive read/write, and fiber-optic communications

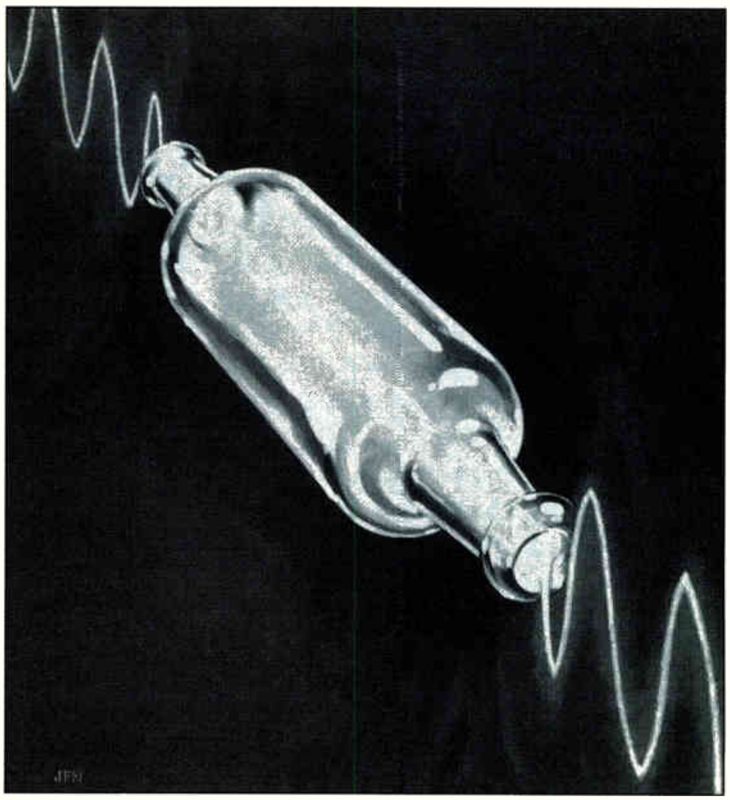
by Lawrence Curran

Analog design is under the gun to keep pace with systems built around digital signal processors, microprocessors, and other advanced digital chips that are tracking upward in speed, accuracy, and resolution. Breaking bottlenecks in linear integrated circuit performance has a host of companies busy. They're targeting to have better monolithic remedies soon for analog-to-digital conversion, disk-drive systems, analog filtering, and fiber-optic communications.

Some companies are taking a close look at flash approaches to boost raw conversion speed (see story, p. 67), as others wrestle with self-calibration techniques and processing evolutions. Another challenging area involves data-separator ICs, devices in disk drives that need to acquire and process signals, yet distinguish data bits from noise. Much faster devices of this sort are essential as storage capacities soar. Analog Devices Inc. has developed two application-specific integrated circuits with these read channel requirements in mind (see story, p. 75).

The same creative forces are at work with analog filters, intended for use in digital systems, and in linear chips for the emerging fiber-optic communications market. The goal in both applications is increasing the integration level and performance. For example, Maxim Integrated Products Inc. has developed a microprocessor programmable, switched capacitor active filter (see story, p. 85). It can be configured to serve a variety of lowpass, bandpass, allpass, and notch filter purposes using the microprocessor. Linear fiber-optic ICs are in their early formative stages as companies develop devices to speed interboard communications. In this area, however, two semiconductor firms—Signetics Corp. and Advanced Micro Devices Inc.—are taking different development approaches in response to implementing fiber-optic data interface standards (see story, p. 64).

Overall, companies are concentrating on improving the raw conversion speed of ADCs. At least four—Honeywell Inc., TRW's LSI Products, Crystal Semiconductor Corp., and Texas Instruments Inc.—have investigated the flash approach. For those imaging and signal-processing applications willing to pay a high price, Honeywell's Solid State Electronics Division in Colo-



Companies in North America requiring strategic alliances in Europe, and the important market in West Germany, can find partners among the twelve thousand production firms based in the state of Baden-Wuerttemberg.

As a region enjoying a world-wide reputation for quality of engineering design and technology development Baden-Wuerttemberg is attracting increasing attention from multinational corporations due to the job skills and management experience of its business community and industrial base.

The State Government of Baden-Wuerttemberg and its Trade and Investment Office in Stuttgart are ready to talk with any company in the United States and Canada that has a serious interest in establishing a business presence in West Germany.

To obtain details of incentives available to expanding companies in Baden-Wuerttemberg: contact:

Ministry of Economic Affairs
and Technology
Department for Industrial Development
Theodor-Heuss-Strasse, 4
D-7000 STUTTGART 1
Tel: (0711) 123 23 82

Trade and Investment Office
Schloss Strasse, 25
D-7000 STUTTGART 1
Tel: (0711) 22 787 0

In North America call: (914) 232-1188

BADEN-WUERTTEMBERG
Federal Republic of Germany

The material is published by J. Woodman Associates, Inc., 143 Bedford Rd., Katonah, NY 10536, which is registered under the Foreign Agents Registration Act as an Agent for the Trade and Investment Office of the State of Baden-Wuerttemberg, Stuttgart, Federal Republic of Germany. This material is filed with the Department of Justice where the required registration is available for public inspection. Registration does not indicate approval of this material by the United States Government.

Circle 65 on reader service card

CRYSTAL BUILDS THE FIRST 12-BIT FLASH CONVERTER CHIP

The sampling analog-to-digital converter has a 1.5-MHz throughput, 10 times faster than competing 12-bit monolithic devices and toe-to-toe with costlier hybrids

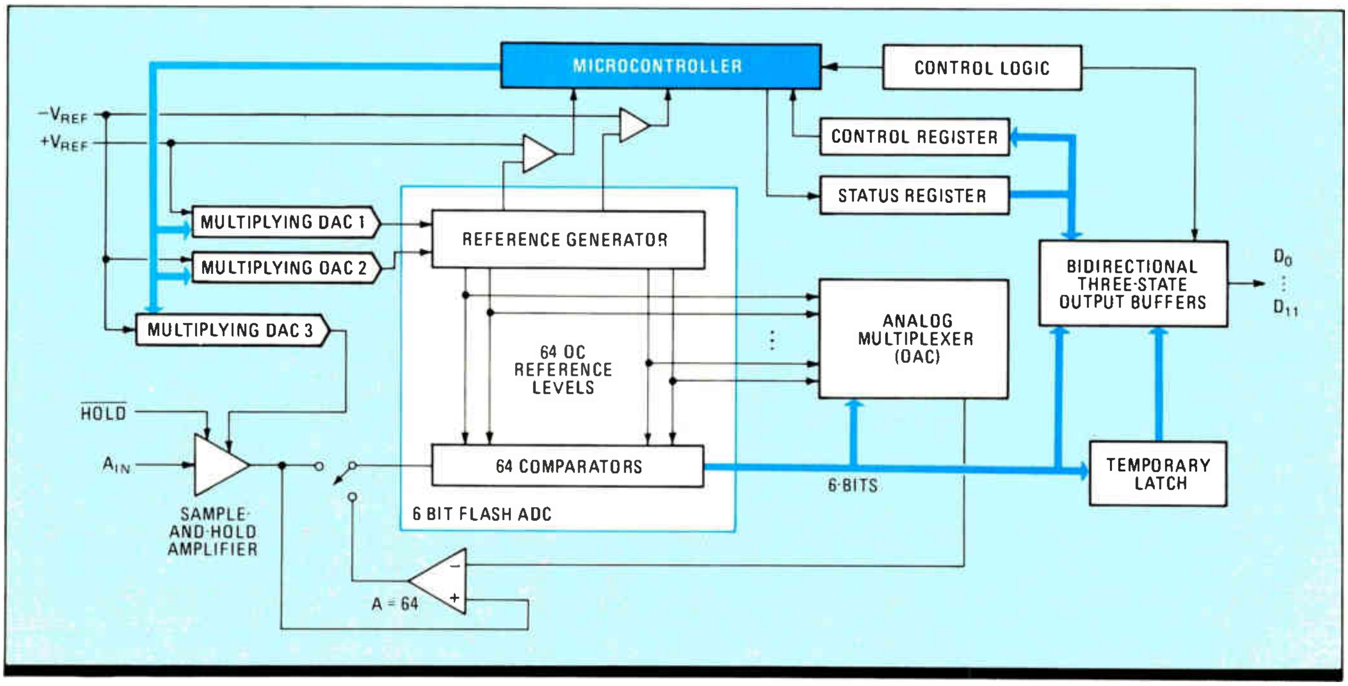
by Bernard C. Cole

The first 12-bit, monolithic flash converter is now in prototype production at Crystal Semiconductor Corp. The sampling analog-to-digital converter is not only more accurate and faster than any other monolithic ADC chip, it's also the equal in performance of 12-bit hybrid circuits, which not only cost more than chips but also consume more power.

To get higher throughput, resolution, and accuracy all on one chip, the Austin, Texas, company went to a moderate-speed architecture called two-step (see fig. 1), which freed up enough area on the chip to add the analog/digital circuitry needed to get the higher speed and the self-calibration for accuracy over time and temperature ranges. As a result, Crystal's converter achieves 1.5-MHz throughput, about 10 to 12 times faster than competing 12-bit monolithic chips, even those fabricated with high-speed biCMOS, says John R. Croteau, Crystal's manager for high-resolution data-acquisition products. Hybrid circuits, already behind monolithics in price and power consumption, take another step backward because the Crystal ADC's typical conversion time of 1.0 μs (2.5 μs maximum), and 1.5-MHz throughput rivals their performance.

Crystal's CMOS CSZ5412 integrates entire analog subsystems, including a background reference, a proprietary reference generator circuit, and auto-zeroing techniques. It also features a digital self-calibration scheme built around an on-board microcontroller. Setting an on-board control register location allows the device to calibrate itself every 300 to 400 μs. With all this done on-chip, accuracy is designed into the CSZ5412 rather than being factory-calibrated, Croteau says.

Achieving 12-bit accuracy was pulled off by Crystal's engineers without any sacrifice in throughput or conversion speed (see story, p. 70). To obtain 1.5 MHz throughput, the CSZ5412 uses



1. 12-BIT. Using a 3-μm linear CMOS process, Crystal designers have built a 12-bit monolithic ADC with a typical conversion time of 1 μs.

second sample/hold holds it valid at point B during the second flash. Crystal engineers say that the first S/H allows the second to release after the first flash conversion; its acquisition period is thereby pipelined with the second flash. The first S/H will then acquire the analog input signal and ensure that the voltage at point A is valid to 12-bit accuracy before the end of the second flash. Another convert command can be issued before the decoder has settled, leading to the pipelined cycles.

To achieve 12-bit accuracy, the CSZ5412 piles digital calibration on top of its analog techniques. Upon power up, the CSZ5412 resets and is initially calibrated. Anytime afterward, hardware or software can initiate calibration, ensuring accuracy over operating life or temperature conditions.

The combination of analog and digital calibration techniques employed by Crystal engineers teams up to achieve better than 0.02% total harmonic distortion. On the digital side, Crystal designers incorporated a correcting micro-controller that ensures no missing codes and better than 68-dB signal-to-noise distortion. Offset and full-scale errors are similarly calibrated to within ± ½ LSB.

In the CSZ5412, background calibration is an ongoing process that fine tunes the device's offset and gain transparently to the user. Obtained by setting an on-board control register location, the feature allows the circuit to calibrate itself every 300 to 400 μs, depending on the converter's other activity. This provides the ADC's guaranteed accuracy, Croteau says. During every background calibration cycle, the converter compares its positive and negative full-scale code transitions with its positive and negative voltage reference signals. If the error exceeds ± ¼ LSB, the device adjusts its transfer function accordingly, he says.

In the first flash conversion, the 64 reference levels define the end points of 64 segments that are the chip's transfer function. Ideally, references are evenly spaced, to achieve a perfectly linear transfer function. Any errors in the references cause nonlinearity and distortion. To prevent that, the reference generator circuit constantly adjusts the converter's linearity, ensuring accuracy throughout its operating life. A reference generator consists of an integrator and 64 sample/hold amplifiers (see fig. 3).

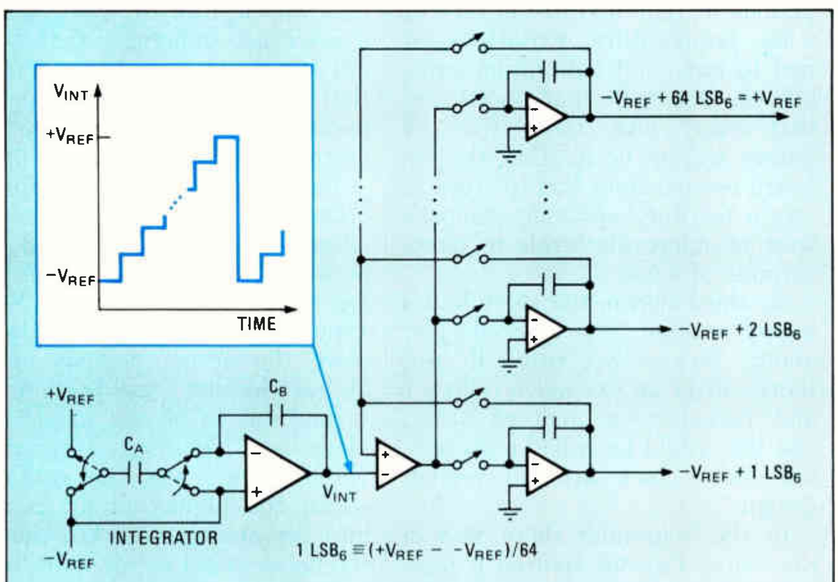
In operation, the integrator generates a ramp starting at zero scale, -VREF, and ending at full scale, +VREF. The sample-and-hold amplifiers sequentially sample the integrator's output, resulting in 64 evenly spaced reference voltages. This "walking reference" continually ripples through the sample-and-holds, updating the references.

In addition, the CSZ5412 maintains excellent differential linearity at its segment boundaries. Inaccurate decisions by the comparators in the 6-bit flash can lead to missing codes. Therefore, all comparators are auto-zeroed to avoid errors traceable to offsets or low-frequency noise. An integral part of the comparator, the auto-zero technique involves storing the comparator's offset on a capacitor: in effect, subtracting it during the comparison. The auto-zeroing improves rejection of low-frequency phenomena such as 60-Hz or 50-Hz line noise.

In the two-step scheme, it is possible for offset errors to occur as a result of threshold voltage mismatches in transistors or other factors. To compensate for these errors, the CSZ5412 adjusts the starting point of the walking reference. Each time the integrator finishes its ascent, it returns to its starting point, -VREF. Before the ramp begins, a digitally-variable capacitor array (multiplying DAC2) adjusts the starting point to zero scale. The magnitude of adjustment is determined during the converter's calibration cycle. During calibration, the CSZ5412 switches -VREF into its analog input. An on-chip microcontroller then uses MDAC2 to servo the walking reference's starting point to the output of the sample/hold (S/H_1), thus compensating for all offsets.

The resulting setting of MDAC2 is stored on-chip in static random-access memory and is subsequently used each time the integrator returns to zero scale. The CSZ5412 similarly adjusts its full-scale setting. The ramp rate in the integrator determines the spread between reference levels and therefore the CSZ5412's analog input range. The CSZ5412 calibrates full scale by trimming the capacitor in the integrator and thus the ramp rate. After it adjusts offset during calibration, the CSZ5412 switches +VREF into its analog input. It then adjusts the final reference value to precisely equal the output of sample/hold (S/H_1), which includes all full-scale errors. □

For more information, circle 480 on the reader service card.



3. WALKING REFERENCE. To achieve an evenly spaced transfer function during its first flash conversion, the CSZ5412 incorporates a walking-reference design.

Only one company has the technology, the resources, and the vision to top the 68020.

Putting GaAs ICs to work:

How to make high-speed measurements more accurately.

Let's face it...your measurements are only as good as your timing standard.

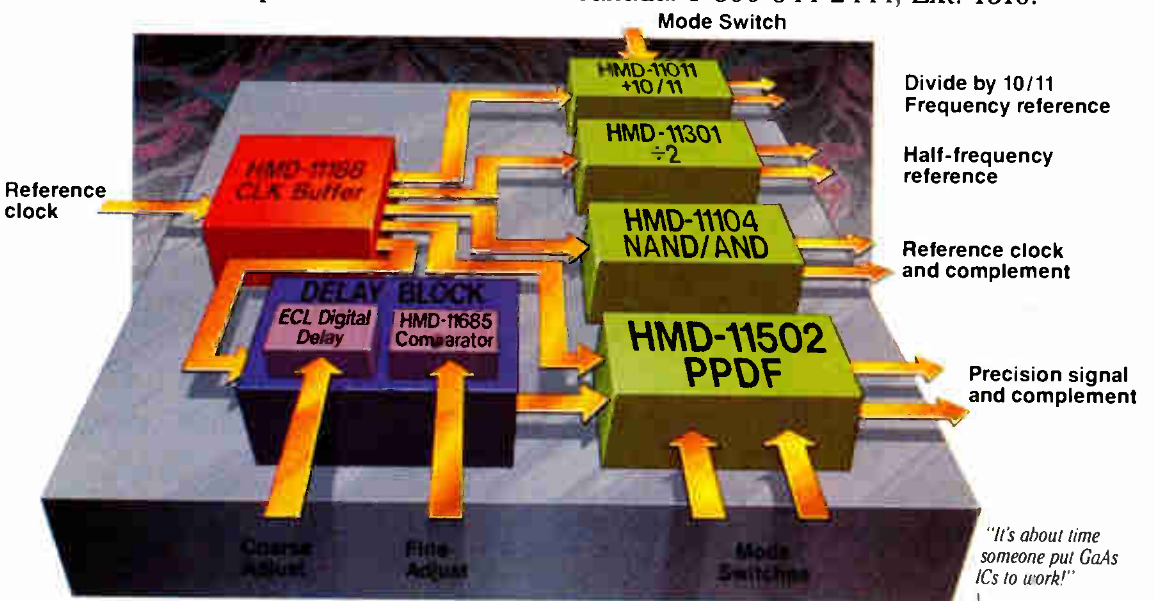
When measuring high-speed ICs, edge placement accuracy is a critical issue. But now, the unique Harris HMD-11502-2 Programmable Pulse Driver/Formatter (PPDF) makes life a little easier. It generates complex pulse trains with independent, variable control of leading and trailing edge placement!

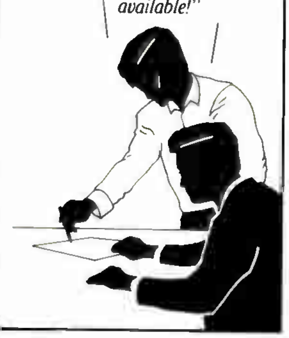
We used our PPDF with other Harris GaAs ICs to build this precision signal generation system for testing our own devices. It's just the ticket for measuring propagation delay, setup and hold times. Edge placement accuracy can be controlled to within 50 picoseconds!

The Delay Block "programs" the output waveform of the PPDF, with our HMD-11685 GaAs IC Comparator providing continuous fine adjustment over the 250 picosecond "steps" of the ECL digital delay.

This circuit is a key building block for our high-speed test pattern generator. If it's fast enough for our GaAs ICs, just imagine what it can do for your ECL devices!

For more information, write or call us: Harris Microwave Semiconductor, 1530 McCarthy Blvd., Milpitas, CA 95035. In U.S., phone 1-800-4-HARRIS, Ext. 1510, or (408) 433-2222, Ext. 202 (TWX: 910-338-2247). In Canada: 1-800-344-2444, Ext. 1510.





IN GALLIUM ARSENIDE, THE NAME IS

HARRIS

Harris Semiconductor: Analog - CMOS Digital
Gallium Arsenide - Semicustom - Custom

HARRIS

MIXED-SIGNAL ASICs GRAB DISK DATA TWICE AS FAST

Analog Devices' read/write chips recover data at 50 MHz with error rates as low as discrete designs; they greatly speed up the job of designing hard-disk drives

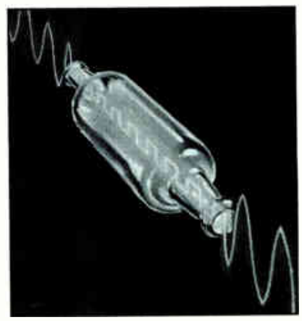
by Stan Runyon

Analog Devices Inc. is easing a major bottleneck in disk-drive performance with a pair of application-specific integrated circuits that recover data from disk heads at greater than 50 Mbits/s—double the throughput of competing designs. The new chips also recover data at error rates as good as discrete active components and small-scale ICs, which are now the bread and butter of readback electronics. The AD890 precision wideband channel processing element and the AD891 rigid-disk data-channel qualifier work in concert to produce low-jitter, accurately positioned digital pulses corresponding to recorded flux transitions on the disk platter (see fig. 1).

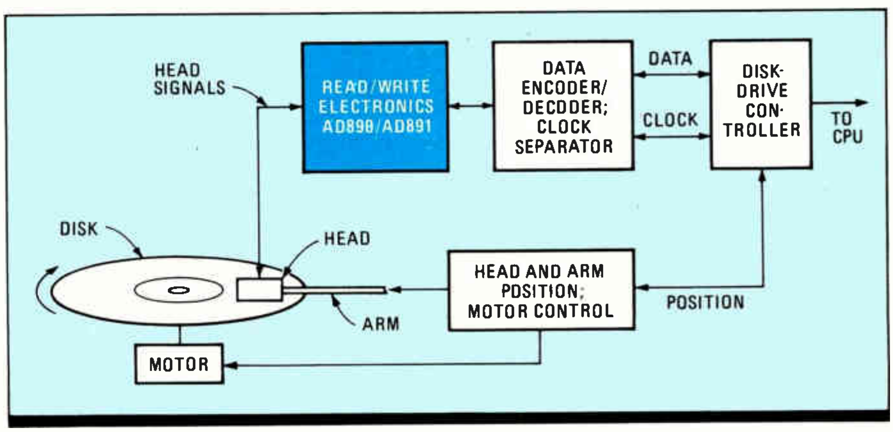
A 4-GHz bipolar process using thin-film resistors and sophisticated mixed-signal capabilities, both new strokes in designing a data-recovery circuit, enhance performance of the 890/891 chips. The Norwood, Mass., company also provides flexibility for disk-drive design through user-defined passive filters. By choosing filter components, disk-drive manufacturers can use the 890/891 chips to produce variable performance levels and match those levels to required data transfer rates. The discrete approach is less flexible by comparison and needs considerable space. It also requires tweaking or trimming of components even at the lower 25-MHz rate.

The upshot of Analog Devices' accomplishment is faster product development—a key factor in the supercompetitive disk-drive market. The 890/891 chips are optimized for hard-disk drives but have also generated serious inquiries from developers of fiber optic data links and optical disk drives, which have similar signal processing requirements, says Phil Carrier, Analog Devices product marketing manager. Volume shipments of the 890/891 chips have begun to a major disk drive manufacturer for its next-generation of drives, to be introduced in 1988. The chips cost $7.50 each in quantities of 10,000 and packaged in a plastic leaded chip carrier.

The 890/891 chips foreshadow a family of tailored-performance ASICs from Analog Devices (see story, p. 79). Already developed is a single-IC version of the pair, although this device has reduced performance because of the coupling between mostly analog front-end circuitry and digital output. Also in the works are ICs implementing other disk drive electronics—all with greater flexibility and performance in specific application areas. Included are a 50-Mbit/s, ECL, third-order phase-locked loop device with a 200-MHz voltage-controlled oscillator and fast acquisition times; lower-speed TTL versions of the disk-drive ICs; and ICs with embedded read-channel PLLs and encoding/decoding logic and data separators. Versions of these components optimized for optical applications, such as CD ROMs and WORM drives, are also planned.



In data-recovery circuits, the read-signal channel presents design challenges because of a difficult electrical and mechanical environment: low and continuously varying signal levels from the head; severe noise corrupting the already weak signal; mechanical tolerances affecting rotational accuracy; and temperature variations eroding re-



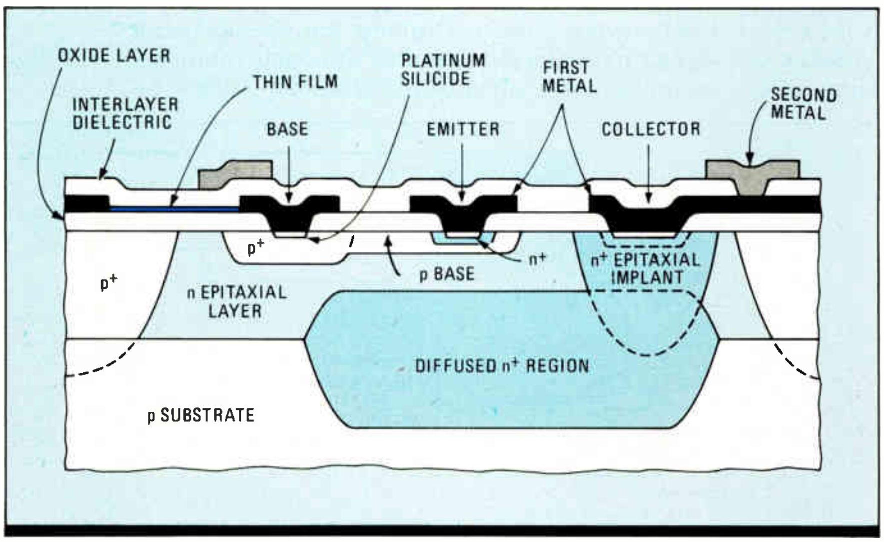
1. DISK-DRIVE ELECTRONICS. The AD890/891 chips, two new ASICs from Analog Devices, double data recovery rates and produce low-jitter, accurately positioned digital pulses.

peatable performance. Working in this difficult environment, other approaches had revealed drawbacks, leading Analog Devices to believe there was room for improvement.

Discrete active components and small-scale ICs—available from National Semiconductor Corp. in Santa Clara, Calif., and Silicon Systems Inc. in Tustin, Calif.—cannot exceed bit rates of 15 to 25 MHz without considerable design effort and cost. This occurs because small component variations produce unacceptable phase differences, timing skew, propagation-delay mismatches, and other subtle effects. If the stored bits are not recovered accurately and with precise timing, drive performance will be impaired regardless of the data encoding scheme. In contrast, if the stored bits are recovered error-free, then digital ICs are capable of performing—even at high throughput rates—the subsequent functions of data separation, clock regeneration, and data decoding.

A FLASHY PROCESS

The technology behind the Analog Devices' readback IC pair is a 4-GHz bipolar process called Flash, featuring double-level metallization and laser-trimmed thin-film resistors (see fig. 2). Although the Flash process is not unique to Analog Devices, its combination with thin-film resistors is a first. The thin-film resistors are key: They provide temperature-stable performance and are highly predictable, which allows the precise design of gain and exponentiation function blocks. Control comes through stable and predictable currents in the bias circuits and the ability to compensate for temperature variations in gain and offset. The internal logic is constructed with reduced-swing emitter-coupled logic, with typical propagation delays remaining below 600 ps per gate; outputs are standard ECL levels. The primary benefit of this scheme is a high-speed process that is factory—not user—trimmed.



2. FLASH PROCESS. Double-level metallization and laser-trimmed thin-film resistors, which have stable temperature performance, provide the chips' factory-controllable features.

The 890/891's operation is enhanced by their sophisticated mixed-signal capabilities, a new stroke in designing a data-recovery circuit (see fig. 3). On a disk, binary signals are recorded as flux reversals. These occur at intervals that depend on the particular data encoding scheme, creating the need for low jitter and stable phase response in the recovery circuit. The read head senses the flux changes and generates a weak signal, which is then amplified by a preamp located as close as possible to the head. This signal then goes to the AD890 variable gain amplifier, the crucial performance element over the wide dynamic range of the head signal.

The VGA provides a continuously variable gain of over 30 dB; its output is precisely the level required for optimal operation of the subsequent circuitry. The control signal for the VGA comes from the automatic-gain-control circuit, which must constantly adjust the VGA's gain. The control circuit completes a feedback loop which uses the signal level (the signal from the head) to maintain the desired output level.

The read-head signal, as delivered by the VGA, goes through several filter and buffer stages, and is then used for two functions: driving the control circuit and continuing through the signal processing chain so the actual binary data can be extracted. The AGC circuit's precision full-wave rectifier produces an output proportional to the average value of the input signal—the output of the VGA. In turn, this steady-state output is used to develop an exponentially proportional signal to set the VGA gain.

The exponential factor ensures that the overall loop gain and response will not vary with AGC setting. The attack and decay rates of the AGC gain must be matched to the application: too slow would result in insufficient response time while too fast would cause instability and gain pumping. Gain pumping is an undesirable effect in which the actual gain changes do not conform with the intended changes.

At this point, the amplified signal is not yet ready for decoding into 1s and 0s. Additional filtering and equalization are required to shape the signal amplitude and phase spectra to compensate for distortion, phase shifts, and nonlinearities in the writing and reading processes. These undesirable effects stem from head-coil inductance, mechanical-arm resonances, and other subtle causes.

The filter design is difficult and must be undertaken by the drive manufacturer based on the disk technology's characteristics and the head design. Filtering represents value added by the manufacturer, and here passive RLC components yield the best repeatability, stability, and cost characteristics. For filtering purposes, present digital signal processor ICs cannot handle 50-MHz data rates and the low signal levels would require expensive conditioning and ADCs.

The filters also differentiate the signal to locate its peaks. Both the normal and differentiated versions pass to the AD891 threshold comparators. The threshold level is set to qualify valid pulses while ignoring noise. The comparator outputs go to a flip-flop and then to a one-shot, which produces data-output pulses of precise width. It is critical that the one-shot have highly stable outputs—even slight drift or jitter can be interpreted as incorrect data-bit timing, leading to problems in the disk controller's timing recovery circuitry.

In addition to filtering options, the readback ICs also offer flexibility in other areas. One feature allows the automatic gain control to be turned on or off by digital control lines and another sets a programmable gain amplifier by external voltage levels. Also, input clamping can be switched in to prevent disk write signals from overloading the input, which would erode transition times in the read mode. Filtering and equalization are designed to occur in stages for optimizing the signal.

Overall, the readback ICs live up to stringent design goals. Specifications for the 890/891 functional blocks guarantee data bit recovery at up to 50 Mbit/s, though the ICs have achieved up to 70-Mbit/s rates. The AGC bandwidth is 100 MHz and its control voltage response is linear to within ±0.25 dB over a ±26 dB range (and nearly as good to over 40 dB). The VGA's equivalent noise figure is only 5 nV-Hz.

In addition, the threshold comparators show less than 3-ns propagation delay and are matched to better than 300 ps. Finally, the timing error contributed by the AD891 from offset, gain, and drift is guaranteed to be less than 1 ns. This is in lieu of the more common "typical" specification, with its usual wide spread in actual values, which often forces the circuit designer to incorporate compensating trims.

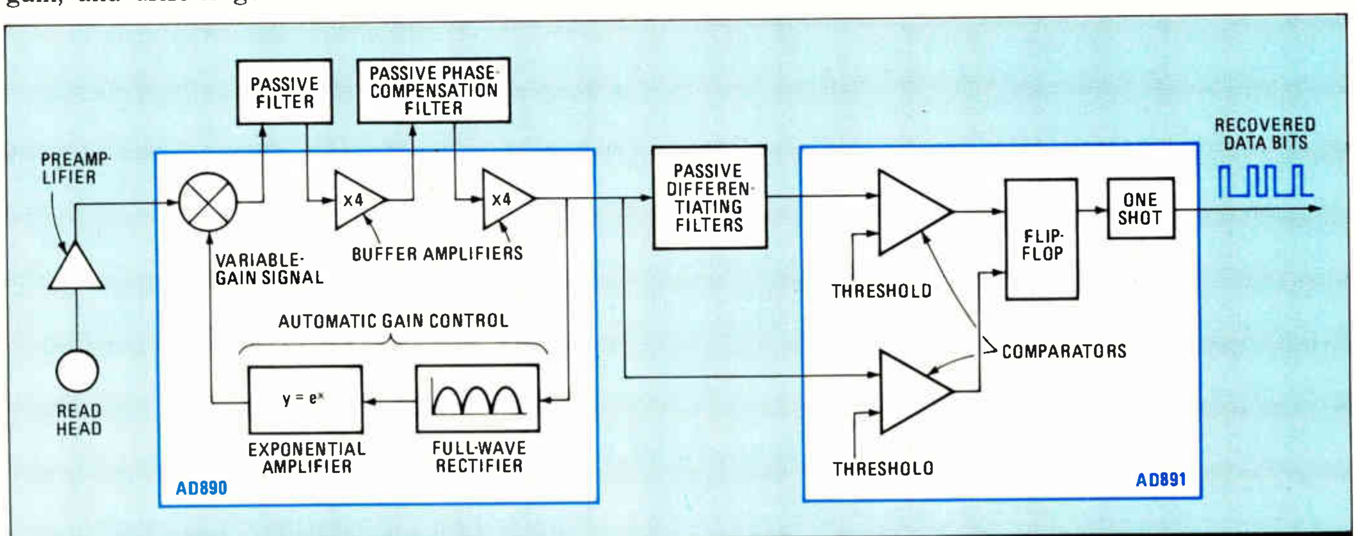
Development of the IC pair took nine months from initial planning to functional first silicon. A proprietary circuit simulator, called ADICE (Analog Devices' Spice-like Simulator), running on a VAX 8800 was used for the bulk of the 890/891 design. In addition, a CALMA-based automated layout and device checking package was used in the design process for the final layout.

The new ASICs should speed development of a new generation of high-speed products that should dominate this kind of specific application during the 1990s.

The 890/891 are the result of a convergence of several influences within Analog Devices: the identification of markets where existing technology may be inadequate; the search for high-volume market niches; process technology that allows high-speed, highly-predictable designs; and a careful understanding of disk-drive manufacturer's design needs.

In addition, developing a subsystem for a specific application area was a shift from Analog Devices' traditional approach of providing high-performance, building-block components such as op amps, ADCs and DACs, or DSP chips—parts that could serve in almost any electronic circuit design. Ray Stata, Analog Devices' president and chairman of the board, says "The new ASICs should lead to the development of an entirely new generation of high-speed analog signal-processing ICs—products that should dominate this kind of specific application in the 1990's." □

For more information, circle 481 on the reader service card.



3. DATA RECOVERY. Sophisticated mixed-signal functions are needed to achieve error-free data recovery at high rates. The AD890's variable gain amplifier provides output at precisely the level required for optimal operation of circuitry.

ANALOG'S MAJOR MOVE TO NEW MARKETS

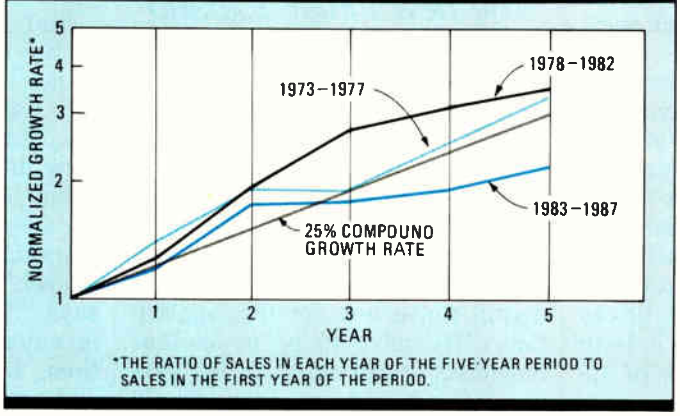
The times, they are a changing, and nobody knows that better than Ray Stata, president and chairman of Analog Devices Inc. Specifically, the military and industrial markets that have long been Analog's mainstays are changing, with growth slowing and customer spending declining. So, over the next five years, Stata plans to emphasize new markets, and he's determined not to miss out on any opportunity to sell his products, especially where no one else is trying. And while he's at it, he wants to improve quality all across the board, from cutting design time to eliminating late deliveries.

Known as the quintessential purveyor of data-acquisition devices, the Norwood, Mass., company, doesn't want to be regarded that narrowly any more. "Our business is better characterized as real-world signal or information processing, rather than acquisition, because our products do more than acquire data," says Stata. While most of its revenue will still come from data-acquisition devices, especially in the industrial and military markets, the company wants to strengthen its position in other areas as well.

Analog has targeted two markets on which it pins its expansion hopes: high-performance computer and peripheral applications, where it is already a player, and portions of the consumer hardware market dominated by Japanese companies. Both markets have substantial growth projections and high-performance needs, characteristics that, in the past, allowed Analog to rise to the fore in the analog integrated-circuit market. The AD890/891 mixed-signal data-recovery ICs that Analog is planning for the high-performance disk-drive arena (see page 76) constitute Analog's first foray into the world of application-specific ICs and look to be the harbinger of things to come.

A clue to the shift in market focus may be found in company financial data. Analog Devices had fiscal 1987 revenues of $370.4 million, up 11% from last year's $334 million. And while growth goals in recent five-year plans at Analog have been in the 25% per year range (see graph), Stata says "We'll probably tell stockholders to expect more like 20% in the near term." That's primarily because of the slowed military and industrial market growth.

GROWTH SLOWS AT ANALOG DEVICES



*THE RATIO OF SALES IN EACH YEAR OF THE FIVE-YEAR PERIOD TO SALES IN THE FIRST YEAR OF THE PERIOD.

One analyst sees Analog's push for more computer and selected consumer device business as a sensible result of a dimming of prospects in the military market. Some 30% of Analog's worldwide revenues come from military system customers, "but slower military sales growth coupled with tougher pricing could prevail through the next administration," says Michael Kubiak, a semiconductor analyst at Kidder, Peabody & Co. in San Francisco.

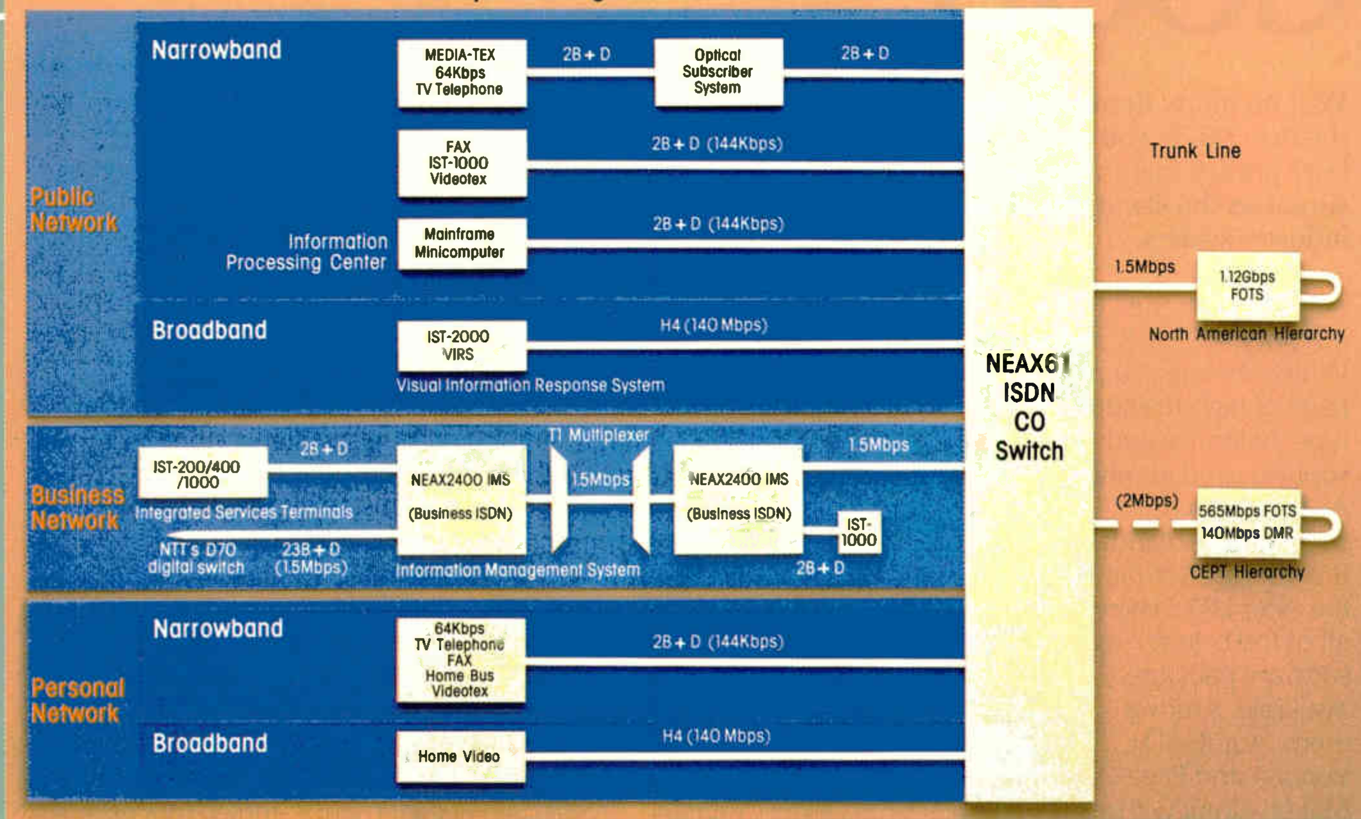
Stata isn't divulging any details of the financial goals of the five-year plan for 1988-1992, which the company has been working on for over a year, but outlines of the plan plus the efforts of internal task forces and some insight from analysts provide clues about the company's future. Indications are that high-performance computer and peripheral applications will account for 30% of revenues in two or three years, up from 20% today; that the company is going after performance-oriented Japanese-dominated analog sockets in consumer hardware; and that there's a bottom-up push to improve product quality and to shorten the time required to design and deliver products.

While these goals can be accomplished, no one says it's going to be easy. Because the company is giving itself five years to get the changes in place and to establish its market share, Kubiak is optimistic, but wary. "Analog has a good shot at achieving those goals," he says. But he notes that some of the consumer applications Analog may be targeting are also attracting Motorola Inc. and Texas Instruments Inc. Analog has succeeded in the analog business by avoiding competition with such giants. "Historically, they've done a good job of getting into markets that aren't served by the billion-dollar companies," Kubiak says. "Now that's changing. These are highly competitive, high-volume markets, and Analog still has to prove that it can handle that kind of competition."

On the other hand, he notes that Analog faces only limited competition in its traditional business. "The fragmented nature of the analog market protects them from any one competitor across all the company's product lines. Only Burr-Brown Corp. competes with Analog in both analog IC and assembled products, and Japanese competition is limited," says Kubiak.

One advantage for Analog is that the computers and peripherals markets are not dominated by any of the power-hitters. Andrew Rappaport, president of the Technology Research Group, a Boston consulting and market research organization, points out that lin-

ISDN system configuration at TELECOM 87



Digital switching system: NEAX61

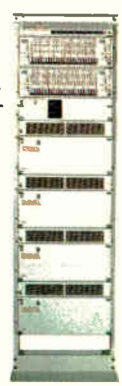
The core of the demonstration was the NEAX61. It displayed integrated broad- and narrowband switching capability, as well as 1.5Mbps high-speed packet switching.

Network management system (NMS)

The NMS efficiently monitors/controls switching and transmission networks. For easy trouble-shooting, it offers expert system technology which guides users to the source of system problems.

1.12Gbps FOTS

The 1.12Gbps Fiber Optic Transmission System (FOTS) demonstrated its ability to combine 16,128 voice channels into a single-mode fiber.



AT THE R&D ZONE

NEC's intensive R&D efforts, ranging from components to total systems, gave visitors a glimpse of many futuristic visions come true.

4Gbps FOTS

This ultra high-speed system utilizes 1.55μm DFB LDs and InGaAs APDs and transmits over 30km without repeaters.

Photonic switching

NEC's display included a photonic switching system with 8×8 matrix optical switches. The system demonstrated 140Mbps broadband switching capability using IST-2000 video communication terminals.

High resolution CCD color camera

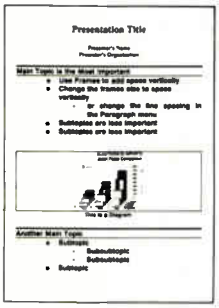
A compact HDTV camera, featuring 1.24-million pixel CCD chips, showed the latest advance in CCD technology.

NEC

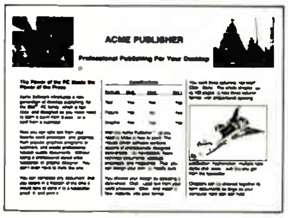
GOOD

Wait no more. Because with the Acer LP-75, you get a laser printer that meets and even surpasses the standards set by the industry leaders.

Consider the LP-75's memory – 1.5 MB standard. Which means you print an A4 page of high resolution type, halftones and sophisticated graphics. All in one feed.



Fully emulating the HP LaserJet family, the Acer LP-75 takes all of the best selling software packages available. Among them, AutoCAD, Ventura and PageMaker, along with countless other applications from over 500 software houses.



With its full page of high resolution graphics, the Acer LP-75 makes complex merging of text and graphics a cinch.

The extras – at no extra cost

Unlike other laser printers the Acer LP-75 is also standard equipped with vector graphics capability for CAD, CAM and CAE applications which lets you preview complex drawings or schematics.

Font support includes nine resident fonts of popular faces and a library of over 70 others in a choice of either cartridge or diskette.

A complete product line

At Acer Technologies our long-term commitment to research and development has enabled us to build better, more affordable machines.

Desktop publishing hardware soon available includes an Acer Scanner, 19" high resolution monitor and the Acer Mouse.

Software user support includes Acer Form developed as the ideal solution for professional documents and forms. And support drivers such as AutoCAD are available for professional users.

From printers to peripherals, data communication products to stand alone PCs and advanced multiuser systems, what we do best is provide complete and integrated solutions.

It's what we've been doing now for many years. And something we intend to keep on doing.

Acer. A name synonymous with quality, reliability, price performance and advanced technology. In short, value.

So check us out. Ask your nearest dealer about the Acer LP-75. And see how it can help you make a good impression in business.

IMPRESSIONS

Technical specifications

• 1.5MB RAM memory • HP LaserJet Printer Command Language compatible • Nine resident fonts standard • Vector graphics capability • 300x300 dpi full page graphics • Serial and parallel interface • 418mmx408mmx205mm(DxWxH)

HP LaserJet is a registered trademark of Hewlett Packard Corp.
AutoCAD is registered trademark of Autodesk Corp. Ventura is registered trademark of Xerox Computer Services. PageMaker is registered trademark of Aldus Corp.

E-001

Acer Technologies Corporation
401 Charcot Avenue, San Jose, California 95131, USA.
Tel: 408-9220333. Fax: 408-9220176, 408-9220177.
Call toll-free (800) 7821155 (California only), (800) 5381542 for the name of the dealer nearest you.

ACER
A New Word For Value

MAXIM'S PROGRAMMABLE FILTER OUTPERFORMS THE FIELD

For the first time, a filter IC combines full programmability and high performance

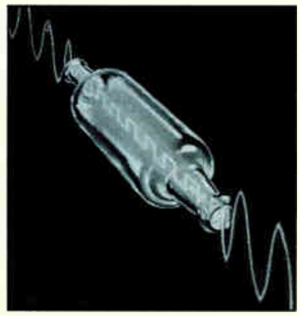
by Bernard C. Cole

A new family of microprocessor-programmable switched-capacitor active filters boasts a combination that has eluded filter designers till now: a wide range of programmable features and superior performance. The MAX260 filter series from Maxim Integrated Products Inc. can be reconfigured by a microprocessor to serve as any of a wide variety of lowpass, bandpass, allpass, and notch filters—and there's no need for external components. Under direct microprocessor control are the center frequency, the Q value, the order of the filter, the resolution, and the type.

The performance of the MAX260 series (see fig. 1) should open new applications for programmable filters. The MAX260 features a maximum center frequency of about 75 to 100 kHz, a four to five times improvement over competitive devices, and a Q value range of 90, also a four to five times improvement, says David Fullagar, vice president of research and development for the Sunnyvale, Calif., company. Moreover, he says, the center frequency can be programmed to any of 64 values over its range, while the Q can be programmed to take on any of 128 values over its full range.

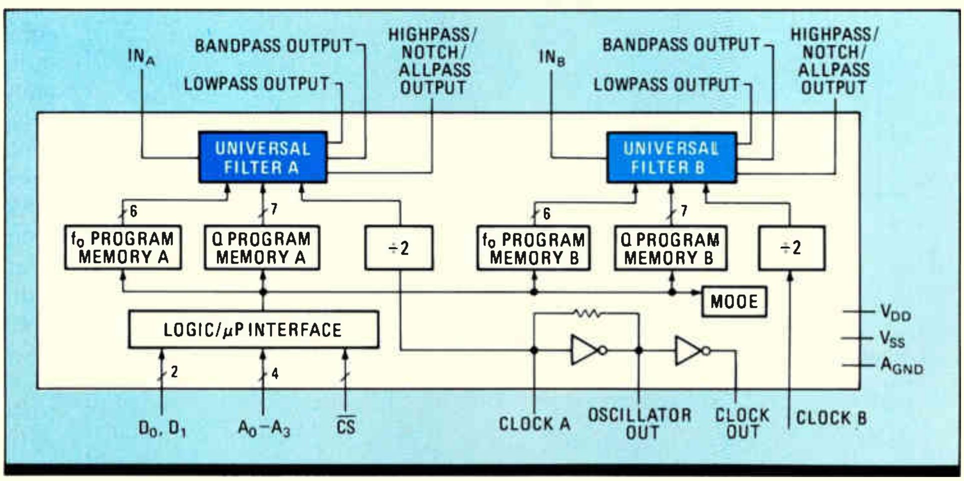
Systems designers are searching for satisfactory programmable filters because they find the task of analog filter design bewildering. That's not surprising, given the number of variables and choices going into the shaping of a needed circuit response. After the question of exact shape comes one of filter type, then parameters, and then the choice of implementation—passive or active. Both active and passive filters, once designed in, are pretty well fixed. And with the conventional, nonprogrammable filter, changing the filter characteristics would require a change in components, something digital designers are not prone to do.

Recent attempts to build microprocessor-programmable switched-capacitor filters have met with mixed results. On the one hand, a number of active-filter-based designs have emerged that combine reasonably high performance and microprocessor programmability but only by keeping tight constraints on applications. Such a filter, for instance, may be confined to a job in data communications, telecommunications, or instrumentation. On the other hand, some general-purpose switched-capacitor filter designs can be reconfigured under microprocessor control, but only at substantial performance costs compared to traditional switched-capacitor filters. In exchange for this programmability as to type and order, such designs have kept center frequency to no more than 20 kHz, Q values to 20 or so, and clock frequency to no more than 300 kHz.



Another advantage of the MAX260 family is that it can be programmed as a second-, fourth-, or eighth-order filter. Competitive devices cannot directly implement a second- or fourth-order filter; they require the addition of an allpass filter to bring the order from the eighth to the sixth, fourth, or second. Competitive microprocessor-controlled universal filters operate at clock frequencies that go nowhere near the MAX series rate of 2 MHz.

Also, because of a proprietary self-biasing scheme, noise specifications of the MAX series are one-fourth to one-third that of competitive programmable devices. In a fourth-order Cheby-



1. DUAL FILTERS. All members of the MAX260 filter family of microprocessor-controlled active filters have two second-order sections that combine features of both active-RC and switched-capacitor filters.

DATACUBE World Review

ISSUE 2 VOL. 1

NEW PC/AT-BASED IMAGE PROCESSING BREAKTHROUGH.

INSIDE:

- Datacube Boosts International Service
- High Speed DSP Processor Module Receives Kudos
- MaxVideo Family Continues To Grow
- New Look For Frame Stores

MaxVision AT-1 is Datacube's new, powerful plug-in image processing solution for the IBM PC/AT and its clones.

The MaxVision AT-1 has achieved immediate acclaim as a superior development-level image processing system for OEMs, system integrators, consultants and users designing vision and image processing systems for government, defense, security, industrial automation, medical imaging, university R&D, and educational applications.

MaxVision's image processing functions and operations include: real-time image integration; near real-time image convolutions; erosions and dilations, histograms; region-of-interest selective processing; Sobel and Roberts edge enhancement; temporal filters; selectable image thresholding; brightness slide, stretch and squeeze; and analysis of object attributes.

Small But Powerful

MaxVision AT-1 is a small box which can go anywhere, but its thin, stylish design makes a neat fit on top of your PC/AT and right under your CRT. Inside the box is a powerful real-time ALU processor, a multiplier unit, three image frame buffers, and input/output, and processing path look-up tables. Its pixel control feature means users can choose regions of interest within an on-screen image, and process only pixels inside that region's borders. But the real power of MaxVision's Hardware is that its software lets you use it fully, without having to get involved with any hardware details.

Complete Image Processing Software

The MaxVision AT-1 software has three layers. A window/mouse user interface allows a quick interaction with the image processing system. All the capabilities of the system are available as mouse selectable items. Besides the user interface, there are two additional layers to MaxVision's software. A command line interpreter enables more experienced programmers to bypass the mouse-driven menus by entering C language-formatted or natural language commands via the keyboard. Finally, all MaxVision's image processing functions and primitives are stored as C-callable functions ... allowing programmers to create, for example, their own icon-based user interface or to develop dedicated image processing programs.

Simple To Use

MaxVision is truly easy to run. Simply plug it into any IBM PC/AT, turn on the power, slip in the distribution floppy, and start processing images.

MaxVision takes its commands from a pointer device like a mouse, or from the keyboard. All you do is point to the appropriate section of the user friendly menu and the corresponding action takes place. No need to learn how to program a complicated image processor... you can spend your time doing image processing.

Datacube's MaxVision AT-1 has emerged as the standard for PC/AT-based image processing. MaxVision AT-1 is a small, inexpensive, but powerful image processor that plugs into the IBM PC/AT, HP Vectra and PC/AT clones. The advanced hardware and software of the MaxVision processor transforms the PC/AT into a unique, interactive, imaging system that acquires, displays and manipulates video images captured from standard TV cameras.

Easy to use, MaxVision takes commands from a mouse or keyboard. No complicated programming is required. Just plug it in and start your image processing using its user-friendly menu. And even though it's simpler to use than you would expect, it is designed to run a wide variety of powerful image processing routines.

Contact Datacube for the latest on image processing solutions.

DATACUBE

Datacube, Inc.
4 Dearborn Road, Peabody, MA 01960
(617) 535-6644 • 1-800-445-7008
FAX: (617) 535-5643

Circle 87 on reader service card

It's one thing to fill a document with data, another to fill it with content that makes someone take action. The document that best persuades not only has a typeset appearance, with visual as well as typographic elements, but also has superior content—facts and figures drawn from all possible sources to make a point of view, a point of sale.

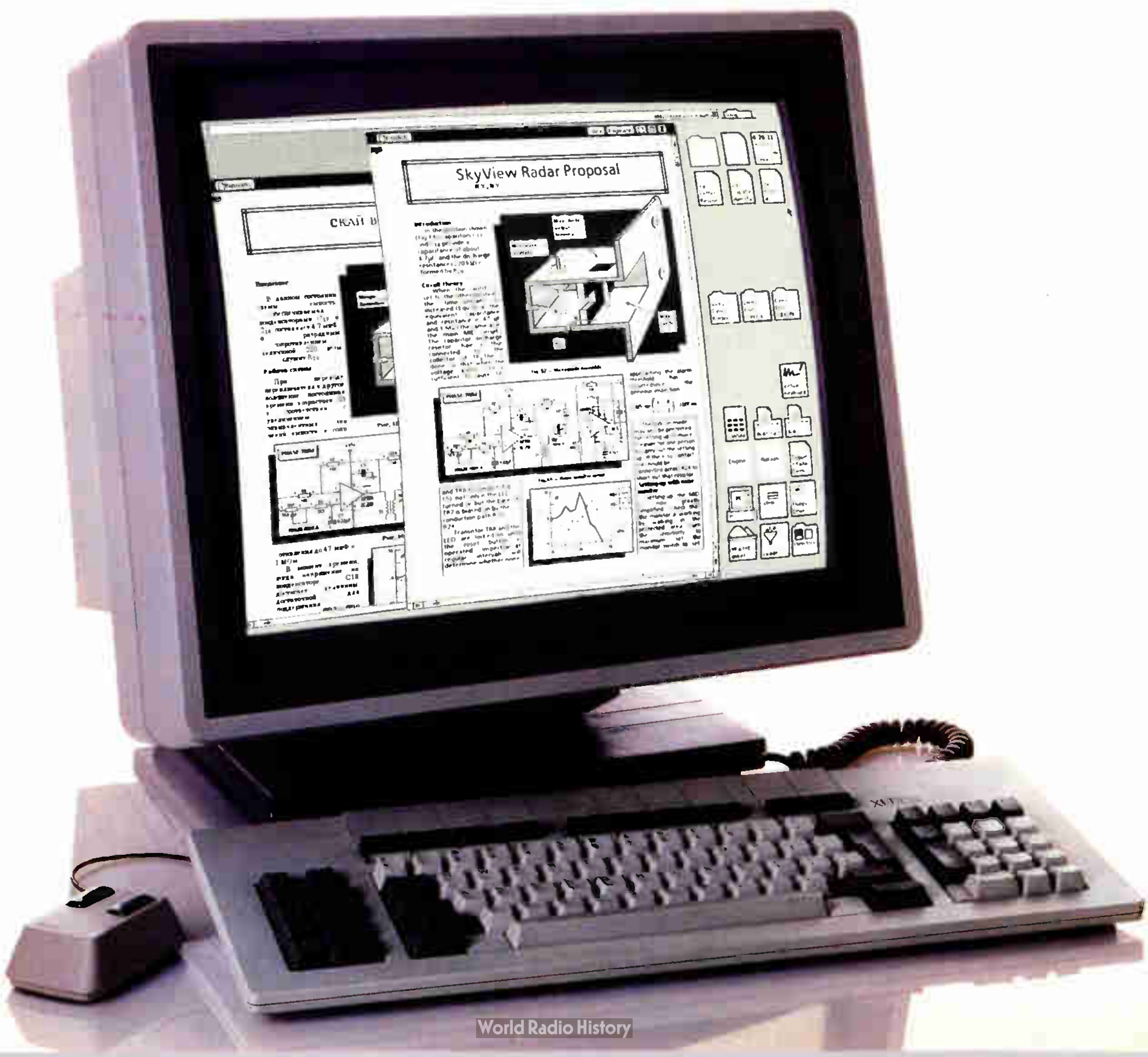
This is what Xerox Document Systems are all about. Whether mainframe resident software, networked publishing systems, or stand-alone systems and software, Xerox Document Systems let you, the user, combine information from desktop and beyond to produce documents with superior quality and impact.

Take for instance, the Documenter, pictured below.

Consisting of the Xerox 6085 Professional Computer System, the Xerox 4045 Laser CP printer and Xerox ViewPoint software, the Documenter can do an entire job from start to finish—creating, editing, assembling, formatting text and graphics, and printing—in one seamless operation.

But the Documenter is not merely another desktop publishing system. Its networking capability allows it to access information both external and internal. With the Documenter's multitasking power linked to your organization's data base, or

Xerox Document Systems create proposals that will be tossed around



XEROX

run in the optional PC emulation mode, or used as your electronic mailbox, you're in touch with vital facts and figures crucial to your success and that of your department. The figures for an illuminating graph can now be summoned from another department's data. A striking example that cinches an argument can now be supplied half a world away. Suddenly what is being said is every bit as good as it looks.

Call for a demonstration of the Documenter. It's the document processing solution that goes far beyond the desktop.

Team Xerox. We document the world.

For more information about Xerox Document Systems and the Documenter, call us at 1-800-TEAM-XRX (1-800-832-6979), ext. 240C, or clip the coupon below.

Xerox Corporation, P.O. Box 24, Rochester, NY 14692.

NAME (please print)

TITLE

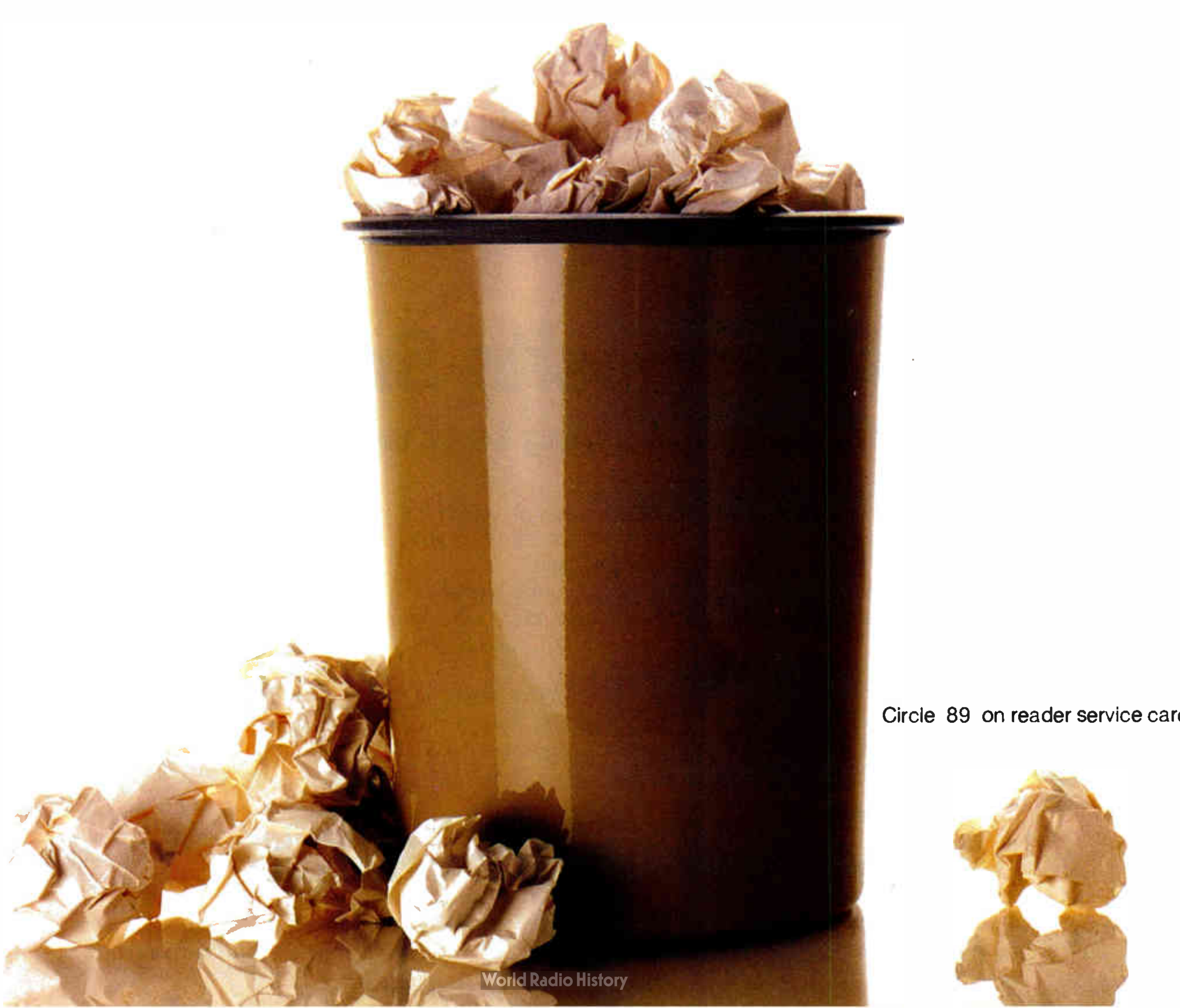
COMPANY

ADDRESS

CITY STATE ZIP

XEROX®, 6085 and 4045 are trademarks of XEROX CORPORATION. 425-12-87

...not tossed out.



Circle 89 on reader service card

EXECUTIVE OUTLOOK: CRASH ISN'T CHANGING PLANS—YET

Executives around the world are watching for clear signs of a coming recession, but with none in sight, development of products and technologies goes on apace

"Steady as she goes, but keep your eyes peeled!" is the watchword for captains of the worldwide electronics industry. The stock market crash has them checking and rechecking the horizon, but they still see no solid shape that calls for a course correction.

So on they go with plans they had already made for new products and technology development. Not one interviewed for *Electronics'* annual survey of industry executives on the outlook for the coming year would admit to having shelved any work in progress or trimmed back production plans as a result of the stock-market debacle or recent changes in monetary exchange rates. Technical innovation, for now, marches on, while contingency plans are drawn up.

Overseas managers have a special set of problems to face during the coming year. The falling value of the dollar puts major pressure on many European electronics companies (p. 93). The rising yen also plagues the Japanese, wiping out profits and forcing them to relocate production overseas (p. 97).

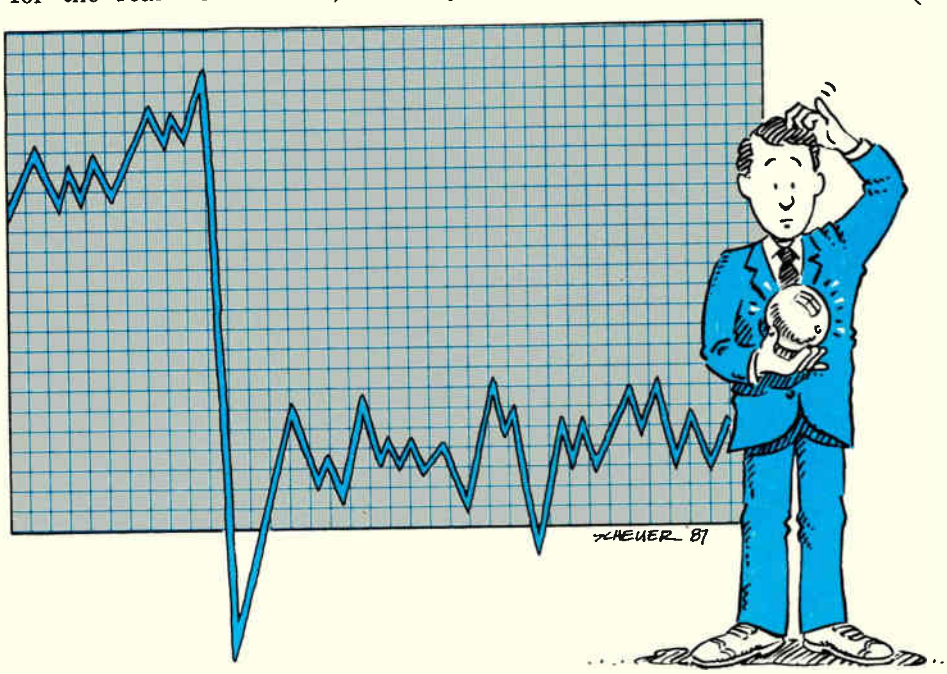
In the wake of the October crash in stock markets around the world, all the executives surveyed are alert for any sign of an economic downturn. So far, most of them don't see one coming. But virtually everyone says it's too early to tell—that it will take time for the real impact of the crash to be felt.

"No one claims they've seen any impact yet," says Alfred J. Stein, chief executive officer of VLSI Technology Inc. in San Jose, Calif. "I think that is a very good sign. However, by the same token, I would not expect to have seen anything yet. I think it will be six months to a year before we know what kind of impact it will have."

Stein himself is wary: "Personally, I cannot help but believe we are going to see some slowdown." And a number of other executives agree with him. Most are not sure exactly what they are worried about, but they can't imagine the crash would have no repercussions. At least two—James A. Bixby, president of Brooktree Corp. in San Diego and Joe Henson, president and chief executive officer at Prime Computer Inc., in Natick, Mass.—used nearly identical words to express their views: You can't yank a trillion dollars out of the economy in a week and not see *some* effect.

But the effect to date seems to be caution, not action. Expectations are being scaled back and plans are being laid for trimming expenditures—if a downturn comes. "I think you have to be very careful about assumptions, and my guess is people will be more careful than they would have been otherwise," says Dean Morton, chief operating officer of Hewlett-Packard Co., Palo Alto, Calif. Meanwhile, nobody wants to make the mistake of overreacting, thereby choking off growth that would otherwise have occurred.

While exercising a certain amount of caution, a number of executives are also expressing a degree of optimism, the reasons for which vary. One reason, ironically, is the slump endured by

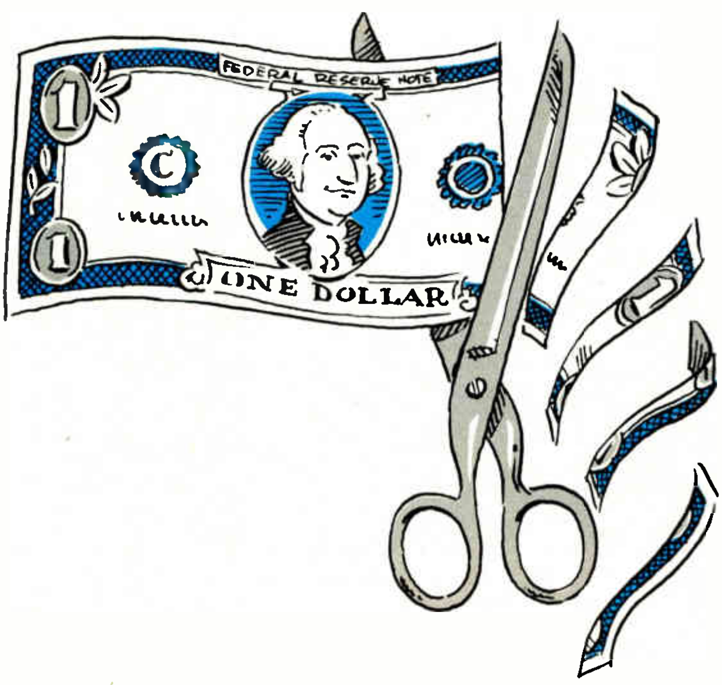


the electronics industry in 1985 and 1986. It left a lot of companies in excellent shape to weather any downturn that might occur. "We went through two terrible years while the economy was doing pretty well," says Gordon E. Moore, chairman and chief executive officer of Intel Corp. in Santa Clara, Calif. "I think we all got ourselves better positioned for pretty tough times. We shrunk our own employment from a peak of over 26,000 to about 18,000. We haven't enjoyed the good times long enough to build that back up again." Walden Rhines, senior vice president of Texas Instruments Inc.'s Semiconductor Group in Dallas, echoes Moore's point. "The depth of our recessions tend to be proportional to the height of our euphoria," Rhines says. "We've only had a modest upturn in 1986-87."

And that lack of euphoria could help offset any ill effects from the stock market crash. VLSI Technology's Stein, for one, thinks times have changed since 1983 and 1984, when the boom got out of hand and book-to-bill ratios ran as high as 1.5 and 2. "That has not happened in this cycle," he says. "It went up nicely, to the 1.2 to 1.3 range, and now it has dropped back down to around 1. It is a nice, strong, steady buildup. This market crash adds to the caution against overbuilding, overcapacity, or false bookings."

The aftershocks of the U. S. market crash are, of course, reverberating overseas. However, overseas markets tended not to slide as fast or as far, and the effects are likely to be gentler. In West Germany, for example, economists are revising downward their projection of gross national product growth, from the 2% forecast before the crash to about 1.5%.

That decline is not big enough to ignite panic. Siemens AG, for example, is delaying expansion or cutting back capacity in some rather low-tech sectors, but it will not allow high-tech fields to suffer, says Alexander Grossmann, a vice president at the Munich company. Similarly, Klaus Bomhardt, managing director at Heilbronn-based Telefunken electronic GmbH, says, "We have not changed our plans to further develop our facilities, and we are counting on another business increase in 1988." And Lubo Micic, managing director of ITT Semiconductors Group in Freiburg, says, "We will not alter our investment plans, nor will we delay the development of new products." In France, Jacques Bouyer, president and general manager of RTC-Compelec SA, also says no projects or programs have been shelved.



The Tokyo stock exchange slid in sympathy with the U. S. markets, but it didn't drop as far, and it rebounded sooner. "This particular crash was centered in the U. S. and the direct impact in Japan was small," says Hiroshi Asano, executive vice president of Hitachi Ltd. in Tokyo. "But the indirect impact—the increase in the value of the yen—hurts badly." It crimps considerably the export-oriented industry of the Japanese.

Some American executives think that the stock market crash may end up helping the U. S. economy in other ways as well—notably by spurring some much-needed action on the federal deficit. "Now our friends in Washington are saying they're going to reduce the deficit in 1988 and 1989," says J. Tracy O'Rourke, president and chief executive officer of Allen-Bradley Co. in Milwaukee. And while the dollar is cheaper and the balance of trade therefore better, O'Rourke says, "miraculously, somehow, inflation does not seem to be responding ... Profits are up. Liquidity is up. Money is relatively cheap, and there's lot's of it."

"I think if the crash did nothing more than to get that damn Congress and Administration together to do something constructive, it's going to be almost worth it," says John Krehbiel, chairman of Molex Inc. in Lisle, Ill.

A number of U. S. executives, however, think the electronics industry has some built-in strengths that will keep it prosperous no matter what the government does. Several point out that the computer industry—the major market for components—is starting a strong new product cycle. "There has been a change from the low-end machines—the 8088-based machine—to the 286-based machines," says Intel's Moore. "The 386-based machines are coming out at the high end and the first real 32-bit software is becoming available." All of which means that the new product cycle is working against the possibility of an economic slump. "I personally believe the product cycle will dominate," Moore says.

The declining dollar is sharing attention on the economic scene with the stock market crash. What the weaker dollar means to electronics industry executives depends on where they do business. Those who manufacture in the U. S. and sell abroad think the cheap dollar is great. "That's what we need to help solve the deficit in foreign trade," says Edson de Castro, chief executive officer of Data General Corp. in Westboro, Mass. For those who make their products both overseas and in the U. S., "it's a mixed bag," says James Norling, general manager of Motorola Inc.'s Semiconductor Product Sector in Phoenix, Ariz.

Actually, things aren't that simple even for exporting companies. The weak dollar means products are cheaper overseas, and hence more competitive. But it also means the companies themselves would be cheaper, too, if any overseas investors decided to mount a takeover attempt. "In high-tech America right now . . . not only is the dollar low but most of the stocks are at near-term lows," says Wilfred J. Corrigan, chairman of LSI Logic Corp in Milpitas, Calif. "That will be very tempting."

Most executives discount the danger of Asians or Europeans going on a buying spree in the U. S. They cite the failure of such acquisitions in the past; the likelihood of government disapproval, as in Fujitsu Ltd.'s attempt to buy Fairchild Semiconductor Corp.; and, most of all, the danger for the buyer of scaring off the talent he's trying to ac-

THE DECLINING DOLLAR: BAD NEWS FOR SOME EUROPEANS, BUT NOT ALL

The steep, steady decline of the value of the U. S. dollar against West European currencies is hurting some European electronics businesses, but not all of them. It all depends on where their markets and production facilities are.

From March 1985 till October of this year, the value of the U. S. dollar tumbled 41.4% against the average of West European currencies. This has, in effect, made American goods—and goods from countries whose currency is tied to the dollar—less expensive on European markets and, conversely, European wares correspondingly more expensive in U. S. markets.

"The difference between the franc and the dollar has more of an effect on our outlook than the stock market crash," says Guy Dumas, president of Matra Harris, the chip-making subsidiary of Matra SA in France. "We have not found a solution."

West Germany's electronics industry, however, is not suffering heavily from the dollar's drop because only 7% or so of this sector's exports finds its way to the U. S.—far less than Japan's exports to America. "And should the dollar weaken even more, the effect on the electronics industry will not be all that dramatic," says Alexander Grossmann, a vice president at Siemens AG, Munich. Siemens itself, he says, is not suffering all that much from the dollar's decline, because Siemens has a strong manufacturing base in the U. S.

Neither do other firms over-dramatize the situation. "Prices for microelectronic parts are dollar-based world-market prices," says Klaus Bomhardt, managing director at the semiconductor device maker Telefunken electronic GmbH in Heilbronn. "That means a producer's income is essentially a dollar income."

Jacques Bouyer, president of RTC-Compelec SA in France, agrees. "A large portion of business is dollar-connected as far as market prices are concerned. But cost structures are not always dollar-connected. The result is a squeeze on the market."

Iann Barron, chief strategic officer at Inmos Ltd., Bristol, UK, thinks it possible that the prices of devices and production equipment from Japanese vendors will become more tied to the yen in the coming year, and less to the dollar, as they have been. As a consequence, semiconductor prices should then firm up, he thinks.

"One strategy for solving the dollar problem is to balance out dollar income and dollar expenditures as best as possible," says Telefunken's Bomhardt—by setting up factories in the dollar area and purchasing materials there. A number of European companies are considering setting up a production facility in the U. S. or are availing themselves of the cost advantages there. A case in point is the computer board and systems maker PEP Modular Computer GmbH in Kaufbeuren.

"Although we are not suffering too severely, the dollar's low value compared to the Deutschmark is pushing our profit margin down," says Josef Kreidl, PEP's president. To help offset this, the company assembles its systems and peripherals in West Germany but completes them in the U. S., using American components—memories, for example—as much as possible. "We may even start full production in the U. S.," Kreidl says.

Among the lucky firms that already have a lot of production capacity in the U. S. is the ITT Semiconductors Group in Freiburg, West Germany. "We sell more components from our U. S. facilities to other countries than we sell to the U. S. from our European facilities," says Lubo Micic, the group's managing director. "Since that balances things out, we are not that much affected by the dollar problem."

LOOK FOR HOT DEVELOPMENTS IN EVERY AREA AT THE ISSCC

They include: a user-configurable gate-array, a 32-bit GaAs RISC chip, a 40-MHz 32-bit processor, advanced data converters, an 8-ns biCMOS 256-K SRAM, a ferroelectric SRAM

by Bernard C. Cole

Unlike recent International Solid State Circuits Conferences, the 1988 edition of the world's most prestigious semiconductor event will feature hot developments in all major chip areas. Last February, the ISSCC was heavy in memory circuits, both in terms of numbers of papers and in their significance. The 31st edition, set for Feb. 17 to 19 in San Francisco, is balanced with significant developments in semicustom logic, processors, and analog devices, as well as in all types of memories—random-access, read-only, and nonvolatile.

Memory is still a major player. Among the highlights are two speedy 60-ns dynamic RAMs, one a 16-Mbit design from Matsushita and the other a 4-Mbit design from Siemens; and two biCMOS 256-Kbit static RAMs from Hitachi and Fairchild that feature access times of 8 and 12 ns, respectively. There also will be a novel nonvolatile ferroelectric static RAM from Ramtron.

In logic, Actel will introduce a user-configurable gate-array technology based on a new antifuse technology that boosts density. Microprocessor fans can cheer for Texas Instruments' gallium arsenide 32-bit central-processing unit with a reduced-instruction-set architecture technology, and a 40-MHz 32-bit CMOS design from General Electric. On the analog side, there's an automatic place-and-route system for mixed analog and digital circuits from IBM and a number of advanced data-conversion circuits from Analog Devices, AT&T Bell Laboratories, Hitachi, NEC, and Philips.

As always, the big story in DRAMs and SRAMs will focus on density and speed. Garnering a lot of attention will be a 60-ns 16-Mbit DRAM from Matsushita Semiconductor Research Center, Osaka, Japan. Built with an aggressive 0.5-μm CMOS process, it incorporates a high-capacitance trench structure that surrounds the active devices. The result is a cell that's only 3.3 μm^2. There's also a 60-ns 4-Mbit DRAM, hot-electron-resistant, from Siemens AG, Munich, West Germany. Its designers believe the memory will scale well to 16 Mbits without sacrificing 5-V operation. This part uses dual-gate FET peripheral circuits, which promise a hundredfold improvement in device lifetime over single-gate designs. Fabricated with a conservative 0.9-μm CMOS process, its trenched-capacitor-based cell measures only 10.58 μm^2.

Two biCMOS 256-Kbit SRAMs will be eye-openers. From Hitachi Ltd.'s Device Development Laboratory in Tokyo comes one laid out as 256-Kbits by 1 bit, which smokes along at 8 ns. Its 66.3 μm^2 cells are made with a 1-μm double-polysilicon, double-metal process; power dissipation is 400 mW at 50 MHz. Only slightly slower is the 12-ns design from Fairchild Semiconductor Corp. of Puyallup, Wash., now a part of National Semiconductor Corp. Also a 256-K-by-1 bit array, it has

ISSCC: DAY 1 IS DOMINATED BY DIGITAL

HIGH-SPEED DATA RECOVERY	CCDs AND SENSORS	GATE ARRAYS
• AT&T Bell Laboratories • Fujitsu • Matsushita • National Semiconductor • University of California, Berkeley	• Fujitsu • Philips • Sony • Stanford University • Toshiba	• Actel • Hitachi • IBM • NTT • Thomson-Mostek
HIGH-SPEED MICROPROCESSORS	**INTEGRATED SIGNAL-PROCESSING SUBSYSTEMS**	**HIGH-SPEED DIGITAL CIRCUITS**
• General Electric • Hitachi • LSI Logic • Rockwell International Microelectronics • Stanford University • Texas Instruments	• CNET-CNS • General Electric • Hitachi • Siemens • Zoran	• AT&T • Fairchild-National • Fujitsu • IBM • NEC

ISSCC: DAY 2 RANGES FROM TELECOM TO DSP	
TELECOMMUNICATIONS CIRCUITS	**VIDEO AND GRAPHICS SIGNAL PROCESSORS**
• AT&T • Granger Associates • Mitel • Rockwell International • TRW LSI Products • University of California, Berkeley	• General Electric • Hitachi • Matsushita • NTT • Toshiba • Visual Information Technologies
NONVOLATILE MEMORIES	**STATIC RAMs**
• General Instrument Microelectronics • Hitachi • Intel • Ramtron • Seeq Technology • SGS Microelectronics	• Fairchild-National • Fujitsu • Hitachi • IBM • Motorola • Philips
HIGH-SPEED LOGIC	**ANALOG TECHNIQUES**
• AT&T • CNET-CNS • Cypress Semiconductor • Lattice Semiconductor • MIPS Computer Systems	• Analog Devices • NEC • Philips • SGS Microelectronics • University of California, Berkeley

96.5-μm^2 cells and dissipates about 750 mW.

Although traditional EPROM and EEPROM designs will also push the speed and density barriers, standing out will be a novel 256-by-1-bit ferroelectric shadow RAM integrated onto the same chip with peripheral circuitry fabricated using standard CMOS technology. The device is significantly faster than EEPROMs—production devices will sport 100-ns read-erase-write cycles [*Electronics*, March 5, 1987, p. 32]. According to the researchers from Ramtron Corp., Colorado Springs, Colo., the nonvolatile RAM uses a single 5-V supply and can be reprogrammed as many times as the most durable EEPROMs, in excess of 10^8 cycles, over the full military temperature range of -55°C to +125°C.

In semicustom logic, check out a CMOS electrically configurable gate array from Actel Corp. of Sunnyvale, Calif. It employs an antifuse architecture for programming both horizontal and vertical elements. That's a departure from traditional CMOS programmable logic devices, which use a stored charge to program a cell, or bipolar PLDs, which use a fusible link. The result is significantly increased density. Prototypes made with 2-μm CMOS technology feature 295 configurable modules with eight input/outputs each, 55 user-definable pins, and 112-K programming elements in a 260-by-360-mil die.

In a more traditional vein will be super-high-speed logic devices from Cypress Semiconductor Corp., San Jose, Calif., and Lattice Semiconductor Corp., Beaverton, Ore. Cypress offers a 66-input-term and 258-product-term ultraviolet-based programmable logic array. It is made with an 0.8-μm double-metal CMOS process and features an unprecedented 50-MHz throughput, dissipating only 440 mW. Lattice also describes an electrically erasable device: a 9-ns, 450-mW PLD fabricated with a 1.0-μm CMOS process that features a 20-ns programming time.

Heading the processor list will be a 32-bit GaAs RISC microprocessor from Texas Instruments Inc., Dallas. Containing a 16-by-32-bit register, 32-bit arithmetic logic unit, and a six-stage pipeline, the circuit is fabricated with integrated injection logic and a 1.5-μm heterojunction GaAs bipolar process.

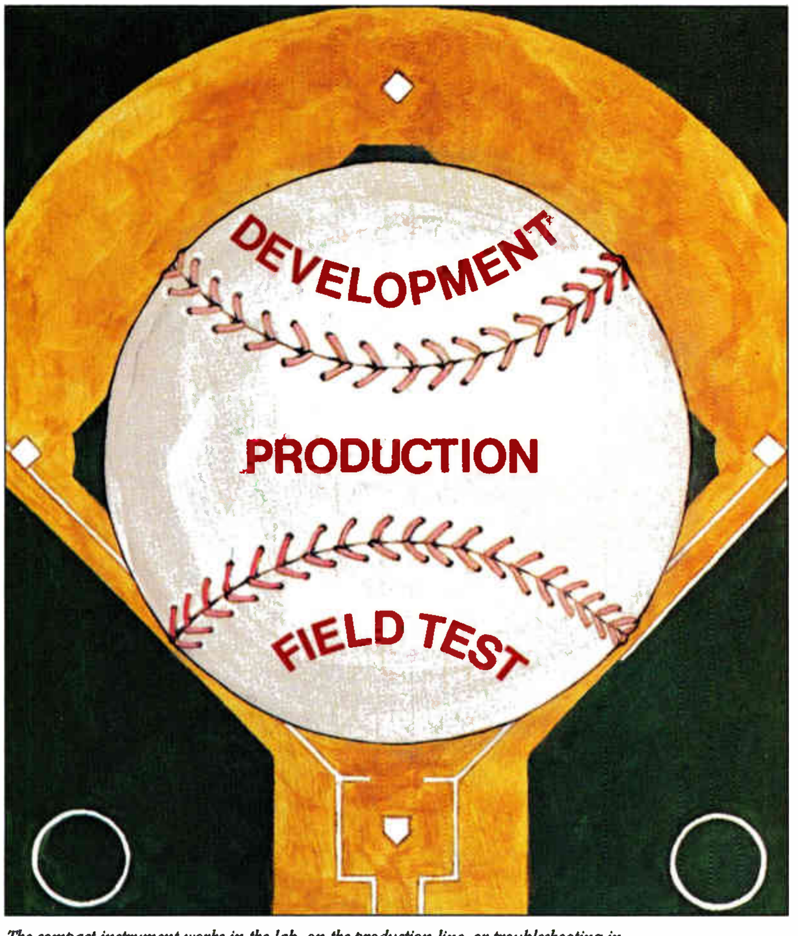
Then there's General Electric Co.'s 32-bit entry from its Syracuse, N. Y., operation. The 40-MHz CPU is fast: 25-ns access time. It gets its horsepower through the use of a four-cycle instruction pipeline, a seven-cycle load-operation pipeline, and a 320-byte instruction cache RAM.

The glare of so many digital offerings won't overshadow the analog developments. One from IBM's General Products Divison, Rochester, N. Y., will address the chore of creating mixed analog and digital circuits with computer-aided design. Using device-level automatic place-and-route methodology, IBM researchers claim up to 75% chip utilization.

At the circuit level, interest will be high for data-conversion offerings that use advanced algorithmic, pipelined, and flash designs. Analog Devices Inc., Wilmington, Mass., will describe a 14-bit, 10-μm analog-to-digital converter, and Hitachi Ltd., Tokyo, will lay out details of an 8-bit 20-MHz half-flash ADC as well as a 10-bit 20-MHz ADC with an internal sample and hold. And from Philips Research Laboratories in Eindhoven, the Netherlands, comes a 15-bit, two-stage, digital-to-analog converter. □

ISSCC: DAY 3 IS FOR CONVERTERS AND ASICs	
ADCs	• Matsushita • Mitsubishi • Siemens • Texas Instruments
• AT&T • Analog Devices • Crystal Semiconductor • Hitachi • Philips • University of California, Berkeley • University of Illinois	**ASICs AND INTERFACE CIRCUITS**
DYNAMIC RAMs	• IBM • K.U. Leuven Elektrotechniek • MIT • Philips • Sony • Stanford University
• Bundeswehr University • IBM	

TRIPLE THREAT.



The compact instrument works in the lab, on the production line, or troubleshooting in the field, and its system software makes it easy to design new tests.

Fluke's Board Tester Can Cover All The Bases.

"Some digital testers star in the development lab, others shine in production testing, and a few are best at troubleshooting in the field. But the 9100 series of microprocessor board testers from the John Fluke Manufacturing Co. aims to do a job in all three test roles. The Everett, Wash., company is grooming the compact emulative testers for design debugging in the lab, as well as for functional testing and fault isolation in the factory and field.

One of Fluke's goals for the 9100 series is ease of use. The software simplifies and speeds other test-writing chores so that the typical troubleshooting program can be developed in only 20% of the time it usually takes..."

Excerpted from an exclusive article in the May 14, 1987 issue.

McGraw-Hill **Electronics**

THE LEADER IN NEW TECHNOLOGY COVERAGE

HIGH SPEED STATIC RAMS.

From bit-wide to byte-wide, from 25ns to 70ns, Toshiba is the power — and the speed — in static RAMs.

When you think fast, think Toshiba. We have the organizations and the speeds to meet your requirements. In the popular 4K x 4, we offer a 25ns version in the standard 20 pin type and in a 22 pin version with an output enable function of 15ns. The output enable helps eliminate bus contention while increasing speed.

We were first with 2K x 8 devices which are ideally suited for cache memory applications. We now have a 25ns version in addition to our 35ns offering. Both are now available in plastic DIPs.

For high speed bit-wide applications, we are in full production of two versions of our CMOS 64K x 1 SRAMs. One with access times to 35ns, and one with the lowest standby power in the industry at only 100μA. Both plastic DIP and plastic SOJ packaging are available.

A new product introduction is the 16K x 4 CMOS static RAM with access time of 25ns. Standard 22 pin plastic DIP and SOJ versions are available, as well as a 24 pin plastic DIP and SOJ version with output enable access time of 15ns.

For byte-wide applications we have an 8K x 8 device with access times to 35ns. Packaging is 28 pin 300 MIL plastic DIP. For applications where parity is required, we have an 8K x 9 with speeds to 35ns. This device is also in a 300 MIL plastic DIP.

So when you're thinking fast, think Toshiba. The power in high speed SRAMs.

FAMILY TYPE: HIGH SPEED MOS STATIC RAMS					
PART	ORG'N	SPEED	PACKAGE	SAMPLES	PROD'N
TMM2068AP	4KX4	45	20P DIP	NOW	NOW
TMM2068AP	4KX4	35	20P DIP	NOW	NOW
TMM2068AP	4KX4	25	20P DIP	NOW	NOW
TMM2018AP	2KX8	45	24P DIP	NOW	NOW
TMM2018AP	2KX8	35	24P DIP	NOW	NOW
TMM2018AP	2KX8	25	24P DIP	NOW	NOW
TMM2089C	8KX9	45	28P SB DIP	NOW	NOW
TMM2089C	8KX9	35	28P SB DIP	NOW	NOW
TMM2089P	8KX9	45	28P DIP	NOW	NOW
TMM2089P	8KX9	35	28P DIP	NOW	NOW
TMM2088P	8KX8	45	28P DIP	NOW	NOW
TMM2088P	8KX8	35	28P DIP	NOW	NOW
TC55416P	16KX4	45	22P DIP	NOW	NOW
TC55416P	16KX4	35	22P DIP	NOW	NOW
TC55416P	16KX4	25	22P DIP	NOW	NOW
TC55416J	16KX4	45	24P SOJ	NOW	NOW
TC55416J	16KX4	35	24P SOJ	NOW	NOW
TC55416J	16KX4	25	24P SOJ	NOW	NOW
TC55417P	16KX4	45	24P DIP	NOW	NOW
TC55417P	16KX4	35	24P DIP	NOW	NOW
TC55417P	16KX4	25	24P DIP	NOW	NOW
TC55417J	16KX4	45	24P SOJ	NOW	NOW
TC55417J	16KX4	35	24P SOJ	NOW	NOW
TC55417J	16KX4	25	24P SOJ	NOW	NOW
TC5561P	64KX1	70	22P DIP	NOW	NOW
TC5561P	64KX1	55	22P DIP	NOW	NOW
TC5561P	64KX1	45	22P DIP	NOW	NOW
TC5561J	64KX1	70	24P SOJ	NOW	NOW
TC5561J	64KX1	55	24P SOJ	NOW	NOW
TC5561J	64KX1	45	24P SOJ	NOW	NOW
TC5562P	64KX1	55	22P DIP	NOW	NOW
TC5562P	64KX1	45	22P DIP	NOW	NOW
TC5562P	64KX1	35	24P DIP	NOW	NOW
TC5562J	64KX1	55	24P SOJ	NOW	NOW
TC5562J	64KX1	45	24P SOJ	NOW	NOW
TC5562J	64KX1	35	24P SOJ	NOW	NOW
NOTE: DIP = PLASTIC CDIP = CERDIP SB DIP = SIDE BRAZED CERAMIC SOJ = SMALL OUTLINE J LEAD PACKAGE					

TOSHIBA.
THE POWER IN HIGH SPEED SRAMS.

TOSHIBA AMERICA, INC.

MINNESOTA, Electric Component Sales, (612) 933-2594; **MISSISSIPPI, Montgomery Marketing, Inc., (205) 830-0498; MISSOURI**, D.L.E. Electronics, (316) 744-1229; **MONTANA**, Components West, (206) 885-5880; **NEVADA**, Elrepco, Inc., (415) 962-0660; **NEBRASKA**, D.L.E. Electronics, (316) 744-1229; **NEW ENGLAND**, Datcom, Inc., (617) 891-4600; **NEW HAMPSHIRE**, Datcom, Inc., (617) 891-4600; **NEW JERSEY**, Nexus-Technology, (201) 947-0151; **NEW MEXICO**, Summit Sales, (602) 998-4850; **NEW YORK**, Nexus Technology, (201) 947-0151; Pi-tronics, (315) 455-7346; **NORTH CAROLINA/SOUTH CAROLINA**, Montgomery Marketing, Inc., (919) 467-6319; **NORTH DAKOTA/SOUTH DAKOTA**, Electric Component Sales, (612) 933-2594; **OHIO**, Steffen & Associates, (216) 461-8333; (419) 884-2313, (513) 293-3145; **OKLAHOMA**, MIL-REP Associates, (214) 644-6731; **OREGON**, Components West, (503) 684-1671; **PENNSYLVANIA**, Nexus Technology, (215) 675-9600, Steffen & Associates, (412) 276-7366; **RHODE ISLAND**, Datcom, Inc., (617) 891-4600; **TENNESSEE**, Montgomery Marketing, Inc., (205) 830-0498; **TEXAS**, MIL-REP Associates, (512) 346-6331, (713) 444-2557, (214) 644-6731; **UTAH**, Straube Associates Mountain States, Inc., (801) 263-2640; **VERMONT**, Datcom, Inc., (617) 891-4600; **WEST VIRGINIA**, Steffen & Associates, (419) 884-2313; **WASHINGTON**, Components West, (206) 885-5880, (509) 922-2412; **WISCONSIN**, Carlson Electronics, (414) 476-2790, Electric Component Sales, (612) 933-2594; **WYOMING**, Straube Associates Mountain States, Inc., (303) 426-0890; **CANADA, BRITISH COLUMBIA**, Components West, (206) 885-5880; **ONTARIO**, Electro Source, Inc., (416) 675-4490, (613) 726-1452.

Circle 107 on reader service card

Our newest sales angle is a straight line.

Time for some straight talk.

At ITT Cannon, we didn't survive in the interconnect business for 70 years without continually changing to meet the needs of the marketplace.

So when you asked for faster, more efficient servicing, we changed. We streamlined. We created a straight line access between customer and manufacturer.

Now it's easier than ever to do business with Cannon.

We made specialists out of our sales force so they can answer your product needs immediately. Or put you in touch with someone who can. The object is to give you a straight access to the person who can get the job done.

We added more manufacturer representative organizations and distributors across the country. Now there are hundreds of people in more cities to service you directly.

We're constantly updating our extensive sales network on the newest product information. So, when you deal with a Cannon salesperson, you not only get straight line delivery, but also straight line answers about any of our products.

No doubt about it. You expect us to keep up with your needs. We demand it.

Sales responsiveness. Part of the new story at Cannon.

Talk to us.

Worldwide Headquarters
10550 Talbert Ave.
Fountain Valley, CA 92708
Or call (714) 964-7400

ITT CANNON
We're making progress
Not excuses

Circle 108 on reader service card

ASET'S IMAGE REPEATER GETS DOWN TO SUBMICRON RESOLUTION

Photolithographic maskmaker can handle design rules as fine as 0.8 micron

by Larry Waller

In the drive to develop technology that can fabricate integrated circuits with submicron design rules, the image repeater has generally been overlooked. But now American Semiconductor Equipment Technologies Inc. has built a repeater that can handle submicron design rules, giving photolithographic fabrication techniques an important edge in their battle with newer electron-beam methods.

Repeaters, the precision tools used in making photomasks, function similarly to steppers—they project the pattern of a computer-generated design for an IC onto a section of the mask material, then move and project the pattern onto another portion. Besides reproducing the resolution of the design itself, they must be able to move and stop with a high degree of accuracy. ASET's 600 series (see fig. 1) of repeaters can handle resolution as low as 0.8 μm. Its positional resolution—the precision with which the repeater can move to a given position—is 0.1 μm, a 50% improvement over the 0.2 μm that is standard both with competing repeaters and with e-beam equipment. Along with increased precision, the new repeaters provide significantly expanded stage travel, of 13 by 13 in., which can produce a mask pattern of this size. By contrast, present systems typically travel only 6 by 6 in., or 6 by 9 in. at best.

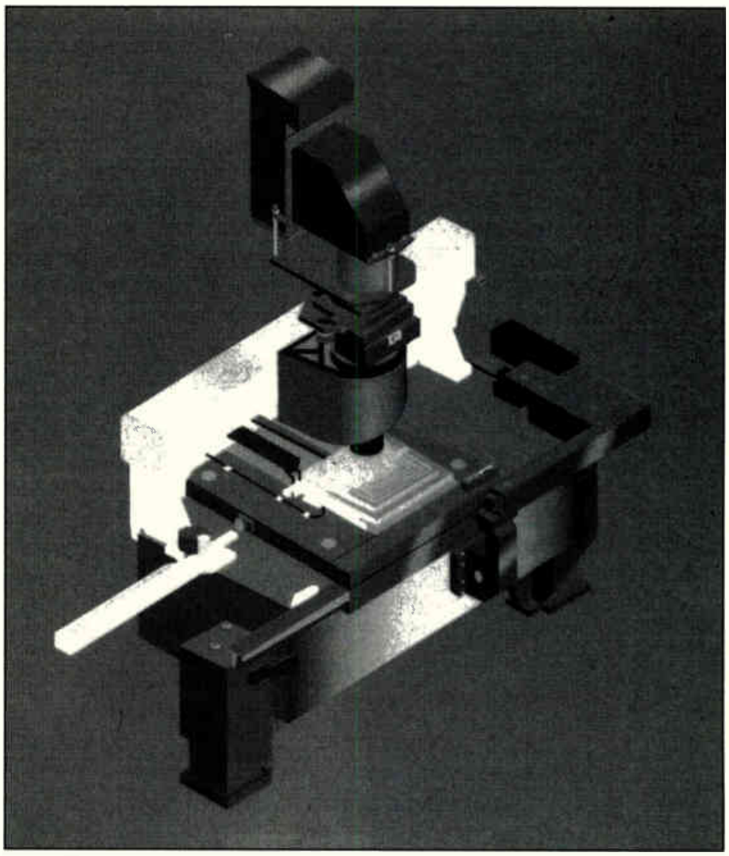
ASET, a Woodland Hills, Calif., company that builds photolithographic fabrication equipment (see p. 115), achieved the improvements by drawing on technology borrowed from steppers. The 600 series includes an entirely new camera and employs high-numerical-aperture Zeiss lenses. The company also totally redesigned the mechanical staging that moves repeaters and the laser interferometer system that monitors this movement. The result is a system that can handle resolution down to 0.9 μm over an entire 14-mm-by-14-mm image field, and 0.8 μm over 11 mm by 11 mm.

The new design is a direct response by ASET to what its customers want. In 1986, the company surveyed its users about improvements they would like to see in their repeaters. Some 95% of them listed submicron capability as the most important thing ASET could provide.

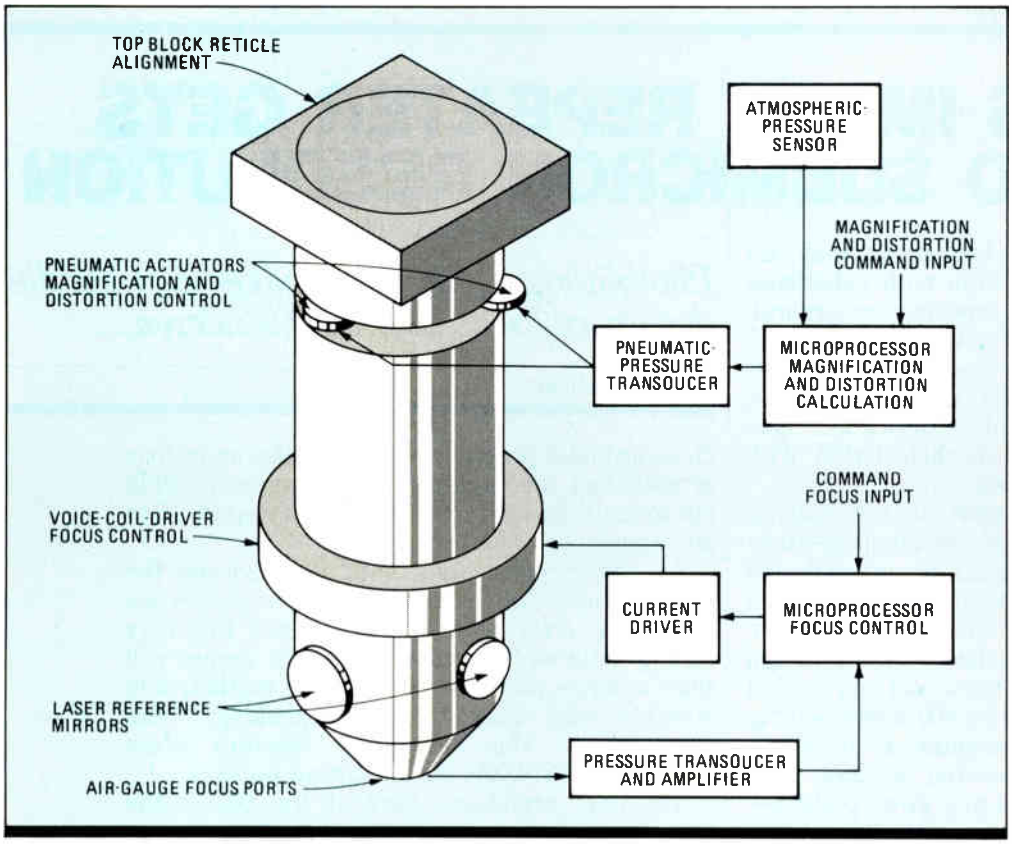
Besides its finer resolution, the 600 series maintains the key advantage of photolithography over e-beam techniques: faster throughput. For typical circuit densities on six-inch wafers, the repeater can make a mask, or reticle, in about five minutes or less, says Chris Van Peski, ASET's vice president for advanced projects. An e-beam system takes several hours. To aid throughput, a reticle changer under program control handles up to four reticles, and can exchange and align each within six seconds. Present image repeaters require 15 to 20 seconds, he says.

All things considered, ASET is convinced the new repeater will have a marked impact when shipments start next month. "From the very strong interest, we expect the 600 series will take a large part of the repeater market, and compete with e-beam for maskmaking," Van Peski says. The new ASET repeater costs $830,000 to $870,000, depending on options.

The only brand-new part of the 600 is the camera which Van Peski says "has features unheard of in an image repeater, but necessary to meet the tight tolerances demanded by the



1. MASKMAKER. The ASET 600 series of image repeaters is designed especially to make masks for new sub-micron wafer-exposure equipment.



2. CONTROLS. Among the camera-control features is a separate microprocessor control for two key tasks: reducing distortion in the camera reduction ratio and directing its vertical positioning.

maskmaking industry." Its functions are to hold the lens and reticle in the proper position and attitude.

Among the new features is the apparatus for controlling focus to tolerances of 0.2 µm, measured by an air gauge at the bottom of the assembly and four pneumatic bridges that sense the distance above the surface (see fig. 2). Outputs of the bridges drive four silicon differential pressure sensors. The sensors' output is used by a microprocessor to control the vertical position, or focus, of the camera.

The 600 is the first repeater to employ a voice coil driver, which provides force without friction, to move the camera. A separate control system governs the camera reduction ratio, compensating for distortion and any changes in the index of refraction of the air as a function of pressure changes. The control loop senses barometric pressure, and also accepts input commands, and adjusts the vertical position and attitude of the object plane. Position of the reticle is sensed by three linear transducers, which provide feedback.

Pneumatic actuators, chosen because they operate without heat dissipation, allow the camera to move extremely small distances with high accuracy—as little as 0.1 mm with resolution of 1 µm. On the other hand, the repeater can also cover greater distances altogether. Its expanded stage travel will accommodate the six-inch wafers that are becoming the standard size in new semiconductor fabrication plants.

For the laser interferometer system, whose position monitoring task is the basis for repeater precision, ASET assembles for the first time on the 600 series many features appearing on other lithography gear. Among other things, it employs a standard dual frequency interferometer from Hewlett-Packard Co., along with specially designed differential interferometers that measure the stage position relative to a reference mirror mounted directly onto the lens housing. If the camera moves laterally, the laser system commands the stage to move a like amount. "This is important to compensate for any camera motion," Van Peski says. The system is calibrated to provide position resolution of 1/32 wavelength, or just under 0.02 µm.

Closely linked with the laser system, the mechanical staging redesign is supported by a base 20 in. high, 62 in. long, and 30 in. wide that is fashioned from a block of granite. Because the motion during movement is determined by the flatness of the top and bottom of the block, the base is machined flat to 1 µm. The stage itself is supported by air bearings at all points of relative motion, so no friction or wear occurs. Both the x-stage and y-stage are anchored by the granite block, rather than the y-stage serving as a base for the x-stage, as in much other equipment.

In addition to finer resolution and greater precision in operation, the 600 series incorporates a number of other new features. One is grid matching, the capability of changing its internal grid system to match a grid data base from another repeater. ASET added this feature because in more than half of their business, independent maskmakers must match a mask set previously produced. To use it, the maskmaker needs only to measure the mask and transmit the data to the 600.

The 600 is operated through a CRT with job-oriented display screens. The computer is a Hewlett-Packard 9000 series 200 with 1 Mbyte of main memory. Extensive diagnostic software aids troubleshooting and repair of the system.□

For more information, circle 483 on the reader service card.

Two heads are better than one.

On October 5th, Fluke and Philips joined forces in a global alliance for test and measurement equipment. That means Fluke now sells and services Philips products in North America. With the same customer-driven support that Fluke has delivered for over 40 years. Call us. Because now there's a competitive alternative to HP and Tek. And that's a turn for the better. For you. Phone 1-800-426-0361 Ext. 77.

FLUKE®

Circle 113 on reader service card

HOW GREG REYES TURNED AROUND TRE

Greg Reyes, president of American Semiconductor Equipment Technologies Inc., formerly TRE Semiconductor, uses a simple approach with any U. S. company that happens to be in the market for photolithography equipment for integrated-circuit fabrication. He says that all other things being equal, the customer ought to buy from an American company. An American company such as his, for example. He takes issue with anyone who calls the "Buy American" line an appeal to jingoistic nationalism. "It's not really flag-waving, or even a strategy," he protests.

As Reyes sees it, ASET's approach to selling to U. S. customers rests on a hard-headed recognition of the realities that govern how such big-ticket equipment as wafer steppers and image repeaters are bought. Even the most patriotic U. S. customer cannot be expected to lay out a million dollars or so solely because a product was made in California rather than Tokyo. The key word is "solely." Reyes argues that when the quality of the equipment built in the U. S. matches that of equipment built in Japan and the price is competitive, why not keep the money at home? As he puts it: "Why buy Japanese? I'll give you a machine as good as theirs. If it's equal, I'll get the order."

ASET has done well with this pitch as an attention-getter, but it's not betting its future on pure flag-waving. The company has also put together a deft marketing strategy that seeks to avoid head to head confrontation with much larger U. S. competitors GCA Corp. and Perkin-Elmer Corp. Instead of going after the big merchant-market semiconductor companies, ASET focuses on selling to captive operations and selective niches, including gallium arsenide production and mask making. The company plays on the "special relationships" captives demand from suppliers, which are extra service, close coordination in applications, and prompt delivery of equipment. ASET counts Honeywell Inc. as its best customer, along with many other companies that are not in the merchant market but which nevertheless make a lot of ICs.

With this approach, the company has racked up improving sales since Reyes, a semiconductor-industry veteran, led a small group that bought it in March of 1986. Sales are now hitting an annual level of $20 million, and ASET is starting to show a profit.

REYES: "Why buy Japanese? I'll give you a machine as good as theirs."

Getting to that level took a lot of work. ASET had fallen on hard times during the chip recession of 1982-1985. Turning it around required nothing less than a "revitalization," in Reyes' words. At the heart of the changes was an infusion of experienced management to fill key positions. Reyes has held top posts over a 20-year career at major chip firms, and also headed Eaton Corp.'s Semiconductor Equipment Group.

Reyes says the crux of the problem at TRE Semiconductor was that owners had little knowledge of the semiconductor business. TRE Semiconductor was a subsidiary of TRE Corp., a conglomerate into everthing from defense technology to cement. As a result, the semiconductor subsidiary lost its way and started losing money—$25 million in all.

Reyes saw that TRE Semiconductor could be a bargain at the right price: "Despite the losses, it still possessed strong technology." The company also had a long-standing reputation in the field. It was founded in 1961 as the Microform Division of Electro-Mask Corp., the first independent maskmaker in the semiconductor business. And because of the red ink, Reyes says, TRE was a "very motivated seller."

The members of his group put together a deal with TRE that got them a $20 million company for $5 million in cash. Once in charge, the new owners moved quickly. Top priority became a state-of-the-art wafer stepper that was already in the works. With further refinement, it became ASET's 900 series, now selling at a steady clip. It features five models, one of which—the I-line ASET stepper, with 365-nm lenses at the deep ultraviolet wavelength—is a banner product, pivotal in submicron applications. ASET is the major supplier to U. S. GaAs chip makers, who use it for 0.5-μm applications, and has shipped six systems against a growing backlog.

Although the future of steppers is downgraded in some quarters as a mature business, Reyes and ASET believe otherwise. He cites consultant projections of about 20% growth through the early 1990s, and is planning accordingly. Production of machines, now at two a month, can be boosted to five, which would increase volume past $50 million annually. A next-generation stepper is scheduled for unveiling in two years.

ASET is also looking beyond the semiconductor industry at several other promising niches. The company has an edge in these niches—ASET's mechanical staging equipment is somewhat larger than competing gear, so it can accommodate the manufacture of bigger products than wafers. Liquid-crystal displays and fine-line printed-circuit boards are potential applications, and Reyes says ASET has shipped machines to major companies in both fields. *–L. W.*

NEC TAKES AN EARLY LEAD IN IMPROVED-DEFINITION TV

Motion-adaptive techniques and 60-Hz noninterlaced screen scanning are among the features aimed at solving distortion problems that plague today's televisions

by Charles L. Cohen

First out of the gate in the race to implement improved-definition television is NEC Corp. This month the Tokyo company is starting to market its IDTV chip set, and its subsidiary, NEC Home Electronics Ltd., is launching sales of an IDTV receiver.

Like other implementations that are sure to follow from Hitachi, JVC, Matsushita, Sanyo, Sharp, and Toshiba, the chips from NEC use digital image storage and signal processing to wring the best possible picture from the TV signals broadcast in Japan and the U. S. Motion-adaptive techniques and 60-Hz noninterlaced screen scanning are among the picture-enhancing features.

IDTV is the first step along Japan's chosen route to high-definition TV, due in the mid 1990s [*Electronics*, Oct. 15, 1987, p. 113]. It aims to cure many of the picture-distortion problems found in today's TV sets, and to improve image resolution. Planned for some time, IDTV had to wait until the price of semiconductor memory came down enough to make it feasible in the consumer market.

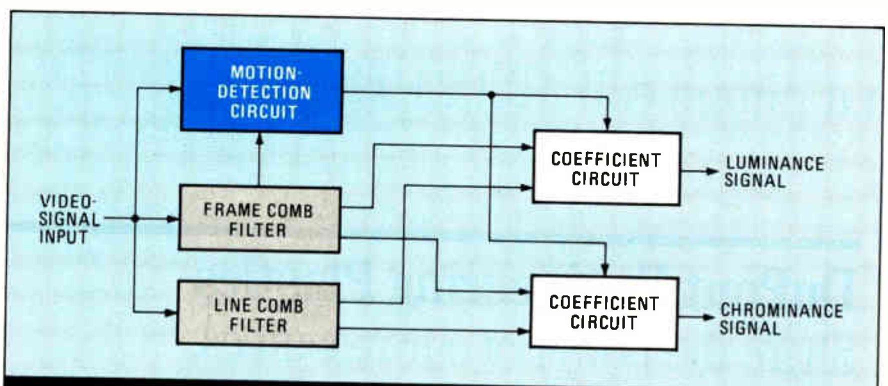
Thanks to its large complement of memory, a TV set built with NEC's chip set is able to perform signal processing along the time axis, a claim current digital TVs cannot make; they only do signal processing along the vertical and horizontal axes of the image. Some of the system's nearly 7 Mbits of memory are used in a circuit that detects motion in the image and then maps out where in the image the motion is. More of the memory is used to separate the signal's luminance and chrominance components—known as the Y and C signals—and to perform the interpolation required for noninterlaced scanning. Both the Y-C separation and interpolation are motion-adaptive, relying on the motion-detection circuit to select the appropriate technique for a given area of the picture. All three processes—motion detection, Y-C separation, and interpolation—use data from more than one image field at a time.

NEC's chip set [*Electronics*, Oct. 1, 1987, p. 25] includes 7 image-field memories, 11 scan-line memories, and a handful of data converters. In addition, there are six special-purpose chips that detect motion in the image, separate the Y and C signals, perform signal processing, demodulate the color signal, perform interpolation, and generate clock signals.

In today's TV sets, color-signal components crossing over into the luminance signal reduce resolution and generate what is known as dot crawl at outlines within the image. Also, high-frequency Y-signal components that spill into the C signal produce spurious coloration, commonly called cross-color. Better Y-C separation is the answer to both dot crawl and cross-color. Oblique resolution—resolution along a line 45° from the horizontal—in current TVs is also not as good as it could be because of limitations in their Y-C separation circuits. And the interlaced scanning used in today's sets causes line flicker and reduces vertical resolution; both are addressed by moving to noninterlaced scanning.

IDTV tackles these problems with generous digital memory and digital signal processing. So much memory is used, in fact, that IDTV sets would be priced out of sight were it not for the current levels of memory density. They'll start out expensive, even so: NEC is setting the price tag at $2,500 in Japan for its first 27-in. model.

But such sets can improve the picture in ways that current digital TVs cannot. Digital motion-adaptive techniques dramatically improve Y-C separation and the interpolation process that makes noninterlaced



1. Y-C SEPARATION. NEC's system detects motion in the TV image. A motion map is used to pick which filter separates the luminance and chrominance signals for each part of the picture.

scanning possible. In signal-processing terms, an IDTV set differs from a conventional TV in that it operates not just in a two-dimensional frequency domain, but in a three-dimensional one, says Shigeo Niitsu, supervisor of the Systems Engineering Department of NEC's Semiconductor Application Engineering Division. In addition to the horizontal and vertical frequency spaces used by conventional-TV signal processing, IDTV uses the time axis during processing. In other words, signal processing in an IDTV set involves more than one picture frame at a time.

Detection of motion within the transmitted image involves comparing one frame with the next to see what has changed. Motion detection is important to an IDTV set because it allows the Y-C separation and interpolation circuits to switch from one technique to another for areas of the picture, depending on whether the areas include motion.

For the areas of the picture where there is motion, Y-C separation and line interpolation are achieved by in-field adjacent-line techniques. Interpolation of lines by this technique is used in some present large-screen TVs—primarily projection types—to provide increased scanning-line density. It is adequate for picture areas with motion because of the limits of the human brain: some image distortion is caused, but fine details within moving objects cannot be discerned by the viewer.

On the other hand, for some types of still pictures, adjacent-line interpolation can cause very visible picture degradation. IDTV sets, by using interfield interpolation in nonmoving parts of the picture, eliminate this degradation.

Motion-adaptive logic in the IDTV set switches from conventional line-comb filters and the use of adjacent-line interpolation—used in image areas with motion—to interframe techniques for separation and interfield techniques for interpolation where no motion is detected. The motion-detection circuitry maps out the areas of the image that have motion on one of the system's seven field-buffer chips. Of the 4 bits it stores for each picture element, 2 bits are used for Y-C separation and 2 bits for line interpolation of the Y signal. This makes possible a stepwise change between in-field and interfield processing (for line interpolation) and between in-field and frame-level processing (for Y-C separation).

Conventional digital TVs use line-comb filters to do Y-C separation, and NEC's IDTV system uses them too, in areas where motion is present. But it takes advantage of the way the NTSC signal was designed to vastly improve Y-C separation in nonmoving parts of the picture.

Like other digital TV systems, IDTV operates at a sampling frequency of four times the 3.58-MHz chrominance subcarrier, or 14.32 MHz, with a resolution of 8 bits. In a standard signal, the Y signal's components are at even multiples and the C signal's components at odd multiples of half the line frequency. The result is that C-signal components reverse in phase for each successive frame, while Y-signal phase remains the same. Because of digital frame storage, this situation can be exploited to obtain excellent Y-C separation of still portions of the picture. For both luminance and chrominance, the desired signal can be obtained and the undesired one canceled simply by digitally adding or subtracting signal values from successive frames.

Thus the IDTV set's Y-C separation circuit (see fig. 1) behaves as a line comb filter—and uses scan-line memories to do its job—in areas of the picture where there is motion. The interframe portion of this circuit is called a frame comb filter, and relies on four field-buffer chips.

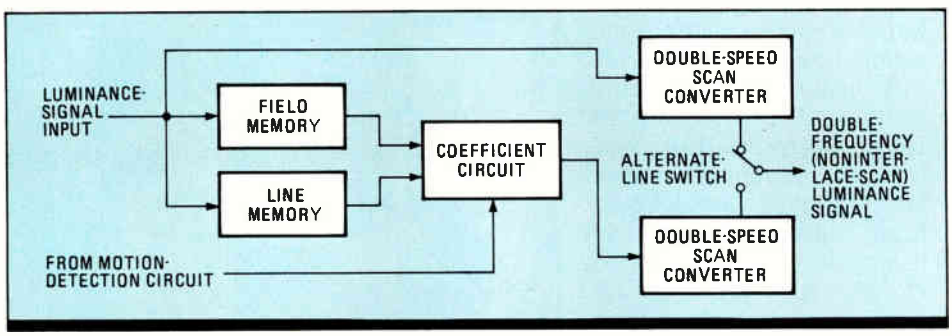
SIGNAL CONVERSION

Access to data from the previous field is also crucial to the interpolation subsystem (see fig. 2) that converts a signal for 30-Hz interlaced scanning into a 60-Hz noninterlaced-scan signal, improving vertical resolution and eliminating interline flicker. This process involves writing twice as much image data on the screen per unit of time; that extra data is generated through interpolation.

In current TVs, 30 frames are displayed every second, and each frame consists of two interlaced 262.5-line fields. Each field scans every other line of the full frame. The viewer's eye and brain integrate the successive fields appearing on the screen, but the vertical resolution apparent to the viewer is only about 60% or 70% of the total number of lines appearing on the screen.

In the IDTV receiver, the incoming signal provides information for every other line on the screen every 1/60th of a second, and the chip set adds the missing lines so that an entire noninterlaced frame is written to the screen in that period, with no missing lines. Thanks to field-buffer storage, these missing lines of the Y signal are simply picked up from the previous field in a process called interfield line interpolation.

Interfield line interpolation doesn't work, how-



2. INTERPOLATION. To get 60-Hz noninterlaced scanning, scan lines between the ones transmitted in each field are filled in by interpolation of a type determined by the presence or absence of image motion.

BERLIN

IS A POTENT MARKET

for active and passive electronic components such as integrated circuits, micro-processors, diodes, transistors, thyristors, capacitors, resistors, crystals, crystal filters and piezo-electric elements.
Producers wishing to develop the potential of the Berlin market by setting up their own production facilities (or in conjunction with a Berlin-based manufacturer) will receive comprehensive advice on how to realize these projects and utilize the many advantages offered by Berlin.

ELECTRONIC COMPONENTS

$120 million

Berlin's annual requirement.

This annual demand of $ 120 million which is currently being met thorough purchases from outside sources is an invitation to doing business in Berlin. It is also a stepping stone from Berlin into the European market.

Economic Development

BERLIN

Hans J. Spiller, 4 Liberty Square, 3rd Floor, Boston, MA., 02109, Telephone: (6 17) 5 42-31 15
Joachim R. Bechtle, 456 Montgomery St., Suite 1010, San Francisco, CA., 94104, Telephone: (4 15) 7 88-07 85

EXIT.

Sit at your workstation. Enter an image. And exit with color hardcopy. That's all you have to remember about compatibility with a Seiko Color Hardcopier.

Because it doesn't matter what workstation you work with—Sun, Apollo, H-P, DEC, IBM, Silicon Graphics or one of 50 others. Our hardcopier works with them all. Without forcing you to write any software.

Plus, Seiko Color Hardcopiers are the only ones that let you connect up to 4 dissimilar systems to it at the same time. Making it a very cost-effective shared resource.

Of course, there's a lot more to the story. Like colors—thousands of them. And proven installations—thousands of them, too.

So exit this ad and enter our phone number. We'll be happy to show you how to get the industry's best looking color hardcopy from any workstation you use.

Call Martin Nelson at (408) 943-9100 today.

SEIKO I

Seiko Instruments USA

Circle 123 on reader service card

UPDATE: SMART-CARD CHIP RESPONSE IS UNEXPECTED

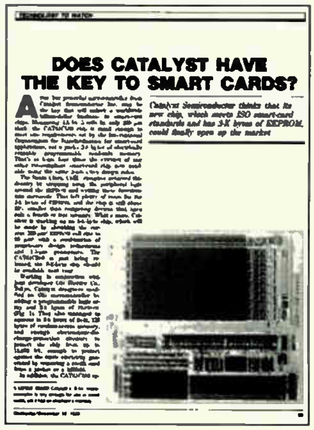
The response to Catalyst Semiconductor Inc.'s single-chip microcontroller for smart-card applications [*Electronics*, Dec. 18, 1986, p. 59] was surprising to president B. K. Marya. He wasn't taken aback by the hundreds of firms that wanted prototypes from the Santa Clara, Calif., company earlier this year. What he hadn't expected was the range of applications that designers had in mind.

"One of the most unusual uses is a debit coin to be used to eliminate pilferage from vending machines," he says. The debit coin, which works like a debit card, would make it unnecessary to store large amounts of change in vending machines.

Among other potential uses for the CAT61C580 are cards for terminal access, data security, product warranty, health status, telephone access and debit, and identification for passport applications. Right now, Marya says, seven customers are sampling the CAT61C580, with production planned for the first half of 1988.

In development, he says, is a second-generation, smart-card-oriented, 8-bit chip with 4 Kbytes of electrically erasable programmable read-only memory and twice the 3 Kbytes of ROM on the current chip. Also planned is a version with 64 Kbytes of EPROM and 16 Kbytes of ROM.

The CAT61C580 measures 4.5 mils by 5 mils by only 200 μm thick, making it small enough to meet the size requirements set by the International Organization for Standardization for smart-card applications. But it has 2 Kbytes of on-chip EEPROM, which is about four times the density of any other ISO-compliant smart-card chip now available that uses the 2-μm CMOS design rules. About 30% smaller than competing devices, the chip, which is jointly designed and fabricated by Catalyst and Oki Electric Co., Tokyo, also contains 128 bytes of RAM besides the 3 Kbytes of ROM.



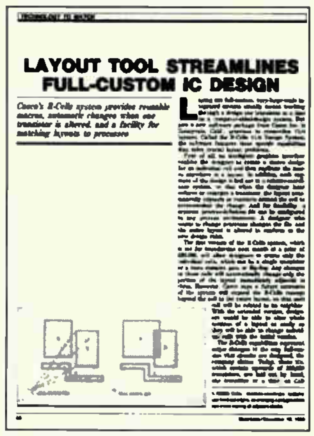
During the fiscal year that ended in March 1987, Catalyst had sales of $4.5 million, mostly from a family of stand-alone EPROMs and EEPROMs. By the end of the current fiscal year, Marya estimates, company income will hit $9 million—and almost 40% of that will be due to sales of smart-card chips. *–Bernard C. Cole*

UPDATE: CAECO'S CUSTOM IC LAYOUT TOOL IS IMPROVED

When Caeco Inc. introduced its R-Cells VLSI Design System last year [*Electronics*, Dec. 18, 1986, p. 80], the software package was hailed as a promising development in the battle for automated layout of full-custom VLSI circuits. But even the company acknowledged that a future extension of the system was needed to allow for alteration of entire sections of a layout.

The company produced that extension about six months later. Called Automated Logic Synthesis, Caeco says it could be the solution to the bugaboo that has plagued vendors in the computer-aided engineering tool industry since that field was founded in the early 1980s—how to duplicate the silicon-efficient designs of handmade chips in the automated layout of complex VLSI chips. "Now, for the first time," says John Clairborne, executive vice president at the Santa Clara, Calif., company, "the layout designer can achieve automatic layout with hand-packed densities."

The new process, which was unveiled at the Design Automation Conference in June, improves the R-Cells in two ways. It ties the front-end schematic capture to the back-end polygon-layout function. And it provides automatic schematic back-annotation in the process. With the improvements, a designer can partition a section of the original schematic into a set of R-Cells. The automatic place and route tool then lays out the cells with as much attention to optimum placement as if a designer had laid out the cells by hand.



The innovations significantly increase a layout designer's efficiency. Clairborne says that a good layout designer could average around 10 transistors a day working by hand. "With our automatic layout product, the designer's productivity is increased tenfold."

Both the original R-Cells and the newer Automatic Logic Synthesis have been well received by Caeco's customers, the company says. Among them are Siemens AG, which will use the software tools in is own full-custom design system. Caeco has a contract to deliver more than 70 of its systems to the West German company in the coming year. *–Jonah McLeod*

NOW: predict the performance of complex MMICs — while you're still designing them!

Explore ideas and new opportunities in circuit designs...

For fast, sure design of hi-rel/rad-hard GaAs MMICs, Harris Microwave Semiconductor's 0.5-micron circuit element library is now in Touchstone®, the leading CAE software for the analysis, simulation, and optimization of linear microwave and RF circuits and devices.

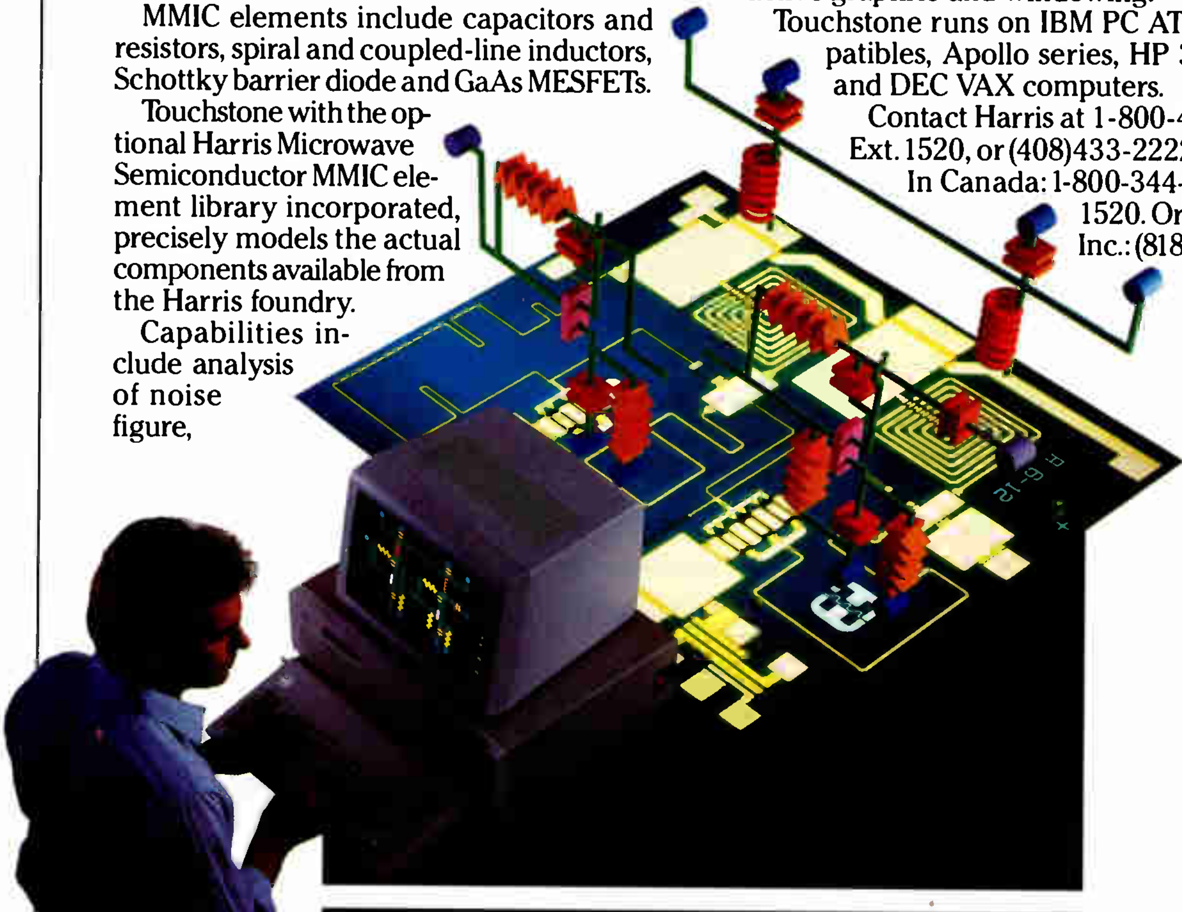
MMIC elements include capacitors and resistors, spiral and coupled-line inductors, Schottky barrier diode and GaAs MESFETs.

Touchstone with the optional Harris Microwave Semiconductor MMIC element library incorporated, precisely models the actual components available from the Harris foundry.

Capabilities include analysis of noise figure, differential phase shift and loss, gain, source mapping and stability circles, group delay and voltage gain. There's an S-parameter data bank, interactive circuit tuner, eight optimizers, more than 120 element models, plus interactive graphics and windowing.

Touchstone runs on IBM PC AT and compatibles, Apollo series, HP 300 series, and DEC VAX computers.

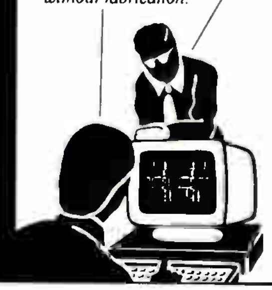
Contact Harris at 1-800-4-HARRIS, Ext. 1520, or (408)433-2222, Ext. 202. In Canada: 1-800-344-2444, Ext. 1520. Or call EEsof, Inc.: (818) 991-7530.



IN CUSTOM MMICs, THE NAMES ARE

EEsof®

HARRIS



Circle 126 For Harris Foundry Information

Circle 158 For EEsof Touchstone Information

MILITARY/AEROSPACE NEWSLETTER

DARPA SHIFTS GEARS IN SMART WEAPONS PROGRAM . . .

The Defense Department's quest to develop an autonomous aircraft with attack, surveillance, and survival capabilities is moving along—but the word is that plans are changing in favor of sensor technology. Phase two of the smart-weapons project is underway but neither the Defense Advanced Research Projects Agency, which is funding the program, nor any of the four principal contractors—Texas Instruments, GM/Hughes Electronics, Martin Marietta, and Northrop—is revealing much of anything. What is becoming clear, however, is that original plans for the 30-month second phase called for a heavy concentration on software development and the use of existing sensor technology. That's changed, says a source close to the project. "More emphasis is now going to be placed on sensors," he says. "If you don't have sophisticated sensors to get raw information on your targets, you're not going to have anything worth processing on your computers." Darpa is playing its hand close to the vest on this one, says another source, adding that further disclosures aren't expected until February.☐

. . . AS LORAL STUDIES AUTOMATED TARGET DETECTION

Loral Corp. is working on the kind of advanced detection technology that could eventually help future weapons automatically seek out and destroy enemy targets. For now, however, the Loral system is being designed for manned aircraft; it will aid in navigation and be capable of detecting even camouflaged targets. Current automatic-detection systems do not fare well in situations where target densities are low; false alarms are frequent. So Loral is looking at ways to improve resolution, classify target types, and filter false targets by quickly analyzing radar data. With funding from the Defense Advanced Research Projects Agency, Loral's Defense Systems Division, in Litchfield, Ariz., is developing a millimeter-wave radar system that will operate in the 33.6-GHz frequency range and be capable of collecting ultra-high-resolution, fully polarimetric data. The airborne system will include both instant display and recording capability on high-density tape, which can later be processed on the ground for more detailed analysis. ☐

HUGHES PUTS TOGETHER THE BIGGEST IR SENSOR ARRAY EVER

An airborne infrared sensor array with 38,400 individual detectors soon to be completed by GMHE/Hughes Aircraft Co. may be the most complex electro-optic array ever built. The array is part of a larger sensor subsystem that plays a key part in the Airborne Optical Adjunct Program, a component of the Defense Department's Strategic Defense Initiative. That effort is trying to demonstrate whether airborne optical sensors can detect and track incoming intercontinental ballistic missiles. The first array has 15 modules, each with four sensor chip assemblies holding 640 IR detectors. It is designed to accommodate up to 44 modules. Data gathered by the detectors is processed first in an analog computer that runs 400 million analog-to-digital conversions/s, and then in a digital processor running at 15 billion operations/s. ☐

FAA TAPS APOLLO FOR AIR TRAFFIC MANAGEMENT SYSTEM

Apollo Computer Inc. will supply work stations to the Department of Transportation for a new Air Traffic Management System that can display, on a single screen, every in-flight aircraft monitored by the Federal Aviation Administration. The DOT is buying 50 work stations for its Transportation System Center in Cambridge, Mass., ranging from Series 3000 personal work stations to high-resolution DN590 turbo three-dimensional-graphics systems. It will be linked with a similar FAA system in Washington to alert air traffic controllers to developing congestion. ☐

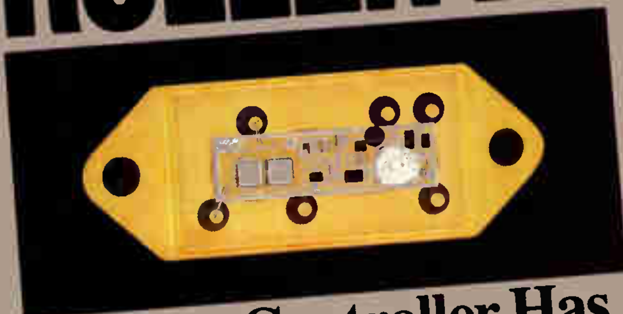
Switching Times

TELEDYNE SOLID STATE
A Division of Teledyne Relays

SOLID STATE POWER CONTROLLER DEBUTS

Miniature Solid State Power Controllers Feature Short Circuit Protection & Status Feedback

Teledyne Solid State has announced plans to expand their existing solid state relay product line with the addition of SSR remote power controllers featuring true status feedback capability. The first of these new products is the M85C-2AS. This 2 amp unit is housed in a 14-pin hermetic DIP and is provided with integrated short circuit and current overload protection. It also features optical isolation, TTL interface and a discrete true status function to indicate that the output section is on and conducting current. This status feedback data can be utilized by the system in real-time operation or used to provide built-in test diagnostics for system maintenance.



10 Amp Controller Has Short Circuit Protection

Teledyne Solid State introduces the M33C, a high power military DC solid state relay power controller which provides short circuit protection whether switching into a dead short or shorting the unit while under load. In either case, the M33C senses the short circuit condition and initiates shutdown in less than five microseconds. The unit will block the short circuit condition until the short is removed and the unit reset by cycling the input control.

The M33C will also sense current overload conditions and prevent damage from thermal run-away due to excessive load current or ambient operating temperatures. Its integrated short circuit/current overload protection feature not only provides self-protection for the unit, but also allows the M33C to act as a remote circuit-breaker, preventing secondary system failures and providing extensive system benefits, including reduced maintenance and reduced life-cycle costs.

TO-5 Relay 25 Years Old– Still Growing

Developed by Teledyne in 1962, the Teledyne TO-5 electromechanical relay has become the industry standard as a versatile, subminiature switching device for loads from dry circuit, and low level signals to 1 amp. During its 25 years of development, Teledyne has evolved it into a broad family of relays which include general purpose, sensitive, and magnetic latching types.

For More Information

Teledyne Solid State, 12525 Daphne Ave., Hawthorne, California 90250 • (213) 777-0077/**European Headquarters:** Abraham Lincoln Strasse 38-42, 6200 Wiesbaden, W. Germany/**Belgium:** 181 Chaussee de la Hulpe, 1170 Brussels/**U.K.:** Heathrow House, Bath Rd., Cranford, Hounslow, Middlesex TW5 9QP/**Japan:** Taikoh No. 3 Building, 2-10-7 Shibuya, Shibuya-Ku, Tokyo, 150 Japan/**France:** 85-87 Rue Anatole-France, 92300 Levallois-Perret

35 Amp Version of Popular 652 Power Solid State Relays Now Available

Teledyne Solid State Series 652 military AC solid state relays now offer a 35 amp version, as well as the popular MIL QPL 25 amp model. The new 35 amp unit provides all the features which have made the 652 a best-seller. These include optical isolation, zero voltage turn-on, logic compatible input current levels, and resistance to shock and vibration at military levels.

Introducing the twc
on earth

The new COMPAQ DESKPRO 386/20™

The world now has two new benchmarks from the leader in high-performance personal computing. The new 20-MHz COMPAQ DESKPRO 386/20 and the 20-lb., 20-MHz COMPAQ PORTABLE 386 deliver system performance that can rival minicomputers'. Plus they introduce advanced capabilities without sacrificing compatibility with the software and hardware you already own.

Both employ an industry-standard 80386 microprocessor and sophisticated 32-bit architecture. Our newest portable is up to 25% faster and our desktop is actually up to 50% faster than 16-MHz 386 PC's. But we did much more than simply increase the clock speed.

For instance, the COMPAQ DESKPRO 386/20 uses a cache memory controller. It complements the speed of the microprocessor, providing an increase in system performance up to 25% over other 20-MHz 386 PC's. It's also the first PC to offer an optional Weitek™ Coprocessor Board, which can give it the performance of a dedicated engineering workstation at a fraction of the cost.

They both provide the most storage and memory within their classes. Up to 300 MB of storage in our latest desktop and up to 100 MB in our new portable.

It simply works better.

most powerful PC's and off.

and the new 20-MHz COMPAQ PORTABLE 386™

Both use disk caching to inject more speed into disk-intensive applications.

As for memory, get up to 16 MB of high-speed 32-bit RAM with the COMPAQ DESKPRO 386/20 and up to 10 MB with the COMPAQ PORTABLE 386. Both computers feature the COMPAQ® Expanded Memory Manager, which supports the Lotus®/Intel®/Microsoft® Expanded Memory Specification to break the 640-Kbyte barrier.

With these new computers plus the original COMPAQ DESKPRO 386™, we now offer the broadest line of high-performance 386 solutions. They all let you run software being written to take advantage of 386 technology. *And to prove it, from now until December 31, 1987, we're including Microsoft® Windows/386 Presentation Manager free with your purchase of any COMPAQ 386-based PC.* It provides multitasking capabilities with today's DOS applications to make you considerably more productive. But that's just the beginning. For more information, call 1-800-231-0900, Operator 43. In Canada, call 416-733-7876, Operator 43.

COMPAQ®

Gates Energy Products has purchased GE's Battery Business Department, making us the world's largest source of sealed rechargeable batteries.

What does this mean to you?

That Gates is dedicated to providing you with the best rechargeable batteries in the world.

Gates now has the technology and resources to offer the largest selection of rechargeable batteries including nickel cadmium, nickel hydrogen and sealed lead batteries–from .065Ah to 300Ah.

Leading the technological advancements at Gates is our new GEMAX™ Series of nickel cadmium cells. These cells are providing more run time and maximizing power delivery in all product applications by incorporating higher capacities and lower internal resistance.

As a result of GEMAX technology, Gates now offers the world's highest capacity, production-volume Sub C cell at 1.4Ah (1-hour rate). And more advancements are on the way.

Our commitment to supply batteries tailored to your specific applications is yet another aspect of our determination to make sure that Gates batteries are superior.

No other rechargeable battery company in the world is taking such dramatic steps to perfect and expand their rechargeable battery products as the new Gates. It's time you discovered the difference.

For more information worldwide, contact one of the Gates Regional Sales Offices listed below.

Gates Energy Products

WESTERN U.S.
4063 Birch St. #130
Newport Beach,
CA 92660
(714) 852-9033

CENTRAL U.S.
2860 S. River Rd.
Suite 401
Des Plaines, IL 60018
(312) 827-9130

EASTERN U.S.
1 Prestige Dr.
Meriden, CT 06450
(203) 238-6840

SOUTHERN U.S.
1835 Savoy Dr.
Suite 200
Atlanta, GA 30341
(404) 458-8755

PACIFIC AND ASIAN
3706 A, Shun Tak Centre
200 Connaught Rd. Central
Hong Kong
011-852-5-403073

EUROPE
Units 12/13
Loomer Rd. Industrial Estate
Chesterton
Newcastle-under-Lyme
Staffs. ST5 7LB, Great Britain
011-44-782-566525

Circle 132 on reader service card

NEW PRODUCTS

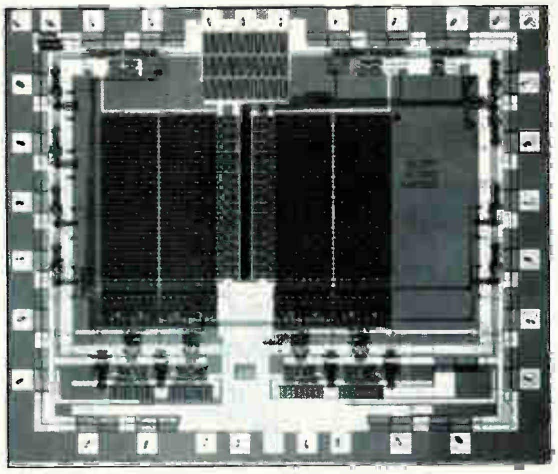
VITESSE'S 1-KBIT STATIC RAM IS TWICE AS FAST AS COMPETITION

GaAs IC HITS 3 NS, YET OFFERS ECL-COMPATIBILITY

Vitesse Semiconductor Corp.'s new 1 Kbit static random-access memory is about twice as fast the competition. It did it by surrounding gallium arsenide core cells with ECL-compatible input/output circuits to deliver 3-ns access times without having to redesign systems around an exotic technology.

The new 256-by-4-bit VS12G422E RAMs will tackle high-end ECL head-on in applications such as cache memories for supercomputers and minisupercomputers, display memory for graphics systems, and data memory for digital-signal processing.

And since the part offers the radiation hardness and wide temperature range typical of GaAs, its will also offer the military market speeds as yet unavailable. The VX12G422E comes in a 24-pin dual in-line package pin-compatible with industry standard 100422 RAMs.



SURROUNDED. The VS12G422E surrounds gallium arsenide core cells with ECL-compatible input/output circuits.

STANDARD POWER. The Camarillo, Calif., company's very simple planar process—much like an n-MOS process—makes it possible to have GaAs cores with TTL or ECL I/O that use the same power sources as standard parts. The technology goes hand-in-hand with a commercialization strategy for its enhancement/deletion mode GaAs process that calls for fielding the most generic parts first [*Electronics*, Sept. 17, p. 48].

"Designers do not have to deal with an exotic technology because parts like the new 1-Kbit SRAM can replace existing RAMs to dramatically speed up systems," says president Lou Tomasetta. "We are directing these chips to customers who are interested in high-speed RAMs, not in exotic technologies." In fact, Vitesse likes to play down the fact that they are working in GaAs. "We would rather the customers think we have a proprietary advanced n-MOS process," says marketing director Thomas Dugan.

The RAM's characterization will be complete by January with shipments set for the same month. Samples were available to selected customers in November.

The GaAs RAM's 4 to 5-ns speed over the −55°C to +125°C military range is relatively flat, especially when compared with ECL and CMOS RAMs, which tend to run only half as fast as their commercial spec when pushed into the military range. Memory chips faster than 10 ns for military applications have not existed until now.

Vitesse managed to develop the device in one month by leveraging design efforts on other parts, specifically by using the same core GaAs memory cells developed for the TTL-compatible RAM introduced in September. Designers also leveraged the ECL logic part from the previously designed parts compatible with Advanced Micro Devices Inc.'s 2901 family.

Considering the device's specifications and GaAs technology, price has been kept in check. This is largely because yields rival those of earlier parts—the very first wafers exceeded 25% yield. Vitesse quickly doubled its yield on the earlier TTL RAMs to over 50% and expects to repeat that with the ECL RAM since the basic cell design is the same. The price of the VS12G422E in 5,000 piece lots will be $70, with single units costing $190.

The new part has a lucrative market to exploit. Dataquest Inc. pegs the 1987 market for ECL RAMs in the U.S. at $156 million and projects the 1988 market to be $175 million. Most sales are in the commercial computer market because high speed ECL RAMs do not maintain their high speed across the military temperature range. The computer segment is expected to grow to $500 million by 1990, but Vitesse thinks the RAM's military applications will expand the total market for very high speed RAMs to much more than $500 million in 1990. – *Tom Manuel*

Vitesse Semiconductor Corp., 741 Calle Plano, Camarillo, Calif. 93010.
Phone (805) 388-3700 [Circle 360]

MAXIM TAKES ON ANALOG WITH FASTER 12-BIT ADC

A novel circuit design that allows Zener diodes to be buried in standard CMOS—instead of using complex biCMOS technology—gives Maxim Integrated Products' 12-bit analog-to-digital converter the cost advantage of a mature technology. The design also opens the door to an almost two-fold edge in speed compared to an industry-leading ADC.

The CMOS Max162 targets the market now dominated by the AD7572 from Analog Devices Inc., Norwood, Mass., and uses the same successive approximation process to achieve 12-bit resolution and linearity. But the 162 boasts a maximum conversion time of 3 μs running with a 4-MHz clock. The AD7572's best is 5 μs, says Brian Gillings, director of strategic planning and applications at Maxim's headquarters in Sunnyvale, Calif.

Maxim created a new Zener-diode design for a buried voltage reference. The advantages of fabricating in a mature MOS process instead of the emerging biMOS technologies accrue largely because biMOS has "as many as three to five more mask steps compared with standard CMOS," says Gillings. Buried Zeners

and "byte" use every bit

number one information source for product tests, analyses and comparisons.

People who specialize in communications are wired into CCMI/McGraw-Hill, to receive not only the hard facts on communications tariffs, but also in-depth analyses and bottom-line recommendations via print, software and on-line products.

And when telecommunications and computer companies plan for the future, they rely on DRI Communications to provide them with forecasts of economic forces and industry trends.

When it comes to turning megabytes into megabucks, nothing computes like McGraw-Hill information.

McGraw-Hill, Inc., 1221 Avenue of the Americas, New York, N.Y. 10020.

McGraw-Hill.
Information that leads to action.

McGraw Hill

boast lower drift and noise than do other common voltage reference devices.

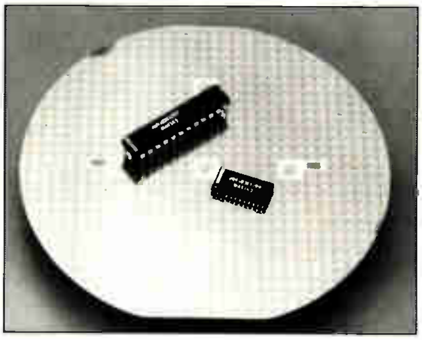
Besides being easier to make, Maxim's design yields faster speeds for such applications as digital signal processing, high-performance industrial control, data acquisition, and electromechanical systems.

The Max162 includes a 12-bit digital-to-analog converter, successive approximation registers, 12-bit latch, multiplexer, clock oscillator, control logic, three-state output drivers, and on-board voltage reference.

FRIENDLY. The part works with most popular microprocessors. For example, it will run with an operating voltage of +5 and –15 volts, like the AD7572, but it also works with the -12V supplies common to analog systems that include microprocessors. Unlike other ADCs, it runs on a 4-MHz systems clock commonly found in many microprocessor-based systems.

The 24-pin part, which has a microprocessor interface, requires only external decoupling capacitors for power supplies and reference voltages. The 162's high speed—90-ns data-access time and 75-ns bus-release time—eliminates wait states. It dissipates 215 mW.

Available in production quantities in December, the 162 has three temperature grades with guaranteed maximum integral nonlinearity of ± 1 least significant bit, and ± ½ LSB over a temperature coefficient to 25 ppm/°C maximum. Commercial temperature-range parts are available in 300-mil plastic dual in-line packages for $46 each in 100-piece lots. Commercial parts are available in



FAST. The Max162 has a microprocessor interface and boasts a 3-μs conversion time.

300-mil surface-mountable small-outline packages. Military-grade parts cost $165 each in ceramic packages. An industrial-temperature range version rated for –40°C to +85°C will also be shipped in December.

– *J. Robert Lineback*

Maxim Integrated Products, 510 N. Pastoria Ave., Sunnyvale, Calif. 94086.
Phone (408) 737-7600 [Circle 361]

XICOR UPS EEPROM DENSITY FOURFOLD

Xicor Inc.'s 16-Kbit CMOS serial electrically erasable, programmable read-only memory boosts the capacity of the company's low-cost nonvolatile memory offerings fourfold. But it retains pin-compatibility with lower density parts, so that designers can pack more memory into their systems without the costs associated with an extensive redesign.

Organized as eight pages of 256-by-8-bits, the 96-by-147 mil X24C16 is two-thirds the size of bytewide EEPROMs. It is housed in an 8-pin dual-in-line package, compared with 24-pin DIPs for bytewide 16-Kbit parts.

The X24C16 uses a two-wire serial interface and software protocol for read and write operations. The serial protocol, which supports bidirectional data transfers, performs a 16 byte-page write in 5 ms.

The 2-μm EEPROM is targeted at a range of low-cost telecommunications, consumer, and battery-powered equipment, and works with 100-kHz microprocessors and controllers. The Milpitas, Calif., firm guarantees data retention for more than 100 years.

64 KBIT. The firm's CMOS thick-oxide, textured poly-cell technology can take the family to still higher bit densities, but Xicor will study potential markets before committing to a 64-Kbit product, says Krish Panu, marketing manager.

Typical active power dissipation of the X24C16 is 2 mA and standby current of 60 μA. A low-power version of the X24C16 for battery-powered systems will operate on 3 to 6 V instead of the 5-V, ± 10% supply for the standard part.

Targeted applications include serial communications with modems, data-retention features in telephone sets, battery-operated computers, consumer systems such as video and audio products, automotive control, and smart cards requiring space-saving serial ports.

The X24C16 is being introduced this

Tandy Computers: Because there is no better value.™

Tandy® Workgroup Solution

A Tandy 4000 computer with hard disk acts as the file server, providing information to Tandy 3000, 1000 and other PC compatibles functioning as workstations.

Each workstation can run a variety of applications: write memos and letters, send messages, do spreadsheet planning and more.

People and PCs working together.™

Now you can use your PC to share information with your colleagues, update files in a common data base and route messages and other mail—electronically.

TANDY WORKGROUP SOLUTIONS™

Just connect your Tandy computers and other PC compatibles on the proven 3Com® network. People in your office will still be able to work independently, but they'll have the added advantage of working together as a group—a workgroup.

You can share printers and communicate with other workgroups in your office. And since 3Com's network software is based on IBM® standards, you can use today's leading business software packages.

Installation is simple and worry free because Radio Shack handles all of the details. We'll even arrange to train your employees, as well as provide the professional service and support your business can rely on.

Come into a Radio Shack Computer Center and see how your business can benefit from a Radio Shack/3Com workgroup.

Send me a new 1988 computer catalog.

Mail to:
Radio Shack
Dept. 88-A-945
300 One Tandy Center
Fort Worth, TX 76102

Name ______________________
Company ______________________
Address ______________________
City ______________ State ____
ZIP ________ Phone ________

Radio Shack®

COMPUTER CENTERS

A DIVISION OF TANDY CORPORATION

3Com/Reg. TM 3Com Corp. IBM/Reg. TM IBM. Corp.

Circle 137 on reader service card

month with a price of $9 in 100-piece quantities. Panu says the learning curve will enable Xicor to lower that price tag to between $5 and $6 in about a year. The 3- to 6-V battery-operation part will carry a price premium ranging from about 10% to 20%. – *J. Robert Lineback*

Xicor Inc., 851 Buckeye Court, Milpitas, Calif. 95035.
Phone (408) 432-8888 [Circle 363]

1-MBIT SRAM HYBRID HITS 45-NS ACCESS

A pair of four-chip modules from Integrated Devices Technology Inc. squeezes 1 Mbit of static random-access memory into the standard footprints and pinouts of 600-mil-wide dual in-line packages yet deliver 45-ns access times—twice the speed of competing 1-Mbit modules.

The 32-pin 128-Kbit-by-8-bit and the 40-pin 64-Kbit-by-16-bit modules team four of IDT's sub-35-ns 256-Kbit SRAM chips with the company's fast FCTA 139 CMOS address-decoder. The chips are surface mounted on a co-fired ceramic motherboard substrate. Because of their speed and density, they can be used by designers as functional equivalents to the monolithic megabit SRAMs likely to debut next year, says Andy Paul, product marketing manager for IDT's Subsystems Division in Santa Clara, Calif.

"The 45-ns speeds, which are needed to serve the new 20-MHz microprocessors, have been broken at the 32-Kbit-by-8-bit level only in the past year," says Paul. Competing megabit modules have 100-ns access speeds.

Four IDT71256 32-Kbit-by-8-bit SRAM chips are configured 128-Kbit-by-8-bits for the 32-pin IDT8M824S45C or 64-Kbit-by-16-bits for the 40-pin 8M624S45C module. "The power [consumption] of these modules is nearly the same as a monolithic part, because the decoder will activate only one of the SRAMs at a time. The other three will be on low-power standby," says Paul.

The maximum operating power dissipation of the 128-Kbit-by-8-bit module is 1.1 W and standby is 250 mW. Paul says 45-ns monolithics megabit SRAMs will have 40 to 50 mW more dissipation in the active state.

Commercial temperature-grade versions are priced at $752 each in 100-piece quantities. A version using plastic-leaded, small-outline packages costs $677 each. Shipments are scheduled to begin in December. – *J. R. L.*

Integrated Device Technology Inc., 3236 Scott Blvd., P. O. Box 58015, Santa Clara, Calif. 95052.
Phone (408) 727-6116 [Circle 362]

Some will follow the old standards. Some will create the new.

An engineer has only a few precious opportunities to create a new industry standard. This is one of them. If you're traveling within the limits of today's technology, but want to break through to the next generation of microprocessing, AMD has some exciting news for you... **Your appointment with destiny has arrived.**

AMD has gone way beyond the limits of existing microprocessing to create the super chip of the 1990s — the Am29000. At 32 bits and 17 MIPS, the Am29000 RISC-based microprocessor is 400% faster than the current industry standard. This exciting evolutionary breakthrough will make a whole new range of applications possible, bringing the power of a mainframe to desktop workstations; and providing embedded controller applications such as fiber optic networking and laser printer and communications controllers.

The Am29000 is just one of many significant developments at AMD. Our recent merger with Monolithic Memories makes us stronger and more versatile than ever before. The opportunities are better than ever for experienced hardware and software engineers to set new standards, with the following opportunities now open.

Am29000

Software Support Engineers

Experience in UNIX and C, plus MS DOS, PASCAL, FORTRAN, and Assembler makes you an ideal candidate. Be involved in customer support, developing tools and utilities, testing S/W packages, user manual review, documentation, writing application notes and magazine articles.

Hardware Strategic Marketing Engineer

Join the team that will provide marketing support for languages, operating systems, and support tools for the Am29000. Blend into our superb talent bank your 3 to 5 years' experience in marketing, design or applications of software for fixed instruction set microprocessors or large minicomputer products. Bring along experience in C, FORTRAN or PASCAL, UNIX*, VRTX or large operating systems, and you will be a prime candidate to be involved in all phases of defining and introducing products, including product definition and market research.

Sr. Product Planning Engineer

You will provide microprocessor and systems architecture design support for Am29000 follow-on products. This includes support for chip design, marketing, and tools development. Requires solid background in hardware and software systems, with knowledge and experience of RISC system architectures preferred.

Senior H/W — S/W Applications Engineers

Support the design-in of the Am29000 using your experience in H/W and S/W design of digital systems in computers and embedded controllers. Required experience ranges between 5 and 10 years for individuals with strong system architecture backgrounds, good communication skills, and knowledge of system optimization.

Software QA Applications Engineers

Develop test plans and perform S/W QA testing, develop and implement test suites for O/S, compilers and assemblers and develop tools and utilities to aid in testing.

Applications Engineers

Join in the design and support of Am29000 demo/evaluation boards and systems, do customer support and publish documentation. You will need experience in H/W design of digital systems and familiarity with Assembler, C, UNIX and MS DOS.

AMD is writing a new chapter in the history of technology for those who dream of creating the new. **You see, at AMD we figure that, if you don't make history, you're history.**

For immediate consideration, please call (408) 749-3119 or send your resume, indicating position of interest, to Advanced Micro Devices, Professional Employment, MS-57, 901 Thompson Place, P.O. Box 3453, Sunnyvale, CA 94088. An equal opportunity employer.

*UNIX is a trademark of AT&T Bell Labs.

Advanced Micro Devices
One Great Company

Product Showcase

New and Current
Products Presented
by the Manufacturer

To advertise call Evelyn Schmidt, Advertising Manager (212) 512-6606

PC/MS DOS, VAX VMS, UNIX

- Fast Version 2.2
- Conditional assembly
- Binary or ASCII Hex file output
- New expanded Manual
- Powerful macros
- Relocatable or absolute code

ENERTEC INC, 19 Jenkins Ave.
Lansdale, PA 19446 215-362-0966
telex 4948709 MC/V

CIRCLE 208

Great Designs Start With Tango-Schematic.™ Just $495.

Designs quickly come to life with Tango-Schematic's easy-to-use drawing editor and extensive component libraries. Features four line types, four text sizes, repeat and block functions, unique built-in word processor. Includes DRC, BOM, Wire List, Net List outputs and crisp plots, prints, or laserprints. The perfect front end to our popular Tango-PCB and Tango-Route board design systems.

For IBM PC/XT/AT/PS2. Just $495. Full-function Demo Package: $10. Order toll-free 800 433-7801. VISA/MC. Thirty-day money back guarantee.

ACCEL Technologies, 7358 Trade St., San Diego, CA 92121
Outside N., S. America contact HST Technology (Austral.a)
Phone. 61-02-34-8499 FAX: 61-02-23-8771

CIRCLE 243

Glide Through PCB Design.

TangoPCB™ Create the toughest board designs with powerful layout software that's a snap to use. Function-rich Tango-PCB supports eight layers, 1 mil grid, OrCAD™ or Schema™ netlist input, print/plot/photoplot output, and more.

TangoRoute™ Get impressive completion rates and remarkable speed with Tango-Route, a four layer, eleven pass autorouter.

Just $495 each.

For IBM PC/XT/AT/PS2. Compare features and you'll buy Tango. Or try full-function Demo Package, just $10. Order toll-free: 800 433-7801. VISA/MC. Thirty-day money back guarantee.

CIRCLE 243

ACCEL Technologies, 7358 Trade St., San Diego, CA 92121

TOKO MINI-INDUCTOR PROTOTYPE KITS

New kits contain a wide variety of adjustable coils in 7mm or 10mm sizes and molded coil varieties. The molded coil kit has 82 values (123 parts), from 30MHz-150MHz or 0.0393-1.173 uH inductances. 7mm kit: 54 values (108 parts), from 10kHz-150MHz and 0.1-22μH. 10mm kit: 70 values (136 parts), covering 10kHz-150MHz, and 0.08μH-56mH. Introductory priced at $39.00. Toko America, Inc., 1250 Feehanville Drive, Mt. Prospect, IL. 60056. Phone: 312/297-0070

TOKO AMERICA, INC. CIRCLE 210

DESKTOP IC CELL DESIGN

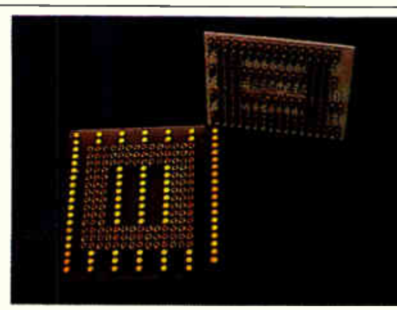
WHY NOT OFFLOAD IC CELL DESIGN FROM YOUR EXPENSIVE CAD SYSTEM TO A PERSONAL COMPUTER?

JUST $4,995 CAN GET YOU STARTED USING DESKTOP CELL PRO WITH NO SPECIAL HARDWARE REQUIREMENTS. BRING CELLS IN FROM YOUR LARGE SYSTEM; SEND BACK VIA GDS-II STREAM

FREE DEMO DISK CALL (408) 438-2199

APTOS SYSTEMS CORPORATION
10 VICTOR SQ., SCOTTS VALLEY, CA 95066

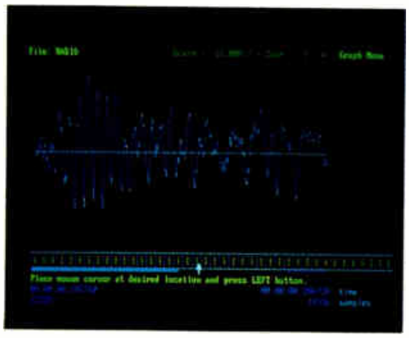
APTOS SYSTEMS CIRCLE 257



PGA & LCC PROTOTYPE TEST ADAPTORS — VLSI

Ironwood's line of **VLSI prototype adaptors** allow prototypeing of devices from 24 pin (video RAM ZIP) **Shrink DIP,** to **240 pin PGA. MP** families **80X86 and 680X0** along with many other patterns. **Annotated test adaptors** for 68010, 68020, 80186, 80386. Gold Machined pins/most wirewrap panel patterns. **Customs — quick turnaround. Burn in sockets. IRONWOOD ELECTRONICS, INC P.O. BOX 21-151 ST. PAUL, MN 55121 (612) 431-7025**

VLSI ADAPTORS CIRCLE 234



DATA ACQUISITION DIRECT TO DISK

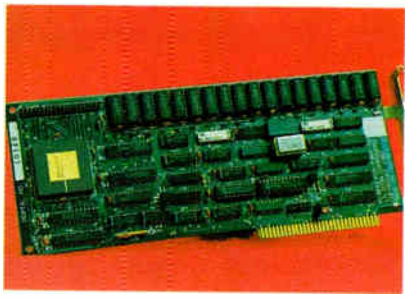
SDI Signal to Disk Interface for hours of real-time signal data storage using an IBM PC. Record/playback 2 channels, 16 bits, up to 50kHz per channel. 50 to 250 Mbyte Winchester drives, 800 Mbyte optical. SCSI interface supports up to 7 drives! Advanced graphics-assisted cut & paste editing. Tape recorder simulation. From $3495. Ariel Corp., 110 Greene St., NY, NY 10012. Call (212) 925-4155.

ARIEL CORP. **CIRCLE 259**

GANG/SET EPROM MULTIPROGRAMMER™ just $695.00

BYTEK GANG WRITER is a production programmer. Duplicates up to 8 devices, optional 16 devices. Copies up to 4 different masters simultaneously, optional 8 masters. Programs all EPROM/EEPROM incl MegaBit Devices. 1 Yr Warranty. Call now for (E)PROM/PLD Multi-Programmer catalogue. 800-523-1565, BYTEK CORP., 1021 S Rogers Cir. Boca Raton, FL 33487, In FL: (305) 994-3520

BYTEK CORP. **CIRCLE 215**



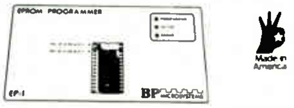
PC-RISC SYSTEM: 40 MIPS

Fill your PC/XT/AT with 1 to 6 PC4000 boards for a high speed PC-RISC System and get up to **40 MIPS** in your PC • Parallel operation • ½ MByte per board • Each PC4000 is more than 2 x speed of VAX 11/780 or 68020 • NC4016 RISC Engine CPU • C(K&R), Assembler & Forth available • Comes w/ dev software • 2 weeks delivery ARO • From $1,295 • Silicon Composers, 210 California Avenue, Suite I, Palo Alto, CA 94306 • 415-322-8763

SILICON COMPOSERS **CIRCLE 202**

NEW IMPROVED

EPROM PROGRAMMER



STILL JUST **$349**

- Now supports over 250 specific EPROM's and EEPROM's from AMD, Intel, SEEQ, TI, Fujitsu, Hitachi, Toshiba, and 21 others
- Programs 87C51, 8749, 8741A, 8742 and other microcontrollers with optional heads
- Splits 16- and 32-bit files
- 30 day money back guarantee
- Free PCDOS software runs up to 38,400 baud
- Gold Textool ZIF socket
- Same day shipment

CALL TODAY FOR MORE INFORMATION

BP MICROSYSTEMS

10681 Haddington, #190 / Houston, TX 77043
(713) 461-9430 (800) 225-2102
Telex: 1561477

CIRCLE 227

YOUR AD HERE

PRODUCT SHOWCASE GETS RESULTS

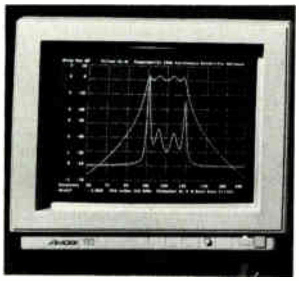
Use this section to boost sales, introduce new products, test new markets, offer free samples, distribute catalogs and product information, and generate new leads. Get full color impact at now extra cost and a high response at a low cost per inquiry. *Electronics'* readers turn to the Product Showcase in every issue to make quick decisions on what to buy. Your ad will be read by more than 131,000 key design engineers worldwide.

ELECTRONICS **CIRCLE 275**

BUGS IN YOUR CIRCUIT?

Wasting time wrapping, unwrapping, cutting traces, bending leads? Test your ideas quickly and easily with the DIP ISOLATOR. Isolate any pin of a DIP IC. Use test points for rewiring. Use with emulator probe to turn off unwanted interrupts, resets. Sizes from 6 to 64 pins. Prices from $22.75. Beta Automation Inc. 3541 Old Conejo Rd., Newbury Park, CA 91320. 805/499-5785.

BETA AUTOMATION **CIRCLE 253**



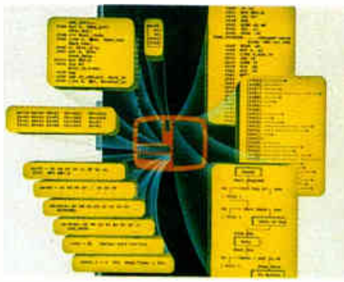
Engineering Software: FILTER designs active filters up to order 30. Bessel, Butterworth, Chebyshev, Allpass; Low, High, Bandpass and Bandstop. Fully menu driven, FILTER designs, plots, and selects component values for any filter in seconds. **LSAP analyzes linear** systems producing Bode, Nyquist, Impulse, Step Response and Root-Locus plots. **Micro-CSMP simulates control and servo systems** with full support for non-linear behavior. Filter is $900, LSAP $450, Micro-CSMP $900 for IBM PCs. **California Scientific Software 818/798-1201** 1159 N Catalina Av, Pasadena CA 91104

CALIFORNIA SCIENTIFIC SOFTWARE **CIRCLE 219**

EXORbus™ COMPATIBLES? OF COURSE!

EXORbus compatible, 6800/6809 family of micro modules for use in process control, production automation, materials testing and data acquisition systems. The 9636 64K Non-Volatile Memory Module is $185.25 each at 100 pieces. Uses 8K X 8 EPROMS or RAMS. Take a look at our 1987 Catalog, "Everything for the EXORbus". Contact Creative Micro Systems, 3822 Cerritos Ave., Los Alamitos, CA 90720. (213) 493-2484

CREATIVE MICRO SYSTEMS **CIRCLE 226**



dICE-51: INCIRCUIT DEBUGGING FOR ONLY $795

The CY-8051 in-circuit element replaces the 8051 and communicates with your IBM-PC over COM1. The powerful dynamic user interface provides source code and symbolic debugging with easy access to all 8051 spaces. Live keyboard, Global Symbol Monitor, 'C' support. Histogram generated during reduced speed execution. Lowest cost, most powerful 8051 design support. Mil spec and CMOS versions available.

Cybernetic Micro Systems
Box 3000 • San Gregorio, CA 94074 • USA
(415) 726-3000 • Telex: 910-350-5842

CIRCLE 206

IBM COMPATIBLE RS232 EASI-DISK 3½"/5¼" FLOPPY DATA STORAGE & TRANSFER SYSTEMS

Information Transfer to/from Non IBM Compatible Systems to/from IBM and Compatibles: (Over RS232 Interface or 488 Interface).

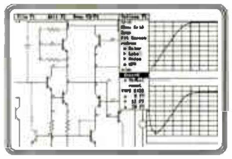
- Reads & Writes IBM PC/MS DOS Disks
- RS-232C/I/O/488
- Rugged Portable Package/Battery Option
- ASCII or Full Binary Operation
- Baud Rates 110 to 38.4 K Baud
- Automatic Data Verification
- Price $895 in Singles - OEM Qtys. Less.

28 other systems with storage from 100K to 35 megabytes.

ADPI
Analog & Digital Peripherals, Inc.
815 Diana Drive Troy, Ohio 45373
513/339-2241 TWX 810/450-2685

FLOPPY DATA STORAGE CIRCLE 214

Analog Circuit Simulation



NEW
SPICE_NET

Make SPICE input files from schematic drawings using pull down menus and a mouse to draw and connect parts. Use an IBM PC with any UC Berkeley compatible SPICE program. Purchase the program for the special introductory price of $245.00 before Feb. 1, 1988.

Simulation Programs for IBM PC's from *intusoft*

- **IS_SPICE, $95.00.** Performs AC, DC and Transient analysis.
- **PRE_SPICE $200.00:** Adds Monte Carlo Analysis, Sweeps, Optimization, libraries and algebraic parameter evaluation.
- **Intu_Scope $250:** A graphics post processor works like a digital oscilloscope. Easy to use with all the waveform operations you will ever need.

(213) 833-0710

P.O. Box 6607
San Pedro, CA
90734-6607

INTUSOFT CIRCLE 220

CUSTOM DESIGN FOR CONTROL COMPUTERS

Why put this expensive specialist on your payroll when we already have the support you need? Vesta specializes in the design and production of control computers for OEM's.

• CREDIBILITY	We have **thousands** of installed systems
• SUPPORT	**Your** application engineer is as close as your phone
• ECONOMICAL	Your break even quantity may be as low as **50 units**
• FAST	Typically 3 to 4 months from ideas to fully functional **product**
• PROGRAMMING	From BIOS to application level
• PRODUCTION	If you don't want to, **we do**

Let us help you get your product into the market, ahead of your competition and at a reduced cost. Call us to discuss your requirements. Our prompt quote will make you happy you did.

VESTA TECHNOLOGY, INC.
7100 W. 44th Ave.•Suite 101•Wheatridge, CO 80033
(303)422-8088

VESTA TECHNOLOGY CIRCLE 271

CONVERT RGB INTO COLOR COMPOSITE VIDEO

Now you can convert RGB computer signals into NTSC color composite video with the ENC Series of RGB Encoders. Three different models for Analog RGB, Sync-on-Green RGB and TTL RGBI. Compatibility with most computers and graphics boards having 15 kHz scan rates. Output of ENCs can drive VCRs, projection TVs, and monitors. Interface cables and application assistance available. ENC encoders are only $395.00 each.
Communications Specialties, Inc.,
6090 Jericho Tpk., Commack, NY 11725.
(516) 499-0907.

CIRCLE 254

ICs PROMPT DELIVERY!!!

SAME DAY SHIPPING (USUALLY)
QUANTITY ONE PRICES SHOWN for DEC. 6, 1987

OUTSIDE OKLAHOMA: NO SALES TAX

DYNAMIC RAM			
1Mbit	1048Kx1	100 ns	$32.00
1Mbit	256Kx4	120 ns	32.00
51258	★ 256Kx1	100 ns	6.75
4464	64Kx4	150 ns	4.15
41256	256Kx1	80 ns	5.75
41256	256Kx1	100 ns	5.15
41256	256Kx1	120 ns	3.95
41256	256Kx1	150 ns	3.75
41264	+ 64Kx4	120 ns	5.25
EPROM			
27C1000	128Kx8	150 ns	$37.95
27C512	64Kx8	200 ns	15.50
27256	32Kx8	250 ns	5.95
27128	16Kx8	250 ns	5.75
STATIC RAM			
43256L-12	32Kx8	120 ns	$11.70
5565PL-15	8Kx8	150 ns	3.30

640K MOTHERBD UPGRADE: Zenith 150, IBM PC/XT, Compaq Portable & Plus; hp Vectra

★ STATIC COLUMN DRAM FOR 386 COMPAQ
+ 2-PORT VIDEO RAM

8087-2 $160.00 80287-8 $245.00 80387-16 $510.00

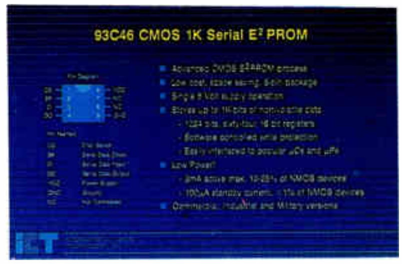
OPEN 6½ DAYS, 7:30 AM-10 PM: SHIP VIA FED-EX ON SAT.

SUNDAYS & HOLIDAYS: SHIPMENT OR DELIVERY, VIA U.S. EXPRESS MAIL

SAT DELIVERY INCLUDED ON FED-EX ORDERS RECEIVED BY:
Th: Std Air $4/1 lb
Fr: P-1 $16.50/2 lb

MasterCard/VISA or UPS CASH COD
Factory New, Prime Parts μPoo
MICROPROCESSORS UNLIMITED, INC.
24,000 S. Peoria Ave.
BEGGS, OK. 74421 **(918) 267-4961**
No minimum order. Please note that prices are subject to change. Shipping & insurance extra, & up to $1 for packing materials. Orders received by 9 PM CST can usually be delivered the next morning, via Federal Express Standard Air @ $4.00, or guaranteed next day Priority One @ $10.50!

MICROPROCESSORS UNLIMITED, INC. CIRCLE 248



1024-BIT SERIAL CMOS EEPROM

The 93C46 is a CMOS EEPROM configured as a 1K bit serial access, 64x16, 5 volt only. The device draws only 3 milliamps max. active and 100 microamps in standby. For applications requiring up to 10,000 erase/wire cycles per register. The 93C46 is in stock at all Marshall Industries locations. Pricing is $1.66 each for 100 pieces. International CMOS Technology, Inc., 2125 Lundy Av., San Jose, CA 408/434-0678.

INTERNATIONAL CMOS TECH. CIRCLE 217

Product Showcase Order Form

The best value for your advertising dollars. For a 1/9 page ad, here's all you have to do:

1) Send a 35mm color transparency of your product. (Black and white glossy photos are also accepted.)
2) Include 10 lines of typed copy, no more than 43 characters to a line. (Include spaces between words and punctuation in your character count.)
3) Write a headline of 32 characters or less.
4) We do all the rest. No production charges.
5) We also accept camera-ready art. Ad size: 2¼" wide x 3⅛" deep.

1x	$750	7x	$715	18x	$600
3x	$735	12x	$645	25x	$570

Send this form with material to: Carol Helton, *Electronics* magazine, Product Showcase Advertising Manager, 1221 Avenue of the Americas, 42nd Floor, New York, NY 10020. (212) 512-2143

Name ______
Title ______
Company ______
Address ______
City ______
State ______ Zip ______
Phone ______

Electronics

We've got a job so important, it takes a retired person to do it.

After a lifetime of working, we want you to handle one more job.

Maybe the most important job you've ever done.

We want you to help give new lives to the 27 million Americans who are functionally illiterate.

Today, illiteracy has become an epidemic that has reached one out of five adults. But you can help stop it by joining in your community's fight against illiteracy.

Call the Coalition for Literacy at toll-free **1-800-228-8813** and volunteer. Beating illiteracy is a big job. But you may find it's the most rewarding job you've ever had.

Volunteer Against Illiteracy. The only degree you need is a degree of caring.

Ad Council Coalition for Literacy

Score One For Our Team.

Cleaning up the environment is easy when we work together! So, Team Up and take the Woodsy Pledge: We Give a Hoot, so We Won't Pollute!

TEAM UP! JOIN THE WOODSY TEAM

Forest Service–USDA

RESUMES

Resumes — Complete instructions and examples; $4, Consultants, Box 567—J, Bergenfield, N.J. 07621.

INVENTIONS WANTED

Inventions, ideas, new products wanted! In-dustry presentation / national exposition. Call 1-800-288-IDEA. Canada, 1-800-528-6060. X831.

SPECIAL SERVICES

Overseas — 75 Countries — Interviewing now. All Fields — for Conn. interview. Send resume: Global Services, (O) Clinton, CT 06413. Transportation not paid to Connecticut.

COMPUTER MARKET PLACE

100Mhz Logic Analyzer Card

For PC/XT, PC/AT Monochrome & Color Card Systems

$1199

- -24 Channels at 25Khz - 25 Mhz
- -6 Channels at 100 Mhz
- -Internal Clock up to 100Mhz
- -External Clock up to 25Mhz
- -Threshold Voltage TTL, ECL, or variable from -10 to +10v
- -Totally Software Controlled
- -All Software Included

PAL/EPROM Programmer Card

For PC/XT/AT Systems

$399

- -Programs All 20 and 24 Pin MMI, NS, TI PALs
- -Programs Eproms from 2716 to 27512 and 27512A
- -Software Functions Include: Read, Write, Verify, Protect, Edit, Print, and File Save and Load of Program.
- -All Software Included

CALL NOW FOR ORDERS AND TECHNICAL INFORMATION (201) 994-6669
Link Computer Graphics, Inc. 4 Sparrow Dr., Livingston, NJ 07039

SPICE* up your *PC

Z/SPICE professional circuit simulation
Full version $300 — Student version $79

ZTEC 6745 Lindley Ave., Reseda, CA 91335 (818) 609-8948

SPICE Circuit Simulation 8/16/32 bit PC's
PC too slow? Need > Maxmem?

Northern Valley Software
28327 Rothrock Dr. R.P.V., CA. 90274
(213) 541-3677

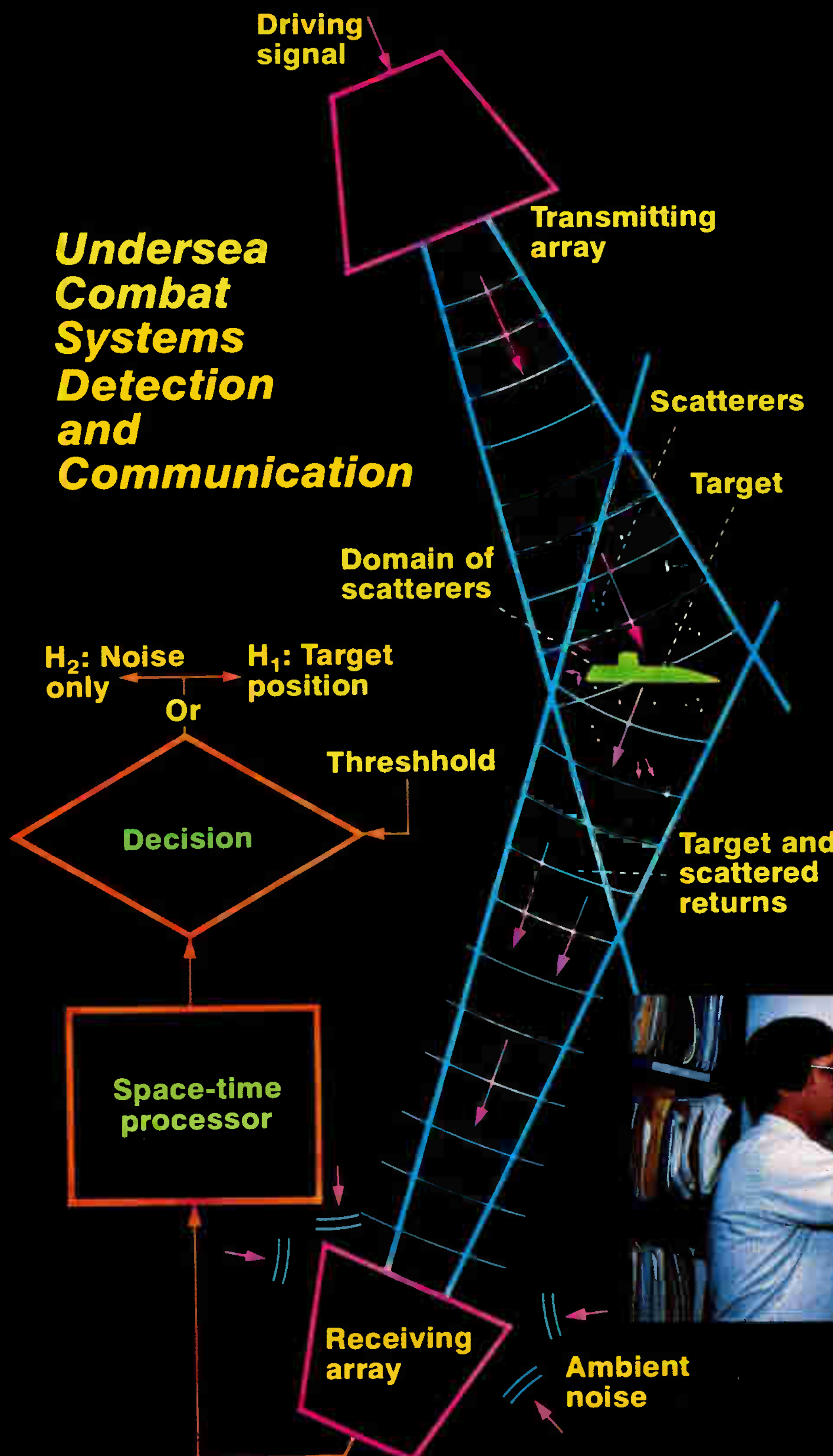
RELIABILITY PREDICTION SOFTWARE

ARE YOUR PRODUCTS RELIABLE?

RelCalc 2 automates MIL-HDBK-217D on your IBM PC!

Very easy to use. Demo package $25.

T-CUBED SYSTEMS (818) 991-0057 — 31220 La Baya Drive, # 110 Westlake Village, CA 91362

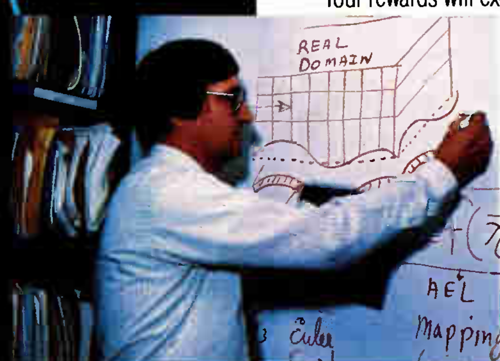


CAN YOUR THEORIES SOLVE THE UNSOLVABLE?

Engineers and scientists at the Naval Underwater Systems Center are the foremost experts in underwater technologies. Their exploitation of the underwater environment as a transmission medium is a major factor in the U.S. Navy's technological superiority. But critical problems still are unsolved. In acoustic arrays. In signal processing. In underwater communications and decision-making systems. In hydrodynamics. Finding solutions is critical to national security. To world peace.

We're looking for Ph.D.s with the potential to solve these problems . . . with the potential to become world-class scientists. If you are one of the few, you'll find everything you need at the Naval Underwater Systems Center. Your theories will be translated quickly into models. You'll supervise their tests in laboratories and at sea.

Your rewards will exceed even the great personal satisfaction of solving the unsolvable. Intelligence and initiative are recognized quickly at the Center. You'll become one of the acknowledged experts in one or more fields of international importance. You'll work with other world-class scientists . . . in the U.S. and overseas. You'll interact at the highest levels of our government.



To apply or for more information, write to:

Naval Underwater Systems Center,
Code 083 E
Newport, Rhode Island
02841-5047
Or call 401-841-3585

U.S. Citizenship Required   Equal Opportunity Employer

Advertisers Index

Classified and employment advertising

■ For more information of complete product line see advertisement in the latest Electronics Buyers Guide
* Advertisers in Electronics International
‡ Advertisers in Electronics domestic edition

Electronics Reader Service

If the card below has already been used, you may obtain the needed information by writing directly to the manufacturer, or by sending your name and address, plus the Reader Service card number and issue date, to Electronics Reader Service Management Dept., P.O. Box 504, Dalton, MA 01227.

AFFIX
POSTAGE
STAMP
HERE

Electronics

READER SERVICE MANAGEMENT DEPT.
P.O. BOX 504
DALTON, MA 01227

McGraw-Hill

AFFIX
POSTAGE
STAMP
HERE

Electronics

READER SERVICE MANAGEMENT DEPT.
P.O. BOX 504
DALTON, MA 01227

McGraw-Hill

value-packed filters from 9^{95}

dc to 3GHz

- less than 1dB insertion loss over entire passband
- greater than 40dB stopband rejection
- 5 section, 30dB per octave roll-off
- VSWR less than 1.7 (typ)
- over 100 models, immediate delivery
- meets MIL-STD-202
- rugged hermetically sealed package (0.4 x 0.8 x 0.4 in.)
- BNC, Type N, SMA available

finding new ways ...
setting higher standards

Mini-Circuits

A Division of Scientific Components Corporation
P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500
Domestic and International Telexes: 6852844 or 620156

LOW PASS Model *LP-	10.7	21.4	30	50	70	100	150	200	300	450	550	600	750	850	1000
Min. Pass Band (MHz) DC to	10.7	22	32	48	60	98	140	190	270	400	520	580	700	780	900
Max, 20dB Stop Frequency (MHz)	19	32	47	70	90	147	210	290	410	580	750	840	1000	1100	1340

Prices (ea.): P $9.95 (6-49), B $24.95 (1-49), N $27.95 (1-49), S $26.95 (1-49)

HIGH PASS Model *HP-	50	100	150	200	250	300	400	500	600	700	800	900	1000
Pass Band (MHz) start, max.	41	90	133	185	225	290	395	500	600	700	780	910	1000
Pass Band (MHz) end, min.	200	400	600	800	1200	1200	1600	1600	1600	1800	2000	2100	2200
Min. 20dB Stop Frequency (MHz)	26	55	95	116	150	190	290	365	460	520	570	660	720

Prices (ea.): P $12.95 (6-49), B $27.95 (1-49), N $30.95 (1-49), S $29.95 (1-49)

* Prefix P for pins, B for BNC, N for Type N, S for SMA   *example:* **PLP-10.7**

C105 REV. D

Circle 901 on reader service card