A CAHNERS PUBLICATION

DECEMBER 8, 1988

EDN®

SPECIAL ISSUE—Part 1
Product Showcase No 28

Highlighting key trends in computer-aided engineering, software, power sources, and integrated circuits

Expanded literature section

ELECTRONIC TECHNOLOGY FOR ENGINEERS AND ENGINEERING MANAGERS

PRODUCT SHOWCASE



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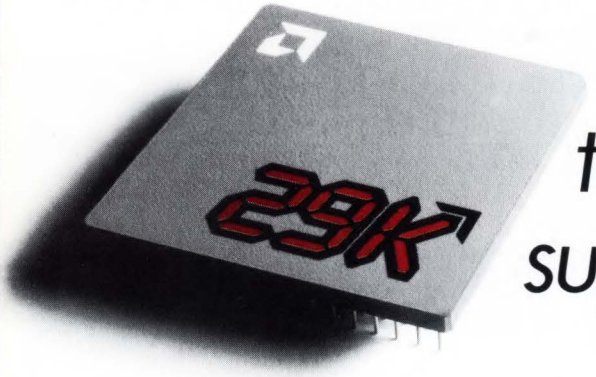



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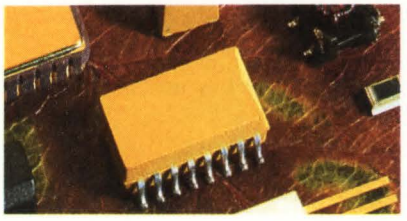

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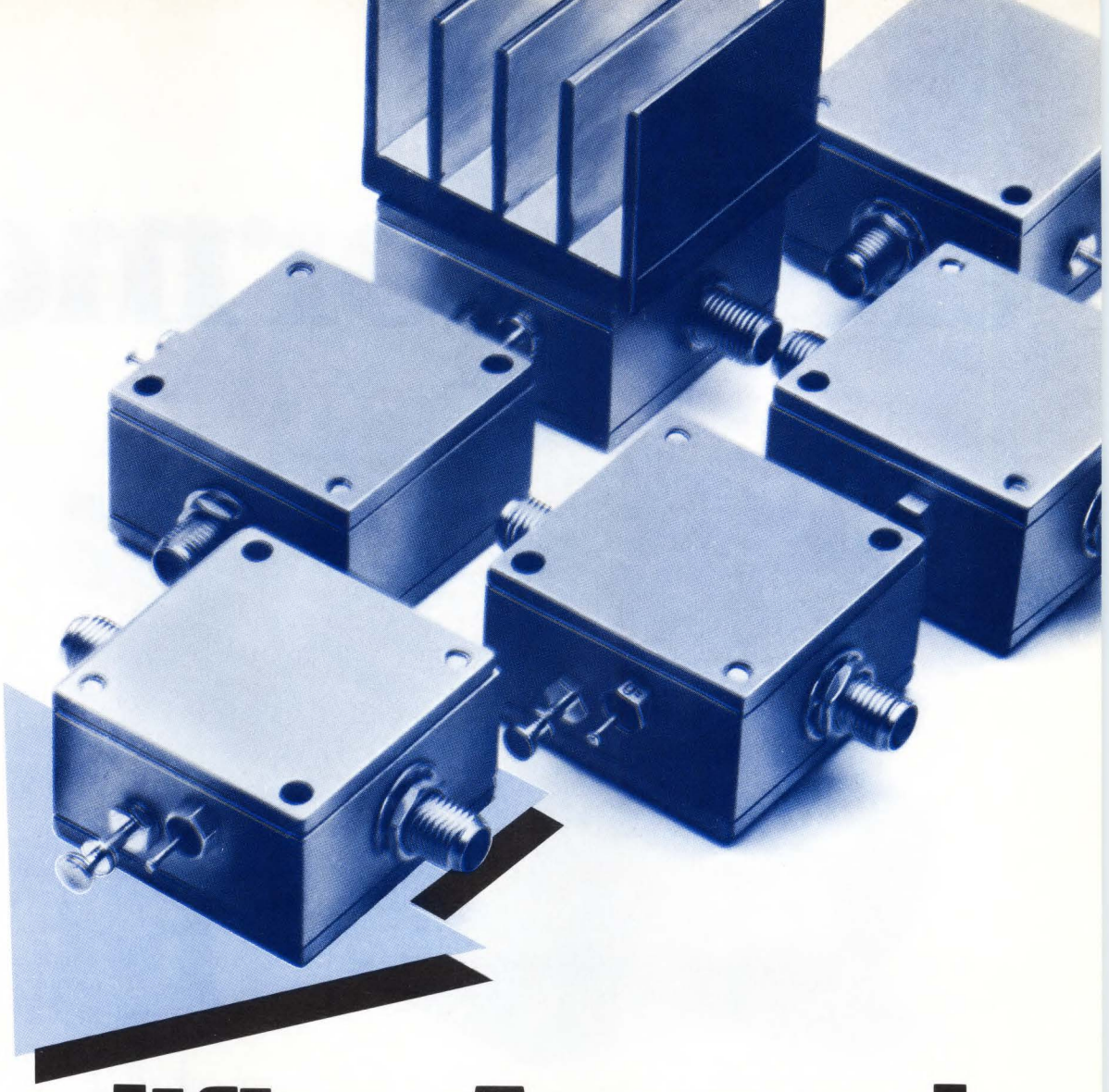

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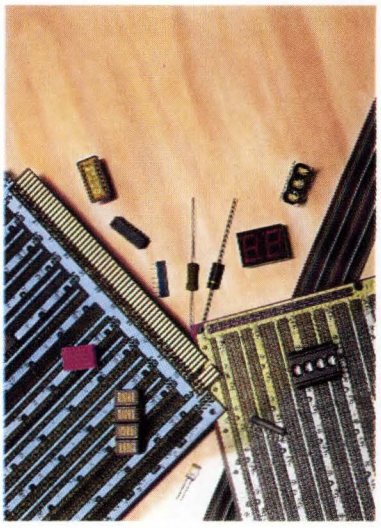
Volume 33, Number 25 December 8, 1988

ELECTRONIC TECHNOLOGY FOR ENGINEERS AND ENGINEERING MANAGERS



On the cover: *Many factors can color your choice of a suitable product, but EDN's Product Showcase No 28 can help sort out the selection process. Part 1 includes staff-written reports and products in four categories: integrated circuits, software, power sources, and computer-aided engineering. Part 2, EDN's December 22 issue, will cover hardware, instruments, components, and computers and peripherals. (Photography by Kevin Bryan; photo colorization by Kim Fisher; art direction by Ken Racicot)*

DESIGN FEATURES

Integrated Circuits

Semicustom ICs combine analog and digital functions 88

Firmly established as a rapid means of designing unique circuits, semicustom ICs are now blurring the traditional distinctions among gate arrays, linear arrays, and custom circuits. Many incorporate both analog and digital functions on the same chip.—*Dave Pryce, Associate Editor*

Software

CASE shows promise but confusion still exists 164

Many software engineers find the CASE market so confusing that they just ignore it and continue to develop software by the same methods they've always used. Fortunately, you can clear away the marketing hype and take a realistic look at what CASE tools can do for your software project.—*David Shear, Regional Editor*

Power Sources

Rechargeable batteries satisfy both backup and primary power needs 206

Rechargeable batteries play a diverse role in today's world of consumer electronic products. In some cases, they play a backup role for computer clock and memory circuitry. On the other end of the spectrum, they provide the primary power for products ranging from watches to laptop computers.—*Tom Ormond, Senior Editor*

Computer-Aided Engineering

PC-based CAE tools facilitate creation of technical documents 258

The current assortment of PC-based desktop-publishing tools has produced a fascinating array of products that can help engineers generate typeset-quality documentation and produce multimedia presentations.—*J D Mosley, Regional Editor*

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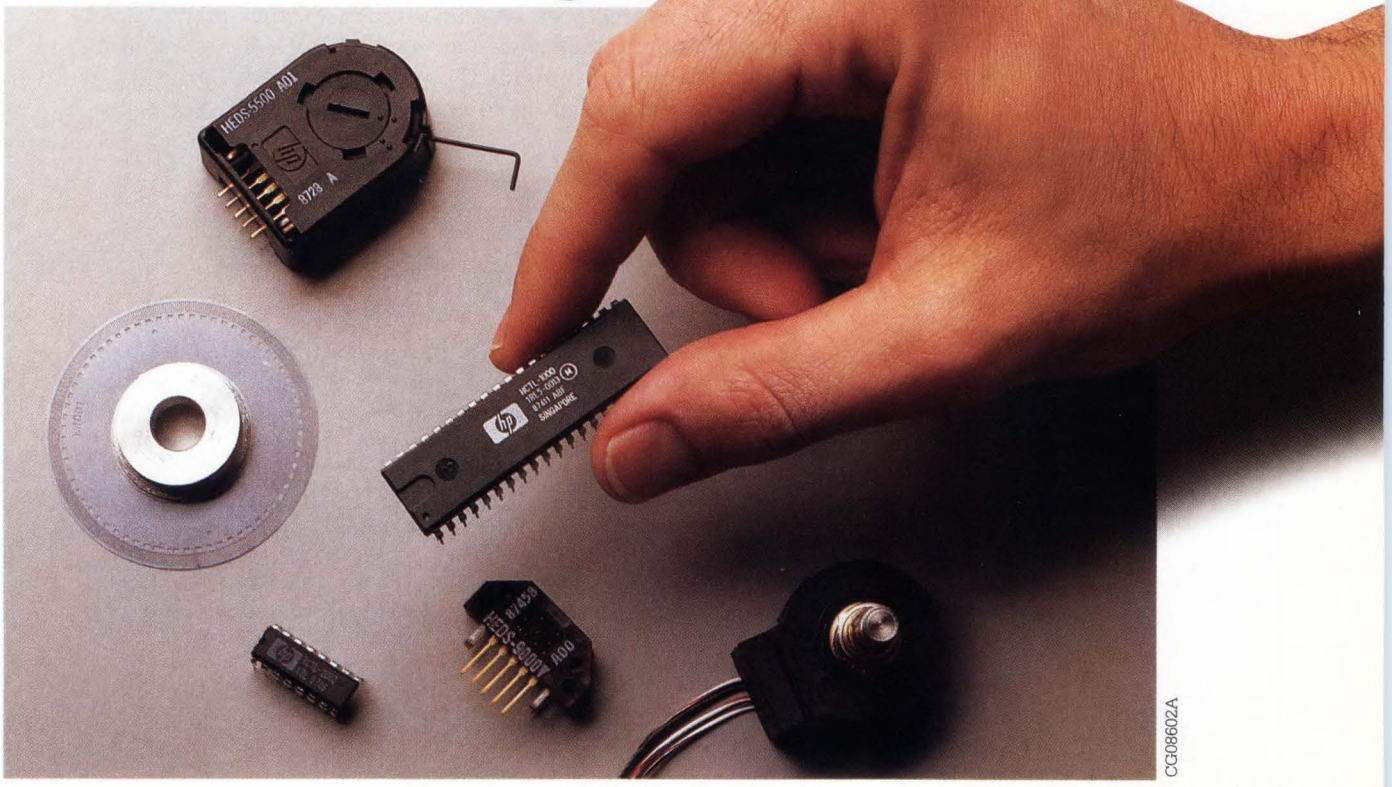

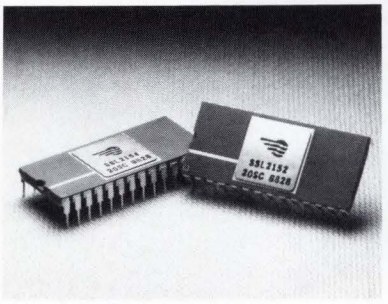

This Product Showcase *provides information on a wide range of products in four areas: integrated circuits (pg 107), software (pg 183), power sources (pg 223), and computer-aided engineering (pg 269).*

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CIRCLE NO 9

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EDITORIAL 55

The EISA bus may be an alternative to IBM's Micro Channel architecture—and it might be a bargaining chip, too.

LOOKING AHEAD 353

Surveys hear large demand for voice-messaging systems . . . Automatic ID equipment to exceed $8.5B by 1993.

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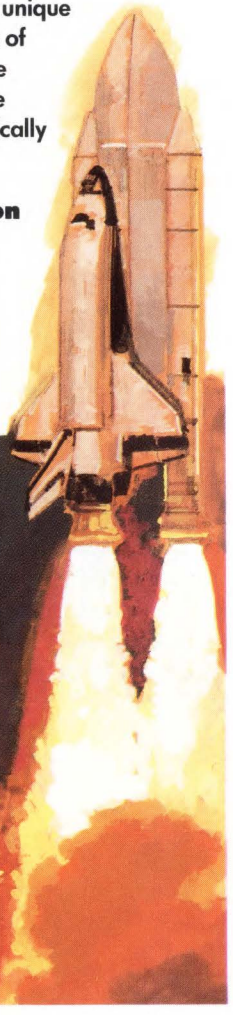
A product-oriented design aid

To save you time in your efforts to keep current, EDN's editors have surveyed the new-product offerings from thousands of companies, screening and selecting only the most significant of those offerings introduced in the last six months. We present our findings—the best of the best—in a format devised to make your product selection as easy as possible. You can keep this Product Showcase as a reference until the next one that covers these four key product areas appears in July.

"OK...SO THE TRAN BUT WHAT ABOUT R

They're everywhere. Worldwide over a thousand Transputer designs are in today's marketplace or are entering production. Some belong to Fortune 500 companies committed to using Transputers to build their next-generation products.

Although Transputer applications are diverse, the theme for each is the same – combining the power of individual Transputers with the unique architectural benefits of parallelism to achieve results that cannot be obtained as economically any other way.



Data Compression

Transputers are being used in the Generic Checkout System at the NASA Kennedy Space Center.

They are embedded within VME based front-end Data Acquisition Modules to provide data filtering for the system.

These modules pre-process data for a network of Unix based workstations that provide real-time control and monitoring of ground and flight equipment, like that used by the Space Shuttle. Only Transputers offered the degree of parallelism needed for this application.



Medical Imaging

University College London is using the parallel processing power of Transputers to convert CAT, NMR and laser scans into rotating 3-D images. These facial, skeletal, and soft-tissue images provide accurate computerized measurements to assist doctors with each step of an operation, and are also used by plastic surgeons to 'rehearse' operations for reconstruction.

Data Collection

British Steel is implementing an intelligent system that is designed to dramatically cut its multimillion dollar annual energy costs. It is built around T800 floating point microprocessors which process information from a highly complex data gathering system. These Transputers operate in parallel, condensing enormous amounts of data into information which helps energy management decide how to respond to a plant's changing demands for different fuels.



Data Transmission



Kokusai Denshin Denwa (KDD), the Japanese international telecommunications company, has developed an image-processing video telephone using Transputers to manipulate and condense images for transmission over telephone links.

This image communications system uses 32 Transputers operating in parallel for ultrafast image processing. It can be connected to PC's to transmit images over telephone lines, function as a video phone, or be programmed to match the specifications of other receiving equipment, such as facsimile machines and TV monitors.



Space

The European Space Agency is using Transputers to build a light-weight, radiation-tolerant, on-board computer for spacecraft. Programs which utilize Transputers in scientific computing and spacecraft control applications are also being developed in the U.S.

Transputers are manufactured on epitaxial silicon and have been shown to withstand aggressive tactical radiation levels.

SPUTER'S TERRIFIC, EAL APPLICATIONS?"

Flight Simulation

British Aerospace have used Transputers to develop a low-cost flight simulator comprising a flat world, ground-grid, buildings, trees and mountains – with an optional Head-up display. Future enhancements will include the addition of undulating terrain and a single or triple window display option.



American companies are also using Transputers to build high-performance flight simulators more cheaply. One U.S. manufacturer utilizes over one thousand T800 processors per system.

3-D Rendering

Pixar in the US has developed a Transputer-based rendering system which quickly renders photorealistic images from 3-D models. The system consists of Transputer boards for VME and AT-bus systems optimized to run Pixar's sophisticated rendering software.

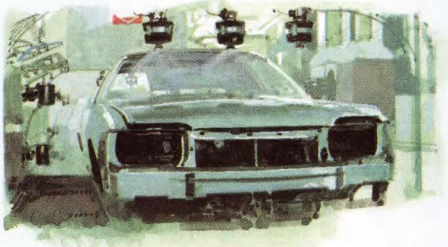


The system holds great promise for such applications as architecture, automobile styling, package design, simulation as well as animation. Pixar's recent computer generated film 'Tin Toy' could not have been done without using this Transputer-based accelerator.

System Control

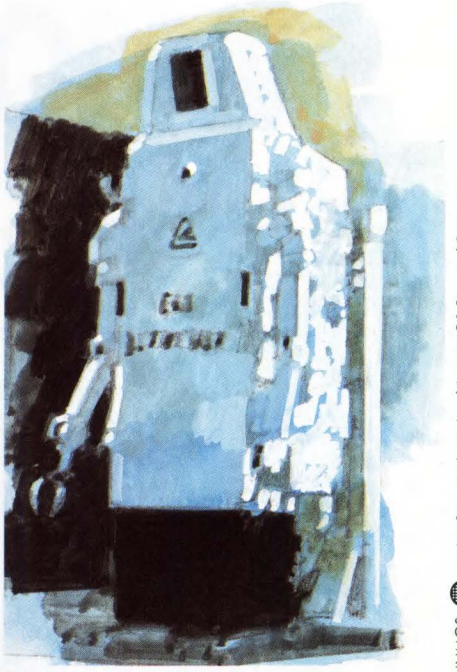
As the number of Transputers in a system design are increased, a proportional increase in performance can be achieved.

In West Germany, Parsytec GmbH is using this principle in their Megaframe Superclusters. Superclusters represent a complete series of reconfigurable industrial control boards as used in the automotive industry, which exploit the Transputer's parallel processing capability.



The basic Model 64, built with T800's, has a performance of 640 MIPS and 96 MFLOPS. The Model 256 comprises four Model 64 cabinets connected by cables and provides 2,560 MIPS and 384 MFLOPS.

Parsytec believes there is no limit to the size Superclusters can grow to. Two Model 256s can be combined easily to realize twice the raw performance of one system.



Robotics

Transputers are ideally suited for robotics applications because their special on-chip links make communication between control centers naturally easy. They are often used in the central control area for dumb robots, in multi-jointed robots, and in machine vision systems.

At the Houston Space Center, NASA and Lockheed are using Transputers in the development of an intelligent, self-manoeuvering, voice-controlled robot named EVA Retriever. EVAR is being built to investigate the autonomous retrieval of objects and astronauts that become detached from the Space Station.

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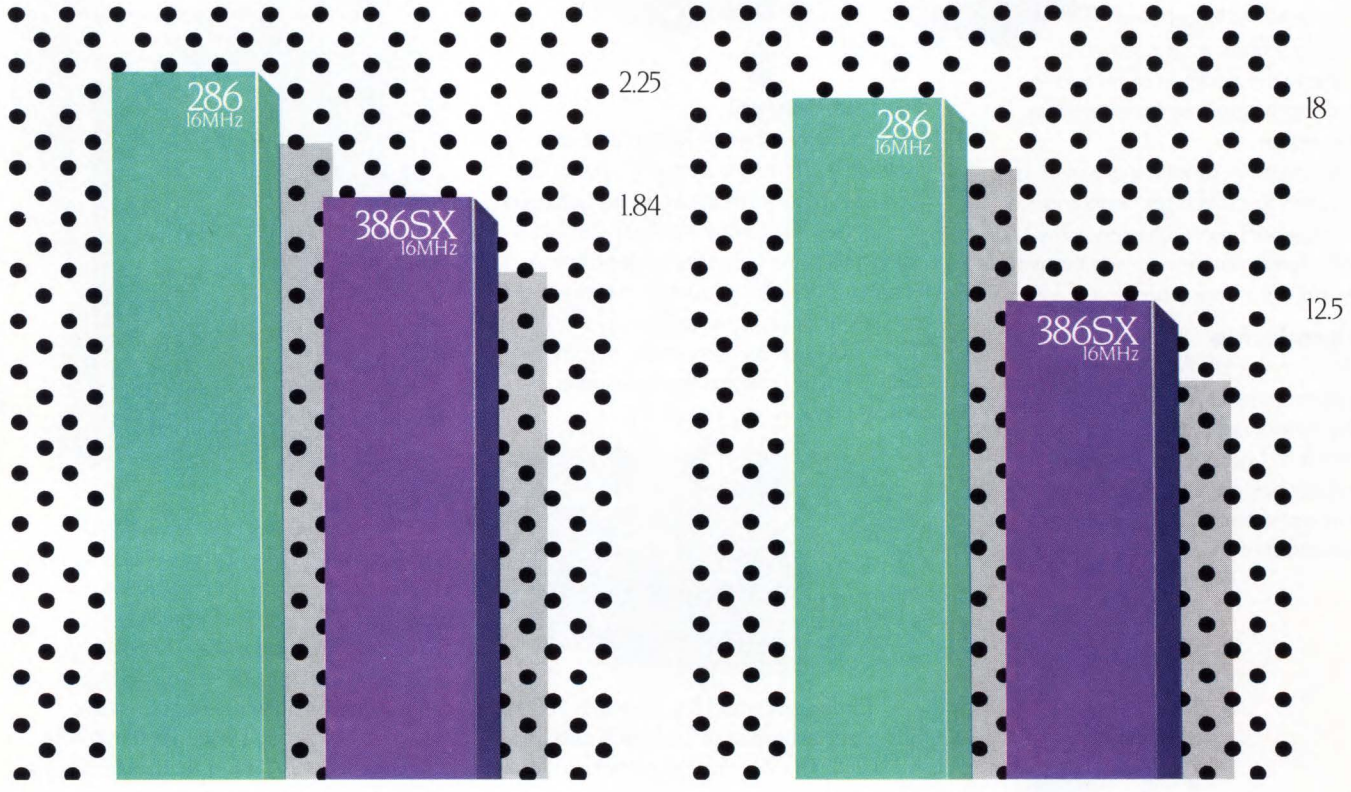

All benchmarks performed with an Everex Step 286-16 with 0 wait states and a Compaq Deskpro 386S™ with 0 wait states. Both systems running 16-bit DOS and OS/2 software. Dhrystone 1.1 compiled with Microsoft® C compiler with no optimization. Run under DOS 3.31. Norton SI by Peter Norton Computing, Inc. performance reported relative to an IBM PC-XT.® MIPS written by Chips and Technologies. Chip cost based on 1000 piece quantity. Product names mentioned herein may be trademarks and/or registered trademarks of their respective companies.

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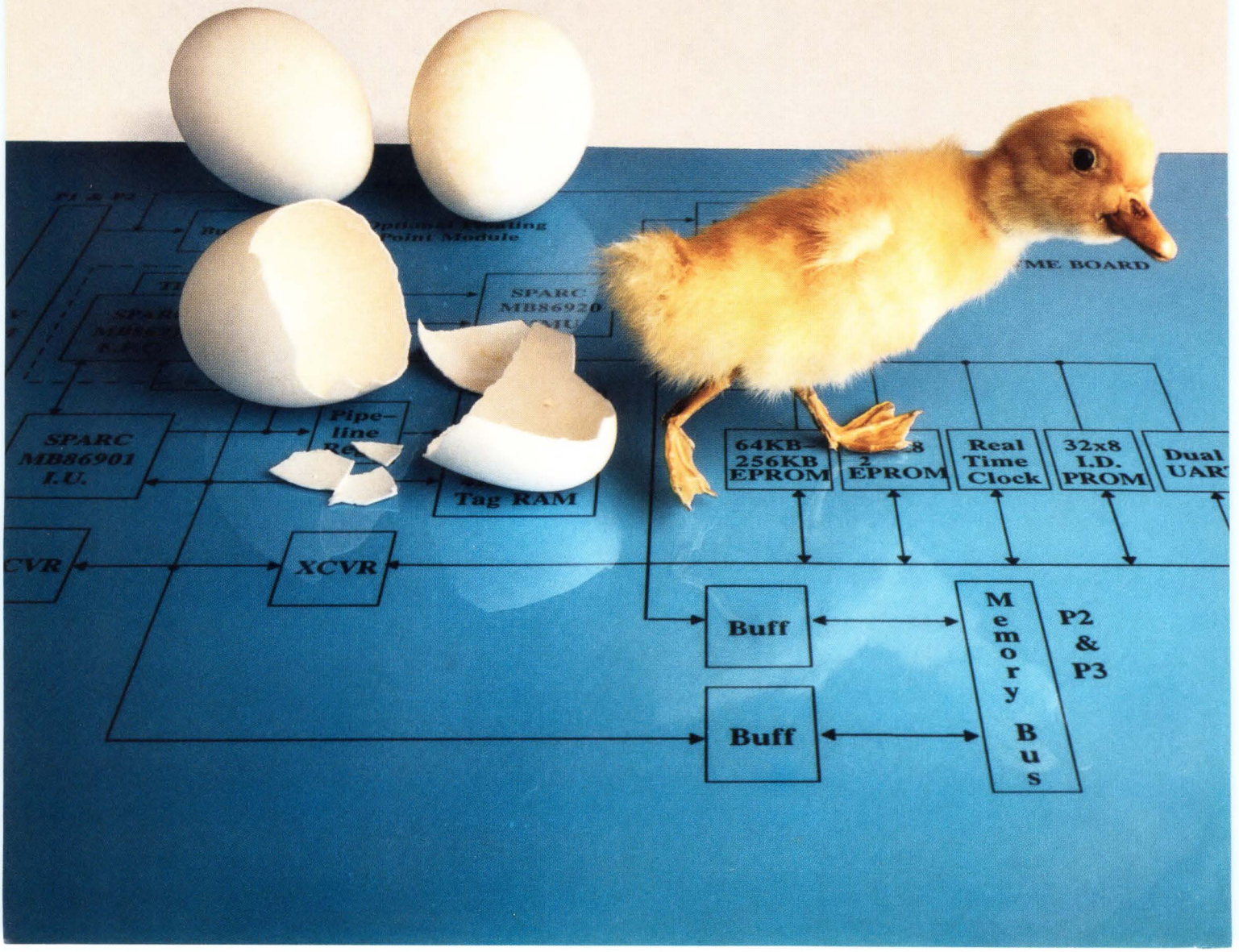

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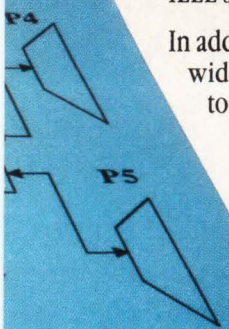

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SAMSUNG NOW

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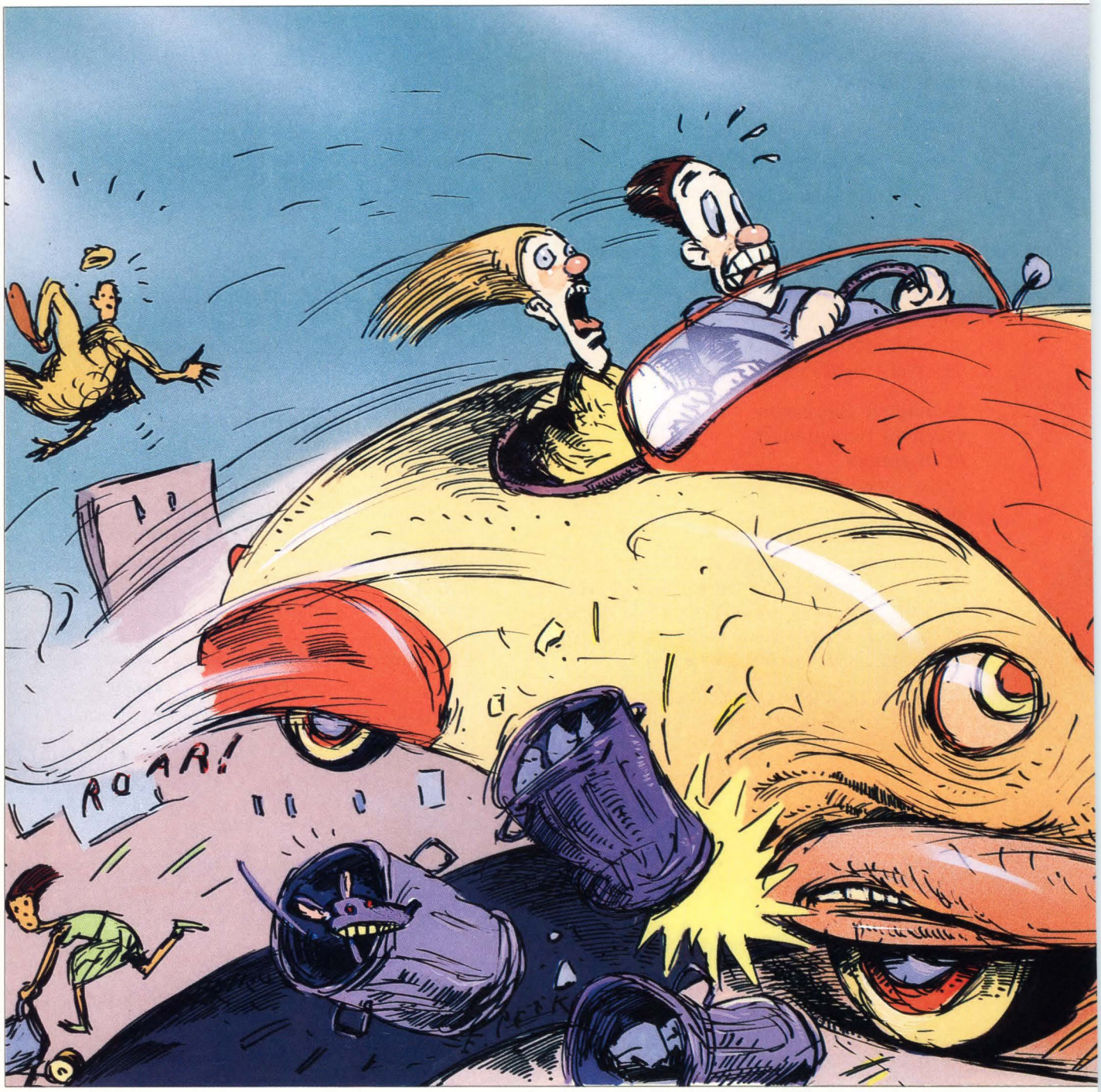

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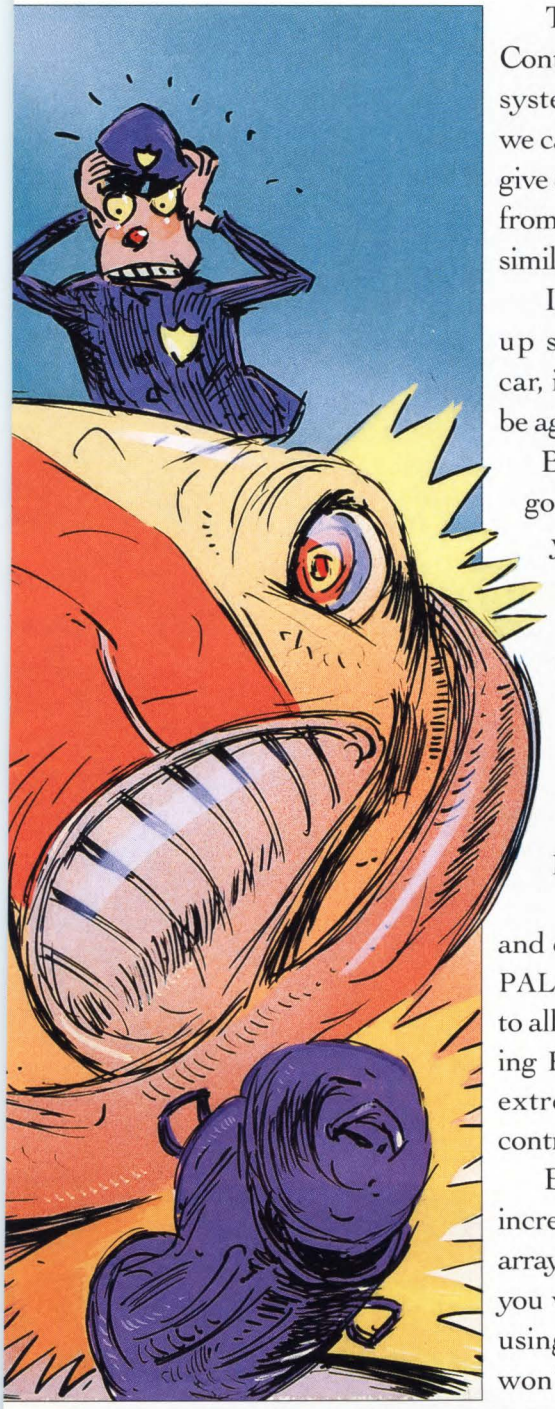
ACCELERATOR. CAR, THEY'D BAN IT.



The new 1- and 4-meg DRAM Controller from Samsung enhances system performance so much that we call it the *System Accelerator*. It can give 80 ns performance—or better—from 120 ns DRAMs.* And make for similar gains in 80 ns DRAMs.

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The Samsung DRAM Controller supports interleaving, and it supports the fastest access modes of the newest DRAMs.

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PART	RAMs SUPPORTED	PACKAGE
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The System Accelerator is available in two versions. One has an externally programmable register and is used for prototyping and moderate-volume applications. The other version is the only DRAM controller available anywhere with a mask-programmed register. It eliminates still more logic parts.

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For data sheets, call DRAM Controller Marketing today at 1-800-423-8624 or 408-922-7754. Or write to DRAM Controller Marketing, Samsung Semiconductor Inc., 3725 No. First St., San Jose, CA 95134-1708.



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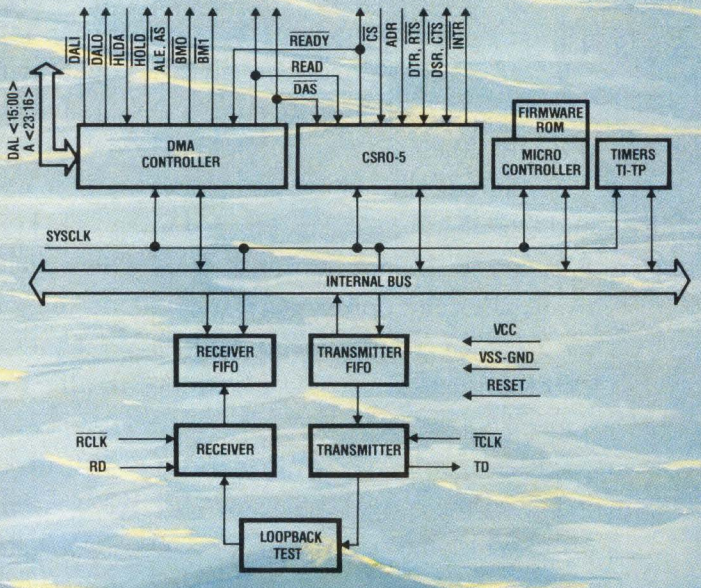

MK5025 Simplified Block Diagram

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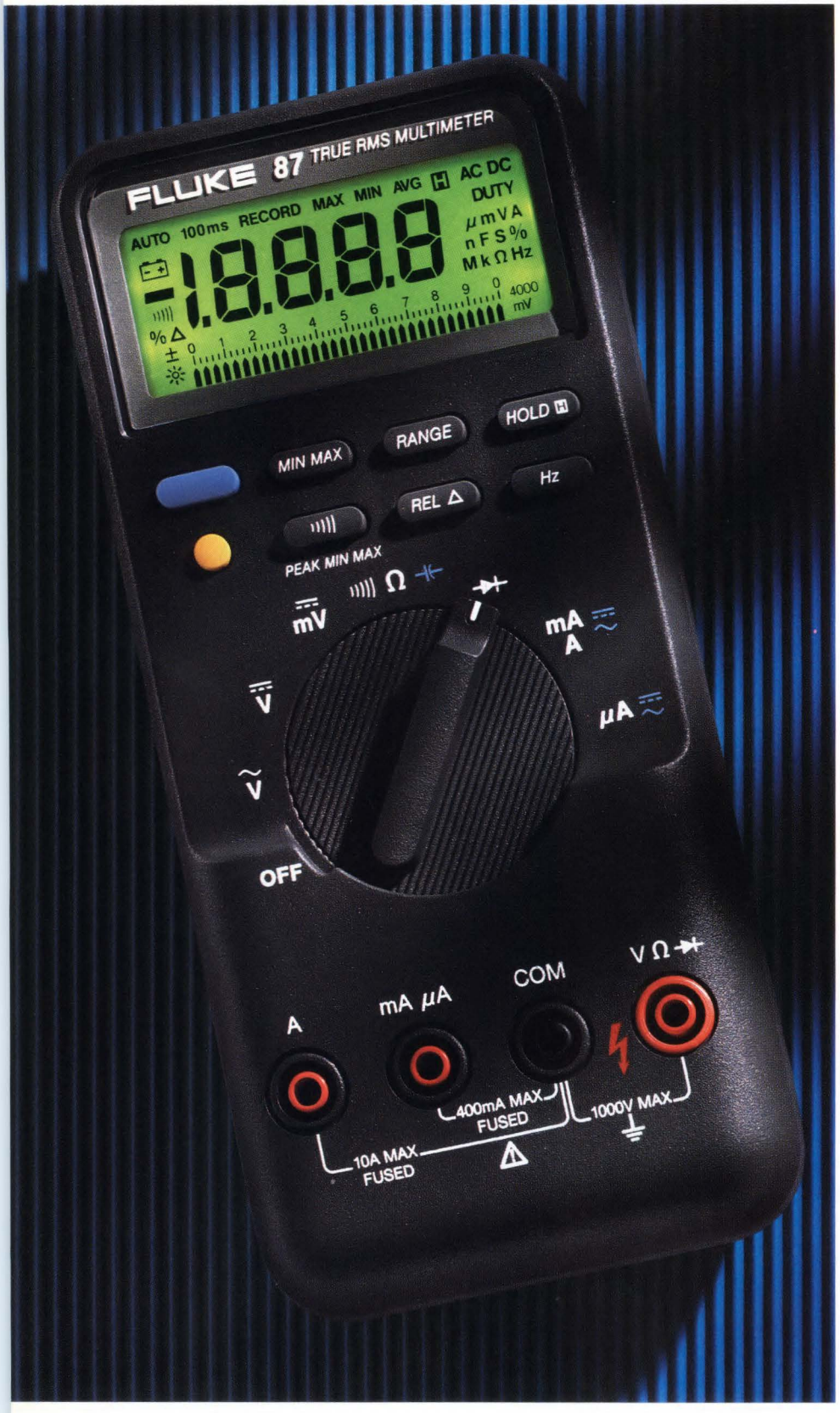

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NEWS BREAKS

EDITED BY JOANNE CLAY

TWO MOTHERBOARD CHIP SETS EMERGE TO SUPPORT THE 80386SX μP

Two San Jose IC vendors have introduced chip sets to help you design Intel's 80386SX μP into a system. The NEATsx (new enhanced ATsx) chip set from Chips and Technologies Inc (San Jose, CA, (408) 434-0600) consists of four devices: the 82C206 integrated peripheral controller, the 82C215 data/address buffer, the 82C811 CPU/bus controller, and the 82C812 page/interleaved/EMS memory controller. Samples of the $92.60 (1000) NEATsx chip set are available now, and volume production is scheduled for January 1989. The 3-IC GCK101SX chip set from G-2 Inc (San Jose, CA, (408) 452-8455) comprises the GC101SX CPU/bus logic-support chip, the GC102 address/data buffer chip, and the GC113 memory-management chip. You can obtain samples of the $75 (1000) GCK101SX chip set now; volume production is slated for the first quarter of 1989. Both vendors' chip sets allow you to build 80386SX-based systems that run at 16 MHz with no wait states.—Steven H Leibson

ASIC VERIFIER PROVES DESIGNS BEFORE PROTOTYPING

The Rapid Prototype Machine (RPM), from Quickturn Systems Inc (Mountain View, CA, (415) 967-3300), is based on reprogrammable hardware emulation. The RPM allows you to perform real-time in-circuit emulation of ASICs before making silicon prototypes. Because the RPM allows your ASIC net list to function in the target system in real time, you can extensively test, debug, and correct design flaws before committing your ASIC to masks. The system connects to your workstation via Ethernet or a SCSI interface, and it can be either a dedicated or a shared resource. Plug adapters allow you to connect the RPM to your system. Pricing starts at $125,000 for a basic system with 25,000-gate capability. The product is scheduled to be available in the first quarter of 1989.—Michael C Markowitz

ANOTHER VENDOR ROLLS OUT A 780M-BYTE, 5¼-IN. HARD-DISK DRIVE

Entering the high-capacity hard-disk fray, Miniscribe Corp (Longmont, CO, (303) 651-6000) has added the Model 9780, a 780M-byte (unformatted) hard-disk drive, to its 5¼-in. disk-drive family. The company claims that the drive is already in volume production, and it has priced the product at approximately $3 per megabyte ($2340). The 9780 employs thin-film, sputtered media and features a 17-msec average access time. Its data-transfer rates are 15M bps for the ESDI version and 4M bytes/sec for the SCSI version. The vendor rates the drive's reliability at a 50,000-hour MTBF. —Steven H Leibson

OPTICAL WORM DRIVE BOOSTS CAPACITY FROM 500M TO 800M BYTES

Maximum Storage Inc (Colorado Springs, CO, (719) 531-6888) has boosted the capacity of its APX-4000 optical WORM (write-once, read-many) disk-drive subsystems from 500M to 800M bytes by improving the drive and introducing a higher-capacity cartridge. APX-4000 subsystems for IBM PCs and compatible computers cost $4250 for the internally mounted version and $4450 for the external version. Single- and double-sided cartridges cost $145 and $195, respectively. The company will retrofit existing APX-4000 drives with the high-capacity capability at no charge.—Steven H Leibson

NEWS BREAKS

DIGITAL CROSSPOINT SWITCH OPERATES AT 50 MHz

Sierra Semiconductor (San Jose, CA, (408) 263-9300) has introduced a monolithic CMOS 32×32 digital crosspoint switch that operates at 50 MHz. The part's maximum signal skew from input to output is 2 nsec. The SC11320 crosspoint switch can independently connect each of its 32 CMOS-compatible inputs to one or more of its 32 outputs. The device produces this high-density switching matrix by employing a 1:32 multiplexer for each of its 32 inputs. A 6-bit latch is associated with each multiplexer, so the user can individually load the desired input address for each output channel.

You can create system matrices larger than 32×32 by cascading multiple switches with their outputs connected in a wire-OR, parallel configuration. In addition, the outputs have a bit-selectable 3-state mode for those design applications in which multiple SC11320 digital switches must share the same system bus. The switch also features some built-in diagnostic features; for example, the information contained in all 32 of the 6-bit latches can be read through a special output bus that the user can connect to the host system for monitoring. The SC11320 operates from a single 5V supply; when operating at 20 MHz, it dissipates a maximum of 850 mW. The standard version of the switch is available in a 120-pin plastic pin-grid array and sells for $81.57 (100). Four other packaging options are available on request.—Anne Watson Swager

CONFERENCES FEATURE DSPs, RISC PROCESSORS

Two seminars, one on digital signal processors (DSPs) and DSP development systems and one on RISC-processor architectures and system applications, will feature commercially available devices and hardware and software development tools. The DSP meeting, which will begin with a 1-day overview of DSP theory, will highlight Fujitsu's MB86232 and MB86220, AT&T's DSP16A and DSP32C, NEC's uPD77230, and OKI's MSM6992, as well as DSPs from Motorola. The conference will also examine products from Zoran, Analog Devices, and Texas Instruments, and it will provide a detailed look at future DSP chips such as the Texas Instruments TMS32040. The West Coast version of the DSP seminar will take place from February 27 through March 1, 1989, at the Anaheim Plaza Hotel, Anaheim, CA; the East Coast version will be presented from April 3 through 5, 1989, at the Massachusetts Institute of Technology, Cambridge, MA.

The RISC seminar will feature RISC-processor chips and chip sets, RISC system architectures, and products based on RISC processors. The organizer, DSPAssociates (Newton, MA, (617) 964-3817), claims that representatives from all the major suppliers of commercially available RISC processors will attend the conference. Among the parts to be discussed will be Sun Microsystems' SPARC, Motorola's 88000/88100, MIPS's R2000 and R3000, AMD's 29000, VLSI Technology's 86C10, and Intergraph's Clipper. The meeting will also include an introduction to RISC architectures, an examination of the current state of the art in RISC processors, and a projection of future trends. The West Coast RISC conference will take place from March 1 through 3, 1989, at the Anaheim Plaza Hotel, Anaheim, CA; the East Coast version is slated for April 5 through 7, 1989, at the Massachusetts Institute of Technology, Cambridge, MA. For further information on the DSP and RISC conferences, contact Amnon Aliphas of DSPAssociates at (617) 964-3817.—Joanne Clay

CY7C123



SRAM 7ns Page 226

22V10



PLD 15ns Page 453

CY7C601



RISC 20 MIPS Page 65

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PROM 18ns Page 338

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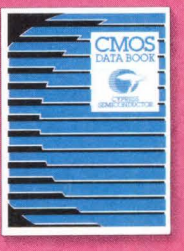

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NEWS BREAKS: INTERNATIONAL

EMULATOR SUPPORTS 32-BIT AND RISC PROCESSORS

The KSE5 in-circuit emulator from Kontron Elektronik GmbH (Eching, West Germany, TLX 526719; in the US: Mountain View, CA, (415) 965-7020) allows you to debug 32-bit-μP systems operating at clock frequencies as high as 25 MHz. The emulator currently supports the Motorola 68020 and Intel 80386 μPs. The company plans to introduce support for Motorola's 68030 μP and AMD's 29000 RISC processor by the second quarter of 1989. Operating in conjunction with the company's KDS development system or an IBM PC/AT or compatible computer running the OS/2 operating system, the emulator allows you to trace and display program activity by using as many as 20 on-screen windows. These windows allow you to display register, stack, and memory contents, and to trace programs in either assembly language or C. You can expand the emulator to provide as much as 2M bytes of simulation memory and as many as 112 trace-analyzer channels.

Further, you can logically and sequentially combine the emulator's triggering conditions to activate breakpoints, trigger the trace analyzer, or stimulate real-time program jumps. Tag bits associated with the emulator's simulation memory allow you to monitor particular types of memory access and to identify areas of your program that have not been executed. The user interface is supported by pop-up menus, help screens, and an automatic command checker. Prices for the currently available KSE5 emulators start at around DM 40,000.—Peter Harold

VME BUS CHASSIS PROVIDES ACTIVE DAISY-CHAIN SWITCHING

Peripheral devices—such as Winchester and floppy-disk drives—for the Target-32 VME Bus computer system plug directly into the unit's VME Bus backplane, minimizing the hardware changes required when you convert from a desktop development system to a rack-mounted target system. The 500W power supply, which provides 5V/80A, +12V/6A, and −12V/2A outputs, plugs directly into the rear of the backplane. Manufactured by Force Computers GmbH (Ottobrunn, West Germany, TLX 524190; in the US: Campbell, CA, (408) 370-6300) Target-32 is based on a 7U-high, 19-in. rack-mounting chassis containing a 20-slot VME Bus backplane. Installed P1 and P2 backplane connectors allow you to implement 32-bit VME Bus systems and to configure subsystem buses on the P2 connectors. Automatic daisy-chain switching at each slot location eliminates any requirement to install or remove jumper links on the backplane when you reconfigure the system. The chassis includes a cooling fan and meets VDE-080 safety requirements and VDE-0871 class-B and FCC RFI emission standards. It costs approximately DM 6000 without any plug-in boards. —Peter Harold

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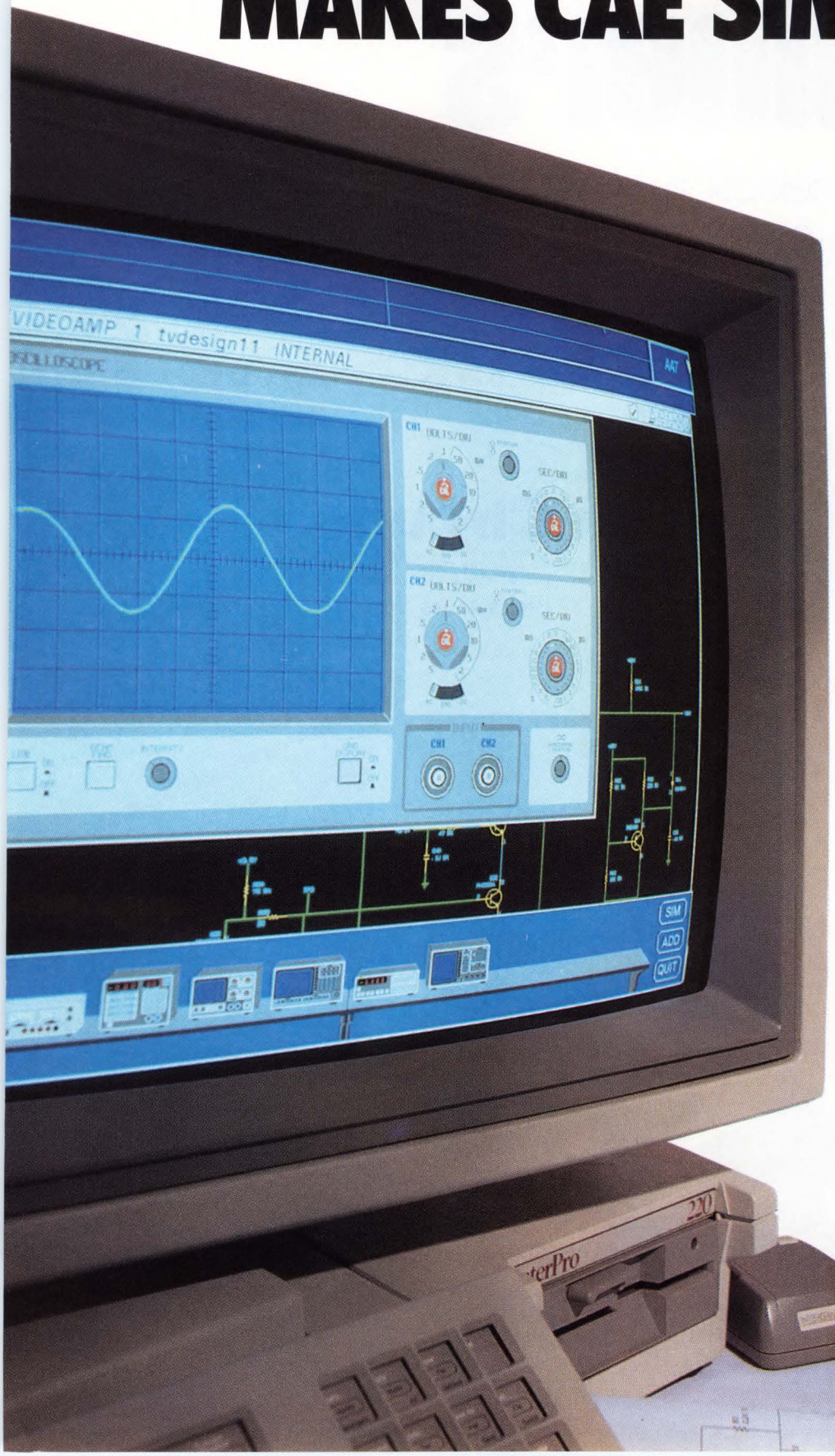

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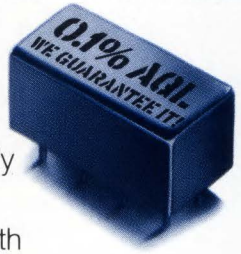

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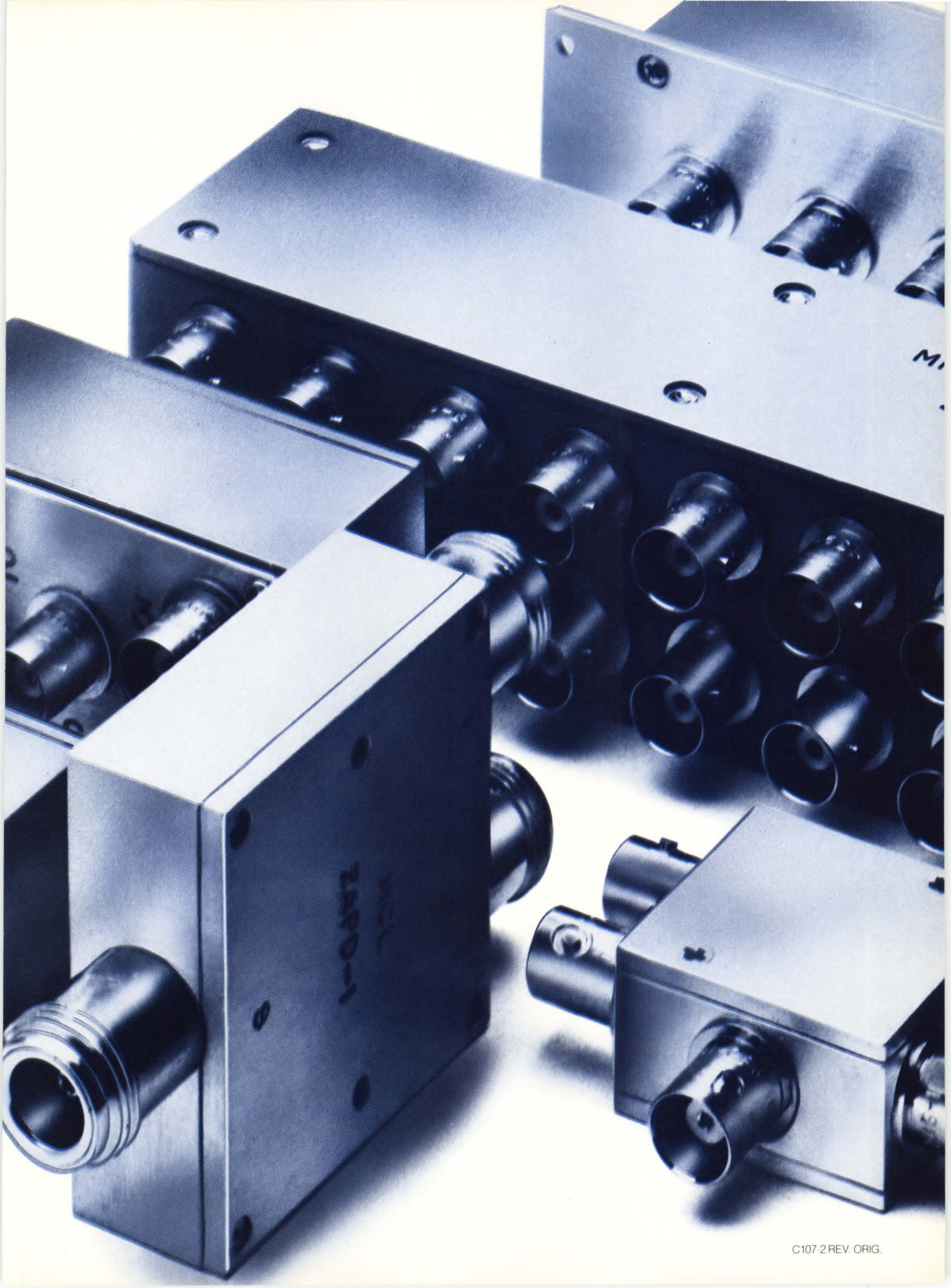

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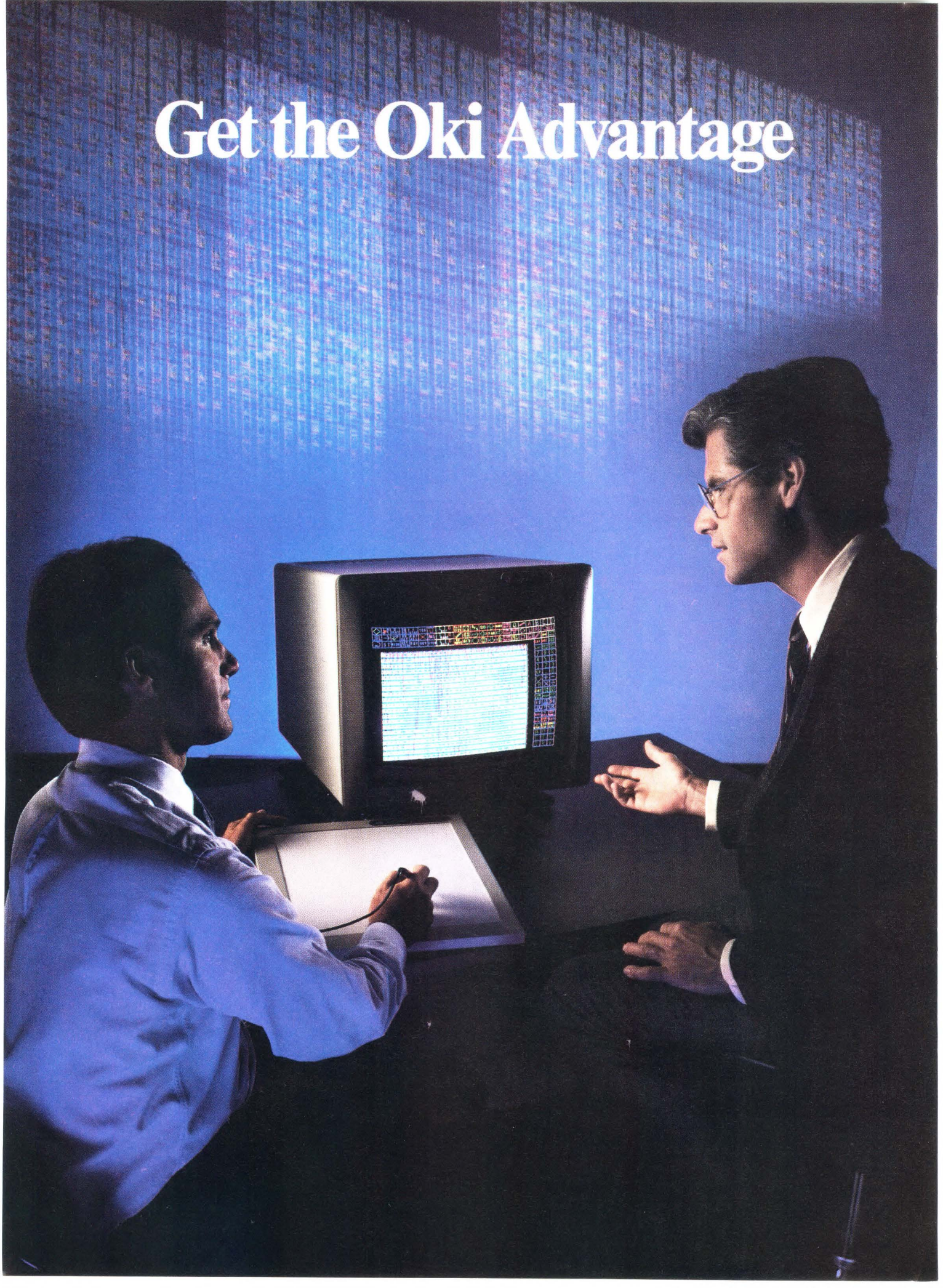
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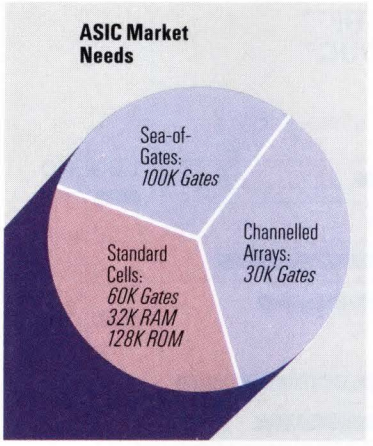

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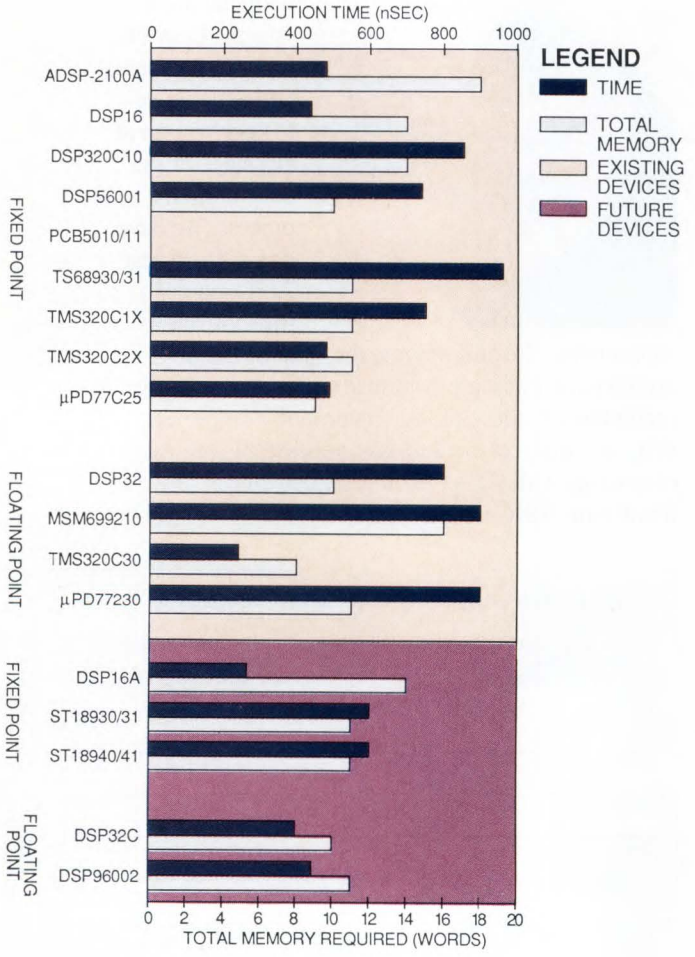
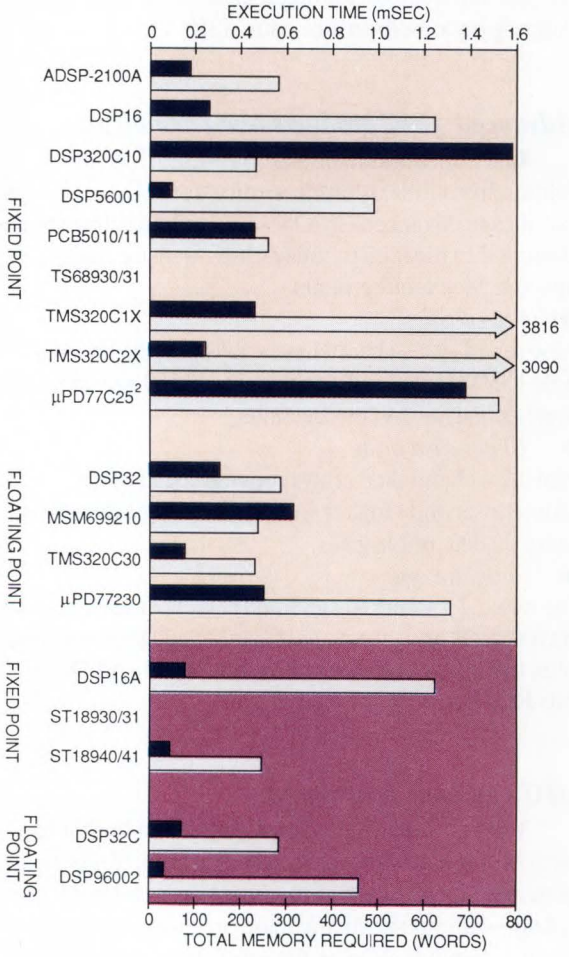
Benchmark update

Some errors were inadvertently introduced into Benchmarks 7, 10, 11, and 12 in the Special Report "EDN's DSP Benchmarks" (EDN, September 29, 1988, pg 126) during the production of the issue. The corrected tables are printed below. These tables also contain some additional information that was not available at the time the report was written.

BENCHMARK 7
DOT PRODUCT



BENCHMARK 10
COMPLEX 64-POINT FFT
(RADIX-2)



1. These DSPs need external address counters in order to access the external memory required to perform this benchmark.

2. This DSP needs an external DMA controller in order to access the external memory required to perform this benchmark.

3. The TMS320C15-25 was used for this benchmark.

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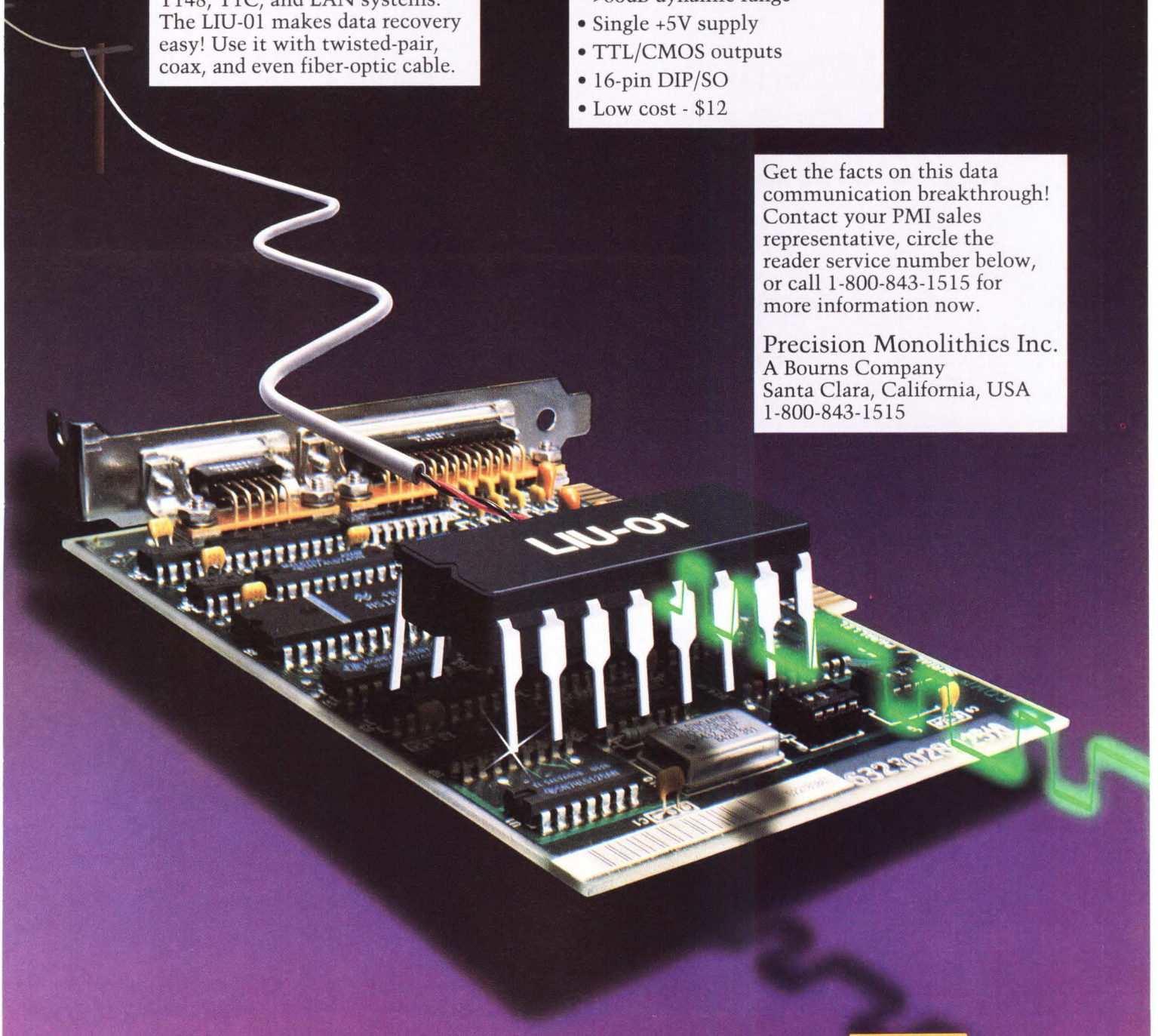

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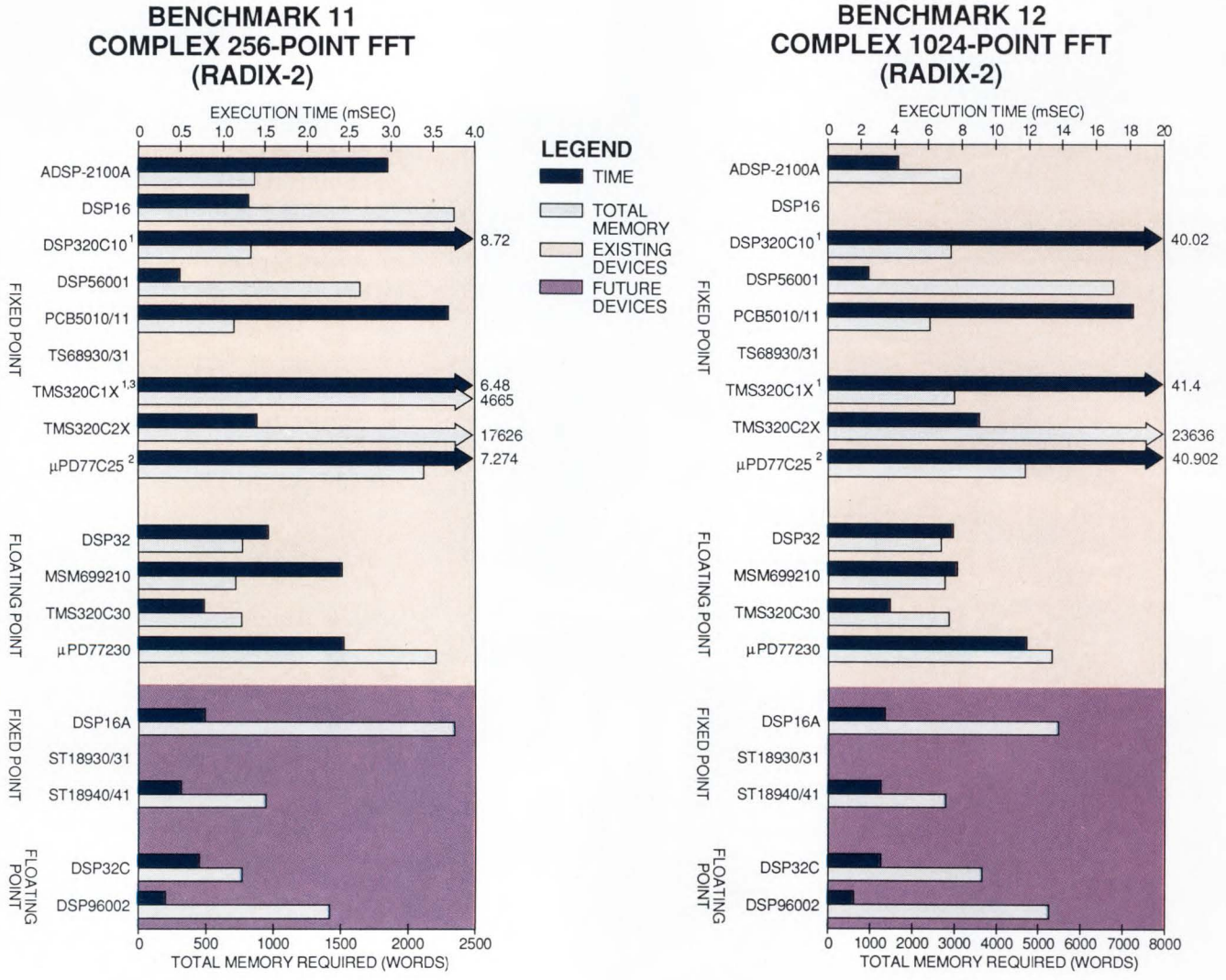

1. These DSPs need external address counters in order to access the external memory required to perform this benchmark.

2. This DSP needs an external DMA controller in order to access the external memory required to perform this benchmark.

3. The TMS320C15-25 was used for this benchmark.

Exercise More with Less

■ MORE EFFECTIVE
By duplicating the motion of cross country skiing, the world's best exercise, NordicTrack provides the ideal aerobic workout. Your total body is exercised simultaneously.

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Unlike bikes and other sitdown exercisers, NordicTrack exercises major muscles in the buttocks and legs more uniformly, as well as exercising the arms, shoulders, and back. You get a total body workout.

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In tests at a major university, NordicTrack burned more calories and provided a greater aerobic workout than an exercise bike and a rowing machine.*

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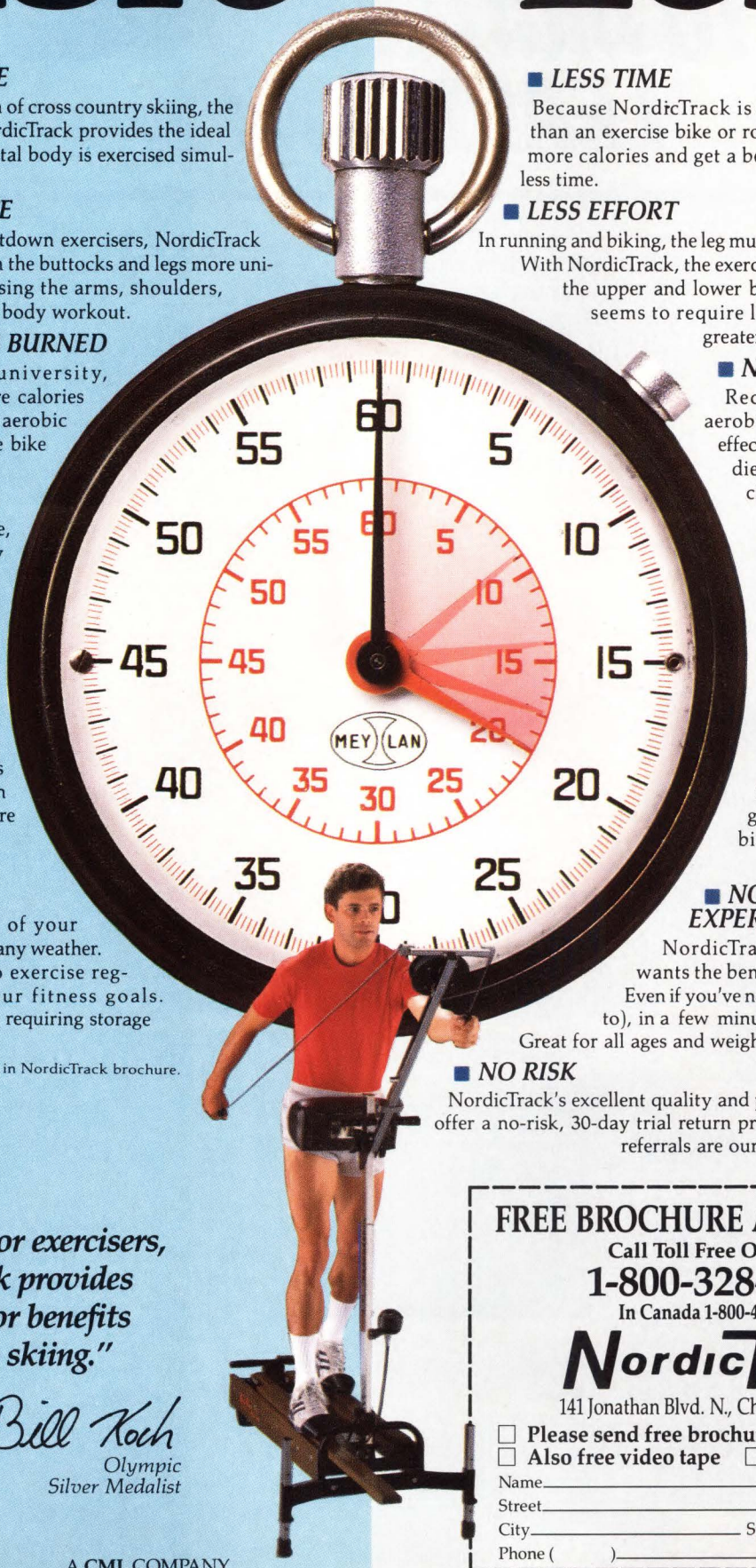
*Scientific test results included in NordicTrack brochure.



■ LESS TIME
Because NordicTrack is so much more efficient than an exercise bike or rowing machine, you burn more calories and get a better aerobic workout in less time.

■ LESS EFFORT
In running and biking, the leg muscles do most of the work. With NordicTrack, the exercise workload is shared by the upper and lower body muscles, so exercise seems to require less effort and provides greater cardiovascular benefits.

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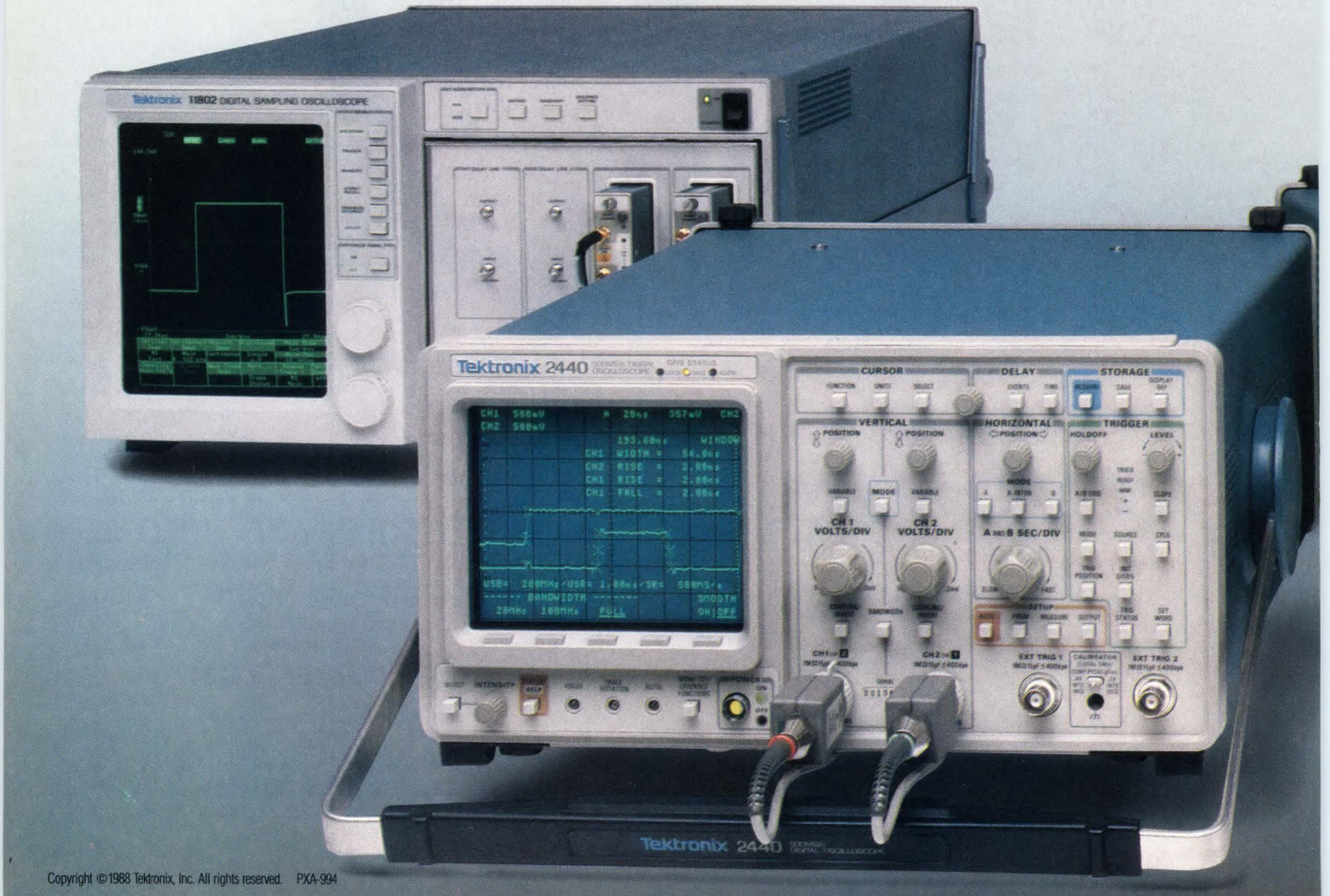

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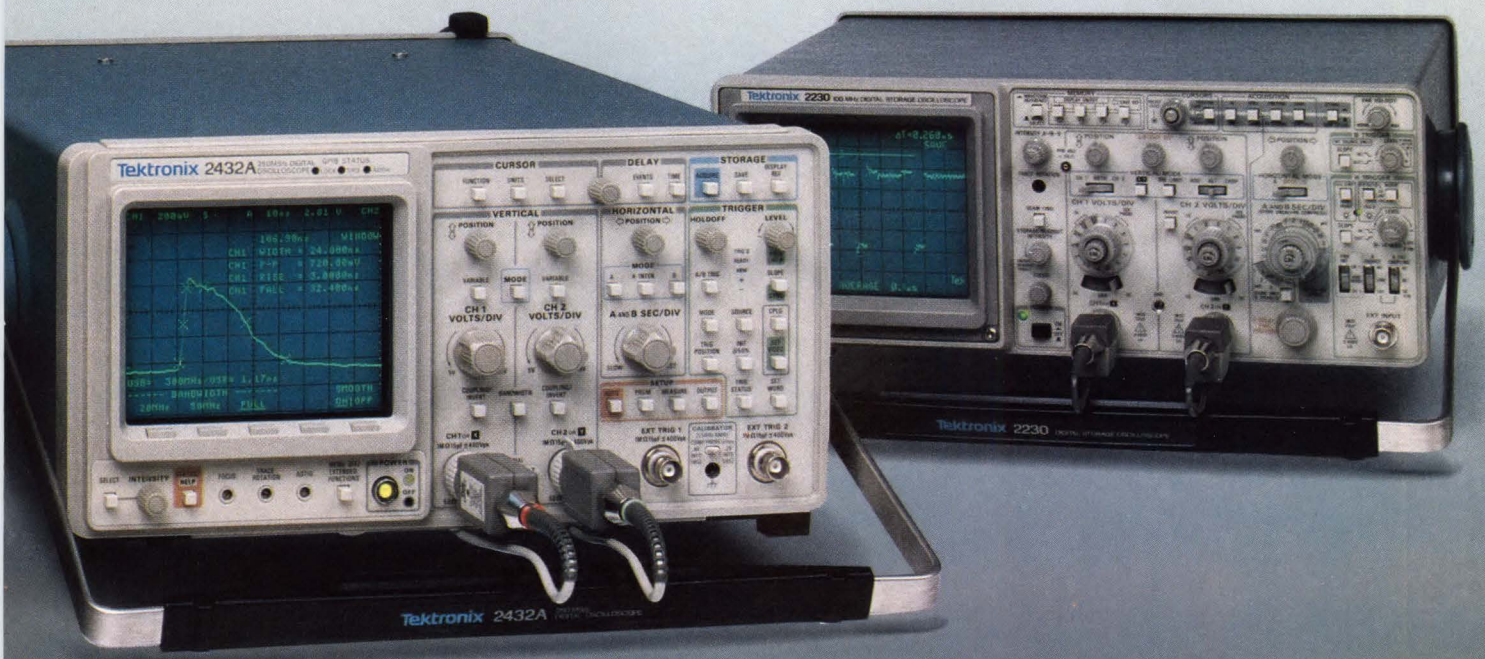

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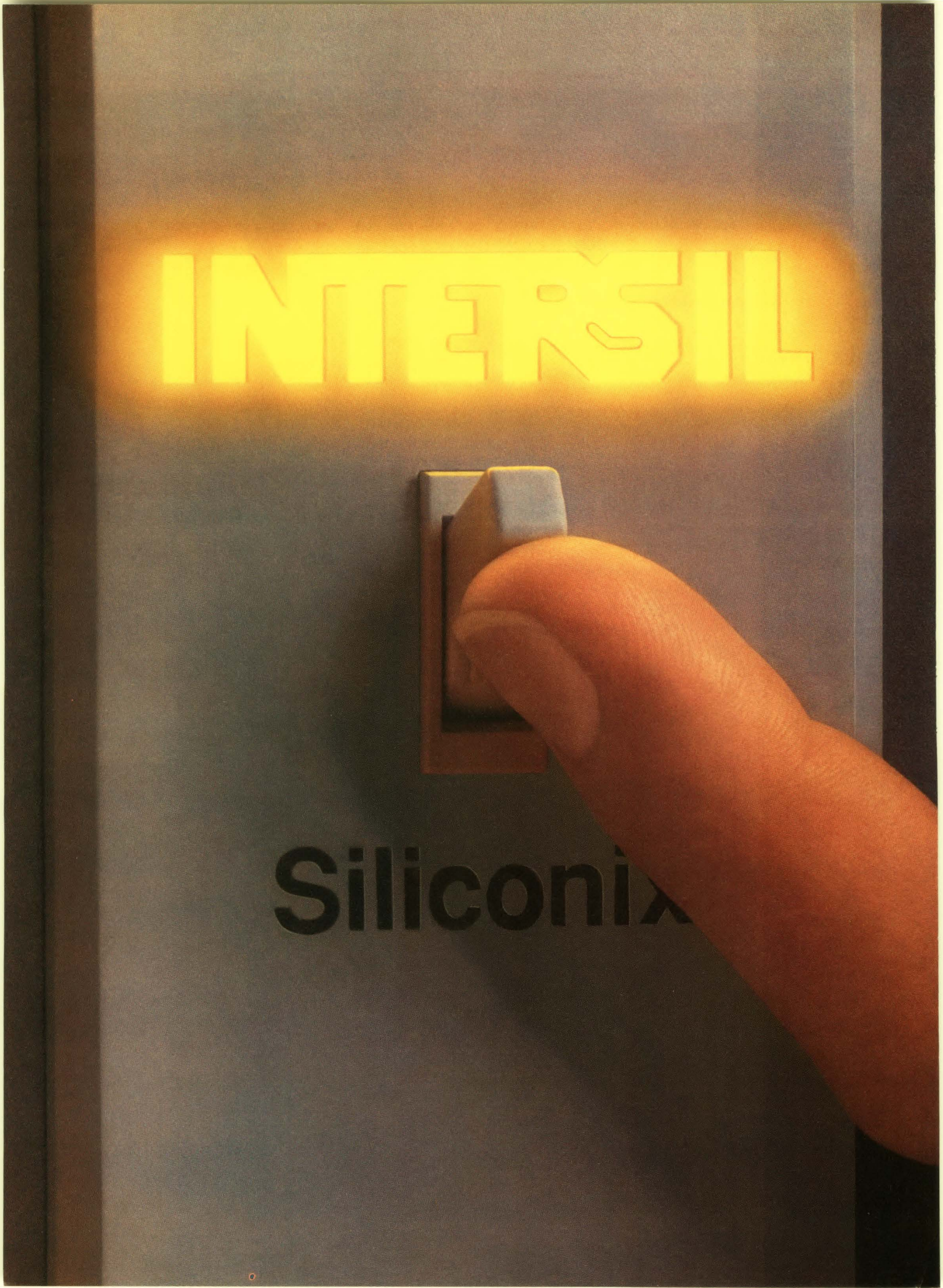
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IH5140-IH5145	Improved High-level CMOS
IH5148-IH5149	High-Level CMOS
IH 5341/5352	CMOS Dual/Quad/Video/RF
IH6108/6208	CMOS 8-/4-Channel Differential Mux
IH6116/6216	CMOS 16-/8-Channel Differential Mux
IH5108/IH5208	CMOS 8-/4-Channel Diff. Fault Protected Mux
IH5116/5216	CMOS 16-/8-Channel Diff. Fault Protected Mux
Coming soon:	
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Most importantly, Hitachi's ZTAT™ technology gives you Zero Turn-Around Time. The on-board one-time user-programmable EPROM eliminates the need to wait three or four months for mask ROM devices. The very *day* you finish development, ZTAT gets you into production. And, you can implement software changes *immediately,* to stay one step ahead of everyone else.

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lopment, ZTAT devices for pilot and small-scale production, and mask ROM devices for large-scale production. And, a full complement of development support tools is available for use with IBM-PC*, DEC VAX*, and Hitachi systems.

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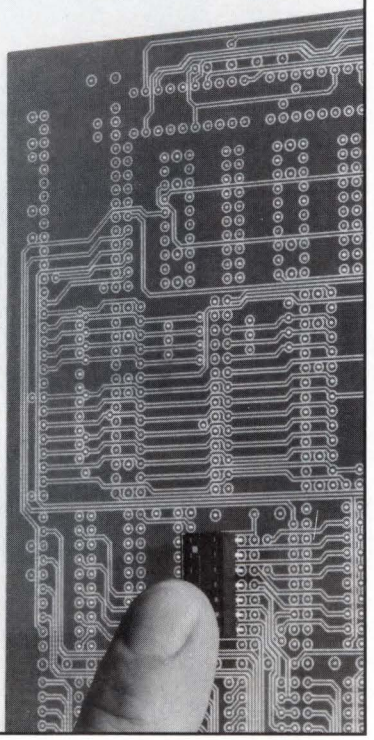

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CIRCLE NO 215

CALENDAR

Fourth Aerospace Computer Security Applications Conference, Orlando, FL. IEEE Computer Society, 1730 Massachusetts Ave NW, Washington, DC 20036. December 12 to 16.

Programming and Interfacing the IBM PC for Data Acquisition and Control (short course), Orlando, FL. Purdue University School of Engineering and Technology at Indianapolis, 799 W Michigan St, Indianapolis, IN 46202. (317) 274-0806. December 12 to 16.

US-Hong Kong Technology Business Conference, Hong Kong. Asian American Manufacturers Association, 800 Menlo Ave, Suite 115, Menlo Park, CA 94025. (415) 321-2262. December 19 to 23.

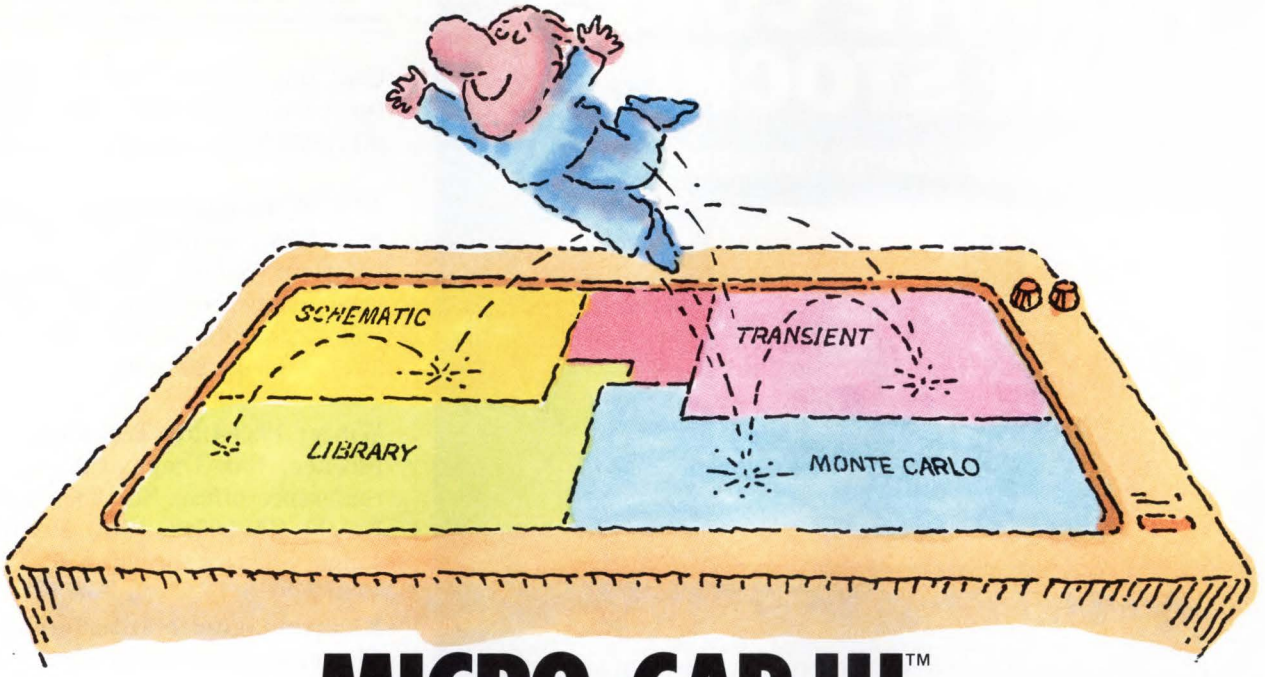
Real-time System Design: A Hands-on Workshop (short course), Washington, DC. John Valenti, Integrated Computer Systems, Box 3614, Culver City, CA 90231. (800) 421-8166; in CA, (231) 417-8888. January 10 to 13.

SC Global 89, San Francisco, CA. Superconductor Applications Association, 24781 Camino Villa Ave, El Toro, CA 92630. (714) 586-8727. January 11 to 13.

OE LASE '89, Los Angeles, CA. Society of Photo-Optical Instrumentation Engineering (SPIE), Box 10, Bellingham, WA 98227. (206) 676-3290; in Europe: SPIE, Koblenzer Strasse 34, D-5300 Bonn 2, West Germany, 49-228-36-15-46, TWX 172-283-747. January 15 to 20.

Fifth Annual Computer Graphics New York Show, NY, NY. Exhibition Marketing & Management Co, 8300 Greensboro Dr, Suite 110, McLean, VA 22102. (703) 893-4545. January 17 to 19.

The 1989 Optical Disk Systems Conference: From the Mail Room to the Board Room, Phoenix, AZ.



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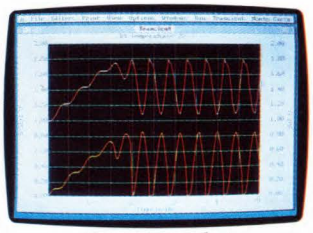
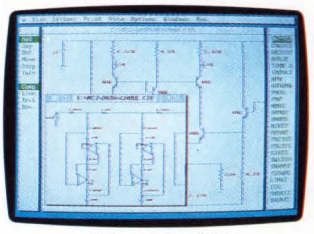
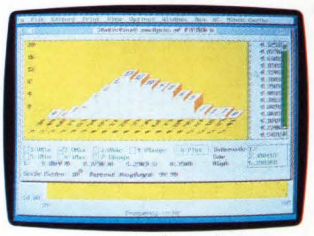


Transient analysis



Schematic editor



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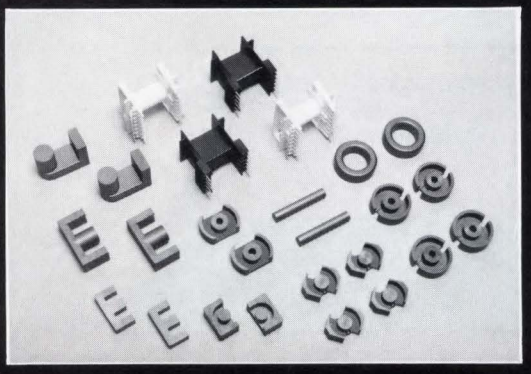

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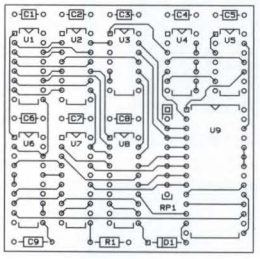

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CIRCLE NO 206

CALENDAR

CAP International Inc, 1 Longwater Circle, Norwell, MA 02061. (617) 982-9500. January 23 to 25.

ATE & Instrumentation Conference West, Anaheim, CA. MG Expositions Group, 1050 Commonwealth Ave, Boston, MA 02215. (800) 223-7126; in MA, (617) 232-3976. January 23 to 26.

Winter 1989 Unix Technical Conference, San Diego, CA. Usenix conference office, Box 385, Sunset Beach, CA 90742. (213) 592-1381. January 30 to February 3.

Electromagnetic Interference—Characteristics and Control (seminar), Center for Continuing Engineering Education, University of Wisconsin-Milwaukee, 929 N Sixth St, Milwaukee, WI 53203. (414) 227-3120. January 31 to February 2.

Power Electronic Conference '89, Santa Clara, CA. Conference Management Corp, 200 Connecticut Ave, Norwalk, CT 06854. (203) 852-0500. February 7 to 9.

Software Development '89, San Francisco, CA. Miller Freeman Publications, 500 Howard St, San Francisco, CA 94105. (415) 995-2471. February 14 to 17.

Compcon Spring 89 (34th IEEE Computer Society International Conference), San Francisco, CA. Kenichi Miura, Fujitsu America, 3055 Orchard Dr, San Jose, CA 95134. (408) 432-1300. February 27 to March 3.

Systems Engineering for Integrated Hardware/Software Applications (short course), Los Angeles, CA. John Valenti, Integrated Computer Systems, Box 3614, Culver City, CA 90231. (800) 421-8166; in CA, (231) 417-8888. March 7 to 10.

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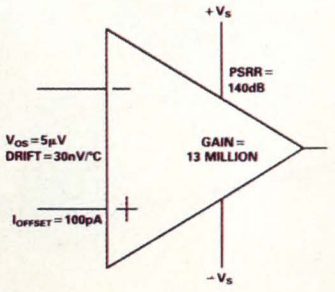
Dual Version Available: AD708



PRODUCT DESCRIPTION

The AD707 is a low cost, high precision op amp with state-of-the-art performance that makes it ideal for a wide range of precision applications. The offset voltage spec of less than 15μV is outstanding for a bipolar op amp, as is the 1.0nA maximum input offset current. The top grade is the first bipolar monolithic op amp to offer a maximum offset voltage drift of 0.1μV/°C, and offset current drift and input bias current drift are both specified at 25pA/°C maximum.

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The AD707 is available in versions specified over commercial, industrial and military temperature ranges. It is offered in 8-pin plastic mini-DIP, small outline, hermetic cerdip and hermetic TO-99 metal can packages. Chips and Mil Standard/883 parts are also available.

APPLICATION HIGHLIGHTS

1. The AD707's 13V/μV typical open-loop gain and 0.1μV/V typical common-mode rejection ratio make it ideal for precision instrumentation applications.
2. The precision of the AD707 makes tighter error budgets possible at a lower cost.
3. The low offset voltage drift and low noise of the AD707 allow the designer to amplify very small signals without sacrificing overall system performance.
4. The AD707 can be used where chopper amplifiers are required, but without the inherent noise and application problems.
5. The AD707 is an improved pin-for-pin replacement for the OP-07, OP-77 and the LT1001.

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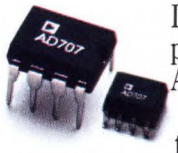

If your analog applications demand precision performance, then you should demand our new AD707 – the world's best dc precision op amp.

The AD707 is the first bipolar monolithic to offer a maximum offset voltage drift of only 0.1μV/°C, and 15μV maximum offset voltage. These features, combined with its ultralow 0.35μV p-p voltage noise, allow the AD707 to amplify extremely small signals without sacrificing system performance.

The AD707 also provides an open-loop gain of 13V/μV, which is the highest of any precision op amp, and unsurpassed 140dB CMRR and PSRR. So it's ideal for a wide range of precision applications, including instrumentation and automatic test equipment.

All this precision makes it easy for you to work within tight error budgets. And because the AD707 is available at a low cost, you can easily work within your design budget, too. Versions start at only $1.25 (in 100s).

For an even more accurate description of what the AD707 can do for you, call Applications Engineering at (617) 935-5565, Ext. 2628 or 2629.
Or write to Analog Devices, P.O. Box 9106, Norwood, MA 02062-9106.

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Signetics Microcontroller Profile

Microcontroller	ROM†	RAM†	Special Features	Timers	Serial Communications	I/O Port	Package	A
80C51/87C51	4K	128	All packages available	2 Std.	Full duplex UART	4 8-bit	40 DIP 44 LCC**	N
83C451/87C451	4K	128	7 Ports Mailbox Port 6	2 Std.	Full duplex UART	7 8-bit	64 DIP 68 LCC**	N
83C751/87C751	2K	64	Small package full performance	16-bit Autoload & fixed rate (2 total)	I²C*	2 8-bit 1 3-bit	24 SDIP 28 PLCC	1
83C652/87C652	8K	256	Pin for pin 80C51 compatible	2 Std.	Full duplex UART & I²C*	4 8-bit	40 DIP 44 LCC**	
83C552/87C552	8K	256	10 bit A/D conv.; 8 high speed outputs; 3 Compare/4 Capture registers 2 PWM outputs	2 Std.; Capture/Compare; Watchdog (4 total)	Full duplex UART & I²C*	6 8-bit	68 LCC**	
83C752/87C752	2K	64	8-bit A/D conv.; 1 PWM output	16-bit Autoload; fixed rate	I²C*	2 8-bit 1 5-bit	28 DIP 28 PLCC	

*Inter Integrated Circuit Serial Communications Bus
**LCC refers to availability in ceramic or plastic packaging
†In bytes

Macro choice–a first in micro control

Signetics CMOS microcontrollers–now you can choose an 80C51 derivative that fits your price/performance requirements.

Macro choice! You no longer have to accept less performance than your design requires, or be forced to use devices with more features and functionality than you need.

Signetics has more 80C51 derivatives than any other supplier. We make it easy for you to choose the device that most closely conforms to your specific needs.

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Only Signetics offers just the right type of program storage for your stage of production. Most of our 80C51 derivatives are available in UV EPROM versions for design-in and prototyping, OTP EPROM for low-volume production and masked-ROM for lowest cost at high volumes.

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Get your design under control now!
Call Signetics at (800) 227-1817, ext. 990D, for a free Microcontroller Information Packet. For surface mount and military product availability, contact your local Signetics sales office.

One standard. 0 defects.

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How the fa

Our new 7.5ns PAL® device is fast enough to prove that standard logic shouldn't set the standard anymore.

It's also fast enough to finally let today's new microprocessors run at the speeds for which they were designed—breathtaking.

Raising your standard.

How fast would you like your standard logic?

How about faster than any TTL logic around? Even FAST™ or AS? You've got it with the 7.5ns PAL device.

And the fact that you can configure it yourself means you can get exactly what you want.

If you want to redesign something, you change the PAL device. Not the board.

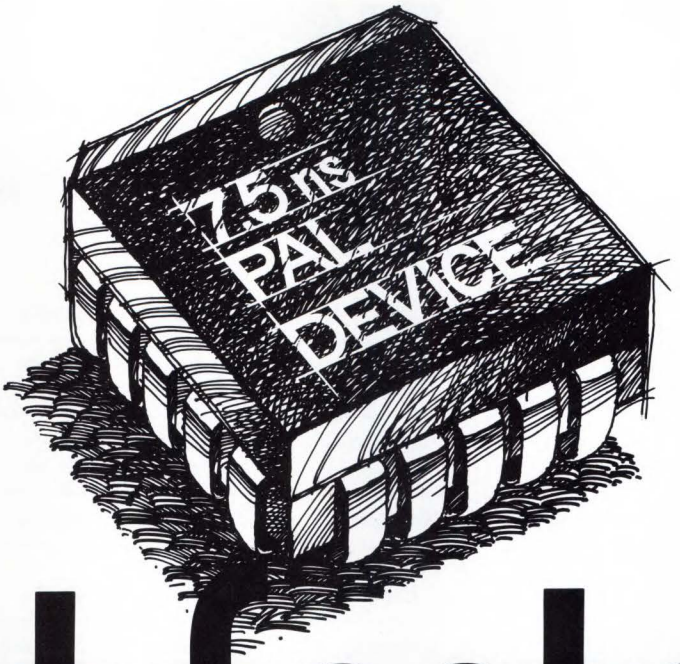
Not only is this the fastest way to get high speed logic, it's also the most practical. One 7.5ns PAL device replaces two to six standard TTL devices.

Which cuts down on board size.

And cuts down chances for a device failure.

7.5ns PAL Device vs. FAST & AS

SSI/MSI		FAST	AS	7.5ns PAL Device
Combinatorial				
74138 Decoder	tPD	8.0	10.0	7.5
74151 Mux	tPD	11.0	15.0	7.5
Register/Latch				
74374 Octal Register	tCO	10.0	9.0	6.5
74373 Octal Latch	tPD	8.0	6.0	7.5
	tLEO	13.0	11.5	7.5
Counters				
74161 Four bit Ctr	tS	5.5	8.0	7.0
	tCO	11.0	13.5	6.5
74269/869 Eight bit Ctr	tS	2.5	5.0	7.0
	tCO	10.0	11.0	6.5



st get faster.

What to give the microprocessor that has everything.

We suggest the first PAL device that can keep up with it.

The 7.5ns PAL device runs at 74 Mhz. It can deliver the speed the new high performance microprocessors need.

Processors like the 29K, the 386 and the 68030.

This PAL device delivers 25% more speed than any other PAL device.

We even have the fastest 22V10.

Our 15ns 22V10 runs at 50Mhz. That's 10ns faster than anyone else on the market. And it lets you run at twice the rate of the new 25Mhz microprocessors.

We've been shipping 20 pin 10ns PAL devices for eighteen months. And now you can get the new 24 pin 10ns PAL device as well.

There's plenty of service and support to get and keep your project moving. And all our fast PAL devices are available in volume when you need them. Now, for example.

For all the facts about our fast PAL devices, drop us a line. Or call us at (800) 222-9323.

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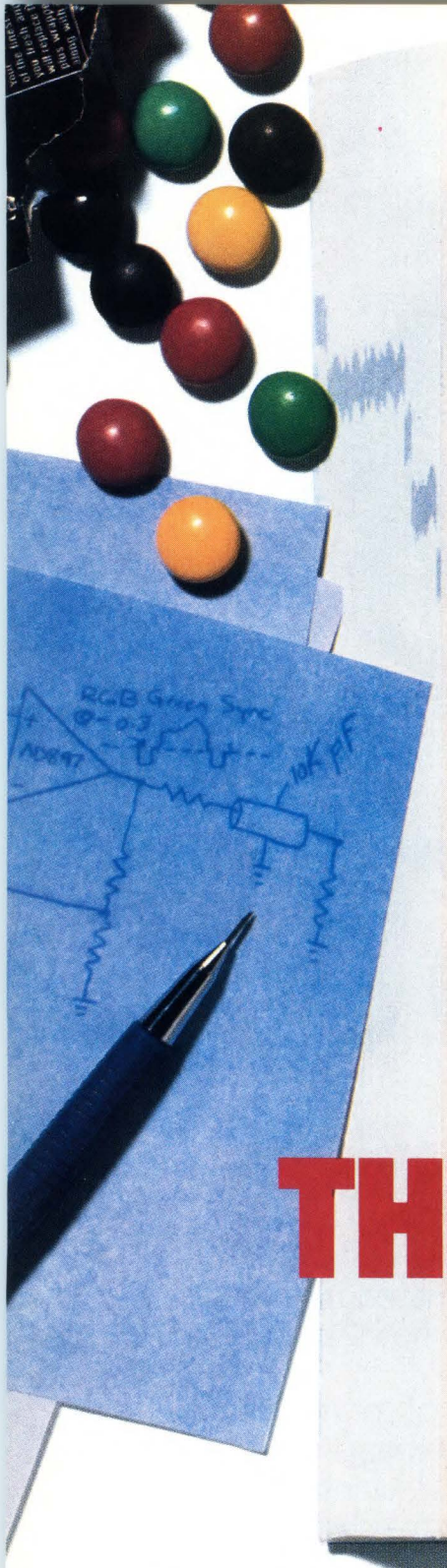


ANALOG DEVICES

AD840 Series

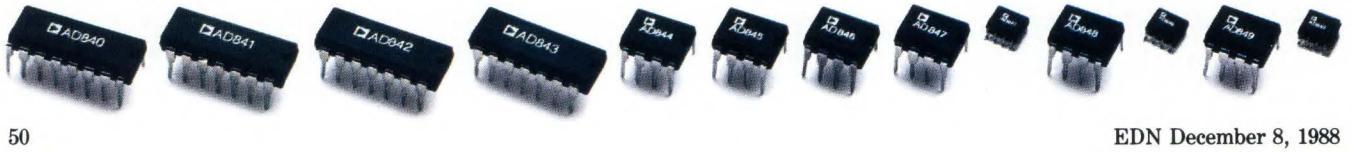
	AD840	AD841	AD842	AD843	AD844
Gain Bandwidth Min Stable Gain	400MHz 10	40MHz Unity	80MHz 2	35MHz Unity	60 to 430MHz Unity
Settling Time (10V Step)	100ns to 0.01%	110ns to 0.01%	100ns to 0.01%	110ns to 0.01%	100ns to 0.05%
Slew Rate	400V/μs	300V/μs	375V/μs	300V/μs	to 2,000V/μs
Quiescent Current (max)	12mA	12mA	14mA	12mA	6.5mA
Comments	HA2540 Improved Replacement	50mA min Output Current	100mA min Output Current	FET-Input, Replaces FET-Input Hybrids	Current Feedback, 2nV/√Hz Noise at 1kHz

THE REVOLUTION IN
STARTS RI

Introducing our AD840 Series with ten new op amps – and the start of a revolution. Because now you can go to just one vendor and get more high speed op amps with higher precision and lower power than from anywhere else.

The AD840 Series, which includes high accuracy, low noise, low cost, FET-input and current-feedback amps, is the result of a major breakthrough we've made in analog process technology. A breakthrough that has not only led to such diversity, but has also made each op amp a performance leader.

For example, several of the products in the AD840 Series offer gain-bandwidths greater than 400MHz, while others offer slew rates up to 2,000V/μs. And all AD840 products offer precision at high speeds, with unprecedented settling time performance as fast as 100ns to 0.01%





High Speed Op Amp Selection Guide

AD840 Series

AD845	AD846	AD847	AD848	AD849	
16MHz Unity	46 to 600MHz Unity	50MHz Unity	175MHz 5	750MHz 25	Gain Bandwidth Min Stable Gain
350ns to 0.01%	100ns to 0.01%	120ns to 0.1%	100ns to 0.1%	80ns to 0.1%	Settling Time (10V Step)
100V/μs	450V/μs	300V/μs	300V/μs	300V/μs	Slew Rate
12mA	6mA	5.7mA	5.7mA	5.7mA	Quiescent Current (max)
FET-Input, Drives Cap Loads	Current Feedback, 75μV max Offset Voltage	Excellent Flash ADC Buffer	Stable into any Cap Load	Low Noise Pre-Amp	Comments

HIGH SPEED OP AMPS GHT HERE.

(10V step) and offset voltage down to 75μV maximum.

This high performance isn't at the expense of power. In fact, each AD840 product consumes 25-50% less power than comparable amps, without sacrificing load drive current. Plus all parts operate with ±15V or ±5V supplies.

The high performance doesn't come at a high cost, either. You'll find that whether you use the AD840 Series op amps to bring a new standard of performance to your designs, or as replacements for industry standards, they're all competitively priced.

If you'd like more information on why the AD840 Series makes us the new revolutionary leader in high speed op amps, call your nearest Analog Devices sales office.

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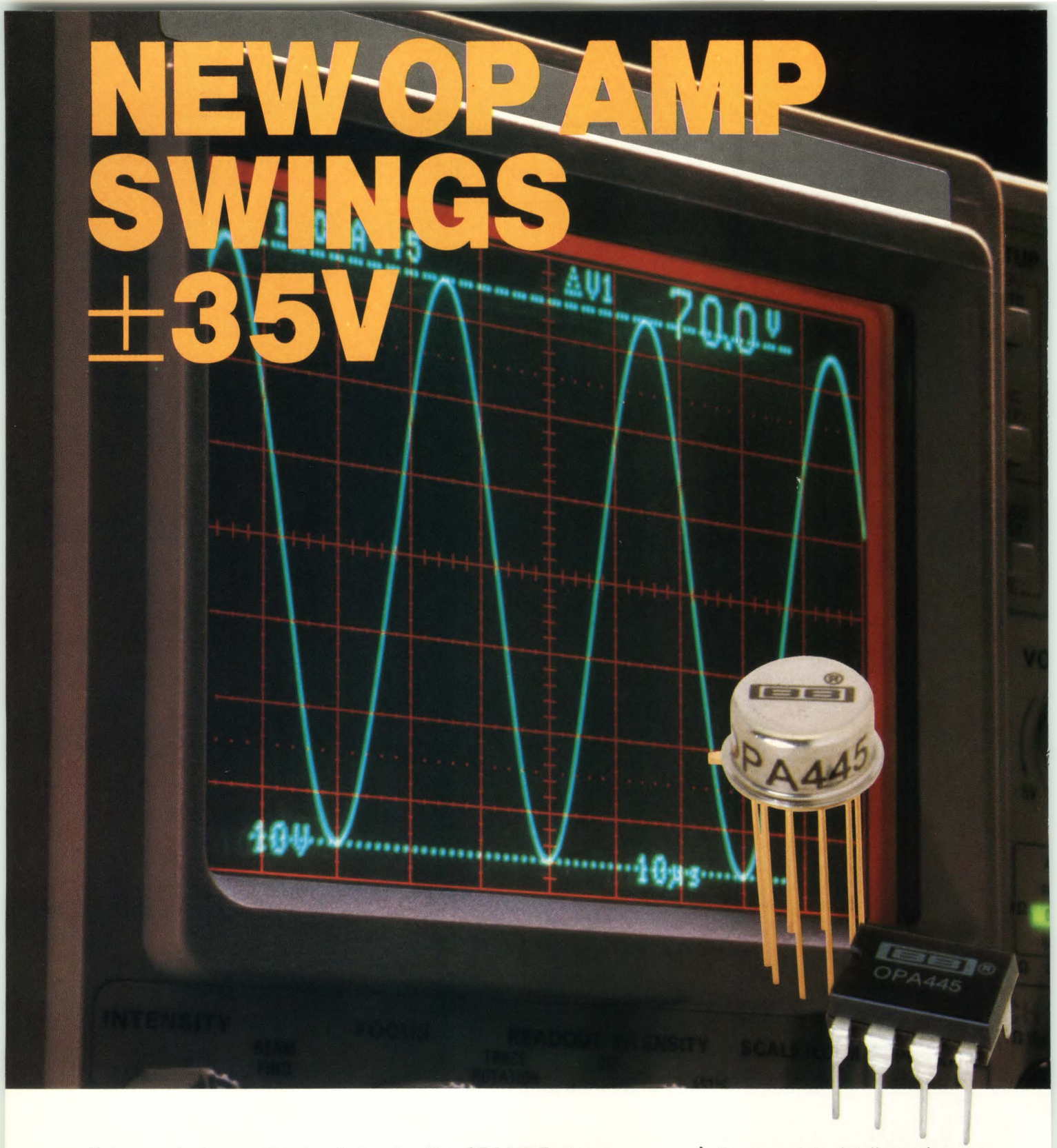
NEW OP AMP SWINGS ±35V



If you need a large voltage swing in a small package, try our new OPA445. Its compact size and voltage-handling ability make it an excellent device for ATE pin drivers, programmable power supplies, and controllers.

Key OPA445 Features

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- ±15mA min output
- 10V/µs slew rate
- Monolithic economy and reliability
- 50pA max bias current
- 80dB min CMR
- 8-pin plastic DIP or TO-99
- –25/+85°C or –55/+125°C models
- $3.80* each (OPA445AP)

For complete details on the new OPA445, call your Burr-Brown sales engineer or Applications Engineering, 602/746-1111. Burr-Brown Corp., P.O. Box 11400, Tucson, AZ 85734.

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*U.S. prices only, in 100s.

CIRCLE NO 200

MAXIM DESIGN NEWS

Analog Design Insights from Maxim Integrated Products December '88

New Power ICs Deliver Improved Performance

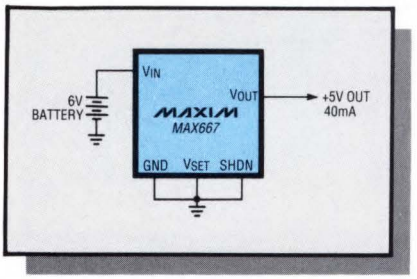
Ultra Low Quiescent Current Low Dropout Regulator

The new MAX667 complements Maxim's growing family of low quiescent current regulators. Its bipolar PNP output stage supplies up to 250mA and its minimum input-to-output voltage is no more than the PNPs saturation voltage. For example, the MAX667 can deliver 5V at 100mA with only 5.12V input. This is particularly useful in 5V systems powered from 5-cell NiCad or 3-cell lead-acid batteries.

The MAX667 PNP transistor's base current flows to ground and not through the load, therefore the IC includes circuitry which adjusts the base current as a function of the load to minimize quiescent current. The MAX667 also features a shutdown input which turns off the output and reduces the quiescent current to 1μA. A "Dropout" indicator goes high as the output PNP begins to saturate.

All of Maxim's regulators can be used either as 5V fixed output regulators with no additional components, or they can be adjusted from 1.3V to 16V using 2 external resistors.

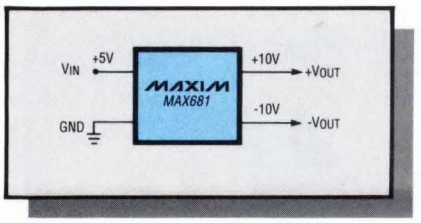
Maxim also makes the MAX666, which differs from the MAX667 in that the output transistor is an NPN. The base current of the NPN transistor is delivered to the load, and the MAX666 operating current is 10uA maximum, independent of output current. The minimum input-output differential voltage of the MAX666 is typically 0.9V at its maximum output current of 40mA. Both the MAX667 and MAX666 have an uncommitted 1.3V comparator for low battery warning.



- **0.12V Dropout Voltage At 100mA**
- **250mA Output Current**
- **Shutdown Control Input**
- **<1μA Shutdown Current**
- **10μA Quiescent Current**
- **Dropout Indicator**

+5 To ± 10V Charge Pump

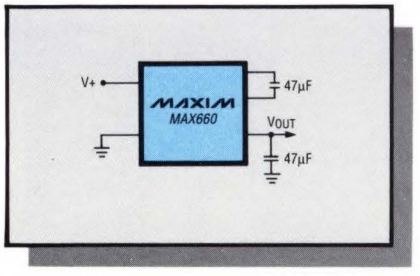
- **No External Components**
- **0.3" 14-pin DIP Package**
- **95% Voltage Conv. Eff.**
- **85% Power Conv. Eff.**
- **10mA Output Current**



100mA Voltage Inverter

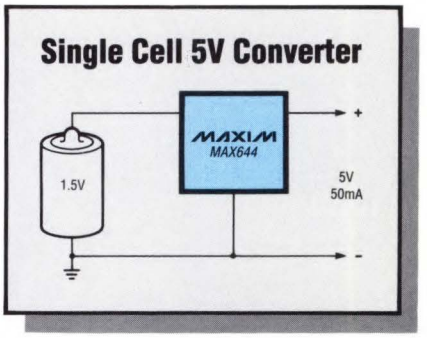
Due in early 1989, the new MAX660 has a typical output impedance of only 5Ω (10Ω max). With a 20mA load and a +5V input, the output voltage is -4.8V worst case and only drops to -4V (guaranteed) when 100mA is drawn. The MAX660 also has thermal shutdown which turns off the oscillator and output in the event of a short circuit. A control pin increases the switching frequency from 12kHz to 40kHz to reduce output ripple.

It is important to note that charge pump voltage inverters such as the ICL7660 and MAX660 do *not* have regulated outputs. Their open circuit output voltage is very nearly -(V_{IN}), but the output voltage is less when a load is applied. The ICL7660's output impedance is typically 55Ω and is guaranteed to be no more than 100Ω. This means that the MAX660 supplies 10 times more power than the ICL7760 with the same voltage drop.

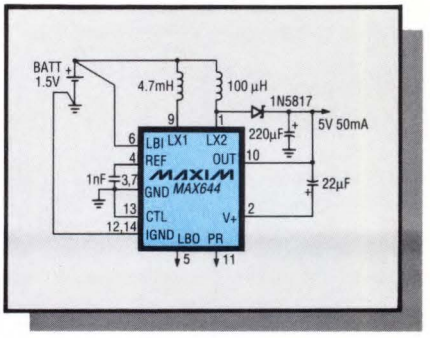


- **Pin Compatible with ICL7660**
- **100mA Output Current**
- **10 Ohm Output Impedance**
- **Charge Pump Uses No Inductors**
- **Adjustable Switching Frequency/Ripple**

Single Cell 5V Converter



The MAX644 efficiently generates a regulated 5V supply when only a very low voltage input, such as a single cell 1.3V battery, is available. The MAX645 is optimized for slightly higher inputs, as with two alkaline cells or one lithium cell. 50mA output current is supplied with minimal external components by employing a unique double-conversion technique (patent pending) where one micro-power boost converter generates 12V for the internal MOSFET switch of a second internal boost converter. This way the MOSFET receives adequate gate voltage for low on-resistance and typically 80% conversion efficiency.



A number of features are included in the MAX644 to minimize external components in battery powered applications.

1) A standby mode in which 5V can still be supplied at low current and where quiescent current drops to 80μA.

2) A low battery comparator output which goes low when the input battery voltage drops below 1.15V.

3) An internal 1.25 bandgap reference.

4) A "Control" input which allows the standby or high power mode to be activated by a switch or logic level.

5) A "Power Ready" output which goes high when the 5V output has reached its proper level after power-up or termination of standby.

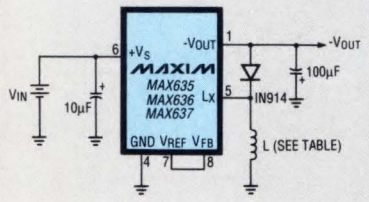
Easy-To-Use DC-DC Converters

Maxim's switching regulator ICs are designed for simple, minimum component count, high effficiency DC-DC converter circuits. All control functions are contained in compact 8-pin mini-dip or small outline packages. Low supply current (135µA typical) is ideal for battery powered applications.

The step-up and inverting ICs feature fixed pretrimmed ±5, ±12, and ±15 output voltages. If output voltages other than ±5, ±12, ±15 are required, the regulators can also be programmed with two external resistors.

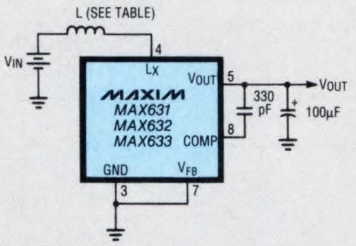
For the part number and manufacturer of inductors used in the circuits below contact MAXIM Applications at (408) 737-7600.

Inverters



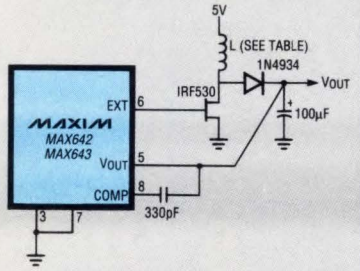
Maxim Part No.	VIN (V)	VOUT (V)	IOUT (mA)	Typ Eff (%)	L (µH)
MAX635	+3	-5	5	60	330
	+5	-5	25	76	330
	+9	-5	40	79	330
	+12	-5	45	85	470
	+15	-5	50	90	680
MAX636	+5	-12	12	74	330
	+9	-12	30	84	330
	+12	-12	40	89	470
MAX637	+3	-15	2	65	470
	+5	-15	8	77	330
	+9	-15	25	85	330

Step-Up Converters



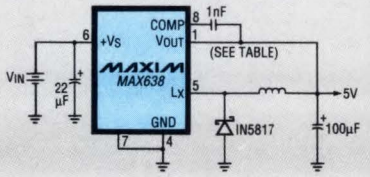
Maxim Part No.	VIN (V)	VOUT (V)	IOUT (mA)	Typ Eff (%)	L (µH)
MAX631	2	5	5	78	470
	2	5	10	74	220
	2	5	15	61	100
	3	5	25	82	470
	3	5	40	75	220
MAX632	3	12	5	79	330
	3	12	10	79	180
	5	12	12	88	470
	5	12	25	87	220
MAX633	3	15	5	73	220
	3	15	8	71	150
	5	15	10	85	470
	5	15	15	85	330
	8	15	35	90	470

Power Step-Up Converters



Maxim Part No.	VIN (V)	VOUT (V)	IOUT (mA)	Typ Eff (%)	L (µH)
MAX642	5	12	200	91	39
	5	12	350	89	18
	5	12	550	87	12
MAX643	5	15	100	92	39
	5	15	150	89	27
	5	15	225	89	18
	5	15	325	85	12

Step-Down Converters



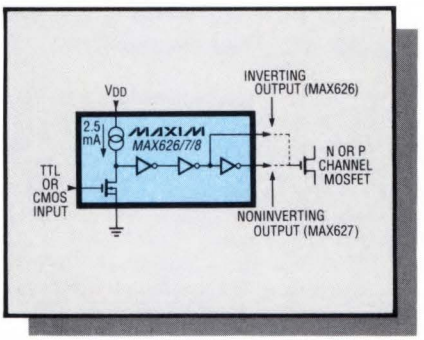
Maxim Part No.	VIN (V)	VOUT (V)	IOUT (mA)	Typ Eff (%)	L (µH)
MAX638	7-9.5	5	35	92	150
	8-9.5	5	55	89	150
	10-14	5	50	92	270
	12	5	60	92	270
	12	5	75	89	180

For **FREE** data sheets on MAXIMs Power Supply ICs, please note the following reader service numbers:

MAX631/2/3 (CIRCLE 10)	MAX641/2/3 (CIRCLE 13)	MAX663/4/6 (CIRCLE 16)
MAX635/6/7 (CIRCLE 11)	MAX644/45 (CIRCLE 14)	MAX667 (CIRCLE 17)
MAX638 (CIRCLE 12)	MAX660 (CIRCLE 15)	MAX681 (CIRCLE 18)

Fast Dual Power MOSFET Drivers

The MAX626/627/628 drivers for power MOSFETs are essentially very low output impedance inverters or buffers, optimized to quickly turn MOSFETs on and off. They are also useful wherever a CMOS buffer or inverter with a 4Ω output is needed. In addition to power FETs, these devices are often used to drive relays, charge pump circuits, and pulse generators.



- **Pin-for-Pin Replacement for TSC426/427/428, DS0026, and ICL7667**
- **4.5V to 18V Supply Range**
- **20ns Typ Rise and Fall Time into 1nF**
- **TTL/CMOS Compatible Input**
- **Drives N- and P-Channel MOSFETs**
- **8 Pin DIP and SO Packages**

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EDITORIAL

The other side of the EISA



Recently, a group of about 60 companies gathered to endorse the *idea* of an Extended Industry Standard Architecture (EISA) for personal computers. According to the group, which is led by Compaq Computer Corp, the EISA will offer PC buyers an alternative to IBM's Micro Channel Architecture (MCA) in high-end PCs. The EISA will offer compatibility with older PC/AT-type add-in boards while also providing a high-speed bus that challenges the performance of IBM's MCA bus. The EISA group adds that, unlike the MCA bus, its new bus will be "open," so that any manufacturer can use it without licenses or royalty payments.

Although the MCA bus isn't a big factor in the PC market yet, the bus is available now. In addition, IBM claims that there are about 500 boards available that take advantage of some MCA features. When given a choice between a real MCA-based computer and the promise of a new "open" architecture, few buyers will wait until mid to late '89 to buy an EISA-based computer. So, instead of creating another bus structure, computer manufacturers may be building a stronghold from which they can negotiate with IBM for a better MCA-technology licensing arrangement.

Keep in mind that for add-in board manufacturers, the MCA bus is open. By making seminar programs and technical documents available, IBM encourages board manufacturers to build boards for its MCA-based computers. Also, several companies now offer MCA-interface chips that ease the task of connecting circuits to the MCA bus. No licensing is needed to connect to the MCA bus.

The MCA technology, however, is closed to CPU or motherboard manufacturers, such as Compaq, Hewlett-Packard, Epson, Zenith, Tandy, and Wyse—many of whom support the EISA proposal. Those companies represent a large portion of the PC market, and they would benefit from a liberal licensing arrangement with IBM.

One of the key players in the EISA movement may be Intel, which pledges to supply an EISA-interface chip set. Announcing a new chip costs little and it lets a company test markets without having a product. Also, because Intel alone supplies the 80386 μP chip and will also be the sole supplier of the 80486 chip when it's produced, the company's participation in the EISA group could cause IBM to negotiate with the group. After all, Intel's μP chips form the heart of IBM's PC family. But remember that Intel manufactures its own PCs, so it would clearly gain something from IBM's loosened grip on MCA technology. It'll be interesting to watch the EISA consortium play its cards during the next year.



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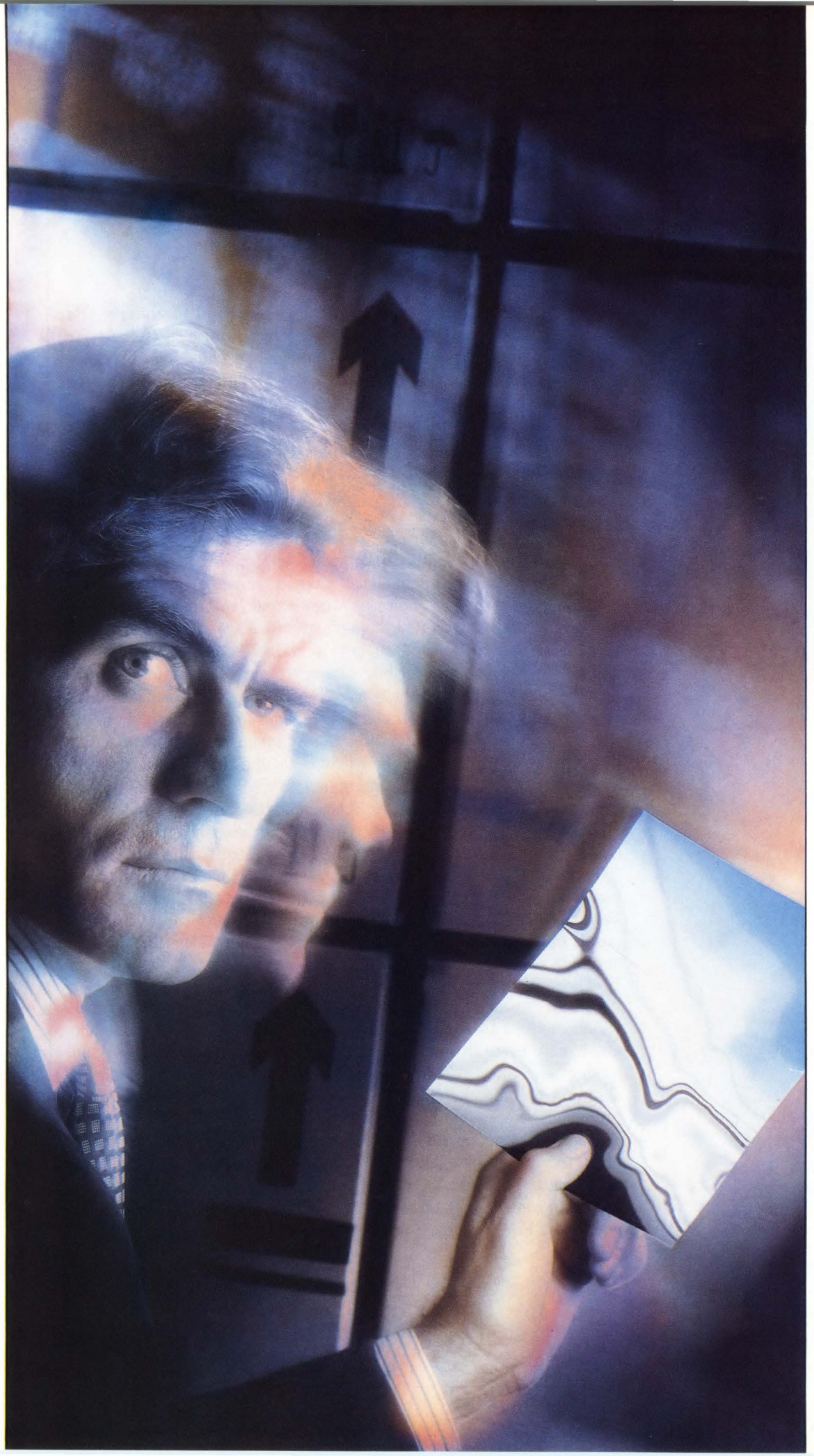
1977, 1976, 1975
American Society of
Business Press Editors Award
1988, 1983, 1981

Jon Titus
Editor



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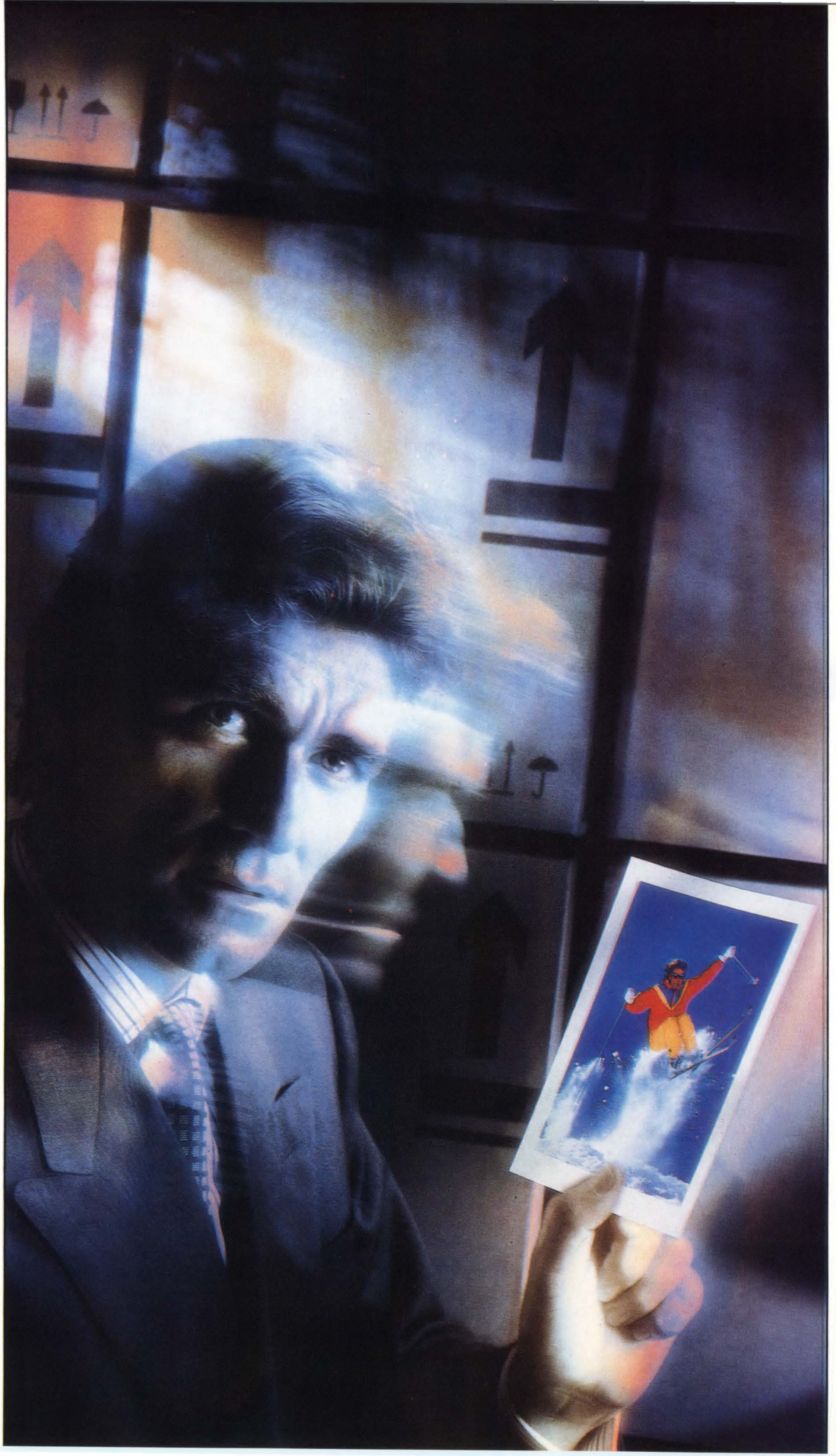
10 MILLION DOLLARS ON A PIECE OF PAPER



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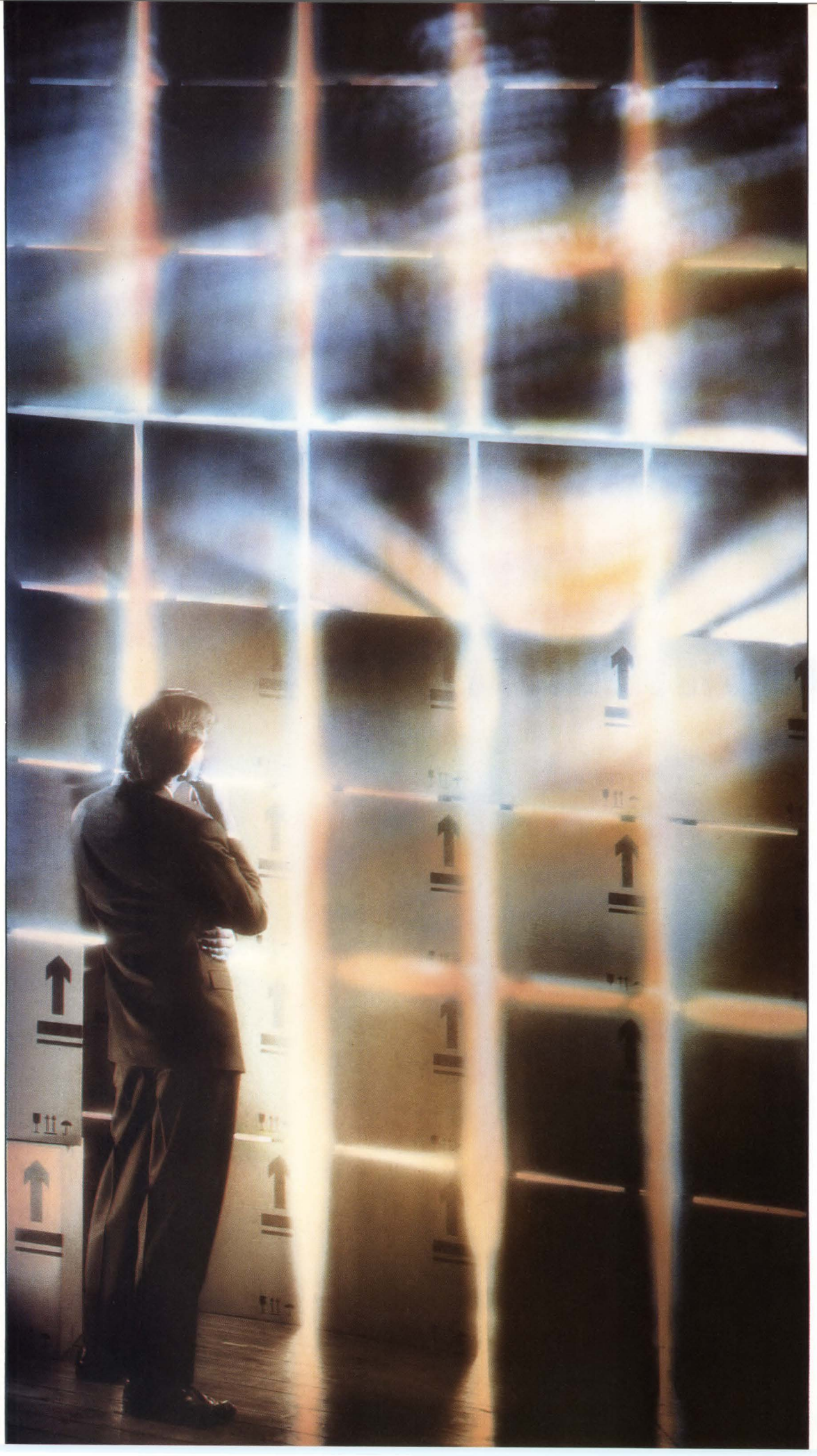
150,000 HOURS TO DEVELOP A PICTURE



NOW WILL

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We predict the big money will be in hardware.

But only if it's of a kind suited to the most advanced electronic media.

That's where ICI Imagedata is currently leading the way, with two very important developments.

The first is D*igital* Paper, the data storage equivalent of traditional paper. It's low cost, indelible and permanent. Yet, unlike paper, Digital Paper offers the areal capacity and recording advantages of optical disks.

One 12" reel made from this unique material holds up to two Terabytes of data (that's 2,000,000,000 Kbytes), on-line if you like.

YOU TAKE A SERIOUS LOOK AT THE FUTURE OF ELECTRONICS?

What's more, it's flexible. We can cut Digital Paper into disks of any size (one 5 1/4" disk provides 1.5 GB of data, fast). Chop it into tag form. Or use it as a tape for mass storage.

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It involves a colored ribbon for use in a thermal printer, plus a new receiver paper which won't tear, scratch, curl or run.

The process is called dye diffusion thermal transfer (D2T2 for short). It produces brilliant color images from an electronic source (video camera, computer, fax etc.). The final picture looks as good as a photographic print (with a choice of millions of colors for every dot), even though it's produced on a simple desk top printer.

So what will these materials mean to you, the hardware manufacturer, software developer or system integrator?

A great deal.

Potential markets for both are enormous . . . everything from data networking and logging, on- and off-line storage and recording to publishing, computer graphics and business presentations.

ICI Imagedata is already inspiring new designs of disk drives, tape drives and thermal printers.

In fact, ICI spends $2.5 million per day on research and development.

But your contribution in electronics will further improve the performance standards we've set. That's why we'd like to discuss the future with progressive hardware and systems developers.

For a detailed brief on the technology and media of the future, call Rick Lamb (D2T2) or David Owen (Digital Paper) toll-free at 1-800-456-3669.

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You'll learn in an hour what's taken us considerably longer to develop.

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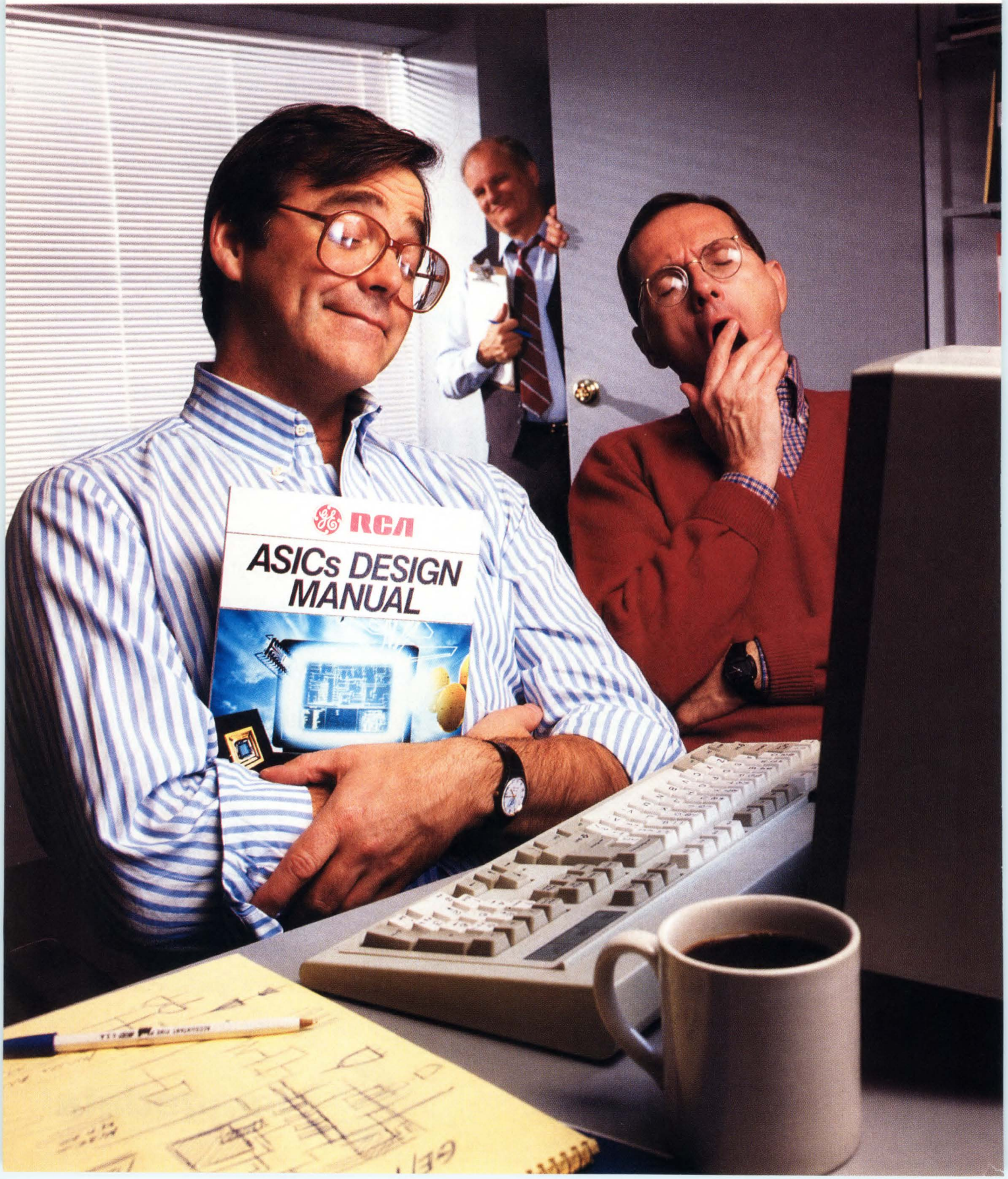
Our ASICs



are boring.

They're easy to design. They're ready on time. And first-time success is virtually 100%.

You've heard all about the excitement of ASICs.

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But, unfortunately, you've probably also heard about one big potential problem: while many ASICs pass the tests specified by the designer, they don't always work in the real world. And that causes excitement you can do without.

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You'll really appreciate the power of our standard cells, which allow you to integrate a whole system, including macros, memories, logic and peripherals, onto a single chip.

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You can choose from a wide range of Supercells, including the leading-edge RS20C51 core micro, RAMs, analog functions, bit-slice processors, HC/HCT logic, Advanced CMOS Logic, and high-voltage cells.

If they aren't enough, we can even generate Supercells to your specs.

And we're also in the forefront of silicon compiler technology. So we can offer you the ability to create designs that are heavily BUS-structured, with your ROMs, RAMs, PLAs and ALUs compiled right into the design.

We also bring you the resources of some very powerful partners, thanks to our alternate-source agreements with VLSI on standard cells; WSI on macrocells and EPROMs; and a joint-development agreement with Siemens and Toshiba on the Advancell® library of small-geometry cells.

Gate arrays, too.

If gate arrays are better for your design, you'll be able to choose from our full line up to 50,000 gates, with effective gate length as small as 1.2μ and sub 1 ns gate delays.

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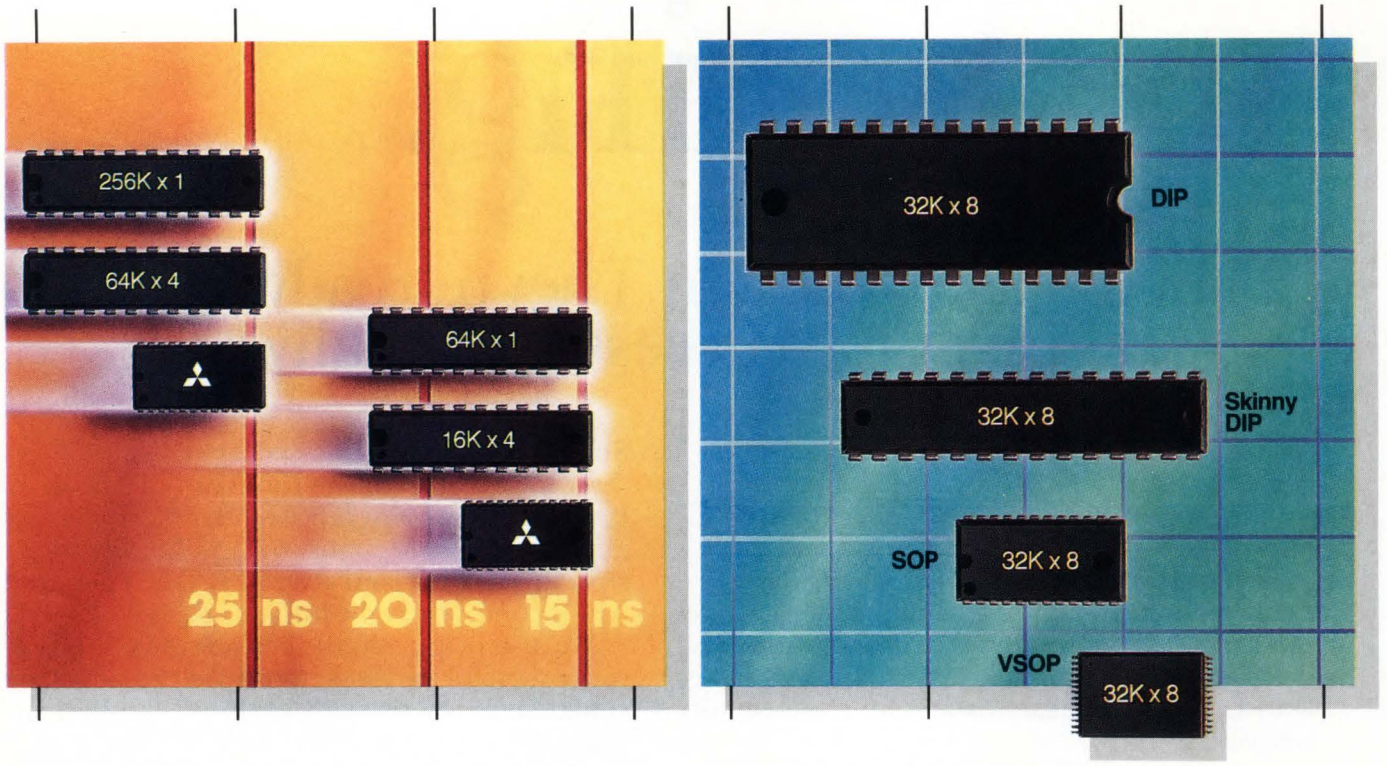

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25ns

And, for even faster systems, we're also introducing 15ns, 64K SRAMs.

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MITSUBISHI STATIC RAMS

DENSITY	ORGANIZATION	PART NO.	ACCESS TIME (ns) 15 20 25 35 45 55 70 85 100 120 150	PACKAGE OPTIONS* PDIP SOP SOJ VSOP
16K	16K x 1 4K x 4	M5M21C67 M5M21C68	■ ■ ■	■ ■ ■ ■
64K	64K x 1	M5M5187	■ ■ ■ ■ ■ ■	■ ■ ■ ■
	16K x 4	M5M5188 M5M5189 ($\overline{OE}$)	■ ■ ■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■
	8K x 8	M5M5178	■ ■ ■	■ ■ ■ ■
72K	8K x 9	M5M5179	■ ■ ■	■ ■ ■ ■
256K	256K x 1	M5M5257 M5M5260 ($\overline{OE}$)	■ ■ ■ ■ ■ ■	■ ■ ■ ■
	64K x 4	M5M5258	■ ■ ■ ■	■ ■ ■ ■
	32K x 8	M5M5255 (CS/$\overline{CS}$) M5M5256	■ ■ ■ ■ ■	■ ■ ■ ■ ■

*PDIP: Plastic DIP SOP: Small-Outline Gull-Wing SOJ: Small-Outline J-Lead VSOP: Very-Small-Outline-Package
Products subject to availability

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MITSUBISHI ELECTRONICS

CIRCLE NO 21

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VME Bus and Multibus II single-board CPUs host 33-MHz 68030 μPs and peripheral ICs

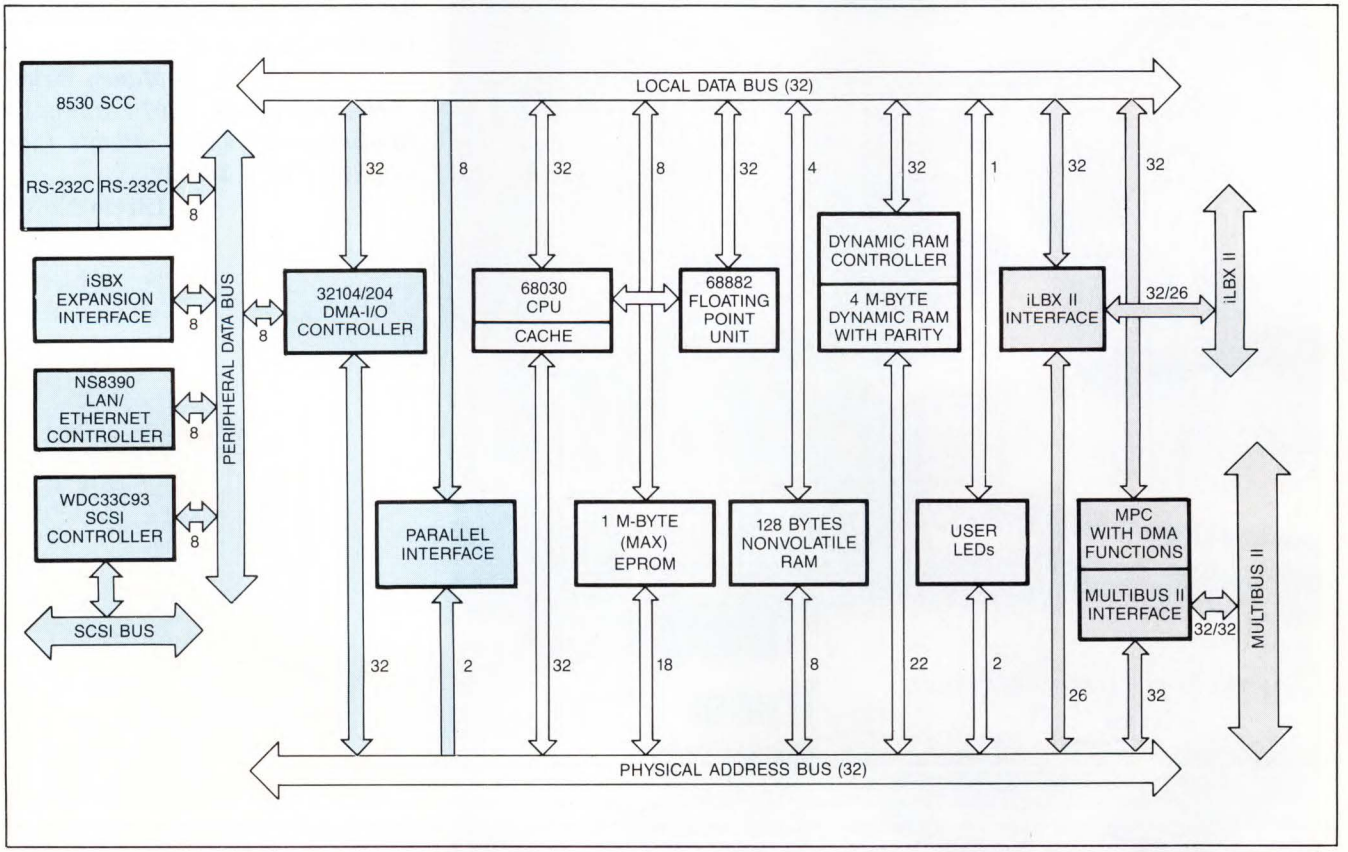
Featuring similar architectures, the HK68/V30XE VME Bus board and the HK68/M230 Multibus II board include 33-MHz 68030 μPs, memory, DMA controllers, and peripheral support chips. The boards target distributed-processing and real-time applications. Both boards also support the VRTX32 real-time operating system and Unix System V.3.

A 68882 floating-point unit, 4M to 16M bytes of static-column dynamic RAM, and two EPROM sockets make up the core of the CPU boards. The static-column dynamic RAM operates in burst mode to load the on-chip cache of the 68030. On consecutive reads, static-column memory eliminates memory-access delays caused by dynamic RAM precharge time. Therefore, the boards offer the memory bandwidth required by the 68030 μPs without using more expensive static RAMS.

In addition, each board includes two serial ports, a parallel port, a SCSI host adapter, an Ethernet controller, and a 4-channel, 32-bit DMA controller. The AT&T WE 32104 DMA controller includes a 16-byte buffer on each channel. The buffers handle mismatches in data width and minimize local- and system-bus usage. For example, the DMA controller accepts incoming data from the SCSI port in bytes and transfers it in 32-bit increments.

The design of the boards dedicates one DMA channel to the SCSI port, one to the Ethernet controller, and the remaining two are software configurable. The SCSI port employs the Western Digital WDC33C93 interface IC and supports both 1.5M-byte/sec asynchronous and 4M-byte/sec synchronous operation. Based on the National Semiconductor 8390, the Ethernet controller employs a 32k-byte static RAM buffer for data packets.

The Multibus II offering includes an interface to the iLBX and iSBX



***Message-passing support provided by the MPC IC** makes the HK68/M230 Multibus II CPU board suitable for use in multiprocessor Unix and VRTX32 applications.*

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If sensitive data is compromised, capabilities — even intentions — can be determined. Armed with this intelligence, an enemy would have the edge in a situation of conflict.

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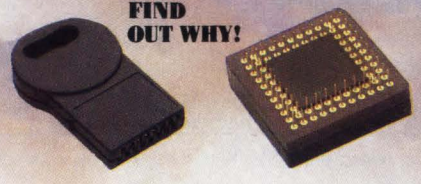

Tracor Ultron

Ultron Labs Corporation
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CIRCLE NO 213

UPDATE

auxiliary buses. You can connect additional 32-bit memory via the iLBX bus on the P2 connector. The 8-bit iSBX bus serves as an interface with other peripherals, and the MPC (message passing coprocessor) IC supports message passing in the Multibus II board.

Each board supports a number of industry-standard software packages, along with the VRTX32 and Unix System V.3 operating systems. Built-in Unix features include TCP/IP (Transmission Control Protocol/Internet Protocol) networking, the SUN NFS (network file system), and the AT&T RFS (remote file system). You can choose from C, Fortran, and Pascal programming tools. The boards also support BusLink software that enables networking via the system backplane and includes built-in-test and system-diagnostic software.

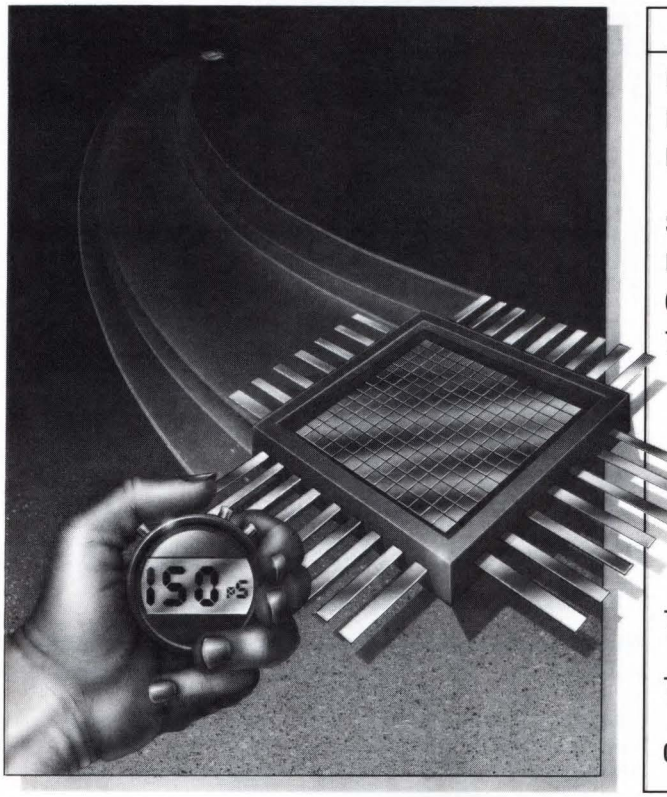
You can purchase the VME Bus HK68/V30XE for $3710 (100). The HK68/M230 Multibus II board costs $4760 (100) and will be available in the first quarter of 1989.

—Maury Wright

Heurikon Corp, 3201 Latham Dr, Madison, WI 53713. Phone (608) 271-8700. TLX 469532.

Circle No 630

SONY'S ECL GATE ARRAY TAKES ON GaAs SPEED.



SONY SPECL PERFORMANCE CHARACTERISTICS	
Process technology	1.2 μm rule
Number of metal layers	2
Number of equivalent gates	210 (3 gates per one internal basic cell)
Supply voltage	$-4.5\ V \pm 0.3\ V$
I/O interface	ECL 100K compatible
Output driveability	50Ω to −2V
Typical internal gate delay	150 ps/gate at IEF=400μ A, L=1 mm, fanin=fanout=1
Maximum toggle frequency of D−FF	2.5 GHz
Typical internal gate power dissipation	3.6 mW for 2-9 input OR/NOR normal output; 8.1 mW for DFF with normal output
Typical output buffer power dissipation	40.5 mW
Typical chip power dissipation	1.0 W (70 ORI3D's, 14 BUF2Y's)
Operating case temperature	0-85°C

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With Sony SPECL™ E3G200, you're ready to benefit with 150 psec/gate speed. In either 24 or 32-pin configurations.

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The #1 Smart Power under the Sun.

According to two leading independent research organizations,* one semiconductor manufacturer sells more smart power than any other by a substantial margin. The Brighter Power.™ SGS-THOMSON Microelectronics.

To those customers who have recognized the advantages of using the best selling smart power technology in the industry and accepted us as partners in the design process, we say "thank you."

To those who haven't yet, we simply ask you to take a look at the two best reasons under the sun for switching to SGS-THOMSON smart power. Multipower-BCD™ and VIPower.™

Two brighter smart power ideas.

Both Multipower-BCD and VIPower (Vertical Intelligent Power) technologies can integrate BIPOLAR, CMOS and DMOS on a single chip. By including power and control on one IC, we're helping customers cut costs and increase reliability. By using efficient MOS power transistors they're lowering dissipation, raising speeds and preventing secondary breakdown.

Unlimited power.

With Multipower-BCD, there's no limitation to the number of power transistors that can be integrated in output stages or to the way they're configured. That means Multipower-BCD gives designers the flexibility to integrate high side, low side, half bridge, full bridge and multiple drivers of any type.

Need higher voltage and current capabilities? SGS-THOMSON delivers with VIPower, an advanced technology that features true vertical current flow just like a power transistor, plus a choice of MOS or BIPOLAR output.

The freedom to succeed.

A long list of high performance smart power devices in two technologies means you can have it your way.

Want even greater flexibility? SGS-THOMSON comes through again with package innovations that have become widely acclaimed industry standards.

Here are just a few of the devices that have made The Brighter Power the number one smart power.

Motor Driving. L6114—Quad 100V DMOS, high voltage switching with 4 independently isolated power outputs.
Inductive Discharge Ignition. VB100—2KVA motor driving, control and protection circuitry all on a single chip.
Power Supplies. L6202—a 1.5A/45V bridge driver that needs no heatsink in a standard outline DIP package.
Automotive. L9801—a 25A high side driver with complete protection circuitry for inductive/resistive loads.

A brighter future.

SGS-THOMSON is not only working harder than the competition to develop new smart power products, we're working harder to keep our customers satisfied. We have the power to make you number one today, and we'll have it tomorrow.

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TEXAS INSTRUMENTS REPORTS ON HIGH-PERFORM IN THE ERA OF MEGACHIP™ TECHNOLOGIES

By any measure, TI responds to your design needs with the highest highs and the lowest lows.

Texas Instruments understands that process technology — not just innovative die design — is the difference between parity and a precise, high-performance solution for you. That's why we developed unique-performance op amp families in three processes: Enhanced JFET, LinCMOS™, and bipolar. Each delivers the specs you demand — the highest highs and the lowest lows.



ANCE OP AMPS

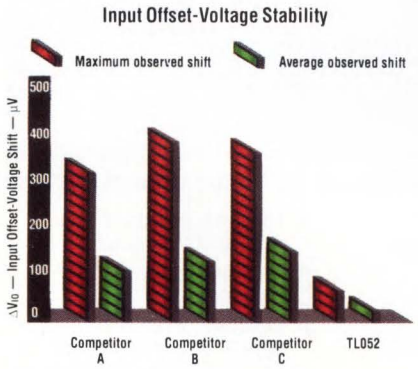
Our Enhanced JFETs achieve a 5X reduction in offset-voltage drift — from 300 μV to 60 μV.

TI's enhanced processing yields bipolar stability with the high slew rates and high input impedances you expect from a JFET.

In fact, TI's precision Enhanced JFET family delivers slew rates that range from 2.9 V/μs to 23.7 V/μs.

Because TI's unequaled stability is maintained over time and temperature variations (*see chart*), you eliminate the need for trim potentiometers. You decrease your costs, end periodic adjustments, and increase system reliability and accuracy.

This remarkably low offset-voltage stability is achieved without the use of a die overcoat or special assembly techniques. Yet TI's precision JFETs are pin-compatible and functionally compatible with industry-standard JFETs, so you can readily upgrade the performance and stability of your existing designs.



TI's Enhanced JFET op amps maintain extremely stable input offset voltage even after stress. (Unbiased plastic DIP units baked at 150°C for 24 hours.)

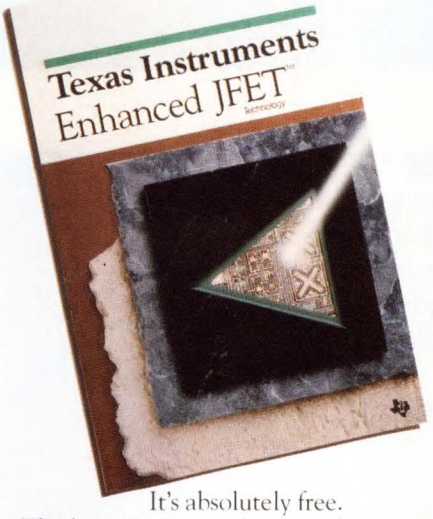
Value in two versions

To meet most commercial, industrial, and military applications, TI's precision Enhanced JFETs come in high-speed (TL05X) and low-power (TL03X) versions. Both are offered as single, dual, and quad devices.

Every member of TI's Enhanced JFET family is available in economical plastic DIPs, ceramic DIPs, surface-mount SO plastic packages, and leadless chip carriers. If you prefer metal cans, they are available, too.

Don't let this opportunity drift away — get TI's free design kit

If you would like to put TI's Enhanced JFETs to the test, we've put together a helpful evaluation and design kit.



It's absolutely free.

The kit contains a selection of plastic-packaged precision Enhanced JFETs and provides a risk-free opportunity to see how their stability measures up in your application.

To get your complimentary design kit, complete the return card and mail it back today.

TI's LinCMOS op amps: More good lows and highs in precision performance.

When your design requirements call for ultimate low-frequency (dc) performance, TI offers a broad range of LinCMOS op amps.

From low noise to low power or high gain, the newest additions to TI's LinCMOS family are:

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- **Low-noise op amps** (TLC2201/A) are the lowest-noise CMOS op amps available. They even beat any JFET.
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Like our Enhanced JFET family, our LinCMOS op amps come in a wide choice of packages, including plastic DIPs for the best possible cost/performance ratio.

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Space needs shrink with new 50-MIL connector system...

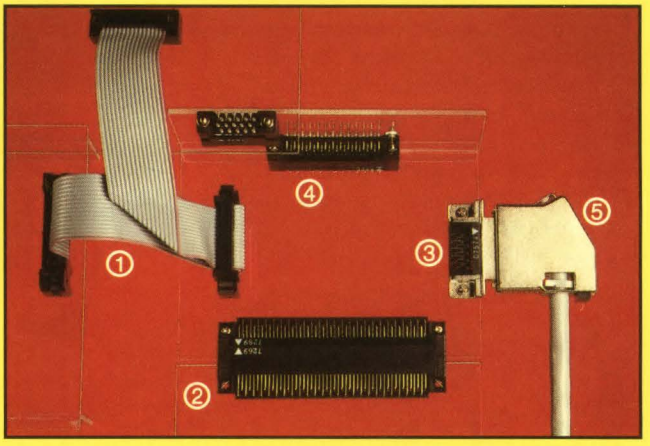


Actual size
100-MIL connector

The new Robinson Nugent PAK-50™ interconnect system replaces existing 100-MIL spacing with 50-MIL spacing, doubling your PC board connector density. You can now reduce the cost of your systems with smaller PC boards without decreasing I/O— or add more I/O without increasing board size.

RN PAK-50™ incorporates a dynamic contact interface, the male and the female contacts simultaneously deflect. This dynamic movement facilitates a high density/high pin count interconnect system with low insertion/ withdrawal forces, low contact resistance, high normal forces, and high wear resistance.

Investigate this cost saving, high reliability interconnect system today. The RN PAK-50™ system includes 2-piece PCB connectors, IDC flat cable connectors, and laminated or discrete wire I/O connectors—all in micro-miniaturized 50-MIL configurations.



This is the complete RN-PAK-50™ Interconnect System:

1. 2-pc. IDC cable connectors—50-MIL cable assures compatibility between .050″ and 100″ center technology.
2. 2-pc. horizontally mated connectors.
3. Right angle board mount I/O connector.
4. 2-pc. vertically mated connectors.
5. Discrete or laminated wire I/O connector with EMI shielded back shell.

CIRCLE NO 27

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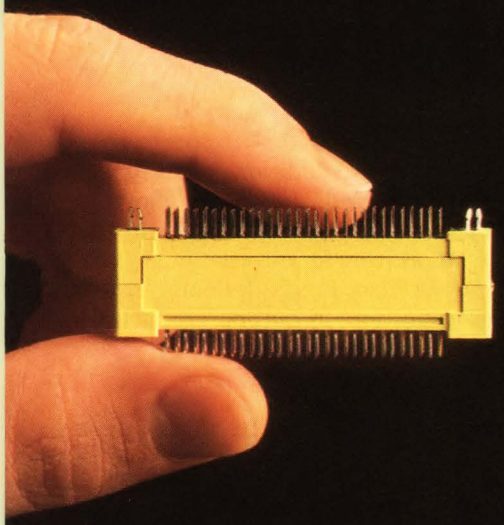
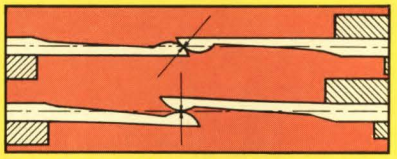


The RN "Partners in Quality" Team delivers new PAK-50™ connector system that shrinks needed board space by 50%!

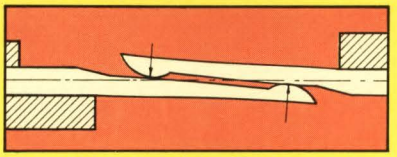
Actual size
PAK-50™ connector

THE RN PAK-50™ redundant ribbon contact is the key to the high reliability of the PAK-50™ interconnect system, providing a low 20 gram insertion force with high 100 gram minimum normal forces. As the RN PAK-50™ connectors are mated, the two straight beam contacts mate in the axial direction of the contacts. Both contact surfaces move together when mated so contact surfaces work together, not against each other. Because contacts are shrouded, they are protected from misalignment and pin damage is minimized.

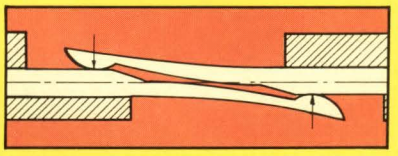
Write today for specifications and test data on the new RN-PAK-50™ micro-miniaturized connector system.



First stage mating—Smoothly curved tips of each contact meet and slide over each other's surface.



Second stage mating—Each curved contact tip wipes against the smooth tapered beam of the other contact.

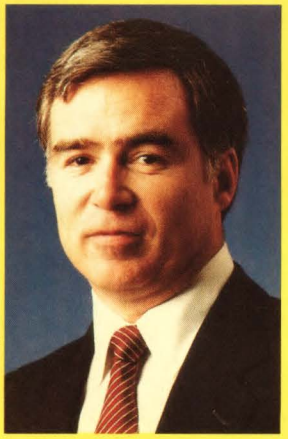


Third stage mating—Finally the mating point of each tip reaches the trunk of the other contact.

CIRCLE NO 28

"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 NO 29

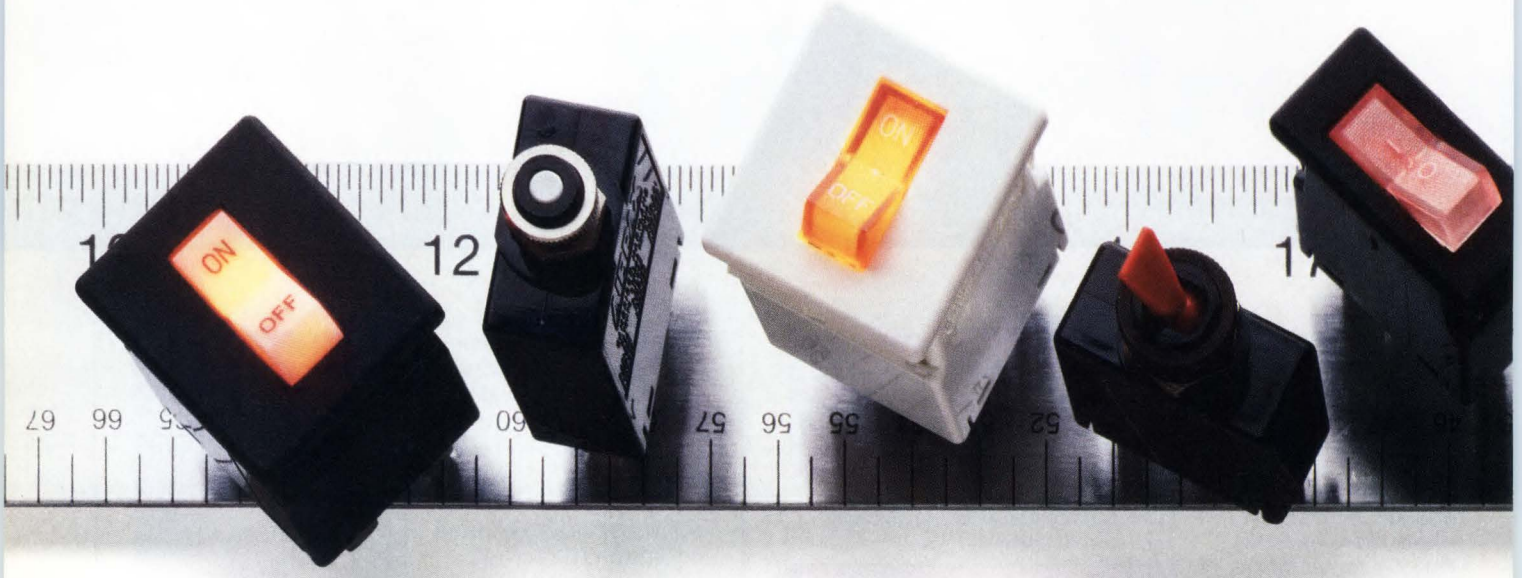
PQ The RN "P/Q TEAM"...your Partners in Quality

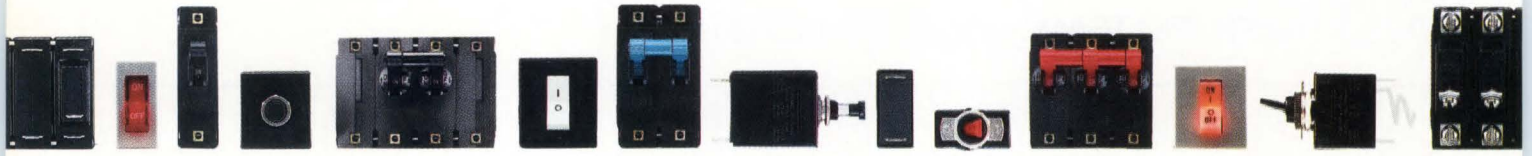
CHOICE
LA SELECCIÓN
LE CHOIX
LA SCELTA
DIE AUSWAHL
選択

For circuit breaker choice that's recognized throughout the world, Airpax has the answer. Our SNAPAK® circuit breakers are available with rocker, toggle, paddle, baton, push-pull or push-to-reset actuation. They offer you a wide choice of reliable, magnetic circuit protection to provide precisely the right style, configuration and rating for your designs.

For enhanced aesthetics in front-panel applications, the SNAPAK family includes paddle, rocker, and baton handles in seven attractive colors. Also available are illuminated rocker handles in LED or neon.

Compact SNAPAK circuit breakers are offered in single- and double-pole designs, in ratings and delays from 0.10 to 15 amperes, in either DC, 50/60 Hz or 400 Hz versions. In addition, a variety of mounting hardware and indicator plates allow vertical or horizontal mounting, with standard "on-off" or "I-O" imprinting for international designs. Reach out to world markets. Contact Airpax Company, Woods Road, Box 520, Cambridge, MD 21613. (301) 228-4600. A division of North American Philips Corporation. In Europe, contact N.V. Airpax S.A., Rue de la Bienvenue, 7-9, B-1070 Bruxelles. Phone: +32-2-526.29.11.

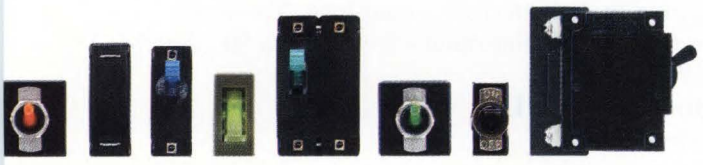




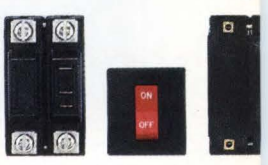
PROTECTION
LA PROTECCIÓN
LA PROTECTION
LA PROTEZIONE
DIE SICHERUNG
保護

For circuit breaker protection that's recognized throughout the world, Airpax has the answer. Our SNAPAK® circuit breakers are UL recognized and CSA certified, and include many versions that are SEV approved, VDE approved, and meet IEC spacing requirements. They offer reliable, magnetic circuit protection in the most compact breaker design worldwide. SNAPAK snap-action ensures greater lifespan, withstanding shock, vibration and temperature fluctuations from -40°C to +85°C. SNAPAK circuit breakers are also trip free, protecting against overload even when forcibly held in the "on" position. Reach out to world markets. Contact Airpax Company, Woods Road, Box 520, Cambridge, MD 21613. (301) 228-4600. A division of North American Philips Corporation. In Europe, contact N.V. Airpax S.A., Rue de la Bienvenue, 7-9, B-1070 Bruxelles. Phone: +32-2-526.29.11.





AIRPAX®
CAMBRIDGE DIVISION



READERS' CHOICE

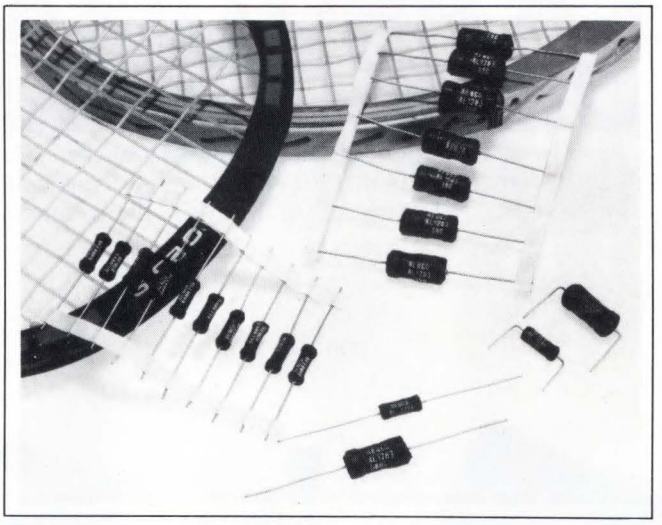
Of all the new products covered in EDN's **August 4, 1988,** issue, the ones reprinted here generated the most reader requests for additional information. If you missed them the first time, find out what makes them special: Just circle the appropriate numbers on the Information Retrieval Service card, refer to the indicated pages in our **August 4, 1988,** issue, or use EDN's Express Request service.

CONTROLLER IC

The 66470 video and system controller IC, used in conjuction with the company's 68070 μP, allows you to build a complete 16/32-bit processing and color display system using as few as 10 ICs (pg 83).
Philips.
Circle No 736
Signetics Corp.
Circle No 737

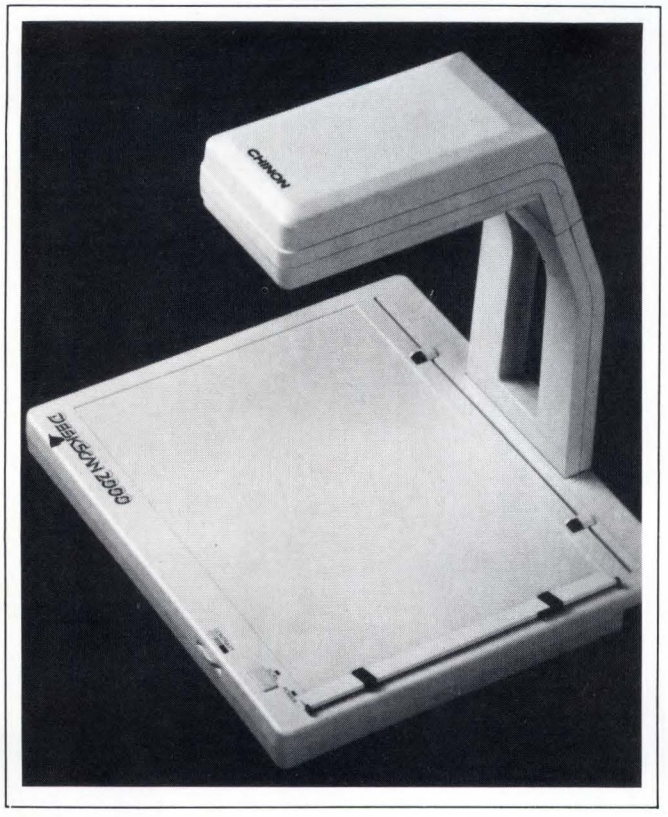
DSP DESIGN TOOL

The Monarch menu-driven, DSP design tool provides a user interface with pull-down menus and on-screen help (pg 246).
The Athena Group Inc.
Circle No 732



▲ LINE CHOKES

The RL1283 and RL1284 Series compact power-line chokes are UL-recognized devices that employ high-saturation core material, which allows them to accommodate high current levels (pg 233).
Renco Electronics Inc.
Circle No 735



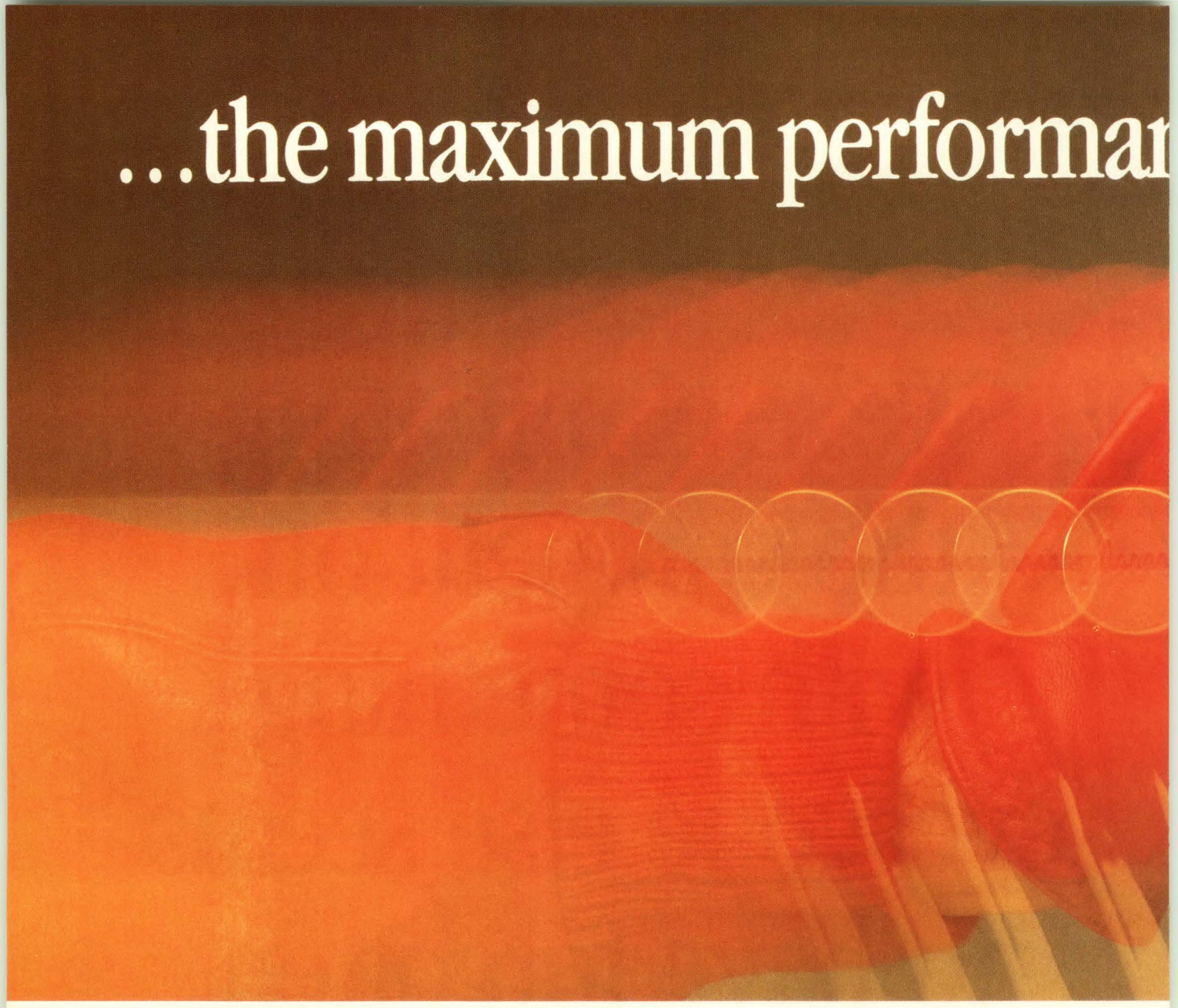
CALCULATOR

The HP-32S RPN (reverse-Polish-notation) scientific calculator solves equations repeatedly without re-entry and uses loops, tests, and flags to make logical decisions (pg 243).
Hewlett-Packard Co.
Circle No 733

◀ IMAGE SCANNER

The Deskscan 2000 image scanner performs overhead scanning in ambient light conditions. The user-selectable resolution ranges from 100 to 200 dots/in. (pg 237).
Chinon America Inc.
Circle No 734

We're eliminating the competition with something everyone else seems to have forgotten you need...



Plessey - Unsurpassed Process Technology

As system design becomes more and more challenging, and product life cycles become increasingly shorter, design flexibility and getting it right the first time have become critical factors in gaining and maintaining that maximum performance edge you've been looking for.

Plessey's investment in advanced process technology is unequaled in the industry. Successive reductions in feature size and continued improvement in process techniques are at the heart of leading-edge Plessey products.

Plessey - The Ultimate in ASIC Technology

Our broad range of ASIC products has grown to the point where we are now able to meet all the needs of ASIC users. We offer a full ASIC product range with a variety of options for digital, analog and mixed analog/digital applications, in gate arrays, standard cells, and full-custom. Advanced, state-of-the-art processes in fine geometry, high-density CMOS, bipolar and ECL technologies give you the highest levels of performance and system integration available today.

Plessey - Unparalleled CAD Support

The Plessey Design System (PDS) is a comprehensive suite of software embracing the design, simulation and implementation of gate arrays, standard cell and compiled ASICs in CMOS and bipolar technologies.

Customers who want to use their own CAD workstations or simulators are accommodated by flexible design interfaces at various stages into PDS.

Plessey - Standard Products And Discrete Components

Plessey's standard product family offers the highest performance product range available in the world today. Capabilities range from CMOS DSP devices operating in excess of 20MHz to the world's most advanced 1.3GHz monolithic log amplifier.

High performance solutions are also offered in radio communications, digital

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nce that gives you the edge.



PLESSEY KEY PROCESS TECHNOLOGY

BIPOLAR

DESCRIPTION	F_t	EMITTER WIDTH	METAL LAYERS
Industry standard	400MHz	14μm	1
High voltage	400MHz	20μm	1
High speed linear	4.5GHz	4μm	2
High speed digital	6GHz	3μm	2
Ultra-high speed	14GHz	0.6μm	3

MOS

PROCESS FAMILY	fCLOCK	MINIMUM FEATURE	VSUPPLY
KC Industry standard CMOS	20MHz	4μm	3-10V
JG Double SiGate NMOS	10MHz	6μm	9-18V
VB High speed CMOS	40MHz	2μm	3-5V
VJ Very fast CMOS	50MHz	1.5μm	3-5V
VQ Ultra fast CMOS	75MHz	1.2μm	3-5V
MH/MA SiGate CMOS	30MHz	4μm	3-15V

BIPOLAR (CDI)

PROCESS	EMITTER WIDTH/ FEATURE SIZE	GRID PITCH	MAX. SPEED	MAX. POWER	MIN. POWER
ORIGINAL CDI	5μm				
CDI FAB I	3.75μm	11.5μm	10ns	2.4pJ	1.5pJ
CDI FAB IIa	2.5μm	8μm	4ns	1.2pJ	0.8pJ
Geometry change (utilizing multi-level differential logic-DML)					
CDI FAB IIb	2.5μm	8μm	800ps	0.8pJ	0.54pJ
CDI FAB III	1.5μm	6μm	400ps	0.4pJ	0.27pJ
CDI FAB IV	1.2μm	4.5μm	200ps	0.2pJ	0.14pJ

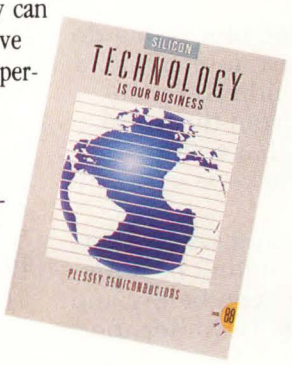
frequency synthesis, data conversion, telecommunications, data communications and consumer products.

Complementing the standard IC family, Plessey manufactures a complete line of discrete components including FETs, transistors and diodes available in SOT-23 and TO-92 packages.

Plessey - Over Two Decades Of Quality Commitment

For more than 20 years, Plessey Semiconductors has been commited to supplying the latest technology, highest quality, and highest performance semiconductor products in the industry. With our unique combination of CAD support, major advances in process technology, and the most advanced research facility in the world, Plessey Semiconductors is, today, a totally commited leader in the industry.

To learn more on how Plessey can help you achieve the maximum performance that gives you the edge, send for our new comprehensive, full color, 72-page short form brochure, or call Plessey Semiconductors today.



In North America call 1-800-441-5665. Outside North America call 44-793-726666.

For further information you can write to us at one of the following addresses:

Plessey Semiconductors
1500 Green Hills Road
Scotts Valley, CA 95066
U.S.A.

Plessey Semiconductors Ltd.
Cheney Manor, Swindon
Wiltshire SN2 2QW
United Kingdom

PLESSEY

Number 1 for ASICs

CIRCLE NO 31

This chip enabled us to process signals of the past.



The Rosetta Stone, discovered in 1799, was the key to deciphering the hieroglyphics that had been incomprehensible for centuries.

Signal processing, when you come right down to it, is multiplication, addition, subtraction and storage. Doesn't sound very exciting.

But put together a set of building blocks that do those simple operations with almost unimaginable digital speed and precision. Then add A/D converters that bring in information from the world around you. Plus D/A converters that restore the digitally processed signals to a form your senses can understand.

And you've built a signal processing system that will enable you to do things that couldn't be done before, see things that couldn't be seen before and understand things that could never be understood before.

That's exciting. And we can help make it happen.

Complete systems solutions.

Our approach to signal processing is simple.

We've taken our unparalleled experience in data conversion and added to it a set of signal processing chips that perform operations that used to require entire circuit boards.

Here's a sample of what they can do for you:

ISP 9110 12-Bit Microprogram Sequencer: expanded 33 word stack, 50 ns minimum cycle time.

ISP 9119 FIFO RAM Controller: uses standard RAMs to build FIFOs up to 64K deep, 15 MHz operation.

ISP 9128 FIR Filter Controller: implements 16-bit filters to 128 Taps, 128 Tap sampling rate of 100kHz.

ISP 9210 16x16 Multiplier Accumulator: innovative high-speed architecture (65 ns commercial, 75 ns military), low-power operation.

ISP 9216 16x16 Multiplier: low-power, industry-standard compatible to AM29516 and MPY016.

ISP 9520/21 Pipeline Register: high-speed access,

These are the chips you need to process signals of the future.

Our DSP building blocks, combined with our data conversion know-how, will help you design systems that depict reality more clearly than ever before possible.



output selectable from any register.

With devices like these, we can give you a total integrated signal processing solution. Plus the added benefits of single-vendor support and package pricing.

Position yourself for the future.

Signal processing is changing every day.

That's why you need more than a signal processing supplier who has a few good parts.

You need a long-term partner who has a commitment to signal processing, and the resources in every area that signal processing calls upon.

For example, the chips of tomorrow will very likely combine signal processing, data conversion and high-speed logic. When you work with us, you'll get our Intersil expertise in processing and conversion. Plus our RCA Advanced CMOS Logic capabilities. Plus the more than 20 years of GE experience in radar, sonar, medical imaging and other demanding DSP applications.

If worries about complexity and cost have deterred you from taking the exciting step into digital signal processing, call us. Together, we'll step into the future.

For more information, contact your local GE Solid State sales office or distributor. Or call toll-free, 800-443-7364, extension 30.

In Europe, call: Brussels, (02)246-21-11; Paris, (1) 39-46-57-99; London, (276) 68-59-11; Milano, (2) 82-291; Munich, (089) 63813-0; Stockholm (08) 793-9500.

General Electric Company, U.S.A.

GE/RCA/INTERSIL
SEMICONDUCTORS

LEADTIME INDEX

Percentage of respondents

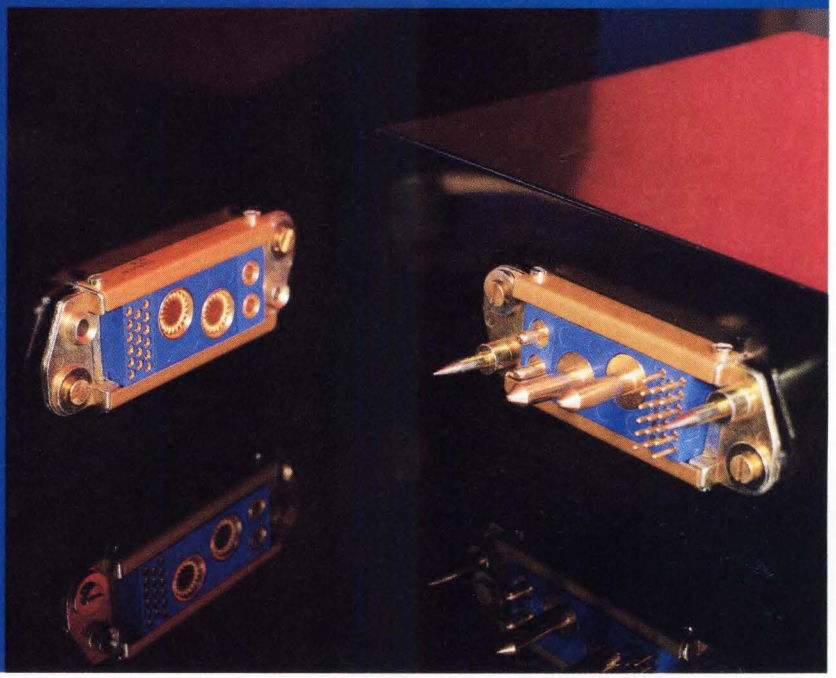
ITEM	Off the shelf	1-5 weeks	6-10 weeks	11-20 weeks	21-30 weeks	Over 30 weeks	Last month's average (weeks) Average (weeks)	
TRANSFORMERS								
Toroidal	6	28	38	28	0	0	8.2	9.5
Pot-Core	0	13	43	38	0	6	11.5	9.5
Laminate (power)	0	30	43	27	0	0	8.5	7.1
CONNECTORS								
Military panel	0	17	50	33	0	0	9.6	3.6
Flat/Cable	20	56	16	8	0	0	4.2	5.5
Multi-pin circular	8	15	46	23	8	0	9.7	6.9
PC (2-piece)	12	29	35	24	0	0	7.3	5.6
RF/Coaxial	10	40	20	30	0	0	7.4	7.1
Socket	25	50	21	4	0	0	3.8	3.9
Terminal blocks	13	54	25	8	0	0	4.8	4.4
Edge card	13	39	35	13	0	0	5.9	6.1
D-Subminiature	20	52	24	4	0	0	4.1	5.0
Rack & panel	7	27	39	27	0	0	8.1	6.6
Power	18	29	41	12	0	0	6.0	5.1
PRINTED CIRCUIT BOARDS								
Single sided	0	54	46	0	0	0	5.3	4.3
Double sided	0	44	50	6	0	0	6.2	5.9
Multi-layer	0	22	78	0	0	0	6.8	8.0
Prototype	0	92	8	0	0	0	3.4	3.6
RESISTORS								
Carbon film	41	34	19	6	0	0	3.4	4.6
Carbon composition	48	28	14	7	3	0	3.8	3.5
Metal film	34	37	20	9	0	0	4.1	5.0
Metal oxide	15	45	35	5	0	0	4.9	5.4
Wirewound	17	39	37	7	0	0	5.2	6.8
Potentiometers	24	35	29	12	0	0	5.2	7.1
Networks	30	40	20	10	0	0	4.3	6.1
FUSES	50	36	14	0	0	0	2.2	3.5
SWITCHES								
Pushbutton	13	54	29	4	0	0	4.5	5.1
Rotary	13	27	30	30	0	0	7.8	6.3
Rocker	17	35	35	13	0	0	5.8	6.6
Thumbwheel	11	26	26	32	5	0	9.0	6.9
Snap action	10	35	30	25	0	0	7.3	8.7
Momentary	14	38	38	10	0	0	5.7	6.0
Dual-in-line	24	24	34	18	0	0	6.2	4.8
WIRE AND CABLE								
Coaxial	25	39	36	0	0	0	4.0	4.6
Flat ribbon	36	42	18	4	0	0	3.3	3.5
Multiconductor	25	38	34	3	0	0	4.3	3.8
Hookup	38	38	24	0	0	0	3.0	3.3
Wirewrap	32	42	21	5	0	0	3.7	2.9
Power cords	23	50	19	8	0	0	4.2	6.8
POWER SUPPLIES								
Switcher	10	24	37	24	5	0	8.6	5.5
Linear	35	29	12	18	6	0	6.1	5.7
CIRCUIT BREAKERS	18	24	24	34	0	0	7.9	7.5
HEAT SINKS	26	48	17	5	4	0	4.5	5.3
BATTERIES								
Lithium coin cells	13	33	40	7	7	0	7.0	5.5
9V alkaline	38	31	31	0	0	0	3.4	4.3
Real-time clock back-up	10	40	40	0	0	10	7.4	5.7
RELAYS								
General purpose	17	31	31	21	0	0	6.6	5.9
PC board	17	27	28	28	0	0	7.3	7.4
Dry reed	7	39	40	7	7	0	7.2	7.3
Mercury	18	27	36	10	9	0	7.5	7.3
Solid state	8	45	31	8	8	0	7.1	9.5
DISCRETE SEMICONDUCTORS								
Diode	36	25	20	19	0	0	5.2	7.4
Zener	34	28	19	16	3	0	5.6	8.8
Thyristor	27	14	27	27	5	0	8.0	6.9
Small signal transistor	36	32	21	11	0	0	4.3	7.2
MOSFET	17	22	33	28	0	0	7.6	6.4
Power, bipolar	27	13	47	13	0	0	6.1	6.1
INTEGRATED CIRCUITS, DIGITAL								
Advanced CMOS	16	32	26	26	0	0	7.0	7.6
CMOS	24	34	28	14	0	0	5.4	8.7
TTL	44	28	16	8	4	0	4.3	6.9
LS	41	26	22	7	4	0	4.6	5.9
INTEGRATED CIRCUITS, LINEAR								
Communication/Circuit	20	27	39	7	7	0	6.8	7.7
OP amplifier	13	38	41	4	4	0	6.0	6.9
Voltage regulator	19	37	33	7	4	0	5.8	6.2
MEMORY CIRCUITS								
DRAM 16K	0	0	40	40	10	10	15.0	13.6
DRAM 64K	0	13	33	40	7	7	13.1	12.8
DRAM 256K	0	14	24	38	10	14	15.1	12.0
DRAM 1M-bit	0	6	27	17	28	22	18.9	15.1
SRAM 4K × 8	0	12	44	44	0	0	10.6	12.2
SRAM 8K × 8	7	0	27	46	20	0	14.3	19.2
SRAM 2K × 8	0	1	44	44	11	0	13.1	16.8
ROM/PROM	8	15	54	15	8	0	9.1	10.5
EPROM 64K	18	24	34	24	0	0	7.1	9.8
EPROM 256K	20	7	40	33	0	0	8.5	11.3
EPROM 1M-bit	10	20	20	40	10	0	10.9	9.4
EEPROM 16K	0	30	40	20	10	0	9.7	10.0
EEPROM 64K	0	20	40	30	10	0	10.9	9.5
DISPLAYS								
Panel meters	7	21	50	14	8	0	8.8	8.4
Fluorescent	15	23	15	38	9	0	10.0	10.1
CRT 12-inch monochrome	20	30	30	10	10	0	7.3	
LED	25	29	21	21	4	0	6.8	6.6
Liquid crystal	13	31	31	25	0	0	7.2	10.8
MICROPROCESSOR ICs								
8-bit	19	37	31	13	0	0	5.6	9.2
16-bit	10	33	43	14	0	0	6.6	8.4
32-bit	0	27	33	33	7	0	10.3	10.0
FUNCTION PACKAGES								
Amplifier	18	29	41	12	0	0	6.0	7.6
Converter, analog to digital	14	23	49	14	0	0	6.7	8.9
Converter, digital to analog	16	21	47	16	0	0	6.8	8.3
LINE FILTERS	25	31	31	13	0	0	5.4	6.9
CAPACITORS								
Ceramic monolithic	30	27	30	13	0	0	5.2	6.0
Ceramic disc	26	29	26	19	0	0	5.8	7.0
Film	26	26	32	16	0	0	5.8	7.4
Aluminum electrolytic	19	35	16	26	4	0	7.3	7.4
Tantalum	22	37	25	16	0	0	5.5	7.9
INDUCTORS	16	20	28	32	0	4	9.0	8.5

Source: Electronics Purchasing Magazine's survey of buyers.

End the connector compromise...

1. LIF RACK & PANEL CONNECTORS
2. MULTIPIN WITH 8-200 AMP CONTACTS
3. MIL-C-28748A RELIABILITY

...in electronic power supplies



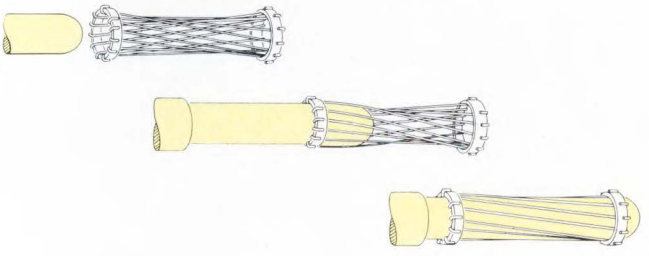
Only Hypertronics ends the compromise in power supply connectors for backplane subassemblies—in military, computer and other electronic systems—by combining Low Insertion Force (LIF) power, signal and MIL spec reliability in a single rack & panel connector.

Our modular design gangs power contacts, rated from 15 to 200 amps, with low-insertion-force signal contacts. Combine these design alternatives with high current/small size performance of the Hypertac® contact—for unique cost and space efficiency.

And now our L Series connectors have been proven to MIL-C-28748A performance standards.

Now you can have it all...in rack & panel connectors for power and signal applications ranging from power supply to portable disc drives. End the connector compromise by calling 1-800-225-9228, toll free.

HYPERTAC®:
Inserting pin into hyperboloid sleeve.



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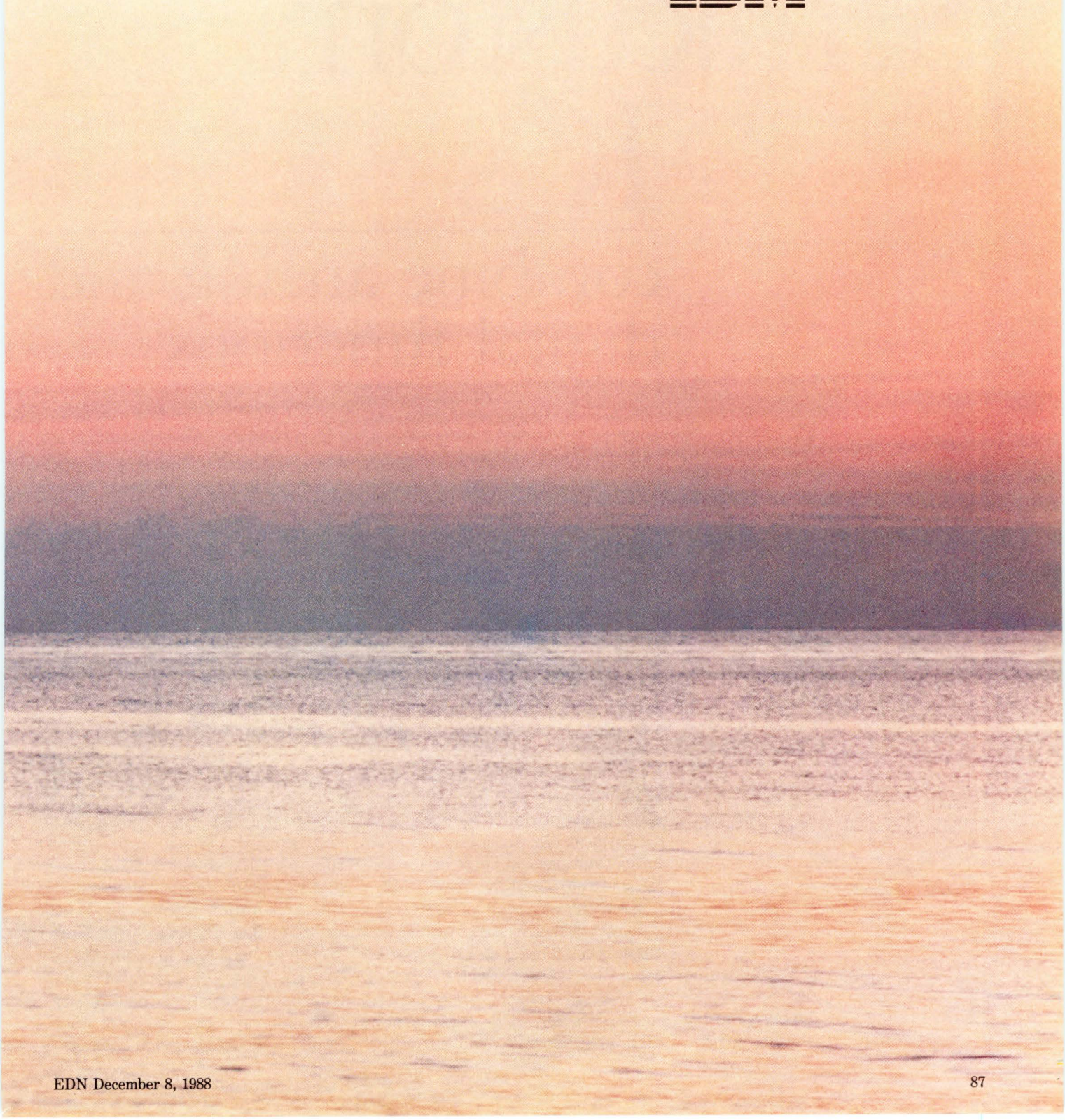


Semicustom ICs

combine analog and digital functions

Dave Pryce,
Associate Editor

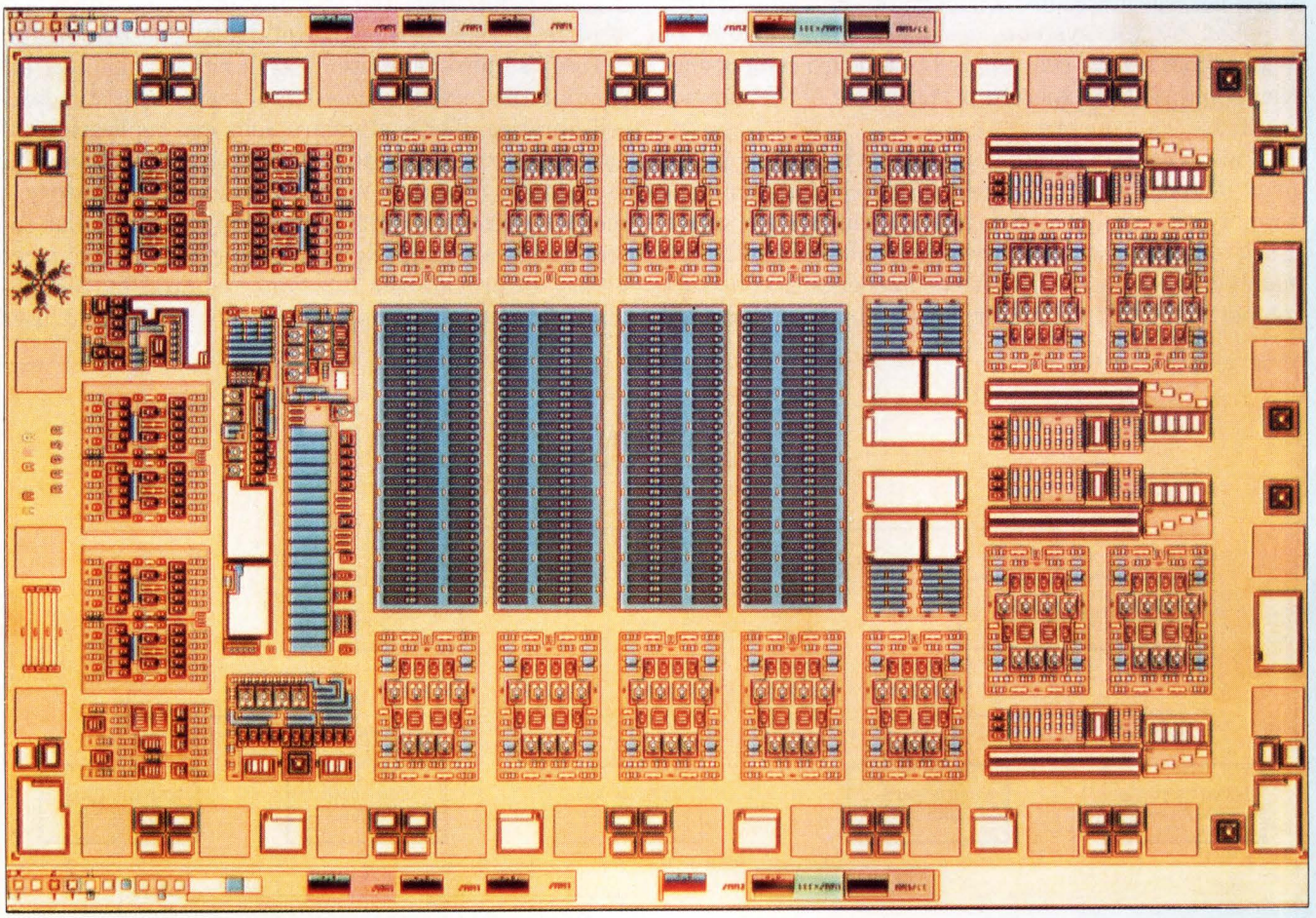
Historically, the distinction between gate arrays (digital circuits) and linear arrays (analog circuits) in the semicustom hierarchy has been clear. But this distinction is changing for many third-generation circuits that provide both analog and digital functions on the same chip. Moreover, the distinction between semicustom and full-custom circuits is beginning to blur as chip vendors expand their libraries of standard cells that can implement complete systems on a single chip—a capability previously reserved for only full-custom circuits. **Fig 1** shows a tree-structured version of the basic custom/semicustom hierarchy. Because interpretations can vary, other versions of this hierarchy are possible.

Even the meanings of previously defined terms are changing. For example, the term "standard cell" was coined to define a machine-crafted method for creating digital-only custom circuits. This term is now somewhat loosely used to define both the analog and the digital building blocks that make up a vendor's semicustom library of circuit functions. These so-called standard-cell libraries, which vary from vendor to vendor, include such functions as op amps, comparators, voltage references. timers, counters, logic gates, and switched-capacitor filters.

Three basic approaches exist

Although the interpretation of the custom/semicustom hierarchy and the definitions of certain terms is open to debate, there are three basic approaches to semicustom circuit design. These approaches roughly correspond to the three generations of semicustom circuits. First-generation circuits, developed in 1971, use an array-based approach in which a predefined die contains a specific quantity of gates, transistors, resistors, and capacitors. The systems designer then configured these individual compo-

Firmly established as a rapid means of designing unique circuits, semicustom ICs are now blurring the traditional distinctions among gate arrays, linear arrays, and custom circuits. Many incorporate both analog and digital functions on the same chip, and vendors' standard-cell libraries can often satisfy the demands of a complete system.



A tile-based, high-speed bipolar array containing a versatile mix of analog and digital functions *(SGS-Thomson Microelectronics)*

The distinction between semicustom and full-custom circuits is changing as vendors expand their cell libraries in order to provide complete systems on a single chip.

nents to form various combinations of specific analog or digital circuits. This approach is principally manual—few CAE/CAD tools are available other than those used by the vendor to lay out the chip.

In the case of analog circuits, the ability of the systems engineer to design and lay out a circuit on a semicustom array was largely a myth fostered by the vendor to gain market acceptance. Most systems designers simply do not have the knowledge and experience to deal with the nuances of the processing technology, parameter variations, and layout restrictions. Except for the simplest of circuits, most array-based analog circuit design is done by the vendor working from black-box specifications, a schematic, or a breadboard supplied by the systems designer. Most vendors of semicustom arrays can supply breadboard components that replicate the expected performance of the individual active components.

Many second-generation circuits, which were developed in 1982, use a tile-based approach that can often simplify the design and layout of semicustom chips. Each tile on the semicustom circuit contains a sufficient number of active and passive components to construct simple analog functions or low-level logic functions. These circuit functions, sometimes called macrocells, are defined by the vendor and stored in the vendor's data base. Although it is possible to capture these circuit functions on a workstation, the tile approach limits the complexity of a design to the number of available tiles on the semicustom chip.

Although tile arrays can ease the system designer's task, they don't usually offer the flexibility of incorporating high-level analog and digital functions. Moreover, most tile-based arrays tend to be at least as wasteful of silicon real estate as are conventional arrays. Although an occasional array-based or tile-based semicustom design might utilize as much as 90% of the available chip area, the vast majority take advantage of no more than 70% of the total available real estate.

Today's third-generation semicustom chips are expanding the mixed analog/digital trend with standard-cell libraries. These standard cells can replicate high-level analog and digital functions that are familiar to the systems designer. With the standard-cell approach, the designer starts with a bare chip and lays out the required analog and digital building blocks from a cell library to provide the functions required by the systems designer. This approach is not unlike that used

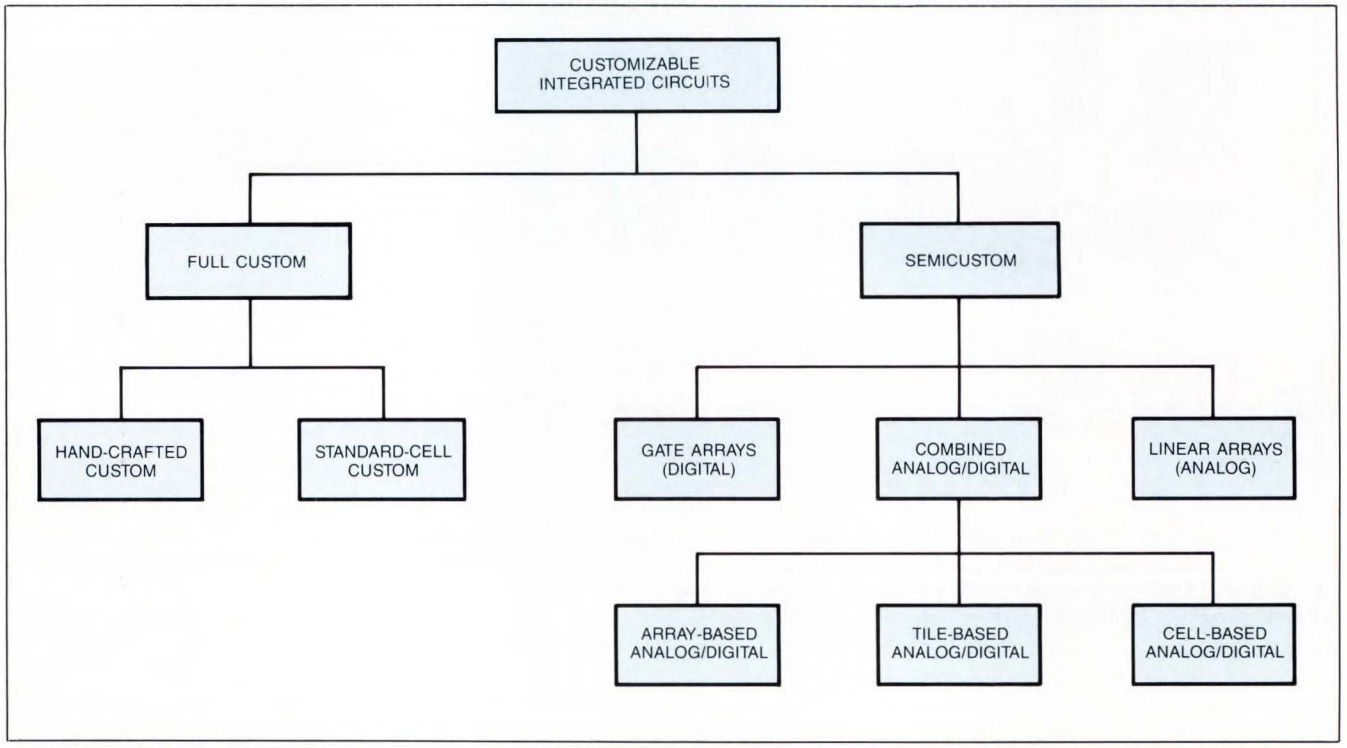


Fig 1—The hierarchy of customizable circuits *is open to interpretation, but this version is typical. Semicustom circuits that combine both analog and digital functions are available in array-based, tile-based, and cell-based forms as well as combinations of the three.*

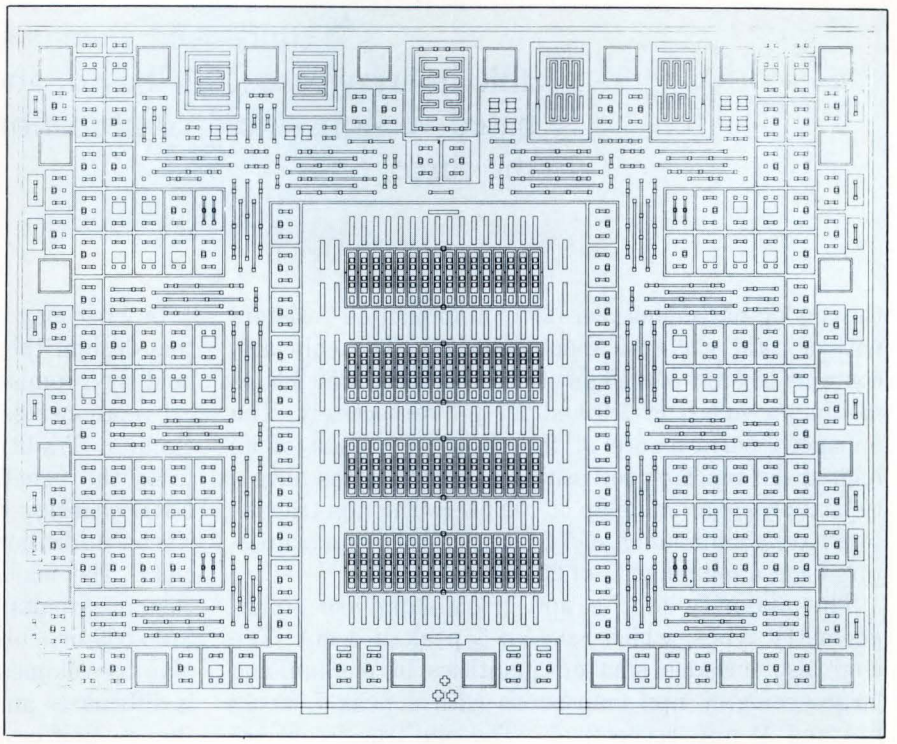


Fig 2—Typical of the array-based semicustom chips, *the CS-1100 from Cherry Semiconductor contains a useful mix of analog and digital components. Located in the center of the chip are 64 I²L gates that are speed-power programmable over a wide range of current. The balance of the chip area contains 102 npn transistors, 41 pnp transistors, and 339 diffused resistors.*

to design a full-custom circuit, the difference being a macrolevel design versus a component-level design. In many cases, the utilization of chip real estate with standard cells is nearly as high as that obtained with a hand-crafted, component-level design.

All three approaches to semicustom circuit design are likely to coexist indefinitely, and some ciucuits are designed using some combination of the three. However, the overall direction of semicustom circuit design clearly points to the greater use of mixed-mode (analog/digital) chips and to higher levels of integration, which provide greater support for the systems designer. In addition to the changes in circuit architecture, semicustom circuits are also changing in performance levels. Many of the newer analog/digital semicustom chips are capable of operating at higher frequencies and higher voltages than heretofore possible.

Typical of the array-based semicustom circuits that combine analog and digital capabilities is the CS-1100 (**Fig 2**) from Cherry Semiconductor Corp (CSC). Although more heavily weighted toward analog functions, the 12,000 mil² chip contains a good mix of logic gates, npn and pnp transistors, and diffused resistors. Included on the CS-1100 are 64 I²L (integrated injection logic) gates that are speed-power programmable over an operating-current range of 100 nA to 200 μA. The propagation delays of these gates range from 7 μsec at 100 nA to 50 nsec at 200 μA. One of the advantages of I²L gates is the ability to operate at low currents to conserve power—albeit at a sacrifice in speed. Another advantage is the ability to operate with supply voltages as low as 1V from a single supply. By comparison, CMOS gates require a minimum of 2.5V and ECL gates require a −5.2V supply.

In addition to the 64 gates, the CS-1100 also contains 102 npn transistors, 41 pnp transistors, and 339 diffused resistors that range in value from 135Ω to 4.8 kΩ. Included in the mix of npn transistors are four high-current types that have a typical dc beta of 150 at 100 mA and can operate at currents as high as 300 mA. The majority of the chip's npn complement is made up of small-geometry types that feature a typical dc beta of 150 from 10 μA to nearly 10 mA. The f_τ (gain-bandwidth product) of these npn transistors is typically 400 MHz at collector currents in the range of 100 μA to 1 mA. The pnp transistors are lateral types, which have a lower dc-beta (40) and a much lower f_τ (2 MHz) than do the npn types. Despite the lower performance, you can use these pnp transistors in a variety of circuits, such as level shifters and current mirrors.

CSC also offers larger array-based analog/digital chips. The CS-1500, for example, is a 17,000 mil² chip that contains 98 I²L gates, 126 npn transistors (including four high-current types), 72 pnp transistors, and 462 diffused resistors. The pnp transistor complement includes 56 lateral types and 16 substrate types. You can use the substrate types only as emitter followers because of the common collector-substrate connection. Both the CS-1100 and CS-1500 are limited to a maximum operating voltage of 12V—a limitation imposed by the I² gates. Typical NRE charges are $6000 for the CS-1100 and $7400 for the CS-1500; unit costs (1000 pieces) for 24-pin DIPs are $3.25 and $3.75, respectively.

Extending the performance boundaries of combined analog and digital chips, the QuickChip 4 from Tektronix provides a mixture of fast ECL gates and high-frequency bipolar transistors. Large in size at 38,000 mil², the QC-4 features 300 equivalent gates in its digital section and a combined total of 468 npn and pnp transistors in its analog section. Also included in

Semicustom circuits are available in array-based, tile-based, and cell-based versions—and combinations of the three.

the analog partioning are 1290 ion-implanted resistors with a total value of about 1380 kΩ. The chip also contains 16 MOS and 16 junction capacitors, which have maximum values of 1.0 and 2.7 pf, respectively. The enhanced performance of the QC-4 is a result of its high-speed bipolar processing. The ECL gates have a typical propagation delay of 400 psec. The npn transistors have a minimum f_τ of 5.5 GHz, and the pnp transistors have a minimum f_τ of 20 MHz.

The majority of the npn transistors are small-geometry types, which have an f_τ peak at 3 mA. The chip also includes smaller quantities of medium-and large-geometry npn transistors with a peak f_τ at 12 mA and 24 mA, respectively. The pnp transistors are lateral and substrate types, which accounts for their lower cut-off frequency of 20 MHz. The QuickChip 4 is a modified tile array. Tektronix provides a design guide, process specifications, and device modeling for all transistors and resistors in the analog section.

Tektronix also provides a design guide for the chip's ECL gate array, along with specifications and models for the digital cell library. Digital functions include OR, NOR, AND, and NAND gates; multiplexers and decoders; buffers; latches; inverters; and TTL interfaces. Because of its performance capabilities and the variety and quantity of its components, the QC-4 lends itself well to the design of high-speed modems, D/A and A/D converters, digital phase-locked loops, programmable amplifiers, and analog multiplexers. Typical NRE charges for the QC-4, which includes CAD software, are $25,000. The unit cost is $32 in 1000-piece quantities.

In what may prove to be a breakthrough in semicustom design, the Flexar Delta arrays from Exar Corp hold the promise of changing the economic and technical relationships between semicustom and full-custom circuits. Traditionally, semicustom circuits have offered the benefits of fast turnaround times and low NRE charges, but they could not match the efficient silicon utilization and low unit cost of full-custom circuits. The major stumbling block to the use of full-custom circuits is the high NRE charges—typically $100,000 or more. Unless a systems manufacturer can plan on volumes of at least 100,000 units annually, it is difficult to amortize these NRE charges, even given the low unit costs.

Chips provide greater flexibility

With the Flexar Delta arrays, Exar claims it is now possible to manufacture semicustom circuits in high volume and with fast turnaround times, low NRE charges—and, because of the efficient utilization of silicon real estate, low unit costs. In 1986, Exar introduced the Flexar Beta series, which featured programmable components. With the Delta series, it has extended this programmability to include the chip's die-size, which has a direct bearing on unit costs. Compared with the Beta series, the Delta series also adds thin-film resistor capability and higher-frequency operation. The latter feature is a direct result of the Delta series' 3-μm bipolar processing, which yields npn transistors with cut-off frequencies of 1 GHz.

The architecture of the Flexar Delta chip is based on a symmetrical cell. The Delta 2000 (**Fig 3**) is stacked

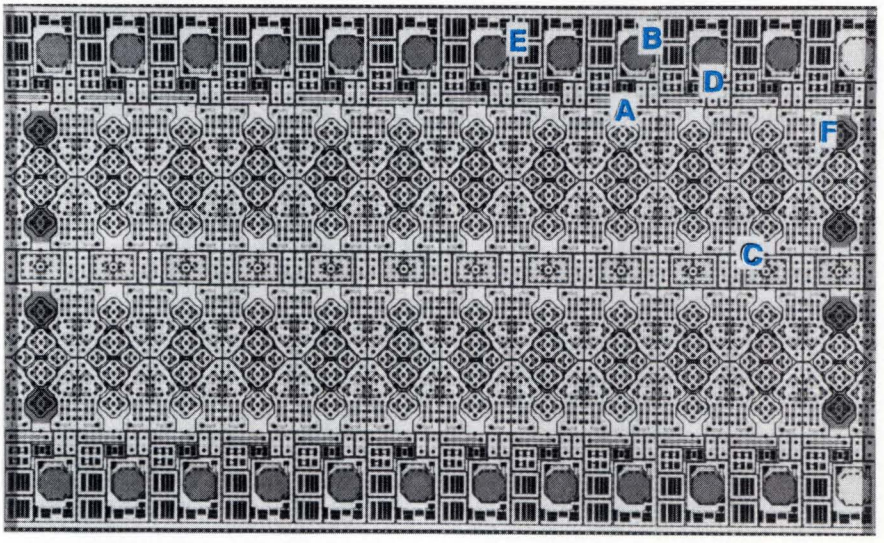


Fig 3—This mixed analog/digital array is programmable. *The Flexar Delta 2000 from Exar features programmable components such as Twinstors* ***(a)****, Padstors* ***(b)****, and thin-film resistors/programmable capacitors* ***(c)****. Other components include Schottky diodes* ***(d)****, power npn transistors* ***(e)****, and a user-programmable pad that defines the horizontal size of the chip* ***(f)****.*

two cells per row; the Delta 4000 has four cells per row. The layout can expand horizontally in either direction; and, because the components are programmable as transistors, resistors, or capacitors, near 100% silicon utilization is possible. When the design is completed, the wafer is scribed to fit the circuit exactly. Permanent bonding pads and scribe lines define the vertical dimensions of the chip. Horizontally, the user places bonding pads on either side of the programmable scribe lines to complete the circuit. The bonding pads and scribe lines are programmed in the final metal and passivation stages. In this way, the user can design a silicon-efficient circuit and then program the die size to fit the design.

Each symmetrical cell in the Delta chips contains several types of programmable components. The basic element, called the Twinstor, is user-programmable as two common-collector npn transistors, one dual-collector pnp transistor, two matched resistors, or one cross-under resistor. You can use the Twinstor as a general-purpose npn transistor operating at currents to 10 mA or as a dual-collector pnp transistor at currents to 500 μA. The breakdown voltages exceed 20V, thus covering the majority of applications. In **Fig 3**, the Twinstors are the four major formations shown in line in the center of the cell.

Another key component of the Delta chips is the Padstor, which can be a bonding pad, a medium-current npn or pnp transistor, a capacitor, or a zener-zapping network for use in trimming. The Delta 2000 contains as many as 1310 components; the Delta 4000, as many as 4900. Exar's macrocell library for the Delta series includes 10 digital cells and 100 analog cells. The typical NRE charges of $7,000 and unit pricing of $1 (1000) make the Delta chips among the most cost effective on the market.

The original pioneer of the linear semicustom market, Interdesign, introduced its first series of linear-only chips in 1971. Since then, Interdesign has introduced a variety of semicustom chips that include both analog and digital functions, notably its Digilin series. Interdesign was purchased by Ferranti several years ago, and Ferranti-Interdesign was purchased this year by Plessey Semiconductors. The combined strength that Plessey now offers makes it a formidable competitor in the analog/digital semicustom market.

The Digilin products include the ULA-G series and the ULA-P series. Both series of bipolar chips contain a central matrix of digital cells for implementing logic functions, and standard and special peripheral cells for implementing linear and special functions. The G series places greater emphasis on linear functions, and the P series favors logic functions. The G chips, which come in seven sizes, contain 30 to 578 2-input NOR gates. The P chips, which come in five sizes, contain 128 to 1152 NOR gates.

The number of peripheral cells varies according to the chip size and the series. The number of standard peripheral cells in the G chips ranges from 10 to 35; the number in the P chips ranges from 16 to 44. Both the G and P chips contain four special peripheral cells located at each corner of the chip. Although the component count varies between the G and P series, each standard peripheral cell contains a range of transistors and resistors for implementing a variety of linear functions.

In the G series, for example, each standard periphseral cell contains 12 transistors and 23 resistors. These components are designed to provide I/O interface with bipolar, MOS, and CMOS technologies, and to provide high-performance linear functions such as op amps, comparators, oscillators, sample-and-hold circuits, and analog switches. The special peripheral cells, which also vary somewhat between the G and P series, include specialized functions such as high-current drive transistors, bandgap references, regulators, shaping capacitors, and matched-resistor banks.

The Digilin cell library includes over 50 digital and 40 analog macrocells for replicating circuit functions. Breadboard components, which can be simulated with SPICE ASCII files, are available for the analog section. NRE charges range from $10,000 to $20,000, and unit costs for 16-pin DIPs range from $3 to $15, depending on the circuit selected.

Plessey also has analog/digital semicustom arrays that are fabricated in CMOS. The MA family, for example, consists of eight arrays that vary in size from about 5,000 to 42,000 mil^2 and have a combined array- and cell-based architecture. The arrays provide a mix of components ranging from 45 gates and 400 discrete MOSFETs to 1150 gates and 2500 MOSFETs. The MA chips are fabricated in a polysilicon-gate oxide-isolated process that allows device operation from 3 to 15V and supports toggle frequencies to 50 MHz and amplifier bandwidths to 5 MHz.

The architecture of the MA chips allows the use of macrocells for both digital and analog functions. The macrocell library contains over 100 digital functions, including most 4000 series logic functions, and over 30 analog functions. The analog macrocells include op

The overall direction of semicustom circuits is toward mixed-mode chips that support the systems designer by providing higher levels of integration.

amps, sample-and-hold amps, comparators, bandgap references, analog switches, and current mirrors—even a D/A converter that is based on charge-sharing principles. The MA library is supported on Mentor Graphics workstations, FutureNet for PC-based design systems, and the Analog Workbench for analog design. NRE charges for the MA series range from $10,000 to $50,000, depending on the array. Unit prices for 16-pin DIPs range from $3 to $20.

The recently merged SGS Semiconductor Corp and Thomson Components-Mostek Corp, now operating as SGS-Thomson Microelectronics, has two notable offerings in mixed analog/digital semicustom circuits. For example, the TSGSM series of HCMOS standard cells offers a library of 94 logic cells and 66 analog cells from which the user can create semicustom circuits. The TSGSM series allows as many as 1500 equivalent gates with each gate having a typical propagation delay of 4 nsec. Overall, operating speeds to 15 MHz are possible in the digital part of the circuit. The analog cells are capable of amplifier bandwidths to over 3 MHz. The TSGSM library is supported on VAX, Daisy, and Mentor workstations.

In contrast with the HCMOS cell-based TSGSM series, the tile-arrays in the Polyuse J series are fabricated in a high-speed bipolar process that incorporates both ECL and I^2L logic with high-frequency npn transistors and low-frequency pnp transistors. The ECL logic can operate to 100 MHz; the I^2L logic to 2 MHz. The npn transistors have a typical f_T of 3 GHz; that of the lateral pnp transistors is only 8 MHz. **Fig 4** shows the J09 chip, which is in the middle of the size range of the 5-chip Polyuse J series.

There are five different types of tiles used in the J series; the quantity of each tile depends on the particular chip size. The tile types are linear, power, I^2L logic, ECL logic, and built-in functions. The built-in functions include a bandgap reference, an oscillator (RC or quartz), a voltage regulator, and an R-2R ladder for a 6-bit DAC. The J13 chip, for example, contains the built-in functions plus 14 linear tiles, 4 power tiles, 20 ECL NOR gates, and 288 I^2L gates. Also included on the chip are 26 protection diodes, 21 capacitors with a total value of 70.5 pf, and 811 resistors with a total value of about 45.6 MΩ.

The cell library for the Polyuse J series includes such analog functions as a programmable op amp, a programmable comparator, and a comparator with hysteresis. I^2L logic functions include AND/NAND gates; OR/NOR gates; and RS, JK, and D flip-flops. ECL logic functions include a 2-input NOR gate, 3-input OR/AND gates, and a D flip-flop with set and reset functions. Design tools for the Polyuse J series include support for PC/AT (IBM or compatible) workstations using PCAD and PSPICE, and VAX-VMS mainframes using Berkeley SPICE (2G6) and a GDS2-compatible layout editor. NRE charges include a fixed charge of $10,000 plus an additional turn-key design charge,

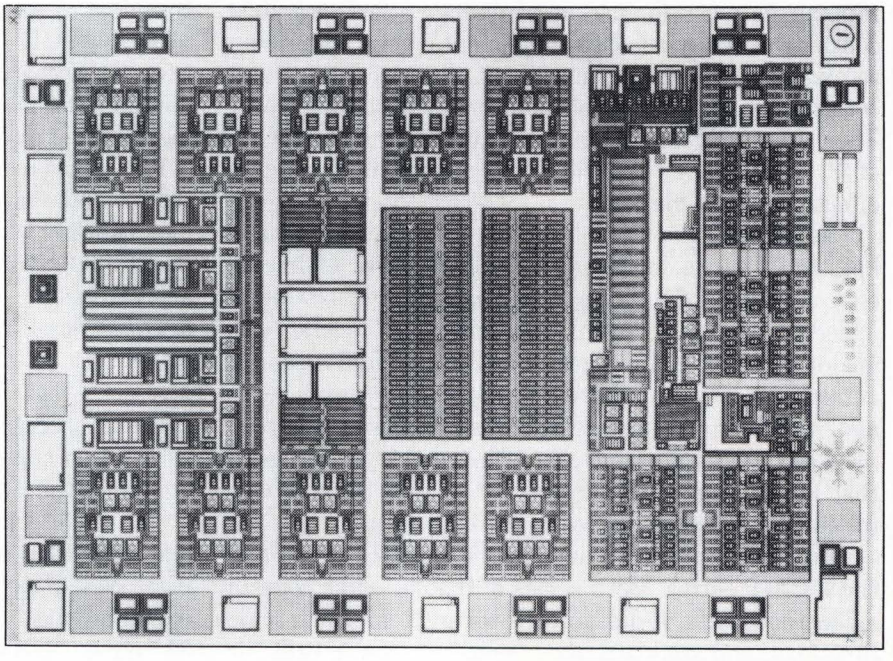


Fig 4—This tile-based chip accommodates a variety of analog and digital functions. *Part of the Polyuse J series from SGS-Thomson Microelectronics, the chip contains ECL gates, I^2L gates, op amps or comparators, protection diodes, capacitors, and resistors. The chip also includes built-in functions, such as a bandgap reference and an oscillator.*

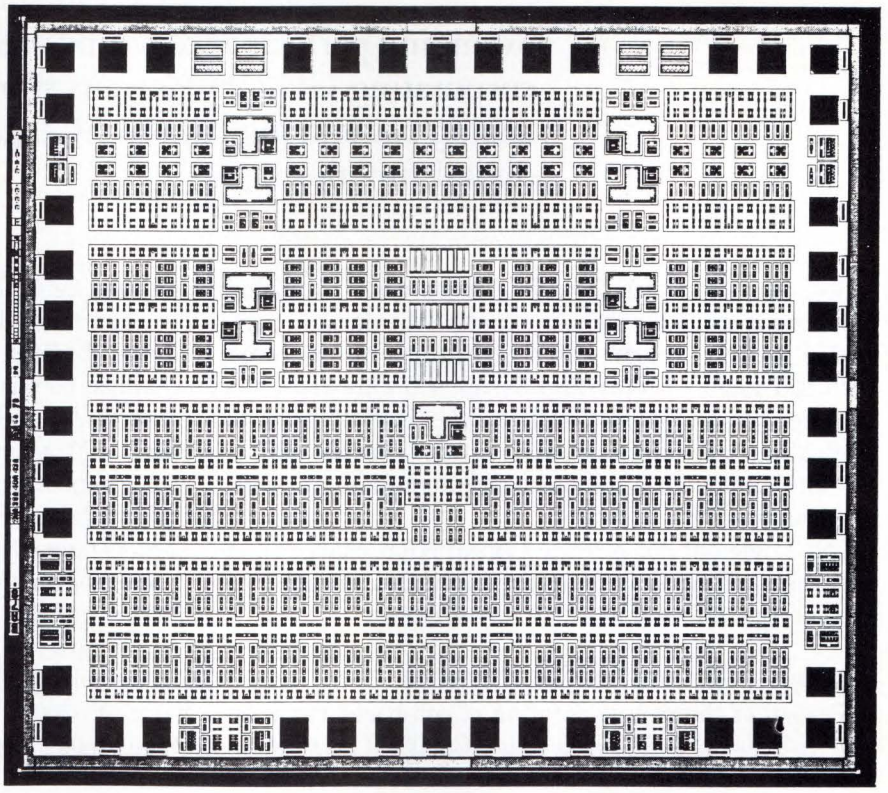


Fig 5—Split into two roughly equal parts, *the FB3635 mini-tile array from Micro Linear is useful for high-performance analog and digital circuits. The top half of the chip contains components for analog circuit design; the bottom half contains ECL gates for digital design.*

which depends on circuit complexity. Unit pricing depends on the array selected and the annual volume. The J06, for example, in a 16-pin DIP costs $7.50 each for 1000 per year and $1.70 each for 50,000 per year.

Continuing the trend toward tile arrays, Micro Linear Corp has recently expanded its FB3600 line of analog mini-tile arrays to include the FB3635, a chip that offers both analog and digital capabilities. The FB3635 (**Fig 5**) can accommodate design complexities to 8 op amps or 16 comparators in its analog section and as many as 130 ECL NAND gates in its digital section. In addition to op amps and comparators, the analog section can implement such functions as a 2-quadrant multiplier, an AGC circuit, an analog multiplexer, a video amplifier, and a modulator/demodulator. Each of these functions requires approximately the same number of components as one op amp. The array can also hold a single 8-bit DAC, four 100-MHz cascode amplifiers, and a voltage reference.

The digital section of the FB3635 contains 65 mini-tiles for logic design. You can use these ECL logic tiles to implement 42 latches, 21 80-MHz D flip-flops with set and reset, or 130 2-input NAND gates. The ECL gates feature a 2-nsec propagation delay. Special input and output components provide interfacing to TTL, CMOS, and ECL logic levels.

The nearly 20,000 mil^2 FB3635 contains a total of 121 mini-tiles of 11 types. The types for analog design are called general purpose, specialized design, power devices, and precision resistors. The types for digital and specialized design are called npn-intensive, wideband amplifier, Schottky core, ECL logic and bias, TTL output, and Schottky peripheral. The typical f_τ of the transistors in the analog section is 720 MHz for the npn types and 25 MHz for the pnp types. The FB3635 contains 2805 total components, including 901 npn transistors, 63 pnp transistors, and 48 Schottky devices. The total resistance includes 818 kΩ of diffused resistance and 3064 kΩ of implanted resistance.

Micro Linear offers its own turn-key design program where the customer provides only the block diagram or system schematic along with circuit specifications and testing and packaging requirements. Also available is a customer-based design program that Micro Linear supports with accurate models from its design library and an interface to the ViewLogic workstation platform. NRE charges for the FB3600 family, range from $15,000 to $35,000. Depending on the chip, unit pricing ranges from $3 to $8 in 20,000-piece quantities.

Representative of the devices available from LSI Logic Corp is the LAD310 series of analog/digital arrays, which have a combined array- and tile-based architecture. The LAD310 series consists of seven chip sizes that are manufactured using a BiCMOS process that has 0.9 μm CMOS channel lengths, 1.5 μm bipolar emitters, and two metal layers. The f_τ of the bipolar npn transistors is typically 6 GHz. The chip architecture consists of two basic sections: The upper part of the chip contains a digital CMOS compacted array surrounded on three sides by digital I/O buffers; the lower part is an analog tile array with its own I/O buffers.

Gate densities for the digital section range from 1206 to 114,987 gates with as many as 239 I/O pads. The analog section contains from 96 to 672 tiles and as many as 97 I/O pads on the largest chip. The LDA310 series, which can implement high-performance analog and digital functions, uses a channel-free architecture throughout the array to achieve maximum silicon utili-

Some semicustom chips are extending performance boundaries by incorporating GHz-range transistors for analog use and high-speed ECL gates for digital functions.

zation. An extensive library of more than 25 analog functions is available to help expedite the design of the analog section. Sophisticated algorithms incorporated with LSI Logic's proprietary design software allow the designer to accurately model complex circuits prior to fabrication. The digital library contains over 250 different macrocells with standard and high-drive versions of each.

LSI Logic did not provide typical NRE charges and unit costs, citing that there are too many variables to provide this information with any accuracy.

Standard cells have high performance

Typical of the new generation of cell-based semicustom circuits, the SC70000 and SC80000 CMOS standard-cell libraries from Sierra Semiconductor provide a wide range of choices in analog and digital building blocks from which the designer can construct the final circuit. The SC70000 cell library is based on a 2-μm process; the SC80000 cells are based on 1.5-μm process. The 1.5-μm process permits the design of such analog functions as 65-MHz phase-locked loops, 100-MHz comparators, and 100-MHz D/A converter cells. The process also provides digital capabilities that include 120-MHz flip-flop toggle rates, gate delays of 1 nsec, and gate densities of 100,000 devices.

Sierra's cell library contains 245 digital and 50 analog standard cells. Included in the digital cell library are decoders/multiplexers, arithmetic functions, flip-flops, latches, buffers, and EEPROMs. Analog cells include op amps, comparators, voltage references, and multiplexers. All cells in both libraries are supported by Sierra's MIXsim, a behavioral-level simulator for use with complex analog and digital functions. The MIXsim CAE tools are available on the Mentor Graphics IDEA Series engineering workstations.

Another manufacturer of CMOS standard cells is the Microelectronic Division of NCR Corp. Similar in concept to Sierra's products, NCR has a wide range of analog and digital cells in its 1.5-μm (VS1500) and 2-μm (VS2000) CMOS libraries. **Fig 6** shows a combined analog/digital chip fabricated from VS2000 standard cells.

NCR's digital library, which contains over 150 cells, includes configurable RAM and ROM, shift registers, counters, ALUs, supercells, and core μPs. The analog library includes op amps, analog switches, a bandgap reference, a 50-nsec comparator, a 40-MHz VCO, an 8-bit DAC, an 8-bit flash ADC, and a dual-slope 10-bit ADC. Of particular interest to suppliers of military systems, NCR's VS1500 and VS2000 processing is certified to MIL-STD-883C. Because of the vast differences possible in the complexity and size of the final chip, costs can vary widely. However, NCR indicates

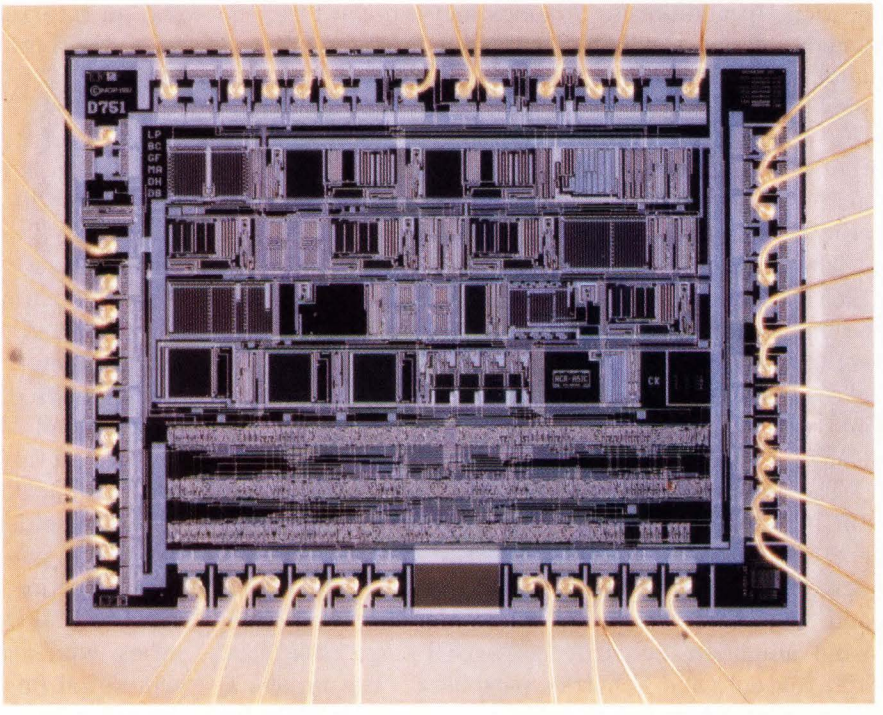


Fig 6—This chip was manufactured using a CMOS standard-cell library. *The VS2000 2-μm library from NCR's Microelectronic Division includes 20 analog cells, 130 digital cells, and 25 macrocells and core cells.*

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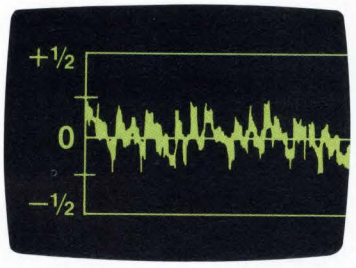

Differential Non-Linearity is less than ± 0.5 LSB over an analog input range of 0 to 10V, assuring no missing codes.

Additional features include:

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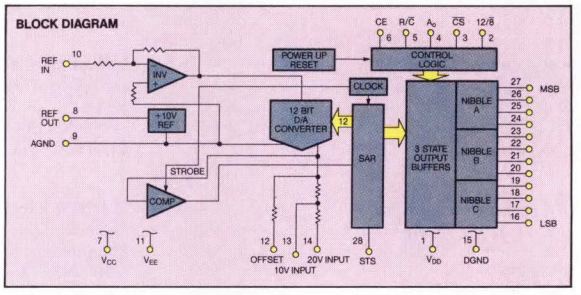
10V, 5MA Reference Output—Easier to use as a system reference

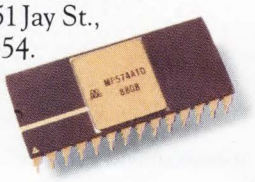
200 ns Bus Access Time—Works with faster microprocessors



Onchip Clock, Reference—Requires no external components for most applications

3-State Output Buffer—For direct interface with 8- or 16-bit microprocessor bus

Don't miss out on full 12-bit performance. For A/D converters with the best cost performance, **call Micro Power Systems' Hotline, (408) 562-3615;** 3151 Jay St., Santa Clara, CA 95054. And ask about our technical seminars.



MICRO POWER SYSTEMS

One novel approach to semicustom circuit design features programmable devices for flexibility and a programmable die size for efficient use of silicon real estate.

that typical NRE charges are about $45,000 with an average price of about $6 per chip.

National Semiconductor Corp, a major manufacturer of a vast array of off-the-shelf products, also offers a CMOS standard-cell library for implementing mixed-mode semicustom circuits. Although the analog portion of its SCL library of 2-μm standard cells is presently limited to eight macrocells, including op amps, comparators, and references, all of National's new CMOS VLSI products are designed with a core process that ensures compatibility with its standard cell library, thus providing some assurance that the analog library will grow.

The SCL library of digital cells, however, is quite broad. Included in the digital library are 24 gates; 14 flip-flops; 5 counters; 8 multiplexers; 42 I/O buffers; 36 bidirectional buffers; and 9 LSI/VLSI functions, such as RAM, ROM and EEPROM. The processing for SCL analog/digital circuits meets MIL-STD-883C requirements. National expects the market for combined analog/digital cell-based ICs to grow from $50 million in 1987 to over $2 billion by 1990, and they are ready to participate.

Although space does not permit a detailed description of their products, there are many other companies participating in the rapidly growing analog/digital semicustom market. VTC Inc, for example, offers the bipolar VJ800 and VJ900 array-based circuits and the VL1000, VL2000, and VL3000 cell-based circuits. The VJ900 and VL3000 are particularly notable in that they

For more information . . .

For more information on the semicustom products described in this article, circle the appropriate numbers on the Information Retrieval Service card, contact the following manufacturers directly, or use EDN's Express Request service.

Advanced Linear Devices Inc
1030 West Maude Ave, Suite 501
Sunnyvale, CA 94086
(408) 720-8737
Circle No 365

Cherry Semiconductor Corp
2000 South County Trail
East Greenwich, RI 02818
(401) 885-3600
Circle No 366

Custom Arrays Corp
525 Del Ray Ave
Sunnyvale, CA 94086
(408) 749-1166
Circle No 367

Custom Silicon Inc
600 Suffolk St
Lowell, MA 01854
(508) 454-4600
Circle No 368

Exar Corp
2222 Qume Dr
San Jose, CA 95161
(408) 434-6400
Circle No 369

International Microelectronics Products
2830 N First St
San Jose, CA 95134
(408) 432-9100
Circle No 370

LSI Logic Corp
1551 McCarthy Blvd
Milpitas, CA 95035
(408) 433-8000
Circle No 371

Marconi Electronic Devices Ltd
45 Davids Dr
Hauppauge, NY 11788
(516) 231-7710
Circle No 372

Micro Linear Corp
2092 Concourse Dr
San Jose, CA 95131
(408) 433-5200
Circle No 373

National Semiconductor Corp
2900 Semiconductor Dr
Santa Clara, CA 95051
(408) 721-5000
Circle No 374

NCR Corp
2001 Danfield Ct
Fort Collins, CO 80525
(303) 226-9550
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Plessey Semiconductors
1500 Green Hills Rd
Scotts Valley, CA 95006
(408) 438-2900
Circle No 376

SGS-Thomson Microelectronics
1000 East Bell Rd
Phoenix, AZ 85022
(602) 867-6100
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Sierra Semiconductor
2075 North Capitol Ave
San Jose, CA 95132
(408) 263-9300
Circle No 378

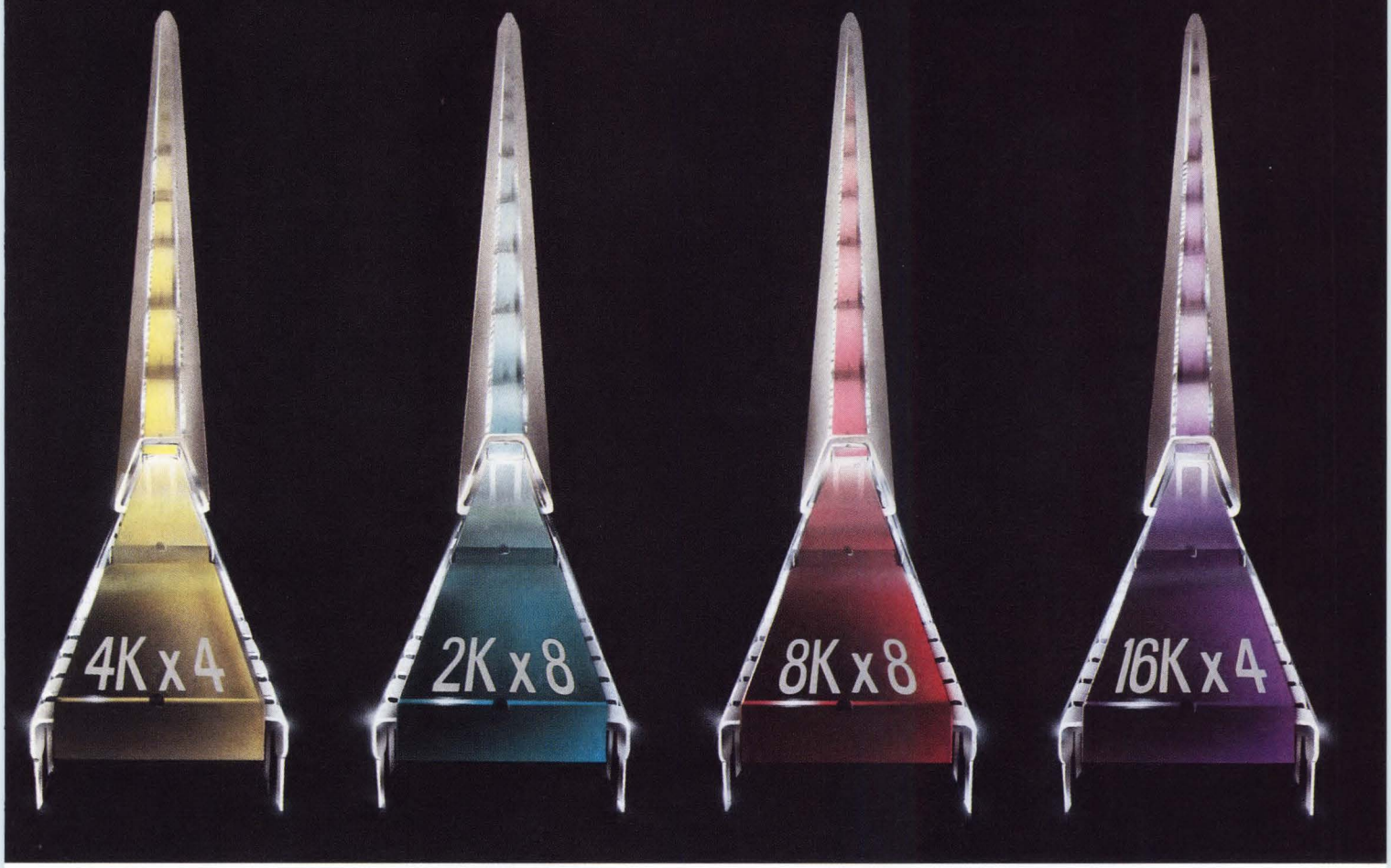
Silicon Systems
14351 Myford Rd
Tustin, CA 92680
(714) 731-7110
Circle No 379

Tektronix Inc
Box 500, MS 59-420
Beaverton, OR 97077
(503) 627-2515
Circle No 380

Texas Instruments Inc
Box 655303
Dallas, TX 75265
(800) 232-3200
Circle No 381

VTC Inc
2401 E 86th St
Bloomington, MN 55425
(800) 882-2742
Circle No 382

PERFORMANCE
means 15ns wide word SCRAMs



15ns

SCRAMs are Static CMOS Random Access Memories from Performance Semiconductor. At 15ns address access time these 64K's and 16K's are the world's fastest. SCRAMs are manufactured in Performance's six inch class 1 fabrication facility using PACE II 0.7 micron gate length technology which has set the standard for memory speed.

There is immediate availability of 15ns 64K and 16K bit SCRAMs compatible with JEDEC standard pinouts. Also available from stock are 17, 20 and 25ns speed versions.

15NS SCRAM PRODUCT GUIDE

PART	CONFIG.	SPEED	AVAIL.
P4C164	8K x 8	15ns	NOW
P4C188	16K x 4	15ns	NOW
P4C198	16K x 4	15ns	NOW
P4C198A	16K x 4	15ns	NOW
P4C1982	16K x 4	15ns	NOW
P4C1981	16K x 4	15ns	NOW
P4C168	4K x 4	15ns	NOW
P4C169	4K x 4	15ns	NOW
P4C170	4K x 4	15ns	NOW
P4C1682	4K x 4	15ns	NOW
P4C1681	4K x 4	15ns	NOW
P4C116	2K x 8	15ns	NOW

FAST, COOL, & AFFORDABLE

For further information or to order 15ns SCRAMs call or write:
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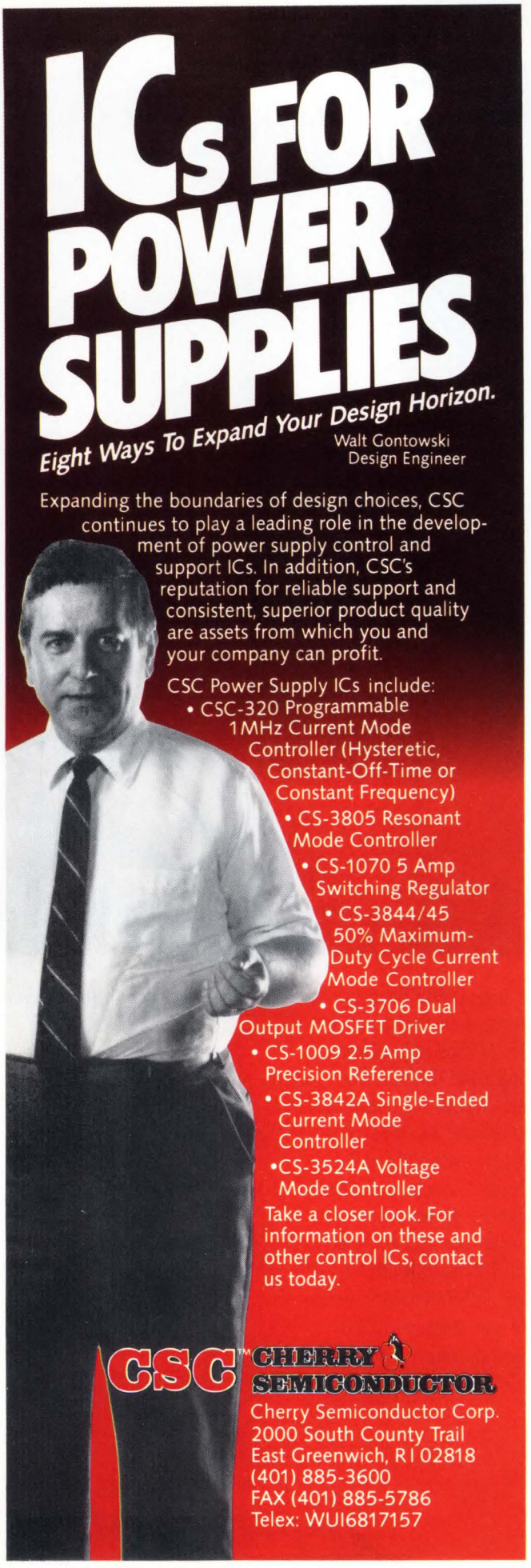
Sunnyvale, CA 94089
Telephone: 408 734·9000

PERFORMANCE
SEMICONDUCTOR CORPORATION

CIRCLE NO 34



have true-vertical 1.5-GHz pnp transistors that provide near-complementary performance with the 6.5-GHz npn transistors.

Advanced Linear Devices (ALD), in what may be a unique approach to standard-cell semicustom/custom circuit design, uses its off-the-shelf products as the standard cells. ALD feels that this function-specific approach can virtually guarantee first-time success because the standard parts used in the designer's breadboard are exactly duplicated in the final semicustom chip. ALD sells a design kit for $185 that contains 86 cells (standard parts in plastic DIPs), data sheets with full specifications, and a design manual.

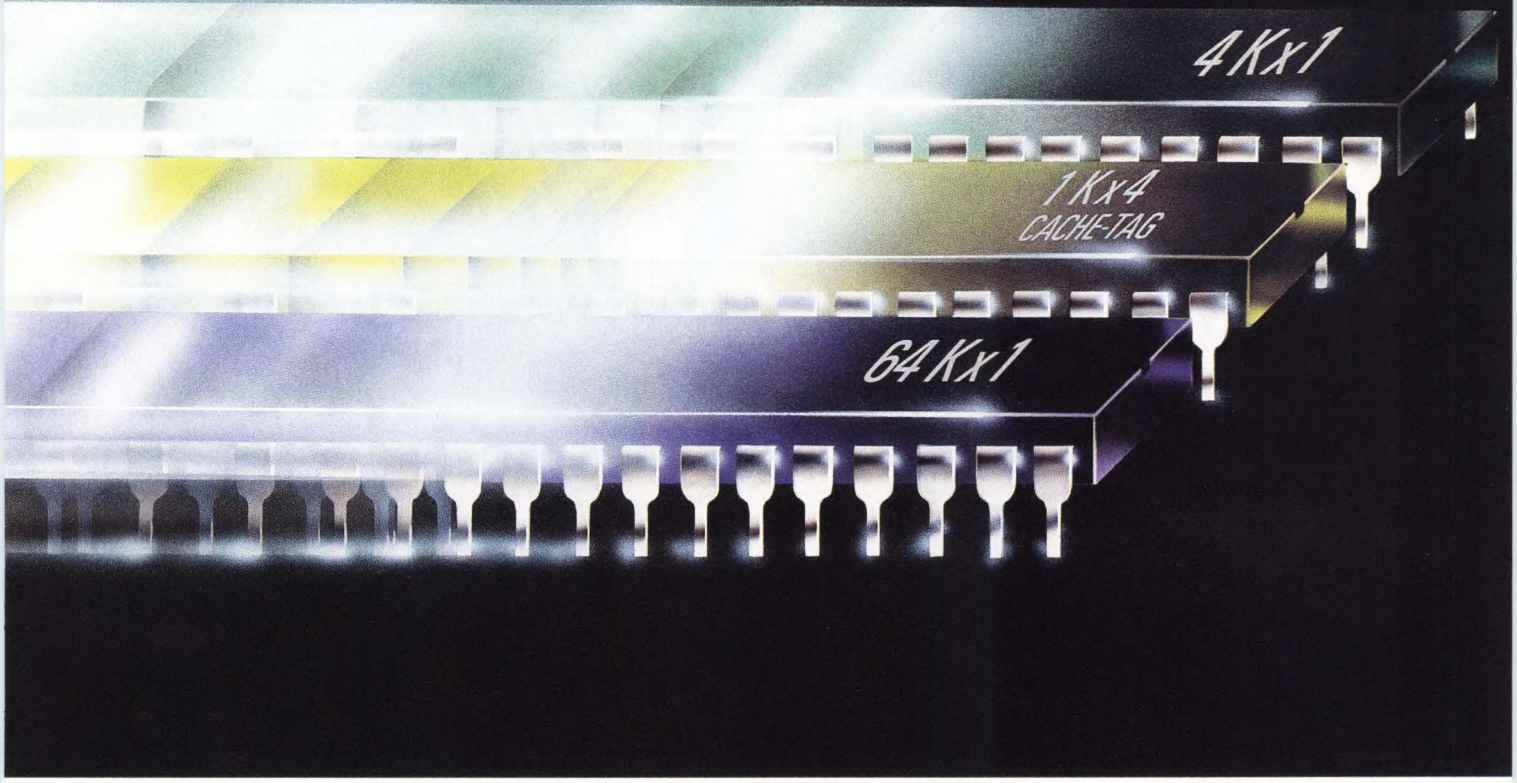
Fabricated in BiCMOS, the cell-based LinASIC products from Texas Instruments offer high-performance analog compatibility with the company's catalog products. Using 3-μm processing, the final chip can contain as many as 1000 CMOS gates, each with a propagation delay of 4 nsec. TI has approximately 300 digital cells and 50 analog cells in its library.

Other companies that offer array-based or cell-based semicustom products include Custom Arrays Corp, Custom Silicon Inc, International Microelectronics Products, Marconi Electronic Devices, and Silicon Systems.

With the increasing emphasis on combining analog and digital functions on a single chip, the number and types of semicustom products are rapidly proliferating. Compared with only five years ago, when there was a distinct lack of suitable mixed-mode circuits, today's system designer can choose from a variety of processing technologies and circuit complexities. Moreover, tile-based and cell-based circuits are making the designer's job easier by providing greater flexibility and more accurate modeling of the essential building blocks. EDN

Article Interest Quotient (Circle One)
High 494 Medium 495 Low 496

PERFORMANCE
means 10ns sub-micron SCRAMs



10ns

SCRAMs are the world's fastest Static CMOS Random Access Memories at 64K and 4K bit densities. SCRAMs are manufactured in Performance's PACE II 0.7 micron gate length technology which has set the standard for memory speed.

There is immediate availability of the 10ns 64Kx1 and all 4K bit versions compatible with JEDEC standard pin-outs. In addition there is immediate availability of Performance's proprietary Cache-Tag 1Kx4 SRAM, P4C151, with user features including two cycle (flash) chip clear and 4-bit compare.

10NS SCRAM PRODUCT GUIDE

PART	CONFIG.	SPEED	AVAIL.
P4C187	64K x 1	10ns	NOW
P4C147	4K x 1	10ns	NOW
P4C148	1K x 4	10ns	NOW
P4C149	1K x 4	10ns	NOW
P4C150	1K x 4	10ns	NOW
P4C151	1K x 4	10ns	NOW

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For further information or to order 10ns SCRAMs call or write:
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PERFORMANCE SEMICONDUCTOR CORPORATION

CIRCLE NO 35

Introducing the fastest EPROMs in



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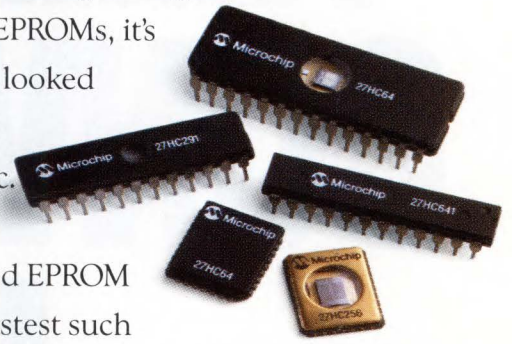

Choose from five family members, with 16K to 256K configurations. Each one able to counter the traditional system design problems of bipolar PROMs and slow EPROMs. Each one packaged in plastic, including surface mount. And each one built with the low power advantages of CMOS.

Part #	Memory	Speed
27HC191	16K	35ns
27HC291	16K	35ns
27HC64	64K	45ns
27HC641	64K	45ns
27HC256	256K	55ns

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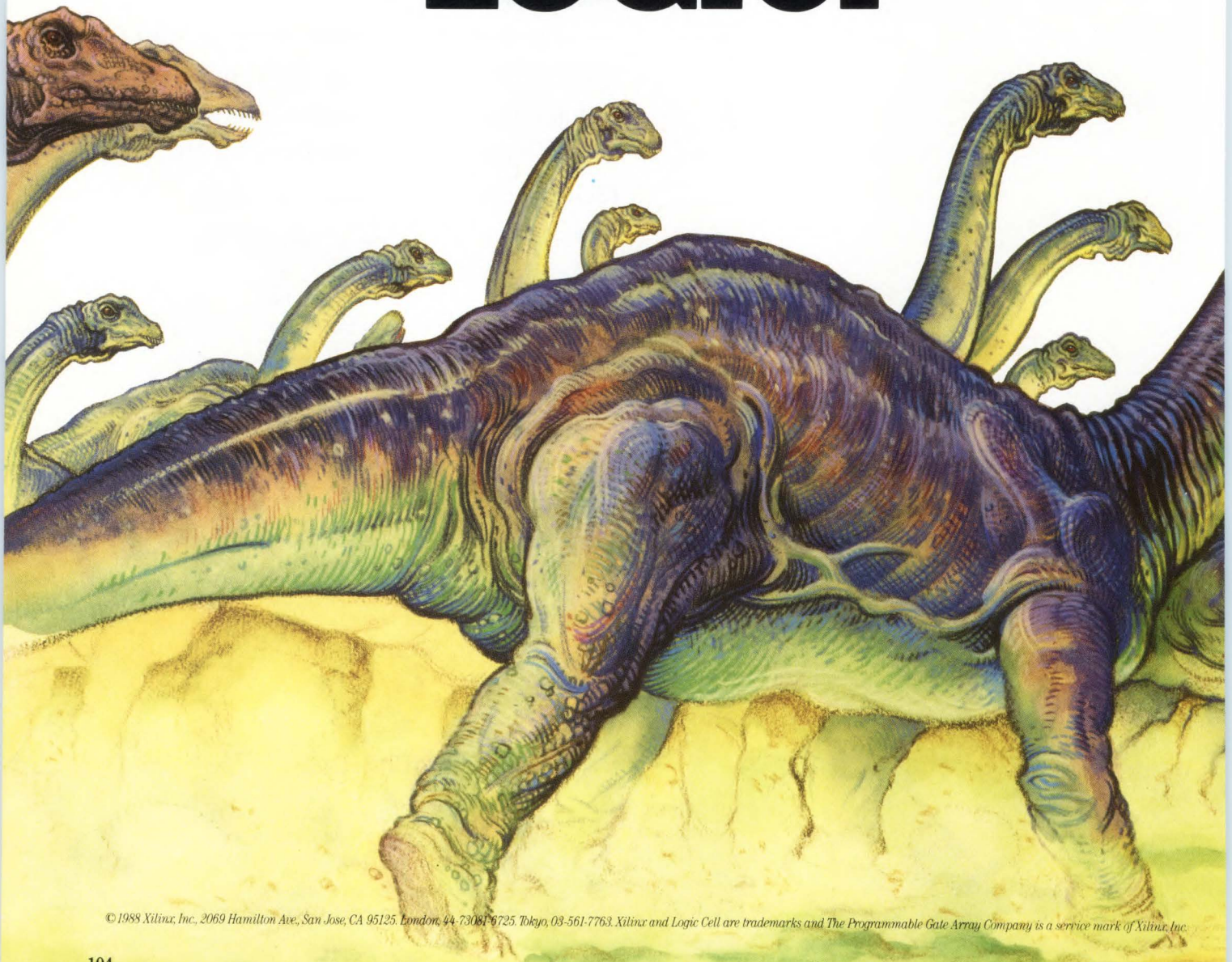
CIRCLE NO 36

XILINX DEFIES CONVENTIONAL LOGIC.



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Convention says that gate arrays often take months to develop.

Convention says that TTL and PLD-based designs sacrifice production cost effectiveness.

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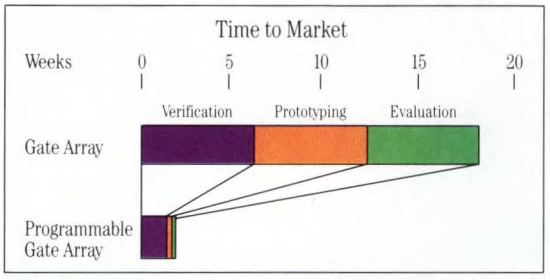
With Xilinx Programmable Gate Arrays. They give you all the benefits of gate arrays, but you can program them right at your desktop.



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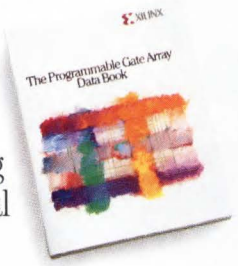

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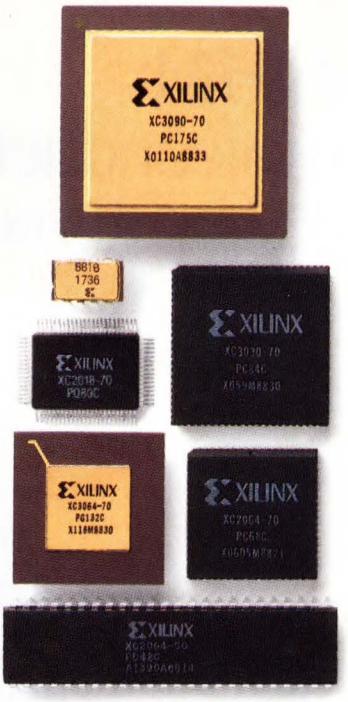

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CIRCLE NO 37

ROHM Semiconductors

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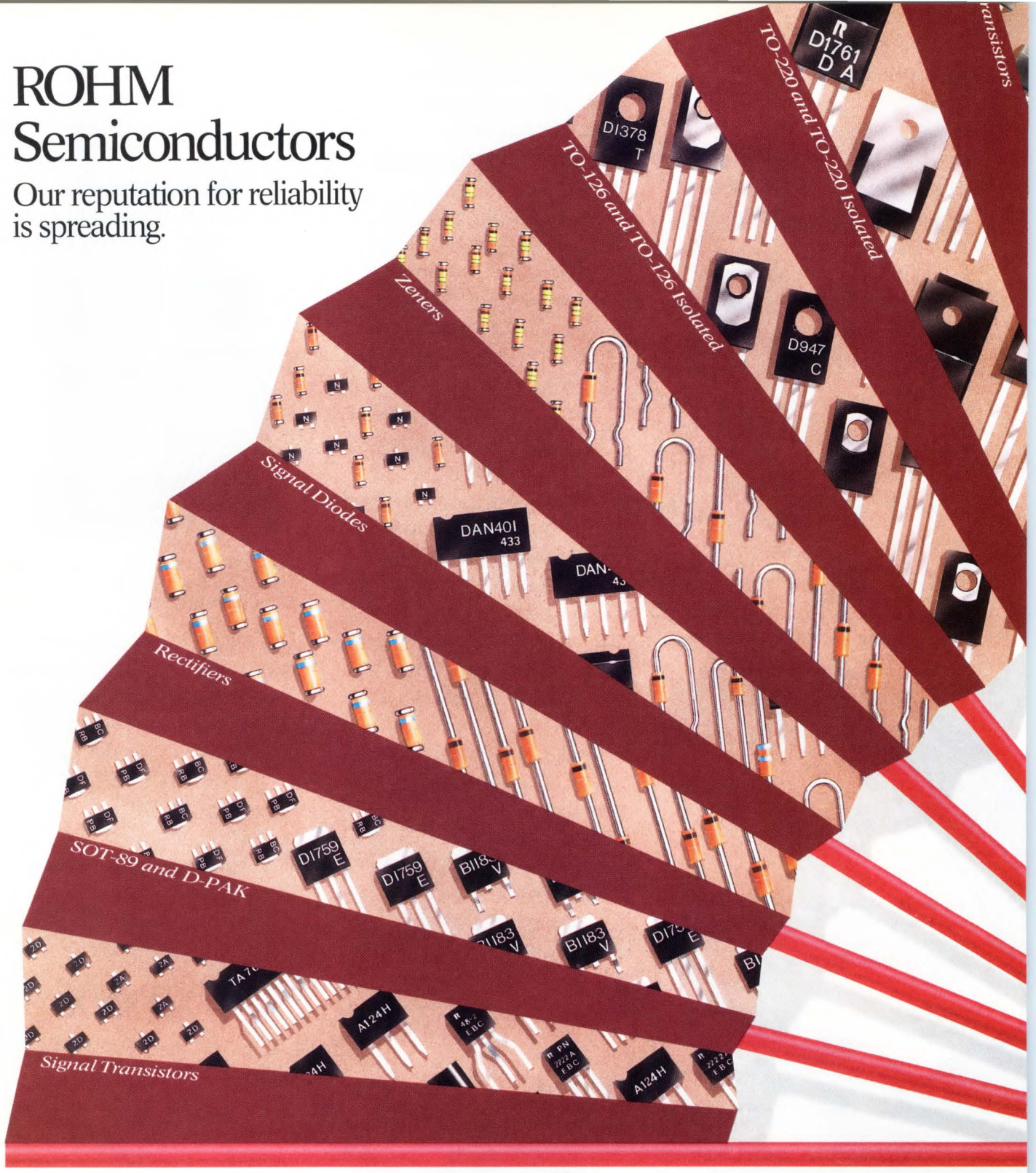

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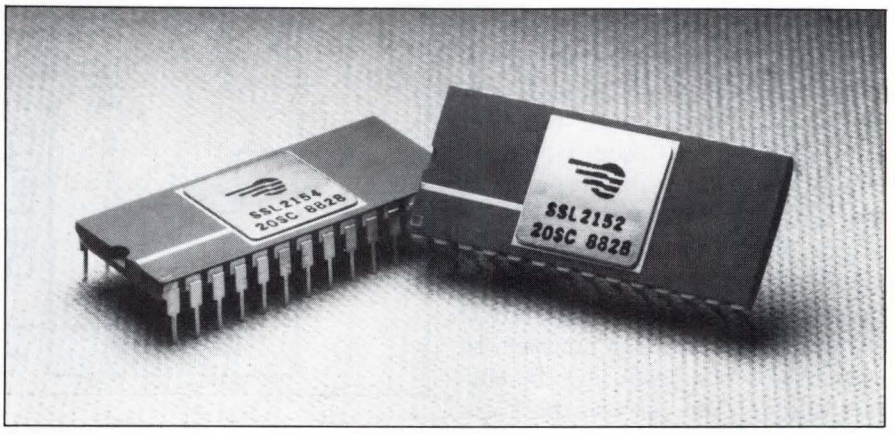
ROHM

CIRCLE NO 38

8-bit cache-address comparators feature 17-nsec delay time

The SSL2152 and SSL2154 are 8-bit cache-address comparators with an on-chip 2k × 9-bit static-RAM array, a parity generator, a parity checker, and a 9-bit comparator. The ninth bit handles parity checking. The bipolar/CMOS ICs feature a delay time, from address-compare to match-output, as fast as 17 nsec. The ICs are completely compatible, in both function and form factor, with the TACT2152/54 devices from Texas Instruments. The inputs and outputs are TTL compatible, and you can cascade both devices to obtain wider tag addresses or a deeper tag-memory size. The SSL2152 has a totem-pole Match output; the SSL2154 has an open-drain Match output that you can use to wire-OR multiple devices. You



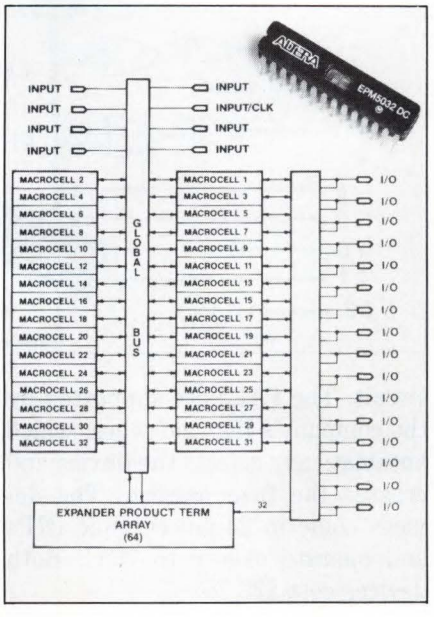
can read data from the RAM at the D_0-D_7 pins. A flash-clear function erases the entire memory for system initialization and context switching. Both devices come in 28-pin, 600-mil, ceramic side-brazed DIPs, ceramic DIPs, plastic DIPs, and PLCCs. A 17-nsec version in a PLCC costs $52 (100).

Saratoga Semiconductor, 10500 Ridgeview Ct, Cupertino, CA 95014. Phone (408) 864-0500. FAX 408 446-4416.

Circle No 559

Erasable PLD operates at 60-MHz system-clock rates

The EPM5032 is an erasable programmable logic device (EPLD) built with the company's multiple-array-matrix (Max) architecture. It features a 20-nsec propagation delay, which lets it operate at clock rates greater than 60 MHz. The chip has 32 macrocells, 64 logic expanders, and an internal global bus for making connections among logic functions. The logic expanders can create extra product terms between macrocells. The EPLD has eight dedicated input pins and 16 pins that you can configure as dedicated inputs, outputs, or bidirectional I/O ports. Because the Max architecture doesn't attach the flip-flops permanently to the I/O pins, you



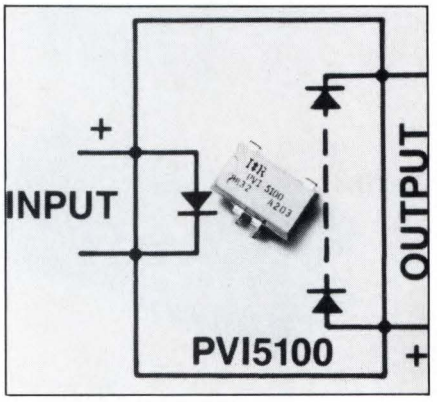
can bury any flip-flop without using up I/O pins. You can program the device with the company's recently released Max + Plus software package for the IBM PS/2 and PC/AT computers. The package accepts schematic inputs or a high-level-language description of the desired logic functions, and it configures the EPLD to accomplish the design. The EPM5032 is available in a ceramic 28-pin DIP; a 20-nsec version costs $31.20 (100). Max + Plus costs $3400 alone; with PLDS-Max programming hardware, it's $4995.

Altera Corp, 3525 Monroe St, Santa Clara, CA 95051. Phone (408) 984-2800.

Circle No 562

Photovoltaic optocoupler provides 5V output without power supply

The PVI5100 Photovoltaic Isolator (PVI) is an optocoupler that provides a 5V output signal at 10 μA for an input signal of 10 mA. The optocoupler doesn't require a power supply; it produces the output voltage from a photovoltaic generator (PVG). The current input to the device drives an internal gallium aluminum arsenide (GaAlAs) LED that causes an infrared emission to strike the PVG, producing the output voltage. You can use the PVIs as inputs to the company's HEXFET power MOSFETs. The dielectric isolation between the input and output is 2500V rms, and the input current range is 2.0 to



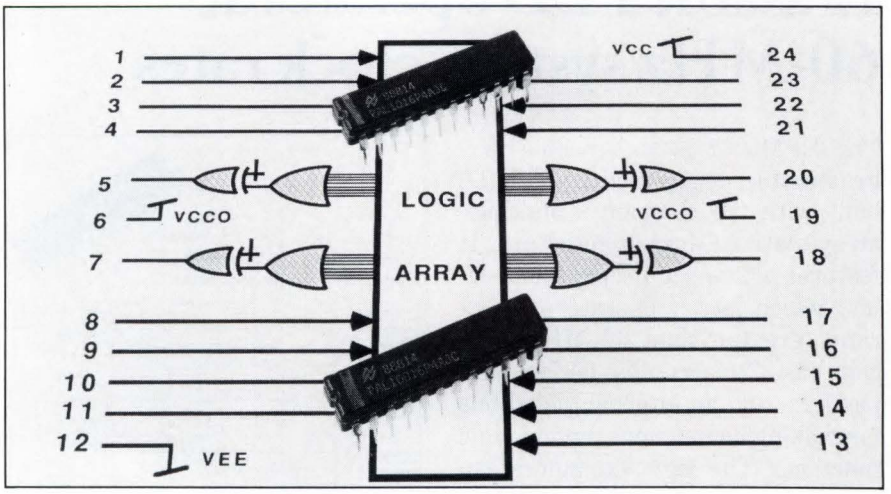
50 mA dc. The optocoupler can also operate with 1A current pulses for pulse widths of 100 μsec at a duty cycle of less than 3%. The maximum input pulse amplitude decreases logarithmically from 1A to 50 mA when the duty cycle is 100%. The device's turn-on time is 10 μsec max for a 10-MΩ load and 15 μsec max for a 1-MΩ load. The turn-off time is 400 μsec max for a 10-MΩ load and 100 μsec max for a 1-MΩ load. The maximum capacitance on the input or output is 1 pF. The LED's forward voltage drop is 1.4V; the short-circuit current is 10 μA for a 10-mA input. The device operates over −40 to +100°C and comes in an 8-pin DIP. $2.37 (1000).

International Rectifier, 233 Kansas St, El Segundo, CA 90245. Phone (213) 607-8869.

Circle No 564

ECL PAL ICs offer a 4-nsec worst-case propagation delay

The PAL1016P4A and PAL10016P4A are ECL PAL ICs with 10 KH and 100K ECL-compatible inputs and outputs, respectively. They feature a worst-case propagation delay of 4 nsec. The PALs are compatible with the company's 6-nsec PAL family, so you can program them with standard PAL programmers. The PALs are essentially combinatorial-logic devices, and they don't have output registers or macrocells. They generate four logic outputs from 16 input lines. Each of the four outputs contains eight product terms for a maximum of 32 product terms per PAL. You can configure each output independently as logical true or false. Once the PALs have been programmed and verified, you can program an additional fuse to disable further verification, which makes it difficult to copy the



circuit. The PALs are supported by the company's Plan software, which automatically selects the device and creates the fuse pattern. The devices come in 24-pin ceramic DIPs and operate over 0 to 75°C. Both devices cost $22.75.

National Semiconductor Corp, 2900 Semiconductor Dr, Box 58090, Santa Clara, CA 95052. Phone (408) 721-6053. TLX 346353. TWX 910-339-9240.

Circle No 565

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And to prove we're not all talk, Hamilton/Avnet and Rockwell stand behind all MONOFAX quality products with a five-year warranty.

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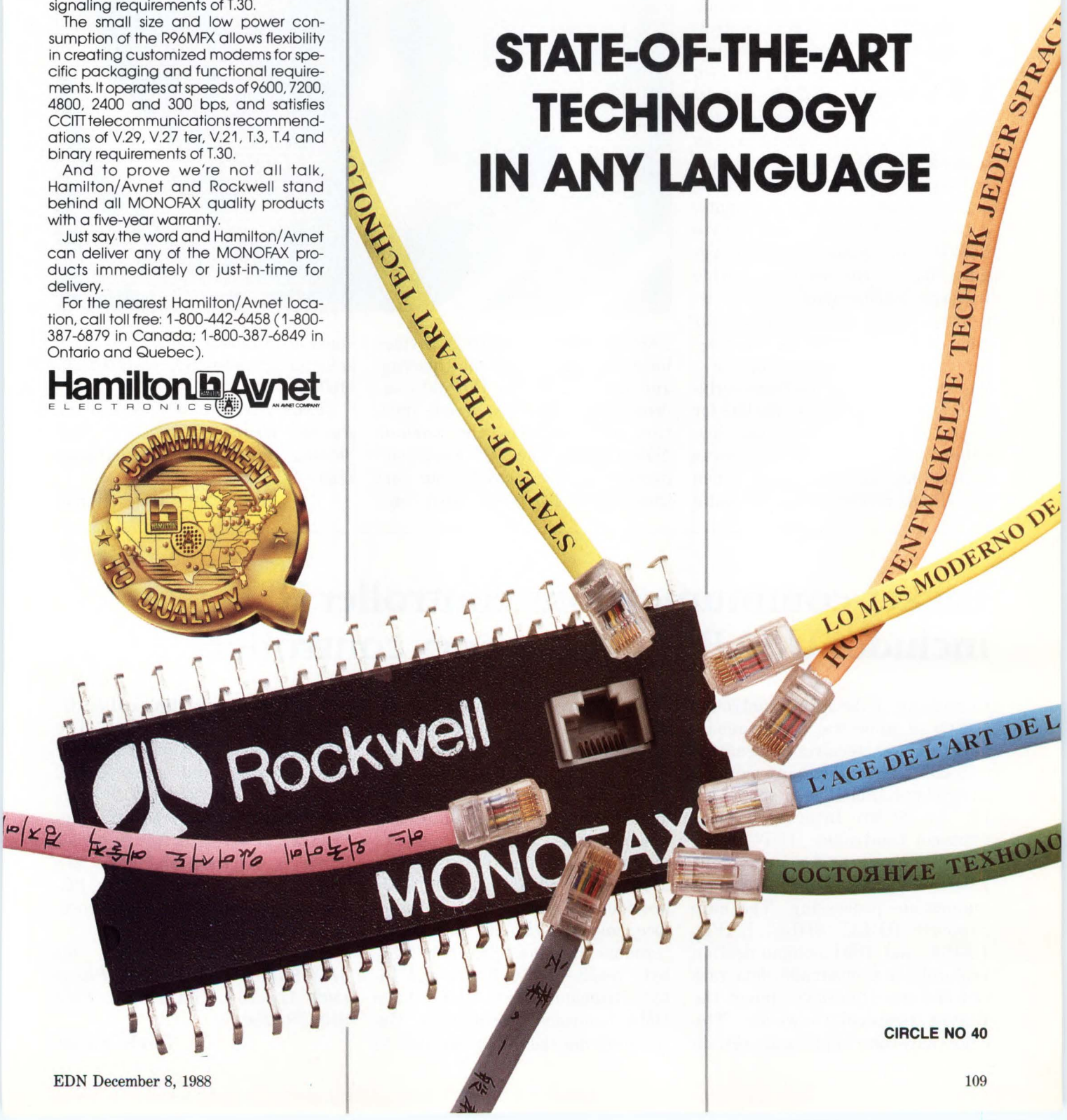
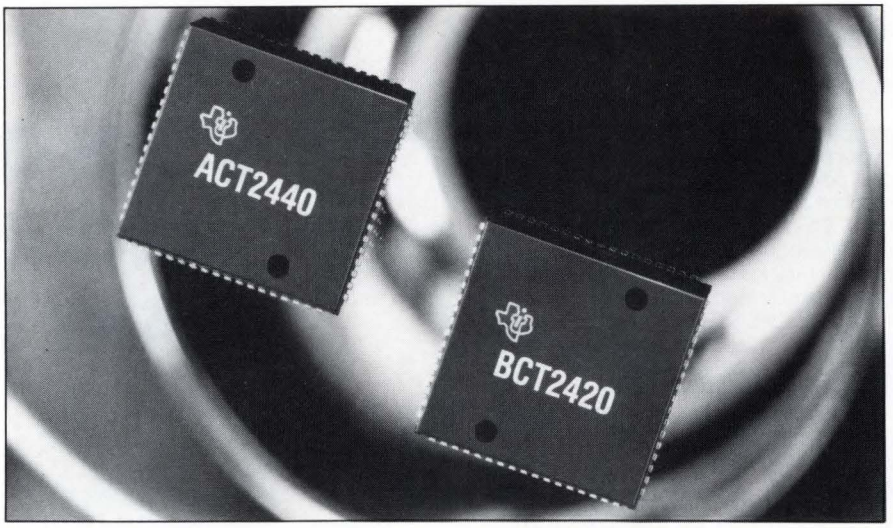


CIRCLE NO 40

Nubus interface chip set reduces development time



The SN74ACT2440 (ACT) and SN74BCT2420 (BCT) are a 2-chip set for interfacing to the Nubus. The ACT is a 32-bit Nubus controller, and the BCT is a 16-bit Nubus transceiver. One ACT and two BCTs implement a 32-bit master/slave interface that conforms to the IEEE P1196 specification. You can organize the ACT's input and output signals into five groups: Nubus status outputs, master/slave inputs, data/address interface control, byte decode, and Nubus card-slot signals. The status outputs provide buffered Nubus signals. The master/slave inputs control the master and slave state machines. The master state machine initiates bus locking and unlocking, performs arbitration, and provides status bits for cycle control. The slave state machine monitors the Nubus status and notifies the local board when the Nubus addresses it. The data/address interface control provides buffered signals for multiplexing and demultiplexing the data/address lines. The byte-decode function differentiates the various Nubus cycles. The BCT has a comparator for slot identification, and three 16-bit I/O ports. Both chips come in 68-pin packages. The ACT sells for $24; the BCT costs $13.33 (1000).

Texas Instruments, Semiconductor Group (SC 850), Box 809066, Dallas, TX 75380. Phone (800) 232-3200, ext 700.

Circle No 551

Packet-communications-controller IC includes USART and memory controller

Combining a data-link controller (DLC), a universal synchronous/asynchronous receiver/transmitter (USART), and a dual-port memory controller (DPMC) in a single IC, the Am79C401 Integrated Data Protocol Controller (IDPC) provides a platform for intelligent ISDN, X.25, SNA, and LAN communication processing. The chip supports HDLC, SDLC, LAPB, LAPD, and DMI communication protocols at a maximum data rate of 2.048 bps. It doesn't support the Bisync protocol, however. The chip's hardware implements certain HDLC Layer-2 functions, such as: short- and long-packet checking, received-packet length counting, Flag and Abort or Flag and Mark Idle generation and checking, bit-residue handling, and zero-bit inserting and deleting. The chip operates with no wait states when used with a 12.5-MHz 80188 μP. The DLC provides the packet network interface, and the USART provides a terminal interface. The chip's 32-byte receive FIFO buffer and 16-byte transmit FIFO buffer have DMA handshake capabilities. You can program the serial interface to run in either nonmultiplexed or 31-time-slot multiplexed mode. The chip comes in a 68-pin PLCC or LCC package and costs $20.52 (100). The Am79LLD401 Low-Level Driver software package provides a common interface to higher layers of software and costs $18 (100). The ITC board, a plug-in, PC-compatible evaluation board, costs $1750.

Advanced Micro Devices, Box 3453, Sunnyvale, CA 94088. Phone (800) 538-8450. TLX 346306. TWX 910-339-9280.

Circle No 550

Sorry, no checks for Intel ICE.

	AMC	Intel
▶ Supports the new 16 MHz 80C186 and 80C188 as well as other Intel CPUs at full speeds with no wait states	✓	
▶ VALIDATE/Soft-Scope is a complete in-circuit source level debugger that shows variables, data structures and assembly instructions	✓	
▶ VALIDATE/Soft-Scope has in-circuit source level debug capability in 286 protect mode	✓	
▶ Tool chain supports Microsoft C (Also other versions of C and Pascal, FORTRAN, PL/M, Assembler, Jovial)	✓	
▶ Add processor support by merely adding emulator board and probe module	✓	
▶ Has unlimited breakpoint capability	✓	
▶ Over a megabyte of overlay memory is available	✓	

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In Japan contact Applied Microsystems Japan, Ltd., Nihon Seimei Nishi-Gotanda Building, 7-24-5 Nishi-Gotanda Shinagawa-KU, Tokyo T 141 Japan. Call 03-493-0770.

CIRCLE NO 41

Token-bus-controller IC simplifies MAP-network interfaces

In conjunction with the company's SAB82511 token-bus modem, the SAB82510 token-bus controller implements a 1M-, 5M- or 10M-bps carrierband network interface that conforms to the IEEE-802.4 standard. As a result, the device is suitable for use in equipment that connects to MAP (Manufacturing Automation Protocol) or Proway factory-automation networks. You can also operate the controller at 20M bps on a fiber-optic link and interface it to a broadband modem.

The SAB82510 performs OSI-model layer-2 MAC (media access control) functions. It communicates with a host-system processor via shared memory and employs a set of high-level commands that you can link as chained command blocks. To maximize throughput, it has a 10-channel on-chip DMA controller that supports the command



block chain, four prioritized levels of transmit-frame data chain, four prioritized levels of receive-frame data chain, and the IEEE-802.4 immediate response (request-with-response) mechanism. It also has a real-time-clock feature that lets you synchronize token-bus stations to real time to within 2-msec accuracy.

The controller's host interface is pin-programmable: It can operate on an 80186 or a 68000μP bus. However, the shared-memory communication scheme lets you interface the device to other μPs. The CMOS SAB82510 operates from one 5V supply. It comes in a 68-pin plastic leaded chip carrier and costs $94 in sample quantities.

Siemens AG, Zentralstelle für Information, Postfach 103, 8000 Munich 1, West Germany. Phone (089) 2340. TLX 5210025.

Circle No 570

Siemens Components Inc, 2191 Laurelwood Rd, Santa Clara, CA 95054. Phone (408) 980-4500.

Circle No 571

Delta codec meets requirements for military communications

Meeting the requirements of the NATO Eurocom D1-IA8 specification, the FX619 full-duplex, single-chip CVSD (continuously variable slope delta) codec is suitable for use in a variety of military communications systems. It can be used in data mutiplexers, switches, and telephones. Because it includes both encoder and decoder sections, as well as the audio filters that are required on the encoder input and decoder output, the device can significantly reduce component counts, particularly on multichannel line cards. You can program the delta codec's sampling rate to 16k, 32k, or 64k bps. An on-chip oscillator that requires a 1.024-MHz crystal provides the timing for the device's switched-capacitor filters and CVSD modulator and demodulator. You can also use an external clock to sample in the 8k- to 64k-bps range. For multiplexer applications, an enable input allows you to enable or disable the encoder section of the device. You can program the device to perform either a 3-bit or a 4-bit companding algorithm. The chip comes in a 22-pin ceramic DIP or a 28-lead ceramic surface-mount package. It operates over −40 to +85°C, is processed to MIL-STD-883C requirements, and sells for £20 (1000).

Consumer Microcircuits Ltd, 1 Wheaton Rd, Witham, Essex CM8 3TD, UK. Phone (0376) 513833. TLX 99382.

Circle No 553

Mx-Com Inc, 4800 Bethania Station Rd, Winston-Salem, NC 27105. Phone (919) 744-5050.

Circle No 554

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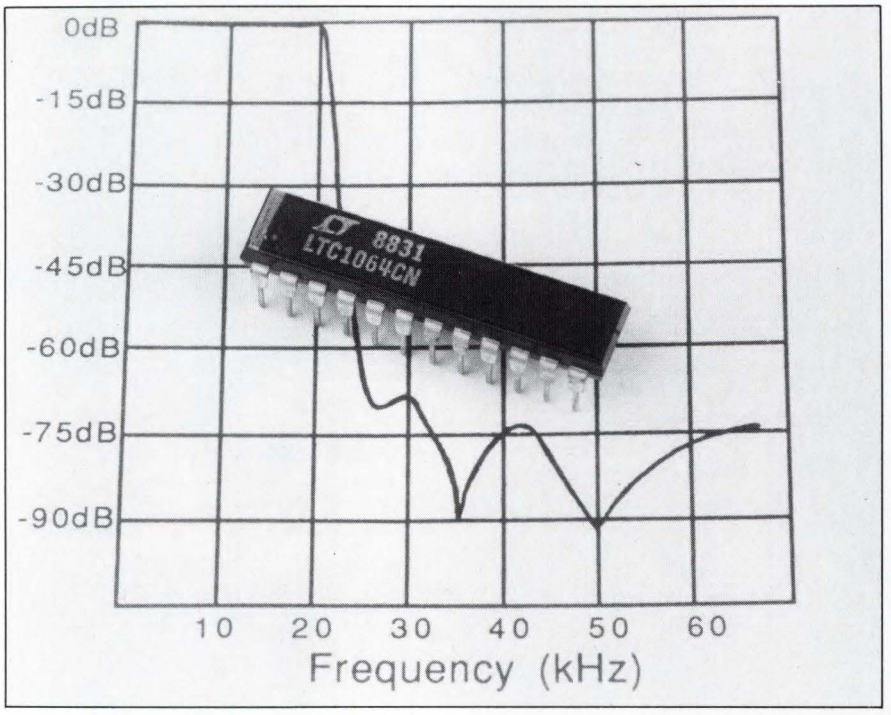
S-MOS SYSTEMS

S-MOS Systems, Inc.
2460 North First Street
San Jose, CA 95131-1002

CIRCLE NO 42

Switched-capacitor filters operate with 7-MHz clock frequencies

The LTC1064 contains four switched-capacitor-filter building blocks. Each block operates with an external clock and three to five external resistors to realize second-order lowpass, highpass, bandpass, and notch filters. The center frequency can range from 0.1 Hz to 100 kHz at a circuit Q of 10. The center frequency can be extended to 140 kHz when the circuit Q is less than 5. The input frequency can range as high as 500 kHz. You can realize eighth-order filters with the IC by cascading all four second-order sections. The IC lets you design any of the classical filters, such as Chebyshev, Butterworth, Cauer, and Bessel filters. It can operate at a clock frequency as high as 7 MHz and from power supplies that range from ±2.37 to ±8V. The chip has three modes of operation: mode 1 allows all sections to operate with a clock-frequency-to-center-frequency ratio (f_{CLK}/f_O) of 50:1; mode 2 lets all the sections operate with an f_{CLK}/f_O equal to 100:1. Mode 3 permits you to operate two sections with an f_{CLK}/f_O of 50:1 and the other two sections with an f_{CLK}/f_O of 100:1. The clock feedthrough is typically 0.2 mV rms for clock frequencies less than 1 MHz. The IC comes in a 24-pin plastic or ceramic DIP and costs $8.40. Delivery is from stock to 6 weeks.



Linear Technology Corp, 1630 McCarthy Blvd, Milpitas, CA 95035. Phone (800) 637-5545.

Circle No 567

Modem processor implements networking protocol for error-free communication

The SC11013/SC11006 is a chip set that implements the Microcom Networking Protocol (MNP) in a 2400-bps modem. The chip set provides two modes of operation. The direct mode allows the modem to function as a standard 2400-bps, Hayes-compatible modem. In the autoreliable mode, the modem can communicate with modems that don't have the MNP implemented. After the modem-handshake sequence is completed, an answering modem looks for the protocol characters from the originating modem. If the modem detects the error-correction characters within 8 sec, the MNP begins to control data transmission. If the characters are not detected, the modem makes a normal connection. The MNP protocol eliminates the need for both the transmitter and the receiver to run the same block-transmission protocols. You can connect any system to a modem and automatically send error-free data. In addition, the protocol compresses data, offering rates to 2900 bps with a 2400-bps modem. To implement the MNP in a standard modem, you'll need an 8k × 8-bit static RAM; an 8530-type USART; and the following logic circuits: a 4053, 74HC08, 74LS74, and 74HC27. The chip set alone costs $33.50.

Sierra Semiconductor, 2075 N Capitol Ave, San Jose, CA 95132. Phone (408) 263-9300. TLX 384467.

Circle No 552

SIEMENS

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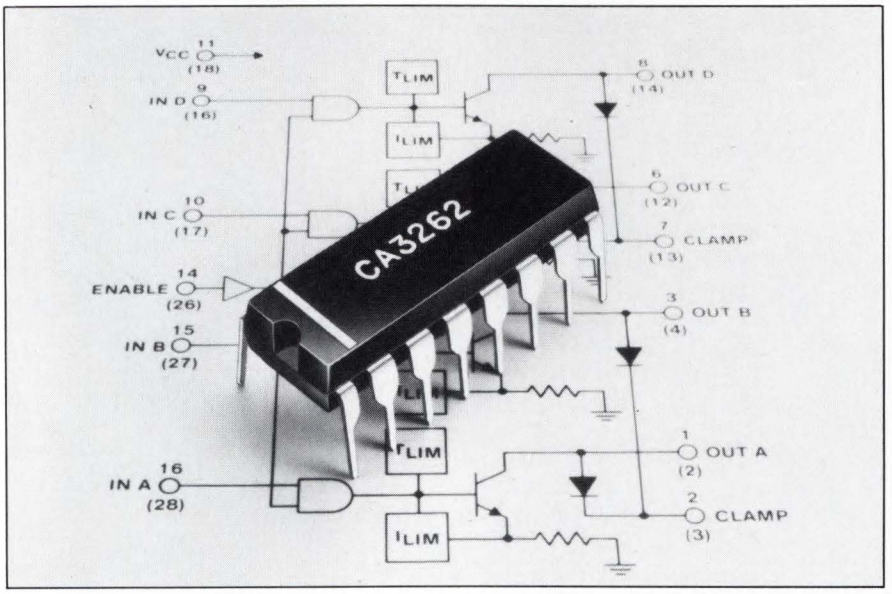
CIRCLE NO 43



Quad-driver power switch has on-chip current and thermal protection

The CA3262 quad-driver power switch is a bipolar device for interfacing logic signals to high-current resistive or inductive loads. It contains four independent driver circuits that can switch output currents greater than 700 mA. The chip has four 2-input logic circuits that connect to open-collector output transistors. The inputs to the device can be either CMOS or TTL compatible. Each output transistor has a metallic current sensor that develops a voltage proportional to the current. The voltage is amplified and fed back to a current-limiting amplifier in the transistor's base. The feedback limits the output current to between 0.7 and 1.5A. The maximum saturation voltage is 0.6V at 700 mA. In addition, each output transistor has a temperature-sensing diode that thermally limits the output current whenever the transistor's temperature exceeds 150°C. Each output transistor connects to internal clamp diodes to limit inductive transients. You can connect the open-collector outputs to supply voltages ranging to 35V dc. The chip comes in either a 16-lead plastic DIP or a 28-lead PLCC and costs $2.87.



GE Solid State, Box 2900, Somerville, NJ 08876. Phone (201) 685-6713.

Circle No 568

Static RAMs have on-chip address and data latches for pipelining

The TR9C1640 and the TR9C1643 are 16k × 4-bit static RAMs that contain address and data latches. The address latch frees the system-address bus after the device is enabled, and the transparent data latch gives your system extra time to accept previously fetched data while the static RAM executes a new read cycle. The static RAMs employ a common bus for the four data I/O lines. The TR9C1640, which comes in a 22-pin DIP, has two control lines: $\overline{E}$ (enable) and $\overline{W}$ (write). The falling edge of the enable signal initiates a memory cycle and freezes the address in the static RAM's address registers. After this falling edge on the $\overline{E}$ input, your system can change the state of the address lines without affecting the current memory cycle. Pipelined memory systems frequently need this extra latitude on address-line timing. During a TR9C1640 write cycle initiated by the write-control line, the static RAM drives the data I/O lines until $\overline{W}$ is asserted. The assertion of $\overline{W}$ causes conflicts in some systems, so the TR9C1642 includes the $\overline{G}$ control line, which gives you an extra way to shut off the static RAM's output drivers. The $\overline{G}$ output-enable command adds an extra pin, so the TR9C1643 comes in a 24-pin DIP. Both static RAMs come in 25-, 35-, and 45-nsec versions that cost $15.75, $12.75, and $9.25 (1000), respectively.

Triad Semiconductors Inc, 5575 Tech Center Dr, Suite 120, Colorado Springs, CO 80919. Phone (719) 528-8574. FAX 719-528-8875.

Circle No 569

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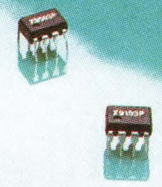

Part No.	Max. Resistance
X9103	10K Ω
X9503	50K Ω
X9104	100K Ω

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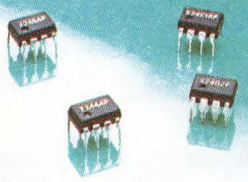
SERIAL I/O

E²PROMS AND NOVRAM



Part No.	Organization
X2402	256 x 8
X2404	512 x 8
X24C04	512 x 8
X24C16	2048 x 8
X2444	16 x 16

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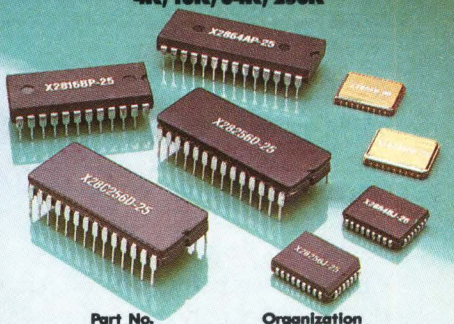
E²PROMs

4K, 16K, 64K, 256K



Part No.	Organization
X2804A	512 x 8
X2816B	2K x 8
X2864A	8K x 8
X2864B	8K x 8
X2864H	8K x 8
X28256	32K x 8
X28C256	32K x 8

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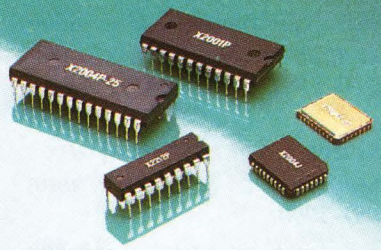
NOVRAMs*



Part No.	Organization
X2201A	1K x 1
X2210	64 x 4
X2212	256 x 4
X2001	128 x 8
X2004	512 x 8

*NOVRAM is Xicor's nonvolatile static RAM device.

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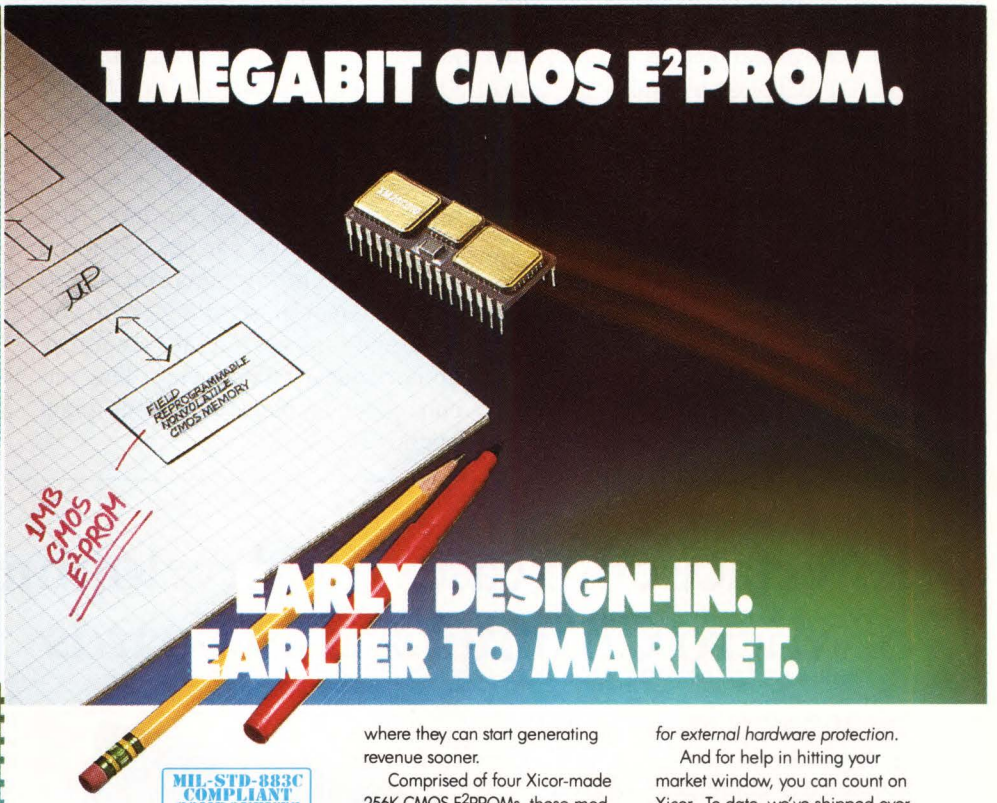
1 MEGABIT CMOS E²PROM.



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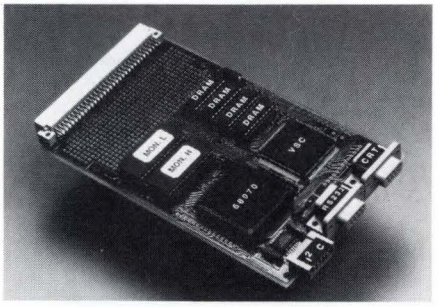
CIRCLE NO 44

Video- and system-controller IC promises low-cost 16/32-bit color computers

With the company's 68070 μP or other 68000-family μPs, the 66470 video-and system-controller IC forms the nucleus of a 16/32-bit color computer. The device incorporates a dynamic-RAM controller, display-control logic, a pixel accelerator, and an interface for an optional image coprocessor. Its system-controller functions include reset, address decoding, interrupt, and DTACK-generation logic, plus a watchdog timer.

The on-chip address decoder provides chip-select lines for as much as 1.5M bytes of video/system RAM, 0.5M bytes of ROM, and 1k byte of peripheral I/O space. You can configure as much as 1M byte of the RAM as video memory to provide 768×560-pixel, 16-color or 384×280-pixel, 256-color displays. Lower screen resolutions are also



possible. You can program the video start address anywhere within the video RAM, configure the video RAM for logical or physical screen modes, and generate screens with colored borders. You can also achieve a variety of special effects, including horizontal and vertical smooth scrolling, and you can divide the screen into a number of horizontal subscreens. The on-chip pixel accelerator speeds pixel manipulation.

The 66470 provides a digital output for an external D/A converter or color look-up table; its timing is compatible with European, Japanese, and US TV and Teletext standards. You can also operate the video RAM as a frame grabber. The chip comes in a 124-pin, quad flat-pack, surface-mount package. Samples cost $50 (100). Functionally enhanced production parts will be available during 1989 at $25 (100), and, by 1991, the 68070/66470 chip set should sell for around $30 in high volume.

Philips, Components Div, 5600 AM Eindhoven, The Netherlands. Phone (040) 757189. TLX 51573.

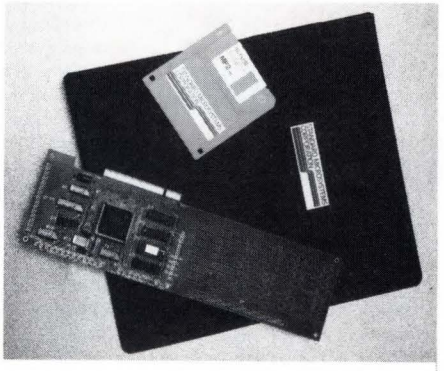
Circle No 555

Signetics Corp, 811 E Arques Ave, Sunnyvale, CA 94088. Phone (408) 991-2000.

Circle No 556

Interface chip eases the development of Micro Channel add-in boards

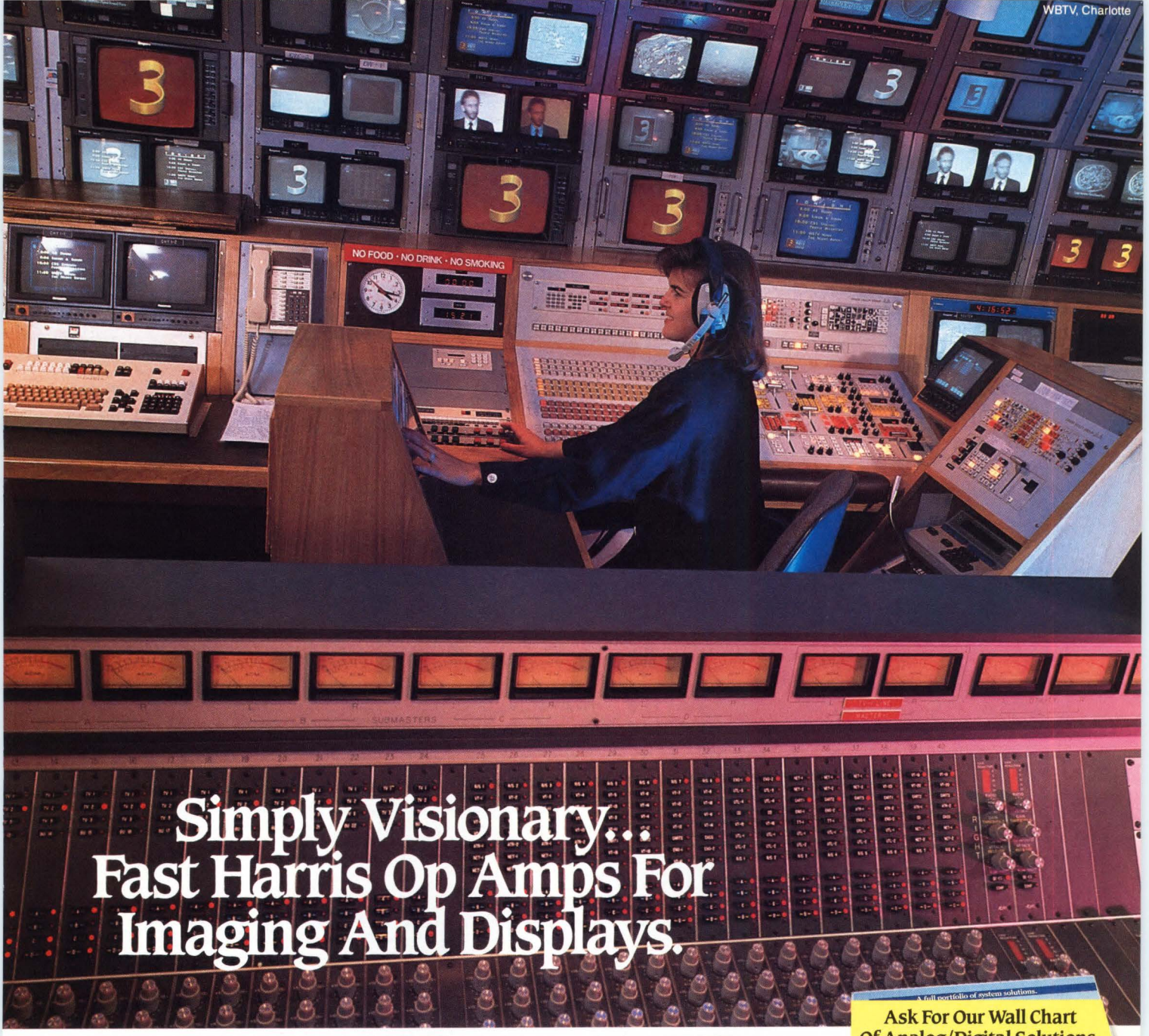
The MC194C18 Micro Channel Interface Circuit (μCIC) is a CMOS device that simplifies the design of plug-in boards for IBM PS/2 computers. The 68-pin IC implements all of the mandatory functions of the Micro Channel bus, as well as a number of optional functions. To support the Programmable Option Select (POS) function, the IC provides the signals needed to place the card ID data on the bus. Three additional POS registers implement the mandatory bits defined by IBM. The chip supports two independent DMA channels from the plug-in board. After arbitrating on the bus for a DMA cycle, the chip allows



single- or multiple-cycle (burst) data transfers. The chip includes a local bus-arbitration circuit, which simplifies the implementation of a shared-memory function on an adapter board. It also features an interrupt interface that lets you map four user-interrupt sources, in one-to-one or many-to-one fashion, to four interrupt-request signals on the bus. You can use an on-chip timer/frequency generator as a fifth interrupt source. The chip supports both asynchronous and synchronous extended cycles. It also has a programmable wait-state generator, which simplifies the interface to slow memory or I/O peripherals. It costs $8.85 (1000).

Standard Microsystems Corp, 35 Marcus Blvd, Hauppauge, NY 11788. Phone (516) 273-3100. FAX 516-273-3123.

Circle No 557



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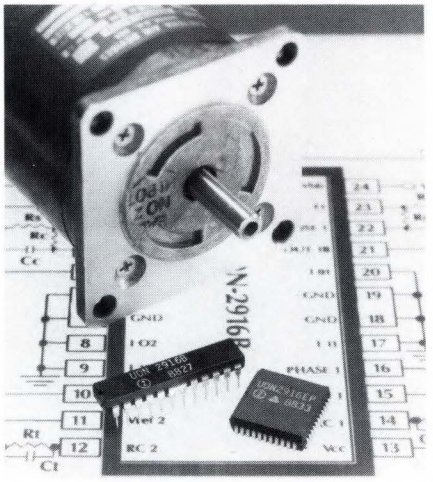
Dual full-bridge PWM motor drivers provide bipolar drive in a single package

The UDN2916B and UDN2916EB are dual full-bridge, motor-driver ICs. Each device has two full bridges with clamping and flyback diodes for protection against inductive loads. Internally generated delays prevent crossover currents from flowing when the current direction is switched. Self-resetting, internal thermal-protection circuitry disables the outputs whenever the chip's temperature exceeds 160°C; the circuitry re-enables the outputs at 150°C. Each bridge has its own independent PWM circuitry and is capable of sustaining 45V. Under PWM control, each bridge can furnish continuous output current as high as ±750 mA and start-up current of



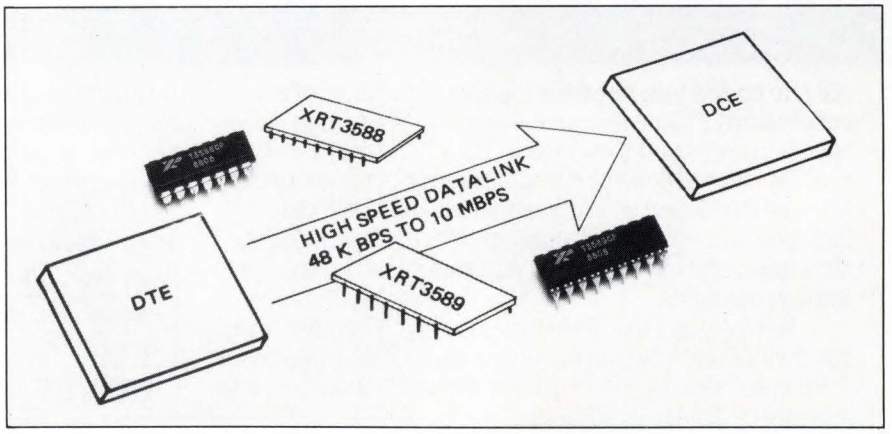
±1A. The output-saturation voltage is less than 1.8V (source plus sink) at an output current of ±500 mA. The maximum output current for each bridge is set by an external reference voltage and an external sense resistor. A digital phase input controls the direction of the motor-winding current flow. Both devices operate over −20 to +85°C. The UDN2916B comes in a 24-pin plastic DIP and dissipates 3.125W at 25°C. The UDN2916EB comes in a 44-lead plastic leaded chip carrier for surface mounting and dissipates 4.16W at 25°C. The UNN2916B costs $2.09; the UDN2916EB is $2.41 (1000). Delivery is eight to 12 weeks ARO.

Sprague, Semiconductor Group, Box 2036, Worcester, MA 01613. Phone (508) 853-5000. FAX 508 853-5049.

Circle No 558

Interface chip set meets CCITT V.35 and BELL 306 specifications

The XR-T3588 and XR-T3589 comprise an interface chip set that conforms to the CCITT V.35 and Bell 306 specifications. The set permits communications between data-terminal equipment (DTE) and data-communications equipment (DCE) at rates from 48k to 10M bps. The XR-T3588 has three independent transmitters, which employ an internally temperature-compensated voltage source in order to meet the pulse-shape and offset requirements of the V.35 spec. The XR-T3589 contains three independent line receivers, which convert differential signals to TTL-compatible outputs. The line receivers meet the V.35 noise and common-mode specifications. To meet the line-impedance specification, the chip

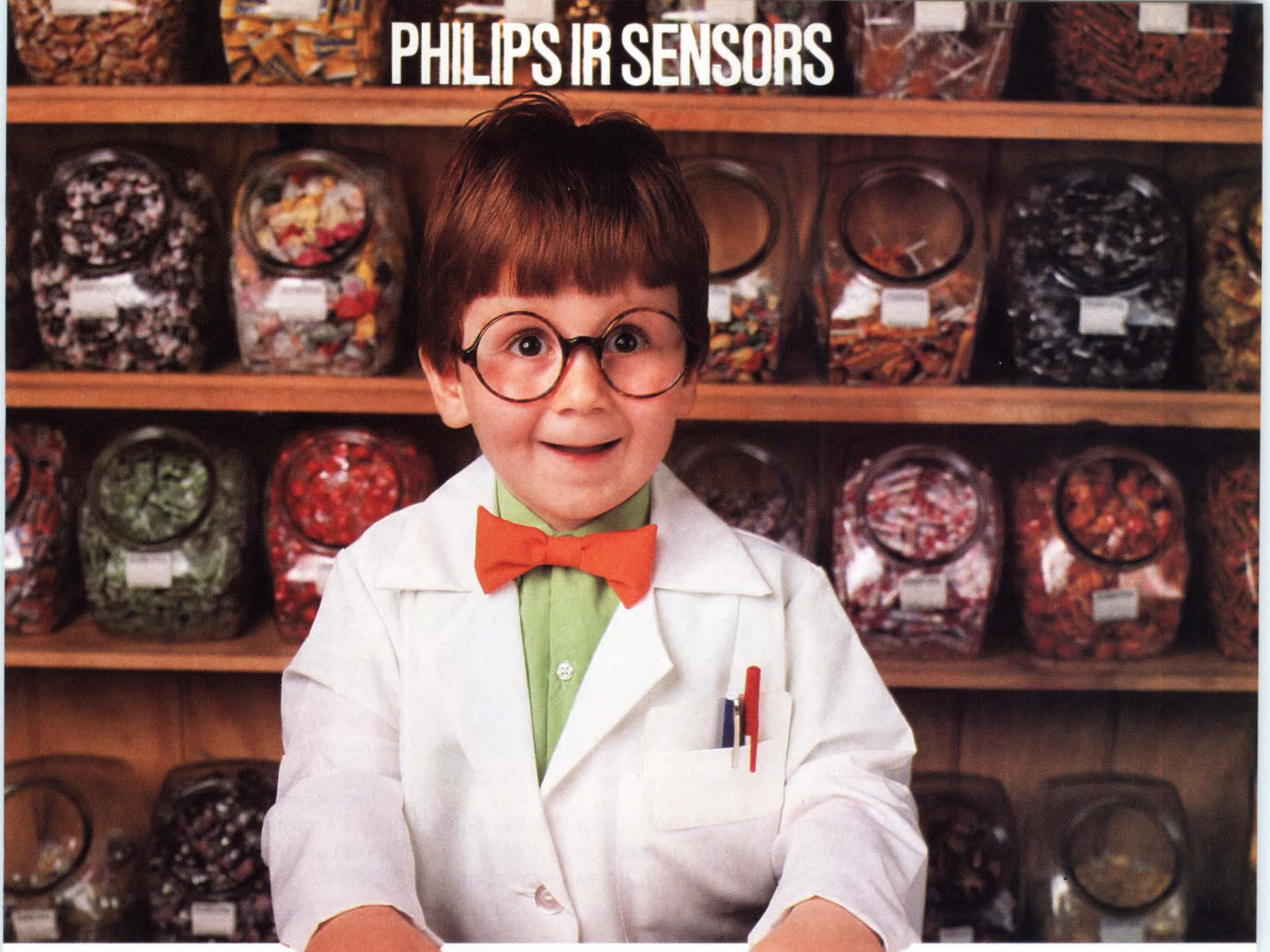


set requires external termination resistors. Each IC has two TTL-compatible inputs, which can power down individual transmitters or receivers in applications that don't require three channels. The transmitter comes in a 14-pin DIP, and the receiver comes in an 18-pin DIP. The chip set costs $4.18 (5000).

Exar Corp, 2222 Qume Dr, Box 49007, San Jose, CA 95161. Phone (408) 434-6400. FAX 408-943-8245. TWX 910-339-9233.

Circle No 561

PHILIPS IR SENSORS



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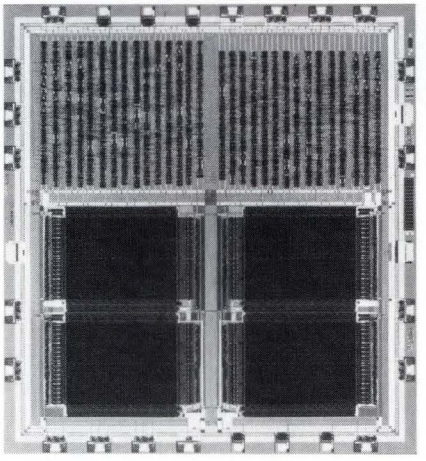
In Canada: Philips Electronics Ltd., 601 Milner Ave., Scarborough, Ontario M1B 1M8 (416) 292-5161

Bidirectional FIFO buffer provides full-duplex asynchronous communication

The 67C4701 is a 512×8-bit FIFO buffer that exchanges data bidirectionally between devices that use different data rates. It provides full-duplex asynchronous communication between two CPUs operating in a multiprocessing mode or between a CPU and a peripheral device. It can accept and transfer data asynchronously and simultaneously at data rates ranging from 0 to 16.7 MHz. The FIFO buffer is based on a dual-port CMOS RAM cell containing two 512×9-bit FIFO buffers. The ninth bit is reserved as a framing or parity bit. Each port writes into one FIFO buffer and reads from the other one. A byte-

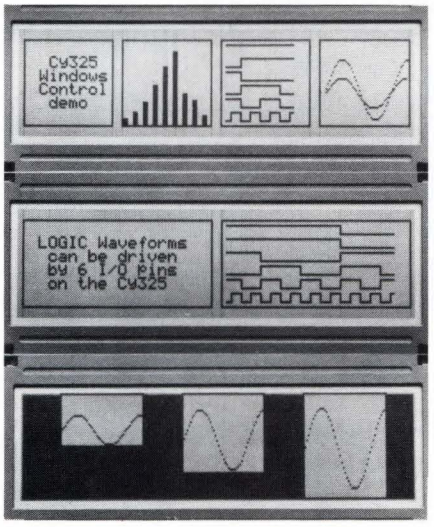


detect feature compares the value of the bytes being read with a preprogrammed 8-bit value in an internal register. When the two values match, the device generates an interrupt that indicates a byte detect. The chip also generates framing bits as a means of identifying specific data or command blocks. This feature reduces the overhead required to search the FIFO buffer for desired information. Programmable almost-full and almost-empty flags let you tailor the flag positions for individual systems. The IC comes in a 28-pin plastic DIP and costs $42.50 (100).

Advanced Micro Devices Inc, 901 Thompson Pl, Box 3453, Sunnyvale, CA 94088. Phone (408) 732-2400. **Circle No 563**

Windows-controller IC manages windows on graphic LCD

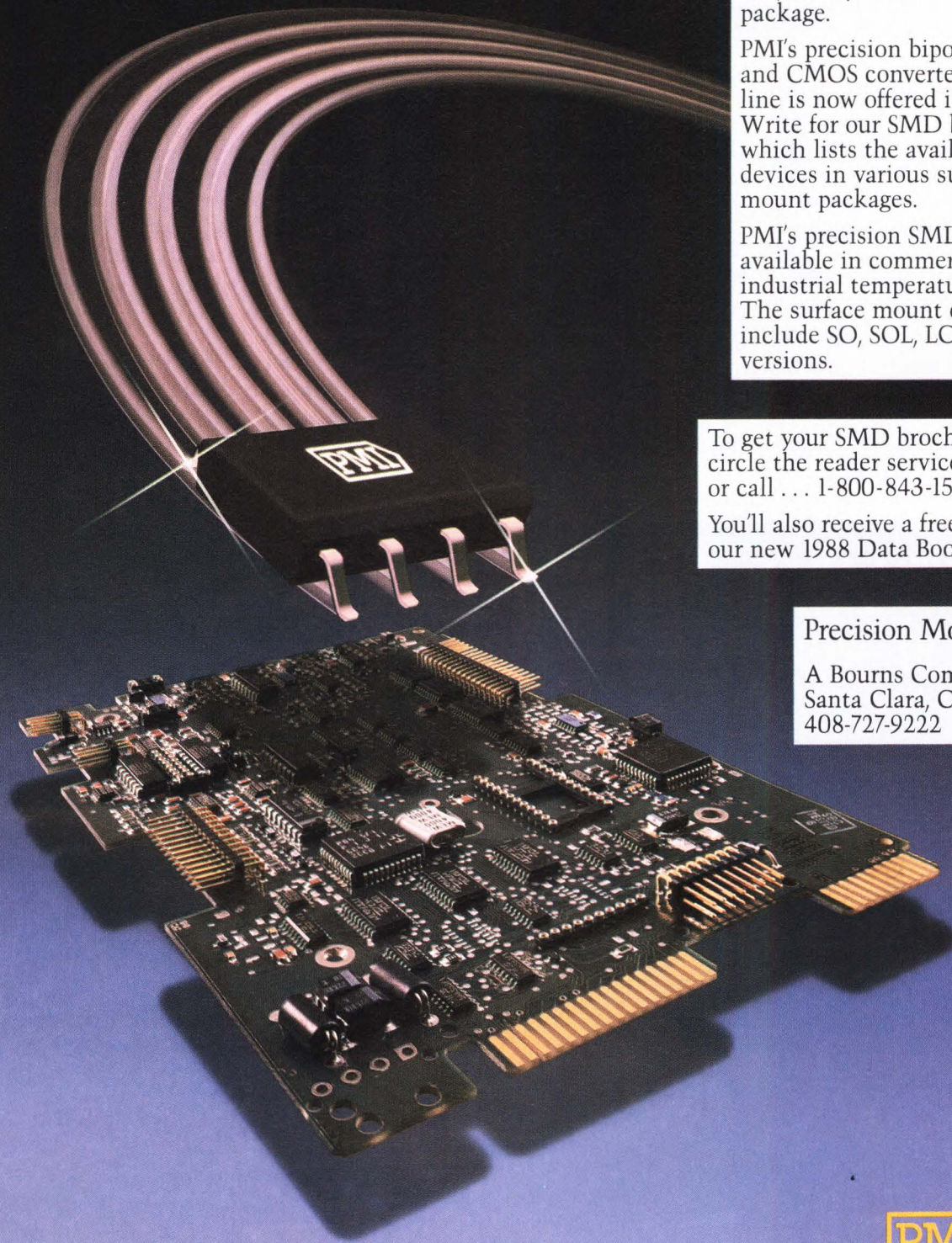
The CY325 Windows Controller creates and manages windows on graphic LCD displays having a resolution of 240×128 pixels. You can select any of more than 200 default or built-in window functions with a single command. You can write both text and graphics into the current windows; they offer automatic cursor management, clipping, and scrolling. You can write text and graphics independently, erase them, or overlay them in a single window, or you can write text to one window and graphics to another. You can define windows within windows. By simply specify-



ing the heights of the bars as arguments, you can generate bar graphs. A plotting feature lets you plot a graph in a specific window. Another feature generates logic waveforms from six digital-input pins. The device has both parallel and serial TTL interfaces, and you can attach it to the company's CY233-LINC Local Intelligent Network Controller, which lets you connect as many as 255 LCD displays to a single serial I/O port. $75.

Cybernetic Micro Systems, Box 3000, San Gregorio, CA 94074. Phone (415) 726-3000. TWX 910-350-5842. **Circle No 560**

Finally . . . Precision In Surface Mount Devices



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CIRCLE NO 163

Two-chip set provides Micro Channel interface for memory boards

The EL2010 is a 2-chip set that provides an interface for 16-bit memory-expansion boards for the IBM PS/2 Micro Channel bus. The chip set supports as much as 16M bytes of memory and allows you to mix 256k- and 1M-byte dynamic-RAM chips. The two chips contain identical circuitry and perform complimentary functions. One chip performs memory-address multiplexing, translational RAM control, and address comparison for two serial I/O ports and one parallel I/O port. You can designate the serial ports as COM2 to COM8, and the parallel port as LPT2 or LPT3. The parallel ports are automatically directed to the proper channel when the software selects LPT2 or LPT3. The other chip handles timing and control signals. The control signals include memory-control lines, parity control and checking, data-buffer enabling, Micro Channel status feedback, and I/O-control lines. Both chips contain a full complement of POS registers, which are written to when the host initializes the card. To avoid conflicts, each chip responds to different read commands from the POS registers. The host can enable, disable, and reassign optional onboard ROM under software control by using the POS registers. The chip set provides two selectable, authorized board-ID codes. $35 (1000).

Edson Laboratories Inc, 9 Spring St, Waltham, MA 02154. Phone (617) 647-9300. TLX 853664.

Circle No 566

Wouldn't you like to reduce the overall height of your appliance by 65%

At the same time, you can also save 14% volume in your battery compartment and reduce the battery weight by 18%.

VARTA Ni-Cd button cells offer you the optimum wh/l and wh/kg, making space available for promotional extra-features.

Excellent Price/Performance Ratio, Low Self-Discharge, Rugged Construction, High Charging Efficiency and Good Load

Performance of VARTA Ni-Cd button cells equip your product with a much higher degree of market acceptance.

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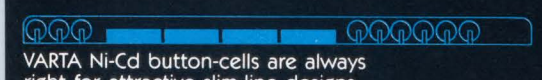

VARTA Ni-Cd button-cells are always right for attractive slim-line designs.



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CIRCLE NO 47

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Who offers you the broadest line of power semiconductors... Darlington, FETMOD™, MOSBIP™ SCR/diode modules, rectifiers and thyristors?

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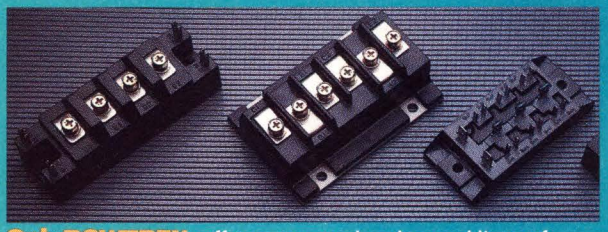

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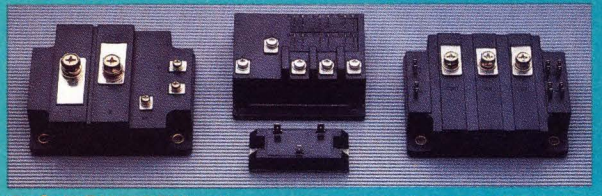
Only POWEREX offers you a complete line of low-power triacs and SCRs as part of the broadest line of power semiconductors available.



Only POWEREX offers you more advanced Darlington modules, including Application Specific (ASM™) modules: Single device, Phase-Leg, H-Bridge, Three Phase, Chopper and Common Emitter, 5-600 A, with $V_{CEV(SUS)}$ from 200 to 1400 V.



Only POWEREX can provide a modular solution for all the key power components from logic interface devices, input rectifiers and DC regulating components to the output power stage. POWEREX now offers the world's widest array of input power stage thyristor and diode modules. Ratings of 20-800 A, with V_{DRM}/V_{RRM} from 400 to 3000 V. Circuit configurations include Single device, Phase-Leg, Three Phase Bridge and Center Tap in common cathode or common anode configuration.

Recent additions to the product line are a family of Center Tap fast recovery diodes rated at 20-100 A up to 1200 V, a new compact 150 A/1600 V Dual thyristor module, and a new 1200 V/300 A GTO thyristor module.

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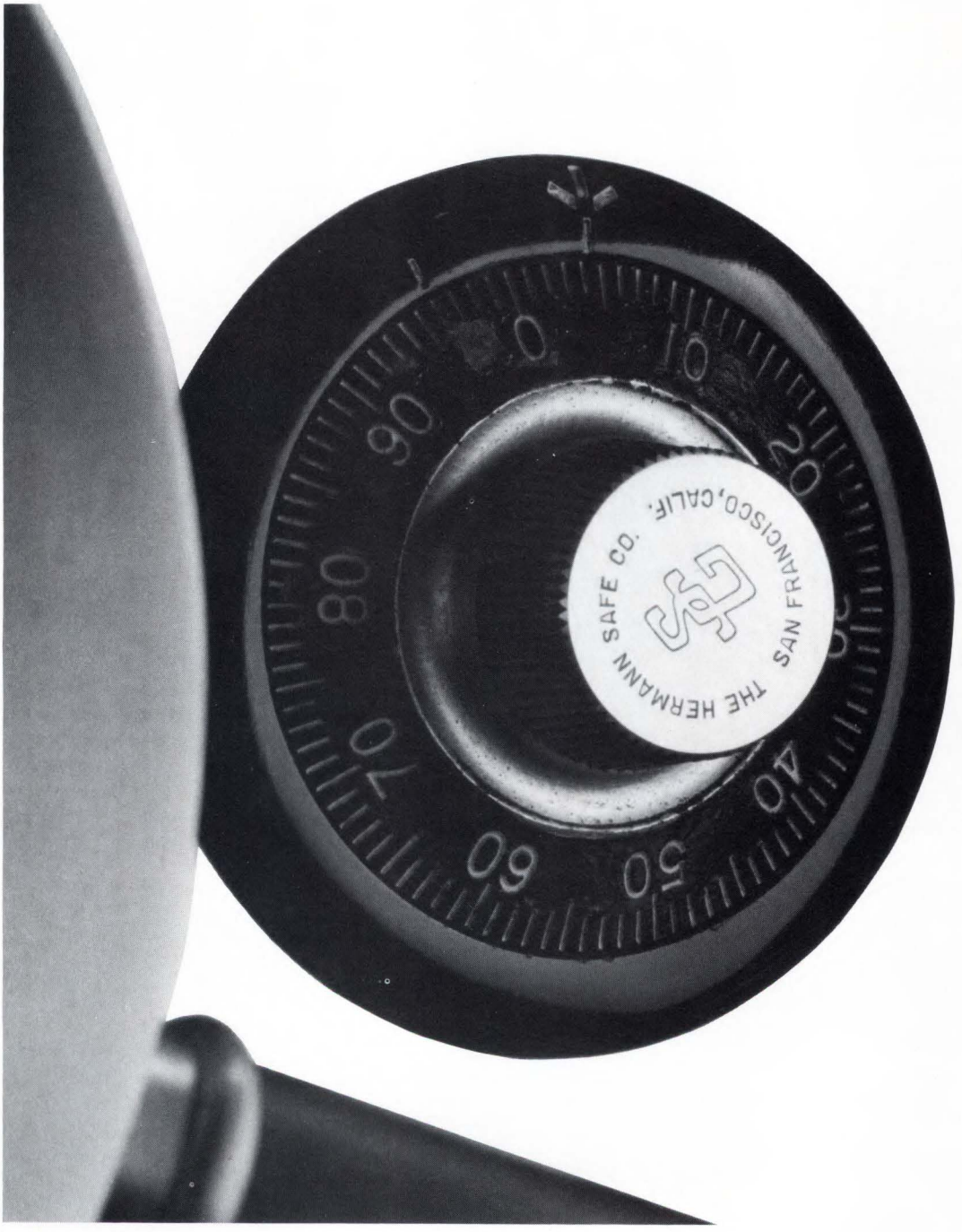
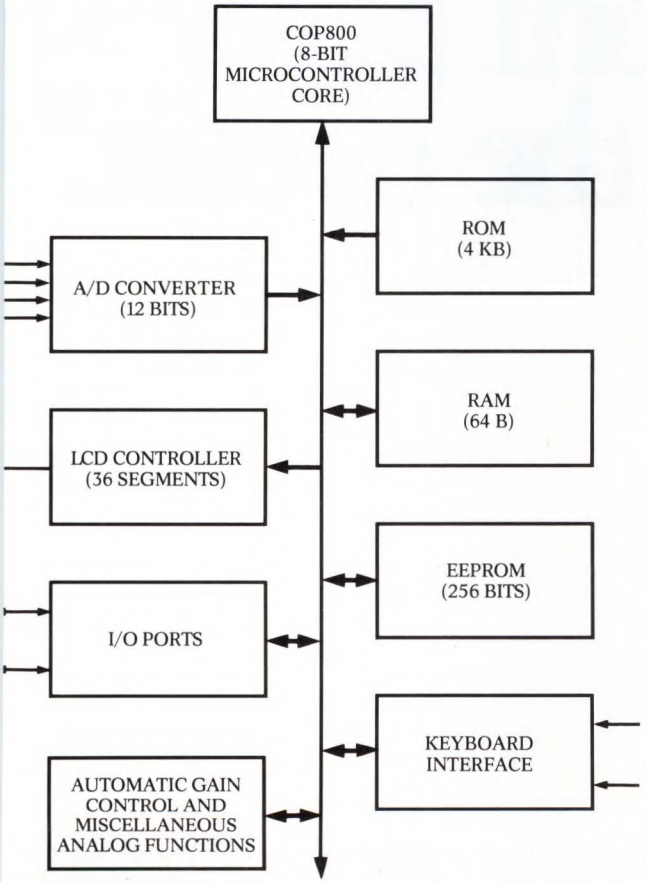
CIRCLE NO 46

E²/DIGITAL/ANALOG COMBINATION Y



THE TECHNOLOGY OU CAN BANK ON.

To be perfectly honest, we didn't invent the concept that says high integration equals high profit. But as you can see from the application diagram on this page, we definitely perfected it. With our Triple Technology,™ a process that allows you to combine E^2, digital, and analog functions on the same chip. And, create higher levels of integration than ever before.



Single chip measurement and control system, integrating several EEPROM, analog, and digital functions.

In this case, our customer's last product was a medical instrument the size of a paperback, with 70 different components. By combining a sophisticated 8-bit controller, RAM, ROM, A/D converter, and 256 bytes of EEPROM on the same chip, we helped them shrink the same instrument to the size of a matchbox. And cut the costs just as dramatically.

As a result, they have a product that sets new standards for the industry. And for their shareholders. And by working closely with their designers, we were able to create this one-chip solution with standard cells from our library. In fact, our customer only had to design about 200 gates of logic using our standard digital cells.

Turnaround time from code to first silicon was only 18 weeks. And because of our development tools and mixed-mode simulation (MIXsim™), the first prototypes worked.

Of course, this is only one example. With 250 digital, 50 analog, and over 20 EEPROM cells in our library, we can create literally thousands of combinations. Including Analog/E^2, E^2/Digital, Analog/Digital, and E^2/Analog/Digital. For every application you can imagine. And we can execute them all in high performance CMOS.

So, no matter what you're designing, call or write for our complete library card. And we'll show you a combination you can always bank on. Your ideas and our technology.

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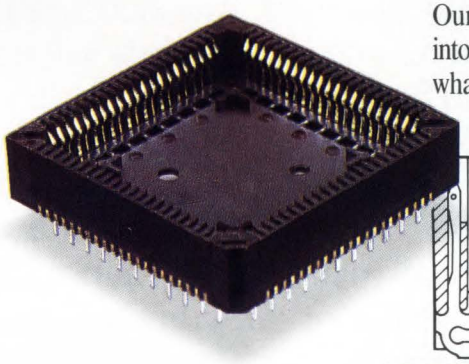
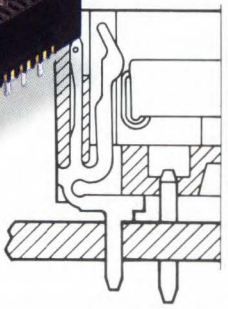
CIRCLE NO 49

A chip carrier socket that won't play "pop goes the circuit."



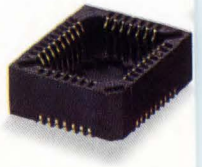
Our sockets are designed to get solidly into contact and stay in contact. No matter what the outside influences. Pop-out is simply not a problem.



Controlled contact interface angle in AMP HPT sockets ensures positive chip carrier retention. Our exclusive removable housing allows direct inspection of solder joints, and fast repair/replacement of contacts.

The contacts are High Pressure Tin, an AMP proprietary design which creates very high normal forces—a minimum of 200 grams per contact—for maximum retention and reliable interconnection. Short-signal-path contacts float in the housing to accommodate thermal expansion.

Two basic styles of sockets are available: square or 32-position rectangular EPROM and SO-J. Both come in solder



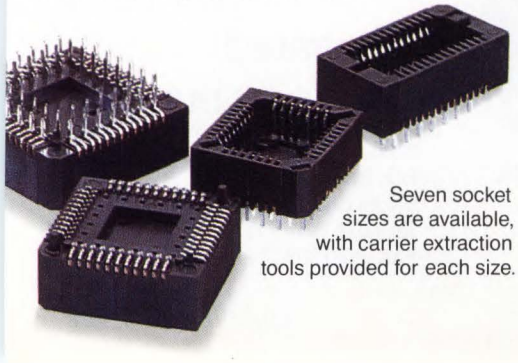
AMP is a trademark of AMP Incorporated.

tail or surface mount versions and feature all the important details. Tin-over-nickel plating is applied after the contacts are formed, to assure full plating. We've built in visual indicators for locating pin 1, and polarizing to aid correct insertion.

Orientation holes in the 94V-0 housing floor make registration to the pc board both fast and simple, ideal for hand or tube-loaded robotic insertion. And the high pin counts make very effective use of real estate.

Call the AMP Information Center at 1-800-522-6752 for literature on HPT PLCC Sockets. AMP Incorporated, Harrisburg, PA 17105-3608.

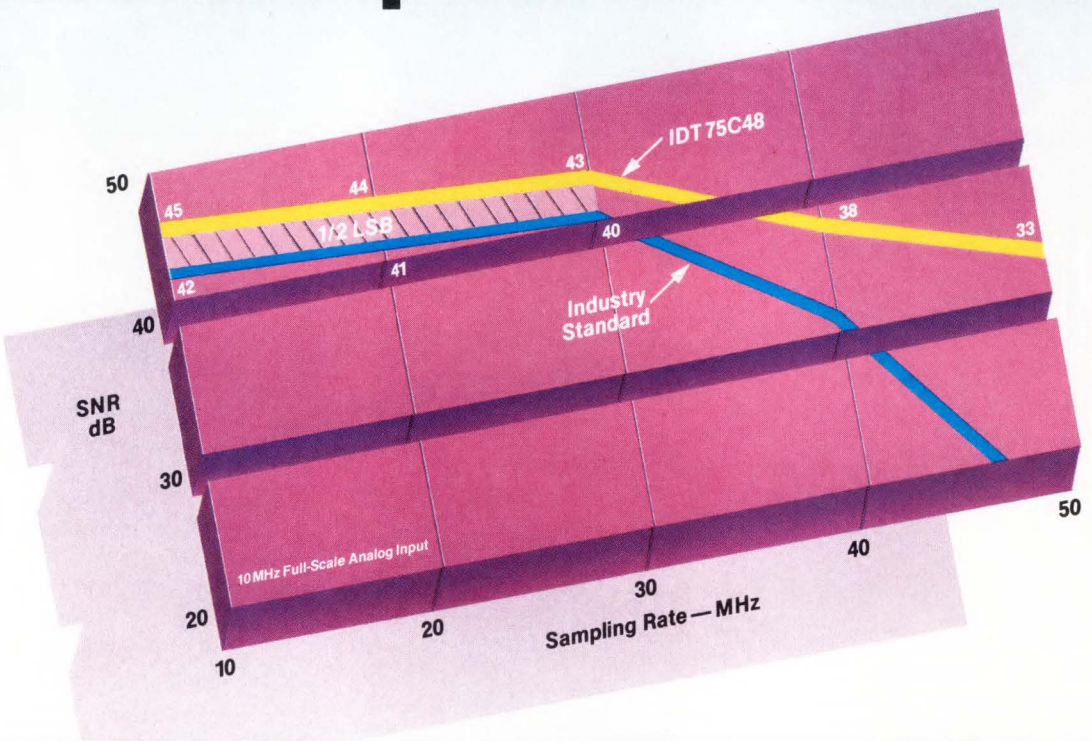
AMP Interconnecting ideas



Seven socket sizes are available, with carrier extraction tools provided for each size.

50% Faster than the Industry Standard

CMOS Flash ADCs From IDT Exceed Bipolar Performance



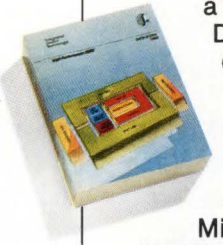
The IDT 75C48 and 75C58 8-bit Flash A/D Converters, manufactured using IDT's CEMOS™ process, are pin and function compatible with the industry standard yet provide higher speeds, lower operating temperatures, and greater reliability.

50% Faster. Uses Half the Power of Bipolar. The IDT 75C48 and 75C58 run at a record breaking 30 MHz. The small signal input bandwidth exceeds 100 MHz. And with a 50% power savings over bipolar, your system runs cooler and more reliably.

Higher Reliability. The IDT 75C48 and 75C58 use IDT's on-chip Error Detection and Correction circuitry (patent applied for) to ensure that your data is not corrupted. No more missing codes over all temperature and voltage extremes.

Full-Speed Performance. The IDT 75C48 and 75C58 signal to noise ratio (SNR) at 30 MSPS clock rate and 10 MHz analog input frequency is greater than 40 dB over the full temperature range and power supply extremes. That's more than a ½ LSB accuracy improvement over the bipolar industry standard. By testing SNR specs during production we can guarantee the performance of the final product. And that allows you the additional freedom to optimize your system by operating closer to the spec limits.

Even Easier System Integration with the IDT 75C58



In addition to the features found on the IDT 75C48, the IDT 75C58 offers extra enhancements designed to ease system integration.

- ☐ Overflow indication ensures that the input signal is within range.
- ☐ Three-state outputs ease the use of multiple Flash ADCs in a system.
- ☐ Power-down mode for ultra-low power applications.

Expanded Package Options

Packages include 28-pin plastic and hermetic DIPs, LCCs, and SOICs. MIL-STD-883C versions are also available.

Call For More Information

If you have questions concerning price and availability, or need technical information call our Marketing Hotline at (408) 492-8229.

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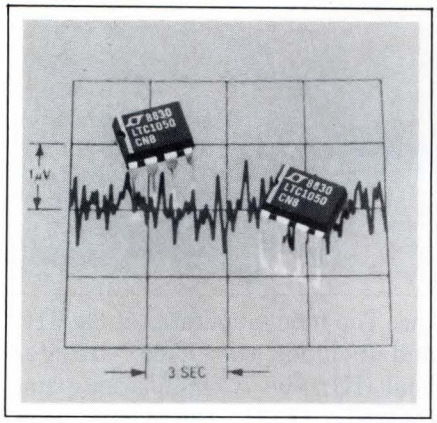
CIRCLE NO 51



OP AMP

The LTC chopper-stabilized op amp includes sample-and hold capacitors on the chip. A military version guarantees a maximum offset voltage of 5 μ V over the −55 to +125°C temperature range. Other features include a maximum offset voltage drift of 0.05 μV/°C, a dc to 10-Hz input noise voltage of 1.8 μV p-p, and a minimum voltage gain of 130 dB. The op amp has a slew rate of 4V/μsec and a gain bandwidth product of 2.5 MHz while drawing only 900 μA of current from a single power supply. Overload recovery time from positive and negative saturation conditions are 1.5 msec and 3 msec, respectively. The op amp has a minimum power-supply rejection ratio of 125 dB and a common-mode rejection ratio of 120 dB. The device is available in 8-pin plastic and ceramic DIPs and an 8-pin SO8 package. Commercial version, $2.25 (100).

Linear Technology Corp, 1630 McCarthy Blvd, Milpitas, CA 95035. Phone (800) 637-5545. FAX 408-434-0507.

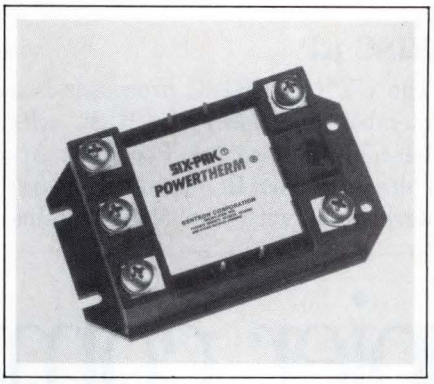
Circle No 572

ECL SRAMs

The IDT10490 is a BiCEMOS ECL-compatible static RAM with a 10-nsec access time. The 64k × 1-bit memory is compatible with 10K ECL levels. A similar device with the same organization and access time, the IDT100490 is compatible with 100K ECL levels. The IC achieves the 10-nsec access time while consuming 120 mA of power-supply current. The devices have separate input and output data lines and operate with a minimum write-pulse width of 8 nsec. The outputs have open emitters, which ease memory expansion. Both devices come in 22-pin, 300-mil ceramic DIPs. The IDT100490 is also available in a plastic DIP. IDT100490 in a plastic DIP or IDT10490 in a ceramic DIP, $88.50 (100).

Integrated Device Technology Inc, Box 58015, Santa Clara, CA 95052. Phone (408) 727-6116. TWX 910-338-2070.

Circle No 576

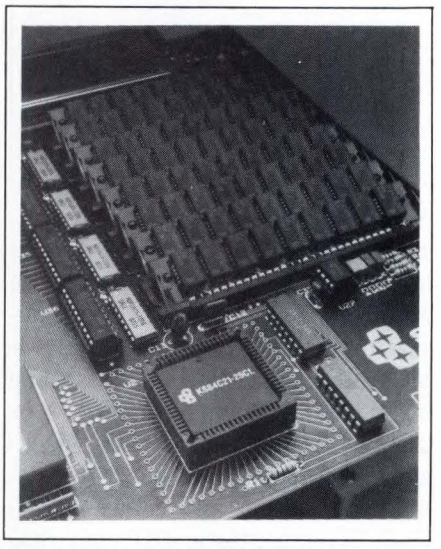


HYBRID MOSFET

The EFM049-M46 is a hybrid module containing a high-powered MOSFET. The device is rated for 32A of drain current with a maximum drain-to-source resistance of 0.23Ω. In addition, the device can withstand a drain-to-source voltage of 400V. It is specifically designed as a power linear amplifier where the drain current is a function of the gate-to-source voltage. Functional trimming of individual gate-to-source resistors permits current sharing when you connect more than one module in parallel. The device is built with the company's Powertherm construction process, which produces 2500V rms of electrical isolation between the device and the heatsink. The module has a gate terminal for quick connection or can instead be supplied with a solder lug. $156.

Gentron Corp, 6667 N Sidney Pl, Milwaukee, WI 53209. Phone (414) 351-1660. TLX 26881.

Circle No 573

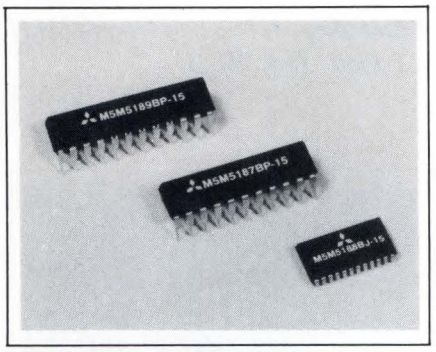


DRAM CONTROLLERS

Two dynamic RAM controllers accelerate the access times of DRAMs. The KS84C21 supports 256k- and 1M-bit DRAMs; the KS84C22 supports these devices as well as 4M-bit DRAMs. Both controllers are available in both externally programmable versions and mask-programmable versions. The externally programmable version has a mode register that lets you select the following options: synchronous or asynchronous operation, interleaved or noninterleaved accesses, staggered or burst access, wait-state insertions, and a variety of refresh options. In the mask-programmed version, the mode register is programmed at the factory. The controllers can make 120-nsec DRAMs appear to a system as 80-nsec DRAMs. The controllers have page, nibble, and static column-access modes and can drive 500-pF loads. The KS84C21 comes in a 68-pin plastic leadless chip carrier (PLCC), and the KS84C22 is available in a 84-pin PLCC. From $22.80 (1000).

Samsung Semiconductor, 3725 N First St, San Jose, CA 95134. Phone (408) 434-5561.

Circle No 574



64k-BIT SRAMs

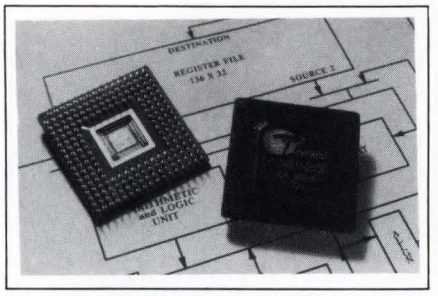
These three 64k-bit static RAMs have 15-nsec access times. The M5M5187B has a 64k × 1-bit organization; the M5M5188B has a 16k × 4-bit organization. Both devices come in 22-lead, 300-mil plastic DIPs or 24-lead small-outline J (SOJ) packages. The M5M5189B has a 16k × 4-bit organization and comes in 24-lead, 300-mil plastic DIP and SOJ packages. It also has an output-enable pin for data-bus control. The chips use a mixed-MOS technology, which combines NMOS memory cells with CMOS peripheral circuitry for fast access times and low power dissipation. The chips typically consume 300 mW in the active mode and 5 μW in the standby mode. The chips operate from a single 5V supply, and all inputs and outputs are TTL compatible. The chips also feature a chip-select line that has a high-impedance state for wire-ORing multiple chips together. $33.00 to $42.00 (100).

Mitsubishi Electronics America Inc, Semiconductor Div, 1050 E Arques Ave, Sunnyvale, CA 94086. Phone (408) 730-5900. FAX 408-730-4972. TLX 172296.

Circle No 575

RISC μP

The CY7C600 RISC processor is a member of a family of RISC μPs based on the Scalable Processor Architecture (SPARC) under licensing agreement with Sun Microsystems



Inc. The family operates at 33 MHz and includes the 7C601 Integer Unit (IU), the 7C608 floating-point controller (FPC), the 7C603 memory-management unit (MMU), and a caching susbsystem composed of the 7C153 256k-bit Cache RAM and the 7C181 Cache tag RAM. The FPC interfaces with a floating-point unit (FPU), such as the TI TMS8847, to execute floating-point arithmetic concurrently with the IU. The 7C601 communicates with external memory via a 32-bit address bus and a 32-bit data/instruction bus.

The chip set is designed for fast

Every copier company talks

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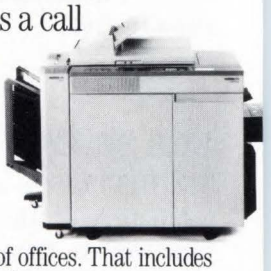
Choosing a new copier isn't easy. You look at copiers, you listen to promises. It all gets very confusing.

Now, you don't have to listen to a lot of talk about promises. You can read ours. Because we put it in writing. If you try to compare it to other copier guarantees, you'll find there's no comparison. Suddenly, a difficult decision becomes a very easy choice to make.

Look at the certificate above. Nobody offers you as good a copier guarantee as Harris/3M. So, while copier salespeople are all giving you a lot of talk, ours will give you something great to read.

Send in the coupon. Or give us a call at 1-800-TLC-COPY. (In Canada, 1-519-668-2230.) We'll send you our 8-page *Consumer Guide to Copiers*. Then, we can talk about it.



Harris/3M copiers have features for all sizes of offices. That includes the 6070. Seventy copies a minute, guaranteed.

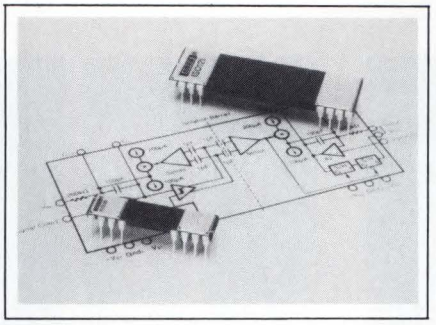
virtual caching, which means that the system's MMU doesn't have to translate a virtual address to a physical one for a cache "miss." The IU samples interrupts on every clock and provides an acknowledgement in one to three clock cycles. The first instruction of an interrupt service routine can be executed within 6 to 8 cycles of receiving the interrupt request. The chip set occupies 23 square inches and costs $2984. The commercial 33-MHz 7C601 costs $634 (100).

Cypress Semiconductor Corp, 3901 N First St, San Jose, CA 95134. Phone (408) 943-2600.

Circle No 577

ISOLATION AMPS

The ISO120 and the ISO121 isolation amplifiers have input-to-output isolation specifications of 1500V rms and 3500V rms, respectively. Both amplifiers have input and output



sections that are galvanically isolated by matched 1-pF capacitors. The input voltage modulates the duty cycle of a free-running oscillator to transmit the signal across the barrier. The output section receives the modulated signal, converts it back to an analog voltage, and removes the modulation ripple components.

A synchronized mode lets you synchronize the free-running oscillator to an external source to eliminate beat frequencies. The amplifiers specify a nonlinearity of ±0.01% FSR max, a gain temperature coefficient of ±20 ppm/°C, an isolation-mode rejection ratio (IMR) of 115 dB at 60 Hz, and a small-signal bandwidth of 60 kHz. The ISO120 in a 20-pin DIP, $17 (100); the ISO121 in a 40-pin DIP, $21.30.

Burr-Brown Corp, Box 11400, Tucson, AZ 85734. Phone (602) 746-1111. TWX 910-952-1111. TLX 666491.

Circle No 578

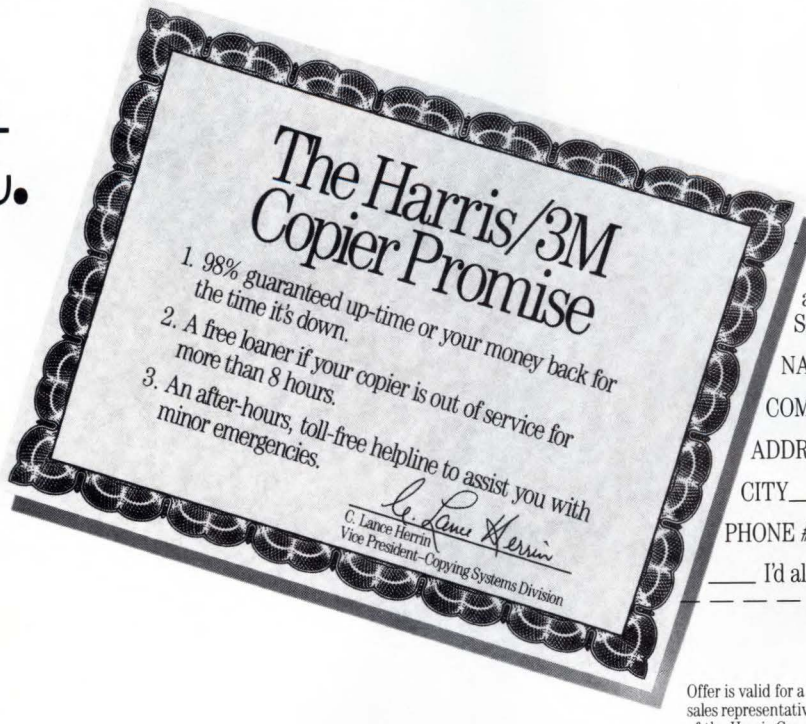
FLOPPY CONTROLLER

The DP8473 PLUS-2 floppy-disk controller is software compatible with the NEC μPD765A but has additional features. These features include an analog-data separator and write precompensation on the chip. The chip also integrates all of the logic to interface with the IBM PC/AT computer and most of the logic to interface with the IBM PS/2 computer. The chip contains buffers with 40-mA capabilities to drive as

Text continued on pg 136

about customer satisfaction.

it.



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Send to Harris/3M, P.O. Box 785, Dayton, OH 45401

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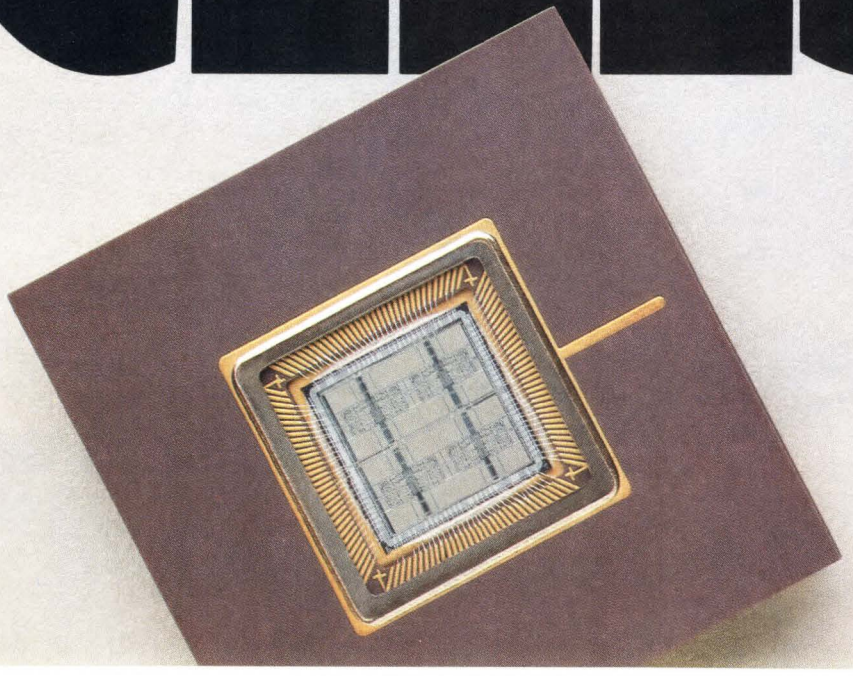
CIRCLE NO 52

BUILD KILLER CELLS.



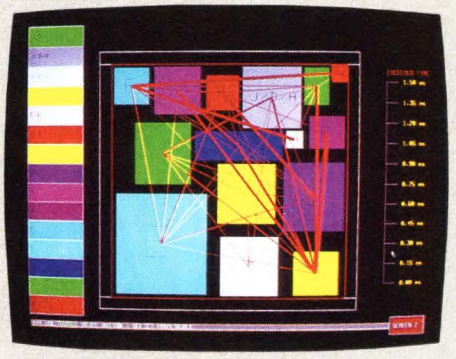
This is the stuff reputations are built on.

A cell design with 200,000 gates. More than 1000 library elements. 2MB of memory. And sub-micron HCMOS technology.

You can search high and low, but there's only one place in the world you can find a chip of such staggering complexity.

LSI Logic.

Designs like this are precisely why we're the #1 domestic ASIC supplier with more than 5,000 working cell and array-based designs in the field.



High complexity Cell-Based ASICs require advanced tools like the MDE chip floorplanner to optimize delays and verify performance prior to layout.

And why our Modular Design Environment (MDE)™ software is the best foundation for building killer cells.

MDE is the industry's most advanced design software for ASICs. It arms you with the capability to build today's most sophisticated cell-based designs. Easily. And with the smallest possible die size.

Besides MDE, LSI Logic delivers more than 400 LSI and VLSI building blocks, including RISC microprocessor cells and industry-standard processor and peripheral functions; the longest list of SSI and MSI functions; and memory compilers to develop exactly the RAM or ROM your chip requires.

And if your application calls for lower densities, that's covered, too. Because LSI Logic has more cost-effective cell-based solutions than you can imagine.

No matter what kind of cell-based ASIC you build, LSI Logic will deliver a fully-tested prototype in as little as 4 weeks.

All in the production quantities you want, thanks to our advanced worldwide wafer fabrication, assembly, and test facilities.

So find out more about LSI Logic's Cell-Based ASICs by calling the sales office nearest you.

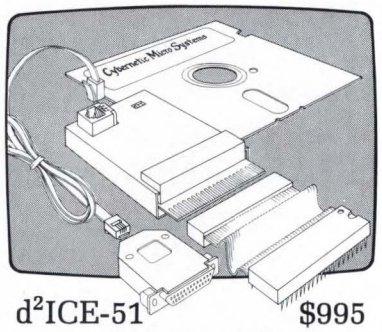
After all, we can help you make a killing.

LSI LOGIC

LSI Logic Sales Offices and Design Resource Centers: Scottsdale, AZ 602-951-4560, Milpitas, CA 408-433-8000, San Jose, CA 408-248-5100, Irvine, CA 714-553-5600, Sherman Oaks, CA 818-906-0333, Denver, CO 303-756-8800, Altamonte Springs, FL 305-339-2242, Boca Raton, FL 407-395-6200, Norcross, GA 404-448-4898, Chicago, IL 312-773-0111, Bethesda, MD 301-897-5800, Waltham, MA 617-890-0161, Ann Arbor, MI 313-930-6975, Minneapolis, MN 612-921-8300, Edison, NJ 201-549-4500, Poughkeepsie, NY 914-454-6593, Raleigh, NC 919-872-8400, Worthington, OH 614-438-2644, Beaverton, OR 503-644-6697, Trevose, PA 215-245-4705, Austin, TX 512-338-2140, Dallas, TX 214-788-2966, Bellevue, WA 206-822-4384, Canada 403-262-9292, France 33-1-46212525, Israel 972-3-403741/6, Italy 39-39-651575, Japan 81-3-589-2711, Korea 82-2-785-1693, Netherlands 31-4120-30335, Scotland 44-506-416767, Sweden 46-8-903-4680, Switzerland 41-32-515441, United Kingdom 44-344-426544, West Germany 49-89-926903-0. © 1988 LSI Logic Corporation. Modular Design Environment and MDE are trademarks of LSI Logic Corporation.

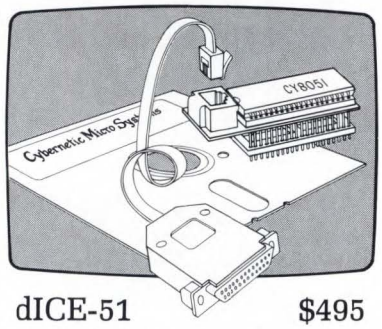
CIRCLE NO 53

Low Cost 8051 Tools



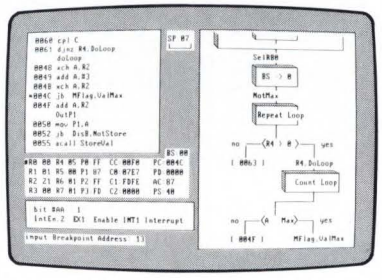
d²ICE-51 **$995**

This Real-Time ICE is the lowest cost and smallest sized full speed 8051 in-circuit emulator. Full access to hardware I/O. Includes all debugging features of Sim and dICE below. Fits in shirt pocket.



dICE-51 **$495**

This reduced-speed in-circuit 8051 debugger provides full access to I/O but will not run real-time. With the same user interface features as Sim8051 below, dICE-51 generates execution profiles during reduced speed execution. (CMOS and MIL also available.)



Sim8051 **$395**

This software Simulator/debugger allows 'no-circuit', debugging of 8051 code on IBM-PCs. All Cybernetics 8051 debug tools offer multi-window source code displays, symbolic access to data, single key commands, breakpoints, trace, full speed and single step execution, execution profiler, and more.

Other 8051 tools include:

Cross Assembler	$195
8751 Programmer	$195-$345
Debugger Demo Disk	$ 39

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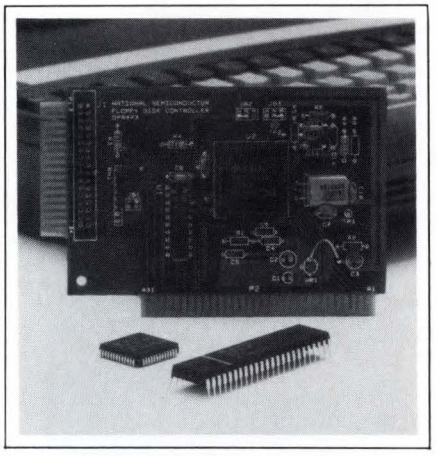
Cybernetic Micro Systems
Box 3000 • San Gregorio, CA 94074
(415) 726-3000 • Telex: 910-350-5842

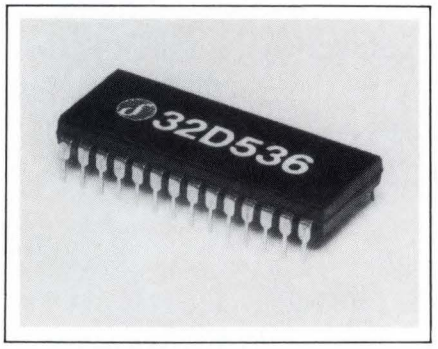
Integrated Circuits



many as four floppy-disk drives. It also has buffers with 12-mA capabilities for driving the data bus. The chips can handle data rates as high as 1M bps and can seek as many as 4000 tracks/surface using an implied-seeking technique that moves the read/write head with the read or write command. The CMOS part is available in a 52-pin PLCC and a 48-pin DIP. $16 (1000). A demonstration board is also available.

National Semiconductor Corp, Box 58090, Santa Clara, CA 95052. Phone (408) 749-7421. TLX 346353. TWX 910-339-9240.

Circle No 579

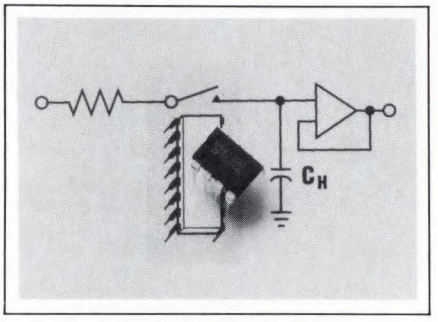


1,7 RLL ENDEC

The 32D536 combines a 1,7 RLL encoder/decoder (ENDEC) and a data synchronizer on a single chip. In the read mode, the IC performs data synchronization, sync-field search and detection, address-mark detection, and data decoding. In the write mode, it converts NRZ data into a 1,7 RLL format, performs write precompensation, and generates the preamble field and address marks. The IC can operate at data rates ranging from 7.5M to 15M bps. The data rate is set by an external resistor. The data synchronizer uses an on-chip PLL that employs a zero-phase restart technique to minimize acquisition time. The chip requires a single +5V supply and is optimized to operate with the company's 32C452 and Adaptec's AIC010 controllers. The chip is available in 28-pin PLCC and SOL packages. $16.14 (1000).

Silicon Systems, 1361 Myford Rd, Tustin, CA 92680. Phone (714) 731-7110.

Circle No 580



ANALOG SWITCHES

The DG417 and DG418 are SPST analog switches; the DG419 is a SPDT analog switch. All three ICs specify a 35Ω on-resistance, a 17-nsec switching speed for t_{on}, and a leakage current of 250 pA. The switches guarantee break-before-make switching action. The ICs can withstand greater than ±4000V of electrostatic discharge (ESD) on all pins with respect to ground. The switches operate from ±15V supplies and dissipate less than 35 μW. Industrial grade models of all three ICs are available in 8-pin plastic DIPs and small outline packages. Military versions come in 8-pin ceramic DIPs and include a model that complies with MIL-STD 883. From $1.45 to $9.84 (100). Samples are available from stock; production quantities, eight weeks ARO.

Siliconix Inc, 2201 Laurelwood Rd, Santa Clara, CA 95054. Phone (800) 554-5545, ext 1900.

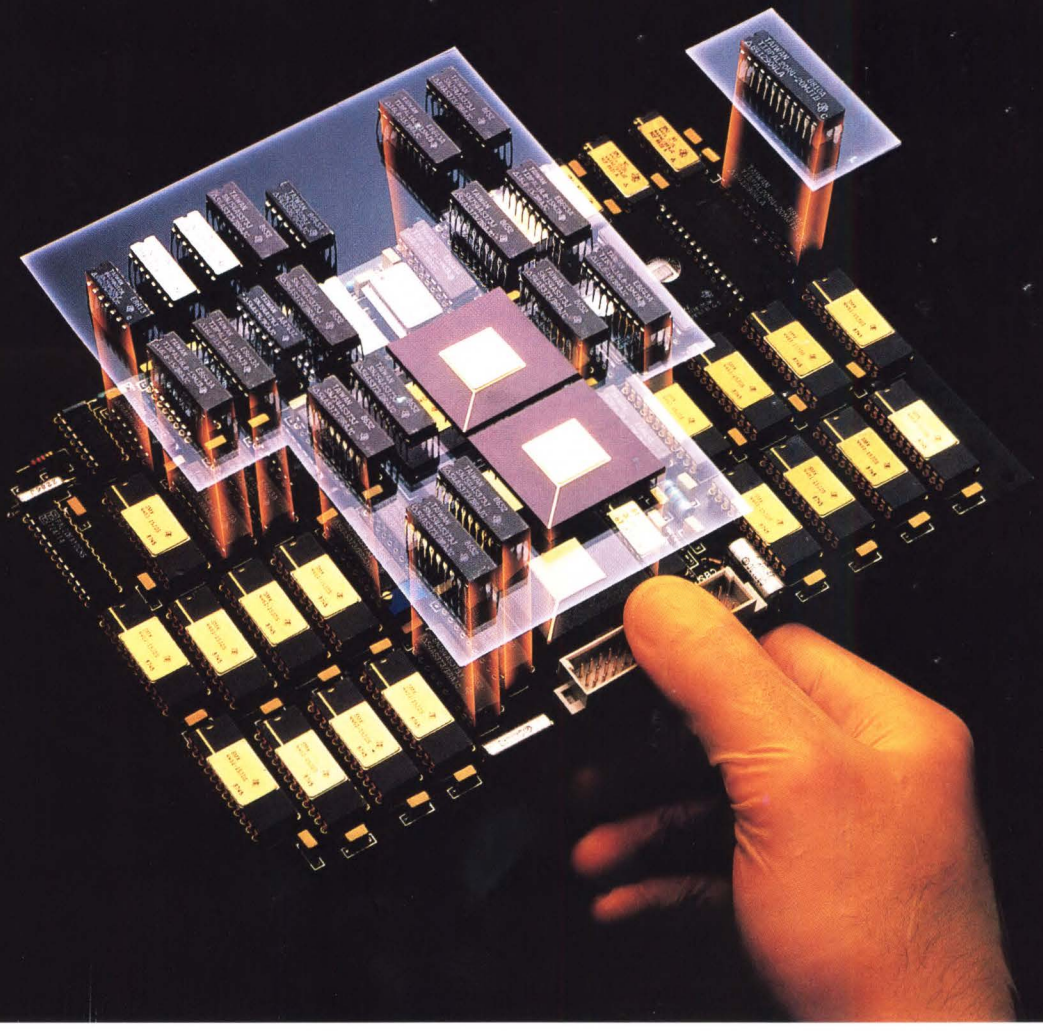
Circle No 582

TEXAS INSTRUMENTS REPORTS ON

SYSTEMS LOGIC

IN THE ERA OF

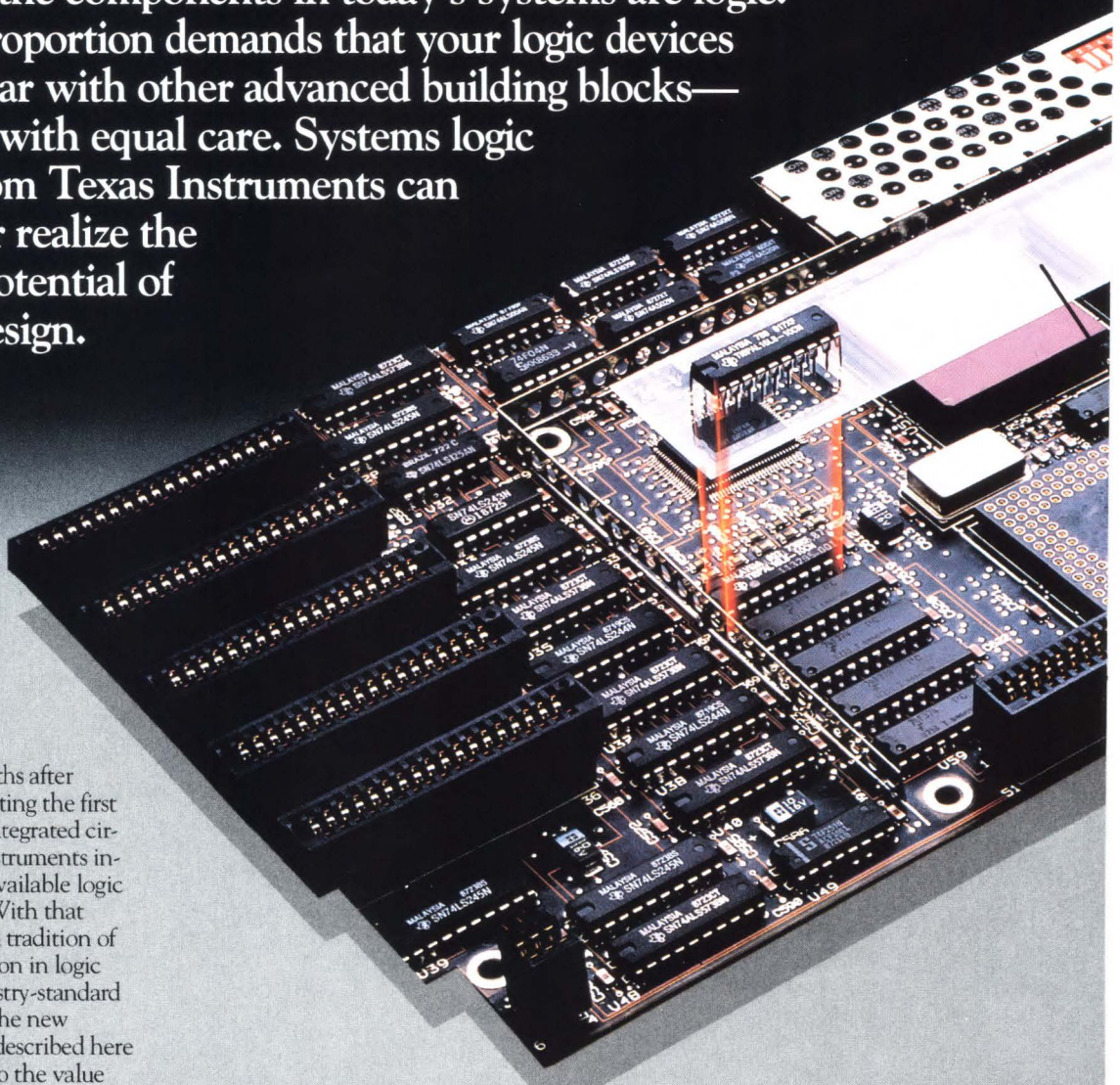
MegaChip TECHNOLOGIES



Systems logic in the Era of MegaChip Technologies:

No system should ever be limited by its to help your design perform at its best.

Up to 65% of the components in today's systems are logic. Such a large proportion demands that your logic devices perform on a par with other advanced building blocks—and be chosen with equal care. Systems logic alternatives from Texas Instruments can help you better realize the performance potential of your system design.



Within months after demonstrating the first working integrated circuit 30 years ago, Texas Instruments introduced a commercially available logic function, an RS flip-flop. With that beginning, TI established a tradition of development and innovation in logic that encompasses the industry-standard SN54/74 Series TTL and the new families of advanced logic described here that can add significantly to the value and performance of your overall system.

For example, for systems that require off-the-shelf flexibility with a degree of customization, TI's Programmable Logic Devices (PLDs) include popular 10-ns PAL® ICs available in high volume. And, to keep pace with today's high-speed microprocessors, TI plans to continue to drive PLD performance to sub-10-ns speeds.

TI's Advanced CMOS Logic (ACL) supports the design goal of high performance combined with low-power operation, while TI's new BiCMOS bus-interface family delivers very high drive current at very low power compared to bipolar circuits.

ON THE COVER: Suspended above the board, provided by Rockwell International, Missile Systems Division, are military versions of TI advanced logic devices.

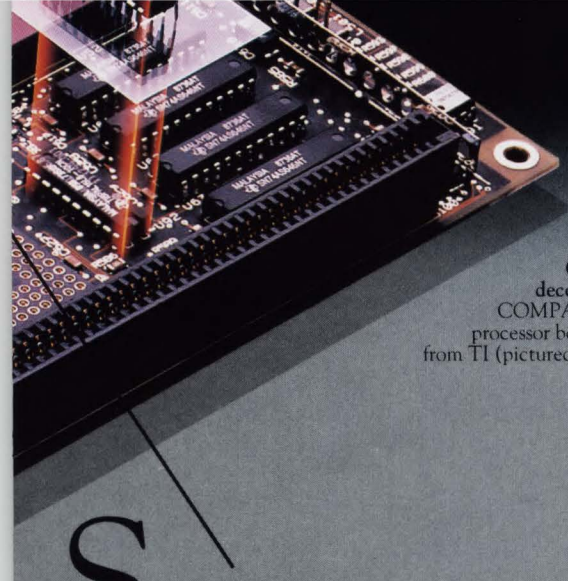
TI's MegaChip Technologies

Our emphasis on high-density memories 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, and they are the means by which we can help you and your company get to market faster with better products.

For systems requiring moderate densities and fast prototype cycle times, TI offers a new series of one-micron CMOS gate arrays. When you need higher levels of integration plus increased design flexibility, TI's one-micron CMOS standard cells provide the means for system consolidation.

And for military applications, TI offers a wide choice of high-reliability logic functions.

On the following pages are details of what you can expect from TI's range of logic options:



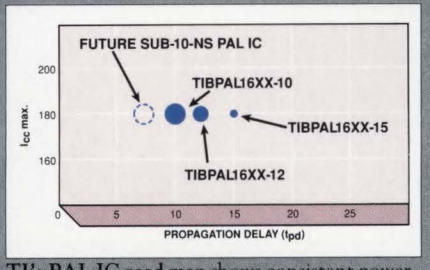
Contributing significantly to fast address decoding in speed-critical paths of the COMPAQ DESKPRO 386/20™ personal computer processor board are two TIBPAL16L8-10 PAL circuits from TI (pictured above a segment of the board).

Speed your system to market with TI's superfast PLDs.

PLDs are a functional alternative to standard logic ICs and gate arrays or standard cells.

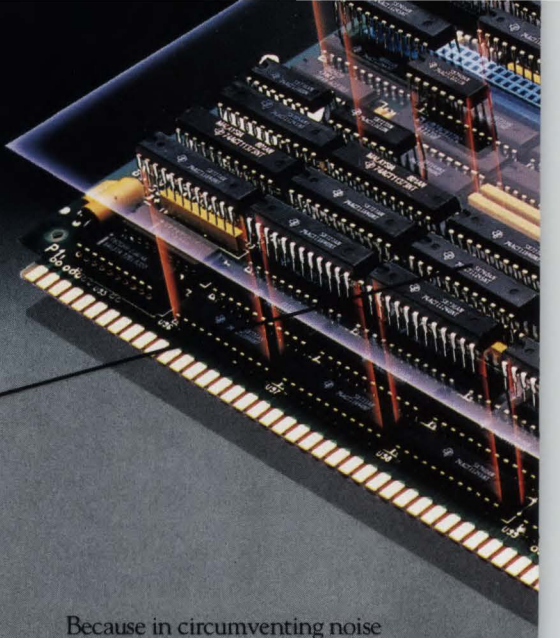
Because TI's PLDs are off-the-shelf items you program yourself, you avoid the longer design cycle times of custom ICs and move on to market faster. These PLDs offer very attractive performance advantages. Consider these:

- **TIBPAL16XX-10 PAL ICs** from TI deliver a 10-ns propagation delay and are available in quantity. Clock-to-Q time is 8 ns, and output-registered toggle frequency is 62.5 MHz. IMPACT-X™ technology gives these PAL ICs their superior speed; they are well suited for use with high-speed processors such as the Motorola 68030, the Intel 80386, and RISC-based architectures. The 10-ns performance brings a higher level of integration to speed-critical paths.
- **TI's TIEPAL10H16P8-6 IMPACT™ ECL PAL circuit** delivers even faster operation: 6-ns propagation delay max. You can now streamline conventional ECL designs by consolidating several discrete components into a single custom function.
- **TI's new 7-ns Programmable Address Decoder** is intended to help you squeeze more performance out of memory interface systems. By performing address decoding much faster than conventional PAL architectures—in 7 ns—the TIBPAD16N8-7 allows you to take advantage of the new processors to increase overall system performance.
- **TI's 50-MHz Programmable State Machines (PSMs),** TIB825S105B (16 x 48 x 8) and '167B (14 x 48 x 6), are ideal for use in high-performance computing, memory interface, telecommunications, and graphics. These PSMs may be used to implement custom sequential logic designs such as peripheral I/O controllers and video-blanking controllers.
- **The TIBPAL22VP10-20,** with a 20-ns delay, is 20% faster than the competition's "A" version and much more flexible. A programmable output macrocell allows two extra, exclusive output configurations, for a total of six.
- **TI's TICPAL16XX Series 20-pin CMOS PAL ICs** are the cure for power problems. They operate at virtually zero standby power and are reliable, high-performance replacements for conventional TTL and HCMOS logic. The devices can be erased and reprogrammed repeatedly.



TI's PAL IC road map shows consistent power and consistently higher speeds, with even faster versions on the way.

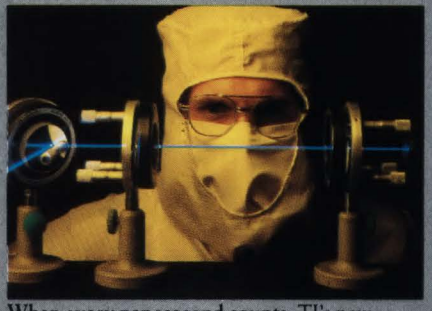
Turn page for more information



Get high speed, low power, and low noise with TI's broad ACL family.

It's an extensive family that includes gates, flip-flops, latches, registers, drivers, and transceivers. It's a readily available family in DIP and SOIC packages. It's TI's high-performance EPIC™ ACL family, bringing with it an important bonus—major reductions in noise.

Family speed is comparable to advanced bipolar 54/74F; 24 mA of sink/source current will drive 50-ohm transmission lines; and low power is characteristic of TI's EPIC technology. All this with "ground bounce" substantially reduced compared with end-pin ACL. The reasons are innovative packaging and a circuit-design technique called OEC™ (Output Edge Control) which softens the transition states that cause simultaneous switching noise. In fact, EPIC ACL noise levels are typically 10% less than those of bipolar devices.



When every nanosecond counts, TI's new high-performance ACL family can help you significantly improve system speed.

The rapidly increasing customer acceptance of TI's ACL family confirms its noise-reduction advantages and its ease of use.

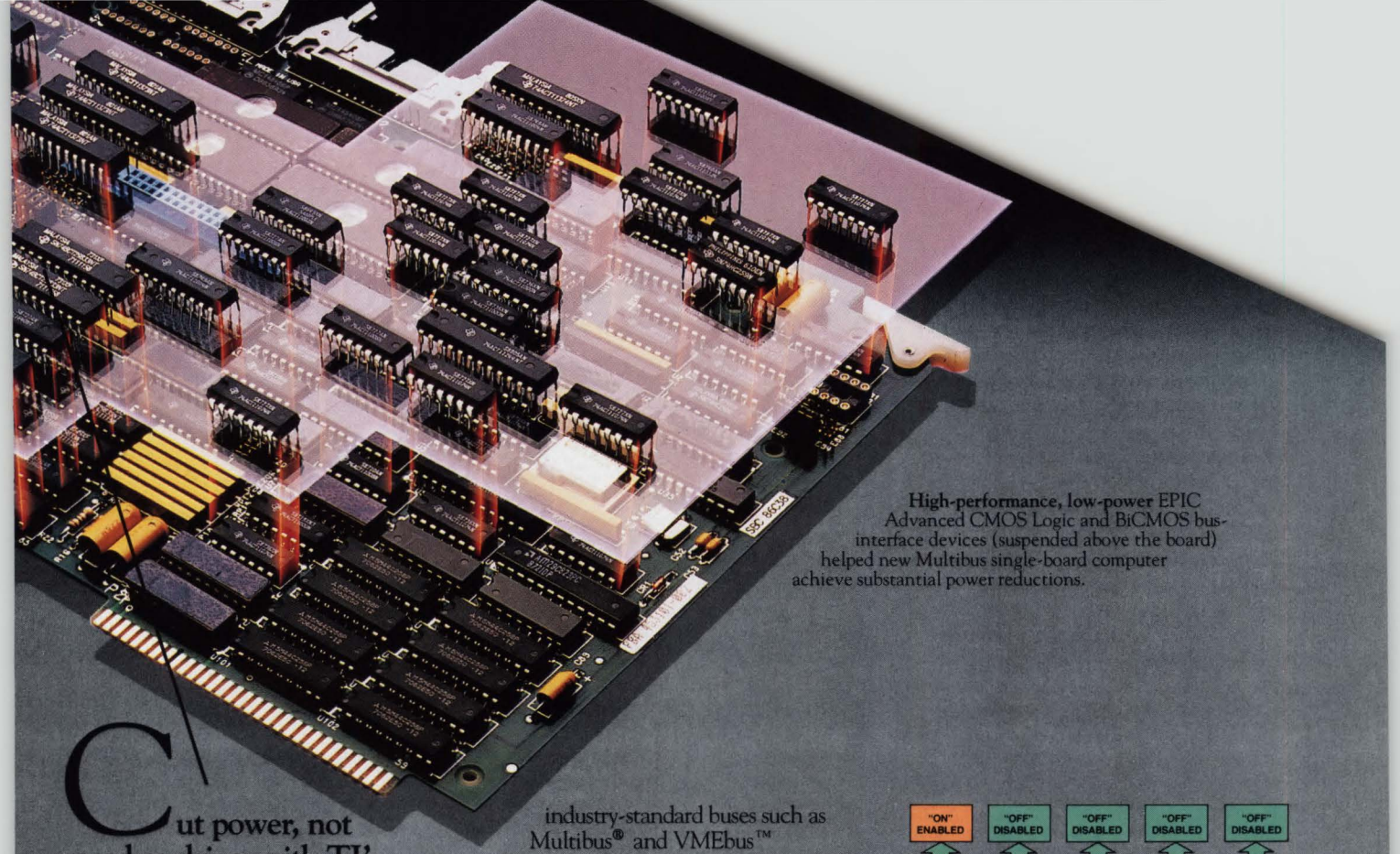
System design advantages

A unique "flow-through architecture" simplifies board design, layout, and troubleshooting. Inputs surround power pins on one side, outputs on the other, and control pins are strategically located at the package ends.

From a systems perspective, TI's arrangement offers the lowest-cost design when compared to end-pin ACL. Because in circumventing noise problems, end-pin designs can require additional components that take up to 32% more board area and slow system performance.

There are 146 functions, in both AC and ACT versions, currently announced in TI's ACL family, including such innovative, highly complex functions as advanced transceivers, line drivers, latches, feedback registers, multiplexers, and counters.

This ACL family, developed in cooperation with and supported by Philips/Signetics, fully meets JEDEC industry-standard No. 20 specifications for Advanced CMOS Logic.



High-performance, low-power EPIC Advanced CMOS Logic and BiCMOS bus-interface devices (suspended above the board) helped new Multibus single-board computer achieve substantial power reductions.

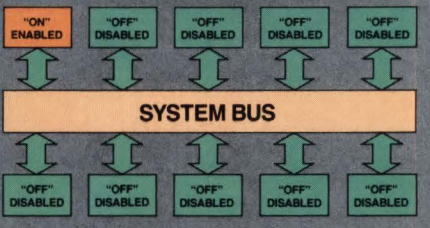
Cut power, not speed or drive, with TI's BiCMOS bus-interface ICs.

This new family is a simple, effective means to reduce system power consumption without compromising advanced performance.

As the BiCMOS name implies, TI combines bipolar IMPACT and CMOS processing to achieve switching speeds comparable to advanced bipolar products and provide the 48/64-mA drive current needed for high-capacitive loads and backplanes. In particular, family members meet the drive requirements of industry-standard buses such as Multibus® and VMEbus™

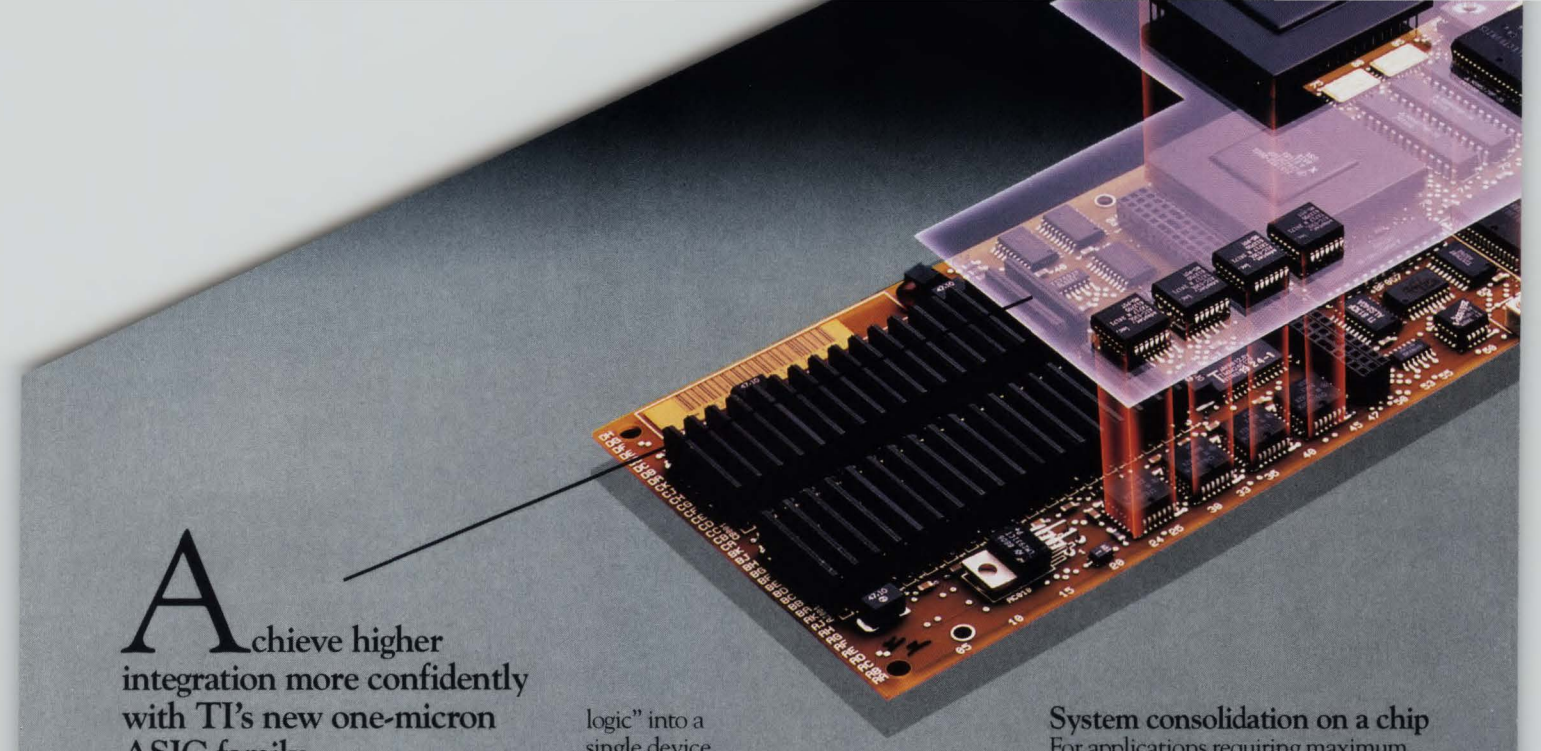
In addition, TI's BiCMOS devices can reduce disabled currents by 95% and active currents by 50%-80% compared to bipolar equivalents. Result: System IC power savings can be more than 25%.

There are more than 60 functions comprising TI's BiCMOS bus-interface family. Included are 8-, 9-, and 10-bit latches, buffers, drivers, and transceivers—a wide choice that means you can easily find what you need to implement high-performance bus-interface designs.



An innovative circuit design in TI's BiCMOS bus-interface logic helps lower disabled currents. This is key to overall power savings because in a typical bus network only one device is enabled at a time.

Turn page for more information



Achieve higher integration more confidently with TI's new one-micron ASIC family.

Now, you can integrate more of your systems logic using TI's new one-micron CMOS ASIC (application-specific integrated circuit) family—the TGC100 Series gate arrays and the TSC500 Series standard cells. Each offers different degrees of design flexibility and system integration. The result is significantly reduced component count which cuts board size and system cost while improving reliability and performance.

And TI is supporting the family with comprehensive kits that help minimize design cost, risk, and time by providing a comfortable, easy-to-use design environment.

Efficient logic consolidation

Using TI's new TGC100 Series gate arrays, you can sweep major chunks of "glue logic" into a single device while realizing fast design and prototype cycle times. Array densities currently range to more than 8K usable gates and 142 bond pads; the Series will be extended to more than 16K usable gates and 216 bond pads in a major production release planned for late 1988. Prototype delivery is typically two to three weeks from approval of postlayout simulation results.

The TGC100 Series Design Kit gives you complete autonomy and control over the design process. It is a comprehensive set of the tools required for successful gate-array design and validation *(see last page for details)*.

Standard packages for the TGC100 Series range from 28-pin DIPs to 84-pin PLCCs, with optional packages up to 144 pins.

System consolidation on a chip

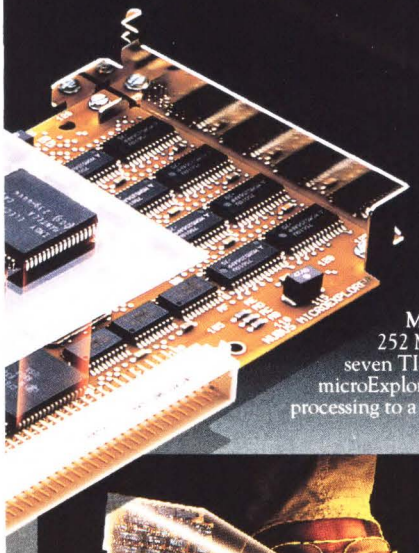
For applications requiring maximum design flexibility and higher levels of integration, TI has disclosed its third-generation standard-cell family, the TSC500 Series.

Complex system designs can be implemented using a growing core of basic SSI/MSI functions, as well as scan cells for testability and MegaModule™ building blocks such as register files. FIFOs, bit-slice family functions, RAM, and ROM are other aids to implementation. Output cells with drive capability up to 64 mA are available.

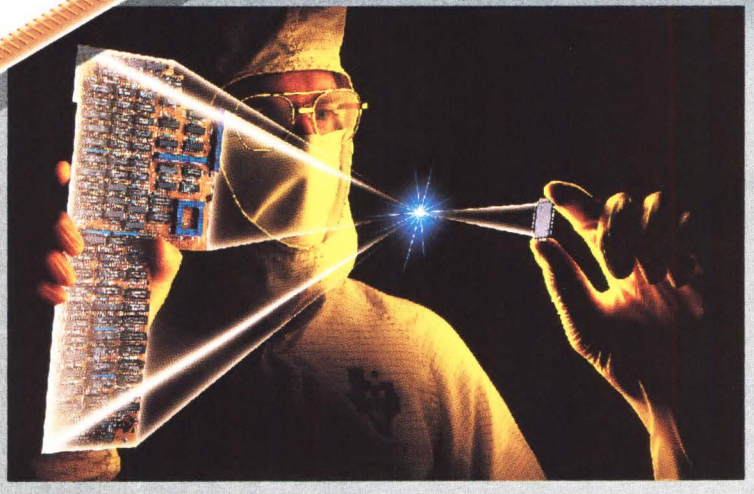
Package options include conventional through-hole DIPs, surface-mount PLCCs, and plastic quad flatpacks (QFPs) in both JEDEC and EIAJ standards, as well as high-pin-count plastic pin-grid arrays.

Both the TGC100 and TSC500 Series have a typical propagation gate delay of

logic. TI offers advanced logic families



Major logic consolidation, the equivalent of 252 MSI and LSI devices, was possible using the seven TI ASIC functions shown above the microExplorer™ board which brings symbolic processing to a MacIntosh II® desktop computer.



480 ps for a two-input NAND gate with a fanout of three; flip-flop toggle rates range up to 208 MHz. Both series offer output and bidirectional buffers with variable slew-rate control. And both series are fabricated in TI's high-performance EPIC process.

Apply TI's advanced logic to improve the performance of military systems.

Among TI's broad selection of logic devices produced to military requirements is a large PAL family. Propagation delays as fast as 15 ns are available over the military temperature range. The introduction of a 12-ns, 20-pin PAL circuit is planned, as well as military versions of the TIB825S105B and '167B Programmable State Machines.

TI is offering military counterparts selected from its ACL family, as well as 54F functions. Soon to come will be the BiCMOS family of bus-interface functions.

Included among TI's lineup of military ASICs are versions of the one-micron TGC100 Series gate arrays discussed at left, as well as two-micron standard cells.

TI's logic devices are among the more than 800 military functions offered compliant to MIL-STD-883C, Class B. Of this total, TI provides more than 200 to DESC-standard military drawings and is qualified to supply 285 JM38510 Class B devices (QPL 75).

THIRTIETH ANNIVERSARY
1958 1988
INVENTION OF INTEGRATED CIRCUIT

Milestones in Innovation

TI's tradition for milestone innovations extends from the infancy of semiconductor technology into the MegaChip Era. Among the major highlights:

- First commercial silicon transistor (1954)
- First commercially produced transistor radio (1954)
- First integrated circuit (1958)
- First integrated-circuit computer (1961)
- First hand-held calculator (1967)
- First single-chip microprocessor (1970)
- First single-chip microcomputer (1970)
- First single-chip speech synthesizer (1978)
- First advanced single-chip digital signal processor (1982)
- First video RAM (1984)
- First fully integrated trench memory cell (1985)
- First gallium arsenide (GaAs) LSI on silicon substrate (1986)
- First single-chip Artificial Intelligence microprocessor (1987)

Turn page for more information.

Comprehensive support from TI helps you improve your design performance as you improve system performance.

To enable you to excel in designing the logic portion of your system for maximum performance, TI has compiled or is making available a wide range of design tools and aids:

PLDs: The TI PLD data book (472 pages) contains design and specification data for 78 device types. Four application notes are incorporated as a reference tool. A qualification book is available, and a state-machine design kit is forthcoming.

ACL and BiCMOS Bus Interface: TI's ACL data book (348 pages) contains detailed specifications and applications information on the members of the one-micron ACL family. The ACL designer's handbook (299 pages) spells out the technical issues confronting advanced-logic design engineers and describes methods for handling the issues. A qualification book (358 pages) features extensive reliability and characterization data, die photos, and application derating factors. Customer evaluation capability is enhanced by TI's system evaluation board (available for demonstration through TI field sales offices) and third-party characterization boards.

Data sheets are available on each member of TI's BiCMOS bus-interface family.

ASICs: The TGC100 Series Design Kit gives you the tools needed to successfully complete a gate-array design: A macro library for Daisy or Mentor engineering workstations containing the graphic symbol and functional and simulation models for each macro; a software library of TI-specific software tools that streamline and simplify the design process; a design manual that answers "how to" questions about designing with the TGC100 Series; a two-volume data manual providing detailed specifications for each macro in the TGC100 Series software library; and a software user's manual.

An equally comprehensive design kit for the TSC500 Series is currently in development.



Extensive design support available for TI's systems logic families includes that for the new TGC100 Series gate arrays *(at top)*, Programmable Logic Devices *(at left)*, and Advanced CMOS Logic.

For more information on TI's advanced systems logic ICs and their support tools, complete and return the coupon today. Or write:
Texas Instruments Incorporated
P.O. Box 809066
Dallas, Texas 75380-9066

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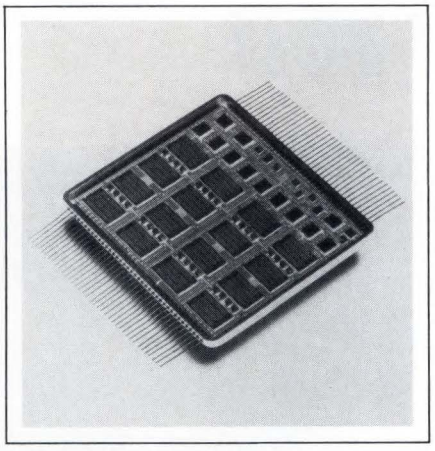


4M-BIT MODULE

The Model M4194 Kbit 4M-bit memory module can be configured as a 512k×8-, 256k×16-, or 128k×32-bit static RAM. The user selects the configuration by grounding a pin on the hybrid. The design lets you use the device with 8-, 16-, and 32-bit μPs. For example, when operating with an 80386 μP, the data byte-enable lines from the CPU can determine which byte to access. The CMOS device has inputs that represent only one CMOS load, which reduces loading and capacitive effects.

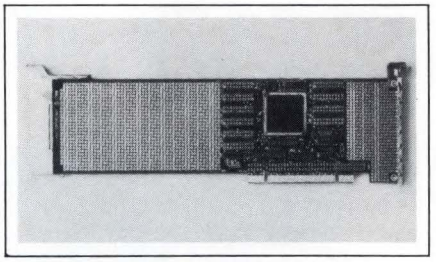
The hybrid module consists of 16 individual 32k×8-bit memory cells and 19 ICs for buffers, latches, decoders, control logic, byte selection, and timing. It operates from a single +5V supply and, when operating at 25°C, typically draws 9.0 mA for the 8-bit mode, 27 mA for the 16-bit mode, and 37.5 mA for the 32-bit mode. Typical current draw for the standby modes are 25 μA, 330 μA, and 535 μA, respectively. The maximum access time for any of the modes is 100 nsec at −55°C, 120 nsec at 25°C, and 150 nsec at 125°C. $995.00 (1000).

White Technology Inc, 4246 E Wood St, Phoenix, AZ 85040. Phone (602) 437-1520. TWX 910-951-4203.

Circle No 581

PS/2 INTERFACE IC

The ONE CHIP PLUS supports the features of the Micro Channel in IBM's PS/2 computers. It has



programmable decoding for extended memory, expanded memory, multiple I/O ports, and ROM. The chip supports the Micro Channel DMA arbitration and burst-mode DMA. It also has programmable memory and I/O timing to match slow or fast devices. The chip lets you program the board's ID, define programmable option select (POS) bits, and define pins to match a chip function to a board layout. It contains multiplexed memory lines for direct connection to 1M-bit RAMs in single-in-line or dual-in-line packages. A development system includes a software and hardware development kit. The software development kit includes extended and expanded memory drivers that conform to the Lotus Intel Microsoft (LIM) 4.0 specification. The hardware kit includes the interface IC and a Micro Channel development board. Development system, $995; interface chip $27.50 (1000).

Capital Equipment Corp, 99 S Bedford St, Burlington, MA 01803. Phone (617) 273-1818.

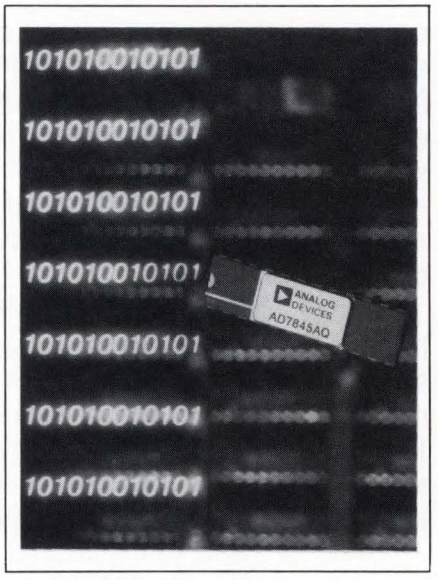
Circle No 583

PORT EXPANDER

The 87C75PF port expander contains two 8-bit bidirectional I/O ports, a 32k×8-bit EPROM, and multiplexed address/data lines. The device eliminates the need for converting two of the four available I/O ports on the company's 8051, 8096, and 80188 μCs into address and data lines to access external memory. The chip's EPROM access time is 170 nsec. The chip provides configuration registers for compatibility with specific μC architectures. The configuration registers let you relocate EPROM in memory, relocate the special function registers in memory, program the reset level to active high or low, and use either double or single memory planes. The CHMOS II-E chip comes in a 40-pin ceramic DIP and a 44-lead PLCC. $20 (10,000).

Intel Corp, Literature Dept, #W-471, Box 58065, Santa Clara, CA 95052. Phone (800) 548-4725.

Circle No 585



MULTIPLYING DAC

The AD7845 4-quadrant multiplying DAC has 12-bit resolution. An LC²MOS fabrication process permits an amplifier to be implemented on the chip. Standard μP control signals, such as $\overline{CS}$ and $\overline{WR}$, control 12 digital input latches. When both control lines are active low, the latches are transparent. All of the digital inputs are compatible with TTL and 5V-CMOS levels.

The output amplifier has four on-chip programmable feedback resistors and can supply ±10V into a 2-kΩ load. The internally compensated amplifier settles to 0.01% of the full-scale range in under 5 μsec. The full-power bandwidth is 250 kHz, and the unity-gain small-signal bandwidth is 600 kHz. The DAC has a total harmonic distortion of −90 dB with a 6V rms, 1-kHz reference-input signal level. The DAC operates from ±15V supplies.

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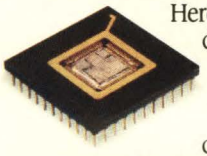

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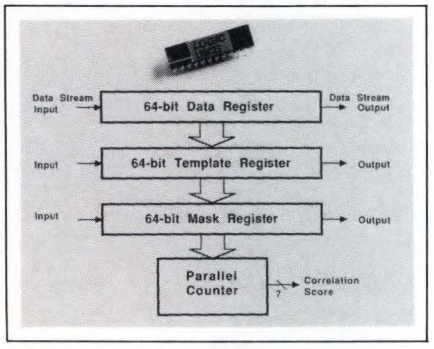
Analog Devices Inc, 804 Woburn St, Wilmington, MA 01887. Phone (617) 935-5565. TWX 710-394-6577. TLX 924491.

Circle No 584



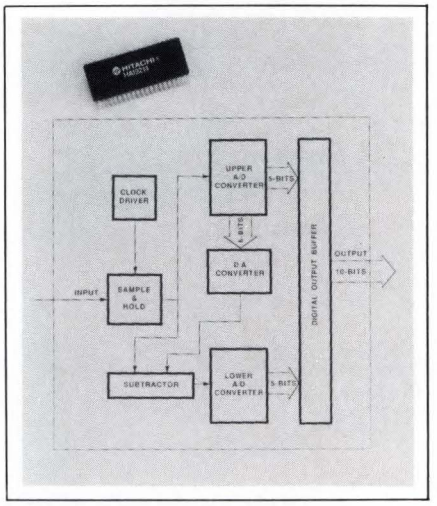
DIGITAL CORRELATOR

The L10C23 64-bit digital correlator chip can search for a 64-bit pattern in a 50-MHz data stream, such as an image from a robot's camera. The chip compares a 64-bit datastream value in a data register with a value in a 64-bit template register and generates a 7-bit correlation value to indicate the degree of match. The chip generates the correlation value in 20 nsec. A 64-bit mask register lets you disable individual bits. The chip can set a compare output flag even quicker when you preload a 7-bit threshold value into the chip and the correlation value exceeds the threshold.

Since each of the registers have outputs, you can cascade a number of chips to search data streams for longer patterns, such as 128 bits, 192 bits, and longer. The CMOS IC draws 25 mA from a single +5V power supply and comes in a 24-pin ceramic DIP, ceramic leadless chip carrier, or plastic DIP. The ceramic part complies with MIL-STD-883C Class B. For the plastic IC, $34.60 for a 20-nsec version and $25 for a 50-nsec version (1000).

Logic Devices Inc, 628 E Evelyn Ave, Sunnyvale, CA 94086. Phone (408) 720-8630.

Circle No 586



A/D CONVERTER

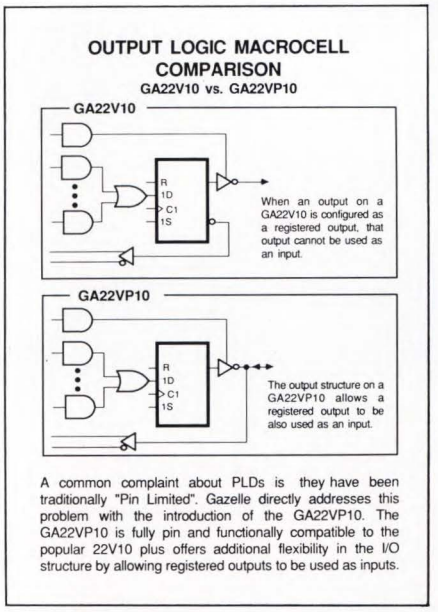
The HA19214 is a 10-bit A/D converter with an on-chip sample-and-hold (S/H) circuit. The chip uses a 2-step parallel conversion method that simultaneously converts the upper 5 bits and the lower 5 bits. This half-flash conversion method achieves 20 million conversions/sec. The device is constructed with monolithic bipolar technology and typically consumes 900 mW operating from ±5V supplies. The converter has a typical signal-to-noise ratio of 52 dB at an input frequency of 5 MHz. The digital outputs are compatible with high-speed CMOS levels, and the converter accepts high-speed CMOS and TTL logic levels on the clock input line. The device comes in a 42-pin plastic shrink DIP with 0.07-in. spacing between pins. $240 (100).

Hitachi America Ltd, 2210 O'Toole Ave, San Jose, CA 95131. Phone (408) 435-8300. FAX 408-435-2748. TLX 171581.

Circle No 587

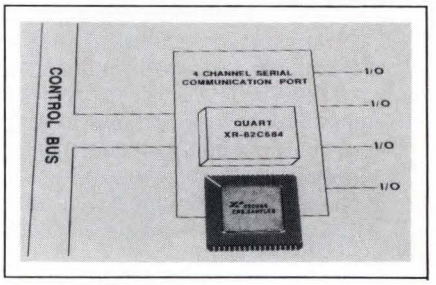
GaAs PLD

The GA22VP10 PLD is built with GaAs material. A patent-pending circuit technique creates inputs and outputs that are TTL compatible, thus making the GA22VP10 pin compatible with the industry-standard silicon 22V10 PLD. The feedback paths on the device allow its registered outputs to be bidirectional, whereas its silicon counterpart has output registers only. The GA22VP10-7 version runs at 110 MHz, and its propagation delay, output enable time, and output disable time are each 7.5 nsec. It also has a 3-nsec set-up time and a clock-to-output time of 6 nsec. The device consumes 1W and operates from −55°C to +125°C. The GA22VP10-7 comes in a 24-pin side-brazed DIP. $35 (10,000).



Gazelle Microcircuits Inc, 2300 Owen St, Santa Clara, CA 95054. Phone (408) 982-0900. FAX 408-982-0222.

Circle No 588



QUAD UART

The XR-82C684 quad universal asynchronous receiver and transmitter (QUART) provides four independent full-duplex asynchronous communication channels in a single IC. Each channel can handle 1M-bps transmission rates when using either a 1-MHz or a 16-MHz

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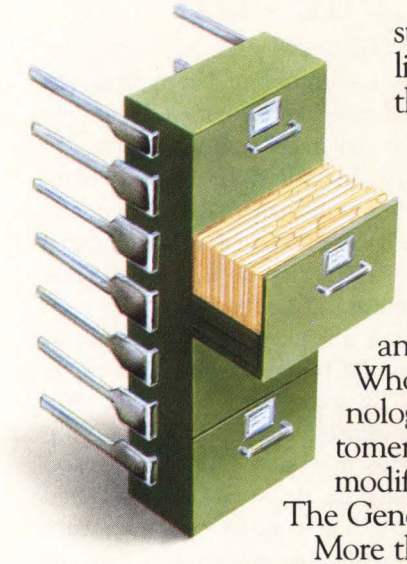

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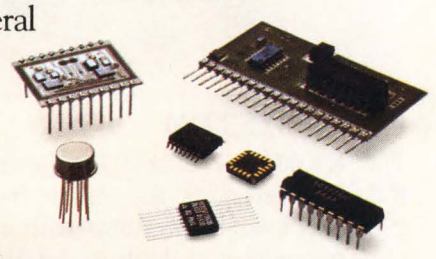


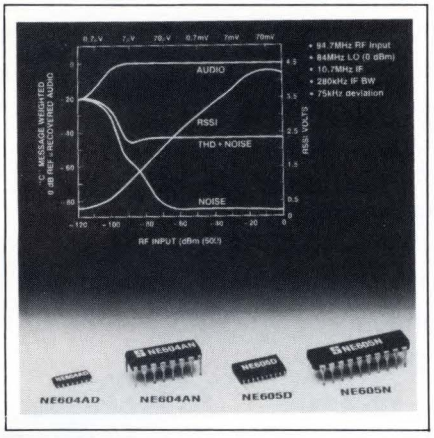
A Sampling of Silicon General Specials.

SILICON GENERAL

external clock. In addition, you can select the operating speed of each receiver and transmitter from one of 33 internally fixed bit rates. The IC can interface with a variety of μP families via two pin-selectable modes: 88XXX and 68XXX. The chip has two 8-bit input ports and two 8-bit output ports. Other features include polling or interrupt-driven status registers; on-chip FIFOs for received and transmitted data; flow control, which can inhibit transmission from a remote device if a receive buffer is full; and two 16-bit counter/timers. The device comes in 68- and 44-pin PLCCs and a 40-pin DIP. $23.18 (1000).

Exar Corp, Box 49007, San Jose, CA 95161. Phone (408) 434-6400. FAX 408-943-8245.

Circle No 589



FM IF SYSTEM

The NE605 monolithic low-power FM IF system is for single frequency conversion systems with input frequencies as high as 1 GHz. The input stage is a Gilbert cell mixer with an on-chip local oscillator. The mixer has a typical noise figure of 5 dB, a conversion gain of 13 dB, and an input third-order intercept point of −10 dBm. The oscillator can operate in excess of 1 Ghz. The mixer drives a 2-stage limiting IF amplifier. The bandwidth of the first amplifier is 40 MHz with a gain of 39.7 dBV from a 50Ω source; the bandwidth of the second limiting amplifier is 28 MHz with a gain of 62.5 dBV from a 50Ω source.

The IF can have a center frequency as high as 25 MHz; however, the gain-bandwidth distribution is optimized for a 455 kHz. The output of the second limiting amplifier feeds a Gilbert cell quadrature detector. The demodulated output is available at two pins—one continuous and one through a mute switch. The chip has a sensitivity of 0.22 μV into a 50Ω matching network. The unit comes in 20-pin DIP. $3.08 (100).

Signetics Inc, 811 E Arques Ave, Sunnyvale, CA 94088. Phone (408) 991-2000.

Circle No 591

SERVO CONTROL CHIP

The ML4404 trajectory-generator chip optimizes the track-access speed of head-positioning servos for high-end disk drives. The chip generates a velocity profile that produces the optimal velocity for positioning the READ/WRITE heads on 3½- and 5¼-in. disk drives. The ML4404 features an anticipate function, which modifies the trajectory curve to eliminate the overshoot problem. The chip also provides control of the settling time at the destination track by means of an external resistor. Designed on the company's FB3620 tile-array platform, the ML4404 can be customized to specific requirements with minor modifications to the double-layer metal masks. The chip is part of a four-chip set that is available on evaluation boards. $7.40 (1000).

Micro Linear Corp, 2092 Concourse Dr, San Jose, CA 95131. Phone (408) 433-5200.

Circle No 590

BUS INTERFACES

The Meta-Flops are six interface devices designed to be resistant to metastable states and for use in data synchronization applications, such as digital system buses. The devices include the SN74AS3074, a dual, D-type, positive-edge-triggered flip-flop with preset and clear; the SN74AS3274, an 8-bit bus-interface circuit with preset; the SN74AS3374, an 8-bit bus-interface circuit; the SN74AS3474, a 9-bit bus-interface circuit; the SN74AS3674, an 8-bit bus-interface circuit with preset and clear; and SN74AS4374, an 8-bit bus-interface circuit. Each device employs two flip-flops and one delay per channel. The second flip-flop acts as a filter to reduce the probability of an output entering a metastable state. The devices operate from 0 to 70°C. $1.37 to $4.68 (1000).

Texas Instruments Inc, Semiconductor Gr (SC-856), Box 809066, Dallas, TX 75380. Phone (800) 232-3200, ext 700.

Circle No 592

ECL GATE ARRAY

The E3G200 200-gate ECL gate array is a member of the company's SPECL product line of ECL bipolar devices with 0.6-μm emitters. Its features include a 100K ECL compatible I/O interface, 210 equivalent gates, 150-psec/gate internal gate delays at IEF = 400 μA, a 2.5-GHz maximum toggle frequency for a D-flip flop, a typical gate power dissipation of 3.6 mW for a 2- to 9-input OR/NOR gate, and a typical chip power dissipation of 1W. The chip operates from a −4.5V supply, and the outputs drive a 50Ω load tied to −2V. The company's design center accepts schematics, net lists, or pattern-generation tapes from customers to develop the custom ICs. Nonrecurring engineering costs for chip development are $33,000. The gate array is available in 24-lead and 32-lead flat packs. $50 (OEM).

Sony Corp of America, Component Products Div, 10833 Valley View St, Cypress, CA 90630. Phone (714) 229-4192. FAX 714-229-4271.

Circle No 595

When World Class Precision and Performance Are Required



Highest precision available with 10 μV input offset voltage from Raytheon.

Raytheon's RC4077 Series high-precision op amp family offers the highest performance in the industry. Looking for the lowest input offset voltage—Raytheon has it. The lowest power dissipation—Raytheon has it. The 4077 Series can upgrade your system to new heights of precision and performance. You can depend on Raytheon's reliability and advanced design techniques to enhance your system.

☐ **Ultimate precision:** ± 10 μV maximum guaranteed input offset voltage, delivered in a variety of package types including low-cost commercial plastic DIPs, sets the RC4077 series apart from other precision op amps. No monolithic op amp—except noisy chopper-stabilized types—has better V_{OS} performance. Additionally Raytheon offers an 8-lead SOIC specified at ± 25 μV.

☐ **Well balanced specs:**
I_B: 2 nA maximum
Gain: 5 million minimum
Power dissipation: 50 mW maximum
CMRR: 120 dB minimum
PSRR: 110 dB minimum

☐ **Companion product:** Raytheon's LT1001 high-precision, high-performance op amp follows RC4077's lead with a very low 15 μV offset voltage. The LT1001 offers 2 nA offset current and gain of .45 million minimum.

☐ **No wait:** The RC4077, LT1001 and other members of Raytheon's broad line of op amps are available now from your local distributor. The RC4077 with 10 μV offset is priced at $3.00 each in 100-piece quantities.

Call Raytheon for access to the right operational amplifier technology at the right price. We offer the precision and performance your system needs to compete.

Raytheon Company
Semiconductor Division
350 Ellis Street
Mountain View, CA 94039-7016
415/966-7716

Access to the right technology

Raytheon

CIRCLE NO 58

MOSFETS

There are power MOSFETs in the BLF-series that operate at HF, VHF, and UHF, with power ratings as high as 300W for the HF and VHF devices and as high as 150W for the UHF devices. Both ranges start with 2W devices. Compared to bipolar types, these MOS transistors exhibit lower wideband noise levels, greater tolerance of load mismatch, and freedom from thermal runaway and parasitic oscillation. In addition, you can drive them from a voltage source rather than a current source. As a result, in many applications there is no need for an output driver stage, and the ability to modulate the output power by modulating the MOSFET's gate voltage suits the devices for use in AM transmitters. Sample quantities of many of the low- and mid-range power MOSFETs are available now, with production volumes available by the middle of 1989. As a guide price, the 10W, 500-MHz BLF543 is expected to sell for around gld 50 (100).

Philips, Components Div, Box 218, 5600 MD Eindhoven, The Netherlands. Phone (040) 757189. TLX 51573.

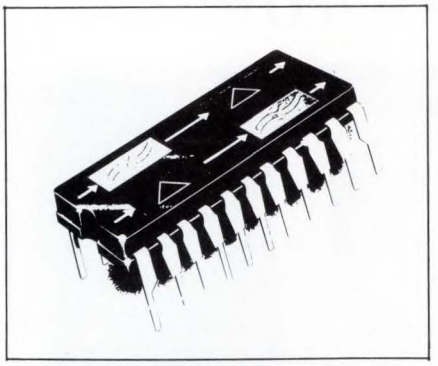
Circle No 614

Amperex Electronics Corp, George Washington Highway, Smithfield, RI 02917. Phone (401) 232-0500.

Circle No 615

DELTA CODEC

Meeting the requirements of the NATO Eurocom D1-IA8 specification, the FX619 full-duplex, single-chip CVSD (continuously variable slope delta) codec is suited for use in a variety of military communications systems. Because it includes both encoder and decoder sections plus the audio filters that are required on the encoder input and decoder output, the device can significantly reduce component count.



You can program the delta codec's sampling rate to 16k, 32k or 64k bps with internal timing derived from an on-chip oscillator that accepts a 1.024-MHz crystal. Alternatively you can clock the device from an external clock source to achieve sampling rates anywhere in the 8k- to 64k-bps range. Clock outputs let you synchronize external circuitry to the codec, and an enable input lets you enable or disable the encoder section of the device. Other features include encoder and decoder forced-idle modes and 3- or 4-bit companding algorithms. The FX619 is packaged in a 22-pin ceramic DIP or a 28-lead ceramic chip carrier. About £20 (1000).

Consumer Microcircuits Ltd, 1 Wheaton Rd, Witham, Essex CM8 3TD, UK. Phone (0376) 513833. TLX 99382. FAX 0376-518247.

Circle No 623

Mx-Com Inc, 4800 Bethania Station Rd, Winston-Salem, NC 27105. Phone (919) 744-5050.

Circle No 624

MODEM IC

The FX429 single-chip 1200-baud fast frequency-shift keying modem is targeted for use in trunked radio systems. It conforms to the UK's MPT1317/1327 Band-III trunked radio-protocol specification, but you can use it in other radio- or cable-based data-link applications. The device operates in full-duplex mode at 1200 baud. While transmitting data, you can program the device to automatically generate and transmit preamble bit-reversals for link synchronization, and a 2-byte check-sum for the transmitted data. You can disable the check-sum function to allow continuous data transmission. In the receive mode, the device detects the 16-bit Sync (control channel frame synchronization) or Synt (traffic channel frame synchronization) word preceeding the data packet. You can also program it to error-check the data, using the transmitted checksum. The FX429 has an on-chip clock oscillator that accepts a 4.032-MHz crystal or external clock input and an 8-bit μP-compatible control/data interface. Its 1.008-MHz output drives peripheral circuitry. Fabricated in CMOS, the device operates from a 5V supply and draws a typical supply current of 5 mA when active. It is available in a 24-pin DIP or a surface-mount package. £6.78 (1000).

Consumer Ltd, 1 Wheaton Rd, Witham, Essex CM8 3TD, UK. Phone (0376) 513833. TLX 99382.

Circle No 596

Mx-Com Inc, 4800 Bethania Station Rd, Winston-Salem, NC 27105. Phone (919) 744-5050.

Circle No 597

I/O CONTROLLER

The SAB82525 is a functionally enhanced version of the SAB82520 high-level serial communications controller. It provides two independent full-duplex HDLC channels, each provided with its own clock oscillator, baud-rate generator, digital PLL, and time-slot alignment circuitry.

In addition to OSI-model layer-1 functions, the controller's on-chip link-access-procedure (LAP) controller handles several layer-2 functions, including flag insertion and detection, bit-stuffing, CRC generation and checking, and address field recognition. The controller can handle serial I/O data rates as high as 4M bps and supports X.25 LAP-B, ISDN LAP-D, and SDLC (normal response mode) protocols. Com-

HP TURNS 030.



It couldn't have happened to a better company.

This past June, Hewlett Packard became the first major U.S. computer manufacturer to introduce a workstation system based on Motorola's 68030 32-bit microprocessor.

As expected, it's turned out to be quite a system. The HP 9000 Model 360, in fact, reaches processing speeds of up to 5 MIPS at 25 MHz. And the new Model 370 hits over 8 MIPS at 33 MHz.

Largely due to Motorola's 030. After all, it delivers more performance than any other conventional microprocessor on the market today, and even outruns a number of RISC* processors. Plus it offers firsts like on-chip data and instruction caches, parallel architecture and unique DRAM interface.

That's why if you're planning a high-performance system, plan on talking to us first. For free benchmarks and more information, call or write Motorola Inc., P.O. Box 20912, Phoenix, AZ 85036. 1-800-441-2447.

After all, one great turn deserves another.

MOTOROLA

*Reduced Instruction Set Computer.

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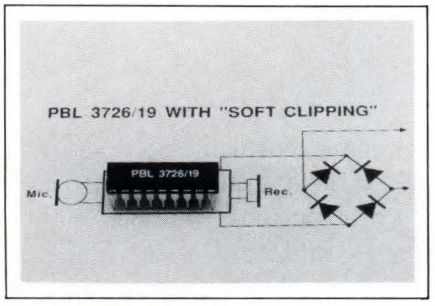
munication with a host processor system is via a μP bus that is pin programmable to operate as either a multiplexed or a non-multiplexed bus. On-chip 64-byte FIFOs and dedicated DMA-channels for the receive and transmit sections of each channel maximize throughput. You can also operate the controller under interrupt control. The SAB82525 is a CMOS device with a typical active power consumption of 25 mW and a standby power consumption of 4 mW. It is packaged in a 44-pin plastic leaded chip carrier, and is expected to sell for around DM 25 (10,000) by 1990.

Siemens AG, Zentralstelle fur Information, Postfach 103, 8000 Munich 1, W Germany. Phone (089) 2340. TLX 5210025.

Circle No 618

Siemens Components Inc, 2191 Laurelwood Rd, Santa Clara, CA 95054. Phone (408) 980-4500.

Circle No 619



TELEPHONE IC

Suitable for use in telephone handsets, the PBL3726/19 telephone speech-circuit IC features soft clipping to reduce distortion at high speech levels. An on-chip automatic gain-control (AGC) circuit reduces the gain of the transmit amplifier by as much as 5 dB when the ac signal on the telephone line increases to 2V peak.

The circuit performs 2- to 4-wire conversion, has automatic loop-loss compensation, and interfaces to a variety of microphones and loudspeakers. Its high-impedance differential microphone input lets you control the input impedance with external resistors, making it suitable for applications that require a well-defined input impedance. The PBL3726/19 is supplied in an 18-pin DIP. A surface mounting version is also available. $1.40 (10,000).

Ericsson Components AB, Microelectronics Div, Isafjordsgatan 16, 16481 Kista-Stockholm, Sweden. Phone (08) 7574354. TLX 8125008. FAX 08-7526034.

Circle No 627

Ericsson/Rifa Inc, 403 International Parkway, Richardson, TX 75081. Phone (214) 480-8300. FAX 214-680-1059.

Circle No 628

BUS INTERFACE

The MCT83000 is a MIL-STD-1553B remote-terminal interface that decouples 1553B bus transactions from host CPU I/O operations. On the processor side of the interface, the host CPU has continuous access to a 2k×16-bit dual-port RAM that contains validated received 1553B bus messages or 1553B messages that are ready for transmission. Similarly, the device's integral 1553B remote terminal controller has continuous access to a separate 2k×16-bit dual-port RAM that contains complete 1553B bus messages ready for transmission and received 1553B bus messages. Integrated control logic performs burst-mode transfers of complete 1553B bus messages between the two dual-port RAMs at appropriate times during 1553B bus operation. The MCT83000 is also available with 4k×16-bit dual-port RAMs to provide separate data buffers for broadcast commands in accordance with MIL-STD-1553B notice 2. The device also includes low-power 1553B bus transceivers. It is supplied in a 2.375-in. square, 90-pin quad in-line package or flatpack. Around $1200 (100).

Marconi Electronic Devices Ltd, Microsystems Div, Hargreaves Rd, Groundwell Industrial Estate, Swindon, Wiltshire SN2 5BE, UK. Phone (0793) 727005. TLX 444460. FAX 0793-723348.

Circle No 625

Marconi Electronic Devices Inc, 45 David's Dr, Hauppauge, NY 11788. Phone (516) 231-7710. TLX 275801. FAX 516-231-7923.

Circle No 626

SMART SWITCH

The L6122 and L6123 smart power ICs each contain three 100V DMOS power transistors together with the CMOS control logic to turn them on and off. The power transistors have an on-resistance of 0.5Ω and can handle repetitive peak currents as high as 5A. Their continuous current rating is limited only by the power dissipation in the device. For the L6122, which is housed in a 20-pin DIP with six leads dedicated to heatsinking, the allowable power dissipation limits the continuous output current to around 1.5A. The L6123, which is housed a 15-lead Multiwatt power package, can typically handle continuous currents of around 3A. The source and drain connections for each power transistor are lead out separately from the device. Each power transistor is controlled by a separate CMOS/TTL-compatible logic input. An additional control input lets you enable/disable all three transistors at once. You can switch the power transistors at frequencies as high as 200 kHz, making them suitable for applications that utilize pulse-width-modulation control. L6122 $2.20; L6123 $2.50 (1000).

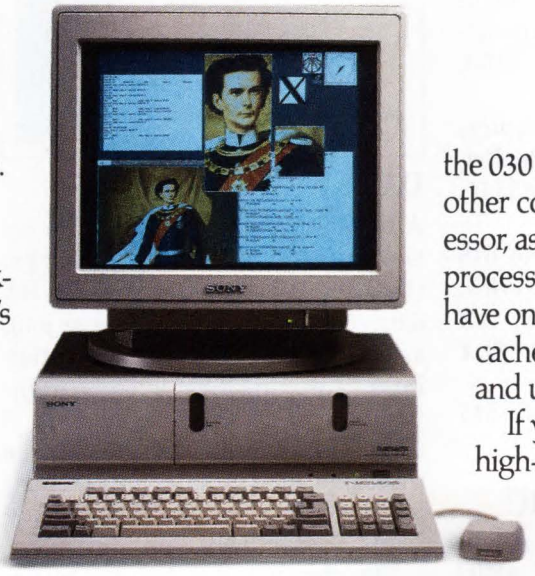
SGS-Thomson Microelectronics, Via C Olivetti 2, 20041 Agrate Brianza, Italy. Phone (039) 65551. TLX 330131.

Circle No 621

SGS-Thomson Microelectronics, 1000 E Bell Rd, Phoenix, AZ 85022. Phone (602) 867-6100. TLX 249976.

Circle No 622

SONY TURNS 030.



It happens to the best of them.

When Sony Microsystems set out to build NEWS-1850, their fastest, most powerful workstation, they turned to Motorola's 68030 32-bit microprocessor.

And they turned out the world's first dual-030 system. With one 030 as the main processor, the other as the I/O processor, and a Motorola 68882 floating point co-processor performing math operations, the NEWS-1850 is one of the most advanced technical workstations on the market.

Which is only natural when you consider that the 030 easily outperforms every other conventional microprocessor, as well as a number of RISC* processors. It's also the first to have on-chip data and instruction caches, parallel architecture and unique DRAM interface.

If you'd like your next high-performance system to be a blazing success, you know who to turn to. Write for free benchmarks and more information to Motorola Inc., P.O. Box 20912, Phoenix, AZ 85036. Or call 1-800-441-2447.

After all, the news has never been better.

MOTOROLA

*Reduced Instruction Set Computer.

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MODEM CHIP SET

Comprising three dedicated DSP devices, the TS7532 chip set lets you implement the receive, transmit, and echo-cancelling functions required in a V.32 (9600-baud) modem. The echo canceller can cope with telephone line echos that are delayed by as much as 1.2 sec—the typical delay introduced by two satellite hops. The devices can also compensate for frequency shifts of as much as 10 Hz in the received signal. The chip-set interfaces to the telephone line via the company's modem analog front-end (MAFE) chip set. It interfaces to the modem's microcontroller via an 8-bit data/control port. The company is currently working on a software upgrade that will allow you to incorporate other operating modes into the modem—for example, V.21, V.22, V.22-bis, V.23, Bell 103, and Bell 202 modes. The TS7532 chip set is manufactured using the company's 1.2-μm HCMOS-3 process. $150, (OEM quantities).

SGS-Thomson Microelectronics, Via C Olivetti 2, 20041 Agrate Brianza, Italy. Phone (039) 65551. TLX 330131.

Circle No 616

SGS-Thomson Microelectronics, 1000 E Bell Rd, Phoenix, AZ 85022. Phone (602) 867-6100. TLX 249976.

Circle No 617

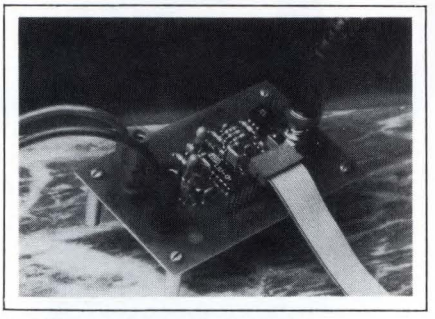
ANALOG/DIGITAL ASIC

The Expert Array lets you subdivide a mixed analog/digital ASIC into sections that are implemented using standard cells and sections that are implemented with mask-programmable arrays of analog components and logic gates. You can define the size and functionality of the standard cell and the array sections, both of which are then integrated onto the same silicon die.

You can use the technique to produce standard-function parts that you can modify for different applications—for example, telephone ICs that you can adapt to different international standards. Alternatively, you can use the technique to accelerate the prototyping phase of a custom design—implementing well-defined circuitry with standard cells and using arrays to implement any circuitry that may require subsequent redesign. For several design iterations, the design costs for the Expert Array are between those for a gate array and those for a standard-cell design.

Mietec, Westerring 15, 9700 Oudenaarde, Belgium. Phone 55332211. TLX 85739. FAX 55318112.

Circle No 620



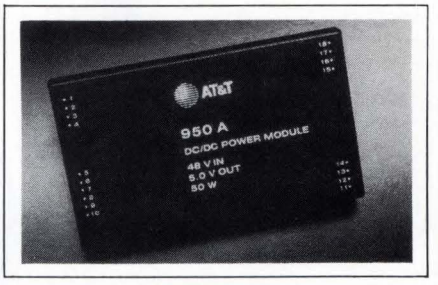
DATA RECEIVER

A monolithic receiver for use in serial data transmission networks, the LIU-01 recovers RZ and NRZ data over transmission lines as long as 6000 ft. It contains a differential-input preamplifier with a gain-bandwidth product exceeding 5 GHz. The preamplifier feeds three threshold comparators for extracting the data, clock, and peak amplitudes, respectively.

The chip also has two automatic line-build-out (ALBO) ports, consisting of two current-driven diodes, which act as variable impedances, for closing an AGC loop around the preamplifier. By averaging the peak detected pulses on an external ALBO filter capacitor, the chip can automatically adjust for signal attenuation-vs-frequency characteristics encountered with varying lengths of twisted-pair, coax, or fiber-optic transmission lines. The chip can handle input signals over a 60-dB dynamic range and data rates ranging from 64k to 4M bps. The device operates from −40 to +85°C and comes in a 16-lead ceramic DIP, plastic DIP, and SOL package. $12 to $15.

Precision Monolithics Inc, Box 58020, Santa Clara, CA 95052. Phone (408) 562-7384. TLX 713719541. FAX 408-727-1853.

Circle No 593

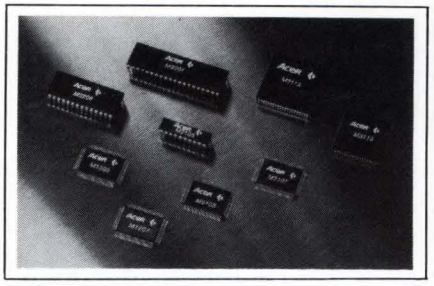


POWER MODULES

The 950A, 950B, 984A, 984D, and 990B1 are additions to the company's 900-series of board-mounted power modules. All of the modules operate from a 48V dc input level. The 950A delivers 50W of power at 5V dc, has a typical efficiency of 85%, and provides parallel operation with load sharing. The 950B delivers 60W at 12V dc, has a typical efficiency of 88%, and also can be operated in parallel with load sharing. The 984A delivers 30W at 5V dc, and has a typical efficiency of 82% and an MTBF greater than 1,000,000 hours operating at 40°C. The 984D delivers 30W at 12V dc, and has a typical efficiency of 86% and an MTBF greater than 1,000,000 hours at 40°C. Both of the 984 modules have 2.0×3.6×0.75-in. footprints. The 990B1 delivers 100W at 12V dc, has a typical efficiency of 88%, and permits parallel operation with load sharing. The 950 units, $121 (500); the 984 units, $79.50 (500); and the 990B1, $164 (500).

AT&T Microelectronics, Dept 51A1230230, 555 Union Blvd, Allentown, PA 18103. Phone (800) 372-2447.

Circle No 594

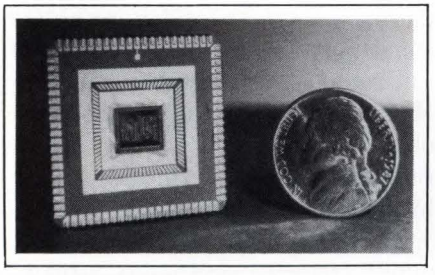


PS/2 CHIP SET

The PC86 chip set provides the system-, graphics-, and peripheral-control functions needed to build a fully compatible PS/2 Model 25 or 30. The chip set's architecture and partitioning simplify manufacturing and reduce costs by making it possible to use only a few chips to build a range of systems. The set consists of the M1201 system controller for the 8086 and V30; the M1203 address and data buffer; the M2107 input/output controller; the M3113 and M3115 MCGA and Hercules graphics controllers; the M3205 50-MHz, 256×18 color palette; the M2201A bidirectional printer interface; and the M5103 floppy-disk-drive interface. You can use the graphics-control and peripheral-control chips separately for PC/XT and PC/AT computers. A PC86 sample set costs $88; $77 (1000).

US Sertek, 926 Thompson Pl, Sunnyvale, CA 94086. Phone (408) 733-3174.

Circle No 598



SYNTHESIZER

The Q2334 single-chip digital frequency synthesizer provides a μP interface to control variable frequency and phase signals that are synthesized from a master reference. It includes two independent frequency synthesizers for use in full-duplex systems, spread-spectrum analysis, or quadrature oscillator applications. The chip provides a resolution of more than 0.01 Hz with an input signal clocking the phase accumulator at 30 MHz. Signal-to-noise ratios are 72 dB for quantization noise and 76 dB for phase noise. The Q2334 is available in 68-pin packages. $98 (1000).

Qualcomm Inc, 10555 Sorrento Valley Rd, San Diego, CA 92121. Phone (619) 587-1121.

Circle No 599

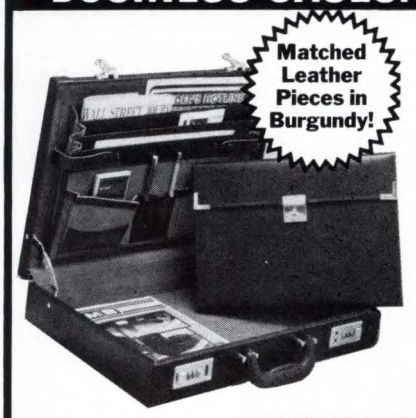
FIBER-OPTIC CHIPS

Designed for fiber-based LANs as well as standard telecommunications, the company offers two 3-chip sets for use at data rates to 50M and 200M bps, respectively. The 50M-bps set operates as a Manchester biphase-mark encoded system. The LED driver (SP9960) in the transmitter section is programmable for drive currents ranging from 15 to 150 mA. The receiver section contains the SL9901, a transimpedance amplifier that interfaces with a PIN diode, and the SP9921 decoder, which performs the clock and data-recovery functions. The 200M-bps set operates from 100M to 200M bps, which includes the FDDI (Fiber Optic Distributed Data Interface) standard. The SP9954 transmitter can drive an LED or a laser diode and features external-resistor programming of the operating current. The receiver consists of the SL9904 transimpedance amplifier and the SP9944 data-slice circuit, which converts the output from the SL9904 to an ECL level. A programmable threshold-detect function directly supports the FDDI requirements. The 50M-bps chip set, $39.03; the 200M-bps chip set, $60.01 (1000).

Plessey Semiconductors, 1500 Green Hills Rd, Scotts Valley, CA 95066. Phone (408) 438-2900. TLX 4940840. FAX 408-438-5576.

Circle No 606

BIG SAVINGS ON... BUSINESS CASES!



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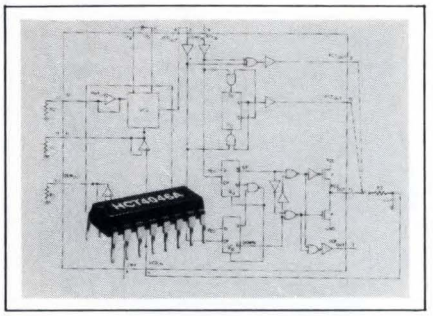


PLL IC

The CD54/74HC/HCT4046A PLL IC contains three different phase comparators—an exclusive OR gate, a J-K flip-flop, and an R-S flip-flop. Its VCO characteristics include a frequency linearity of 0.4% and a typical frequency stability of 0.11%/°C. The VCO operates at frequencies as high as 38 MHz and a VCO-inhibit pin provides on/off control and limits power consumption when the PLL is in standby mode. A signal input and a comparator input are common to all three phase comparators. You can couple the signal input directly to logic-level voltages or indirectly to millivolt-level signals through a series capacitor. The chip's self-bias circuit keeps small signals within the linear range of the input amplifiers. The CD54/74HC4046A operates from a 2 to 6V supply; the CD54/74HCT4046A operates from a TTL-compatible 4.5 to 5.5V supply. Available packages include 16-pin ceramic and plastic DIPs and a 16-pin surface-mount version. In 16-pin plastic DIP, $1.62 (100).

GE Solid State, Box 2900, Somerville, NJ 08876. Phone (201) 685-6562.

Circle No 600

BUFFER AMPLIFIERS

The EHOS-100 and EHOS-200 are high-speed, unity-gain buffer amplifiers with bandwidths (−3 dB) of 125 and 200 MHz, respectively. The EHOS-100 operates from ±15V supplies; the EHOS-200 from ±5V supplies. Included in each of the 2-stage amplifiers are bypass capacitors that improve the transient response. Both amplifiers feature a slew rate of 1500V/μsec and can deliver 100 mA of output current. The buffer amplifiers come in TO-8 metal packages and are available in commercial and military versions. EHOS-100, $10.13 to $24.75; EHOS-200, $9.38 to $24 (100).

Elantec Inc, 1996 Tarob Ct, Milpitas, CA 95035. Phone (800) 821-7429; in CA, (408) 945-1323.

Circle No 602

VIDEO SHIFT REGISTER

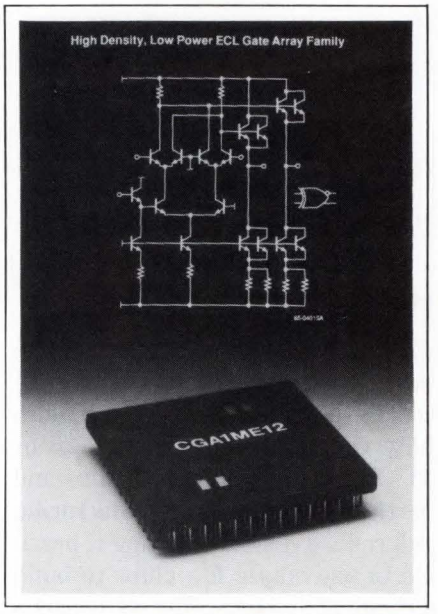
Adapting to a variety of frame buffers and RAM-DAC structures, the Bt424 video shift register reduces component count in high-resolution graphics systems. Because it employs both TTL and ECL circuitry, the register provides a low-to-high speed interface that simplifies system timing. With a 4-bit multitap architecture, the register works with systems running at rates of 125 MHz or faster. You can use the device with other high-speed bipolar products in the vendor's line. The chip operates from a single 5V supply or 5V and −5.2V supplies. It consumes 1.25W and comes in a 68-pin PGA package. $62 (100).

Brooktree Corp, 9950 Barnes Canyon Rd, San Diego, CA 92121. Phone (619) 452-7580. TLX 383596.

Circle No 603

ECL GATE ARRAY

Featuring a typical access time of 3.5 nsec, the CGA1ME12 ECL gate array contains 4584 equivalent gates max, 1280 bits of configurable RAM, and 120 I/O cells. Interfaced among the I/O cells are 34 dedicated power pins. The gates are laid out in 12 contiguous rows with each row containing 1320 transistors and 1320 resistors. For the typical gate, the propagation delay is 300 psec, and the power consumption is 300 μW. The RAM megacell consists of four separate 320-bit blocks. You can configure the RAM blocks independently or combine them to form larger memory blocks. Commercial versions of the device are specified for operation over the 0 to 70°C temperature range. Depending on gate utilization, quantity, and test requirements, prices start at $150. Nonrecurring engineering costs range from $40,000 to $60,000.



Raytheon Co, Semiconductor Div, 350 Ellis St, Mountain View, CA 94043. Phone (415) 966-7639.

Circle No 601

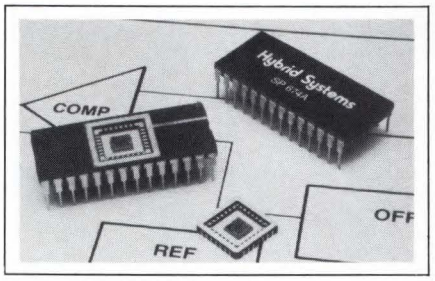
FLASH A/D CONVERTER

Featuring a flash architecture, the monolithic AD770 A/D converter provides an 8-bit output at 200M samples/sec. It has a 250-MHz full-power bandwidth and a 400-MHz small-signal bandwidth. The AD770 can sample signals within the 100-MHz Nyquist-frequency limit without an external S/H circuit. Two reference inputs set the unipolar or bipolar analog-input range within a ±2V span. Force and sense taps allow accurate end-point adjustments for these reference voltages. A reference resistor ladder provides taps at midpoints and quarterpoints. You can use these taps to curve the ADC transfer function and to improve RF decoupling. A proprietary error-correction scheme reduces sparkle codes. All

digital outputs are ECL compatible. The AD770 is available in a 40-pin ceramic DIP for either the commercial or military temperature range. From $175 (100).

Analog Devices, Literature Center, 70 Shawmut Rd, Canton, MA 02021. Phone (617) 329-4700. TLX 924491.

Circle No 607



A/D CONVERTERS

The SP674A and HS574A 12-bit monolithic A/D converters are pin-compatible with Harris's 2-chip H167A and Analog Devices' AD574A. The SP674A and HS574A contain an internal 10V reference, a clock, and 3-state output buffers for direct interfacing to 8-, 12-, and 16-bit μP buses. The SP674A has a typical conversion time of 12 μsec (15 μsec max); the HS 574A's typical conversion time is 15 μsec (25 μsec max). Both converters offer standard bipolar and unipolar input ranges of ±5, ±10V, 0 to 10V, and 0 to 20V. The maximum linearity error is ±0.5 LSB. The company guarantees no missing codes to 12 bits over the specified temperature range. Both ADCs operate from 5V and 12 to 15V supplies and feature a maximum power consumption of 150 mW. Packaging options include a ceramic 28-pin DIP and a ceramic 28-pin LCC. The converters are available in the commercial. industrial, and military temperature ranges. Depending on grade and screening, $25 to $160.

Sipex Corp, Hybrid Systems Div, 22 Linnell Circle, Billerica, MA 01821. Phone (508) 667-8700. FAX 508-667-8310.

Circle No 604

DATA QUANTIZER

The ML4421 is a data quantizer that converts analog signals in fiber-optic receivers to digital pulses. The unit is compatible with Hewlett-Packard's HFBR-24X6 fiber-optic receiver and preamplifier. A dual-stage wideband amplifier, which features an adjustable bandwidth, drives a fast ECL comparator. The output data of the device is available with either ECL or TTL levels. The chip is capable of data rates as high as 100M baud, utilizing the full 50-MHz max bandwidth. The quantizer has a 100-μV input noise spec and a dynamic range of 55 dB. The unit is available in a 24-pin DIP and a 24-pin PLCC. $6.50 (1000).

Micro Linear Corp, 2092 Concourse Dr, San Jose, CA 95131. Phone (408) 433-5200.

Circle No 613

IGNITION PREDRIVER

Designed primarily for automotive applications, the CS-345 drives and controls an external power transistor or FET to start and regulate inductive load currents. An input control voltage between 0.9 and 3.5V triggers the chip's output driver into saturation with a maximum voltage drop of 0.5V. An external resistor sets the CS-345's output drive current (200 mA max). A sense input monitors the load current and sets the regulation to a user-selectable level. Once the IC begins regulating the load current, the status pin switches from a logic-1 to a logic-0. When the control input switches to a logic-0, the output transistor goes into cutoff and shuts off the drive current to the load. The CS-345 is packaged in an 8-pin DIP. $0.94 (1000).

Cherry Semiconductor Corp, 2000 South County Trail, E Greenwich, RI 02818. Phone (401) 885-3600. TLX 6817157. FAX 401-885-5786.

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CASE

shows promise but confusion still exists

In theory, computer-aided software engineering (CASE) promises to automate your software-design process, making it easier for all those involved with a software project to communicate. It's not certain, however, whether CASE actually fulfills that promise. The issue is a complex one, and it's further complicated by the fact that almost everyone has a different definition for CASE. In general, a CASE tool can be defined as any software program that assists you in developing software. Different people fine-tune this loose definition very differently, however.

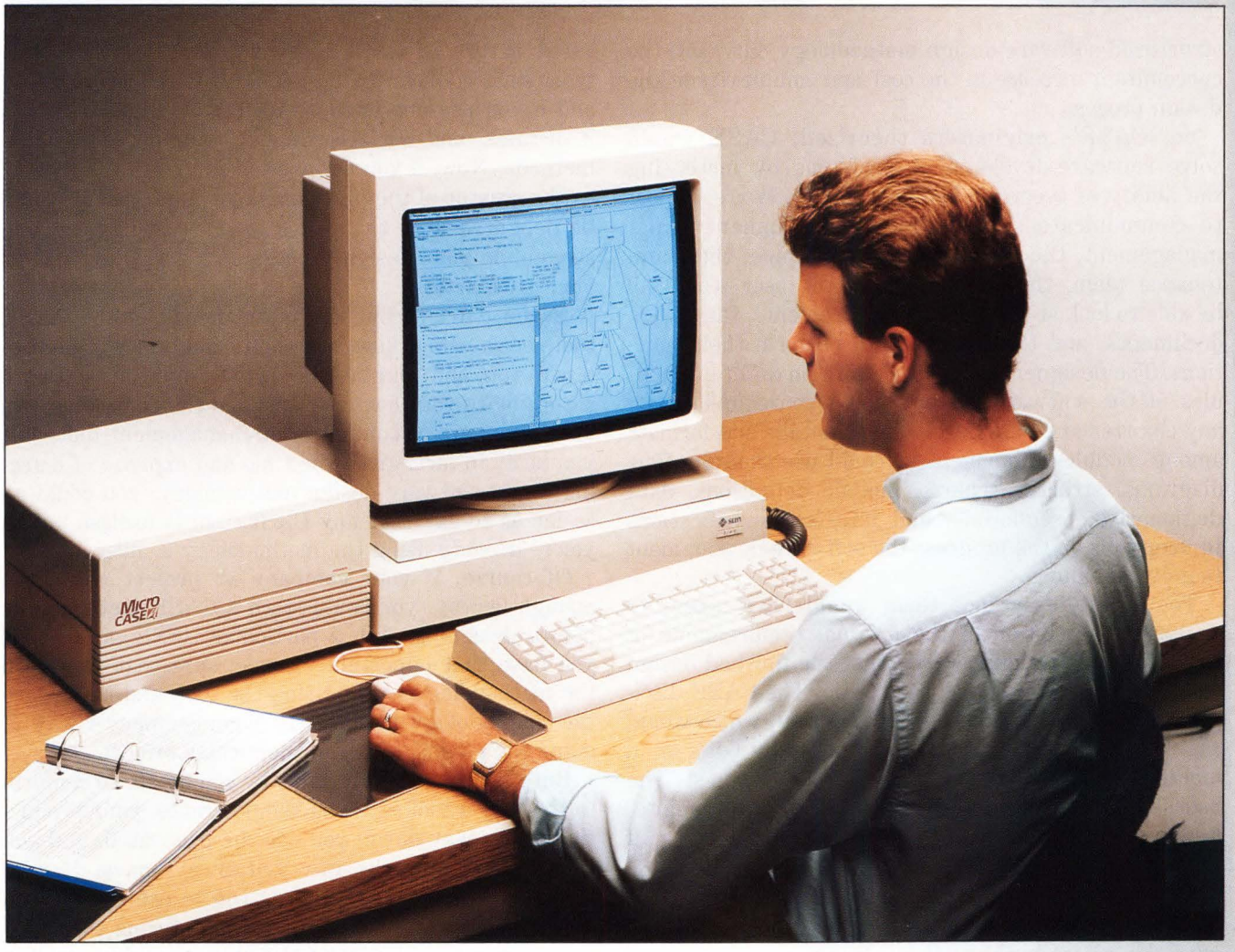
Some refer to design, analysis, and prototyping tools as "front-end" CASE tools, and refer to assemblers, compilers, test programs, integration tools, and configuration-management systems, etc, as "back-end" CASE tools. For the sake of discussion, this article will refer to the "front-end" CASE tools simply as CASE tools and will call the "back-end" CASE tools by their individual names.

CASE began as an attempt to automate certain structured methodologies, dating back to about 15 years ago, that were intended to solve the communication problems that typically plague large software projects. Such problems have been well documented. Frequent cost and schedule overruns, high maintenance costs, questionable reliability, and the failure to create programs to specification have long afflicted the software industry. All of these problems can be traced to difficulties in communication, which are, in turn, often caused by lack of discipline in software-engineering practices.

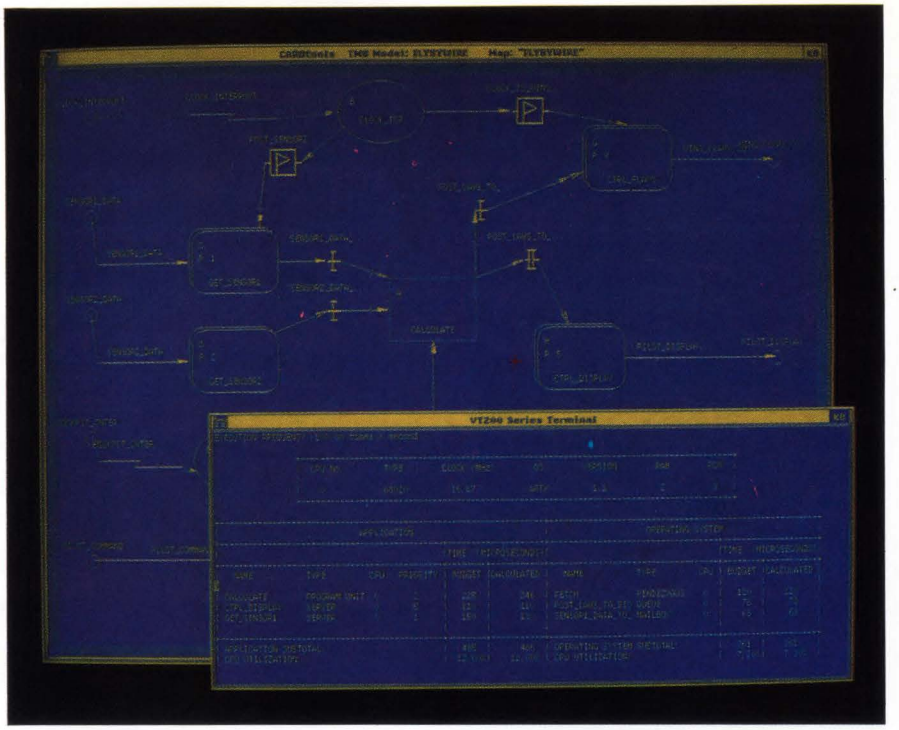
As the number of software engineers developing a software system increases, the potential for communication-related problems goes up. Eventually, the CASE theory goes, you reach a point where the advantages of using a

David Shear,
Regional Editor

Many software engineers find the CASE market so confusing that they just ignore it and continue to develop software by the same methods they've always used. Fortunately, you can clear away the marketing hype and take a realistic look at what CASE tools can and can't do for your software project.



Software-design and -analysis tool *(Microcase)*



Link between design tool and prototyping tool *(Ready Systems)*

structured software-design methodology outweigh the concomitant increase in the cost and complexity of the design process.

So, CASE's originators theorized, CASE would solve software-development problems by increasing the ability of everyone involved in a software project to communicate. The software-development team, management, the quality-assurance people, the maintenance team, the customer, and the user would all be able to look at the original requirements, the design documents, and the final code to perform their functions. The designers, who often work on different modules of the software system, could share updates of any changes and pass development details and formats among modules. Management could use the data-flow diagrams, structure charts, module definitions, data dictionaries, pseudocode, and interface specifications to keep tabs on the progress the software-development team was making.

The quality-assurance team would have access to an exact description of the original requirements of the system, in order to verify that the finished design would do what it was supposed to do. The CASE discipline would produce clear documentation, which would assist the maintenance team in fixing any bugs or in modifying the program at the customer's request. The users would be able to communicate with the maintenance team so they could easily ask for changes, if necessary.

Such an increase in communication was to pay off in greater productivity, higher quality, and lower costs over the entire cycle of the software project. Those are the promises of CASE.

The truth, however, is that CASE is still in its infancy, and it hasn't grown as fast or as big as its parents expected it to. One of the problems lies in the structured nature of CASE design. The available CASE tools each conform to a specific CASE methodology, and if you use one of those tools, you must design as it dictates, and not according to your own individual methods. Now, if you happen to think in the same way as the creator of the particular tool you're using, you'll be delighted with that CASE tool—it will speed and streamline your design process as a calculator speeds your arithmetic.

If you don't accept the methodology of the CASE tool you're using, however, then frankly it will be useless to you, and your best bet is to design your software according to your own methods and then employ whatever compilers or configuration-management tools suit you best. In fact, given the time and expense of learning a new software-design methodology, you could go so far as to say that any CASE tool is useless unless you're *already* using the methodology it automates.

Of course, if your company or project gives you enough leeway, you could learn a CASE methodology before designing with a particular CASE product. If you have that opportunity, make sure that you learn the methodology before using the tool, and make sure the methodology fits in with your company's way of doing things and with your particular project.

But if you try to force the way you create to conform to the way a tool says you should create, your productivity goes way down, you become frustrated, and you end up designing the way you always have. If your manager or customer requires you to use CASE, you may spend late nights at the office entering the information into the system so the manager will see what he or she expects to see.

And the documentation the CASE programs create will also be of questionable value, because the maintenance people will do the same thing you do—they'll

You should first find a software-design methodology that works for you, and then choose tools that help you implement this methodology.

examine the code, as they always have, then try to enter changes into the system in such a way that the documentation will reflect those changes. But they generally won't use the facilities that CASE was intended to provide.

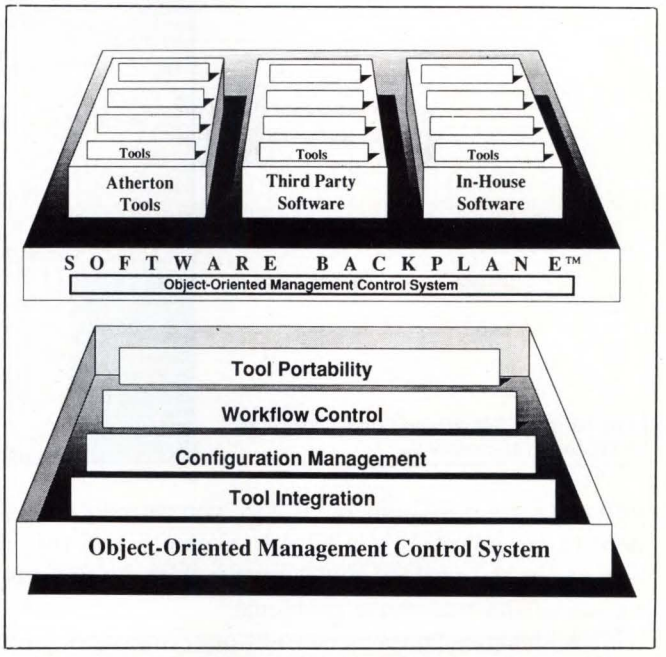
What CASE actually does is to automate certain software-design and -analysis methodologies. To choose a tool properly, you must fully understand the methodology that the tool automates. Unfortunately, there's no standard among these methodologies. You can choose the Yourdon-DeMarco structured-analysis methodology, the Warnier-Orr stepwise-decomposition methodology, the Nassi-Shneiderman structogram methodology, and the Chen-Merise database-design methodology. So far, there is little evidence that these methodologies have resulted in any real success in reducing development time or increasing quality. Their major contribution has been to tell people that using GOTO statements is taboo.

Besides the general methodologies, there are a number of extensions of the methodologies. You may have heard of the Boeing-Hatley, Ward-Mellor, Jackson, and Harel extensions. Individual CASE vendors offer extensions to these extensions. So not only do you have to choose a general methodology and a general extension, but you must consider each manufacturer's implementation of these methodologies and extensions, because each is different. Merely choosing a product can turn into a lot of work.

Two factions have further confused the issue. The first group includes people who adopted CASE in its early stages. Because some of them have an almost religious fervor about their favorite methodologies, they place more emphasis on the tools and techniques than on the tools' practical use in creating software products.

The second faction includes vendors that have made wild marketing claims about their CASE products' abilities. Originally, the story was that CASE would increase your productivity. Then it was going to reduce the total project cost. Then companies claimed it would increase the quality of your software. The current marketing claim is that CASE will make large projects possible. This lack of consistency in communicating what CASE tools will do has injured the CASE market. Many potential customers for CASE tools distrust every CASE vendor because of the exaggerated claims made by a few. Those exaggerations have obscured the more realistic claims of the industry.

One realistic claim is that CASE may make it easier



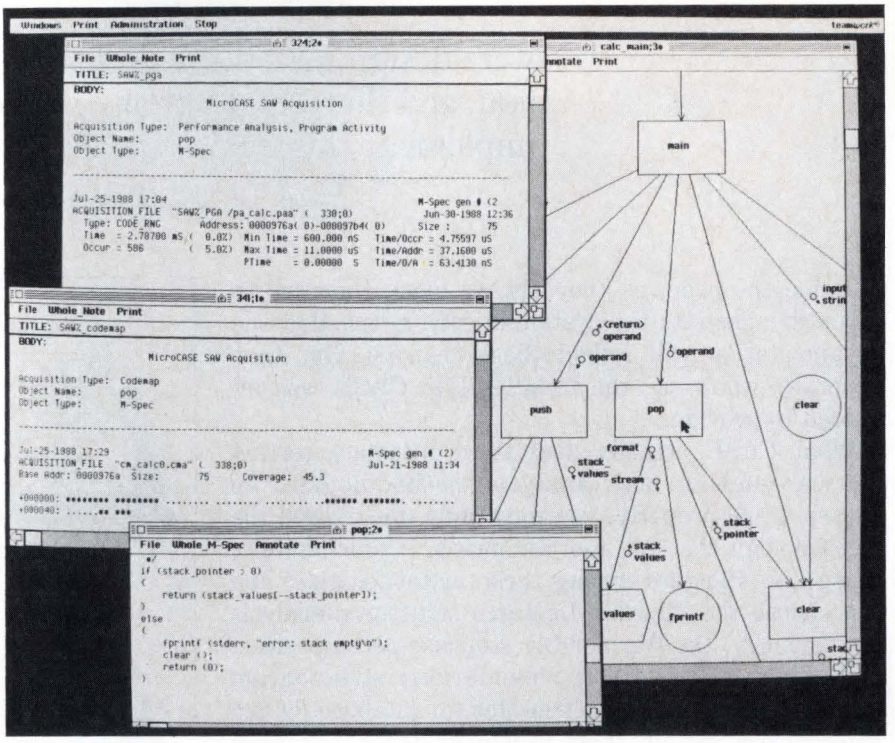
Software that interfaces different CASE tools *(Atherton Technology)*

for a customer to verify that a product does what it was intended to do. At present, it's nearly impossible to monitor large software projects and verify their operation at the time of acceptance. The Department of Defense often uses CASE to solve this problem; it requires software developers to demonstrate that their programs comply with DOD-STD-2167A, which specifies the type of documentation the designers must generate. The DoD can use these documents to verify that the finished product is what it ordered. Generating the documents in accordance with 2167A may make it possible for the DoD, and management, to monitor a project.

A CASE program is no panacea

Remember, however, that a CASE program isn't a panacea for any software-development problem, it's only a tool that assists a human being in designing software. Like any computer program, it can at best do what it was designed to do. A CASE program is designed to automate a particular design methodology. *Your* ultimate purpose, by contrast, isn't to design by one method or another, but to design good software.

Take structured-design methodologies, for instance. In the rarefied atmosphere of academia or a management conference room, structured-design tools look as though they'll solve the bulk of the problems associated



Link between "front-end" and "back-end" CASE tools *(Microcase)*

with software development. Before you actually implement them, however, you have to evaluate how they'll perform in the project environment, with its delivery pressures and real-world problems.

Methodologies based on conventional languages force the language to conform to the methodology, and they depend largely on the discipline and talent of the software engineer to do so. The language itself does not enforce any of these methodologies. When the schedule gets tight, the software engineer often drops the methodology, intending to go back and clean up the documentation later. Further, the software engineer's programming experience and understanding of the methodology has a significant impact on how much of the full potential of the methodology he or she will realize.

You could compare a structured methodology to a waterfall. You start at the top and flow down, step by step, to the final, implemented code. Many software engineers don't naturally design this way, however. For them, the design effort is an iterative process that requires a very free, unstructured environment. The waterfall environment expects you to create in a very precise and structured way. Some people think this way, but many creative people need a free-flow design environment that gives them the leeway to try out many possible solutions to a problem.

Consider, as well, the ramifications of forcing a methodology on software engineers at the design and analysis phase—it may severely affect the overall productivity of the software-engineering effort. True, a particular CASE tool may increase the productivity of those software engineers who have a mindset similar to that of the tool's creator, but for everyone else, the tool will probably decrease productivity.

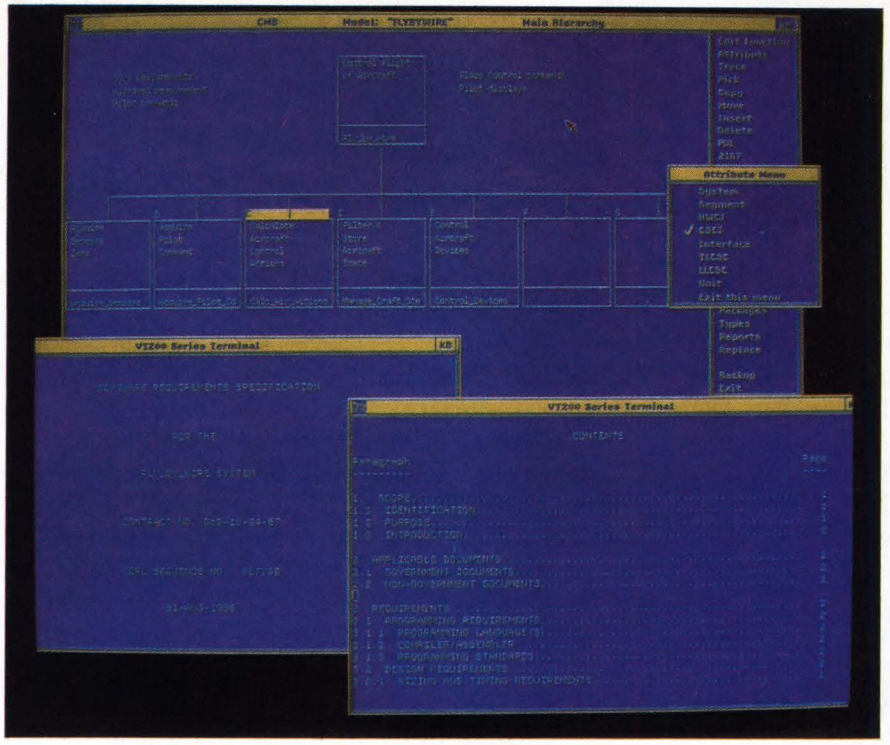
Also note that there's often a wide divergence between what CASE is intended to do and what software engineers actually use it for when they design programs. Although, in theory, CASE will help you create a design from the very beginning, many people actually use it as a hardware engineer would use a schematic-capture program. As Rick Potter of Mentor Graphics points out, "CASE is not used for design, it is used to capture a design." Software engineers, he says, often create designs on the backs of envelopes, chalkboards, and the like, and enter them into the CASE system after the fact.

An all-or-nothing proposition

To use today's structured methodologies successfully, you must strongly believe in them. It's an all-or-nothing proposition. Some people compare the adoption of a new methodology to the adoption of a new religion, because of the discipline a new methodology requires. It's difficult to conform strictly to a methodology, especially because programming languages aren't strict by nature—they let you do almost anything. A methodology that enforces good programming practices can be very constraining.

Further, because the tools for analysis, design, and implementation are separate, you must be careful to keep the data associated with all of these tools current. If any of the data is in error, the design documents will be worse than useless. The most common breakdowns associated with CASE tools result from undocumented changes, which cause the design documents to disagree with the actual code.

There may be alternatives to the structured methodologies of software design that would both support an individual's method of creating software and allow the designer to produce readable, maintainable code. For



DoD documentation generator *(Ready Systems)*

example, you could allow designers to create by their individual methods, leaving those unstructured, and then formalize the documentation by using common databases and some simple, standard documents. CASE systems that will let you use any methodology to design, then automatically convert the data to a standard format are at least a few years in the future.

Combining methodology and language

Another possible approach would be to use a language that incorporates a software-design methodology. Such a language spares you from having to translate the results of a design into the language used to implement the design. When you make changes in the code, you won't have to reverse-engineer the changes. The development and the result are one and the same. The Ada programming environment is a step in this direction. It was, along with Smalltalk, one of the first attempts to create a language that forced the programmer to write readable code.

Object Oriented Programming Systems (OOPS) is another of the latest methodologies to move in this direction. Ed Yourdon, who was instrumental in the development of structured methodologies, has said that OOPS is just the latest catchphrase for good programming. But it may be more than that. OOPS combines data and operations into abstract aggregates called objects. An object is an entity representing a collection of information and a description of how that information can be manipulated.

In the OOPS methodology, you accomplish a task by sending messages between objects. The messages cause operations to be performed and information to be returned. They describe what you want to happen, not how it should happen. The implementation of an operation is hidden within the definition of each specific object.

This procedure is similar to the way that communication takes place among the departments of a company. Say, for instance, that a company's sales department requests that the research department send up some data on the semiconductor industry. The sales department doesn't tell the research department how to handle the task, it just sends the request. Whatever the research department does to fulfill the request occurs inside that department. The sales department merely uses the data when it arrives. As the requirements of the company change, the different departments may add services to accommodate the needs of the other departments. Even after a major reorganization of the company, many of the departments are the same.

IPSE lets you custom-design a CASE toolset

If you do intend to use CASE tools for all the stages of software design, consider using an Integrated Programming (or Project) Support Environment, or IPSE. An IPSE allows you to select any CASE tools, from any manufacturer, and integrate them. It monitors the data flow between the tool's databases and the tools, keeping track of all of the changes. It also allows you to send data from one tool to another.

The configuration-management aspects of an IPSE promise to keep complex projects under control. The environment also promises to make it simpler to monitor a software project, so that the program manager can review and record all operations. The IPSE might prove to be the program manager's best friend; it will let the program manager see what the software engineers are doing without interfering. The software engineers may feel as though Big Brother is watching their

A CASE program isn't a panacea for any software-development problem; it's only a tool that assists a human being in designing software.

every move, but when they're working on very large projects, they'll probably welcome the attention. When it comes time to integrate the system, each software engineer will have more confidence that his colleagues have done their jobs, and there'll be fewer integration problems.

One available IPSE is Atherton Technology's Software Backplane. According to Alan Codkin, the firm's vice president of marketing, the product will "allow you to integrate tools that are the best of breed." Note, however, that before you can use an IPSE, you must set it up so it can integrate your CASE tools. Codkin admits that it can take six months to a year to configure the Software Backplane for large projects.

Until very recently, CASE tools didn't have links to compilers, test programs, and the like. Now, some vendors are offering code generators and reverse-engineering tools, which provide a direct link between these tools. The existing code generators automatically fill in things such as the data declarations and some of the code, but you still have to write most of the code.

Reverse-engineering tools produce design documents from existing code. For a reverse-engineering tool to work, the code to be converted to documents must have been written with a particular methodology in mind. If you start with spaghetti code full of GOTO statements and lacking any structure, you'll have to provide a tremendous amount of effort to make the conversion.

Another type of link is Back Annotator from Microcase. Back Annotator takes the test results, as gathered by Microcase's Software Analysis Workstation, and displays these results in relation to the original source code, so you can see how fast each routine executes and get a report of test-software coverage.

There are some incredibly large programs on the horizon. By 1990, software engineers will be writing programs with 120,000,000 object instructions (**Fig 1**). To have even the slightest chance at performing such a complex software-engineering feat, you must use extremely disciplined and structured methods. Further, these methods must be automated in order to be practical. Trying to keep millions of bubbles in data-flow diagrams current with an eraser and a pencil would be ludicrous. In fact, today's software-design methodologies simply may not support tomorrow's immensely complex projects.

There are also some small programs on the horizon. These programs, created by small teams of software engineers, do not present the same difficulties as the insanely complex project mentioned above. The tool requirements will not be as severe. All you may need to do to increase communication among the software engineers on such a project is to have them use a common database. You probably won't need expensive and complex CASE tools for small projects.

When you hear someone talking in glowing terms about the advantages of CASE, you'd be well advised

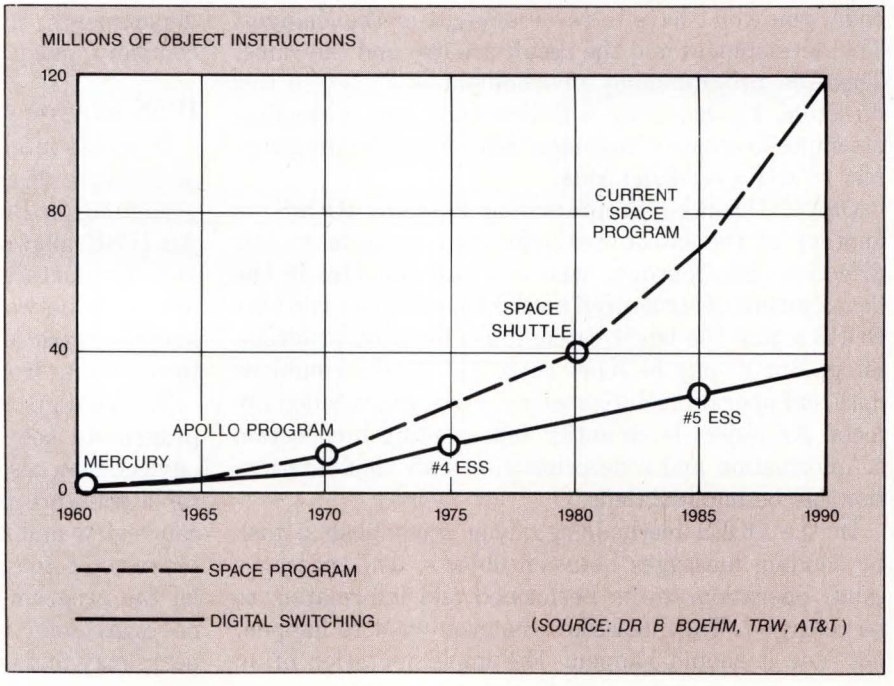


Fig 1—Huge programs seem to be on the horizon. *Automating some portions of the software development cycle is essential if these programs are to be realized.*

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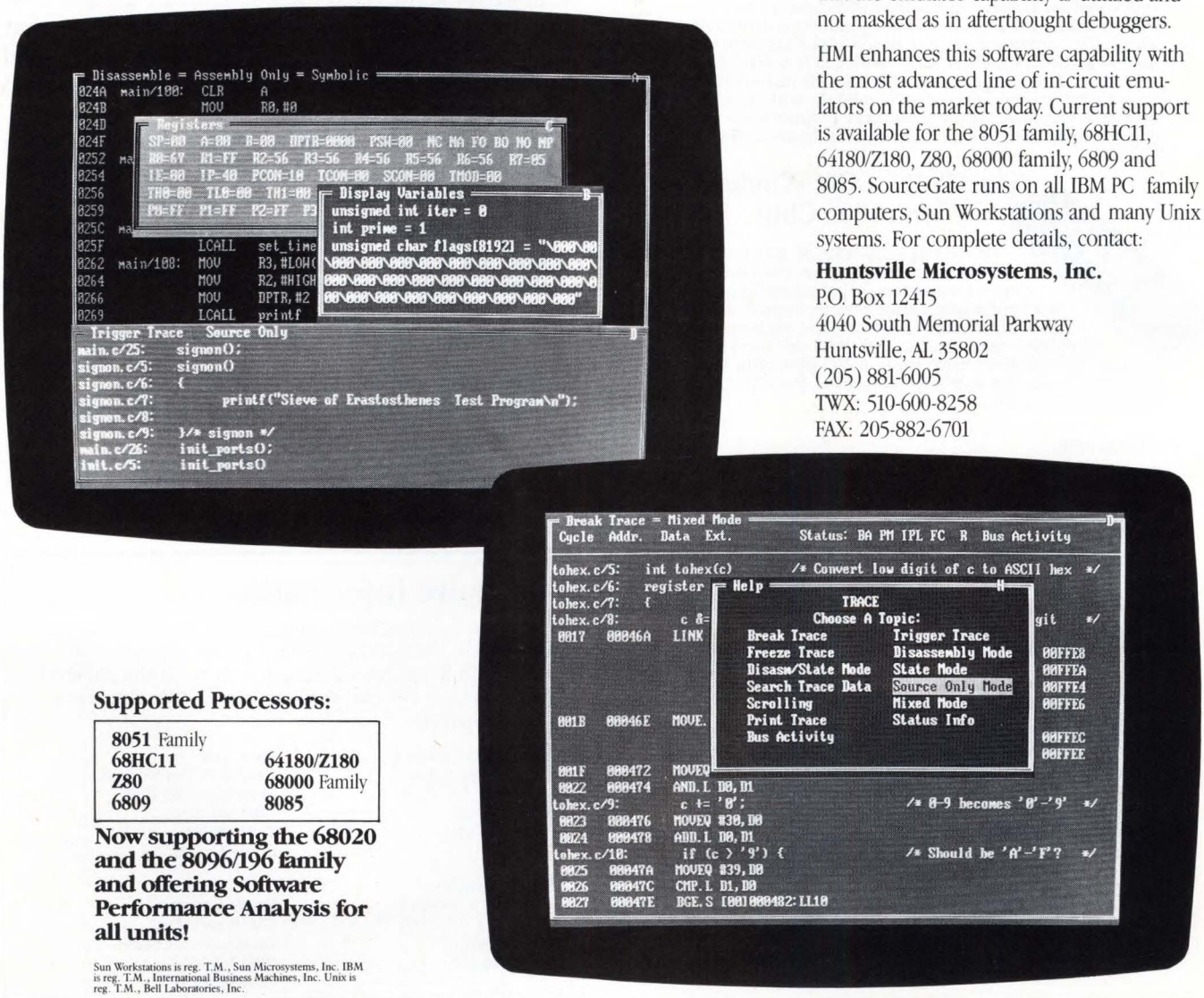

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8051 Family	
68HC11	**64180/Z180**
Z80	**68000** Family
6809	**8085**

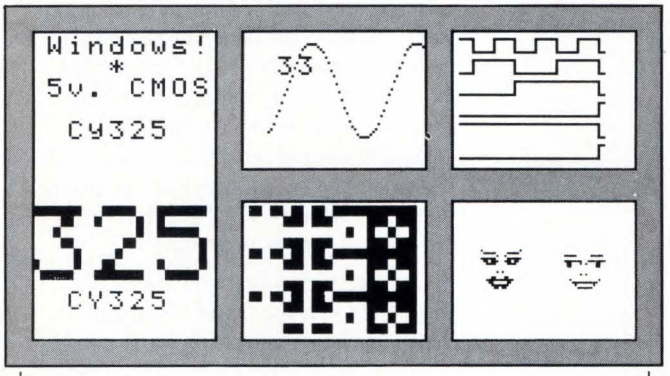
Now supporting the 68020 and the 8096/196 family and offering Software Performance Analysis for all units!

Sun Workstations is reg. T.M., Sun Microsystems, Inc. IBM is reg. T.M., International Business Machines, Inc. Unix is reg. T.M., Bell Laboratories, Inc.

HMI

What's Missing in this LCD Photo?

(answers below)



If you peeked at the answers, then you know it's Motion. In the actual LCD every one of the windows is in motion. Think for a minute how you would make six or seven unique motions *simultaneously* with the low level LCD controllers that you have seen. No way! Now think what your instrument or new system could do with dynamic text and graphics. Tests show that programmers can achieve animated presentations in only hours using the CY325.

The CY325 LCD Windows Controller Chip

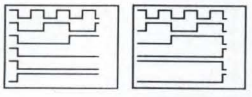


lets you specify any of 250 built-in windows, or create your own with a single command; manage text and graphics with automatic cursor control; wrap or scroll text with window relative pixel plotting and clipping; read an A/D and write the waveform into the window; drive up to 6 I/O pins with logic waves, or use the 'soft-key' feature of the CY325 for menu management.

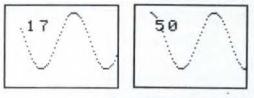
Answer:

Motion is missing in each of the windows in the photo. Text actually scrolls up in the top left window above, and:

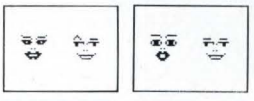
Logic wave forms flow right to left.



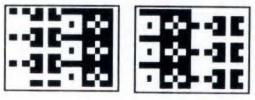
Two actions here! Counter counts and sine wave advances!



Boy and girl wink, smile, and flirt in this window.



Pseudo random patterns change continuously.



The next move is yours —

Write or call today for information on the CY325 LCD Windows Controller Chip. Only $75 each ($20/1000).



Cybernetic Micro Systems

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

CIRCLE NO 64

to ask when the person actually used CASE to create working code for a project that was delivered and is now operating somewhere. Most likely, the CASE fanatic will admit that he hasn't coded for quite some time. The people who tout CASE most seem to focus on the problems of software development and CASE's promise to solve those problems, but they probably haven't actually completed a project with CASE.

Ultimately, CASE represents an attempt to force an engineering discipline on the creation of software. We don't yet know enough about software design, however, to have developed a consistent discipline that will both support individual styles of creativity and allow people to produce code that others can read and maintain.

There should be and there will be a way to make CASE fulfill its promise. But at the moment, CASE's scope of usefulness is limited. Within those boundaries, and depending on how fully you accept the software methdology a particular tool automates, CASE can be a valuable assistant in software design. EDN

References

1. Terry, Chris, "CASE tools," *EDN*, April 28, 1988, pg 110.
2. Terry, Chris, "Customer training and reverse engineering promise to escalate the acceptance of CASE," *EDN*, March 17, 1988, pg 73.

For more information . . .

For more information on the CASE tools discussed in this article, contact the following manufacturers directly, circle the appropriate numbers on the Information Retrieval Service card, or use EDN's Express Request service.

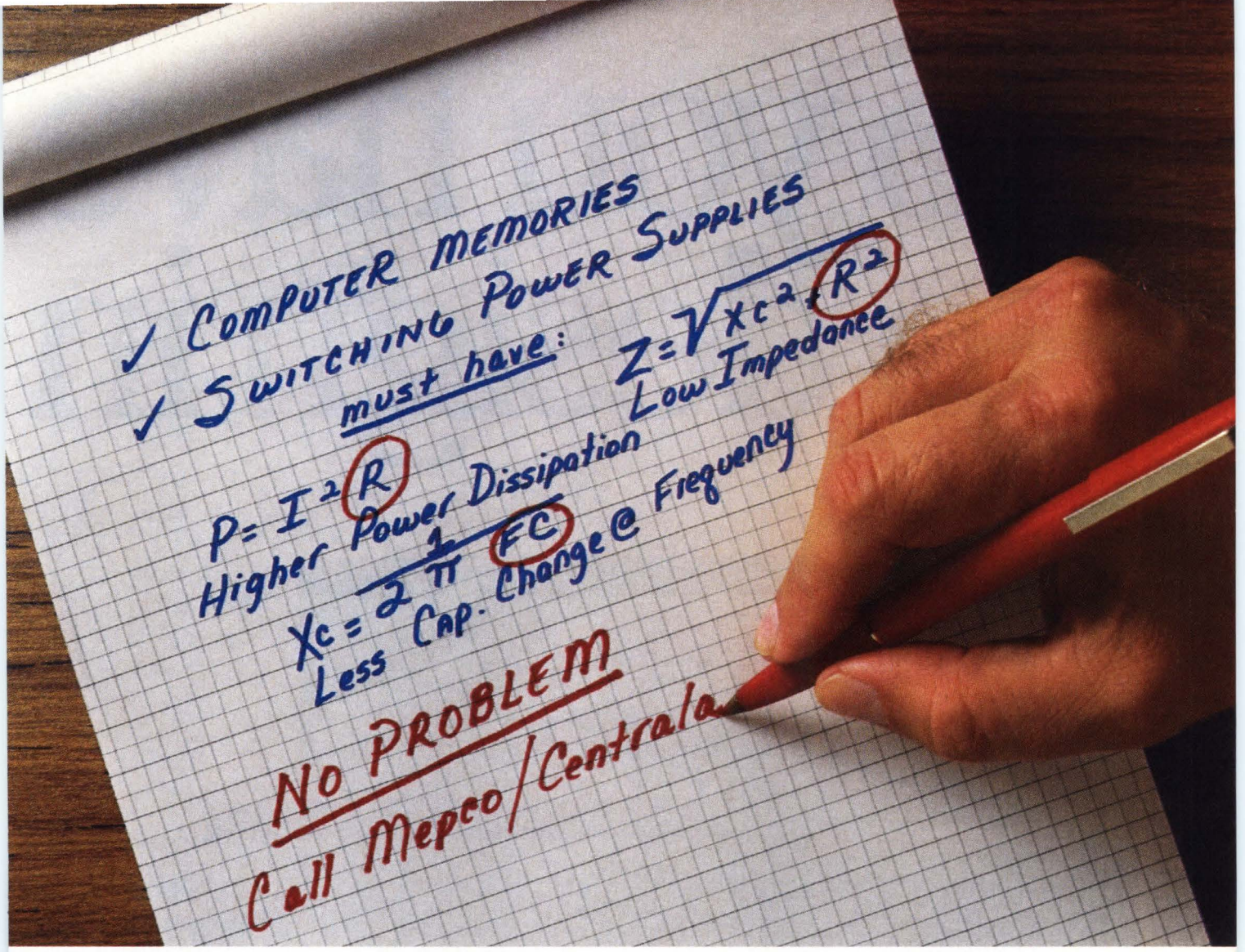
Atherton Technology
1333 Bordeaux Dr
Sunnyvale, CA 94089
(408) 734-9822
Circle No 430

Microcase
19545 NW Von Neumann Dr
Beaverton, OR 97006
(503) 690-1300
TLX 469558
Circle No 432

Mentor Graphics
8500 SW Creekside Pl
Beaverton, OR 97005
(503) 526-4757
Circle No 431

Ready Systems
470 Potrero Ave
Sunnyvale, CA 94086
(408) 736-3400
Circle No 433

Article Interest Quotient (Circle One)
High 491 Medium 492 Low 493



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Make a note to give your computer memory and switching power supply designs more efficiency and reliability with highest-performance Mepco/Centralab capacitors.

You want performance: Our unique (patented) 49XC Star Chip® Tantalum Capacitors, in ratings from 1.0 to 220 μF, provide unrivaled electrical/mechanical characteristics — lowest ESR, low impedance, minimal capacitance change and higher power dissipation at 100 kHz to 1 MHz, and higher. Plus survival at cryogenic temperatures!

You want selection: Choose our Star Chip® Tantalum Capacitors with ESR of 50 or 100 milliohms at 100 kHz — in 100 μF at 10 volts, 47 μF at 10 volts, 22 μF at 20 volts, 10 μF at 25 volts, or 33 μF at 15 volts. Higher capacitance, coupled with stability over frequency, provides low impedance.

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EDN120888

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PHILIPS

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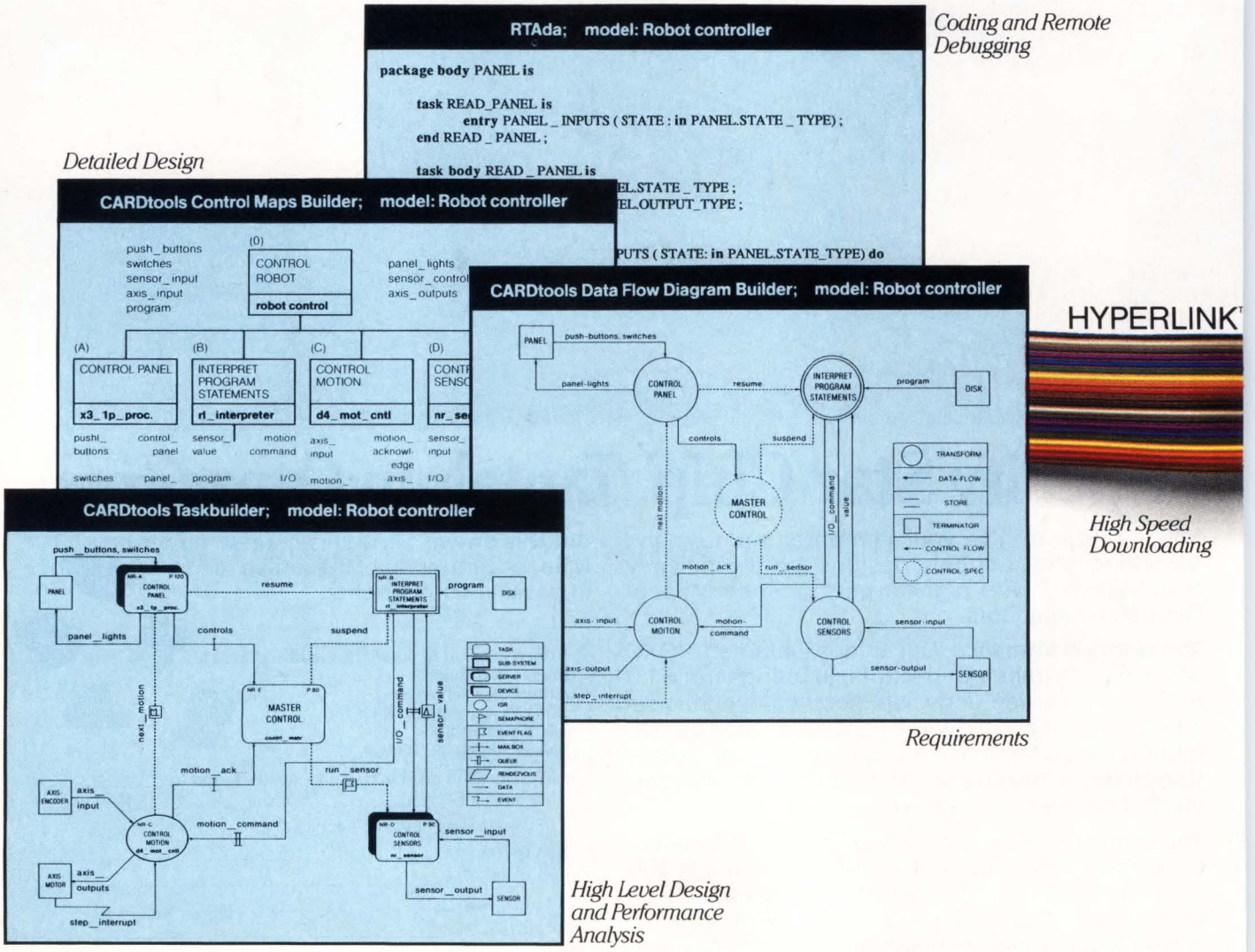
Do you have to design in



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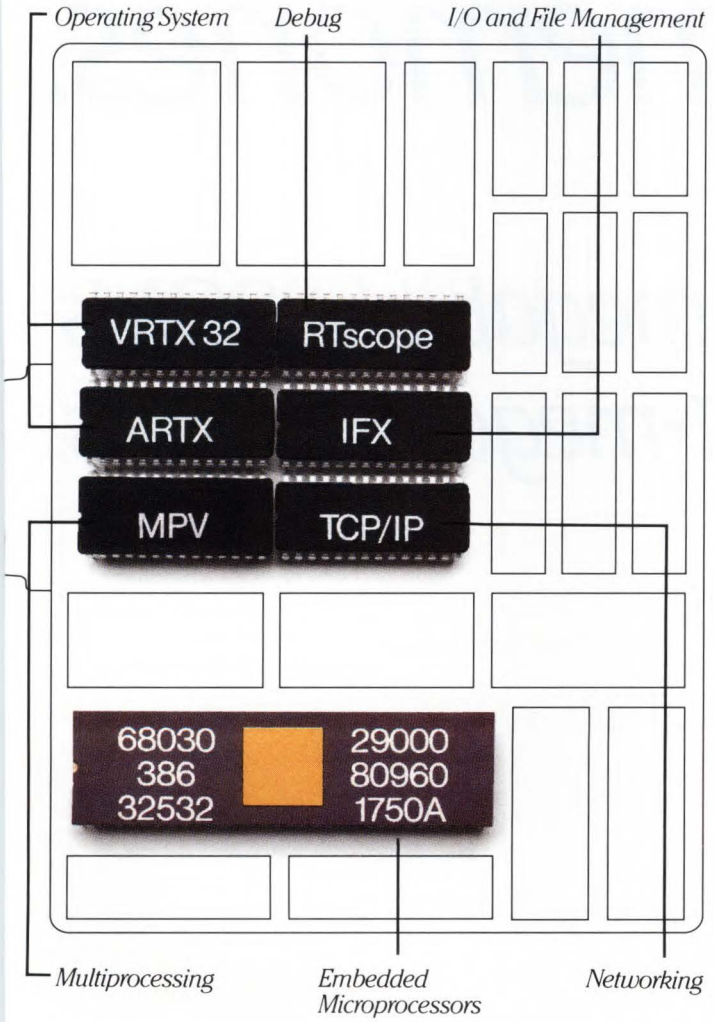
what it takes real-time?



TARGET

Successful real-time design for embedded systems takes more than extraordinary helpings of craft and creativity. It also takes the right tools. Which may explain why our CARD (Computer-aided Real-time Design) technology is behind the development of well over fifty million lines of real-time code.

We're not talking about ordinary tools spruced up with a few real-time extensions. CARD technology was created exclusively for the real-time world specifically for integrating run-time and software development environments.

We are talking about tools such as reusable software components like VRTX®, the real-time operating systems standard. Real-time implementations of C and Ada. Automated analysis tools for verifying system performance. Our CARDtools™ product gives you everything you need including specifically tailored design aids to manage software organization and data flow.

And automated documentation so complete, so accurate, it satisfies even the DoD's rigid 2167A specs. Not to mention the demands of our hundreds of exacting commercial customers.

So if you'd like to have what it takes to make your next real-time project run more efficiently call us, toll free, at (800) 228-1249. Or (214) 661-9526 in Texas.

Because you can only be a success in real-time design if you've got the right stuff.

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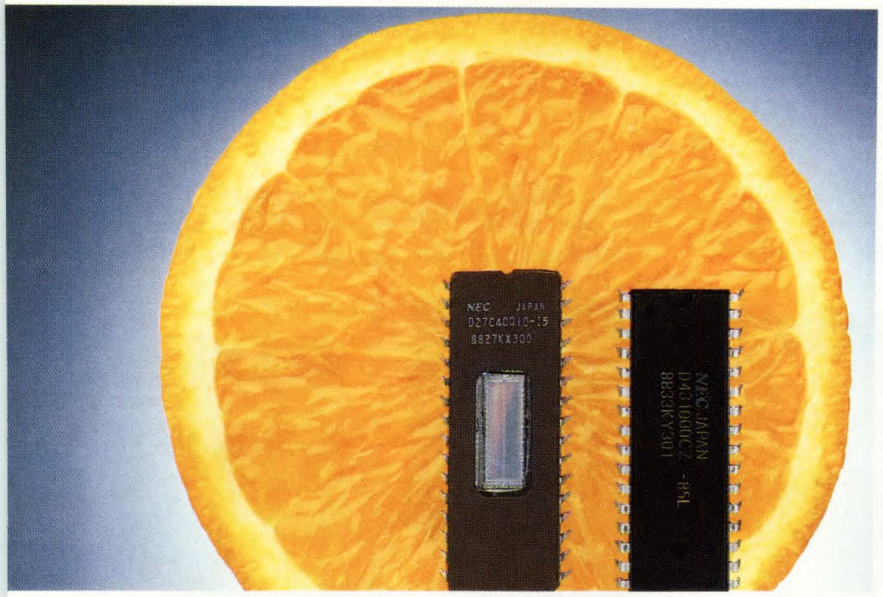
C&C Computers and Communications

class of

NEC expands your design horizons with a new class of high density memories – 4M EPROMs and 1M SRAMs. These chips not only give you greater capacity, they also offer high speed and low power consumption.

4-Megabit UV EPROMs

NEC leads the industry again with the introduction of 4M EPROMs. Providing unprecedented flexibility for storage of large-scale programs and fixed data, these devices help you achieve higher design goals.



The μPD27C4001DZ is fabricated with a 1.0μm CMOS process. It comes in a 512K x 8 organization, and offers many advanced features, including –

- ☐ Fast access: 150/170/200ns.
- ☐ Fast programming: less than 60 seconds for all 4 megabits.
- ☐ Low power consumption: 30mA (max) active; 100μA (max) standby.
- ☐ 32-pin DIP with JEDEC standard pinout.

1-Megabit SRAMs

Our new SRAMs give you 1-megabit density combined with 85ns access speed and low power consumption: 70mA (max) active, 100μA (max) standby. For battery back-up needs, we offer the L-version which requires only 50μA (max) for data retention. The μPD431000 family features:

- ☐ 128K x 8 organization.
- ☐ 3 speeds: 85/100/120ns.
- ☐ 32-pin 600 mil plastic DIP; or 525 mil SOP.

To find out how megabit memories can multiply your design possibilities, call NEC today.

UK Tel:0908-691133. Telex:826791.
Hong Kong Tel:3-755-9008. Telex:54561.
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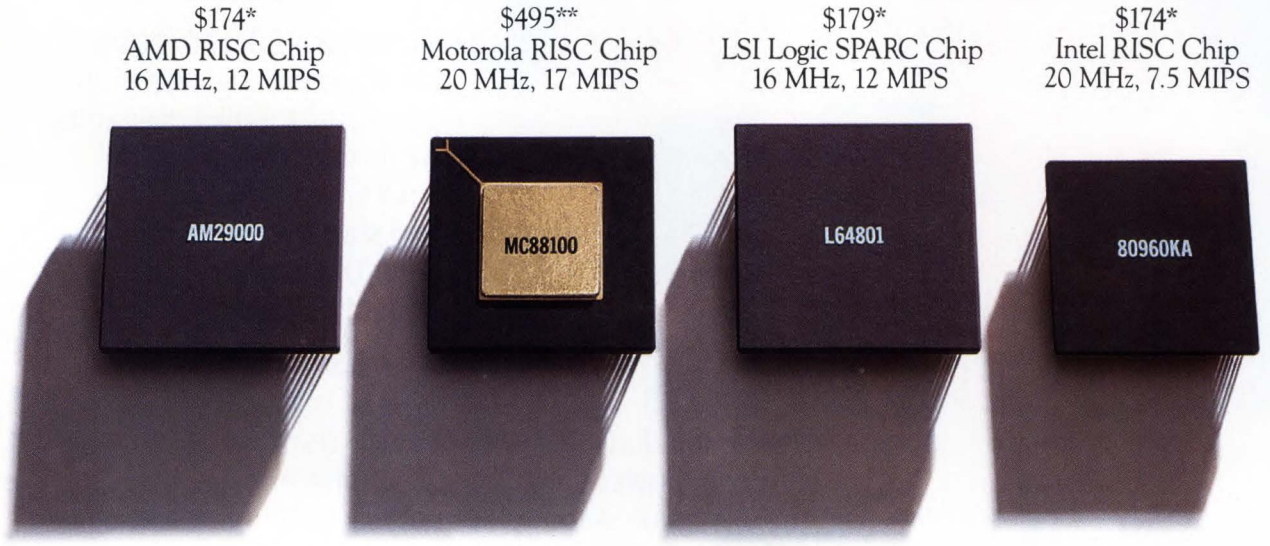
Australia Tel:03-267-6355. Telex:38343.

NEC

SOME THINGS JUST AREN'T WORTH THE RISC.



Any chip above would do a good job as an embedded controller in a disc drive, laser printer, or workstation.

It's just that one can do it for a lot less money. The VL86C010 32-bit RISC chip (ARM) from VLSI.

It gives you the performance you need right now, in volume, for about $5 per MIPS. (The nearest competitor is $10 per MIPS. If and when the product is available.)

YOU NOT ONLY SAVE CASH, YOU SAVE CACHE.

Because our chip is not only less expensive, but easier to use than most RISC chips, you save a bundle on your entire system.

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YOU'LL THANK US FOR OUR SUPPORT.

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$50*
VLSI RISC Chip
12 MHz, 6.33 MIPS



peripheral support we do. Nobody.

Ours is the only RISC chip with off-the-shelf peripheral support for memory, video, audio, and other I/O functions.

Don't want to mess with microcode? That's okay. ANSI C, FORTRAN 77, and an Assembler/Linker will do very nicely, thank you.

And we're working on development support tools like industry standard real-time executives and in-circuit emulators.

But we saved the best for last. Because VLSI is a leader in ASIC and always has been, we're now using our RISC as an ASIC core.

That means you can build your very own RISC system quickly and easily using VLSI design tools.

Call 1-800-872-6753 and ask for our free VL86C010 brochure. Or write to us at 8375 South River Parkway, Tempe, AZ 85284.

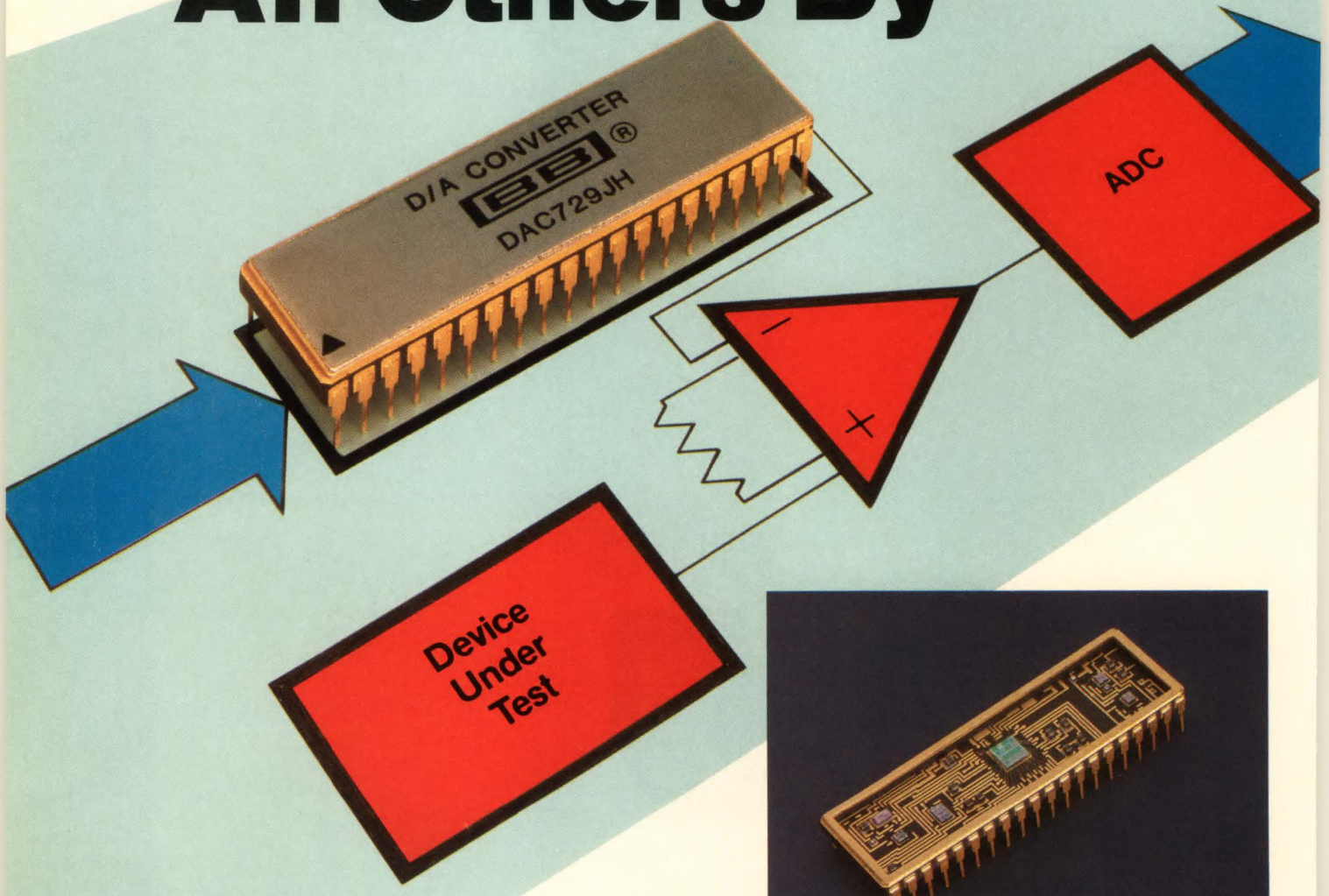
And reduce your RISC.

*Prices based on: EDN, June 9, 1988; Electronics, April 14, 1988; Microprocessor Report, May and September 1988; Quantities of 100. **Price based on sample quantities.

VLSI TECHNOLOGY, INC.

NEW 18-BIT DAC729

The DAC To Measure All Others By



This 18-bit D/A converter sets new standards for resolution, accuracy, and dynamic range.

Originally designed as a programmable ATE reference, DAC729's exceptional accuracy and stability also make it an excellent choice for digital audio, precision controller, and precision waveform generator applications. Consider these features:

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- complete with 10V reference, precision output op amp
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Put the new DAC729 to your test now. Call your Burr-Brown representative or Applications Engineering, 602/746-1111, for full details. Burr-Brown Corp., P.O. Box 11400, Tucson, AZ 85734.

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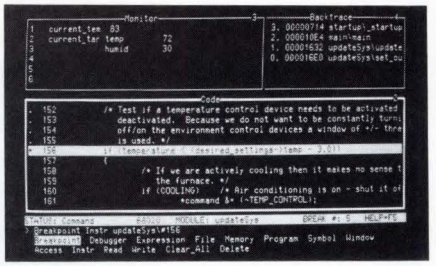
CIRCLE NO 77

CASE tool set aids software development for embedded processors

The HP 64000 UX Case Solutions for Embedded Processors consists of a set of tools that cover all phases of software development—from specifying requirements to monitoring maintenance. The tools run on the HP 9000 Series 300 computers and generate code for target systems that are based on embedded μPs of the MC68000 family. The latest additions to the tool set are C cross-compilers, source-level debuggers, and branch analyzers.

The C cross-compilers follow the draft ANSI standard (without function prototyping) and are fully compatible with the HP-UX C preprocessor and the standard HP-UC *cc* command-line interface. They provide the complete support and math libraries specified by the draft ANSI standard, as well as libraries that use the MC68881 floating-point coprocessor. Optimizing features in-



clude one that lets you opt for maximum speed or minimum space. The cross-compilers can generate fully re-entrant code and have options for the run-time checking of array bounds and NULL pointer dereferences. These packages work with the HP 64870 assembler/linker.

The source-level cross-debuggers permit both C and assembly-language debugging and can work with an internal simulator, with an external out-of-circuit emulator that uses a real μP and real memory, or with an external in-circuit emulator—the debugging interface is identical in all three cases. You can single-step through your code, or set breakpoints and run the program at full speed until it reaches a breakpoint.

The Basis Branch Analyzers (BBAs) use the prototype hardware, running the program under test, to generate reports on all C functions and on branches, whether they have been executed or not. The BBAs tell you how thorough your test cases are for a given embedded-μP product. Prices depend on the number of host users and start at $2329 for the C cross-compilers, $2665 for the cross-debuggers, and $1800 for the Basis Branch Analyzers.

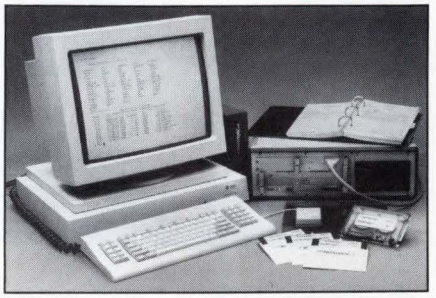
Hewlett-Packard, 3495 Deer Creek Rd, Palo Alto, CA 94304. Phone local sales office.

Circle No 351

Communications and development package links real-time environment to Unix

Combining communications and software development, the Unibridge package links Unix host systems to OS-9-based real-time target systems. The package allows the systems to communicate via the Ethernet LAN protocol and the TCP/IP.

The software package includes a C-language cross-compiler for the Unix host, communications software for the Unix host and OS-9 target, and both a C compiler and a debugger for the OS-9 target. The C cross-compiler generates executable OS-9 memory modules. You can debug the code at the source



or symbolic level with the OS-9-based debugger. You can also debug from the Unix host. TCP/IP lets you access the entire OS-9 system from the Unix host.

After debugging, you can use the target as a stand-alone system or as a real-time front end to a Unix-based supervisor system. The downloaded code can access all of the shareable system modules in OS-9. For diskless operations, you can store the OS-9 operating system, C compiler, and debugger in ROM.

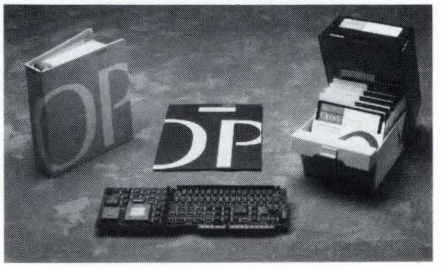
The package runs on Sun and HP 300 workstations and on DEC VAX systems (using either VMS or DEC Unix). $6500.

Microware Systems Corp, 1900 NW 114th St, Des Moines, IA 50322. Phone (515) 224-1929. TWX 910-520-2535.

Circle No 352

Unix running on a 32-bit coprocessor lets PC perform 10 or more MIPS

The 260PM coprocessor board plugs into computers of the IBM PC family, the PS/2 Models 30 or 35, and compatibles. The board uses the 25-MHz National 32532 μP, which can directly address as many as 20M bytes of 32-bit memory; the coprocessor itself provides 4M bytes, and the remainder resides on optional daughter boards. The 260PM comes with a 32381 floating-point processor that supports both single- and double-precision arithmetic calculations in IEEE format.



The 32532 μP runs the vendor's port of Unix System V, release 3.1, with Berkeley 4.2 extensions. Because the system allows fast transfers between PC memory and coprocessor memory and because it uses DOS system calls for all I/O operations, the coprocessor can run computation-intensive applications at maximum speed. The vendor offers the X Windows System developed by MIT; C, Fortran77, Cobol, and Common Lisp compilers; and many third-party applications packages. An optional package supports an intelligent Ethernet controller that runs TCP/IP.

The coprocessor can run both Unix and DOS applications simultaneously, and can support multiple users under Unix. However, the use of the PC's processor as an I/O front end may degrade multiuser performance, so the vendor recommends that you use the coprocessor board in single-user, graphics-intensive applications such as CAE, software-development, or expert and natural-language AI systems. $6995.

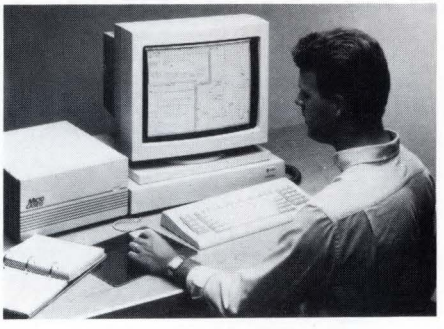
Opus Systems, 20863 Stevens Creek, Bldg 400, Cupertino, CA 95014. Phone (408) 446-2110.

Circle No 353

CASE tools link design database and test tools

Two tools, developed jointly by Cadre Technologies (Providence, RI) and MicroCASE Inc (Beaverton, OR), provide close 2-way links between the design database generated by Cadre's Teamwork structured-analysis and -design tools and MicroCASE's analysis and verification tools for embedded systems.

One of the tools, Source Frame Builder, creates a source-code frame for each module in the structured-design chart, and inserts the body of the module specification into the source frame. The program locates the data structures in the data dictionary, and translates them into C declarations; if you have already defined a module specification body in C code instead of in pseudocode or structured English, the program inserts the C specification into the source frame. You can then build on the data declarations to complete the coding of the module.

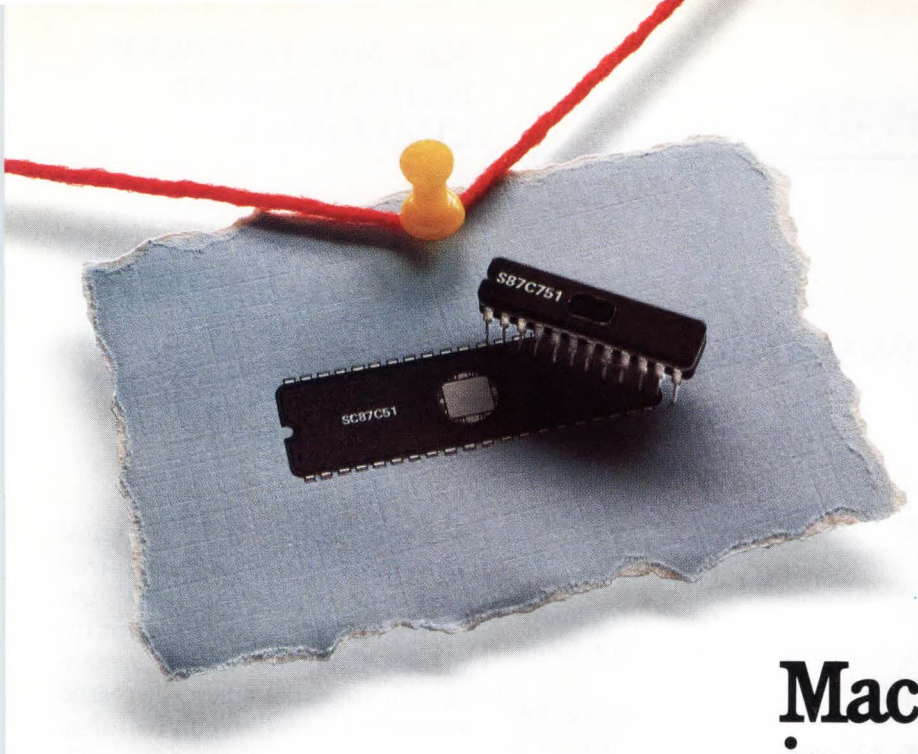


The second tool, Back Annotator, uses symbolic information generated by the compiler to append the test results of trace, performance-analysis, and code-coverage tools to the appropriate module specifications in the design database. The resulting combined information about the design and run-time performance makes it easier to fix bugs and implement enhancements.

Source Frame Builder and Back Annotator are available for Sun 3 and Sun 386i workstations. The price of the package is $1995; delivery is 10 weeks ARO.

MicroCASE, 19545 Von Neumann Dr, Beaverton, OR 97006. Phone (503) 690-1300.

Circle No 354



Macro performance in a micro size



Signetics 83/87C751 microcontroller—the performance of an 80C51 packed into a 24-pin skinny DIP or SMD 28-pin PLCC.

Designed around the 80C51 architecture, our new 83/87C751s let you use your existing instruction set and code to gain the enormous benefits of a smaller package at a smaller price.

A lot of guts in a little package. Its 16 MHz operation means you don't have to sacrifice performance. You'll appreciate the convenience of EPROMs in UV or OTP. Coupled with the flexibility of an I^2C serial bus port. And the efficiency of an 8-bit architecture backed by a complete Signetics development system.

Think of it. Increase the power of your 4-bit applications. Or replace your logic blocks. Or lighten your handheld designs. All while decreasing system costs.

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One standard. 0 defects.

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CIRCLE NO 70

Emulator's windows monitor at multiple levels

Used in conjunction with the company's CT Series of PC-based 8-bit in-circuit emulators, the Viewfinder emulation-control software and Pathfinder debugger let you use windows to simultaneously trace programs at both the assembler and source-code levels.

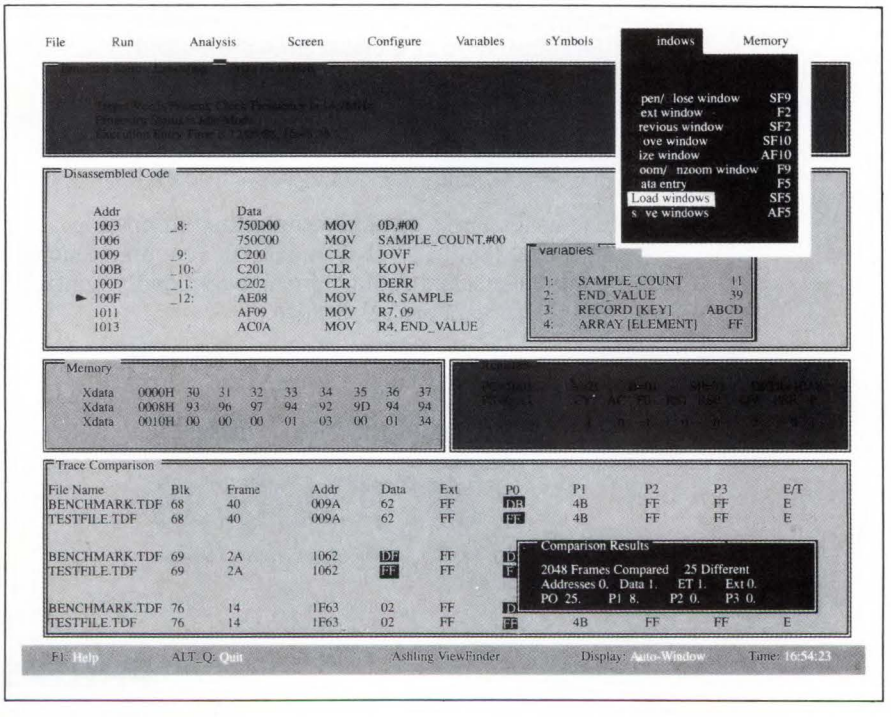
Viewfinder helps you choose the content, size, and position of the windows to be displayed, so that you can simultaneously follow the logically connected areas of your system. For example, you can display program code, and the contents of specific memory locations and processor registers all at the same time. In addition, you can maintain and update windows that are not currently displayed.

By adding the Pathfinder package and a suitable compiler, you can trace program activity at all software levels. You can, for example, display the high-level-language source code that relates to a real-time program trace, and so compare the intended to the actual program flow.

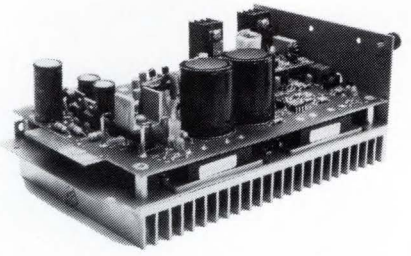
Pathfinder is now available for use with a PL/M-51 compiler or a C compiler for the 8051 μC, but versions that run with C compilers for 68HC11, Z80, and 64180 μPs are scheduled for release during the first quarter of next year. Viewfinder is free if you purchase any of the company's new development systems; you can buy it separately for $275. The cost of Pathfinder ranges from $1250 to $1500.

Ashling Microsystems Ltd, Plassey Technological Park, Limerick, Ireland. Phone 061-334466. TLX 70357. FAX 061-334477.

Circle No 629



MHz MEETS POWER ENHANCEMENT CHALLENGE



A major manufacturer of digital communication systems required a drop-in replacement AC/DC power unit for an existing multiplexer. The new power system specifications demanded increased reliability, added circuit features, international agency approval, and Bellcore quality compliance.

Design specs included:
- Input: 120/240VAC
- Outputs: +5 VDC, +12VDC, -12 VDC
- Current Limiting
- Alarm Window Detectors
- Forced Load Sharing
- N+1 Redundancy

All this and more had to fit in the same space configuration as the old power system. Lorain® Megahertz Power™ zero current switching technology provided the space needed for the additional circuit features required.

Lorain response — A dedicated Lorain Power Team worked closely with the OEM in the development and manufacture of the improved power system. This team dedication and Lorain Megahertz Power Modules made it possible to ship completed power units to the OEM six weeks after the final specifications were received.

Lorain can make it happen for you — Take the hassle out of the power supply requirements. Put Lorain Megahertz Power to work for you today. Lorain understands power...talk to us. Write or call Lorain Products, 1122 F Street, Lorain, OH 44052, Phone (216) 288-1122.

CIRCLE NO 71

It seems that every custom power supply project starts with inflexible performance specifications, impractical space limitations, and unrealistic completion schedules.

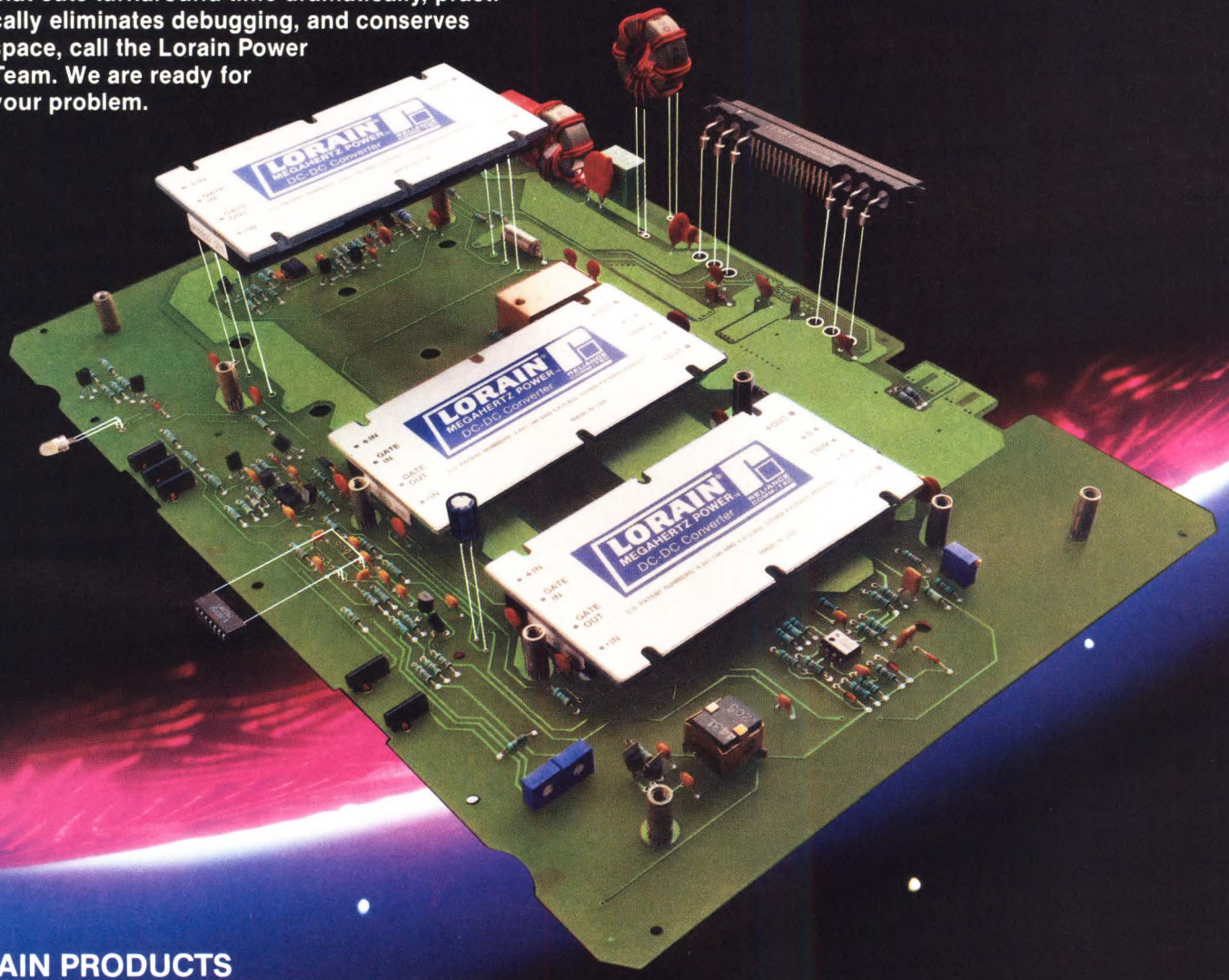
That is why Lorain custom power supplies start with Lorain Megahertz Power Modules. These compact, field proven modules contain a patented megahertz technology that provides exceptional power density, extremely high operating efficiency, quiet operation, and agency compliance. There are over 170 master and booster modules to accurately meet your system requirements.

To these, we add custom circuitry to match your input and output specifications; design-in visuals, forced load sharing, and other peripheral components; even allow for future expansion capabilities with additional plug-in booster modules.

If you are looking for a custom power solution that cuts turnaround time dramatically, practically eliminates debugging, and conserves space, call the Lorain Power Team. We are ready for your problem.

The Flexible, Practical, Realistic solution to custom power

Custom Lorain® Megahertz Power™ Supplies



LORAIN PRODUCTS
1122 F Street, Lorain, OH 44052-2293, (216) 288-1122

RELIANCE COMM/TEC, CANADA
St. Thomas, ONT., (519) 631-0780

RELIANCE COMM/TEC

CIRCLE NO 72

SIGNETICS HEADQUARTERS
Sunnyvale, CA
Phone: (408) 991-2000

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Huntsville
Phone: (205) 830-4001

ARIZONA
Phoenix
Phone: (602) 265-4444

CALIFORNIA
Canoga Park
Phone: (818) 340-1431

Irvine
Phone: (714) 833-8980
(213) 588-3281

Los Angeles
Phone: (213) 670-1101

San Diego
Phone: (619) 560-0242

Sunnyvale
Phone: (408) 991-3737

COLORADO
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FLORIDA
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Ft. Lauderdale
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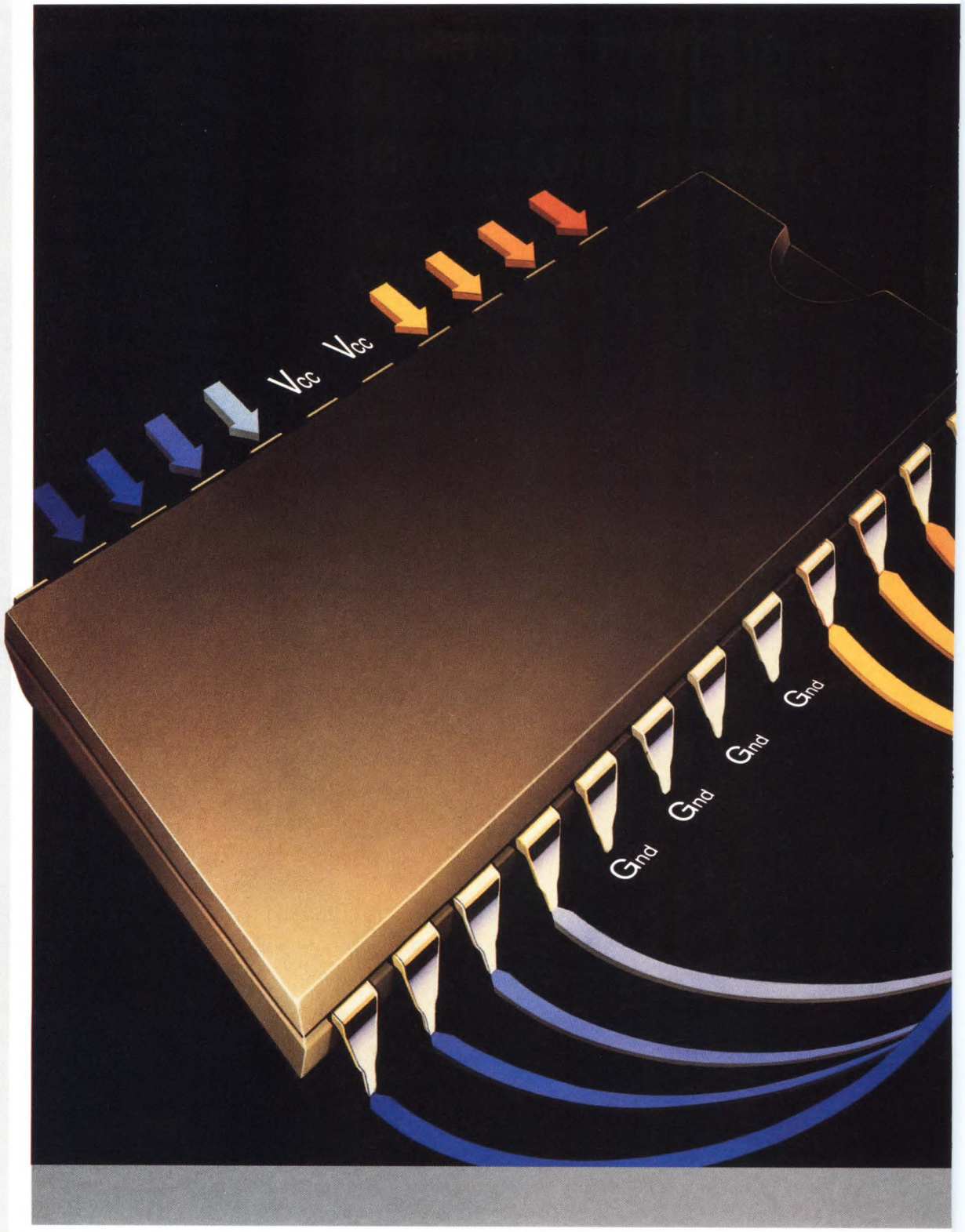
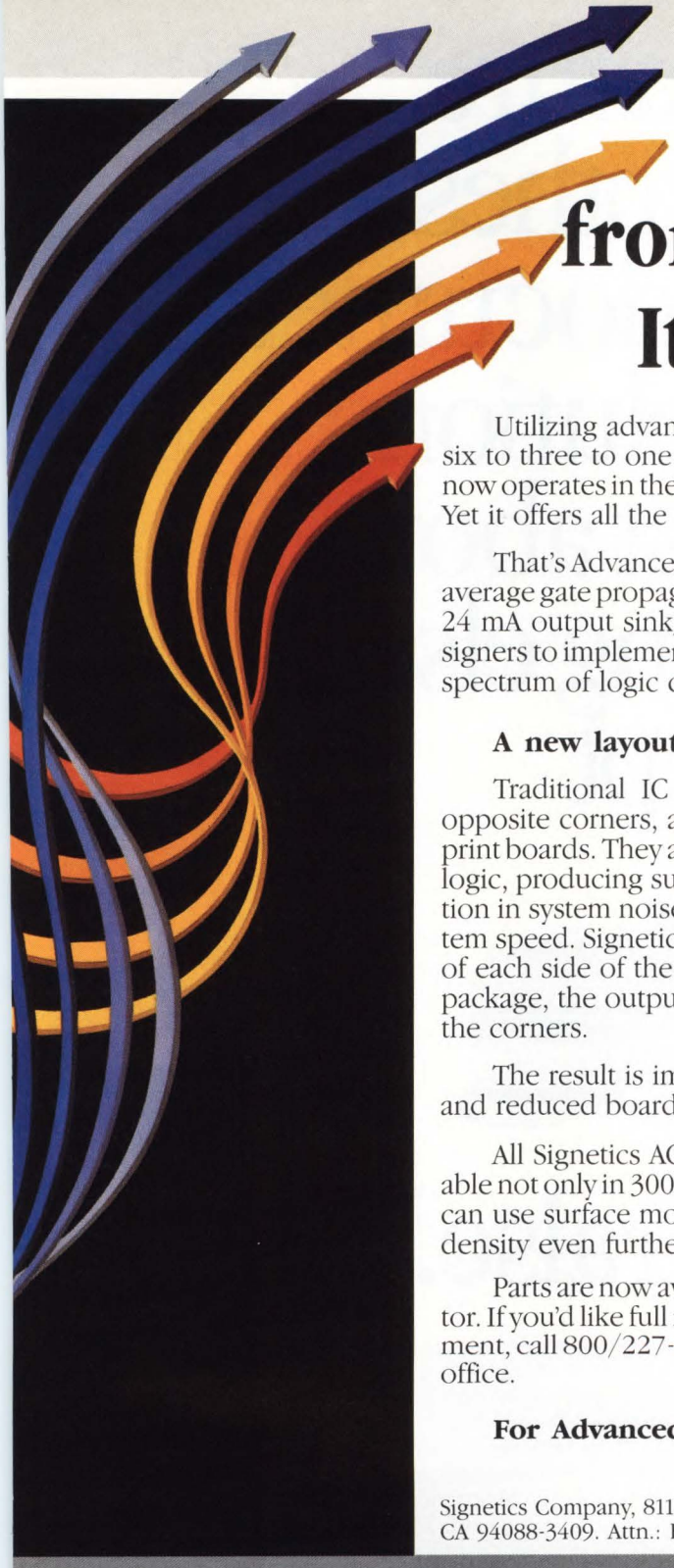
SIGNETICS CANADA, LTD.
Etobicoke, Ontario
Phone: (416) 626-6676

Nepean, Ontario
Signetics Canada, Ltd.
Phone: (613) 225-5467





ACL from Signetics. It's logical.

Utilizing advances in fabrication technology, moving from six to three to one micron gate lengths, Signetics CMOS Logic now operates in the realm of the most advanced bipolar families. Yet it offers all the acknowledged CMOS benefits.

That's Advanced CMOS Logic (ACL) from Signetics. With an average gate propagation delay of 3 ns (150 MHz operation) and 24 mA output sink/source capability, Signetics ACL allows designers to implement the CMOS benefits across the whole speed spectrum of logic circuitry.

A new layout for a new technology.

Traditional IC pin-outs, with supply pins at diagonally opposite corners, are a remnant from the days of single-sided print boards. They are inherently unsuitable for advanced CMOS logic, producing supply and ground noise resulting in a reduction in system noise margins, loss of stored data and lower system speed. Signetics ACL has multiple supply pins at the center of each side of the package, the input pins on one side of the package, the output pins on the other side and control pins at the corners.

The result is improved system reliability, simplified design and reduced board area.

All Signetics ACL ICs (74 AC/ACT11XXX family) are available not only in 300 mil wide DIP but also in SO packages, so you can use surface mounting techniques to increase PCB packing density even further.

Parts are now available through your local Signetics distributor. If you'd like full information on this important logic development, call 800/227-1817 ext. 983 or call your local Signetics sales office.

For Advanced CMOS Logic, the name is Signetics.

Signetics Company, 811 East Arques Avenue, P.O. Box 3409, Sunnyvale, CA 94088-3409. Attn.: Publication Services MS27. Telephone: 408/991-2000

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"I'll measure, analyze, synthesize, model, test, document, provide solutions, and do just about everything else except



ask for a raise."

"I'm more than a test box, more than software. I'm the only complete frequency response analysis workstation in the business of servo control and power supply design.

I'm a master of stability analysis, because I test, model, synthesize, predict and verify *so* quickly. Imagine stabilizing loops in minutes, synthesizing feedback networks in seconds, and making Bode plots at the press of a button.

To optimize performance, you can connect up to three channels directly to an existing circuit and immediately plot frequency response. I'll then determine the compensation network needed to obtain the gain and phase margin you desire, at the frequency *you* choose–in seconds, not hours.

I can synthesize unlimited worst-case scenarios, predicting your design's performance each time. You get more design options from which to choose, so you'll be more confident in your decisions.

I do much more than optimize circuits. I'm great at characterizing components and networks, measuring input and output impedance and determining audio susceptibility. I allow you to create and analyze electronic and mathematical models, solve complex equations and generate root locus plots. I also do file math, including adding or deleting time delays, combining data files and converting transfer functions from open-loop to closed-loop response and back.

You'll do so much more because I do so much more. You'll become more efficient, productive, and valuable to your company, because you'll spend your time designing, rather than operating test equipment. See for yourself. Call **1-800-262-2522** (in California, **213-539-2522**) to ask for a demonstration.

I love to impress people with my abilities. Don't you?"

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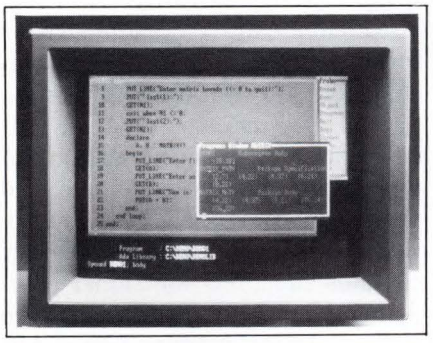
68K VME TOOL SET

SYS68K/Running Start is a software development package for the vendor's CPU-29 and CPU-32 VME-Bus computer boards. The package consists of more than 120 C- and assembly-language source-code routines that provide multitasking operating-system facilities. The package comes in IBM PC/AT-compatible format on double-density diskettes. You can use your PC/AT system to write applications software, but you need a 68020/68030 C cross-compiler, crossassembler, and linker in order to generate executable code that you can download to the target system. The library includes routines for servicing CPU interrupts, serial communications, timer and clock functions, and VME-Bus functions. Test modules included in the package verify the correct operation of onboard peripheral devices and local memory. $490.

Force Computers Inc, 3165 Winchester Blvd, Campbell, CA 95008. Phone (408) 370-6300. TLX 172465. FAX 408-374-1146.

Circle No 441



ADA FOR OS/2

According to the vendor, the Alsys Ada compiler is the only validated Ada compiler for the OS/2 operating system. The compiler runs on an 80286- or 80386-based computer that has at least 2M bytes of main memory; 4M to 6M bytes is recommended to avoid excessive swapping overhead. You'll need at least 20M bytes of free disk space and 40M bytes or more for developing medium-size or large applications. The multilibrary lets you share compilation units among libraries, thus eliminating version-control problems and allowing programmer teams to easily facilitate the units. You can select the compiler's high-level optimizer, which uses a combination of lattice algebra and interval analysis. At compile time, this optimizer detects many potential run-time errors, such as constraint errors and uninitialized variables.

The compiler comes with managers for individual libraries and families of libraries; a unit manager that lets you manipulate individual units in an Ada library; a binder tool that combines separately compiled Ada units; and a run-time executive that provides application programs with facilities for tasking, exception handling, memory allocation, and I/O. An optional 2-volume developer's tool kit includes a symbolic debugger and cross-reference, pretty-printing, and source-recompilation tools. Compiler and 4M-byte memory for 286 machines, $3595; compiler for 386 machines, $3095; Developer's Toolset Volumes I and II, $995.

Alsys Inc, 1432 Main St, Waltham, MA 02154. Phone (617) 890-0030. FAX 617-890-8660.

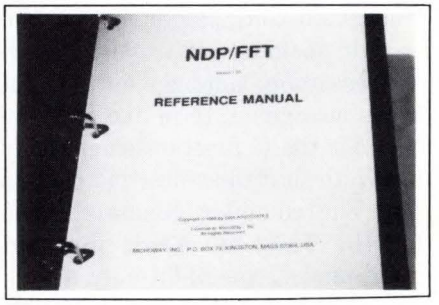
Circle No 440

PROTOTYPING TOOL

C Executive PC host lets you develop and test multitasking applications software on your IBM PC/XT, PC/AT, or compatible before downloading it to run on an embedded system under the C Executive real-time kernel. The kernel is ROMable and is available for 15 different 8-, 16-, and 32-bit target μPs. On your PC host, you can usually exercise and test all application modules, except target-specific device drivers. The C Executive PC host lets you overlap applications prototyping and target-board development and often allows you to delay selection of the target CPU until after you've analyzed the performance of the PC prototype. The C Executive package includes a version of the kernel that runs on your host and a version that runs on an embedded 8086, 80186, or 80286. PC host package, $575; with file system, $825; target package, $500 each.

JMI Software Consultants Inc, Box 481, Spring House, PA 19477. Phone (215) 628-0846.

Circle No 442



DSP LIBRARY FOR 386

NDP/FFT is a library of assembly-language DSP routines that you can call from programs developed with NDP Fortran-386 or NDP C-386 compilers. The routines run in protected mode on all 80386-based machines that have an 80287, 80387, or mW1167 numeric coprocessor; NDP/FFT automatically detects which coprocessor is present at run-time. The routines can access the entire 4G-byte address space of the 80386 CPU. However, the amount of memory present in the machine determines the practical limit on array sizes; a 1024×1024 single-precision array typically requires 8M bytes of storage. Functions in the library include Radix-2 FFTs for real or complex data; arbitrary-length FFTs; convolution, correlation, and autocorrelation; complex cepstrum and inverse cepstrum; Hann, Hamming, and Blackman-Harris windows; polar/rectangular complex-number conversions; and other DSP functions. $250.

MicroWay, Box 79, Kingston, MA 02364. Phone (508) 746-7341. FAX 617-934-2414.

Circle No 444

TRANSPUTER TOOL KIT

The Transputer Toolset allows you to develop C and assembly-language software that runs on a single Inmos transputer or on a transputer network. The tool kit includes a C compiler, an assembler, a linker, a librarian, and loaders for both single- and multiple-transputer configurations. The tool kit is written in C and comes in C source-code form. You use your host computer's compilation facilities to create an executable version. You control optimization and placement of the code in memory. It usually generates assembly-language output, but it can also generate in-line machine code for the C functions that easily map into the transputer instruction set. The compiler generates code for the 64/32-bit ANSI floating-point model, the 32-bit-only model, or a mixture of both. The C library contains transputer run-time routines and host-interface facilities. The package is set up for installation on IBM PC or Macintosh II machines, as well as Apollo, Sun, or DEC machines running System V or BSD4.3 versions of Unix. $995.

Logical Systems, Box 1702, Corvallis, OR 97339. Phone (503) 753-9051.

Circle No 443

IMAGE PROCESSING

Visilog is an image-processing package for computer vision and scene analysis. The library and interpreter run on a variety of workstations and incorporate the fundamental tools of image processing, such as zoom, pan, and scroll functions; convolution; elementary filtering; frame grabbing; and image editing. In addition, they provide sophisticated scene-analysis methods, which include edge detection, a complete set of morphological operators, shape-recognition algorithms, image segmentation, stereoscopic vision, and 3-D reconstruction of 2-D scan slices. The base module contains an interactive interpreter and a library of routines that you can call from application programs written in C, Fortran, or Pascal. You can obtain optional modules for advanced morphology and application-specific modules for shape recognition and other functions. $2500.

Matrox Electronic Systems Ltd, 1055 St Regis Blvd, Dorval, Quebec H9P 2T4, Canada. Phone (514)685-2630.

Circle No 445

ENCRYPTION TOOL

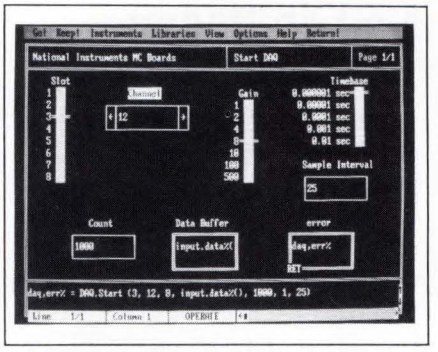
The EDS-002S software simulator runs on IBM PCs and compatibles under DOS version 2.0 or higher. The package allows you to develop and test encryption-related programs that will work with the vendor's CA34C168 data-encryption processor (DEP). If you use the simulator in interactive mode, it executes each command immediately after you enter them on the keyboard; you can then observe the results of the command. Alternatively, you can use the text editor to create a file containing a series of commands that the simulator will execute in sequence. You can run these command files as complete programs or call them as subroutines from other applications programs. Because the simulator emulates all functions of the DEP exactly, you can develop and test cryptographic products before completion of the hardware. $1450.

Calmos Systems Inc, 20 Edgewater St, Kanata, Ontario K2L 1V8, Canada. Phone (613) 836-1014. TLX 0534501. FAX 613-831-1742.

Circle No 446

DATA-ACQUISITION TOOL

LabWindows is a set of data-acquisition and -analysis tools for programmers who use QuickBasic and C languages. The tools let you develop application software for systems with instruments that connect



to the CPU via GPIB or RS-232 links, or via plug-in D/A or A/D boards. In the interactive mode, a pictorial screen with a fill-in-the-blanks format lets you call up high-level library functions and generate tested, syntactically correct code for reading or controlling instruments.

In addition, you can create your own library functions. When you have fully tested your software by running it interactively under the interpreter, you can use the standard compilers for QuickBasic or C to generate a stand-alone version of your program. The libraries that come with the package include instrument drivers that control a variety of specific instruments; you don't need to know the instruments' programming protocol. You can also create your own custom drivers for instruments that are not included in the libraries. The standard LabWindows Analysis Library has functions for array manipulation, complex arithmetic, and vector- and matrix-algebra. The optional Advanced Analysis Library contains functions for signal processing, digital filtering, and curve fitting. LabWindows, $495; Advanced Analysis Library, $895.

National Instruments, 12109 Technology Blvd, Austin, TX 78727. Phone (512) 250-9119. TLX 756737. FAX 512-250-0382.

Circle No 447

RELAY SOFTWARE

The PCI-20073S-1 software package is an enhanced version of the industry-standard RD1000/PC re-

POWER SUPPLIES AT YOUR COMMAND.

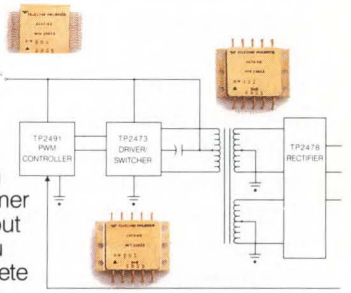


Introducing a complete system of modular hybrid components for military SMPS designs.

What do you do when all the primary electronics are in place, but there's precious little time, budget or real estate left for the power supply?

Call Teledyne Philbrick. We offer a unique, new series of complete modular hybrid power components that are designed to be customized to your exact specifications.

Just choose the configuration you need. The 2491 Regulating Pulse Width Modulator provides all the control functions for the PSU. The 2473 is a dual MOFSET switch with high speed drivers and current sensing circuitry. And the 2478 Dual Schottky Bridge Rectifier provides up to three output voltages from a single power package.



New modular power hybrids are ideal for missiles, RPVs and other military systems. Combine them with a transformer and input/output filters, and you create a complete custom power supply—in a fraction of the time, and at a fraction of the cost, it would take to start from scratch.

Qualified to MIL-STD-1772, Teledyne Philbrick is a leading manufacturer of high performance, high reliability standard and custom microcircuits for industrial, medical, military and space applications worldwide. Send for complete specifications. Or call us toll-free at 1-800-325-1330 (outside MA).

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Fax: 818-889-8215

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Tel: 571-9596
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Fax: 571-9439

JAPAN:
4th Floor
Taiko No. 3 Bldg.
2-10-7 Shibuya-Ku
Tokyo 542, Japan
Tel: 797-5251
Telex: 781-24335
Fax: 797-5255

CIRCLE NO 74



lay-ladder software. The enhancements include the ability to program the logical equivalents of as many as 32 16×16 stepper drums; that is, each drum can step 16 times and selectively open or close as many as 16 contacts at each step. In conjunction with the vendor's PCI-20000 data-acquisition system, the software simplifies the design of process-monitoring and -control functions. You can first use the PC as a development system to configure a data-acquisition and -control algorithm and then use it as a controller to run the algorithm.

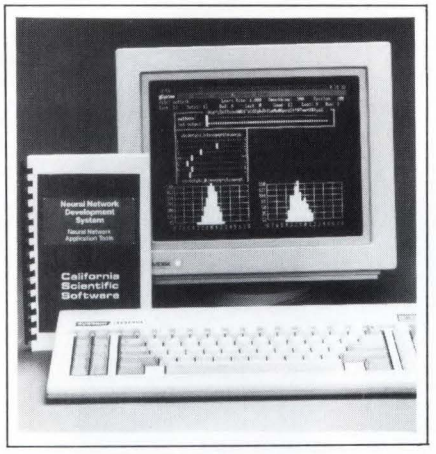
A screen editor displays conventional and enhanced relay-ladder symbols that you can select and enter with single keystrokes; it also lets you search forward and backward for rungs and delete and insert rungs. You can access an online help screen at any time, and you can monitor or even modify a running program. The software also provides password security protection. $995.

Burr-Brown, 1141 W Grant Rd, #131, Tucson, AZ 85705. Phone (602) 746-1111.

Circle No 448

NEURAL NETWORK

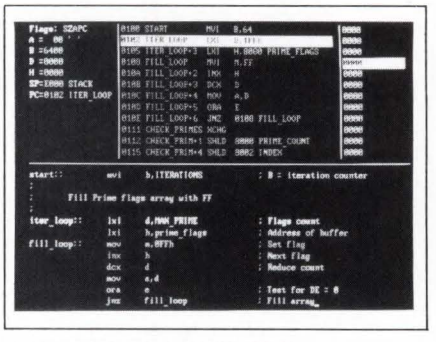
BrainMaker is a neural-network simulation program that provides an overview of neural-network technology and allows you to find out quickly whether your control and data-recognition problems can be handled by a neural network. The program provides support for five types of linear and nonlinear neurons, has special I/O facilities for



visual or symbolic data manipulation, and allows you to work with fuzzy logic. The package includes sample neural networks, including some that perform optical-character recognition, speech synthesis, image recognition, and image enhancement. To run the program, you need an IBM PC or compatible that has at least 256k bytes of main memory and runs under DOS 3.0 or higher. $99.95.

California Scientific Software, 160 E Montecito #E, Sierra Madre, CA 91024. Phone (818) 355-1094.

Circle No 449



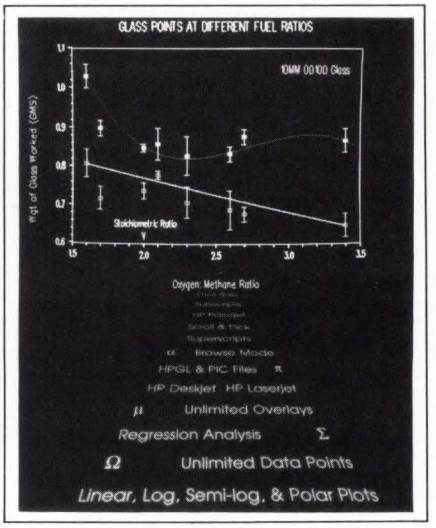
647180 DEBUGGER

The Source Level Debugger runs on any IBM PC or compatible and, in conjunction with the vendor's Icebox or IceAlyzer in-circuit emulators, allows you to debug C- and assembly-language programs for a target system that is based on the Hitachi 647180 μP. The debugger displays a window for each logical set of data. Every window is automatically updated whenever the emulator stops at a breakpoint. The source window shows the source code in its original form, with comments. The other windows show register and stack contents, data, and disassembled code.

Debugger commands allow you to page through the source code and search for a specific symbol. Using the symbols that you've defined in your program, the debugger shows all the addresses and address references; if it can't find an exact match, it displays the closest matching symbol with the and an offset from that symbol. The debugger allows you to transfer data between the host PC and the emulator in either binary or hex format. You can save any screen display to a file, thereby creating a log of a debugging session. $750.

Softaid Inc, 8930 Rte 108, Columbia, MD 21045. Phone (301) 964-8455. TWX 650-265-2092. FAX 301-596-1852.

Circle No 450



DATA PLOTTER

Tech*Graph*Pad 3.0 integrates the data-retrieval, -manipulation, and -output requirements of engineers and scientists. You can generate linear, log, and R-Theta plots; perform curve fitting; and select the size and placement of labels, data notations, axes, grid form, and scaling factors. Major enhancements of

SPECTACULAR DISPLAYS OF SPEED.

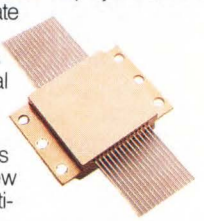


Introducing video driver hybrids from Teledyne Philbrick.

High-resolution graphic displays require quick response. That's why Teledyne Philbrick has combined all the driver ICs and transistors you need in one powerful space-saving package.

Where discrete components fall short, new 1900 Series Video Display hybrids come on strong as high speed trans-conductance amplifiers with high voltage, open collector outputs. They accommodate standard RS-170 or RS-343 interfaces. And accept differential or single-ended inputs with a common-mode input voltage range of +3V.

The 1901 is capable of driving up to 50V pp swings into 6pF loads with bandwidths of over 146MHz. Combining an output buffer stage with the 1901, the 1902 provides up to 100V pp swings in 20pF loads. These specifications provide flexibility in CRT selection and ease of mechanical mounting in projection and high brightness displays. Both the 1901 and the 1902 eliminate the need for pre-amps, ensure rise times of 2-4ns and provide easy thermal management.



Altogether, the 1900 Series gives you a powerful, new edge in designing sophisticated, compact imaging systems for CAD, avionics and large screen applications.

Qualified to MIL-STD-1772, Teledyne Philbrick is a leading manufacturer of high performance, high reliability standard and custom microcircuits for industrial, medical, military and space applications worldwide. Send for complete specifications. Or call us toll-free at 1-800-325-1330 (outside MA).

MIL-STD-1772 Qualified

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Telex: 935008
Fax: 571-9439

JAPAN:
4th Floor
Taiko No. 3 Bldg.
2-10-7 Shibuya-Ku
Tokyo 542, Japan
Tel: 797-5251
Telex: 781-24335
Fax: 797-5255

CIRCLE NO 75

release 3.0 include a worksheet "browse" mode that brings up Lotus 1-2-3, Symphony, or Quattro spreadsheets and lets you retrieve data from them; an improved user interface; user-controllable color for both on-screen display and hard-copy output; and drivers for HPGL-compatible laser printers and color printers.

The software lets you read an unlimited number of data points per set; provides error bars, superscripts and subscripts; and creates both Lotus and HPGL .PIC graphics files that you can integrate with text in your documents. The program runs on IBM PCs and compatibles, PS/2s, Apollo Series 3000/4000 workstations that have an MS-DOS emulator, and VAX/VMS machines that have MS-DOS services. $395; upgrade, $99.

Binary Engineering, 100 Fifth Ave, Waltham, MA 02154. Phone (617) 890-1812.

Circle No 451

OS-9 SHELL

The SH software package is a programmable shell command interpreter for the OS-9/68k operating system. It provides a user interface that is fully compatible with a standard Unix operating-system shell. Its features include parameter passing, string substitution, variable definition, and control-flow primitives that allow bidirectional communication between the operating-system shell and invoked processes. To determine control flow, you can use return codes as arguments or use standard command outputs as inputs to the shell.

You can also perform calculations and check files and shell variables for their type and state. In addition to AND and OR command groupings, the shell includes high-level commands such as if-then-else, do-while, and case statements. The SH package is supplied on an OS-9 diskette. $650.

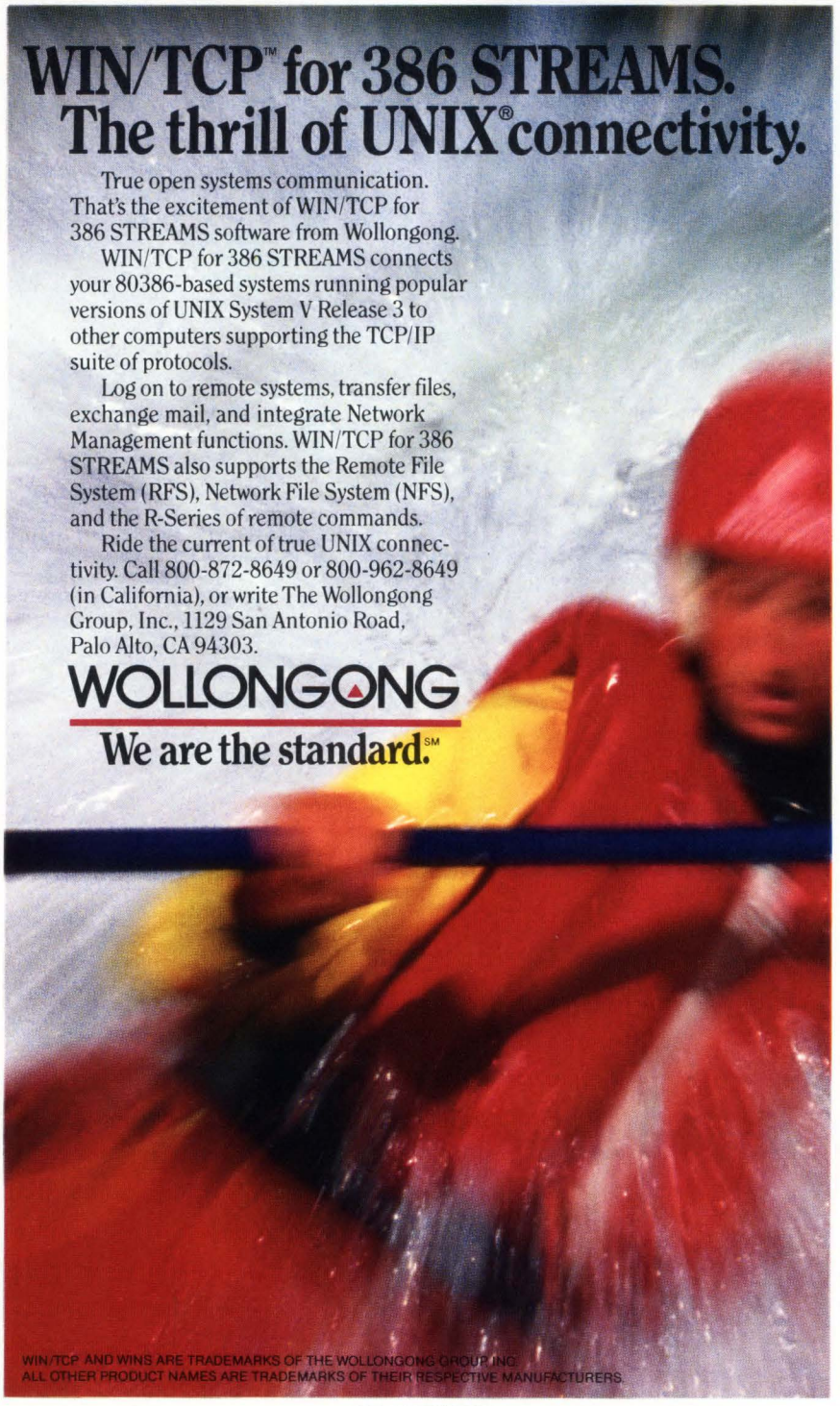
EKF Elektronik GmbH, Weidekampstrasse 1a, 4700 Hamm 1, West Germany. Phone (02381) 12630. TLX 828621. FAX 02381-15067.

Circle No 459

NETWORK SOFTWARE

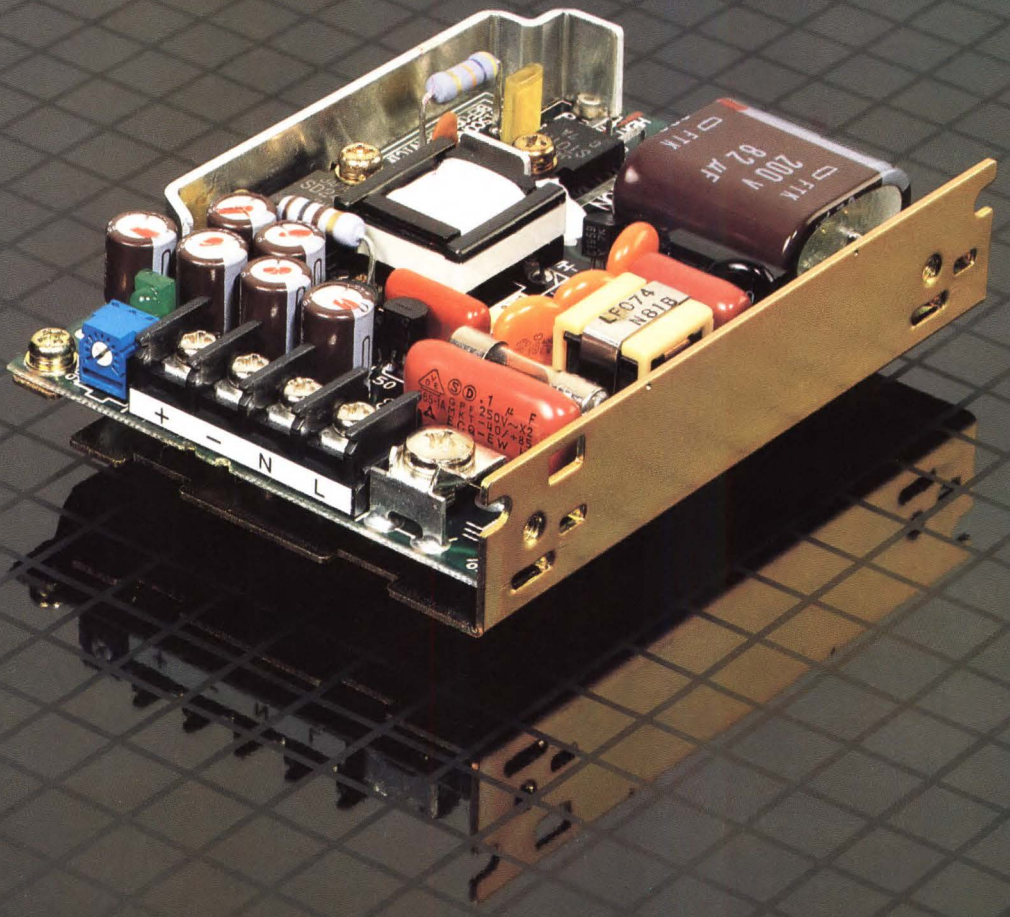
The NFM/ARC and VBF/ARC software drivers simplify the integration of Arcnet communication facilities into VME-Bus systems that run the OS-9 operating system. The software drivers operate with the vendor's VME-Bus Arcnet interface cards. The NFM/ARC package links with Microware's OS-9/NET network file manager to provide transparent access to remote systems, thereby making files held on remote systems appear as if they

Text continued on pg 202



CIRCLE NO 76

FAK, Kepco's solution to your problem of "not enough space for your power supply."



15 Watt Model
Shown Actual Size

Very low profile, very compact, single output KEPCO/TDK Switching Power Supplies

KEPCO®
THE POWER SUPPLIER™

146-1631

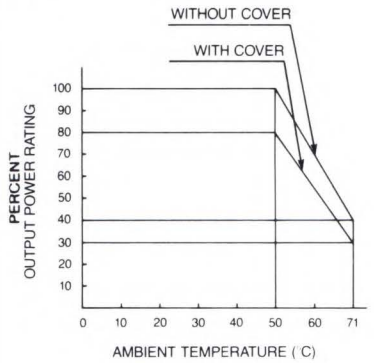
SERIES FAK

These modern single output switchers employ advanced surface mount technology to achieve small size and very low profile, to fit where space is at a premium. They are designed to the standards of UL and CSA. Input is 85 ~ 132V a-c; outputs are 5V, 12V, 15V, and 24V. The 15 and 25 Watt models employ flyback topology; the 50 Watt models are forward converters.

FEATURES:

- **Power-OK LED:** green.
- **a-c input 85-132V; d-c input 110-170V.**
- **High frequency operation** (up to 260 KHz) for high efficiency.
- **Soft-start circuit:** Limits a-c turn-on surge.
- **Adjustable voltage:** Internal trimmer accessible through the case allows manual adjustment of the voltage setting.
- **Holding time:** Output is sustained by internally stored energy for 30 milliseconds typically, 20 milliseconds minimum.
- **Built-in EMI filter** attenuates conducted noise below the requirements of FCC 20780 for Class B computing devices. Optional perforated metal covers attenuate radiated noise and provide protection.
- **Safety:** All models recognized by UL, certified by CSA.
- **Connections:** Input and output connections are via screw terminal barrier strip.

FIG. 1
OUTPUT POWER VS AMBIENT TEMPERATURE



FAK GENERAL SPECIFICATIONS

SPECIFICATION		RATING/DESCRIPTION	CONDITION
Temperature		0-71°C (see Fig. 1)	Operating
		−40°C to +85°C	Storage
Humidity		95% RH	Non-condensing; operating & storage
Shock		20g, 3 axes (11msec ±5msec pulse duration)	Non-operating 3 shocks each axis
Vibration		5-10Hz: 10mm amplitude, 3 axes	Non-operating 1 hour each axis
		10-55Hz: 2g, 3 axes	
Isolation	Output to case	500V d-c, 100MΩ	25°C, 65% RH
Withstand voltage	Input to output	2KV a-c for 1 minute	25°C, 65% RH
	Input to case	2KV a-c for 1 minute	
Safety		UL 478 recognized; CSA certified	
Enclosure		Optional metal	
Type of construction		PC card, L-chassis	
Cooling		Convection	

FAK INPUT CHARACTERISTICS

SPECIFICATION		15W	25W	50W	CONDITION
Voltage range		85-132V a-c; 110-170V d-c			
Brownout voltage		80V a-c/105V d-c			
Current	typ	0.28A	0.5A	0.9A	Nominal input, rated load, 25°C
	max	0.35A	0.65A	1.1A	
	typ	0.4A	0.65A	1.2A	Minimum input, rated load, 25°C
	max	0.45A	0.8A	1.4A	
Fuse value		2A	2.5A	3.15A	
Initial turn-on surge, first 1/2 cycle		22A	43A	43A	Nominal input, rated output, 25°C cold start
Frequency		Nominal 50/60Hz; range 47-440Hz(1)			Single Phase
EMI		Meets conducted noise standard of FCC 20780, Class B			
Soft-start circuit		Thermistor limiter			
Leakage current		0.5mA (max)			UL method (115V a-c)
Startup time		100ms (max)			
Holdup time	typ	30msec			Nominal input, rated load
	min	20msec			
Circuit type		Flyback bipolar	Flyback bipolar	Forward converter FET	
Switching frequency		70KHz (typ)	50KHz (typ)	260KHz (typ)	Rated load

(1)At 440Hz the leakage current exceeds the UL safety specification limit.

UL RECOGNIZED CSA CERTIFIED

This KEPCO product is backed by a firm **1-YEAR WARRANTY**

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TEAR ON DOTTED LINE TO REMOVE AND SAVE.

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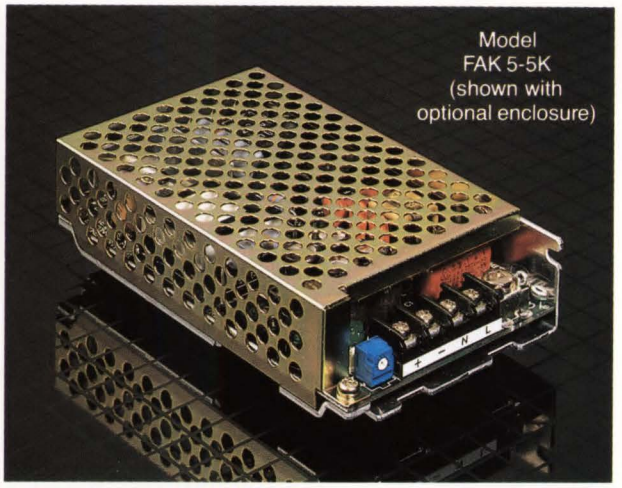
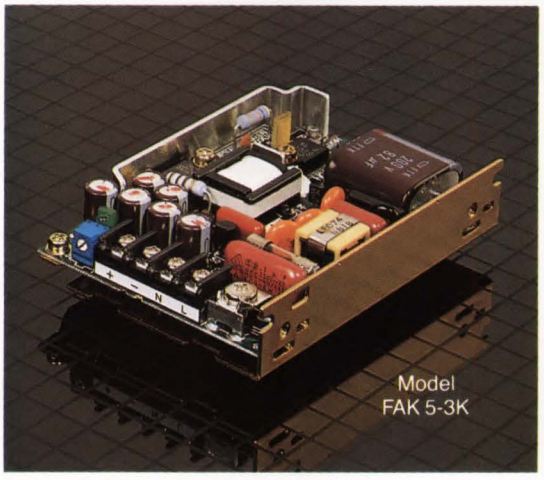
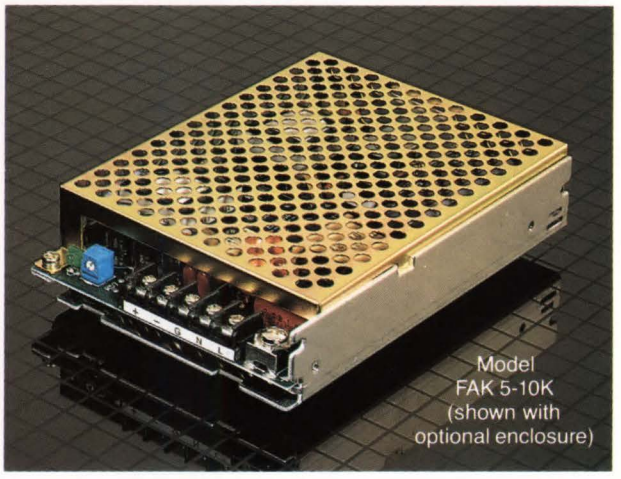
KEPCO/TDK Series FAK 15, 25 & 50 Watts


Model FAK 5-5K (shown with optional enclosure)


Model FAK 5-3K


Model FAK 5-10K (shown with optional enclosure)

FAK MODEL TABLE

SPECIFICATION	OUTPUT VOLTAGE		OVP SETTING	OUTPUT CURRENT	CURRENT LIMIT(2)	RIPPLE(3)				NOISE(3) (SPIKE)	EFFICIENCY
Unit	Volts		Volts	Amps	Amps	mV				mV	percent
Condition	Factory set(1)	Adjustment range		0-50°C (see Fig 1)	nom input, 25°	Source p-p typ	Source p-p max	Switching p-p typ	Switching p-p max	d-c to 50MHz p-p max	nom input max load typ
15 WATT MODELS											
FAK 5-3K	5	4.5- 5.5	NA	0-3.0	3.3~ 5.0	10	30	30	60	120	70%
FAK 12-1.3K	12	10.8-13.2	NA	0-1.3	1.4~ 2.3	10	30	30	70	190	
FAK 15-1K	15	13.5-16.5	NA	0-1.0	1.1~ 2.0	10	30	30	70	220	
FAK 24-0.7K	24	21.6-26.4	NA	0-0.7	0.8~ 1.4	10	30	30	80	310	
25 WATT MODELS											
FAK 5-5K	5	4.5- 5.5	6.0~ 6.9	5	5.5~ 7.5	10	30	30	70	120	70%
FAK 12-2.1K	12	10.8-13.2	13.7~15.7	2.1	2.3~ 3.3	10	30	30	70	190	
FAK 15-1.7K	15	13.5-16.5	17.0~19.0	1.7	1.9~ 2.8	10	30	30	70	220	
FAK 24-1.1K	24	21.6-26.4	27.0~30.5	1.1	1.2~ 1.8	10	30	30	80	310	
50 WATT MODELS											
FAK 5-10K	5	4.5- 5.5	6.0~ 6.9	0-10.0	10.5~12.0	10	30	25	50	120	75%
FAK 12-4.2K	12	10.8-13.2	13.7~15.7	0- 4.2	4.4~ 5.1	20	40	25	50	190	
FAK 15-3.4K	15	13.5-16.5	17.0~19.0	0- 3.4	3.6~ 4.1	20	40	25	50	220	
FAK 24-2.1K	24	21.6-26.4	27.0~30.5	0- 2.1	2.2~ 2.6	30	60	25	60	310	

(1) Nominal input, maximum load, 25°C (2) 15W & 25W models: Foldback, fixed. 50W models: Rectangular, fixed.
(3) 0 to 50°C, 10% to 100% load.

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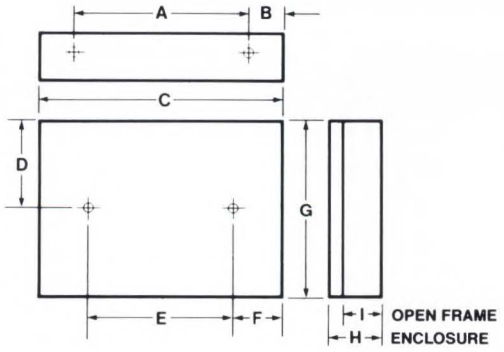
FAK OUTPUT CHARACTERISTICS

SPECIFICATION		RATING/DESCRIPTION	CONDITION
Source effect	typ	0.6%	Minimum to maximum input
	max	2.0%	
Load effect	typ	1.2%	10% to 100% load
	max	3.0%	
Temperature effect	typ	0.6%	Nominal input rated load, 0-50°C
	max	2.0%	
Combined effect (source, load, temperature)	typ	±1.0%	
	max	±3.0%	
Time effect (drift)	typ	0.1%	0.5-8.5 hr maximum load, 25°C
	max	0.5%	
Recovery characteristics	Excursion	<4%	Nominal input, 25°C; step load change from 50% to 100% of rated load
	Recovery within ±1%	<1msec	

OUTLINE DIMENSIONAL DRAWINGS

Dimensions in light face type are in inches,
dimensions in bold face type are in millimeters.



MODEL	A	B	C	D	E	F	G	H(1)	I(2)
15 WATTS	2.91 **74**	0.33 **8.5**	3.74 **95**	1.3 **33**	2.16 **55**	0.9 **23**	2.76 **70**	0.9 **23**	0.78 **20**
25 WATTS	3.54 **90**	0.47 **12**	4.53 **115**	1.3 **33**	2.75 **70**	0.94 **24**	2.76 **70**	1.12 **28.5**	0.98 **25**
50 WATTS	3.93 **100**	0.39 **10**	5.12 **130**	1.85 **47**	2.75 **70**	0.98 **25**	3.74 **95**	1.12 **28.5**	0.98 **25**

(1) With cover (optional)
(2) Open frame

Tolerances: 0.04" (1.0 mm) unless otherwise noted
Mounting: 4-40 tapped holes — (2) side;
maximum screw penetration 0.2 (5 mm)

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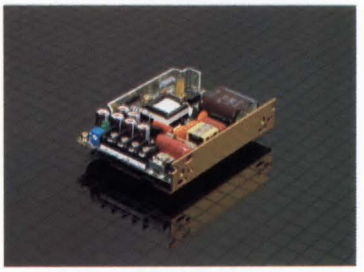
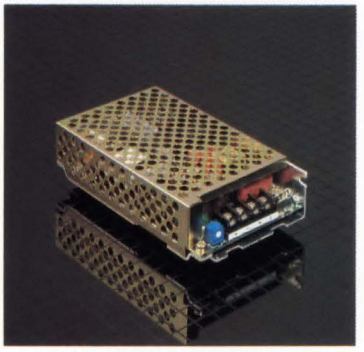
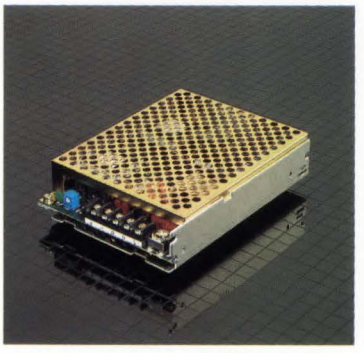


15 Watt Model FAK 5-3K
(optional enclosure CA-21)



25 Watt Model FAK 5-5K
(shown with optional enclosure CA-22)



50 Watt Model FAK 5-10K
(shown with optional enclosure CA-23)

OPEN FRAME DIMENSIONS

15W:
inches — 0.78 x 2.76 x 3.74
mm — 20 x 70 x 95
25W:
inches — 0.98 x 2.76 x 4.53
mm — 25 x 70 x 115
50W:
inches — 0.98 x 3.74 x 5.12
mm — 25 x 95 x 130

CASED DIMENSIONS

15W case (CA-21):
inches — 0.9 x 2.76 x 3.74
mm — 23 x 70 x 95
25W case (CA-22):
inches — 1.12 x 2.76 x 4.53
mm — 28.5 x 70 x 115
50W case (CA-23):
inches — 1.12 x 3.74 x 5.12
mm — 28.5 x 95 x 130

NET WEIGHT

15W: 5.60 oz, 160 gm
25W: 5.98 oz, 170 gm
50W: 8.80 oz, 250 gm

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Salem Industrial Park, PO Box 551
Whitehouse Station, NJ 08889
Telephone (201)534-9007
TWX 710-480-2839
FAX: (201)534-5672

CIRCLE NO 140

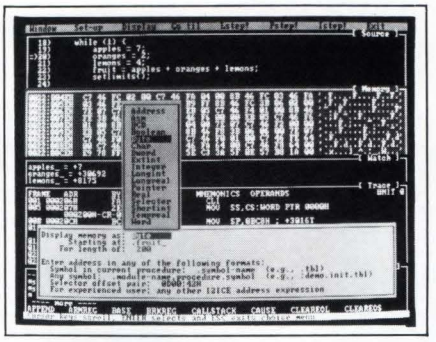
GLASSMAN HIGH VOLTAGE INC.

are held on a local disk.

The VBF/ARC software operates on a lower level and lets you use standard OS-9 operating-system calls to transfer single data packets across an Arcnet LAN; it achieves bulk data-transfer rates as high as 800k bps. The driver comes with Vivaway's VBF variable block file-manager software, which provides multichannel access to the network and handles concurrent-network requests and request queues. NFM/ARC, £85; VBF/ARC, £75.

Comendec Ltd, Aston Science Park, Love Lane, Aston Triangle, Birmingham B7 4BJ, UK. Phone 021-359-0981. TLX 33435. FAX 021-359-0433.

Circle No 460



DEBUGGER

The Iceview debugger interface links IBM PCs and compatibles to the vendor's in-circuit emulator for 8086, 80186, and 80286-based systems. You can open windows in order to access application source-code displays, an execution tracer, registers, and other debugging information. You can view changes in the data as you step through your program or when the program reaches a breakpoint. You can control as many as four in-circuit emulators from one PC host and thus debug multiprocessor systems. With the optional iPat unit, you can display histograms and tables relating to execution speed and code coverage. Upgrade for registered users of the I²Ice in-circuit emulator, $495, until December 31, 1988; thereafter, $1600.

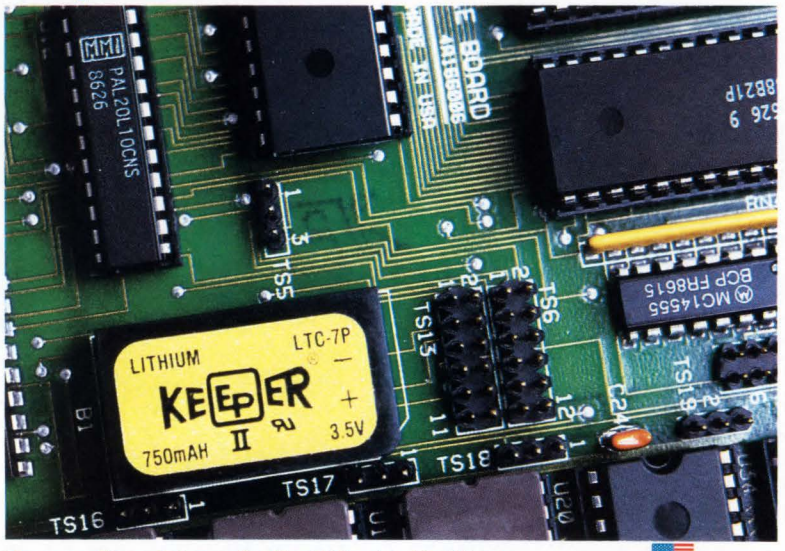
Intel Corp, Development Tools Operation, 5200 NE Elam Young Parkway, Hillsboro, OR 97124. Phone (503) 681-8080.

Circle No 453

CASE TOOL FOR DSP

The DSPlay XL/32 software package is a digital-signal-processing (DSP) design tool that runs on IBM PC/XTs, PC/ATs, and compatibles. It allows you to create a block diagram (FlowGram) of a DSP circuit on the screen and define the function of each block by means of equations or library-function names. The tool automatically creates executable machine code for AT&T's WE DSP32 μP. When you've completed your block diagram, you can download the code to the DSP32 proces-

Why Do So Many Engineers Specify Keeper II® Lithium Batteries?



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CIRCLE NO 78

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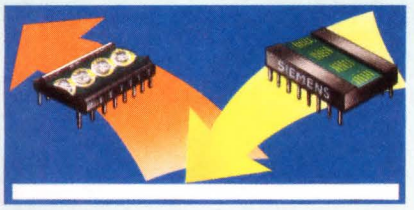

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CG/2600-043 WLM 835

CIRCLE NO 187



sor with a single keystroke. You can then execute the code in real-time. The DSPlay XL/32 package optimizes the code for the vendor's ZPB32 DSPeed processor board, which plugs into an expansion slot of the host PC. However, you can also use the package as a stand-alone tool for developing software that runs on other DSP32-based target systems.

The package includes a graphic editor, a text editor, a library that contains more than 60 predefined block functions, filter-design aids, a code generator that makes use of the library functions, and a debugger. It also includes an assembler and a disassembler, which allow you to create new functions that are not in the library. DSPlay XL/32 software, $1495; software with ZPB32-HS processor board, $2695.

Burr-Brown, Box 11400, Tucson, AZ 85734. Phone (602) 746-1111. TLX 666491.

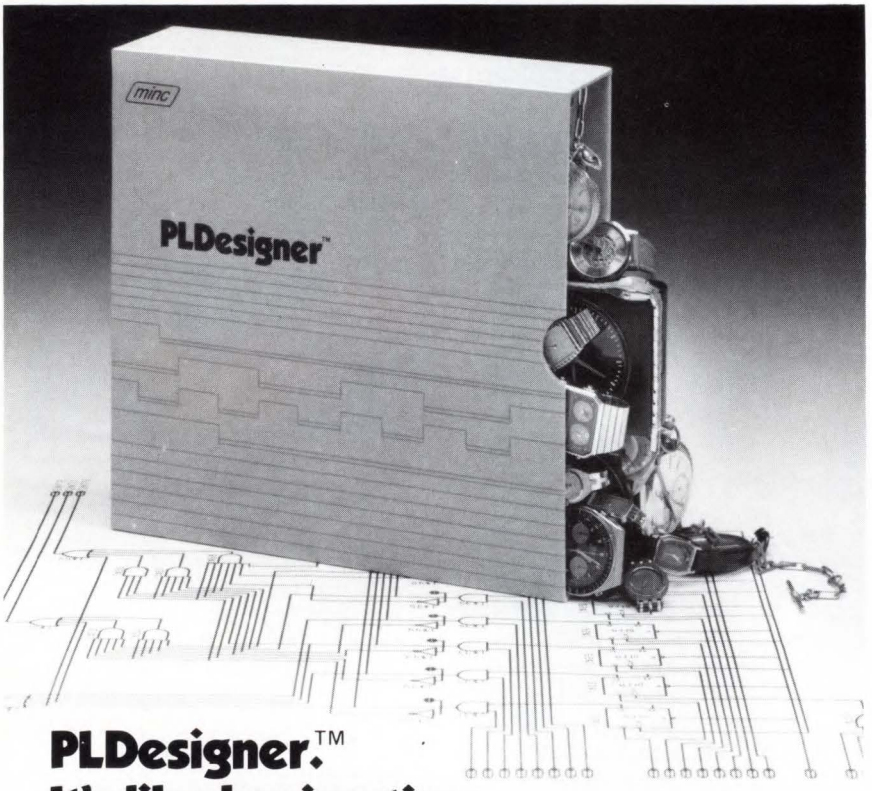
Circle No 452

LANGUAGE TRANSLATOR

QParser+ can automatically construct the syntax trees that are needed in order to translate from one programming language to another and provides a technique for the resolution of grammatical conflicts. The program uses an advanced pragma language to generate code within the skeletons for both C and Pascal; however, you can modify the language and customize the skeletons to generate code for other languages. For example, you can use QParser+ to create translator programs for Pascal or dBASE III to C, Basic to Pascal, Bit Map to PostScript, and many other combinations. You can also create programs to convert files from the format of one word processor to the format of a different word processor, or from one CAD format to another. The program runs on IBM PCs and compatibles that have at least 256k bytes of RAM and two disk drives, and operates under PC-DOS 2.0 or higher. Another version runs on VAX/VMS machines. PC version, $475; VAX version, $2000.

QCad Systems Inc, 1164 Hyde Ave, San Jose, CA 95129. Phone (408) 727-6671.

Circle No 458



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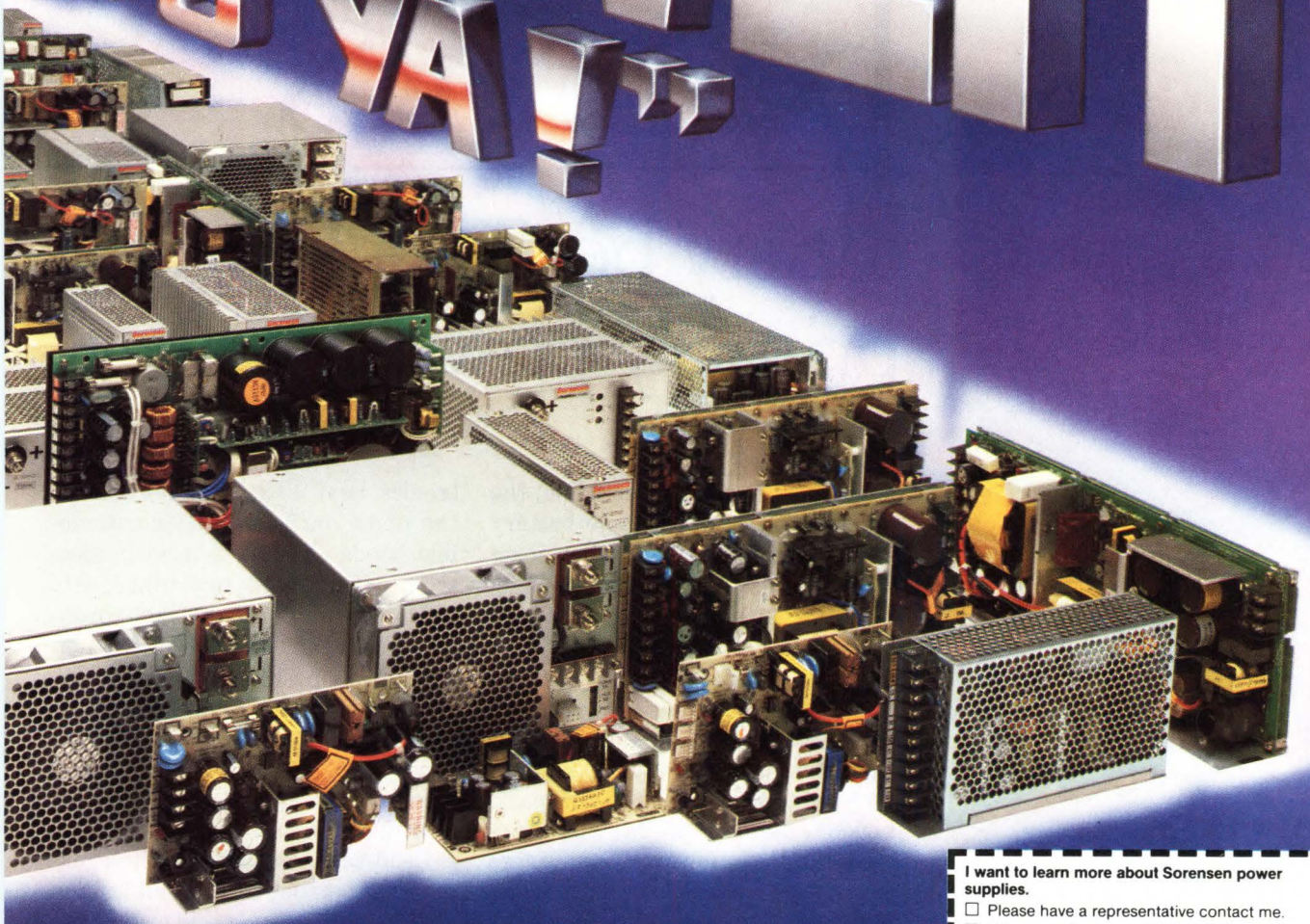
CIRCLE NO 81

"MORE POWER TO YA!"



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- STS 300W, 6 output

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CIRCLE NO 82

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Tom Ormond,
Senior Editor

When you look at the bottom line, the selection of a rechargeable battery system is going to involve some compromises. The reason is simple: There is no perfect battery system—each technology has its pros and cons. Tradeoffs are going to involve cost, cell capacity, operating mode, space, weight, and life considerations. For many years, two battery technologies led the pack: nickel cadmium (NiCd) and lead-acid. Today, however, designers can opt for a third rechargeable-battery system—lithium. Let's take a look at what these systems have to offer.

Age has its preference

Lead-acid batteries have been around for over a century. Available from such manufacturers as Gates, Power-Sonic, and Compu-Tech, these batteries have been used extensively in the transportation industry. However, the lead-acid batteries used in today's electronics bear little resemblance to the units you'll find under automobile hoods. The units used in electronic equipment are inherently safe—there are no leakage problems, and they can be stored and used in any position. Lead-acid batteries are sealed, require no water during their lifetimes, and vent gases from built-in pressure-relief valves only during extreme overcharge conditions.

Lead-acid batteries are less expensive than both NiCd and lithium devices with comparable capacities. Their capacity values range to 100 Ahr, they deliver 2V per cell, and they can withstand a moderate amount of overcharging and rough handling. On the negative side, lead-acid batteries are primarily designed for high-power applications and are not available in button, coin, 9V-transistor, or the well-known letter sizes. Lead-acid batteries are best suited for applications involving moderate to high

Rechargeable batteries play a diverse role in today's world of consumer electronic products. In some cases, they play a backup role for computer clock and memory circuitry. On the other end of the spectrum, they serve as the primary power source for products ranging from watches to laptop computers.



NiCd batteries with capacities ranging from 1.3 to 20 Ahr *(Sanyo Energy Corp)*

There is no perfect battery system—each technology has its pros and cons.

discharge rates, such as video cameras and emergency standby power supplies. They work best in charging circuits that sense battery conditions and shut down at full charge.

Cyclon-sealed lead-acid rechargeable batteries from Gates provide reliability, ruggedness, and long life in a number of applications. These single-cell and monobloc batteries feature a spirally wound design of positive and negative plates that feature pure-lead grids. A proprietary recombination technology eliminates water loss and acid leakage and allows the batteries to be installed close to delicate electronic circuitry. In addition, the batteries provide long float service—as long as ten years at 23°C—and an exceptional cycle life of 200 to 2000 cycles. The batteries' highly retentive separator lets you operate, store, and charge the units in any position.

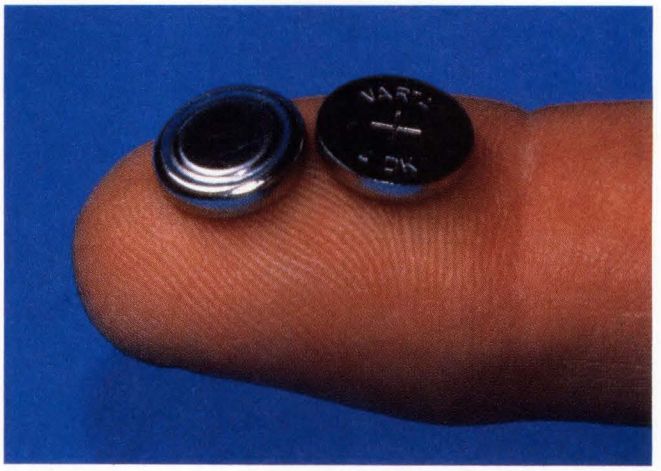
The Cyclon 2V cells are available in four sizes that have capacity ratings ranging to 25 Ahr. For short periods, the D cell delivers more than 100A; the X, J, and BC cells deliver 200A, 350A, and 600A, respectively. You can connect these cells in series or in parallel to provide a wide range of voltage and Ahr-capacity batteries.

The monobloc products also provide impressive performance. Monoblocs are available in 2.5-, 5-, 8-, 12.5-, and 25-Ahr capacities in 4 or 6V modules. The single cells are available in 2.5-, 5-, 12.5-, and 25-Ahr versions in configurations to match most voltage and capacity requirements. It costs $3.41 (1000) for a single D-cell unit.

Model PS-605 from Power-Sonic is a sealed lead-acid battery with a 0.5-Ahr storage capacity. The unit measures about the same size as four AA penlight cells, thus giving designers a way to replace nonrechargeable dry cells with a single rechargeable 6V battery.

Like all Power-Sonic batteries, the PS-605 is maintenance free, sealed, and usable in any position. The recombination-type cells feature a retained electrolyte system, which allows discharge currents of as high as 5A and provides a life expectancy of as long as seven years in standby service. In cyclic applications, the battery accommodates 300 to 500 recharges. The energy density of the PS-605 is 1.24 Whr/in.^{3}; the specific energy is 15 Whr/lb. The battery measures $2.24 \times 0.55 \times 1.97$ in., weighs only 0.21 lbs, and costs $5.40 (500).

Compu-Tech offers the 6V rechargeable lead-acid bATpac—a backup battery for the IBM PC/AT and compatible computers. The unit charges continuously while the system power is on, and it reliably backs up clocks and setups for as long as 12 months while the power is off.



NiCd batteries designed for solar-converter applications *(Varta Batteries Inc)*

The bATpac's expected lifetime is greater than 10 years. Battery installation is simple: You connect the bATpac to a standard IBM PC/AT disk-drive power connector and then plug the battery's cable into the computer's external battery connector. The bATpac features a spare disk-drive power connector to replace the one used by the battery. Double-sided tape secures the battery to the side of the computer's power supply. The battery's capacity is 500 mAhr, and its charge and discharge operating temperatures are -20 to $+50$ and -60 to $+60$°C, respectively. The charge time for 12-month backup capacity is six hours and only two hours for a 2-month charge. The bATpac is sealed in a small ($2.375 \times 2.375 \times 1$ in.), high-impact polystyrene case and costs $39.95.

NiCd batteries are pervasive

Lead-acid rechargeable batteries serve well in many applications, but they take a back seat to nickel cadmium devices when it comes to popularity. Nickel cadmium cells and batteries are made by such manufacturers as Gates, SAFT, Sanyo, and Varta. They come in a variety of sizes and are available in many shapes—including button, square, and cylindrical—in both sealed and vented configurations. The nominal voltage of a NiCd battery cell is 1.2V. It has a flat discharge curve and can accommodate high discharge rates with minimal voltage drops. However, these devices do have one applications-related problem.



Lead-acid batteries with capacities ranging to 25 Ahr *(Gates Energy Products Inc)*

When continuously subjected to less than full-range identical charge/discharge cycles, a NiCd battery develops a memory. If the operating conditions remain constant, this memory characteristic presents no problems. However, if you try to extend the discharge cycle beyond the memorized shallow-discharge period, the cell will act as if it has reached maximum discharge—even though it may have a considerable amount of service remaining. Fortunately, you can overcome this memory drawback by putting the battery through a slow deep-discharge cycle. Subsequent charging erases the memory effect, and the battery will then operate efficiently through its full discharge curve.

The FNC NiCd batteries made by Hoppecke feature fiber-structured electrodes made of a nickel composite material. The fibers of the electrode provide a high conductive density, which results in a low internal resistance. Nevertheless, the material is so porous that 90% of the electrode volume is available to interact with the active element.

The 3-D fiber structure in the FNC battery is elastic, thus the electrode absorbs mechanical stresses and changes in volume during charge/discharge cycles. The electrodes are positive and negative plate sets and are installed in impact-resistant, translucent plastic containers. The cell cover and container are heat-welded together, and the pole bushing is sealed by an O ring. The translucent plastic container makes it easy to check the electrolyte level.

You can recharge FNC batteries in just 30 seconds. This short recharge time permits true opportunity charging in automatic-guidance vehicle (AGV) systems. The batteries attain 80% of their capacity in this short period using recharge currents as high as 7C (C equals the rated capacity) efficiently and without damage. Battery life ranges from 3000 to over 100,000 cycles, depending on the application.

FNC devices are supplied as individual cells for installation in racks or battery cabinets. They are also available in various tray assemblies. These batteries are designed for heavy-duty applications such as engine starting and UPS applications involving kVA requirements into the tens of thousands. Depending on the environmental conditions, a 24V unit for engine-starting applications costs from $500 to $4500.

NiCd batteries are not typically employed in such demanding service. The 4DK NiCd battery from Varta

Providing all the computer power

Sanyo has developed a lightweight rechargeable NiCd battery designed to provide at least three hours of continuous service without recharging in the SLT286, Compaq's first laptop computer. Per Compaq specifications, the battery has a fast recharge capability and provides enough power to operate a full-function 286-based computer that includes a hard disk.

To meet these demanding requirements, Sanyo scientists increased the amount of active material typically employed in the company's Cadnica line of NiCd batteries. They also reduced the thickness of the battery can, the substrate, and the separator material; and they developed a patented negative-electrode chemistry to improve the battery's discharge capacity by 40%.

The battery pack consists of 10 1.2V cells and weighs only 1.8 lbs. A built-in, delta-type recharger can completely recharge the battery pack from an ac source in 1.5 hours. A special LED lamp on the ac adapter indicates the system's charge state. Offering a 2.4-Ahr minimum capacity, the battery pack is rated for a 29-Whr minimum power output and is designed to be replaced after approximately 500 discharge cycles.

The battery pack has a novel voltage characteristic toward the end of its discharge cycle: its voltage decreases gradually rather than suddenly, as is the case with normal NiCd batteries. An automatic feedback system within the computer uses this discharge characteristic to trigger an alarm system during the final 5% of the discharge cycle. Computer users thus have time to save all work-in-progress to disk. The battery pack, which comes as a standard component with the SLT286, costs $129.

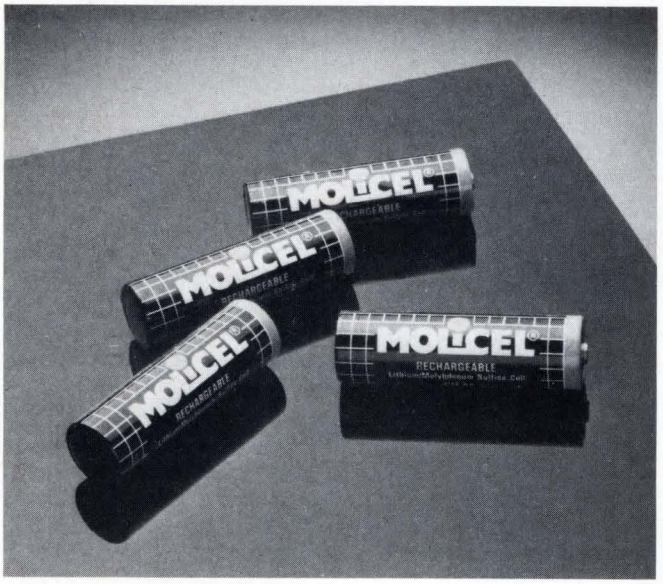
Lead-acid batteries are less expensive than both NiCd and lithium devices with comparable energy densities.

was developed primarily for use in watches and other 1.2V applications that utilize a solar converter. The battery is competitive with the super-capacitor system used in watches—a system that is ineffective if the solar cells are denied light for an extended period of time. The 4DK battery also works quite well as a memory-backup device in solar calculators. The operating range for the 4DK is −20 to +50°C, and it features a proprietary pressure-relief vent for added protection against abusive treatment.

The 4DK also features a mass-plate construction. This construction provides a number of benefits. First, the self-discharge rate is very low—the battery retains over 40% of its charge after one year of storage. The construction also provides inherent overcharge/overdischarge protection. Finally, the mass-plate construction eliminates memory-effect problems, which extends the battery's service life in a trickle-charge configuration to as long as six years at 0 to 45°C. The 4DK costs $1.13 (5000).

Varta also offers the DKT Series of NiCd batteries—a line of 1.2V button cells that have capacities ranging from 8 (8 DKT) to 80 (80 DKT) mAhr. These units allow designers to miniaturize a wide range of high-tech products. In this case, the mass-plate construction results in a battery that measures just 0.13 in. high. The batteries' height allows designers to use low-profile stacks for higher voltage in a given space.

The DKT batteries also offer some electrical advantages. For example, at its 40-mAhr, 10-hour (C/10) discharge rate, the 40 DKT battery retains its rated voltage for approximately 80% of the discharge time. The battery has a two- to six-times longer standby life than conventional cells and accommodates significantly lower recharging rates (C/100 versus the typical C/20 recharging rates). These characteristics apply to all units in the DKT line. DKT batteries can also handle applications involving permanent trickle charging, and prices range from $1 to $1.37 (5000).



Lithium batteries designed for memory-backup service *(Moli Energy Ltd)*

Batteries automatically recharge

Gates Energy has developed a rechargeable NiCd battery that does not require a separate charger when it's used in radio cassette recorders—or other consumer electronic products—that have been adapted for it and employ ac/dc power supplies. Called PowerStick, the battery replaces multiple configurations of C- and D-size disposable batteries and automatically charges whenever the product is plugged into an ac outlet.

The automatic rechargeability feature stems from the addition of a contact in the host product's battery compartment. The contact connects with a special charging ring on the PowerStick battery, forming a patented charging system that charges the PowerStick but has no effect on alkaline or other types of disposable batteries.

The initial market introduction of the PowerStick has focused on such products as radios and radio cassette recorders, but the product also accommodates the needs of a broad range of portable consumer electronics. The batteries come in two basic versions designed for regular and high-energy applications, respectively. The standard model is manufactured in configurations equivalent to multiples of three and four C-size disposable batteries and multiples of two, three, and four D-size batteries.

PowerStick Plus, the second model, is intended for more demanding applications, such as portable TVs, and for products requiring longer operating times. It is available in designs equivalent to multiples of two, three, and four D-size batteries. It costs $19.95 (1000) for a pair of standard PowerSticks that are equivalent to three C-size disposable batteries.

Sanyo has developed an ultrathin rectangular NiCd battery designed to pack the most power density into the shrinking space available in many of today's portable products. The KF Series of 1.2V devices will be marketed to original equipment manufacturers under the Cadnica Slim name.

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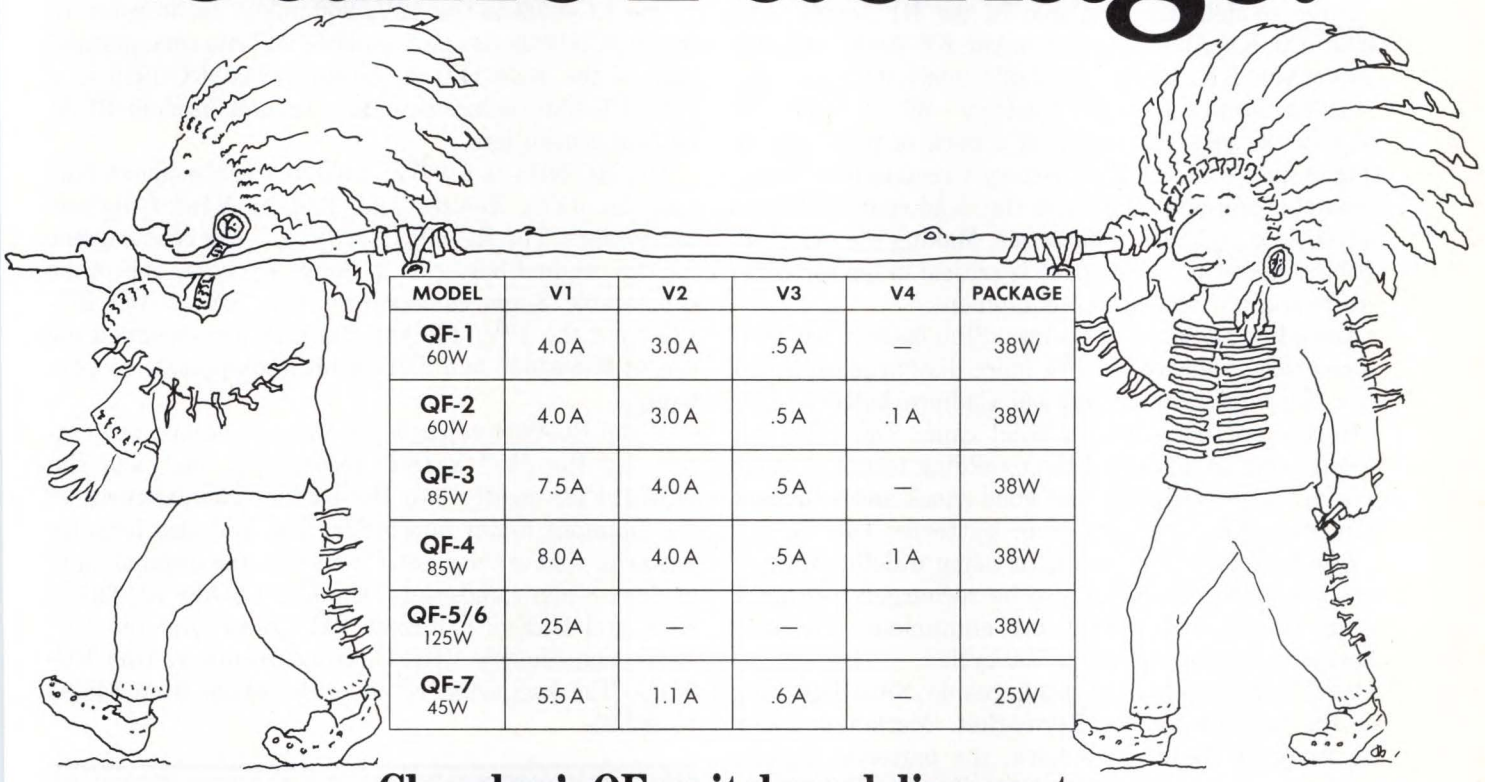

MODEL	V1	V2	V3	V4	PACKAGE
QF-1 60W	4.0 A	3.0 A	.5 A	—	38W
QF-2 60W	4.0 A	3.0 A	.5 A	.1 A	38W
QF-3 85W	7.5 A	4.0 A	.5 A	—	38W
QF-4 85W	8.0 A	4.0 A	.5 A	.1 A	38W
QF-5/6 125W	25 A	—	—	—	38W
QF-7 45W	5.5 A	1.1 A	.6 A	—	25W

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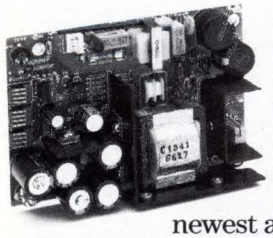

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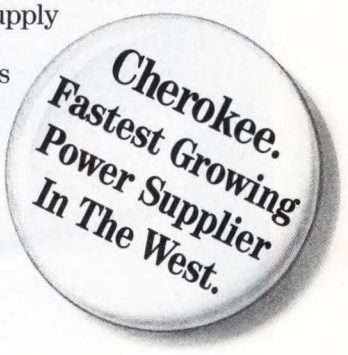



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NiCd batteries can accommodate high discharge rates and still show a minimal voltage drop.

Three models are available in the KF family: the 600-mAhr KF-A600, the 900-mAhr KF-A900, and the 1200-mAhr KF-A1200. At $2.62 \times 0.66 \times 0.22$ in., the Cadnica Slim KF A600 battery—$6.44 (100)—is roughly the size and shape of a pack of gum, and it weighs only 0.81 oz. The battery's rectangular shape eases stacking and eliminates the dead space between conventional cylindrical batteries. Making the most out of the smallest possible space is critical in lap-top computers and portable stereo equipment.

According to Sanyo, a Cadnica Slim battery has 50% more energy density, or 50% more discharge capacity, than the equivalent cylindrical Cadnica battery. The batteries are packaged in steel cans. The cans are sealed using an advanced laser-welding technique that provides high reliability and good shock and vibration characteristics. Cadnica Slim batteries can be recharged effectively in one hour using a delta voltage-sensor system. They can also be recharged overnight using conventional recharging equipment. The discharge/recharge cycle life is 500 cycles.

SAFT offers a line of rechargeable NiCd batteries for the portable VCR aftermarket. Marketed under the Again & Again trademark, the batteries replace original-equipment batteries for Zenith-JVC, RCA-Hitachi, Panasonic, and Sony recoders.



NiCd batteries that can replace the original equipment batteries in a variety of VCRs *(SAFT America Inc)*

The RC-1209 is the 12V, 900-mAhr counterpart to the RCA NB009. Its performance and run time parallel that of the RCA-Hitachi battery. The RC-1215 is a 12V, 1.5-Ahr replacement for the unit used in RCA-Hitachi camcorders.

The RC-9614 is a 9.6V, 1400-mA replacement battery for JVC, Zenith, and Toshiba VHS C-format camcorders. The RC-6013 is a 6V, 1.3-Ahr replacement for the original batteries in Sony, Kyocera, and other comparable 8-mm camcorders. The 12V, 2-Ahr RC-1220 and the 12V, 1.2-Ahr RC-1212 are designed for use in Panasonic and JVC-Zenith equipment, respectively.

Model RC-9610 replaces the original-equipment battery for the JVC VHS-C record-only unit, and the RC-7210 fits neatly into the battery compartment of the Olympus 8-mm camcorder. The line also includes batteries that are designed to replace the original units in Sony 8-mm camcorders (the 6V, 1.5-Ahr RC-6015), RCA and Hitachi C-format VHS recorders (the RC-1217), and Sharp's VHS C-format recorders (the RC-9611). The suggested retail prices range from $49.95 to $69.95.

For more information . . .

For more information on the rechargeable batteries described in this article, contact the manufacturers directly, circle the appropriate numbers on the Information Retrieval Service card, or use EDN's Express Request service.

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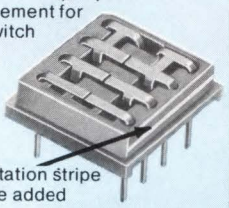

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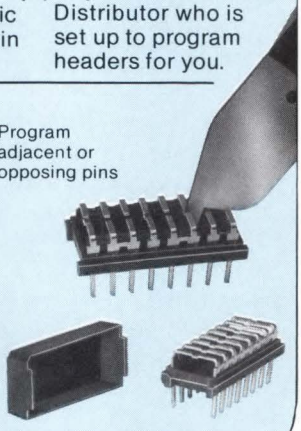

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CIRCLE NO 87

Nickel cadmium and lead-acid technologies have pretty much had the rechargeable battery market to themselves over the past few years. This state of affairs is about to change with the advent of lithium batteries.

Model 06A600 batteries from Moli Energy employ a lithium anode and a molybdenum sulfide cathode. Lithium is the lightest metallic element and the most electronegative metal—properties that make high-density batteries possible. Molybdenum sulfide is a stable solid that is formulated to have a high conductivity.

The cells operate on the intercalation principle. In this process, lithium atoms are inserted into the molybdenum sulfide without substantially changing that compound's molecular structure. During cell discharge, the metallic lithium anode generates ions that move through a liquid nonaqueous electrolyte and deposit themselves between the molecular layers of the molybdenum sulfide.

Model 06A600 cells are available in the standard AA size. They have a 1.3 to 2.2V output, a 220-mΩ nominal dc impedance, and a 600-mAhr (1-Whr) capacity. Their charge retention at 21°C is 90% after one year and is projected at 50% after eight years. The cell life, which is heavily dependent on the application and depth of the cell discharge, typically measures 400 cycles. The discharge and charge operating ranges are −30 to +55 and −10 to +45°C, respectively.

The cells are configured in a cylindrically wound format. This construction provides maximum electrode surface, thus maximizing the discharge-rate capability. The anode and the cathode are wound on a central pin and kept apart by a microporous polypropylene separator. Model 06A600 cells have a nickel-plated steel case and a glass-to-metal seal to accommodate the positive cell terminal. Laser-welding techniques provide a lifelong hermetic seal. A coined vent is provided on the bottom of the package to safely release any pressure that develops from extreme electrical or mechanical abuse. Battery prices range from $3 to $4 (10,000).

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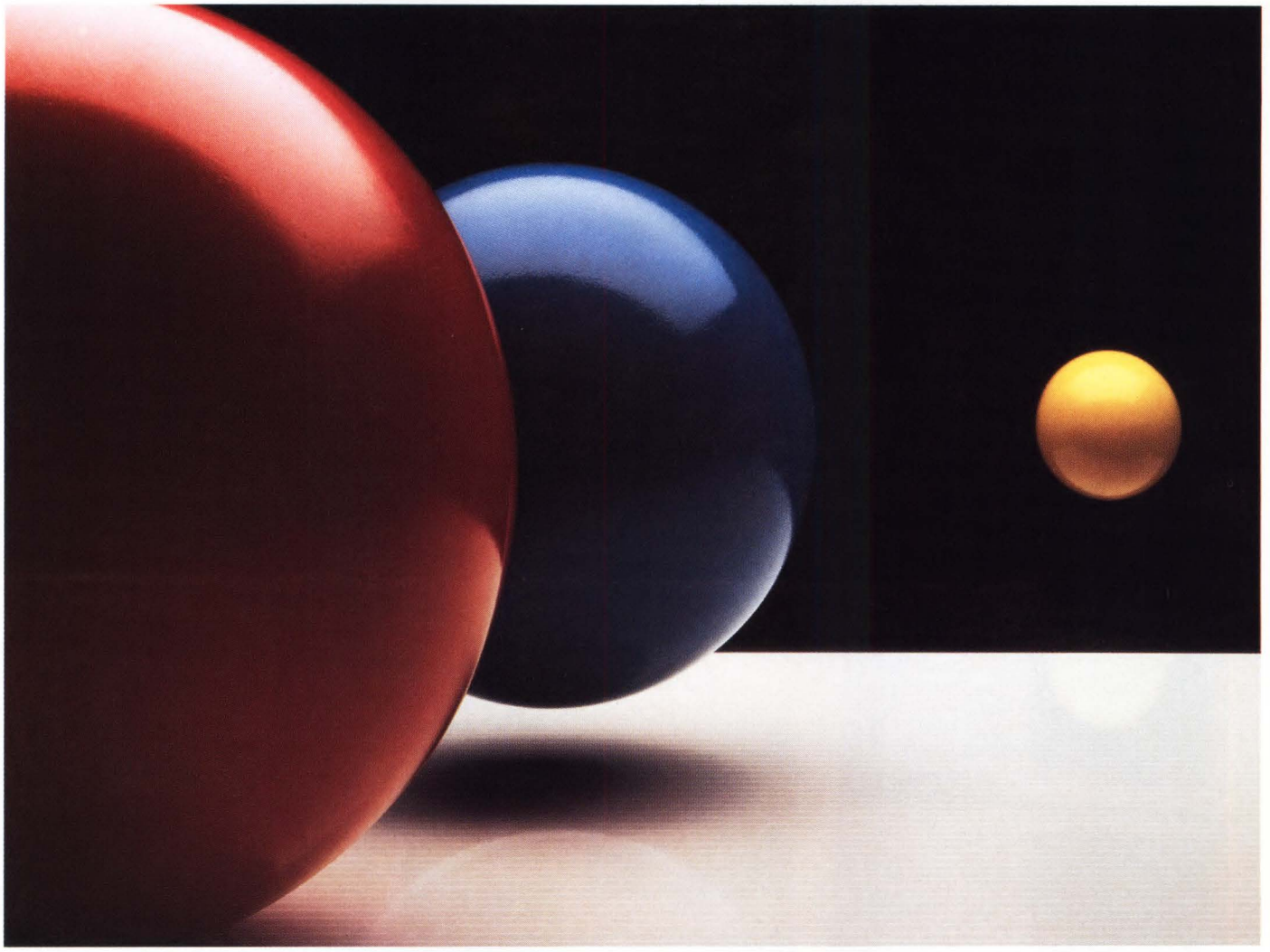

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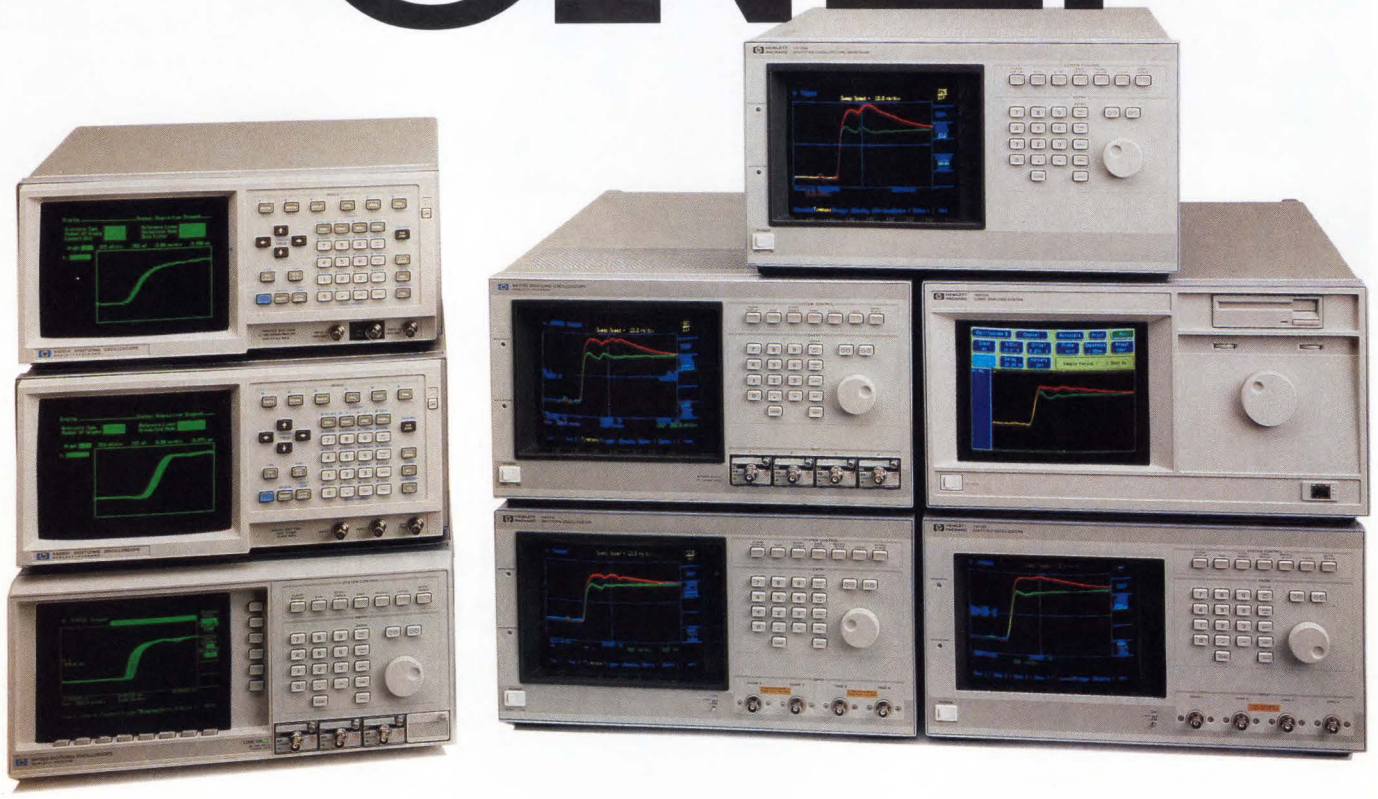

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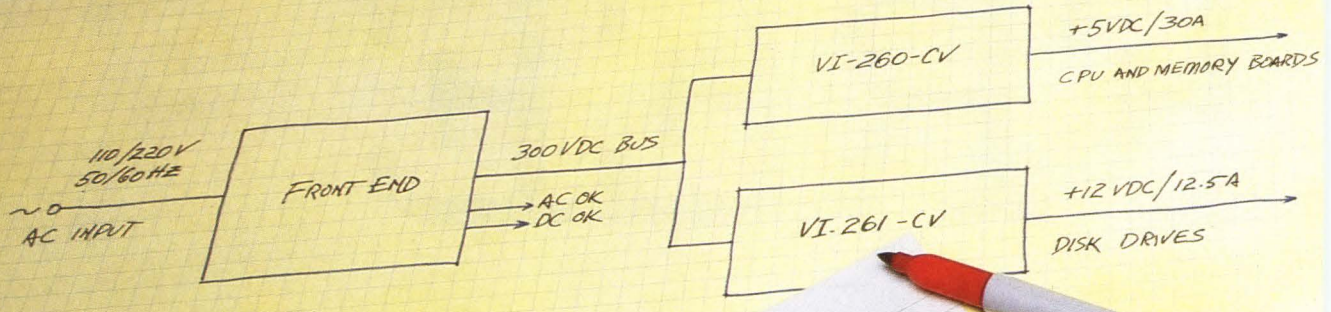
New Solutions From VICOR ...









MUST HAVE

- UL, CSA, TUV
- 82% EFFICIENCY
- HIGH RELIABILITY
- POWER OK
- SEQUENCING
- 50 MS HOLD-UP
- FCC-CLASS-B
- PROGRAMMABLE OUTPUTS



VIC

NEW OPTIONS REQUIRE 50 WATTS OF -12 VOLTS. CAN THE POWER SYSTEM BE EXPANDED?

DESIGN REVIEW TOMORROW 8:00AM



VI-200 Series
DC-DC Converters and Power Boosters™

Family Features:

- Up to 36 Watts/cubic inch
- 50, 75, 100, 150, 200 Watts
- UL, CSA, TUV
- 80-90% Efficiency
- Size: 2.4" x 4.6" x 0.5"
- Remote Sense
- Thermal Shutdown
- Current Limit and OVP
- Compatible Power Boosters
- MTBF >700,000 hours

Product Highlights:

The VI-200 Series is Vicor's second generation family of "zero-current-switching" component-level, DC-DC converters. Operating at frequencies up to 2 MHz, VI-200 Series converters redefine the state-of-the-art in terms of power density, efficiency, noise performance, reliability and ease-of-use. Family features include: enhanced output programmability, remote sense, wide input voltage ranges, current limiting, output OVP, logic

Driver Selection Chart

NOMINAL LINE (VDC)	STD/MIN LINE (VDC)	INPUT VOLTAGE LOW LINE (VDC)	HIGH LINE (VDC)	TRANSIENT VOLTAGE* (VDC)	OUTPUT VOLTAGE 5V	12V	24V	48V	OUTPUT POWER (W)
300	170	200	400	425	–	VI-261-CU VI-261-CW VI-261-CX VI-260-CX	VI-262-CU VI-262-CW VI-262-CX	VI-263-CU VI-263-CW VI-263-CX	VI-264-CU VI-264-CW VI-264-CX	200 150 100 75 50
300	170	200	400	425	–	VI-251-CU VI-251-CW VI-251-CX VI-250-CX	VI-252-CU VI-252-CW VI-252-CX	VI-253-CU VI-253-CW VI-253-CX	VI-254-CU VI-254-CW VI-254-CX	200 150 100 75 50
150	85	100	200	215	–	VI-251-CU VI-251-CW VI-251-CX VI-250-CX	VI-252-CU VI-252-CW VI-252-CX	VI-253-CU VI-253-CW VI-253-CX	VI-254-CU VI-254-CW VI-254-CX	200 150 100 75 50
150	85	100	200	215	–	VI-241-CU VI-241-CW VI-241-CX VI-240-CX	VI-242-CU VI-242-CW VI-242-CX	VI-243-CU VI-243-CW VI-243-CX	VI-244-CU VI-244-CW VI-244-CX	200 150 100 75 50
72	45	55	100	110	–	VI-241-CU VI-241-CW VI-241-CX VI-240-CX	VI-242-CU VI-242-CW VI-242-CX	VI-243-CU VI-243-CW VI-243-CX	VI-244-CU VI-244-CW VI-244-CX	200 150 100 75 50
72	45	55	100	110	–	VI-231-CU VI-231-CW VI-231-CX VI-230-CX	VI-232-CU VI-232-CW VI-232-CX	VI-233-CU VI-233-CW VI-233-CX	VI-234-CU VI-234-CW VI-234-CX	100 75 50
48	36	42	80	90	–	VI-231-CU VI-231-CW VI-231-CX VI-230-CX	VI-232-CU VI-232-CW VI-232-CX	VI-223-CU VI-223-CW VI-223-CX	VI-224-CU VI-224-CW VI-224-CX	150 100 75 50
48	36	42	80	90	–	VI-221-CU VI-221-CW VI-221-CX VI-220-CX	VI-222-CU VI-222-CW VI-222-CX	VI-223-CU VI-223-CW VI-223-CX	VI-224-CU VI-224-CW VI-224-CX	150 100 75 50
36	18	21	56	60	–	VI-211-CU VI-211-CW VI-211-CX VI-210-CX	VI-212-CU VI-212-CW VI-212-CX	VI-213-CU VI-213-CW VI-213-CX	VI-214-CU VI-214-CW VI-214-CX	75 50
36	18	21	32	36	–	VI-211-CU VI-211-CW VI-211-CX VI-210-CX	VI-212-CU VI-212-CW VI-212-CX	VI-213-CU VI-213-CW VI-213-CX	VI-214-CU VI-214-CW VI-214-CX	75 50
24	18	21	32	36	–	VI-201-CU VI-201-CW VI-201-CX VI-200-CX	VI-202-CU VI-202-CW VI-202-CX	VI-203-CU VI-203-CW VI-203-CX	VI-204-CU VI-204-CW VI-204-CX	75 50

Booster modules available as boosters. Change VI-2XX-XX to VI-BXX-XX.

Booster Selection Chart

OUTPUT VOLTAGE 5V	12V	24V	48V	OUTPUT POWER (W)
VI-B61-CU VI-B61-CW VI-B61-CX	VI-B62-CU VI-B62-CW VI-B62-CX	VI-B63-CU VI-B63-CW VI-B63-CX	VI-B64-CU VI-B64-CW VI-B64-CX	200 150 100
VI-B51-CU VI-B51-CW VI-B51-CX	VI-B52-CU VI-B52-CW VI-B52-CX	VI-B53-CU VI-B53-CW VI-B53-CX	VI-B54-CU VI-B54-CW VI-B54-CX	200 150 100
VI-B41-CU VI-B41-CW VI-B41-CX	VI-B42-CU VI-B42-CW VI-B42-CX	VI-B43-CU VI-B43-CW VI-B43-CX	VI-B44-CU VI-B44-CW VI-B44-CX	200 150 100
VI-B31-CU VI-B31-CW VI-B31-CX	VI-B32-CU VI-B32-CW VI-B32-CX	VI-B33-CU VI-B33-CW VI-B33-CX	VI-B34-CU VI-B34-CW VI-B34-CX	100 75 50
VI-B21-CU VI-B21-CW VI-B21-CX	VI-B22-CU VI-B22-CW VI-B22-CX	VI-B23-CU VI-B23-CW VI-B23-CX	VI-B24-CU VI-B24-CW VI-B24-CX	150 100 75 50
VI-B11-CU VI-B11-CW VI-B11-CX	VI-B12-CU VI-B12-CW VI-B12-CX	VI-B13-CU VI-B13-CW VI-B13-CX	VI-B14-CU VI-B14-CW VI-B14-CX	75 50

Converter/Booster Specifications (At T_{BP} = 25°C, nominal line, nominal load ±5%/±1, unless otherwise

PARAMETER	MIN	TYP	MAX	UNITS
INPUT CHARACTERISTICS				
I_{IR} Inr Rush Charge		60×10^{-6}	100×10^{-6}	I^2t
Input Reflected Ripple Current - pp		10%		dB
G_{IR}		$20+20\log\left(\frac{V_{IN}}{V_{OUT}}\right)$		
I_{RR} Input Ripple Rejection		$20+20\log\left(\frac{V_{IN}}{V_{OUT}}\right)$	2	mA
A_{IR}		1.3%	9	%/1%
Input Ripple Rejection		6		
A_{IR}		0.92		
No Load Power Dissipation			1%	
W_{NL} Input Current Logic Disable		0.5%	0.2%	
I_{LD} Long Term Drift		±.05%	±.02%	
$\Delta W/\Delta t$		±.05%	0.02	
OUTPUT CHARACTERISTICS		0.01	3%	
Set Point Accuracy		1%	0%	
ΔV_{OUT} Load Regulation			2%	
ΔV_L Line Regulation				
ΔV_T Output Temperature Drift	110%	1%	±35%	
$\Delta V/\Delta T$ Peak to Peak Output Ripple			±25%	
ΔV_R High Trim/Program*		125%	135%	
V_{HIGH} Low Trim/Program*	0.5			
V_{LOW} Programming Accuracy	115%			
ΔV_{PR} Total Remote Sense Compensation*	105%			
ΔV_{RS} OVP Set Point	20%			
V_{OVP} Current Limit*				
I_{LIM} Short Circuit Current*		10^{-2}		
I_{SHORT}		10^{-2}		
DYNAMIC CHARACTERISTICS		10^{-4}		
t_{PD} Turn On Time from Power On		10^{-4}		
t_{LE} Turn On Time from Logic Enable				
t_{LV} Line Transient Response			50	
t_{LT} Load Transient Response			100	
BOOSTER CHARACTERISTICS				
Z_{GO} Gate Out Impedance		1		
Z_{GI} Gate In Impedance				
V_{GIH} Gate In High Threshold	0.95			
V_{GIL} Gate In Low Threshold	0.95			
I_{GIL} Gate In Low Current				
I_A/I_T Current Sharing Accuracy				
V_A/V_T Voltage Sharing Accuracy				
ISOLATION CHARACTERISTICS				
Isolation Voltage (Input to Output)	3,750			
Isolation Voltage (Output to Baseplate)	500		50	
Isolation Voltage (Input to Baseplate)	2,500			
Isolation Resistance			95%	

OFF-LINE Modular Power From 50 to 600 Watts!

*From AC line in, to highly regulated DC out, **VICOR** now offers the **total design solution through a complete family of Off-Line Front End and DC/DC modular power components.***

The system configuration changes...The power budget changes...What do you do about the power supply? If you are designing with modular power components, configuring the most effective power system is as straight forward as changing the mix of components used. **Configurable Power**...the most efficient and cost effective means to maintain flexibility and minimize time to market.

Off-Line Front Ends

The Front Ends are available in output power ratings of 250, 500, and 750 Watts and are designed to deliver an unregulated 300 Volt DC bus to Vicor's VI-26X Series of DC/DC converter modules.

FRONT END SELECTION CHART

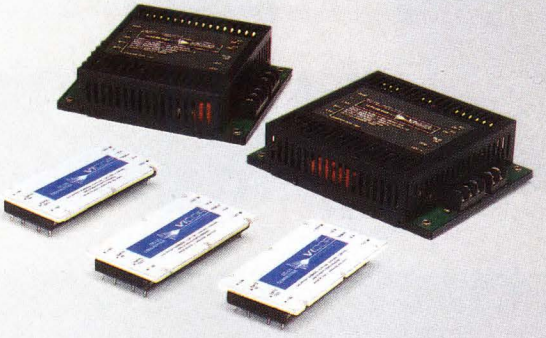
	PACKAGE		OUTPUT POWER		
MODEL	PC MOUNT	CHASSIS MOUNT	250W	500W	750W
VI-FPE6-CUX	✓		✓		
VI-FKE6-CUX		✓	✓		
VI-FPE6-CQX	✓			✓	
VI-FKE6-CQX		✓		✓	
VI-FPE6-CMX	✓				✓
VI-FKE6-CMX		✓			✓

OPERATING PARAMETERS (ALL MODELS)			
	INPUT VOLTAGE (VAC)		
NOM	LOW	HIGH	TRANSIENT (1 SEC)
110	90	135	150
220	180	270	300

Strappable to provide operation from 90 VAC to 270 VAC single phase lines, the Front Ends feature conducted EMI/RFI filtering to VDE/FCC A & B, 50 msec holdup, active in-rush limiting and a BUS-OK status output. An opto-isolated AC-OK output is provided for advance warning of DC BUS dropout due to AC line failure.

DC/DC Converters

The VI-26X Series is Vicor's family of 300 Volt input, "zero-current-switching," component-level, agency approved, DC/DC converters. These converters represent the state-of-the-art in terms of power density, efficiency, noise performance, reliability and ease-of-use. Available in 38 standard combinations of power rating and output voltage, the VI-26X Series modules in combination with the Front Ends, offer unprecedented flexibility in providing off-the-shelf solutions to virtually any off-line power requirements.

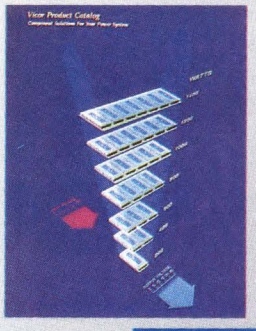


CONVERTER/BOOSTER SELECTION CHART

Shaded modules available as boosters. Change VI-2XX-XX to VI-BXX-XX.

OUTPUT VOLTAGE*					OUTPUT POWER
5V	12V	15V	24V	48V	(W)
—	VI-261-CU	VI-262-CU	VI-263-CU	VI-264-CU	200
VI-260-CV	VI-261-CV	VI-262-CV	VI-263-CV	VI-264-CV	150
VI-260-CW	VI-261-CW	VI-262-CW	VI-263-CW	VI-264-CW	100
VI-260-CX	VI-261-CX	VI-262-CX	VI-263-CX	VI-264-CX	75
VI-260-CY	VI-261-CY	VI-262-CY	VI-263-CY	VI-264-CY	50

*Other output voltages from 2 to 100 Volts are available as semi-custom modules. Consult factory or see page 30 of the Vicor Product Catalog.



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VICOR CORPORATION

Component Solutions For Your Power System

CIRCLE NO 91

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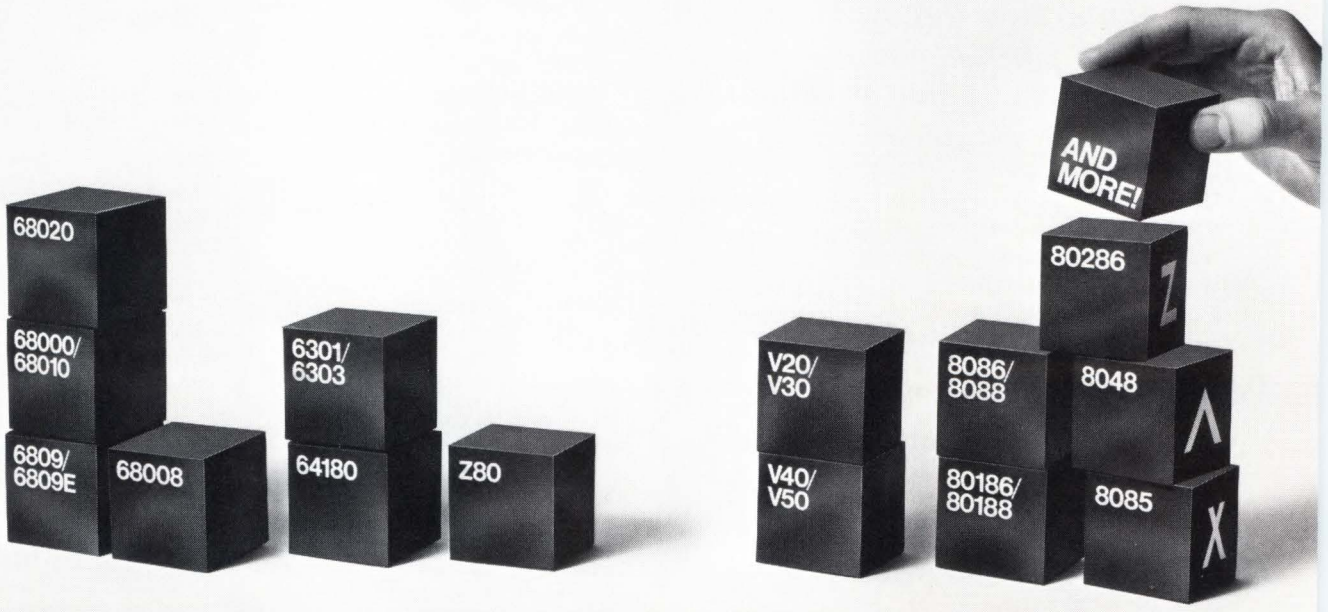

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Our ERX-series emulators provide over *80 debugging commands, with 256,000 hardware breakpoints, real-time performance analysis, high-level language debug and trace analysis* of program execution while you emulate in real-time. And they interface directly to your personal computer (AT-class) to provide you with a complete host development station and emulation manager. This consolidated approach utilizes industry-standard equipment and eliminates the use of a proprietary dedicated chassis.

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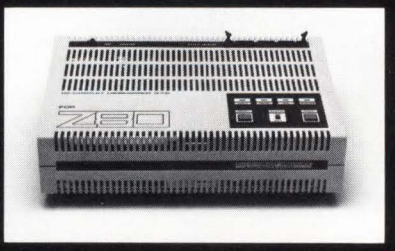




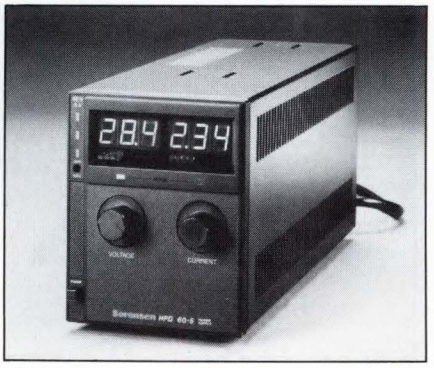
ZAX

Zax Corporation

CIRCLE NO 92

Programmable power supply uses switching technology to achieve high power densities

These 300W HPD Series programmable power supplies use switching technology to achieve power densities of 1W/in.^{3} and typical efficiencies of 80%. The product line includes three models: 0 to 15V at 20A, 0 to 30V at 10A, and 0 to 60V at 5A versions. The units require standard 115V ac, 60-Hz single-phase inputs. The units all meet FCC Part 15 subpart J Class A specs for reduced EMI.



The supplies' internal architecture uses a linear post regulator that provides an output ripple of 1 to 3 mV rms. The line- and load-regulation specs are 0.02% + 4 mV, and the typical transient response for a ±50% load change is 500 μsec. The operating temperature range is 0 to 30°C.

Each unit is housed in a ¼-rack-size enclosure, which measures 5.2 × 4.3 × 11.7 in. You can use the supplies as stand-alone bench equipment or combine four of them in an optional 19-in. rack adapter. A standard unit includes a 10-turn voltage adjust, a single-turn current adjust, and constant-voltage and -current indicators. Twin LED bar graphs display voltage and current levels proportional to the maximum supply output.

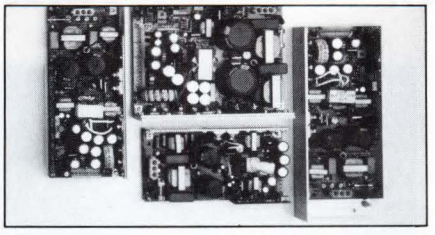
After the units warm up for 60 minutes, the supply output is either within ±0.02% for the constant-voltage mode or 0.03% for the constant-current mode. Overload short-circuit protection is standard. Overvoltage protection is available in each of two internally mounted option cards. The M5 option also provides remote programming, remote on/off, and a 25-pin rear-panel subminiature D connector. The M9 option offers an IEEE-488 interface. The supplies cost $1195 each. The M5 option card is $150, and the M9 card is $450.

Sorenson Co, 5555 N Elston Ave, Chicago, IL 60630. Phone (312) 775-0843. TWX 910-221-5199.

Circle No 388

Compact power supply fits 130W into less than 40 in.^{3}

The RF-130/4 switching power supply packs a lot of power into a small space: as much as 130W into less than 40 in^3. You can configure the 6.1 × 3.95 × 1.6-in. supply to operate from 95 to 132 or 190 to 264V ac from 47 to 440 Hz. At the nominal 110/220V, the unit can supply 130W of power continuously and can generate as much as 150W for short periods.



Four dc outputs are provided: 5V at 12A, 12V at 8A, −12V at 1A, and −5V at 1A. All of the positive outputs have 1% line and load regulation; for the negative outputs, that spec is 3%.

By using a series-resonant switching configuration operating at 250 kHz, the supply exhibits low EMI (it meets FCC and VDE class B EMI levels for conducted noise without external filtering) and has a calculated MTBF of 80,000 hours. The unit returns to within 1% of final value in 500 μsec following a 25% load step.

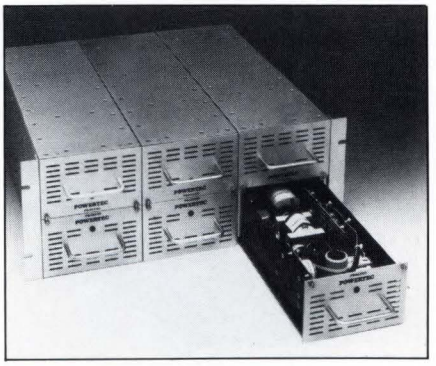
The output voltages have a maximum of 100 mV p-p noise in the 50-Hz to 20-MHz range; below 1 MHz, the noise is only 50 mV p-p. At 40°C, the unit is rated to supply 80W with free-air cooling, and it will supply the full 130W with forced-air cooling. The unit is specified for storage over −25 to +75°C. You can obtain the full rated power output at an ambient temperature of 40°C if you provide forced-air cooling of at least 200 linear feet per minute. In free-air conditions at 40°C, you should derate the power output to 80W. The supply costs $140 (250).

Resonant Power Technology Inc, 3350 Scott Blvd, Building 60/01, Santa Clara, CA 95051. Phone (408) 982-0200.

Circle No 387

Modular 1500W power system suits fault-tolerant designs

By using the 29D Series modular power supplies with the company's Powersystem enclosures, you can implement 2-, 4-, or 6-supply fault-tolerant subsystems. You simply connect one more supply than you need; six 300W supplies connected in parallel will still supply 1500W if one fails. When used in parallel, the supplies feature automatic load sharing. Output current proportionality is within ±10% of each output's current rating.



The individual supplies' power ratings range from 225 to 300W, and each supply provides five isolated floating outputs with voltages ranging from 5 to 24V dc. The first output supplies 5V and 30 or 40A. Outputs 2 through 5 offer combinations of 5, 12, 15, and 24V.

Four of the five outputs have paralleling capability: Output 1 can be paralleled with an output from another supply, and outputs 2 through 4 can also be paralleled with outputs from the same supply as long as the outputs have equal voltages and polarities.

The supplies meet all domestic and international safety standards. The company offers isolation diodes for failed supplies, and the enclosures allow for "hot plug-in"—you can replace a supply without taking the system off line. They require 110 or 220V ac input power, which is field selectable. Line and load regulation is ±0.2% on all outputs with the exception of the fifth output, which features a ±5% load regulation. A step-load change or a 25% shift in rated maximum load causes an output change of less than 3%. The output recovers to within 1% in less than 400 μsec.

The enclosures are 7 in. high and 17.5 in. deep. The 2-, 4-, and 6-supply units are 5.7, 11.3, and 19 in. wide, respectively. A supply with isolation diodes and outputs of 5V/30A, 12V/3.75A, 12V/2.25A, and 24V/3A costs $508 (25). The enclosures range from $158 (25) for a 2-supply unit to $484 (25) for a 6-supply unit.

Bonar Powertec, 20550 Nordhoff St, Chatsworth, CA 91311. Phone (818) 882-0004. TLX 277483.

Circle No 386

Bipolar operational power supply provides more than a dozen functions

The BOS/S can function as a dc power supply, an electronic load, a voltage source, a power pulse generator, a current source, a power function generator, and a direct-coupled amplifier. It also performs the functions of a variable gain amplifier, a fast-slewing power supply, a dc amplifier, an ac power supply, a differential amplifier, and a signal-inverting amplifier. The current or voltage output is controlled via a front-panel mode switch.

Control can be internal or external. A 10-turn potentiometer controls the output over a minimum to maximum range. You can also control the output with an external ±10V source. An optional digital control board allows you to program most of the unit's functions via the IEEE-488 bus or an RS-232C data-transfer bus.



The talk and listen functions have 12-bit resolution. The voltage and current regulation are 0.005%, and the TC is 0.01%/°C in the voltage mode and 0.03%/°C in the current mode. The rms ripple equals 3 mV in the voltage mode and 0.05% in the current mode. Voltage- and current-output changes over eight hours are 0.02 and 0.03%, respectively. Standard features include adjustable output limiting, indications of mode and remote operation, and analog or digital voltage and current meters. $1095 to $1995. Delivery, stock to eight weeks ARO.

Electronic Measurements Inc, 405 Essex Rd, Neptune, NJ 07753. Phone (201) 922-9300.

Circle No 385



Generations from now, when today's state-of-the-art fighting systems have taken their place in armament history books, today's Abbott power supplies will still be operating reliably.

GENERAL DYNAMICS LAND SYSTEMS

Outfitted for Enhanced Reliability, for example, our new 60 Watt triple-output switching DC-DC converter achieves an MTBF rating up to 600,000 hours; more than 68 years. A single-output model is rated even longer.*

Yet this compact package is fully self contained. It meets the tough EMI limits of MIL-STD-461C. And the punishing environmental specs of MIL-STD-810C and MIL-S-901C.

While the BC60 is brand new, this is no "developmental" power supply. Its topology is identical to our field proven BC100 and BC200 models. Its design integrity is verified through rigorous ESS testing.

We're delivering power supplies for projects critical to America's defense, including MILSTAR, the EH101 helicopter, the TOW missile, INEWS and the F/A-18 Hornet.

For a copy of our 1988 Military Power Supply Product Guide, write us at 2721 S. La Cienega Boulevard, Los Angeles, CA 90034. (800) 556-1234 XT9; CA (800) 441-2345 XT9.

*MTBF FIGURES CALCULATED PER MIL-HDBK-217E GROUND.

Our power supply is built to outlast the tank.



Versatile new 60 Watt switcher measures 5 x 4 x 1.5 inches. Provides outputs of 5, 12, 15, 24 or 28 V dc, from inputs of 18 to 36 V dc. Operating temperature from −55°C to +100°C. Overvoltage protection & short circuit protection standard.

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CIRCLE NO 94

Supplies feature calculated MTBF of >300,000 hours

PLB Series power supplies are available in single-, dual-, and triple-output versions, with total output power ratings of between 60 and 100W. They are also supplied as either open-frame or enclosed units. The power supplies conform to UL-1012/478, VDE 0805/06, and CSA 22.2 electrical safety requirements and VDE 0871 and FCC RFI emission regulations. All the supplies feature a calculated MTBF of greater than 300,000 hours at 35°C.

You can switch the power supplies so that they operate from 115 or 230V ac line supplies. With normal convection cooling, they are rated for full power operation at ambient temperatures as high as 55°C. But you can also operate them at ambient temperatures as high as 70°C if you linearly derate the output power to 50% at 70°C. The outputs have a hold-up time of 30 msec at full load, and the supplies have an isolated power-fail warning output. The outputs are protected against continuous overload, short-circuit, and overvoltage conditions. The 5V/20A version of the supply includes remote sensing that can compensate for voltage drops as great as 0.5V in connecting leads. To provide greater output power or power-supply redundancy, you can parallel as many as four units together and still meet the leakage current requirements of the relevant safety standards.

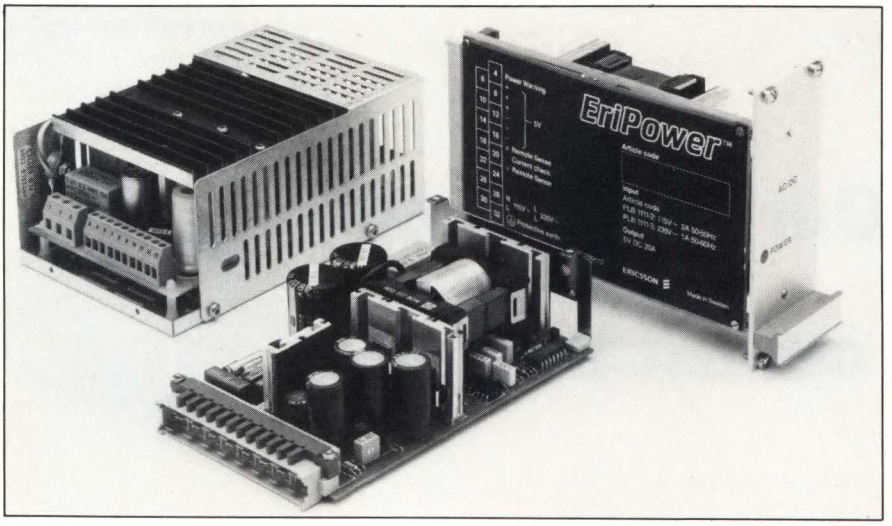
Versions are available that mount into standard 19-in. Eurocard-rack-mounting systems. A 60W triple-output version and a 100W single-output power supply have front-panel widths of 10TE (2 in.) A triple-output 60W version costs $108 (100).

Ericsson Components AB, Power Products Div, 16481 Kista-Stockholm, Sweden. Phone (08) 757-5000. TLX 10948. FAX 08-757-4884.

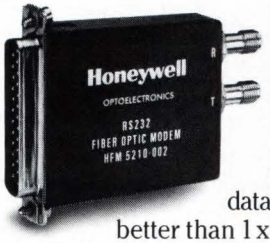
Circle No 389

Ericsson Components Inc, Box 853904, Richardson, TX 75085. Phone (214) 480-8300. TLX 735389. FAX 214-680-1059.

Circle No 390



When you need a high quality Fiber Optic data link, the choice is clear. HFM5132 and HFM5210.



Perfectly clear to be exact. That's because our HFM5132 and HFM5210 modems are designed to be virtually distortion free. And both provide EMI/RFI protection, data security and bit error rates better than 1×10^{-9} As well as eliminating ground loop and lightning problems.

Powered with a HFA7002-004 power cube or through pin #9, the HFM5132 fiber optic modem is designed to interconnect with standard RS232 connectors. The HFM5132 has a 20dB optical budget into a 100/140 micron fiber optic cable. Thus, allowing transmission of data over 4 kilometers (2.5 miles).

Allowing full duplex data communications, the HFM5132 can be ordered for either synchronous or asynchronous operation. In the synchronous version, the user can send full duplex data and clock at rates from DC to 9.6 Kbps with two full duplex control signals from DC to 1.2 Kbps. The asynchronous version allows full duplex data to be sent from DC to 19.2 Kbps and two full duplex control signals from DC to 1.2 Kbps. An additional control line (pin #24 to pin #17) can be used from DC to 2.4 Kbps.

The HFM5210 has a 17dB optical budget into a 100/140 micron fiber optic cable that extends link length to 3,400 meters (2 miles). Designed to interface with standard RS232 drivers and receivers, the HFM5210 also plugs directly into 25 pin connectors. However, it has several unique features. Among these, the fiber optic transmitter and receiver in the modem obtain their power from the RS232 interface drivers of the host equipment. Therefore, the link directly replaces a wire cable without any additional power source (wall plugs or host power supply) requirements.

Once you've examined all the facts about the HFM5132 and HFM5210, you'll find the message comes through loud and clear. Honeywell is the obvious choice. And we're *the one choice for all your fiber optic needs*. That's because Honeywell Optoelectronics is one of the world's leading designers and manufacturers of fiber optic data communication components. With our proven track record and the experience of the over 100 year old, multinational Honeywell corporation you can rest assured we'll be there when you need us. Now. And in the future.

For additional information and data sheets of these products contact Honeywell Optoelectronics, 830 E. Arapaho Road, Richardson, Texas 75081. Or call **1-800-367-6786**. In Texas call 214-470-4271.



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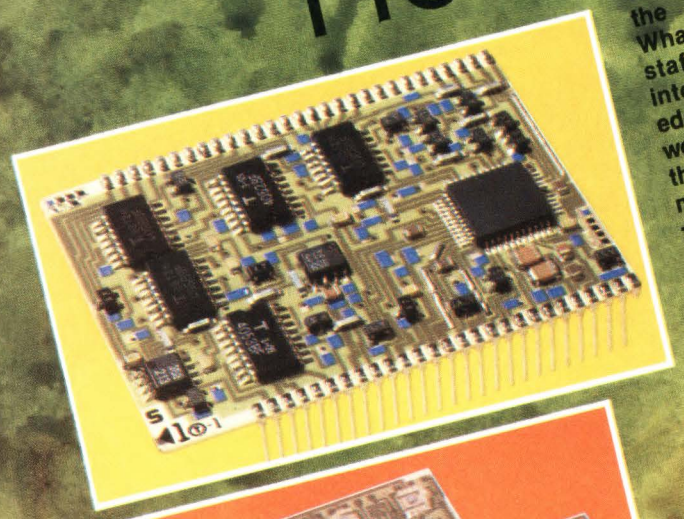

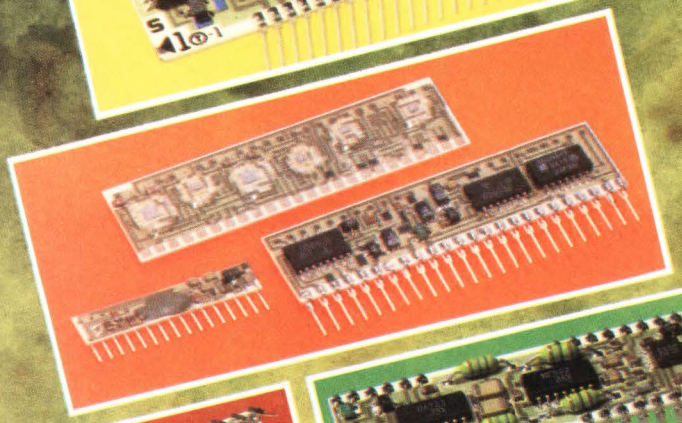



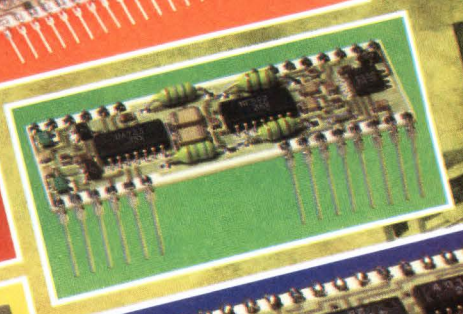

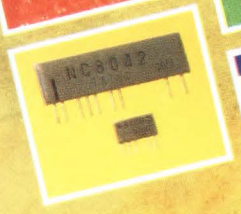

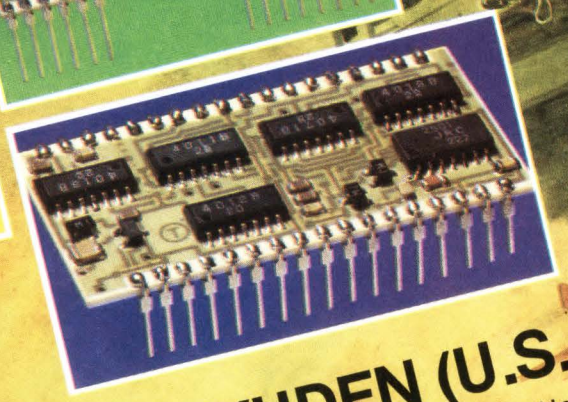

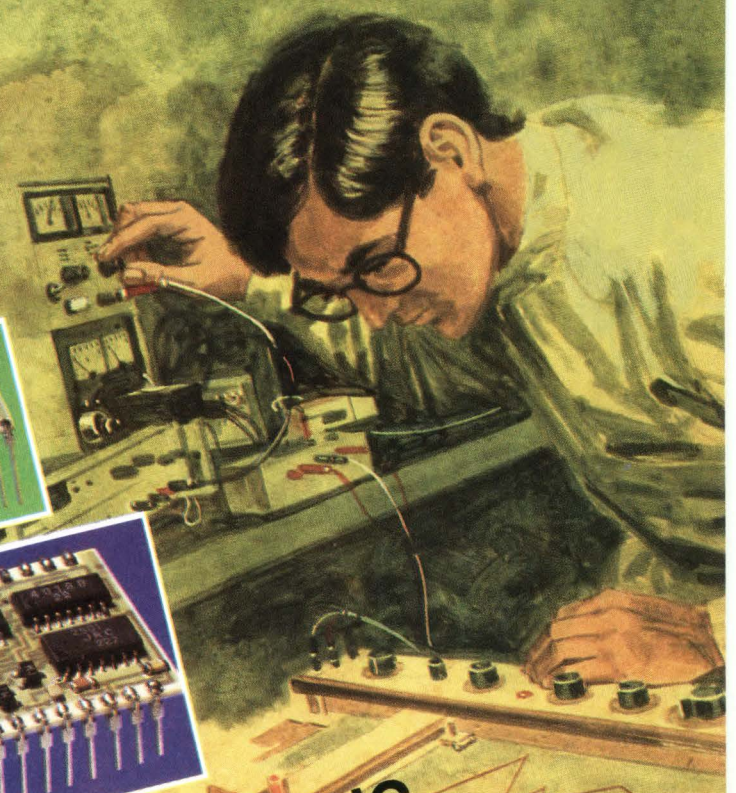

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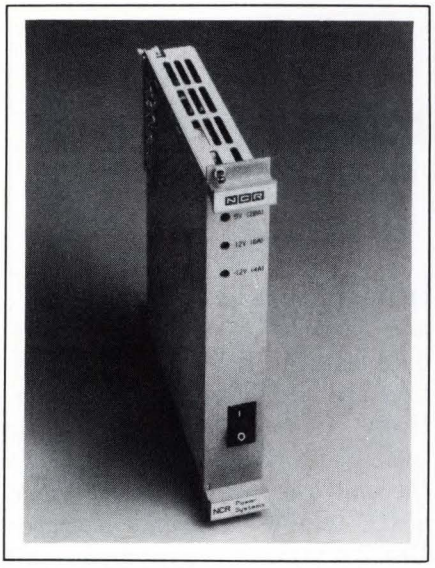
Power Sources



VME POWER SUPPLY

Designed especially for VME applications, this switching power supply features three outputs and delivers up to 200W of power; it supplies 5V at 20A, 12V at 6A, and -12V at 4A. You can remotely enable and disable the outputs by a 2.4V dc signal and an open collector signal, respectively.

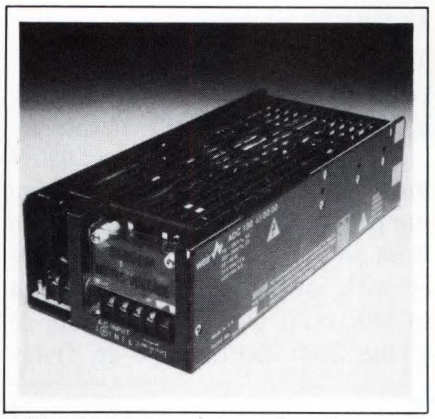
The supply meets UL, CSA, and VDE standards for safety and EMI, and it complies with DIN-41494 Eurocard packaging requirements. The calculated MTBF is 50,000 hours. The power supply interfaces with the VME Bus via a direct plug-in connection. The unit is configured in a $1.588 \times 10.3 \times 6.4$-in. package and weighs 3 lbs. $277 (1000).

NCR Power Systems, 3200 Lake Emma Rd, Lake Mary, FL 32746. Phone (800) 327-7612; in FL, (407) 323-9250.

Circle No 707

SWITCHING SUPPLY

The ADC 150 switching power supply provides 150W of power through five outputs and accepts input drive from either the ac power mains or a low-voltage battery source. Alternative versions are available for use with either 48 or 24V batteries. The unit has four regulated outputs, which have voltages of 5V at 20A, −12, −5, and

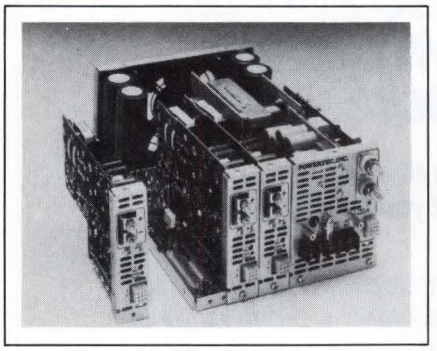


24V; the one semiregulated output delivers −12V. All outputs are current limited, and overvoltage protection is provided for the 5V output.

When the supply is operated from ac input power, the built-in trickle charger ensures that the standby battery remains fully charged. The unit automatically draws power from the battery during blackout and brownout conditions. Depending on your battery's capacity and the load conditions, power will continue from two minutes to several hours. However, the holdup time will be longer for a brownout than for a blackout. The supplies comply with all international safety standards. $500.

Weir Electronics Inc, 418 Third St, Annapolis, MD 21403. Phone (301) 268-0122. FAX 301-268-7909.

Circle No 708



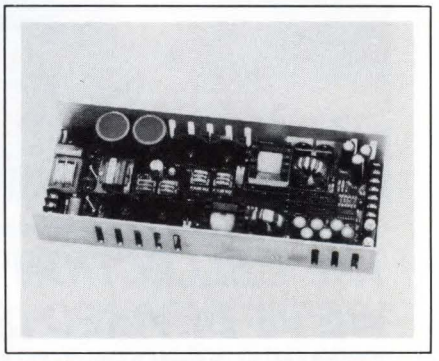
POWER SUPPLIES

Capable of accepting up to three auxiliary modules with 2 to 48V outputs, the 6A, 6B, and 6C power supplies allow you to configure a power supply suited to your requirements. The $5 \times 8 \times 11$-in. mainframe enclosure provides power to the plug-in auxiliary units and contains the main output supply. The main outputs range from 2 to 24V dc. The 5V main output can have current ratings from 90 to 150A. You can choose a composite power rating of 600W (6A series), 800W (6B series) or 1000W (6C series).

You can parallel outputs that have identical voltages, regardless of current ratings. When connected, the outputs automatically share current in proportion to their current ratings. The supplies' features include overvoltage protection, remote sense, automatic thermal shutdown, soft start, an EMI filter, and reverse-voltage protection. From $939 to $1079. Delivery, stock to eight weeks ARO.

Powertec, 20550 Nordhoff St, Chatsworth, CA 91311. Phone (818) 882-0004. TLX 277483. FAX 818-998-4225.

Circle No 709



SWITCHING SUPPLY

The ME 404 switching power supply delivers 400W with dual outputs and supplies 5V at 40A and 12V at 17A. You can select an input range of 90 to 132V ac or 180 to 264V ac; input frequency is between 47 and 63 Hz. The $2.5 \times 5 \times 13$-in. supply's switching frequency is 100kHz, and its efficiency is >75%. You can adjust the outputs from 5 to 20% of their rated voltage. The unit can also survive a 50% overload for 30 sec.

Each unit includes overvoltage,

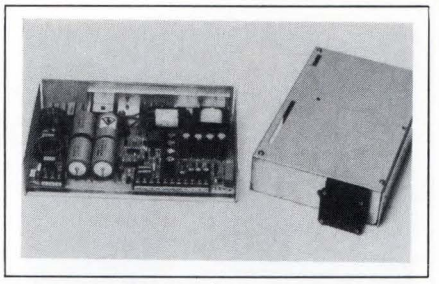
overcurrent, reverse-voltage, and thermal protection. Both line and load regulation are 0.2%. The units operate at temperatures as high as 55°C and meet UL, CSA and TUV safety regulations. $390.

MicroEnergy Inc, 350 Randy Rd, Carol Stream, IL 60188. Phone (312) 653-5900 FAX 312-653-0075.

Circle No 710

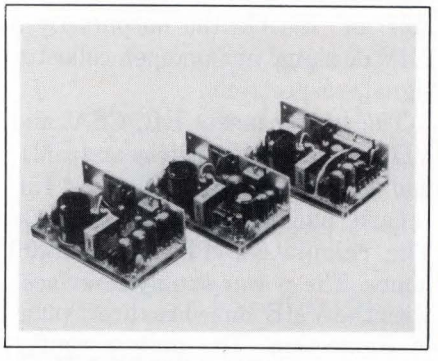
POWER SUPPLY

The F550/48 provides 550W of continuous power at a typical efficiency of 82%. The single 48V output allows power peaks as high as 600W for 10 sec. The supply operates from jumper-selectable ac input ranges from 95 to 132V ac or 180 to 254V ac with input frequencies from 44 to 440 Hz. It also operates from dc inputs from 250 to 370V dc. Overcurrent protection, overvoltage, and thermal protection are standard features. Line and load regulation are ±0.5 and ±2%, respectively. If you provide forced air cooling of >3 ft/sec, you can operate the unit over a temperature range of 0°C to 70°C. The unit measures 13×7.5×2.5 in. and meets all safety regulations.



Powerline Inc, 10 Cochituate St, Natick, MA 01760. Phone (617) 655-7987. TWX 510-100-3630.

Circle No 711



AC/DC SUPPLIES

The UA Series 15 and 18W supplies accept universal ac inputs of 85 to 264V ac at frequencies of 47 to 440 Hz without the need for modification, external switching, or strapping. They can also operate from 110 to 370V dc inputs. Single-, dual-, and triple-output models are available with output choices of 5, 12, 15 and 24V in the single units; 5, 12 and 15V in the dual units; and 5, ±12, ±15, ±5V in the triple units.

The switching frequency is 80 kHz, and efficiency is 75% typ. Line and load regulation are 0.5 and 1%, respectively. The units include FCC class 'A' input filters and have overvoltage and short-circuit pro-

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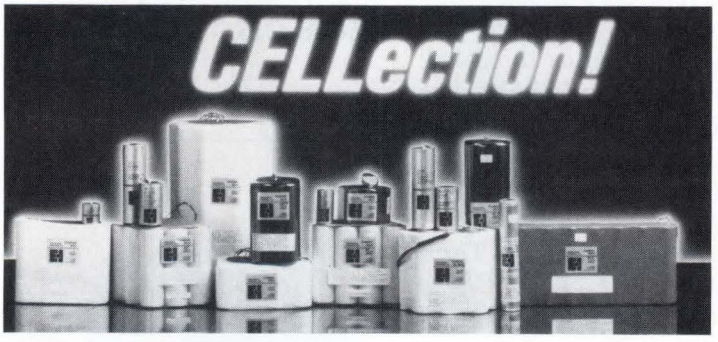

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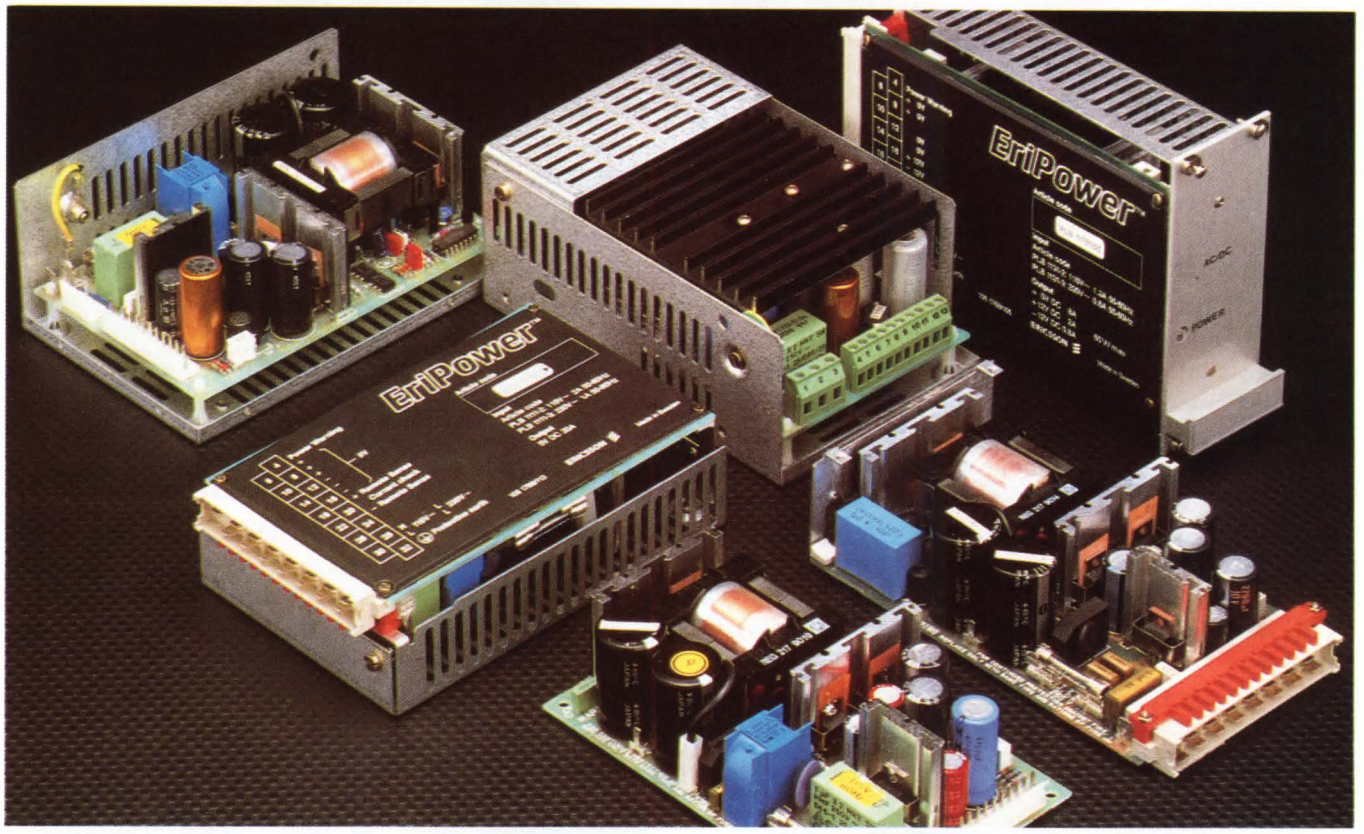
CIRCLE NO 97

These six power supplies are all the same



They're all reliable, with an MTBF of over 300,000 hours. They're all very compact and between 78% and 85% efficient. And, they all meet internationally recognized standards including VDE, IEC, UL, CSA, BS and FCC with respect to safety and RFI.

The differences you see are purely in mechanical construction. The options mean there's a PLB series AC/DC power supply to suit almost every application, whether you need rack or chassis mounting.

These new 60 to 100 Watt SMPS use highly developed flyback technology to minimize component count and maximize efficiency. As a result, they're up to 50% smaller than comparable power supplies.

You can choose from single, dual or triple output versions and all units are user selectable 115/230 VAC. The output voltages, in combinations of ±5, ±12, ±15, 24 or 48 VDC, can be adjusted by ±5% with a potentiometer on the PCB. Standard features include comprehensive protection circuitry, together with a power warning signal.

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In short, the PLB is smaller, more efficient, more reliable and more flexible than other power supplies in its class. But then, you would never expect anything less from Ericsson, would you?

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Fax: (214) 680-1059

Ericsson Components AB
Power Products, S-164 81 Stockholm, Sweden
Tel: +46 8 757 4011
Telex: 10948 POWERI S
Fax: +46 8 757 4884

ERICSSON

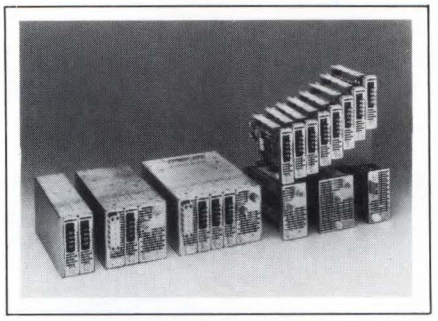
tection. The operating temperature range is −20 to 50°C; however, you can operate the units at 60°C if they supply 50% of their rated power. The supplies comply with UL standard 1012. $45 (OEM qty).

International Power Sources Inc, 10 Cochituate St, Natick, MA 01760. Phone (617) 651-1818. TWX 510-100-3630.

Circle No 712

POWER SUPPLIES

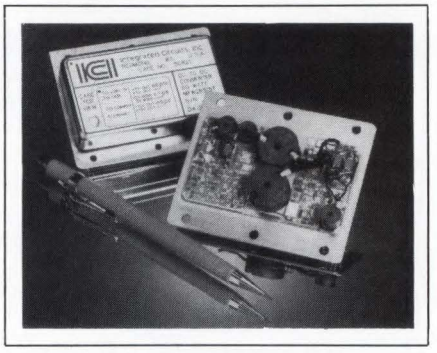
SPM2, SPM3, and SPM5 are high-power, modular switching power supplies that deliver as much as 500, 1000 and 1500W, respectively. You can configure more than 28 types of modules with single, dual and triple outputs into these three power chassis. Additionally, you can obtain up to 1000W of automatic battery backup by including the G5 UPS module in your power-supply system.



The SMP2 accommodates two modules in a 5×2½×11-in. package and delivers 500W of power; one module delivers 5V at 60A, and another delivers 5V at 10A and ±12V at 10A. The 5×5¼×11-in. SMP3 package delivers 1000W and accommodates three power modules, which deliver 5V at 150A, ±12V at 10A, and 24V at 10A. The 5×8×11-in. SMP5 package accommodates five modules and can be similarly configured to deliver 1500W max. The models and assemblies are approved by UL, CSA and TUV/VDE. All models come fully configured. SPM2, $420; SPM3, $616; SPM5, $924.

Power-One DC Power Supplies, 740 Calle Plano, Camarillo, CA 93010. Phone (805) 987-8741. TWX 910-336-1297.

Circle No 713



DC/DC CONVERTERS

The MFW Series converters offer as much as 70W of power from single, dual, or triple outputs. All models operate over an input-voltage range of 19 to 40V dc (28V dc nomi-

Text continued on pg 238

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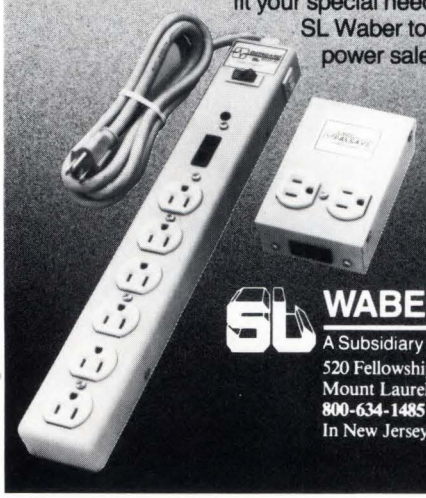

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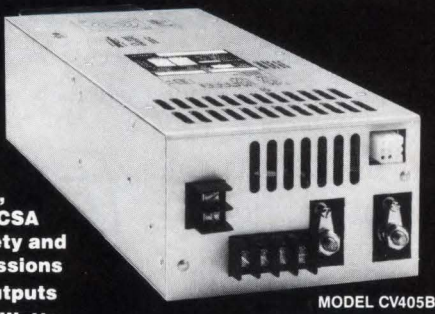

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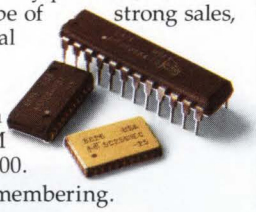

For additional information on how you can break the SRAM speed barrier, call 208-386-3900.

Micron, it's a name worth remembering.

Part #	Organization	Speed*	Packages
MT5C2561	256K X 1	**25ns**	PDIP, CDIP, SOJ, LCC
MT5C2564	64K X 4	**25ns**	PDIP, CDIP, SOJ, LCC
MT5C2565	64K X 4 $\overline{OE}$	**25ns**	PDIP, CDIP, SOJ, LCC
MT5C2568	32K X 8	**25ns**	PDIP, CDIP, SOJ, LCC
MT5C6401	64K X 1	**15ns**	PDIP, CDIP, SOJ
MT5C6404	16K X 4	**15ns**	PDIP, CDIP, SOJ
MT5C6405	16K X 4 $\overline{OE}$	**15ns**	PDIP, CDIP, SOJ
MT5C6406/7	16K X 4 S. I/O	**15ns**	PDIP, CDIP, SOJ
MT5C6408	8K X 8	**15ns**	PDIP, CDIP, SOJ, LCC
MT5C1601	16K X 1	**15ns**	PDIP, CDIP, SOJ
MT5C1604	4K X 4	**15ns**	PDIP, CDIP, SOJ
MT5C1605	4K X 4 $\overline{OE}$	**15ns**	PDIP, CDIP, SOJ
MT5C1606/7	4K X 4 S. I/O	**15ns**	PDIP, CDIP, SOJ
MT5C1608	2K X 8	**15ns**	PDIP, CDIP, SOJ

*Slower speeds also available.

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we never stop asking "What if..."

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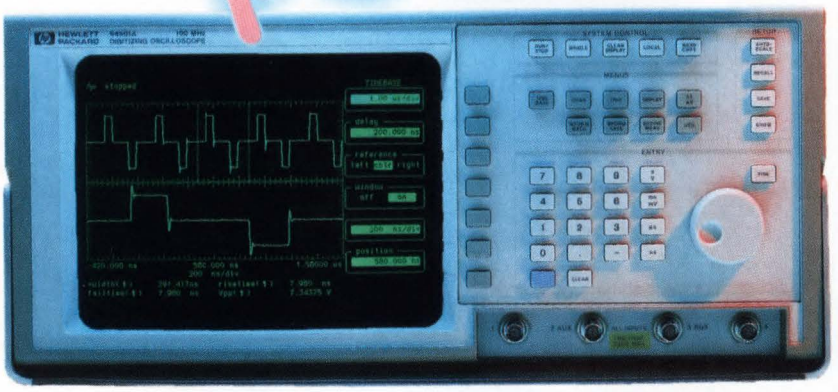

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The combination of low price, high performance and a full set of features makes the HP 54501A the best scope available, even when compared feature-for-feature to competitive scopes costing up to twice as much.

An intuitive operating interface makes the HP 54501A extremely easy to work with. And it's packed with features that make set-ups and measurements a snap—including HP Auto Scale, dual timebase windowing and four separate set-up memories.

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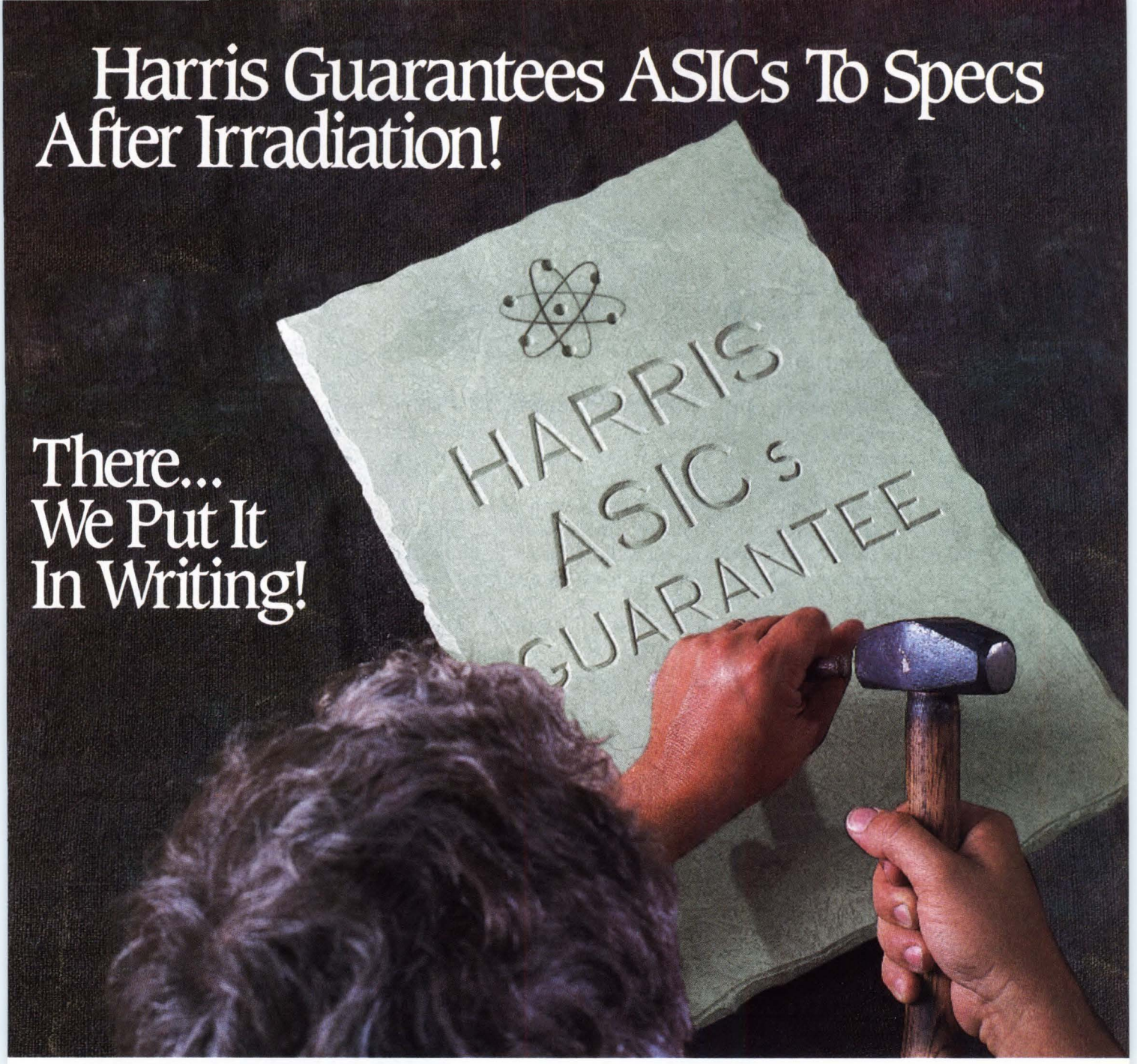



We're hard-liners about reliability in rad-hard ASICs. Including MIL-STD 883C and to Class S.

Hey...it happens to the best of 'em... your rad-hard ASIC design's first pass requires first aid!

For better results, avoid rigid design systems that lock you into the wrong solution and keep you there. Come to Harris; nobody offers you more front-end flexibility.

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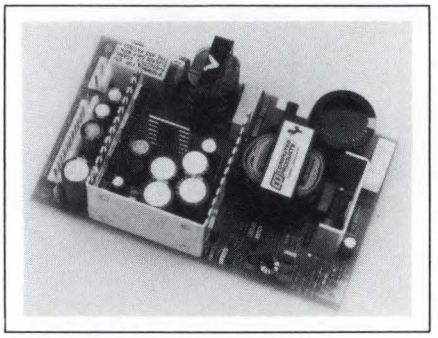
nal) and provide outputs of 3.5, 5, ±12, and ±15V. The converters provide full load operation at case temperatures of −55 to +85°C. The MFW Series features a dual-mode inhibit/synch pin, which serves as both an output inhibit and a synchronization input. Output ripple is maintained at <50 mV p-p for single- and dual-output models, and 85 mV for triple-output models.

The converters feature full I/O isolation, internal filtering, and short-circuit protection. They come in hermetically sealed, metal packages that measure 1.77×3.08×0.55 in., excluding flanges. Environmental screening to MIL-STD-883 is available as an option. $695 to $795 (100). Delivery, stock to 12 weeks.

Integrated Circuits Inc, Box 97005, Redmond, WA 98073. Phone (206) 882-3100. TWX 910-443-2302.

Circle No 714



UNIVERSAL SUPPLIES

The NFS110 Series single- and quad-output switching power supplies accept any input voltage from 85 to 264V ac without the need for jumper wires or a switch. They are designed for small to medium-sized, digitally based systems and have no minimum load requirement. The open-frame supplies measure 7×4.25×1.8 in. and produce 110W of output power. Single-voltage outputs of 5, 12, 15, and 24V are available; the outputs of the quad supplies are available in combinations of ±5, ±12, ±15, and 24V.

The supplies' typical efficiency is 70%, and line regulation is ±0.1% max; total regulation is typically better than ±3%. The calculated MTBF is 125,000 hours based on MIL-HDBK 217E. The units have built-in line filters in order to meet FCC and VDE Limit B line-conducted noise specifications. The series is UL, CSA, and VDE approved. $141; $116 (500).

Computer Products Inc, 2900 Gateway Dr, Pompano Beach, FL 33069. Phone (305) 974-5500. TWX 510-956-3098.

Circle No 715

POWER SUPPLIES

The PS310, PS325, and PS350 are 25W power supplies that provide 1.25-, 2.5-, and 5-kV outputs, respectively. Voltage regulation is 0.001% for ±10% line-voltage changes, and ripple is <0.002% of

DC-DC CONVERTERS

New Options *Expanded Product Line* *Advanced Technology* *Low Profile*

KZ SERIES 25/40/100 WATTS 6 Sided-Shielding	**Single and Triple Outputs:** 5, 12, 15, 24, ±12, ±15 Vdc **Inputs:** 20-60 or 36-72 Vdc
DCW SERIES 15/20/22 WATTS High Isolation	**Single Outputs:** 5, 12, 15 Vdc **Inputs:** 12, 24, 48 Vdc
DCW SERIES 12 WATTS 2-1 Input Range	**Dual Outputs:** ±12, ±15 Vdc **Inputs:** 5, 12, 48 Vdc
DCE SERIES 5 WATTS Low Noise	**Single and Dual Outputs:** 5, 12, 15, ±12, ±15 Vdc **Inputs:** 5, 12, 24, 28, 48 Vdc
DCR (Regulated) 24-Pin DIP Package	**Single and Dual Outputs:** 5, ±5, 12, ±12 , 15, ±15 Vdc **Inputs:** 5, 12, Vdc
DCU (Unregulated) 24-Pin DIP Package	**Single and Dual Outputs:** 5, ±12, ±15 Vdc **Inputs:** 5, 12 Vdc



KZ SERIES

FEATURES

- Remote Control Shutoff
- Adjustable Output Voltage
- Current Mode Control
- 200 KHz Switching Frequency

intronics 57 Chapel Street, Newton, MA 02158, (617) 964-4000, TWX 710-335-6835, TELEX 200095, FAX (617) 527-3310

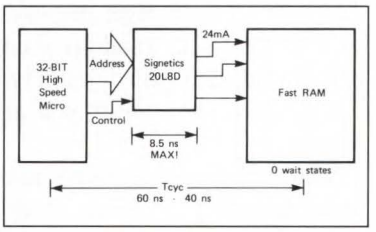
CIRCLE NO 103

"Vroom!"

Turbocharge your memory for zero wait state design with Signetics fast 7.5ns PAL®-type devices.



Vroom! Now you can get the zero wait state performance that will allow memory to keep pace with the new ultra-fast microprocessors. And you won't have to pay top price for your memory to do it!



7.5ns PAL-type device improves system performance.

Vroom! Boost system speed, lower memory cost. Signetics offers the fastest (7.5ns) PAL-type devices for high-speed decoding. Now you can design with slower, less expensive, more available memory devices and still enhance system speed. And all Signetics PLDs are easily supported by ABEL, CUPL or our powerful AMAZE design software.

7.5ns 20-pin		7.5ns 24-pin	
PLUS16L8-7	PLUS16R6-7	PLUS20L8-7	PLUS20R6-7
PLUS16R4-7	PLUS16R8-7	PLUS20R4-7	PLUS20R8-7

Vroom! We've got the guts! That's right, we have those essential PLDs you need to improve total system performance. Programmable Macro Logic, Logic Arrays, Logic Sequencers and our PAL-type products that cut system cost while boosting system speed.

Turbocharge your memory now! Call Signetics at (800) 227-1817, ext. 985D, for a free High-Speed Decoder Handbook. For surface mount and military product availability, contact your local Signetics sales office.

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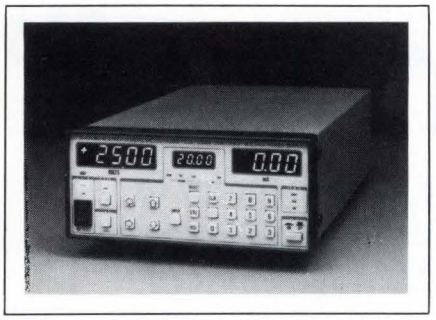
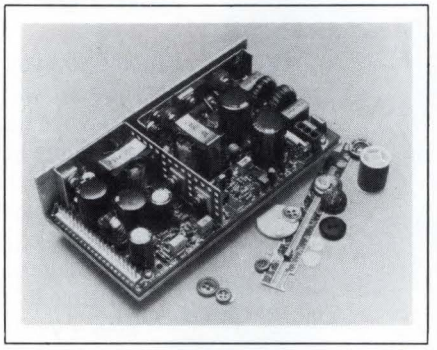


full scale. Two 4-digit displays provide a continuous readout of current and voltage; a third display indicates which parameter you are entering.

The supplies feature arc and short-circuit protection, and user-selectable hard and soft current limits. You can adjust the resolution to 1V. The connectors accommodate both remote voltage setting/ramping, and current and voltage monitoring. The supplies store and recall as many as 10 instrument settings. An optional IEEE-488 bus port allows you to program input settings as well as read output and instrument status. $995.

Stanford Research Systems Inc, 1290D Reamwood Ave, Sunnyvale, CA 94089. Phone (408) 744-9040. TLX 706891. FAX 408-744-9049.

Circle No 716



POWER SUPPLY

The MD225-2112 switching power supply measures 8×4×1¾-in. and provides 225W of output power; three outputs deliver 5V at 25A, +12V at 8A, and −12V at 0.5A. The 5V output has overvoltage protection. The unit operates from either 115 or 230V ac inputs, which you select via a voltage-select connector. The power circuit is a 100k Hz FET forward converter, and the supply's efficiency is 73% for the 115V input and 75% for the 264V input. The operating temperature ranges from 10 to 50°C with 300 lfm cooling. The unit meets VDE 0871 Level A conducted EMI requirements, and international safety approval is under way. $450; $280 (1000).

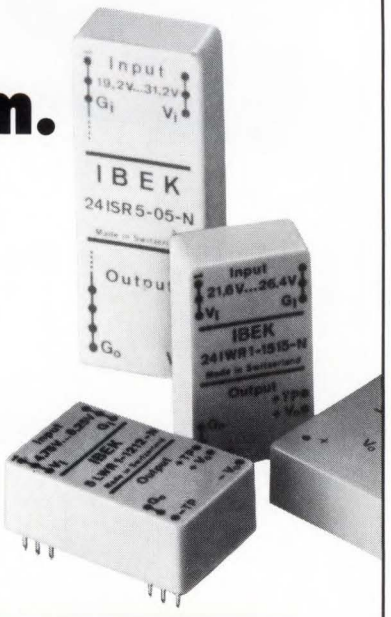
Modular Devices Inc, 4115 Spencer St, Torrance, CA 90503. Phone (213) 542-8561.

Circle No 717

POWER SUPPLY

The MAX-704 delivers 700W and provides 100A at 5V for logic and memory applications. As many as three auxiliary outputs provide

If You're Fed Up With Outdated DC/DC Converter Technology, Get It Out Of Your System.



If you're a design engineer, you know how frustrating it is to design a system utilizing typical P.C.B. mounted converters. Because the market is filled with old technologies that are inefficient, unreliable, bulky, and lack the kind of flexibility you need.

Melcher has the solution: four lines of state-of-the-art units that offer you superior performance in a smaller package size. These units have higher isolation, lower noise, a wider input range, and the widest temperature range compared to the "competition." Consider these facts:

- **IWR Series (1 watt)**
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  - —1″ x 2″ package
- **ISR5 & ISR10 Series (5 & 10 watts)**
  - —9–33 V input range
  - —Adjustable output
  - —Exceptionally low output ripple
- **IPS Series (6 watts)**
  - —2:1 input range
  - —75% efficiency

For more information on these superior units, just give us a call. Because when it comes to P.C.B. mounted converters, Melcher has the answer.

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(508) 653-9979, TELEX 5101003630,
FAX (508) 655-7984

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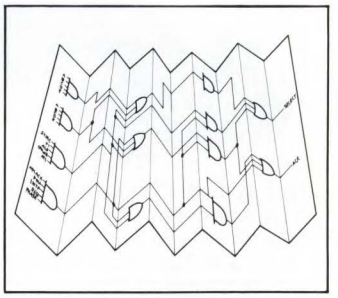
01-944-8111 (FAX) 01-940-5838



"Thwap!"

When you're tired of hitting the wall–Signetics Programmable Logic Arrays offer those additional product terms you're aching for.

Thwap! The 12ns Signetics PLUS173D (24-pin) and PLUS153D (20-pin) have a proven architecture with programmable AND and OR arrays that eliminate "product term depletion." In fact, when you require more than eight product terms per output these devices will outperform the fastest PAL® parts available in a fraction of the board space.



Design flexibility and efficiency with shared product terms.

Thwap! More design flexibility and efficiency. All product terms (up to 48) can be shared among all individually controlled outputs. The result—no speed penalty, improved design flexibility (active high or active low), no redundancy and enough product terms to keep you from hitting the wall. And that's not all! These PLAs, like all Signetics PLDs, are supported by ABEL, CUPL or our powerful AMAZE design software that makes designing easy.

Thwap! We've got the guts! That's right, we have those essential PLDs you need to improve total system performance. Programmable Macro Logic, Logic Sequencers, PAL-type devices and our new PLAs that reduce part count and improve system reliability.

Get the product terms you need! Call Signetics at (800) 227-1817, ext. 986D, for a PLD Data Manual. For surface mount and military product availability, contact your local Signetics sales office.

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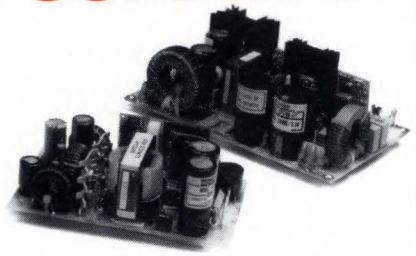
ULTRA-RELIABLE LOW POWER SWITCHING POWER SUPPLIES



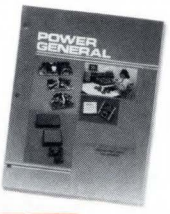
As a systems designer requiring low power switchers, it's easy to get crushed between Marketing's demands for reliability and Purchasing's demands for standard product. Until now, reliable low power switching power supplies has been the proverbial contradiction in terms.

Well, Power General has the SP series solution. These compact, cost effective supplies are available at 40, 50, 65, and 80 watts. They utilize a forward converter topology, fixed frequency operation, and surface mount technology to achieve performance features such as:

- > 90,000 hours MTBF
- Meet VDE, UL, CSA standards
- Indefinite output protection
- High efficiency operation
- Input VDE "B" line filters
- Small size
- Full five year warranty

Power General, utilizing the latest technology to provide complete, innovative solutions to your power needs.

FREE HANDBOOK!
Call for your free 1988 Power Supply Handbook



Put Power General To Work For You!

POWER GENERAL

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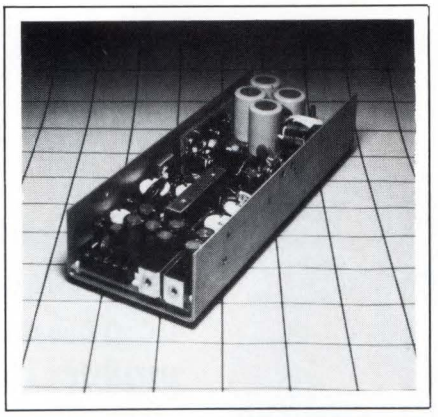
CIRCLE NO 109

Power Sources



regulated 12 or −5.2V at 20A max. All outputs feature a ±5% user-adjustment range and overload protection, and the 5V main output has overvoltage protection. Remote inhibit is standard, and power-fail is available as an option. The calculated MBTF is 80,000 hours. The supply meets international safety requirements such as UL 478, CSA 22.2, IEC 380 and 435, and the Class A RFI standards of FCC and VDE 0871. The supply meets SELV requirements because it features creepage and clearance distances of 4 and 8 mm, respectively. $549 (100). Delivery, stock to six weeks ARO.

Todd Products Corp, 50 Emjay Blvd, Brentwood, NY 11717. Phone (516) 231-3366. TWX 510-227-4905.

Circle No 718

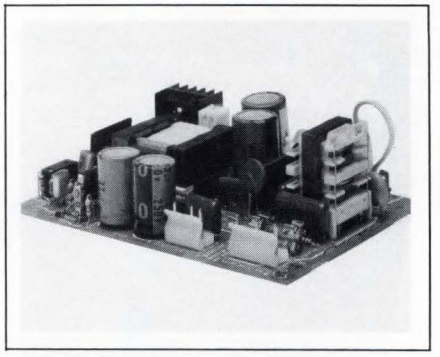


NiCd BATTERIES

The Cadnica Slim KF Series 1.2V nickel-cadmium rechargeable batteries come in rectangular packages and are designed to fit into small spaces. The KF-A600, KF-A900, and KF-A1200 versions have capacities of 600 mAhr, 900 mAhr, and 1200 mAhr, respectively. All versions measure 66.5 mm long and 16.8 mm wide. Their thicknesses are 5.6, 7.8, and 10 mm, respectively. The batteries can be charged overnight using conventional recharging equipment or in an hour using a delta voltage sensor system. They can be recharged more than 500 times. $6.44 (100).

Sanyo Energy Corp, 1201 Sanyo Ave, San Diego, CA 92073. Phone (619) 690-6620. FAX 619-690-2122.

Circle No 719



POWER SUPPLIES

PD Series open-frame switching power supplies feature a 75% efficiency and two jumper-selectable inputs ranging from 100 to 120 and 200 to 240V ac. The two outputs are suited to most commercial plasma displays: 200V dc at 10 to 150 mA and 5V dc at 60 mA. The 200V output has 0.7% line regulation, 2.5% load regulation, and 0.8% temperature drift. Respective figures for the 5V output are 0.2%, 1%, and 1.4%. Ripple and noise for both outputs are 1% max, and operating range (without forced cooling) spans 0 to 50°C. The supplies conform to UL,CSA, and TUV safety requirements and are designed to meet FCC and VDE Class B RFI rules. The supplies are housed on a 3.75×5.125 in. board. $96 (OEM qty).

Panasonic Industrial Co, 2 Panasonic Way, Secaucus, NJ 07094. Phone (201) 348-7000.

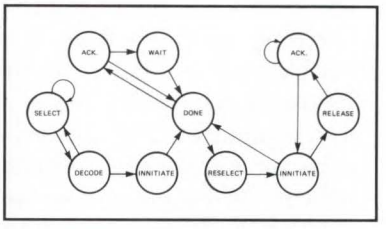
Circle No 720

"Clak!"

IF-THEN-ELSE. Programmable Sequencers for advanced state machine design. From Signetics—who else!



Clak! At last, advanced state machine design is easy. Signetics Programmable Logic Sequencers (PLSs), including the new 50MHz PLUS405, have a unique architecture that employs buried registers to store intermediate values. The result—greater silicon and pin utilization with increased system functionality.



Advanced state machine designs become easy with Signetics sequencers.

Clak! IF-THEN-ELSE functionality. Signetics unique architecture makes complex IF-THEN-ELSE states possible. Connecting any AND term to any OR term (product term sharing) eliminates redundant state transition terms. And JK or SR type registers optimize the logic used in generating state transitions.

In addition, all our PLDs are supported by ABEL, CUPL or our powerful AMAZE software with auto test vector generation to make your job easier.

Clak! We've got the guts! That's right, we have those essential PLDs you need to improve total system performance. PAL®-type devices, Programmable Macro Logic, Logic Arrays and our high-speed PLSs with buried registers that make advanced state machine design easier.

Make your state machines state-of-the-art! Call Signetics at (800) 227-1817, ext. 987D for a PLD Data Manual. For surface mount and military product availability, contact your local Signetics sales office.

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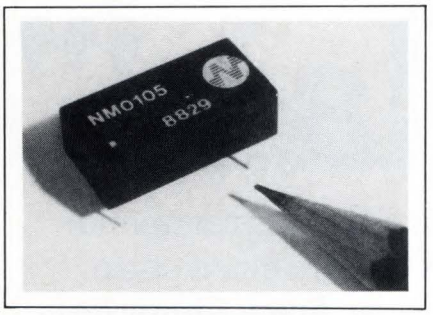
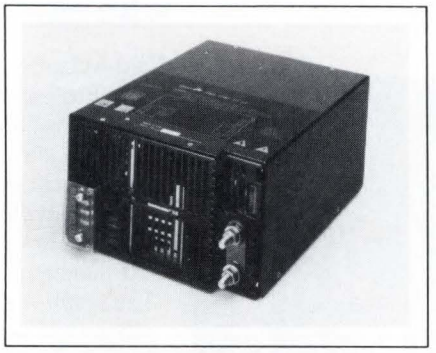


DC/DC CONVERTER

The NM0105 pc-board mountable, dc/dc converter generates a 5V output from a 1.2 to 1.5V input voltage. Because it allows you to power electronic circuitry from a single-cell battery, the device is suitable for use in hand-held, battery-powered equipment. The converter provides an unregulated output, and delivers an output power as high as 200 mW. It operates over a temperature range of 0 to 70 °C. An extended-temperature-range version is under development. The NM0105 is packaged in a 7-pin DIP with dimensions of 20.3×10.2×7.1 mm (0.8×0.4×0.28 in.). Around £6 (100).

Newport Components Ltd, Tanners Dr, Blakelands North, Milton Keynes MK14 5NA, UK. Phone (0908) 615232. TLX 825621. FAX 0908-617545.

Circle No 721



SWITCHMODE SUPPLY

The SMS-1500-00-00 single-output switchmode power supply delivers 5V at currents as high as 300A. To achieve greater output power or fail-safe operation, the vendor can fit the power supply with active current-sharing circuitry that allows you to parallel as many as five units. The output is fully floating, and you can adjust it from 4.5 to 5.5V by means of an internal potentiometer. Load regulation is >0.4% for a load change from 300 to 1500W, and line regulation is <0.2% for a change in input voltage from 195 to 265V.

The supply also features an electronic power-factor correction system that virtually eliminates qaudrature current components from being drawn from the line input. The output has overcurrent and overvoltage protection, and flag outputs indicate fully operational and power-fail conditions. The power supply features operating-temperature protection and a remote shutdown facility. The unit meets IEC, VDE, CAS, UL and BS safety requirements and international EMC requirements. Around $1400.

Weir Electronics Ltd, Durban Rd, Bognor Regis, Sussex PO22 9RW, UK. Phone (0243) 865991. TLX 86543. FAX 0243-868613.

Circle No 722

Weir Inc, 418 3rd Street, Annapolis, MD 21403. Phone (301) 268-0122. FAX 301-268-7909.

Circle No 723

EVALUATION BOARDS

The IP-2361 and IP-2362 evaluation boards allow you to evaluate the performance of single-, dual-, or triple-output IP-series power supplies. They accept as many as three of the vendor's IP-series dc/dc converters or power-booster modules. Configured as a single-output 5V power supply, the board can deliver a current as high as 90A. Other single-, dual-, or triple-output configurations can deliver a total output power as high as 600W.

To assist accurate parametric

Text continued on pg 248

POWERLINE—A FULL LINE OF SWITCHING POWER SUPPLIES FROM 30–1500 WATTS

PX Series
- Low Cost 40–150 Watt
- 1–4 Outputs

N Series
- UL, CSA, IEC, BSI, VDE
- FCC Approved
- 55–350 Watts, 1–5 Outputs

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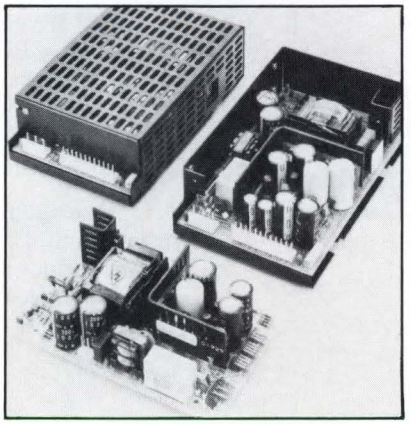
- 3U HIGH Eurorack Mounting
- 11 Inputs DC & AC
- 13 STD Outputs 5–110 VDC

F/ER Series
- 200–550 Watt • 1–5 Outputs
- 24 and 48 VDC Inputs
- 110/220 VAC Inputs

LOW COST CUSTOMS WELCOMED



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CIRCLE NO 110

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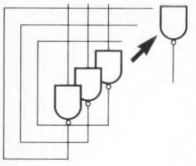
Complete your design within hours with Signetics Programmable Macro Logic "instant" gate arrays.



Click! A programmable "instant" gate array. The PLHS501, the first of our Programmable Macro Logic (PML) products, provides up to 1300 equivalent gates—a complete solution in a 52-pin PLCC package. And its wide NAND input capability makes it ideal for high-speed address decoding and bus interface applications.



Third generation single NAND array architecture with NAND foldback paths.

It's also the easiest way to reduce your NRE costs, inventory problems and quality concerns. It's easy to use because it's supported by our powerful AMAZE software which gives you a complete system in an instant.

Click! AND/OR design constraints vanish in an instant. Signetics folded NAND array architecture provides 100% interconnectibility to eliminate routing restrictions. And 100% gate selectability to build flip-flops, multiplexers and decoders resulting in total silicon utilization.

Click! We've got the guts! That's right, we have those essential PLDs you need to improve total system performance. PAL®-type devices, Programmable Logic Arrays and Logic Sequencers plus our new PML products such as the PLHS501, that simplify complex design problems by eliminating interconnect restrictions.

Conquer complexity—instantly! Call Signetics at (800) 227-1817, ext. 988D, for a PML Design and Applications Manual. For military product availability, contact your local Signetics sales office.

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- memory sweep feature with pre-defined amplitude weighting
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88-059

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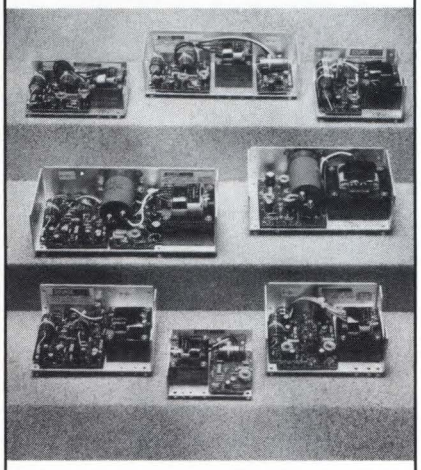

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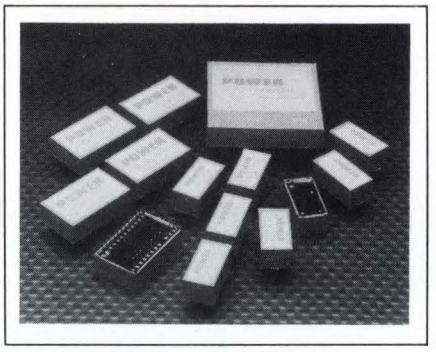
248 **CIRCLE NO 111**

testing of the power supply, the board has oscilloscope jacks that are connected to appropriate points in the circuit. Provisions let you access the gating and output-voltage trimming connections provided on each module. To minimize noise generated from the supply, you can plug in the vendor's phasor modules, which maintain a constant phase angle between the switching cycles of each converter. The IP-2361 evaluation board accepts converter modules with input voltages of 100 to 400V dc, and the IP-2362 board accepts converters that require input voltages of ≤100V dc. Around £115 (Irish).

InPower Europe Ltd, Ballysimon Rd, Limerick, Ireland. Phone 061-49677. TLX 70322.

Circle No 724



DC/DC CONVERTERS

The Power-Industries Series pc-board mountable, dc/dc converters feature output power ratings of 0.3 to 6W. The converters are available in single- or dual-output versions with output voltages of 5, 9, 12, or 15V. They are available with nominal input voltage ratings of 5, 12, 24, or 48V. In total, the series comprises over 100 regulated and unregulated dc/dc converters as well as special models for use with LAN transceivers. All the units have short-circuit protection and I/O isolation of 500 to 2500V dc. Their switching frequency ranges from 80 to 120 kHz.

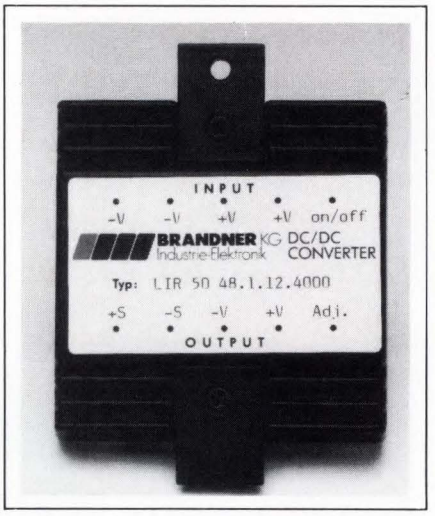
The converters are housed in 16- or 24-pin DIPs, or in 31×31×10- or 51×51×10-mm packages. The package material is self-extinguishing and the potting compound is approved for aeronautical applications. Version with 5V input, ±12V output, and 0.7W output power, $14.50 (100).

Ericsson Components AB, Power Products Division, S-164 81 Kista-Stockholm, Sweden. Phone (08) 757-5000. TLX 10948. FAX 08-757-4884.

Circle No 725

Ericsson Components Inc, Box 853904, Richardson, TX 75085. Phone (214) 480-8300. TLX 735389. FAX 214-680-1059.

Circle No 726



DC/DC CONVERTERS

Large Input Range (LIR) Series encapsulated dc/dc converters tolerate more than ±25% changes in input voltage without performance degradation. Three input-voltage ranges are available: 18V to 36V (24V nominal), 36V to 72V (48V/60V nominal), or 72V to 144V (110V nominal). The supplies, which measure 76.2×76.2×17 mm (3×3×0.67 in.), are available with total output power ratings of 40 or 50W and with either single, dual, or triple outputs at 5, 12, 15 or 24V. All the outputs are fully regulated and have short-circuit protection. Additionally, they are guaranteed to start up under full-load conditions. The converters can operate at ambient temperatures as high as 65 °C without

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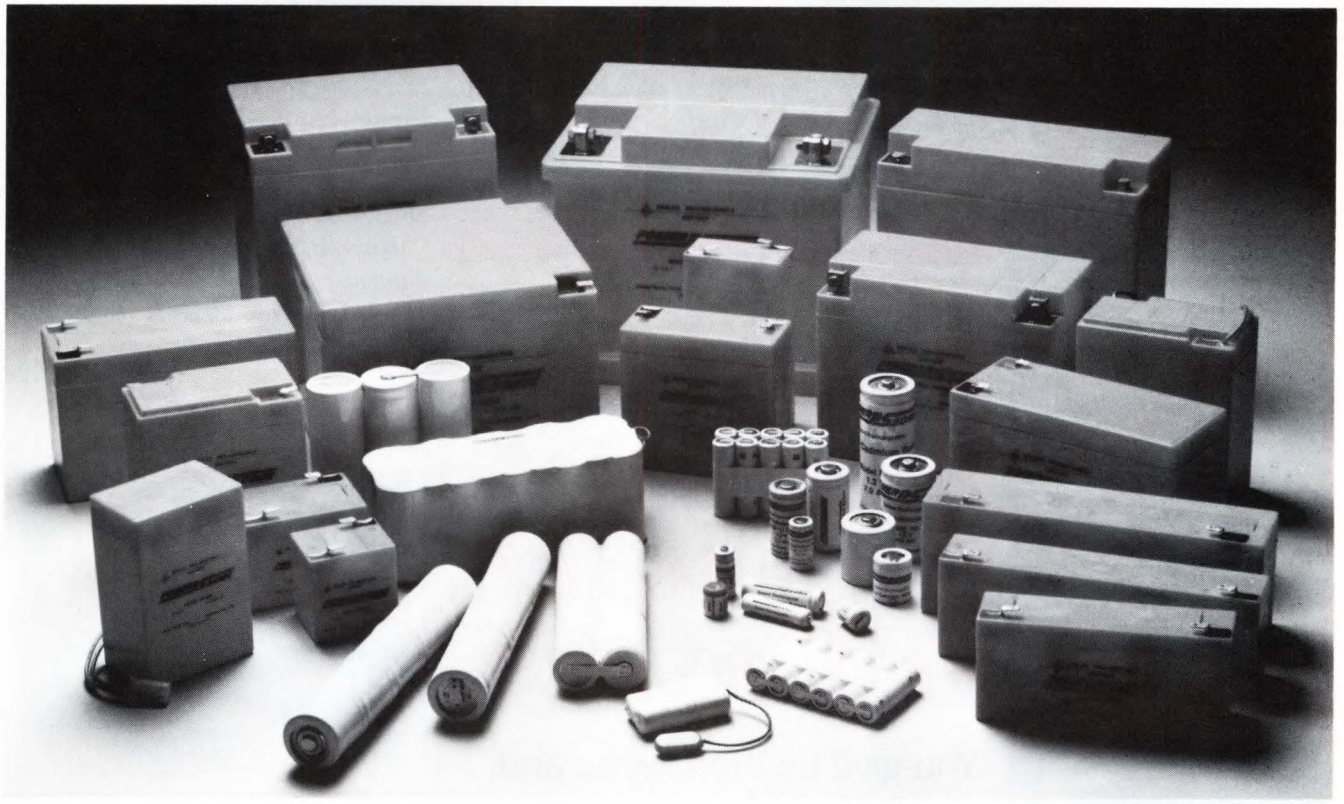

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POWER-SONIC CORPORATION
P.O. Box 5242, 3106 Spring Street, Redwood City, CA 94063 USA
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derating. They are available with solder-pin, screw-fit, or push-fit connectors. 40W version, around £73 to £81; 50W version around £80 to £90 (100).

Brandner Vertriebs GmbH, Siemensstrasse 26, 8755 Alzenau, West Germany. Phone (06023) 330105. TLX 4188593. FAX 06023-4609.

Circle No 727

DC/DC CONVERTER

The PWR1546A dc/dc converter features an output noise of <1 mV p-p (0.6mV typ) over a dc to 10 MHz bandwidth. You don't need any external parts to obtain this performance. The converter is designed to power sensitive analog circuits such as data converters and high-gain amplifiers. It has a 5W output capability and transforms a 5V input to a ±15V output. The 2×2×0.4-in. unit includes I/O filtering and 6-sided shielding, which further reduces noise from radiating into the surrounding circuitry.

The converter employs linear circuitry to fully regulate each output and features a 750V dc continuous input-to-output isolation rating. Stress ratios are small enough to yield an 890,000 hour MTBF at 25°C. $33 (OEM qty).

Burr-Brown Corp, Box 11400, Tucson, AZ 85734. Phone (602) 746-1111. TLX 666491. TWX 910-952-1111.

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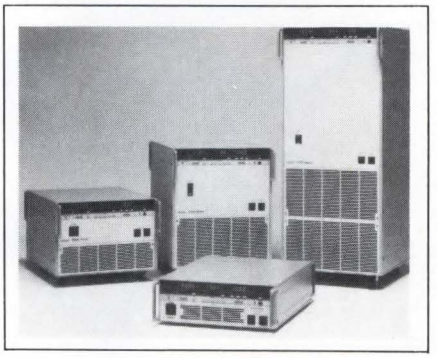
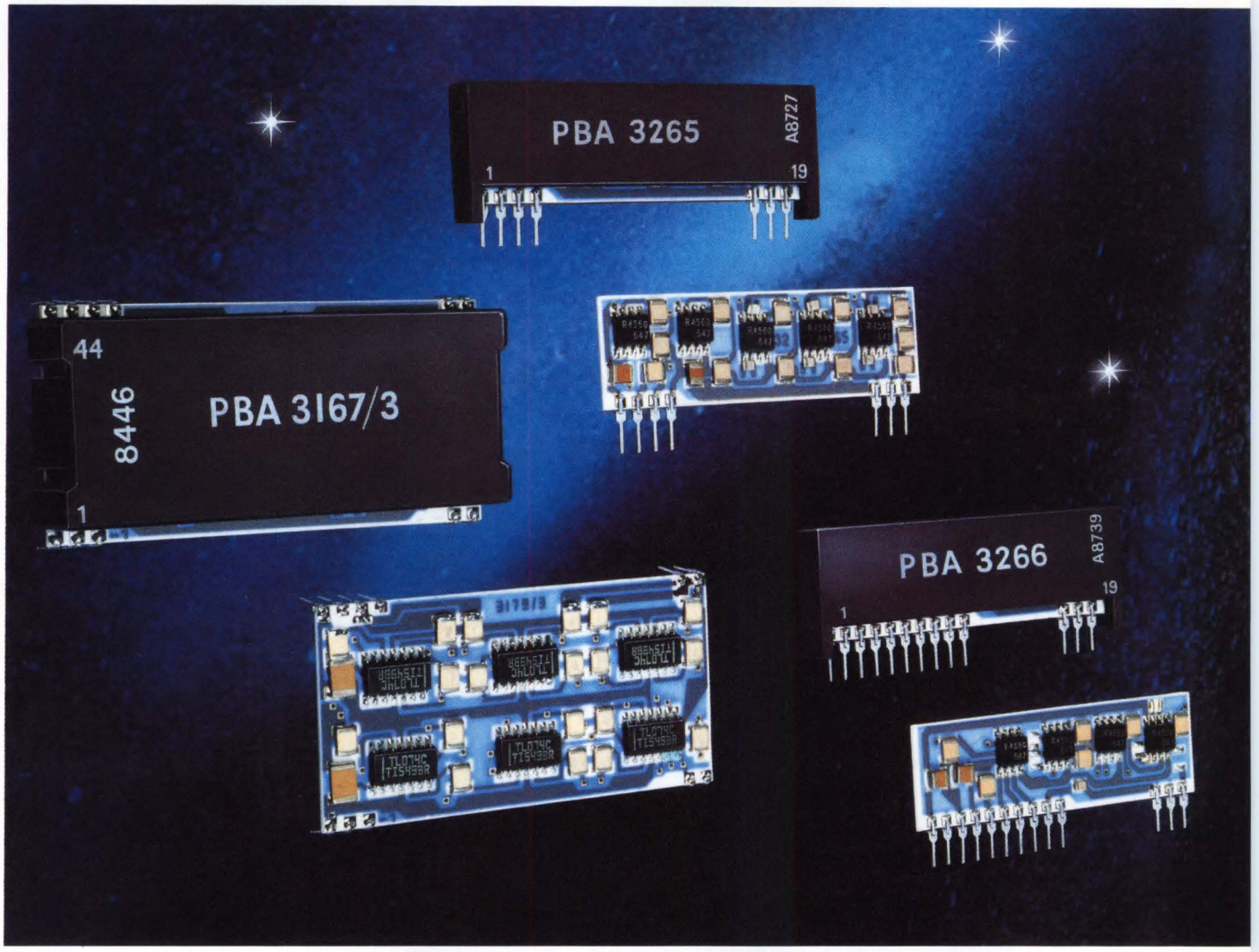


AC POWER SOURCES

The PCR programmable ac power sources allow you to conduct input power tests by simulating ac input power conditions. The sources can simulate power interruptions, power outages and voltage spikes. Four standard models range from 500 VA to 4000 VA and can be combined for a total of 60 kVA. You can digitally control the output frequency over a range of 5 to 500 Hz. The output sine wave is digitally synthesized for minimum distortion and can be programmed by an external signal source. The output is fully isolated from the input line power but may be synchronized to the ac line frequency. Output voltages range from 1 to 280V ac.

The programmable memory lets you select voltage and frequency settings via the front-panel switches. An optional IEEE-488 I/O card or a KIK RCO1-PCR remote control unit allows you to control

Digital Audio Filters.



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PBA 3265.
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PBA 3266.
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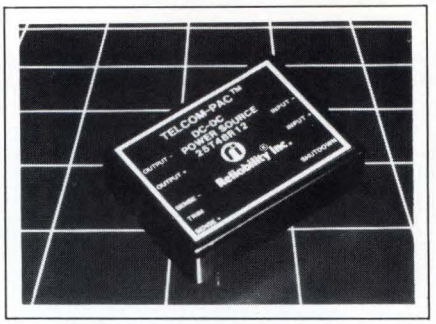
Kikusui International Corp, 19601 Mariner Ave, Torrance, CA 90503. Phone (213) 371-4662.

Circle No 729

DC/DC CONVERTERS

The 25/30W Telcom-Pac Series converters feature an extra-wide input range of 20 to 72V dc. The pc-board mountable, low-profile converters are available in 5, 12, and 15V outputs at 5, 2½, and 2 A, respectively. They maintain line and load regulation of 25 mV and have <50 mV p-p output noise and ripple. The switching frequency is 85 kHz, and efficiency exceeds 80%.

The 2.56×3.44×0.825-in. units feature 6-sided shielding, I/O isolation of 500V dc, an input π filter to minimize reflected input ripple,



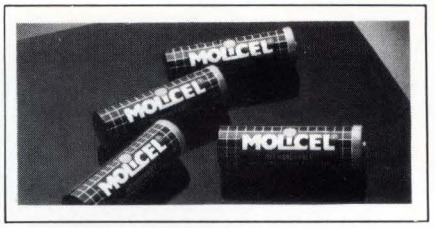
and short-circuit and overvoltage protection. Capabilities include remote shutdown, external trim adjustment, and remote sensing. $95 (OEM qty). Delivery, 8 to 10 weeks.

Reliability Inc, Box 218370, Houston, TX 77218. Phone (713) 492-0550. TLX 4620383.

Circle No 730

LITHIUM BATTERIES

The Molicel 06A600 and 06B800 models are high-energy, rechargeable lithium cells. At 21°C, their charge retention is 90% after one



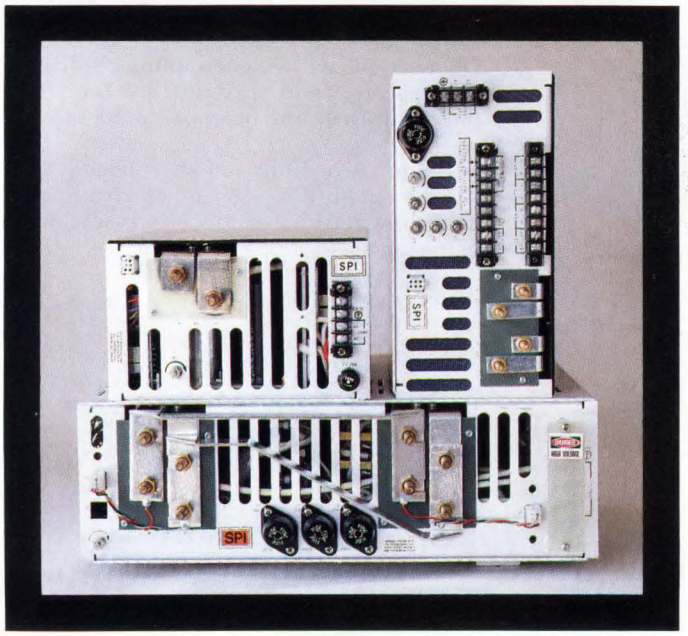
year and 50% after eight years (projected).

'AA' size cells are available in two design types. The A-type cell has a 600 mAhr capacity with a 400-cycle long life. The B-type cell has an 800 mAhr capacity with a 200-cycle reduced life. The output voltages for the A and B types are 2.2 to 1.3V and 2.3 to 1.3V, respectively. The dc cell impedance for both types is 220 mΩ typ. Both cells are UL recognized. $3 to $4 (10,000).

Moli Energy Limited, 3958 Myrtle St, Burnaby, BC, Canada V5C 4G2. Phone (604) 437-6927. TLX 04356708.

Circle No 731

SO, IT'S POWER YOU WANT?



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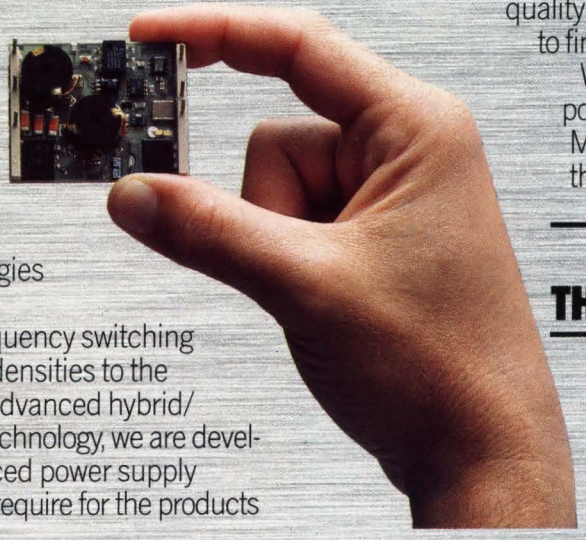

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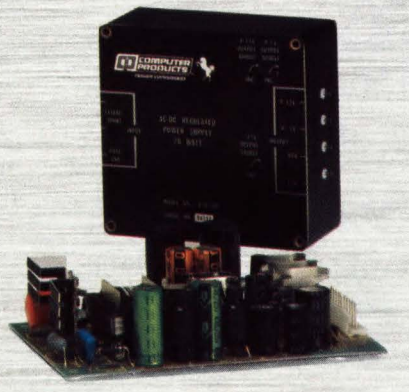

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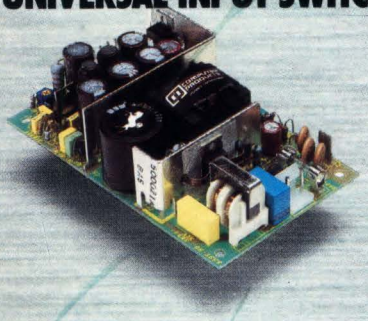

Power your system from any worldwide line voltage without changing jumper wires or switches. The NFS Series universal input switchers provide single or multiple outputs for 40 watt, 50 watt, or 110 watt applications. Check out the NFS40 series, which measure a mere 5" x 3" x 1.2". The NFS50-7608 directly replaces the industry standard 6.3" x 3.9" 40 watt supply and offers a bonus of 10 additional watts for system extras. And the NFS110 series will deliver 110 watts from a small 7"x 4.25" x 1.8" package. Its +12V output will deliver up to 9A peak current to start disk drives.

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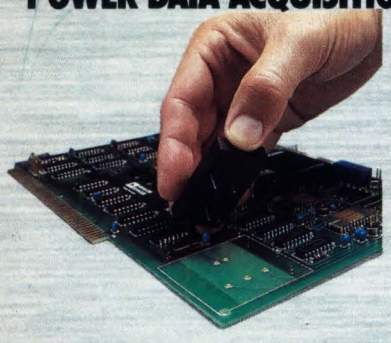

The H, EA and AF Series are isolated and regulated DC/DC converters having the same industry standard footprint to provide flexibility for your design. Ideally suited for powering analog and digital circuitry such as OP Amps, A/D and D/A converters, logic and microprocessors. Packaged in 1.0" x 2.0" x 0.38" non-conductive cases, these 1 to 4.5 watt converters are available for a variety of input and output voltages. All units feature isolation of 500V, setting accuracies to ±2% max. and fully regulated output to ±1% max.

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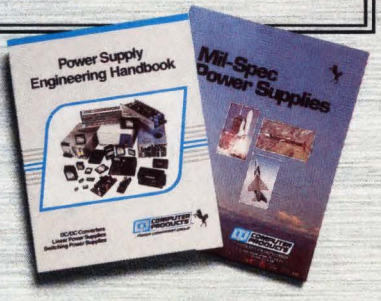

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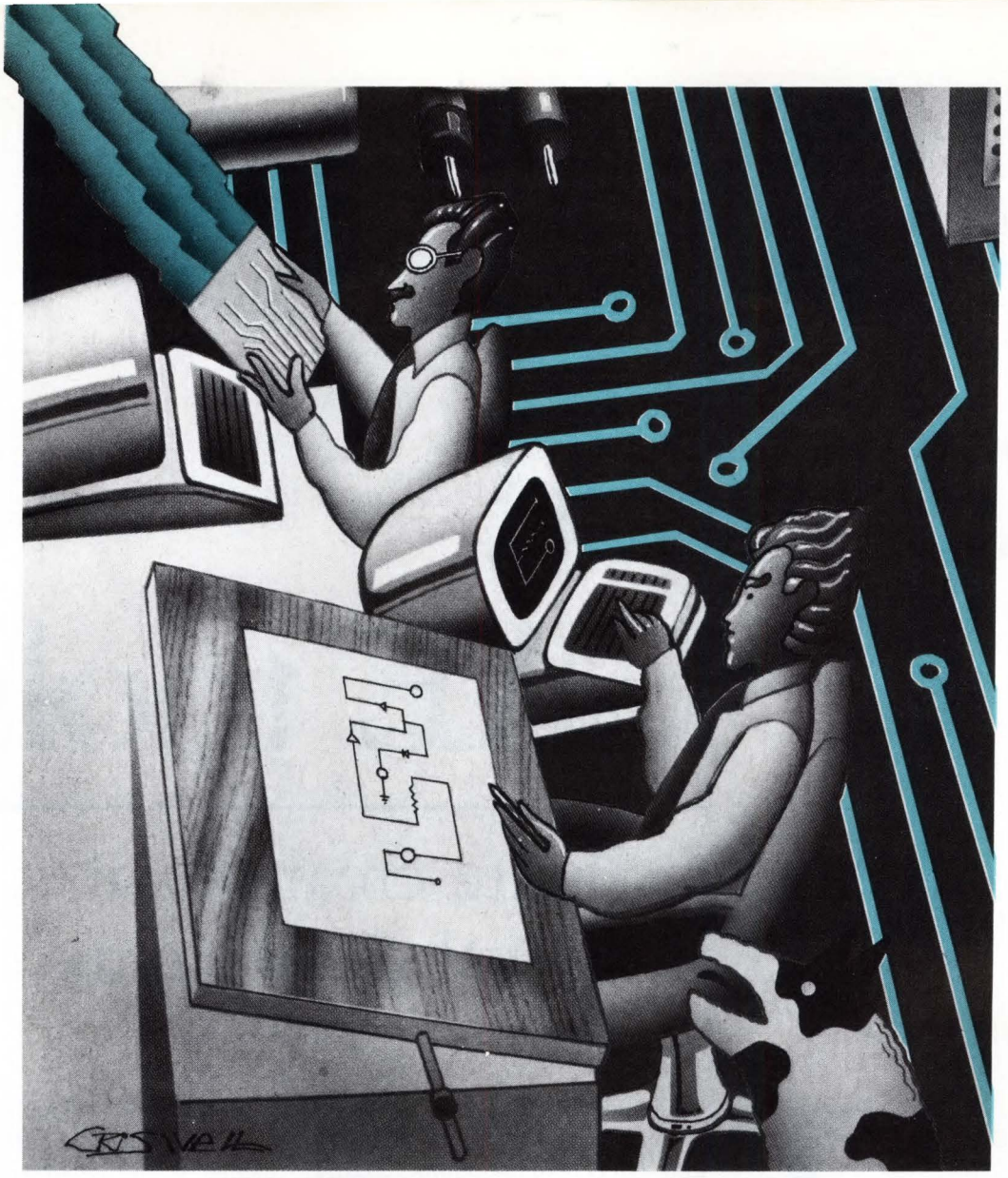

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J D Mosley,
Regional Editor

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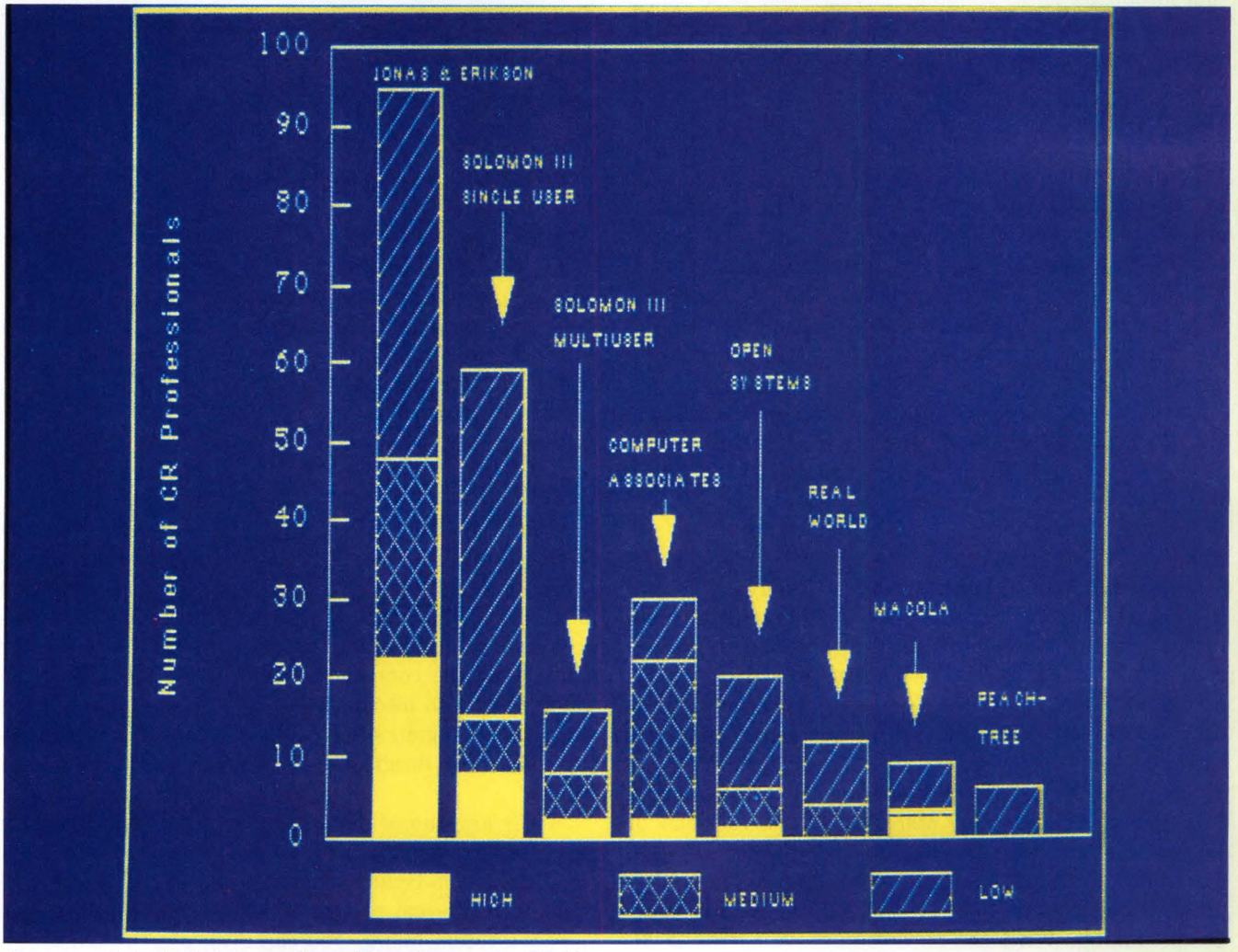
All of the documentation and presentation software packages that you'll read about in this article are capable of accessing Autodesk's AutoCAD files. AutoCAD was chosen as the standard by which to measure compatibility in order to simplify the process of assessing the software and its usefulness.

At the low-end of technical publishing is the generation of pages of text (from a printer) containing references to pages of graphics (from a plotter). Although there once was a time when letter-quality printing was the best computer hard copy available, most of the popular word-processor programs available today offer laser-printer support. The typeset appearance of a laser printer's output allows an engineer on a tight budget to produce a basic document that looks more sophisticated than typewritten text.

The MASS-11 Word Processor from Microsystems Engineering Corp, for example, costs $395 and accurately displays and generates technical characters—Greek letters, for instance. The MASS-11 program lets you specify page widths as wide as 250 characters, and it can format text into multiple

The current assortment of PC-based desktop-publishing tools has produced a fascinating array of products that can help engineers generate typeset-quality documentation and produce multimedia presentations. Learning curves do vary, however, and many of these tools are best suited to technical editors and graphic artists.



A screen shot of what is possible with a document-publishing program *(Lotus Development Corp)*

Using a laser printer, an engineer on a tight budget can produce a basic document that looks more sophisticated than typewritten text.

columns. A similar program, the $249 pcTEX from Personal TEX, provides typeset-quality mathematical and engineering symbols and includes output drivers for dot-matrix, HP Laserjet, and Postscript laser printers. A third program, ChiWriter from Horstmann Software Design, includes a spelling checker and has the ability to depict chemical structures. The basic ChiWriter program costs $99.95; keyboard and printer modules, a mail-merge facility, an index generator, and chemistry support are packaged as separate modules ranging in price from $19.95 to $149.95.

To include engineering or scientific graphs as part of your document, you may want to try Binary Engineering's Tech*Graph*Pad (**Fig 1**), a $395 program that produces X-Y, semilog, log/log, and polar plots from spreadsheet or ASCII data files for output to various printers and plotters. Alternatively, you can save the plots to disk as .PIC files for use with a desktop-publishing program.

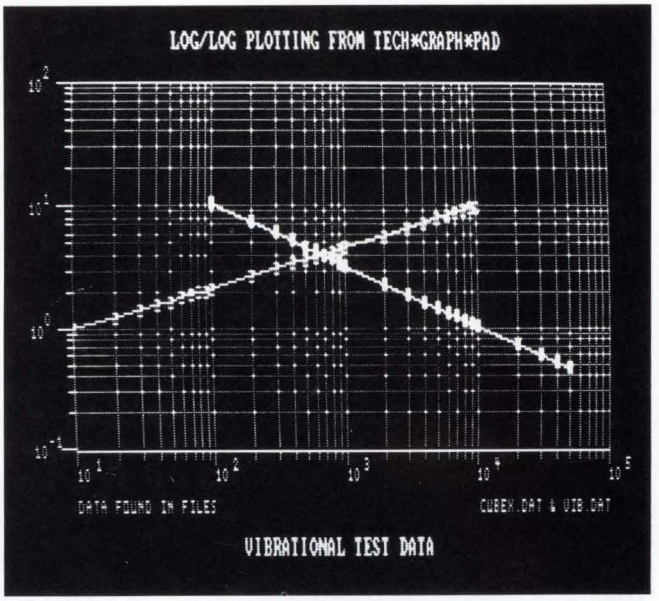


Fig 1—To produce typeset-quality engineering plots, *you can use Binary Engineering's Tech*Graph*Pad program to import spreadsheet and ASCII data files and convert them into printable plots.*

Word publishing arrives

Laser printers today are also capable of printing graphics interspersed throughout the text. Traditionally, word-processor programs could not easily generate such a mix of text and graphics, but a new genre of programs that combines word processing and simple desktop-publishing functions allows you to use a single output device to produce technical documentation.

These word-*publishing* programs are typically available as the most current versions of the same word-processing programs with which you are probably already familiar. By upgrading to a word-publishing version of your present word-processing software, you can reduce your learning curve and speed the completion of your document. These packages usually allow you to import the word-processing texts you previously produced, and they interpret the embedded printer commands to produce basic word-publishing documents. You then only have to fine tune the font definitions for headlines, captions, references, and other particulars.

The latest revisions of Wordperfect ($495), Microsoft's Word ($450), and Micropro's two versions of Wordstar ($495) all provide desktop-publishing features like laser font control, snaking of column copy, multiple columns, full-page monitor support, and paragraph linking. With the exception of Wordstar 2000, you can also use any of these programs as front-end text processors for dedicated desktop-publishing programs such as Xerox's Ventura Publisher and Aldus's Pagemaker. High-end desktop-publishing programs don't have full-featured word-processing capabilities, only simple editing capabilities. Even though the word-publishing programs' graphics capabilities are typically limited to simple line drawings, you can use AutoCAD's drawing interchange file format (DFX) to produce ASCII files that you can then import into your word-publishing document.

Benefits of document processing vary

A number of other programs—dubbed by their manufacturers document-composition or document-processing systems—are also vying for the attention of technical publishers. These programs vary in usefulness and sophistication, but they do provide greater control of page composition than word processors can offer. They also incorporate standard word-processing capabilities—again something that the high-end desktop-publishing programs like Ventura and Pagemaker lack.

At the low-end of the document-processing category are products such as Lattice's $375 Highstyle and Ashton-Tate's $295 Byline. Highstyle is actually an assortment of individual programs linked via the Highstyle Access System menu. You can even use the package's word processor, page previewer, icon editor, snapshot utility, and print formatter as independent utilities. As a result, you can incorporate your present word-

processing program into the Highstyle system by providing the Access System with your word processor's directory path. However, Highstyle limits your hardcopy options to the Panasonic Laser Partner, PCL Level-4-compatible laser printers, and three types of Hewlett-Packard Laserjet printers.

Highstyle's Access System is menu driven, with one notable exception: To use the snapshot utility, you must install it from DOS each time you boot your computer because snapshot resides in RAM. Instead of permitting you to import CAE graphics directly into your document, Highstyle requires that you do a screen dump of an on-screen CAE graphic into the snapshot utility's buffer, and then save the buffer to disk as a file with a .PIC extension. You can use the Highstyle picture command to insert the screen image into your document, and then crop it and scale it. You have the option of clearing the snapshot buffer and removing the utility from memory when you aren't using it.

The word processor—Highstyle Edit—includes a spelling checker. However, the program imposes requirements that you won't find with standard word processors: You must leave a blank line after every

Enhance your AutoCAD technical documents

Once an engineer decides to enter the technical-publishing domain and begins to accumulate software packages, the next step is to decide what other peripherals and utilitarian features might be advantageous.

One of the first peripherals a professional desktop publisher invests in is a good-size, high-resolution monitor. And if you do a large amount of technical publishing for electronics applications, that will have to be a large *color* monitor. Princeton Graphic Systems (Princeton, NJ) sells a $1375 color monitor, the 16-in. Ultra 16, which offers 1024×768-pixel resolution. Moniterm (Minnetonka, MN) has developed a $2395 monochrome version of AutoCAD Release 9 for its Viking 19-in. and 24-in. monitors.

For those engineers who have been disappointed with the resolution of their scanned CAD drawings transmitted via facsimile machines, the Gammalink (Palo Alto, CA) CAD-Fax facsimile/modem package may be worth the $1995 price tag. The software that comes with this PC expansion card divides your AutoCAD drawing into 8½-in. strips with alignment markers, which lets the recipient accurately piece together the resulting engineering-size drawing.

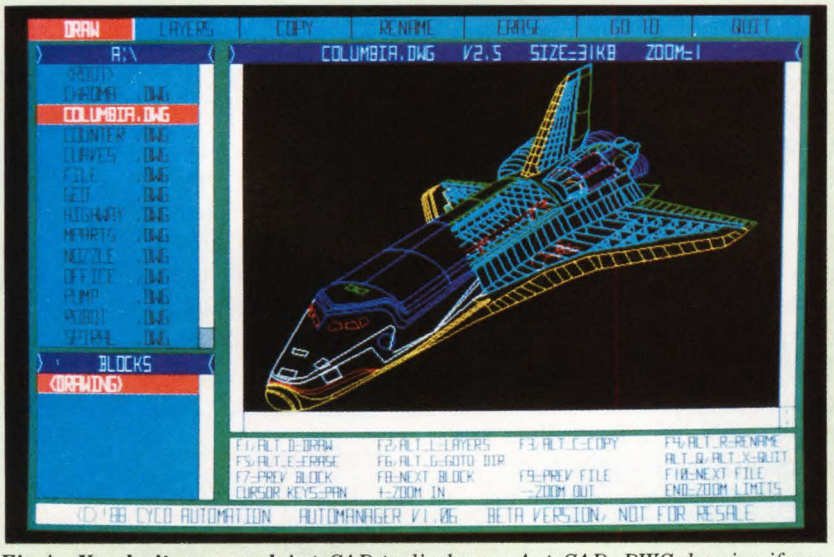


***Fig A—You don't even need** AutoCAD to display an AutoCAD .DWG drawing if you use Cyco International's Automanager utility.*

You'll also find that it is possible to browse through and manage AutoCAD files even without AutoCAD (**Fig A**). Cyco International's (Atlanta, GA) Automanager lets you zoom and pan AutoCAD's .DWG files, and it even lets you peel through successive layers in a drawing. Alternatively, you can use the $199 program from within AutoCAD to look at other drawings without exiting from the one you are in the process of creating. Another Cyco program, the $149 Autosave, lets you reconstruct AutoCAD drawings that have been corrupted by disk crashes or power failures or that have been (gasp!) accidentally deleted.

Word-publishing programs are typically available as the most current versions of the same word-processing programs with which you are probably already familiar.

paragraph; you must type two spaces after each sentence; you can't start a line with a period; and you must precede certain characters (backslash, underscore, and braces) with a backslash if you want them printed in your document. Highstyle ignores spaces found at the beginning of a line, but you can insert hard spaces by using the underscore character. You create multiple columns, boxes, and tables with simple dot commands. To preview your document, you must first format it to disk. The preview version uses your standard CRT's fonts so that the spacing will be accurately depicted, but the result is not a WYSIWYG display.

Highstyle's Icon Editor, a tool for creating pictograms, is a nice touch. Icon size is limited to 254×254 dots. Highstyle also generates bar codes. Other standard desktop-publishing features let your computer automatically control the following: page formatting; numbering for pages, chapters, sections, and headings; multilevel headers and footers for consecutive or odd-and-even pages; multilevel bulleted or numbered lists; widow and orphan elimination; kerning and leading options; and line spacing.

If you need more flexibility

In contrast to Highstyle's restricted hard-copy options, Byline works with several 9-pin and 24-pin dot-matrix printers, as well as the HP Laserjet Series and the Apple Laserwriter and other Postscript-driven devices. The ability to work with Postscript-driven devices not only gives you flexibility for in-house printing, but it lets you produce 2540×2540-dpi *typeset* hard copy with a Linotype L-300 phototypesetter. It also lets you use some of the new high-resolution laser printers, like the $16,995 600×600-dpi Varityper from the company of the same name (East Hanover, NJ). Although Byline comes with 12 printer fonts in point sizes ranging from 6 to 144, the HP Laserjet printers are limited to the font sizes offered in the B or F cartridge—point sizes of 18 or less.

The program also includes a snapshot utility called Camera. You have to be in DOS to access it, and only graphics images will "photograph." Any attempts to grab a screen of text will only produce a warning beep. The Camera utility can save as many as 99 of these screen images in consecutively numbered .CAM files within the current disk directory. You must then use the DOS copy command to transfer these files to the Byline disk directory. Afterwards, you can import the images into your Byline document for positioning, cropping, and editing.

You can import and export text files generated by Wordstar, Wordperfect, Xywrite, and Multimate word processors. Byline also imports graphics files produced by PC Paintbrush, Macpaint, Windows Paint, and Lotus 1-2-3 .PIC files. It is possible to produce documents

Mac II also targets CAE-oriented publishing

Now that AutoCAD is available for use on the Apple Macintosh II, CAD and CAE packages are available for "Mac-tonian Engineering" (**Ref 1**). Accordingly, it seems appropriate to note that both Pagemaker and Ventura Publisher are also available for the Mac.

If it's group projects you're involved with, you might want to consider Ashton-Tate's $395 Full Write Professional. Not only does this MAC-based program provide typical desktop-publishing features, it adds automatic highlighting of revisions, posted notes for comments and reminders, strikeout text for marking deletions, and a document work history that records the original author, last editor, dates of creation and alteration, the number of work sessions, the time invested in the document, and the total number of keystrokes. Full Write also provides integrated document outlining, Bezier curves, and bit-map scaling, and it automatically wraps text around irregularly shaped objects.

Another package, called Cricket Presents (from Cricket Software, Malvern, PA), permits output from a Mac to a variety of non-Postscript output devices, including film recorders and ink-jet printers. The $495 program also lets you send your file via modem to a Autographix Imaging Center to create 35-mm color slides, transparencies, and prints.

Reference

1. Blissmer, Robert H, "Mac-tonian Engineering," *Engineering Tools*, May 1988, pg 36.

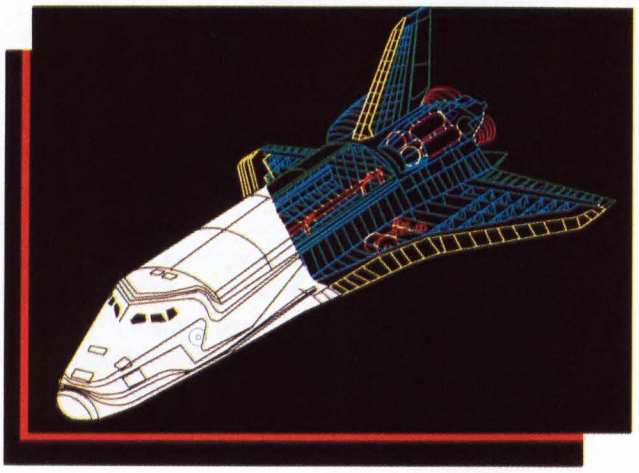


Fig 2—You can combine desktop publishing with presentation graphics *by converting your AutoCAD drawings using Kinetic's CadConvert program and importing the resulting .CGM file into the Kinetic Graphics System.*

with multiple columns, and you can adjust the kerning and leading of your output.

A new version of Byline was slated for release last month. In this version, Ashton-Tate plans to provide the ability to directly import CAD images. The company also promises better support for the Laserjet Series, but as of the time of this writing beta copies were not available. Other promised upgrades include mouse support, the ability to import Windows and GEM files, and the implementation of virtual memory for scanned images.

A significant step beyond document processing is document publishing, and one product that really shines in this arena is Lotus Manuscript 2.0. The program not only combines word and document processing, but provides much greater user control than the document-processing packages offer. Manuscript 2.0 is priced at $495; upgrades for registered Manuscript 1.0 owners cost $75, and are free for customers who purchased version 1.0 after December 1, 1987.

The program includes the following: a 110,000-word spelling checker, a 220,000-synonym thesaurus, an integrated outliner based on the *Chicago Manual of Style*, equations support (no character limit), line numbering for government documents, an unlimited number of user-defined libraries for storing formatted, boilerplate text or complex table layouts, user-definable hot keys and macros, context-sensitive help screens, and nine different formats for automatically numbering lists, headings, and captions.

Manuscript 2.0's Autosort command lets you alphabetize blocks of text within your document or table. You can also specify footnotes, level notes, and end notes. The program offers 16 text attributes, including strikethrough, small caps, double underscore, superscripts, and subscripts. Multiple-line headers and footers can include pictures, columns, and varied fonts. To simplify your introduction to the program, Manuscript 2.0 comes with document templates for a user's manual, letter, memo, proposal, and technical specifications.

Additional features include column balancing for aligning the bottom of adjacent columns; floating graphics; rule-based and user-definable hyphenation; and the automatic importation of spreadsheet data, AutoCAD graphics, and bit-mapped scanner images. A table editor lets you manipulate columns of spreadsheet data. You can quickly preview blocks of text or graphics from within the text editor, or preview the entire formatted document with a variety of display options. The program generates tables of contents, tables of tables, and tables of figures. For group revisions, Manuscript 2.0 provides a Comment Facility for initialed notations and a Document Compare feature that either places change bars in the margins of a document screen or changes the text attributes. You can also temporarily exit to DOS and return to the exact spot you were editing in your document.

Manuscript 2.0 even lets you mix portrait and landscape print orientations within the same document—a feat that even dedicated desktop-publishing programs like Ventura Publisher can't accomplish. You can organize as many as 18 files for batch printing. The package supports Postscript typesetters and the HP Paintjet color printer.

Bitstream's Fontware installation kit and the Bitstream Charter Roman-style text font come bundled with Manuscript 2.0. For $195, you can buy soft-font families from Bitstream (Cambridge, MA) that let you add typefaces to your laser printer's repertoire—a significant consideration if you are using a laser printer that isn't Postscript compatible or that has a limited assortment of hardware font cartridges. (Most Postscript printers come with several Adobe fonts.) However, one family of soft fonts can occupy 1.5M bytes of disk space, so restrain yourself from purchasing an assortment of fonts if your drives are near capacity.

Notwithstanding all these super capabilities, to achieve the maximum control over your document's hard copy, the dedicated desktop-publishing programs

Document-composition and document-processing systems are vying for the attention of technical publishers.

still reign supreme. The most popular programs in the PC category are Xerox's Ventura Publisher and Aldus's Pagemaker. At one time Ventura Publisher was the undeniable choice for producing any massive technical document: Pagemaker was incapable of wrapping text across multiple pages. Fortunately, Pagemaker Version 3.0 overcomes this limitation. Nevertheless, Pagemaker still lacks several important documentation features: an index generator, automatic numbering of figures and tables, and the ability to control footnotes.

Moreover, Pagemaker cannot directly import AutoCAD files; instead you must go into AutoCAD and plot your drawing to an .ADI plotter file. Pagemaker then creates a Microsoft Windows metafile from the plot. However, if the resulting metafile exceeds 64k bytes, Pagemaker cannot import the file, and you'll just have to plot your AutoCAD drawing on a plotter.

Kinetic Corp sells a $99.95 program, CADConvert, that translates AutoCAD .DXF vector graphics files into Computer Graphics Metafile (CGM) format (**Fig 2**). You can then directly access these files from a number of programs, including Pagemaker, or send the output to one of more than 100 different types of output devices. The Converted AutoCAD image retains all of its original features, including colors, hatching patterns, and 3-D perspective.

Package imports AutoCAD images directly

Ventura Publisher, as opposed to Pagemaker, imports AutoCAD .SLD images directly. It also includes features that facilitate the creation of complex documents, but learning to use this program can take quite a bit of time. Nonetheless, most commercial typesetters can easily produce phototypeset output from Ventura files, and many do not directly support output from Pagemaker. Several tutorial books are available that can help guide you through the learning process, and a network of Ventura user-groups offers further support. The program, like Pagemaker, is menu driven and supports a mouse.

Xerox announced Ventura Publisher Version 2.0 at September's Seybold Desktop Publishing Conference in Santa Clara, CA, but a beta copy was unavailable at the time of this writing. From the point of view of a technical publisher, the most important improvement is the optional Ventura Publisher Professional Extension. This package is intended to simplify the creation

For more information . . .

For more information on the PC-based CAE desktop-publishing and presentation-graphics software discussed in this article, contact the following manufacturers directly, circle the appropriate numbers on the Information Retrieval Service card, or use EDN's Express Request service.

Aldus Corp
411 First Ave S
Seattle, WA 98104
(206) 622-5500
Circle No 395

Ashton-Tate
20101 Hamilton Ave
Torrance, CA 90502
(213) 329-8000
TLX 664228
Circle No 396

Autodesk Inc
2320 Marinship Way
Sausalito, CA 94965
(415) 332-2344
Circle No 397

Binary Engineering
100 Fifth Ave
Waltham, MA 02154
(617) 890-1812
Circle No 398

Horstmann Software Design Corp
Box 5039
San Jose, CA 95150
(408) 298-0828
Circle No 399

Kinetic Corp Inc
Distillery Commons 250
Louisville, KY 40206
(502) 583-1679
Circle No 400

Lattice Inc
2500 S Highland Ave
Lombard, IL 60148
(312) 916-1600
Circle No 401

Lotus Development Corp
55 Cambridge Parkway
Cambridge, MA 02142
(617) 577-8500
FAX 617-225-1299
Circle No 402

Micropro International Corp
33 San Pablo Ave
San Rafael, CA 94903
(800) 227-5609
Circle No 403

Microsoft Corp
Box 97017
Redmond, WA 98073
(206) 882-8088
Circle No 404

Microsystems Engineering Corp
2400 W Hassell Rd, Suite 400
Hoffman Estates, IL 60195
(312) 882-0111
Circle No 405

Personal TEX Inc
12 Madrona Avenue
Mill Valley, CA 94941
(415) 388-8853
Circle No 406

Varityper
11 Mt Pleasant Ave
East Hanover, NJ 07936
(201) 887-8000
Circle No 407

Wordperfect Corp
288 W Center St
Orem, UT 84057
(801) 225-5000
Circle No 408

Xerox Corp
101 Continental Blvd
El Segundo, CA 90245
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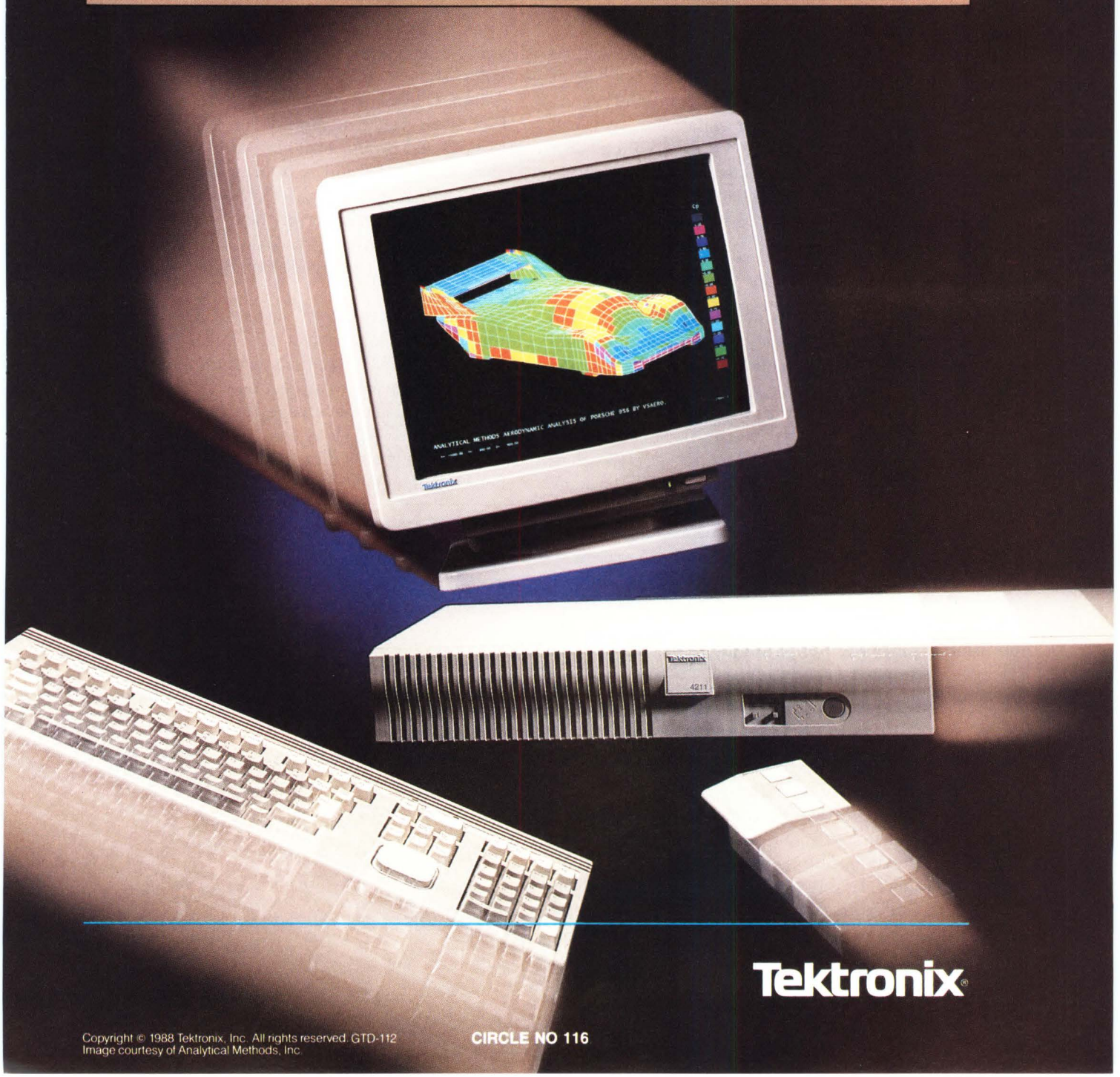

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Image courtesy of Analytical Methods, Inc.

CIRCLE NO 116

The dedicated desktop-publishing programs still reign supreme when it comes to achieving the maximum control over your document's hard copy.

and manipulation of complex tables. It can create sophisticated mathematical and scientific equations and provide for vertical justification throughout a document, and it offers a cross-referencing feature.

Neither Ventura Publisher nor Pagemaker can provide color separation for your technical drawings. Although programs are available that provide color separation for the Apple Macintosh, such capability is lacking in the IBM PC environment. Instead, both Ventura and Pagemaker provide "spot color": You can define a line or image as being a particular color for output on a color printer such as the $1395 HP Paintjet. At present, if you really need color separation, you can spend $30,000 to $80,000 to buy a dedicated 80386-based workstation, but both Xerox and Aldus predict that 1989 will herald the advent of reasonably priced programs that provide synthetic color separation for 80386-based PCs.

Multimedia graphics win bids

Bearing in mind the ever-increasing sophistication of graphics manipulation at the desktop level, and considering the increasing demand for sophisticated PC graphics comparable to those produced with a Macintosh, you shouldn't be surprised that desktop-publishing and multimedia-presentation-graphics capabilities are becoming indelibly fused. The Kinetic Graphics System (KGS) best illustrates this trend. The package combines limited desktop-publishing facilities with the ability to produce and organize multimedia presentation graphics. For $995, you receive five software modules that operate in an integrated fashion to provide simple word processing, layout control (akin to traditional desktop publishing), system control (for seamless operation), graphics development, and art design. KGS-created word images cannot exceed 64 132-character lines.

Where do you stop?

Although KGS is primarily a graphics package and not suitable for producing extensive textual manuals, you can certainly use it to produce word and graphics charts, slides, handouts, and figures to support your technical publication. Moreover, it offers one especially exciting feature. It lets you automatically generate Presenter's Guides: either monochrome or color replicas of a slide or transparency being used in your presentation, along with an area for notations. You can also generate similar Audience Guides, which have three replicated slides and three notation areas.

You can output your images to any of more than 75 printers and plotters, or you can make your own slides with General Parametrics' (Berkeley, CA) Videoshow. If you prefer, you can also order slides, transparencies, Presenter's Guides, flip charts, murals, and video conversions directly from one of the five US Kinetic Presentation Centers. Prices for 48-hour processing services range from $1.50 for monochrome Presenter's Guides to $6 for plastic-mounted 35-mm color slides. Twenty-four-hour processing service boosts the price to $2 to $9, and ASAP rush processing costs $3 to $18.

Using CADConvert to translate your AutoCAD .DXF files, you can import the resulting .CGM file into KGS and produce sophisticated slides such as that of **Fig 2.** You can add text in any of six fonts and in sizes ranging from 1 to 500 points, along with text features such as subscripts and superscripts, single and double underlining, accents, highlights, and eight kinds of bullets. The layout module lets you merge and overlay images.

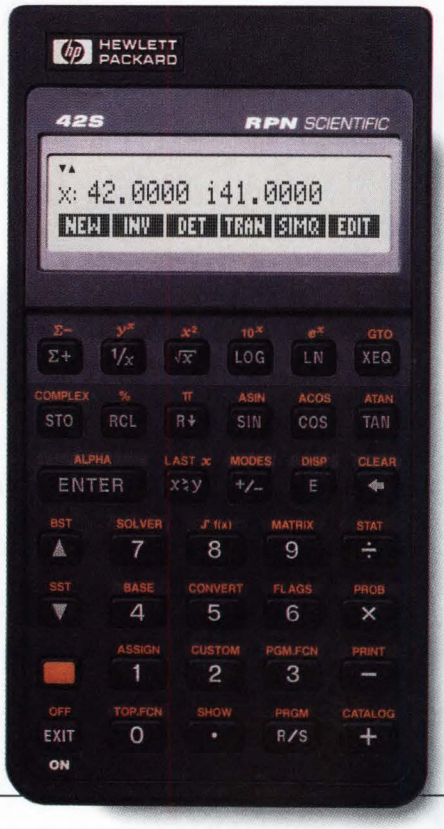
Because KGS is project oriented, the images it generates for a given project are linked and organized. Accordingly, KGS's Quickshow option lets you sequentially view your entire project on your monitor. Besides giving you a 5-sec-per-image review of your progress, Quickshow also provides continuous loop operation for unattended use as a demonstration for trade shows or for customer education. EDN

Reference

1. Mosley, J D, "Electronic documentation tools blend text and graphics for CAE," *EDN*, September 3, 1987, pg 81.

Article Interest Quotient (Circle One)
High 482 Medium 483 Low 484

The new HP-42S. Designed for high performance engineering.



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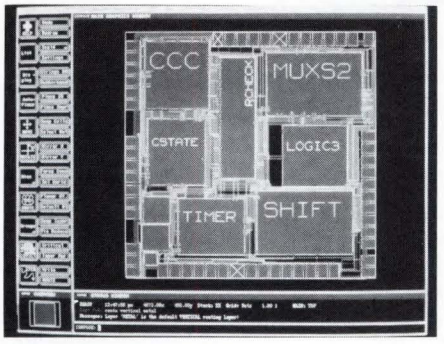
High Tech Basic

Integrated IC CAD package lets you design from schematic capture to verification

The IC Design System includes programs that take you from schematic capture through design verification, thus saving you the time and trouble it takes to learn several different user interfaces in order to work through the various stages of IC design. You can customize any of the system's programs to meet your needs; you can create your own commands, connect a string of commands into a single command, or develop complete applications packages.

The layout editor, EDS III version 1.1, is adapted from the Calma GDS II IC-layout design system. It gives you access to GDS II libraries for development of handcrafted masks.



Compose, a chip-assembly tool, accepts predefined standard cells, compiled cells, or handcrafted custom blocks. Using this tool, you can automatically or interactively place, route, and optimize your chip.

For timing simulation and critical-path analysis, you can use a package called Timemill. Timemill exercises every path in the design, not just the paths exercised by your simulation vectors, and so increases the probability of producing a reliable circuit.

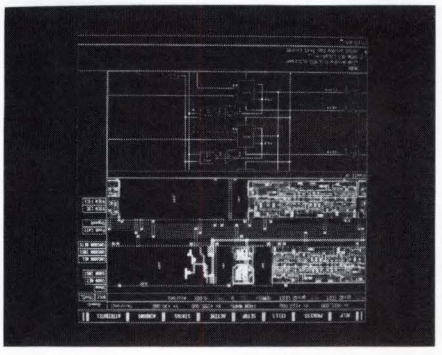
Using the program DRC/Extract, you can perform interactive hierarchical-layout checking. Another program, named Compare, verifies that the circuit implemented in the layout is the one you defined in the schematic. The Compare program also identifies electrically correct layouts. The IC Design System runs on Sun workstations and costs $59,000.

Valid Logic Systems, 2820 Orchard Parkway, San Jose, CA 95134. Phone (408) 432-9400.

Circle No 435

Interactive design-rule checker highlights errors on screen

An enhanced version of the design-rule checker Remedi offers interactive checking with the option of limiting the type of checking you're performing at any given time. It also includes an error locater that finds and highlights on screen any design-rule violations. The programs run under Chipgraph, the company's IC-layout system. Because you can define your checking parameters, you can avoid the problem that arises when a single violation generates a voluminous error report. You can, for example, limit your checks to selected cells, to geometries within a selected area, or to a particular level of abstraction in a cell hierarchy. Remedi can check designs based in technologies like CMOS, BiMOS, bipolar, and GaAs.



Interactive identification and highlighting of design-rule violations with the error locater gives you the chance to modify or correct the errors as you go. Remedi can generate a status report, including the dates and times that specific checks were made.

When you are ready to compare your schematic to your layout, Remedi LVS (Layout Versus Schematic) displays your layout in one window on your workstation and the corresponding area of your schematic in another window. If you point to an object in one window, Remedi highlights the corresponding object in the other window. Although Remedi LVS is not by itself a software checking tool, it works with Dracula II LVS from Cadence (San Jose, CA) and makes interpretations of the Dracula checks easier than working with the usual hard-copy error reports.

Until January, the enhanced Remedi is available for $14,900; thereafter, the price will be $24,900.

Mentor Graphics Corp, 8500 SW Creekside Pl, Beaverton, OR 97005. Phone (503) 626-7000.

Circle No 437

Foundry-independent silicon compiler simplifies ASIC design

Using the ASA silicon compiler, even systems designers can create ICs independent of any particular semiconductor process or technology. During the design process, you can also generate test patterns and evaluate your design for testability.

The compiler's hardware description language allows you to describe both the function and structure of an IC design in a hierarchical form. As a result, you can adopt a top-down approach to IC design. From the outset, the ASA compiler generates layout information so that as you use the compiler's logic editor and simulator, layout-dependent effects—for example, propagation delays—are taken into account. During the layout stage, you can allow the compiler to perform floor-planning and routing operations automatically or interactively.

Version-I of the compiler includes a cell library of SSI and MSI logic functions. You can create macro cells from this library, or add your own cells to it using CIF format cell descriptions. The company plans to offer a second version that will include parameterized cells for regular structures such as RAMs, ROMs, and PLAs. The ASA compiler runs on DEC VAX computers under the VMS operating system. Its open-system software structure allows you to interface it with a variety of existing CAD tools. From around gld 360,000 to gld 900,000.

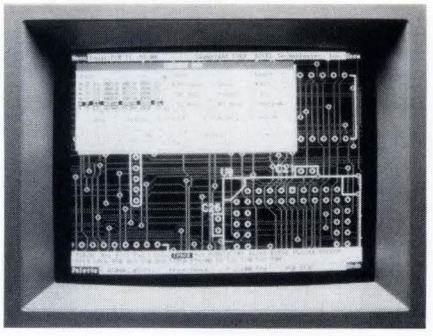
Sagantec BV, Kemenade 12b, Son, 5600 CC Eindhoven, The Netherlands. Phone (04990) 77117. TLX 59163. FAX 04990-73297.

Circle No 438

Low-cost PC-based software performs pc-board design and autorouting

Tango-PCB and Route Series II software packages are powerful enough to design and route a 19-layer pc board. The packages offer an improved user interface that gives you easy access to the main menu, a secondary menu of frequently used commands, a zoom window, and undo commands. You can also link specific commands to different keystrokes with user-defined macros. The packages run on IBM PCs and compatibles.

At a resolution of 1 mil, Tango-PCB Series II has a maximum work space of 32 in^2. The grid system supports snap and visible grids, as well as relative grids, which let you manually place and route regularly and oddly spaced components on any grid you create. The software offers tracks that you can define from 1 to 255 mils; seven pad shapes



with dimensions from 1 to 4095 mils and hole diameters from 1 to 255 mils; and text strings of variable height and line width. The 19 layers you can use include top and bottom silk-screen, solder-mask, and assembly layers to support double-sided surface-mount technology.

Both packages support drivers for CGA, EGA, Vega Deluxe, VGA, Hercules, MCGA, and other graphics cards with resolutions as dense as 1024 × 768 pixels.

The packages can generate hard copy on printers from Epson, IBM, Toshiba, Okidata, Star Micronics, and Hewlett-Packard; on plotters from Hewlett-Packard, Houston Instruments, Roland, and Calcomp; and on Gerber photoplotters.

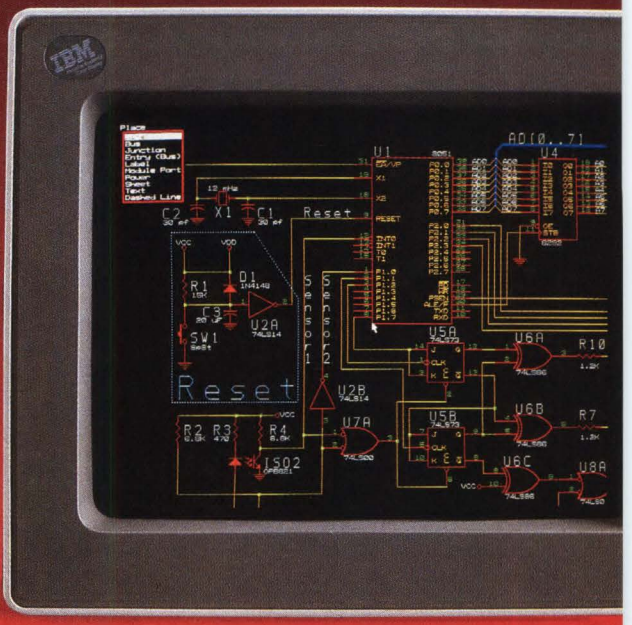
Tango-PCB Series II and Tango-Route Series II, when purchased together, cost $995 and come with a year of free updates. Series I owners can upgrade for $50 per product. Separately, the software for pc-board layout costs $595, and the routing program is available for $495.

ACCEL Technologies Inc, 7358 Trade St, San Diego, CA 92121. Phone (619) 695-2000.

Circle No 436

Schematic Capture

The Best Gets Better



Introducing SDT III

OrCAD/SDT set the standard for low-cost PC-based schematic capture. Now comes SDT III to make the best even better. New feature enhancements and advanced schematic capture capabilities give you *the power of an engineering workstation for the price of your PC, plus only $495.*

Intuitively Simple

Pop-up menus, full English commands, & a logical progression of steps - - all designed to mirror your own intuitive approach to design and simplify the learning process.

Yet, SDT III has the power to let you create and manage complex designs. The program's unique hierarchical approach lets you organize very large worksheets into smaller, more manageable parts. With over 200 hierarchical levels, even complex gate array designs are possible.

SDT Timesavers

Check out the following timesavers from SDT III. They'll enhance your productivity while providing maximum flexibility for your design tasks.

- Library of over 3700 ready-made parts
- Object Editor for custom-created parts
- Part rotation/mirroring
- More than 100 keyboard macros
- Rubberbanding of wires & buses
- User-defined text/object sizes

Schematic Capture & Beyond!

The benefits of SDT III extend beyond schematic capture. For example, you can transfer the finished schematic data to other design programs in your system such as board layout and analog or digital simulation. SDT III provides over 20 netlist formats, including EDIF. Need to print your schematic for documentation or a report? Besides supporting all leading printers and plotters, SDT III provides you with source code to develop your own printer/plotter drivers. You can even customize your output with your choice of template dimensions, text or worksheet sizes.

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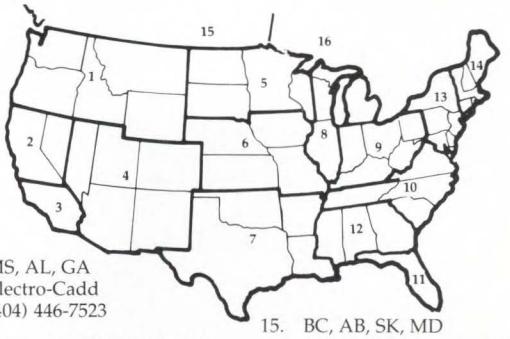

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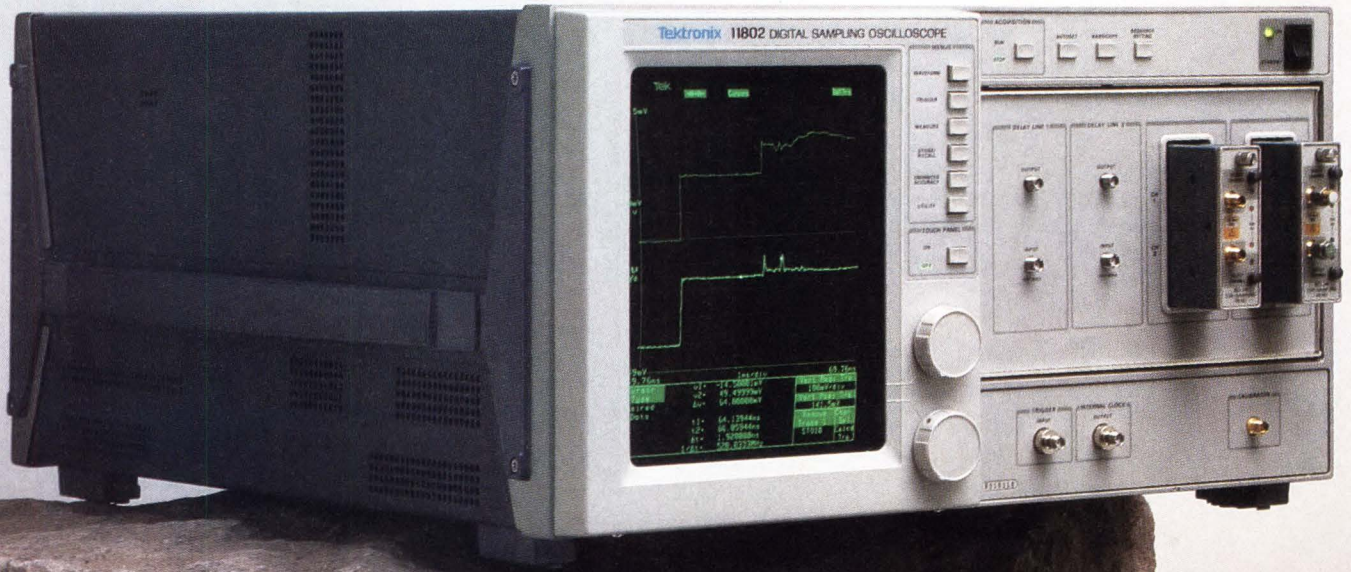
WHEN THERE'S NO ROOM FOR ERROR:



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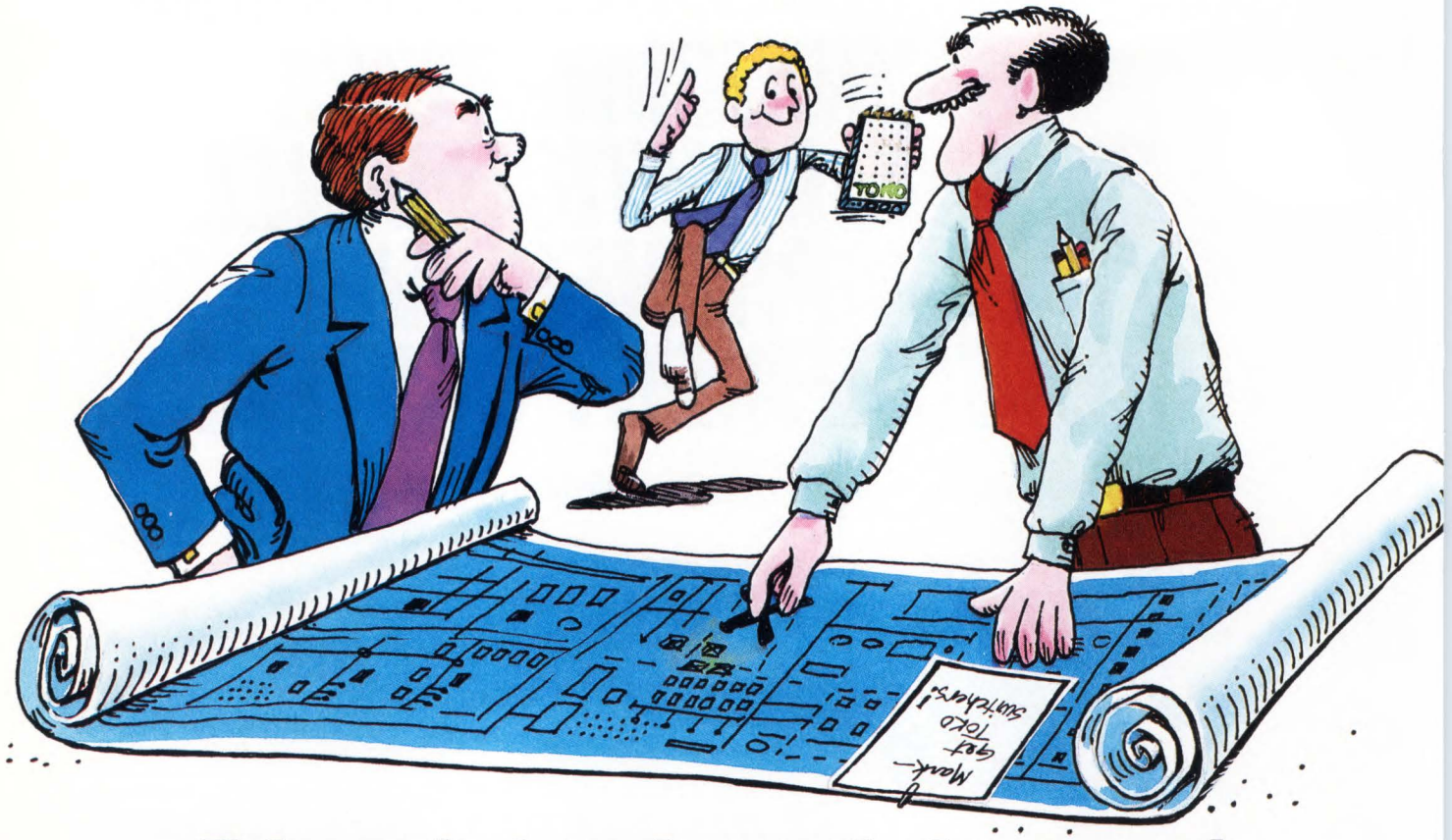

Toko switchers have what you need.

There's no need to overbuy or add extra bulk and heat when you're specifying a low-wattage power supply. Toko has the output power you need in leading-edge switchers.

With over 250 models in the under 50-watt category, Toko offers you the right switcher at a price that will also make the controller happy. Whether you're powering computer peripherals, portable devices or other systems where space is at a premium, Toko is the name to know.

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Low power is different.
The design requirements for a low-power compact switcher are as unique as your own product needs. Toko's 30+ years of experience in magnetics and filtering technology have led to development of switchers that pack the most clean reliable power into your available space.

SERIES	VAC INPUT VOLTAGE	RATED POWER	NO. OF OUTPUTS	NO. OF STANDARD MODELS
ET	85-132	10W	3	6
		15W		
EM	170-264	10W	3	6
		15W		
PU & PS	85-132/ 110-175/ 170-264	10W	1	192
		15W		
		30W		
		50W		
PE&PT	85-132/ 170-264	15W	3 (PT) 1 (PE)	60
		30W		
		50W		
MW	85-264*	15W	3	7
		30W		
		50W		

*Automatic (no jumpers required)

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With MTBF over 200,000 hours, 105°C electrolytic capacitors, 100% 8-hour burn-in, and 20% derating of all components, you may never need our 2-year guarantee. Toko dependability and commitment to servicing your needs give you the lowest cost of ownership in the long run. Our prices and no-charge options save you money now.

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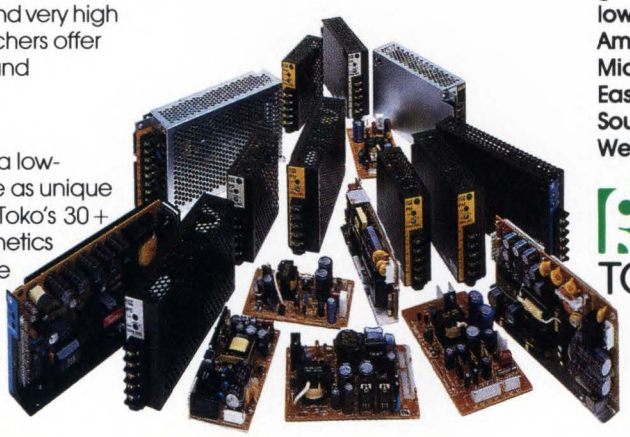

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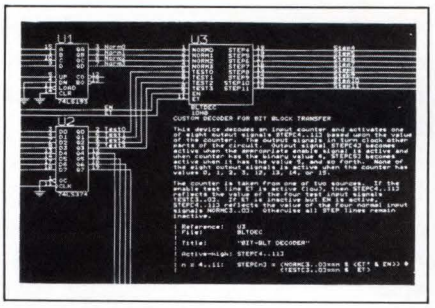
CIRCLE NO 122



PLD SOFTWARE

OrCAD/PLD allows you to store equations, state-machine procedures, and text describing the logic in a specific device next to its symbol on the schematic. If you make subsequent design changes to the internal logic of the PLD, the software will reflect those changes in the documentation next to the device symbol on the schematic. You can define the logic using a proprietary form of indexed equations that reduce large and complex Boolean equations to a single line. OrCAD/PLD expands the indexed equation into Boolean logic, then optimizes it for the device. You can also use a procedural programming language for state machines, truth tables, Boolean equations, and schematic symbols to define the PLD.

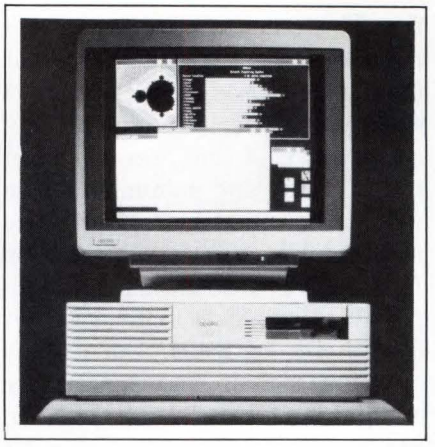
OrCAD/MOD is an optional utility for the company's existing simulation product, which can read JEDEC files and use the information to create simulation models of the PLD. You can then exercise the PLDs with the other components in your circuit to produce a timing-based, board-level simulation. The software comes with more than 200 full-specification timing models; it also allows you to develop your own models, if needed. Each device, $495.

OrCAD Systems Corp, 1049 SW Baseline St, Suite 500, Hillsboro, OR 97123. Phone (503) 640-9488.

Circle No 522

WORKSTATIONS

Delivering 7 and 4 MIPS, the Series 4500 Personal Super Workstation and Series 3500 Personal Workstation are based on the Motorola



MC68030 μP. The Series 4500 uses 33-MHz central and floating-point processors, offers memory from 8M to 32M bytes, and has a throughput nearly twice that of the Series 4000. The Series 3500 uses 25-MHz processors and has 4M to 32M bytes of memory. You can get both computers with 155M to 696M bytes of disk memory. Both workstations are fully compatible and expandable throughout the personal-workstation product family and you can upgrade from the Series 3000 and 4000 products.

The Series 4500 is available in three 19-in.-display configurations: a 1280 × 1024-pixel monochrome display; a 1024 × 800-pixel, 8-plane color display; and a 1280 × 1024-pixel, 8-plane color display. You can purchase Series 3500 in the following configurations: a 15-in., 1024 × 800-pixel monochrome display; a 19-in., 1280 × 1024-pixel monochrome display; a 15- or 19-in., 1024 × 800-pixel color display; and a 19-in., 1280 × 1024-pixel 8-plane color display. Series 4500, from $18,990; Series 3500, from $7990.

Apollo Computer Inc, 330 Billerica Rd, Chelmsford, MA, 01824. Phone (617) 256-6600.

Circle No 521

PCB WORKSTATION

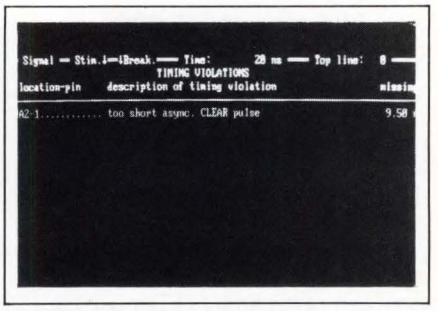
The SeriCAM PC-based workstation runs software developed by Infinite Graphics; the hardware is from Hewlett-Packard and Mitsubishi. The workstation consists of



two monitors, a keyboard, a mouse, a disk drive, and an optional graphics tablet. The software lets you use CAD-generated pc-board design data to produce board-manufacturing information for output to laser or vector plotters. You can adjust feature sizes, step-and-repeat the circuit design to produce multiple originals, and merge the circuit with venting patterns that are stored in a panel database. Once you have set the design parameters, the system design-rule-checking function identifies rule violations and lets you correct them and store the corrected design. The program can direct output to magnetic tape or to a local-area network for use by any currently available photoplotter. The software is menu driven. $55,000 (including all hardware).

E I Dupont de Nemours & Co Inc, Imaging Systems Dept, Eagle Run Site, Wilmington, DE 19898. Phone (302) 733-9191.

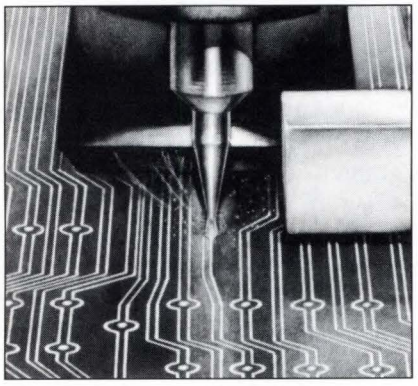
Circle No 543



TIMING VERIFIER

TIM Rev 5.0 is an optional enhancement for SUSIE 5.0 that automatically reports simulation timing violations. TIM is fully interactive so you can fix design errors and modify chip-propagation delays on the

New BoardMaker™ cuts prototyping costs.



Advanced software, personal-sized hardware.

The new BoardMaker breaks through price and size barriers for making your *own* prototype circuit boards with most CAD systems. How? By combining proprietary new software and rugged small-size hardware developed as a totally integrated peripheral.

High performance.

BoardMaker speed has just been boosted to a blazing 88 inches/minute. (So making a typical 2" x 3" board now takes just four minutes.) You can produce single-and double-sided boards, and form conductor lines as small as 5 mils. Throughplating is offered as an option. All board production is mechanical—there are no chemicals, fumes or toxicity problems.

Low cost: $5,000.

You can pay for your BoardMaker after making about a dozen boards. (The cost is one-third that of older technology machines.) You'll save at least a week at every level of design. And you'll eliminate all the outside prototyping charges you're paying for now: standard charges *and* rush charges. For more information, call (415) 883-1717 or use the reader card.

LBO

20A Pamaron Way
Novato, CA 94948

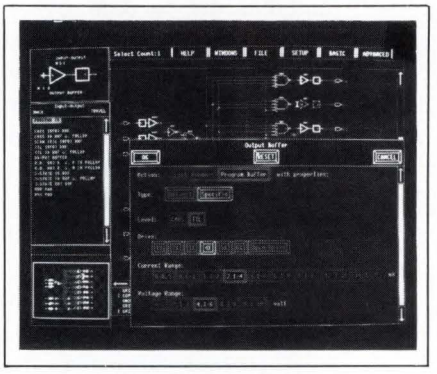
CIRCLE NO 123

Computer-Aided Engineering

fly. The enhancement simulates multiple PLDs and processors at the system level and can report such violations as edge-to-edge, setup and hold time, set and reset time, clock, and minimum pulse width. You can also graphically see metastability. TIM Rev 5.0 runs on IBM PC/XT, PC/AT, and 386 computers under MS-DOS 3.0, requires 512k bytes of RAM, can display over 1000 signals, and is a 12-state simulator. TIM, $2495; SUSIE, $1495.

Aldec Co, 3525 Old Conejo Rd, Suite 111, Newbury Park, CA 91320. Phone (805) 499-6867.

Circle No 524



PROTOTYPING PCB

ProtoView allows key layout and manufacturing considerations to be specified earlier than usual in the design process. The package is integrated into the IDEA capture and simulation tools, Board Station PCB CAD tools, and Package Station thermal-analysis tools, and lets you specify critical component placement. You can also partition the design and automatically or interactively place components according to design rules, device properties, and connectivity. ProtoView provides an estimate of placement area and identifies areas of concern early in the design cycle, which can help you guide the proper layout of your boards.

The software provides simultaneous 2-sided placement, handles mixed technology such as surface-mount devices, through-pin devices, and mixed analog and digital components. You can view the schematic and resulting layout on a split screen, and ProtoView will highlight iterative placement modifications to indicate changes. Finally, you can generate reports to provide symbol and component usage count, spares count, and the company part number. Through December, $8000; thereafter, $14,900.

Mentor Graphics Corp, 8500 SW Creekside Pl, Beaverton, OR 97005. Phone (503) 626-7000.

Circle No 525

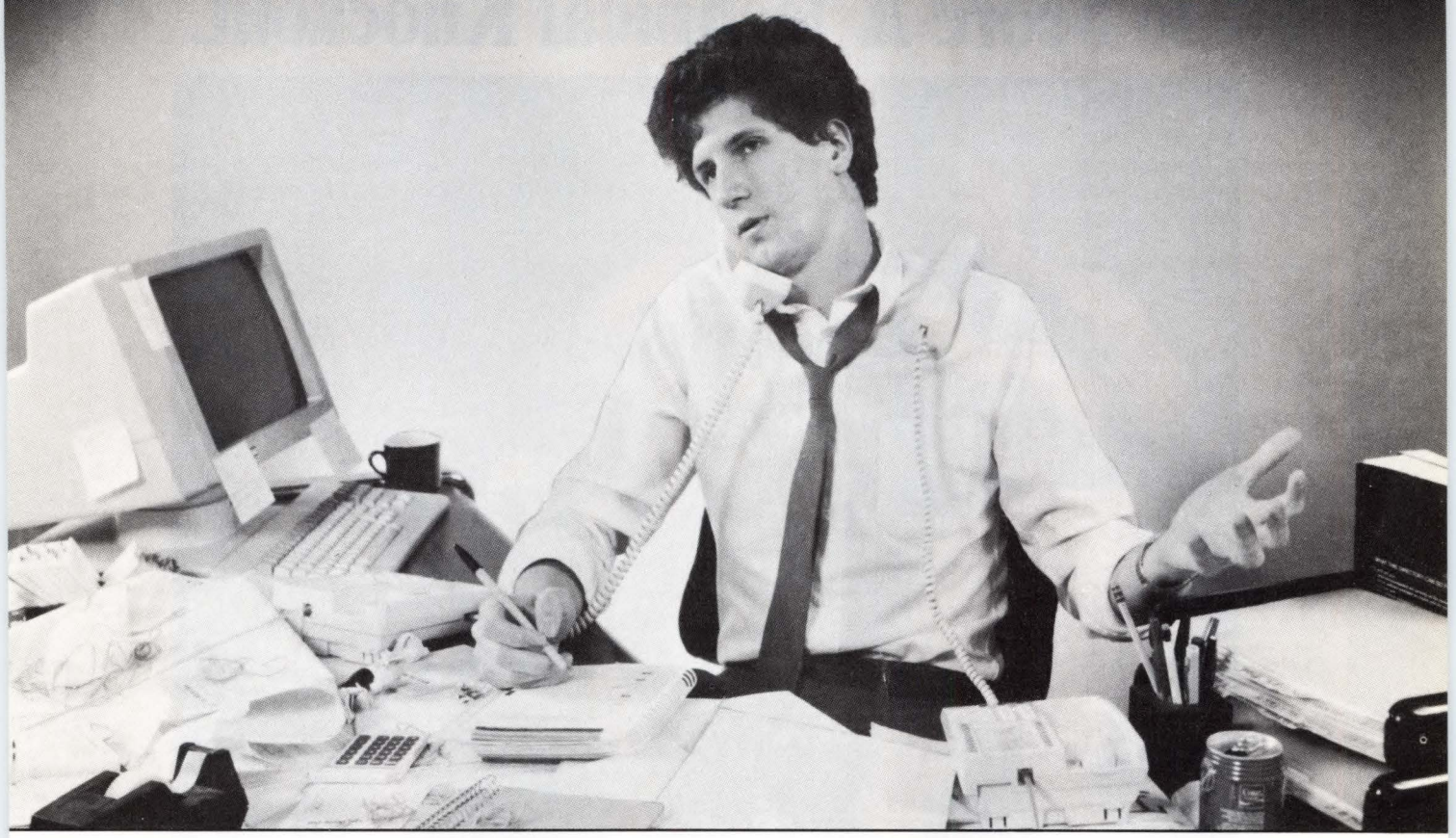


PC-BASED ICP

The BoardSite 4100 and BoardSite 4400 are IBM PC-based in-circuit programming systems for onboard programming of PROMs, EPROMs, EEPROMs, μPs, microcontrollers, and PLDs. Because you needn't worry about damaging surrounding devices while programming, you lower manufacturing and service costs. The programmers connect to any IBM PC-compatible computer via a high-speed expansion bus (provided as part of the package) and rely on the PC for data-flow control, disk storage, and processing speed.

Available in both benchtop and portable models, the BoardSite 4100 can program boards singly, while the BoardSite 4400 will program several boards simultaneously. Included in the package is a menu-driven board-profile-development software program, which leads you through the steps to cre-

WHO DO YOU CALL WHEN YOUR DEBUGGER WON'T DEBUG?



The problem with most real-time operating systems is simple, they're not an integrated solution. You end up dealing with a multitude of suppliers for languages, compilers, debuggers and other important development tools. And when something does go wrong, it can be a frustrating experience trying to straighten out the mess.

Why Not Try the Microware One-Stop Total Solution?

Microware's OS-9 Real-Time Operating System is a total integrated software system, not just a kernel. We offer an extensive set of development tools, languages, I/O and Kernel options. ***And this total integrated solution is entirely designed, built and supported by the same expert Microware team.***

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The modular design of OS-9 allows our Operating System to adapt as your requirements change. OS-9 can support a complete spectrum of applications — from embedded ROM-based code in board-level products all the way up to large-scale systems.

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CIRCLE NO 124

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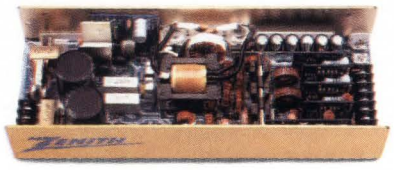

It took an industry heavyweight like Zenith to put it all together. The kinds of options and features you'd have to pay extra for with other manufacturers. Combined with competitive pricing. And even a smaller footprint, so you save on space, too.

It all adds up to a full family of technically superior standard switching power supplies. And a value you'll find hard to match. Because we've outclassed the other contenders in every round:

- **CERTIFIED.** The Zenith series meets international safety requirements of UL 478; CSA 22.2, No. 154; IEC 380; VDE 0806; VDE 0871/B; FCC PART J, CLASS B.
- **FLEXIBLE.** All outputs are independently isolated, mag amp regulated, and adjustable. Outputs 2 and 3 can be widely adjusted between 10 and 15V. to meet different equipment demands–at no extra cost!
- **TOUGH.** Exceeds 100,000 MTBF for durable performance.
- **RELIABLE.** Comes with 2-year limited warranty, backed by Zenith.

Output & Voltage Current Ratings

Model	Max Output Power (Watts)	Main Output Volts DC (Min/Max)	Main Output Amps (Min/Max)	2nd Output Volts DC (Min/Max)	2nd Output Amps (Min/Max)	3rd Output Volts DC (Min/Max)	3rd Output Amps (Min/Max)	4th Output Volts DC (Min/Max)	4th Output Amps (Min/Max)	Size (inches)
ZPS-250-N	250	4.75/5.25	3.5/35.0	10.0/15.5	0.4/4.0 PK6	10.0/15.5	0.4/4.0 PK6	4.75/5.25	0.3/3.0	5.0 x 2.5 x 13
ZPS-300-N	300	4.75/5.25	4.5/45.0	10.0/15.5	0.8/8.0 PK12	10.0/15.5	0.8/8.0 PK12	4.75/5.25	0.4/4.0	5.0 x 2.5 x 13
ZPS-400-N	400	4.75/5.25	5.5/55.0	10.0/15.5	1.0/10.0 PK15	10.0/15.5	1.0/10.0 PK15	4.75/5.25	0.6/6.0	6.0 x 2.5 x 13

For optional steel cover substitute -C for -N in model number.

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ZENITH

THE QUALITY GOES IN BEFORE THE NAME GOES ON*

*1988 Estate of Rocco Marchegiano (A.K.A. Rocky Marciano) under license authorization by Curtis Management Group, Indianapolis, Indiana.

ZV3

ate the board profile that contains information such as address locations, bus widths, and data source necessary to program the board. You also get password-controlled access to multiple levels of programming capability to protect against unauthorized or accidental changes to board profiles. BoardSite 4100, from $9500; BoardSite 4400, $14,500.

Data I/O Corp, 10525 Willows Rd NE, Redmond, WA 98073. Phone (206) 881-6444. TLX 152167.

Circle No 526

AMP SYNTHESIZER

The Complex Match II tool package can synthesize linear amplifiers and lossless passive impedance-matching networks. You can use Complex Match II to design amplifiers to approximate a specified transducer power-gain response using low input and output VSWRs or to approximate specified gain and noise vs frequency responses using low maximum output VSWR. The package works no matter how complex the load and source impedances are. You don't need equivalent circuits for the impedances to be matched or an analytical expression for the gain response.

The amplifier design techniques are based on those described by Pieter Abrie in *The Design of Impedance-Matching Networks for Radio-Frequency and Microwave Amplifiers*. Complex Match II requires an IBM PC-compatible computer with 512k bytes of RAM, a math coprocessor, graphics card, and a hard disk. $4500.

Compact Software, Inc, 483 McLean Blvd at Corner of 18th Ave, Paterson, NJ 07504. Phone (201) 881-1200. TLX 130073.

Circle No 527

PC PCB DESIGN

The MAXI/PC software package allows you to design double-sided surface-mount designs having 16 signal layers and multiple power and ground planes—all with a resolution of 1/1000 in. MAXI/PC supports placement, gate and pin swapping, component rename, back annotation, and routing. The PC-based software can accommodate boards with as many as 500 IC equivalents, 1023 components, 3500 connections, and 64 pad codes. $995.

Racal-Redac, Inc, 238 Littleton Rd, Westford, MA 01886. Phone (508) 692-4900.

Circle No 528

DESIGN INTERFACE

The EDIF Design Interface allows you to transfer schematics and netlists freely among multivendor ASIC design automation tools and complies with the EDIF (Electronic Design Interchange Format) specification. Because the interface is bidirectional, you can read and write schematics and net lists in any combination between any EDIF-compatible systems, such as those from Synopsis, Mentor, Daisy, TI, Cadnetix, HP, and ViewLogic. A group of CAE tools and ASIC vendors proposed EDIF as an industry standard for design interchange in 1983 and many have since committed to it. The interface is available free of charge and is bundled with the Design Compiler and updates.

Synopsys Inc, 1500 Salado Dr, Mountain View, CA 94043. (415) 962-5000.

Circle No 529

PC PC-BOARD DESIGN

Easy Route, an integrated CAE software package, includes schematic capture, automatic routing of traces, interactive layout, error checking, and artwork production. The schematic capture editor allows copy, move, delete, and permits you to add complete or partial drawings to your design. It produces a net list and a parts list compatible with EDIF, Futurenet, P-CAD, and Racal-Redac.

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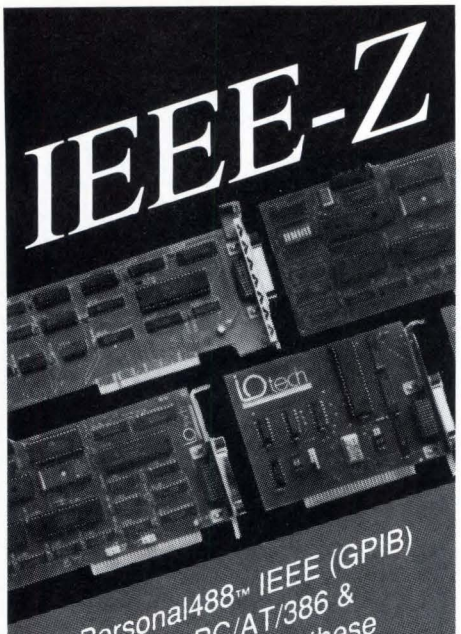

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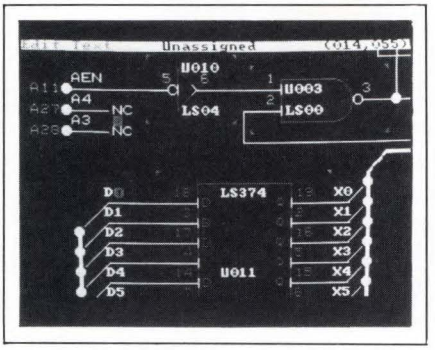
CIRCLE NO 127

Computer-Aided Engineering



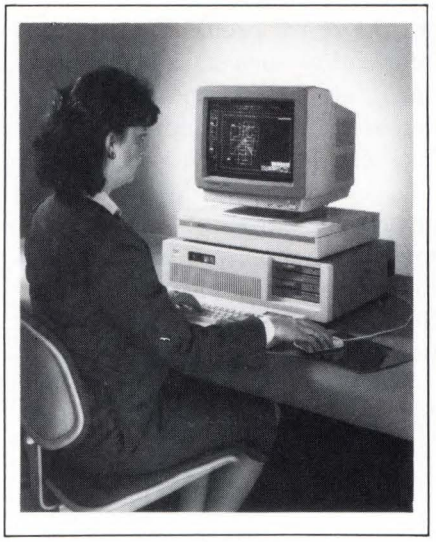
The autorouter can route as many as 256 layers, two at a time. You can define routing grids, line widths, line clearance, and pad shape. You can also preroute or exclude routing from certain areas of your board. Your traces and components can be off grid and your traces can have multiple widths. Easy Route accepts net lists from EDIF, Futurenet, PCAD, Racal-Redac, Schema, OrCAD, and many other vendors. The software runs on the IBM PC, PC/XT, PC/AT, PS/2, and compatibles having IBM CGA, IBM EGA, or HGA graphics adapters. It can interface with many dot-matrix printers and pen plotters, and can produce Gerber files as well. $500.

Advanced Microcomputer Systems, Inc, 1321 NW 65th Pl, Fort Lauderdale, FL 33309. Phone (800) 972-3733; in FL (305) 975-9515.

Circle No 530

PC CADD

ACCLAIM! is a PC-based CADD (computer aided design and drafting) package offering on-demand 3D model construction, allowing you to import and export 3D models between other systems for analysis. On-screen menus, prompts, messages, and an intuitive command structure simplify the user interface. You can also perform geometric construction and editing; have access to multiple, independently-scaled views; and use ANSI, ISO, DIN, JIS, and BSI standard dimensioning. ACCLAIM! can group figure, layer, and overlay concepts



and has text handling capabilities as well. The package includes CADRE-II design/drafting software and a coprocessor module. The module contains a Motorola 68020 32-bit μP, used as a coprocessor, and 4M bits of RAM, loaded with the Cadra-II software on boot-up. An AMD 29116 16-bit μP running alongside a custom gate array power the graphics.

To run ACCLAIM!, your IBM PC, PC/XT, PC/AT, PS/2 or compatible computer must use MS-DOS 3.1 or higher. Other requirements include an internal card slot for the interface card; a hard-disk drive with at least 20M bytes; either a Microsoft Mouse or compatible, or a Summagraphics Summasketch tablet and stylus; and IBM EGA, IBM VGA, or IBM 8514 compatibility. A complete turnkey system, built on a 10-MHz 80286-based PC, $14,995; a 16-MHz 80386 version, $17,995. ACCLAIM!, $10,795.

Adra Systems, Inc, 59 Technology Dr, Lowell, MA 01851. Phone (508) 937-3700. TLX 6974550.

Circle No 531

MAC CAD

The Dreams CAD package gives you an 8×8-ft drawing size, real-world scaling, geometric tools, object manipulation, layering, and associated dimensioning. Its color-pattern editor allows you to create

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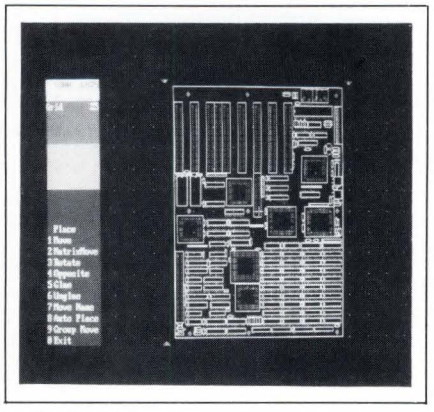
new colors, edit existing shades, and import colors from different documents. In addition, colors can be averaged and blended with "finger painting" and "paint bucket" tools. Dreams offers ten shades of laser-printer gray for noncolor environments.

Geometric capabilities include parallel lines, Bezier curves and splines, and various line constraints for precision drawing. Object manipulation features like 32× zoom-in/zoom-out, object and text rotation around various axes in fractional degrees, and dimensioning that automatically updates as you make changes, are also at your fingertips when you use Dream. The vendor plans add-ons including a plotter-driver utility and a file-conversion module allowing 2-way communication with DFX and IGES files. $500. Registered MacDraft user-update, $200.

Innovative Data Design Inc, 2280 Bates Ave, Suite A, Concord, CA 94520. Phone (415) 680-6818.

Circle No 532



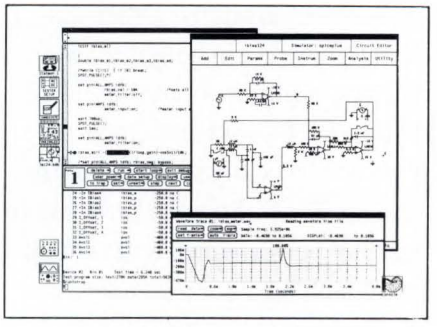
PC CAD

Using the smooth-panning feature of Schema II+, you can review your entire schematic without redrawing. This upgrade from Schema II also has a user-defined step-and-repeat function to simplify drawing traces and placing components. The IBM PC-based CAD software offers you the flexibility of input entry via keyboard or mouse, with mouse-accessed menus nested either one or two deep. Schema II+ allows you to assign as many as nine separate device libraries of 4500 parts each to a particular drawing. An on-line parts browsing feature displays the parts in the libraries and lets you select one and return with it to the drawing for placement.

To create a new component, you can access Schema II+'s re-entrant object-oriented editor directly from within the schematic editor. Schema II+'s Library Management software automatically places the new component in the library of your choice and makes the part immediately available for placement. You can design circuits using any degree of hierarchy you want, using as many as 99 pages/block. The Schema II+ post processor can append and flatten your hierarchical design for interface to other vendors' software. You can also see the results of nine design rule checks. $495.

Omation Inc, 1210 E Campbell Rd, Suite 100, Richardson, TX 75081. Phone (214) 231-5167.

Circle No 533



CAE ANALOG ATE

The Test Development Tool Kit is a total simulation solution for designing and testing the function of an IC in a simulated working environment. You can design a load board, model the interface to the tester, determine how a device is working in the environment, and debug a program before the device is in silicon. The package links the Analog Workbench analog circuit simulator and Image (Interactive Menu-Assisted Graphics Environment) high-level, graphics-based environment that allows you to write code for fast, easy test-program development. Analog Workbench features schematic capture, a full set of simulated test instruments, stress analysis, manufacturing-yield analysis, and a power-circuit-design capability.

Teradyne's Image lets you simulate analog or mixed-signal test systems on a workstation and simplifies programming and debugging. Some of the tester instrumentation models included with the Test Development Tool Kit are both dc and ac source meters, a precision source meter, a time-measurement system, and a quad op-amp test loop. The tool kit is compatible with Sun 3 workstations and comes with a tester interface, statistical-analysis tools, a parametric plotter, a translator, a basic device library, and test-instrument models. $21,500.

Analog Design Tools Inc, Box 3422, Sunnyvale, CA 94088. Phone (800) 345-4356; in CA, (408) 737-7300.

Circle No 534

DESIGN-IN TEST

RapidTest combines a fault simulator, a test program-development language called TDL (Test Description Language), and a hierarchical menu facility called the Test Manager. You use RapidTest to measure the effectiveness of manufacturing defect-detecting test programs in ASIC and pc-board designs. Using RapidTest, you can ensure the testability of your design by modeling defects, developing a test program, and measuring the quality of the program while the project is still in the design phase.

Incorporating schematics you create with the ValidGED graphics editor, and libraries and simulation vectors you develop with ValidSIM, RapidTest determines all faults in a circuit that are detectable by a

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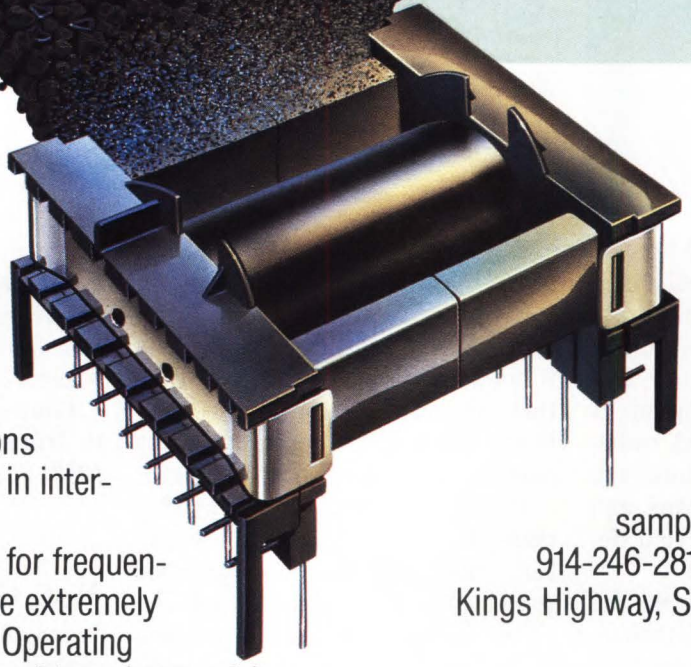

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For information and samples, call Terry Parisian at 914-246-2811. Or write him at 5083 Kings Highway, Saugerties, NY 12477.

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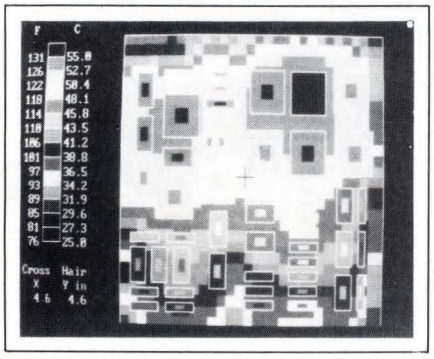
test program and pinpoints the types and locations of undetectable defects. The output report provides fault-coverage statistics for testability checking, toggle test data for controllability checking, uncovered fault lists for directed pattern improvements, and a histogram of faults detected per test vector to optimize testing time.

RapidTest supports three logic levels (1, 0, and unknown) and four drive strengths (hard, soft, memory, and indeterminant), separate rise- and fall-device delays, and back annotation of wire and fan-out delays. You can run the software on Sun 3 and 4 workstations, DEC VAXStation II 3000, and 8000 Series workstations and mainframes. $17,500.

Valid Logic Systems, 2820 Orchard Parkway, San Jose, CA 95134. Phone (408) 432-9400.

Circle No 535



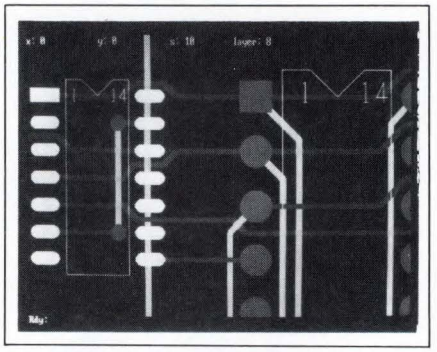
HEAT-ANALYSIS TOOL

Performing 3-D thermal analysis of your pc-board designs is the province of this software tool that interfaces with the EE Designer III. The package models component conduction, convection, and radiation characteristics and lets you predict thermal distributions and locate thermal problems in your designs.

Extracting information from the EE Designer III's system database, the thermal-analysis software considers board size, density, package type and orientation, copper density areas, and heat-dissipation values. You can even specify environmental parameters like temperature, pressure, humidity, and air velocity to find their impact on your placement. Using a finite-difference numerical scheme to compute the thermal analysis, the software typically performs a thermal evaluation of a 100-component circuit board on an IBM PC/AT in 2½ minutes. This thermal-analysis software option requires an IBM PC, PC/XT, PC/AT, PS2, or compatible computer with a 640-kbyte RAM, color graphics, a hard disk, and a mouse. $1000; EE Designer III, $3995.

Visionics Inc, 343 Gibraltar Dr, Sunnyvale, CA 94089. Phone (800) 553-1177; in CA, (408) 745-1551. TLX 346352.

Circle No 536



MULTIFEATURE CAD

DC/CAD Release IV offers a parts autoplacer that operates in three passes. The first pass generates an initial placement guided by your circuit net list; the second pass optimizes routing channels and spreads components to improve routing efficiency; the third pass swaps parts to minimize routing difficulty. Further, you can place critical components interactively and tag these parts as movable or locked in place.

During collision checking, Draftsman-EE IV, the multipurpose editor, emits warning messages for routes and pads. You can use the editor for swapping pads and parts from top to bottom or vice versa. A 3:1 graphics speed improvement on standard IBM EGA cards is another benefit of the new release.

To aid in routing your designs, DC/CAD Release IV has a rip-up and retry router. Some utilities included in DC/CAD Release IV allow you to create pads and vias from a menu-driven interface; to back-annotate the numbering of parts; and to convert Gerber format photoplotter files to Draftsman-EE so you can examine the photoplots with the editor. $3495.

Design Computation Inc, Route 33, Sherman Square, Farmingdale, NJ 07727. Phone (201) 938-6661. TWX 510-601-8352.

Circle No 538

PARAMETRIC MODELER

Running on a Cyber 910 workstation, the ICEM Parametric Modeler combines several conceptual-design capabilities, such as parametric dimension-driven geometry, feature-based construction, complete 2-D/3-D associativity, solid modeling, complex assembly design, and assembly layout. Functioning under the ICEM suite of CAD/CAM tools, the Parametric Modeler utilizes the ICEM EDL information-management system, based on a relational database manager, to control the design. You can design using parametric "features"; that is, you can select a hole, a shaft, a slot, or a flange from a menu, rather than having to build them from lines, arcs, and splines. Performing "What if..." analysis is as simple as regenerating a model with new parameter values. The Modeler also lets you assemble the components. From $14,500.

Control Data Corporation, Box 0, Minneapolis, MN 55440. Phone (800) 553-2215.

Circle No 537

MAC CAD

VersaCAD/Macintosh version 2.0 contains substantial improvements over earlier releases of this CAD program for the Macintosh. A 3-D visualization feature allows you to

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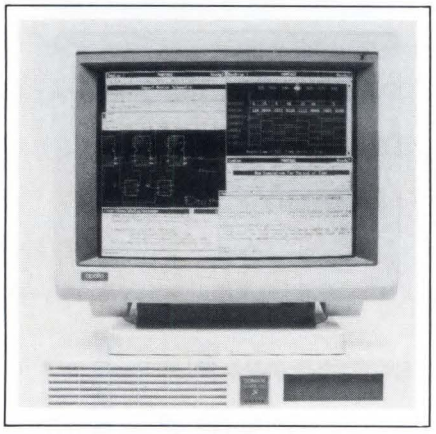
transfer 2-D designs to 3-D format; you can then display the design using any mix of wireframe, isometric, perspective, or hidden-line views. If you change one of these views, the program automatically updates the other views to reflect the changes. Light-source color shading provides surface-model renditions.

The package includes three Hypercard stacks: a parametric-design stack that lets you define relationships between different views and assemblies of your design, a database stack that lets you include descriptive information about any design object, and a drawing-manager stack that produces a catalog of all the designs you have completed with the aid of VersaCAD/Macintosh. The PICT import/export feature lets you transfer designs between VersaCAD and other Macintosh applications. You can also perform the transfer by means of other standards such as IGES, DXF, and ASCII file formats. $1995.

Versacad Corp, 2124 Main St, Huntington Beach, CA 92648. Phone (714) 960-7720.

Circle No 539

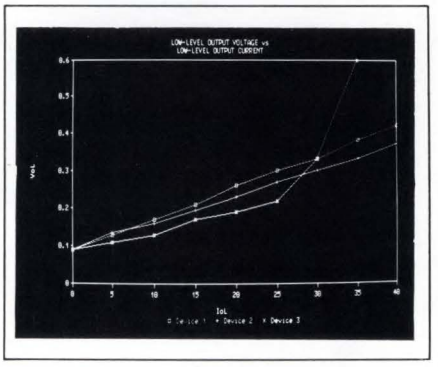


DESIGN VERIFIER

The VantageSpreadsheet lets you use VHDL (VLSI Hardware Description Language) statements to create a schematic, simulate the design's operation, and display the results in real time. You can select multiple windows for displaying your definitions. You can also display all or part of the resulting schematic and see waveforms at critical nodes. The package includes a complete implementation of IEEE specification 1076 VHDL standard. The package comes with VHDL-compatible library models. You can import schematics created with other CAE tools that use existing standards such as Unix, VHDL, and EDIF (Electronic Design Interchange Format). However, because the simulator uses incremental compiling techniques, you can make changes on the fly and see the results immediately without going through time-consuming, start-up procedures such as net-list extractions. When you're satisfied with the performance of the design, you can re-export the modified schematic to your standard CAE tools for full processing. The program runs on Apollo Domain workstations and costs $30,000 to $60,000, depending on the host's configuration.

Vantage Analysis Systems Inc, 428-40 Christy St, Suite 201, Fremont, CA 94538. Phone (415) 659-0901. FAX 415-659-0129.

Circle No 540



ASIC ANALYSIS

The Characteristic and Timing Analysis (CTA) package allows you to automate any Logic Master measurement, collect and format the test results for analysis, and control the Logic Master from a spreadsheet program. CTA is compatible with any product contained in the vendor's Logic Master ASIC-verification family. The program provides menu-driven routines for making ac and dc measurements of prototype ASIC devices and for the Shmoo-plotting of the interaction of any two device variables. One of the menus lets you measure propagation delay, setup time, and hold time. You can also create your own analysis routines using any of the 30 preprogrammed CTA functions. Prices start at $3000 for the Logic Master ST workstation.

Integrated Measurement Systems, 9525 SW Gemini Dr, Beaverton, OR 97005. Phone (503) 626-7117.

Circle No 542

SIMULATOR

The Transmission Line Calculator electromagnetically simulates transmission lines in pc-board, hybrid, and system-level designs. The software works on IBM PCs with math coprocessors, as well as Sun and Apollo workstations. Because the software uses the design's database to check signal quality, you don't have to generate test vectors or input patterns. When combined with the vendor's Motive analysis tool, the software provides worst-case analysis. It lets you check for path delays and clock skew in digitally synchronous designs. From $3550.

Quad Design Technology, 321 N Aviador Blvd, Suite 111, Camarillo, CA 93010. Phone (805) 987-6221.

Circle No 541

PAPERLESS BLUEPRINT

PreVIEW allows you to communicate your design with all members of the product-process team—engineers, CAD designers, managers, manufacturing, QA, purchasing, and service—while maintaining document control. You can allow the team to view all sources of design information, including scanned images from paper-based drawings



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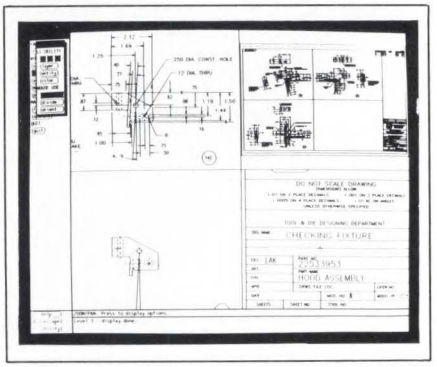
Because when it comes to DC-DC converters, the biggest ideas are now available in the smallest packages.

ASTEC

The Real Power



and documentation, CAD drawings, and 3-D models on PCs under MS-DOS or on Sun or Apollo workstations under Unix. The PreVIEW software gives you or your team the ability to create new views, zoom in or out, and mirror and rotate to generate different perspectives of the design. Your colleagues can make notations about dimensions or specifications or highlight questionable areas and then return a "marked up" electronic version of the documentation for your review. You receive a "clear overlay" that you can view on top of the CAD database.

You can also use PreVIEW to overlay two revisions of a drawing to compare them and graphically determine what changes have been made. The software accepts CAD data in either IGES or standard plot file format, and it supports the complete MIL-D-28000 engineering-drafting application subset of IGES. PreVIEW allows you to output data in several different plotter and printer formats including HPGL, CGM, and PostScript, and the files are compatible with many desktop publishing packages. From $2595.

Rosetta Technologies Inc, 1225 Northwest Murray Rd, Portland, OR 97229. Phone (503) 626-2288. FAX 503-643-6760.

Circle No 546

PC-BOARD CAD

The Versatron 2000 pc-board CAD system not only allows you to design double-sided pc boards, but it also allows you to etch and drill your own prototype boards. The CAD system, which is based on a dedicated 16-bit color-graphics computer with 1.2M bytes of RAM, features high-speed redrawing of any part of the layout, labeling of component pads, dynamic rubberbanding, and automatic generation of vias when you move tracks from one side of the board to the other.

The system also has a multipass autorouter that in many cases is capable of 100% routing. You drive the system using a mouse and pop-up screen menus. To increase speed, the system runs entirely in RAM, only requiring disk storage to access component libraries and to store completed layouts. In addition to generating normal hard-copy plots, the plotter provided with the system can also plot the track layout directly onto a copper-clad pc board ready for etching. By replacing the plotting head with the drill head supplied, you can also drill the pc board. £5750 for all the necessary hardware and software.

Versatronics Ltd, Mardy Rd, Cardiff CF3 8EQ, UK. Phone (0222) 770488. FAX 0222-779295.

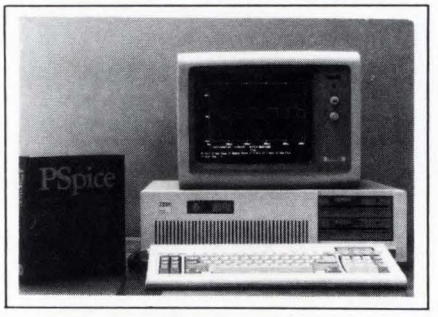
Circle No 547

ANALOG ANALYZER

FanSim (FFT, Frequency ANalysis, and SIMulation) provides comprehensive simulation capability in the frequency domain. Inputs may be real, measured-response, or time-domain functions obtained from the vendor's TutSim program or generated internally by the program. FFT techniques convert time-domain responses to spectral functions. The program will find the transfer functions of real or simulated systems and will find poles and zeros. It will accept input or produce output in the form of polynomial functions, poles/zeros, graphical curves, spectral arrays, or pole residues. The program is menu driven and provides more than 40 functions for the manipulation of spectra. To run the program, you need an IBM PC or compatible that has at least 330k bytes of RAM (512k bytes recommended); an IBM CGA or EGA, or a Hercules graphics card; and a math coprocessor. $395; demo disk, $39.95.

Tutsim Products, 200 California Ave, Suite 212, Palo Alto, CA 94306. Phone (415) 325-4800.

Circle No 544



OS/2 PSPICE

You can now perform analog circuit simulation using PSpice under the OS/2 operating system on the PC family of computers—PSpice is a widely used analog device-level simulator and is not limited to PS/2 computers. The OS/2 version of PSpice can access all of the memory installed in the PC—each transistor needs about 2.3k bytes of RAM—and can also run as a background task. All of the PSpice options—Probe, Parts, Monte Carlo analysis, Digital Files interface, and Device Equations—are also available for OS/2. The OS/2 version of Probe has no limit on the number of data points it can display. PSpice, $1450; Device Equations, Monte Carlo analysis, and Digital Files interface, $550; Probe and Parts, $750 each.

MicroSim Corp, 20 Fairbanks, Irving, CA 92718. Phone (800) 826-8603; in CA, (714) 770-3022. TLX 265154.

Circle No 523

ZIATECH CORPORATION

CONTROL POINT

Test and Control Product News from Ziatech Corporation Winter, 1988

For Hostile Environments –

NEW HOT AND COLD RUNNING STD SYSTEM INTRODUCED BY ZIATECH



XTP DOS, Ziatech's new wide temperature/low power STD DOS system, can withstand temperatures ranging from -40° to +85° C. For a guide to choosing the right STD DOS system for your application, see page three.

New CMOS System and Board Level Products from the STD Bus Leader

A new Ziatech STD DOS system called XTP DOS, and three new board-level products are now available for low power battery-based applications and for wide temperature environments.

(Continued on page 2)

STD CMOS market heats up ..... Page 1,2

Choosing the right dose of STD DOS ..... Page 3

New STD 80286 SBC runs PC DOS, OS/2 ..... Page 4

Modem meets the STD Bus ..... Page 4

ZIATECH CORPORATION

ZIATECH MERGES CMOS AND WIDE TEMPERATURE ON STD BUS

(Continued from page 1)

TEMPERATURE RANGE FROM -40° TO 85° C

XTP DOS extends Ziatech's popular STD DOS features (see story, page three), allowing it to withstand temperatures ranging from -40° to + 85° C.

NEW PRODUCTS

These extreme temperatures are usually found in factory floor and outdoor applications.

In addition, XTP DOS can be used in battery-based applications because of its low current consumption. This combination of extended temperature operation and low power consumption makes factory control systems, portable instruments and remotely-located data acquisition systems the principal application areas for XTP DOS.

TTL BACKPLANE-COMPATIBLE CMOS SBC

XTP DOS consists of an STD DOS-equipped ZT 88CT08 Single Board 80C88 Computer, with the optional ZT 88CT25 Expanded Memory System and the ZT 88CT41 Quad Serial Interface. These CMOS products are designed so that they can be used with TTL or CMOS-based products.

INTEGRATED SINGLE BOARD COMPUTER

The ZT 88CT08 provides performance exceeding an IBM XT personal computer, and contains several IBM PC/XT peripherals and a 520K on-board memory capacity. It can also be purchased without the STD DOS operating system for ROM-based applications.

EXPANDED CMOS MEMORY

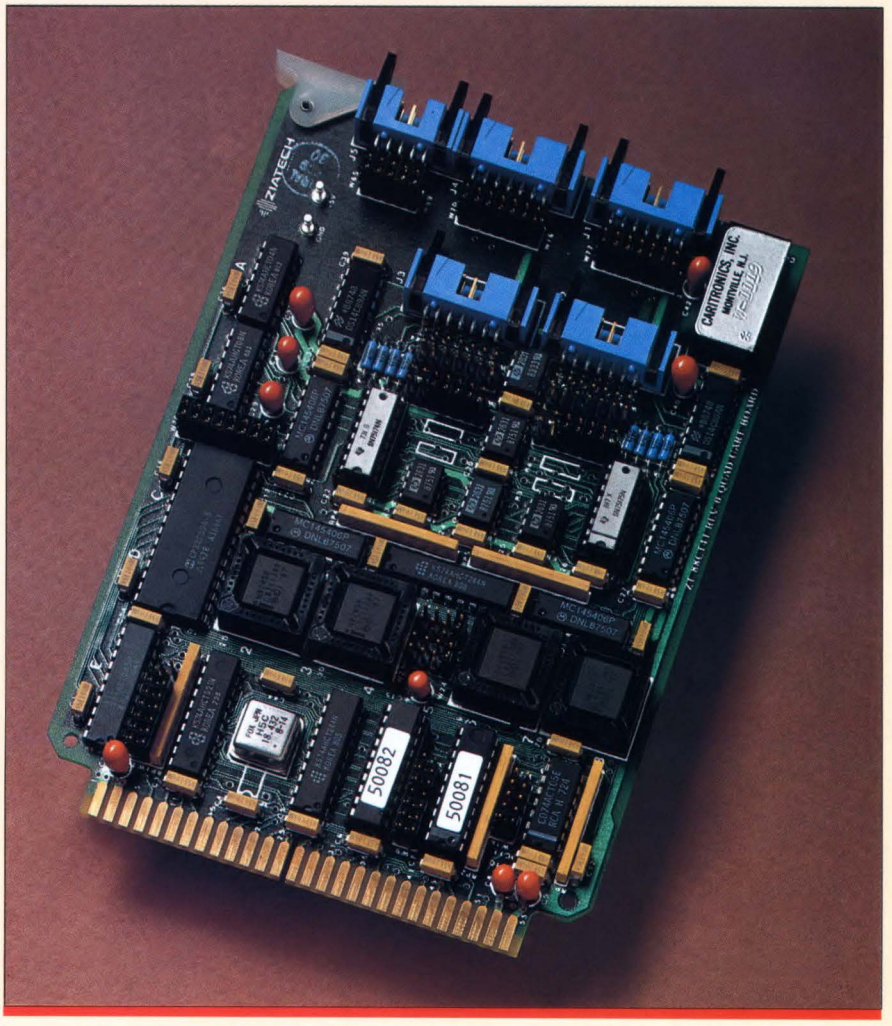
Mass storage for XTP DOS is provided by the ZT 88CT25 Expanded Memory System, a low power version of Ziatech's most versatile memory unit. The ZT 88CT25 can be used for expanded main memory or for RAM or ROM disk storage beyond the STD Bus' physical address limit of 1 Mbyte of memory.

The ZT 88CT25 breaks conventional STD Bus memory barriers through the use of the Expanded Memory Specification (EMS), originally developed by Lotus, Intel and Microsoft for personal computers and adapted for the STD Bus exclusively by Ziatech.

FOUR-CHANNEL SERIAL INTERFACE

The ZT 88CT41 Quad Serial Interface provides four RS-232-C channels with two channels configurable for RS-422-A/485. FIFO and optical isolation options are available.

For more information, check the XTP DOS box on the return card.



The ZT 88CT41 Quad Serial Interface is one of several Ziatech CMOS boards with low power consumption and a wide temperature option for harsh environments. This I/O board provides additional RS-232-C and/or RS-422-A/485 channels to STD Bus systems.

Embedded Control System Features –

HOW TO CHOOSE AN STD DOS SYSTEM

STD DOS, first introduced by Ziatech in 1985, combines the benefits of IBM PC DOS with the industrial STD Bus computer.

Most STD DOS products on the market today can run PC software for STD system development and target system operation. While this PC-compatibility is important, STD DOS systems also need certain control system features to better serve embedded industrial applications. Here are some of the features STD Bus users should look for in an STD DOS system.

A BIOS FOR CONTROL

The BIOS (Basic Input Output System) in an STD DOS system should have industrial control capability built-in. Many STD DOS systems use PC BIOS clones meant for desktop PC use, not the factory floor. This type of BIOS has limitations in a control environment. A PC, for instance, will not "boot" without a video terminal and keyboard attached. Similarly, power-up diagnostics in a PC BIOS clone can take up to 20 seconds to run, and may need to be disabled for a control system requiring a fast start. This can only be achieved with a BIOS intended for control systems.

BOOT OUT OF EPROM

An STD DOS system should be capable of loading PC DOS and a user's application from EPROM, providing a fast start and eliminating the need for rotating disks. A battery-backed RAM disk is also helpful to let users customize autoexec.bat and config.sys files.

ROM/RAM DISK

In harsh environments where disk media is inappropriate, RAM and ROM disks provide a more rugged form of mass storage. Data compression for increased storage capacity is also a benefit, because it increases system efficiency.

NO FRONT PLANE CONNECTORS

Front plane connectors, which make a system difficult to configure and repair, should be avoided in an STD DOS system.

DEVELOPMENT FEATURES

Features that speed and/or simplify the development of STD DOS systems are invaluable to OEMs, for example, under pressure to get STD Bus-based products to market.

EXPERIENCE, SUPPORT

A potential user should also look at a company's experience working with STD DOS, embedded control and real-time applications.

ZIATECH HAS IT ALL

Ziatech's family of STD DOS systems contain all of the features mentioned here, plus several more.

Ziatech has been manufacturing STD DOS systems for over four years, with superior technical support and documentation.

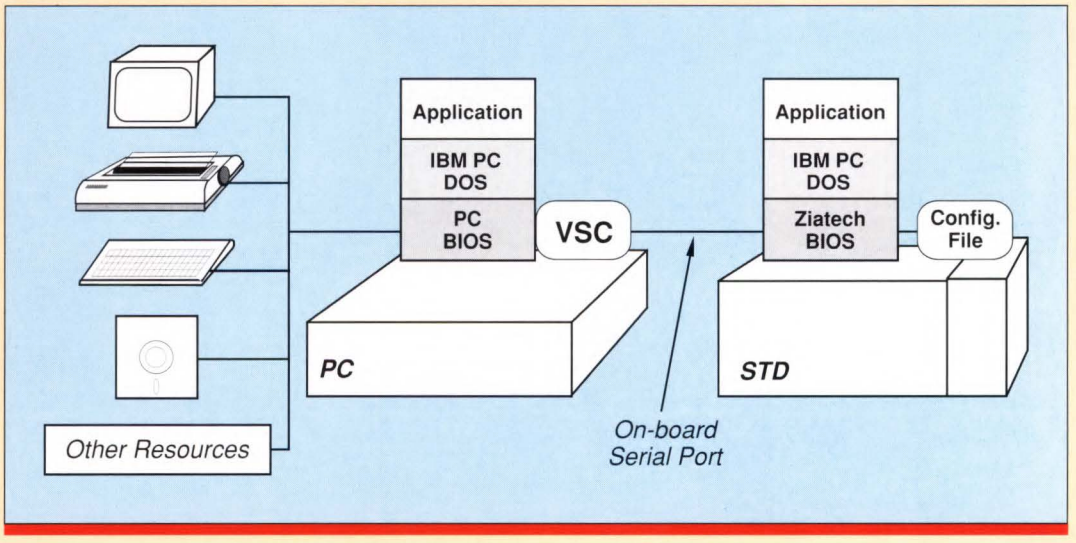
Its STD DOS product line includes single board systems based on the 8088, NEC V20 and NEC V50 microprocessors, with power ranging from the IBM PC to the IBM AT.

OTHER ZIATECH FEATURES

In addition to the features discussed above, Ziatech's STD DOS systems offer:

- STD-8088 Compatibility
- Multi-Video Support
- Expanded Memory
- Multitasking
- Low Power/Wide Temperature
- Integrated Systems
- Formal 3-day Training Class
- PC Compatibility
- Industrial Network

For more information and a free STD DOS brochure, check the STD DOS box on the return card.



Ziatech's STD DOS BIOS features built-in Virtual System Console support for development, maintenance, and diagnostics.

CIRCLE **166** ON INQUIRY CARD

NEW 80286 STD SBC RUNS PC DOS AND OS/2

PRODUCT PREVIEW



The ZT 8818, a new 80286-based single board STD Bus computer for applications that require high processor performance and extensive operating system support, will be introduced by Ziatech in mid 1989.

The ZT 8818 SBC will be supported by Ziatech's STD DOS (see story, page three), as well as OS/2 and real-time operating kernels such as VRTX. This single board system will feature the functionality of several typical STD Bus boards and up to 4 Mbytes of memory.

The ZT 8818 will join Ziatech's large offering of NEC V20-, NEC V50-, 8088- and 80188-based single board STD Bus computers.

For more information on the ZT 8818, contact Ziatech.

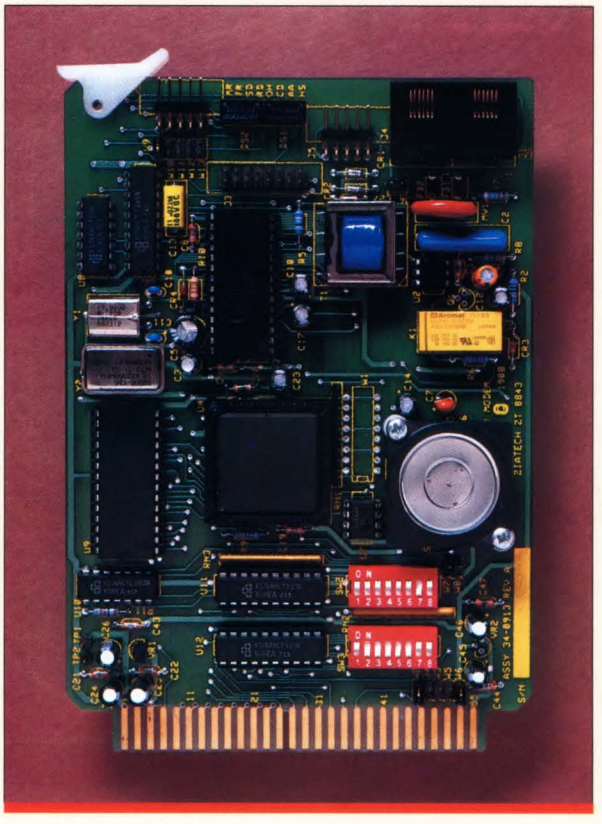
NEW MODEM CONNECTS STD BUS COMPUTERS

Ziatech has added a new modem board to its repertoire of industrial I/O products for the STD Bus.

The ZT 8843 is a 300/1200/2400 BAUD modem, fully compatible with industry standard Hayes™ AT Command Set. This provides access to a vast range of existing communications software for STD DOS-based or non-DOS applications.

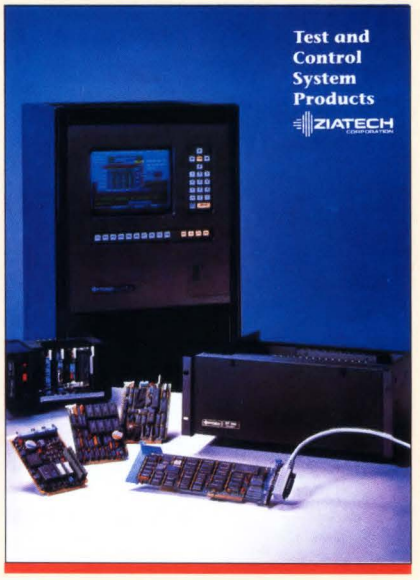
The ZT 8843 provides automatic dialing and answering capabilities for unattended operation and a speaker interface which allows on- or off-board audible phone monitoring. In addition, eight LED indicators provide a visual status of operation.

For more information, check the New Products box on the return card



The ZT 8843 is a 300/1200/2400 BAUD Modem for STD Bus computers, compatible with industry standard Hayes™ AT Command Set.

Ziatech Product Line At A Glance



Ziatech products include STD Bus board-level and integrated computers, STD software systems, an industrial STD/PC network and IEEE 488 interfaces for microcomputers.

These products are reviewed in a new Test and Control System Products brochure that can be obtained by returning the Control Point postcard.

CONTROL POINT

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ZIATECH CORPORATION

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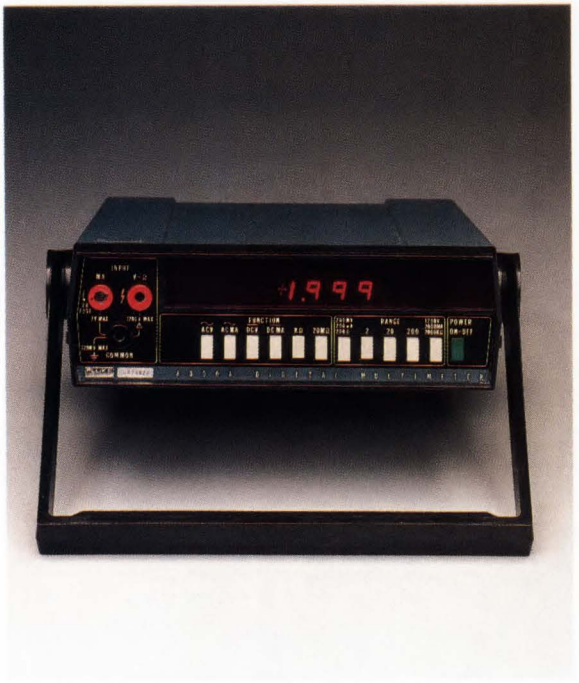
ITT Telex 4992316
FAX (805) 541-5088
Telephone (805) 541-0488

Remember the first Fluke multimeter you ever used?

That was then.



The Fluke 8000A Multimeter. An instant winner with engineers all over the world, this was the first voltmeter to combine high quality performance with a low price. It featured Fluke's first LED display, as well as our first large-scale custom integrated circuit. Within one year, it outsold all other voltmeters in the world.

FLUKE

PHILIPS

PHILIPS

This is now.

Today, Fluke continues to lead the world in multimeter technology, with an impressive selection of world-class meters. Choose from over 42 different models—in handheld, benchtop, and system configurations, with multiple features and functions, 3½ to 7½ digits of resolution, and basic dc accuracies to 0.001%.



Fluke 83



Fluke 87



Fluke 85

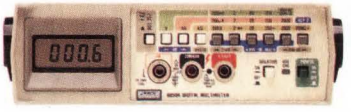
Fluke's newest meters, the 80 Series, add the features of many dedicated instruments to leading edge DMM design, bringing new meaning to the term multimeter. These 3¾-digit, 4000 count meters offer 11 functions, 40 ranges, and basic dc accuracy to 0.1%. Unique features include Input Alert,™ Min Max Average recording, Min Max Alert,™ and protective holster with Flex-Stand.™



(Left to Right) Fluke 77 Low-cost DMM. Fluke 23 Industrial DMM. PM2718 true-rms DMM. Fluke 27 Ruggedized DMM. Fluke 8060A true-rms Precision DMM.



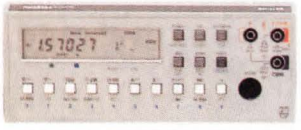
8920A 3½ digit Wideband True RMS AC Multimeter with autoranging, db and rear panel linear analog output.



8050A 4½ digit Bench/Portable Multimeter with 0.03% basic dc accuracy, true rms ac, dB and relative.



37 3½ digit Bench/Portable Multimeter with 0.1% basic dc accuracy, Touch Hold,® Min/Max recording and relative.



PM2525 5½ digit Bench/System Multimeter with 0.02% basic dc accuracy, frequency, time, temperature dB and recording.



8840 Series 5½ digit Bench/System Multimeters with 0.003% basic dc accuracy, ohms accuracy to 0.008%.



PM2535 6½ digit System Multimeter with 0.0025% basic dc accuracy, up to 100 readings per second, IEEE-488.



8506A 7½ digit Thermal RMS System Multimeter with 0.001% basic dc accuracy, 500 readings per second.



8520A 5½ digit Bench/System Multimeter with 0.005% basic dc accuracy, burst memory and math capabilities.

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PM 6666 Programmable Timer/Counter



PM 5193 Programmable Synthesizer/Function Generator



732A dV Reference Standard



6062A 2 GHz Synthesized RF Signal Generator



2176A Benchtop 10-Input Digital Thermometer



80i-KW Current/Power Probe



0 MHz Logic Analyzer (115 channel)



PM 2525 5½ - Digit △ Multifunction Multimeter



80K-40 High Voltage Probe



87 3¾ digit Handheld DMM

52 Handheld Dual-Input Thermometer △



PM 6303 Automatic LCR Meter



Hz Real Time Digitizing Oscilloscope



8506A 6½ - Digit Precision Thermal RMS Multimeter



△ 8060A Precision 4½ - Digit DMM

½ - Digit Bench/System Multimeter



PM 6654C Programmable System Timer/Counter





5786 2 nS Pulse Generator



90 Series µP Board Tester ▷

◁ PM 3296A 400 MHz Real-Time Oscilloscope







it DC AC Volts System Digital Meter



9000A Series Micro-System Troubleshooter △



8920A True RMS Digital Voltmeter



070 100 MHz Oscilloscope



PM 3320A 200 MHz and 250m S/S Digital Storage Oscilloscope

The Fluke and Philips product line includes 299 instruments and hardware products, 36 software packages and 319 accessories. We also have a challenge for you. See if you can pass this test:

1. I would evaluate test and measurement equipment from a new supplier that offered better performance and value.

☐ True ☐ False

2. I am aware that Fluke now sells, services and supports Philips test and measurement equipment in North America.

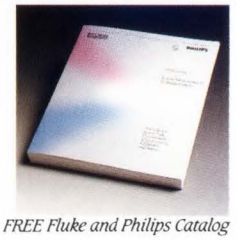
☐ True ☐ False

3. I don't buy out of habit, or because the salesman bought me a terrific lunch.

☐ True ☐ False

If you answered true to these three questions, you're ready for our challenge: Try something new. Take a look at the Fluke and Philips products you may not have considered before. You'll find them in the new Fluke catalog, along with all the technical data you'll need to make an intelligent comparison, *before* you buy. Call your local Fluke sales office, or **1-800-44-FLUKE** for your free catalog, today.

Go ahead. We can meet the challenge. Can you?



FREE Fluke and Philips Catalog

Oscilloscopes	*Multimeters*
Signal Generators	*Logic Analyzers*
Counters/Timers	*Calibrators/Standards*
Board Testers	*Data Acquisition*
Thermometers	*Operator Interfaces*
Plotters	*Systems*

FLUKE

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Now Fluke has 29
And one challenge for er



5700A Multi-function Calibrator



PM 3655 100 MHz Logic Analyzer (up to 96 channels)



1900A Multifunction Counter



37 3½ - Digit Analog/Digital Bench/Portable Multimeter



PM 8238 Multi-point Data Recorder



Application Software Packages



77 3½ - Digit Handheld DMM



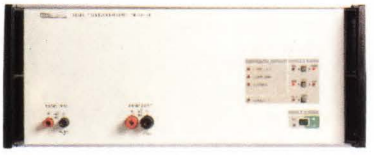
23 3½ - Digit Handheld DMM



7261A Universal Counter/Timer



2393A "Tem Pak" Temperature Logging System



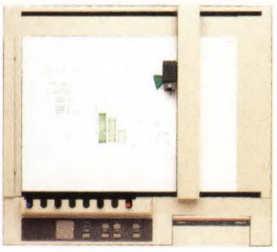
5220A Transconductance Amplifier



PM 3570 40



1050 Series Color Touch Control Screen



PM 8155 Multicolor Digital PenPlotter



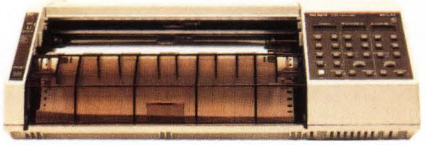
5440B Direct Volts Calibrator



PM 3340 2



7457A Automated Calibration System



PM 8272 XY and Strip Chart Recorder



1752A Data Acquisition System







2280B Data Logger △



△ System 21 Modular GPIB Switching System

8842A 5

△ PM

9100A Series Digital Test System △



9100A Series I/O Module



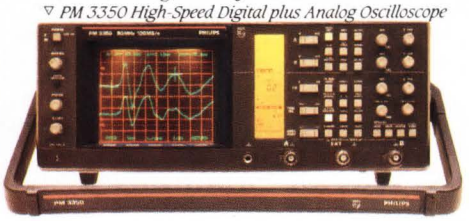
742A-10K Resistance Standard ▷

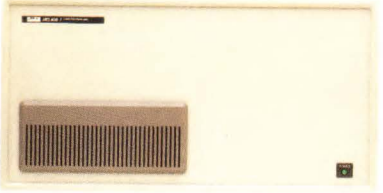
Helios-I Computer Front End ▽



8520A 5½ - Dig

▽ PM 3350 High-Speed Digital plus Analog Oscilloscope







PM 3

And here's the ultimate challenge: Try to find a company that gives you better service and support than Fluke.

When you buy Fluke or Philips products, you can count on getting more than the hardware you order.

Because we also deliver Fluke service and support. We stand behind every Fluke or Philips instrument we sell, and we challenge you to find anyone in the industry who consistently backs up their gear better than us.

In fact, we've invested millions in facilities, people, training and replacement parts. To provide you with the support you need in over 60 Technical Service Centers worldwide.

Here's a quick rundown of all the extras you can depend on when you buy from Fluke.

PRODUCT SUPPORT:

- **The Best Service Warranty in the Industry.*** We warrant the entire instrument after we service it—not just the repaired portion.
- **Repair and Calibration Services.** Complete certification and reporting is standard with Fluke Service. Services meeting MIL-STD-45662 and NRC standards are also available.
- **Standard Price Service.** Select the service you need and pay a fixed price for a one-time repair or calibration.
- **Extended Warranty Service.** Provides routine calibration at regular intervals, repairs whenever they are needed, or both.
- **On-Site Service.** For those customers with large systems or special service needs.
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- **Pick-up and Delivery** (at selected Fluke Technical Service Centers).
- **Product Reliability Data, Manuals, and Product Change Notices** are available on Fluke and Philips products. Base sets of product change notices on Fluke products are also available on microfiche, as is an annual subscription service.

*Certain Limitations.

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The LTC1090/91/92 are available in plastic or ceramic DIP packages. Pricing for the LTC1090CN is $11.95, and for the LTC1091CN8 and LTC1092CN8 it's $10.95, in quantities of 100. Military versions of each are also available.

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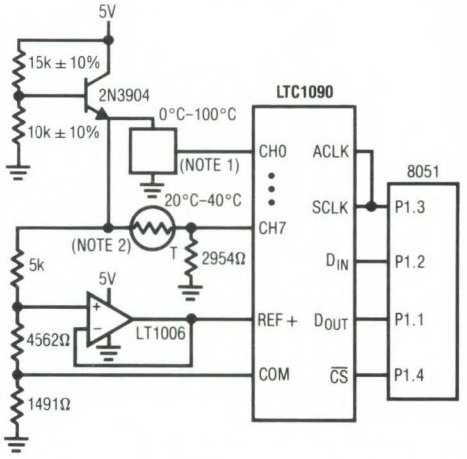

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CIRCLE NO 134

EDITED BY CHARLES H SMALL

Latch adds 32 bits to μP's output

Noor Singh Khalsa
EG&G Inc, Los Alamos, NM

By connecting the output of an 8031 single-chip μP's internal UART to a serial-to-parallel register, you can add 32 bits of output. Those extra output bits can be useful if, for example, you use an 87C257 EPROM (**Fig 1**). The 87C257 eliminates demultiplexing circuitry but at the expense of ports P0 and P2.

The software in **Listing 1** puts the 8031's internal UART into Mode 0 and then shifts out four successive bytes at 1 MHz (max) from P3.0 to the UCN-5883 serial-to-parallel register. Then the software strobes the register via P3.1. This simple software requires no shifts, no rotations, and no counts.

Note that the UCN-5883's open-collector outputs are active low (120 mA peak). Its strobe and output-enable lines, however, are active high, unlike those of most μP peripheral chips. EDN

LISTING 1—8031 PARALLEL-TO-SERIAL ROUTINE

```
Initialization
        MOV     SOON, #0            ; initialize UART to MODE 0

Output  routine
        MOV     SBUF,BYTE4          ; send last byte first
        JNB     TI,$                ; wait till it's sent
        MOV     SBUF,BYTE3          ; send 3rd byte
        JNB     TI,$
        MOV     SBUF,BYTE2          ; send 2nd byte
        JNB     TI,$
        MOV     SBUF,BYTE1          ; send 1st byte
        JNB     TI,$                ; wait till it's sent
        SETB    P1.0                ; raise strobe
        CLR     P1.0                ; lower strobe
```

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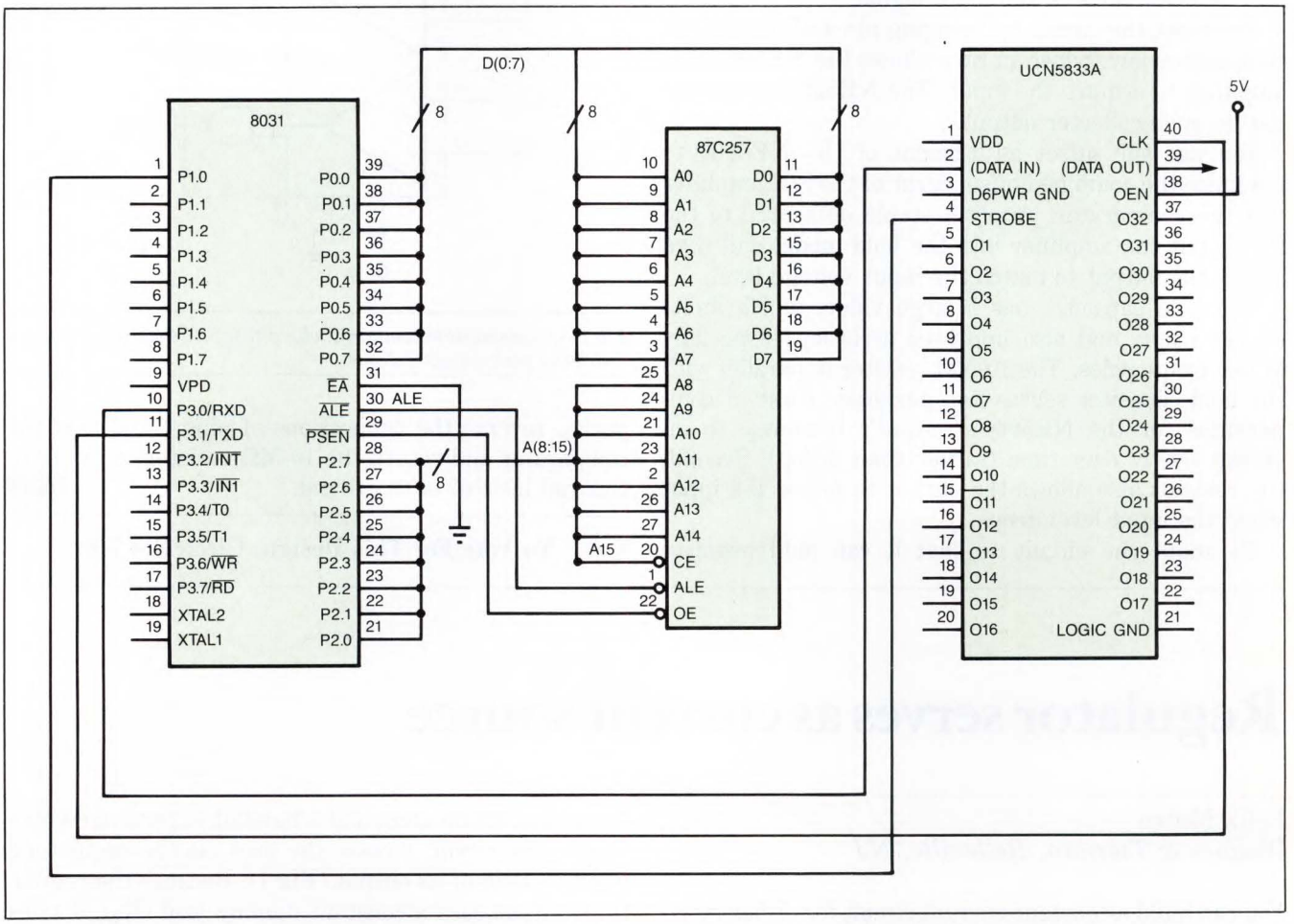

Fig 1—Linking a series-to-parallel register *to a single-chip μP's internal UART enables a simple software routine to add 32 bits of output to your design.*

Peak detector offers high bandwidth

Nicholas C Gray
Signetics Corp, Sunnyvale, CA

The high-speed peak detector in **Fig 1** uses a highly accurate, fast S/H amplifier controlled by a high-speed comparator. The S/H amplifier holds the peak voltage until the comparator switches the amp to its sample mode in order to capture a new, higher voltage level. The circuit handles all common wave shapes and exhibits 5% accuracy from 50 Hz to 2 MHz.

The comparator's output goes low when the input signal exceeds the value of the currently held output. This transition puts the S/H amplifier into sample mode. Once the output reaches the value of the input, or the input signal falls below the output's level, the comparator's output goes high; the high output brings the S/H amplifier back to the hold mode, thereby holding the peak value of the input signal.

You reset the circuit by bringing pin 4 of the NE522 comparator low, which in turn allows the NE5060 S/H amplifier to acquire the input. The NE522 comparator has an open-collector output.

You use the offset adjustment of the NE5060 to minimize the combined offset error of the S/H amplifier and the comparator: Apply a stable dc source to the input, put the amplifier into the hold mode, and then adjust the output to match the input voltage level.

The hold capacitor has a large value, which limits output ripple and also improves accuracy—especially at low frequencies. The 10-MΩ resistor in parallel with the hold capacitor serves two purposes: First, it compensates for the NE5060's output's tendency to increase slowly over time (rather than droop). Second, the resistor also allows the output to follow the input when the input level drops.

To adapt the circuit so that it can hold negative peaks, reverse the connections of pins 1 and 2 of the comparator and return the 10-MΩ resistor to the positive rail instead of to ground. EDN

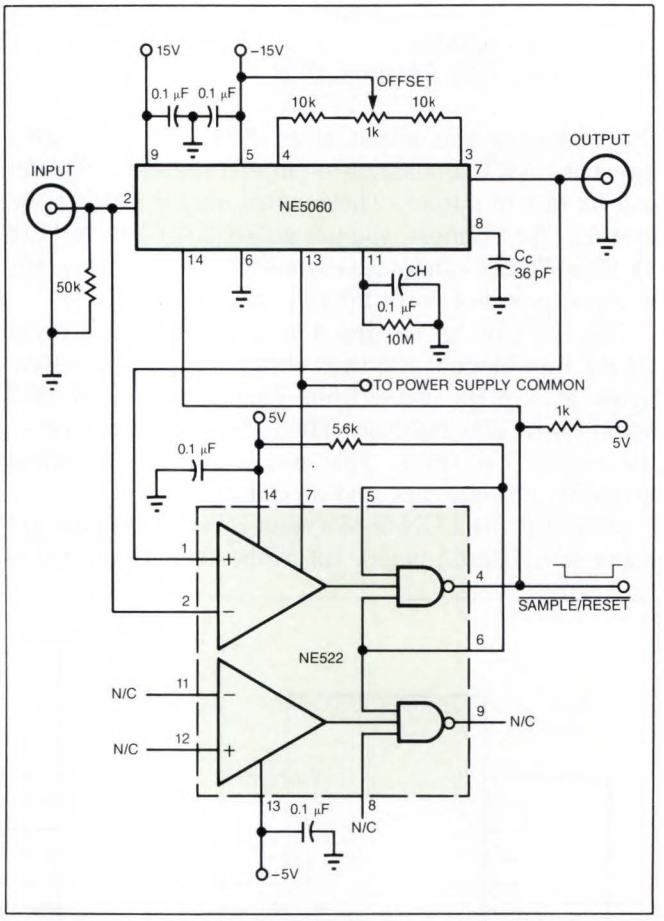

***Fig 1—A comparator combined** with a fast S/H amplifier creates a wideband peak-voltage detector.*

To Vote For This Design, Circle No 748

Regulator serves as current source

Felix Matro
Wallace & Tiernan, Belleville, NJ

You can build a constant-current circuit for either resistive or inductive loads with just a few simple parts: an adjustable, 3-terminal voltage regulator; a power transistor; an op amp; and a handful of passive components. The circuit powers the load via the regulator's input instead of its output (**Fig 1**). Because the regulator's output sees a constant dummy load (R_1), it tries to consume a constant amount of current, no matter what the voltage across the actual load really is. Hence

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7007/1	5/12	4.33X2.12X0.64
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7007/3	15/5	4.33X2.12X0.64
7007/4	24/3.5	4.33X2.12X0.64



SINGLE OUTPUT: 150-200W

7030/1	5/30	5.90X3.54X0.81
7030/2	12/16.5	5.90X3.54X0.81
7030/3	15/13.0	5.90X3.54X0.81
7030/4	24/8.0	5.90X3.54X0.81
7030/5	28/7.0	5.90X3.54X0.81

DUAL OUTPUT: 80-120W

8001	±5/8	5.90X2.81X0.81
8002	±12/4.5	5.90X2.81X0.81
8003	±5/4.0	5.90X2.81X0.81
8004	±24/2.5	5.90X2.81X0.81

TRIPLE OUTPUT: 117-135W

8506	5/9, ±12/3	5.51X4.29X0.81
8606	5/9, ±24/3	5.51X4.29X0.81

INPUT: 170-360VDC
(MIL 704A)

Model	V/A	Size
7701/1	5/20	5.12X2.91X0.81
7701/2	12/11	5.12X2.91X0.81
7701/3	15/8.5	5.12X2.91X0.81
7701/4	24/5.5	5.12X2.91X0.81
7701/5	28/4.5	5.12X2.91X0.81

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the regulator's input serves as a constant-current source for the actual load.

You can power the circuit with any one of the commonly available ±15 or ±12V supplies. The voltage dropped across the regulator and dummy load obviously decrease the total compliance voltage of the circuit.

You set the load's current with R_1. The current equals $1.25A/\Omega \times R_1$. Q_1 is a switch controlled by the op amp. As long as V_{CON} is less than V_{THR}, Q_1 is on, where $V_{THR} = V_{SUPPLY} \times R_3/(R_2 + R_3)$. Of course, you don't have to use the particular op amp and switch transistor shown in **Fig 1;** you can adapt virtually any components that can handle the current and voltage required for your application. You can also return R_1's wiper to the ADJ input of the regulator and thereby avoid running all of the dummy load's current through the wiper. EDN

To Vote For This Design, Circle No 746

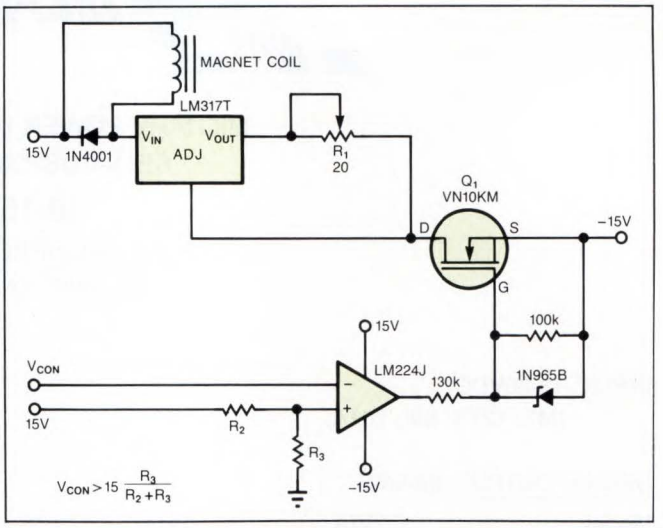

Fig 1—Once you realize that a voltage regulator *must consume a constant current to supply a fixed dummy load at its output, you can understand how that regulator can function as a constant-current source for a live load that is connected to that regulator's input.*

Solenoid driver limits hold current

Athos Follo
ALC App Lab Chim, Milan, Italy

In many applications, a solenoid driver must first briefly supply a large amount of pull-in current, which quickly actuates the solenoid. Thereafter, the driver must supply a much lower holding current to avoid burning the solenoid out. To avoid using the customary, cumbersome large capacitors or power-wasting resistors, you can use the switching technique in **Fig 1.**

As long as the input to the circuit is low, diode D_1 holds transistor Q_1 off; a low input also prevents the op-amp circuit from oscillating. When the input reaches 24V, Q_1 switches on and pulls in the solenoid. Concurrently, D_4 is back biased, and C_1 begins charging up. When C_1 charges up, the op-amp circuit begins to oscillate, switching Q_1 on and off.

The time constant defined by R_1 and C_1 determines the length of the period during which the solenoid receives full power. R_3 and C_2 set the oscillator's frequency, and R_2 sets the oscillator's duty cycle. The hold current is directly proportional to the duty cycle. For the components shown in **Fig 1,** the full-power period is 300 msec, the oscillator's frequency is 3 kHz, and its duty cycle is 50%. EDN

To Vote For This Design, Circle No 749

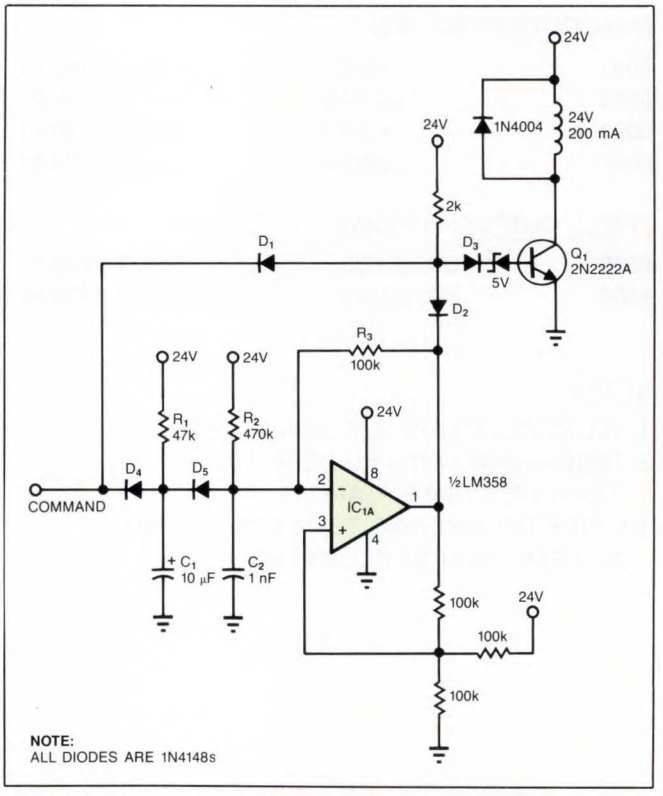

Fig 1—This solenoid driver supplies a long full-power pulse *in order to pull in the solenoid. This pulse is followed by a train of short pulses that holds in the engaged solenoid without burning it out.*

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Three measurements characterize filters

Michael M McDermott
Delco Electronics, Kokomo, IN

By merely making measurements of a bandpass filter's gain at three key frequencies, you can calculate the filter's essential parameters: H_0, f_0, and Q. The three frequencies are: the expected center frequency of the filter and each −3-dB point. This type of bandpass filter responds in the following way:

$$H(f) = \frac{H_0}{\sqrt{1 + \dfrac{Q^2\left[\left(\dfrac{f}{f_0}\right)^2 - 1\right]^2}{\left(\dfrac{f}{f_0}\right)^2}}}. \quad (1)$$

If you call the three key frequencies f_1, f_2, and f_3 and the respective gains H_1, H_2, and H_3, then you can calculate H_0, f_0, and Q from the following equations:

$$f_0 = \sqrt[4]{\frac{H_1^2H_2^2(f_2^2 - f_1^2) + H_1^2H_3^2(f_1^2 - f_3^2) + H_2^2H_3^2(f_3^2 - f_2^2)}{H_1^2H_2^2\left(\frac{1}{f_1^2} - \frac{1}{f_2^2}\right) + H_1^2H_3^2\left(\frac{1}{f_3^2} - \frac{1}{f_2^2}\right) + H_2^2H_3^2\left(\frac{1}{f_2^2} - \frac{1}{f_3^2}\right)}}, \quad (2)$$

$$Q = \sqrt{\frac{H_2^2 - H_1^2}{\left(\frac{f_0^2}{f_1^2}\right)H_1^2\left(\frac{f_1^2}{f_0^2} - 1\right)^2 - \left(\frac{f_0^2}{f_2^2}\right)H_2^2\left(\frac{f_2^2}{f_0^2} - 1\right)^2}}$$

$$H_0 = \sqrt{\frac{H_1^2H_2^2\left(\frac{f_0^2}{f_2^2}\right)\left(\frac{f_1^2}{f_0^2} - 1\right)^2 - H_1^2H_3^2\left(\frac{f_0^2}{f_2^2}\right)\left(\frac{f_2^2}{f_0^2} - 1\right)^2}{\left(\frac{f_0^2}{f_1^2}\right)H_1^2\left(\frac{f_1^2}{f_0^2} - 1\right)^2 - \left(\frac{f_0^2}{f_2^2}\right)H_2^2\left(\frac{f_2^2}{f_0^2} - 1\right)^2}}.$$

Alternatively, once you know f_0 and Q:

$$H_0 = H_1 + Q^2\left(\frac{f_0^2}{f_1^2}\right)\left(\frac{f_1^2}{f_0^2} - 1\right)^2. \quad (3)$$

Thus you have two approaches to calculating a filter's basic parameters. EDN

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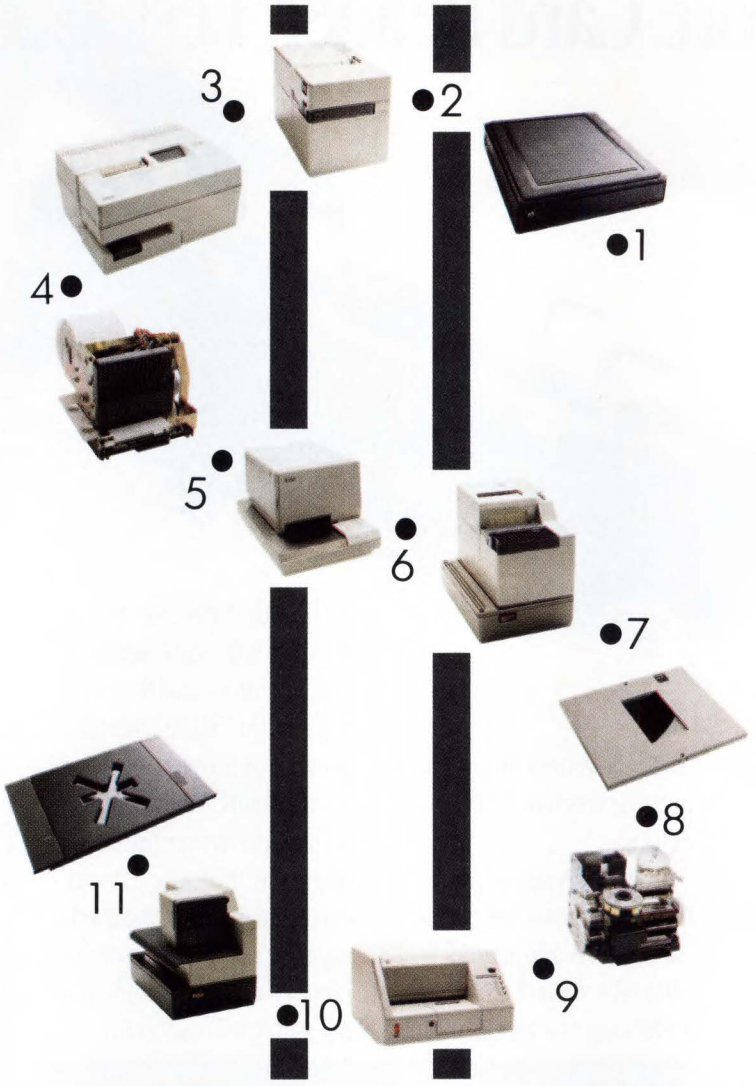

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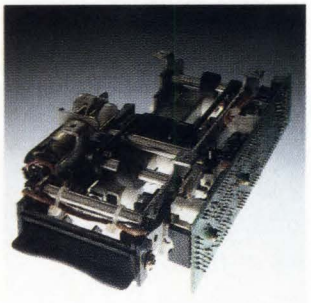

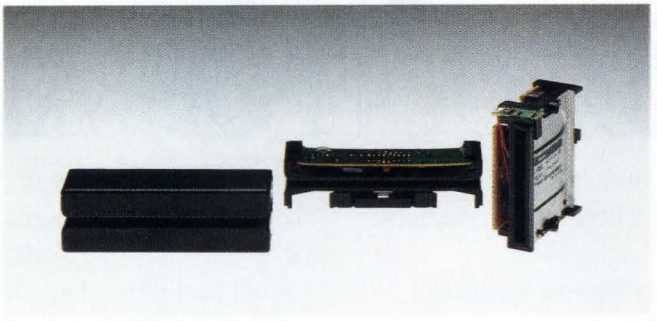

Manual magnetic card reader/writer unit

Model	Card standard	Features	Dimensions (mm)
MCS-135	ISO 3554 Track 1 and 2	One way, double track: simultaneous reading	100×32×32.5 (with cover)
MCS-136	ISO 3554 Track 2 and 3	One way, double track: simultaneous reading	
MCI-111	ISO 3554 Track 2	Magnetic card insertion system	67×65×24

Motorized magnetic card reader/writer unit

Model	Card standard	Features	Dimensions D×W×H (mm)
MCA-1601	Accepts all standards	Extremely thin and half the volume*	183×139×45.4

*Compared with conventional Tokin models.

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Summary of high-resolution graphics cards

This report identifies all manufacturers of high-resolution graphics cards for the IBM PC/AT and PS/2 and details the products they manufacture. It features a market summary, a product-evaluation scheme, and definitions of the terms used to describe the cards. This 1988 report is three times longer than the 1987 edition. $250.

Jon Peddie Associates, 6201 Asoct Dr, Oakland, CA 94611.

INQUIRE DIRECT

Guide to personal computers

The 2nd edition of *The Guide to Personal Computers in Industrial Automation* is a comprehensive single-source reference for the use of IBM-compatible and Macintosh personal computers. The 102-pg guide lists 700 products from 300 vendors. Entries include application software, PC hardware, industrial computers, industrial I/O devices, and peripherals. The guide also provides applications in process monitoring and control, data acquisition, PLC (programmable logic controller) programming/documentation, statistical quality control, manufacturing resource planning, operator interface, and cell control. A training section provides application training and technology reviews that include charts, photos, and diagrams. $39.95.

Synopsis Corp, 2708 Salisbury Plain, Raleigh, NC 27612.

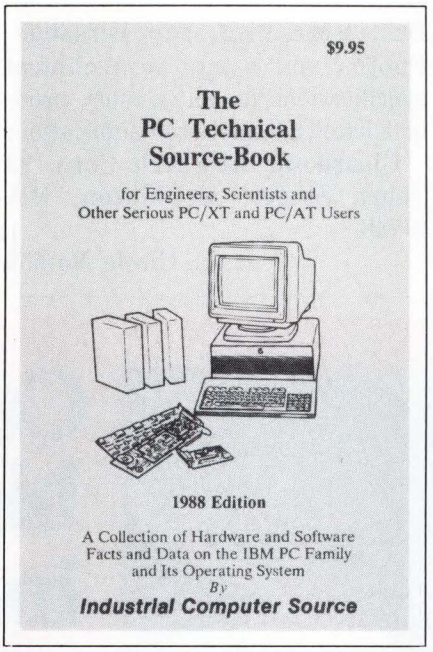
INQUIRE DIRECT

Report helps you evaluate communications issues

The 390-pg volume, *The Impact of Evolving Communications Technologies,* helps you assess the impact of major communications developments on public and private networks. The table of contents provides a single-source reference to subjects ranging from artificial intelligence to voice synthesis and recognition. The report presents applications, economic and technical considerations, and technical comparisons. Each section of the book details a technology, such as local-area network/metropolitan-area network (LAN/MAN) and wideband services, fiber optics, ISDN, and virtual networks. Tables, diagrams, and flow charts illustrate the text.

Bellcore Licensing, 290 W Mt Pleasant Ave, Livingston, NJ 07039.

Circle No 645



Manual targets IBM PC/XT and PC/AT users

Aimed primarily at engineers, scientists, and other professional IBM PC/XT and PC/AT users, *The 1988 PC Technical Source-Book* is a collection of hardware and software information on the IBM PC family and its operating system. The 76-pg manual provides an introduction to the IBM PC for the beginner and a ready reference for the experienced user. Topics covered include I/O bus 62-pin connectors, a bus signal summary, memory maps, I/O maps, DMA channels, switch settings, and DOS commands. Further topics are AT CMOS memory, 8237 DMA controllers, keyboard scan codes, IBM PC/XT and PC/AT I/O card dimensions, and hex and decimal equivalents.

Industrial Computer Source, 5466 Complex St, Suite 208, San Diego, CA 92123.

Circle No 650

Brochure sums up STE Bus board architecture

You can find helpful information about STE Bus (IEEE-1000) 8-bit processor-board architecture in this illustrated 6-pg brochure. The publication contains charts and diagrams that compare the performance of the STE Bus with a 16-bit bus. It also includes information about the STE Bus's ability to handle multiple masters. Further, the booklet describes the processing of interrupts and how the device allows priority to be determined without the use of daisy chaining or device-dependent timing constraints.

STEMUG-US, Box 7529, Newark, DE 19714.

Circle No 646

Leaflet offers F-O multiplexer options

This 6-pg, fold-out brochure describes 15 port cards and their configurations. A chart provides detailed specifications, such as data rate or frequency response, interface type, number of channels, and signal type. The publication also includes photographs and diagrams.

Versitron Inc, 9005-8 Junction Dr, Annapolis Junction, MD 20701.

Circle No 653

Newsletter for datacomm/telecomm users

This quarterly newsletter, *Network News,* informs data-communications users about the latest time- and money-saving restoration and analysis techniques being used in networks around the globe. Focus-

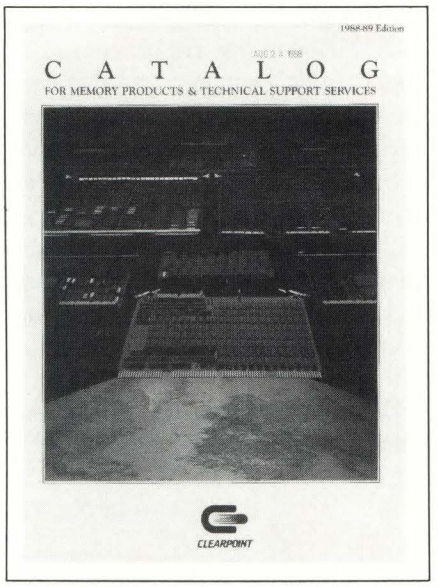
ing on the vendor's most recent product developments, the 3rd edition features the Interview 6600 protocol tester, a line of network restoration systems, the Artacs PBX management system, and the training courses offered by the company.

Atlantic Research Corp, Teleproducts Div, Marketing Communications, 7401 Boston Blvd, Springfield, VA 22153.

Circle No 647

Catalog lists workstation memory products

The 1988-89 edition of the *Catalog for Memory Products and Technical Support Services* details the vendor's line of workstation memory products for DEC, Sun, Apollo, IBM, and Macintosh machines. The text also presents the vendor's add-in memory for open architecture buses, such as DEC's Q-Bus, VME



Bus, VME/VSB, and Versabus. Photos and complete technical specifications for all memory products listed complete the publication.

Clearpoint Research Corp, 99 South Street, Hopkinton, MA 01748.

Circle No 655

Booklet summarizes PC products

The vendor's compact 64-pg catalog (No 288) contains a listing of high-performance single-board computers and IBM PC/AT-compatible systems. Another section provides a list of components for packaging a passive-backplane system. The reference data section features such information as terminology, NEMA enclosure standards, an RS-232C pin guide, and RAM/ROM cross-references.

Diversified Technology, Box 748, Ridgeland, MS 39158.

Circle No 652

Information on the UTX/32 version of Unix

The company's brochure describes how UTX/32 provides the standard benefits of Unix, which include protection of users' software investments, a wide range of applications

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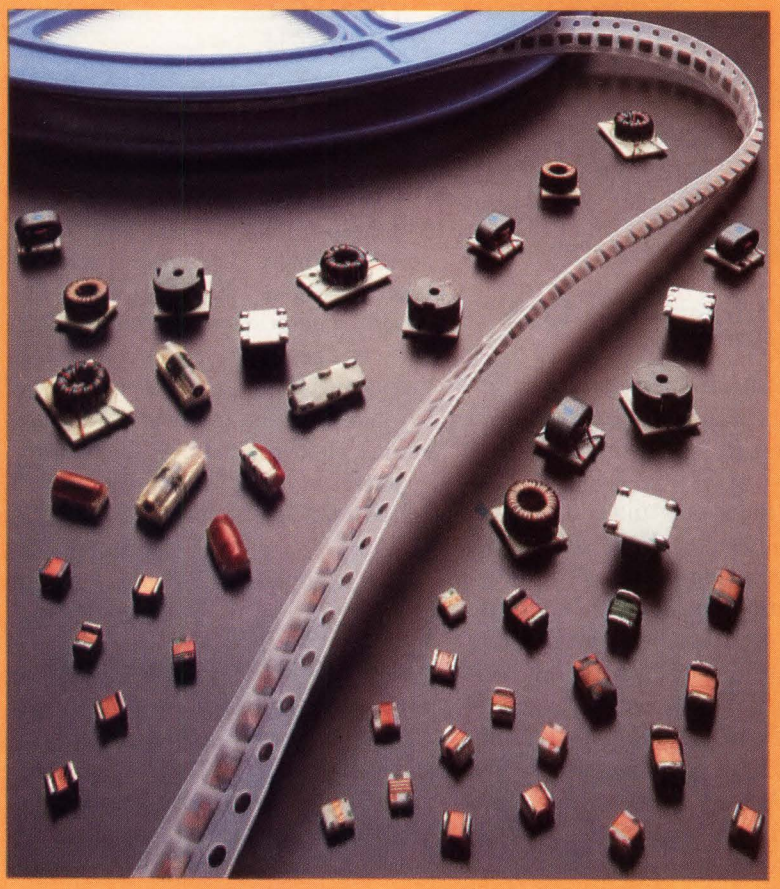

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software, transparent communication between heterogeneous computer systems, and compatibility with numerous hardware architectures. The publication also explains how the UTX/32 incorporates the advantages of the company's experience in designing real-time computer systems.

Gould Inc, Computer Systems Div, Box 409148, Fort Lauderdale, FL 33340.

Circle No 649

Guidelines for handling tape cartridges

The *3M Black Watch ½-in. Tape Cartridge Care and Handling* guidelines can help users get optimum performance from the vendor's tape cartridges, which are used with the IBM 3480 tape-cartridge subsystem. The seven guidelines describe storage procedures, temperature and moisture conditions, how to avoid potentially dangerous magnetic fields, and how to spot cartridge damage that could cause damage to drive heads. The recommended ways to handle, clean, stack, and bulk-erase the tape cartridges are also explained.

Data Products, 3M/Magnetic Media Div, 8200 Highwood Dr, Minneapolis, MN 55438.

Circle No 654

Publications clarify data-acquisition systems

This technical data sheet and application note explain the FERA/FERET fast-encoding and readout data-acquisition systems. The 4-color, 8-pg data sheet details the features of these modular systems and describes units for fast A/D conversion (Model 4300B), time-to-digital conversion (Model 4303), and fast-access memory (Model 4302). It also reports on modules that provide logic decisions based on analog and time information. The application note, *FERA/FERET Fast-Encoding and Readout ADC/TDC Systems (AN 4004A),* presents the systems using text, tables, and diagrams, and discusses several configurations.

LeCroy Corp, 700 Chestnut Ridge Rd, Chestnut Ridge, NY 10977.

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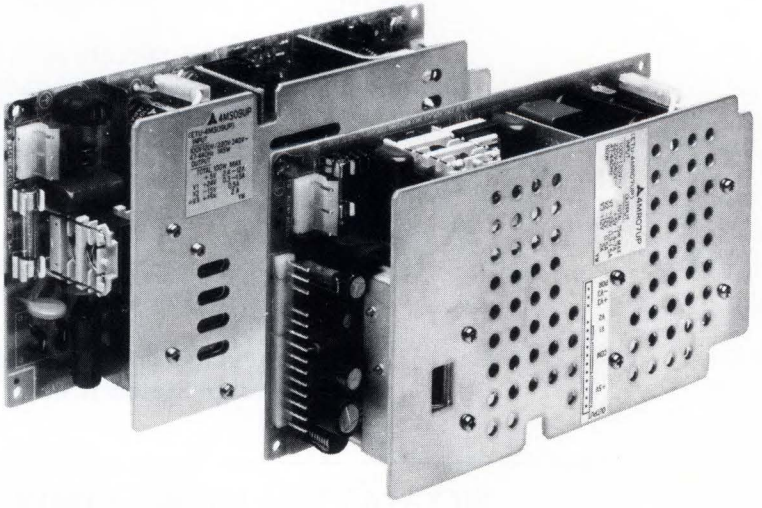

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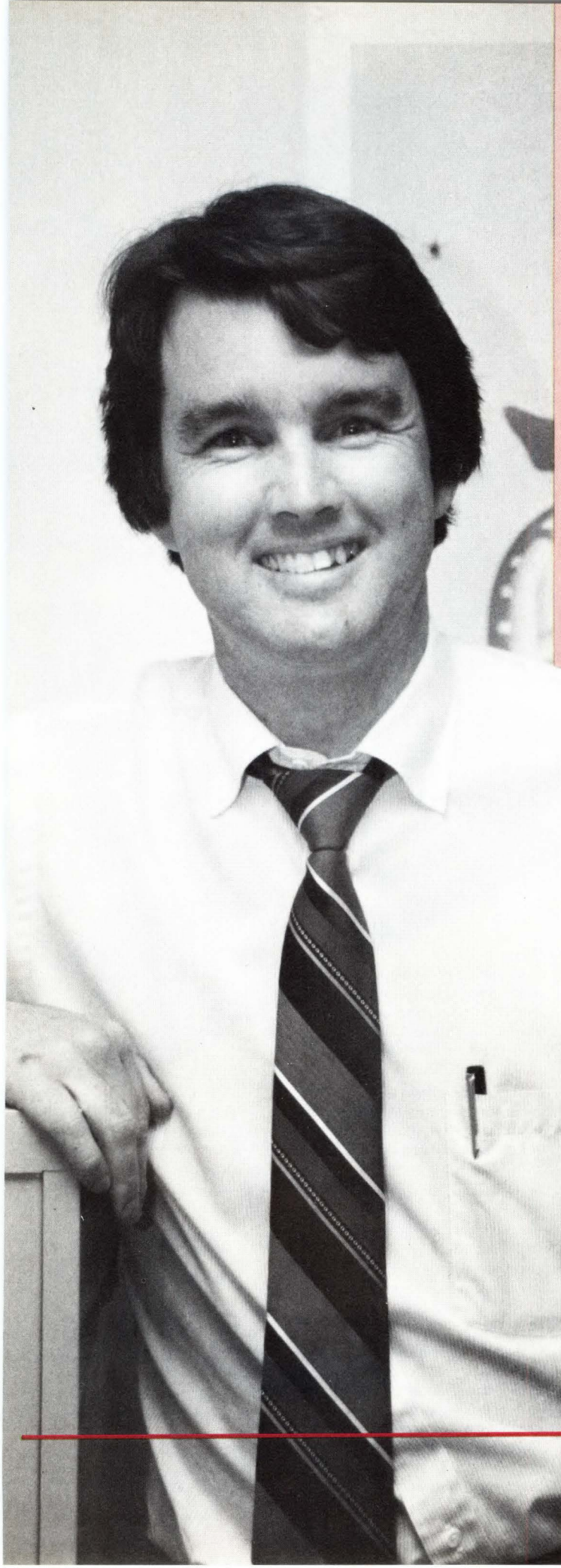

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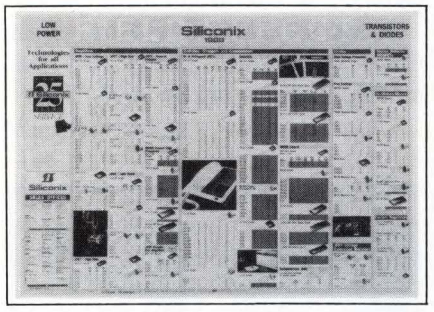
CIRCLE NO 143

Reprint describes use of floating annular ring

This reprint of a paper published in *IEEE Transactions on Components, Hybrids, and Manufacturing Technology* discusses the "Advantages of a Floating Annular Ring in Three-Layer Tab Assembly." To help explain these advantages, it presents a figure with three drawings that show a comparison of three types of construction, one of which is the annular-ring construction. The paper concludes with a discussion of applications and three additional figures.

Rogers Corp, Box 700, Chandler, AZ 85244.

Circle No 410

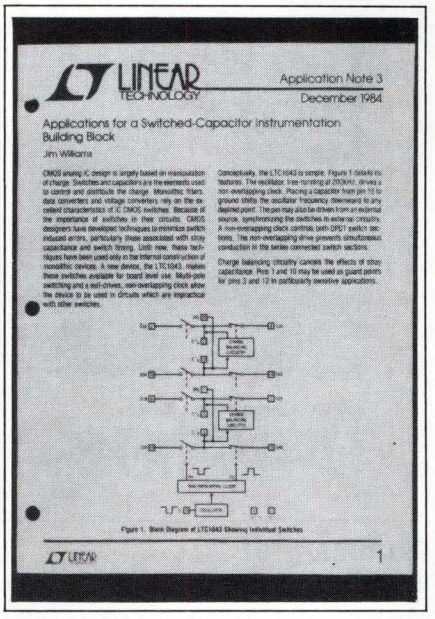


Visual aid helps you choose the best FET

This 22×32-in. wall chart helps you select the most suitable FET for your design—whether it's a low-leakage/low-noise JFET, an ultra-high-speed DMOS FET, or a low-power MOSFET. The chart also includes specifications for the vendor's most popular low-power discrete FETs. For easy reference, the chart is organized by major circuit categories, such as amplifiers, switches, choppers, commutators, diodes, current regulators, oscillators, mixers, and voltage-controlled resistors. Within each application area, the parts are sorted according to selection criteria—for example, amplifier FETs are sorted by critical parameters and by package options.

Siliconix Inc, 2201 Laurelwood Rd, Santa Clara, CA 95054.

Circle No 415



App note explains switched-capacitor filters

AN3: Applications for Switched-Capacitor Building Blocks discusses part values for a variety of tested circuits using switched-capacitor building blocks. Among the circuits detailed are a ±5V precision instrumentation amplifier, a variable-gain amplifier, relative-humidity signal conditioners, an LVDT (linear variable differential transformer) signal conditioner, and A/D and V/F converters. The note also provides complete schematics.

Linear Technology Corp, 1630 McCarthy Blvd, Milpitas, CA 95035.

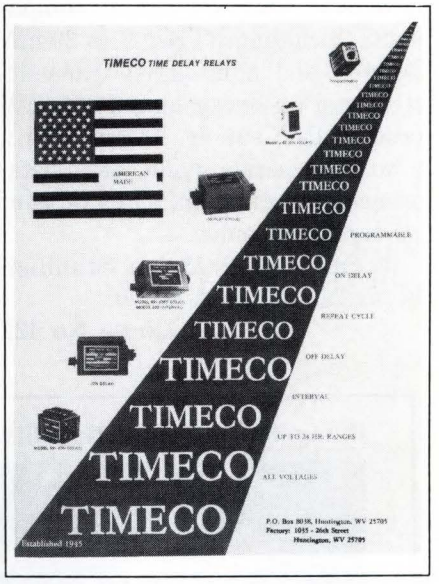
Circle No 412

Search for discrete semiconductors on disk

The Discrete Semiconductor Version of *Specs in Secs* is the vendor's second catalog on disk, providing information on an entire line of discrete semiconductors. The selection encompasses bipolar power transistors, power MOSFETs, small-signal devices, RF devices, optoelectronic devices, rectifiers, optoelectronic devices, rectifiers, zeners, thyristors, and sensors. The directory lists more than 6500 devices, 20,000 cross-references, 44 standard-package types, and 87,000 parameters. According to the vendor, when you make a search using either the part number or the parameter, the model numbers of the best devices for your needs appear in order of suitability. You can then consult the appropriate data book or device data sheet to confirm your choice as the best selection. $2.

Motorola Semiconductor Products, Literature Distribution Center, Box 20912, Phoenix, AZ 86036.

Circle No 411



Folder features timers and relays

This 8-pg publication details the vendor's line of timing controls consisting of time-delay relays and timers. The booklet provides a selection chart for time-delay relays and a timer selection guide. It also includes specifications, photographs, and diagrams.

Timeco Inc, Box 8036, Huntington, WV 25705.

Circle No 413

Publication reports on power-transistor reliability

The 68-pg *Bipolar Power Transistor Reliability Report* gives up-to-date performance information for the vendor's devices. It explains the purpose of all tests performed on a reliability audit and gives the actual

audit results. The report includes graphs and tables showing the failure rates in time and trends for each major device package.

Motorola Semiconductor, Literature Distribution Center, Box 20924, Phoenix, AZ 85063.

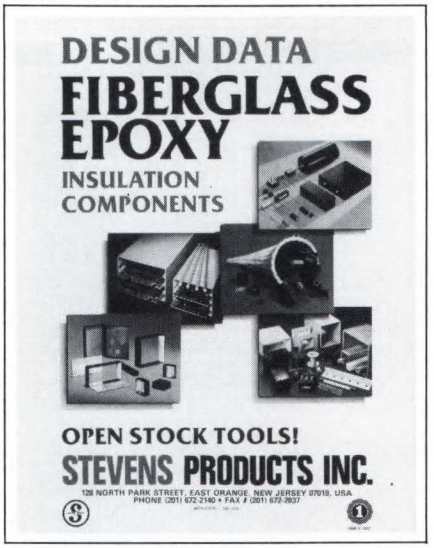
Circle No 417

Volume contains array of industrial products

This 64-pg expanded souce book presents an entire line of digital panel meters (DPMs). In addition, it lists a wide variety of components, including RTDs, 4- to 20-mA isolated and nonisolated transmitters, and an encapsulated 175-mW process loop supply. It provides a product selection guide, price lists, ordering information, and a table of conversion formulas.

Acculex, 440 Myles Standish Blvd, Taunton, MA 02780.

Circle No 422



Summary of insulation components

This 6-pg, 4-color brochure covers fiberglass epoxy insulation components, including materials, potting forms, coil bobbins, coil-form tubing, microminiature tubes, and circuit-board forms. The pamphlet lists tolerances and typical properties of glass epoxy sheets and describes header plates. A separate mandrel list is also available.

Stevens Products Inc, 128 N Park St, East Orange, NJ 07019.

Circle No 418

EMI filters categorized

This 32-page catalog, entitled *EMI Filters for Professional and Military Applications*, describes a range of lowpass, bulkhead-mounting, feed-through EMI filters. It presents standard ranges of filters that are approved for British Standard assessment levels, and includes cross-reference tables for relevant US MIL-STD specifications. The booklet also includes application notes and installation procedures for the filters.

Beck Electronics Ltd, Main Cross Rd, South Denes, Gt Yarmouth, Norfolk NR30 3PX, UK.

Circle No 424

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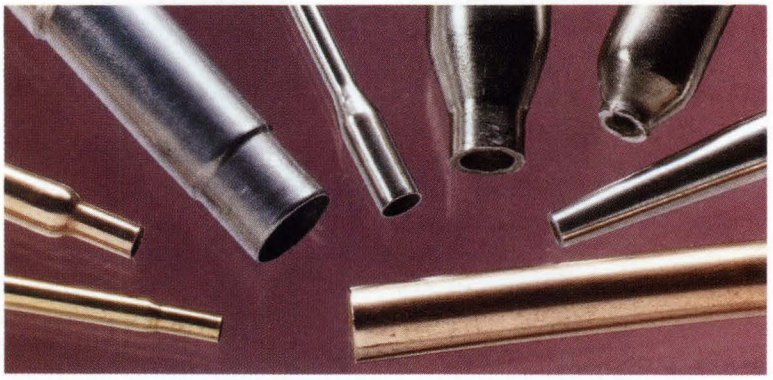

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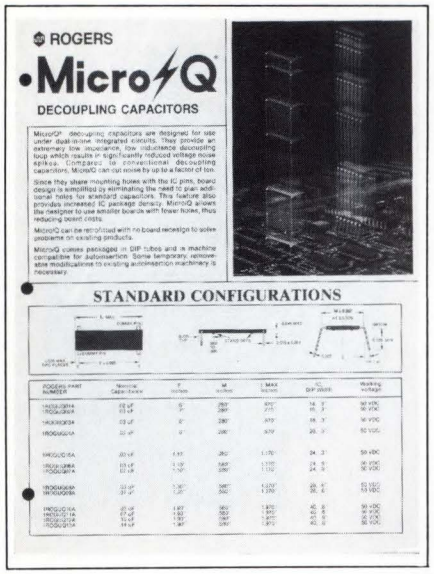
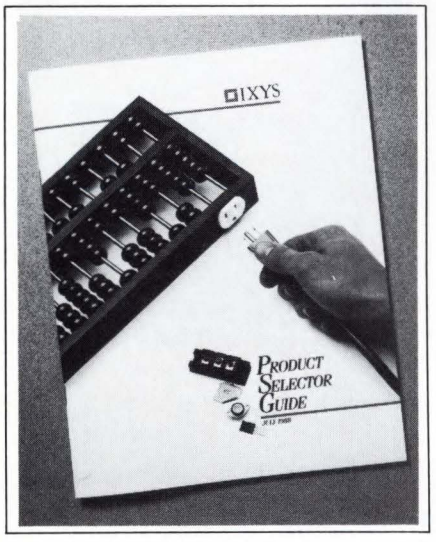


Data sheet deals with decoupling capacitors

This data sheet examines the vendor's Micro/Q decoupling capacitors. It gives you product specifications, describes standard and special configurations, and provides electrical performance.

Rogers Corp, Circuit Components Div, 2400 S Roosevelt St, Tempe, AZ 85282.

Circle No 416



Booklet deals with power MOSIGBTs and MOSFETS

This selection guide surveys the company's entire product line, which consists of power MOSIGBTs (MOS insulated gate bipolar transistors), power MOSFETS, Smart-power devices, and power interface ICs. The 52-pg booklet describes each product family and lists performance characteristics and package outlines. It also includes a 7-pg cross-reference section and a response card for further information.

IXYS Corp, 2355 Zanker Rd, San Jose, CA 95131.

Circle No 419

Brochure details surface-mount resistors

This 24-pg brochure details the company's range of surface-mount resistors and resistor networks. The publication contains full specifications for 13 different series of surface-mount resistor products, including wirewound power resistors, metal-film power-chip resistors,

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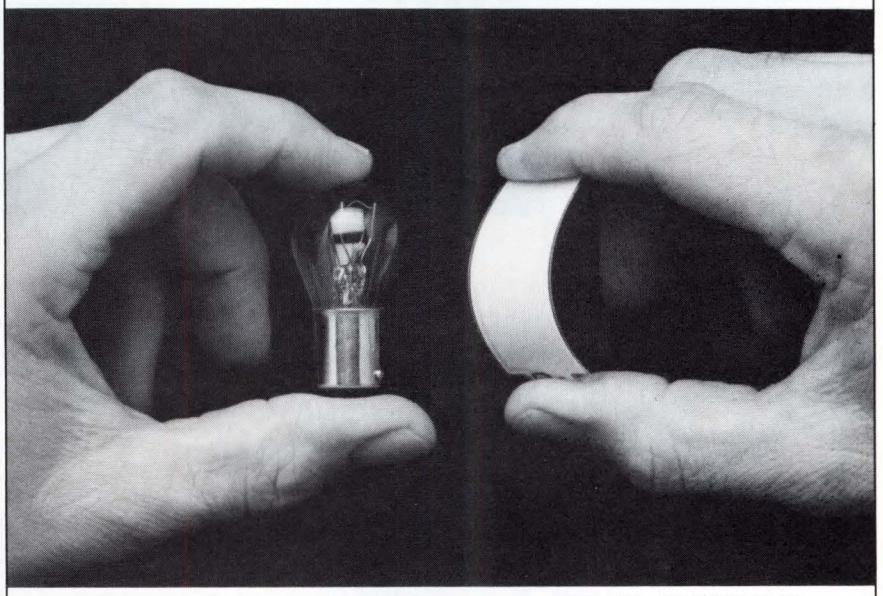

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Pliable: Flexibility permits bending to fit unique shapes.

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CIRCLE NO 148

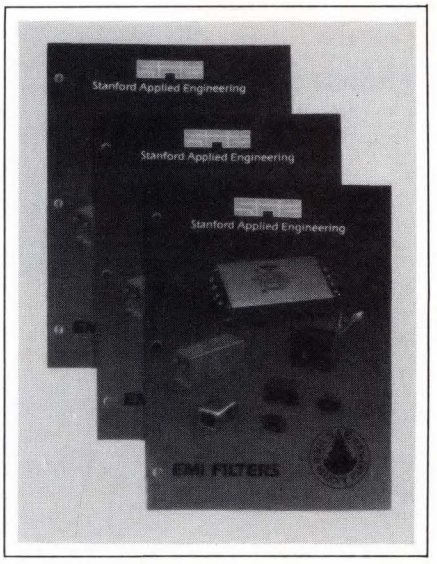
general-purpose flat-chip resistors, and precision flat-chip resistors. Further, it lists the package options that are available for the company's close-tolerance, temperature-tracking SMD resistor networks.

Welwyn Electronics, Resistor Div, Bedlington, Northumberland NE22 7AA, UK.

Circle No 423

Summary of EMI/RFI filters

The company's Fall 1988 EMI Filter Catalog lists a wide selection of EMI/RFI filters and accessories. It provides general descriptions, insertion-loss values, schematics, and ordering information. The publication also features a glossary of terms, an emissions testing laboratory description, and an international safety agency summary containing nine different specifications. It provides information about FCC and VDE requirements and EMI filter applications. The company has expanded the catalog to include more than 450 parts.

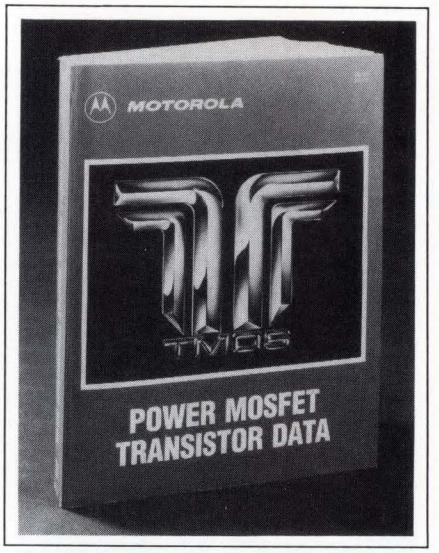


Stanford Applied Engineering, 3520 De La Cruz Blvd, Santa Clara, CA 95054.

Circle No 420



CIRCLE NO 149



Data book covers TMOS power MOSFETs

In addition to a variety of the vendor's standard devices, the revised *TMOS Power MOSFET Transistor Data Book* highlights logic-level power MOSFETs, surface-mount DPaks, GemFETs, and Sense-

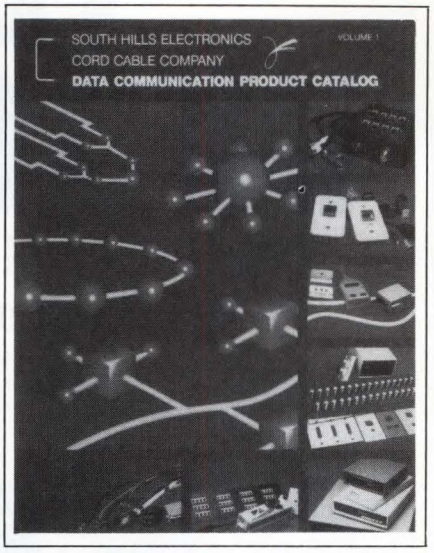
FETs. The updated applications section includes a section on avalanche limitations, commutating safe operating area, and dV/dt. Further, the publication presents reliability data, applications and basic design information, a selector guide and cross-reference, and data sheets for more than 500 devices. $3.75.

Motorola Inc, Literature Distribution Center, Box 20924, Phoenix, AZ 85063.

INQUIRE DIRECT

Catalog focuses on enhanced customer service

This 152-pg catalog describes the vendor's enlarged customer-service sections located at three separate distribution centers in Pittsburgh, PA; Rochester, MN; and Los Angeles, CA. The publication is divided into nine parts that cover coaxial and multiconductor cables, cabling



systems, patch panels, cabinets, connectors, converters, modems, multiplexers, power equipment, switches, and other related products for installing, expanding, or modifying computer communications systems. Specific sections on local-area networking cover coax, twinax, Ethernet, cabling system, twisted-pair, and multimode fiber-optic systems.

South Hills Electronics, 760 Beechnut Dr, Pittsburgh, PA 15205.

Circle No 414

Brochure, data sheets let you compare encoder specs

Using this 6-pg, 4-color brochure, you can compare mechanical-, electrical-, and environmental-performance specifications for an array of encoders, motor/encoder packages, and trackball systems for use in industrial, avionics, medical, military, robotics, and commercial applications. The company also offers three data sheets that describe the Models EHC25, 815, and 84C incremental encoders.

Litton Encoder, 20745 Nordhoff St, Chatsworth, CA 91311.

Circle No 421

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Your Partner for Innovative Circuit Protection

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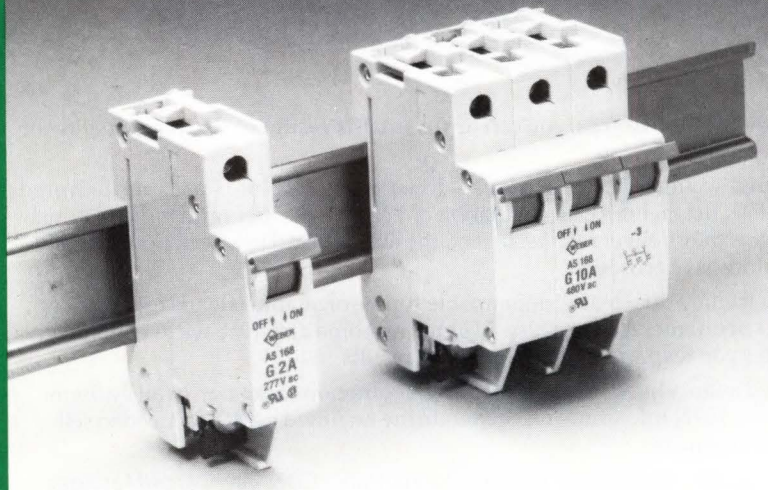

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CIRCLE NO 150

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For further information, contact Donna Pono, EDN Info Cards/Manager, at (617) 558-4282.

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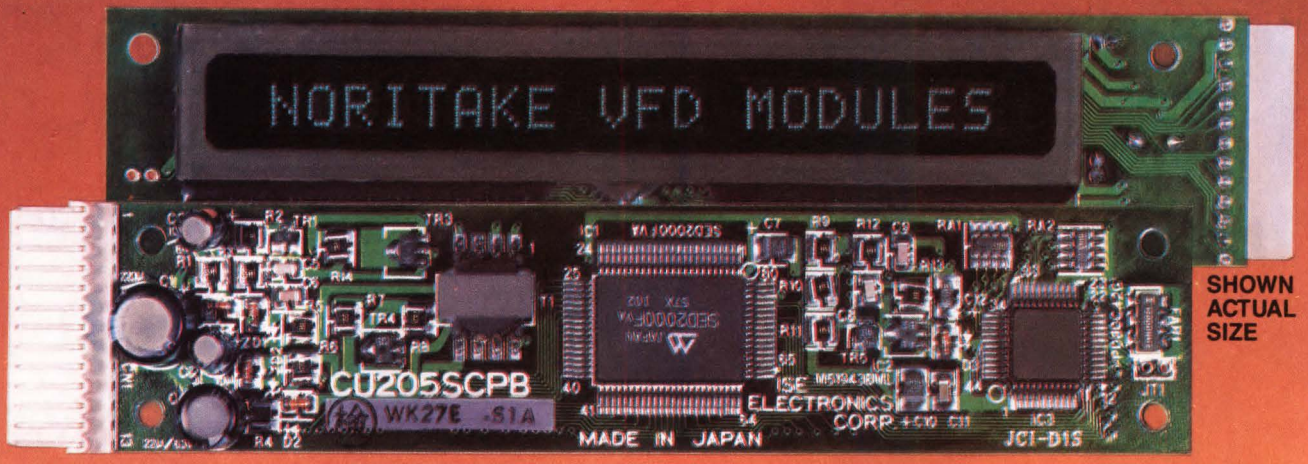

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								ROM	RAM
SCPB	14-SEGMENT + COMMA +D.P.	FU169SCPB-S1A	1 X 16	9.4	S/P	X	X		
		FU209SCPB-S1A	1 X 20	9.0	S/P	X	X		
	5 x 7 DOT MATRIX	CU205SCPB-S1A	1 X 20	5.0	S/P		X		1
	5 x 7 DOT MATRIX + CURSOR	CU20026SCPB -S20A	2 X 20	5.0	P	X	X		5
		CU40026SCPB -S20A	2 X 40	5.0	P	X	X		2
MCPB	5 x 7 DOT MATRIX + CURSOR	CU406MCPB -S1A; -S31A	1 X 40	5.0	S/P	X	X	X (-S31A)	8
		CU20026MCPB -S1A; -S31A	2 X 20	5.0	S/P	X	X	X (-S31A)	8
		CU40026MCPB -S1A; -S31A	2 X 40	5.0	S/P	X	X	X (-S31A)	4

Models shown are available on an immediate delivery basis. Custom designs can also be economically developed on a fast turn-around cycle, to satisfy specific needs. As new models are continuously being introduced, contact your nearest Noritake Sales Office or Representative firm for details.

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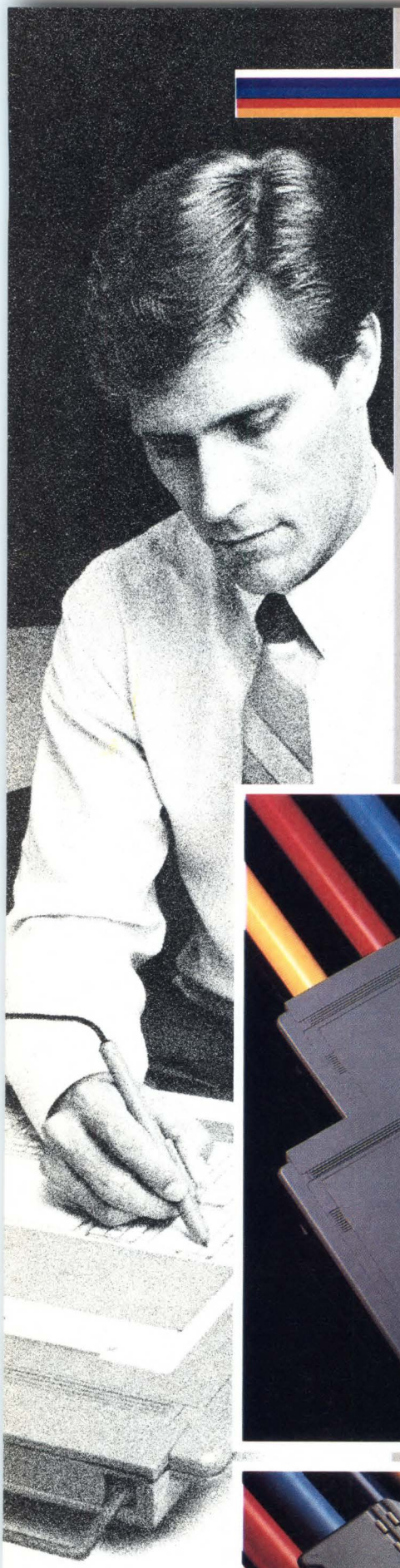

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If you've ever used a digitizer, you probably were surprised that it didn't do what you thought it would. You assumed that whatever you picked or moved or drew on the tablet would be accurately displayed on the screen and precisely reflected on output. In spite of its straight-forward appearance, it didn't take you long to learn that all digitizers were not created equal, or accurate, or even easy to use.

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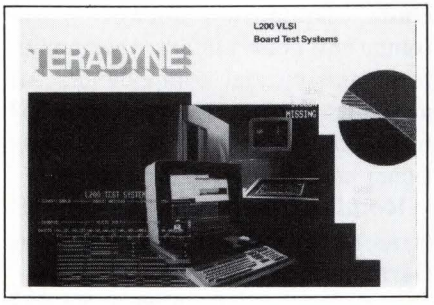
CIRCLE NO 154

Listing of electronic test equipment for rent

This 1988-89 rental catalog covers electronic test equipment that you can rent. The 36-pg listing includes products from major instrumentation manufacturers, such as Hewlett-Packard, Tektronix, Intel, and Fluke. The instruments for rent fall into 26 categories, including analyzers, meters, generators, oscilloscopes, desktop computers, and telecommunications. Rental terms and conditions, illustrations, and a product index complete the publication.

GenStar Rental Electronics Inc, 6307 DeSoto Ave, Suite J, Woodland Hills, CA 91367.

Circle No 660

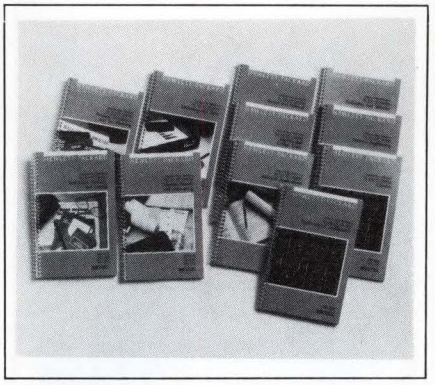


Brochure surveys VLSI board-test systems

This 12-pg, 4-color brochure provides an overview of the five members of the vendor's L200 VLSI board-test systems. Discussing the features that provide cost-effective solutions to individual test requirements, the brochure elaborates on the modular architecture and the use of the VAX/VMS system. Further, the pamphlet describes the software support for all the systems: the L200 test-development environment and in-circuit pattern libraries, the Lasar Version 6 simulation system for functional test-program generation, and the Board-Watch networking and test-data management system.

Teradyne Inc, Inquiry Systems & Analysis, 25 Drydock Ave, Boston, MA 02110.

Circle No 661



Books for calculator applications

The vendor is offering profession-specific solution books for the HP 27S and the HP 28S calculators. The five books available for the HP 27S are titled Real-Estate, Banking, and Leasing; Business Finance and Accounting; Marketing and Sales; Personal Investment and Tax Planning; and Technical Applications. For the HP 28S calculator, the titles are Algebra and College Math; Calculus; Electrical Engineering; Probability and Statistics; Vectors and Matrices; and Mathematical Applications. $9.95 each.

Hewlett-Packard, Corvallis Div, 1000 NE Circle Blvd, Corvallis, OR 97330.

INQUIRE DIRECT

IEEE announces advanced 488 standards

Digital Interface for Programmable Instrumentaion (ANSI/IEEE Std 488.1) and *IEEE Std 488.2 Standard Codes, Formats, Protocols, and Common Commands for Use with ANSI/IEEE Std 488.1-1987* (ANSI/IEEE Std 488.2) offer higher productivity, improved test quality, reduced costs, and more flexible performance and configuration of the test system. The first document updates the 1978 IEEE-488 standard, specifying the basic communications link between as many as 14 devices and a controller, such as a personal computer. The other publication covers the syntax and protocols of messages sent between the devices and the controller in an IEEE-488 bus system and explains how to handle status, error reporting, and high-level programming. ANSI/IEEE Std 488.1, nonmembers, $30; members, $21. ANSI/IEEE Std 488.2, nonmembers, $52; members, $36.40.

The Institute of Electrical and Electronics Engineers Inc, Standards Office, 345 E 47th St, New York, NY 10017.

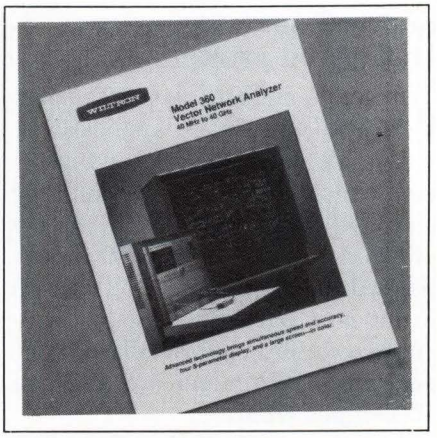
INQUIRE DIRECT

Catalog features devices for spectroscopy

This 1988 catalog of photonic devices describes more than 45 spectroscopic products, including 18 new devices. Among the products the catalog presents are photodiodes and photodiode arrays, photomultiplier tubes, detector tubes, and light-source lamps.

Hamamatsu Corp, Box 6910, Bridgewater, NJ 08807.

Circle No 664



Booklet covers network analyzer

This 22-pg brochure describes the 360 vector network analyzer covering the 40-MHz to 40-GHz range. Application information includes measurement of complex impedance and transmission characteristics, amplitude and phase matching, group delay, semiconductor characteristics, insertion loss/gain and phase, and time domain. It illus-

trates the simultaneous display of four S parameters on a color screen. It also describes a 4-channel frequency converter that makes frequeny-translation measurements. Specifications and ordering information complete the publication.

Wiltron, 490 Jarvis Dr, Morgan Hill, CA 95037.

Circle No 662

Pocket-size guide for fiber-loss measurements

The 20-pg PG-160 Pocket Guide, *Fiber Loss Measurements with the Intelco 160A,* describes the two most commonly used fiber-cable-loss measurement methods—the stored cross-reference method and the calibrated output power method. The guide also contains step-by-step procedures and figures to illustrate the test setups.

Intelco Corp, 8 Craig Rd, Acton, MA 01720.

Circle No 665

Source book categorizes DPMs and printers

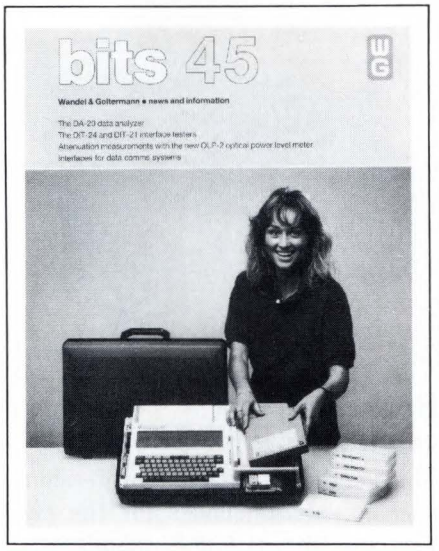
This 48-pg industrial source book highlights numerous applications, wiring diagrams, 4- to 20-mA process loop schemes, suggestions for use, and prices for a wide variety of products. A listing of an expanded line of digital panel meters includes a battery-operated high-speed counter, a portable LCD voltage-input DPM, and a micro-size RTD-input DPM.

Acculex, 440 Myles Standish Blvd, Taunton, MA 02780.

Circle No 666

Periodical features test instruments

The latest issue (No 45) of *bits* highlights the DA-20 data analyzer, the DIT-24 and DIT-21 interface testers, attenuation measurements with the OLP-2 optical-power level meter, and interfaces for data-



communications systems. This 32-pg edition comprises seven sections: current events, exhibitions, new products, a glossary, product highlights, applications, and special reports. Photographs, diagrams, graphs, figures, and tables complete the publication.

Wandel & Goltermann GmbH & Co, Electronic Measurement Technology, Postfach 1262, D-7412 Eningen u A, West Germany.

Circle No 663

PC-resident measurement systems described

This 4-color brochure covers the Virtual Cat family of pc-resident measurement systems. It lists features of the family's digital storage oscilloscopes, logic analyzer, pattern generator, and basic instrument package. Also included in the package are price lists, data sheets, and application notes.

Virtual Instrument Corp, 23 Clarke Circle, Bethel, CT 06801.

Circle No 674

App note explains accuracy at high speed

Application note 47W-7011 describes how to achieve picosecond accuracy when making propagation delay and rise-time measurements on high-speed signals. The note suits component-test, digital-design, and computer-peripheral-test applications. Screen illustrations of waveforms accompany the step-by-step instructions.

Tektronix Inc, Box 1700, Beaverton, OR 97077.

Circle No 669

Instrument catalog

The 548-pg 1988-89 edition of *Measuring Equipment* has 13 sections covering ATE, signal generators, radio-telephone test equipment, signal analyzers, EMI testers, field-strength meters, network analyzers, logic analyzers, voltmeters, power meters, oscilloscopes and recorders, frequency and time standards, and power supplies. Other products described in the catalog include termination networks, attenuators, noise meters, thermometers, and coaxial components. An appendix deals with equipment for broadcasting, radio communications, and radio monitoring.

Rohde & Schwarz, Mühldorfstrasse 15, 8000 Munich 80, West Germany.

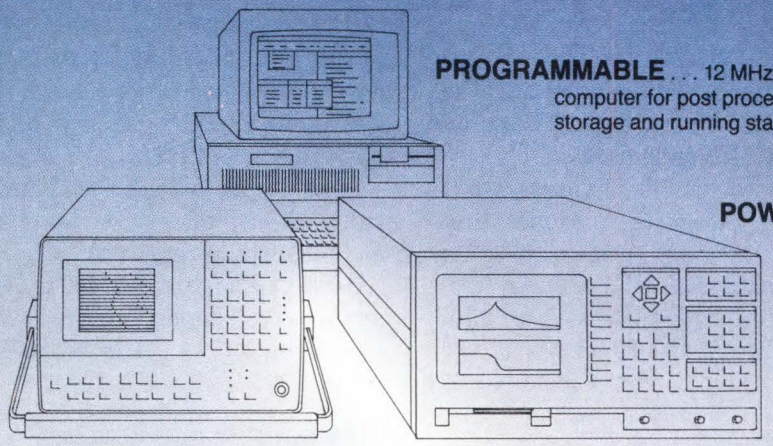
Circle No 673



Catalog provides test and prototype equipment

This 32-pg mail-order catalog describes breadboarding products, logic test equipment, power supplies, and test instruments. New

for lab or field vibration, acoustics, servo, electronics, structures, maintenance



PROGRAMMABLE . . . 12 MHz/80286 IBM-compatible computer for post processing, automation, storage and running standard or user programs

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PORTABLE . . . 100 kHz dynamic signal analyzer with high real time speed, 1/3 octaves, large buffer and spectral map displays

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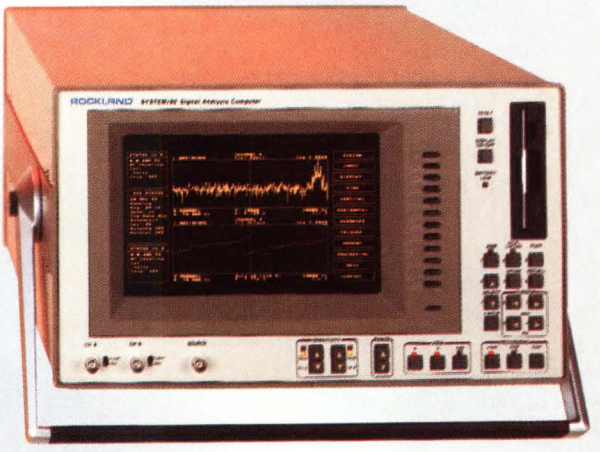



Keyboard included with all models

ROCKLAND

CIRCLE NO 153

Rockland Scientific Corporation, 10 Volvo Drive, Rockleigh, NJ 07647

What do IBM, HP, Raytheon and others know about 80X86 embedded system development you should know?

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CIRCLE NO 142

products include the BOA, a microcomputer applications workstation; the LA-1610, a logic analyzer; and the LCT-5, a logic test kit. The catalog, which is divided into 19 product categories, includes product summaries, photographs, and specifications.

Global Specialties, Box 1405, New Haven, CT 06505.

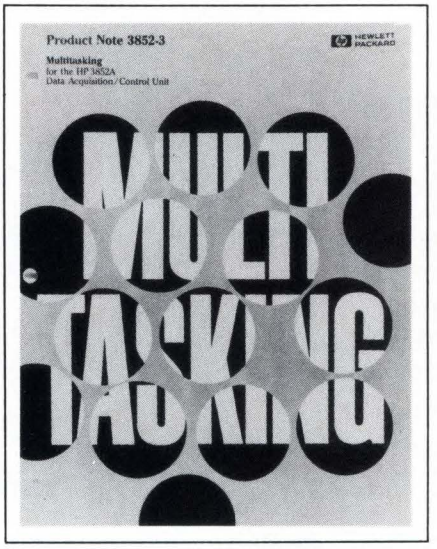
Circle No 671

Catalog of used equipment

The *Electronic Instruments Used Equipment Catalog* contains more than 750 items of reconditioned test equipment. The 12-pg brochure lists products from major instrumentaion manufacturers, such as Hewlett-Packard, Tektronix, Waveteck, and Fluke. Rental and leasing options as well as purchasing information complete the publication.

Continental Resources Inc, 175 Middlesex Tpk, Bedford, MA 01730.

Circle No 670



Note documents data acquisition/control system

In addition to providing programming examples, Product Note 3852-3 describes how the multitasking features of the HP 3852A data acquisition/control system let you space time-critical decisions in relation to the application. It explains how you can prioritize, download, and run tasks independently under four different conditions. The note examines each of these conditions and gives examples of how you can implement the programs.

Hewlett-Packard Co, 19310 Pruneridge Ave, Cupertino, CA 95014.

Circle No 668

Digitizing scope covered

Product Note HP 54111D-1 explains how to sample analog data at a rate of 2G samples/sec using the HP 54111D digitizing oscilloscope. After introducing the device in a general description, the note describes how to implement the HP 54111D using Basic software. A section on theoretical performance goes on to explore what level of performance can be expected from interleaving two channels. The publication concludes with a description of the typical performance you can expect when you use this instrument.

Hewlett-Packard, 19310 Pruneridge Ave, Cupertino, CA 95014.

Circle No 667

Brochure examines power meters

A 4-color brochure describes the features, specifications, and accessories for the 6960A and 6950 power meters. Characteristics of the 6960A outlined in the 10-pg brochure are accuracy levels, frequency range, software, outputs, and GPIB operation. Among the 6950's features discussed are portability, accuracy, speed, and adaptability. Additionally, two pages contain descriptions, specifications, and an accessories chart for the vendor's line of power sensors.

Marconi Instruments Inc, 3 Pearl Ct, Allendale, NJ 07401.

Circle No 672


there IS JUST
ONE way to
Raise THE Standards
in Computer graphics.

Our Bt458 set the standard for workstation color graphics. Now we say "standard" is not enough.

Question authority. Challenge the status quo. And flex your creative muscles.

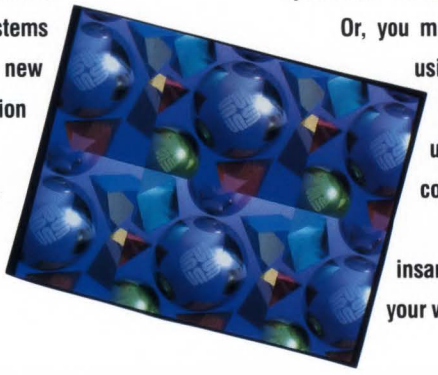
Why? Because it's up to *you* to take computer graphics to the next higher plane.

Which brings us to our legendary **Bt458**, the industry standard triple 8-bit RAMDAC. For our many customers who have based successful workstation graphics systems on the **Bt458**, we now offer a plastic package, the new **Bt458KPJ** with a drastic reduction in power dissipation from the original.

But why be conventional? Go for greatness. Design in the latest wave in RAMDACs instead—our new 135 MHz **Bt459**.

The **Bt459** enables you to stretch the envelope.

A display of brilliance—that's the least we expect from you.



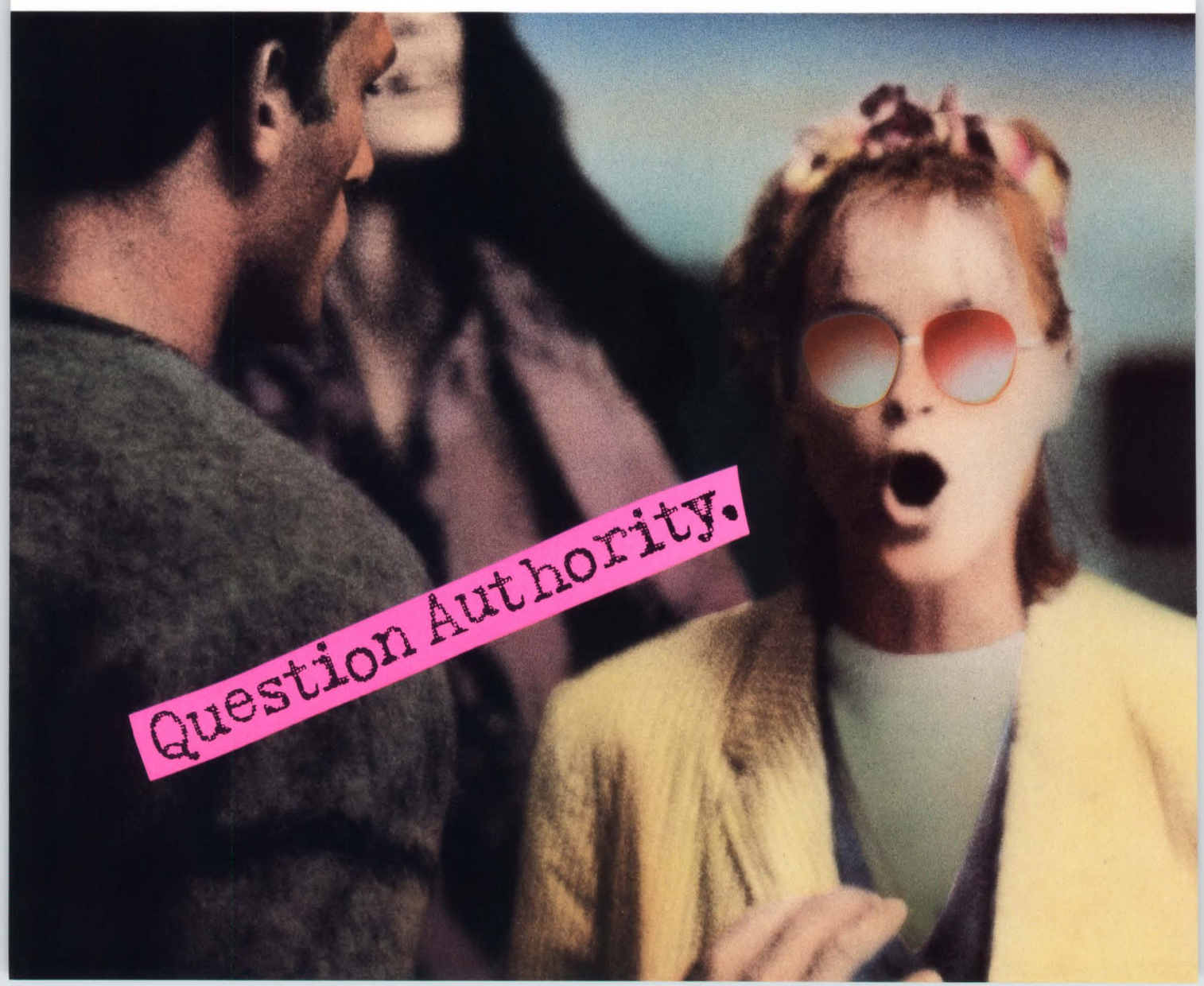
It gives you 256x24 color palette RAM with 16x24 overlay color palette, programmable multiplexing of the pixel and overlay ports, and bit plane masking and blinking.

Plus the **Bt459** provides 1x to 16x integer zoom support, panning support, cursor control and easy customization of frame buffer dimensions. Imagine the possibilities.

(If all this doesn't get your creative juices pumping, you better move into management.)

Or, you may want to explore true color graphics, using our **Bt457** RAMDACs. Unless of course you're of a more radical nature and prefer using 170 MHz **Bt461** with five times the color palette.

The point is, if you want to design insanely great workstation graphics, we've got your weapons.



IBM set the VGA standard.

First we met it. Then we topped it.

VGA is VGA is VGA. *Until* **you look at it from our point of view.**

We would be happy to sell you our new Bt476. It's a low-cost VGA RAMDAC in a 28-pin DIP, pin compatible with the IMSG171. Customers who have evaluated the Bt476 have made it their second—or *primary*—**source for existing VGA designs.**

We would *rather* **challenge you to consider the future of VGA. Because that's exactly what we've given it—a** *future*, **with a pin compatible family of VGA RAMDAC alternatives.**

Start with our Bt476 in a 44-pin PLCC, for added performance in a smaller footprint, SMT package—at the same price as the 28-pin DIP.



We paint our masterpieces in silicon—to inspire yours.

Then differentiate your system with higher resolution and increased functionality. Our pin compatible Bt471 256x18 RAMDAC gives you higher performance and a color overlay palette. And the Bt478—in the same 44 pin PLCC—gives you triple 8-bit DACs, up from 6 bit. So you can leap from the limitations of 256k possible colors to the full spectrum of 16 million colors.

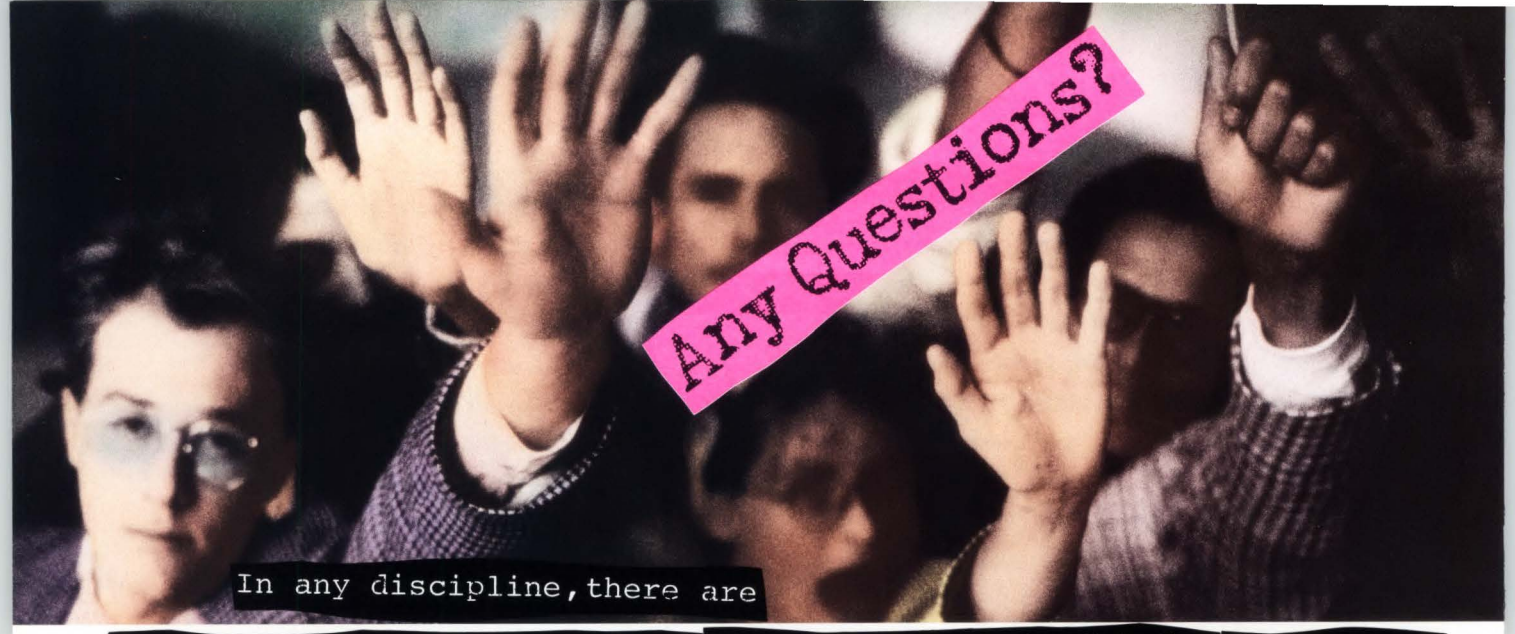
Or break into true color VGA today with our Bt473. It gives you the option of full VGA compatibility or full 24-plane color capability.

Sure, these alternatives demand that you stretch the current VGA standard. But isn't that what standards are for?

Designers of the world, unite—with Brooktree. We're your full-line supplier of RAMDACs, and all the motivation you need to develop world-beating solutions.

Brooktree





followers and there are leaders. Life's more meaningful for the latter.

Q ***Is an 18-bit wide color palette really enough for quality desktop presentation graphics?***

A Why restrict yourself to 256K visible colors when the 24-bit wide Bt473 gives you 16 million colors to work with. It's the smart way to get true 35mm slide quality graphics. Or achieve 24-bit wide pseudo color using the Bt478.

Q ***Anti-aliasing images at a small incremental cost?***

A It's possible. Stick with your 640x480 VGA monitor and use the Bt473. Its anti-aliasing capability provides full true color display without having to upgrade monitors.

Q ***How do you handle D-size monochrome drawings and high-res color graphics in the same system?***

A With the Bt459. Its block mode gives you software selectable virtual resolution. Just unfold the color bit planes—starting at 1280x1024x8—to customize the frame buffer to your application. And since the Bt459 fully supports panning, it enables you to move over an image as large as 5120x2048x1.

Q ***Pan and zoom?***

A Also fully integrated into the Bt459. We use pixel replication techniques to provide cost effective zoom, 1x to 16x.

Q ***How do you cope with multiple applications running simultaneously in a window environment, each requiring its own 256 word color palette?***

A The Bt461 does windows—up to five of them displayed at a time, each with their own color palette. Or you can have a 1024 word palette for pseudo color graphics with an alternate 256 word gamma-corrected true color palette.

Q ***What's the best way to support cursors?***

A Start with our Bt431 for a single 64x64 user definable cursor, designed to talk to the overlay ports of all our high speed RAMDACs. Or take a more integrated approach with the Bt459's user-definable cursor. It provides you a 64x64x2 bit map to play with. So you can create a 3-color cursor or an X windows 2-color cursor.

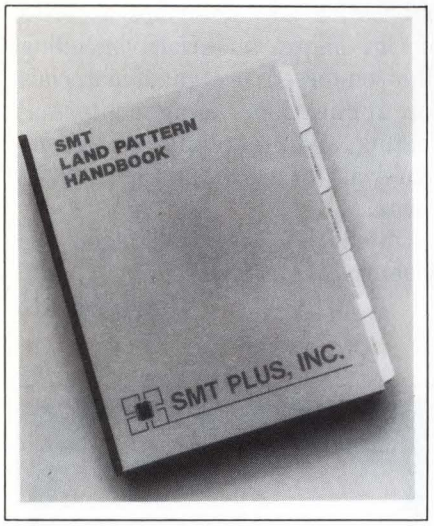
PART	PALETTE SIZE	640 x480	1024 x768	1280 x1024	1600 x1200	APPLICATIONS
Bt450	16x12	✓	✓			Low-end 16-color graphics terminals
Bt451 Bt457 Bt458	256x12 256x8 256x24		✓ ✓ ✓	✓ ✓ ✓		Pin compatible, industry standard family for high resolution workstation graphics
Bt459	256x24		✓	✓		Next generation workstations
Bt453	256x24	✓	✓			Macintosh compatible
Bt454	16x12		✓	✓	✓	High-end 16-color graphics terminals
Bt461	1280x8		✓	✓	✓	Next generation workstations
Bt471 Bt476* Bt478	256x18 256x18 256x24	✓ ✓ ✓	✓ ✓ ✓			Pin compatible family for PS/2 VGA graphics in 44-pin PLCC
Bt473	256x24	✓	✓			True color VGA graphics

* Bt476 also available in 28-pin DIP

Brooktree

Ask us.

We challenge you to be creative. And we provide the fuel to fire your imagination. Nobody offers more RAMDACs, more performance options or functional possibilities. For complete product details on any or all of these products, or if you dare wear one of our "Question Authority" buttons, call Brooktree at 1-800-VIDEO IC. Brooktree Corporation, 9950 Barnes Canyon Rd, San Diego, CA 92121. TLX 383 596



Handbook for SMT land patterns

The SMT Land Pattern Handbook consists of more than 80 completely dimensioned land patterns for SMT components. Each of its 12 sections begins with a list of instructions and suggestions. The categories of footprints used by the vendor are labeled SO (small-outline package), SO medium body, SO wide body, SO metric, PLCC (plastic leaded chip carrier), LCC, quad flat packs, chip R/C (resistors and capacitors), tantalums, MELF (metal electrode face bonded), inductors, and SOT (small outline transistors).

SMT Plus Inc, Box 612314, San Jose, CA 95161.

INQUIRE DIRECT



Solving EMI-shielding and heat-dissipation problems

This booklet, entitled *Applications Updates, Fresh Approaches Which Solve EMI Shielding and Heat Dissipation Problems,* provides 20 applications for packaging engineers whose equipment has unusual material, performance, or environmental requirements in regard to EMI shielding or heat dissipation. The publication deals with the conductive elastomers, wire-shielding solutions, flexible circuit shielding, EMI-shielded display windows, specialty laminates, and heat-transfer materials. Each application is illustrated with a diagram or photograph.

Chomerics Inc, 77 Dragon Ct, Woburn, MA 01888.

Circle No 635

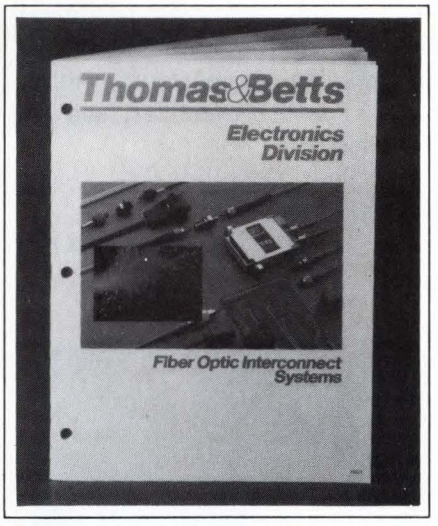


Publication discusses connection systems

The 32-pg *Handbook of Power-Lok Connection Systems* gives you specifications and diagrams of the vendor's connection-system products. The booklet is divided into 11 sections that deal with a variety of connection systems, such as a large-surface-area contact mating system, straight-solder printed-board connectors, and 90° solder printed-board connectors. Other sections present insulator dimensions, removable contacts, crimping information, contact crimp tools, and accessories.

Positronics Industries Inc, Box 8247, Springfield, MO 65801.

Circle No 640

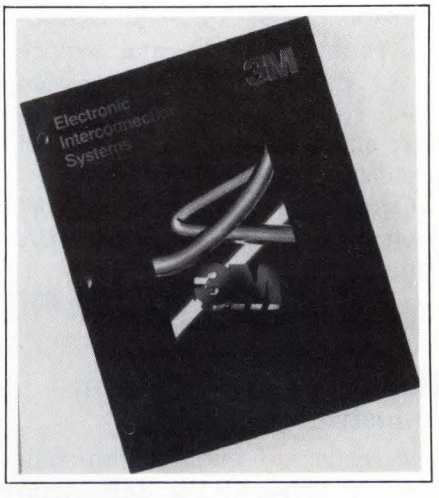


Fiber-optic catalog

This 42-pg catalog describes the vendor's fiber-optic system interconnections. The publication introduces the Pre-Cap Series connectors and defines interconnection requirements for interfacing both plastic and glass optical fibers with data-communications systems. It also features installation tooling and includes assembly kits to help you install glass fiber connectors.

Thomas & Betts Corp, 1001 Frontier Rd, Bridgewater, NJ 08807.

Circle No 638



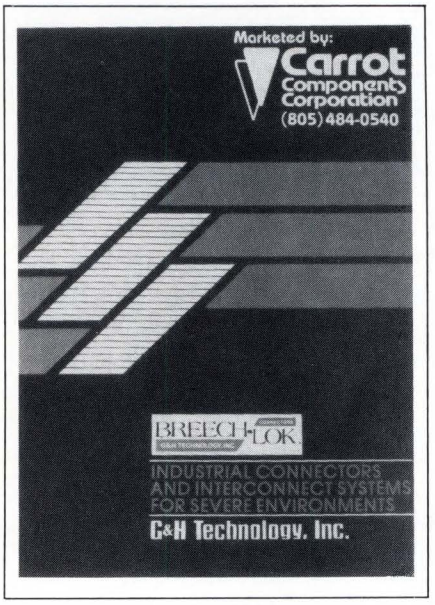
Book helps you solve interconnection problems

This 490-pg catalog, *Electronic Interconnection Systems,* presents a broad range of solutions to electronic interconnection problems.

The volume features technical drawings of the elements in the vendor's line of connectors, cables, sockets, cable assemblies, and accessories.

3M, Dept 33-28, Box 3064, Cedar Rapids, IA 52402.

Circle No 639



Listing of connectors

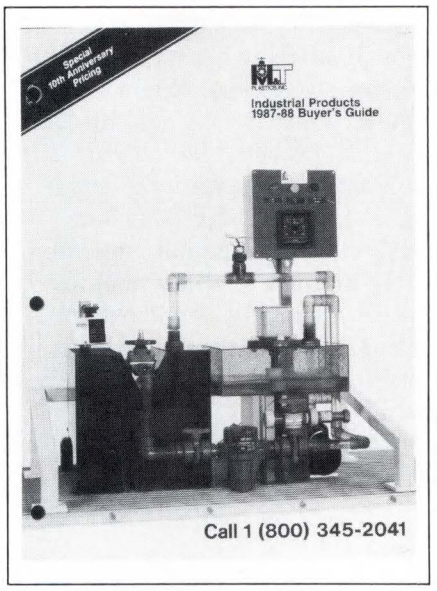
The vendor's 12-pg catalog of BLC Breech-Lok connectors features specifications, mechanical drawings, contact arrangements, and information about backshell accessories, crimp contacts, and service tools. Also included is information about straight plugs; mounting, in-line, and jam-nut receptacles; and protective covers.

Carrot Components Corp, 750 W Ventura Blvd, Camarillo, CA 93010.

Circle No 637

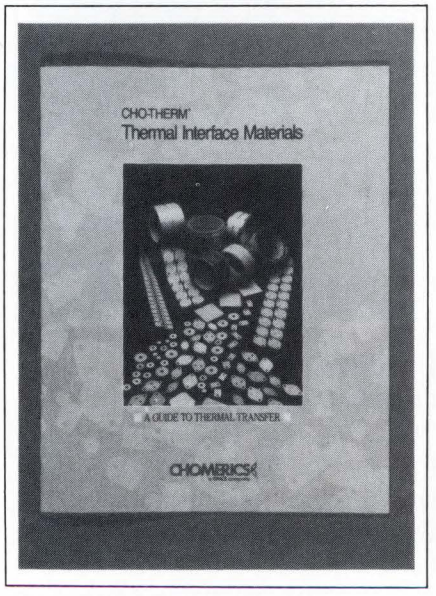
Buyer's guide focuses on industrial products

The vendor presents its 10th anniversary issue of the Industrial Products 1987-88 Buyer's Guide. The 170-pg catalog contains listings with specifications and prices for a wide selection of industrial thermoplastics, pipes, fittings, and valves. Other listings include flow and analytical instruments, recorders, and metering pumps.



M&T Plastics Inc, 6715 Joy Dr, East Syracuse, NY 13057.

Circle No 636



Removing heat from power-semiconductor devices

This guide tells you how to remove heat from power semiconductor devices using Cho-Therm thermal interface materials. The 20-pg publication covers fundamentals, including the theory behind heat transfer, thermal conductivity, thermal impedance, volume resistivity, dielectric strength, compression deflection, and stress relaxation. The publication also describes a series of Cho-Therm materials, including film-reinforced urethane materials for applications using conformal coating, and film-reinforced silicone materials for use in the 150 to 200°C range.

Chomerics Inc, 77 Dragon Ct, Woburn, MA 01888.

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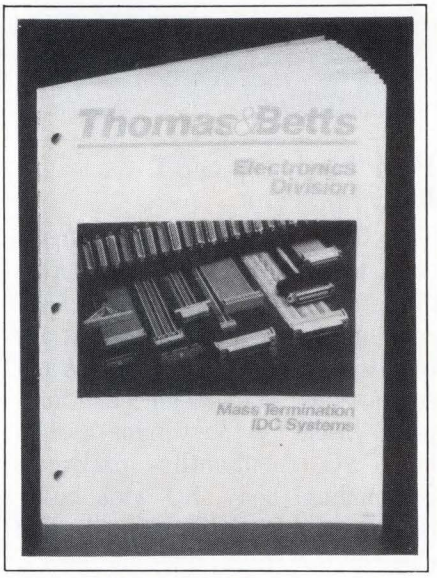

Mass termination IDC systems

Mass Termination IDC Systems focuses on flat cable, mass-termination connectors, and installation tooling. The 128-pg publication chronicles the development of Ansley flat cable, the result of pioneering work for NASA to replace cumbersome wiring harnesses. Also recounted in the book is the development of connections with insulation-displacing contacts (IDCs), a breakthrough that made stripping, soldering, and welding individual conductors practically obsolete. The publication encompasses a line of standard and custom flat cable, headers, sockets, and connectors. Also provided are a handbook and glossary containing engineering data on IDC technology.

Thomas & Betts Corp, 1001 Frontier Rd, Bridgewater, NJ 08807.

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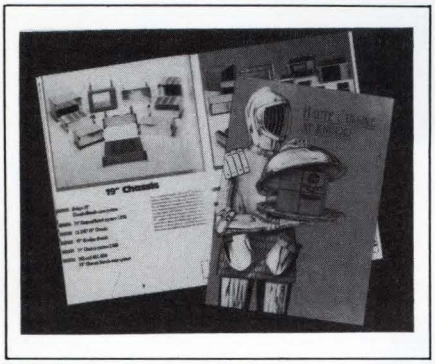


Enclosure and laboratory furniture cataloged

This 15-pg short-form catalog titled *Haute Cuisine* details the company's range of equipment enclosures and accessories. The publication lists 19-in. standard enclosures and nonstandard enclosures manufactured from aluminum, steel, and plastic; racking systems; control consoles; laboratory furniture; and equipment trolleys.

Knurr AG, Schatzbogen 29, 8000 Munich 82, West Germany.

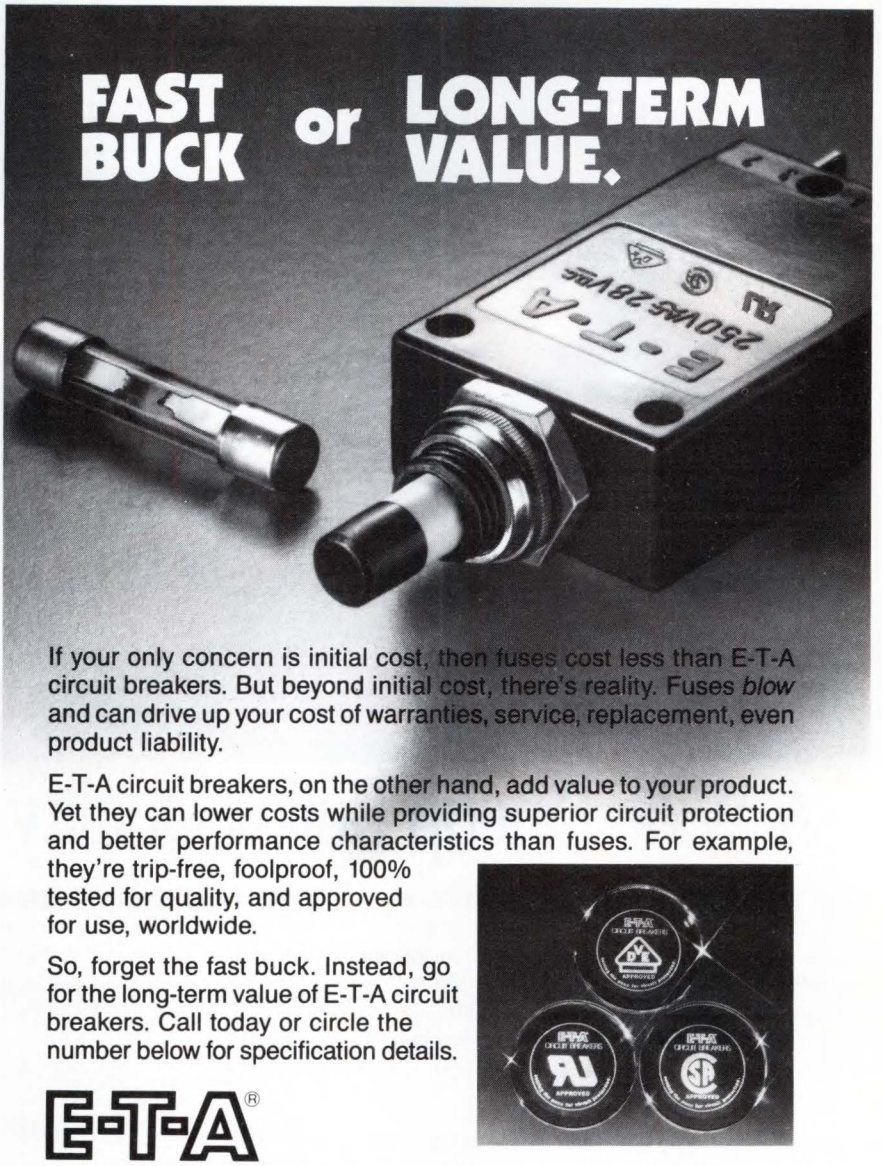
Circle No 644

Brochure examines impedance systems

The 12-pg publication, *Innovators in Controlled Impedance Interconnections*, discusses the characteristics of controlled impedance systems, design parameters, and the vendor's design, prototype, and production facilities for these systems. The brochure also features the Invisicon-controlled impedance surface-mount connector.

Rogers Corp, Box 700, Chandler, AZ 85244.

Circle No 641



CIRCLE NO 155

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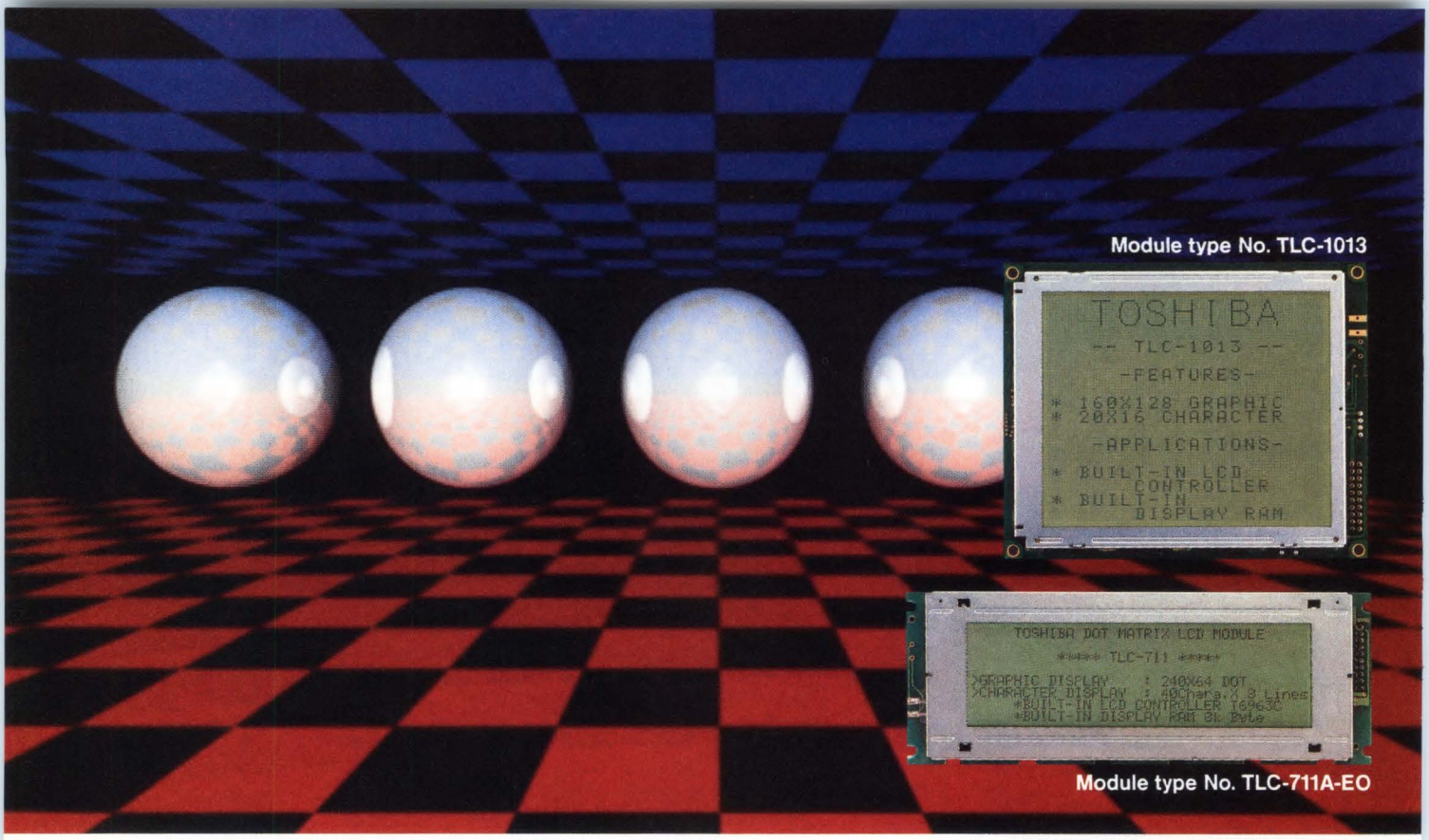
EDN



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Model name	Number of characters	Outline dimensions (mm)
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TLC-241	16 × 1	80 × 36 × 12
TLC-491	16 × 2	80 × 36 × 12
TLC-731	16 × 4	87 × 60 × 12
TLC-501	20 × 2	116 × 37 × 12.5
TLC-721	20 × 4	98 × 60 × 12
TLC-691	24 × 1	126 × 36 × 12
TLC-771	24 × 2	118 × 36 × 12
TLC-601	40 × 1	182 × 33.5 × 13
TLC-591	40 × 2	182 × 33.5 × 13
TLC-1001	40 × 4	221 × 76 × 12.5
*TLC-673-JO	16 × 1	80 × 36 × 14
*TLC-493-JO	16 × 2	80 × 36 × 14

*Built-in LED backlight

Graphic Display Type with Built-in Controller

Clear display thanks to high contrast TN.
Easy-to-use C/G, RAM and ROM built-in types.

Model name	Number of dots	Outline dimensions (mm)	Controller	Built-in EL module
TLC-1021	120 × 64	85 × 70 × 20	T6963C	TLC-1021-EO
TLC-682	160 × 64	125 × 50 × 18	T6963C	—
TLC-711A	240 × 64	180 × 65 × 12	T6963C	TLC-711A-EO
TLC-1013	160 × 128	129 × 104.5 × 14	T6963C	TLC-1013-EO
TLC-1091	240 × 128	241 × 125.3 × 12	T6963C	TLC-1091-EO
TLC-1101	160 × 32	140 × 40 × 12	T6963C	—

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Model name	Number of dots	Outline dimensions (mm)	Controller	Built-in EL module
TLX-1021	120 × 64	85 × 70 × 20	T6963C	TLX-1021-EO
TLX-711A	240 × 64	180 × 65 × 12	T6963C	TLX-711A-EO
TLX-1013	160 × 128	129 × 104.5 × 14	T6963C	TLX-1013-EO
TLX-1301V	240 × 128	241 × 125.3 × 12	T6963C	—
TLX-1391	128 × 128	85 × 100 × 14	T6963C	TLX-1391-EO
TLX-341AK	128 × 128	93.2 × 86.6 × 12	(T6963C)	—
TLX-1241	480 × 128	277 × 86 × 14	(T7779)	—
TLX-761	640 × 64	320 × 47 × 14	(T6963C)	—

( ): Recommended controller ICs.

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CIRCLE NO 157

EDN PRODUCT MART

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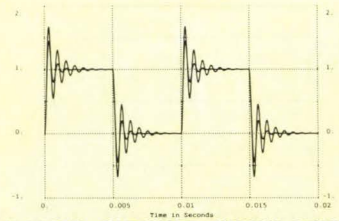

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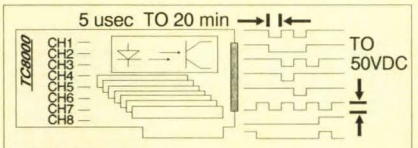

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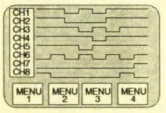

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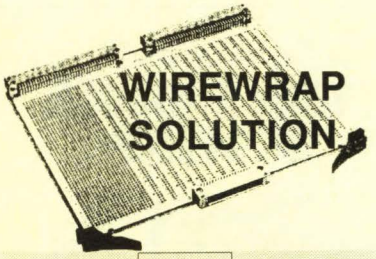

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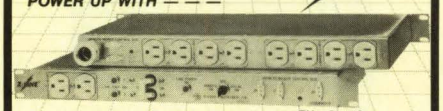

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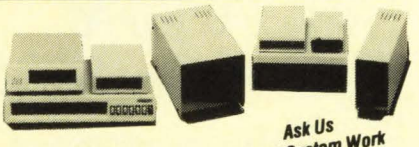

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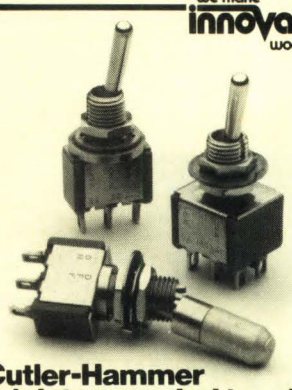

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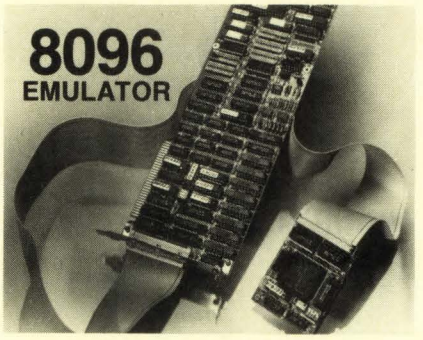

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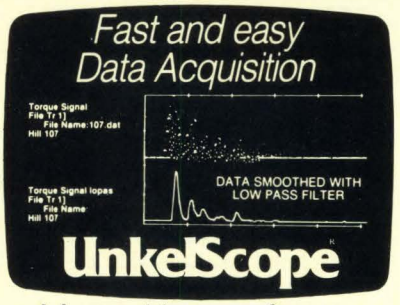

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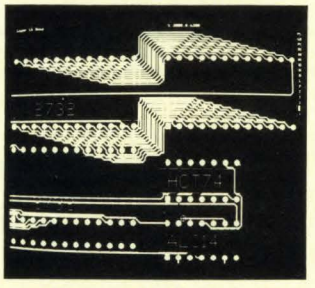

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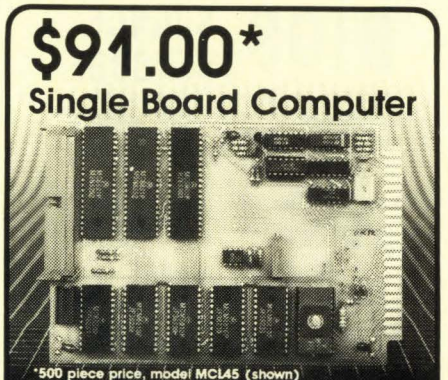

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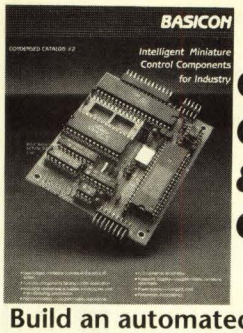

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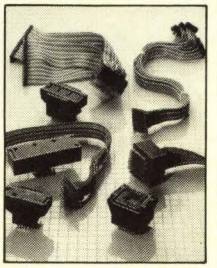

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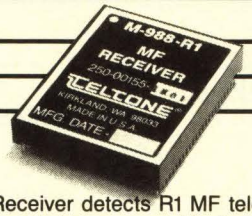

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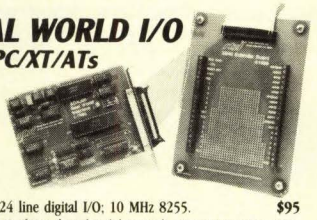

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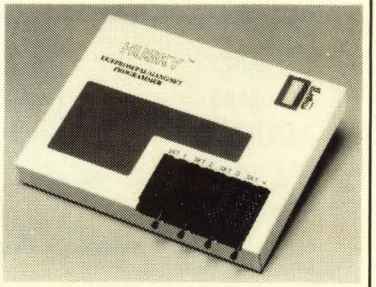

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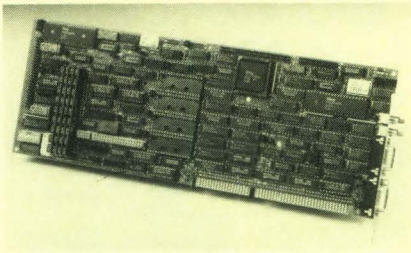

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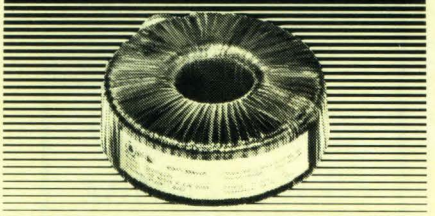

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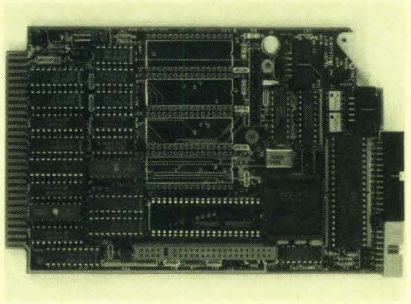

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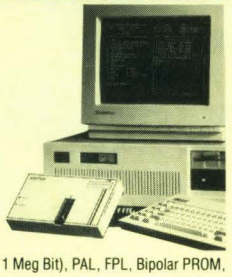

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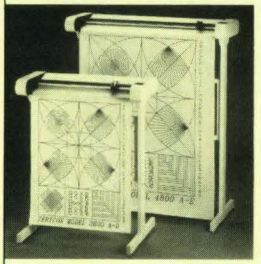

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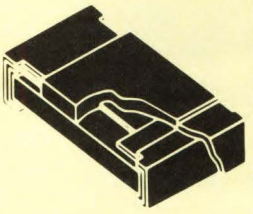

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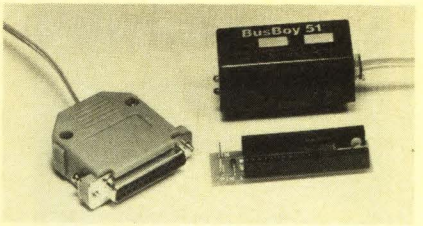

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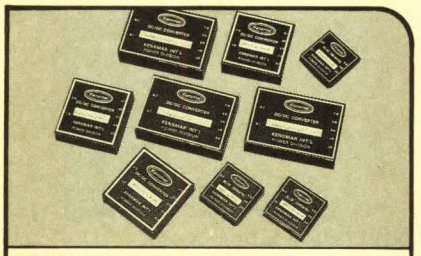

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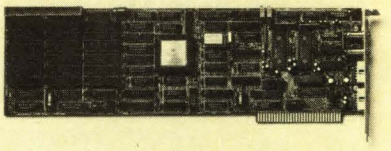

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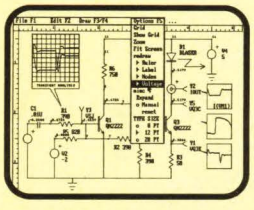

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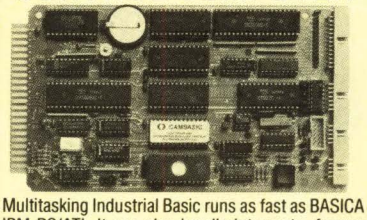

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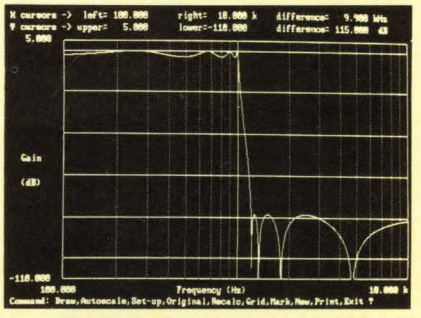

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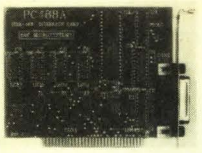

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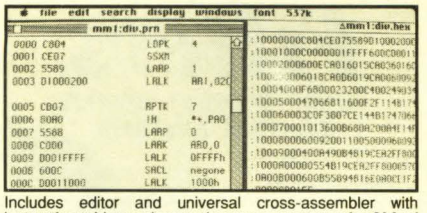

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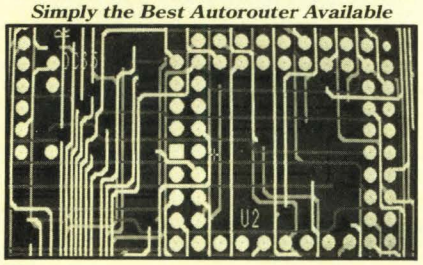

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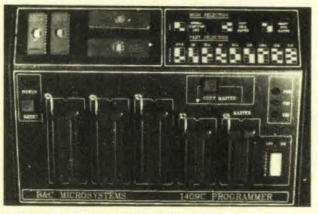

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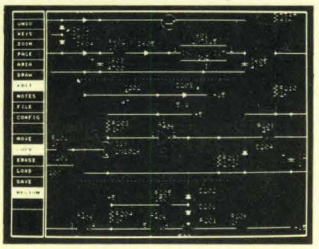

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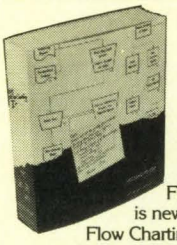

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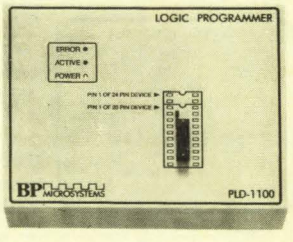

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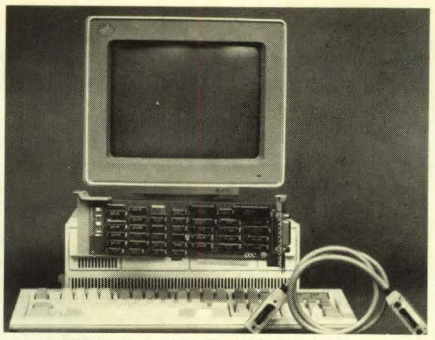

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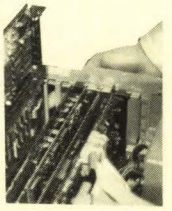

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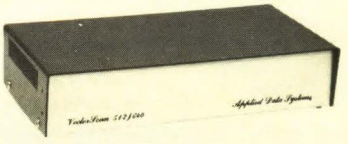

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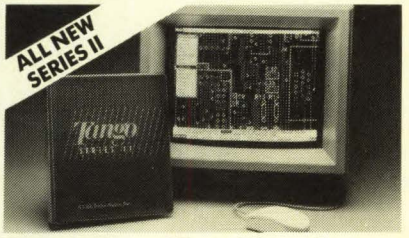

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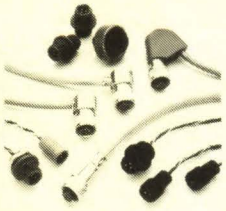

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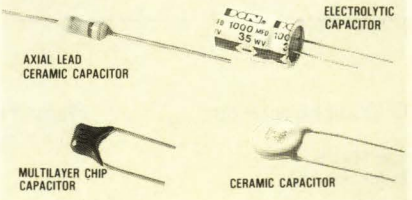

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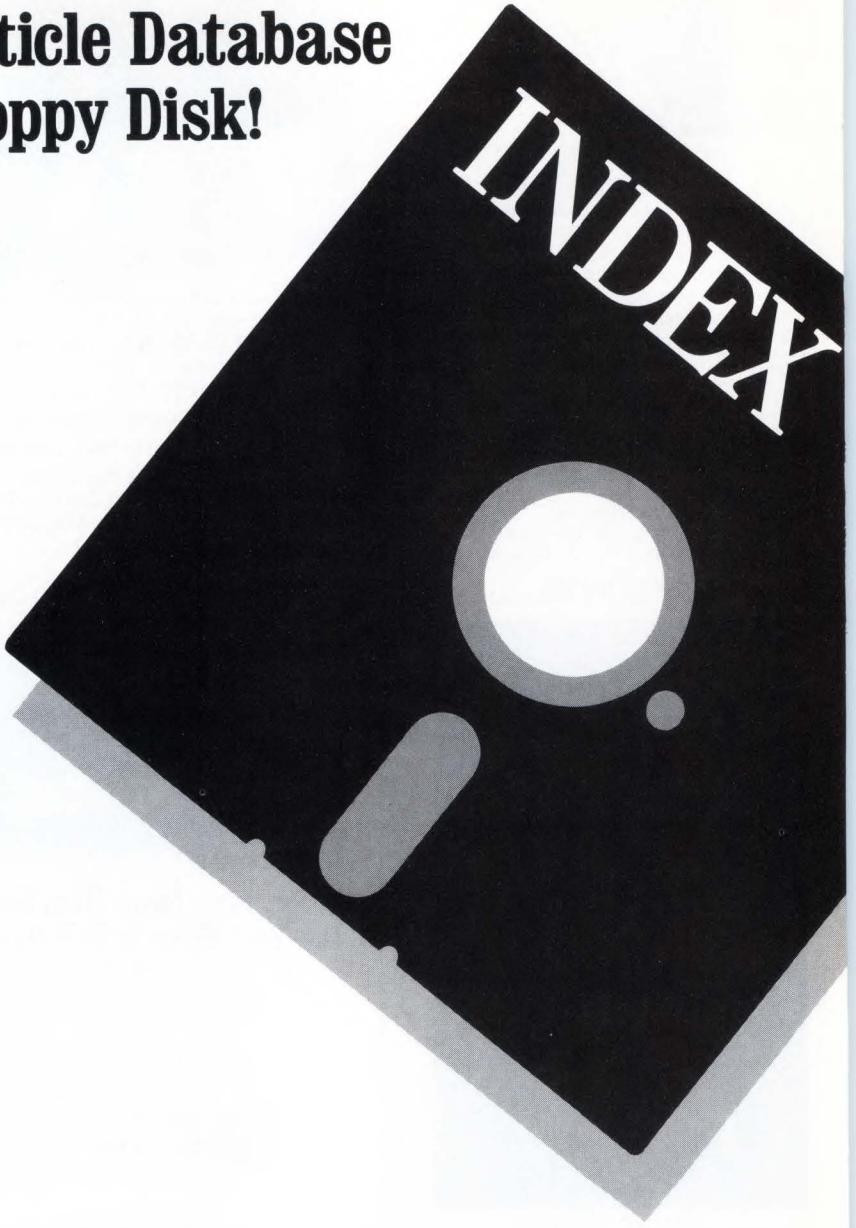

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1989 Editorial Calendar and Planning Guide

Issue Date	Recruitment Deadline	EDN Editorial Emphasis	EDN News Edition
Jan. 5	Dec. 15	Power Semiconductors, Computer Peripherals Software	Closing: Dec. 20 Mailing: Jan. 12
Jan. 19	Dec. 29	Computer Boards, Analog ICs	Closing: Jan. 6 Mailing: Jan. 26

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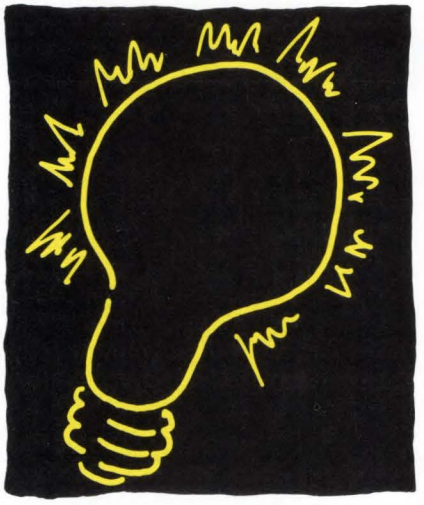
Microprocessor Logic and ASIC Design Engineers

Challenge your expertise in logic design and/or microprocessor system design using flow charts and timing diagrams for digital design and detailed design analysis. Your experience should include vendor libraries, test vector generation, simulation checkout and TTL emulators for gate array standard cell design. Familiarity with CAE systems used in logic design, test vector generation, simulation checkout and documentation is also necessary. You must have five years' related experience plus a BSEE or equivalent degree. An MSEE degree is preferred.

Systems Architects

You'll design new products by investigating and evaluating system compatibility and performance of design alternatives and new technologies. You'll develop hardware compatibility tests and performance analysis tools.

Qualify with a BSEE, MSEE preferred, and three years' hardware background with a knowledge of microprocessor-based systems software. In addition, experience with CPUs/Memory/Bus architecture,



numeric co-processors, file subsystems, network communications, graphic subsystems and state machines is required.

Systems Software Engineers

You'll evaluate, design and develop firmware, operating systems, device drivers and utility software for PC systems. Along with your BSEE/BSCS, you'll need four years' related experience in PC software development, 8086/286/386 Assembly/'C' language programming in MS-DOS, OS/2 and/or UNIX/XENIX operating system environments.

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As a key contributor, you will evaluate the performance and compatibility of storage technologies and new products. You will also develop device drivers and systems software. You must be familiar with PC-disk or tape technology/products, and understand systems architecture such as PC hardware, BIOS, MS-DOS, NETWARE, OS/2, or UNIX/XENIX. Qualify with four years of related experience and a BSCS, BSCE, or BSEE. Experience programming in 8086 Assembly and 'C' is required.

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As a Compaq Packaging Engineer, you'll help improve the quality of Compaq products. You'll need a BS in Packaging Engineering or equivalent degree, plus three to ten years' experience in a computer or electronic component manufacturing environment. Your expertise should include shock and vibration testing as well as evaluation of packaging cushioning materials. International packaging and project management experience is desirable.

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You'll do board level in-circuit testing, using Genrad 227X series ATEs and 229X series workstations. A BSEE along with three years' experience, including ATE programming, is required.

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Assure proper specification of components used in circuit board assemblies by verification of vendor compliance to these requirements. A Bachelor's degree in Engineering with a minimum of two years' experience as a Development or Project Engineer in a computer product related or a component manufacturing environment will qualify you.

Sustaining Engineers

You'll be part of a top team involved in analog and digital component evaluation and failure analysis of electrical and electromechanical components. Your BSEE and three to seven years' experience should include familiarity with SMT components, technical support in a high-volume printed circuit board manufacturing environment, and knowledge of PCB layout, design and chemical processes. You should also be adept at component supplier interfacing on specification and quality improvement.

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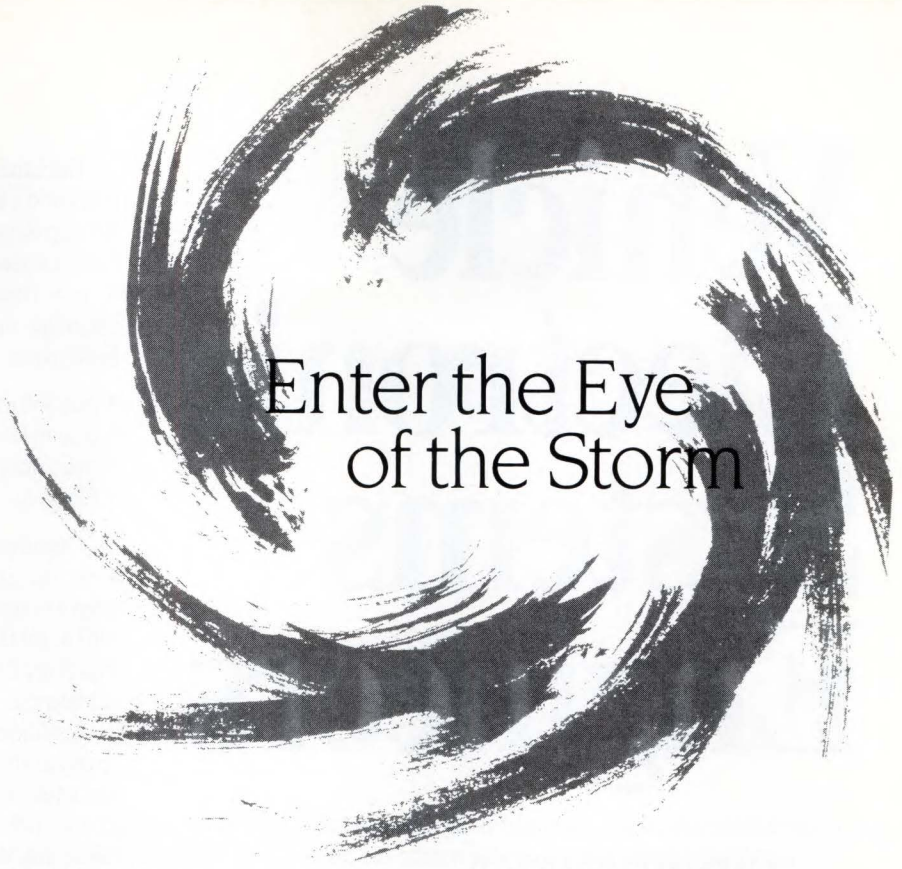

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Work with schematics, logic diagrams and engineering notes to plan and execute topological design of VLSI MPU circuits. Support revisions of existing design and direct design staff. Requires Associate Degree and 2-5 years related experience.

CIRCUIT DESIGN ENGINEERS

Perform design and analysis of high speed CMOS circuits related to microprocessors and peripherals, and assist test/product engineers. Requires BSEE and 2+ years experience with knowledge of microprocessor functionality and characteristics.

32-BIT PRODUCT ENGINEER

Responsible for the success of the 32-bit Product Line. Duties include forecasts, price strategy, competitive analysis, cost analysis, new product introduction, first level technical contact with customers and intra company representation. Requires BSEE and 3+ years experience in computer systems; MBA helpful.

PRODUCT ENGINEERS

Responsible for yield/cost management and improvement, characterization of products to support design, manufacturing and quality improvements, and customer interface. Requires BSEE and 1-5 years experience with knowledge of microprocessor functions and characteristics.

SOFTWARE ENGINEERS

Design, implement and maintain operating systems, compilers, assemblers, simulators and run-time support packages for the M68000, M88000 and DSP 56000 product families. Requires BSCS, BSEE or equivalent and programming experience in a UNIX C environment and/or Graphics.

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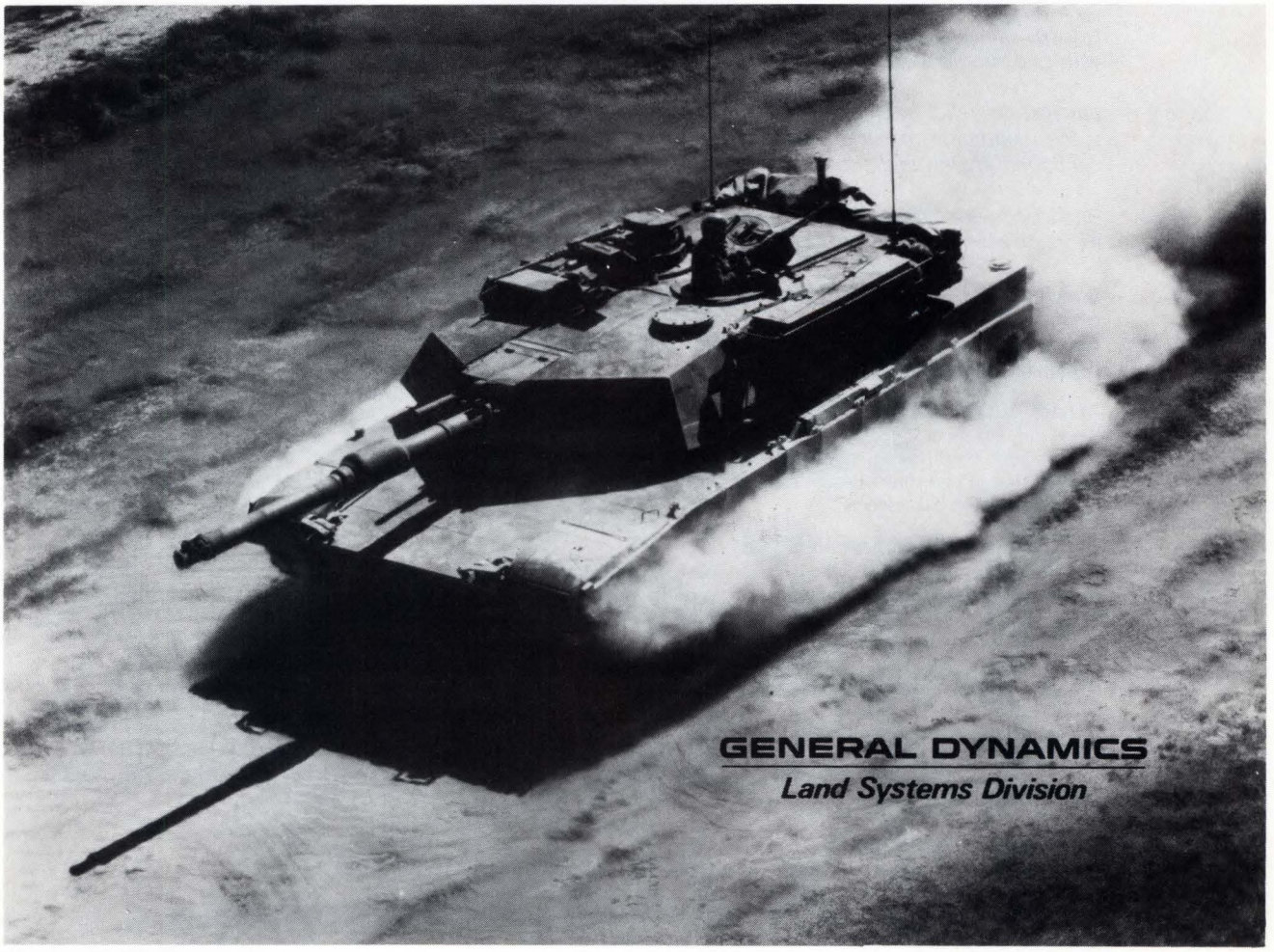
In addition to the many opportunities to improve your technical ability, we offer an excellent compensation program and a full range of benefits including relocation assistance, complete family medical and dental plans, life insurance and a generous savings and stock investment plan.

For immediate consideration, send your resume and references to: Manager, Professional Staffing, General Dynamics Land Systems Division, P.O. Box 2072, MZ 436-11-34, Drawer 133, Warren, MI 48090. Equal Opportunity Employer.



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Cabletron Systems Incorporated is a leading manufacturer and supplier of local-area-network hardware and software products. To continue the leadership, key individuals are needed to develop our next generation of products.

Our engineering environment is dynamic, fast-paced and reputed for quality and efficiency; opportunities for advancement based on achievement abound. Individuals with experience and knowledge of network theory and protocols will be given special consideration.

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You will be responsible for directing the activities of 20 Software Engineers developing a variety of Local Area Networking products. This person must possess great leadership and organizational skills and be able to perform in a fast-paced, dynamic environment. Involvement with IEEE and ISO standards bodies, along with experience in TCP/IP, UNIX, MS-DOS, TOP, and C desired. This position reports directly to the Engineering VP. A BSEE and 3+ years of related experience are required.

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You will be responsible for developing the functional requirements for Cabletron's next generation of networking media and management products. These positions will require extensive interfacing with customers, sales, and engineering. Knowledge in the following areas is required: IEEE802.X, IBM TOKEN RING, FDDI, TCP/IP, SNMP, ISO, X.25, TOP, Bridging, Routers, and Gateways. These positions require a BSEE or BSCS and 3+ years of related experience.

Senior Software Engineers

We seek self-motivated individuals with 5-10 years of programming experience and at least 2 years of network protocol experience to lead development of a network management system that will incorporate accepted protocols over a wealth of different media types. Candidates should have knowledge of IEEE 802, TCP/IP, SNMP, OSI Network Management, CMIS/CMIP, and Netview. Thorough understanding of standards processes and excellent communication skills are required. A BSCS is a must.

Software Engineers

You should have 2+ years of large-scale development experience with excellent top-down programming skills, in order to be responsible for design and code development of network management and its relationships to network products. MS-DOS, UNIX, OS/2 systems-level development experience, C, and good documentation skills are required. BSCS in Math required.

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Individuals with 3+ years of firmware experience are needed to design and develop reliable I/O drivers and diagnostic routines for Local and Wide Area Network products. You should have a detailed understanding of hardware and assembler-level programming for the Intel and Motorola microprocessor families; experience with 802.3, 802.5, and TI is helpful. BSEE/BSCS required.

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Positions in Development Test and Quality Assurance require a BS in EE or CS with 2+ years' experience or an MS with 1-2 years' background in software development or software QA. The ability to program in C and microassembly is required. Knowledge of LANs and Communications is desired as well as an understanding of the Product Development Life Cycle principle.

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- **Application Engineers**
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- **Manufacturing Engineers**
- **QA Engineers**
- **Components Engineers**
- **Manufacturing Test Technicians**

Cabletron offers a competitive starting salary and a comprehensive benefits package including life, medical and dental insurance, paid holidays and vacation. Interested applicants should submit resumes to: Cabletron Systems Inc., Department 205, P.O. Box 6257, Rochester, NH 03867. No phone calls or recruiters, please. Cabletron Systems Inc. is an Equal Opportunity Employer.

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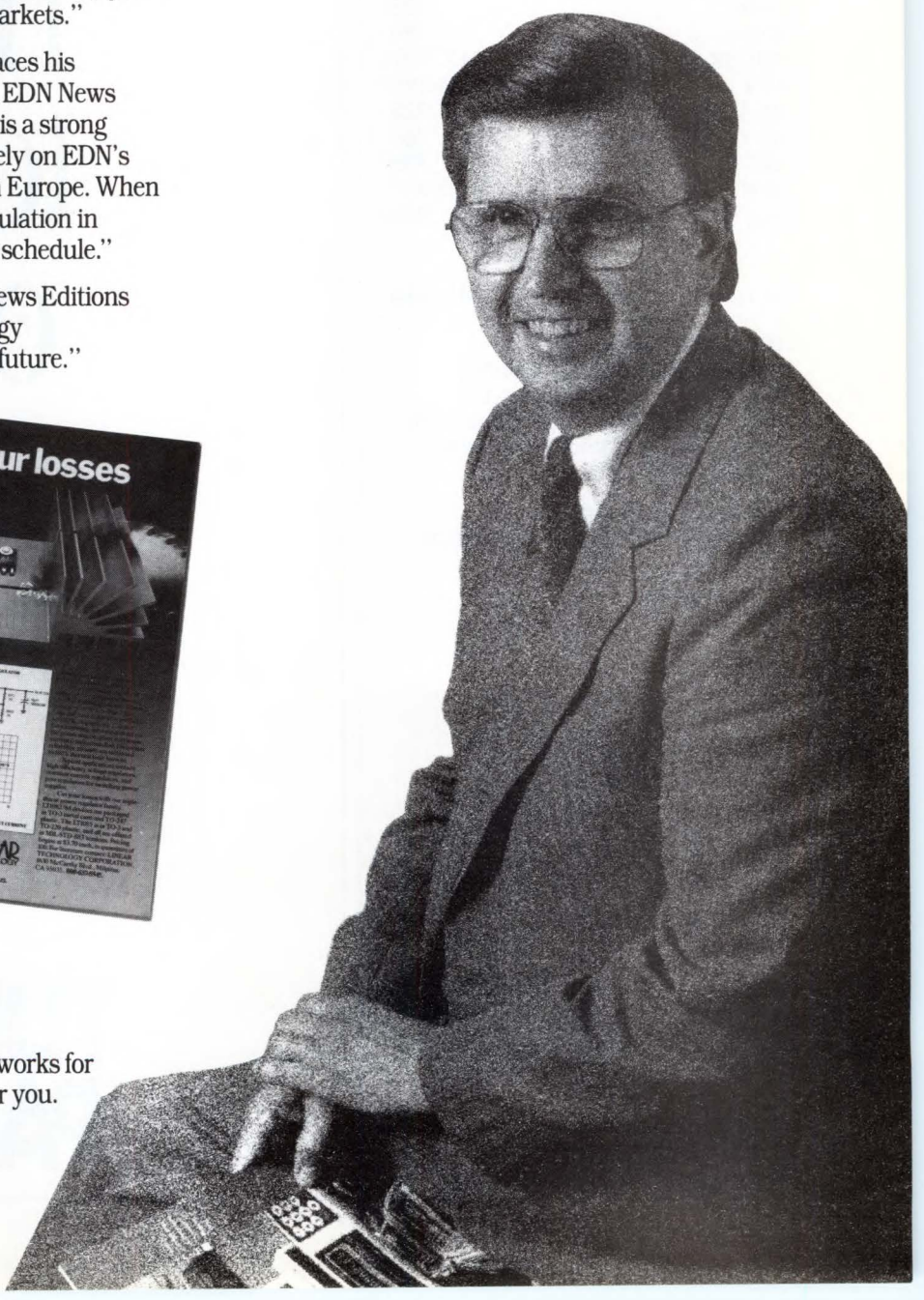
For complete global coverage, Ehrsam places his advertising in EDN Magazine Edition and EDN News Edition. "Linear Technology Corporation is a strong supporter of EDN Magazine Edition. We rely on EDN's targeted coverage of the U.S. and Western Europe. When EDN News Edition added Pacific Rim circulation in December 1987, we added it to our media schedule."

For Bill Ehrsam, "EDN's Magazine and News Editions form the cornerstone for Linear Technology Corporation's media plan now and in the future."





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LOOKING AHEAD

EDITED BY CYNTHIA B RETTIG

Surveys hear large demand for voice-messaging systems

Low-end, affordable voice-messaging systems that offer both flexibility and power became a realistic option for small- to medium-size businesses and departments just last year. Dataquest Inc (San Jose, CA) believes these low-end systems will encourage the development of single hardware bases that can support multiple-voice applications. Advancements that let PCs operate as the processing medium for voice messaging are the primary reasons why these low-end systems exist now and will flourish in the future. In 1987, more low-end systems were shipped than the total of all voice-messaging systems shipped in 1986, and the sales of the less expensive systems helped to triple the overall number of systems sold last year.

In a similar study conducted by BIS Mackintosh, an electronics consulting company based in Luton, England, researchers also concluded that the extent to which small businesses and individuals can benefit from voice messaging will define the success of the market as a whole. BIS Mackintosh thinks that voice messsaging could potentially become more significant than telex, fax, and electronic mail within the next two or three years.

The first voice-messaging machines, introduced in 1981, were very large and expensive—averaging $350,000. In 1987, says Dataquest, the average price had dropped to $55,000. Low-end voice-messaging systems, ranging in price from $5000 to $50,000, are now available with anywhere from 2 to 16 ports (systems with 32 ports are becoming available as well). Small- to medium-size companies find they can save money through such system features as automated attendants, voice menus, and audiotex (and the possibilities of voice response). Businesses can thus avoid paying employees to answer and route calls, or to convey frequently requested information. Dataquest finds that departments within large organizations can use the low-end systems to complement the overall voice-messaging systems of their organizations; departments can use their local systems for their particular needs and call-processing applications. In large organizations, Dataquest finds, it's usually faster to implement—and easier to adjust and maintain—a single department's own system. Pushing all local needs through the mainframe used by the organization as a whole creates its own difficulties.

BIS Mackintosh notes that, to date, the US has led the field in voice-messaging systems in the private sectors. Users of such systems are able to save in both time and costs. BIS believes, for example, that voice messages are typically "shorter and more to the point" than some other message systems.

Dataquest concludes that voice-messaging systems are downright "addictive." It found that what might begin as a convenience for occasional messages can become a vehicle for such tasks as exchanging ideas, scheduling meetings, and circulating announcements. As companies find more and more uses, demands will grow for more ports. Dataquest does not, however, foresee the low-end market directly competing with high-end systems. Rather it expects them to complement one another—the target markets for the two types of systems seldom overlap.

FORECAST SUMMARY—PRIVATE VOICE MESSAGING SYSTEMS

	1988	1989	1990	1991	1992	1993
NORTH AMERICA (CANADA AND USA)	13,400	23,600	40,900	71,200	122,600	215,300
EUROPE (FRANCE, WEST GERMANY, ITALY, SPAIN, SWEDEN, AND UK)	363	414	795	1,295	2,600	5,200
ASIA PACIFIC (JAPAN AND AUSTRALIA)	30	46	90	170	440	1,000

(SOURCE: BIS MACKINTOSH LTD)

Automatic ID equipment to exceed $8.5B by 1993

Valued at $688 million in 1983, the combined market for automatic identification equipment should gross $4.4 billion in 1990 and go on to top $8.5 billion by 1993, according to Market Intelligence Research Company (Mountain View, CA). Automatic identification equipment, in general, collects and classifies data on large numbers of items. Basically, automatic identification processes encompass all operations for data input and database query that don't require a keyboard. Automatic methods include optical character recognition, bar coding, radio frequency or surface-acoustical-wave tagging, magnetic stripping, biometric recognition, and machine vision.

MIRC observes that many industries, such as banking, defense, automobile manufacturing, and health care, now depend on automatic identification equipment for daily routine functions. In addition, various industries have already developed their own standards for the use of such equipment.

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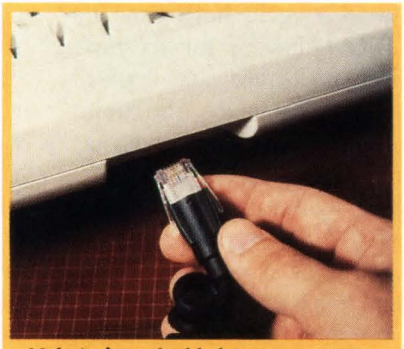

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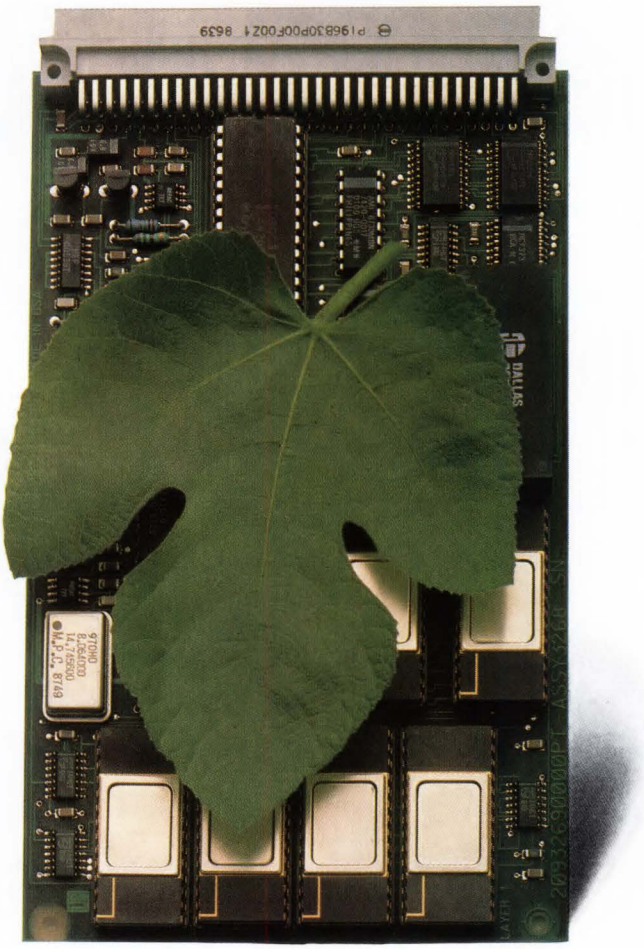

V.32

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While the data pump is functionally identical to the industry standard UDS V.32 modem, it has been stripped of its on-board power supply and DAA. These functions can be easily imported via the board edge connector.

For the bare facts about technical details and quantity pricing, contact Universal Data Systems, 5000 Bradford Drive, Huntsville, AL 35805. Telephone 205/721-8000; Telex 752602 UDS HTV.

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