A CAHNERS PUBLICATION

JULY 20, 1989

EDN®

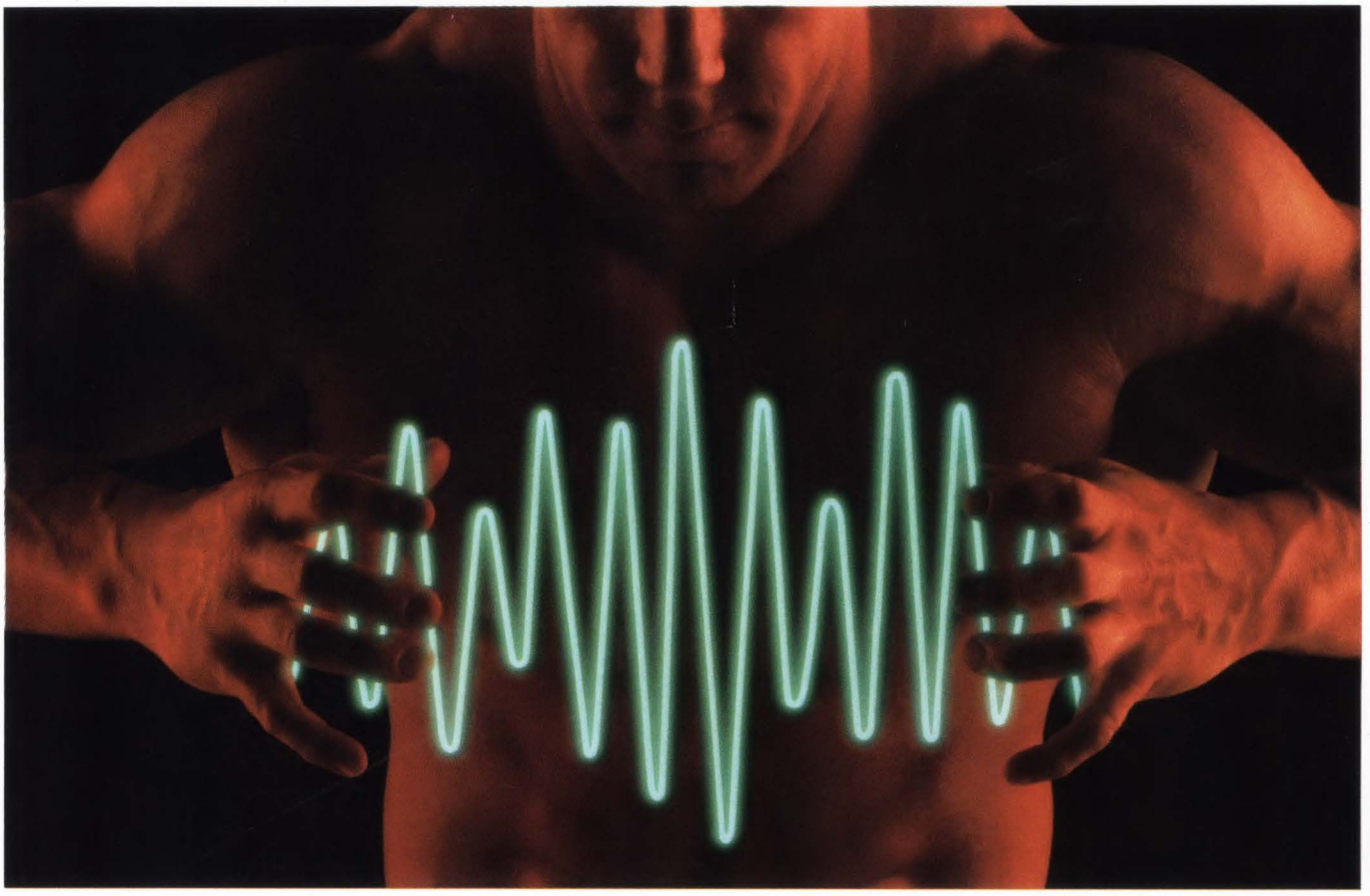
SPECIAL ISSUE — Part 2
Product Showcase No 29

Highlighting key trends in instruments, computers & peripherals, CAE, and components

Expanded literature section

ELECTRONIC TECHNOLOGY FOR ENGINEERS AND ENGINEERING MANAGERS

Compressed Data Doubles Throughput



The EXAR 2400 MNP5 Modem Chip Set

For The Next Generation V.22 bis Modem

The cost effectiveness and superior performance of MNP® protocol for V.22bis modems is making it the most demanded feature by all 2400 modem users. The XR 2400 MNP2-5 chip set allows you to out muscle your competition in this fast growing market, right now!

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EXAR's 2400 MNP5 data compression scheme increases the effective throughput by up to 100% or 4800 BPS, and that's in full duplex mode, cutting transmission costs dramatically. You don't waste time or energy.

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Not only is the transmission time cut in half but data is now error free. Your customers get the data fast and correct the first time.

XR2400 MNP2-5 Features

- MNP5 for error free 4800 BPS throughput in full duplex mode
- MNP2-4 for 100% error correction
- CCITT V.22bis compliant
- CCITT V.42 compatible
- Low power CMOS for laptop and portable modems
- Same hardware for MNP/NON-MNP V.22bis designs
- Simple and cost effective implementation
- ...and more

Call EXAR today at **(408) 434-6400** and discuss your future products with... The XR-2321 (V.23/V.21) for Quad modem applications, V.42/V.42bis enhancement to the XR-2400 chip set, and the XR-2900 FAX/DATA modem.

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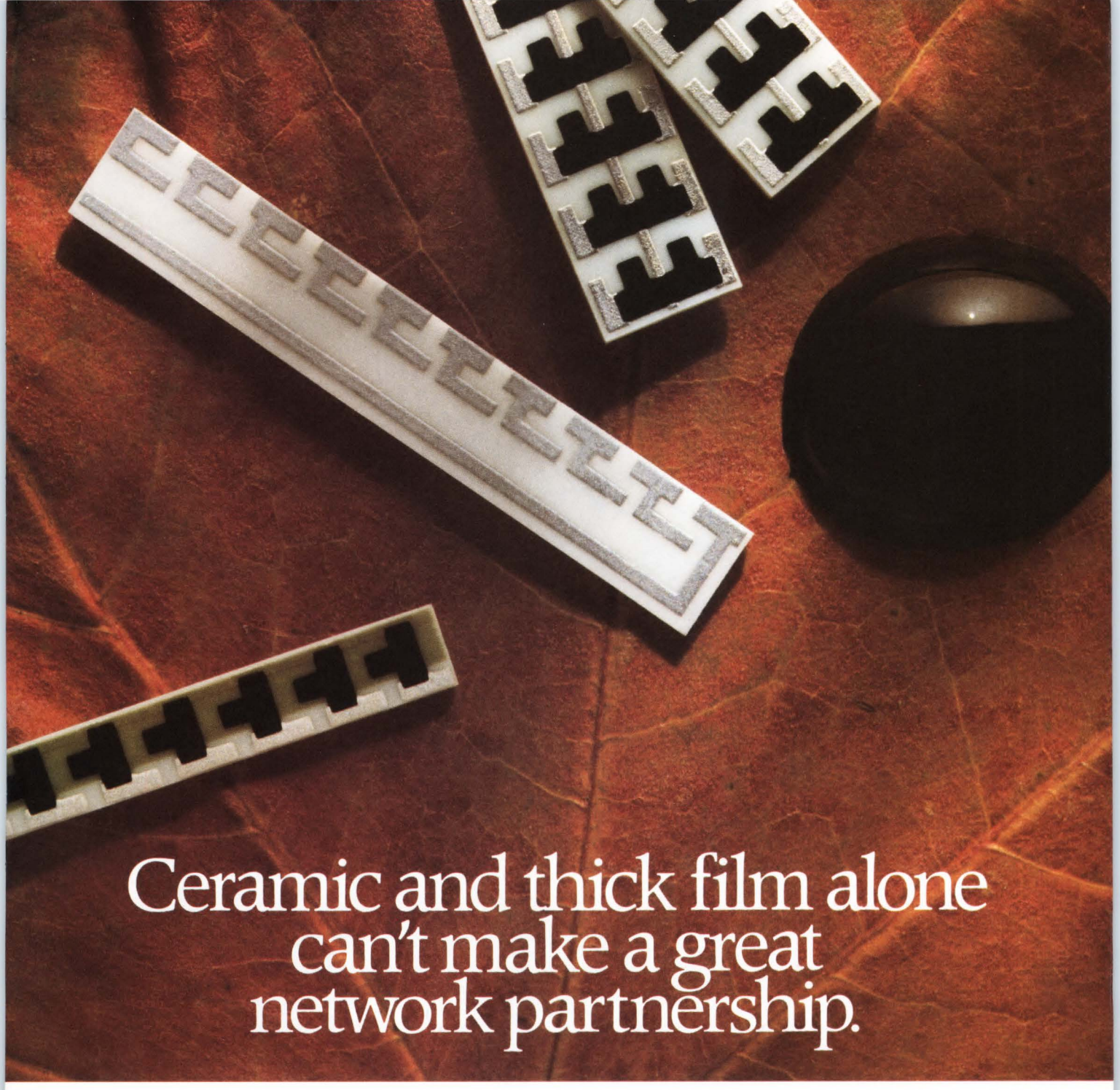

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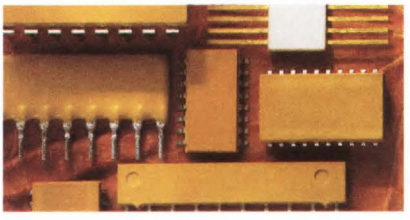

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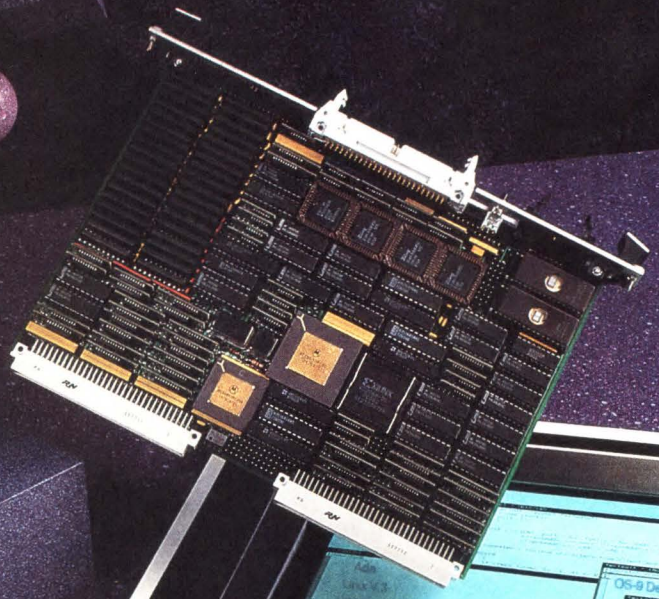

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LOW PASS Model *LP-	10.7	21.4	30	50	70	100	150	200	300	450	550	600	750	850	1000
Min. Pass Band (MHz) DC to	10.7	22	32	48	60	98	140	190	270	400	520	580	700	780	900
Max, 20dB Stop Frequency (MHz)	19	32	47	70	90	147	210	290	410	580	750	840	1000	1100	1340

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HIGH PASS Model *HP-		50	100	150	200	250	300	400	500	600	700	800	900	1000
Pass Band (MHz)	start, max.	41	90	133	185	225	290	395	500	600	700	780	910	1000
	end, min.	200	400	600	800	1200	1200	1600	1600	1600	1800	2000	2100	2200
Min. 20dB Stop Frequency (MHz)		26	55	95	116	150	190	290	365	460	520	570	660	720

Prices (ea.): Qty. (1-9) P $14.95, B $36.95, N $39.95, S $38.95

*Prefix P for pins, B for BNC, N for Type N, S for SMA *example:* **PLP-10.7**

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CIRCLE NO 13

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SPECIFICATIONS

	TOSW-230 ZSDR-230		TOSW-425 ZSDR-425	
Freq. Range(MHz)	10-3000		10-2500	
Insert. Loss (dB)	typ.	max.	typ.	max.
10-100MHz	1.3	1.9	1.3	1.7
100-1500MHz	1.1	1.9	1.1	1.7
1500-3000MHz	1.8	2.7	1.8	2.5
Isolation(dB)	typ.	min.	typ.	min.
10-100MHz	60	40	60	40
100-1500MHz	40	28	40	30
1500-3000MHz	35	22	35	22
1dB Compression(dBm)	typ.	min.	typ.	min.
10-100MHz	17	6	17	6
100-1500MHz	27	19	27	19
1500-3000MHz	30	28	30	28
VSWR(ON)	typ.	max.	typ.	max.
	1.3	1.6	1.3	1.6
Switching Time (μsec) (from 50% TTL to 90% RF)	typ. 2.0	max. 4.0	typ. 2.0	max. 4.0
Oper. Temp.(°C)	-55 to +100		-55 to +100	
Stor. Temp.(°C)	-55 to +100		-55 to +100	
Price (10-24) (1-9)	$39.95 $89.95		$59.95 $109.95	

10 to 3000MHz from $39.95

Now, high-speed, high-isolation switches with with built-in drivers, tough enough to pass stringent MIL-STD-202 tests. There's no longer any need to hassle with the complexities of designing a TTL driver interface and then adding yet another component to your subsystem...it's already included in a rugged, low-cost, compact assembly. Available in the popular hermetically-sealed TO-8 package or a small EMI-shielded metal connectorized case, these tiny PIN-diode reflective switches, complete with driver, can operate over a 10 to 3000MHz span with a fast 2μsec switching speed.

Despite their small size, these units offer isolation as high as 40dB(typ), insertion loss of only 1.1dB(typ), and a 1dB compression point of +27dBm over most of the frequency range. All models are TTL-compatible and operate from a dc supply voltage of 4.5 to 5.5 V with 1.8mA quiescent current. Switch to Mini-Circuits for highest quality innovative products...and leave the driving to us.

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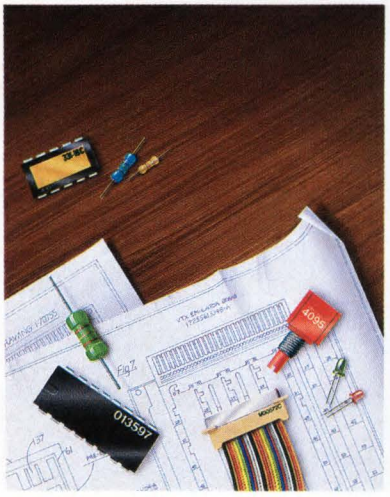
F126 REV.A

EDN Magazine Edition

Volume 34, Number 15 July 20, 1989

ELECTRONIC TECHNOLOGY FOR ENGINEERS AND ENGINEERING MANAGERS



On the cover: *Part 2 of EDN's Product Showcase No. 29 covers a multitude of products in four technology areas: instruments, computers and peripherals, computer-aided engineering, and components. Leading off the product sections are staff-written articles on in-circuit emulators for μCs (pg 64); add-in graphics boards for PC/AT bus, VMEbus, and Multibus systems (pg 114); mixed analog-digital simulators (pg 160); and solid-state relays (pg 190). (Illustration by Thomas Szumowski; art direction by Ken Racicot)*

DESIGN FEATURES

Instruments

Computers and Peripherals

Computer-Aided Engineering

Components

Continued on page 7

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THE POWER SUPPLY

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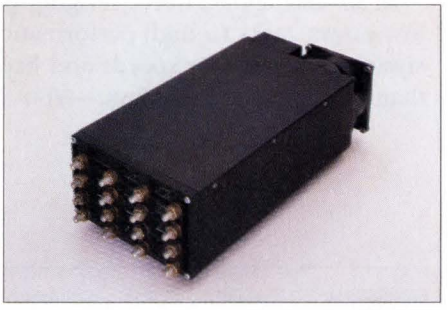
THE WESTCOR STAKPAK™. NEW GENERATION 250 TO 1200 WATT SINGLE OR MULTIPLE OUTPUT OFF-LINE SWITCHER. 3.2 X 5.5 X 11.4 INCH CASE. FAN-COOLED.

Stack the odds in your favor by designing-in Westcor's 6 watt/cubic inch high power megahertz switcher. Capitalizing on patented and proven megahertz module technology and innovative thermal management techniques, the StakPak provides up to 1200 watts of power at 50°C with 1 to 8 isolated and fully regulated outputs.

For existing designs the StakPak's small size and low profile allow system enhancement without mechanical redesign. Simply replace your open frame switcher with up to 1200 watts of StakPak power or replace your "box switcher" with 2 StakPaks and realize up to twice the power without losing additional space. StakPak power factor correction provides 850 watts of output power from a standard 115 VAC wall outlet. In new designs, more space can be devoted to functionality or the system can be downsized.

The StakPak's 8 module output section can be factory configured in virtually an infinite number of voltage, current and power combinations. Special models providing between 250 to 1200 watts and outputs from 2 to 95 VDC are available.

Other features include outstanding electrical performance; UL, CSA, VDE safety agency approval (in process); variable speed fan option for low ambient noise enviroments and 3 phase or DC input options. Indeed, with unprecedented power density, versatility and new features, the StakPak redefines power packaging. Please contact Westcor for a data sheet, pricing and additional information.



STANDARD 1200 WATT STAKPAK MODELS
(110/220 VAC input)

Model	Output Voltage (VDC) and Maximum Current (amperes) per Channel				
	#1	#2	#3	#4	#5
Single Output					
SP1-1801	2 @ 240				
SP1-1802	5 @ 240				
SP1-1803	12 @ 100				
SP1-1804	15 @ 80				
SP1-1805	24 @ 50				
SP1-1806	28 @ 42				
SP1-1807	48 @ 25				
Dual Output					
SP2-1801	2 @ 120	5 @ 120			
SP2-1802	5 @ 120	5 @ 120			
SP2-1803	5 @ 120	12 @ 66			
SP2-1804	12 @ 66	12 @ 66			
SP2-1805	15 @ 53	15 @ 53			
Triple Output					
SP3-1801	5 @ 180	12 @ 16	12 @ 16		
SP3-1802	5 @ 150	12 @ 33	12 @ 16		
SP3-1803	5 @ 180	15 @ 13	15 @ 13		
SP3-1804	5 @ 150	15 @ 26	15 @ 13		
Quad Output					
SP4-1801	5 @ 150	12 @ 16	12 @ 16	5 @ 30	
SP4-1802	5 @ 150	15 @ 13	15 @ 13	5 @ 30	
SP4-1803	5 @ 150	12 @ 16	12 @ 16	24 @ 8	
SP4-1804	5 @ 150	15 @ 13	15 @ 13	24 @ 8	
Five Output					
SP5-1801	5 @ 120	12 @ 16	12 @ 16	5 @ 30	24 @ 8
SP5-1802	5 @ 120	15 @ 13	15 @ 13	5 @ 30	24 @ 8

Total output power may not exceed 1200 watts for any model, single or multiple output. Lower power StakPak models are available. Please contact the factory.

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CIRCLE NO 15

***EDN's Product Showcase** provides descriptions of a host of items, beginning with instruments on pg 87. Coverage continues with details of computers and peripherals (pg 131), computer-aided engineering (pg 173), and components (pg 199).*

PRODUCT UPDATES

PRODUCT REVIEWS

LITERATURE

Continued on page 9

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CIRCLE NO 16

DATA I/O Corporation

Continued from page 7

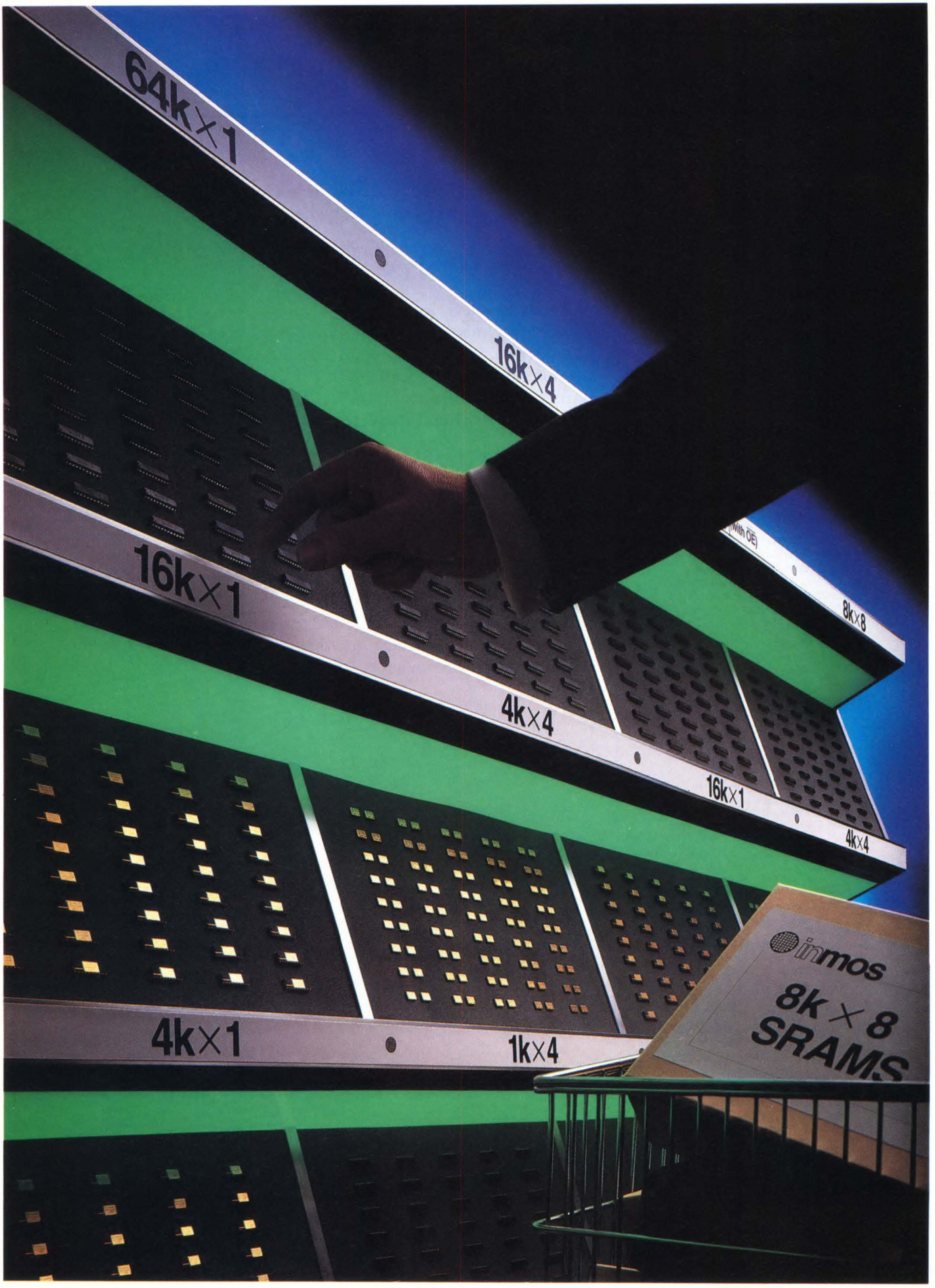
EDITORIAL

With all the talk about HDTV technology, we should pause to figure out who will watch it and who will pay for it.

DEPARTMENTS

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 December.


64k×1
16k×4
16k×1
8k×8
4k×4
16k×1
4k×4
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1k×4
inmos
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SRAMS

You don't need us to tell you that all SRAMs are in short supply.

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If you need SRAMs and you need them now, there's never been a better time to talk to INMOS.

Organisation	Part No.	Access Time (ns)	Organisation	Part No.	Access Time (ns)
4K×1	IMS 1203	20,25,35,45	64K×1	IMS 1600	20,30,35,45,55
	IMS 1203M	25,35,45		IMS 1601L	45,55
				IMS 1600M	45,55,70
1K×4	IMS 1223	20,25,35,45		IMS1601LM	45,55,70
	IMS 1223M	25,35,45			
			16K×4	IMS 1620	25,30,35,45,55
16K×1	IMS 1403	25,35,45,55		IMS 1620M	45,55,70
	IMS 1403M	35,45,55		IMS 1620LM	45,55,70
	IMS 1403LM	35,45,55			
	IMS 1400M	45,55,70		IMS 1624	25,30,35,45,55
				IMS 1624M	45,55,70
4K×4	IMS 1423	25,35,45,55		IMS 1624LM	45,55,70
	IMS1423M	35,45,55			
	IMS 1420M	55,70	8K×8	IMS 1630M	55,70
				IMS 1630L	45,55,70,100,120

Key: M – Mil-std-883C, L – Low Power. Available soon – a new 256K SRAM.

For a copy of our 1989 Memory Databook – or, of course, a quote, contact your local INMOS or SGS-THOMSON Microelectronics office. An existing SGS-THOMSON range of SRAMs is also available.

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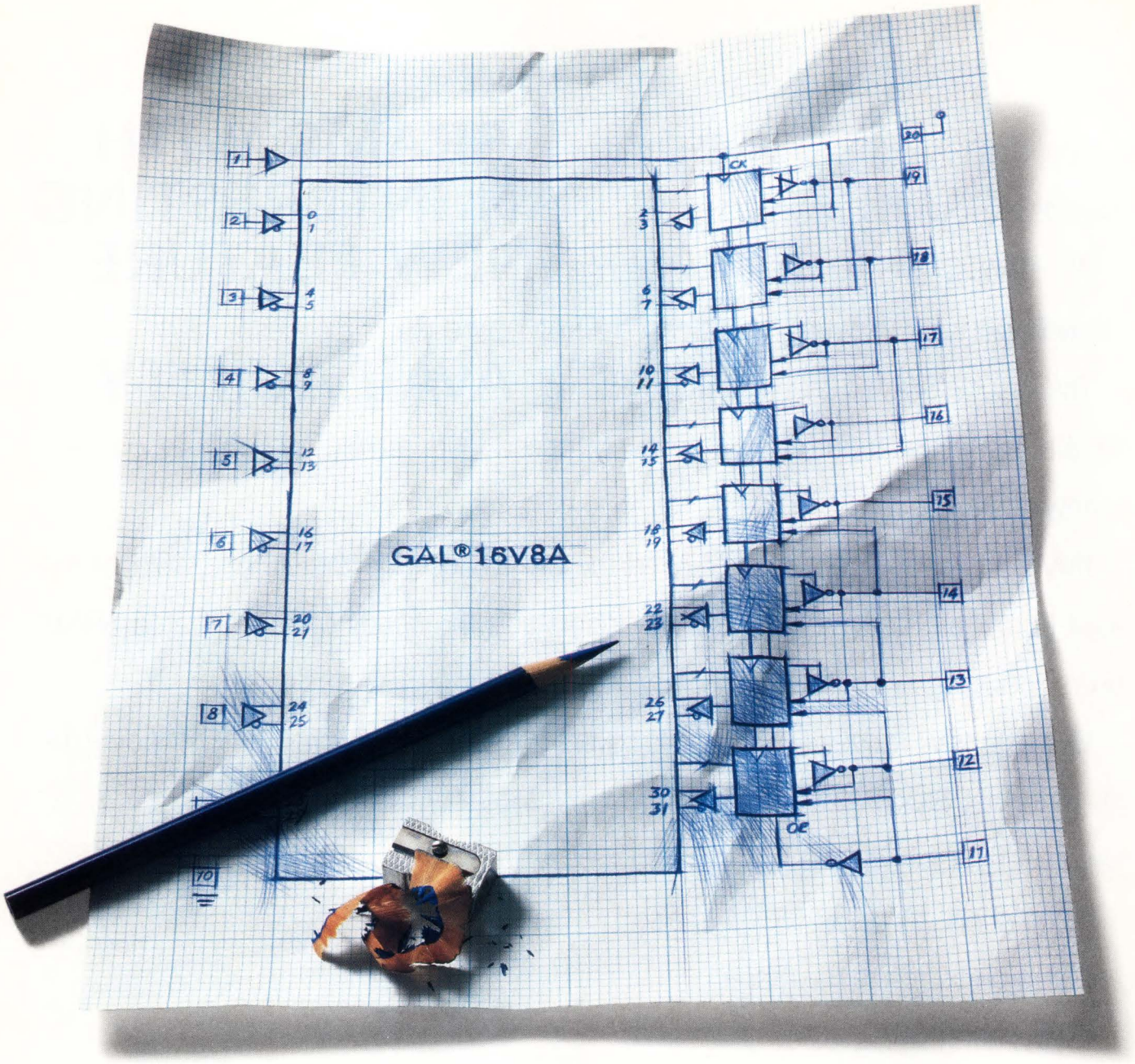
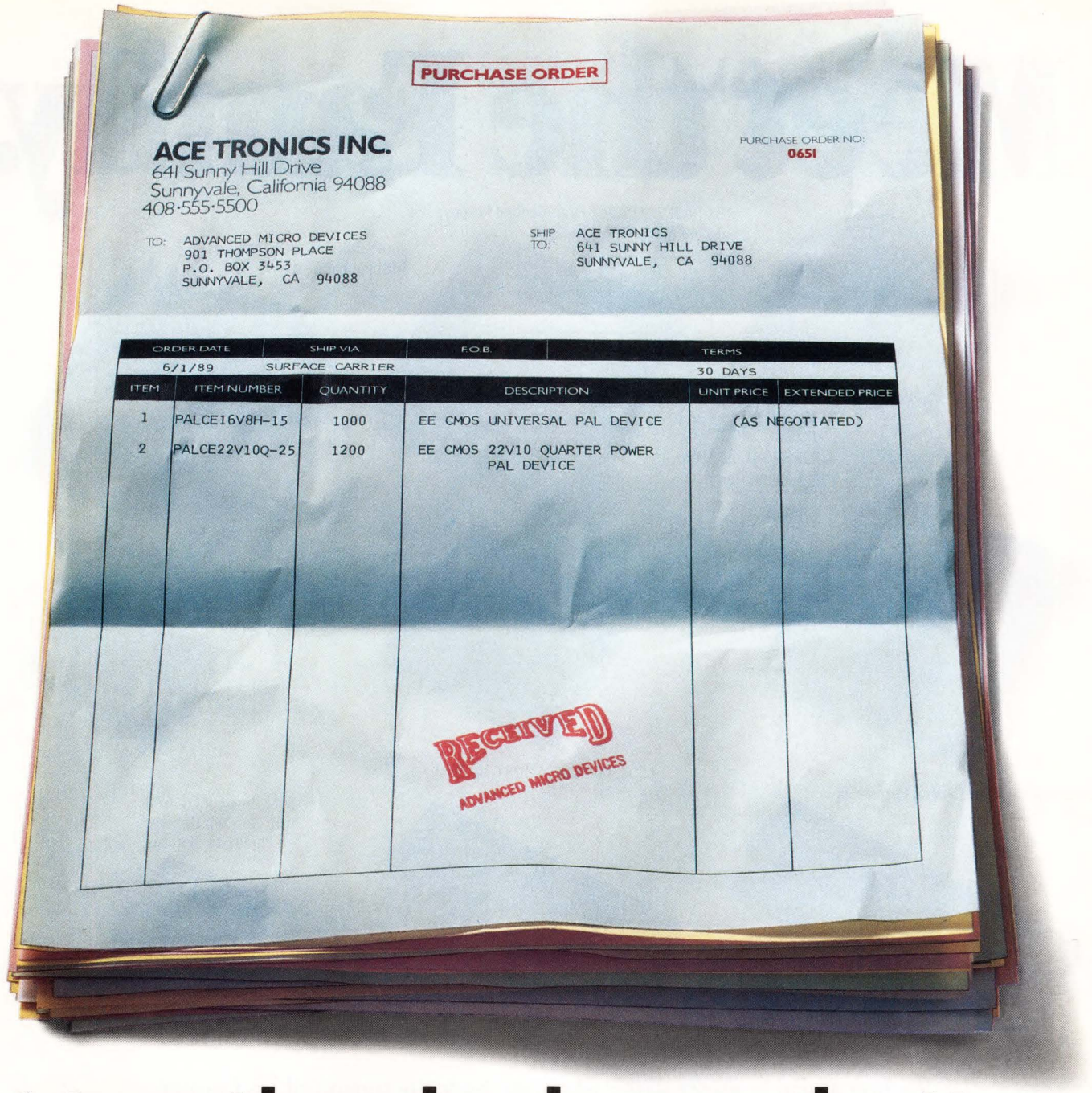


Universal CMOS PAL devices have always looked good on paper.



Now they look even better.

Our Universal PALCE16V8 20-pin device runs at 15ns using only 90mA. It's fully pin-out, function and fuse map compatible. Use it anywhere you'd use a GAL® device.

The PALCE22V10 is also flexible. It's just like the bipolar 22V10 with 25ns speed, but it requires as little as 55mA.

Both chips are electrically erasable which makes your life easier. And because they're 100% tested parts, you get almost perfect programming and post-programming functional yields. You can program and reprogram them until they're just the way you want them. And faster versions are on their way.

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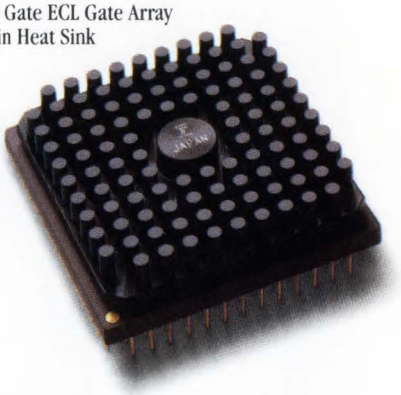
32-bit IEEE Floating-Point General Purpose DSP
1.2 μ CMOS 450K Transistors

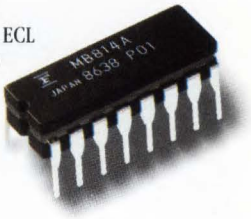
100PS 10K Gate ECL Gate Array
with Pin Fin Heat Sink

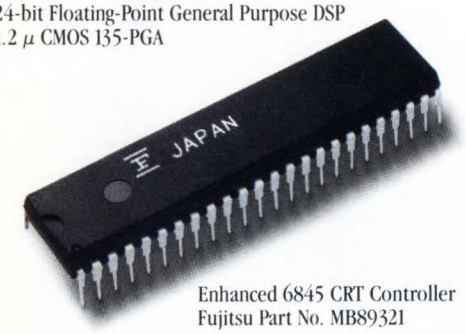


24-bit Floating-Point General Purpose DSP
1.2 μ CMOS 135-PGA

1.5 μ 3000 Gate CMOS Gate Array

Ultra High Speed ECL
(1.5 GHz typical)

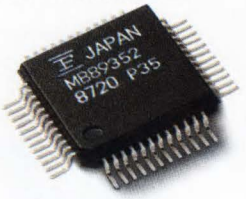




Enhanced 6845 CRT Controller
Fujitsu Part No. MB89321

64K x 4 DRAM
Zig Zag Package

SCSI Protocol Controller
with On-Chip Drivers,
48 Pin Plastic Flat Pack



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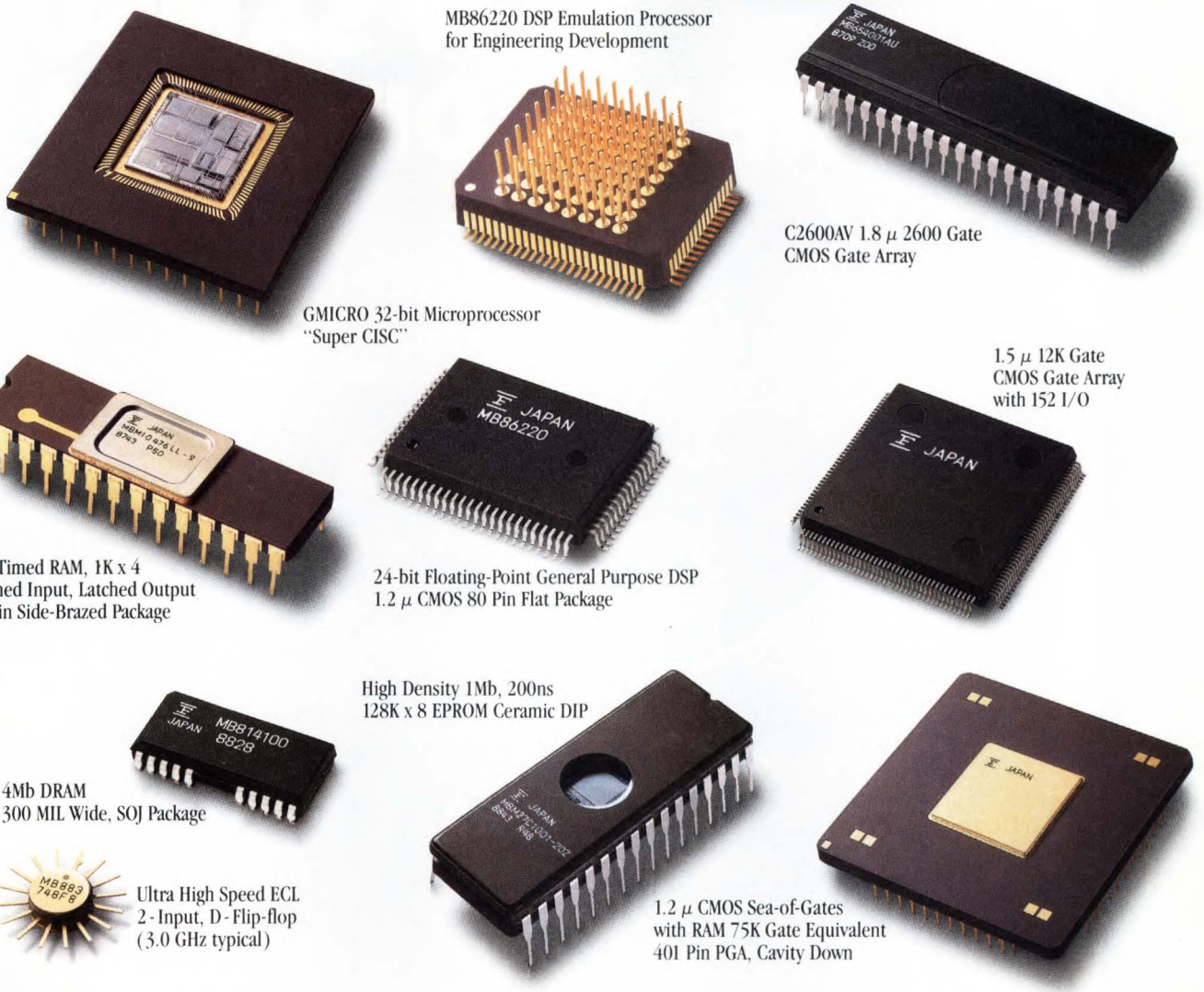

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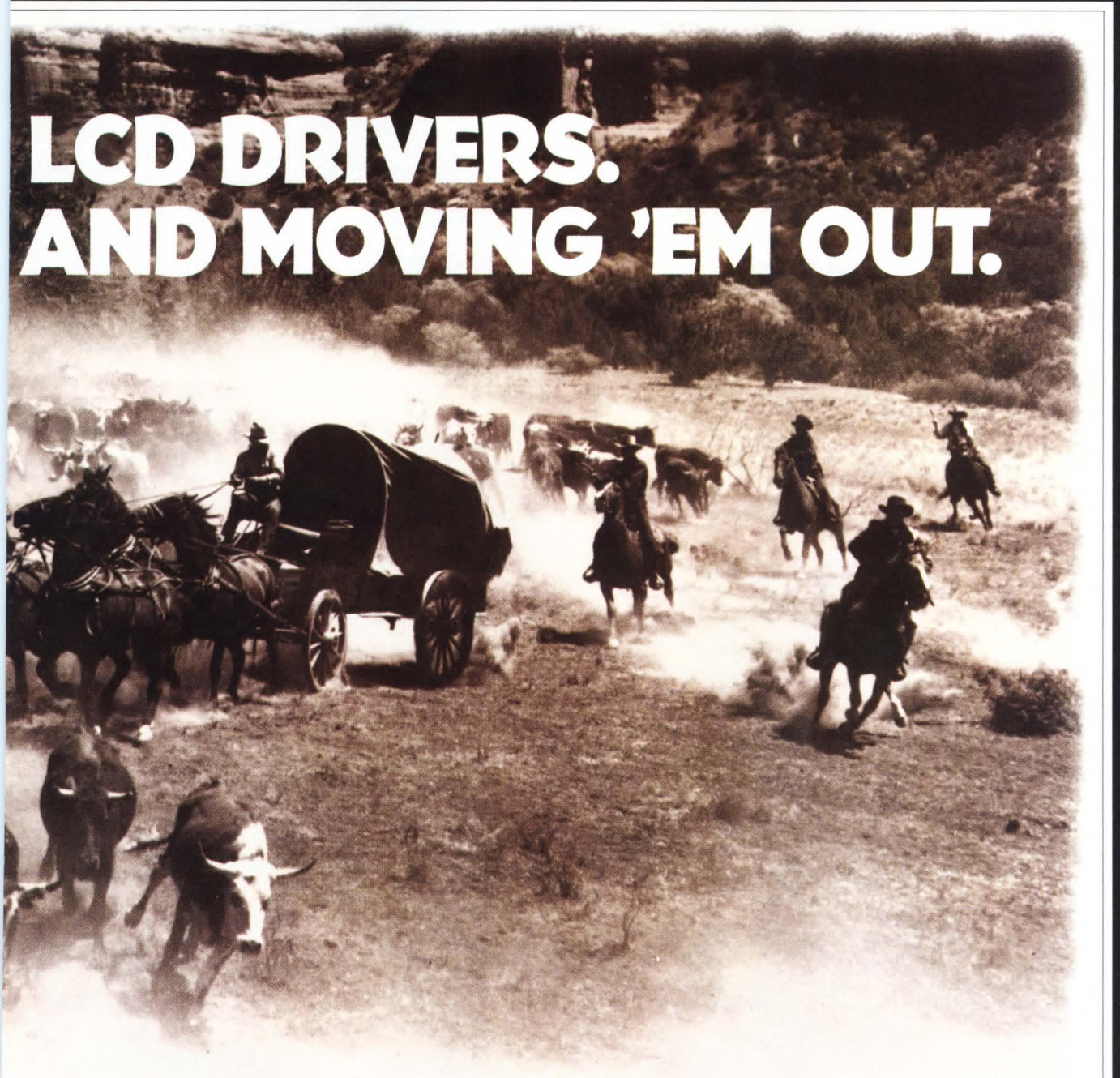
KS0102Q	Segment driver	100 QFP	Graphic
KS0081Q	Common & segment driver	100 QFP	Graphic
KS0082Q	Video LCD interface	80 QFP	Graphic



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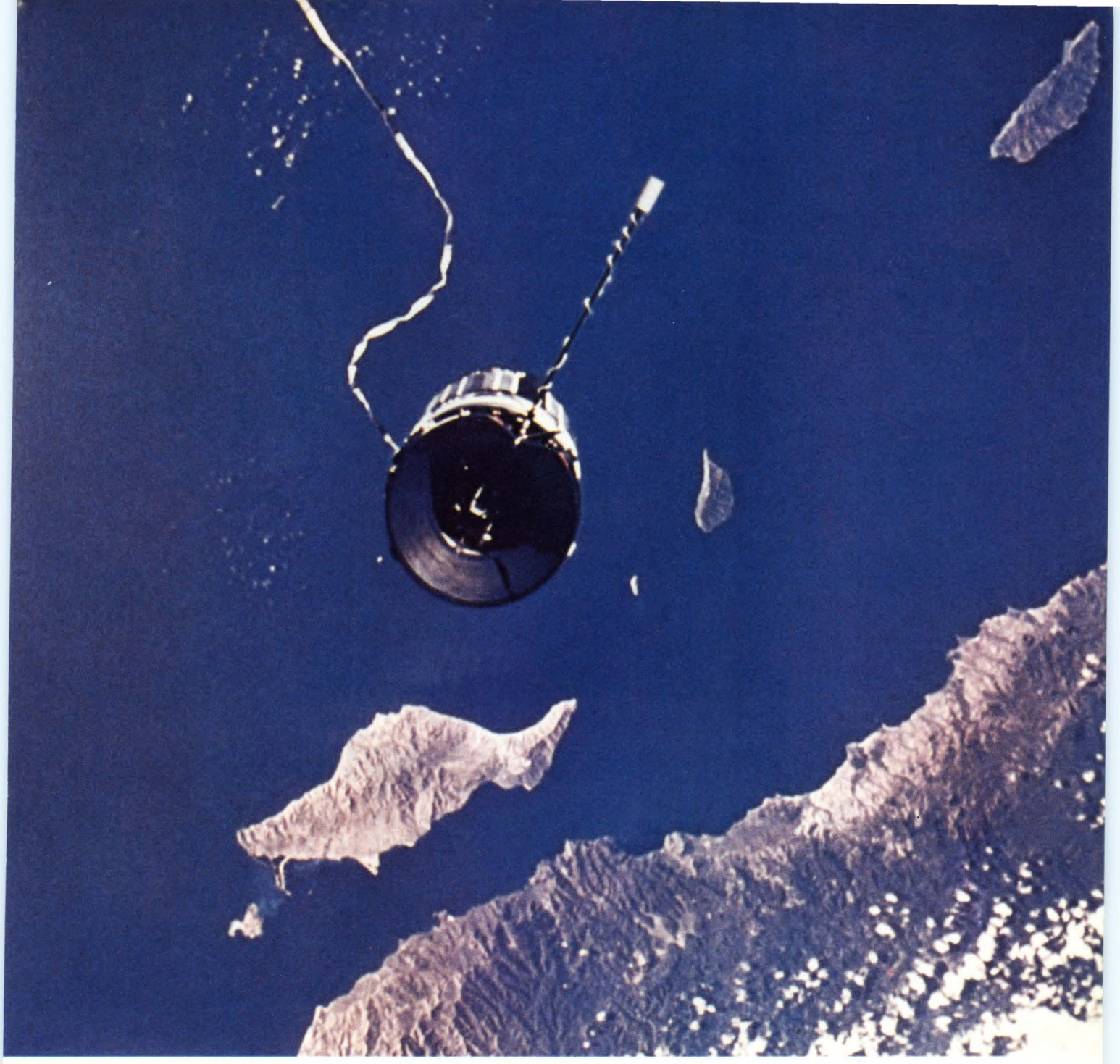

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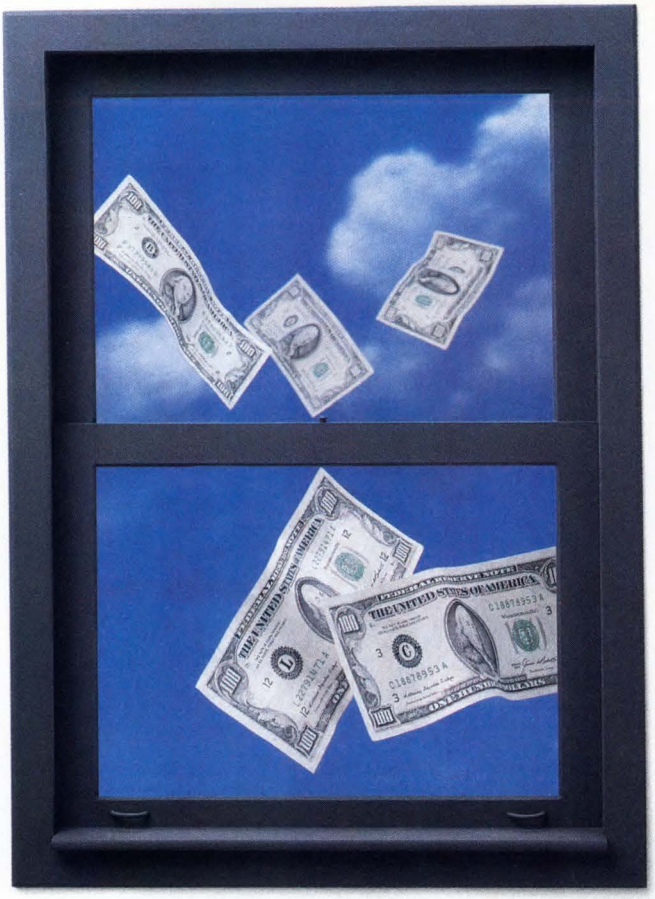

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NEWS BREAKS

EDITED BY JULIE ANNE SCHOFIELD

DSP μP SPEED INCREASED TO 27 MHz

Motorola's Microprocessor Products Group (Austin, TX, (512) 891-2030) has announced the availability of a faster version of its digital signal processor, the 56001. The 30% increase in throughput, from 20.5 to 27 MHz, lets the faster 56001 execute as many as seven tasks simultaneously and perform instructions at 13.5 MIPS. Software for systems based on the original version of the 56001 will run on the faster version with no modifications. The 27-MHz 56001 is available now in a pin-grid-array package for $144 (1000).—Anne Watson Swager

GaAs ICs FEATURE CLASS S MILITARY SCREENING

Triquint Semiconductor (Beaverton, OR, (503) 644-3535) is now shipping wafers and dies screened to US Department of Defense Class S requirements. This level of screening permits the use of the company's GaAs ICs in satellite systems. Triquint also offers packaged ICs screened to Class B requirements in accordance with MIL STD 883 test methods 5004 and 5005. The company's future plans include providing devices that meet MIL-Q-9858 approval by the spring of 1990 and devices that meet MIL-M-38510 approval by the fall of 1990. These approval ratings will let customers use Triquint's GaAs ASICs and standard products in earthbound DoD systems. —Anne Watson Swager

MAXIM/VTC ALLIANCE YIELDS HIGH-PERFORMANCE BIPOLAR ICs

High-performance op amps and comparators are the first products to result from the recent alliance between Maxim Integrated Products (Sunnyvale, CA, (408) 737-7600) and VTC Inc (Bloomington, MN, (612) 851-5000) to jointly develop high-performance analog ICs. The products use Maxim's design expertise and VTC's complementary bipolar process, which features 6.5-GHz npn and 1.5-GHz pnp transistors. Unlike most high-performance analog ICs, these parts operate from standard digital 5 and −5.2V supplies. The Max408/VA708 is a 100-MHz op amp with a 100V/μsec slew rate, a 3-mV offset, and a 50-mA drive capability suitable for 50Ω transmission lines. The device consumes a quiescent current of only 7 mA. It's also available in dual and quad packages and costs $3.39 (100).

The MAX9690/VC7690 ECL output comparator features a 1.9-nsec maximum propagation delay and a 600-MHz operating frequency. Latched and TTL versions of the comparator are also available. The devices are available in plastic and ceramic DIPs and SOIC packages and cost $4 (100).—Doug Conner

FIRST EISA BUS INTERFACE CHIPS UNVEILED

With the introduction of a chip set that handles the interfacing chores between add-in boards and the 32-bit Extended Industry Standard Architecture (EISA) bus, board and system designers alike are freed of the need to design their own interface circuitry for a bus whose specifications are not yet cast in concrete. The 82350 chip set from Intel Corp (Folsom, CA, (800) 548-4725) includes the 82358 bus controller, the 82357 integrated system peripheral, and the 82352 EISA bus buffer. These chips reside on the system mother board. The 82355 bus master interface controller for

add-in boards provides an interface between the local functions of the bus master card and the EISA bus master protocol. The chip set is available in 25- and 33-MHz versions.

Intel is sampling the chip set now; production quantities will be available in the third quarter of this year. The 82358 is $99, the 82357 is $120, the 82352 is $18.75, and the 82355 is $35 (1000).—Margery Conner

INFRARED LIGHT SERVES AS A CONNECTIVITY MEDIUM

Photonics Corp (Campbell, CA, (408) 370-3033) has developed an office-connectivity technology that uses infrared light as the medium instead of cable. Initially, the company plans to offer an end-user product called Photolink to connect RS-232C devices or Appletalk LAN nodes. Each Photolink connects by cable to one to four terminals or computers and communicates with other Photolinks by bouncing infrared light off the office ceiling. Photonics plans to extend the technology for use in token-ring, IBM 3270, and Ethernet networks, and is interested in licensing the technology for OEMs.—Maury Wright

16-CHANNEL DIGITAL VOICE RECORDER STORES 128 SEC OF AUDIO

The $97.50 DVR-16 digital voice recorder can record and play back 16 different phrases and features a maximum recording time of 128 sec. Electronic Devices and Engineering Co (Palm Springs, CA, (619) 320-8880) offers the product in a 1-oz, 2×2×1-in. package. An unregulated 8 to 12V dc supply powers the recorder and its 1W output amplifier. The product stores 128 sec of audio by using an 8k-bit/sec digitizing rate. For highest quality, it can store 35 sec of audio by using a 32k-bit/sec rate. The company also offers the DVR-4, which has a maximum recording time of 35 sec, for $59.50.—Maury Wright

ASSEMBLY LINES AT EXPO SMT WILL BUILD TWO PRODUCTS

Two assembly lines at Expo SMT will crank out operational products: a telephone amplifier and an "electronic jukebox" that incorporates a custom IC and several discrete LEDs. A third assembly line will demonstrate the use of fine-pitched surface-mount devices, including tape-automated-bonding parts. Expo SMT is scheduled for September 25 to 28 in Las Vegas, NV. For more information on the exposition, contact Expo SMT International (Los Gatos, CA, (408) 354-1036).—Steven H Leibson

START-UP OFFERS FAST, HIGH-DENSITY NONVOLATILE MEMORIES

Simtek Corp (Colorado Springs, CO, (719) 531-9444), a start-up semiconductor vendor determined to move nonvolatile memories into the mainstream of electronic design by making them fast and dense, has introduced its first parts: a 256k-bit EEPROM and two 64k-bit static RAMs (SRAMs) with shadow EEPROM. All employ silicon nitride for nonvolatility and require only a 5V power supply. The STK28C256 EEPROM, organized as a 32k×8-bit device, is available in speeds ranging from 70 to 120 nsec and costs $188 to $295 (100), depending on the speed rating. The EEPROM incorporates an internal timer and latches for address and data lines in order to simplify in-circuit programming.

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Both SRAMs are 8k × 8-bit devices that merge an EEPROM cell with each static RAM cell. The STK10C68A dedicates a pin for the read and write control of the EEPROM array, and the STK11C68A uses a pattern sequence on its address, data, and control lines to initiate EEPROM storage and recall operations. Both SRAMS are offered in 35-, 45-, and 55-nsec versions, which cost $48.75, $40.60, and $32.50 (100), respectively. Samples of the EEPROM and the SRAMs will be available in the fourth quarter of 1989.—Steven H Leibson

IN-CIRCUIT EMULATOR SUPPORTS CREDIT-CARD-SIZE "PC"

Softaid Inc's (Columbia, MD, (301) 964-8455) Wildcard ICEalyzer is an in-circuit emulator (ICE) designed for Intel Corp's (Santa Clara, CA, (408) 987-8080) Wildcard. Despite its diminutive size, the credit-card-size Wildcard is a substantially complete IBM PC/XT-class machine that only lacks random-access memory. Jack Ganssle, President of Softaid, says that the tiny computer is ideal for embedded, real-time control applications that you can implement with an 8088 μP—except for one thing: To make such a small unit, Intel removed many of the "hooks" you need to connect an ICE. According to Ganssle, Intel's claim that you can develop code for the Wildcard on any PC is true, but if your code is time critical, debugging it requires an ICE's capabilities. That's where the $5495 Wildcard ICEalyzer comes in. You unplug the Wildcard from your target system and plug in the special Wildcard attached to the ICEalyzer chassis with a ribbon cable. The Wildcard ICEalyzer includes all of the capabilities you expect in a full-featured ICE and—according to the vendor—is the first ICE to emulate an entire computer.—Dan Strassberg

ASIC VENDOR ANNOUNCES ENHANCED CAD TOOLS

Incorporating both the Logic Assistant and the Test Assistant, VLSI Technology's (San Jose, CA, (408) 434-3000) suite of design tools, called V8, is scheduled for full release in the fourth quarter of this year. The Logic Assistant integrates architectural design, analysis and partitioning, and high-level design capture in one tool. It also provides a graphical display of the results of VLSI's probabilistic fault simulator and its timing verifier. The Logic Assistant doesn't support commercial hardware-description languages, but the tool has hooks to allow their future integration.

The Test Assistant automates test-program development by letting you isolate blocks that you can test as discrete functional entities. The software inserts both isolation circuitry and the logic required to test RAM structures generated by VLSI's Built-In Self-Test compiler. Additional modules within V8 include the Gate Assistant and the Chip Assistant. The cost of V8 depends on your hardware configuration and can run to $265,000.—Michael C Markowitz

CMOS LOGIC FAMILY ACHIEVES 3.7-NSEC PROPAGATION DELAYS

IDT (Santa Clara, CA, (408) 727-6116) has announced a C-speed version of its 74FCT logic family. The C-speed series achieves propagation delay speeds as low as 3.7 nsec with power dissipation similar to its established FCT-A series. The first four devices in the series will be the 74FCTC383 and -384 octal latches and the 74FCTC244 and -245 buffers. The buffers can drive as much as 64 mA. The parts are available in sample quantities in small-outline (SOIC) packages; they cost $5.30 to $6.50 (100). —Richard A Quinnell

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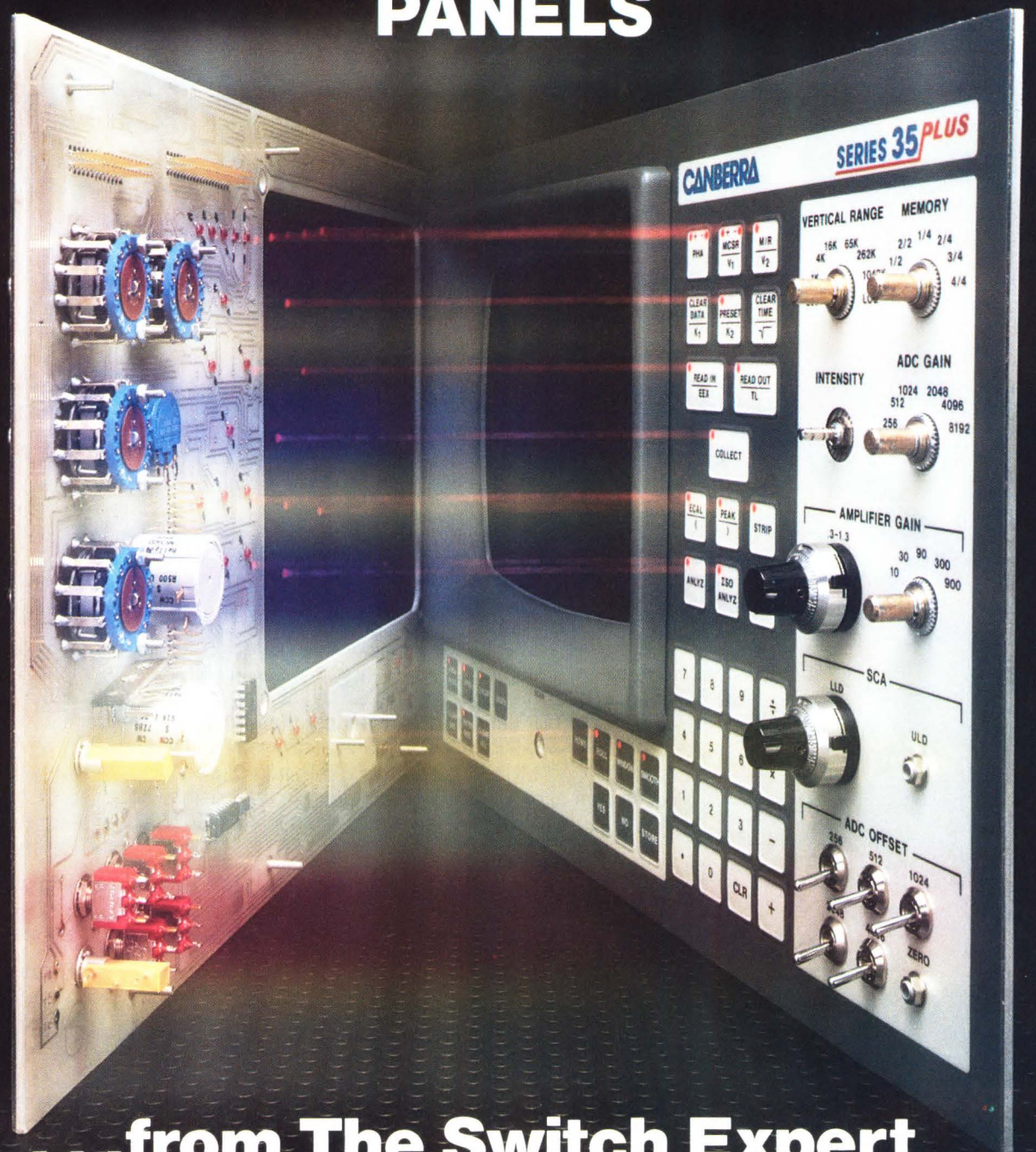

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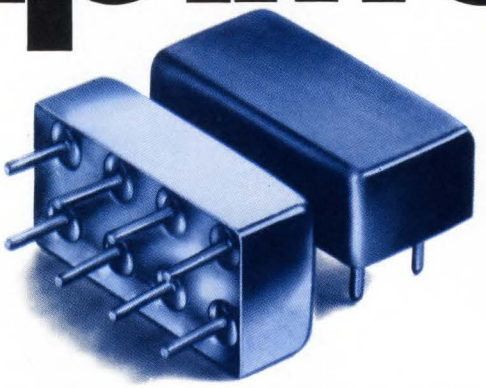

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◇MAN-1HLN	10-500	10	0.8	15	3.7	70	15.95
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††Midband $10f_L$ to $f_{u/2}$, ±0.5dB †1dB Gain Compression ◇Case Height 0.3 In.
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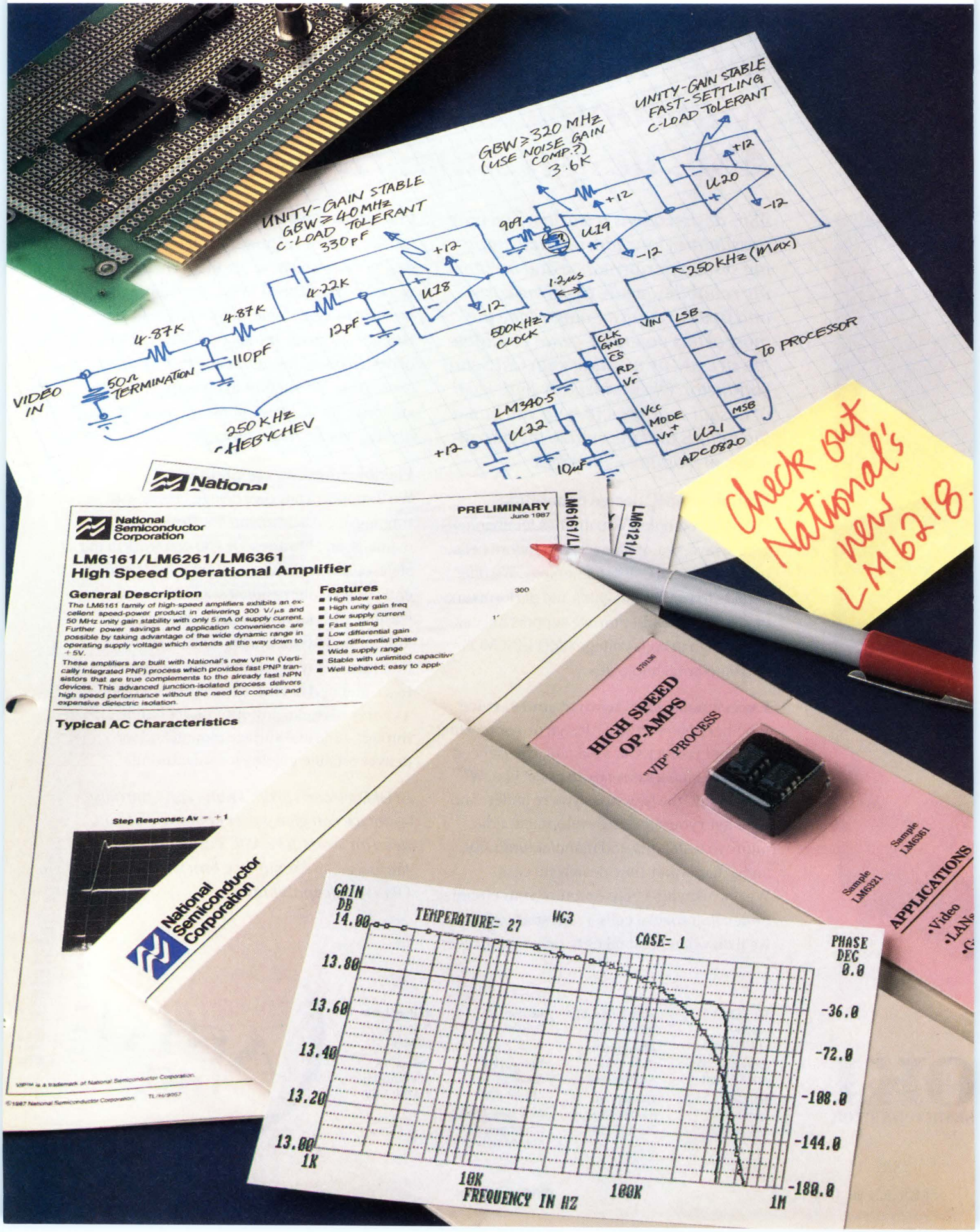

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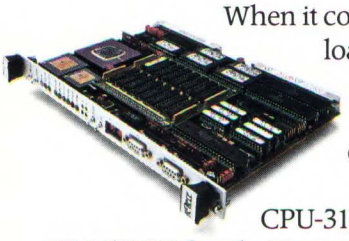

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CIRCLE NO 33

SIGNALS & NOISE

Non-US engineers benefit the industry

While reading through the article "Improving working conditions for engineers: Should the IEEE do more?" by Paul Kinnucan (EDN, April 13, 1989, pg 283), I came across an interesting comment by Irwin Feerst of the IEEE on pg 286. He comments that there should be legislation to make the hiring of non-US nationals illegal.

In the first place, I completely agree with the IEEE that there is indeed a shortage of professional electrical engineers in this country to perform specialized jobs.

I disagree with Irwin Feerst's comments for two reasons: In the first place, it is simply not true that non-US engineers often work for extremely low wages; if he would care to ask any US corporation that has actively hired non-US nationals in the past, or look at the wage records, he would see his accusation bite the dust. That the Immigration and Naturalization Service (INS) approves petitions for sponsorship based on qualifications and wage offerings to non-US nationals is legal proof of this fact.

Second, it seems that he has not realized the impact that the hiring of non-US nationals has had upon the overall productivity of this country's electronics industry. When one carefully considers the various factors, one will come to the conclusion that there simply aren't enough US engineers who have the necessary advanced qualifications for various EDA/CAD/CAM positions. Irwin should also realize the scientific and technical contributions that non-US citizens have made to this country. If he picks up the recent issue of the IEEE's *Spectrum* on the N-10 (Intel 860 chip) and glances at the cover photo, he will realize that more than 40% of that team is composed of non-US nationals. Perhaps that will prove to him the gross disregard he has for achievements by "outsiders." If he sees the other advancements made in Electronic Design Automation and the semiconductor industry as a whole, he will perhaps realize the contributions that have been made.

Although technology would surely advance, it would do so at a slower rate without the perseverance and dedication of a handful of these non-US nationals towards the general improvement of productivity in the electronics industry. I wish Irwin would have a realistic perception of what is going on around him, rather than making his really amusing accusations!

Congratulations on doing such a fine job with your magazine. I am an ardent reader, and I especially liked the 5-part series by Bob Pease on troubleshooting analog circuits (EDN, January 5 through March 2, 1989, issues).

M Pansare
Engineer, Electronic CAE Support
Allied-Signal Aerospace Co
Columbia, MD

A degree doesn't confer an education

This letter is a response to Walter Jones's letter in the March 30, 1989, issue of EDN (pg 33). Although I do agree that a well-rounded education is ideal for all students, I disagree with some of Walter Jones's comments regarding [the value of] an American degree overseas.

He quotes Ronald Kohl's statement in the October 1988 issue of *Machine Design* as stating: "in Europe and Japan a degree from an American university is considered almost meaningless." As I do not have a copy of that article, I cannot respond directly to such an inane statement.

Although a Bachelor of Science degree shows that a person has completed all the recommended courses for graduation, it is not a guarantee that he or she will fully understand all given situations.

SIGNALS & NOISE

Some of the best engineers I have known do not profess any degree. Indeed, one of the best authors of analog circuitry is Jim Williams. To my knowledge, Jim has had no formal engineering courses, yet I find his understanding and explanations to be excellent.

What must be recognized is that there is no start, nor end, to an education. It is most definitely what one makes of it. I know that sounds a bit oversimplified. The real world is the best place one can obtain a continuing education. It is a never-ending process, whether [you do it by] reading a current best seller or by reading the latest issue of EDN.

I am most grateful for receiving my BSET from California Polytechnic State University, San Luis Obispo, CA. It provided me with an excellent foundation of "learning by doing." Some of the best advice I received while I was at Cal Poly pointed out that learning is a never-ending process. I never had the opportunity to thank Mr Robert Janeway personally, before he passed away, for his advice. I can not say it any better.

Thomas Walter
Reutlingen
Federal Republic of Germany

Hats off to Pease

Thanks for printing Robert A Pease's series on troubleshooting analog circuits (EDN, January 5 through March 2, 1989). Thanks also for the biographical information you supplied about Bob. You can add to Bob's attributes his willingness to help others. Several times he's sent me helpful critiques of articles I've written on voltage-to-frequency converters. And he's always been willing to provide samples of National chips so I can experiment with them before writing about them.

Forrest M Mims, III
Contributing Editor
Modern Electronics
Seguin, TX

Data Converter Choices Holding You Up?

Choosing a data converter from the stampede of products available can really hold you up. PMI's family of conversion products offers solutions that separate us from the herd.

Free up valuable PC board space with PMI's new **DAC-8043 12-bit D/A Converter** in a small 8-pin mini-DIP package. Also, scout PMI's new **DAC-8143 12-bit DAC** with serial daisy-chainable interface serial input/output pins to build board-saving, 3-wire digital interfaces. These are just two of the many exciting new products in PMI's data converter corral.

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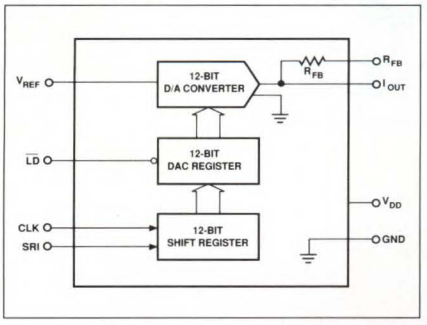
DAC-8043 Functional Block Diagram



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Internal parasitic inductance <5nH

Improved reliability

Reduced EMI and RFI

High current connections all on the top of the device

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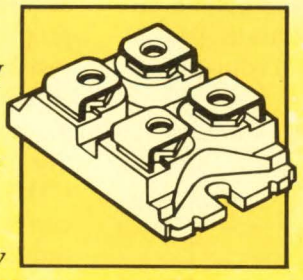

New standards for TO-218 and TO-220. SGS-THOMSON also offers replacements for the standard TO-218 and TO-220 packages. These fully encapsulated packages eliminate the need for additional isolation hardware. Not to mention the cost.

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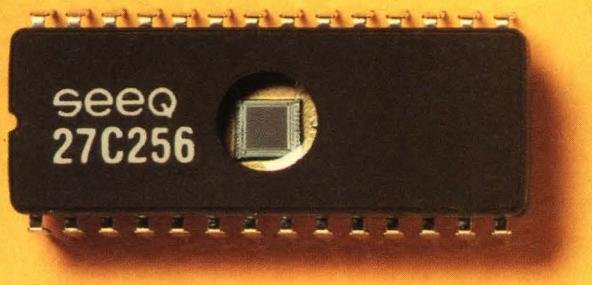

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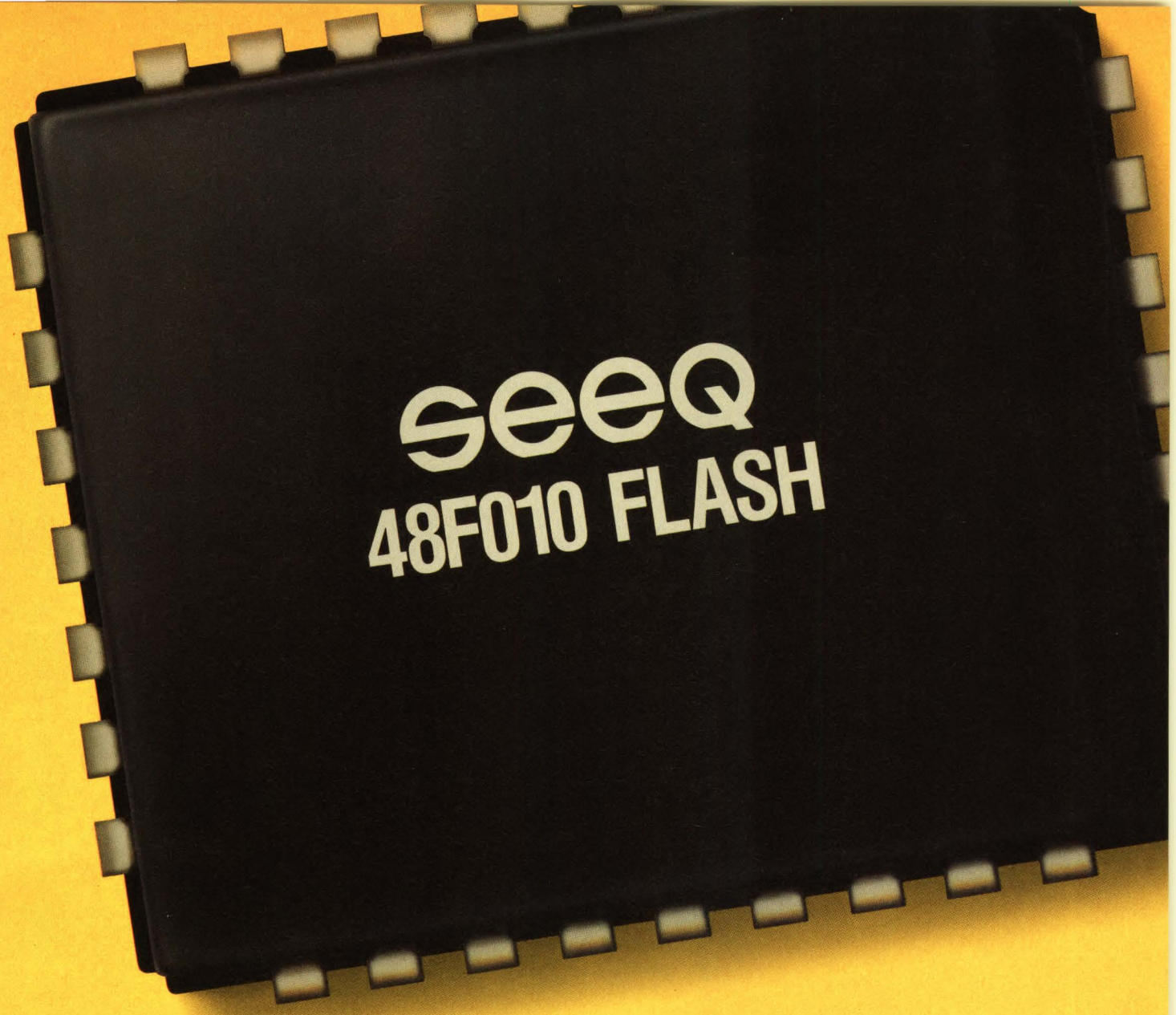
You can get our 1Mb FLASH in ceramic and plastic surface mount packages, as well as both plastic and

The electrical erasure of an EEPROM.



ceramic DIPs. The DIP packages are in a 32-pin JEDEC format so you can easily upgrade in density from 512K through 2Mbit with no hardware changes.

All of which make FLASH perfect for hard disc replacement in laptop computers and portable instruments, program memory in point-of-sale terminals and industrial controllers.

So next time you look at program memory, check out our latest FLASH. For more information just call us toll free at **1-800-3EEPROM.** Or write SEEQ Technology, Inc., 1849 Fortune Drive, San Jose, CA 95131.

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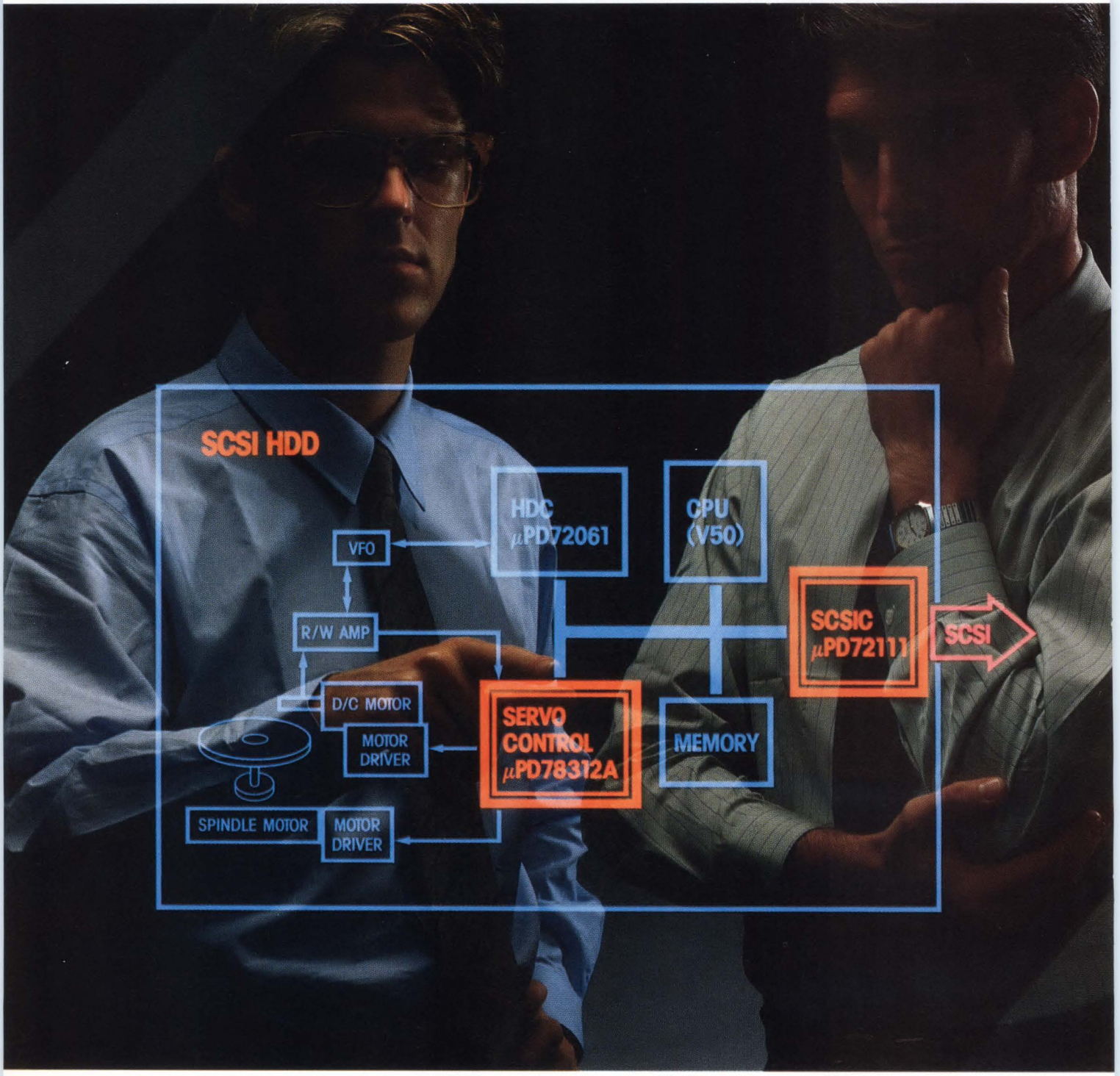

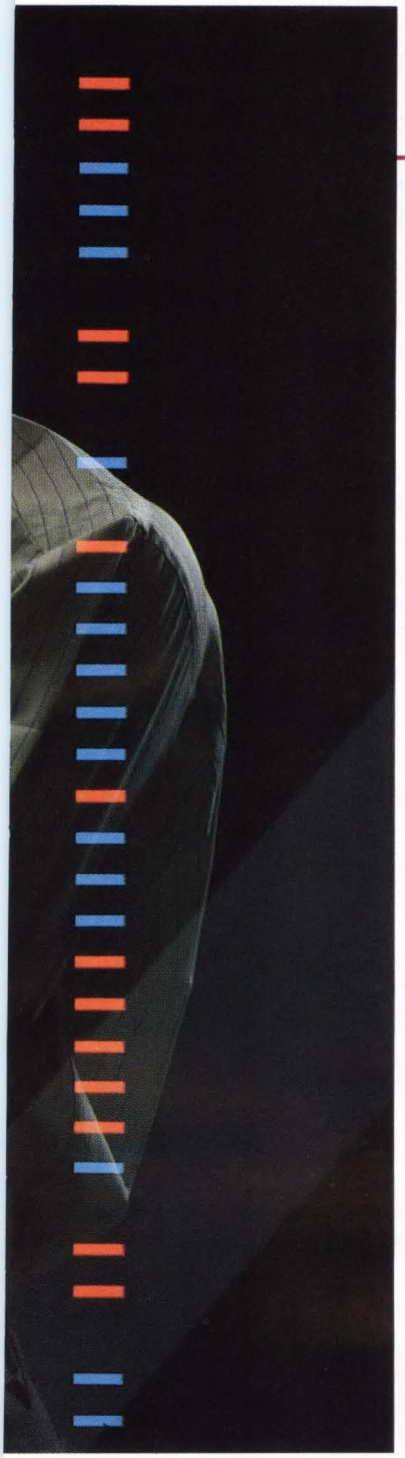

NEC's complete chip set for high-end SCSI hard disk drives.

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- ☐ 2-channel, 16-bit up/down counter with quadruple counting and up/down discrimination.
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- ☐ 8-bit programmable real-time output ports.
- ☐ EPROM version available.

Versatile, high-speed SCSI controller.

Our SCSI controller gives you a competitive edge with features like high-speed sequence control. Overhead is minimized because high-level commands drive an on-chip, hard-wired sequencer.

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If you want clear solutions to the challenges of hard disk drive design, call NEC. Our experts have been driving the technology for years.

NEC

CIRCLE NO 40

CALENDAR

SparcIntosh (conference), San Francisco, CA. Corey Green, The Yankee Group, 200 Portland St, Boston, MA 02114. (617) 367-1000. July 25 to 26.

Supercomputers, Hypercubes and High Performance Architectures (short course), Boston, MA. John Valenti, Integrated Computer Systems, 5800 Hannum Ave, Culver City, CA 90231. (800) 421-8166; in Canada, (800) 267-7014. July 25 to 28.

Basic Integrated Circuit Technology Seminar, Sunnyvale, CA. Integrated Circuit Engineering Corp, 15022 N 75th St, Scottsdale, AZ 85260. (602) 998-9780. FAX 602-948-1925. August 15.

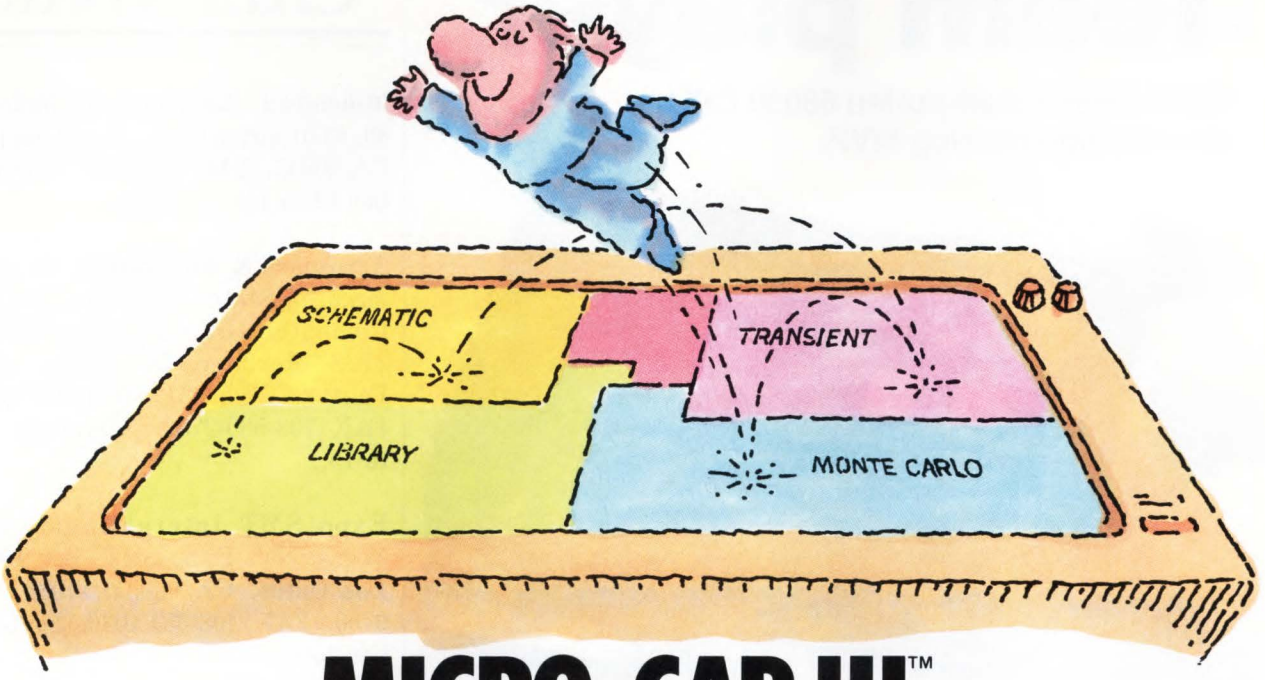
Data Communication Concepts (seminar), Los Angeles, CA. Technology Transfer Institute, 741 10th St, Santa Monica, CA 90402. (213) 394-8305. August 23 to 25.

11th Quartz Devices Conference and Exhibition, Kansas City, MO. Electronic Industries Association, 1722 Eye St NW, Washington, DC 20006. (202) 457-4981. August 28 to 31.

International Test Conference 1989, Washington, DC. International Test Conference, Box 264, Mt Freedom, NJ 07970. (201) 895-5260. FAX 201-895-7265. August 29 to 31.

Surface Mount '89, San Jose, CA. MG Expositions Group, 1050 Commonwealth Ave, Boston, MA 02215. (800) 223-7126; in MA, (617) 232-3976. August 29 to 31.

Real-time Structured Analysis & Design (short course), Washington, DC. John Valenti, Integrated Computer Systems, 6053 W Century Blvd, Los Angeles, CA 90045. (800) 421-8166; in CA, (213) 417-9700. FAX 213-410-2952. August 29 to September 1.



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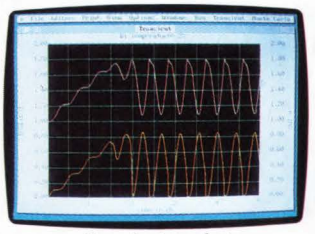
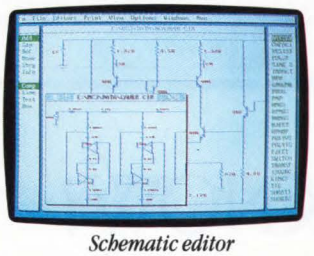
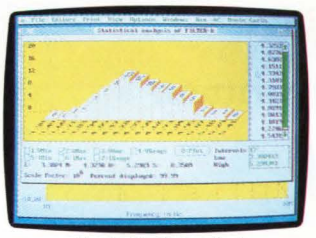


Transient analysis



Schematic editor



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CIRCLE NO 44

CALENDAR

Midcon/89, Rosemont, IL. Midcon/89, 8110 Airport Blvd, Los Angeles, CA 90045. (213) 772-2965. September 12 to 14.

Aerospace & Electronics '89 (conference), Santa Clara, CA. National Computer Graphics Association, 2722 Merrilee Dr, Suite 200, Fairfax, VA 22031. (703) 698-9600. FAX 703-560-2752. September 12 to 15.

Expo SMT International, Las Vegas, NV. Expo SMT, Box 1869, Los Gatos, CA 95031. (408) 354-0700. FAX 408-354-1036. September 25 to 27.

DISKCON, San Jose, CA. Julie Sunseri, 710 Lakeway, Suite 170, Sunnyvale, CA 94086. (408) 720-9352. FAX 408-736-2523. September 26 to 27.

IEEE International Conference on Computer Design (ICCD '89), Cambridge, MA. Giovanni De Micheli, Center for Integrated Systems, Room 129, Stanford University, Stanford, CA 94305. (415) 725-3632. October 2 to 4.

Electronic Imaging Conference East, Boston MA. MG Expositions Group, 1050 Commonwealth Ave, Boston, MA 02215. (800) 223-7126; in MA, (617) 232-3976. October 2 to 5.

20th Korea Electronics Show, Seoul, Korea. Joseph Burke, US Department of Commerce, Washington, DC 20230. (202) 377-5014. October 7 to 12.

Systems 89, Munich, West Germany. Gerald G Kallman, Kallman Associates, 5 Maple Ct, Ridgewood, NJ 07450. (201) 652-7070. FAX 201-652-3898. October 16 to 20.

The plot that took 20 years to unfold.

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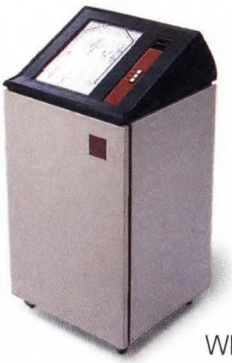
If you've got a plotting problem, chances are the company that can solve it is the one with the longest history of doing just that. That's why we'd like you to reflect on the rather long history of Versatec. Because our past might just have an impact on your future.



1969. The revolution begins.

Woodstock, miniskirts and those amazing Mets. In technology, it was a year filled with excitement. A man on the moon. The jumbo jet and Concorde. The artificial heart.

But there was another event that almost went unnoticed. One that would change forever the way engineers worked. Versatec was formed. And a little while later, we introduced the first 11-inch electrostatic plotter.

While crude by current standards, our first plotter started a revolution in engineering productivity that's still going strong today, 20 years and 50,000 systems later.

In fact, today there are more Versatec electrostatic plotters in more places throughout the world than all other brands combined.

1973. The plot widens.

Watergate hearings. Rabies vaccine. Supermarket scanners. Color copiers. And a new development in engineering that would change the world—computer aided design.

Automotive, architectural, aeronautical and electrical engineers were clamoring for vastly wider plots than anything ever seen before.

Versatec responded with a whole new line of wide carriage plotters. In widths from 20 to a whopping 72 inches. Plus the ability to print on paper or vellum in clear or matte finishes. A little later we'd add 200 ppi resolution, the first RS-232 and direct CRT interfaces, first I/O multiplexer, minicomputer graphics software, universal graphics software and a few dozen other innovations.

1976. Supplies meet demand.

While R2D2, C3PO and the space shuttle were cavorting in space, Versatec announced something a little more down-to-earth. Our very own supplies research group. Dedicated to making sure that our electrographic supplies are as advanced as our plotters, these folks are now responsible for over 50 patents covering a wide range of papers, films, toners and other supplies. And our warehouses in the U.S., Canada and Europe can ship our supplies at a moment's notice.

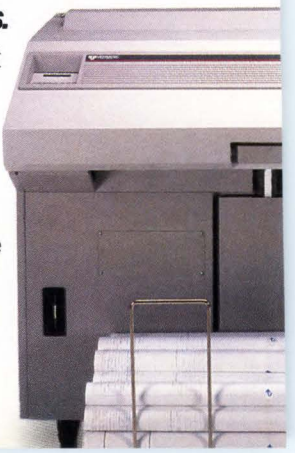
1982. The color purple (and green and blue and yellow).

While E.T. and disk cameras were getting lots of attention, we were giving serious attention to R&D. And especially to customers who needed more dimension in their plots.

The result was the world's first electrostatic color plotter. Then we carried that technology even further with second-generation systems in 24, 36, and 44 inch formats. Followed by high resolution thermal plotters in color. And another long list of firsts, including a random element processor, plot server, color plotting software, color toners and media.

1988. Drawing some fine lines.

We shouldn't have to tell you what happened in the world last year. But we would like to remind you of one important event in the world of plotting. We introduced the first wide format laser plotter—the Model 8836. This remarkable machine



XEROX

does everything but cook your lunch. It plots at a sizzling one inch per second with 400 ppi resolution, in D and E sizes. Then it cuts, rolls and tapes each plot and drops it into a bin. The architects went nuts. And the CAD guys danced with joy.

There's no time like the present.

As you can tell by now, we've been listening and responding to customers for 20 years. And lately we've been hearing a lot about size, performance and cost.

So we went to work on something entirely new. And the results are truly amazing. It's called the 8500 series. A new generation of plotters with half the size, more performance and far less cost than any other electrostatic plotters ever made. Plus the greatest range of connectivity solutions and software compatibility available anywhere. These new machines have reduced plotting time from over an hour to under two minutes.

How to learn from history.

The important lesson from our long history is simple. Whenever you need a solution to almost any plotting problem, you can count on Versatec for the answer.

No other company has the experience, range of products, technical resources and service and support. And no other company is as dedicated to its customers.

It's been that way for 20 years. And we're making sure it stays that way for the next 20.

So find out what Versatec can do for you. Call us at our toll-free number now: (800) 538-6477; in California, (800) 341-6060. And discover a whole new world of plotting solutions.

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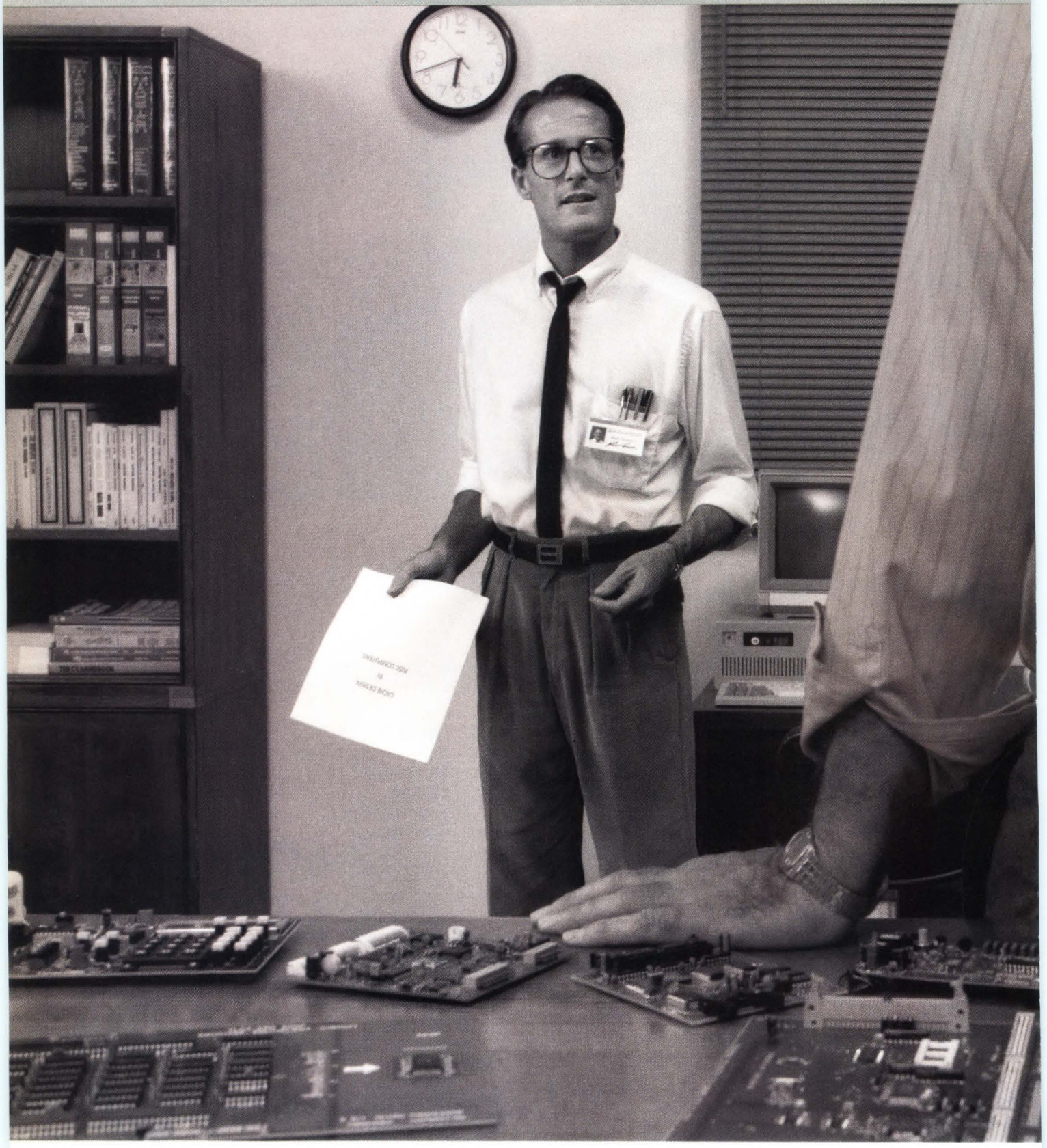
Map was produced on a Versatec electrostatic color plotter by TenTime, Denver, CO.

CIRCLE NO 45

"What if I told you there's a 15ns 64K SRAM available



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The exceptional access speed of the new 15ns 64K SRAM family is the result of a little technological wizardry and lots of 1.0μ CMOS know-how. The bottom line is a 15ns 64K SRAM that dissipates less power and requires a smaller-sized die than more costly BiCMOS devices.

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When it comes to SRAMs, Toshiba's got all the speeds, configurations and densities you need. Including 256K, coming soon.

Toshiba High-Speed SRAMs

Configuration	Density	Speed (ns)				Availability
64K x 1	64K	35	45	55		Now
16K x 4	64K	15	20	25	35	Now
16K x 4 (OE)	64K	15	20	25	35	Now
8K x 8	64K	15	20	25		Now
8K x 9	72K	15	20	25		Now
64K x 4	256K	20	25	35		Early '89
64K x 4 (OE)	256K	20	25	35		Early '89
32K x 8	256K	20	25	35		Early '89
32K x 9	288K	20	25	35		Early '89
16K x 12	192K module	25	35			Now
16K x 16	256K module	25	35			Now

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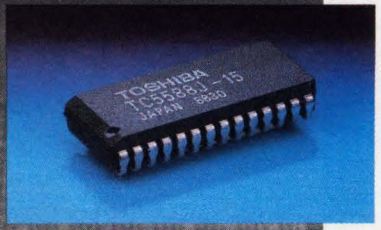

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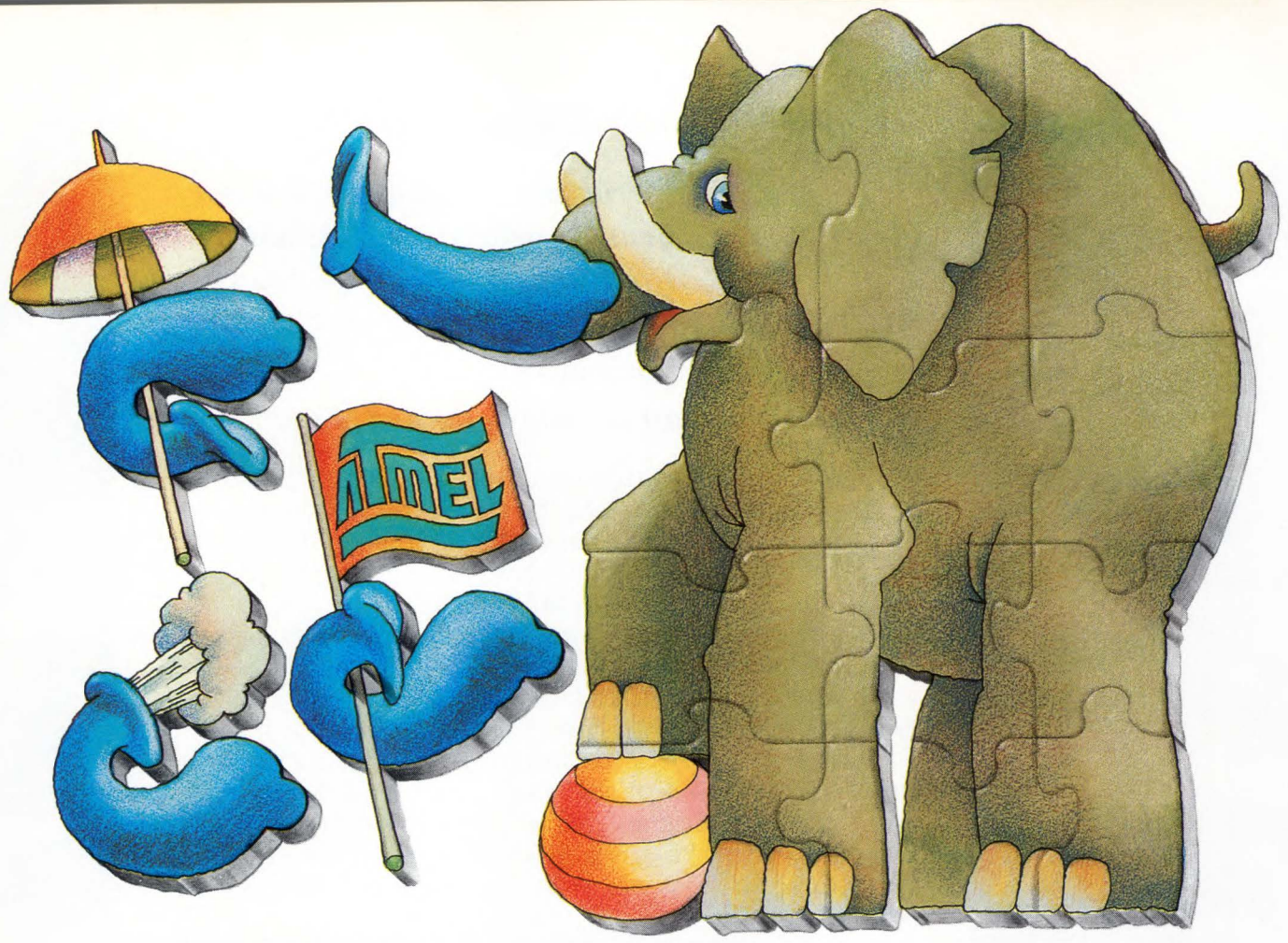

THE JUMBO REPROGRAMMABLE GATE ARRAY

Puzzled by all the logic arrays in the jungle? There's only one leader. To spot him make sure that:

- His array can really do the big jobs. It should be able to replace a whole board of old-fashioned logic.
- His array gives you a speed/power savings.
- His array is easy to use, and has a programming scheme that you're used to.

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NOW THE GOOD NEWS!

You probably already know how to run this beauty. Its structured architecture is similar to what you have been working with all along, so you use your usual design methods and make only minor changes to your software and hardware.

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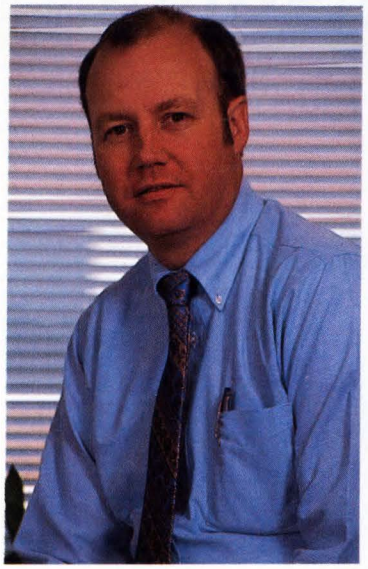
The people who make the difference

EDITORIAL

HDTV: Who'll watch; who'll pay?



People are talking about the high-definition-television (HDTV) market as if it exists and is already slipping away from US companies and into the hands of our consumer-electronics "enemies" in Japan. However, it will be some time before HDTV is on the market, so we should ask TV stations and consumers if they want HDTV and are willing to pay for it. The US government and the electronics industry spend time worrying about display formats, compression standards, and signal bandwidths; but if people won't pay for HDTV and won't watch it, HDTV might turn out to be a technical oddity like quadraphonic sound and AM stereo.

Today's TV audiences are much different from those of only a few years ago, and changes in viewing habits continue. In a few years, there will be fewer teenagers to watch what appeals to today's young audiences. Likewise, there is large growth among minority populations who will want TV programs that appeal to their entertainment needs. Instead of maintaining several major TV networks, population changes portend the continued fragmentation of TV audiences into narrow segments.

Already, major TV networks are feeling the effects of declining advertising revenues as advertisers spend their money elsewhere to reach specific audiences. Many TV advertisers are being attracted to the low-power VHF and UHF TV stations that cater to a local ethnic or age group. With smaller ad budgets spread among many TV stations, few of the small, low-budget stations will be able to afford an HDTV operation.

Besides stations being able to afford HDTV equipment, people must be interested enough in HDTV programs to watch them. During the 1988 Summer Olympics in South Korea, an HDTV-technology display captured viewers' attention when the program was a live broadcast. But, when the station played recorded Olympic events, viewers didn't prefer HDTV to today's standard TV. So, many viewers may shun any promise of HDTV when they face hours of reruns and today's vapid programs. The people involved with HDTV technology have forgotten that consumer needs and not technological innovations define new market opportunities.

Even if consumers do eventually show interest in HDTV, the US effort may be stillborn because of a reliance on government money and direction. Current US efforts hinge upon funds supplied by the Defense Advanced Research Projects Agency (DARPA), which will get the HDTV program underway. Many people confuse the DARPA effort with a plan to produce a consumer product. In fact, DARPA simply wants to ensure the development of high-definition displays for combat information.

With the inability to translate military developments into consumer products, the US electronics industry should be wary of government—particularly military—involvement in a consumer HDTV effort. Unfortunately, the American Electronics Association's HDTV consortium wants the US government to fund almost half of its efforts. Many in the US electronics industry think that HDTV sales will overshadow personal-computer sales, thus making HDTV a major consumer of integrated circuits and other electronic components. If that is true, the US electronics industry should be willing to invest its own money in a home-grown HDTV effort. So far, our industry seems unwilling to match the HDTV investments made by Japanese companies. Perhaps before they start collecting funds, people in the electronics industry should ask consumers whether or not they really want HDTV. If they find that consumers really want HDTV, they should then ask themselves why they didn't start investing in HDTV research years ago.

Jesse H Neal
Editorial Achievement Awards
1987, 1981 (2), 1978 (2),
1977, 1976, 1975

American Society of
Business Press Editors Award
1988, 1983, 1981

Jon Titus
Jon Titus
Editor

If you believe EPLDs are constrained by their architecture, this should open your mind.

Introducing MAX. A totally new architecture that will change your thinking about EPLDs.

Still think that EPLDs can't be fast and dense?

Then prepare to erase and reprogram your thinking.

The new MAX family from Altera has a radically different EPLD architecture that can make your fastest, densest designs fly out the door in no time.

With twice the speed and three times the density of conventional EPLDs.

At the heart of the MAX architecture are Logic Array Blocks incorporating three major innovations:

First, streamlined, totally programmable macrocells with multiple control product terms.

You can choose from a family of devices with a full range of densities from 16 to 128 macrocells in a variety of packaging options.

Secondly, Logic Expanders that let you assign additional product terms to any macrocell.

Finally, decoupled I/O that lets you use all your pins and flip-flops independently.

Tying it all together, a Programmable Interconnect Array (PIA) links MAX's multiple LABs efficiently.

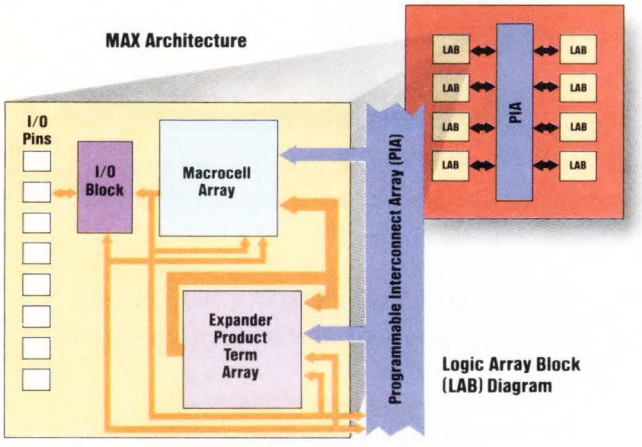
When you combine the MAX architecture with a high speed, 0.8 micron CMOS process, you get high density devices with extraordinary performance.

And to get those devices to market faster, there's MAX+PLUS.™ Logic synthesis makes it the most powerful, easy to use software ever developed for EPLDs.

That's why the MAX family is destined to become the new standard for logic design.

For more information, call Altera today: 1-800-545-3377.

And see how easy it is to change your thinking about EPLDs.



Logic Array Block (LAB) Diagram

At the highest densities, MAX incorporates a Programmable Interconnect Array that gives you the high performance of small arrays with large array density.

ALTERA

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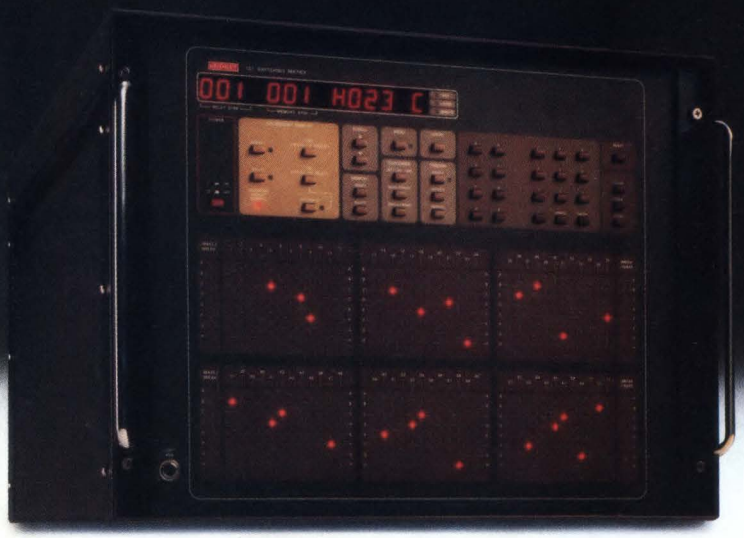
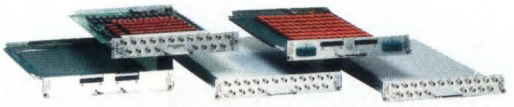
SWITCHING SOLUTIONS

for your ATE



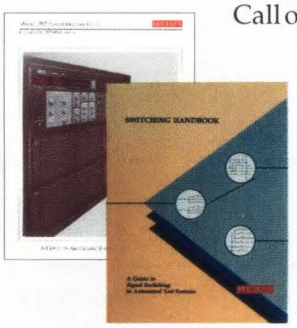
Model 707 Switching Matrix—the heart of a superior ATE system—accepts up to 6 matrix cards.

It's in the cards. Keithley's Model 707 Switching Matrix accepts a full range of interchangeable switching cards, so you can custom-design your test system for the best performance. Optimize switching characteristics to specific signals for more reliable, repeatable test results.



Connect quick. The 707's built-in analog backplane conducts signals between cards and eliminates external cabling. Control up to 2880 relays from one IEEE-488 address for signals from 5μV to 200 VDC, and up to 30 MHz.

Point and program. Program your test interconnect quickly and easily with the optional light pen. Use the pen to toggle any relay state, verify the setup on the display, and record up to100 relay configurations—or transfer them to computer memory.



Call our Technical Support Hotline, **(800) 552-1115**, any time before 7:00 p.m. EST. Our Applications Engineers are available to help you configure your next switching system.

And be sure to ask for your free copy of Keithley's authoritative *Switching Handbook* and the *Model 707 Configuration Guide.*

The Model 707 Switching Matrix

KEITHLEY

EEPROM-based programmable filter handles eighth order and can be cascaded

The SC22324 CMOS programmable switched-capacitor filter allows you to implement an eighth-order filter function with a single component. The device stores the programming information in EEPROM, giving you the flexibility of a dynamically programmed device without needing to reconfigure the part at power-up. The SC22324 is also suitable for prototype development, and for production quantities you can replace it with the SC11324 custom mask version.

The device is organized as four cascaded biquad filters, any of which can be selected as the output stage. This organization allows you to use the device as a second-, fourth-, sixth-, or eighth-order filter without rewiring. You can also cascade devices to create higher-order functions. Each of the biquad sections can be a lowpass, highpass, notch, or allpass filter type with bandwidths as high as 100 kHz.

You program the filter through a 4-pin serial interface, providing 59 bits for each biquad section—4 bits for filter type and 55 bits for coefficients. The programming information loads into temporary registers. You can cause the filter to use either the contents of the temporary registers or the EEPROM simply by applying a logic signal to the Sel pin. The ability to switch between the two locations allows you to reprogram the chip without disturbing its operation. You transfer the temporary register contents to EEPROM by applying −5V to the Sel pin.

In addition to the filter sections, the device provides two op amps, an on-chip oscillator, and a programmable filter clock counter. One of the two op amps is connected to the first biquad section's input; the other is undedicated. You can use these op amps for antialiasing or output-signal smoothing filters, or you can bypass them altogether. The counter generates the filter's clock from either the oscillator or an external signal. The counter's divide ratio can be stored in EEPROM.

A designer's kit is available for the SC22324. The kit comprises a programming station that connects to an IBM PC or compatible, two SC22324 devices, filter design software, and a textbook on switched-capacitor filter design. The programming station can accept two devices simultaneously, allowing you to test filters through the sixteenth order. When using the kit to program functions that are higher than the sixteenth order, the software prompts you to change devices.

The design kit for the SC22324 programmable filter *includes software, a textbook, and a programming station that connects to an IBM PC.*

The SC22324 costs $49 (100), and the kit costs $1875. The SC11324 custom mask version will cost about $6 in production quantities.

—Richard A Quinnell

Sierra Semiconductor, 2075 N Capitol Ave, San Jose, CA 95132. Phone (408) 263-9300. TLX 384467. FAX 408-263-3337.

Circle No 381

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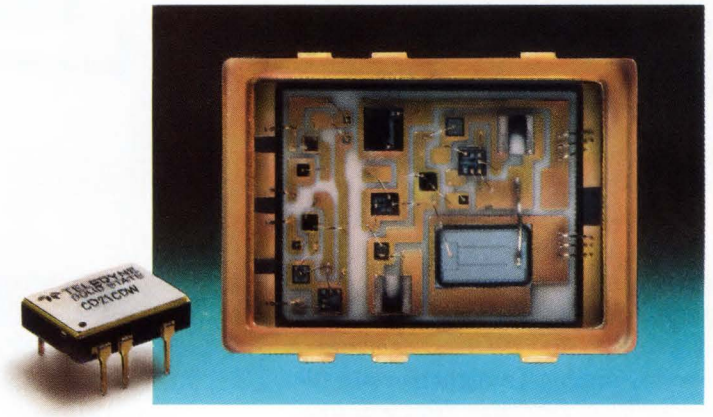


ACTUAL SIZE CERAMIC PACKAGE

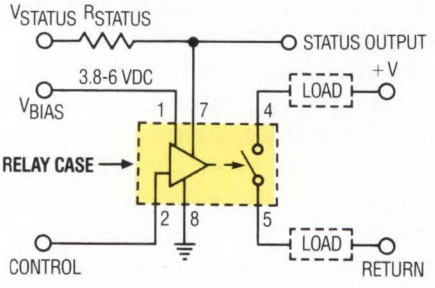
PART # CD21CDW

Review the electrical characteristics and call us for immediate application assistance.*

ELECTRICAL CHARACTERISTICS (–55°C to + 105°C unless otherwise noted)				
	Min	Max	Units	
Bias Voltage (V_{BIAS})	3.8	6.0	V_{DC}	See Note 1
Bias Current (I_{BIAS})		15.0	mA	$V_{BIAS} = 5V_{DC}$
Control Voltage (V_{IN})	0	18.0	V_{DC}	
Control Current (I_{IN})		250	µA	$V_{IN} = 5V_{DC}$
Turn-Off Voltage $V_{IN\,(OFF)}$	3.2		V_{DC}	
Turn-On Voltage $V_{IN\,(ON)}$		0.3	V_{DC}	
Continuous Load Current		1.2	A	–55°C to + 25°C
I_{LOAD} @ 60 VDC		0.7	A	+ 85°C
Output Trip Current (I_{TRIP})	2.4 (Typ.)		A	+ 25°C, 100ms
On-Resistance (R_{ON})		0.65	Ohms	
Turn-On Time (T_{ON})		1.5	ms	
Turn-Off Time (T_{OFF})		0.25	ms	
Status Voltage (V_{STATUS})	1	18	V_{DC}	
Status Current (I_{STATUS})		2	mA	$V_{SAT} \leq 0.3V_{DC}$ See Note 2

Notes:
1. Series resistor is required for bias voltages above $6V_{DC}$. $RS = (V_{BIAS} - 6V_{DC})/15$ mA
2. A pull up resistor is required for the status output. $R_{STATUS} = (V_{STATUS} - 0.3)/I_{STATUS}$
3. Output will drive loads connected to either terminal (sink or source).
4. Status circuit is a built-in test feature checking the input circuitry of the relay. Status output is low (on) when the input is on.

All power FET relays may drive loads connected to either positive or negative referenced power supply lines (source or sink modes).



TELEDYNE SOLID STATE
A Division of Teledyne Relays

*For immediate application assistance call 1-800-284-7007.

Teledyne Solid State, 12525 Daphne Avenue, Hawthorne, California 90250.

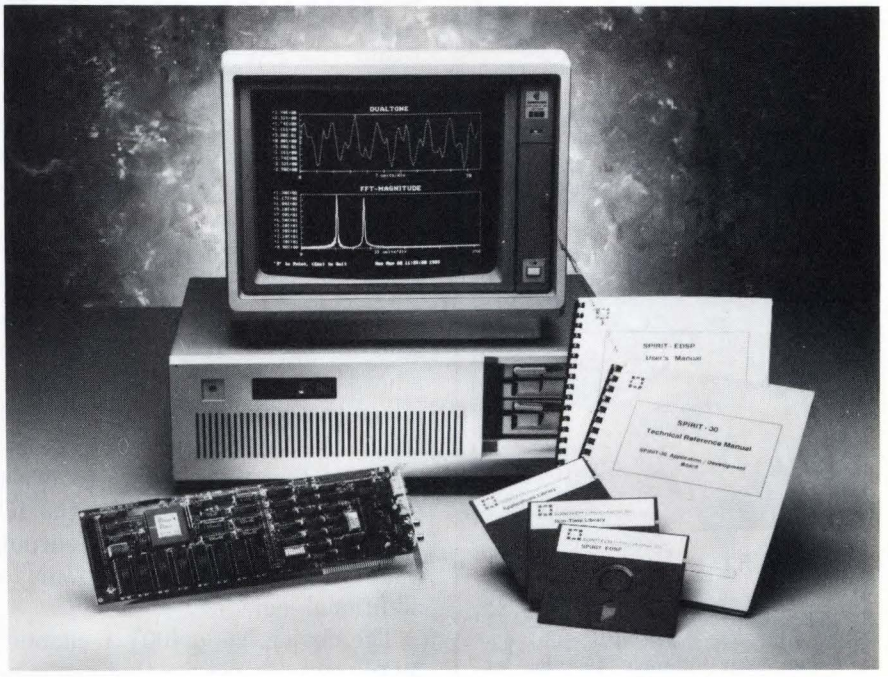
PC-based DSP add-in card yields 33M-flops performance

An add-in card for IBM PCs and compatible computers called the Spirit-30 performs 33M flops (floating point operations per second). The board, based on the Texas Instruments' TMS320C30 digital signal processor, targets applications such as signal processing, array processing, and graphics. Software support includes a DSP library, a C compiler, a debugger, and a real-time operating system.

The TMS320C30 processor includes 8k bytes of memory and a DMA controller on chip. Furthermore, the processor executes a floating-point multiply-and-accumulate operation in a single 60-nsec instruction cycle. Key benchmarks show that the Spirit-30 board executes a 1024-point complex FFT in 3.1 msec, executes a 64th-order FIR filter algorithm in 4.67 μsec, and multiplies 3×3 by 3×1 matrices in 0.78 μsec.

The Spirit-30 board includes 128k bytes of 25-nsec static RAM that is dual ported between the TMS320C30 and the PC host bus. A daughter board allows you to add 512k bytes of static RAM. You can also substitute EPROM for static RAM on the board for use in standalone or embedded applications. The board can transfer data at 1M bytes/sec across the host bus of an 8-MHz IBM PC/AT or a compatible computer, and as fast as 2M bytes/sec over the buses of some faster PCs.

In addition to the PC host-bus interface, the accelerator board includes six expansion connectors that support external devices such as memory boards, data-acquisition boards, and graphics products. The expansion ports include a 37-pin universal host interface, a 60-pin main-memory expansion bus, a 60-pin peripheral memory-expansion port, a 50-pin parallel I/O port, and two serial ports. You can also connect multiple Spirit-30 boards via the expansion connectors for multiprocessor applications.



FFTs, spectrum analysis, and Viterbi decoding *represent just a few of the functions you can perform using the TMS320C30-based add-in DSP accelerator card.*

For software development, the company offers the menu-driven EDSP software environment that supports evaluation, debugging, simulation, and real-time DSP needs. The debug module features single-step operation, supports 16 breakpoints, provides code disassembly, and allows display and modification of memory and registers. The environment also includes a runtime library that allows the PC host to download programs, start and stop execution of the processor, and read and write blocks of memory on the DSP board.

You can also purchase the DSPL (Digital Signal Processing Library), which provides more than 35 optimized DSP function modules developed in C. Examples of the modules' functions include spectrum analysis, cepstral analysis, Viterbi decoding, FFTs, and discrete cosine transforms. Finally, the TMS320-C30 C compiler, assembler/linker/simulator, and SPOX real-time operating system can run on the board.

The Spirit-30 board costs $2495, and the EDSP software environment adds $495. You can purchase the DSPL for $295, or $985 if you need the source code.—***Maury Wright***

Sonitech International Inc, 83 Fullerbrook Rd, Wellesley, MA 02181. Phone (617) 235-6824. FAX 617-235-2531.

Circle No 378

PRODUCT UPDATE

Driver IC lets logic signals control 400V circuits

Using the PWR-DRV1 integrated circuit, your logic circuit can control solenoids, relays, motors, or other high-voltage components. This handy IC packs a lot of capability in an 8-pin DIP.

For starters, the IC has a zener diode to create its own 5V power from either dc or rectified ac voltages as high as 120V. This feature allows you to place the driver near a load that's far from your logic and to use the load's supply voltage instead of the logic supply to drive the IC. The 5V created by the IC is available at one of the output pins, so you can supply power to additional logic.

The device has a 400V n-channel MOS power transistor that can handle as much as 275 mA of continuous current. It can also handle as much as 2A in 300-μsec pulses with a 2% duty cycle. A protection diode is connected between the drain and the device common to handle inductive switching transients. A Set-Reset latch controls the transistor, thereby allowing you to use either continuous or pulsed logic signals to turn the driver on and off. The latch responds to signals as short as 100 nsec.

Two additional features of the power driver are a current mirror to sense the load current and a comparator. The current mirror creates an output current proportional to the load current in a 1:50 ratio. You can connect a resistor between the mirror output and the device common to create a load-sense voltage as high as 200 mV.

The comparator has a 150-mV threshold with ±50 mV of hysteresis to prevent oscillation. Its output signal can drive as much as 5 mA, making the comparator suitable for driving an LED as an indicator. It can also be used to drive the latch-input lines, allowing you to activate the power driver with an analog signal instead of a logic signal.

Capable of handling 275 mA at 400V, *the PWR-DRV1 accepts logic-level control signals. Its many features include an onboard control latch, a load-current mirror, and a comparator.*

The PWR-DRV1 comes in an 8-pin plastic DIP capable of handling 750-mW power dissipation or in a 16-pin version that handles 1W. The device sells for $3 (100).

—Richard A Quinnell

Power Integrations Inc, 411 Clyde Ave, Mountain View, CA 94043. Phone (415) 960-3572. FAX 415-940-1226.

Circle No 379

TWO REASONS TO INVEST IN SONY 6/8-BIT, 20-MHz A/D CONVERTERS.

MILD CLIMATE.

90mW

power dissipation.

(70 mW, 6 bit)

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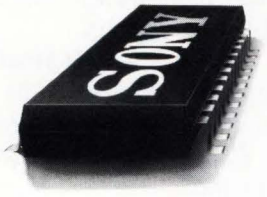
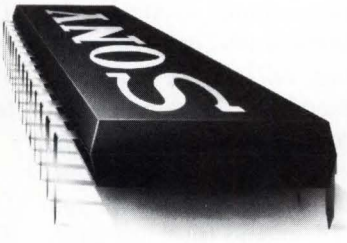


SOP package.



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CXD 1175M	8	CMOS	90mW	SOP
CXA 1096P	8	BIPOLAR	350mW	DIP
CXA 1096M	8	BIPOLAR	350mW	SOP
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CIRCLE NO 52

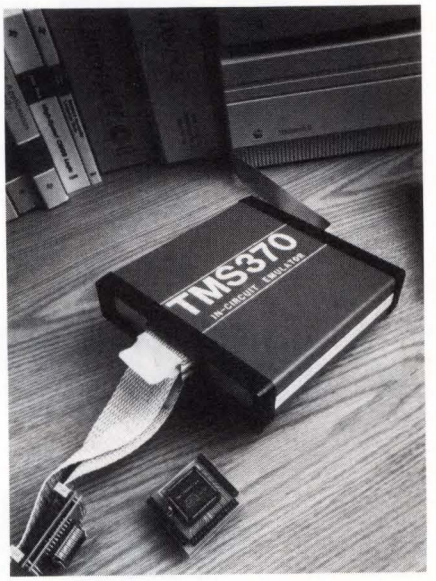
TMS370 in-circuit emulator includes EEPROM programmer

For $2995 you can buy an in-circuit emulator for Texas Instruments' TMS370 microcontroller family that will also let you program both the data EEPROM and the program EEPROM of your target device. The MR370 development kit is a 7×7.5-in. unit that lets you perform real-time emulation and debugging at clock speeds reaching 20 MHz with no wait states.

The MR370 contains 16k bytes of 120-nsec emulation overlay memory and a 68-pin PLCC (plastic leaded chip carrier) emulation plug on 8 in. of woven cable. A pop-out socket eliminates any need for specialized chip-extraction tools to remove the TMS370 from the emulator.

You don't have to provide a power supply for the MR370 because it draws its power from the target TMS370's socket. The MR370 consumes only 110 mA more current than the target device. This situation also prevents power-supply contention problems that can occur when the target device and the emulator are not powered up simultaneously. Furthermore, the unit has no hardware switches or jumpers to configure.

The MR370's software includes a TMS370 macroassembler, editor, and communications software. You can program as many as four software breakpoints and perform software tracing, as well as examine, edit, disassemble, and single-step through program memory. The unit comes with a monitor/debug command set in firmware that lets you download binary and Intel hex files, so your host computer doesn't need special driver software to communicate with this emulator. You can examine and change internal data memory, registers, and I/O ports.



Combining an in-circuit emulator with EEPROM programming capability, *the MR370 development kit from Macrochip Research lets you perform real-time TMS370 emulation and debugging at clock speeds reaching 20 MHz.*

Although this unit is suitable for use with any host computer that has an RS-232C port, you can order the MR370 with software for IBM PCs or compatible computers and Macintosh computers. The standard kit works with the TMS370C050, TMS370C350, and TMS370C850 microcontrollers. Options include $250 28-pin DIP and PLCC adapters that allow you to emulate TMS370C010, TMS370C310, and TMS370C810 microcontrollers. The company provides a 30-day money-back guarantee and a 1-year warranty.

—J D Mosley

Macrochip Research Inc, 1301 N Denton Dr, Suite 204, Carrollton, TX 75006. Phone (214) 242-0450. FAX 214-245-1005.

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4K x 4 CS	MCM6269	25, 35ns	PDIP
4K x 4 OE	MCM6270	25, 35ns	PDIP, PSOJ
16K x 4	MCM6288	20, 25, 30, 35, 45ns	PDIP
16K x 4 OE	MCM6290	20, 25, 30, 35, 45ns	PDIP, PSOJ
64K x 1	MCM6287	25, 35ns	PDIP, PSOJ
8K x 8	MCM6264	30, 35, 45, 55ns	PDIP, PSOJ
32K x 8	MCM6206	35, 45ns	PDIP, PSOJ
Cache Tag RAM Comparators			
4K x 4	MCM4180	22, 25ns	PDIP, PSOJ
4K x 4	MCM62350	22, 25ns	PDIP, PSOJ
4K x 4	MCM62351	22, 25ns	PDIP
Synchronous Fast Static RAMs			
16K x 4	MCM6293	20, 25ns	PDIP, PSOJ
16K x 4 OE	MCM6294	20, 25ns	PDIP, PSOJ
16K x 4 OE	MCM6295	25, 30ns	PDIP, PSOJ
4K x 10	MCM62963	20, 25ns	PLCC
4K x 12	MCM62973	20, 25ns	PLCC
4K x 12 OE	MCM62974	20, 25ns	PLCC
4K x 12 OE	MCM62975	20, 30ns	PLCC

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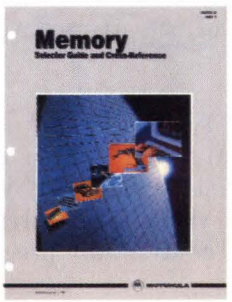

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Please send me more information on Fast Static RAMs.

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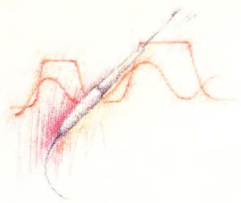


TEST & MEASUREMENT INSTRUMENTS

In-circuit emulators for μCs

probe software activity in a closed environment

Steven H Leibson, Regional Editor

Tricky techniques allow in-circuit emulators (ICEs) for μCs to peer into the inner workings of the single-chip devices, helping you to develop faster and more reliable software in a shorter period of time.

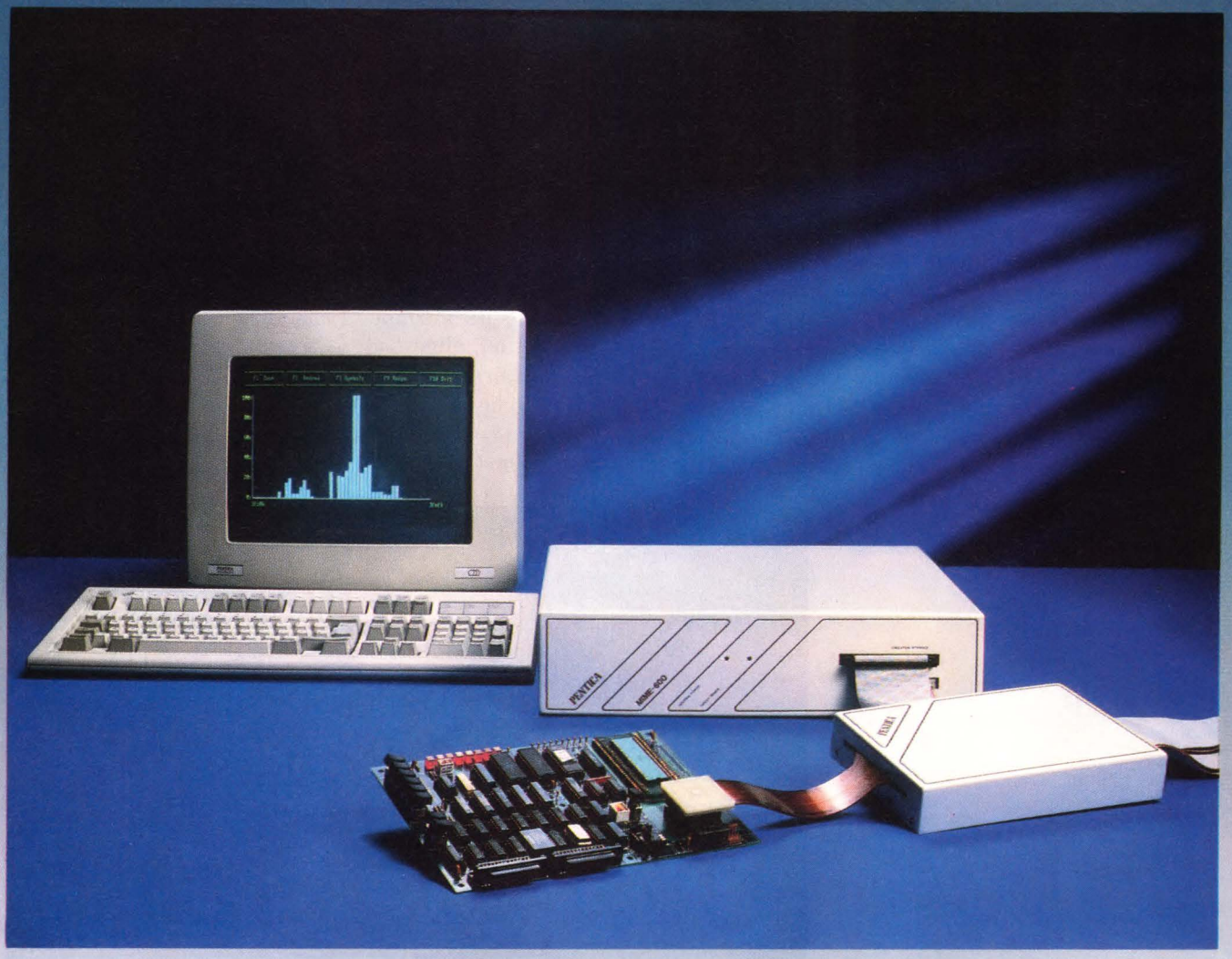
In-circuit emulators (ICEs) for μCs are tougher to build and select than their counterparts for μPs. In their nonexpanded or single-chip mode, μCs hide the software machinations taking place on chip, making your software more secure, but consequently much tougher to develop and debug. You cannot hang a logic analyzer on a μC's address and data buses because those buses lack external access points. Traditional ICE techniques used for μPs do not work for the same reason. Consequently, an army of ICE vendors, using a variety of ingenious techniques to provide access to the μC's inner sanctum, has geared up to serve the special needs of the μC software developer.

Emulators for μPs can't cope

To understand the unique requirements of μC emulators, you must examine the internal structure of a μC. The μC's core processor communicates with the IC's RAM, ROM, and I/O components over internal address and data buses. μCs have several operating modes, including the above-mentioned nonexpanded or single-chip mode, and an expanded mode. The operating modes determine whether or not the internal address and data buses are available on the μC's pins. When used in expanded mode, the μC sacrifices some or all of its I/O pins, replacing them with address and data pins so that the processor can use external ROM and RAM. In this mode, the μC takes on the characteristics of a μP, allowing you ready access to the data flow into and out of the processor. However, in single-chip mode, the μC reveals little about the software it is executing, which makes in-circuit emulation, software development, and debugging difficult.

Most μCs can also change the operational definition of their I/O lines under program control. One μC I/O

Illustrations by Margery Mintz



In-circuit emulator for a μC, running a software performance analysis (Pentica Systems Inc)

pin might be able to assume the guise of a general-purpose digital-I/O pin, an interrupt pin, an analog-I/O pin, or an address-bus or data-bus pin, depending on the software being executed. In general, μP emulators are not designed to handle a μC's chameleon-like I/O features.

Emulators save time and money

Generally, time-to-market considerations drive the decision to purchase an emulator in the first place. You could probably develop your μC software simply by burning enough EPROMs (assuming an EPROM version of your chosen μC exists). If your code doesn't work the first time—a likely scenario—you may be in for some tough debugging sessions because most μCs don't incorporate any software-debugging aids. The time-honored (and time-consuming) approach to μC software debugging requires a lot of engineering intuition: You guess what's wrong with your program and then burn another EPROM.

If you prefer to take a more direct approach to debugging by setting break points, single-stepping your code, examining registers, and manipulating the μC's memory, you'll

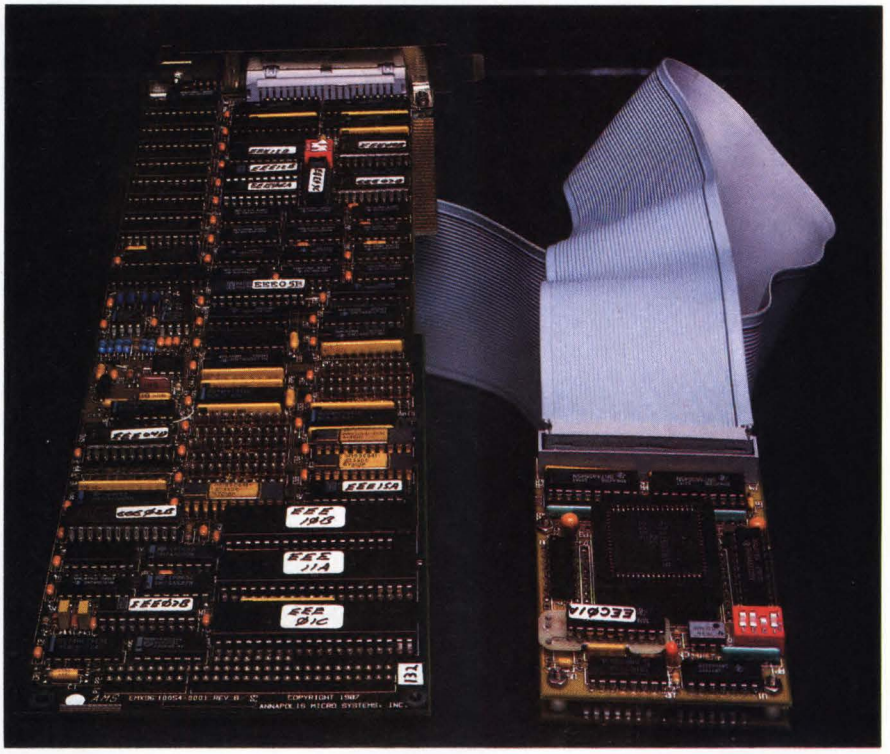
If an emulator helps you get your product into production weeks or months sooner, it's probably worth its weight in gold.

need some sort of debugging tool to support your efforts. Because many products that employ μCs as control processors lack an appropriate user interface for debugging, you must either design, build, and debug such an interface—which is not an optimal use of development time since the interface probably won't be used after the product goes into production—or use an in-circuit emulator specifically designed for the task. If an emulator can help you decrease your production time by weeks or months, it's worth its weight in gold. μC emulators also give you the time-saving advantages of proven operation and ready availability.

A μC ICE must be flexible enough to accommodate the variable nature of the μC's I/O pins and capable enough to determine just what is happening inside the chip. ICE vendors use a variety of techniques, including features developed for μP ICEs such as trace and performance analysis, to accomplish these feats. The emulation techniques used to build a μC emulator determine how accurate the emulation will be and how much the emulator will cost. You must decide how accurate an emulation you need and how much you are willing to spend.

Several μC ICE products are listed in **Tables 1** through **4**. Note the wide range of prices. In general, the prices correlate with the emulation accuracy of the ICE and its amount of installed emulation memory. In addition, almost all μC emulators are based on the IBM PC or a compatible computer. Many of these emulators take advantage of advanced user interfacing techniques for PCs such as windowing, pull-down menus, and on-line help screens such as those used for

In-circuit emulator with associated emulation pods (American Automation)



Bus-based in-circuit emulator (Annapolis Micro Systems Inc)

business applications. If you don't already own a PC, you'll need to add its purchase price to the cost of the emulator. Since most μC software-development tools such as assemblers and compilers run on PCs, you probably already have one for your product.

You must balance an emulator's total cost against its limitations. Some limitations to watch out for include emulation speed, the loss of address space to the emulator's code, loss of the use of one or more interrupt vectors, loss of the use of an interrupt pin, loss of interrupt service after reaching a break point, loss of I/O ports, unsupported μC operating modes, and unsupported μC instructions. These limitations aren't always listed on the emulator's spec sheet, so you should ask about them before making a purchase.

Watch out for cable noise and loss

Another possible limitation that usually will not appear on the emulator's spec sheet involves the emulation cable that links the emulator to your target hardware. This cable generally must be short so that it will not degrade the I/O signals between the emulator and the target. You should also beware of grounding problems that might be caused by a high-impedance emulation cable.

Many emulator vendors provide additional ground paths to link the emulator to the target hardware to avoid noise problems. A noisy link between emulator and target can cause problems by generating phantom bugs, which are nothing more than artifacts caused by the emulator and its cable. If the μC you're emulating incorporates an A/D converter, grounding is even more critical because a high-impedance ground line between the emulator and the target hardware can offset A/D-converter readings and, in extreme cases, make the emulator useless as a debugging tool for your converter code.

At the low-cost end of the spectrum, software plays a major role in the emulation. The dICE-51 emulator μC from Cybernetic Micro Systems is an excellent example of the tradeoffs that can be made between emulation accuracy and price. The dICE-51 combines the company's software-based 8051 μC simulator and a preprogrammed 8051 μC called a CY-8051. (For a discussion of μC software simulators, see **box**, "Software simulation mimics hardware.") The 8051 simulation program resides in the PC and executes your 8051 μC application code; the CY-8051 plugs into the 8051 socket in your target hardware.

When the dICE-51 simulation program executes an I/O instruction, it sends a command to the CY-8051 μC over a serial link. The CY-8051 executes the I/O

In single-chip mode, the μC reveals little about the software it is executing, making in-circuit emulation, software development, and debugging difficult.

commands sent by the software simulator, thus allowing the simulator to communicate with your target hardware. Because the CY-8051 allows the 8051 simulator to interact with real hardware, the accuracy of the simulation improves substantially. However, the dICE-51 software simulator running on the PC is merely interpreting the 8051 code; your 8051 software will not run in real time (full speed). In fact, the speed of your PC determines the execution speed of the simulation. The dICE-51 manual states that your software will run at 1% or less of the full 8051 speed.

Extensive use of software in the design of the dICE-51 simulation creates other limitations as well. For example, you can only use the lower 48k bytes of the 64k-byte code space supported by the 8051. In addition, the serial link between the PC and the CY-8051 consumes the μC's serial port. As a result, the CY-8051's serial I/O hardware is not available for application-related duties. Instead, the dICE-51 simulates the serial port's operation with software. These limitations are reflected in the dICE-51's relatively low price.

If you need full-speed emulation to verify your code, often a necessity for embedded-system designs, software simulation will not fill the bill. You need a more accurate emulator. Recognizing that many product developers need full-speed emulation, Cybernetic Micro Systems' d^2ICE-51 uses a different, and more expensive, emulation approach to provide that capability. The d^2ICE-51 employs an 8051-compatible DS5000 μC from Dallas Semiconductor to emulate an 8051 μC. The DS5000 μC is a hybrid device that incorporates a processor, 32k bytes of static RAM, and a battery to

Software simulation mimics hardware

Software simulators allow you to test your μC code on a PC-based software simulation of the μC before the target hardware becomes available. You can use a software simulator to help you develop μC code in several ways. The first and most obvious use of a simulator is to prove the operation of a software algorithm you're planning to use in the final product. You can also use the simulator to test alternative algorithms and determine which approach works best for a particular μC's architecture and instruction set.

Simulators also allow you to exercise your software with a variety of stimulus data, using inputs that might not be easy to generate when working with prototype hardware. Further, if you have several programmers working on the project, software simulators can prevent the inevitable battle over who gets to use the target hardware and the in-circuit emulator. Because software simulators cost less than in-circuit emulators, you may be able to provide one to each programmer and save the emulator for the final system integration or particularly nasty software bugs.

When selecting a software simulator, you should be concerned with the development tools supported by the simulator. You'll need to feed the object files generated by your cross assembler and cross compiler to the simulator, so be sure to find out what object-file formats the simulator supports. Because you can use a software simulator to single-step your code and examine your system's simulated registers and memory, you'll also want to know what symbolic formats the simulator supports.

Several vendors offer software simulators for a few μCs. The SimCASE-8051 ($895) from Archimedes Software (San Francisco, CA, (415) 567-4010), the SIM 8051 ($395) from Cybernetic Micro Systems, the 8051 SIMulator ($99) from HiTech Equipment Corp (San Diego, CA, (619-566-1892), the SIM51 ($200) and the SIM52 ($250) from Lear Com Co (Lakewood, CO, (303) 232-2226), and the Sim51 ($250) from Logical Systems Corp (Syracuse, NY, (315) 478-0722) are all software simulators for Intel's 8051 μC. In addition, Archimedes offers the SimI/O-8051 ($495), an add-on package for the company's simulator that allows you to define complex stimulus vectors using the C programming language. Lear Com Co also offers the SIM96 ($300); Cybernetic Micro Systems also markets the SIM 8096 ($595) for Intel's 8096 μC and Waferscale Integration Inc (Fremont, CA, (415) 656-5400) offers a software simulator for its PAC1000 μC as part of the $3595 PAC-SDT-Silver development kit. All of these products run on an IBM PC or compatible computer.

maintain the RAM's contents. Dallas Semiconductor markets a version of the d²ICE-51 for DS5000 emulation.

The d²ICE-51 software downloads your 8051 code into the DS5000, where it is executed in real time. During single-step operation, a second μC in the d²ICE-51 takes over the control of the I/O lines from the DS5000 and operates in a manner resembling the

TABLE 1—REPRESENTATIVE IN-CIRCUIT EMULATORS FOR THE EXTENDED 8051 μC FAMILY

MANUFACTURER	MODEL NUMBER	μCs SUPPORTED	EMULATION RAM (BYTES)	PC LINK	PRICE	TRACE BUFFER	TRACE BUFFER SIZE (WORDS)	COMMENTS
ADVANCED MICRO-COMPUTER SYSTEMS	PRO-32	8031, 8032, 8051, 8052, 8053	8k–64k	PC BUS	$495–$695	YES	1.5k	
ADVANCED MICRO SOLUTIONS	AMS 51	8051	32k	SERIAL	$1595	NO		
AMERICAN AUTOMATION	AA572	SEE COMMENTS	64k	SERIAL	$3950	OPTIONAL	4k	SUPPORTS 42 MEMBERS OF THE 8051 FAMILY THROUGH ADAPTERS COSTING $2795–$4495.
APPLIED MICROSYSTEMS	EC 7000/8051	8031, 8032, 8051, 8052	128k	SERIAL	$3500	YES	4k	
CYBERNETIC MICRO SYSTEMS	dICE-51 d²ICE-51	8051 8031, 8051	N/A 4k–28k	SERIAL SERIAL	$495 $995–$1250	NO NO		SOFTWARE EMULATION.
HUNTSVILLE MICRO-SYSTEMS	HMI-200-8051	8031, 8032, 8051, 8052, 8053, 80C59, 80C154	128k	SERIAL	$4995	YES	4k (2)	SUPPORTS OTHER 8051 FAMILY MEMBERS THROUGH OPTIONAL ADAPTERS.
INTEL	ICE-5100/252	8031, 8032, 8051, 8052	64k	SERIAL	$4995	NO		
KONTRON	SE 8031	8031, 8032	48k	SERIAL	$5095	NO		EXPANDED-MODE μCs ONLY.
METALINK	MC-8344	8344	32k	SERIAL	$1895	YES	2k	
	MC-80154	8031, 8032, 80C154	32k	SERIAL	$1895	YES	2k	
	MC-80252	8031, 8032, 80C252	32k	SERIAL	$1895	YES	2k	
	MC-8052	8031, 8032, 8051, 8052, 8053, 80C154	32k	SERIAL	$2895	YES	2k	
	MC-80521	8031, 8051, 8053, 80C321, 80C521	128k	SERIAL	$3495	YES	2k	
	MI-80C451	80C451	128k	SERIAL	$3495	YES	4k	
	MI-83C451	83C451	128k	SERIAL	$4995	YES	4k	
	MI-80C452	80C452	128k	SERIAL	$3695	YES	4k	
	MI-80512	80512, 80532	128k	SERIAL	$4995	YES	4k	
	MI-80515	80515, 80535	128k	SERIAL	$4995	YES	4k	
	MI-80532	80532	128k	SERIAL	$3495	YES	4k	
	MI-80535	80535	128k	SERIAL	$3495	YES	4k	
	MI-80C652	80C652	128k	SERIAL	$3495	YES	4k	
	MI-83C751	83C751	2k	SERIAL	$3995	YES	4k	
NOHAU	EMUL51-PC	SEE COMMENTS	32k–128k	PC BUS	$1495–$1915	OPTIONAL	4k–16k	SUPPORTS SEVERAL 8051 FAMILY MEMBERS WITH POD BOARDS THAT COST $295–$995.
	EMUL31-PC	SEE COMMENTS	32k–128k	PC BUS	$1495–$1915	OPTIONAL	4k–16k	SUPPORTS SEVERAL 8051 FAMILY MEMBERS WITH POD BOARDS THAT COST $295–$595.
ORION INSTRUMENTS	UNILAB	8051, 8052	32k–128k	SERIAL	$3940–$5930	YES	170-2730	SUPPORTS OTHER 8051 FAMILY MEMBERS THROUGH OTHER PPAK ADAPTERS THAT COST $600–$1500.
SIGNUM SYSTEMS	E232-52	8031, 8032, 8051, 8052, 80C154	64k	SERIAL	$3795	YES	2036	
	E232-152	80C152A/B/C/D	64k	SERIAL	$4950	YES	2036	
	E232-515/35	80512, 80515, 80535	64k	SERIAL	$4950	YES	2036	
SOPHIA SYSTEMS	SA98-8051	8031, 8051	64k	PC BUS	$7800	YES	2k	
ZILTEK	ICE-ENGINE	8031, 8032, 8051, 8052	64k	SERIAL	$5095	YES	2k	INCLUDES ICE-ENGINE/BX-8 AND ICE POD 8051.

NOTE: N/A=NOT APPLICABLE.

Bus-based emulators download code to the target system at several hundred-thousand bytes/sec; emulators that use a serial link transfer a few thousand bytes/sec.

operation of the dICE-51. You can set break points in your code that tell the d²ICE-51 when to switch between the DS5000 and the 8051. The break point replaces three bytes of your application code with breakpoint code, so you must be careful where you set break points. If you overlay an 8051 instruction that does not occupy three bytes, you may have problems when resuming program execution after the break point occurs, because the instruction following the break point has been overlayed with one or two bytes of breakpoint code. The d²ICE-51 manual provides suggestions for preventing this problem, but this limitation further illustrates the tradeoffs between software emulation techniques and emulation accuracy.

In addition, the DS5000 has only 32k bytes of code RAM; the emulation software uses the lowest 4k bytes, leaving only 28k bytes for your application code. Thus, you cannot use the d²ICE-51 to debug large 8051 programs. You must also move your interrupt vectors while using the emulator because the 8051's interrupt vectors are in the lower 4k-byte address space consumed by the emulator. The d²ICE-51 replaces the real interrupt vectors with a block of "pseudo" interrupt vectors starting at hexadecimal location 1000, which you use instead of the real vector addresses. These emulator limitations may or may not present major problems to your development efforts. However, the tradeoffs Cybernetic Micro Systems made in creating the d²ICE-51, which were made possible by the DS5000, are reflected in the price of the emulator.

The DS5000-8051 μC relationship is unique. Most emulator vendors rely on bond-out chips for emulating μCs. A bond-out chip is based on the corresponding μC, but the semiconductor manufacturer makes the processor's address and data buses available on additional pins. Because these bond-out chips require high-pin-count packages and are low-volume products, they cost much more than the corresponding μCs. This additional cost drives up the price of the emulator. Occasionally, the ICE vendor can find a version of the μC that is designed to accept a piggybacked EPROM. These piggyback devices work like the bond-out parts but cost much less, allowing the ICE vendor to charge less for the emulator.

With a bond-out or piggyback part used for the emulation, ICE vendors can apply the full range of μP emulation techniques to μCs. The emulator can run at full speed because the code is running on a real μC, not a software simulation. I/O transactions take place at full speed during the emulation because the bond-out and piggyback devices do not sacrifice I/O pins to make the address and data buses accessible. Yet the prices of emulators based on piggyback and bond-out parts still vary substantially, based on the product-design

TABLE 2—REPRESENTATIVE IN-CIRCUIT EMULATORS FOR THE 68HC11 μC FAMILY

MANUFACTURER	MODEL NUMBER	μCs SUPPORTED	EMULATION RAM (BYTES)	PC LINK	PRICE	TRACE BUFFER	TRACE BUFFER SIZE (WORDS)	COMMENTS
AMERICAN AUTOMATION	AA572-68HC11	68HC11A2/A8	64k	SERIAL	$8445	OPTIONAL	4k	INCLUDES AA547 DEVELOPMENT STATION.
APPLIED MICROSYSTEMS	EC7000/68HC11	68HC11	64k	SERIAL	$9600	YES	1k	
HUNTSVILLE MICROSYSTEMS	HMI-200-68HC11	68HC11	64k	SERIAL	$4995	YES	4k (2)	68HC11F1 SUPPORTED BY A $395 ADAPTER.
KONTRON	KSC 6811	68HC11	64k	SERIAL	$9195	OPTIONAL	16k	
ORION INSTRUMENTS	UNILAB	68HC11	32k–128k	SERIAL	$3540–$5530	YES	170–2730	
PENTICA SYSTEMS	MIME-600	68HC11	64k	SERIAL	$9353	YES	8k	
SOPHIA SYSTEMS	SA98-68HC11	68HC11	64k	PC BUS	$7800	YES	2k	
ZILTEK	ICE-ENGINE	68HC11	64k	SERIAL	$6295	YES	2k	INCLUDES ICE-ENGINE/BX-8 AND ICE POD 68HC11.

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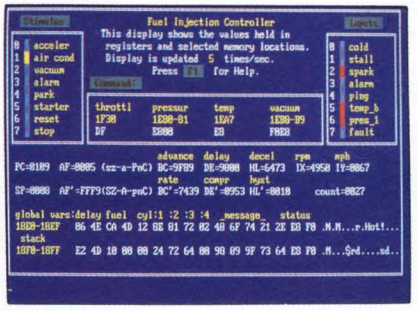

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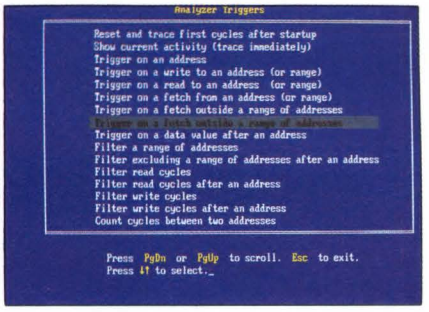

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CIRCLE NO 55

Some emulators have performance analysis options that use the trace buffer to identify code bottlenecks.

approach taken by the ICE vendor, the amount of emulation memory built into the emulator, the speed of that emulation memory, and the trace features of the product. Once again, you must decide which features you will need and which you can't afford.

Bus-based emulators download faster

You can divide μC ICE product design approaches into two fundamental philosophies: bus-based and serial. Though all of the emulators listed in the **tables** rely on a PC (a few work with other host computers as well), some emulators are designed to plug into the PC's expansion bus and some are designed as separate units that communicate with the PC over a serial link. Card-based emulators that plug directly into the PC's bus generally cost less than the emulators that communicate serially with the PC because you don't pay for an additional case or power supply. Furthermore, bus-based emulators can download code to the target hardware at several hundred thousand bytes/sec, while emulators that use the relatively slow serial link are limited to a few thousand bytes/sec. That serial link can become a very real and irritating bottleneck for downloading large programs, especially when you are in the throes of debugging.

However, bus-based emulators force you to keep your target hardware near your PC. The PC bus' signal-speed limitations and the μC's I/O signals restrict emulation cables to a few feet at best. The separately packaged, serially linked emulators allow you to put the emulator close to the target hardware while keeping the PC (and you) separated from the target by a safe distance. This feature may be important if you are developing code for large, μC-controlled mechanical products such as industrial robots or jet engines. In addition, you can easily move an externally packaged emulator from one PC to another or even use a switch to connect two PCs to one emulator. If you want to move a bus-based ICE, you'll have to open your PC to extract the emulator board (or boards).

Another differentiating factor among μC emulators is the emulation memory and its corresponding cost. Some vendors offer their emulators with the maximum amount of emulation memory that can be addressed by the emulated μC. Other vendors choose to lower the price of their entry-level products by putting some fraction of the maximum possible emulation memory in the emulator and offering memory expansion kits as an option. If you aren't planning to write large application programs, you can save money by purchasing an emulator with less emulation memory; however, you should remember to account for any differences

TABLE 3—REPRESENTATIVE IN-CIRCUIT EMULATORS FOR THE 8096 μC FAMILY

MANUFACTURER	MODEL NUMBER	μCs SUPPORTED	EMULATION RAM (BYTES)	PC LINK	PRICE	TRACE BUFFER	TRACE BUFFER SIZE (WORDS)	COMMENTS
AMERICAN AUTOMATION	AA572-8096	8096, 8097, 8096BH, 8097BH	64k	SERIAL	$8945	OPTIONAL	4k	INCLUDES AA547 DEVELOPMENT STATION.
	AA572-80196	80196	64k	SERIAL	$8945	OPTIONAL	4k	INCLUDES AA547 DEVELOPMENT STATION.
ANNAPOLIS MICRO SYSTEMS	EMX96TV	8096, 80196, 80C196	64k	PC BUS	$3130	NO		
HEWLETT-PACKARD	64771A	80C196-KA	64k	SERIAL	$13,450	YES	1k	
HUNTSVILLE MICROSYSTEMS	HMI-200-8096	8095BH, 8096BH, 8097BH, 8098, 80196, 80197	64k	SERIAL	$4995	YES	4k (2)	
INTEL	ICE-196KB/HX	8XC196KB	128k	SERIAL	$13,500	YES	2k	
	ICE-196KB/MX	8XC196KB	64k	SERIAL	$10,500	YES	2k	
	ICE-196KB/PC	80C196KB	64k	PC BUS	$3000	YES	2k	
	VLSICE-96P	8096 FAMILY	64k	SERIAL	$8995	YES	4k	
ORION INSTRUMENTS	UNILAB	8096BH, 8097BH, 80C196	32k–128k	SERIAL	$3840–$5830	YES	170–2730	

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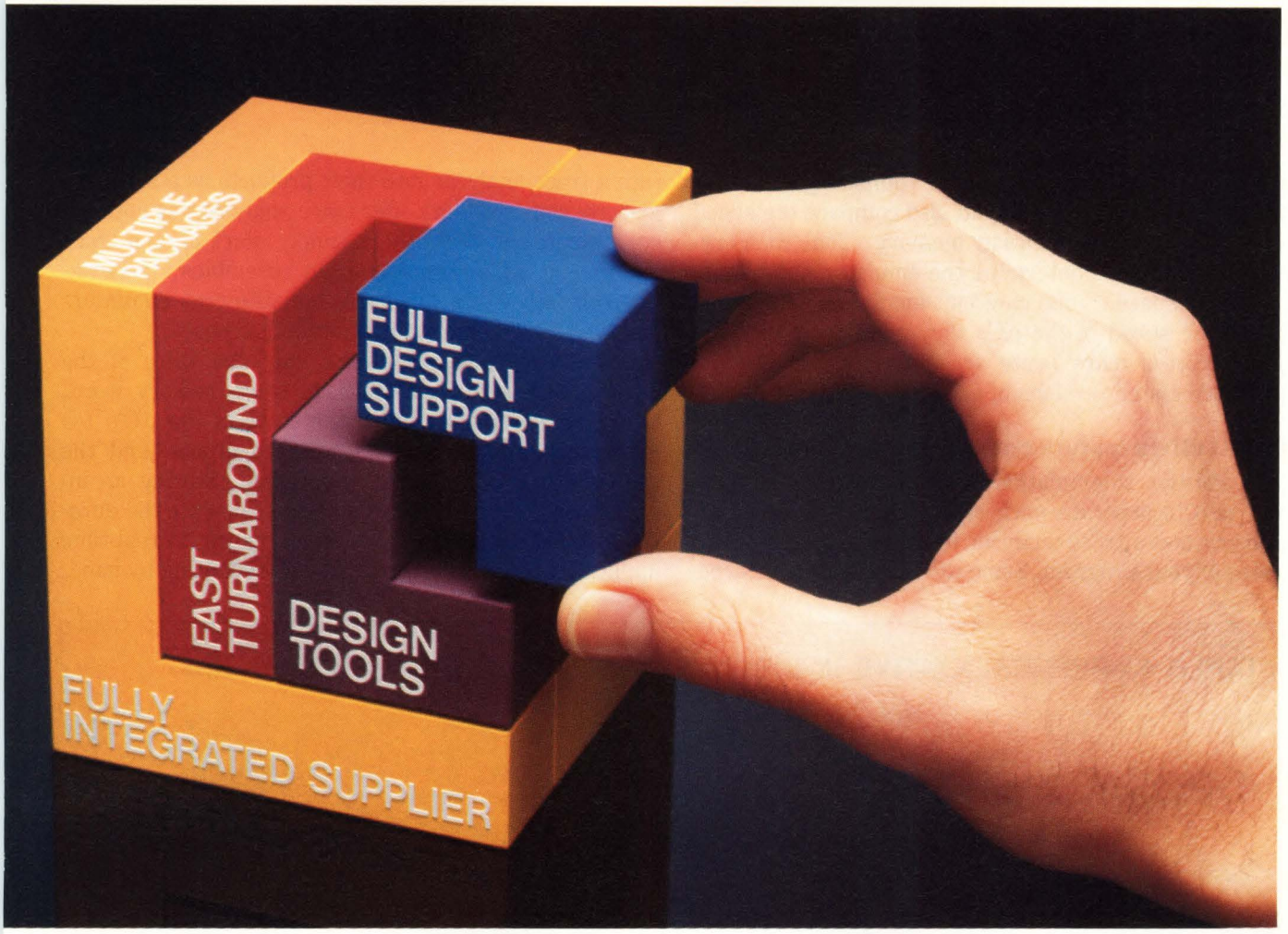

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[1] SPICE developed by University of California

CIRCLE NO 56

Some in-circuit emulators cannot run at the full speed of the μCs they emulate.

in emulation-memory size when comparing emulator prices. In addition, you should also compare the speed of the emulator's emulation memory. That memory-speed rating helps determine the emulator's maximum emulation speed. Some in-circuit emulators cannot run at the full speed of the μCs they emulate, a problem that becomes more acute as semiconductor vendors introduce faster versions of existing μCs.

Trace buffers capture critical events

In addition to emulation memory, many μC emulators also incorporate various amounts of trace-buffer memory and a trace analyzer to capture the execution states of your program. Some μC ICE vendors incorporate a trace analyzer into their products as a standard feature; some vendors offer trace analyzers as optional equipment; and still others simply don't offer a trace analyzer at all. A trace analyzer resembles a general-purpose logic-state analyzer, but different emulators use the trace memory for different purposes.

Some trace analyzers store only the state of the address and data buses in each trace-memory word. Other emulators also store the state of the μC's I/O lines, the states of general-purpose inputs, and the time that the trace word was stored. Storing an instruction's execution time helps you calculate the duration of your code's critical sections, which, in real-time applications, can help you avoid cycle counting by hand.

TABLE 4—REPRESENTATIVE IN-CIRCUIT EMULATORS FOR ASSORTED μCs

MANUFACTURER	MODEL NUMBER	μCs SUPPORTED	EMULATION RAM (BYTES)	PC LINK	PRICE	TRACE BUFFER	TRACE BUFFER SIZE (WORDS)	COMMENTS
AMERICAN AUTOMATION	AA547	SEE COMMENTS	64k	SERIAL	$3950	OPTIONAL	4k	THE AA547 SUPPORTS SEVERAL μCs USING ADAPTERS THAT COST $2495–$6500.
HEWLETT-PACKARD	64735A 64786A 64787A	647180 32020 320C25	126k 128k 128k	SERIAL SERIAL SERIAL	$12,040 $13,550 $14,200	YES YES YES	1k 1k 1k	
MACROCHIP RESEARCH	320C10/15 320C14 320C25 TMS370	320C10, 320C15 320C14 320C25 TMS370 FAMILY	8k 8k 32k 16k	SERIAL SERIAL SERIAL SERIAL	$1795 $2495 $2495 $2995	NO NO NO NO		WORKS WITH IBM PC, APPLE MACINTOSH, OR DEC VAX COMPUTERS. WORKS WITH IBM PC, APPLE MACINTOSH, OR DEC VAX COMPUTERS. WORKS WITH IBM PC, APPLE MACINTOSH, OR DEC VAX COMPUTERS. WORKS WITH IBM PC, APPLE MACINTOSH, OR DEC VAX COMPUTERS.
NATIONAL SEMICONDUCTOR	MOLE MOLE MOLE	COP400 FAMILY COP800 FAMILY HPC FAMILY	2k 16k 16k	SERIAL SERIAL SERIAL	$3760 $4995 $4930	YES YES YES	256 2000 2000	INCLUDES ASSEMBLER. INCLUDES ASSEMBLER. ASSEMBLER ($495) AND C COMPILER ($790).
ORION INSTRUMENTS	UNILAB	SEE COMMENTS	32k–128k	SERIAL	$2990–$4980	YES	170–2730	THE UNILAB SUPPORTS A LARGE NUMBER OF μCs WITH OPTIONAL PPAK ADAPTERS THAT COST $600–$1500.
SIGNUM SYSTEMS	E232-DSP17 E232-S8	320C17, 320E17 SUPER8	16k 128k	SERIAL SERIAL	$6900 $5200	YES YES	32k 32k	
SOFTAID	647180X	647180	80k	SERIAL	$5995	YES	1k	
SOPHIA SYSTEMS	SA98-6301 SA98-6305 SA98-7807/09 SA98-7810/11 SA98-78310/312 SA98-SUPER8 SA98-Z8	6301, 6303 6305 7807, 7808, 7809 7810, 7811 78310, 78312 SUPER8 FAMILY Z8 FAMILY	64k 64k 64k 64k 64k 64k 64k	PC BUS PC BUS PC BUS PC BUS PC BUS PC BUS PC BUS	$7800 $9300 $7800 $7800 $8300 $9300 $9300	YES YES YES YES YES YES YES	2k 2k 2k 2k 2k 2k 2k	
TEXAS INSTRUMENTS	XDS/22	TMS370 FAMILY	64k	SERIAL	$8250	YES	2k	
THORSON ENGINEERING	MICROAID/HC05	68HC05	8k	SERIAL	$2100	YES	2k	
ZAX	ERX ERX	6301 6801	128k 128k	PC BUS PC BUS	$5995 $5995	YES YES	4k 4k	
ZILTEK	ICE ENGINE	6301	64k	SERIAL	$5595	YES	2k	INCLUDES ICE-ENGINE/BX-8 AND ICE POD 6301.

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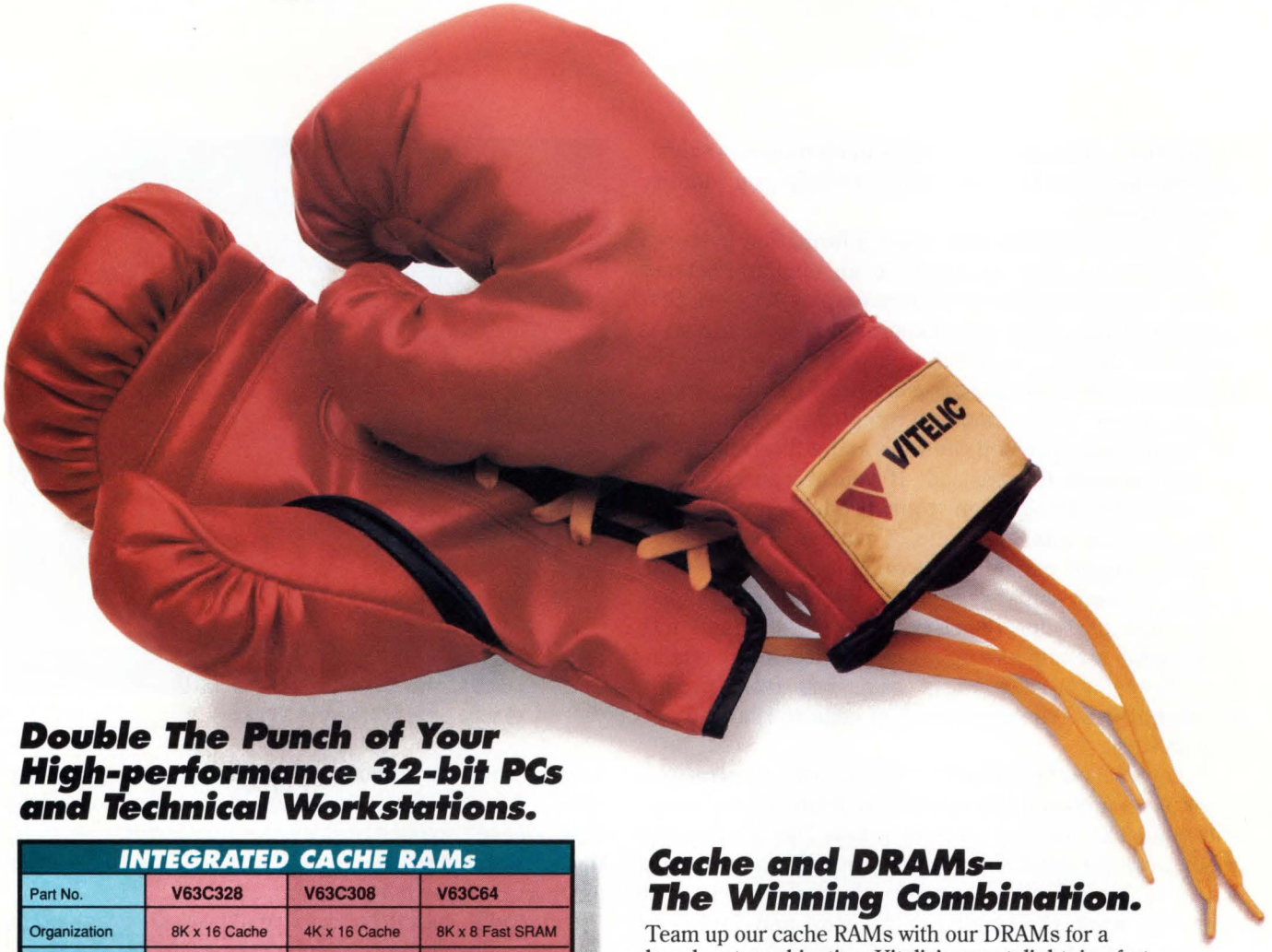

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Imagine a μC-based controller running an internal-combustion engine at 3000 rpm and suddenly halting the processor when the emulator hits a break point.

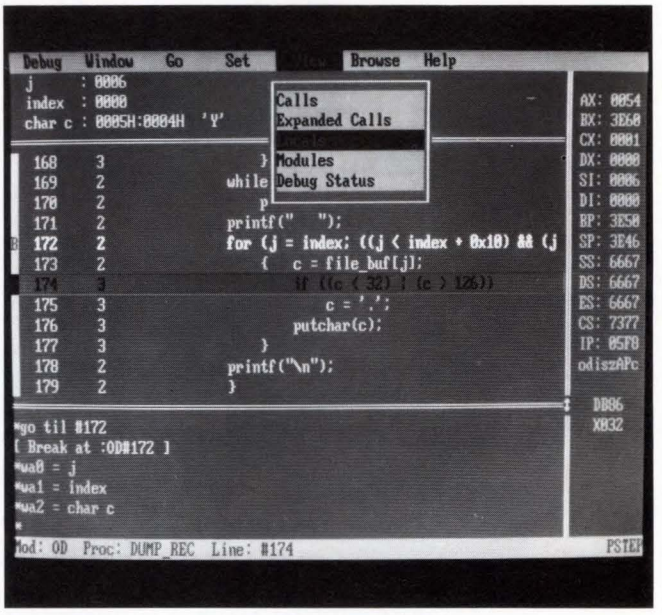
In addition, some emulators have performance-analysis options that use the trace buffer to help you identify code bottlenecks.

You should consider how trace information is stored in addition to what is stored in an emulator's trace buffer. Emulator trace analyzers employ triggers that resemble those built into general-purpose logic-state analyzers. Again, you will find a wide variation in the ability to define the trigger conditions ranging from a single, simple trigger word to complex, multilevel trigger sequences with loop counters and a filtered display of the captured information. If you are purchasing a μC emulator to shorten your product-development time, you will want to carefully evaluate the utility of complex-trigger capabilities available with some emulators. If your software is intricate and you suspect that some particularly nasty bugs might crawl into your code, a complex-trigger capability in an emulator's trace analyzer might save you from paging through several thousand lines of code to find the elusive critters.

A key reason to buy an emulator with a trace analyzer is to prevent the emulation from halting when the emulator reaches a break point. Not all development projects need this feature, but if you are using a μC to control some ongoing physical process, you may not want the emulation to stop and leave the process without processor control. Imagine a μC-based controller running an internal-combustion engine at 3000 rpm and suddenly halting the processor when the emulator hits a break point. The result would probably be quite spectacular. Emulators that lack trace buffers halt and switch to single-step mode when they reach a break point. Because the trace analyzer is monitoring, rather than controlling, the emulation, it can halt when a trigger occurs without halting the emulation.

Don't make assumptions about trace analysis

However, the incorporation of a trace buffer into an emulator does not guarantee that the emulator won't halt when a break point is reached. For example, Intel's ICE-196KB/HX and ICE-196KB/MX emulators both have 2k-word trace buffers; the higher-priced HX model allows you to view the trace buffer without stopping the emulation; the MX model does not. The HX version also incorporates additional trace-related features such as an event timer, conditional trace capability, and a "fastbreak" facility that provides you with access to program-variable values while the emulation is running. Therefore, don't assume that a trace buffer



Windowed debugging screen with pull-down menus (Intel Corp)

ensures that the emulation will continue automatically after a break point is reached. If the emulator's data sheet doesn't explicitly state the relationship between the emulator and the trace analyzer, ask the vendor for more specific information.

Debugging based on trace analysis and break-point activities allows you to examine the registers and memory of the μC. When μC programs were small and all coding was done in assembly language, it was possible (though not particularly convenient) to use the absolute hexadecimal addresses of your program variables during the debugging process. Now that embedded programs have become large enough to bump into the typical μC's 64k-code ceiling and are coded in high-level languages such as C, symbolic debugging using variable names instead of absolute addresses is either required or at least very desirable.

Most μC ICE vendors provide symbolic debugging capabilities for at least some assemblers and compilers available for the emulated μC. Some emulators allow you to single-step your program with either assembly-language or high-level-language line granularity. If you already have a specific cross assembler or cross compiler, you'll want to find out if the μC ICE vendor supports the software development products you're using. Some μC emulator vendors, such as American Automation and Intel, offer their own assemblers and compilers, so you can be fairly confident that the software tools and emulator from the same vendor will

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Don't assume that a trace buffer ensures that the emulation will continue automatically after a break point is reached.

work together smoothly. Most emulator data sheets mention something about the product's software compatibility.

Data-sheet specifications can help you narrow your emulator selections to a few good candidates, but many of the issues and pitfalls you'll encounter when using μC emulators don't appear on the spec sheets. It's always safer to ask about an emulator's limitations than to assume the answers to your questions. If you make the right choice, a μC in-circuit emulator is bound to save you precious time during software development and system integration. The wrong choice may cost you more time, in terms of debugging emulator-induced problems, than you gained by using the in-circuit emulator in the first place. EDN

Article Interest Quotient (Circle One)
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For more information . . .

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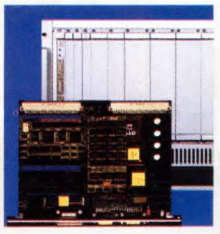

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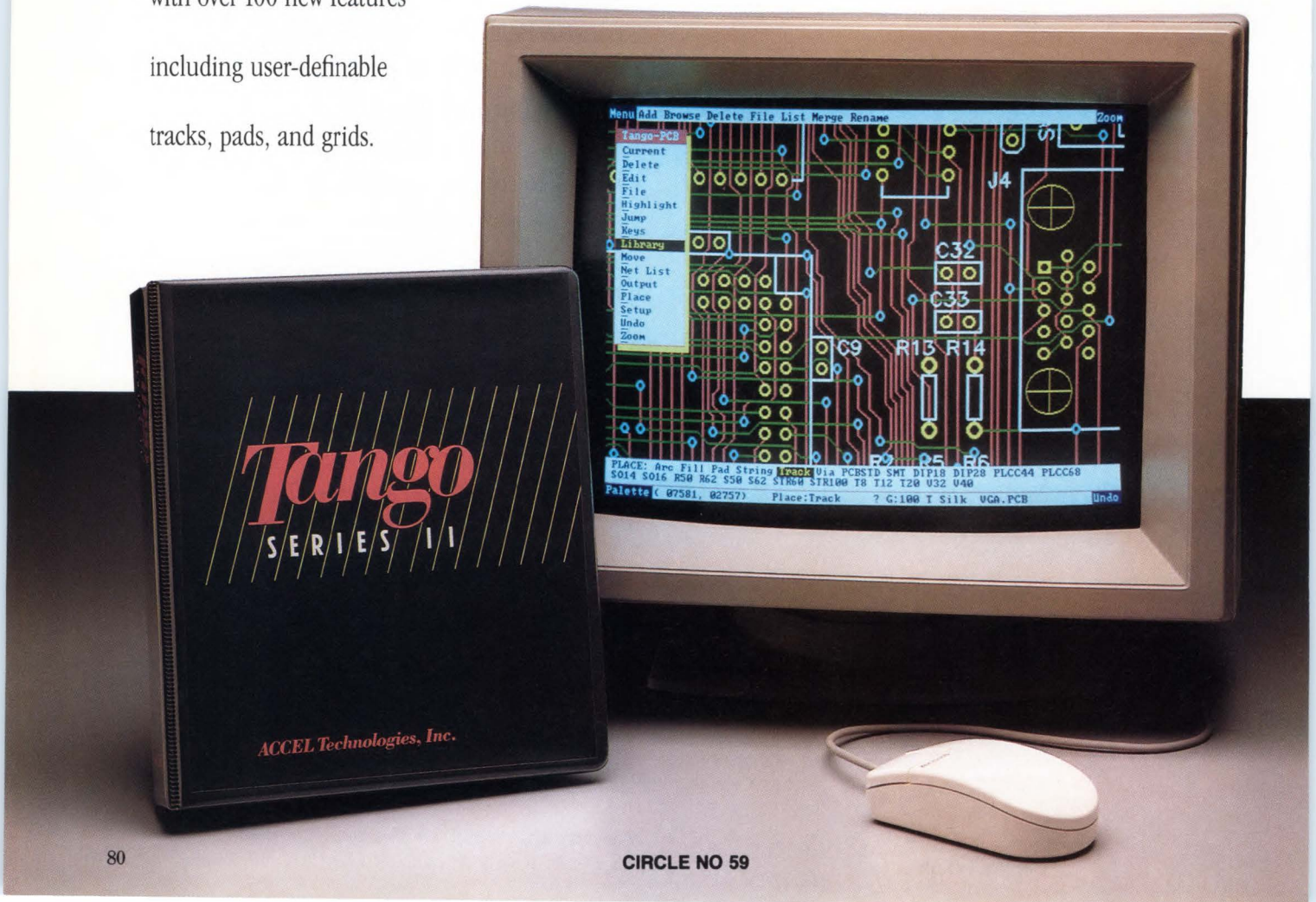

CIRCLE NO 59

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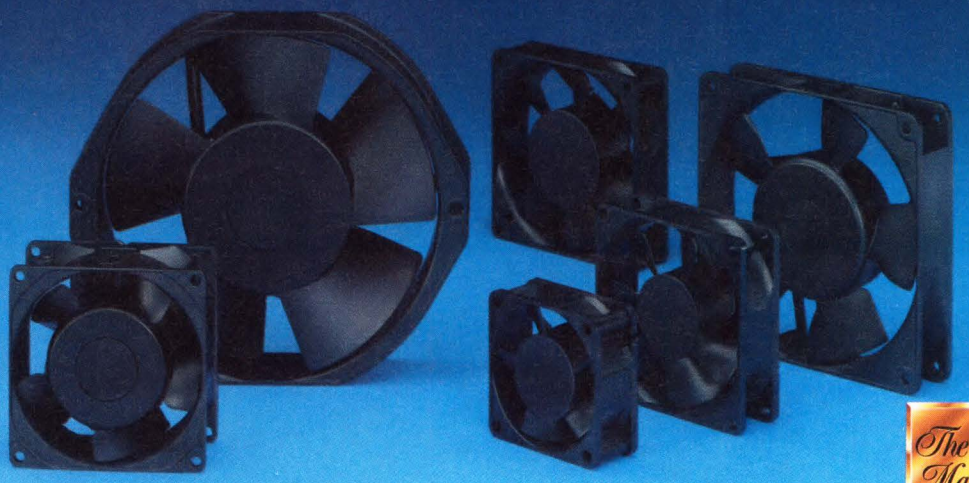

The Marks of Excellence™

FOR LOW NOISE AND LONG LIFE

Quiet. That's the first thing you notice about Boxer cooling fans. They're so quiet you can scarcely hear them. But they do the job they're designed for. Efficiently. Reliably. And they go on doing it. Without problems. Year after year after year. They're ideal for microcomputers, printers, facsimile machines and such equipment.

Now you can get the full line of Boxer low noise axial cooling fans from NMB Technologies. AC and DC fans. More than 100 models. All popular sizes and capacities from 9 to 215 CFM. Some with speed sensors. Approved by UL, CSA, and VDE.

Progress at NMB never stops. We saw a market need, so we've just introduced a new N/L series of 12V and 24V DC fans with even lower noise levels. 28 models are available, with noise levels as low as 20dBA. Now, that's quiet!

Boxer fans owe their reliable quality to the NMB commitment to vertical integration. All components are made in-house, including the precision bearings, so we can keep tight quality control. And our own automated, high-volume production capabilities make them extremely price competitive.

Boxer. One of the industry's true Marks of Excellence for superior performance and customer satisfaction. Now from NMB Technologies. Call or write today for our new brochure.

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Boxer Fan Division
9730 Independence Avenue • Chatsworth, CA 91311
Telephone: 818.341.3355 • FAX: 818.341.8207 • TLX: 651340

CIRCLE NO 60

FULL SPE

For the name of your nearest distributor in Europe, call 44-296-625462. Or contact Applied Microsystems Corporation Ltd., Chiltern Court, High Street, Wendover, Aylesbury, Bucks HP22 6EP, United Kingdom. **In Japan, call 03-493-0770.** Or contact Applied Microsystems Japan Ltd., Nihon Seimei, Nishi-Gotanda Building, 7-24-5 Nishi-Gotanda, Shinagawa-KU, Tokyo T141, Japan. AMC 240

ED AHEAD.

INTRODUCING THE FIRST 33-60 MHz MICROPROCESSOR EMULATOR FOR THE 68020 AND 68030.

Put your phone in front of you and get ready. You're about to get in touch with the future of high speed microprocessor emulation.

For quite some time Applied Microsystems has been designing a radical new concept in 32-bit development. Now it's ready. The EL 3200.

It's capable of not only matching current speeds, but can efficiently expand to support faster speeds and advanced 32-bit microprocessors of the future.

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It runs at full target clock speed—33 MHz for 68020 and 68030. It fully supports 68030 cache burst and synchronous bus cycles. And, since it sits as a node right on the trunk of your Ethernet network, the EL 3200 can be accessed from any workstation.

The EL 3200 offers your choice of source level or symbolic debugging. Whether you want to work in Assembly or C, we can provide the software tools for your exact needs.

The sophisticated breakpoint system has hundreds of real-time access breakpoints, six real-time execution breakpoints and unlimited software execution breakpoints. As an option, you can have up 2MB of no wait state overlay memory that runs at full clock speed, so there are no restrictions on memory, software or interrupts. The 16K deep by 139 bit wide trace provides true 32 bit support.

Seeing is believing. For a demonstration or more information, pick up your phone.

Dial full speed ahead and ask for Telemarketing. In WA (206) 882-2000.

Applied Microsystems Corporation, P.O. Box 97002, Redmond, Washington, USA 98073-9702.

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Applied Microsystems Corporation

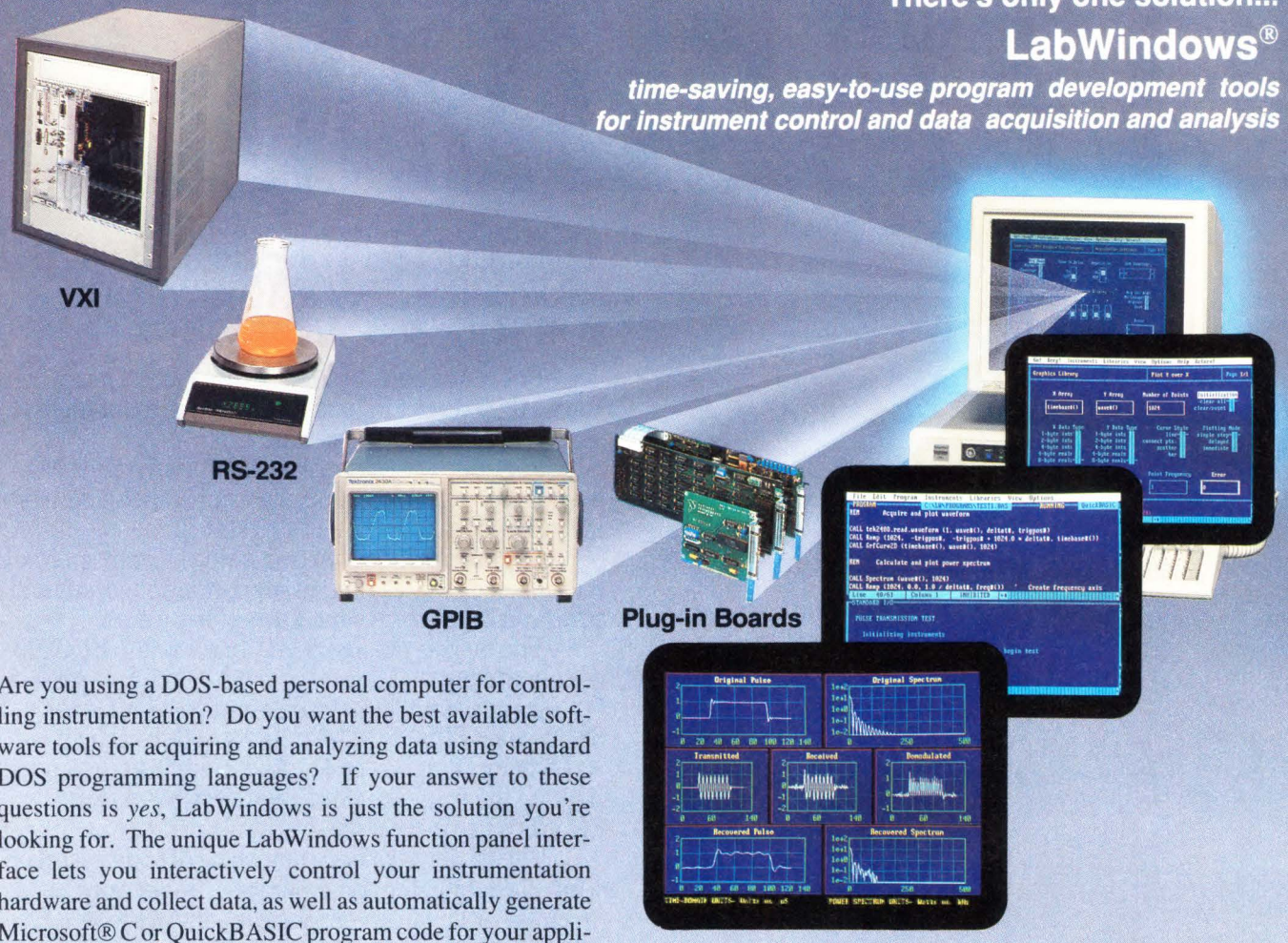
CIRCLE NO 61

DOS + QuickBASIC or C + Instrumentation Code Generation = ?

There's only one solution...

LabWindows®

time-saving, easy-to-use program development tools for instrument control and data acquisition and analysis



Are you using a DOS-based personal computer for controlling instrumentation? Do you want the best available software tools for acquiring and analyzing data using standard DOS programming languages? If your answer to these questions is *yes*, LabWindows is just the solution you're looking for. The unique LabWindows function panel interface lets you interactively control your instrumentation hardware and collect data, as well as automatically generate Microsoft® C or QuickBASIC program code for your application.

With LabWindows you can control GPIB, RS-232, or VXI instruments, or plug-in data acquisition cards for PS/2 and PC-AT computers. For standalone instrument users, the LabWindows instrument library has over 50 ready-to-use instrument drivers so you can program your instrument using intuitive instrument-specific function panels, without knowing the instrument inside-out.

Because acquiring data is only one element of your application, LabWindows has a complete set of QuickBASIC and C compatible libraries for data analysis, presentation, and storage. Manipulate arrays, create a histogram, or use the optional Advanced Analysis Library to perform operations such as Fast Fourier Transforms, digital filtering, and curve fitting. Give your programs a big performance boost using the specially optimized LabWindows analysis routines for computers with an 80387 numeric coprocessor. For your data presentation and storage needs, use the LabWindows Graphics Library to create multiplot graphs, bar charts, or scatter plots, and use the Data Formatting Library for data logging and file operations.

If you're looking for the right tools to take maximum advantage of your DOS computer using QuickBASIC or C for data acquisition and analysis, there is only one solution...LabWindows. Call National Instruments at (800) IEEE-488 to speak with a sales or applications engineer about how LabWindows can help you.

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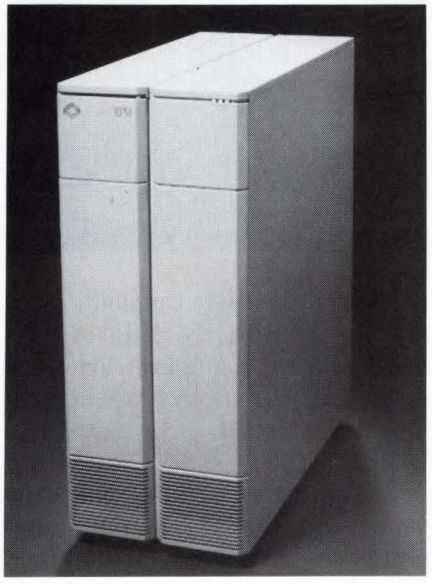
In-circuit ASIC verification tool checks designs before prototypes

The Rapid Prototype Machine (RPM) Emulation System is a real-time, in-circuit, ASIC verification tool based on Xilinx's Logic Cell Array (LCA). You can design a circuit implementation, transfer the design to the RPM hardware, plug the RPM emulator into your target system, and prove that the logic works in concert with the target system. If it doesn't work, the emulation system lets you reconfigure the LCAs to debug and correct problems.

The basic RPM configuration supports real-time emulation of designs with as many as 25,000 gates. Modular expansion permits the gate capacity to grow to 100,000 gates. Stimulus generation and logic analysis are built into the basic configuration. Interface cables and plug adapters insert into standard ASIC sockets, and optional component adapters allow the use of standard components, such as memory devices and μPs, as part of the emulation.



The RPM Emulation System consists of stand-alone emulation hardware and software. The software is made up of the emulation setup and embedded design-analysis tools. An Ethernet interface or a SCSI port connects to Daisy, Valid, and Mentor workstations and allows the workstation to control the emulation system. Prices start at $125,000.

Quickturn Systems Inc, 1023 N Shoreline Blvd, Mountain View, CA 94043. (415) 967-3300. FAX 415-967-3199.

Circle No 351

Graphics-based software simplifies linking ASIC design with test

TekWaves graphics-based software simplifies the job of generating test patterns for ASICs. In its initial release, the software runs only on Apollo workstations and supports only the vendor's LV500 ASIC-verification system. However, TekWaves already handles files generated by simulators from six firms and the vendor expects to support additional workstation types. Because the tester-hardware description files are in a format destined to become an industry standard, the vendor expects that the software will be used nearly everywhere that ASICs are designed or tested.

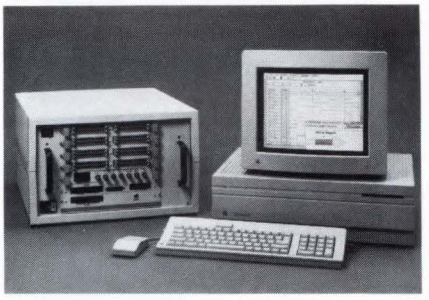
The graphics-based software displays stimulus files in either state or timing formats. You can enter and edit stimuli in both formats. You can, for example, "drag" waveform edges to alter timing and "wire" icons together to create programs without using a programming language. All files and file operations appear as icons. You use a mouse and an on-screen representation of a card file to select files and tools. Among the functions you can select in this manner are filtering to align timing cycles or to stretch or remove pulses, and checking of stimulus files to ensure that they comply with tester-hardware limitations. The software costs $5000.

Tektronix Inc, Box 12132, Beaverton, OR 97212. Phone (800) 245-2036.

Circle No 352

Macintosh-based logic analyzer samples at 1 GHz and can expand to 384 channels

The CLAS 4000 configurable logic-analysis system can have as many as 384 channels and can acquire data at 1 GHz on 64 channels. The base model of the system includes a Macintosh SE, and the higher-performance version includes a Mac II with a 13-in. color monitor. The logic analyzer and the Mac communicate via the computer's SCSI bus, allowing you to configure systems with several logic-analyzer mainframes.



Each mainframe accommodates from one to four logic-analyzer modules. Currently, there are two varieties of modules, a 200-MHz unit that accepts 96 inputs when operated at 50 MHz and a 1-GHz 16-channel unit with two levels of trace control and event recognition. You can use the modules as several independent but closely coupled instruments, or, with the help of software, you can configure them as a single analyzer. Both types of modules time-stamp data for time correlation.

The 200-MHz module, which the vendor calls the "pyramid" unit, operates in both state- and timing-analysis modes. It also has a mode that automatically captures data before and after the inputs satisfy the trigger conditions. Additionally, you don't have to move probes to continue viewing the activity on selected signal lines as the module achieves sampling rates beyond 50 MHz by multiplexing channels. Instead, the supplied software lets you specify which channels you want to view and relays within the module disconnect the signals you are willing to forego viewing. Prices for CLAS 4000 systems with one analyzer mainframe and a computer range from $19,950 to $50,270. Delivery is 90 days ARO. The vendor also offers pods and disassemblers for popular μPs.

Gould Inc, 19050 Pruneridge Ave, Cupertino, CA 95014. (800) 538-9320. TWX 910-338-0509.

Circle No 353

Bus extends VXIbus for physical instruments and multiple mainframes

The MXIbus (pronounced MIX-ee-bus) enhances the VXIbus, which, by allowing implementation of high-performance card-level instruments, in turn extends the VMEbus. The MXIbus lets you daisy-chain mainframes containing VXI instrument modules and even lets you add full-size instruments and PCs to your VXIbus system.

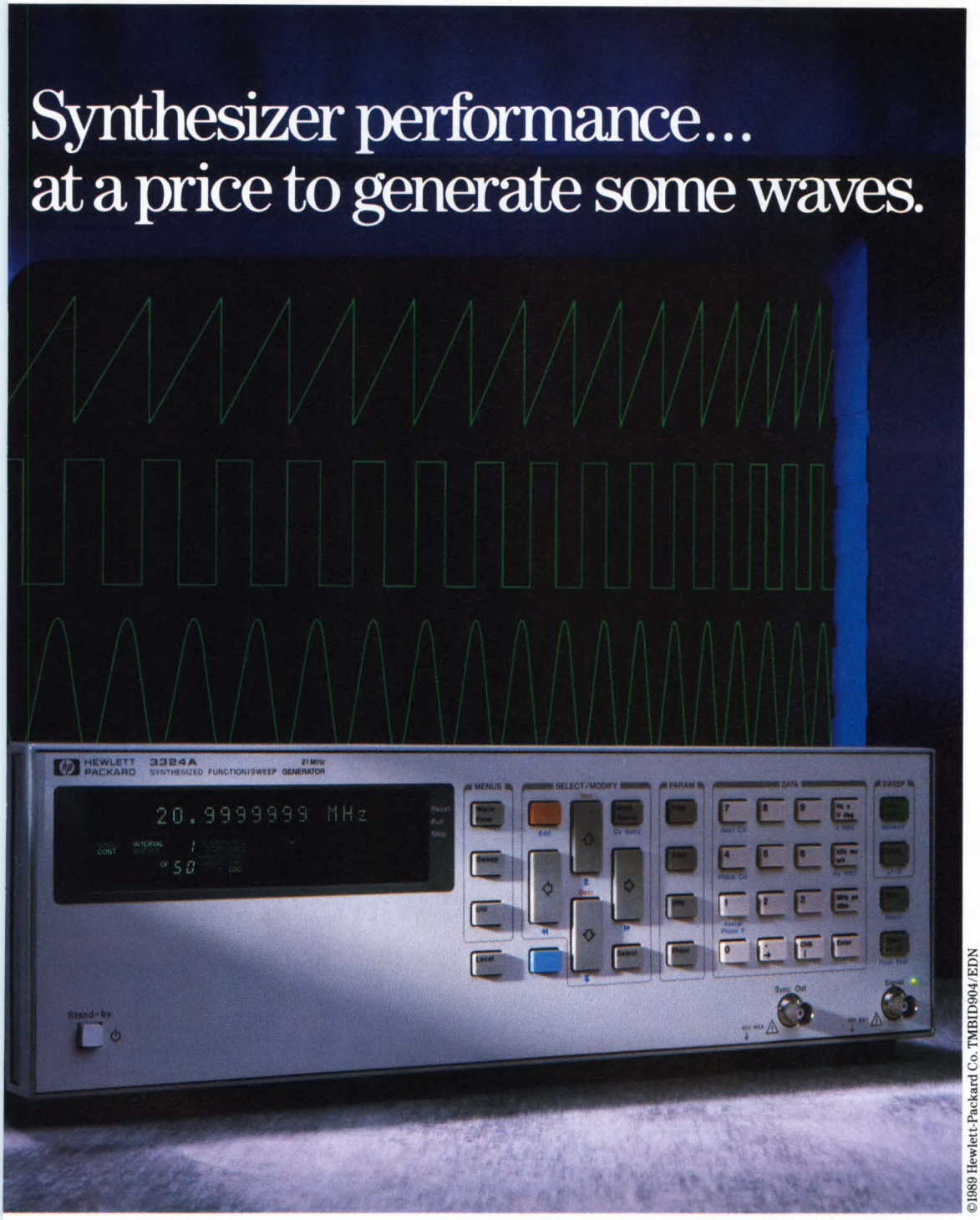
MXIbus—an acronym for Multisystem eXtension Interface bus—provides a 32-bit, multimaster, frame-to-frame interface that lets a single VXIbus resource manager configure an entire multiframe system. Incorporating a backplane-bus-on-a-cable design, the MXIbus assigns VXIbus logical addresses to the physical devices connected to the bus. Its multi-drop parallel bus architecture provides a way to couple a VXIbus tightly to external industry-standard personal computers and to instruments that will never physically fit on a VXI module. With the MXIbus and a PC, a VXIbus system developer can use industry-standard software to speed development tasks.

To support the MXIbus, the developer has introduced the MXI-VXI and AT-MXI interfaces. The $1995 MXI-VXI board is a C-size VXI module with slot 0 capability. You can connect as many as 32 VXI mainframes as a single VXI system with 512 slots and a common address map. A 2-meter MXIbus cable costs $300. The $995 AT-MXI board links an IBM PC/AT to one or more VXIbus mainframes via the MXIbus. The PC/AT treats each VXIbus chassis and its internal instrument cards as though they were plugged directly into the PC/AT.

National Instruments, 12109 Technology Blvd, Austin, TX 78727. Phone (512) 250-9119. FAX (512) 250-0382. TLX 756737.

Circle No 354

Synthesizer performance... at a price to generate some waves.



The new HP 3324A Synthesized Function/ Sweep Generator.

At a price of just $3,500;* it's bound to generate some waves. That's much less than you'd expect to pay for a function generator that has 5 ppm frequency accuracy, 9-digit frequency resolution and multi-interval sweep capabilities too.

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And there's more. Such as the high-stability frequency-reference option, and a high-voltage output option for making really big waves. Call **1-800-752-0900** today. Ask for **Ext. 216W** and we'll send our new detail-packed brochure and application information.

*U.S.A. list price.

HEWLETT PACKARD

Datalogger with voice synthesizer "phones in" alarm messages

The ADAS Dialog datalogger monitors the ac line voltage and the status of eight contacts at an unattended site. In the event of an alarm, the logger calls an operator on an ordinary dial-up phone line and, using a speech synthesizer, describes the nature of the alarm condition. The unit can call several operators in sequence until it receives an answer; it can also call a different list of numbers and articulate a different message for each alarm condition. A printer attached to a standard port logs the time of each alarm, the phone numbers called, the phone number that answered, and the time that the alarm condition was corrected.

An operator who visits a normally unattended site monitored by the logger can use the logger as a telephone—the unit includes a standard telephone keypad, a microphone, and a loudspeaker. A remote operator can also dial the datalogger and have it articulate the current status of all monitored conditions. Password protection restricts such reports to authorized operators. You can change the passwords and alarm messages from the unit's panel or via a telephone or radio link. The attached printer will permanently record such changes.

You can program the logger's operating mode based on the time of day and the day of the week. For example, the unit's internal clock can restrict outgoing alarm calls to nights and weekends. The datalogger costs under $2000.

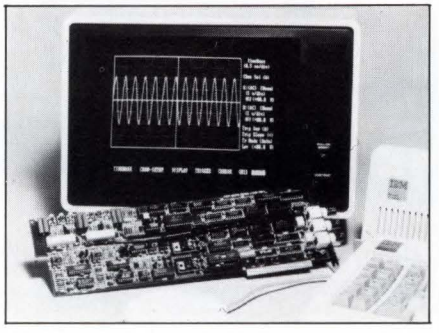
Acurex Corp, Box 7555, Mountain View, CA 94039. (415) 964-3200. TLX 346391.

Circle No 355

Under-$1k PC-based DSO effectively takes 500M samples/sec on repetitive waveforms

Costing only about half as much as most of its competitors, the PCIP-scope plugs into the IBM PC bus and acquires waveforms in real time at a rate of 20M samples/sec. When sampling repetitive signals, the unit can use sequential equivalent-time sampling and hence can acquire data at a 500M-samples/sec effective rate. Analog bandwidth, however, is 10 MHz, so you needn't use the highest sweep speed to obtain adequate sampling rates for the fastest signals the unit can capture.

After you appropriately append the PC's CONFIG.SYS file, the scope software, in the form of a device driver, loads automatically each time you load DOS. The software allows you to issue commands in English. For example, the command to set the vertical sensitivity



of channel A to 2V/div is "SET A VER 2V". You can issue such commands in two modes: An immediate mode allows the PC to emulate a benchtop instrument; a programmed mode simulates operation of a remote unit connected to the PC via IEEE-488. You send commands to the scope with PRINT statements and read data from it with INPUT statements. In response to a "hot-key" sequence you define, the scope display appears on the PC's screen.

The unit's two channels have a maximum sensitivity of 5 mV/div and 1-MΩ input resistance. The inputs handle signals to ±20V without requiring attenuation. The trigger source can be either of the vertical inputs or a separate signal. With an external trigger source, you can trigger based on the signal's level or slope; under software control you can select the exact trigger point. The PCIP-scope costs $999; a probe with a switchable ×1/×10 attenuator costs $75.

MetraByte Corp, 440 Myles Standish Blvd, Taunton, MA 02780. (508) 880-3000. FAX 508-880-0179.

Circle No 356

It's a trap.

Trap tricky hardware and software bugs, precisely.

Powerful debug commands aren't worth much if they're too difficult to use. We've designed the SA98 to trap bugs based on simple, well defined, and detailed commands.

Quick Change Artistry

No more running up and down command trees to change or modify an emulator condition. Change commands without stopping the emulator. Define in-depth breakpoints. Call up help menus and files as you need them. And you can go from 8- to 32-bit microprocessors quickly.

You Set the Rules

Define your own soft keys and macro commands. With the PC/AT or XT function keys configured for emulation functions, you can type in and modify commands directly.

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The SA98 command structure is so powerful and precise, comparing it to other systems is tough on them. Let the power of the SA98 trap your toughest problems and break out of conventional traps.

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CIRCLE NO 63

VF Technology... The Bright Decision

Futaba, a world leading manufacturer of vacuum fluorescent displays, offers a wide assortment of *display tubes* in many sizes and formats. Also, Futaba offers *display modules* with all the electronics required to refresh the display and easily interface with host system.

GRAPHIC DISPLAY

Both front glass phosphor, which provides maximum viewing angle and uniform surface appearance, and conventional back glass phosphor, with optimum brightness and software dimming capabilities, are available. All Futaba graphics modules offer complete drive electronics, bit mapped control with a DC/DC converter. All active components are surface mounted onto a single board.

DOT MATRIX MODULES

Utilizing Futaba's dot matrix displays, a completely intelligent line of "dot modules" is available. Each includes all drive, power supply and microprocessor components surface mounted onto a single board. Surface mounted technology results in higher reliability and allows for a smaller overall package and lower cost. All dot modules require only a 5V DC power source and can accept parallel or 8 possible serial baud rates.

GRAPHIC DISPLAYS/MODULES

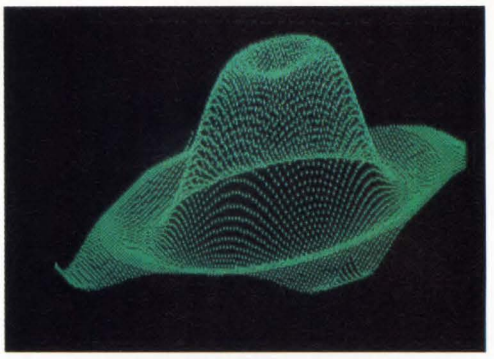
Futaba Display	Futaba Module	Pixels (Row X Char.)	Brightness (FT-L)	Module Dimensions (in.)
GP1013A	GP1013A02	64X34	200	3.35X2.95X0.7
GP1005B	GP1005B03	128X64	400	7.28X3.35X1.77
GP1010B	GP1010B01	176X16	200	7.32X2.16X1.70
GP1009B	GP1009B03	240X64	200	6.2X2.76X1.57
GP1006B	GP1006B04	256X64	200	9.84X3.35X1.77
GP1002C	GP1002C02	320X240	100*	7.10X6.30X1.60
GP1018A	GP1018A01	400X240	40	7.10X6.30X1.61
GP1004C	GP1004C03	640X400	30	9.65X7.3X1.85
GP1019A	GP1019A03	640X400	35	7.10X6.70X2.56

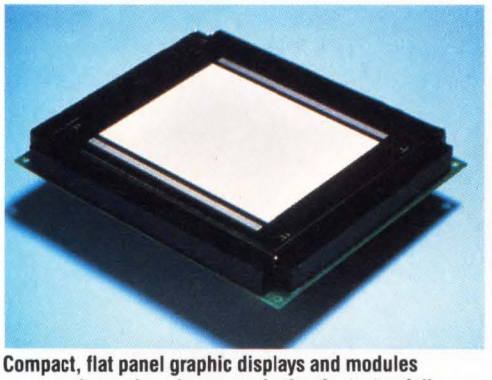
*Different Versions Available

DOT MATRIX/CHARACTER DISPLAY MODULES

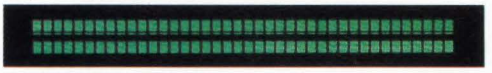
Futaba Display	Futaba Module	Char. X Row	Dot Format	Char. Ht. (in.)	Module Dimensions (in.)
16LD03G	M16LD03B	16X1	5X7	0.433	8.90X1.95X.98
16SY03Z	M16SY03B	16X1	14 SEGMENT ALPHANUMERIC	0.200	4.92X1.32X.83
20SD01Z	M20SD01	20X1	5X7	0.200	6.3X1.97X.75
20SD42Z	M20SD42	20X1	5X12	0.344	7.1X2.16X.88
40SD02Z	M40SD02	40X1	5X7	0.200	9.45X2.16X.88
40SD42Z	M40SD42	40X1	5X12	0.344	9.45X2.16X.88
202SD03Z	M202SD03	20X2	5X7	0.200	6.7X2.56X.90
402SD04Z	M402SD04	40X2	5X7	0.200	10.43X2.56X.90

MANY OTHER DISPLAYS **NEW MODULES AVAILABLE SOON**

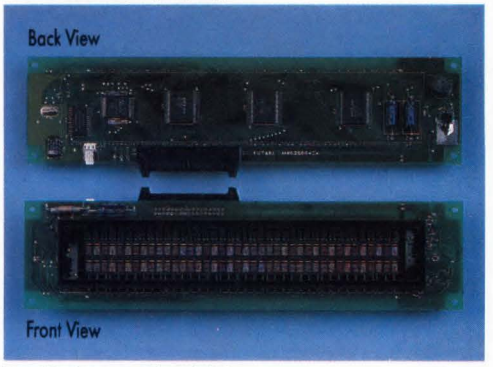




Compact, flat panel graphic displays and modules present clean, sharp images, whether for text or full graphics application.

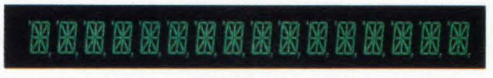


2 x 40 character (display)



2 x 40 character (module)

Pattern flexibility and pleasing appearance are offered by Futaba in dot displays and modules.



Futaba also offers a complete catalog of alphanumeric, segmented displays.

Futaba supports its products with design engineering and system integration assistance. Call or write today.

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Electronic Components Division

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CIRCLE NO 64

ASIC/PLD VERIFIER

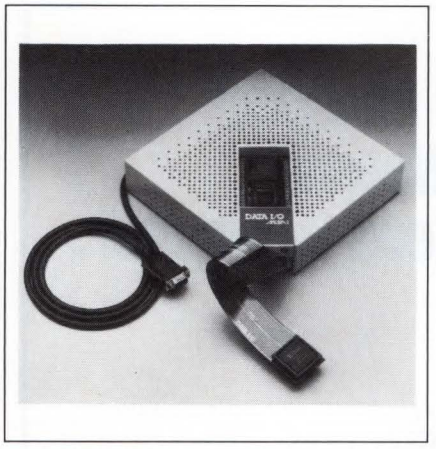
The Personal Logic Design Verification System (PLDVS) allows you to perform functional tests and develop test programs for your ASIC- and PLD-based designs. The system consists of hardware and software that combine with your IBM PC/AT or compatible computer to form a test workstation.

The PLDVS hardware includes plug-in cards for the computer and a generic socket adapter to receive the device under test. The adapter accepts devices with as many as 128 signal pins and is configurable to any device pinout and package style. You can program the system to simultaneously stimulate and read the signal pins, check for pin continuity, and monitor signal-drive current—all at rates as high as 200,000 vectors/sec. The system, which double-latches signal readings using fixed TTL or CMOS-logic thresholds, has five power supplies to operate the device under test. You can control each supply individually and set its output anywhere between −12.5 and +12.5V.

The software allows you to create test programs using a Pascal-like language. You can enter test vectors in tabular form or generate them with algorithms. The software also includes a variety of utilities that allow you to design custom test-result displays. When used with the company's Max+Plus logic-design software, the system accepts waveform descriptions for test vectors. You can also display the test results as waveforms and compare simulation results with the actual performance of the company's Max EPLDs. PLDVS, including software, interface, adapters, and documentation, $6595; graphical-interface-design software, $3400.

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

Circle No 669



IN-CIRCUIT VERIFIER

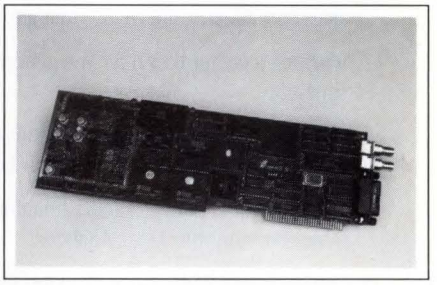
The Mesa I in-circuit verifier offers a combination of modeling, emulation, simulation, and analysis features to ease the verification and debugging of designs using the Xilinx Logic Cell Array. This debugging tool consists of four parts: a logic pod, a probe and cable assembly, an IBM PC/AT controller board, and Microsoft Windows-based software.

The Mesa I connects the programmable gate array (PGA) in your circuit in parallel with a second PGA, called the shadow, which receives stimuli as if it were in your circuit; however, you can halt, interrogate, and reconfigure the shadow without affecting your circuit's operation. For example, using scan-test techniques, you can get a snapshot view of your design's interior logic state by halting the shadow and reading out the internal states. For a real-time view of interior nodes, you can configure the shadow to bring the internal nodes to the output pins, even if all the pins are utilized in your design. The shadow doesn't need to generate the normal output signals while the target device is running your circuit.

The pod and probe come in 68-and 84-pin versions. The controller board supports as many as four pods, providing power and interface signals to each. To use the Mesa I, you need an IBM PC/AT or compatible. The computer must have at least 640k bytes of RAM, 1.5M bytes of hard-disk space, and a display compatible with the IBM EGA. You can use a mouse, but it's not necessary. $9390. Delivery, eight weeks ARO.

Data I/O Corp, Box 97046, Redmond, WA 98073. Phone (206) 881-6444. TLX 152167. FAX 206-882-1043.

Circle No 670



SYNTHESIZER

The VDS-8-PC 7½-digit direct-digital frequency synthesizer provides an 8-MHz max output frequency and 0.1-Hz resolution combined with a 2000-point arbitrary waveform generator on a pc board that plugs into the IBM PC bus. In addition to user-defined waveforms, the unit produces sine, square, and triangular waves; pulses; ramps; and exponential, logarithmic, and $\sin(\times)/\times$ functions. The maximum output is 10V p-p into a 50Ω load. You can control the output level with a software-controlled step attenuator. You can load arbitrary waveforms into the unit via the PC bus or an IEEE-488 port; the unit is fully programmable via the IEEE-488 bus. The unit produces logarithmic and linear fre-

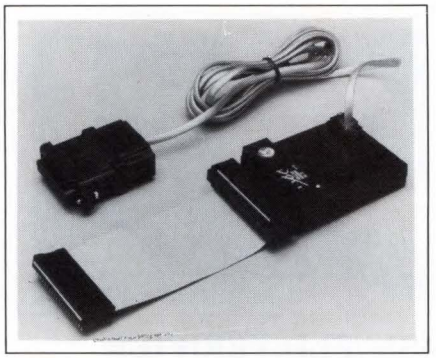
quency sweeps and can produce waveform bursts containing 1 to 255 repetitions. $2495. Delivery, stock to eight weeks ARO.

Sciteq Electronics Inc, 8401 Aero Dr, San Diego, CA 92123. Phone (619) 292-0500. FAX 619-292-9120. TLX 882008.

Circle No 671

IN-CIRCUIT EMULATOR

The d²ICE-51 consists of two components—the hardware module and the controlling software that runs on IBM PCs, PS/2s, and compatible computers. The software is similar to the vendor's simulator software: Through multiple windows, it allows you to control and examine the



operation of the target processor, an 8051 8-bit μC. You can run your program and observe the source code, registers, memory accesses, I/O operations, and traces. You can set up a flow window to show a flow chart, a disassembled trace, or a histogram of interrupt rates. The hardware can include 32k bytes of on-chip RAM. You plug a cable into the target processor socket; the emulator derives its operating power from the target system. You also connect the emulator to one of the RS-232C ports on the host PC. With 4k bytes of RAM, $995; with 28k bytes, $1250; CMOS versions, add $200 to $250.

Cybernetic Microsystems Inc, Box 3000, San Gregorio, CA 94074. Phone (415) 726-3000. TWX 910-350-5842.

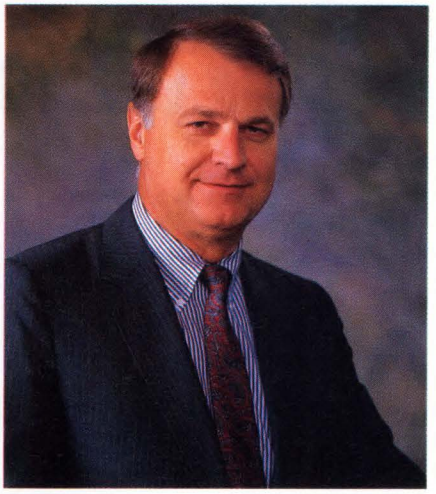
Circle No 672

DSP DEBUGGER

The Bug-56 symbolic debugger for systems that use Motorola's 56001 chip operates under MS-DOS. Except for a resident monitor called Degmon—a scant 64 words of specialized code placed in the 56001's program memory—nearly all of the debugger's code runs on the main processor of your PC. To run Bug-56, you must install a board containing the DSP chip in one of the PC's I/O slots. One such board, the vendor's $595 PC-56, contains, besides the 56001, a 14-bit ADC and DAC capable of sampling analog data at a rate of 20k samples/sec. The software provides a windowed display

Text continued on pg 99

Partners in Solutions



Letter from

Hank Josefczyk,

Senior Vice President

Marketing and Sales

A couple of years ago, while many semiconductor companies remained committed to business as usual, we at NEC Electronics made a major change. We realigned our resources so we could more effectively address our customers' total service, support, and applications needs.

The result was the formation of strategic sales units—groups of specialists from sales, customer service, applications engineering, and marketing who are responsible for managing the customer-NEC interface. This allowed our customers to deal with one team of NEC Electronics people who had both access to the full range of the company's capabilities and the responsibility to integrate those capabilities in ways that best satisfied their needs.

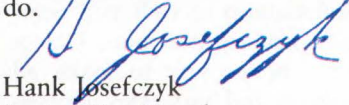
Today, as other companies are just beginning to move in this direction, we're up and running. We have organized into teams which focus exclusively on the needs of particular industries such as automotive and telecommunications and placed them in locales close to the customer. Soon we will bring this focus to personal workstation and other key markets.

And today, one huge benefit for our customers is an effective shortening in both time and distance between our customers and NEC Corporation's operations in Tokyo to allow easier and more complete access to our extremely broad range of products and processes.

Since the mid 1980s, NEC Corporation has been the world's number one semiconductor supplier. The major reason is our technological breadth. We offer thousands of leadership products in virtually every major semiconductor arena. And we offer them on as wide a range of processes as customers will find anywhere. Together, these mean more customer choices and more opportunities to succeed than anyone else offers.

It's become clear in the IC business that anything less than a complete solution is really no solution. What matters is not having either the most products, the widest range of processes, or the best service and support. What matters is having all three and then making sure they can be united in ways that solve the customer's problem in a complete and timely manner.

At NEC, this is what we work to do.



Hank Josefczyk
Senior Vice President,
Marketing and Sales
NEC Electronics

EXECUTIVE OUTLOOK

Translating Global Thinking Into Customer Commitment

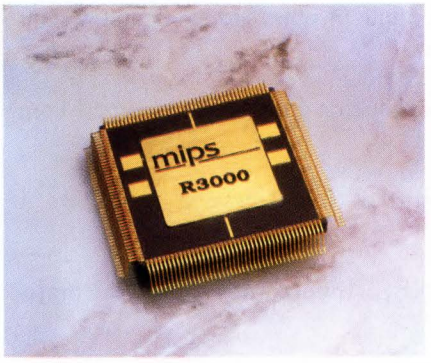
When NEC Corporation decided to expand in the U.S. marketplace about a decade ago, it realized that if it were to remain the leader in the world market for semiconductors, it would have to see itself less as a Japanese company that sold products in other countries and more as a truly global enterprise with focused commitments to every regional market it served. The result of this thinking was the consolidation of several small U.S. subsidiaries into NEC Electronics, Inc. in 1981.

With its charter to translate NEC Corporation's global thinking into tangible commitments to North American customers, NEC Electronics has become a company committed to offering the best of both worlds.

First, NEC Electronics is a North American company in terms of both resources and perspective. With a major manufacturing facility in Roseville, California, and customer design centers throughout the U.S., it is well positioned to serve the North American marketplace.

And second, it is supported by the world's largest semiconductor company—an organization with thousands of industry-leading products and a wide range of advanced process technologies.

"We think we bring a lot to the party," says Hank Josefczyk, NEC Electronics' Senior Vice President of Marketing and Sales. "And by this I mean total support as well as a comprehensive product portfolio. Unless you have a better way to make all your products and processes accessible to the customer, you're only handicapping yourself."



MIPS RISC Microprocessors

One of the key differentiators for NEC Electronics in North America has been its on-shore manufacturing. In 1984, NEC became the first Japanese semiconductor supplier to manufacture ICs in the U.S. Impressive by even today's standards, the company's 200,000-square-foot Roseville, California, facility rests on a 73-acre site and was developed with an initial investment of $100 million.

Now NEC has announced a major expansion: a new 220,000-square-foot facility on the company's Roseville site. Representing an additional investment of $400 million and eventually resulting in 400 new jobs, the facility will begin full production in 1991. It will focus on high-end memory products while the existing facility will produce a variety of ICs, including custom micros and ASICs.

NEC Electronics is also making a major commitment to expanding its design center capability. By the end of next year, the number of its North American ASIC and custom micro design centers will more than double. "This opens a couple of new doors too," adds Josefczyk. "More and more, we will be merging capabilities to develop our regional product design centers. And more and more, our customers' products will be both designed and manufactured in North America."

Complementing these and other capabilities is NEC's extremely wide range of industry-leading products and processes. Offering thousands of different device types, NEC is a leader in virtually all major semiconductor product segments from micro to ASIC, to memory, to peripherals, to supercaps, to LEDs and lasers. In addition, it offers them in an exceptionally wide range of processes including bipolar, ECL, CMOS and BiCMOS. Of these products, NEC Electronics is focusing closely on two segments it considers of special importance to its North American customers: micro and ASICs.

In micro, NEC offers a breadth of impressive solutions that few, if any, other semiconductor companies can match. "It's like a mountain," says Chi-Foon Chan, General Manager of NEC Electronics' Micro Group. "In order to reach a great height, you need a very broad base. We're aiming high. So, we're building accordingly."

This broad base includes an industry-leading presence in the four principal micro segments—microprocessors, microcontrollers, digital signal processors, and intelligent peripherals.

The company continues to offer a growing range of its proprietary "V Series" 8-, 16-, and 32-bit CPUs, which offer particularly impressive integration and performance levels.

And, as a result of a recent agreement with MIPS Computer Systems,

NEC is now in the RISC CPU business. The company is now an alternate source for MIPS' new 20-MIPS, 25-megahertz 32-bit chip—the industry's speed leader. And the two companies are co-developing a 60-MIPS chip in ECL technology. This version will be available in early 1990.

NEC Corporation is also the world's largest manufacturer of single-chip microcontrollers and is now focusing on custom micros. These are microprocessor cores that can be combined with digital and analog macros in standard cell libraries.

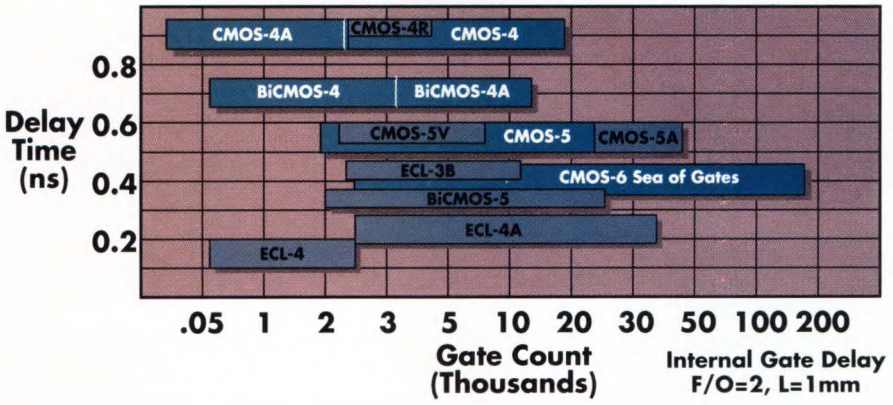
"We think we have a real advantage here," says Chan. "Other companies are planning to do this. But we're already doing it in our micro-based design centers in both California and Massachusetts."

NEC has also etched strong positions for itself in the digital signal processing and peripheral areas. NEC Corporation is number two in DSP worldwide and, in peripherals, NEC Corporation was the first to set the worldwide standard in several major graphics and floppy-disk controller areas.

Complementing this expansive range of micro products is an increased commitment to micro support. In addition to more than 75 people focused exclusively on micro products at its two U.S. custom micro centers, the company also has more than 35 applications engineers based in its 22 U.S. sales offices who concentrate on micro.

In recent years, NEC has also come on strong in another product arena critical to its U.S. customers: ASICs. Long considered a secondary player in this market, the company has moved ahead of many well-known ASIC suppliers such as LSI Logic and Toshiba to become number two in ASIC worldwide. And, according to Dataquest, NEC Corporation has an excellent chance of replacing Fujitsu as the world's ASIC sales leader by the end of 1989.

Most Comprehensive Selection of ASIC Devices Available



For ASIC design, NEC supports a flexible blend of CAD tools called the OpenCad™ Integrated Toolset that combines the best third-party software with NEC's product-specific proprietary design software. Logic synthesis by Synopsis®, high-speed simulation on ZyCAD's MACH 1000™, system simulation on HILO™, and floorplanning and power calculations by NEC give users unlimited design possibilities. Front-end interface support with Valid, Mentor Graphics®, Daisy, HP, VIEWlogic, or FutureNet software on Sun, Apollo, VAX, or PC platforms give almost any designer an open door to NEC's advanced technologies. And they provide powerful block libraries with more than 300 macros, including analog, peripheral, and megamacro functions.

"As NEC's custom micro and ASIC operations move closer together in the coming years, we expect many exciting new possibilities to emerge," says Hiro Hashimoto, General Manager of ASICs. "It's the synergy story. As we blend, we will become more than the sum of our parts. The result will be even more rapid progress and more benefits for our customers."

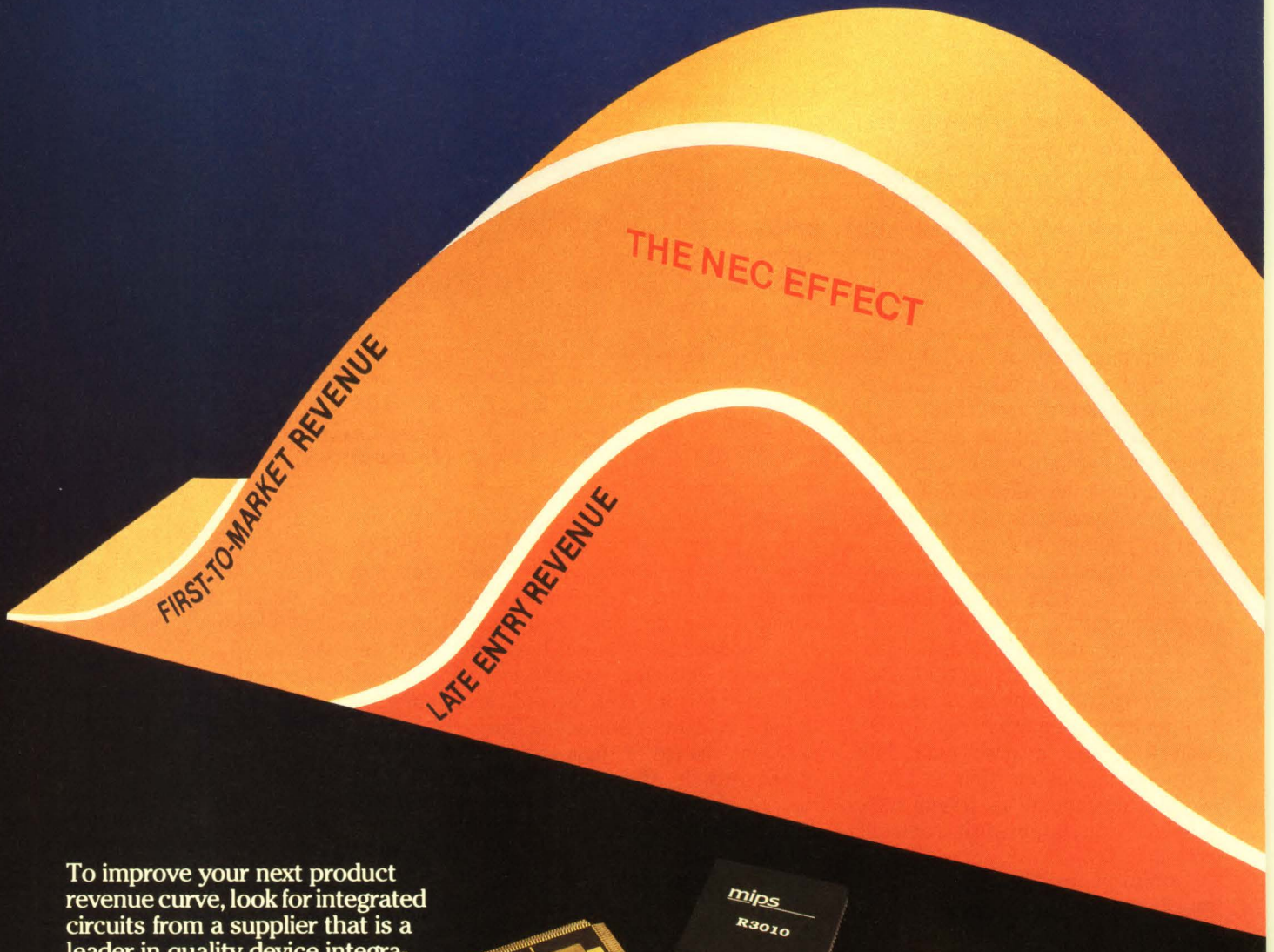
It's easy to see why the phrase "the best of both worlds" is especially appropriate to NEC Electronics. As an affiliate of NEC Corporation in Japan, it has access to products and process technologies second to none. And, as a North American-based company in its own right, it provides the kind of total support—industry-leading manufacturing, design expertise, technical support, and service—that allows it to get as close to the customer as a semiconductor company can get. "It's a powerful combination," adds Josefczyk, "one that really helps our customer stay on top in their markets."

Worldwide Ranking

ASIC ($)		MOS-Digital ($)		Memory ($)		Total Semiconductor ($)	
Fujitsu	488 M	NEC	3114 M	NEC	1481 M	NEC	4.53 B
NEC	455 M	Toshiba	2546 M	Toshiba	1439 M	Toshiba	4.30 B
LSI Logic	367 M	Hitachi	1885 M	Hitachi	1114 M	Hitachi	3.51 B
Toshiba	360 M	Fujitsu	1437 M	Mitsubishi	943 M	Motorola	3.03 B

Source: Dataquest

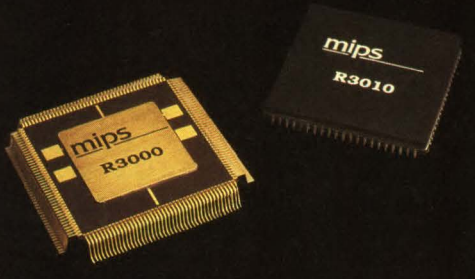
Expand your product revenue curve



To improve your next product revenue curve, look for integrated circuits from a supplier that is a leader in quality device integration. You should also look for the leader in process technology and manufacturing capability. And finally, look for the engineering support and design assistance you need to minimize your product development time.

When you're through looking, you'll see NEC.

At NEC, you'll see the best quality devices up to 970,000 equivalent transistors — or 177,000 gates. You'll see CMOS, BiCMOS and ECL implementation across a broad range of products including custom micro, ASIC, and RISC. And you'll see production capability exceeding $600 million worth of components per month in 24 worldwide locations using the best silicon the world has to offer. Then, you'll see focused design assistance and local engineering support in 22 centers in the U.S. to help you bring your product to market fast.



MIPS looked to NEC for worldwide manufacturing, marketing and support for their RISC family of microprocessors.

Call today for our new ASIC and micro selection guides and see how NEC can help you expand your next product revenue curve.

NEC Electronics Inc.
401 Ellis Street
Mountain View, CA 94039-7201
1-800-632-3531/415-965-6158

NEC

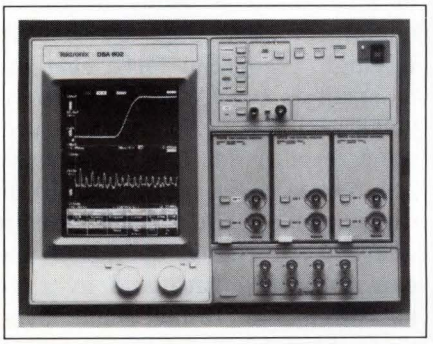
CIRCLE NO 66

with pull-down menus that let you access many facilities—for example, the full-screen symbolic debugger with program tracing, symbolic breakpoints, and symbolic patch assembly.

The debugger lets you directly modify control-register bits, and it can update the register display and make changes to register and memory contents while programs run at full speed. In addition, the debugger features on-line help, a file browser, and a capability called DSPeek, which provides a graphics display of the data in any 56001 memory space with programmable scaling and zooming. The software can perform an FFT to let you view the data in the frequency domain and can send data to the PC's speaker, enabling you to hear as well as see the effects of program changes. To avoid having to simultaneously debug programs running on the DSP chip and the PC's μP, Bug-56 also lets programs running on the 56001 perform a wide range of MS-DOS functions. $395.

Ariel Corp, 433 River Rd, Highland Park, NJ 08904. Phone (201) 249-2900. FAX 201-249-2123.

Circle No 673



SIGNAL ANALYZERS

The DSA 601 and 602 digitizing signal analyzers combine a high-speed DSP capability with a digital storage oscilloscope that has a 1-GHz bandwidth and that, in one version, takes 2G 8-bit samples/sec in real time. The instruments perform floating-point operations almost

two orders of magnitude faster than the vendor's previously highest performing scopes. They also perform several functions that the earlier products could not; for example, they can present simultaneous displays of waveforms and their spectra and update them "live" at approximately 20×/sec.

Among the features made possible by signal processing is the ability to dejitter waveforms. The instruments automatically time-shift newly acquired data sets to provide the best fit with a stored reference waveform. The result is a jitter-free display. The instruments provide very deep waveform storage. Each waveform can comprise as many as 32k samples. All units contain nonvolatile storage for 258,560 samples. As an option, you can add storage for more than 450,000 additional samples. Both DSA instruments accommodate three plug-in units. Without plug-ins or options, 2-channel DSA 601 mainframe, $21,025; 4-channel DSA 602, from $27,125.

Tektronix Inc, Box 500, Beaverton, OR 97077. Phone (800) 835-9433.

Circle No 674

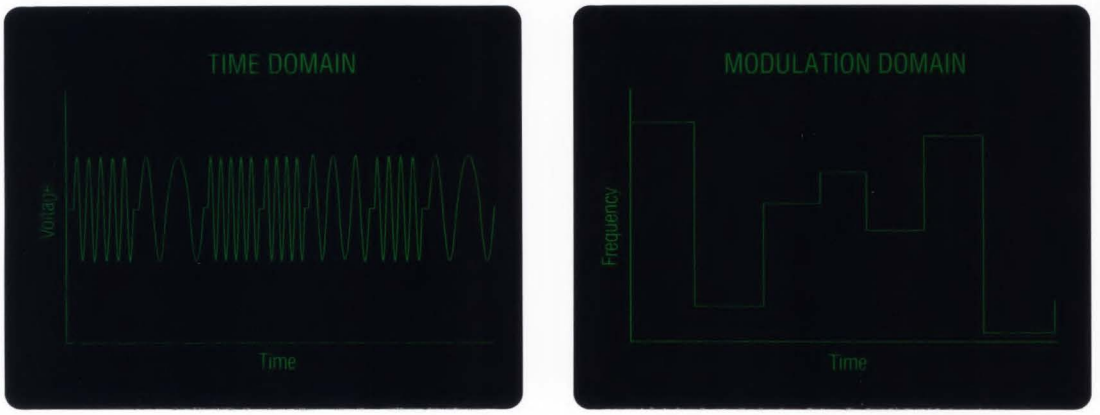
SOURCE/MEASURE UNITS

The Models 236 and 237 source/measurement units combine the capabilities of a DMM, an electrometer capable of measuring 10 fA, and a 4-quadrant dc power source that can also generate arbitrary waveforms. You can use the instruments on a benchtop or mount them in an equipment rack; they are just 3½ in. high. They can force currents as small as 100 fA and voltages as small as 100 μV. Voltage-measurement resolution is 10 μV, and basic accuracy is 0.03% of reading. To reduce noise, the units permit guarded 4-terminal operation and can both integrate and average measurements. To find small deviations about a large value, the units suppress (automatically subtract) offsets as large as 1100V or 110 mA.

The instruments can acquire 1000 values/sec and store them in an internal memory. You can then empty the memory via an IEEE-488 interface at a rate of 125 measurements/sec. Similarly, you can update the source output from the

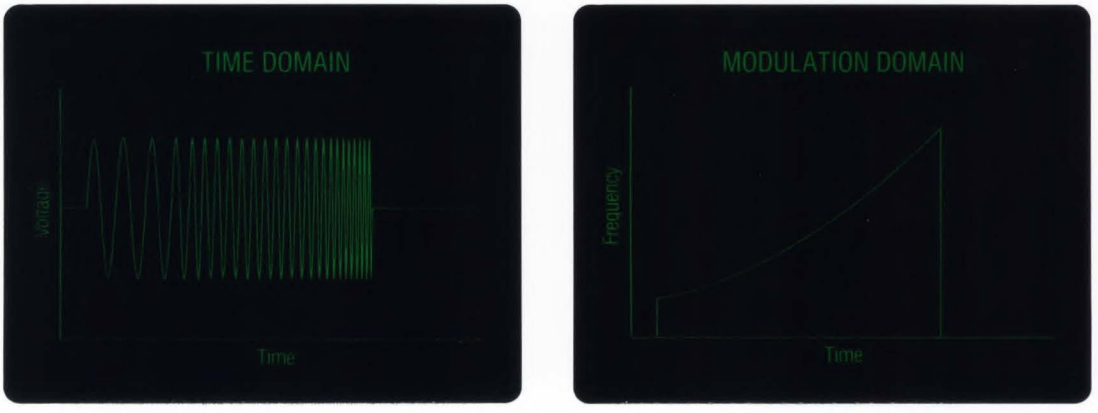

p, hop, hop, hop, hop
chirp, chirp, ch
jitter, jitter, jitte

...like you've never seen them before.



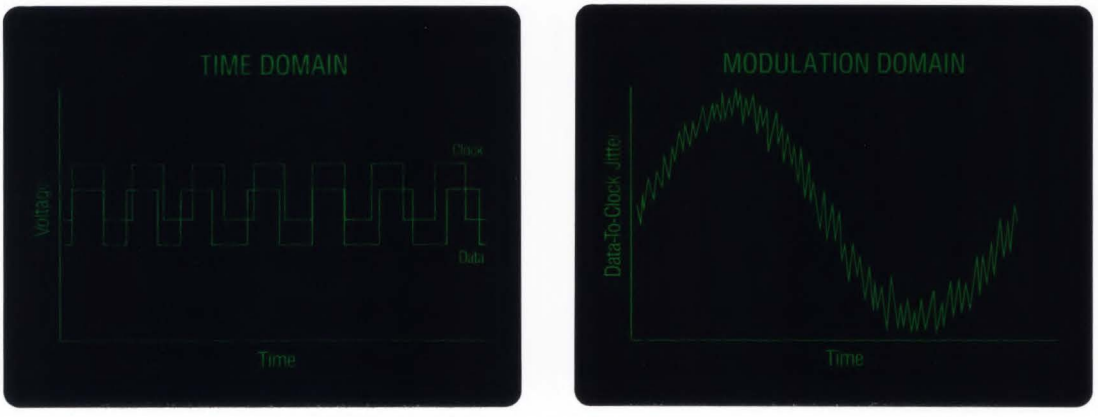
hop

...a time-domain view of a frequency-agile signal (left) reveals little useful information. The new modulation-domain view on the right clearly shows the hopping sequence, settling times, and channel frequencies.



chirp

...no quantitative data is available from the time-domain view of a radar chirp on the left. However, the frequency vs time display of this single-shot event clearly shows chirp linearity and frequency.



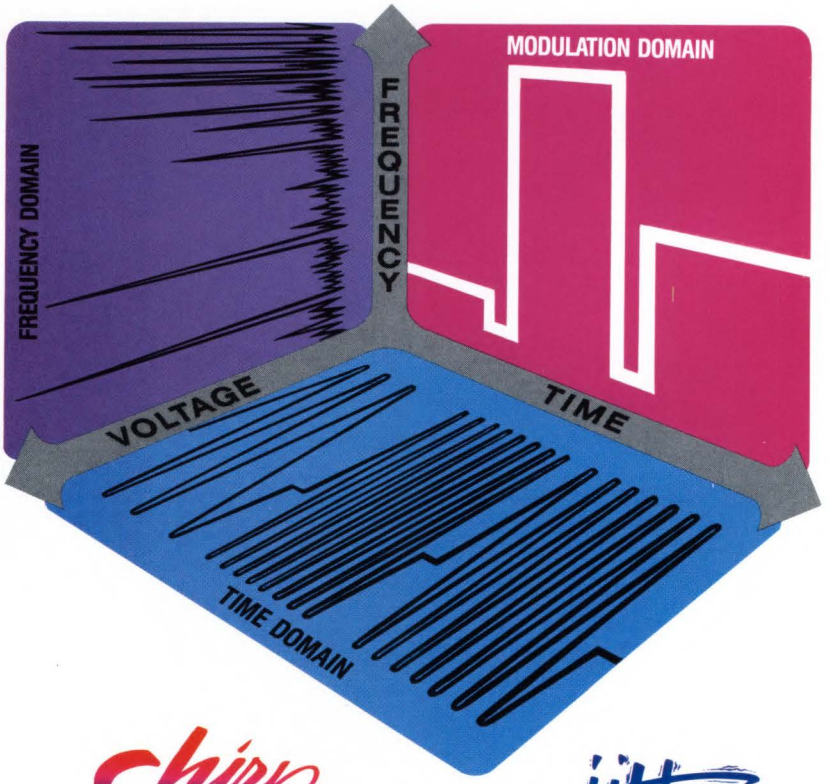
jitter

...a time-domain view of jitter shows only that the jittered data's edge is constantly changing with respect to the clock. In the modulation domain, the jitter magnitude and periodic content are clear.

HP introduces the modulation domain.

Totally new measurement concepts are rare. The oscilloscope was one. It brought the time domain to voltage measurements. Spectrum analysis, which added the frequency domain, was another. Now, there's a breakthrough that puts you in the modulation domain. Dynamic frequency and time interval analysis.

The new HP 5371A Frequency and Time Interval Analyzer gives you entirely new ways to view dynamic signals. Views that simplify and speed analysis of transient signals, modulation, and frequency stability. As well as time transients, jitter, and timing relationships between signals. If you're designing equipment for communications, radar, mass storage, data processing, and ATE, the HP 5371A gives you new insights for faster troubleshooting and characterization.



hop ...agile radio measurements that were impossible until now.

Say goodbye to static back-to-back and "golden unit" testing that's been costing you time and money without delivering the quantitative measurements you need.

Complete characterization of hopping radio transmitters is easy for the HP 5371A. Its dynamic single-shot capability captures hopping sequence, carrier frequencies, and modulation. Then it displays signals in a frequency vs time plot for quantitative measurements of overshoot and settling time (valuable for VCO signals too). You can also examine FM details. And, histogram displays give a clear picture of channel usage.

chirp ...radar signal characterization in a snap.

Because the HP 5371A captures single-shot events and performs fast statistical computations, you can simply and inexpensively characterize pulse parameters that affect target resolution, range, and accuracy.

There's no easier way to analyze chirp linearity or phase coding than the direct measurements of frequency vs time in the modulation domain. And histogram plots of pulsewidth jitter and pulse repetition frequency give you quantitative and reliable measures of system performance. Expensive and cumbersome delay line discriminators are eliminated...forever.

jitter ...finally, precise quantification for performance prediction.

The HP 5371A's statistical analysis and histogram capability, combined with time-variation plots, give you a valuable new tool for quantifying the affects of jitter and wander in digital communications, data storage, and computer systems.

Histogram displays and statistics of frequency or time interval show you quickly whether jitter effects are Gaussian or systematic. These results reveal valuable information leading to the prediction of bit error rate. And modulation domain displays give you a useful view of jitter periodicity. An FFT of this data gives you a jitter spectrum. With the HP 5371A, you can troubleshoot faster and get better characterization of timing jitter than ever before.

See the back page for more information.
Call 1-800-752-0900, Ext. 215U, or mail the reply card for additional product information and a FREE videotape.

HEWLETT PACKARD

The HP 5371A...your window to the modulation domain.

As significant a development as the scope or spectrum analyzer, the new HP 5371A Frequency and Time Interval Analyzer is the first commercially available instrument to make continuous frequency measurements and display frequency vs time directly. It's sure to become a basic tool in every R&D lab.

Performance to match your measurement needs.

- dc to 500 MHz (500 MHz bandwidth at microwave frequencies)
- 2 GHz to 18 GHz capability available with the HP 5364A
- up to 10 million measurements per second
- 1 ns minimum pulsewidth
- 150 ps single-shot resolution, 1 ps repetitive resolution
- 2 mV trigger level resolution

Powerful arming and triggering for measurement control.

- Holdoff by time, events or signal edge
- Sample by time, events or edge
- Arm on any of three input channels: External, A, or B

A choice of measurement modes and analyses.

- Frequency, period, phase and time interval
- Positive or negative pulsewidth, duty cycle
- Rise time, fall time
- Time variation, event timing, histograms, statistics, limit test

Plus accessories and HP-IB compatibility

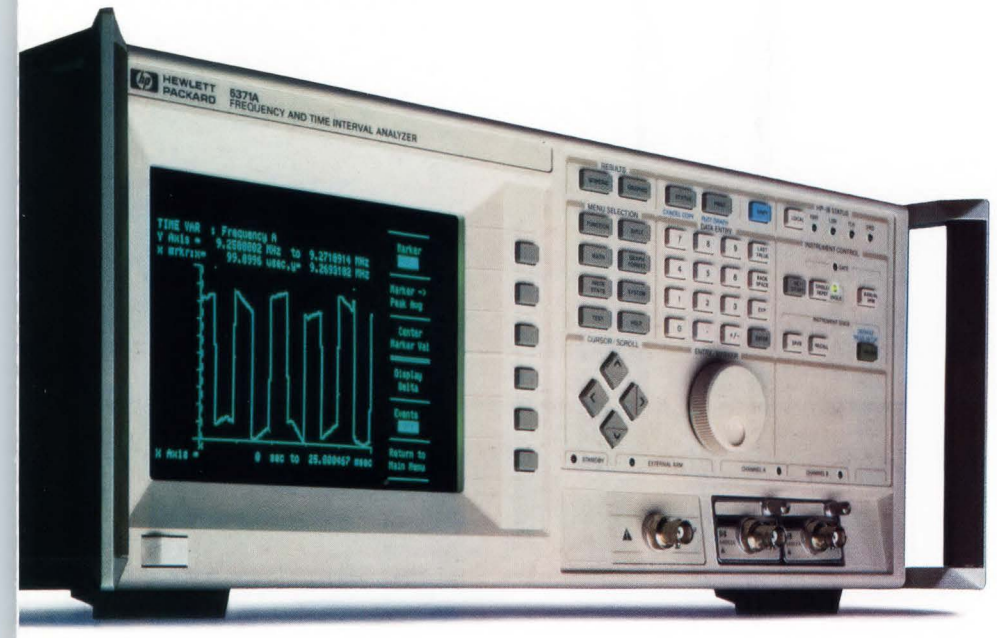
Of course you can combine the HP 5371A with other test instruments and computers via the HP-IB for enhanced capability. It will also drive HP printers and plotters directly for hard-copy records. And a variety of accessories and options are available to match your specific application.

Get there faster in the modulation domain

Like its predecessors — scopes and spectrum analyzers — the frequency and time interval analyzer is sure to give designers greater insight into system problems, and provide dramatic savings in product development and manufacturing. That's the best reason yet to explore the modulation domain. So mail the attached reply card today. Or, better yet, call 1-800-752-0900, Ext. 215U. Now, it's up to you.

HEWLETT PACKARD

we never stop asking "What if..."



internal memory at 1000 points/sec. Source settling time is 500 μsec, and the units' outputs are transient free when you turn power on or off. Model 237, $6295; Model 236, $4995.

Keithley Instruments Inc, 28775 Aurora Rd, Cleveland, OH 44139. Phone (800) 552-1115; in OH, (216) 248-0400. TLX 985469.

Circle No 675

WAVEFORM DIGITIZER

The AT6400 is a waveform digitizer that has capabilities equal to those of competitive units that cost three or four times as much. It digitizes two to eight channels to 14 bits at a combined maximum rate of 1M samples/sec; you can slow the rate in 0.25-μsec increments to 1/16M samples/sec and in steps of 1.6 to 3% to 2 samples/sec. The most sensitive full-scale range is ±128 mV. The inputs are differential, and are

isolated from the chassis. CMRR exceeds 80 dB at 60 Hz. System noise is <3 counts p-p, and full-power analog bandwidth is 500 kHz. The unit uses your IBM PC/AT or compatible computer as a host; its proprietary interface plugs directly into the 16-bit bus and transfers data to memory using DMA. The maximum rate for long bursts of data depends on the bus speed; on a 10-MHz PC/AT clone, in which I/O operations do not slow the clock (as they do on faster machines), you achieve speeds in excess of 300k points/sec. With a PC/AT equipped with 16M bytes of RAM, you can record 8M samples. A trio of third-party software packages, Dadisp, Assystant, and Snapshot Storage Scope, are sold separately and incorporate drivers for the unit. From less than $4000; software, $500 to $1000. Delivery, 90 days ARO.

Acrosystems Corp, 66 Cherry Hill Dr, Beverly, MA 01915. Phone (508) 927-8880. FAX 508-922-5114.

Circle No 676

SPECTRUM ANALYZER

The compact, 42-lb 2782 spectrum analyzer has a 1024 × 1024-pixel, nonfading, 2-color display that uses a CRT in conjunction with a liquid-crystal shutter. The device can indicate the presence of signals from 100 Hz to 33 GHz and can perform direct fundamental mixing to 28 GHz. Using external waveguide mixers, the analyzer can display

signals at 1.2 THz. Even beyond 5 GHz, the dynamic range exceeds 100 dB. At 28 GHz, the resolution bandwidth can be as small as 3 Hz or as large as 10 MHz. At 18 to 20 GHz, single-sideband phase noise is lower than that of some competitive instruments by as much as 30 dB. Third-order modulation products are −90 dBc (90 dB below carrier) to 6.5 GHz and −80 dBc above 6.5 GHz.

The menu-driven operator interface always lets you see the names of all menus above the current one in the hierarchy. A press of the ESC key allows you to exit from the current menu to one at the next higher level; from the top level, pressing ESC causes the menus to disappear and enlarges the spectrum display. In addition to the soft keys beside the display, the front panel includes a dedicated numeric keypad, cursor keys, and three rotary control knobs. One knob always controls frequency. You assign functions to the other knobs via the menu system. The unit includes two IEEE-488 ports, simplifying the creation of control programs that, for example, send data to mass-storage peripherals. $65,000.

Tektronix Inc, Box 500, Beaverton, OR 97077. Phone (800) 835-9433.

Circle No 677

IEEE-488 CONTROLLER

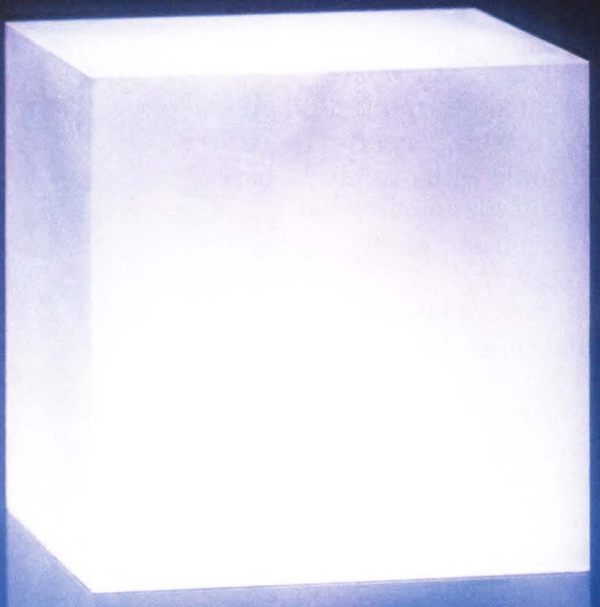
The Micro488A allows you to connect IEEE-488 devices to an RS-232C or RS-422 port that operates as fast as 57.6k bps. The unit can act as a talker or a listener on an IEEE-488 bus as long as 4000 ft that connects as many as 14 devices. To minimize traffic through the relatively slow serial interface, the unit can output stored character strings in response to 1-character commands. You can define as many as 100 of these "macros." The unit, which uses Hewlett-Packard programming syntax, can also buffer 32,000 characters. $695.

IOTech Inc, 25971 Cannon Rd, Cleveland, OH 44146. Phone (216) 439-4091. TWX 650-282-0864.

Circle No 678

Text continued on pg 111

For System Simulation Users, The Build-vs-Buy Decision Just Became Obvious.



Build With Teradyne EDA.

As board and system complexity is growing, and the time-to-market window continues to shrink, simulation of systems at all levels has become a crucial requirement—especially with ASIC-based designs.

Teradyne EDA makes full system simulation practical. No longer will your best attempt at true simulation be limited to a piecemeal, simulator-by-simulator break-up of your entire system. Now, you can build a highly modular, truly integrated, open simulation environment—one that supports completely interactive mixed-mode, mixed-level simulation through multiple simulators.

Introducing MultiSim, The First Multi-Vendor Simulation Environment.

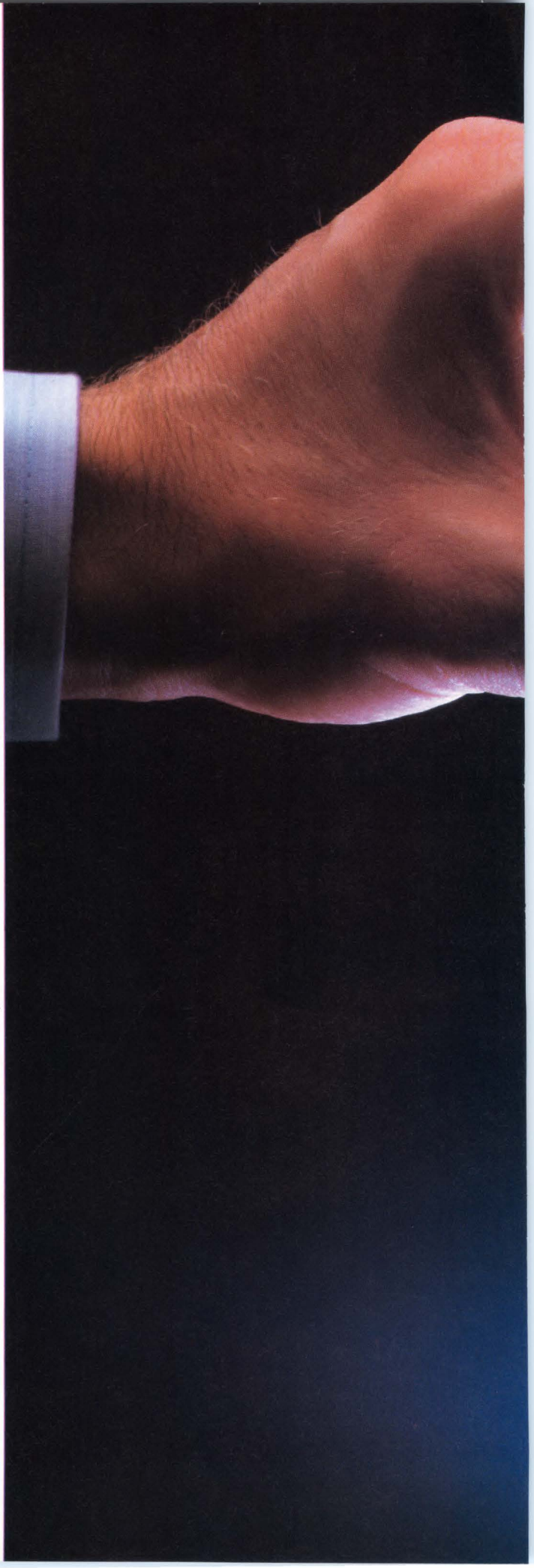
MultiSim,™ the newest Teradyne EDA product, provides a software backplane that allows multiple simulators from multiple vendors to work concurrently on a single design. Now, you can build with exactly the simulators you want, keep all of your models and use the simulator that's best for each part of the design. You don't throw anything away.

MultiSim, which runs on industry platforms, is the solution for system simulation at all levels, in even the most sophisticated design environment. Integrate your custom in-house simulators with ASIC vendor and commercial simulators, as well as Teradyne's AIDA, LASAR or VANGUARD tools which operate in the MultiSim environment.

For further information, contact Georgia Marszalek at Teradyne EDA, 5155 Old Ironsides Drive, Santa Clara, CA 95054, (408) 980-5200.

TERADYNE

CIRCLE NO 71

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Now you can get world famous Wren™ disk drives direct from your local distributor.

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With capacities from 50 MBs to 1.2 GBs and industry standard ST506, SCSI, ESDI and PC-AT interfaces, there is a Wren solution for your needs.

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Imprimis is the world's leader in 5¼" high-performance, high capacity disk drives. The complete line of Wren drives feature field proven MTBF in excess of their 40,000 hr. specification.

PC-AT compatible

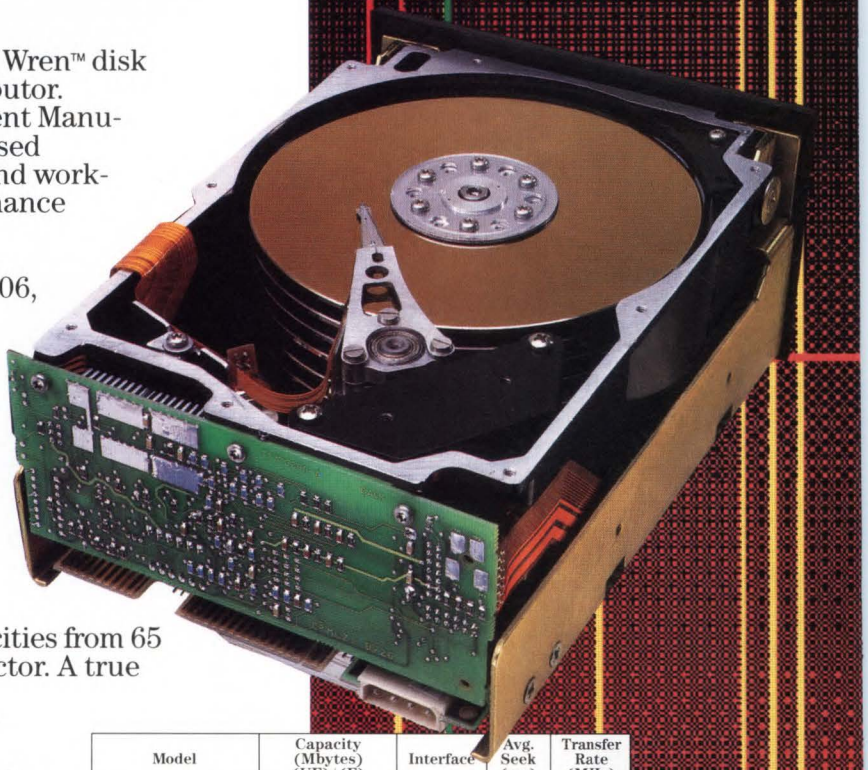
Wren PC-AT models offer capacities from 65 to 380 MBs in a half-height form factor. A true 1:1 interleave provides faster data access. Wren provides the ultimate price/performance ratio for AT-compatible microcomputer users.

Easy IBM PC, XT and AT installation

Several models come in "kits." Kits contain everything you'll need to install the drive, plus easy-to-follow instructions. Installation takes less than 30 minutes. A diskette-based software routine prepares the drive for use. Kits are available for Apple Macintosh and Novel LAN too.

Factory certified RLL

All RLL models are certified at the factory using RLL controllers so you can be sure they'll work on your system.



Model	Capacity (Mbytes) (UF) / (F)	Interface	Avg. Seek (ms)	Transfer Rate (MHz)
WREN VII	1200/1050	*SCSI	16.0	15-23
WREN VI	766/676	*SCSI	15.5	15
	766/676	ESDI	15.5	15
WREN VI H/H	383/338	*SCSI	15.0	18-20
	383/338	ESDI	16.0	15
	383/338	AT	16.0	15
	274/242	AT	16.0	15
	164/145	AT	16.0	15
WREN V	702/613	*SCSI	16.5	12-16
	385/339	*SCSI	10.7	15-16
	442/390	ESDI	16.0	10
	383/338	ESDI	14.5	10
WREN V H/H	209/183	*SCSI	18.0	9-15
	125/109	*SCSI	18.0	9-15
WREN IV	376/330	*SCSI	17.5	10-15
	350/307	*SCSI	16.5	9-15
WREN III	182/160	*SCSI	16.5	10
	182/160	ESDI	16.5	10
WREN III H/H	106/94	*SCSI	18.0	10
	106/94	ESDI	18.0	10
WREN II	135/115	RLL	28.0	7.5
	96/80	ST506	28.0	5
	86/71	ST506	28.0	5
	86/71	ESDI	28.0	5
WREN II H/H	81/74	AT	28.0	7.5
	77/65	RLL	28.0	7.5
	51/41	ST506	28.0	5

H/H – Half Height Models. **(UF)** – Unformatted Capacity. **(F)** – Formatted Capacity at 512 Bytes/Sector. All WREN Disk Drives have 40,000 hours MTBF. *Apple Mac compatible interface available.

For the authorized distributor nearest you call:

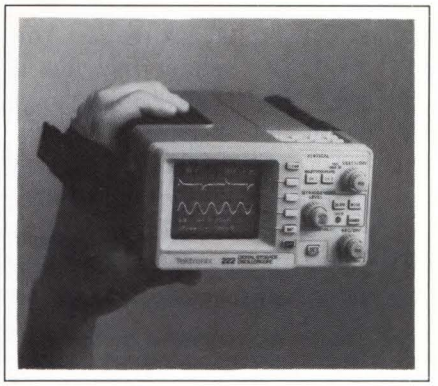
Arrow Electronics:

Industrial OEM	**1-800-777-ARROW**
Commercial Resellers	**1-800-323-4373**

Anthem Electronics:

Northwest Region	**1-800-359-3502**
Central Region	**1-800-359-3517**
Eastern Region	**1-800-359-3511**
Southwest Region	**1-800-359-3501**

Instruments



HANDHELD DSO

The 222 digital-storage oscilloscope (DSO) has a 10-MHz bandwidth and is small enough to fit in your toolbox. With its built-in battery, the scope weighs 4½ lbs and measures 3½ × 6¼ × 10 in. Each of the two y-axis inputs is ohmically isolated from the other input and the chassis. The scope samples to 8-bit precision at 10M samples/sec; at fast sweep speeds, it automatically switches to equivalent time sampling. Despite its small size, the 222 incorporates many conveniences found in full-size DSOs—for example, storage and recall of control setups. An RS-232C port allows you to control the scope from a remote terminal or computer and lets you upload captured waveforms. $2350.

Tektronix Inc, Box 1700, Beaverton, OR 97075. Phone (800) 426-2200.

Circle No 679

VXIBUS COMPUTER

The EPC-2 is a complete 80386-based personal computer in a double-width, C-size VXIbus (VME-bus extensions for instrumentation) module. The plug-in unit includes a 1.44M-byte 3½-in. floppy-disk drive, a 40M-byte SCSI-interfaced hard disk, a CRT controller that conforms to the VGA (video graphics array) standard, a parallel port, two RS-232C serial ports, a keyboard port, and an IEEE-488 port. The unit can combine the functions of a system controller, a VXI slot 0 device, and an IEEE-488 bus con-

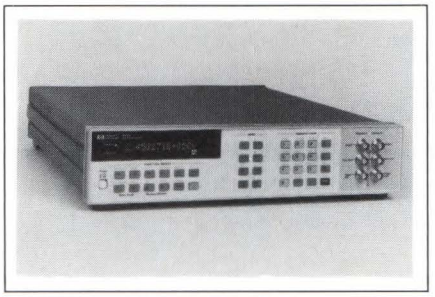
troller. In a package called the EPC-2000, the vendor includes a keyboard, MS-DOS 3.3, Windows/386, a link for migration of programs from a PC to the EPC-2, and a group of software packages collectively called EPConnect 2.0. EPConnect defines a human interface and a program interface to the VXIbus. It provides both development and run-time support. EPC-2000, $9550.

Radix Microsystems Inc, 19545 NW Von Neumann Dr, Beaverton, OR 97006. Phone (800) 950-0044.

Circle No 680

UNIVERSAL SOURCE

The HP 3245A combines a bipolar dc voltage/current source with an arbitrary-waveform generator that has a 4.3-MHz sample rate and produces 1-MHz waveforms. You can set the dc outputs with 6½-digit



precision. Maximum voltage is ±10.25V and maximum current is ±100 mA. You can define waveforms with as many as 2048 points and store multiple waveforms in nonvolatile RAM. An optional software package includes a library of standard waveforms and facilitates waveform definition, capture, modification and playback. With one channel, $4200; with two channels, $6700; software, $400.

Hewlett-Packard Co, 19310 Pruneridge Ave, Cupertino, CA 95014. Phone (800) 752-0900.

Circle No 681

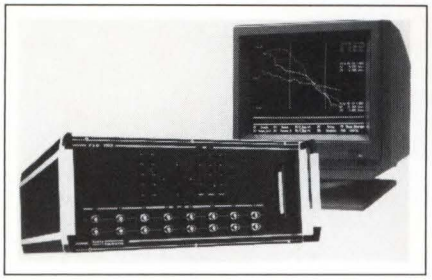
1M-BIT DRAM TESTER

The RAMcheck 1-Meg Adapter works with the vendor's RAMcheck tester and Speed Verifier to perform functional and dynamic tests on 1M-bit dynamic RAMs configured both as 1M-bit×1 and 256k-bit×4 devices. The 3×5.5×1.5-in. adapter, which weighs <1 lb, connects to the similarly sized RAMcheck unit. It automatically identifies the type of device you place in its zero-insertion-force socket, then performs a test in 4 to 7 sec. A 7-segment LED display on the RAMcheck unit indicates the device's condition. When used with the speed verifier, the adapter and the RAMcheck unit permit you to determine a device's access time. $199.

Innoventions Inc, 11000 Stancliff Rd, Suite 150, Houston, TX 77099. Phone (713) 879-6226.

Circle No 682

Instruments



8-CHANNEL DSO

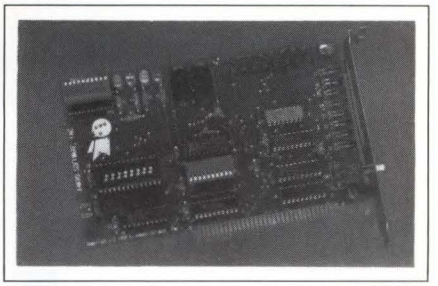
The PSO 7010 8-channel waveform digitizer incorporates a 10-MHz, 80286-based PC and includes a 14-in. high-resolution color monitor, thus creating an 8-channel digital storage scope. The system can include as much as 8M words of waveform memory; word length can be 8, 10, or 12 bits. The maximum sampling rate is 20M samples/sec. The unit includes a 1.44M-byte 3½-in. floppy-disk drive and can run all MS-DOS-based software, including programs that perform mathematical operations on stored waveforms. Such operations include addition, subtraction, multiplication, division, integration, smoothing, and computation of FFTs. $10,000 to $18,000. Delivery, four to six weeks ARO.

Krenz Electronics, 940 Calle Amanecer, Suite P, San Clemente, CA 92672. Phone (714) 361-6866. FAX 714-361-6867.

Circle No 683

PC TESTER

The Postcard is a half-length card that plugs into the IBM PC bus and performs a series of power-on self-test routines that pinpoint problems in "dead" PCs—even in ones that won't load the DOS. One of the routines is a burn-in loop that runs continuously to locate intermittent problems. The card works in IBM PCs, PC/XTs, PC/ATs, PS/2 Model 30, PS/2 Model 30 286, and 80386-based systems. It is compatible with the vendor's Modular BIOS (basic input/output system) and the BIOS of another vendor. Extended diagnostics test a computer's base memory, video functions, rigid and flexible disk drives, parallel and serial ports, keyboard, math coprocessor, and extended memory. $399.



Award Software Inc, 130 Knowles Dr, Los Gatos, CA 95030. Phone (408) 370-7979. FAX 408-370-3399.

Circle No 684

COMPUTERS AND PERIPHERALS

Add-in graphics boards

available for three major buses

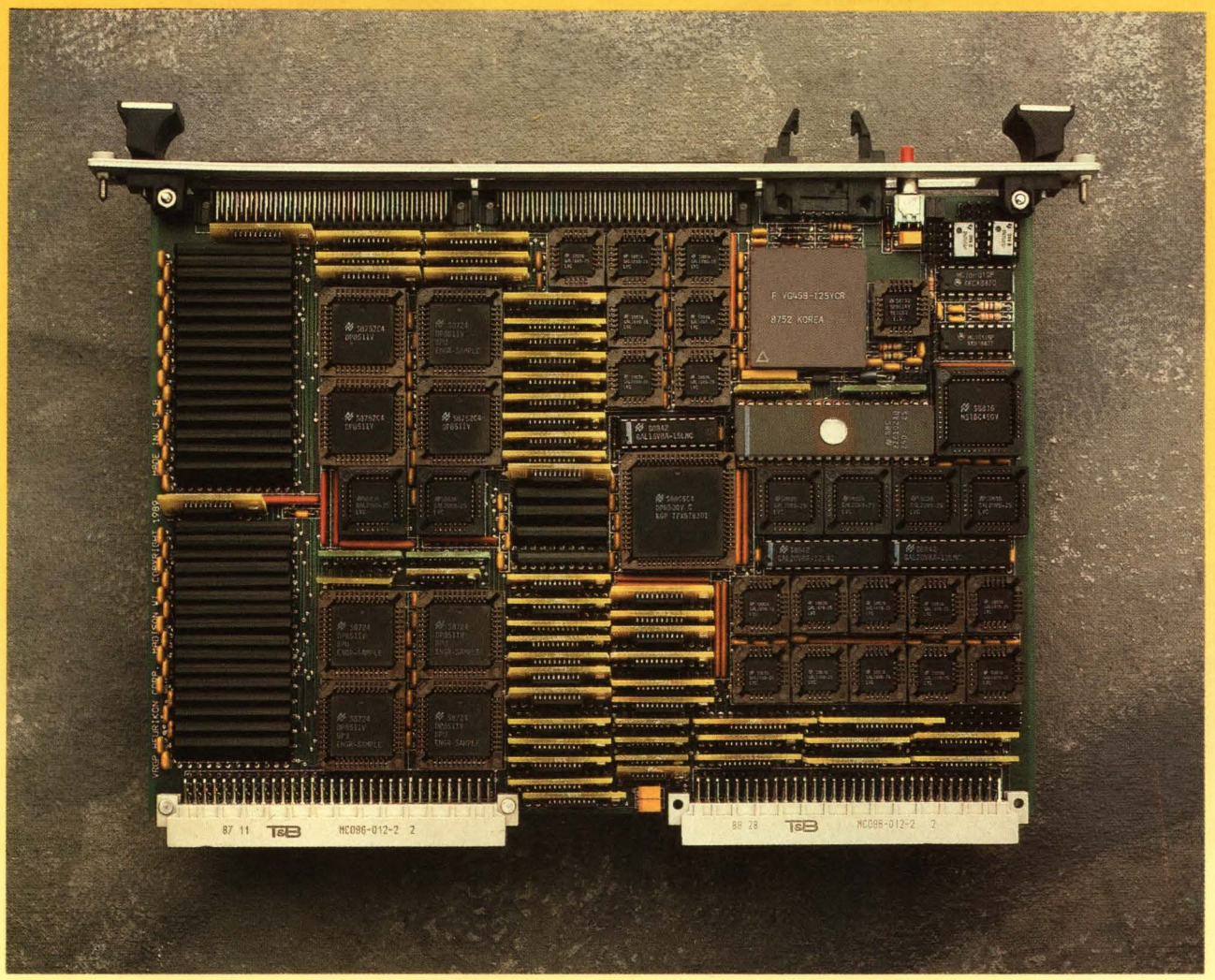
Margery Conner, Regional Editor

As powerful microprocessors such as the 80386 and 68030 become commonplace in PC/AT-bus, VMEbus, and Multibus I and II systems, these systems require equally powerful graphics boards.

A year ago, you had next-to-no boards to choose from if you needed a fast, high-resolution graphics processor for your VMEbus or Multibus I or II system: These chips were mostly found on graphics boards designed for the PC/AT bus. But today you can choose from a wealth of fast, high-resolution graphics boards for all three buses.

Deciding on a board for the PC/AT bus may be more difficult than for the other buses due to the expected emergence of the 8514/A adapter board as an industry graphics standard by the end of this year. (For a representative list of add-in graphics boards for the PC/AT bus, see **Table 1.**) This board offers 256 colors and a resolution of 1024×768 pixels—specs that are respectable rather than impressive. But 1000×1000 pixels is probably the minimum resolution practical for workstation-based CAD/CAE applications, and the 8514/A's specs mark the first time a resolution approaching this minimum has been available as an industry-accepted standard for IBM-compatible PCs.

And standards mean everything when it comes to ensuring a board's success in the PC/AT-graphics market. Consider, for example, that PC/AT-bus graphics boards based on Texas Instruments' TMS34010 graphics processor have been available for more than 18 months, yet none of the graphics software interfaces for the boards—from such respected graphics companies as Number Nine, Matrox, and Graphic Software Systems (Beaverton, OR)—has become a widely accepted graphics standard. Texas Instruments, no doubt seeing this lack of a software-interface standard as



VMEbus 1024 × 1024-pixel, 256-color board, based on National Semiconductor's RGP graphics-processor chip set (Heurikon Corp)

limiting sales of 34010-based boards, has responded by developing the Texas Instruments Graphics Architecture (TIGA).

TIGA comprises a library of graphics primitives—such as drawing a circle—for the 34010. Because the 34010 is programmable, it can command display hardware to draw a circle in an almost unlimited number of ways. This capability gives you great flexibility but makes writing the interface between an application program and the 34010 processor a formidable task. By standardizing graphics primitives in TIGA, TI has made porting the 34010 to application programs a straightforward task.

You can hedge your bet on the probable 8514/A standard by using TIGA with TI's 8514/A emulation software: 34010-based boards running the TIGA interface and 8514/A emulation software will appear to 8514/A application software to be 8514/A boards. You can expect to hear multitudes of claims from the 8514/A-clone manufacturers that the hardware copy of the board is faster than the software emulation and counterclaims from TI that using TIGA and 8514/A emulation software results in unlimited flexibility and no appreciable speed loss. Regardless of how or if these claims are resolved, the 34010 emulation

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TABLE 1—REPRESENTATIVE HIGH-RESOLUTION GRAPHICS BOARDS FOR THE PC/AT BUS

MANUFACTURER/BOARD NAME	PIXEL RESOLUTION	COLORS	GRAPHICS* PROCESSOR	MEMORY (BYTES) DISPLAY	MEMORY (BYTES) PROGRAM	PRICE	COMMENTS
ADEX CORP							
MODEL 1005/1010/1020	1024×768	16 OR 256	ACRTC	0.5M–2M		$1680–3482	
MODEL 1210/1220	1280×1024	16 OR 256	ACRTC	1M–2M		$2396–3556	
COMPAQ COMPUTER CORP							
ADVANCED GRAPHICS 1024	1024×768	256	34010	512k VIDEO RAM	128k	$1499	OPTIONAL $599, 512k-BYTE VIDEO RAM.
CONTROL SYSTEMS, INC							
ARTIST TI12	1280×1024	256	34010	1.25M VIDEO RAM	0.5M	$4259–5495	
ARTIST DESIGNER 16	1280×1024	1	34010	1.25M VIDEO RAM	640k	$4295	
ARTIST XJ10	1024×768	16 OR 256	ACRTC	1M–1.5M		$2695–3795	
ARTIST XJ12	1280×1024	16 OR 256	ACRTC	1M–2M		$3495–5995	
ARTIST TI10	1024×768	16 OR 256	34010	1M–1.5M		$2995–3095	
ENERTRONICS RESEARCH INC							
AUTOROUTE 1024	1024×768	256	34010	1M VIDEO RAM		$1495	$1795 WITH VGA OPTION.
GENDA SYSTEMS CORP							
SUPER HGA	1024×768	256	34010	1M VIDEO RAM	256k	$1895	
IMAGRAPH CORP							
TI1210 SERIES	1280×1024	16 OR 256	34010	1.25M+ OVERLAY	512k–4M	$3235–4195	
IMAGE 32	1024×1024	16.7M	ACRTC	4M		$8995	USES 1M-BIT DYNAMIC RAMS.
MATROX ELECTRONIC SYSTEMS LTD							
PG-1024	1024×768	16 OR 256	34010	512k	512k	$2820–3145	
SM-1024	1280×1024	256	34010	1M	2.5M	$6995	
PG-1281	1280×1024	16 OR 256	34010	1M	1.5M	$3995–4595	2-D GRAPHICS BOARD; CAN BE UPGRADED TO 3-D.
SM-1281	1280×1024	256	34010	2M	2.5M	$8495–8995	3-D GRAPHICS BOARD.
MICROFIELD GRAPHICS INC							
V8	1280×1024	256	2901	2M		$4495	VGA-COMPATIBLE. CUSTOM CHIP PERFORMS BITBLTS.
T8B	1280×1024	256	2901	2M		$3595	EGA-COMPATIBLE. INTERLACED AND NONINTERLACED.
T8A	1280×1024	256	2901	2M		$3495	INTERLACED AND NONINTERLACED.
MICROWAY CORP							
VIDEOPUTER	1024×1024	256	34010	1M	1M–4M	$4995	BOARD ALSO HAS T800 TRANSPUTER THAT SHARES RAM WITH 34010. REQUIRES A MONOPUTER (T800-BASED BOARD) IN SYSTEM.
NUMBER NINE COMPUTER CORP							
PEPPER PRO1024	1024×768	256	34010	1M	0.5M–1M	$2495	ALSO AVAILABLE FOR MICROCHANNEL BUS.
PEPPER 1600	1600×1200	256	34010	1M–4M	1M–4M	FROM $1895	
PEPPER PRO1280	1280×1024	256	34010	1.25M		FROM $2995	
PEPPER SGT PLUS	1280×768	16 OR 256	34010	1M–4M		FROM $1995	VGA PASS-THROUGH.
OMNICOMP GRAPHICS CORP							
OMNI 1400 GDC	1280×1024	256	ACRTC	FROM 1M		FROM $1795	SUPPORTS CGA.
OMNI 1600 GDC	1280×1024	256	ACRTC	FROM 1M		FROM $2145	MULTIPLE OVERLAY PLANES; 16X ZOOM MODEL 1620 SUPPORTS TRUE COLOR WITH AS MANY AS 24 BIT PLANES.

Graphics boards based on the 34010 have been available for the PC/AT bus for more than a year, but no graphics interface has emerged as an industry standard.

TABLE 1—REPRESENTATIVE HIGH-RESOLUTION GRAPHICS BOARDS FOR THE PC/AT BUS (CONT.)

MANUFACTURER/BOARD NAME	PIXEL RESOLUTION	COLORS	GRAPHICS* PROCESSOR	MEMORY (BYTES) DISPLAY	MEMORY (BYTES) PROGRAM	PRICE	COMMENTS
PARACOM INC							
GDS	1024×768	256	T800	1M	1M	$5090–5590	PRICE DEPENDS ON T800 CLOCK SPEED.
PARALLAX GRAPHICS INC							
VIPER	1280×1024	256	16-BIT PROPRIE-TARY	4M		$5495	VGA EMULATION, OPTIONAL VIDEO-INPUT CARD.
PIXELAB							
GC-1280	1280×1024	16	34010	1M VIDEO RAM	0.5M–1.5M	$3300	
GM-1664	1664×1200	1	34010	384k VIDEO RAM	0.5M–1M, 1.5M	$2600	
RENAISSANCE GRX INC							
RENDITION II	1024×768	256	34010	1M	512k	$1495–2395	VGA OPTION; TIGA INTERFACE.
VECTRIX CORP							
PEPE	1024×1024	16	PROPRIE-TARY	0.5M		$2950	
PRESTO	1280×1024	16 OR 256	34010	1.2M	0.5M	FROM $3145	OPTIONAL $850 LINE-DRAW-ACCELERATOR ASIC.
VX1024	1024×768	16 OR 256	34010	768k	0.5M	FROM $1495	$350 VGA OPTION.
WESTERN DIGITAL IMAGING							
VERTICOM MX SERIES	1024×768	16 OR 256	34010	384k–768k	256k–512k	$1695–2095	VGA COMPATIBLE.

*ACRTC=HITACHI'S HD63484, 34010=TEXAS INSTRUMENTS' TMS34010, 2901=AMD'S 2901 BIT-SLICE PROCESSOR, T800=INMOS'S T800 TRANSPUTER.

of the 8514/A is the most practical way, short of purchasing an original and expensive IBM 8514/A adapter board, of ensuring 8514/A compatibility for your PC/AT-bus system.

Manufacturers of 34010-based boards vary in their support of TIGA. Some, such as Compaq, simply say that their boards will run under TIGA, but the buyer must purchase TIGA and install it. Other vendors, such as Omnicomp, enthusiastically embrace TIGA. Omnicomp is even considering making TIGA the standard interface for all its 34010-based boards. But regardless of manufacturers' support, you can usually assume that a 34010-based board will run TIGA.

Another graphics IC that's popular for PC/AT-bus add-in graphics boards is Hitachi's (San Jose, CA) ACRTC. One of the first intelligent graphics controllers, the ACRTC is a hard-wired graphics processor—that is, the processor can implement a graphics primitive, such as drawing a line or a circle, in only one way. Because the graphics primitives are hard-wired, ACRTC-based boards can create shapes at high speeds—often as fast as 34010-based boards. However, ACRTC graphics primitives cannot be modified, unlike those of programmable graphics processors, such as the 34010.

The 34010 and the ACRTC are also the most popular processors for VMEbus systems. (For a representative list of add-in graphics boards for the VMEbus, see **Table 2.**) These aren't the only two processors available, however. The Heurikon HK85/VGRP board, for example, uses National Semiconductor's (Santa Clara, CA) Advanced Graphics Chip Set (AGCS). This chip set has a master raster graphics processor and one bitblit (bit block transfer) processing unit (BPU) per bit plane. The dedication of one BPU per bit plane enables the processor to run at very fast speeds for applications, such as bitblits, that benefit from a parallel rather than a serial architecture.

One graphics board designed for VMEbus systems,

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TABLE 2—REPRESENTATIVE HIGH-RESOLUTION GRAPHICS BOARDS FOR THE VMEBUS

MANUFACTURER/BOARD NAME	PIXEL RESOLUTION	COLORS	GRAPHICS* PROCESSOR	MEMORY (BYTES) DISPLAY	MEMORY (BYTES) PROGRAM	PRICE	COMMENTS
AMERICAN ELTEC							
OPAC	1280 x 1024	16 OR 256	2 QPDMs	2M		$4600 OR $5600	THREE OPACs CAN BE CASCADED TO PROVIDE 24 BITS OF COLOR.
HRG-2	1024 x 2048	16	7220	1M		$1700	
PIG	1024 x 1024	256	ACRTC	2M		$2800-4900	
EUROPEL SYSTEMS							
OPAL 2	2048 x 2048	256	68020	2M		$8500	
FORCE COMPUTERS INC							
AGC-2	1024 x 800	16	ACRTC	1M		$2995	
GRAPHIC STRATEGIES INC							
VGME-34010	1280 x 1024	256	34010	2M	2M	$5495	
VGME-6408	1024 x 1024	256	ACRTC	1M		$2995-3495	
VGME-1024	1024 x 1024	16	7220	1M		$2295	
GREEN SPRING COMPUTERS INC							
VME 360	1024 x 1024	16	34061	512k		$625-850	SINGLE-HEIGHT BOARD.
HEURIKON INC							
HK85/VGRP	1024 x 1024	256	AGCS	1M	0.5M	$4295	AS MANY AS THREE BOARDS CAN BE CASCADED.
IMAGRAPH CORP							
VME GRAPHIC PLUS SERIES	1280 x 1024 (MAX)	16 OR 256	ACRTC	2.5M		$5195-5495	
INTEGRATED SOLUTIONS INC							
VME-GCC	1280 x 1024	16	29116	1M		$3695	2-BOARD SET
VME-GCM	1280 x 1024	1	29116	0.5M		$2795	2-BOARD SET
IRONICS INC							
IV-1651	1024 x 1024	16	7220	0.5M		$1035	
LITTLE MACHINES INC							
VVG/IP	1024 x 768	256	34010	364k VIDEO RAM	2M-4M	$1675-3675	TWO ONBOARD PROMS CAN STORE USER PROGRAMS.
MATROX INC							
VG-1281	1280 x 1024	256	34010	2M-4M	1M	$5495-7495	
METACOMP INC							
1280V-GDS	1280 x 1024	16 OR 256	QPDM	2M	2M	$6980	2-BOARD SET INCLUDES ONBOARD 68020.
1280V-GDP	1280 x 1024	16 OR 256	QPDM	2M		$3525	
MOTOROLA INC							
MVME395	1280 x 1024	256	34010	2M	0.5M	$4995	
MVME393	1024 x 2048 (MAX)	16	34010	2.5M		$2495	CONTROLS A MAXIMUM OF FOUR GRAPHICS DISPLAYS.
OMNICOMP GRAPHICS CORP							
OMNI 8600 GDC	1600 x 1280	256	34020	7M	1M	FROM $6220	
PARACOM INC							
GDS	1024 x 768	256	T800	1M	1M	$5090-5590	PARALLEL PROCESSING ARCHITECTURE REQUIRES $595 BUS ADAPTER.
PARALLAX GRAPHICS INC							
VIPER	1280 x 1024	256	16-BIT PROPRIETARY PROCESSOR	4M		$5795	OPTIONAL VIDEO INPUT CARD AVAILABLE.
PSI-TECH INC							
VME/2T	1280 x 1024	256	68020	1.3M	1M	$7000	2-BOARD SET, SECOND 68020 HANDLES I/O.
RASTER GRAPHICS INC							
RG703	1024 x 768	256	34010	0.5M		$2595	
TADPOLE TECHNOLOGY INC							
TPAGCV	1280 x 1024	256	TWO QPDMs	4M		$9995	

*34010=TEXAS INSTRUMENTS' TMS34010, 34020=TEXAS INSTRUMENTS' TMS34020, ACRTC=HITACHI'S HD63484, AGCS=NATIONAL SEMICONDUCTOR'S RGP AND BPU, QPDM=AMD'S AM95C60, 7220=NEC7220, 34061=TEXAS INSTRUMENT'S TMS34061, 68020=MOTOROLA'S 68020, T800=INMOS'S T800 TRANSPUTER, 29116=AMD'S AM29116.

For more information . . .

For more information on graphics boards such as those discussed in this article, circle the appropriate numbers on the Information Retrieval Service card or use EDN's Express Request service. When you contact any of the following manufacturers directly, please let them know you saw their products in EDN.

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Ironics Inc
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FAX 607-272-5787
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Little Machines
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Canada H9P 2T4
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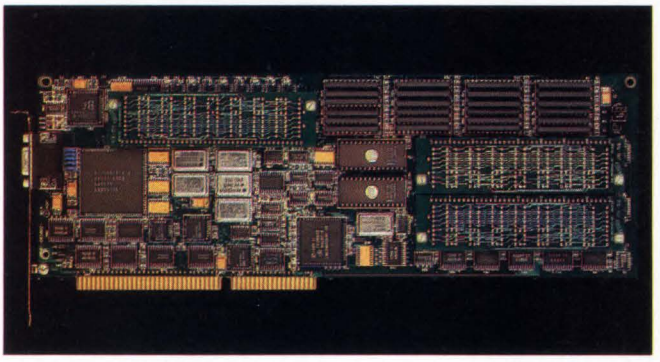
TABLE 3—REPRESENTATIVE HIGH-RESOLUTION GRAPHICS BOARDS FOR MULTIBUS I AND II

MANUFACTURER/ BOARD NAME	MULTIBUS I	MULTIBUS II	PIXEL RESOLUTION	COLORS	GRAPHICS* PROCESSOR	MEMORY (BYTES) DISPLAY	MEMORY (BYTES) PROGRAM	PRICE	COMMENTS
LITTLE MACHINES VG-IP	✓		1024×768	16	34010	384k	4M (MAX)	$1375-3375	
MATROX MG-1281	✓		1280×1024	256	34010	2M-4M	1M	$5220	
MMG-1281		✓	1280×1024	256	34010	2M-4M	1M	$6495-8495	
MICRO INDUSTRIES OME 171		✓	1280×1024	256	34010	2M	1M	$5000	
OMNICOMP GRAPHICS CORP 2400 GDS		✓	1280×1024	256	ACRTC	1M-8M		$13860	2-BOARD SET, GRAPHICS DATABASE MANAGER HARDWARE OPTIONAL.
RASTER GRAPHICS INC RG 653	✓		1024×768	256	34010	0.8M	0.5M	$2595	TWO OPTIONAL OVERLAY PLANES.
RG 503		✓	1024×768	256	34010	0.8M	256k	$3495	TWO OPTIONAL OVERLAY PLANES.

*34010=TEXAS INSTRUMENTS' TMS34010, 68020=MOTOROLA'S 68020, ACRTC=HITACHI'S HD63484.



PC/AT bus 1024×768-pixel, 256-color graphics board, based on the TMS34010 graphics processor (Western Digital Imaging)

Omnicomp Graphics's 8600 GDC, is the only one that boasts the new TMS34020 graphics processor. The 34020 is the next generation of the 34010 and maintains software compatibility with its predecessor. The chip has 32-bit-wide data and address buses and implements bitblits in hardware—the 34010's software bitblits were criticized by some graphics programmers as too slow. If your application requires floating-point calculations, consider the 8600 GDC's optional TMS34082 40M-flops floating-point coprocessor.

Multibus I and II have a smaller selection of boards than the other buses. (For a representative list of add-in graphics boards for Multibus I and II, see **Table 3.**) CAD/CAE demands fuel the need for more powerful systems processors and, consequently, for correspondingly powerful graphics boards. The smaller selection of high-resolution graphics boards for Multibus I and II is due to the fact that, unlike the PC/AT bus and VMEbus, there are no workstations based on these buses to demand higher resolutions for CAD/CAE work.

Because of the probable emergence of the 8514/A as a graphics standard and the huge number of PC/AT-bus-based systems, you can expect to see the 8514/A's resolution of 1024×768 pixels become popular for VMEbus- and Multibus I- and II-based systems as well. And as the 8514/A becomes a standard, its price—as well as the price of 8514/A clones and other graphics boards with comparable resolutions—should drop.

EDN

References

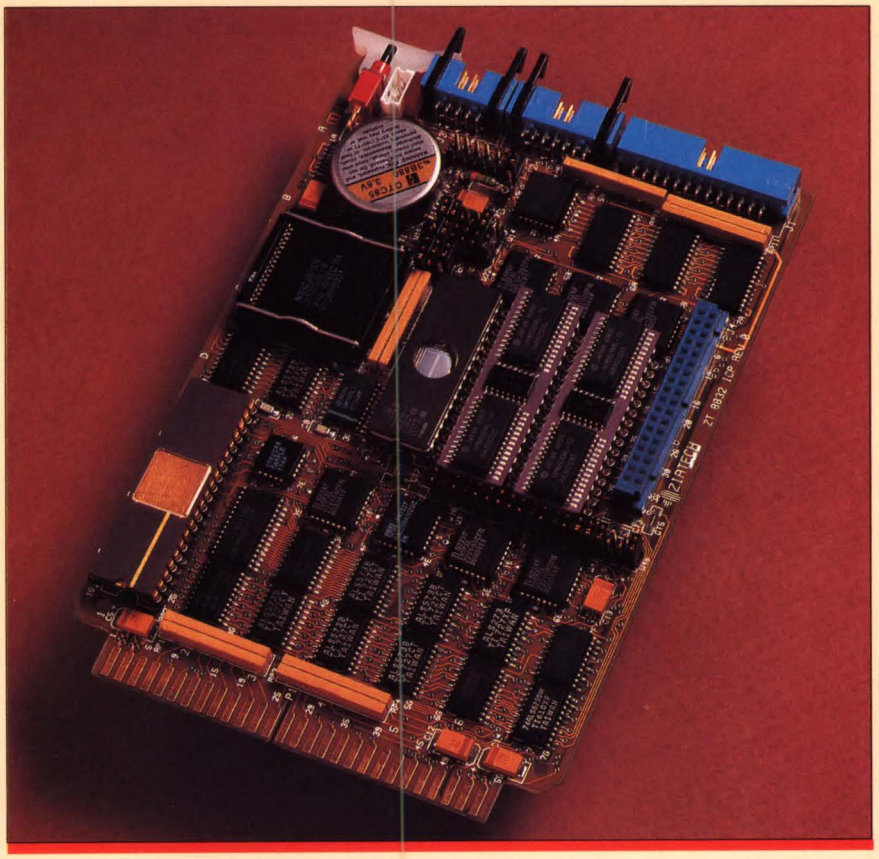
1. VMEbus International Trade Association, "VMEbus Compatible Products Directory," October 1988.
2. "TMS34010 Third Party Guide," Texas Instruments, Dallas, TX, January 1989.
3. Conner, Margery, "Graphics engines," *EDN*, March 4, 1987, pg 112.

ZIATECH CORPORATION

CONTROL POINT

Test and Control Product News from Ziatech Corporation Summer, 1989

STD MULTIPROCESSING BOOSTS PERFORMANCE



Ziatech's new ZT 8832 I/O Control Processor

New Ziatech Multiprocessor Advances STD Bus Control System Capabilities

Ziatech's new STD Bus single board multiprocessing computer and DOS Multiprocessing Extension (DOS MPX) software bring more performance, control, modularity and development flexibility to control applications.

MORE PERFORMANCE

Multiprocessing brings more performance to demanding STD applications by partitioning control systems functions into smaller functions assigned to individual multiprocessors.

Ziatech's new multiprocessor features a large complement of on-board I/O and communicates

(Continued on page 3)

New Single Board PLC Takes the Shape of STD Bus

Ziatech now offers the functionality of a programmable logic controller (PLC) in the compact and cost-effective STD Bus format.

NEW PRODUCT

The company's new Single Board PLC is equipped with 86-LADDER, a high performance ladder logic program from Wizdom Systems. This Allen–Bradley PLC-compatible

(Continued on page 2)

INSIDE

ZIATECH CORPORATION

New Single Board PLC is Fast and Flexible Controller

(Continued from page 1)

program enables the Ziatech Single Board PLC to run faster than conventional PLCs while providing on-line programming, editing, execution and documentation.

LOW COST ALTERNATIVE

This Single Board PLC provides a low-cost alternative to PLCs because it utilizes Ziatech's rugged, low cost STD Bus industrial computers, which are equipped with IBM PC DOS and can run software like 86-LADDER.

SEVERAL COMPUTER CONFIGURATIONS

This industrial computer is available in several configurations, depending upon the control application's requirements.

The Single Board PLC can be purchased in a small STD card cage for embedded applications, or in a panel-mount, a rack-mount or a NEMA 4/12-compatible enclosure.

For more information, check the SBC PLC/86-LADDER box on the return card.

LADDER LOGIC SOFTWARE PROVIDES ALTERNATIVE TO PLCS

Ziatech Corporation has joined forces with Wizdom Systems, the maker of the popular 86-LADDER software package to give control system integrators an exciting alternative to programmable logic controllers (PLCs).

ALLEN-BRADLEY COMPATIBLE

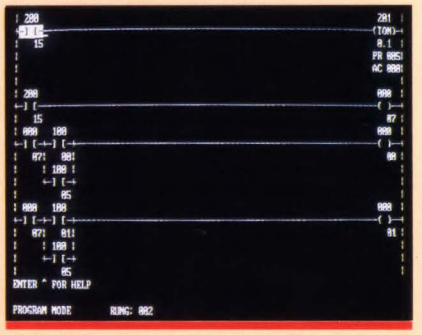
86-LADDER is a family of stand-alone software packages that operates like an Allen-Bradley PLC. The software provides on-line programming ability for Ziatech's STD Bus industrial computers.

FAMILIAR TO WORK FORCE

86-LADDER is intended for control applications where ladder logic is already understood by the work force. This allows use of existing programs and enables trained personnel to quickly develop, test and document factory control systems.

COST REDUCTION

Through its use of the industry standard STD Bus, 86-LADDER can provide a significant cost reduction when compared to a PLC. At the same time, this ladder logic program offers more flexibilty and better performance than its PLC counterparts. The universal compatibility and modularity of the STD Bus platform make this approach especially attractive.



Ladder logic software displayed on the screen of a Ziatech industrial computer.

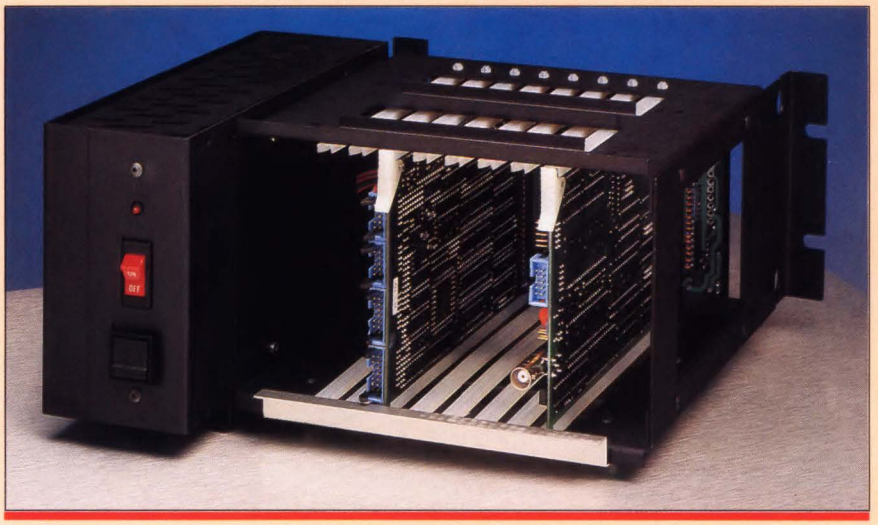
RUNS ON ZIATECH COMPUTERS

The software environment does not require a special PLC programming terminal. It will use any DOS-based computer such as a PC or Ziatech's ZT 1000 Industrial Workstation as the programming and execution device. 86-LADDER supports standard industrial I/O like Opto 22, Digitronics, etc., so a user isn't locked into specific hardware.

ON-LINE DOCUMENTATION

86-LADDER uniquely accepts on-line written comments within the programming environment and produces a "hard copy" printout, keeping the documented version consistent with the actual version running.

For more information, check the SBC PLC/86-LADDER box on the return card.



Ziatech's ZT 200 Embedded Computer emulates a programmable logic controller when running 86-LADDER.

NEW MULTIPROCESSOR FEATURES DOS MPX SOFTWARE FOR FAST DEVELOPMENT, USER INTERFACE

(Continued from page 1)

with the STD system's master processor through shared memory. This technique maximizes the performance of I/O-intensive applications because the master processor delegates tasks through memory and doesn't have to compete with other processors for STD backplane access.

COMPACT STD FORMAT

The new ZT 8832 I/O Control Processor's (ICP) surface mount design features a V40 processor, 800K on-board memory capacity, a math coprocessor option, an SBX expansion socket, three parallel ports, and two serial ports on the compact STD Bus format.

MORE CONTROL

The use of multiprocessors can be an attractive alternative to multitasking, because instead of relying on complex and expensive software to interleave task execution, the system integrator can dedicate specific ICPs to specific tasks that are literally running simultaneously.

MORE MODULARITY

Ziatech multiprocessing provides a simple approach to upgrading or expanding control system performance. Instead of redesigning an entire application to use a faster processor, ZT 8832 ICPs can be added to provide the performance boost required.

MORE DEVELOPMENT FLEXIBILITY

The development of an ICP-based multiprocessing system is simplified by Ziatech's new DOS Multiprocessing Extension (DOS MPX) software, which supports multiple ICPs as DOS devices. The software package includes a ROM for booting the ICP, an installable device driver for the system's master processor and a loader utility. Another significant component of DOS MPX is the Virtual Processor Console (VPC), which provides a user and runtime interface to the ICPs in a multiprocessing system.

DEVELOP IN HIGH LEVEL LANGUAGE

DOS MPX allows programmers to develop applications in a high level language (C is recommended), download them to the ICP and debug them with PC DOS development software. Because DOS MPX is a DOS extension, the ICPs run as if they are in a DOS system.

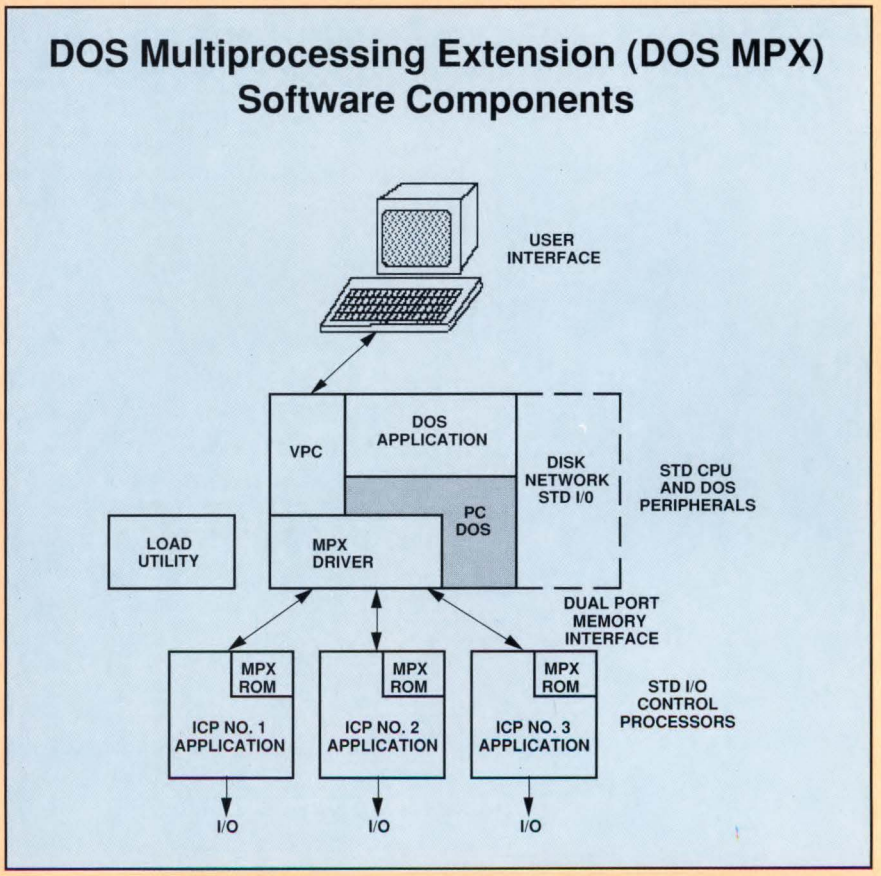
DOS MPX USER INTERFACE

Virtual Processor Console (VPC) allows the system user to toggle via a "hot key" to individual ICP screens for the purpose of viewing application and diagnostic output, and to input data. Soon, VPC will also contain a screen that displays the status of all ICPs in the system.

APPLICATION NOTE

An application note describing the advantages of multiprocessing is available from Ziatech, as well as data sheets on the ZT 8832 ICP and DOS MPX.

For more information, check the ZT8832 ICP box on the return card.



DOS MPX simplifies multiprocessing system development and provides a user interface to multiple processors.

NEW PRODUCTS SERVE REAL-TIME AND RUGGED APPLICATIONS

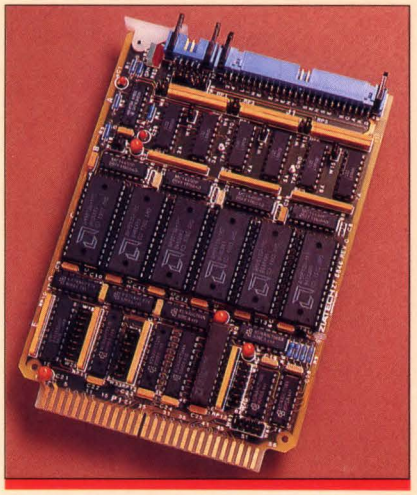
Ziatech continues to add to its line of STD Bus industrial computer products. A round up of recent product releases is featured below.

REAL-TIME EVENT SENSE INTERFACE

This unique STD interface provides high-speed digital I/O for real-time applications. It provides 24 event sense inputs for interfacing STD Bus computers to digital devices of all types.

The ZT 8846 can be programmed to generate interrupts when an event occurs, such as a tripped switch on a material handling conveyor. These interrupts provide an efficient means of signalling an STD Bus processor of real-time events without the burden of polling digital I/O points.

For more information, check the ZT 8846 box on the return card.



ZT 8846 Real-Time
Event Sense Interface

2400 BPS MODEM FOR STD BUS

The ZT 8843 provides full modem capability to STD Bus computers at data rates of 300, 1200, and 2400 bits per second (BPS). Automatic answer capabilities allow for unattended operation, while a speaker interface allows on- or off-board audible phone line monitoring.

This STD modem is compatible with the industry standard Hayes AT Command Set, providing access to a vast range of existing PC communications software.

For more information, check the ZT 8843 box on the return card.

QUAD SERIAL INTERFACE

The ZT 88CT41 provides four RS-232 serial channels to STD Bus systems with two of those channels configurable for RS-422/485. This STD interface features an optical isolation option for the RS- 422/485 channels and a FIFO option for all channels.

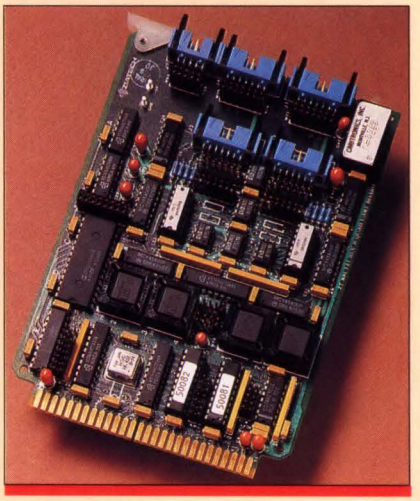
The ZT 88CT41 is a TTL backplane-compatible CMOS interface with low power consumption and an extended temperature operating range of -40° to +85° C for harsh environments.

For more information, check the ZT88CT41 box on the return card.

COMPACT COMPUTER

In addition to the ZT 88CT41 Quad Serial Interface described above, Ziatech also offers a single board computer and a byte-wide memory card that combine TTL-compatible CMOS for low power consumption with an extended temperature operating range (-40° to +85° C) for harsh environments.

The ZT 88CT08 Single Board Computer utilizes the 80C88 microprocessor and contains several IBM PC/XT peripherals and a 520K memory capacity on board.



ZT 88CT41
Quad Serial Interface

EXPANDED MEMORY

The ZT 88CT25 Expanded Memory System provides expanded memory capabilities to STD Bus systems as a PROM disk and/or battery-backed RAM disk, as main memory or as expanded main memory.

For more information, check the CMOS/Extended Temperature Products box on the return card.

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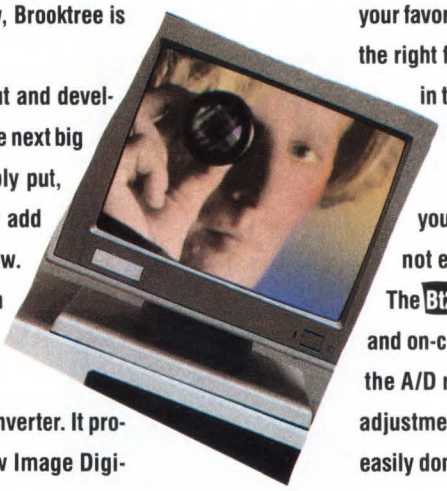

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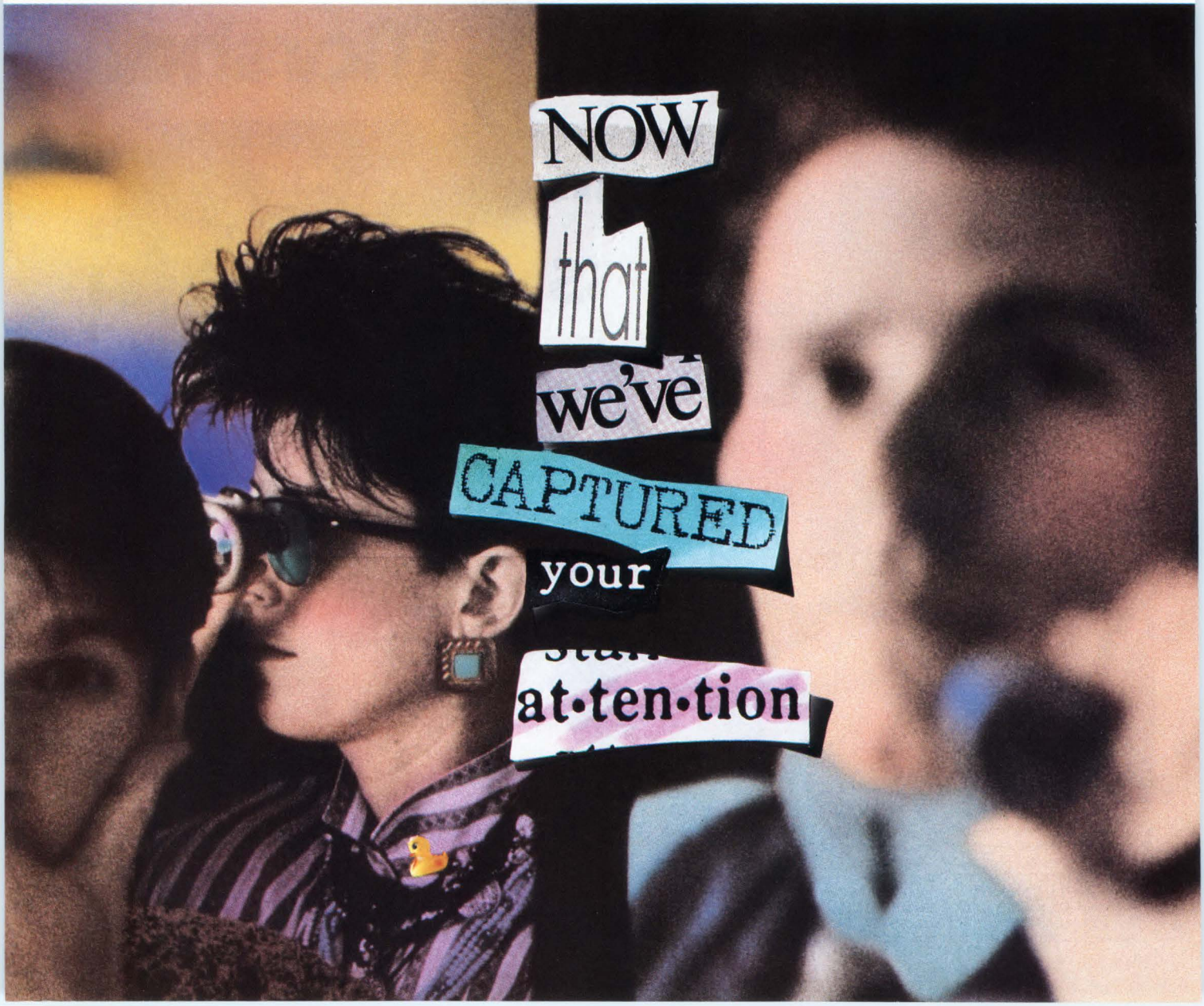

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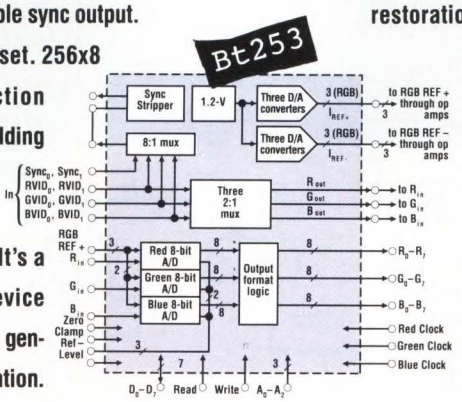

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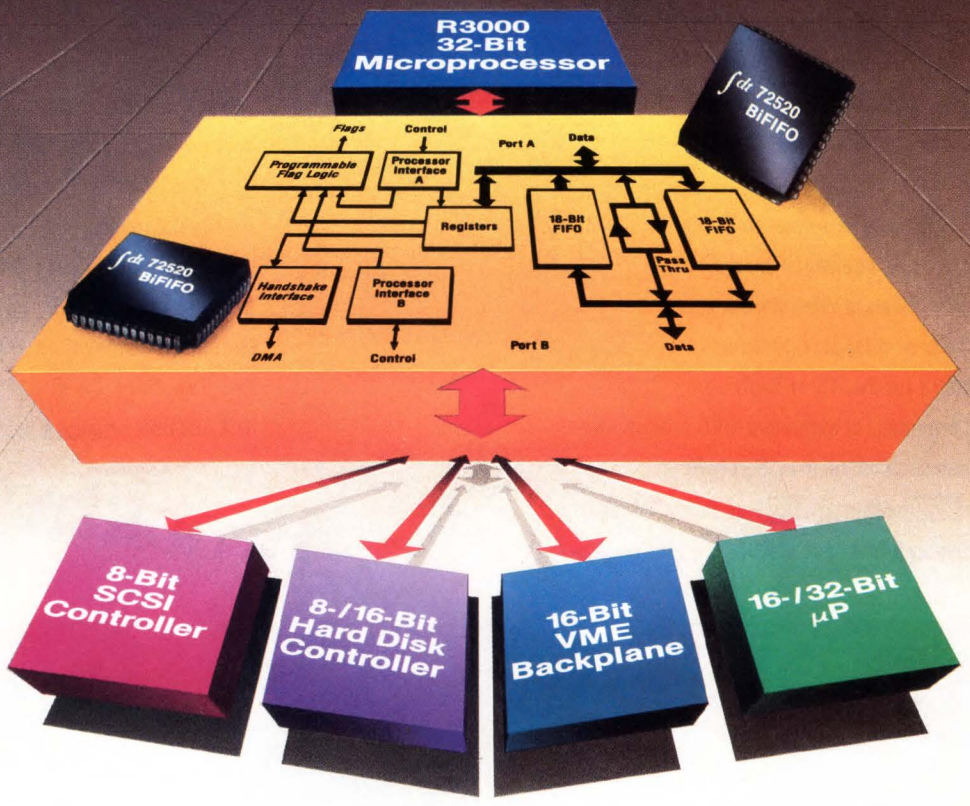
Brooktree

The μP-to-Peripheral Connection



Introducing IDT's BiFIFOs

BiFIFOs bus match efficiently

Applications where a high-performance 32-bit RISC processor must talk to 8- or 16-bit peripheral controllers need IDT's new BiFIFO to minimize system chip count. IDT's bus matching bidirectional FIFOs make the ideal zero wait state connection between state-of-the-art processors and peripherals.

The BiFIFO integrates 18-bit to 9-bit bus matching logic and two full FIFO memories in one chip. Now for the first time a single chip can handle simultaneous communication in both directions. And at 35 ns the BiFIFO meets your processor performance needs.

Programmable configuration interface

Our BiFIFO has a microprocessor interface that gives you control over the BiFIFO's "personality." Ten registers configure features such as programmable flag offset, flag pin assignment, DMA handshake, direct pass-through, and parity.

Flag offset can be programmed to any depth, giving you power over block transfer size and critical interrupts. The BiFIFO's DMA logic manages data block transfers, freeing your microprocessor for other crucial tasks. The pass-through path makes direct processor-to-peripheral command and status communication possible, eliminating external registers and reducing your board size.

Seamless interface for multiprocessing

Making two processors talk is not easy. But IDT's parallel BiFIFO makes the interface seamless, just like its bus matching brother. Multiprocessor arbitration is performed by the BiFIFO, simplifying your overall design. Since both of IDT's new BiFIFOs have the same architecture, whether you are using bus matching or parallel processing, we have the solution for you.

You can count on us

We know what you need. Call our Marketing Hotline at **(408) 492-8675** to find out more about IDT's BiFIFOs. Or call (408) 492-8225 for a free copy of our 1989 Data Book Supplement with information on IDT's full range of high-performance system building blocks including RISC processors, SRAMs, multi-port and FIFO memories, standard and complex logic, and RISC subsystems and modules.

IDT, P.O. Box 58015, 3236 Scott Blvd., Santa Clara, CA 95052-8015, FAX 408-492-8674.

When cost-effective performance counts

∫dt

Integrated Device Technology

CIRCLE NO 76

SIEMENS

Fuel For Thought

20 Mbytes/Sec Advanced DMA For High Speed Engines

Don't let your system run out of gas! Keep your CPU running at top speed with fast Direct Memory Access.

PREMIUM GRADE

The Siemens Advanced DMA co-processor gives your system the kind of accelerated I/O performance it will always need at costs that are hard to beat.

Features	SAB 82257	SAB 82258A
Data Transfer Rate (Mbytes/sec)	8	20
Independent Channels	4	4
Multiplexer Channels	—	32
On-The-Fly Operation	NO	YES
Automatic Command and Data Chaining	NO	YES
Packages	PLCC	PLCC LCC PGA

The SAB 82258A is as fast as they come. It can transfer 32-bit data in single cycle mode at up to 20 Mbytes per second. All while switching between four independent data channels.

EXTRA MILEAGE

With a built-in multiplexer, any one of the four independent channels can control up to 32 separate I/O devices.

And the ADMA co-processor can free the main processor from routine tasks with exclusive operations like on-the-fly verify, compare, translate, and automatic command and data chaining.

FULL SERVICE PUMPS

The ADMA's adaptive bus interface makes it the ideal I/O fuel for any high end 8086/88, 80186/188 or 80286 system. It's a proven device for 32-bit 80386 and 68000/20/30 engines, too.

And an economy model, the SAB 82257, provides solid, fuel efficient performance for simpler 8/16-bit systems.

FILL UP TODAY

For more information and a free ADMA brochure, call: 408-980-4500, ext. 4347. Or fax: 408-980-4529. Or write: Siemens Components, Inc., Microprocessor/Peripheral Marketing Dept., 2191 Laurelwood Road, Santa Clara, CA 95054-1514.

Test driving any other DMA would be thoughtless.

Siemens...Practical Solutions By Design

Distributors: Advent Electronics, Inc., Hall-Mark, Insight Electronics, Marshall, Summit, Western Microtechnology.

CIRCLE NO 77

Can you find the Ap

Anyone looking for the best Electronic Design Automation (EDA) solutions would undoubtedly consider Mentor Graphics, Racal Redac, Cadence or VLSI Technology. Four companies whose superior applications and powerful capabilities place them squarely at the forefront of their markets.

Likewise, when these four industry leaders went looking for the best hardware on which to develop and run their software, they chose Apollo. Discovering that our Series 3500,™ Series 4500™ and Series 10000™ workstations provided ideal platforms for everything from IC layout to full system design.

What appealed to them were the same things that appeal to the thousands of engineers who've come to depend on our machines. They liked our open network-

ollo in this picture?

ing and advanced UNIX® operating system. Qualities that make it easy for developers to work together productively, allowing them to access all the information and processing power needed to get a job done.

They appreciated a complete family of compatible workstations that starts as low as $5490. Assuring solutions to applications as familiar as simulation or as formidable as microwave design.

And they admired system administration features so efficient that even a network with hundreds of users can be managed by just one person.

As you can see, if you're looking for the perfect EDA workstation, you have lots of options. And fortunately all of them are built by Apollo.

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For more information, call 1-800-323-1846 (in MA: 1-800-847-1011) or write Apollo Computer Inc., 270 Billerica Road, Chelmsford, MA 01824.

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FEATURE

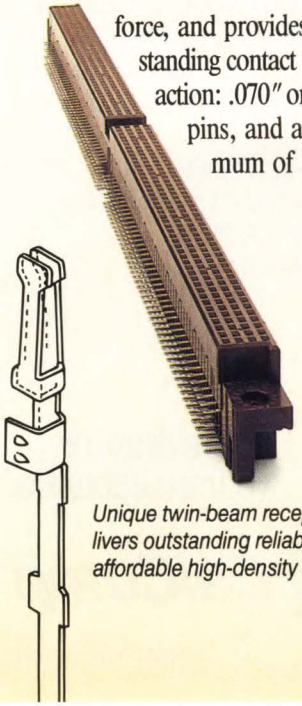
cost reduction."

force, and provides outstanding contact wiping action: .070″ on short pins, and a minimum of .100″ on long. (Coming soon: TBC Plus Connectors, with six rows of contacts and three levels of sequencing.)

AMP TBC Connectors are fully polarized, with closed-entry design to eliminate stubbing, and they come in high-temp materials ready for vapor-phase and IR reflow soldering.

And TBC receptacle assemblies intermate with our popular AMP-HDI pin header assemblies, to give you immediate daughter card cost-reduction, without redesign.

Call 1-800-522-6752 and ask about the AMP TBC Connector Series. AMP Incorporated, Harrisburg, PA 17105-3608.



Unique twin-beam receptacle delivers outstanding reliability in an affordable high-density connector.

AMP Interconnecting ideas

CIRCLE NO 80

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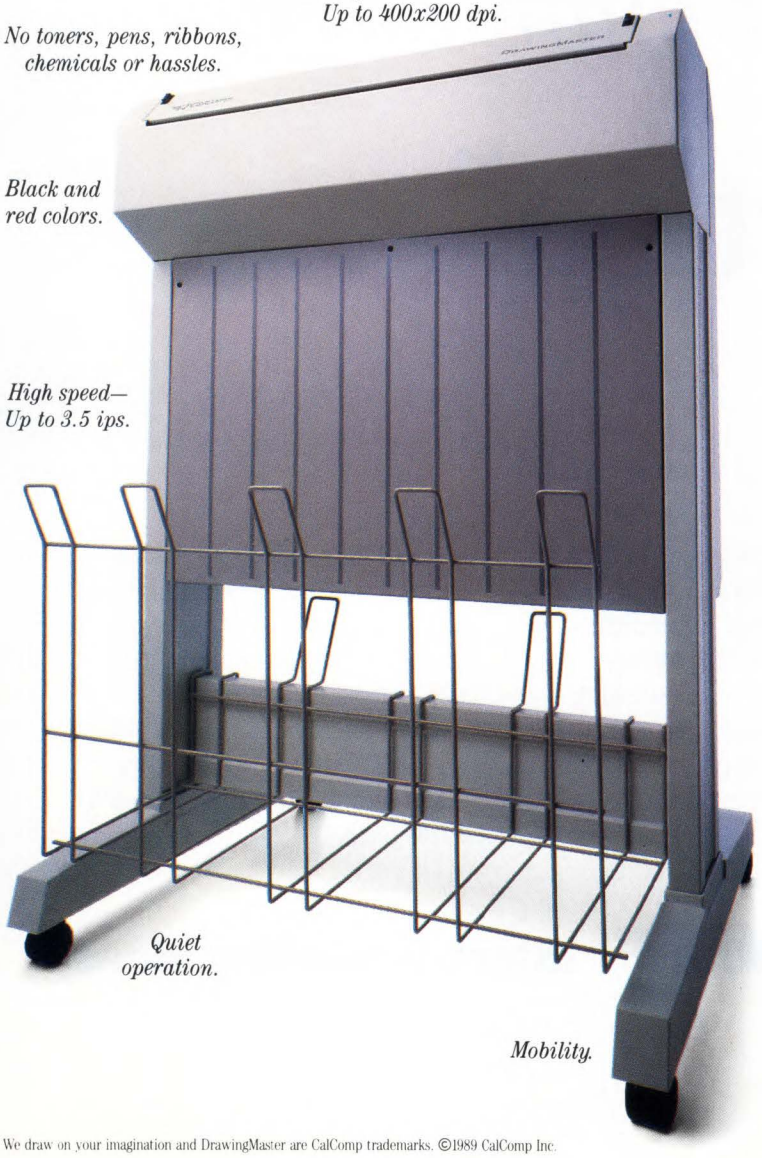
High resolution—
Up to 400x200 dpi.

No toners, pens, ribbons, chemicals or hassles.

Black and red colors.

High speed—
Up to 3.5 ips.



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This one-of-a-kind raster plotter from CalComp breaks all the rules—making it our total output solution for your every design requirement.

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With DrawingMaster also comes CalComp's 30 years of expertise, support and service, complete with an 800 helpline, which, because of the solid performance of DrawingMaster, you'll probably never need.

Like more on this no-fuss wonder?
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We draw on your imagination.™

CalComp

Handheld, pocket-sized computer mimics IBM PC

The IBM PC-compatible Portfolio handheld computer weighs 1 lb and is the same size as a video-tape cassette. The unit, which is MS-DOS compatible, uses a 4.92-MHz 80C88 μP. It has a 128k-byte RAM standard expandable to 640k bytes. Instead of disk drives, the unit uses credit-card sized, quick-access RAM cards that hold either 32k or 128k bytes. The unit also accepts 4M-byte ROM cards, which contain applications programs. You can exchange files with other PCs via a port or dial out over a built-in modem.

The 7.8×4.1×1.2-in. unit has a 63-key PC-like keyboard and offers an 8-line by 40-character LCD. The unit's three AA batteries last one month. The computer's built-in software includes an editor, a Lotus 1-2-3 compatible spreadsheet, an address book with an automatic dialer, a calculator, and a time-triggered appointment reminder. Portfolio costs $400.

Atari Computer, 1196 Borregas Ave, Sunnyvale, CA 94086. Phone (408) 745-2000. FAX 408-745-2088.

Circle No 362

Thumb-actuated, cursor-positioning device provides 2-D axis control in a small space

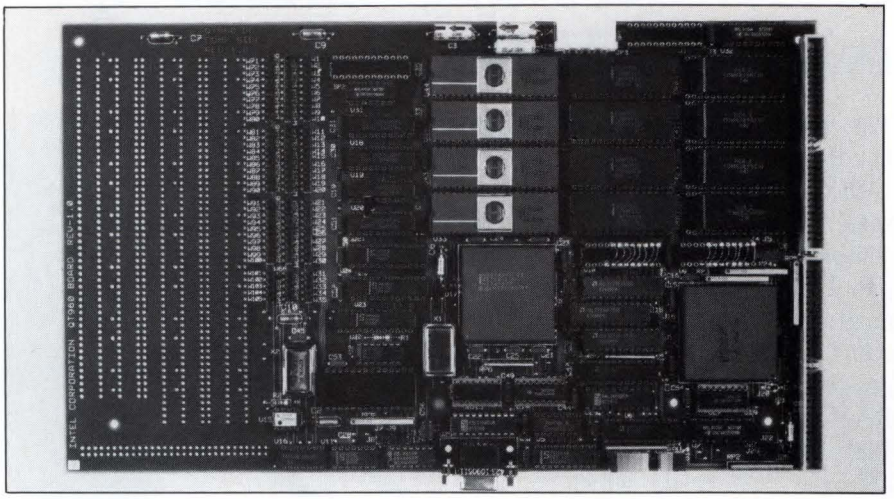
Though it provides functions similar to that of a trackball or mouse, the Isopoint cursor-positioning device requires much less room and, when placed just below a conventional keyboard, allows touch typists to keep their hands near the home row. The Isopoint's design centers around a thin roller coupled to a miniature rotary-shaft encoder that provides one axis of control. You rotate the roller with your thumb or finger to produce a quadrature-output signal from the encoder. The roller rests in a sliding cradle that drives a second encoder through a rack-and-pinion gear train. Thus, you drive the second axis by sliding the cradle back and forth, using the same thumb or finger that you use to turn the roller. The cradle rests on a switch, so you can replicate the click of a mouse button simply by pressing down on the roller assembly.

You can get the Isopoint as an optional device for the company's line of custom keyboards. The company estimates that the Isopoint in OEM quantities would add $30 to the cost of a keyboard.

Alps Electric (USA) Inc, 3553 N First St, San Jose, CA 95134. Phone (408) 432-6000. FAX 408-432-6035.

Circle No 363

Prototyping-board kits feature quasiRISC single-chip μP



The two EVQT960 μP-board kits contain the company's 32-bit, 20-MHz 80960KB quasiRISC processor. The kits include working CPU boards, schematics, programmable-logic equations, and a debugger/monitor. The CPU boards include an onboard prototyping area and a connector.

You can choose a kit from among slightly different 80960KB-based boards. The EVQT960F20 kit costs $1960 and includes 128k bytes of zero-wait-state static RAM and 128k bytes of flash EPROM. The board included in the $960 EVQT960E20 kit hosts 128k bytes of 2-wait-state static RAM and sockets for 128k bytes of EPROM. The boards include a programmable wait-state generator that allows you to simulate different memory-subsystem architectures.

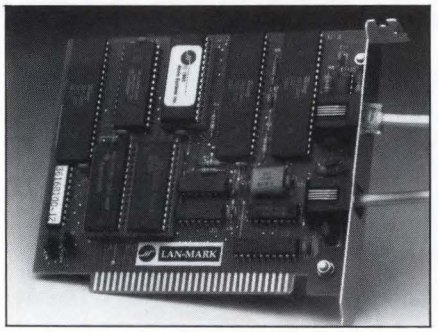
Other features include an RS-232C port and eight DMA channels. You power the boards with any standard IBM PC power supply. The prototyping area of the boards has complete access to the μP's buses and signals.

The boards come with the public-domain Nindy debugger/monitor in EPROM. The kits include disks that contain a schematic database of the CPU board, PLD equations, the CPU-board parts list, and source code for the Nindy debug monitor. You also receive an EVQT960 users' manual and power-supply cables in the kit.

Intel Corp, Dept 9P01, 3065 Bowers Ave, Santa Clara, CA 95052. Phone (800) 548-4725. FAX 408-765-2633.

Circle No 364

1000-ft local-area network connects IBM PCs with 4-wire telephone cables



The Lan-Mark local-area network comprises plug-in boards for IBM PCs, 4-wire cables with RJ-11 connectors, and software. You can link up to 64 IBM PCs over a total cable length of 1000 ft. The manufacturer claims that the network runs at about one-third the effective speed of an Ethernet network.

You can continue to use the LAN even if some of the PCs are switched off. If multiple PCs attempt to read from one PC, the network will not fail. The network is interrupt driven; it does not poll. You operate the network with conventional DOS commands. For example, you can redirect DOS printing commands from one node on the network to another. Thus, even if you are using a program such as Lotus 1-2-3, all printouts will be sent to the remote node.

To install nodes in the network, you plug an interface card into a PC's backplane and connect it with a telephone-type, 4-wire cable to other similarly equipped PCs. Each node on the network has control over which of its devices are accessible from the network. The network software requires DOS 3.1 or higher and occupies 32k bytes of memory.

A 2-station setup costs $399 and includes two 25-ft cables; a 3-station setup costs $599. Extra interface cards cost $199.

Lan-Mark Systems, 1050-L E Duane Ave, Sunnyvale, CA 94086. Phone (408) 243-7000. FAX 408-736-2503.

Circle No 365

Radstone supplies Norden Systems (US) and Marconi Command and Control Systems (UK) with bulk storage memory units developed for the MLRS fire control computer. On time. On budget.

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The Sure-Fire Solution To Cost and Lead-Time Problems In Military Computer Applications

Now there is a new generation of Mil-Spec computer hardware. For systems integrators with tactical computer applications who need a sure-fire solution fast, Radstone has the answer — a complete range of field-proven Mil-Spec, 32-bit VME boards.

All you need to build tomorrow's military systems today, available off-the-shelf, 68020 processors, memory and I/O modules, Multiprocessor capability. On board diagnostics. Real-time Ada and C software support. A choice of Mil-qualified system enclosures.

This total capability is designed for projects where lower development costs, shorter and more predictable timescales are important. Developed by Radstone, one of the world's largest manufacturers of VME boards with leading edge design resources to match. Built by Radstone, in a facility approved to NATO AQAP1 standards. Supported by Radstone, with 30 year's experience of military systems applications.

Call us now for your copy of the new PMV 68 MIL-STD-VME systems guide. Let us show you how we put the sure-fire solution into action.

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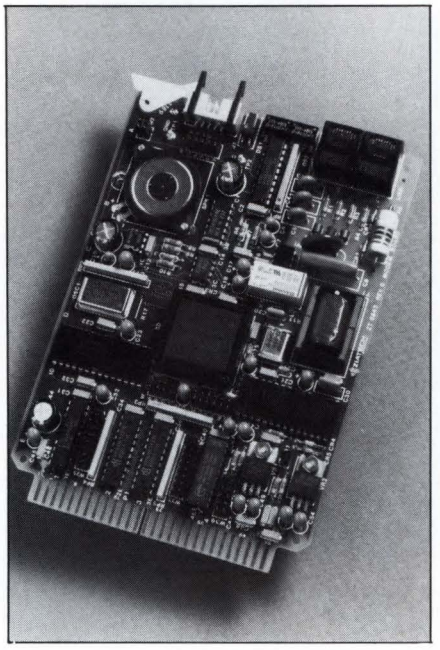
CIRCLE NO 82

Modem board links STD Bus systems over phone lines

The model ZT 8843 modem board for STD Bus systems operates at 300, 1200, or 2400 baud. The board features automatic baud-rate sensing. The unit has automatic-dialout and -answer capabilities; it can operate in pulsed or DTMF tone-dialing modes. It has a speaker interface that you use to listen to the phone line as the board operates. Eight onboard LEDs monitor the status of calls. You connect the board to phone lines with RJ11-equipped cables.



The board is compatible with the Hayes AT command set. Thus, you can access the board from most IBM PC communications programs. The board works with 5- and 8-MHz STD Bus systems. For testing purposes, it offers digital and analog loopback capabilities. It has a 256-bit nonvolatile phone-number and configuration memory. You address the board's UART as a COM1, -2, -3, or -4 device in STD Bus systems that use DOS. For those not using DOS, the UART's port can reside on any 8-port I/O boundary. The unit comes with software for communication, remote log-on, and autodialing.

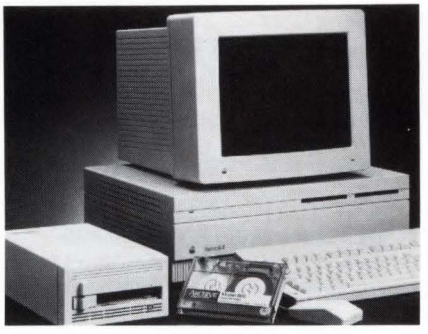
The board meets all common US and international phone-company standards. The AT 8843 modem board costs $395.

Ziatech Corp, 3433 Roberto Ct, San Luis Obispo, CA 93401. Phone (805) 541-0488. FAX 805-541-5088.

Circle No 366

SCSI tape drives back up Apple Macintosh personal computers

The MaxStream SCSI tape drives work with the Mac Plus, SE, and Mac II and IIx. The units have capacities of 60M and 150M bytes. They can transfer data at the rate of 6.75M bytes/min. Because the drives use the company's standard recording format, other computers equipped with the company's tape drives can read data that was written by an Apple computer.



The drives fit in the space of a 5¼-in. floppy disk and use a DC600-type ¼-in. cartridge. The accompanying software allows you to back files up over LANs such as AppleShare, TPOS, 3COM, and Novell. You can use the drives for both manual and automatic scheduled backups. Because the company's software is compatible with MultiFinder, you can perform backups in background mode while continuing to use the computer.

Backup modalities include storing a complete memory image along with A/UX partitions and the boot block, file-by-file backup, or incremental backup of only the most recently updated files. The unit meets UL, CSA, FCC, and TUV safety and EMI specs. The 60M-byte drive sells for $1395; the 150M-byte version costs $2095.

Archive Corp, 1650 Sunflower Ave, Costa Mesa, CA 92626. Phone (714) 641-0279. FAX 714-966-5581.

Circle No 367

WHY DID WE TAKE 150,000 HOURS TO DEVELOP A PICTURE?

When ICI takes this long developing a picture, something exciting is sure to emerge.

In fact here we've produced an image from an electronic source that looks every bit as good as a photograph.

The process is called Dye Diffusion Thermal Transfer, or D2T2 for short.

The source could be a video signal, a computer, a scanner or even a remote signal over telephone lines.

From any of these D2T2 can produce a print or transparency with continuous tones in full color.

An image can emerge in as little as a minute using D2T2, and the whole procedure is clean, dry and silent.

Although this may sound like the technology of the future, it's actually available right now.

Printer manufacturers are already seeing the benefits of being able to transfer brilliant color images direct from the computer screen on to 'paper' or transparency.

Desktop publishing systems can now produce truly continuous tone, full color images. Business presentations will do an even better job of projecting the company image.

The more specialized applications like medical imaging, security or graphic design will find D2T2 indispensable.

Every day ICI spends $2.5 million on research. The expertise we've acquired in colors, polymers, films and coatings has led to new ideas not just in color imaging, but in data storage as well.

Already we've developed Digital Paper, a remarkable material that offers completely flexible optical data storage.

Obviously D2T2 is a revolution no progressively minded printer manufacturer should miss out on, and for that reason ICI is very interested in talking to you.

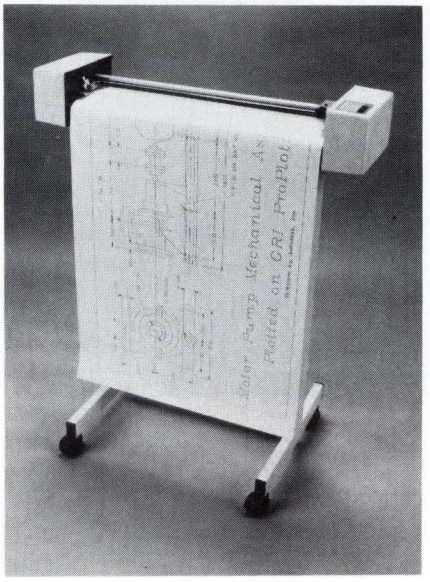
For a complete briefing on D2T2, call Rick Lamb, at 302-886-8484, or write to us at ICI Imagedata, Concord Pike, Wilmington, DE 19897.

ICI Imagedata

Affordable large-format pen plotter suits desktop CAD environments

The ProPlotter produces 22×34-in. drawings on D-sized, 24×36-in. plotting media (it can also produce C-sized drawings). Acceptable plotting media include ordinary bond paper, vellum, and mylar film. The plotter accepts a variety of pen types and point sizes. Liquid-ink disposable pens having 0.25-mm to 0.70-mm point widths are typical. In addition, you can use ballpoint (roller-tip) or fiber-tip pens with appropriate plotting media.

The plotter's maximum pen speed is 7 in./sec. Resolution and repeatability are 0.004 in., which compares with the approximately 0.010-in. width of the most narrow pen point typically used.



The plotter's mechanism uses a double set of paper-pressure rollers to maintain paper alignment. The plotter's command set is compatible with the DM/PL command set of Houston Instrument's DMP series of plotters. Thus, the unit is compatible with common desktop CAD software packages such as AutoCAD. The ProPlotter, including a castered stand, pens, and a connecting cable, costs $1995.

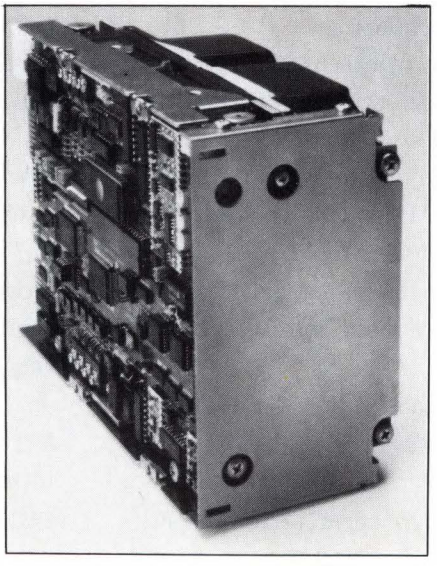
Gerard Research Inc, 46745 Fremont Blvd, Fremont, CA 94538. Phone (415) 651-0217. FAX 415-651-0787.

Circle No 368

5¼-in. disk drive sports programmable SCSI interface

The MK-350 series of ESDI and SCSI 5¼-in. disk drives store 760M bytes. The SCSI version features the TAIS Virtual SCSI programmable interface. With Virtual SCSI, the company claims, you can quickly tailor the disk for a specific application.

The drives' command overhead is <500 μsec. All models have a 16-msec average access time (40 msec max) and 15M-byte/sec data-transfer rate to the disk itself. The units measure 3.25×5.75×8.00 in., weigh 6.6 lbs, and draw 4.5A of peak current (1.8A while on track) from a 12V dc supply and 1.5A from a 5V dc supply.



The Virtual SCSI feature also permits numerous other capabilities: a soft SCSI ID; error management; a 64k-byte cache buffer (with parity checking) that performs read look-ahead for faster data retrieval; zero-latency read/write, buffer-ratio control for more-efficient bus utilization; 5M-byte/sec synchronous data-transfer rate; optional differential capability; and SCSI II compatibility.

The 760M-byte MK-358FA (EDSI) and MK-358FB (SCSI) cost $2495 and $2645, respectively, in OEM quantities; the 380M-byte MK-355FA (EDSI) and MK-355FB (SCSI) cost $1815 and $1965, respectively.

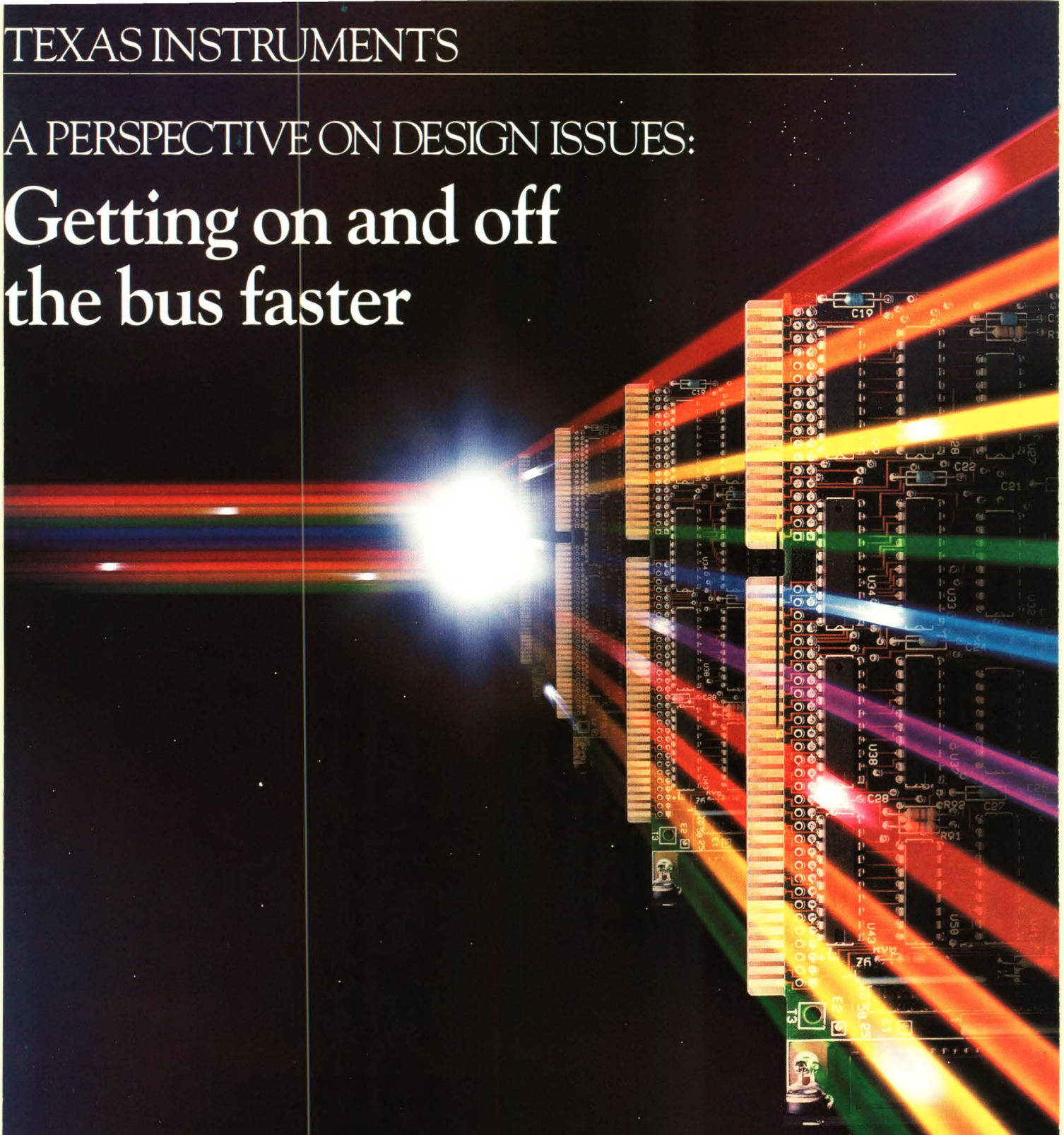
Toshiba America Inc, 9740 Irvine Blvd, Irvine, CA 92718. Phone (714) 583-3108.

Circle No 369

TEXAS INSTRUMENTS

A PERSPECTIVE ON DESIGN ISSUES:

Getting on and off the bus faster

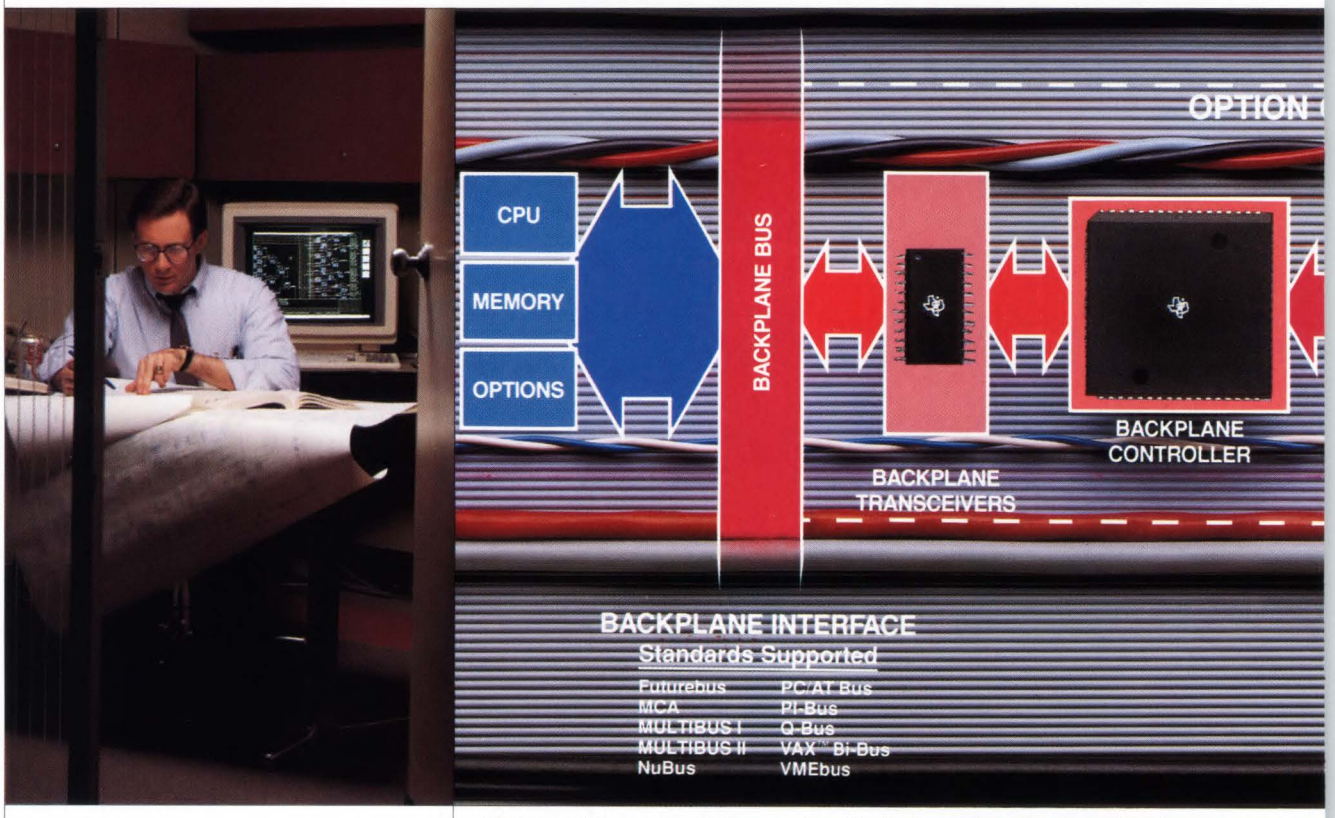


IN THE ERA OF

MegaChip TECHNOLOGIES

New bus interface ICs from TI can keep your total system up to speed.

You not only increase system throughput but cut power and conserve real estate at the same time.



High-speed, low-power implementation of backplane and peripheral interfaces for most popular standards is made possible by TI's comprehensive family of both digital and analog physical-layer

What use is a high-performance CPU if its processing power can't be delivered to the backplane and outward to the peripherals?

Typically, some system throughput is lost at the local bus interface, some at the backplane interface, and some at the peripheral bus interface.

To help you minimize such losses and maximize system throughput, Texas Instruments offers a series of innovative chips for (1) backplane interface and (2) peripheral bus interface, as well as (3) controllers to regulate data flow.

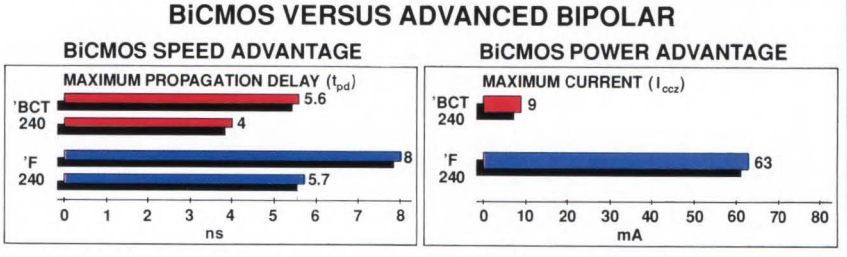
These devices support the major industry standards listed above so that you can achieve system compatibility regardless of the bus you are implementing.

Superior backplane interface performance

To maximize system throughput, data must be able to get on and off the bus quickly. Therefore, the backplane bus transceivers must be capable of high speed and high drive.

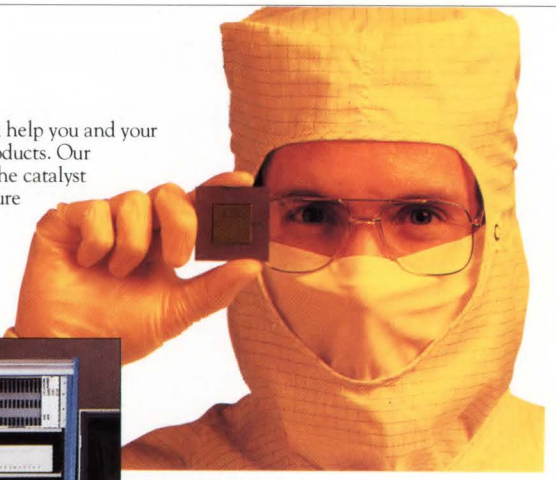
Our high-speed/low-power BiCMOS logic (SN54/74BCTXXX) is specifically designed for bus interface applications.

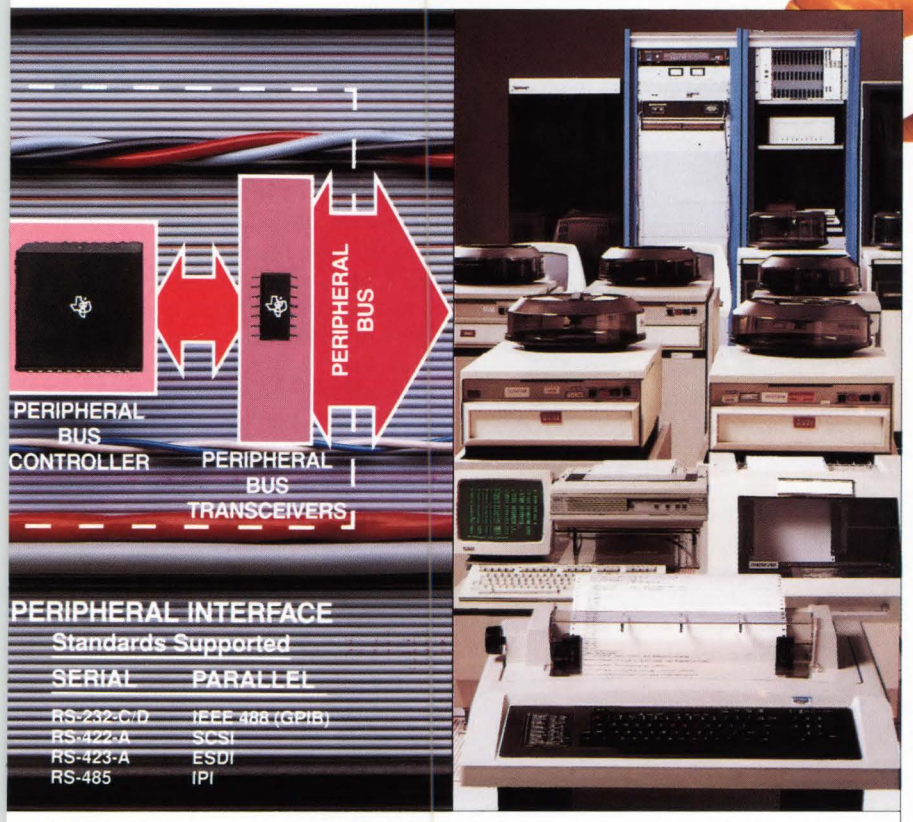
As the name implies, TI BiCMOS merges low-power CMOS with high-speed bipolar, delivering switching speeds comparable to advanced bipolar devices. You also get the 48/64-mA



The BiCMOS lead over bipolar is proven by this comparison between TI's '74BCT240 and a comparable advanced bipolar standard device. Typical propagation delay of TI's BiCMOS part is faster *(left)* while power dissipation is less *(right)*.

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





ICs. To complete the implementation, TI offers a series of innovative standard and ASIC control devices. Use of TI's leadership bus interface devices can help shorten system design cycles.

drive current you need, and total system power savings can be as high as 25% (*see charts*).

There are more than 60 members in our BiCMOS family, including 8-, 9-, and 10-bit latches, buffers, drivers, and transceivers. The family is also available in military versions.

Our family of octal ECL translators (SN10KHT/100KTXXXX) delivers a low-power, high-speed translator solution with 48 mA of drive capability on the TTL side.

Our high-speed Futurebus transceiver family (SN55/75ALS-05X) includes quad and octal devices compatible with Futurebus implementations of the IEEE 896.1 standard. With a drive capability of 100 mA, a 5-ns (typ) propagation delay, and a supply current of 65 mA (max), our SN75ALS053 has the best speed/power ratio of any Futurebus transceiver on the market today. ■

High-performance peripheral interfaces

Peripheral bus interface design decisions revolve around trade-offs between line length, data rate, and noise immunity.

Where data rates are low and line lengths are short, as with the popular RS-232-C/D standard, the major concern is power savings. However, relatively high voltages (30 V) prevent the use of standard CMOS devices. Your answer lies with TI's Linear BiCMOS family.

Included are low-power versions of industry-standard quad drivers and receivers (SN75C188/89). Driver/receiver combinations, ranging from single to quad combinations (SN75C1154), substantially cut package count.

This BiCMOS technology will also allow us to provide charge pump circuitry for single 5-V operation.

Where data rates are high and line lengths are long, as the newer peripherals demand, noise can become a major problem. It is overcome by the use of differential drive. Typically, the major application requirement is higher speeds at, ideally, lower power.

For example, disk drives using ESDI, IPI, or SCSI interfaces will benefit from TI's SN75ALS17X devices conforming to RS-422-A and/or RS-485 standards. These chips are fabricated using our unique IMPACT™ processing that delivers up to 50% greater speed compared to competing products with as much as a 30% power reduction.

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Simplified NuBus design

TI has taken much of the work out of NuBus™ design by introducing the industry's first standard NuBus interface devices. They are the SN74ACT2440 NuBus Controller and the SN74BCT2420 NuBus Registered Transceiver.

A typical implementation, using two 16-bit transceivers and one 32-bit controller (*see below*), replaces as many as 45 discrete devices. Compared to a discrete approach, this solution uses 60% less board space and 90% less power.

Because the necessary logic is embedded within the controller, design cycle time is reduced significantly.

A low-power UART

There is now more need than ever for low-power RS-232 interfaces. Our TL16C450 Universal Asynchronous Receiver/Transceiver (UART), made with CMOS process technology, is an excellent choice for desktop applications and is especially suited for use in laptop/battery-powered units.

A flexible SCSI controller

Available soon, our SCSI controller (designed to conform to ANSI X3.131-1986 specifications) will deliver data rates of 3 Mbytes/s (asynchronous) and 5 Mbytes/s (synchronous).

Unique byte-stacking control logic will allow interface to 16-, 24-, and 32-bit buses. The TI controller will also provide powerful multiphase SCSI commands, including automatic handling of save-data pointer to minimize interrupts to the host processor. Dual 32-byte FIFOs will provide smooth, efficient buffering between processor and DMA ports.

Customized controllers, too

The NuBus and UART controllers are available as part of our ASIC standard-cell library.

In addition, TI offers TGC100 Gate Arrays and TSC500 Standard Cells as part of our ASIC family which allows you to build the precise chip functions you need. ■

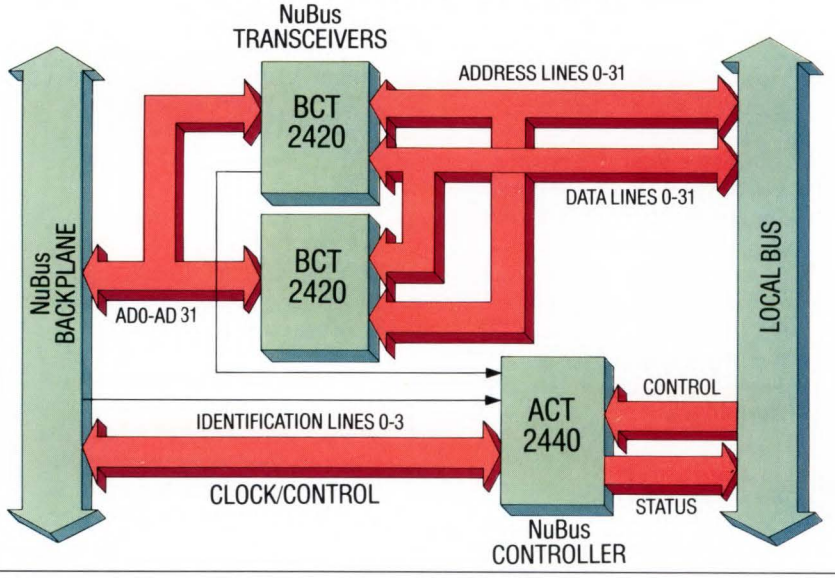
System complexity and the future

As systems become more and more complex, the need will emerge for combining the functionality of controllers and physical-layer devices on a single chip. To that end, TI is applying its acknowledged expertise in physical-layer devices to the design and development of such advanced control-level ICs.

System complexity also brings with it the need for simulation models to make design easier and faster. As a result, we already have simulation models available for more than 1,300 TI devices, including BiCMOS bus interface and ACL logic devices.

Another issue is the increasing difficulty and expense of testing boards in complex systems. Consequently, TI supports the JTAG/IEEE P1149.1 standard with the development of standard products and ASICs having on-chip test cells, as well as with development support software and device models on several leading workstations. ■

TI's 32-bit NuBus Interface Solution



Major space savings are realized by using one TI SN74ACT2440 controller and two SN74BCT2420 transceivers to complete a full 32-bit NuBus master/slave interface. As many as 45 discrete logic devices are replaced, realizing significant reductions in board space, power consumption, and design cycle time.

Please call **1-800-232-3200, ext. 3905**, for your copy of our Bus Interface Devices brochure. Or write Texas Instruments Incorporated, Dept. SSY25, P.O. Box 809066, Dallas, Texas 75380-9066.

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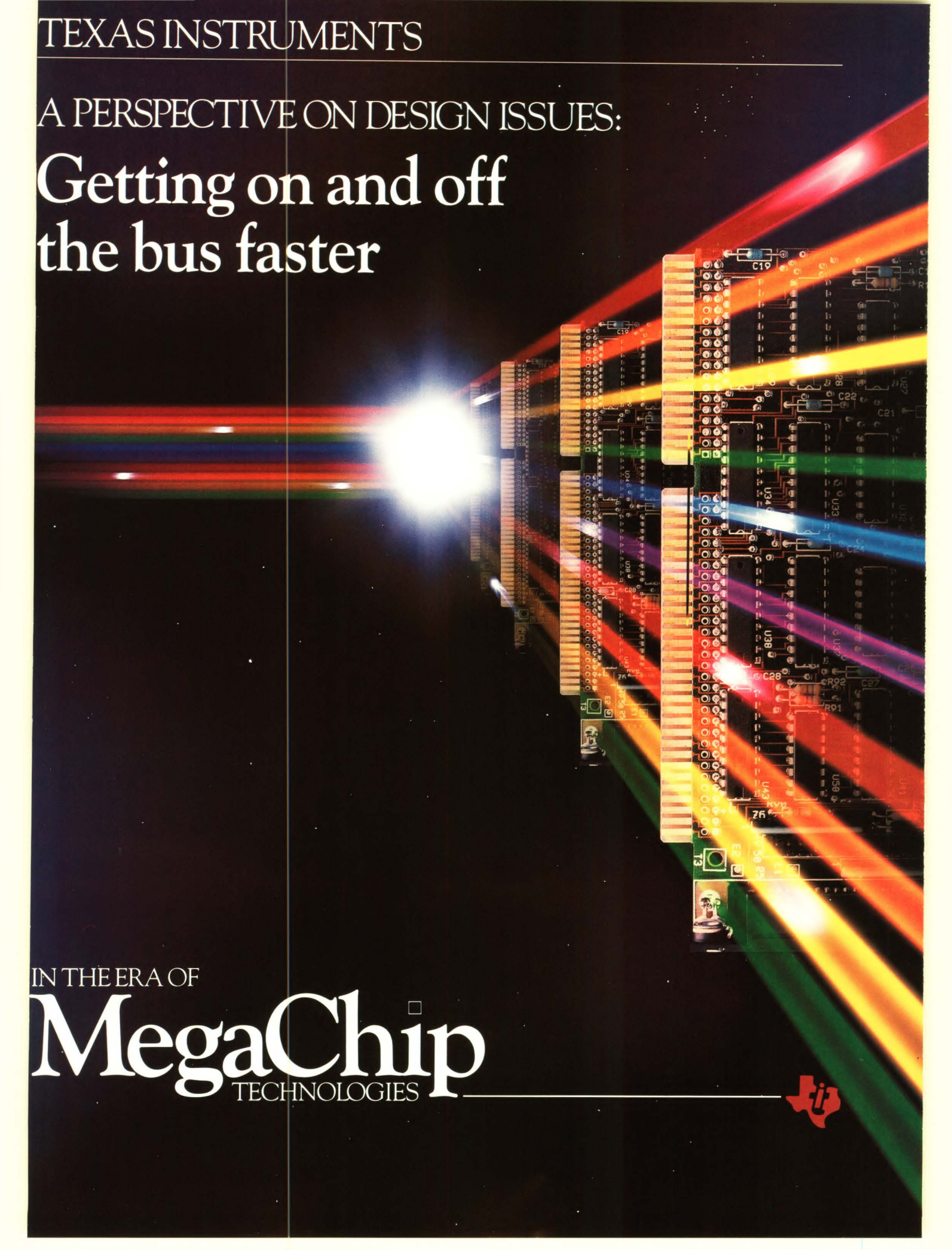
A PERSPECTIVE ON DESIGN ISSUES:

Getting on and off the bus faster

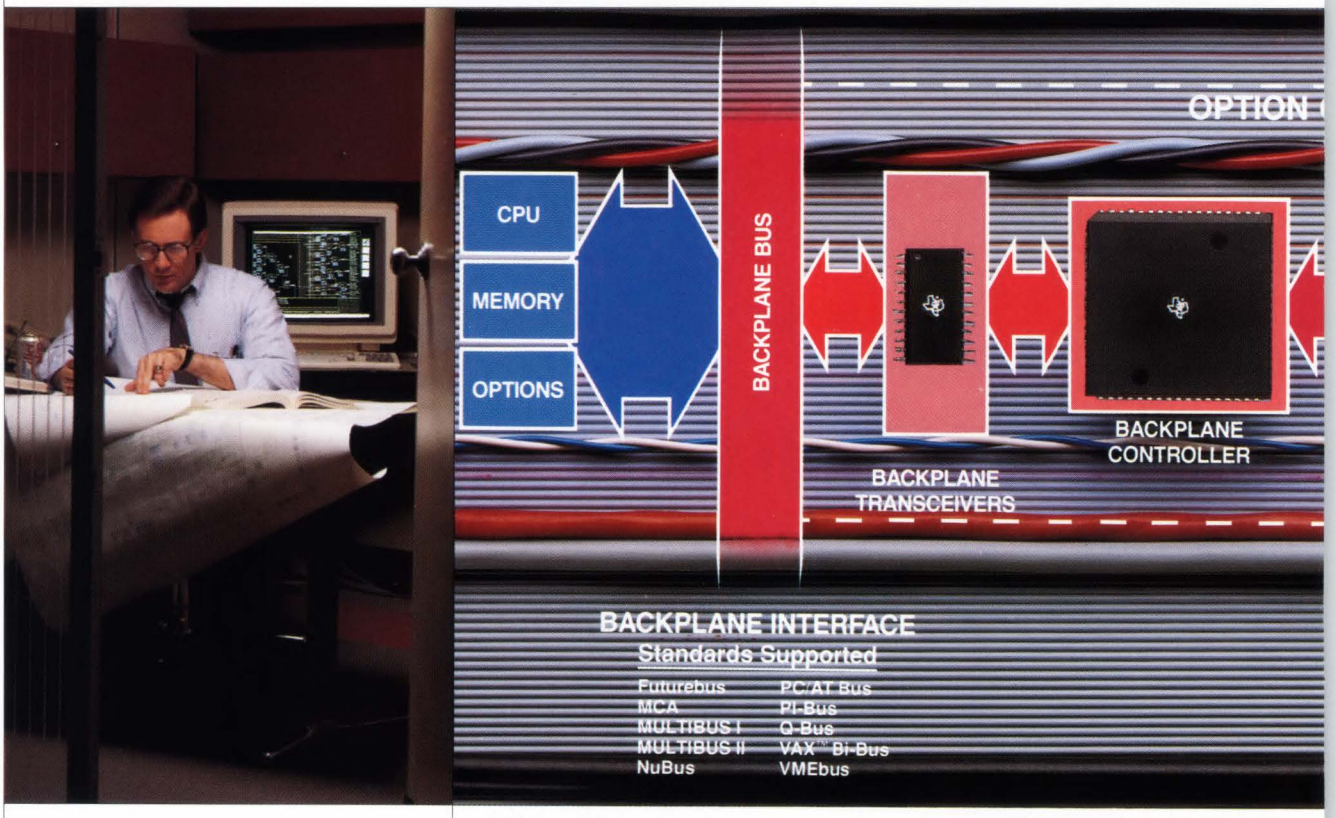


IN THE ERA OF

MegaChip TECHNOLOGIES

New bus interface ICs from TI can keep your total system up to speed.

You not only increase system throughput but cut power and conserve real estate at the same time.



High-speed, low-power implementation of backplane and peripheral interfaces for most popular standards is made possible by TI's comprehensive family of both digital and analog physical-layer

What use is a high-performance CPU if its processing power can't be delivered to the backplane and outward to the peripherals?

Typically, some system throughput is lost at the local bus interface, some at the backplane interface, and some at the peripheral bus interface.

To help you minimize such losses and maximize system throughput, Texas Instruments offers a series of innovative chips for (1) backplane interface and (2) peripheral bus interface, as well as (3) controllers to regulate data flow.

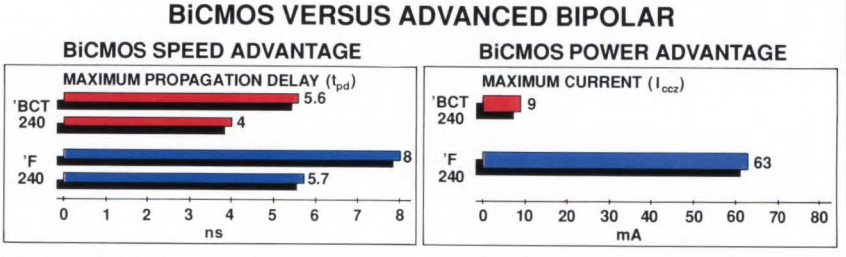
These devices support the major industry standards listed above so that you can achieve system compatibility regardless of the bus you are implementing.

Superior backplane interface performance

To maximize system throughput, data must be able to get on and off the bus quickly. Therefore, the backplane bus transceivers must be capable of high speed and high drive.

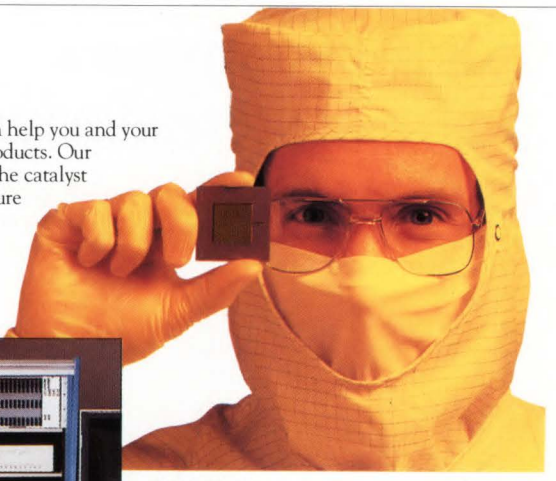
Our high-speed/low-power BiCMOS logic (SN54/74BCTXXX) is specifically designed for bus interface applications.

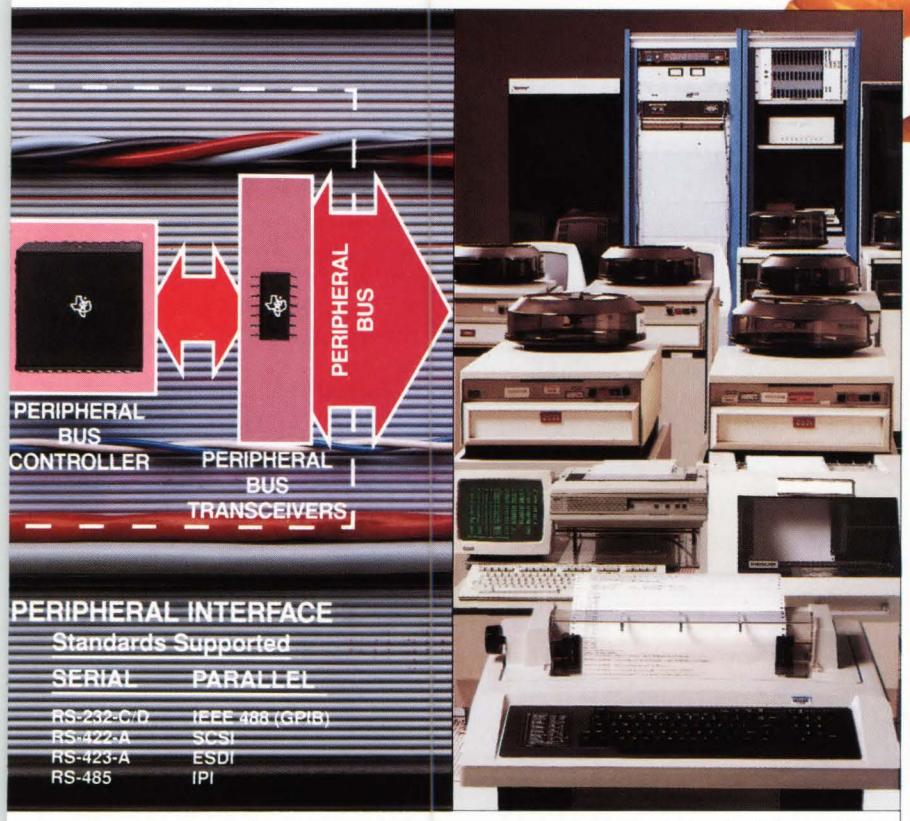
As the name implies, TI BiCMOS merges low-power CMOS with high-speed bipolar, delivering switching speeds comparable to advanced bipolar devices. You also get the 48/64-mA



The BiCMOS lead over bipolar is proven by this comparison between TI's '74BCT240 and a comparable advanced bipolar standard device. Typical propagation delay of TI's BiCMOS part is faster (*left*) while power dissipation is less (*right*).

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





ICs. To complete the implementation, TI offers a series of innovative standard and ASIC control devices. Use of TI's leadership bus interface devices can help shorten system design cycles.

drive current you need, and total system power savings can be as high as 25% (*see charts*).

There are more than 60 members in our BiCMOS family, including 8-, 9-, and 10-bit latches, buffers, drivers, and transceivers. The family is also available in military versions.

Our family of octal ECL translators (SN10KHT/100KTXXXX) delivers a low-power, high-speed translator solution with 48 mA of drive capability on the TTL side.

Our high-speed Futurebus transceiver family (SN55/75ALS-05X) includes quad and octal devices compatible with Futurebus implementations of the IEEE 896.1 standard. With a drive capability of 100 mA, a 5-ns (typ) propagation delay, and a supply current of 65 mA (max), our SN75ALS053 has the best speed/power ratio of any Futurebus transceiver on the market today. ■

High-performance peripheral interfaces

Peripheral bus interface design decisions revolve around trade-offs between line length, data rate, and noise immunity.

Where data rates are low and line lengths are short, as with the popular RS-232-C/D standard, the major concern is power savings. However, relatively high voltages (30 V) prevent the use of standard CMOS devices. Your answer lies with TI's Linear BiCMOS family.

Included are low-power versions of industry-standard quad drivers and receivers (SN75C188/89). Driver/receiver combinations, ranging from single to quad combinations (SN75C1154), substantially cut package count.

This BiCMOS technology will also allow us to provide charge pump circuitry for single 5-V operation.

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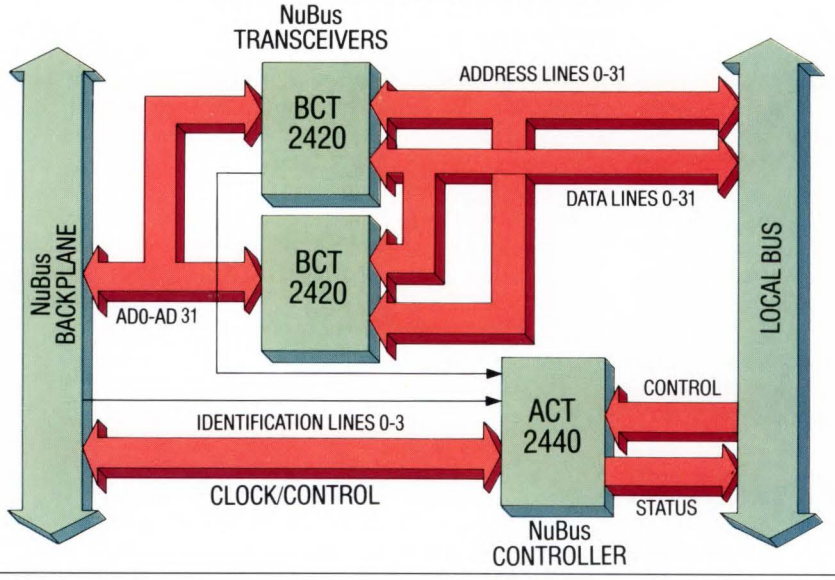

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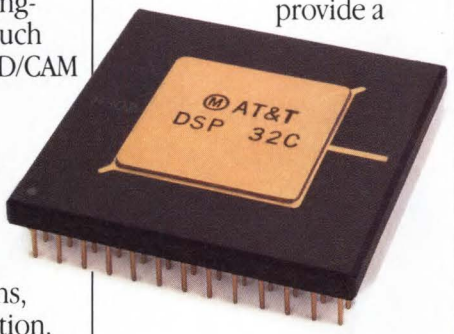

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AT&T: The components of success.

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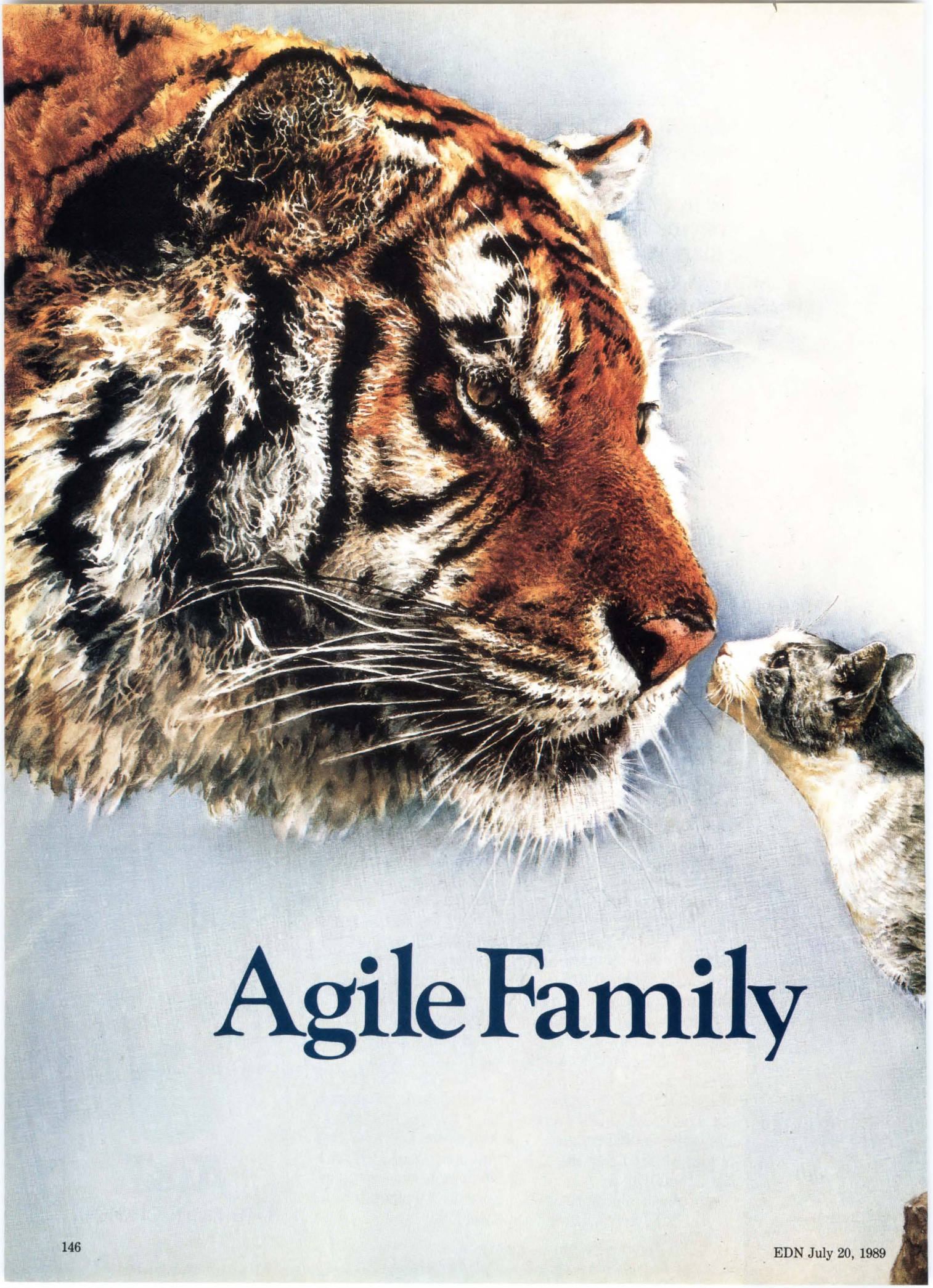

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If you design PC-based systems, our fast memories can eliminate WAIT states and increase your throughput, while maintaining cost-effectiveness. If you design control storage systems, image processing, CAD/CAM equipment, mainframes or simulators, our high-speed memories will keep up with the fast hardware in the rest of your system.

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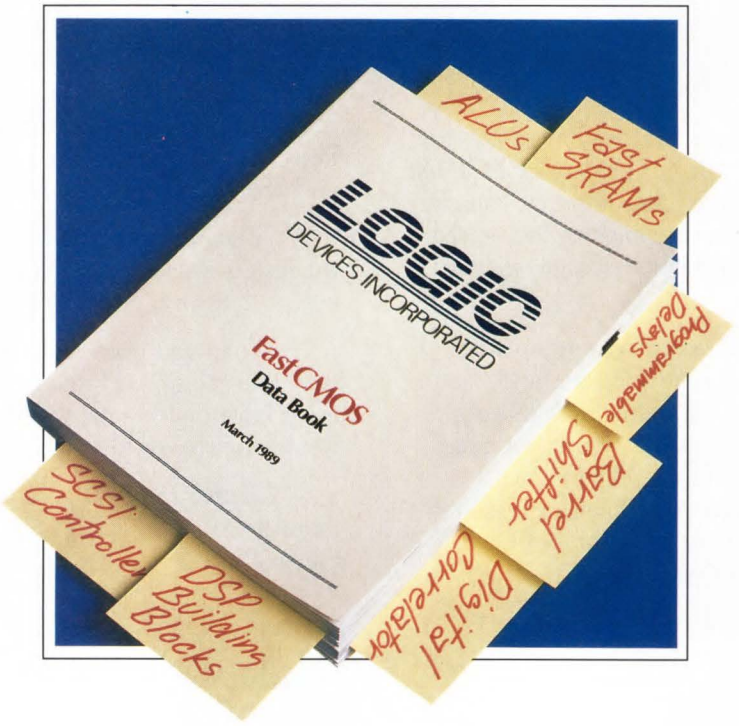

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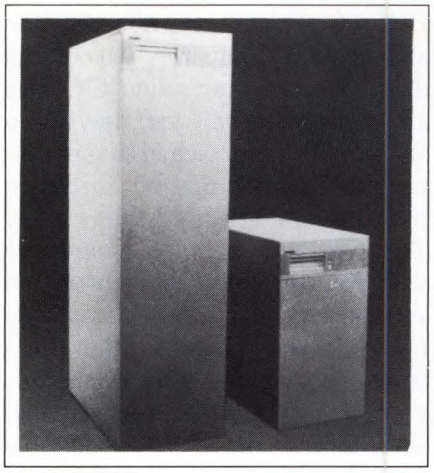


LIBRARY UNITS

The model MW-5G1-B library unit houses as many as 152 double-sided 5¼-in. WORM optical-disk cartridges. The unit has a total formatted storage capacity of 90G bytes. Sometimes called a "jukebox," the unit has a robotic arm that accesses and exchanges the cartridges in <13 sec. The smaller-version model MW-5G1-A holds as many as 56 cartridges with a total formatted capacity of 34G bytes. This version can access the cartridges in <10 sec. Each cartridge can hold as much as 300,000 pages of ASCII text. The units come with one of the company's high-speed WORM drives and provide options for additional drives. The MW-5G1-B can accommodate as many as four drives, and the MW-5G1-A can accommodate two drives. From $31,500.

Mitsubishi Electronics America Inc, Computer Peripherals Div, 991 Knox St, Torrance, CA 90502. Phone (213) 515-3993.

Circle No 690

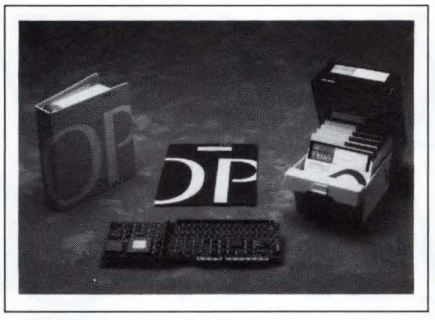
COPROCESSOR BOARD

The Z485 communications coprocessor board for the IBM PC, PC/AT, and compatible computers provides two asynchronous, full-duplex communications channels, operating at speeds as high as 57,600 baud. Board-jumper programming can set the output-signal level to RS-232C or RS-485 specifications. A 9.316-MHz HD64180/Z180 μP with 64k bytes of RAM supervises the data transfer. Options include 256k bytes of RAM and 6.144-MHz operation.

Communications between the host and the board is via a memory window that can be set to either 256 or 4096 bytes. The window base address occupies a fixed address in the PC's memory such as C4C00. The host can control the base address in 256-byte increments within the board's 256k-byte memory map. The board can interrupt the host and vice versa. A host can house multiple boards with different bus addresses. Z485-64, $295; Z485-256, $395.

Z-World Engineering, 1340 Covell Blvd, #101, Davis, CA 95616. Phone (916) 753-3722. FAX 916-753-3722.

Circle No 691

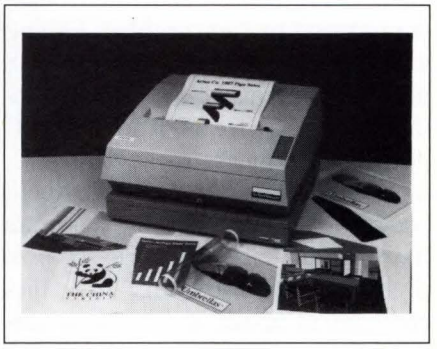


UNIX COPROCESSORS

The models 260PM and 270PM are part of the company's 200 Personal Mainframe family. The series consists of 32-bit Unix coprocessors that reside in IBM PC/XT, PC/AT, and PS/2 model 30 or 35 computers as I/O processors and subsystems for workstations and multiuser systems. The models 260PM and 270PM use National Semiconductor's 32532 μP to provide simultaneous use of the MS-DOS and Unix System V operating systems. The 260PM operates at 25 MHz and achieves 8.5 MIPS of processing speed with 4M to 20M bytes of physical memory in a 4G-byte virtual address space. The 270PM operates at 30 MHz and a similar configuration provides 10 MIPS of performance. The boards utilize the 32381 floating-point processor for single- and double-precision IEEE format calculations. Model 260PM, $6995; model 270PM, $7995; floating-point unit, $895.

Opus Systems, 20863 Stevens Creek Blvd, Bldg 400, Cupertino, CA 95014. Phone (408) 446-2110.

Circle No 692



COLOR PRINTER

The 5232-Color Postscript Printer prints Adobe Postscript images and text at 300 dpi on A- or B-size paper and transparencies. There are three ink sheets available: 4-color (yellow, magenta, cyan, black); 3-color (yellow, magenta, cyan); and monochrome (black). The print controller uses a 16-MHz 68020 μP and either 4M bytes of RAM for A-size printing or 8M bytes for B-size printing. It has 35 Adobe resident fonts in ROM and supports downloadable fonts. The printer interfaces with a host through an RS-232C/422/423 serial port or a Centronics parallel port. It can print a 3-color A-size drawing in 90 sec; a B-size drawing takes 180 sec. An internal 20M- or 80M-byte disk drive is also available. Prices range from $16,900 to $22,900.

Schlumberger Graphics, 385 Ravendale Dr, Box 7169, Mountain View, CA 94039. Phone (415) 964-7900. FAX 415-961-6152. TLX 491178.

Circle No 693

SERVO CONTROLLERS

The 800 Series single-axis, standalone servo motion controllers execute stored-motion profiles, having a velocity accuracy of 1 part in 8 million. You can program and command the units through an RS-232C port that connects to an IBM PC, a "dumb" terminal, or a handheld programmer. In addition, the units have 14 discrete I/O lines for programming and directing. The units can control brush or brushless servos, and they have real-time, adaptive gain control that automatically adjusts for load changes.

Other features include 1-MHz encoder input frequency, storage for eight motion profiles, digital filtering of encoder signals, velocity or torque command, and position and velocity data entry with 7-digit resolution. A variety of configurations range from a board-level unit with an integral power supply to housed units for rack or table mounting. $1162 to $1750.

Superior Electric Co, 383 Middle St, Bristol, CT 06010. Phone (203) 582-9561. TLX 962446. FAX 203-584-1483.

Circle No 694

SPEECH GENERATOR

The Speech Thing contains an 8-bit D/A converter that attaches to the DB-25 parallel-printer port on an IBM PC, PC/XT, PC/AT, PS/2, or a compatible computer. It converts digitized speech or sound files into an analog signal for driving a speaker. When attached to the computer, the unit doesn't interfere with the operations of the printer. The package includes a speaker with volume control, demonstration software, and a 2-pg instruction manual. The demonstration software includes a talking calculator, a graphics-based sound editor, and several prerecorded sounds suitable for inclusion in user-written programs—all of which are recorded by the company's Voice Master PC Digitizer software. The package also includes two versions of the SmoothTalker text-to-speech software. Version 2 occupies 80k bytes of memory space in an IBM PC or a compatible computer. Version 3 has language rules that provide improved speech quality, but it re-

quires an IBM PC/AT- or PS/2-compatible computer and occupies 160k bytes of memory space. You can call both versions from Basic or C programs. $79.95.

Covox Inc, 675-D Conger St, Eugene, OR 97402. Phone (503) 342-1271. TLX 706017. FAX 503-342-1283.

Circle No 695

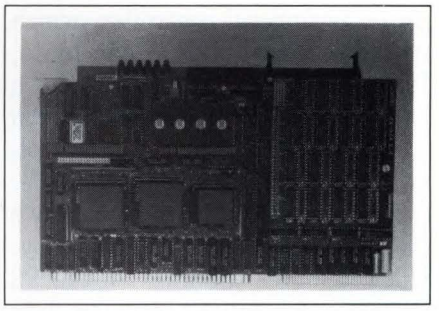
TRANSCEIVER

The Model 2875 bit-driver is a stand-alone, fiber-optic transceiver that's designed to replace the cable connection between wiring concentrators in an IBM token-ring LAN. The unit provides optical isolation between concentrators and transmission capability over longer distances than cable. The maximum standard transmission is 2 km, and a 5-km option is available. The standard operating data rate is 4M bps; a 16M-bps version will be available in the near future.

To install a link you disconnect the cable connection and connect a transceiver at each wiring concentrator. You then connect the transceivers with fiber-optic cable. The front panel contains five LED status indicators for diagnostics. The LEDs indicate fiber transmission, fiber receive, test, energy or lock detection, and a wire fault. The unit measures $7.5 \times 7 \times 3$-in. and weighs 3 lbs. $950.

S I Tech, Box 609, Geneva, IL 60134. Phone (312) 232-8640. TLX 286177. FAX 312-232-8677.

Circle No 696



386 CPU BOARD

The ZX-386/16 single-board computer for Multibus I contains a 32-bit 80386 μP; 2M, 4M, or 8M bytes of dual-ported RAM; 256k bytes of EPROM, and an 80387 coprocessor. The board is jumper selectable for 10-MHz asynchronous or 16-MHz synchronous operation. You can dynamically relocate memory space in increments as small as 64k bytes throughout the entire Multibus I/O memory map. In addition, the board has two RS-232C ports, two SBX connectors, and an 82380 inte-

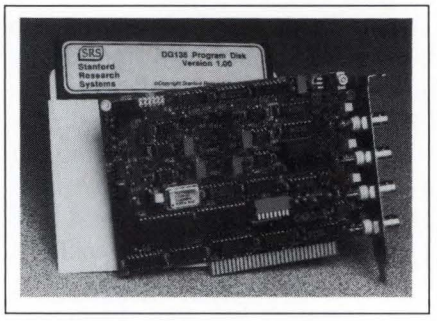
grated peripheral controller, which provides eight DMA channels, three programmable timers, and a 20-channel interrupt controller. An optional NCR 53C90 SCSI controller for its local bus is also available. The unit employs the company's TRU-32 bus-expansion capability, which reserves the lines on the P2 connector for full 32-bit-wide data transfers on the Multibus I. TRU-32 also expands the address range to 256M bytes. $2195 (25). Delivery, six to eight weeks ARO.

Zendex Corp, 6700 Sierra Ln, Dublin, CA 94568. Phone (415) 828-3000.

Circle No 697

DELAY GENERATOR

The DG135 is a dual-channel digital-delay generator card for the IBM PC, PC/XT, PC/AT, and compatible computers. The card provides



two output channels, A and B, with a delay resolution of 25 psec, a delay accuracy of 25 ppm, and a delay range of 6.5 msec. You can configure the A and B outputs to provide a gate pulse that begins with A and ends with B. The device also has a T0 output line that can be programmed in 100-nsec increments relative to an external trigger input.

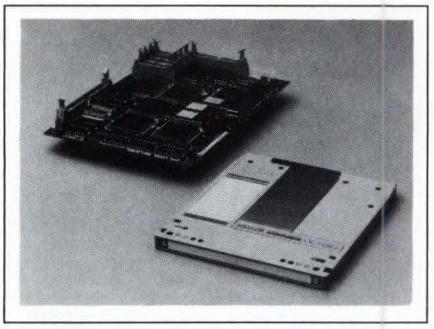
The output drive levels are either TTL or ECL compatible and can drive 50Ω loads. An optional fast rise-time module provides a 100-psec transition time on the output signals. You can use multiple cards as slaves to a common clock in order to prevent drift between channels. The half-size card consumes 7W and comes with a 90-day warranty. Software, which demonstrates the features and performance of the board, is supplied on disk. $1075.

Stanford Research Systems Inc, 1290D Reamwood Ave, Sunnyvale, CA 94089. Phone (408) 744-9040. FAX 408-744-9049. TLX 706891.

Circle No 698

OPTICAL DRIVE

The OD112-1 rewritable optical-disk drive conforms to the ISO standards for 644M-byte drives. The 5¼-in. drive has an average access time of 75 msec and a data-burst transfer rate of 925k bytes/sec. Its companion formatter and controller module, the OF112S, provides a



SCSI interface and a 1.5M byte/sec data-burst transfer rate. The drive uses magneto-optical recording technology. Features include read-after-write capability, data verification, a 1-msec polarity changeover, a track recording density of 16,000 tpi, a linear recording density of 24,000 bpi, and a continuous tracking servo. $5000.

Hitachi America Ltd, Computer Div, 950 Elm Ave, San Bruno, CA 94066. Phone (415) 872-1902. FAX 415-872-1907. TLX 176308.

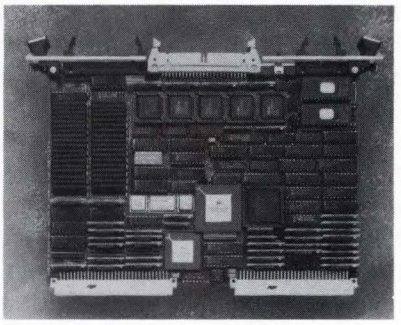
Circle No 699

DISPLAY CARD

The nuVista HR is a plug-in display card for the Macintosh II computer that can drive a display with 1280 × 960-pixel resolution. It can simultaneously display 256 colors from a palette of 16.7 million colors. A 2M-byte version of the card provides a virtual canvas of 2k × 1k pixels, and a 4M-byte version provides a virtual canvas of 2k × 2k pixels. The card uses the TI 34010 graphics processor for graphics manipulations. It also drives noninterlaced displays, provides square pixels, and can pan the entire video memory. It works with high-resolution monitors with 64-kHz horizontal and 60-Hz vertical frequencies, such as Sony's GDM-1953 or JVC's GD-H6020US. The board is fully compatible with Apple's QuickDraw software package. The card can accommodate an additional 2M, 4M, or 8M bytes of memory using an optional NuVMX memory expansion module. 2M-byte version, $3995; 4M-byte version, $5995.

Truevision Inc, 7351 Shadeland Station, Indianapolis, IN 46256. Phone (800) 858-8783 or (317) 841-0332. FAX 317-576-7700.

Circle No 700



CPU BOARD

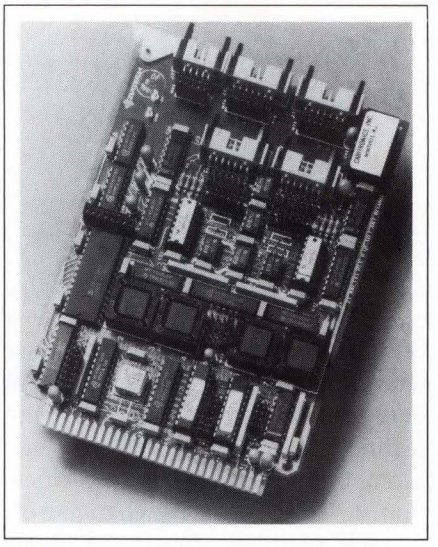
Designed for real-time embedded control applications, the HK68/V3E CPU board for VMEbus systems

features a 32-bit 68030 μP; 1M, 2M, 3M, or 4M bytes of static-column dynamic RAM; and 2M bytes of EPROM. The unit is compatible with 8M-, 12M-, and 16M-byte DRAMs when they become available. A VSB Bus provides high-speed memory expansion. Other features include a SCSI controller, a 68881 or 68882 coprocessor, four RS-232C ports, four 8-bit counter/timers, a mailbox interrupt, a time-of-day clock, and a Centronics parallel port.

By combining the 68030's burst mode with static-column access, the board achieves high-speed cache refills. The board provides 128 bytes of nonvolatile memory for storing device parameters at boot time. Available software tools include the VxWorks and VADSWorks networked real-time development systems. The interface between the Unix host and the board is via Ethernet, ProNet, or a common backplane using the Berkeley 4.3 BSD TCP/IP. The OS-9 operating system and the VRTX32 real-time executive is also available. HK68/V3E, $4495; VxWorks, $12,000; VADSWorks $27,500; OS-9, $1000.

Heurikon Corp, 3201 Latham Dr, Madison, WI 53713. Phone (800) 356-9602; in WI, (608) 251-8715. FAX 608-831-4249.

Circle No 701



INTERFACE BOARD

The ZT 88CT41 4-channel interface board for the STD Bus features four 82050 UARTs that operate at speeds as high as 56k baud in DTE or DCE configurations. The card provides four RS-232C channels with two of them configurable as RS-422/485 ports. The board is a TTL backplane-compatible CMOS interface with low power consumption and an operating range from −40 to +85°C.

You can use the ZT 88CT41 with either TTL or CMOS STD Bus boards. An 8259A programmable interrupt controller can operate in a slave or master configuration. An option optically isolates the RS-422/

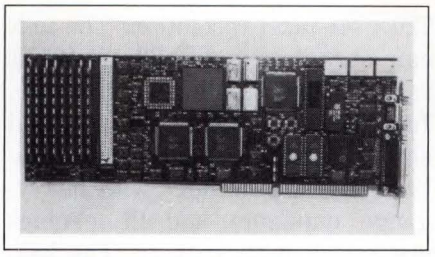
485 channels from the input cable. The isolation voltage is 600V. An other option provides dual, 4-byte, transmit-and-receive, FIFO buffers for each serial channel. ZT 88CT41, $395; optical-isolation option, $100; FIFO buffers, $45.

Ziatech Corp, 3433 Roberto Ct, San Luis Obispo, CA 93401. Phone (805) 541-0488. TLX 4992316. FAX 805-541-5088.

Circle No 702

80386 SBC

The QPC-5142 80386 single-board computer for passive backplane systems is compatible with the IBM PC/AT and contains as much as 8M bytes of dynamic RAM in SIMMs—1M byte is standard. The board is available for either 16-, 20-, or 25-MHz clock speeds. It has an IBM PC/AT-compatible BIOS in 64k bytes of EPROM that can be



jumpered to 128k bytes for custom code. You can transfer the BIOS to RAM for faster access, using a shadow RAM feature.

Other features include a keyboard port with a keyboard-lock feature, a clock/calendar with internal battery backup, an 8Ω speaker port, and a watchdog timer. The board provides two RS-232C ports and one parallel port. You can jumper one of the serial ports as an RS-422 port. The board also has a 68-pin socket for an optional 80387 coprocessor. The board operates from a 5V supply and consumes 14W. Boards with no memory: 16-MHz, $1595; 20-MHz, $1995; 25-MHz, $2495.

Qualogy, 1751 McCarthy Blvd, Milpitas, CA 95035. Phone (408) 434-5200. FAX 408-434-5242.

Circle No 703

SCSI ADAPTER

The SCSI-11 is a SCSI host adapter board for the VMEbus. The board's 4-bus architecture for eliminating bottlenecks, a VMEbus, a VSB Bus interface, a SCSI port, and an advanced-processor-extension (APEX) bus, accesses a quad-ported RAM that decouples the data transfer to each interface. Essentially, each bus operates independently. The board provides a master/slave interface to the VSB Bus and a high-speed DMA channel. In addition, the board uses VTC's VIC068 chip to interface to the VMEbus. The chip provides an

independent DMA channel to the VMEbus. The APEX bus provides 32-bit access to the μP. A selection of PEX and APEX modules are available for more functionality such as IEEE-488 and parallel I/O interfaces. $2195. Delivery, 90 days ARO.

Radstone Technology, 20 Craig Rd, Montvale, NJ 07645. Phone (800) 368-2738; in NJ, (201) 391-2700.

Circle No 704

INDUSTRIAL PC

The DataTough 286 industrial computer is based on an 8-MHz 80286 μP. A base unit contains 1M byte of RAM, a 720k-byte, 3½-in. floppy-disk drive, a 20M-byte hard disk, two serial ports, one parallel port, three available 16-bit slots, a travel-sealed keyboard, and a monochrome monitor capable of 720×348-pixel resolution. The unit can operate over a 32 to 131°F range in humidity levels of 5 to 95%. In addition, the unit can withstand shocks as high as 10g during operation. The unit is built with heavy-gauge aluminum, and all openings are sealed with gaskets. The keyboard is made of a contaminant-resistant membrane. The computer measures 11×21×18 in. and weighs 65 lbs. $4950.

Cimpoint, 1807 W Braker Lane, Suite S, Austin, TX 78758. Phone (800) 622-2993; in TX, (512) 837-3707.

Circle No 705

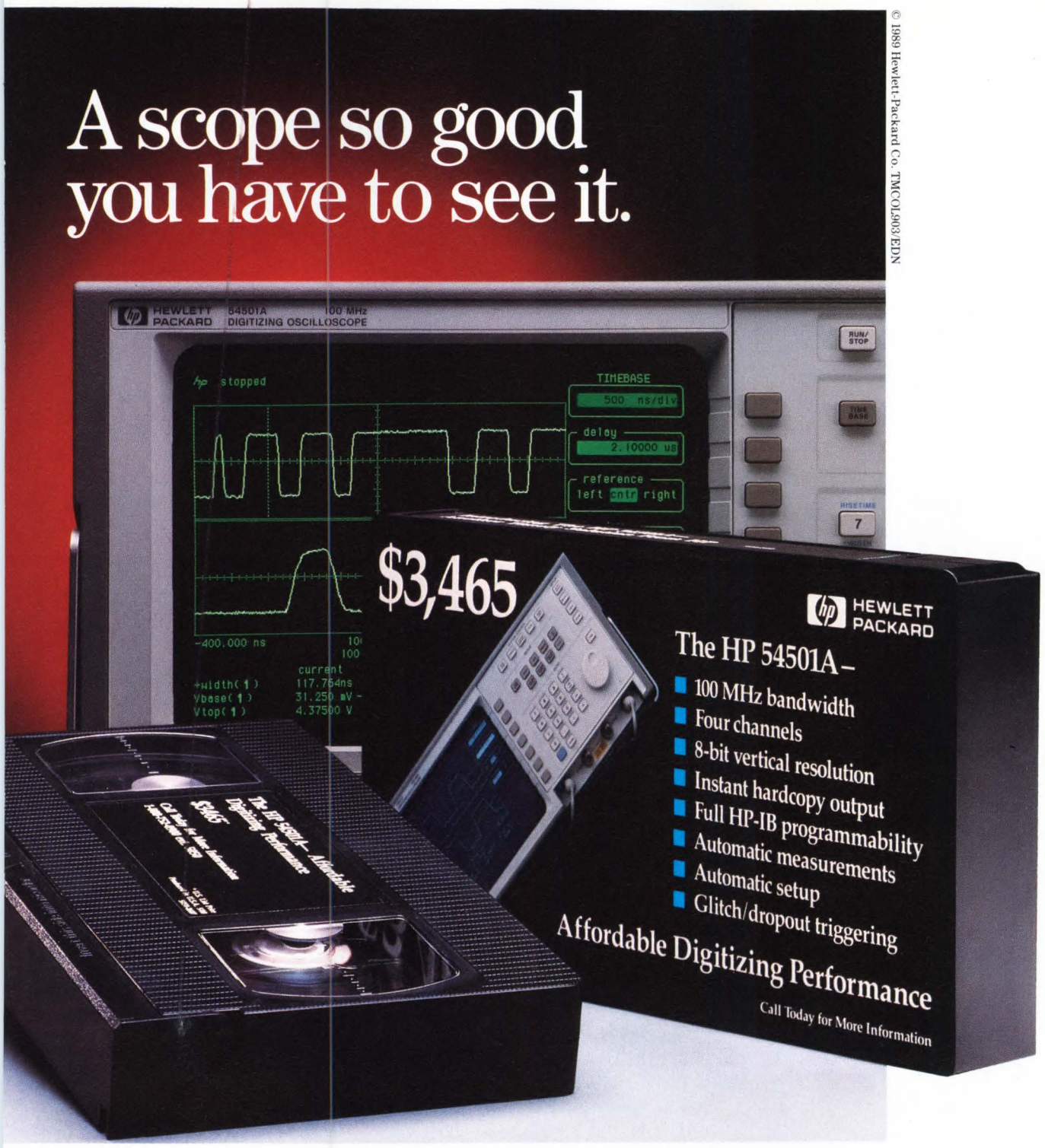
VME CPU BOARD

The MVME143 single-board computer for the VME Bus features a 68030 μP with three versions: 16.7, 20, and 25 MHz. The board also contains a 68882 floating-point coprocessor operating at the same speed as the CPU. The board has 4M bytes of dynamic RAM and four 28-pin sockets for ROM, EPROM, or EEPROM. Using a Z8530 serial communications controller, the board provides two multiprotocol serial ports; it also has an RS-232C debug port on the front panel, using the MC68901 multifunction peripheral (MFP) chip. The MFP also provides four 8-bit timers. An MC68230 parallel interface/timer IC supplies a 24-bit timer that can generate autovectored interrupt to the CPU on level 4. Mostek's MK48T02 provides a battery-backed real-time clock and 2k bytes of battery-backed static RAM. $2995.

Motorola Microcomputer Div, Marcom Dept, DW283, 2900 S Diablo Way, Tempe, AZ 85282. Phone (800) 556-1234, ext 230; in CA, (800) 441-2345, ext 230.

Circle No 706

A scope so good you have to see it.



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COMPUTER-AIDED ENGINEERING

Mixed analog-digital simulators

are picking up speed

Doug Conner, Regional Editor

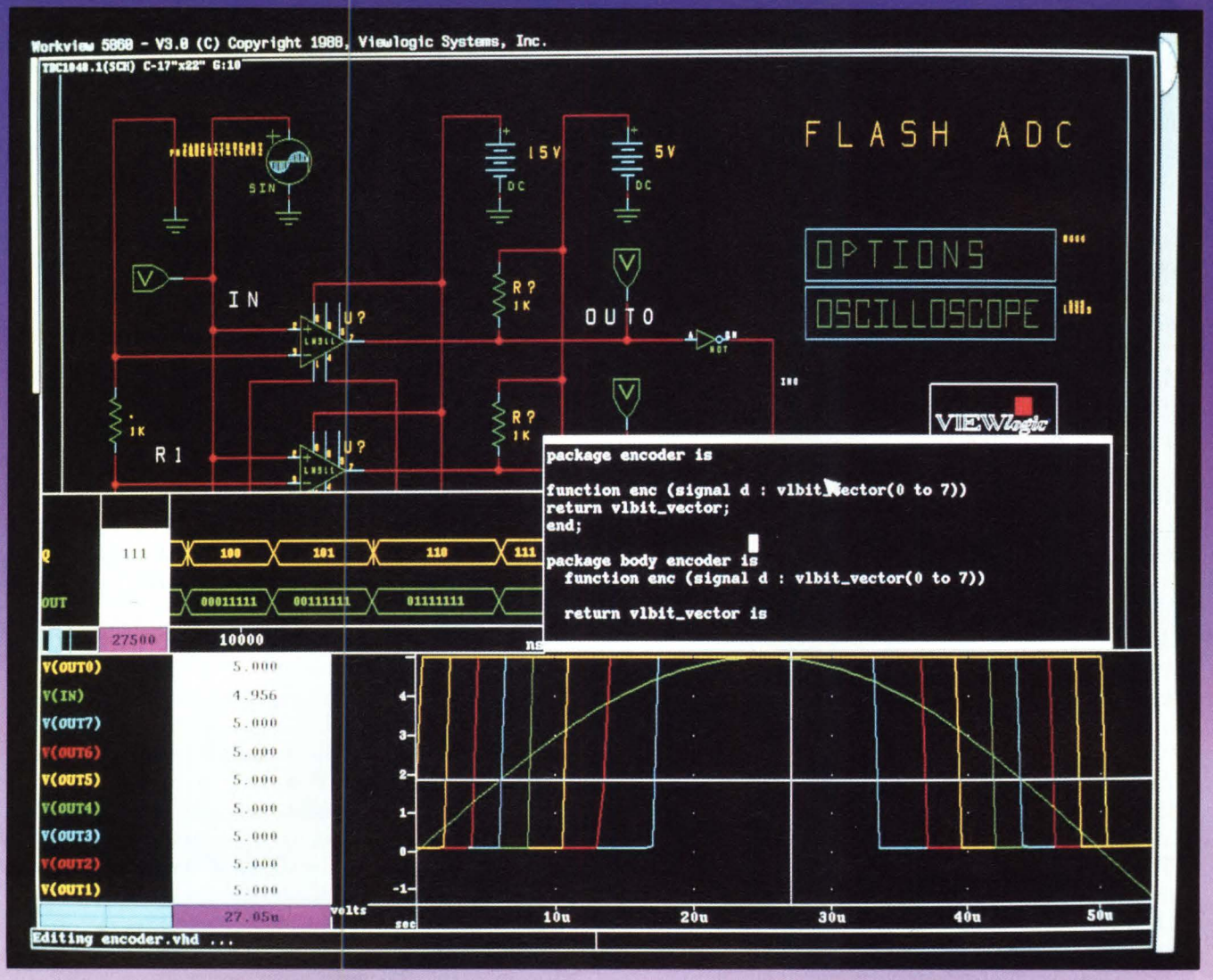
Whether you need a simulator for chip-level, board-level, or system-level design, products to meet your needs are beginning to proliferate.

Because even those systems that are mostly digital start or end in the analog world, you'll need both analog and digital simulation capability to simulate your entire system. Until recently, most designers approached this problem by either avoiding simulation altogether or by using separate analog and digital simulators and hoping that the interface would work. Now, however, you can use mixed-signal simulators that not only accurately simulate the analog and digital portions of a circuit, but also successfully span the interface between them.

If you're designing a mixed-signal ASIC, it's even more urgent to perform mixed-signal simulation. Without full simulation you run the risk of ending up with an ASIC that does everything it was supposed to do but has to be redesigned because the rest of the system doesn't behave the way you thought it would. Surprises that show up after you have silicon are seldom pleasant.

The traditional simulation method, using separate analog and digital simulators and segregating the circuit appropriately for simulation, speeds up the digital simulation but causes some problems. First of all, because the interface between the analog and digital portions of the circuit is not simulated, you have to be very careful to connect the analog and digital sections perfectly. No simulator can verify your connections.

For example, if you connect data lines incorrectly to an A/D converter after a successful simulation of the analog and digital portions of a circuit, all your effort will be wasted, especially if the circuit is an ASIC. That is admittedly a foolish mistake, but the last engineer to make it has yet to be born. A true mixed-signal simulator lets you verify the entire circuit, including



Viewsim A/D combines the Viewsim digital simulator with the PSpice analog simulator (Viewlogic Inc)

feedback paths between the analog and digital blocks.

Another situation where separate simulations are inadequate is in cases where there is a feedback link between analog and digital circuits. For example, in motor or engine control where you have analog sense or drive circuits and the control equations are implemented digitally, you're going to have a difficult time simulating the system without mixed-signal simulation. You can't break up the analog and digital sections and have an effective simulation of your control loop.

These problems notwithstanding, separate analog and digital simulation does have some advantages, one of which being that most designers can find analog and digital simulators that fit their needs. At present, trying to find a mixed-signal simulator that combines the features you need from both analog and digital simulators is still difficult because the choices are few.

Before comparing particular

It's important to simulate the entire circuit board containing an ASIC, or better still, the entire system.

mixed-signal simulators, it's important to know what to look for. Mixed-signal simulators typically comprise separate analog and digital simulators that run in unison. These separate simulators need the net list split into analog and digital sections before they can run the simulation. A tightly integrated combination of the two simulators will handle the net list split internally. A looser gluing of the two simulators may leave the net list split to be performed by the user. The separate analog and digital simulators operate independently except when an analog input to a digital device crosses a threshold or a digital input to an analog device changes state.

Communications between the digital and analog simulators is made difficult by the fact that most analog simulators work in time steps that are independent of the event-driven time steps of a digital simulator. To get the best simulation speed, you need to let both simulators work with their optimum time steps. When data needs to be exchanged between simulators, time must be synchronized.

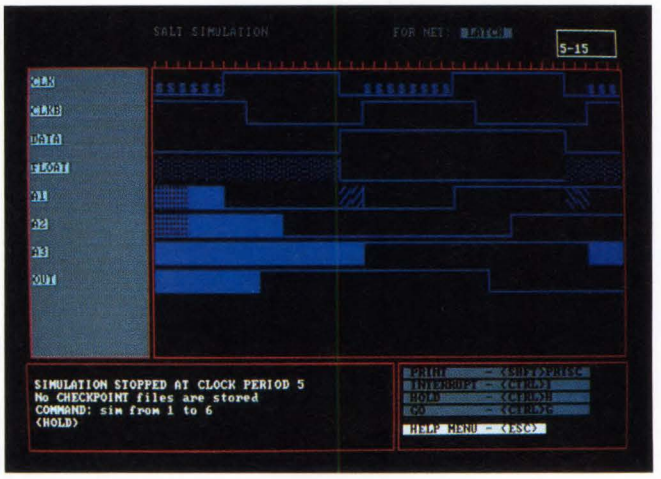
Interface models between analog and digital

Another problem that must be solved is the interface between analog and digital models. In the analog simulator, you need more information on the source and load of digital circuits than you need in the digital simulator. You also need to resolve digital output states and strengths, including high-impedance states. Generally, you need special device models that translate data between the analog and digital simulators.

You have several options when choosing a mixed-signal simulator. One is to simulate the entire circuit with a low-level circuit simulator such as Spice. Because simulation of digital circuits on a low-level simulator is slow in comparison with digital simulation, using Spice is only practical with circuits containing very few digital circuits.

On the other hand, analog simulation is typically the bottleneck when it comes to mixed-signal simulation, though it depends on the ratio of analog elements to digital elements in a design. Despite this, Spice and some other low-level circuit simulators are often on the receiving end of bad press. Two more points should be mentioned regarding Spice.

First, although Spice certainly isn't fast, execution time does not increase with the square of the circuit size, as some marketing literature would have you believe. Spice simulation time is consumed by model evaluations and matrix equations. Model evaluations



The SALT simulator (Cad Group Inc)

increase approximately linearly with circuit size and matrix equations increase exponentially, but with an exponent of around 1.2. If every element in a circuit were connected with all others the exponent would be two, but this does not happen in actual circuit design.

The second problem, convergence, also is not quite as bad as it is usually made out to be. Quotes on convertgence problems are normally in reference to an unrefined version of Spice 2G. Every major vendor of Spice derivatives has refined Spice models to minimize these convergence problems. This isn't to say that convergence problems don't exist, but any simulator that solves differential equations to simulate circuits has to deal with the inherent realities of mathematics when solving them.

Accuracy takes time

If you want the simulation accuracy provided by Spice or other low-level circuit simulators, you usually have to pay the price of significant amounts of time spent in simulations. But there is an alternative. You can sacrifice some of the accuracy of low-level circuit simulators for speed. One approach is to use behavioral simulation.

The concept of behavioral simulation is simple. Model a device or block of circuitry as a black box. At the system level, it isn't necessary to model everything that happens in a circuit, just how the outputs respond to the inputs. In contrast, a low-level circuit simulator such as a Spice tries to replicate the functions of every component in a circuit.

The power of behavioral modeling is not in replacing

TABLE 1—REPRESENTATIVE MIXED-SIGNAL SIMULATORS

MANUFACTURER	PRODUCT	PRICE	COMPUTER PLATFORMS
ANALOGY	SABER	$20,000	APOLLO, SUN, DEC VAX
ANALOGY/HHB	SABER/CADAT	$49,000	APOLLO, SUN, DEC VAX
CAD GROUP	SALT	$3500	APOLLO, SUN, DEC VAX, IBM PC/XT/AT, PS/2, MAINFRAMES[2]
MICROSIM	PSPICE	$4950	APOLLO, SUN, DEC VAX, IBM PC/XT/AT, PS/2, APPLE MACINTOSH II
NCR	DESIGNSIM A/D	$64,000	APOLLO, SUN, DEC VAX
SIERRA SEMICONDUCTOR	MONTAGE	$29,500[1]	SUN (APOLLO 3RD QUARTER 1989)
SILICON COMPILER SYSTEMS	LSIM	$25,000	APOLLO, SUN, DEC VAX
VIEWLOGIC	VIEWSIM A/D	$25,000	SUN, DEC VAX

NOTES: 1. $19,500 WITH LSIM
2. ALLIANT, CDC CYBER, CREY, ELXSI

low-level transistor models but in replacing groups of models, such as op amps and even higher-level blocks. These higher-level behavioral models of analog blocks can speed simulation significantly.

One important advantage of obtaining faster simulation of circuits is the ability to use the simulator as a real design tool, allowing you to try different design tradeoffs and to check the feasibility of different approaches. When simulation runs too slowly, it becomes nothing more than a verification tool.

Behavioral modeling also adapts well to the hierarchical approach of circuit simulation. You can make a behavioral model to simulate the actions of any size of circuit. Using a top-down design methodology, you can simulate a system before the actual system is designed in detail. Each behavioral model can be broken down into sub-models before simulating the detailed circuit design.

Once the detailed circuit has been designed and simulated in a low-level circuit simulation, the blocks can be replaced with behavioral models that describe more accurately how each circuit block will function.

For all their good points, however, behavioral models also have some problems. The simplifications that are often made in making a behavioral model restrict your use of the model. If you use a behavioral model in an unexpected way or look for behavior it was not made to simulate, you might obtain erroneous results. Ideally, when models are made the proper checks are built into them, but that isn't necessarily the case. Analog circuits can be legitimately used in many and sometimes bizarre ways.

One-thousand times faster than Spice

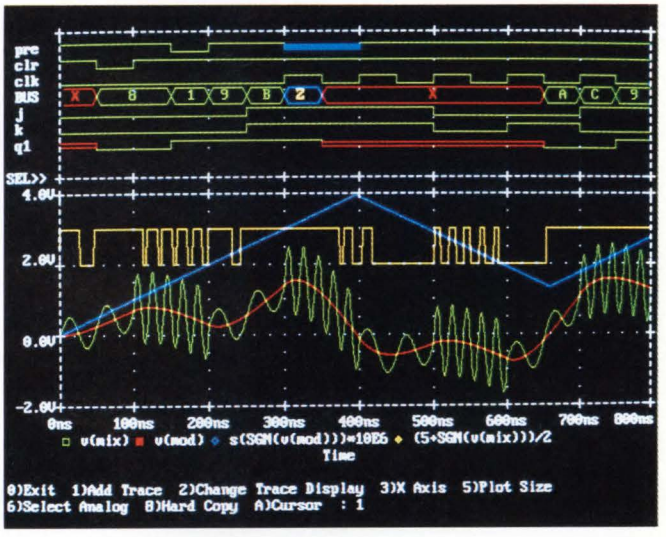
Every mixed-signal simulator in **Table 1** lets you use behavioral models to simulate analog circuits. The Montage simulator from Sierra Semiconductor is unique in that it is intended *only* for behavioral simulation. Montage uses detailed analog behavioral models that integrate tightly with the digital simulator. Sierra Semiconductor claims Montage runs at least 1000 times faster than Spice, yet is accurate enough that the company guarantees that any ASIC you design with Montage will work when they build it.

Several things probably allow the company to make this guarantee. Montage is intended only for ASIC design. Sierra Semiconductor has a library of about 300 analog and digital cells for which it has written detailed behavioral models. It has tight control over the building blocks you use in your design, and the simulator includes extensive error checking to make sure you use the models as intended.

Don't forget board-level simulation

Having a mixed-signal simulator developed by the ASIC vendor to be compatible with their IC process is ideal from the standpoint of developing ASICs. Possibly the only disadvantage of this approach is that this simulator is only appropriate for ASIC design. If you want to simulate the ASIC in a board-level application, you'll have to turn to another simulator.

If you like the idea of Montage but still want to have access to Spice simulation of circuits, there is a



PSpice includes a 28-state logic simulator (Microsim Corp)

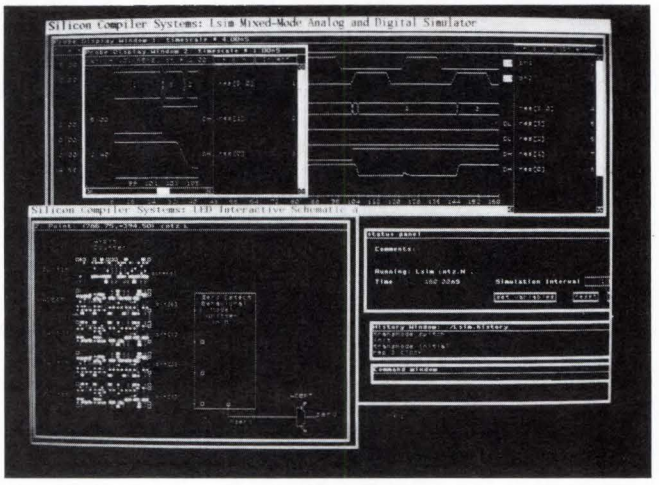
Surprises that show up after you have silicon are seldom pleasant.

solution. Montage is actually based on the Lsim product from Silicon Compiler Systems, a full mixed-signal simulator in its own right. Montage uses the digital simulator within Lsim but Sierra Semiconductor has developed the analog portion of Montage independently.

Lsim includes an interface to HSpice from Meta-Software (Campbell, CA) in addition to analog behavioral modeling. As with other mixed-signal simulators, Lsim lets you simulate some blocks with Spice and others behaviorally. Lsim also lets you use what Silicon Compiler Systems calls multimode simulation, which lets you switch between high-level and low-level models at critical times during a simulation. Lsim's digital simulator includes switch-level, gate-level, and behavioral-level simulation, plus serial and statistical fault simulators. It is intended primarily for IC simulation.

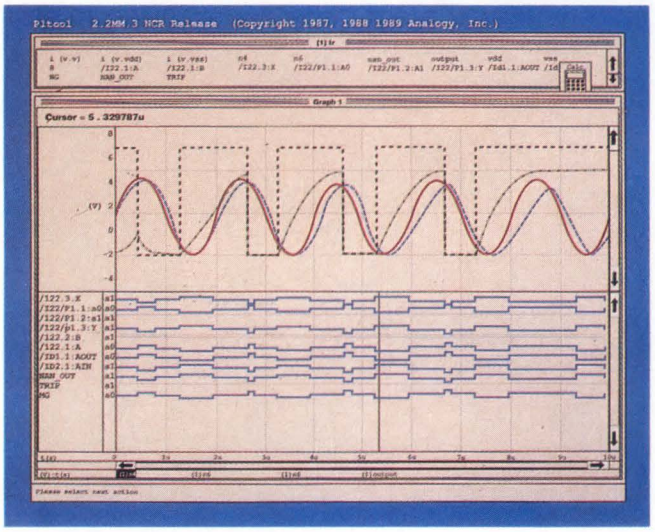
Two simulators that address both the chip-level and board-level simulation problem are PSpice from Microsim and Saber from Analogy. Though these simulators are intended primarily as analog simulators, both have built-in digital simulation capability that is adequate for limited digital simulation. However, the built-in digital simulators are not quite as versatile as dedicated digital simulators. For example, neither of them supports fault simulation, a feature you expect to find with true dedicated digital simulators.

Though PSpice and Saber have considerable overlap in their capabilities, they are totally different packages. PSpice, as the name implies, is a Spice-based simulator. Saber has low-level circuit simulation capabilities similar to Spice, but is completely different from Spice. For example, whereas Spice has models built in to the simulator, Saber has its own modeling language with models separate from the simulator. Both simulators accept Spice models and have extensive libraries of models; both provide software to assist you in developing your own models.

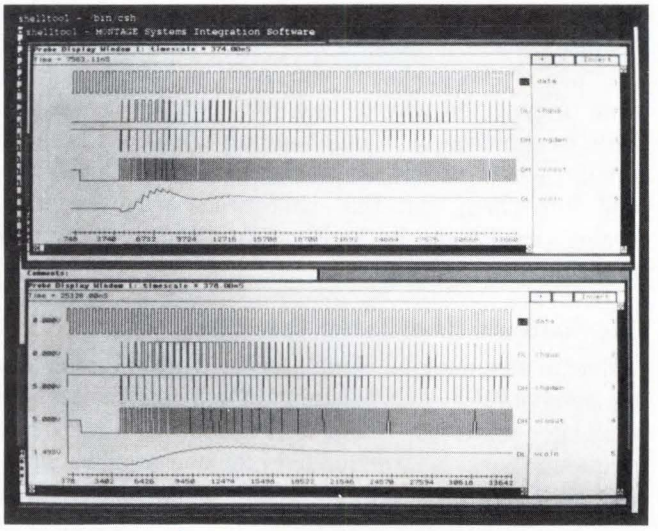


Lsinm provides mixed-signal simulation chip- and system-level designs (Silicon Compiler Systems)

For mixed-signal simulation of circuits requiring more sophisticated digital simulation, both PSpice and Saber have been paired with digital simulators. PSpice has been integrated with Viewlogic's Viewsim and also supports HHB's CADAT simulator. Saber has been teamed with CADAT and is working on interfaces to



DesignSim A/D uses Saber/CADAT combination (NCR Corp)



Montage's speed lets you perform design tradeoffs quickly (Sierra Semiconductor)

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CIRCLE NO 95

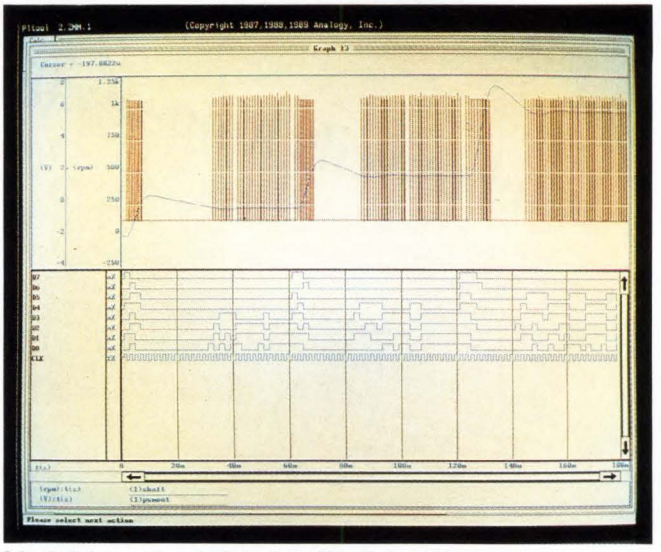
Separate simulators are inadequate in cases where there is a feedback loop between analog and digital circuits.

Gateway's Verilog (Westford, MA) and GenRad's HiLo (Milpitas, CA).

Viewlogic's Viewsim A/D product integrates PSpice with its Viewsim digital simulator to provide a powerful simulator capable of low-level circuit simulation through high-level system simulation of mixed-signal circuits.

Another case of integrating two packages under one roof is DesignSim A/D from NCR, which has taken the Saber/CADAT combination and integrated it to fit the company's needs. The Spice models NCR had previously been using were translated for Saber. DesignSim A/D can take advantage of all the models available for board-level simulation as well as the models NCR has developed for its ASIC process. As a result, you can simulate systems, boards, or ICs all on the same simulator. An additional benefit is realized by having a single company provide the digital simulator, analog simulator, and foundry.

Another mixed-signal simulator approach is the SALT simulator from Cad Group. SALT uses an analog simulator that is less accurate but faster than Spice. The accuracy of a Spice simulation is often much greater than you can measure in a real circuit. Cad Group has tried to reach what they feel is a better balance than Spice has between speed and accuracy.



Saber includes a native mixed-signal capability (Analogy Inc)

SALT also has features to speed up other parts of the simulation process. For example, SALT uses an incremental compiler so that circuit or model changes made between runs can be performed quickly. This simulator saves the state of the simulation as often as you'd like during execution so that you can restart the simulation from any point rather than having to start from the beginning.

SALT also offers features to help you troubleshoot circuit problems after the simulator has uncovered them. For example, a feature called traceback lets you determine all the sources driving a node, helping you spot errors when multiple sources are driving a bus line.

If you need a mixed-signal simulator you have several alternatives immediately available. By the end of this year you can expect products from every major electronic design automation company that isn't currently offering any. Many companies are working on new solutions to mixed-signal problems, not just repackaging products that are already available. EDN

For more information . . .

For more information on the mixed-signal simulators discussed in this article, circle the appropriate numbers on the Information Retrieval Service card or use EDN's Express Request service. When you contact any of the following manufacturers directly, please let them know you saw their products in EDN.

Analogy Inc
Box 1669
Beaverton, OR 97075
(503) 626-9700
FAX 503-643-3361
Circle No 420

Cad Group Inc
3911 Portola Dr
Santa Cruz, CA 95062
(408) 475-5800
Circle No 421

HHB System
1000 Wyckoff Ave
Mahwah, NJ 07430
(201) 848-8000
Circle No 422

Microsim Corp
20 Fairbanks
Irvine, CA 92718
(714) 770-3022
TLX 265154
Circle No 423

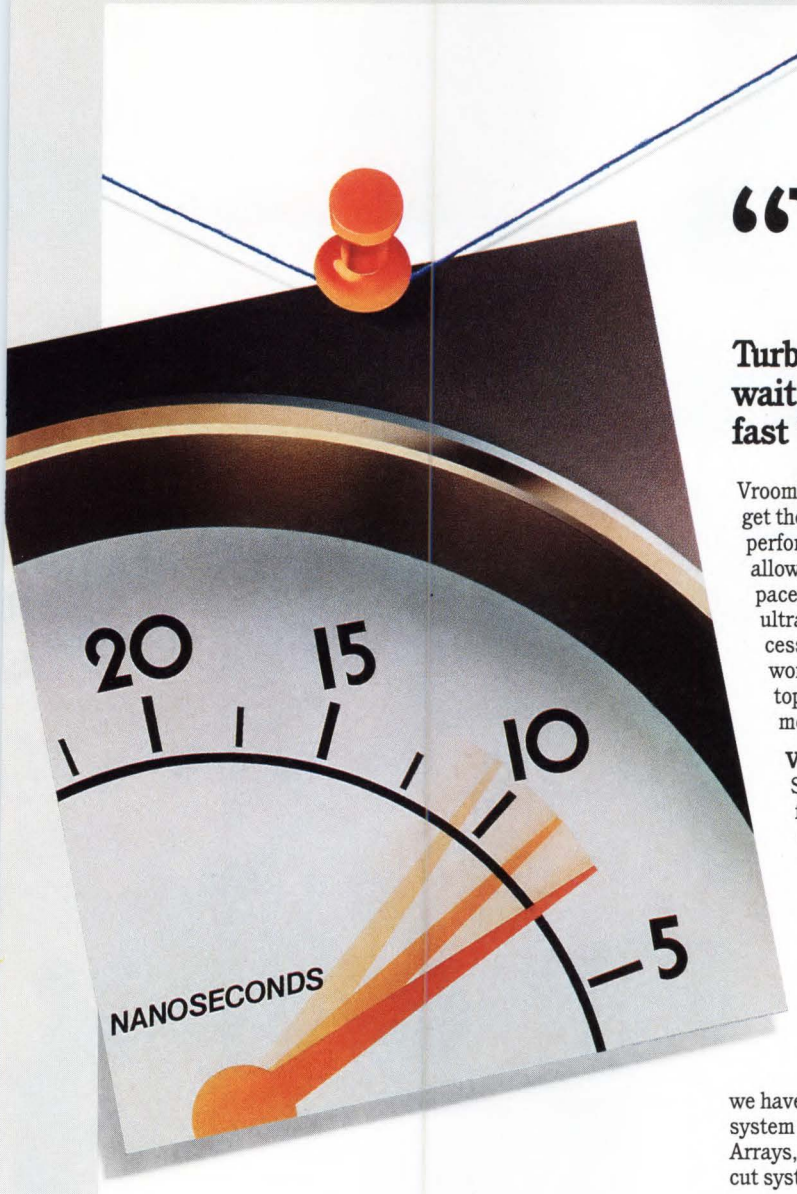
NCR Corp
Microelectronics Div
2001 Danfield Ct
Fort Collins, CO 80525
(303) 226-9550
(800) 334-5454
Circle No 424

Sierra Semiconductor
2075 N Capitol Ave
San Jose, CA 95132
(408) 263-9300
FAX 408-263-3337
Circle No 425

Silicon Compiler Systems
2045 Hamilton Ave
San Jose, CA 95125
(408) 371-2900
FAX 408-559-4916
Circle No 426

Viewlogic Systems Inc
313 Boston Post Rd W
Marlboro, MA 01752
(508) 480-0881
FAX 508-480-0882
Circle No 427

Article Interest Quotient (Circle One)
High 497 Medium 498 Low 499



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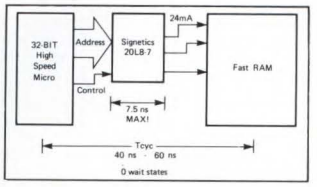

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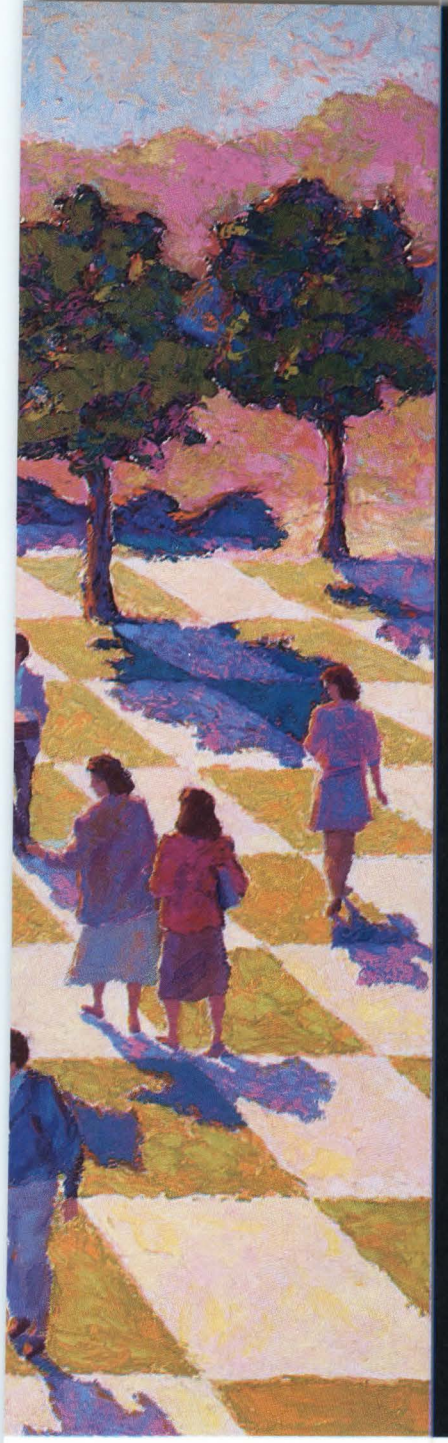

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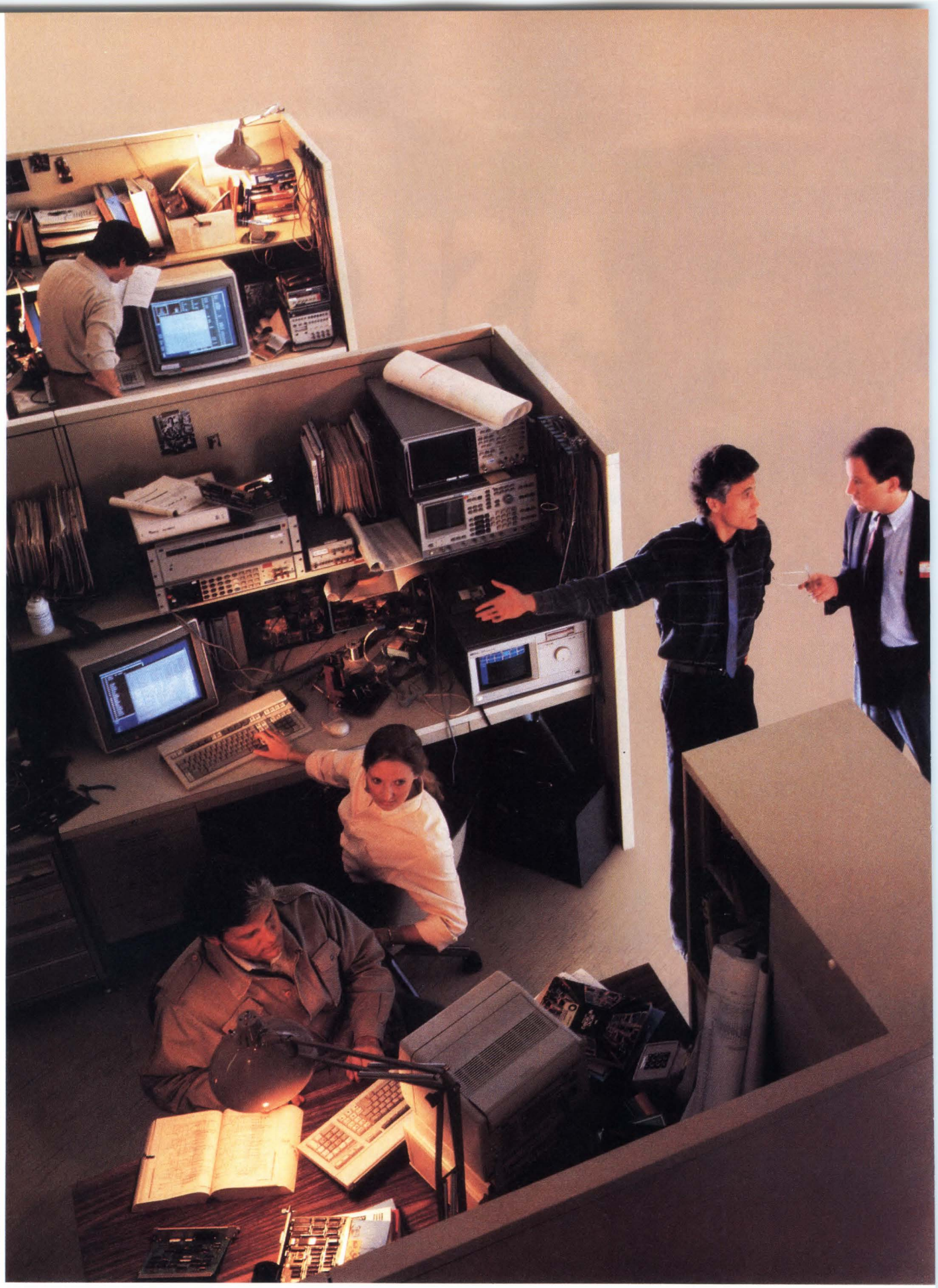

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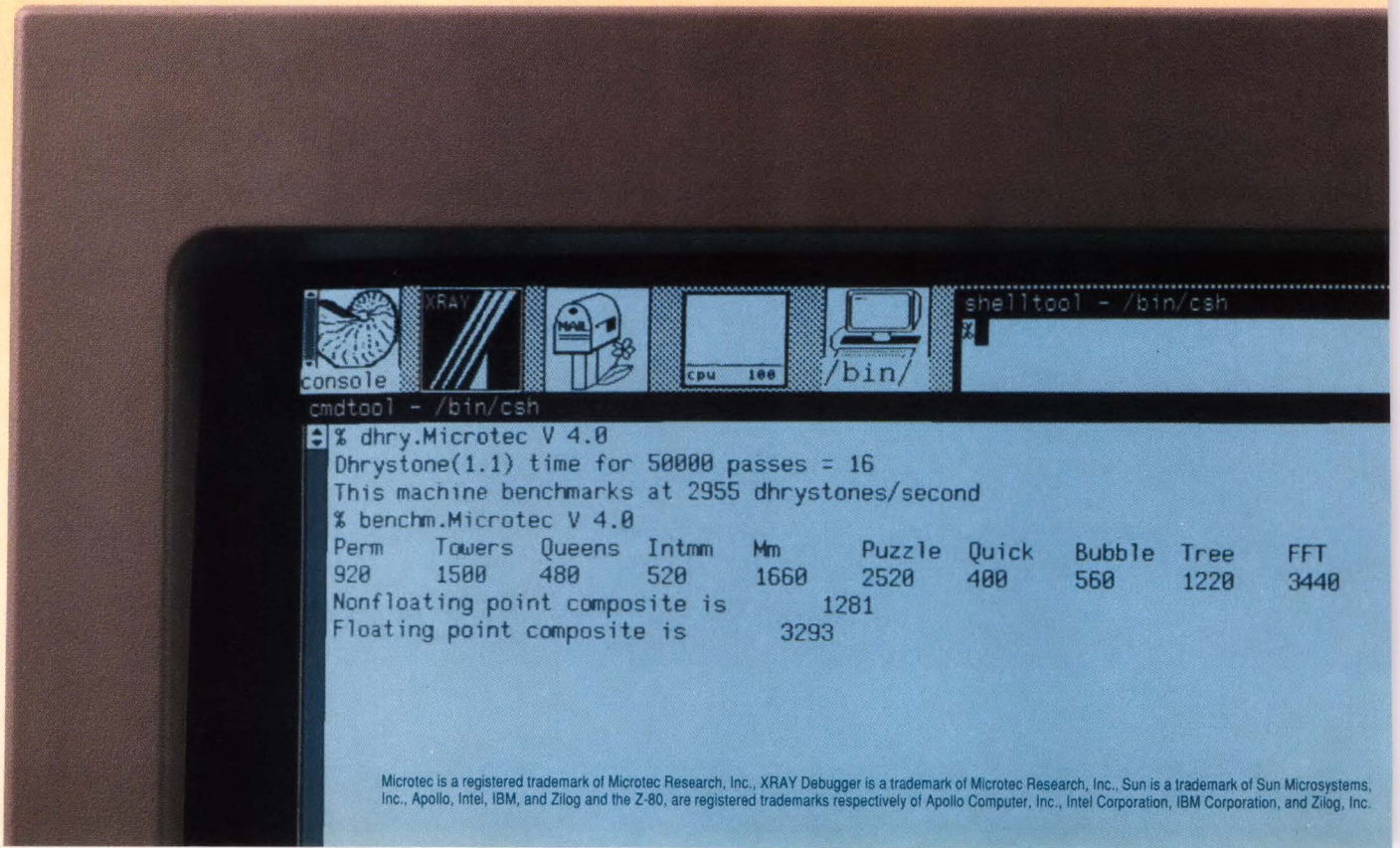
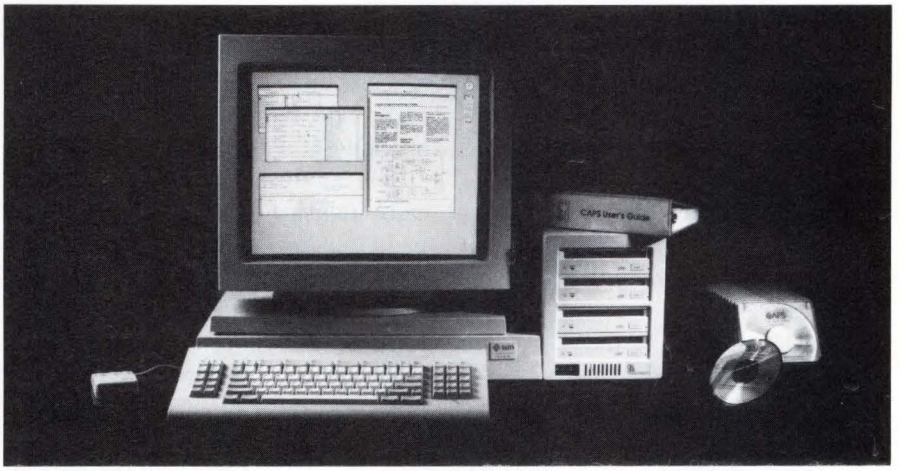


CD-ROM component-selection tool runs on Sun-3 workstations

CAPS (Computer-Aided Product Selection) is a tool that gives you fast, query-driven access to technical specifications, applications data, and the complete text and graphic images of manufacturers' data sheets for hundreds of thousands of ICs and discrete semiconductors manufactured by more than 375 companies. All component information is stored and indexed on more than 12 CD-ROM disks that your workstation reads with the aid of a CAPS-supplied 4-disk CD-ROM reader unit.



You access the database via a menu-driven user interface that lets you search for a part on the basis of fabrication technology, function, and dc or ac parameters. You can identify equivalent devices and alternate sources, find mil-spec parts, locate functionally identical components with different reliability ratings, and look up replacements for obsolete components. The CAPS database also includes in-depth reference data covering component upgrades and downgrades, military and DESC (Defense Electronics Supply Center) part numbers, reliability ratings, QPL (qualified parts list) sources, and manufacturers' addresses and phone numbers. If needed, you can print data sheets and applications notes directly from the database.

The CAPS system is available on an annual subscription basis from Cahners Technical Information Service for $7950. Update disks are issued at 90-day intervals and include information on new components as well as revisions to existing information.

Cahners Technical Information Service Div, 275 Washington St, Newton, MA 02158. Phone (617) 964-3030.

Circle No 357

In-circuit ASIC verification tool checks designs before prototypes

The Rapid Prototype Machine (RPM) Emulation System ia a real-time, in-circuit ASIC verification tool based on Xilinx's Logic Cell Array (LCA). You can design a circuit for ASIC implementation, transfer the design to the RPM hardware, plug the RPM emulator into your target system, and prove that the logic works in concert with the target system. If the logic doesn't work, the emulation system lets you reconfigure the LCAs to debug and correct problems.

The basic RPM configuration supports the real-time emulation of designs that have as many as 25,000 gates. Modular expansion permits the gate capacity to grow to 100,000 gates. Stimulus generation and logic analysis are built into the basic configuration. Interface cables and plug adapters insert into standard ASIC sockets, and optional component adapters let you use standard components, such as memory devices and μPs, as part of the emulation system.

The RPM Emulation System consists of stand-alone emulation hardware and software. The software consists of the emulation-setup and embedded-design-analysis tools. An Ethernet interface or a SCSI port connects to your Daisy, Valid, or Mento workstation and lets the workstation control the emulation system. Pricing for the RPM Emulation System starts at $125,000.

Quickturn Systems Inc, 1023 N Shoreline Blvd, Mountain View, CA 94043. Phone (415) 967-3300. FAX 415-967-3199.

Circle No 358

Analyzer package features test-fixture accessibility

The DFA (design for accessibility) Analyzer is a member of the Testbridge family of design-for-test products that are part of the vendor's Allegro pc-board-design system. The analyzer lets you incorporate access for automatic-test-equipment test fixtures when you place and route components on your board.

Using the DFA Analyzer, you can evaluate the accessibility of signals on boards that use fine-line technology, including micro vias and blind or buried vias. You can also evaluate boards that have surface-mount devices on both sides for accessibility to clamshell-type fixtures and fixtures that probe only one side of a pc board.

The analyzer lets you automatically identify existing via holes and pads that meet test-fixture requirements; the software will limit test points to those locations where the fixture has probes. In addition, the software inserts test points on the proper grid for those nets that don't have a readily accessible test location. To guide the selection and insertion process, you can use the vendor's defaults or introduce your own test rules. In addition, a numerically controlled (NC) drill-hole feature generates NC drill and route tapes of test-point locations to drive the equipment that produces custom test fixtures.

Allegro runs on Sun 3 and 4 workstations and DEC VAX stations. Prices start at $20,000.

Valid Logic Systems, 2820 Orchard Pkwy, San Jose, CA 95134. Phone (408) 432-9400.

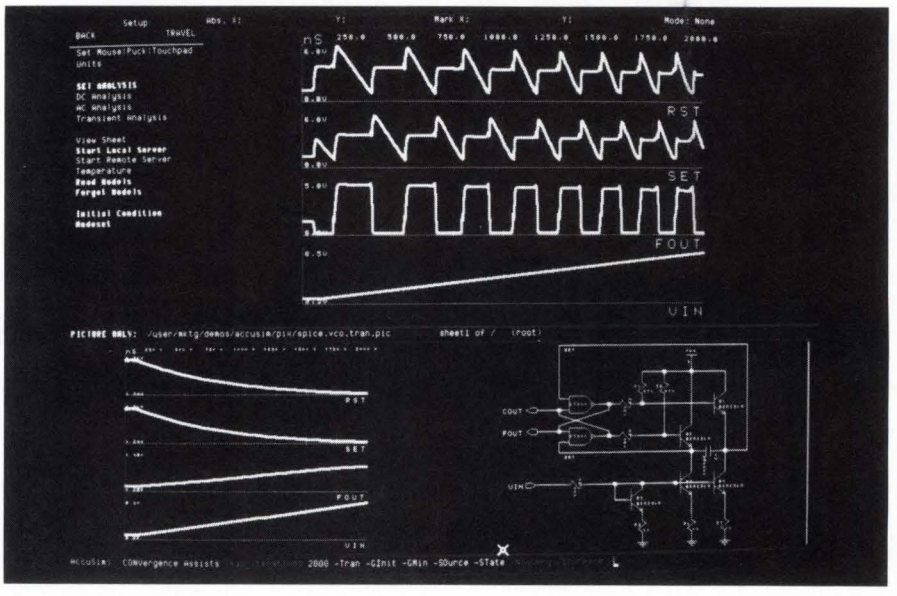
Circle No 359

Analog simulation package offers enhanced convergence and large library

AccuSim, an analog simulation package, provides enhanced convergence performance that lets you concentrate on circuit design rather than on how to make the simulation converge. Among its enhancements is a timestep control, which, the vendor claims, will work on circuits having more than 5000 transistors.

For cases where the standard simulation doesn't converge, AccuSim provides you with five interactive convergence-assistance algorithms. The likelihood of convergence is much greater if the program is able to compute abrupt changes in small steps. The AccuSim lets you enable or disable any of the five algorithms and control the number of convergence-assisted iterations performed by the simulator.

AccuLib, a library of models for AccuSim, contains open models for 1800 parts, including bipolar transistors, diodes, JFETs, MOSFETs, ICs, and power supplies. The vendor plans a library growth of 600 parts per year, provided in quarterly updates.



The cost of adding AccuSim to an existing Idea Series workstation is $22,000; AccuLib, as a site subscription with quarterly updates, sells for $22,000. A Monte Carlo upgrade is available for $7500. Pricing for the full Analog Station, including Apollo DN3010 hardware, starts at $31,900.

Mentor Graphics Corp, 8500 SW Creekside Pl, Beaverton, OR 97005. Phone (503) 626-7000.

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CIRCLE NO 101

Digital-signal-processing workstation performs algorithmic verification

The Signal Processing WorkSystem (SPW) does for signal-processing design what schematic capture did for logic design. Starting from software descriptions of primitives, you can interactively capture DSP system algorithms. You can then apply stimuli to your system's inputs and tweak the system to verify and optimize performance.

The menu-driven SPW features a Block Diagram Editor (BDE), which supports hierarchical design; you use the BDE to focus on algorithmic design. Because the BDE has revision control and offers transparent location and relocation of design data on a network of workstations, you can partition designs among a team of engineers.

The components you use to construct and simulate a DSP system come from the Function Block Library (FBL). This library contains about 100 software-coded function blocks. If you need a function that's not included in the library, you can write source code in C or Fortran to create a custom block. While the simulation is running, FBL lets you view signals, modify simulation parameters, and observe the results.

The Simulation Program Builder takes the signal-flow block diagram from the BDE and converts it into a program that simulates the signal-flow behavior of an entire DSP system. Your design can incorporate multiloop, nested, and hierarchical feedback paths.

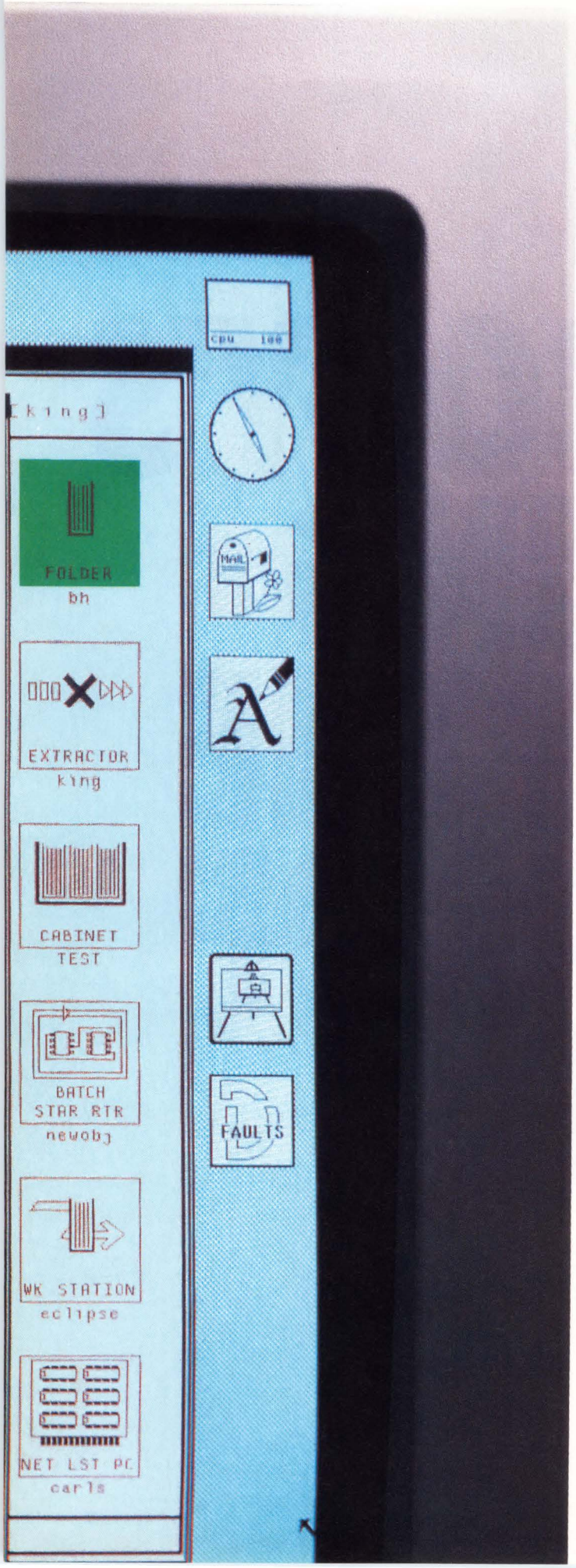
The Signal Display Editor creates, edits, displays, and analyzes signals within your DSP system. Its interactive commands let you cut and paste signals, thereby decreasing the amount of time you devote to signal construction and analysis.

The Signal Processing WorkSystem costs $25,000 and runs on the DEC VAXstation 3000 and on Apollo DN3000 and DN4000 workstations; it will soon be available for Sun 3 workstations.

Comdisco Inc, 101 California St, 38th Floor, San Francisco, CA 94111. Phone (415) 421-1800.

Circle No 361

EVERYBODY'S TALKING ABOUT THE FUTURE OF EDA.



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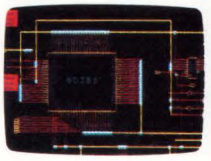
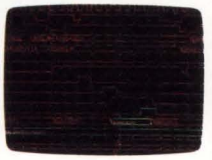
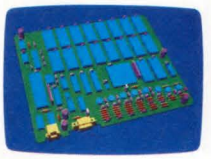


Digital Analysis

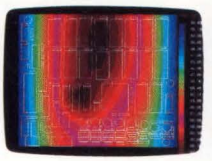


Analog Analysis

Mechanical Design



Thermal Analysis



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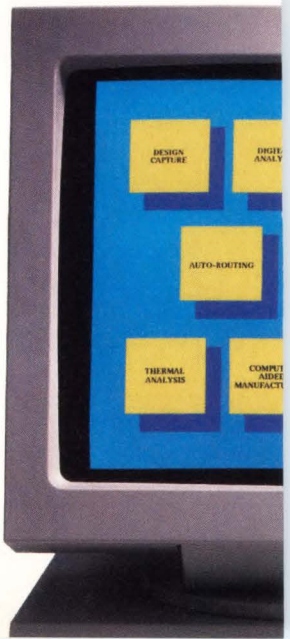

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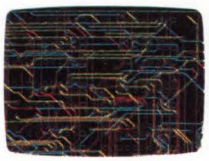
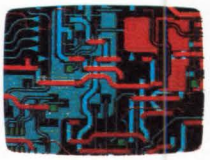
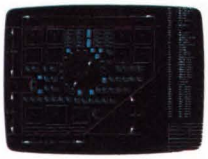


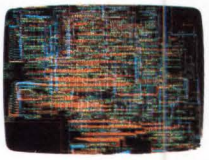
Auto-Routing



Manufacturing Documentation



Fabrication



It uses graphic icons, function keys and a mouse. Just point and click.

With just one uniform interface to learn, there's minimal training. So your design teams are up and running from nearly the first day they sit down.

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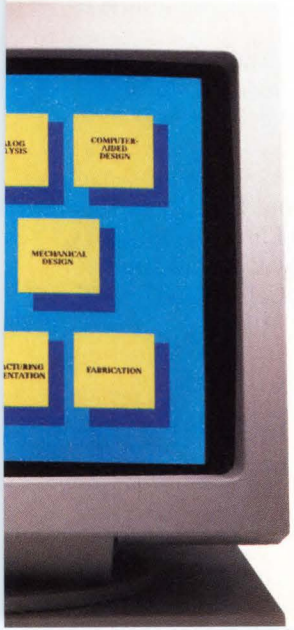
Our design tools play all your favorites. Including UNIX, DOS, Ethernet, IEEE 802.3, TCP/IP, NFS and the X-Windows system—plus the EDIF, IGES and IPC data exchange standards.



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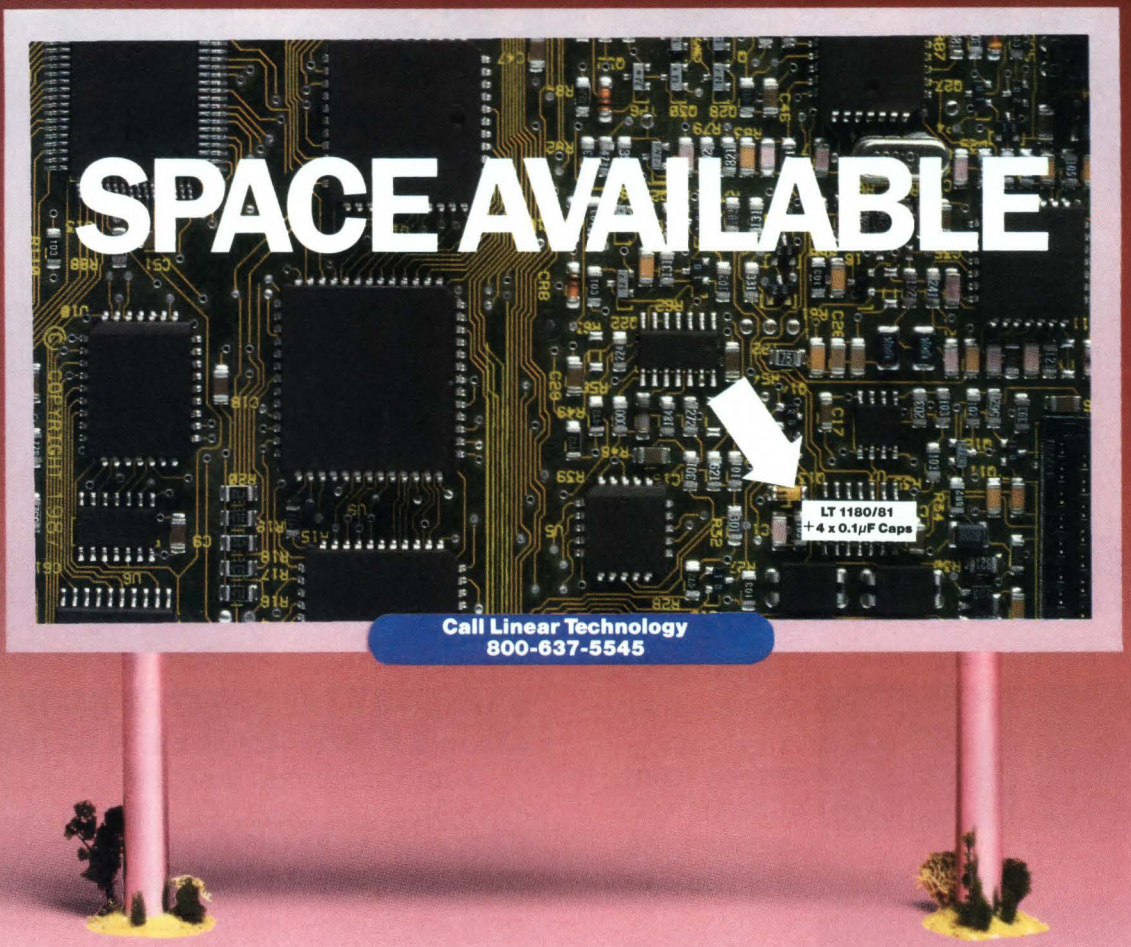

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Part Type	Drivers	Receivers	Power Supply Required	Shutdown	Drivers Fault Tolerant to ±25V	Charge Pump Cap Size Req'd.
LT1030	4	0	±12V	YES*	YES	N/A
LT1032	4	0	±12V	YES*	YES	N/A
LT1039	3	3	+5V, ±12V	YES*	YES	N/A
LT1039-16	3	3	+5V, ±12V	NO	YES	N/A
LT1080	2	2	+5V	YES*	YES	1μF
LT1081	2	2	+5V	NO	YES	1μF
LT1130	5	5	+5V	NO	YES	1μF
LT1131	5	4	+5V	YES*	YES	1μF
LT1132	5	3	+5V	NO	YES	1μF
LT1133	3	5	+5V	NO	YES	1μF
LT1134	4	4	+5V	NO	YES	1μF
LT1135	5	3	+5V, ±12V	NO	YES	N/A
LT1136	4	5	+5V	YES*	YES	1μF
LT1137	3	5	+5V	YES*	YES	1μF
LT1138	5	3	+5V	YES*	YES	1μF
LT1139	4	4	+5V, +12V	YES*	YES	1μF
LT1140	5	3	+5V, ±12V	YES*	YES	N/A
LT1141	3	5	+5V, ±12V	YES*	YES	N/A
LT1180	**2**	**2**	**+5V**	**YES***	**YES**	**0.1μF**
LT1181	**2**	**2**	**+5V**	**NO**	**YES**	**0.1μF**

*RS232 3 state outputs.

Linear's 1180/81 product using 0.1μF Caps and RS232 family:

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CIRCLE NO 104

PARAMETER EXTRACTOR

The Xtract program performs linear and nonlinear modeling characterization of microwave and RF GaAs FETs. The vendor's AnaCat computer-aided test program collects measurement data that Xtract uses to perform FET modeling characterization. From this data, Xtract generates transistor characterization files for a proprietary Bias-Dependent Transistor model. Xtract also supports other FET models to augment model extraction performance. The program's comparison feature lets you verify the quality of modeled results. You can use Xtract to simulate large signal microwave performance and generate s-parameters and dc voltage characteristics of the FET. Xtract runs on Apollo, Sun, and DEC hardware as well as HP 9000 Series 300, and IBM PCs running MS-DOS, PC-DOS, and OS/2. The software includes AnaCat Version 1.2; the Xtract program; an FET kernel; and training, which covers one FET extraction. From $34,500.

EEsof Inc, 5795 Lindero Canyon Rd, Westlake Village, CA 91362. Phone (818) 991-7530.

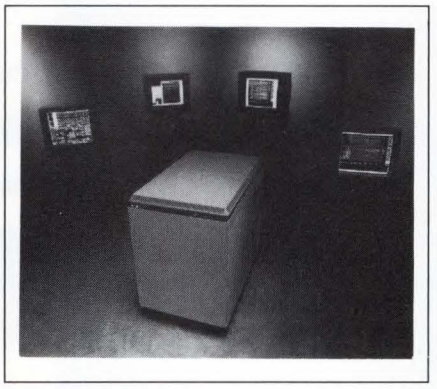
Circle No 707

LOGIC SIMULATOR

Lice is a low-cost, menu-driven logic-circuit emulator program. The simulator has three main menu selections: a logic-default editor, which initializes circuits and sets up the tabular output display; a TTL-family-component dictionary listing; and a logic-circuit entry, which accepts keyboard or diskfile schematics. Lice requires DOS 2.0 or higher with an IBM CGA or equivalent and needs 256k bytes of RAM. It comes with a tutorial manual. $49.

BSoft Software, 444 Colton Rd, Columbus, OH 43207. Phone (614) 491-0832.

Circle No 708



HARDWARE MODELER

The LM-1000 hardware modeling system addresses some of the problems associated with doing system-level simulations of designs involving semicustom ICs. It lets you create a logic model of an ASIC when you have prototypes available. After you mount a device on a device adapter, the modeling method lets you create a functional software shell in which you define the pinouts. A verification utility automatically checks software syntax and semantics.

For standard devices, the LM-1000 hardware modeling system supports a library of more than 600 logic models. Each includes a physical device mounted on a device adapter, shell software that defines I/O, and functional test vectors. Most of the models cost between $1000 and $2000. Because the models utilize the actual physical device, they are by definition correct. As long as the shell software is correct, the model will perform as the actual device—because it is, essentially, the actual device.

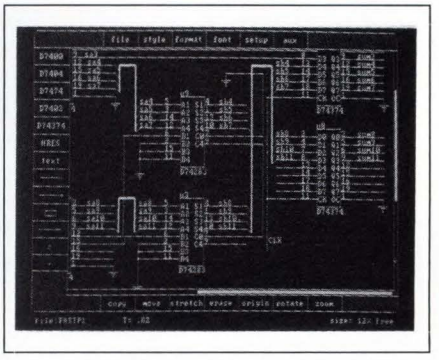
You can drive the LM-1000 from a variety of computers, including the Sun-3 and Sun-4; Apollo Series 3000, 3500, 4000, and 4500; DEC VAXstation, MicroVAX, and VAX; and IBM PC/386 and compatibles. It starts at $50,000 for the minimum unit and is available through Gateway Design Automation, GenRad, Valid Logic Systems, Vantage Analysis, or Viewlogic.

Logic Modeling Systems Inc, 1520 McCandless Dr, Milpitas, CA 95035. Phone (408) 954-5200.

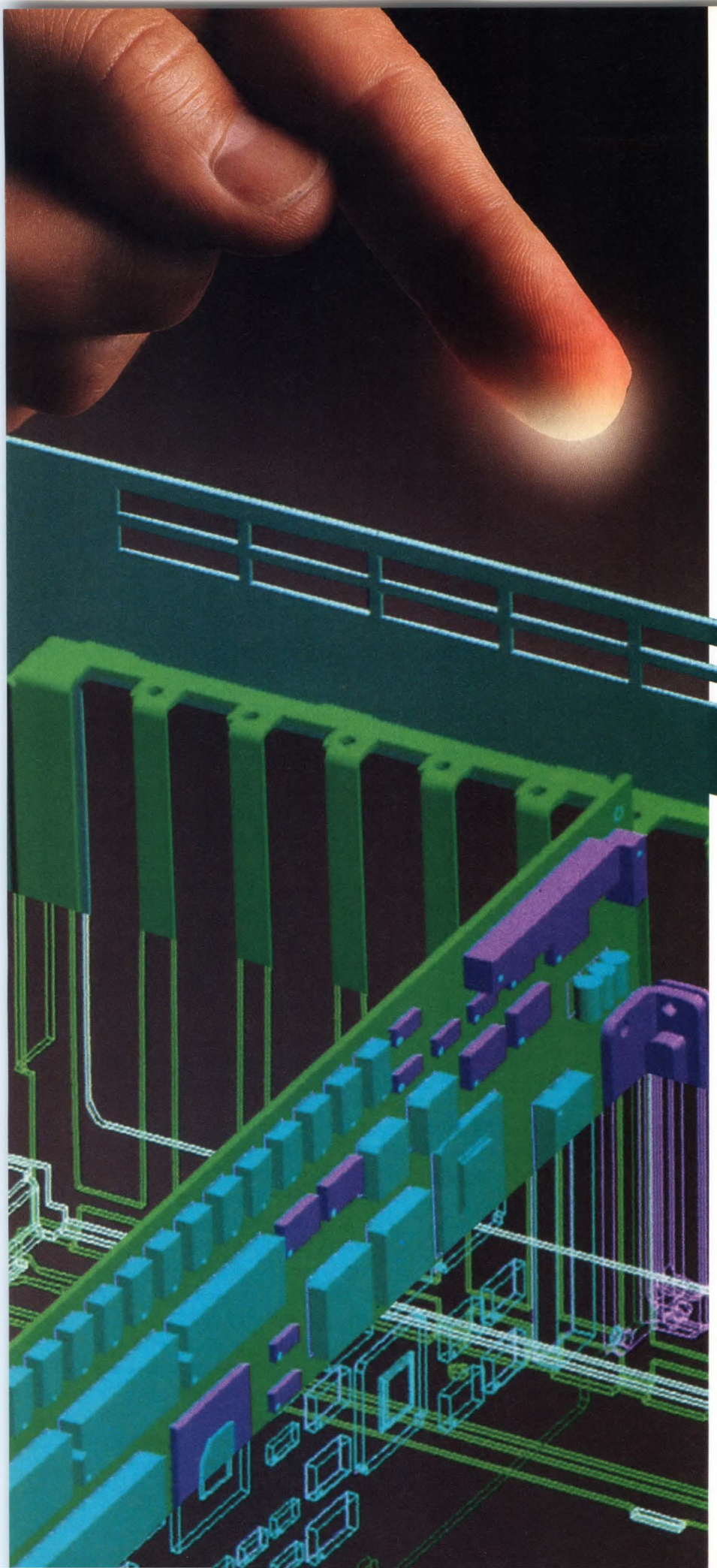
Circle No 709

SCHEMATIC EDITOR

SuperCAD is a low-cost, schematic-entry package that runs on an IBM PC or compatible with 320k bytes of RAM, an IBM CGA, EGA, or Hercules graphics card, a Microsoft mouse, and DOS 2.0 or higher. In addition to the schematic editor, it



comes with a netlist generator, a library-parts builder, and an ASCII screen editor. The parts libraries are organized into five categories: generic (TTL and CMOS), memory, microprocessors, PLDs, and DSP chips. A library of package outlines makes it possible to perform rudimentary board layout with the schematic editor. Menus covering about 40% of all commands are visible at all times, and other commands are accessible via pull-down or pop-up menus. Regardless of page size, SuperCAD allows you to



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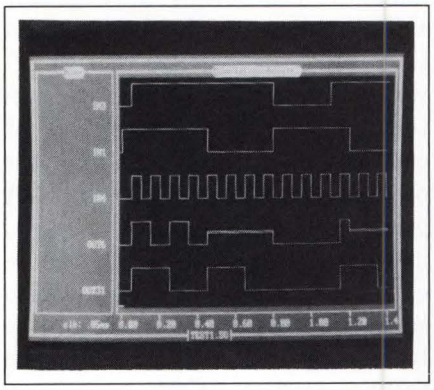
view the entire schematic and zoom in on a small portion. Further, function-key operations include undraw last object, recenter schematic, toggle-mouse mode, and redraw screen. The basic package supports narrow- and wide-carriage Epsom/IBM-compatible dot-matrix printers and can print A- through E-size pages in high or low resolution. $99.

Mental Automation Inc, 5415 136th Pl SE, Bellevue, WA 98006. Phone (206) 641-2141.

Circle No 710



PLD DESIGN TOOL

The CUPL version 3.0 enhancement lets you compile the entire design without concern for the architecture of any one PLD. You then perform simulation as a design-verification step. After you're satisfied that the design is correct, CUPL 3.0 creates a symbol table that indicates the PLD resources you need. You can then choose, either manually or through a database program, the device that best meets your price, availability, and performance requirements.

Highlighting CUPL version 3.0 are models of large devices having as many as one million fuses. To prevent the appearance of bias toward any one PLD supplier, CUPL's designers purposely avoided automating the PLD selection process. Other enhancements include the ability to accept standard EDIF (Electronic Data Interchange Format) output from other vendors' graphics entry packages; many high-level constructs; repeat commands that allow indexing of equations; and a waveform generator that lets you simulate large PLDs that have asynchronous architectures.

The software is free for users on the vendor's 2-year Maintenance and Update Program. An update package for existing MS-DOS users costs $250; for new users, prices start at $1250.

Logical Devices Inc, 1201 NW 65th Pl, Fort Lauderdale, FL 33309. Phone (800) 331-7766; in FL, (305) 974-0975. TLX 383142.

Circle No 711

LOGIC VERIFIER

The Personal Logic Design Verification System (PLDVS) allows you to perform functional tests and develop test programs for your ASIC- and PLD-based designs. The system comprises hardware and software that combine with your IBM PC/AT or compatible computer to form a test workstation.

The hardware portion of PLDVS includes plug-in cards for the computer and a generic socket adapter to receive the device under test. The adapter accepts devices with as many as 128 signal pins and is configurable to any device pinout and package style. The software portion allows you to create test programs using a Pascal-like language. You can enter test vectors in tabular form or generate them with algorithms. By using algorithms, you can quickly generate large numbers of test vectors, allowing you to exercise your design thoroughly. A 25-line program, for example, generates 65,000 test vectors for a counter design. The system software also includes a variety of utilities that allow you to design

custom test-result displays.

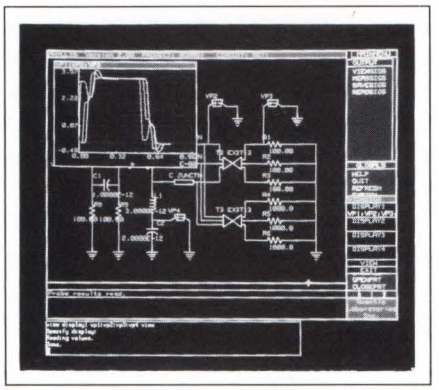
The PLDVS costs $6595, including software, interface, adapters and documentation. The graphical interface design software costs an additional $3400. Both require an IBM PC/AT or compatible computer.

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

Circle No 712

CAE TOOL

The MAXI/PC schematic-capture and pc-board layout package can execute double-sided, surface-mount designs with as many as 16 signal layers; it also handles multiple power and ground planes having a resolution of 1/1000 in. High-speed automatic features include placement, gate- and pin-swapping, component renaming, back-annotation,



and routing. The package runs on IBM PCs and compatibles. $995.

Racal-Redac Inc, 238 Littleton Rd, Westford, MA 01886. Phone (508) 692-4900.

Circle No 713

MULTISOURCE ASIC KIT

The Design Kit enables users of IBM PC-based workstations to design an ASIC and compare its performance in alternative gate-array or standard-cell technologies before committing the design to a vendor. Working within the Viewlogic CAE workstation environment, the kit allows you to reimplement a design in an alternate ASIC technology, resimulate, and compare the design's performance and gate utilization. Vendor technology files provide the data that the software tools use to verify a design's performance. The library contains 109 logic and I/O cells. The verification tools generate delay values that match the vendor's mainframe simulation numbers. The Design Kit checks for spikes, setup- and hold-time violations, and release-time and pulse-width errors. To operate the system, you need an IBM PC/AT or compatible with at least 640k bytes of RAM, an IBM CGA or EGA graphics board, and both a serial and a parallel port. The package includes the generic library, twelve software tools, and a choice of two technology files. $9950. Additional technology files, $1200.

Custom Silicon Inc, 600 Suffolk St, Lowell, MA 01854. Phone (508) 454-4600. FAX 508-458-4931.

Circle No 714

PC-BOARD ROUTER

The HiWire-Plus Autorouter is a rip-up-and-reroute, gridless, via-minimizing, multilayer, IBM PC-based autorouter. It lets you make trace-specific design rules; for example, you can tell the autorouter to route power networks with 21-mil width and 11-mil spacing, some signal traces with 12-mil width and 8-mil spacing, and other signal traces with 5-mil width and 5-mil spacing. HiWire-Plus Autorouter completes board routing; it lets traces cross each other and violate other design rules during the early stages of routing. In subsequent phases of routing, Autorouter optimizes, rips up, and reroutes vias for each network. During the final passes, the router centers traces in

the routing channels and further optimizes vias. For critical traces, you can prewire before starting the autorouter. To operate the HiWire-Plus Autorouter, you need the HiWire-Plus CAD package and an IBM PC/XT, PC/AT, or PS/2 with 640k bytes of RAM. A utility program can translate FutureNet, OrCAD, Schema, and Tango netlists; Algorex, Cadnetix, and SciCards netlist translators are being developed. $895.

Wintek Corp, 1801 South St, Lafayette, IN 47904. Phone (317) 742-8428. FAX 317-448-4823.

Circle No 715

MICROWAVE CAD TOOL

ACADEMY is a graphical design system for microwave and rf engineers, which covers all design phases from schematic entry, through mask layout and circuit simulation, to documentation. You can create a schematic in the standard way, or you can place your layout elements directly (without first having to create a schematic diagram) and then initiate simulation, in which case the program automatically creates a schematic from your component layout data. If you want to change elements or topology, sweep, tune, or optimize your circuit, or perform any other simulation function, you can do so either from the schematic representation or from the layout. The ACADEMY package, which integrates the vendor's Touchstone, Libra, and MiCAD tools, creates a single simulation database that contains all the information regarding the schematic, the layout, and the design parameters of the circuit. As a result, changes in the schematic cause the layout to be updated and, conversely, changes in the layout are immediately reflected in the layout diagram; in either case the netlist is automatically updated. The element-macro feature lets you create custom elements. The program produces fully annotated drawings or schematics for production and design notebooks; if you use other programs such as AutoCAD or Hewlett-Packard's EGS, optional utilities can convert the layout to these formats. The package also provides interfaces to a wide variety of other CAD programs and mask-making tools. Price ranges from $6000 to $14,000, depending on the type of host computer and the number of options selected.

EEsof Inc, 5795 Lindero Canyon Rd, Westlake Village, CA 91362. Phone (818) 991-7530. FAX 818-991-7109.

Circle No 716

ASIC DESIGN TOOLS

ChipCrafter/AX and ChipCrafter/ICX are ASIC-design tools that use expert-system techniques to incorporate custom modules into an ASIC designed with the aid of a fully automated proprietary design tool. Until now, bringing custom modules into an ASIC system has been difficult because the foreign block is rarely compatible with the standard ASIC-simulation system. ChipCrafter/AX provides menus

that let you define the layer assignments and port locations of your custom module, a simulation model of the module, and a schematic symbol in the workstation's format. The vendor's ChipCrafter ASIC-design workstation will then be able to compile the module as a block of standard cells or as an arbitrarily sized block. The large number of rulesets include a wide variety of CMOS fabrication options such as 1.0-μm features and RAD-hard capabilities. ChipCrafter/ICX provides all the features of ChipCrafter/AX, and provides tools and utilities that allow you to export all or part of a design to another design system. Because you have access to the layout in GDS or CIF formats, you can complete design-rule checking, electrical-rule checking, and layout-vs-schematic verification at the design site, and then take the design to any qualified foundry for fabrication. Both tools come with an automatic interface to Mentor Graphics (Beaverton, OR) IDEA workstations. ChipCrafter/AX, $108,000; ChipCrafter/ICX, $149,000.

Seattle Silicon Corp, 3075 112th Ave NE, Bellevue, WA 98004. Phone (206) 828-4422. FAX 206-827-4224.

Circle No 717

SIMULATOR

DesignSim A&D lets you simulate both analog and digital circuits concurrently, and provides a single-screen display of analog and digital signals that are synchronized in time and use the same time scale. You can run simulations of electronic devices at the system, cell, or transistor level with the accuracy of Spice. You can also model electromechanical interfaces. DesignSim A (the analog portion) is based on Analogy Inc's (Beaverton, OR) Saber simulator; DesignSim D (the digital portion) is based on HHB Systems Inc's (Mahwah, NJ) Cadat simulator. DesignSim supplements, and is accessible from, the vendor's Product Design Series I (PDS I) ASIC-design tool set, and is fully integrated into the newer PDS II tool set. When you run a mixed-signal simulation, each simulator schedules its own time steps for optimal execution speed, and both simulators analyze information simultaneously so that feedback is propagated through the analog and digital simulators as required. The simulation and analytical algorithms maintain a high level of accuracy and result in a decrease of simulation time. Pricing for PDS II with DesignSim A&D for a single user, from $64,000.

NCR Corp, 2001 Danfield Ct, Fort Collins, CO 80525. Phone (303) 226-9500.

Circle No 718

PC-BASED PCB CAD

Cadstar 4 is a moderately priced tool in the vendor's trio of pc-board design packages. Cadstar 4 accommodates complex boards with surface-mount devices on both sides of the board and handles multiple power and ground planes. It provides autoplacement routines that let you interactively optimize connections during component movement for higher density and shorter track lengths. The software can handle as many as 1023 components and 3500 connections per design. Cadstar 4 runs on IBM PC/ATs and compatibles as well as on 80386-based systems. $4850.

Racal-Redac Inc, Box 365, Westford, MA 01886. Phone (508) 692-4900.

Circle No 719

PLD COMPILER

The PLDASM-EKF assembler/compiler for a range of programmable logic devices, including PALs, GALs, and MegaPALs, runs under the OS-9 operating system for 68000 family processors. The device accepts Boolean equations for data input and has a macro capability that allows you to define more complex Boolean functions. As you step through generated source-code files, the PLDASM-EKF marks and comments on syntax errors and checks physical restrictions of the selected PLD device. If required, you can display the compiled fuse plot on a terminal, or plot it on a hardcopy device. The PLDASM-EKF generates a standard JEDEC format output file that's suitable for inputting into a variety of PLD programmers. Approximately $500.

EKF-Electronik-Messtechnik GmbH, Wedekampstrasse la, 4700 Hamm 1, West Germany. Phone (02381) 12630. TLX 828621. FAX 02381-15067.

Circle No 720

PC-BOARD DESIGN TOOL

Scepter PCB is a pc-board production tool suitable for use with multilayer analog, digital, and surface-mount boards. The layout editor lets you define component libraries, designate digital and analog packages, and assign I/O pins without the use of text files. The program can place as many as 2000 schematic elements automatically and imposes no limit on the number of components you place manually. Scepter PCB can route as many as 5000 signal nets automatically or 64,000 nets interactively; it can accommodate packages with as many as 2000 pins and can display and edit as many as 50 layers at one time. The Graphical Routing-Feasibility Analysis program uses colors to indicate routing density, allowing you to quickly identify those areas on the board where potential routing-disconnects may occur. The design-rule checker not only identifies trace-to-trace spacing, but also examines all graphics primitives and identifies violations. For example, it accurately calculates clearances

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CIRCLE NO 105

around tapered polygons and identifies traces that may be shorted by any text or logos that are present on the board. $19,999 to $29,999.

Royal Digital Scepter Systems, 2855 Kifer Rd, Santa Clara, CA 95051. Phone (408) 980-9492.

Circle No 721

RULE CHECKER

The LRC-100 Layout Rule Checker works with the vendor's LTL-100/SUN pc-board-design package. You can check all your layout rules in batch mode. You can also interactively select specific design rules for checking, view error vectors, edit the structure, and recheck. The LRC-100's hierarchical checking structure eliminates redundant errors. Its basic capabilities include width checks, spacing checks within a layer or between layers, and internal and external notch checks. You can also verify areas using the intersect, enclosure, and overlap capabilities. You can define rules with the Boolean operators (AND, ANDNOT, OR, and XOR), as well as by path length. In addition, the LRC-100 offers a perimeter check. The package runs on SUN 386i workstations. $9850.

Integrated Silicon Systems Inc, Box 13665, Research Triangle Park, NC 27709. Phone (919) 361-5814.

Circle No 722

RELIABILITY TOOL

The Reliability Prediction Program, RPP-V-3.1, is an interactive program that presents component failure rates when you enter data through form-fill menus. You can enter your own generic parts data or you can use the data from libraries. Further, you can set defaults for the quality level of all parts, for junction temperature of ICs, and for the voltage applied to transistors and diodes. Editing features let you make changes and replicate and export data. RPP-V-3.1 runs on DEC VAX computers under VMS 4.6 or higher. Optional features include a batch-loader program and a component stress-analysis program. The standard Reliability Prediction Program includes library maintenance and global-change features and comes with a 30-day money-back guarantee. First-year charge for the basic program, from $6000; annual renewal charge, 20% of the first-year charge.

Powertronic Systems Inc, Box 29109, New Orleans, LA 70189. Phone (504) 254-0383.

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COMPONENTS

Solid-state relays

satisfy a wide range of switching needs

Tom Ormond, Senior Editor

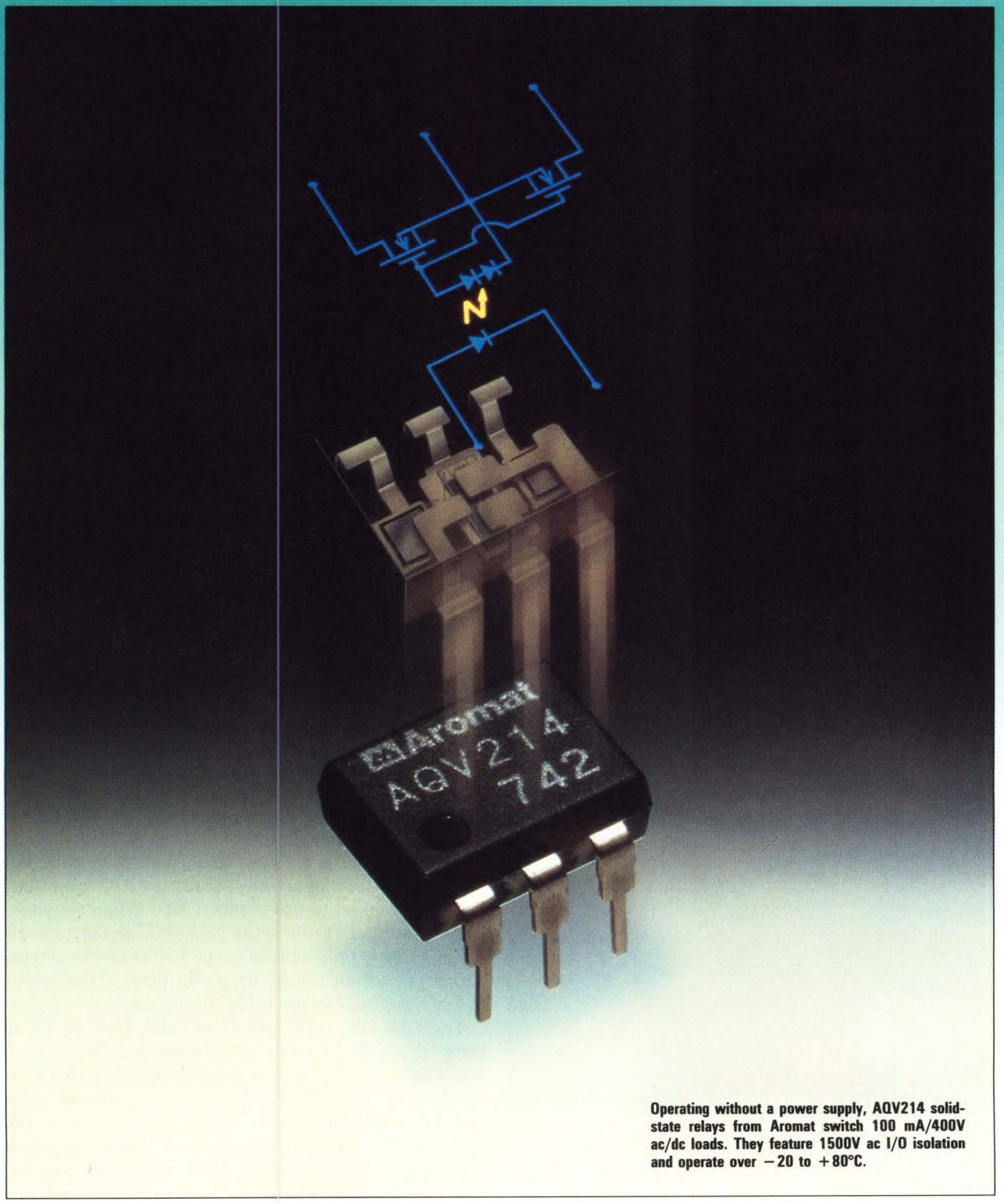
In diverse applications, ranging from replacing reed relays in low-power tasks to high-performance military needs, solid-state relays (SSRs) switch at higher speeds and have longer operating lifetimes than electromagnetic relays (EMRs).

Although, in the decades since their introduction, solid-state relays (SSRs) haven't eliminated the need for electromagnetic relays (EMRs), they do offer many major advantages over the earlier devices. For example, today's SSRs reliably switch ac or dc loads from current levels as low as 1mA to values approaching 100A. In addition, SSRs typically switch these loads 10 times faster and operate at least 10 times longer than EMRs. For almost any application, you can readily find a solid-state relay (SSR) to satisfy your needs.

Switching speed is a big plus for the SSR. At best, SSRs can outperform EMRs by a factor of 1000. Even at worst, SSRs are six times faster than most EMRs. Further, a typical SSR can easily outlive a comparable EMR by 10^4 operations.

SSRs also have no bounce problems because they have no moving parts. For this reason, they're not subject to any mounting restrictions. Noise, EMI, and RFI problems are practically nonexistent in SSRs, because the zero-voltage turn-on and zero-current turn-off capabilities available in most SSRs make them acoustically and electrically silent. Another benefit is the fact that SSRs employ no magnetic parts. SSRs can be mounted as densely as their package form factors allow—they have no relay-to-relay interaction problems.

Despite these obvious advantages, SSRs do present a few minor disadvantages. First, unlike EMRs, they have leakage current. In the off state, the output of an SSR isn't a true open circuit—there's always some leakage current flowing in the output switch. In high-power SSRs, this leakage current can be significant, reaching tens of milliamps. Further, when the SSR is turned off, you encounter such problems as a voltage drop across the output switch contacts. This voltage drop generates heat; when you're design-



Operating without a power supply, AQV214 solid-state relays from Aromat switch 100 mA/400V ac/dc loads. They feature 1500V ac I/O isolation and operate over −20 to +80°C.

In the worst case, a typical SSR switches approximately six times faster than a comparable EMR.

ing with SSRs, you must take into account this dissipation in order to design an adequate cooling system.

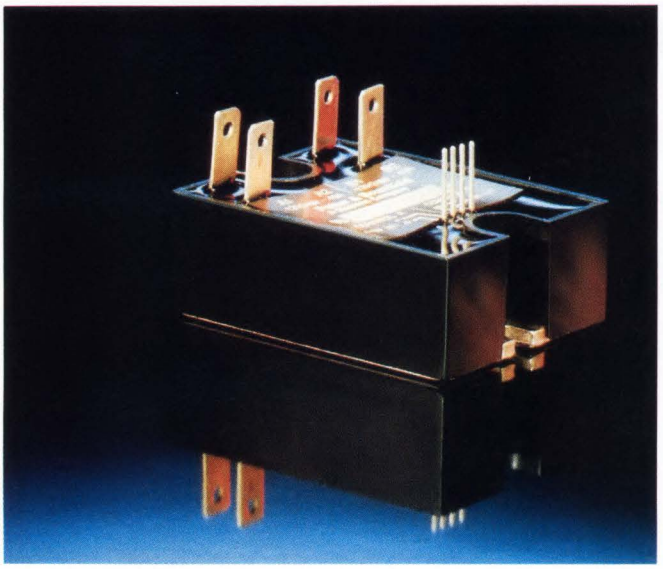
SSRs present you with other considerations. SSRs' output flexibility is limited; they're normally available only in spst NO configurations. This constraint can be a problem in certain applications. Also, designing with SSRs is expensive—an SSR can cost twice as much as a comparable EMR. Nevertheless, the SSRs' higher performance and longer operating life more than make up for their higher cost.

Replacing reed relays in low-power tasks

Although some vendors are working on extending their SSRs' relay capabilities at high power levels, most are focusing on the low-power end of the load range. Let's look at some of the low-power SSR products these vendors offer.

International Rectifier's PVA Series solid-state relays are designed to replace conventional electromechanical and reed relays through long life, high speed, low pickup-power levels, bounce-free operation, and low thermal-voltage levels. These solid-state relays have life expectancies that exceed 10^{10} operations; 300-μsec response time; pickup power as low as 3 mW; a maximum thermal offset of 0.2 μV; a 1000 V/μsec dv/dt withstand capability; and a $10^{10}\Omega$ off-state resistance.

The PVA Series units are single-pole, normally open devices. Internal construction features a photovoltaic generator. This generator consists of an alloyed, multijunction structure that drives a monolithic, bidirectional, N-channel power MOSFET called a "BOSFET." The input circuitry on this BOSFET output structure improves turn-off time and provides gate-protection functions. Further, this input circuitry on the BOSFET chip utilizes both bipolar and MOS technology to form npn transistors, P-channel MOSFETs, resistors, diodes, and capacitors.



To conserve panel-mounting area, SSRD solid-state relays from Potter & Brumfield offer two independent output switches in one package. Models are available that have load ratings of 25 or 40A at 24 to 280V ac for each output switch.

The PVA Series solid-state relays switch ac or dc signals from thermocouple levels through 300V p-p. They easily control signal frequencies into the RF range and feature switching rates as high as 5 kHz. The series includes three part numbers. The PVA2352 operates from a 5-mA input and handles 100-mA loads at voltages ranging to 200V ac or dc. It has an off-state resistance of $10^8\Omega$. Respective figures for the PVA3354 are 100 mA at voltages of 0 to 300V ac/dc and $10^{10}\Omega$. Operating from a 2-mA input, the PVA3324 also handles output loads of 100 mA at voltages of 0 to 300V ac/dc, and it has an off-state resistance of $10^{10}\Omega$.

Output capacitance for all the PVA Series SSRs equals 12 pF at 50V dc; input capacitance measures 1 pF. The devices operate over −40 to +80°C and are housed in an 8-pin DIP measuring $0.42\times0.25\times0.15$ in. The PVA2352 costs $2.87, the PVA3324 costs $3.65, and the PVA3354 costs $3.45 (1000).

The DIH-126, -127, and -136 solid-state relays from Dionics are designed for automatic test equipment (ATE) applications where speed, on-resistance, and leakage-current parameters are critical. These units incorporate an infrared LED input; a proprietary turn-off circuit; and a photovoltaic (PV) diode array connected to the gates of a pair of high-voltage MOSFETs, which serve as the output.

The PV array is a series-connected group of photosensitive diodes that are electrically isolated from—but optically coupled to—the input LED. When activated by the input LED, the array generates an open-circuit voltage that is proportional to the LED's input current. This array output voltage drives the gates of the output MOSFETs, causing the relay to conduct.

The DIH-126, -127, and -136 SSRs drive ac or dc loads, depending on how you configure them. You can also configure the units to accommodate two dc loads. For ac loads, the SSRs handle continuous current levels of 0.3 to 1.25A at ±100 to ±400V. For dc loads, the SSRs handle 0.55 to 1.55A at 100 to 400V. In pulse-type applications (a 20-msec pulse with a 1% duty cycle), current ratings range as high as 18A for dc loads

and 12A for ac loads. The SSRs feature an on-resistance figure ranging from 0.2 to 8Ω, typical output capacitance of 25 to 320 pF, and off-state leakage of 0.05 to 0.8 μA.

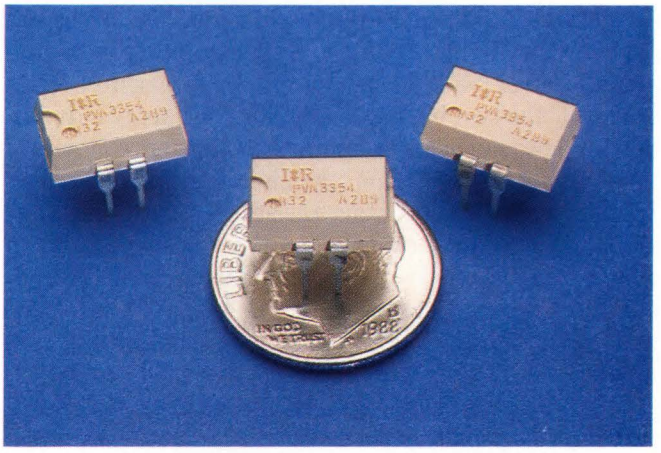
The operating range for the -126, -127, and -136 solid-state relays spans either −20 to +85°C or −55 to +125°C. On-time figures range from 300 to 950 μsec for ac loads and 350 to 1000 μsec for dc loads. Off-time figures range from 400 to 450 μsec and 450 to 550 μsec. Minimum I/O isolation equals 500V ac and minimum I/O resistance measures $10^8\Omega$. The relays are priced at $40.65 (1000).

Who needs a power supply?

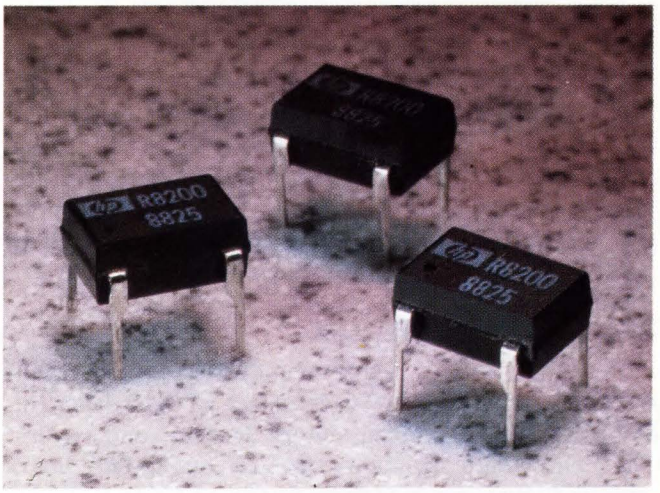
Available in 6-pin miniature DIP and surface-mount versions, Aromat's Photo-MOS type AQV214 solid-state relay switches loads of 100 mA at 400V ac or dc. The device features a 5-pF output capacitance and is well suited for applications involving switching in the 50-MHz range.

The AQV214 employs an LED source, an optoelectronic element (solar cell), and two output MOSFETs. When a signal current flows to the input terminals, the LED emits light; this light passes through transparent silicon and reaches the solar cell, which is mounted opposite the LED. The photoelectric element converts the light to a voltage that is directly proportional to the amount of received light. This voltage passes through a control circuit designed for high-speed response, and it charges the gates of the output MOSFETs. The MOSFETs begin to conduct and turn on the load when the MOSFET gate voltage reaches a preset voltage level. When the input-control signal is removed, the LED stops emitting light. This decreases the voltage being generated by the solar cell and turns off the MOSFETs. Once the MOSFETs stop conducting, the control circuit rapidly discharges the FET gates and immediately turns off the load.

Key input specifications for AQV214 SSRs include absolute maximum ratings of 50 mA for LED forward current, 3V for LED reverse voltage, 1A peak LED forward current, and 75-mW power dissipation. On the output side of the SSR, output-switch on-resistance ranges from 12.5 to 50Ω, and off-state leakage current equals 1 μA max. Maximum turn-on time equals 0.5 msec and maximum turn-off time measures 0.2 msec. The SSRs' I/O isolation equals 1500V ac, and their operating range spans −20 to +80°C. Unlike mercury-type relays, AQV214 devices have no mounting-position restrictions, and they can be mounted in proximity because they are unaffected by magnetic fields. AQV214 solid-state relays are priced at $4.50 (500).



Capable of switching inputs ranging from thermocouple levels through 300V ac or dc, PVA Series units from International Rectifier have lifetimes as high as 10^{10} operations, pickup powers as low as 3 mW, and 0.2 μV max thermal offset voltage.



Designed for small-signal switching applications, HSSR-8200 solid-state relays from Hewlett-Packard feature 50-μsec switching speed, 0.5-μV max contact offset voltage, and a 5-mA max control current requirement. Housed in a 4-pin DIP, the SSRs operate over −40 to +85°C.

Hewlett-Packard's HSSR-8200 solid-state relay consists of a high-voltage integrated circuit optically coupled with an LED. The device is a solid-state replacement for single-pole, normally open electromechanical relays typically used for general-purpose switching of analog signals.

The LED controls the on/off function of the HSSR-8200. The detector IC contains high-voltage MOS transistors and a high-speed photosensitive drive circuit. When the solid-state relay is energized, a photodiode

SSRs have no mounting-position restrictions and can be stacked in proximity to other units.

array converts the LED's optical radiation to voltage and current levels that are sufficient to operate the switch driver as well as drive the gate-source electrodes of the two FETs. The photodiode array supplies all the power needed to operate the output contacts—no power is required from the circuit that is controlled by the switch. Low contact resistance, low offset voltage, and low level control are key features of these single-pole, normally open solid-state relays. Closed-circuit contact resistance equals 160Ω max, offset voltage equals 0.5 μV max, and control current equals 5 mA max.

The contacts of the HSSR-8200 solid-state relays are rated to switch loads of 200V ac/dc at 40 mA max. Maximum contact power dissipation equals 320 mW. In the off position, contact rating for resistance, leakage current, and capacitance are 10,000 GΩ, 0.02 nA, and 4.5 pF, respectively. Typical control reverse breakdown voltage equals 45V, and control-to-contact isolation measures 3000V dc.

The HSSR-8200 SSRs are housed in a 4-pin DIP. For a control current of 5 mA, typical turn-on and turn-off times equal 50 and 45 μsec, respectively. The output switch is rated to withstand an electrostatic discharge of 8000V. All of these SSRs' specifications are guaranteed over an operating range of −40 to +85°C. The HSSR-8200 relays cost $2.43 (10,000).

Handling higher power loads

The Acculex SSR Series of industrial-quality solid-state relays are designed to interface μP-based controllers to real-world pumps, motors, heaters, and coolers. The SSRs' high reliability (MBTF equals 20^6 hours min), industry-standard form factor, and simple 4-wire operation allow them to accommodate high-power switching needs in even the harshest environments.

The SSR-10, -20, and -40 switch loads of 10, 20, and 40A, respectively, at 24 to 280V ac. These ratings are guaranteed only when the units are mounted on heat sinks; you must derate all SSR load ratings for free-air operation. All solid-state relays operate with TTL-level control signals from 3 to 28V dc—input-control current measures only 6 mA max. The SSR Series relays are housed in the industry-standard, 1.75×2.25×0.90-in. hockey-puck package.

All SSR Series solid-state relays employ zero-sense circuitry, which provides zero voltage turn-on and zero current turn-off, and virtually eliminates EMI/RFI problems. Relay turn-on and turn-off time equals 8 msec max. With 4000V-rms optical isolation and dielectric strength greater than 3700V ac, the SSRs protect both personnel and costly equipment.

To virtually eliminate EMI/RFI problems, SSR Series solid-state relays from Acculex employ zero-sense circuitry that provides long-life zero-voltage turn-on and safe zero-current turn-off.

The SSR-10, -20, and -40 have surge-current ratings of 100, 200, and 650A, respectively. A built-in snubber network, which features a 200 V/μsec static dv/dt, provides protection against false triggering. The SSRs have built-in reverse-voltage protection on the input and are UL and CSA approved. The SSR-10, -20, and -40 solid-state relays cost $34, $38, and $46, respectively.

Gordos also makes products for high-power applications. G Series solid-state relays are available in versions that switch 10-to-90A loads at voltages of 140, 250, 280, and 480V ac max. Minimum load voltages measure 36V ac for 480V-ac versions and 24V ac for all other models. The 280V-ac versions have 600V blocking ratings, and the 480V-ac versions feature 1200V ratings to enhance transient protection.

All G Series SSRs operate from either ac (90 to 280V) or dc (3 to 32V) input-control signals. The devices employ back-to-back dual SCR (silicon control rectifier) outputs and feature snubber networks that have a static dv/dt rating of 200 V/μsec. The solid-state relays employ optical techniques to provide 4000V-rms input-to-output isolation. All SSRs are available in either zero-voltage or random-voltage turn-on versions.

Housed in the industry-standard hockey-puck package, which requires a mounting area of 1.75×2.25 in., G Series solid-state relays operate over −20 to +80°C. Maximum on-state voltage drop equals 1.6V and maximum off-state leakage-current values range from 7.5 to 15 mA. Input-to-output capacitance measures 8 pF

max; turn-on and turn-off times are 20 and 30 msec, respectively.

G Series SSRs are UL recognized and CSA certified, and many models also carry VDE approval. A 90A, 480V G Series solid-state relay costs $45.50.

Shrinking panel-mount needs

As noted earlier, most solid-state relays are spst NO devices. However, certain manufacturers offer relays that do let you satisfy high-packing-density needs.

The SSRD Series from Potter & Brumfield features two independent solid-state relays in a common hockey-puck package. There are two models in the series: a model in which each of the two 1 Form A (spst, NO) outputs are rated to switch 40A at 24 to 280V ac; and a model in which outputs are rated to switch 25A at 24 to 280V ac.

SSRD Series solid-state relays employ inverse parallel SCRs as output devices. To provide protection against false triggering, dv/dt snubber networks across the output switches restrict the rise of most voltage transients to within acceptable limits. The SSRs require an input of 4 to 15V dc and are available in both zero-voltage and random-voltage turn-on versions. They employ optical coupling to provide 2500V rms input-to-output isolation and are UL recognized and CSA certified.

The dual-output solid-state relays are housed in a package that measures $1.75 \times 2.25 \times 0.8$ in., excluding the terminals. Output connections are made via quick-connect terminals, and 0.025-in. square posts provide for the input terminations. All terminals are on the top of the package. SSRD Series solid-state relays in 25A, zero-voltage turn-on models cost $30 (100).

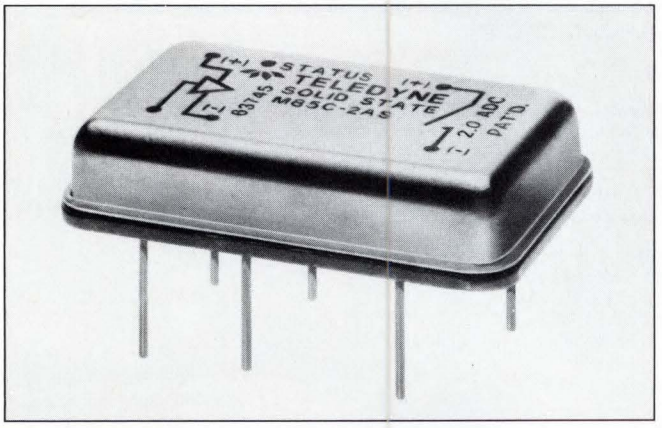
To provide even more real-estate savings, Potter & Brumfield offers SSRQ Series units that feature four 1 Form A solid-state relays. Each of the output switches in the hockey-puck package are rated for 20A at 24 to 280V ac. Each triac output features a dv/dt snubber network that prevents false triggering by restricting the rise of most voltage transients to within acceptable limits.

The input-control range spans 4 to 15V dc on both zero-voltage and random-voltage turn-on models. The optically coupled, UL-recognized SSRQ solid-state relay features 2500V-rms input-to-output isolation. Occupying a chassis area of 1.75×2.25 in., the SSRQ stands only 0.93 in. high. These SSRs have 0.25-in. quick-connect terminals for the output connections and 0.025-in. posts for the input terminations. The SSRs cost $48 (100) for zero-voltage turn-on models.

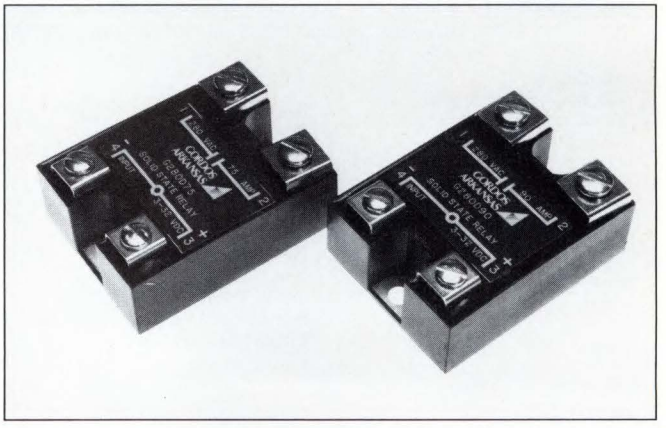
Up to this point, we've dealt with industrial and/or commercial SSRs. When you consider military applications, solid-state relays surpass electromagnetic relays in a number of areas. As previously noted, SSRs have no contact bounce, arcing, or flashing problems—important factors in military systems, where false contact-closure indications (bounce) can be critical. In addition, SSRs are immune to shock and vibration problems. They are also immune to contact contamination and oxide formation—key advantages in dry-circuit applications.

Meeting high-performance military needs

Teledyne's Model M85C-2AS solid-state relays are designed to satisfy the requirements of military sys-



In addition to providing a true output-status indication, M85C-2AS relays from Teledyne feature integrated short-circuit overload protection that functions until you remove the fault condition and recycle the control input.



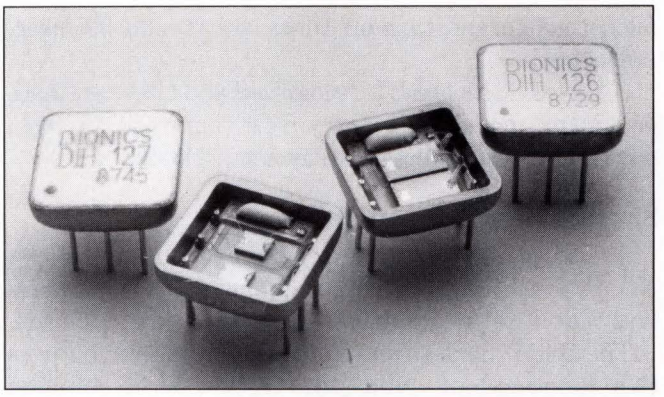
Offering load ratings to 90A at 480V ac, G Series solid-state relays from Gordos employ dual back-to-back SCRs for output switches and feature 4000V rms optical-type input-to-output isolation.

Zero-crossing switching is readily available in SSRs and virtually eliminates RFI/EMI problems.

tems. The SSRs utilize the latest power FET technology to minimize on-state resistance and bipolar offset voltages normally associated with SSR outputs. Built and tested to MIL-R-28750B utilizing the test methods of MIL-STD-883C, the SSRs meet MIL-STD-704 surge and spike requirements.

Housed in hermetically sealed metal DIPs, the M85C-2AS solid-state relays switch loads of 2.1A at 60V dc. SSR control parameters range from 0 to 18V dc at currents of 250 μA to 1 mA. On-state resistance at 25°C equals 0.15Ω max and output voltage drop measures 0.5V dc. Featuring an operating range of −55 to +105°C, the SSRs have a 1-msec max turn-off time. Turn-on time equals 1.5 msec from −55 to +25°C and 3 msec from 25 to 105°C. Maximum output capacitance, dielectric strength, and minimum insulation resistance equal 850 pF, 1000V ac, and $10^9\Omega$, respectively.

The M85C-2AS solid-state relay features an output pin that provides information on the status of the relay output. This output-status feedback provides a built-in test capability for the SSR. The SSRs also feature complete integrated short-circuit and current-overload protection for both the SSR and system wiring. Short-circuit protection is provided whether the relay is switching into a dead short or into a load that's inadvertently been shorted. In either case, the unit senses the short-circuit condition and initiates a shutdown within 5 μsec. The M85C-2AS blocks the short-circuit condition indefinitely until you remove the short circuit and recycle the input control. The SSR inputs and outputs are optically isolated to protect delicate input logic circuits from output-voltage transients. The SSRs cost $90 (100).



Featuring an I/O isolation of 500V ac, DIH Series relays from Dionics are housed in an 8-pin DIP and switch either ac or dc loads as high as 1.25A at 400V.

Only a limited number of applications exist in which you can't use SSRs. The solid-state relay's long operating lifetime and high switching speeds make it the relay of choice for almost all of your switching needs. EDN

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

For more information . . .

For more information on the solid-state relays described in this article, circle the appropriate numbers on the Information Retrieval Service card or use EDN's Express Request service. When you contact any of the following manufacturers directly, please let them know you saw their products in EDN.

Acculex
440 Myles Standish Blvd
Taunton, MA 02780
(508) 880-3660
TLX 503989
Circle No 382

Aromat Corp
629 Central Ave
New Providence, NJ 07974
(201) 464-3550
Circle No 383

Dionics Inc
65 Rushmore St
Westbury, NY 11590
(516) 997-7474
FAX 516-997-7479
Circle No 384

Gordos
Box 824
Rogers, AR 72757
(501) 636-5000
FAX 501-636-2305
Circle No 385

Hewlett-Packard Co
Components Group
370 W Trimble Rd
San Jose, CA 95131
Phone local office
Circle No 386

International Rectifier
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El Segundo, CA 90245
(213) 772-2000
TWX 910-348-6291
Circle No 387

Potter & Brumfield
200 S Richland Creek Dr
Princeton, IN 47671
(812) 386-1000
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Teledyne Solid State
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Circle No 389

ANALOG DEVICES

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AD9003/AD9005

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AD9003
- 12-Bit, 1 MSPS Word Rates
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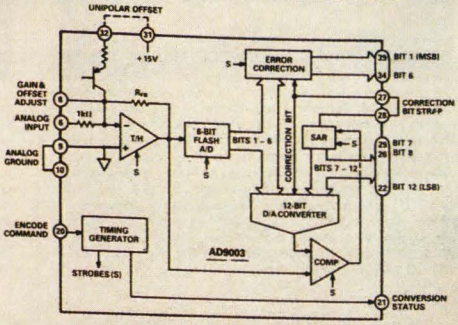
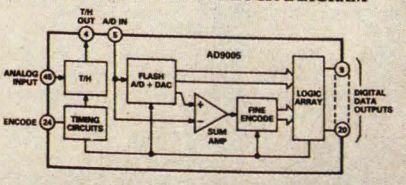
- Single 40-Pin DIP
- −80 dB Harmonics
- 70 dB SNR
- ±0.5 LSB Differential Linearity
- ±0.8 LSB Integral Linearity

AD9005
- 12-Bit, 10 MSPS Word Rates
- T/H and Timing Included
- Single 46-Pin DIP
- −72 dB Harmonics
- 64 dB SNR
- TTL-Compatible
- Offset Binary Output

AD9003 FUNCTIONAL BLOCK DIAGRAM



AD9005 FUNCTIONAL BLOCK DIAGRAM



D9003 DESCRIPTION

he AD9003 A/D Converter is a complete 12-bit, 1 MSPS nalog-to-digital converter which combines low cost and high erformance in a single 40-pin DIP. The unit includes track-nd-hold (T/H), timing, and encoding functions with a power issipation of only 2.2 watts.

his TTL-compatible device is capable of converting analog gnals to the Nyquist limit at encode rates through 1 MSPS. Its ·µs conversion interval includes acquisition time for the inter-al T/H, making it a true megasample-per-second converter.

roprietary conversion techniques achieve linearity equivalent to ie best successive approximation ADC along with subranging onversion speeds. A conversion status signal simplifies transfer-ng output data into system logic. Innovative thick- and thin-lm technologies assure excellent performance over temperature ithout compromising ac characteristics.

he AD9003KM operates at case temperatures from 0 to ·70°C; the AD9003SM and AD9003TM units operate from ·25°C to +100°C.

AD9005 DESCRIPTION

The AD9005 A/D Converter is a complete 12-bit analog-to-digital converter featuring on-board track-and-hold (T/H), voltage reference, and timing circuits.

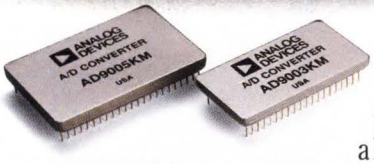
High speed and high resolution are combined by using sub-ranging converter architecture. Signal-to-noise ratios of 67 dB at 540 kHz inputs and 65 dB at 2.3 MHz inputs remain at 64 dB SNR when the input is 4.3 MHz.

This kind of performance is made possible by using advanced bipolar integrated circuits, custom designed for the AD9005 and manufactured by Analog Devices.

Despite its extraordinary combination of high speed and high resolution, the AD9005 dissipates only 3.1 watts. This characteristic and its small size make it extremely attractive for applications in which power or space are at a premium.

Commercial devices operate from 0 to +70°C case temperatures as model AD9005TM; the model AD9005TM covers the military range of −55°C to +125°C.

TO TRACK COMPLETE 12-BIT HIGH-SPEED A/Ds, HOLD ON TO THIS PAGE.



If tracking down complete, high performance 12-bit A/D converters is a problem, get a hold of our new AD9005 and AD9003. They completely eliminate the need for external support circuits. Because both contain track-and-hold, timing, reference circuits, and everything else needed to perform the digitizing function.

For guaranteed ac and dc performance, the AD9005 is the top choice. Signal-to-noise, harmonic distortion, and differential and integral nonlinearity are 100% tested. Harmonic suppression is typically 75 dB at 540 kHz, and 72 dB at 2.3 MHz and 4.3 MHz. The AD9005 offers 10 MSPS encode rates and dissipates only 3.1 watts. And to simplify assessing performance, an AD9005 evaluation board is available.

For applications requiring 12 bits at 1 MSPS, you'll get unparalleled linearity and low power dissipation in the AD9003. And its ac performance is verified with digital signal processing. The AD9005 and AD9003 come in with the right performance, the right specs, and the right prices.

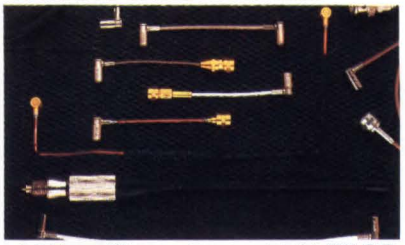
To track down more information, get a hold of applications help at (919) 668-9511, or call your nearest Analog Devices office.

ANALOG DEVICES

Analog Devices, Inc., One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106; Headquarters: (617) 329-4700; California: (714) 641-9391, (619) 268-4621, (408) 559-2037; Colorado: (719) 590-9952; Maryland: (301) 992-1994; Ohio: (614) 764-8795; Pennsylvania: (215) 643-7790; Texas: (214) 231-5094; Washington: (206) 575-6344; Austria: (222) 885504-0; Belgium: (3) 237 1672; Denmark: (2) 845800; France (1) 4666-25-25; Holland: (1620) 81500; Israel: (052) 911415; Italy: (2) 6883831, (2) 6883832, (2) 6883833; Japan: (3) 263-6826; Sweden: (8) 282740; Switzerland: (22) 31 57 60; United Kingdom: (932) 232222; West Germany: (89) 570050.

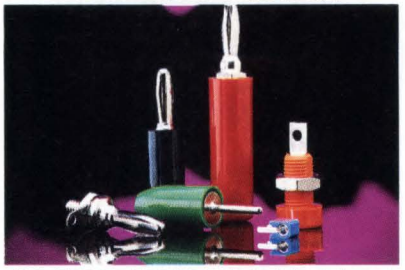
CIRCLE NO 108

COAXIAL RF CABLE ASSEMBLIES



E. F. Johnson JCM commercial-grade equivalents to SMA, SMB and SMC subminiature connectors are now available as RF cable assemblies with any combination of A, B or C type connectors. Virtually any flexible, rigid or semi-rigid coaxial cable can be ordered with the appropriate JCM connectors. The JCM line includes screw and snap-fit connectors in a variety of mounting configurations. These include jacks and plugs in straight and right-angle configurations for bulkhead and PC board mounting, as well as standard mounts with mounting hardware included. In addition, Johnson can create custom modifications of standard items, as well as design and manufacture special connectors to customer specifications. Contact E. F. Johnson, 299 Johnson Ave., Waseca, MN 56093. Telephone: (800) 247-8256. In MN: (507) 835-6303. FAX (507) 835-6485.

ELECTRONIC CIRCUIT HARDWARE



E. F. Johnson has long been a leader in the design and manufacture of Electronic Circuit Hardware. The same design expertise that created stripline plugs and jacks, a semi automatic termination system for volume production applications, can be yours for just about any special hardware application you may have. In addition to the standard plugs and jacks, many specials are made for particular customer applications. Plugs are supplied for crimp applications, with just about any plating, many shank lengths, diameters and thread sizes with many banana plug spring lengths and widths. Contact E. F. Johnson, 299 Johnson Avenue, Waseca, MN 56093. Telephone: (800) 247-8256. In MN: (507) 835-6303. FAX: (507) 835-6485.

SMB TYPE COAXIAL CONNECTORS

E. F. Johnson JCM-B-DC connectors are die-cast miniature coaxial connectors that can be interchanged and intermated with MIL-type SMB connectors, yet cost up to one-half less. They are available in right-angle crimp type plug, right-angle solder type for semi-rigid cable, bulkhead rear mount jack, or PC mount vertical jack with 0.200" mounting centers, in either gold-plated or nickel-plated versions. They accept RG-178, RG-188, and 0.085 semi-rigid cable and meet or exceed MIL-STD-202 for salt spray, vibration, shock, and temperature, while their construction minimizes RFI. Contact E. F. Johnson, 299 Johnson Ave., Waseca, MN 56093. Telephone: (800) 247-8256. In MN: (507) 835-6303. FAX (507) 835-6485.

SUBMINIATURE RF COAXIAL CONNECTORS

E. F. Johnson JCM-A, -B and -C connectors are commercial versions of the popular SMA, SMB and SMC Mil types. The JCM-A cost saving difference is a brass body rather than stainless steel, but internally has the same Teflon dielectric material and beryllium copper contact as the Mil SMA.

The JCM-B and -C types use the same materials as their Mil counterparts. Cost reduced versions are die-cast construction and are interchangeable and intermateable with Mil type connectors.

Because extensive and expensive documentation is not necessary for the JCM-A, -B and -C commercial types, a much lower cost connector, interchangeable with the Mil types, is available. Not only is the cost much lower, but the commercial versions provide the same performance characteristics as the Mil types.

Contact: E. F. Johnson, 299 Johnson Avenue, Waseca, MN 56093. Telephone: (800) 247-8256. In MN: (507) 835-6303. FAX: (507) 835-6485.

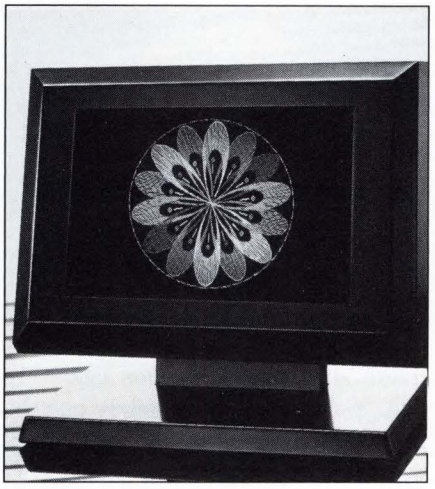
COMPLETE SPACER LINE

A complete line of spacers from E. F. Johnson, available in aluminum, stainless steel, nickel-plated brass, and nylon, serve as an economical means of mounting or stacking printed circuit boards or other devices in electronic equipment. A full range of mounting styles is available, including clearance holes, threaded holes, and male, female, and swage mounts. Metal spacers are available in both round and hexagonal shapes and are available in lengths from 0.125" to 2". Contact E. F. Johnson, 299 Johnson Ave., Waseca, MN 56093. Telephone: (800) 247-8256. In MN: (507) 835-6303. FAX (507) 835-6485.

CIRCLE NO 109

Color LCD panel uses TFT technology to achieve high contrast and sharpness

Using thin-film transistors (TFTs) in an active-matrix arrangement, each pixel in this 6.3-in. LCD panel is driven by its own transistor. Individual red, blue, and green filters over each pixel allow 8-color operation. Deleting the color filters yields a monochrome display of high resolution. The panel uses a fluorescent backlight.



Although its interface is multiplexed, when examined at the individual pixel level the display is statically driven by the individual TFT drive circuits, thereby preserving the simplicity of designing in a multiplexed display and eliminating the resolution vs contrast tradeoff normally associated with other LCD technologies.

The thin-film transistors are FETs. The drain leads form column-selecting terminals and the gate leads form row-selecting terminals. When the display selects a pair of row-column terminals, that FET turns on and activates the LCD pixel connected to that FET's source lead. This action provides high resolution, improved brightness, a wide viewing angle, and significantly improved contrast.

TFTs boast superior image quality because light passes straight through the display without any defocusing on the pixel edges. Other active displays, such as CRTs and emissive flat panels, appear less sharp because the emitted light travels in several directions.

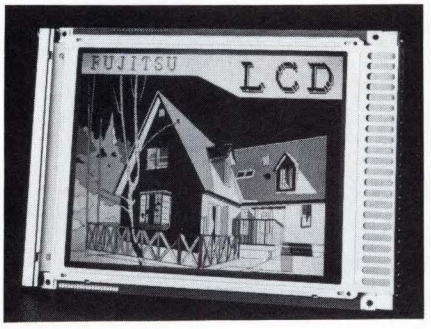
Specifications include a display area of 96×128 mm, a pixel resolution of $640 \times (200 \times 3)$ for color and 640×600 for monochrome, a contrast ratio of 40:1, and a viewing angle of $\pm 45°$. The display's 40-msec response time is suitable for mouse-driven applications. Power consumption from 5 and 25V supplies is 5W with backlight and 1.5W without backlight. The LCD panel costs $700 (OEM qty).

Hitachi America Ltd, Electron Tube Div, 300 N Martingale Rd, Suite 600, Schaumburg, IL 60173. Phone (312) 517-1144.

Circle No 390

Liquid-crystal display uses double-super-twisted-nematic technology

Designed for applications requiring high information content, the FLC640-480WSUB liquid-crystal display (LCD) uses double-super-twisted-nematic (DSTN) technology to achieve its performance. The display's polarizing layers consist of indium-tin-oxide coated-glass substrates that produce a 50° viewing cone and a crisp image in a 640×480-pixel dot-matrix layout.



The black-and-white display features cold-cathode fluorescent sidelighting to reduce the panel's thickness to 0.8 in. A 3-piece, light-diffusion plate behind the panel disperses backlighting evenly over the entire viewing area. The panel has a typical brightness of 60 cd/m^2 (15.12 fL) and a contrast ratio of 15:1.

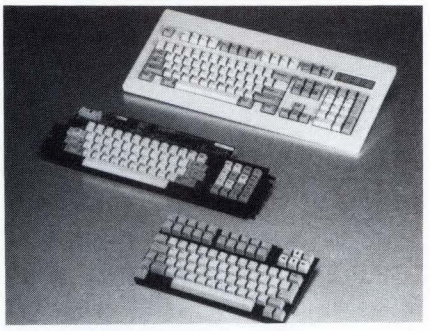
The panel's viewing area measures 8.3×6.2 in. Overall dimensions are 11.7×8 in., for a total of 73 in^3. The display's 180-msec response time can support limited use of graphic pointing devices. The FLC640-480SUB LCD costs $575 (1000).

Fujitsu Components of America, 3330 Scott Blvd, Santa Clara, CA 95054. Phone (408) 562-1000.

Circle No 391

IBM-compatible keyboards feature a choice of linear or tactile switches

Addressing the personal computer and terminal marketplaces, these advanced 101-key keyboards are plug-compatible with IBM PCs. The RT-101 keyboards operate with PC, PC/XT, and PC/AT systems; a slide switch located on the bottom of the keyboard determines the appropriate electronics.



The mechanical keyswitches, which offer 100 million operation cycles, are available in two versions—linear feedback or tactile feedback. Instead of the usual rubber boot, the linear switch incorporates a spring return mechanism, which significantly extends the switch life. An ergonomically placed cursor pad and dedicated screen-control keys make software programs easier to use. You can simultaneously use the numeric pad and cursor keys without toggling the Num Lock key. Tactile bars on the the F, J, and 5 keycaps assist the typist in locating the home position for finger placement.

Other features include interchangeable key caps, an 8-ft cable that exits from either the left or right side of the keyboard, retractable legs to adjust the keyboard angle, and rubber pads on the bottom of the enclosure to provide a positive grip to the work surface. The RT-101 keyboards are available in OEM quantities or through a telemarketing program that offers 50-piece orders at $37.50 each.

NMB Technologies Inc, 9730 Independence Ave, Chatsworth, CA 91311. Phone (818) 341-3355. FAX 818-341-8207.

Circle No 392

Sensors measure 0 to 300 psig, provide 4- to 20-mA output

Combining a silicon sensor and high-performance signal conditioning with the isolation of a stainless-steel diaphragm and package, the ST2000G4A Series pressure transmitters provide a calibrated 4-to 20-mA output signal. Designed for the measurement of hostile media in harsh industrial environments, the transmitters are available in a variety of pressure ranges from ±15 through 0 to 300 psig.

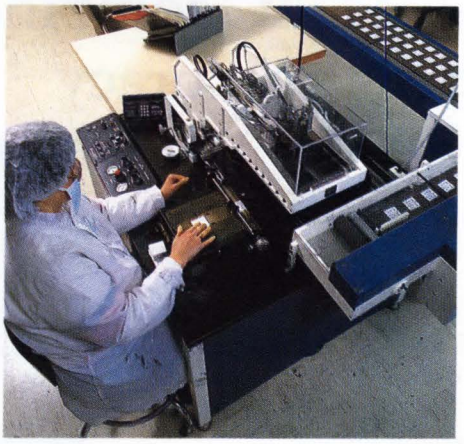
The ST20004G4A Series features laser trimming and factory calibration to ensure field interchangeability without recalibration. The transmitters also feature a special diaphragm/oil-fill isolation technique that minimizes the amount of oil required for optimal performance. The transmitters can handle extreme burst pressures—typically 10 times the normal operating pressure. A 3/8-in. NPT pressure-connection fitting accepts a variety of fittings to meet almost any thread requirement, including metric, without unnecessary body-length extension.

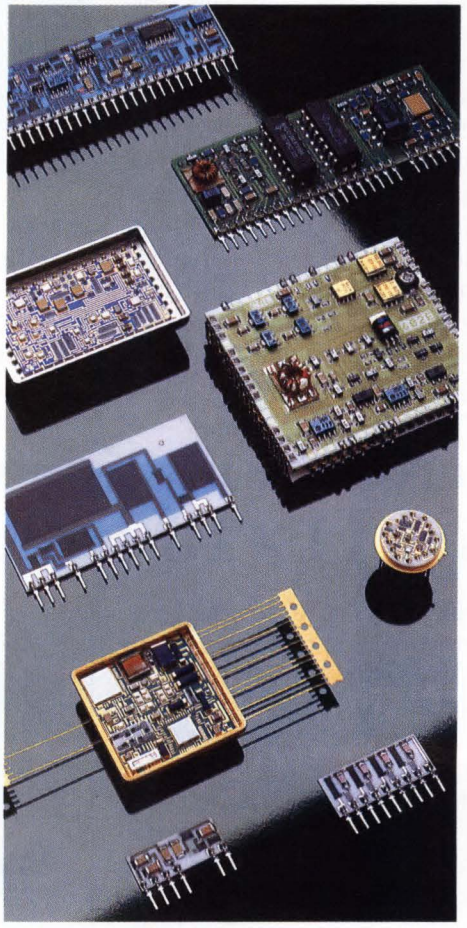
All of the transmitters, which will operate from −40 to +85°C, are temperature compensated within ±1.5% over the 0 to 70°C temperature range. Static accuracy, which includes linearity, hysteresis, and repeatability, is within ±0.5% of full scale. All ST2000G4As feature internal voltage regulation for operation with supply voltages from 12 to 30V dc. Pricing ranges from $75 to $125 (100).

SenSym, 1255 Reamwood Ave, Sunnyvale, CA 94089. Phone (408) 744-1500.

Circle No 393

Application-Specific Hybrid Packaging Solutions.





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For our Capabilities Catalog, write to: Philips Circuit Assemblies, A Division of North American Philips Corporation, Corporate Advertising, 2001 W. Blue Heron Blvd., P.O. Box 10330, Riviera Beach, FL 33404.

Philips Circuit Assemblies

PHILIPS

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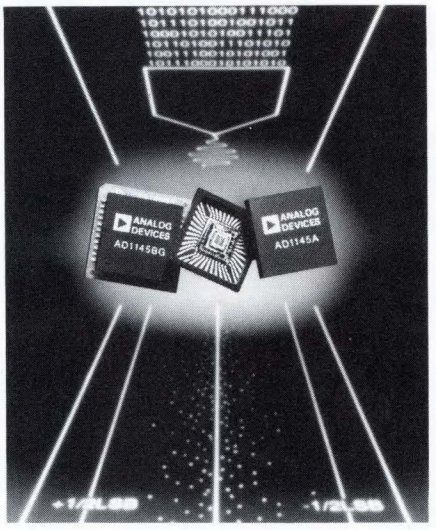
16-bit DAC combines low cost and high accuracy

The AD1145 digital-to-analog converter (DAC) has a maximum differential nonlinearity of ±0.75 LSB and a relative accuracy of ±0.003%. These specifications compare with many other 16-bit DACs that have only 15 bits (or less) of accuracy. The two-chip hybrid also has a number of features that simplify the DAC-to-μP interface.

You can load data into the DAC in a parallel mode for high-speed data transfers or in a serial mode to minimize wiring. Parallel loading accommodates 16 bits simultaneously or in two 8-bit bytes. The DAC can read back the data serially to ensure its validity. Double-buffered latches permit you to simultaneously update multiple AD1145s in multichannel applications, or you can make the input



latches transparent for stand-alone operation. The DAC's output is reset to zero on power-up or upon command.

On-chip application resistors facilitate programming the output voltage ranges when the DAC is used with an external amplifier. The DAC's nominal output range is 0 to 5V. The 5V full-scale settling time is 6 μsec to within ±0.5 LSB. Digital input coding is binary for a unipolar output and offset binary or 2's complement for a bipolar output. Digital inputs are 5V CMOS/TTL compatible.

The AD1145 is available in accuracy grades of ±0.75 LSB and 16-bit monotonicity over a 15 to 35°C temperature range, and ±1 LSB and 15-bit monotonicity over the 0 to 70°C temperature range. Prices start at $29.50 (100).

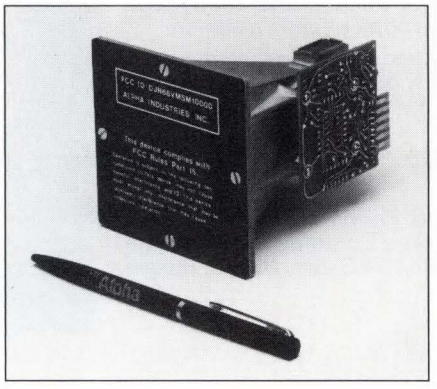
Analog Devices Inc, Box 9106, Norwood, MA 02062. Phone (617) 461-3643.

Circle No 394

Microwave motion-sensor module has an 11 × 18° beamwidth

The MSM10000 is a noncontact, motion-sensor module that combines a microwave transmitter/receiver with signal-processing electronics to detect objects moving within its detection pattern. The use of microwave energy at 10.525 GHz lets you use the unit in extreme industrial environments where dirt, dust, and humidity could reduce the effectiveness of other motion-detection technologies. The MSM10000, which features an 11 × 18° beamwidth, also permits the measuring of both metallic and nonmetallic objects and has the inherent ability to "see through" many optically opaque targets.

The internal circuitry, which includes a power supply, amplifiers,



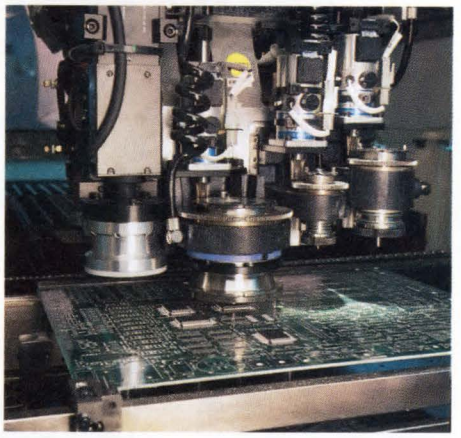
a comparator, and an output switch, drives the microwave oscillator and converts the detected output to a switch closure. The switch closure provides an output of 60V/10 μA in the off condition and 2.5V/500 mA in the on condition. The module operates over a range of input voltages from 14 to 26V dc with a typical operating current of 350 μA. The detection range is adjustable from 1 in. to 8 ft.

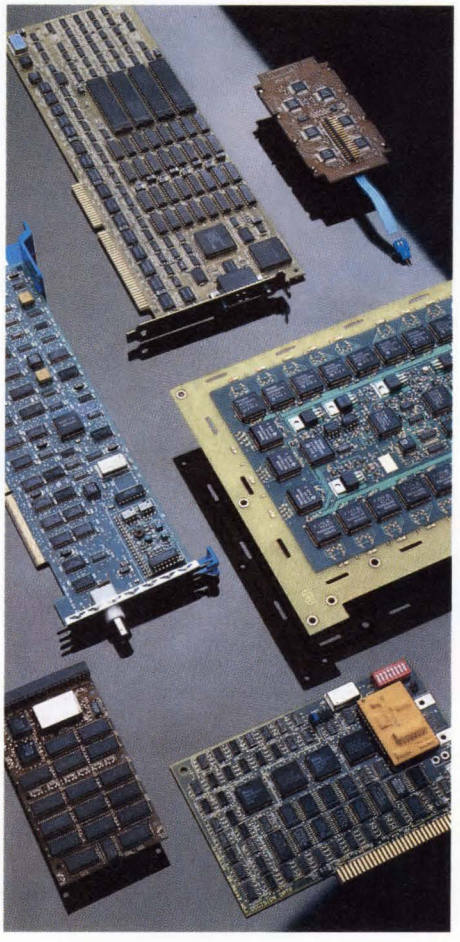
The $250 MSM10000 comes in a plug-in module designed for easy incorporation into standard industrial enclosures. The cast aluminum horn antenna is protected by a window to seal out contaminants. The 4.375 × 3.25 × 2.875-in. unit plugs into a standard printed-circuit-board connector and is secured by four mounting screws on the antenna flange.

Alpha Industries, 20 Sylvan Rd, Woburn, MA 01801. Phone (617) 935-5150. FAX 617-935-4939.

Circle No 395

Tomorrow's manufacturing technologies today... without the investment.





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We're specialists in PC board assembly, committed to long-term service to customers.

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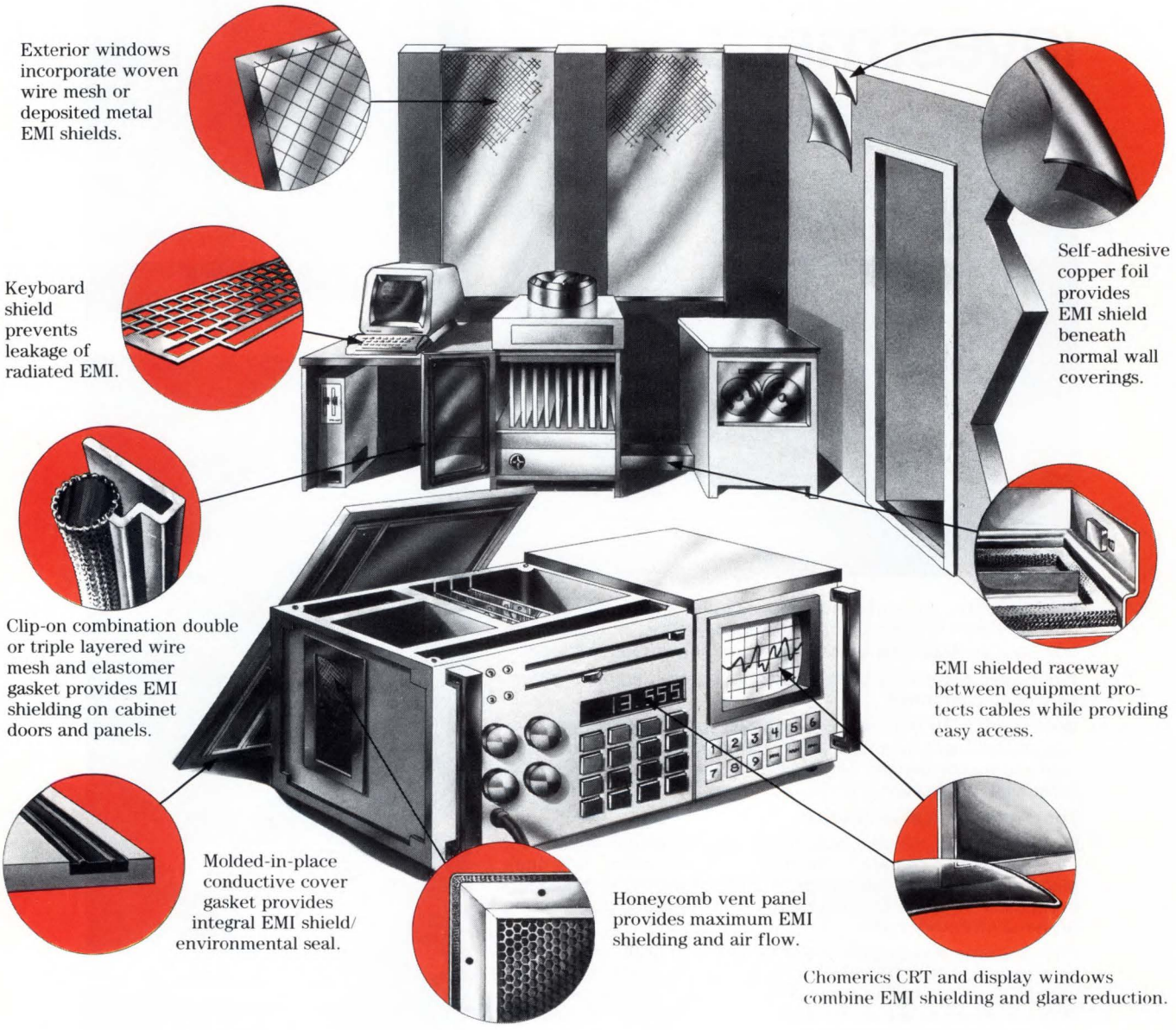
TODAY'S *TEMPEST* APPLICATIONS HAVE CHOMERICS WRITTEN ALL OVER THEM



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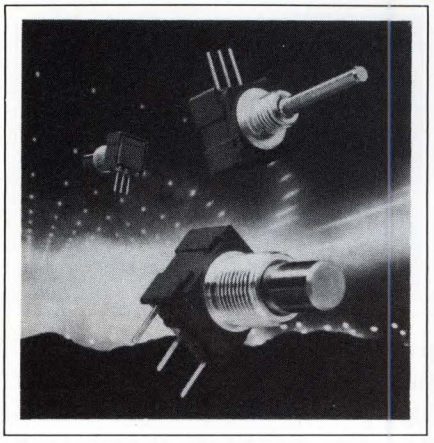


POTENTIOMETER

Featuring a ½-in.-square sealed package, the Model 50 panel control offers designers great flexibility where space is important. With a pc-board mounting bracket, the potentiometer can be easily installed and wave soldered. The Model 50, which has a rotational life of 50,000 cycles, can also serve as a drop-in replacement for other panel controls. Designers can select either conductive plastic or cermet elements, depending on resistance value and reliability needs. Standard resistance values range from 150Ω to 1 MΩ in both linear and audio tapers. Depending on the element type, available tolerances are ±5%, ±10% and ±20%. Independent linearity is ±5%, and contact-resistance variation is 2%. From $1.75 (1000). Delivery, eight weeks ARO.

Bourns Inc, 1200 Columbus Ave, Riverside, CA 92507. Phone (714) 781-5500. TLX 676423.

Circle No 650

DRY-CIRCUIT RELAY

The TZ is a dry-circuit-type single X-bar contact pc-board-mountable relay. It features a 1500V ac breakdown voltage and a 3000V surge resistance between coil and contact. Contact material is silver palladium overlaid gold for dry-circuit switching. The relays will switch 1A at 24V dc or 120V ac. Coil voltage ratings range from 3 to 24V dc. Standard coil sensitivity at nominal operating voltages is 107 mA. The relays have a −25 to +60°C operating range and a 100,000 operations lifetime at rated load. The relays conform to UL, CSA, and FCC Part 68 requirements. $0.96 (1000). Delivery, four to six weeks ARO.

Original Electric Mfg Co Inc, 123 Lincoln Blvd, Middlesex, NJ 08846. Phone (201) 271-5770.

Circle No 651

THERMOSTATS

The Series 6600 bimetallic thermostats are housed in gull-wing, leaded packages that are the same size as an 8-pin DIP. They have an spst, gold-plated contact that's available in either a normally open or normally closed configuration. The contact has a rating of 1A (resistive) at 48V dc. The thermostats can sense over a 40 to 120°C ambient temperature range in 5°C increments. The thermostats are compatible with pick-and-place equipment and are sealed to withstand wave-soldering and board-washing processes. $3.30 (500). Delivery, stock to eight weeks ARO.

Airpax, Husky Park, Frederick, MD 21701. Phone (301) 663-5141.

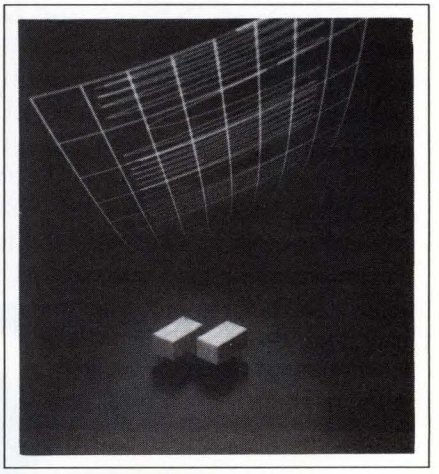
Circle No 652

SENSOR SYSTEM

The LGI-LMS-001 sensor system consists of an ultrasonic level sensor that has a range of 35 ft and a control unit. The control unit powers the sensor and receives the digital data from the sensor over a 50Ω coaxial cable, which can be as long as 500 ft. The control unit compares the data against register data set by the operator and uses the information to control one or two pumps or sound an alarm in case of trouble. An LCD readout indicates the liquid levels and the pumps that are operating. The control unit prompts the operator for six register settings including low-alarm, pump 1 turn-on, pump 2 turn-on, pump 1 turn-off, pump 2 turn-off, and a high-alarm setting. The system features a 0.25-in. accuracy, a 0.1-in. resolution, and a −40 to +60°C temperature range. Internal battery backup, remote alarm relay, and a 4- to 20-mA output are optional. $690.

Lagrange Instruments Inc, Kuchler Dr, LaGrangeville, NY 12540. Phone (914) 223-3336.

Circle No 653



SWITCHING RELAY

The RK is a high-frequency switching relay with a 200-mW input sensitivity. A single-side stable device, the relay is sealed to accommodate dip-soldering processes. Nominal switching capacity is 10 mA at 24V dc. The 0.795 × 0.441 × 0.382-in. relay has a 1 Form C contact arrangement. Isolation at 1.5 GHz is 60 dB, and insertion loss at 900 MHz is 0.3 dB max. Coil voltage ratings range from 3 to 24V, and breakdown volt-

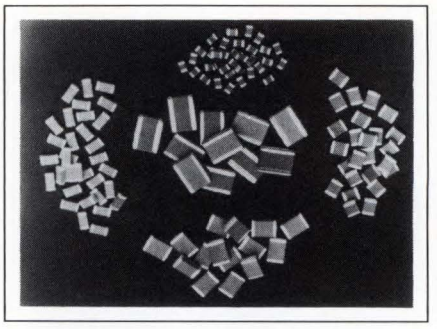
age between contact and coil measures 1000V rms. One- and two-coil latching-type relays are also available. $4.50 (500). Delivery, eight to 12 weeks ARO.

Aromat Corp, 629 Central Ave, New Providence, NJ 07974. Phone (201) 464-3550.

Circle No 654

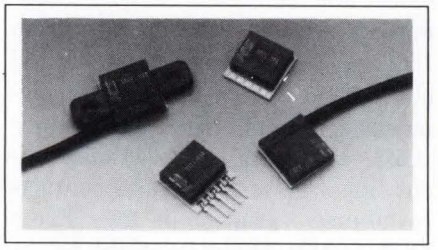
CHIP CAPACITORS

The Type 14C multilayer ceramic-chip capacitors, which operate over the −55 to +200°C temperature range, are intended for surface-mount or hybrid applications that are subject to severe environments such as underhood automotive electronics. Manufactured in the company's proprietary wet-process ceramics technology, the chips offer high performance and high reliability. The capacitors, which have EIA characteristics X8S at 50V dc and X9T at 25V dc, range in value from 390 pF to 0.56 μF. Standard sizes range from 0805 to 1825. The devices are available in 8- or 12-mm tape-and-reel packaging to EIA-481A. Type 14C 0.1-μF capacitor, size 1210, $0.19 (10,000). Delivery, eight to nine weeks ARO.



Sprague Electric Co, Box 9102, Mansfield, MA 02048. Phone (508) 339-8900.

Circle No 655

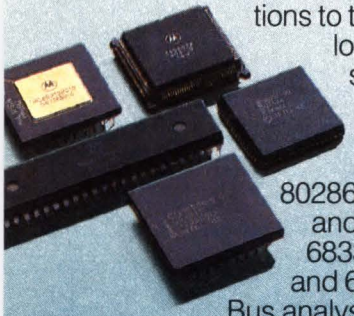


2G ACCELEROMETERS

With the addition of a ±2g range, the 3021 and 3026 Series silicon accelerometers provide the highest sensitivity available in a low-cost, commercially available part, according to the vendor. The devices are also available in other standard ranges from ±5 to ±200g. The 3021 and 3026 devices are general-purpose, solid-state, piezoresistive accelerometers on a ceramic substrate. The 3026 contains a mounting bracket that eases mechanical attachment. The 3031 comes in a surface-mount package for high-volume OEM applications. The 3110 uses the same sensing element and

TEK'S $2995 LOGIC ANALYZER. NOW WITH SUPPORT FOR MORE THAN 20 MICROPROCESSORS.

Only the Tek 1230 lets you start with an entry-level logic analyzer—then, as time goes on, add channels and draw from a comprehensive list of 8- and 16-bit micro support.

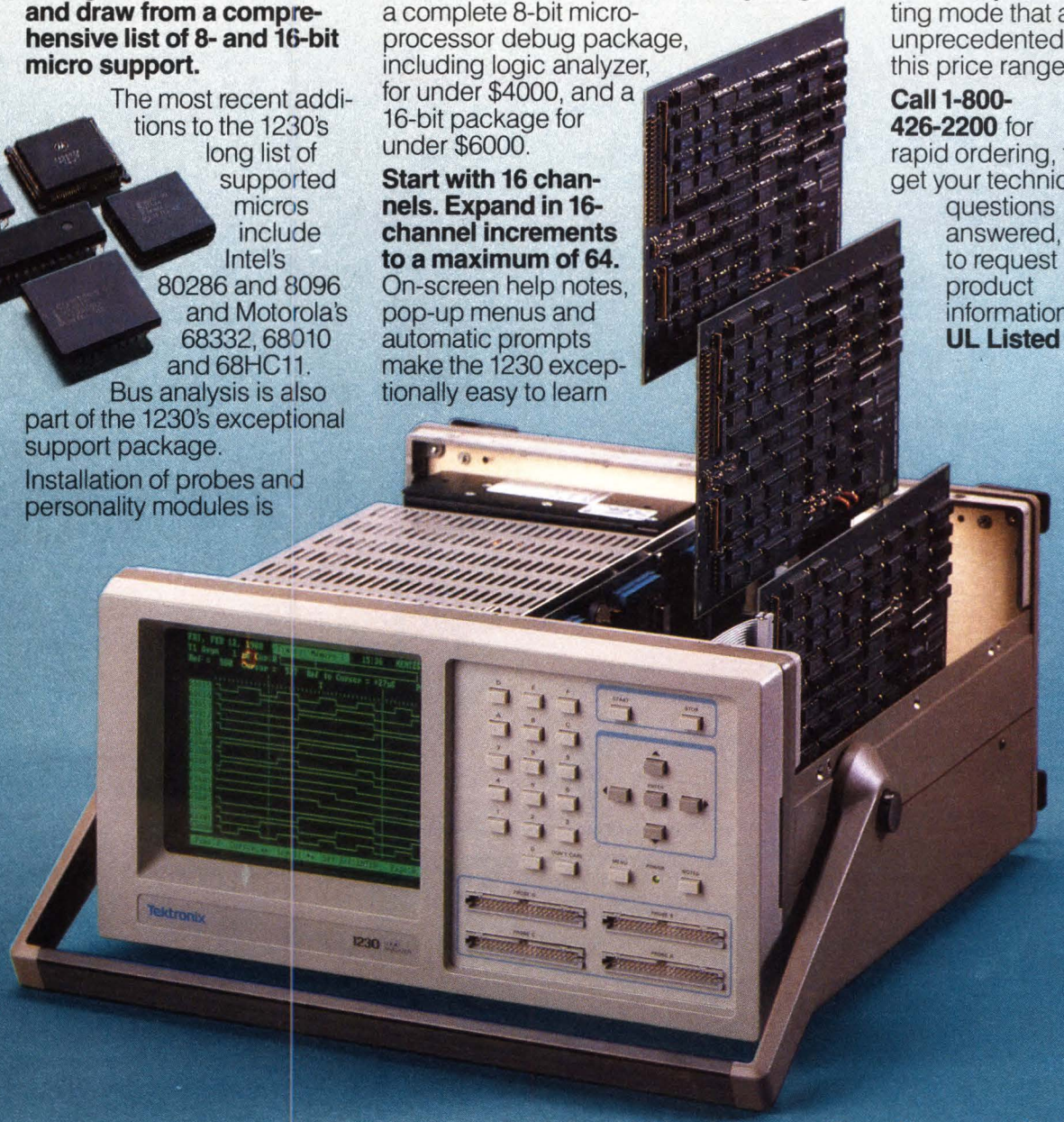


The most recent additions to the 1230's long list of supported micros include Intel's 80286 and 8096 and Motorola's 68332, 68010 and 68HC11. Bus analysis is also part of the 1230's exceptional support package.

Installation of probes and personality modules is effortless; the disassembly itself is more complete and informative than anything else in its class. You can have a complete 8-bit microprocessor debug package, including logic analyzer, for under $4000, and a 16-bit package for under $6000.

Start with 16 channels. Expand in 16-channel increments to a maximum of 64. On-screen help notes, pop-up menus and automatic prompts make the 1230 exceptionally easy to learn and use. Yet you can access features like four 2K deep memories, sophisticated triggering and built-in babysitting mode that are unprecedented in this price range.

Call 1-800-426-2200 for rapid ordering, to get your technical questions answered, or to request product information. **UL Listed**



To order now, call (800) 426-2200. VISA, MasterCard accepted.

Tektronix
COMMITTED TO EXCELLENCE

Circle 3 for Literature

Circle 4 for Sales Contact

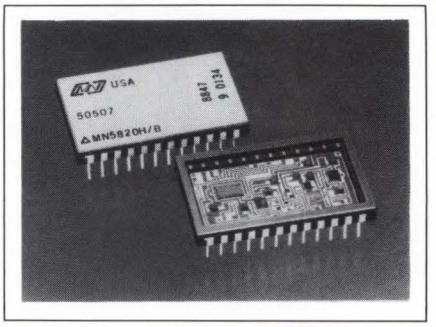
is a signal-conditioned, instrument-grade version that adds temperature compensation and amplification. In sample quantities, $77 to $268; 3031, $5 (OEM qty).

IC Sensors, 1701 McCarthy Blvd, Milpitas, CA 95035. Phone (408) 432-1800.

Circle No 656

20-MHz FLASH ADC

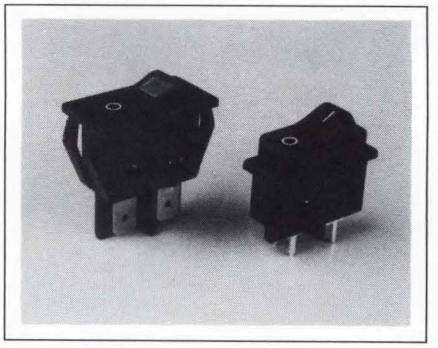
The MN5820 8-bit, 20-MHz flash A/D converter contains, in a single package, all of the support circuits needed to implement flash conversion. Moreover, these support circuits are user configurable. Included in the MN5820 is a bandgap voltage reference, a top voltage-reference (VRT) amplifier, a bottom voltage-reference (VRB) amplifier, an analog-input buffer amplifier, and a 75Ω termination resistor.



The 1.2V bandgap reference is brought out for use with the inputs of the VRT and VRB amplifiers when selecting the MN5820's full-scale range of 0 to 1V, 0 to −1V, or ±1V. You can use the analog-input amplifier to buffer the complex input impedance associated with the flash A/D converter. The 20-MHz flash ADC contains an output 3-state buffer and an overrange flag. The MN5820 comes in a hermetic, 24-pin, double-wide DIP. Commercial version, $150; military version, $233 (100). Delivery, 12 to 16 weeks ARO.

Micro Networks, 324 Clark St, Worcester, MA 01606. Phone (508) 852-5400.

Circle No 657



ROCKER SWITCHES

The 1550 Series rocker switches carry 16A ratings and are available in single-pole and double-pole versions. Both versions fit into a standard single-pole housing. The switches are available in both lighted and unlighted models and

We've put CMOS on display.

If you're looking for the right LED display solution, take a look at HP. We've got a full line of low-power, easy-to-use alphanumeric CMOS displays.

All featuring an integrated on-board CMOS IC. And all designed to provide you with a better way to meet your display requirements.

Take our eight-character 5 x 7 smart alphanumeric display, for example. It's the industry's only customizable display. With up to 16 user-definable characters and the capability to generate foreign characters, special symbols and logos.

Or choose from four-character 5 x 7 CMOS displays in all four LED colors.

Smart 16-segment displays with built-in RAM, ASCII decoder and LED drive circuitry. Which also come in a drop-in 5 x 7 dot-matrix upgrade.

And single-character red hexadecimal displays with a 4 x 7 dot-matrix display.

Best of all, they're from HP. So you're always assured of HP's commitment to excellence in service, support and reliability.

For a free brochure describing our full line of CMOS display solutions, call **1-800-752-0900 ext. 233H.** And see how easy it is to shine.

There is a better way.

HEWLETT PACKARD

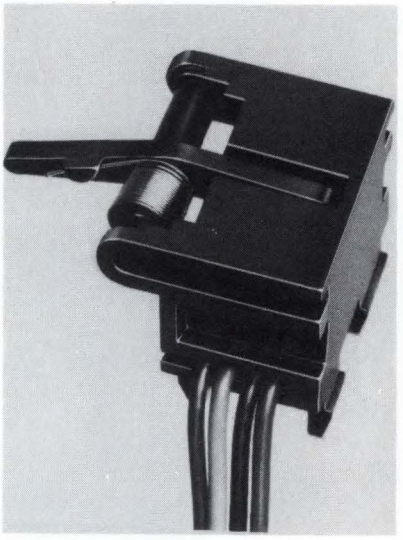
CG08902

Components

feature quick-connect, solder, or printed-circuit terminal options. The switches may be subpanel mounted or snap-in front-panel mounted, and carry all international approvals. $2 and under. Delivery, stock to eight weeks ARO.

Marquardt Switches Inc, Box 465, Cazenovia, NY 13035. Phone (315) 655-8050. TLX 703287. FAX 315-655-8042.

Circle No 658



OPTICAL FLAG SWITCH

The OPB850 optical flag switch consists of an npn phototransistor coupled with a GaAs or GaAlAs infrared light-emitting diode in a molded plastic housing. A lever-arm-actuated flag interrupts the light beam, switching the transistor output between states that can readily drive logic gates. The device features snap-in mounting to allow easy replacement of mechanical, lever-operated switches. The OPB850 snaps into a rectangular opening of $0.315 \times 0.472 \times 0.039$ in. The company can design customized lever arms and spring torques for specific applications. $2.44 (1000).

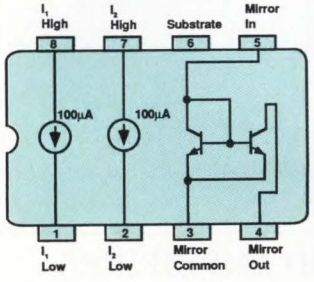
Optek Technology Inc, 1215 W Crosby Rd, Carrollton, TX 75006. Phone (214) 323-2200.

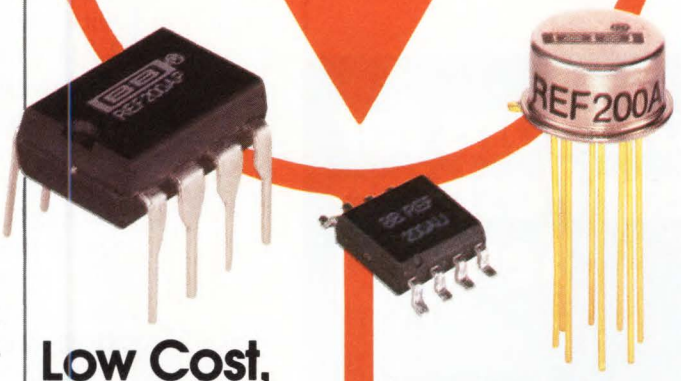
Circle No 659

NEW DUAL CURRENT SOURCE SIMPLIFIES CIRCUIT DESIGNS.

Versatile Circuit Building Block

Our new REF200 dual current source improves performance, simplifies designs, saves board space, and cuts costs in a wide variety of circuits. Try it for low voltage references, sensor excitation, precision biasing, op amp offsetting, duty-cycle modulation, current sinking, even precision waveform generation.





Low Cost, High Accuracy

REF200 combines two 100µA current sources and a current mirror on a single chip. The three sections are dielectrically isolated from each other and laser trimmed for high accuracy. The sections can be easily pin-strapped to produce currents of 50µA, 100µA, 200µA, 300µA, and 400µA. With simple external components, virtually any current can be obtained.

Key features include:

- **0.5% accuracy**
- **25ppm/°C drift**
- **wide 2.5V to 40V compliance voltage**
- **500MΩ output impedance**
- **8-pin TO-99, plastic DIP or SOIC**
- **$2.40* (AP)**

FREE Applications Guide

In developing this part, we learned a lot about current sources. We put it all in our *Current Sources Applications Guide*, covering not only the REF200 but other approaches as well. Both the *Guide* and the product data sheet are available now from your Burr-Brown sales representative, or call **1-800-548-6132** toll-free for immediate assistance.

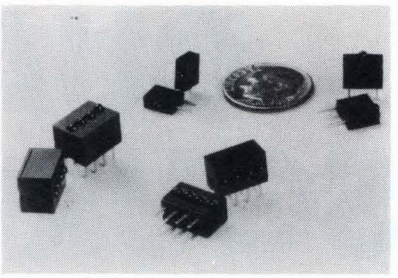
Burr-Brown Corp.,
P.O. Box 11400,
Tucson, AZ 85734

*U.S. prices, in 1000s.

CIRCLE NO 118

BURR-BROWN®

Components

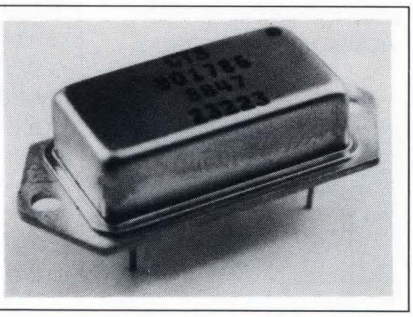


LOW-CURRENT LEDs

The 555 Series LEDs feature a luminous intensity of 0.6 mcd at 1 mA of current—in contrast to other LEDs that require 10 mA of current for the same luminous intensity. The increased efficiency is due to the use of a GaAlAs chip instead of the traditional GaAlP chip. The light source, which emits red light, was developed primarily for use with low-current gate outputs. The LED incorporates a current-limiting resistor to protect sensitive CMOS-driven circuitry. Designed for wave-soldering applications, the 555 Series comes in a variety of packages: right-angle; upright; Quad Bloc right-angle; and Quad Bloc upright. Model 2009, $0.62; Model 3009, $0.89; Model 4009, $1.93; Model 5009, $2.02 (1000).

Dialight Corp, 1913 Atlantic Ave, Manasquan, NJ 08736. Phone (201) 223-9400.

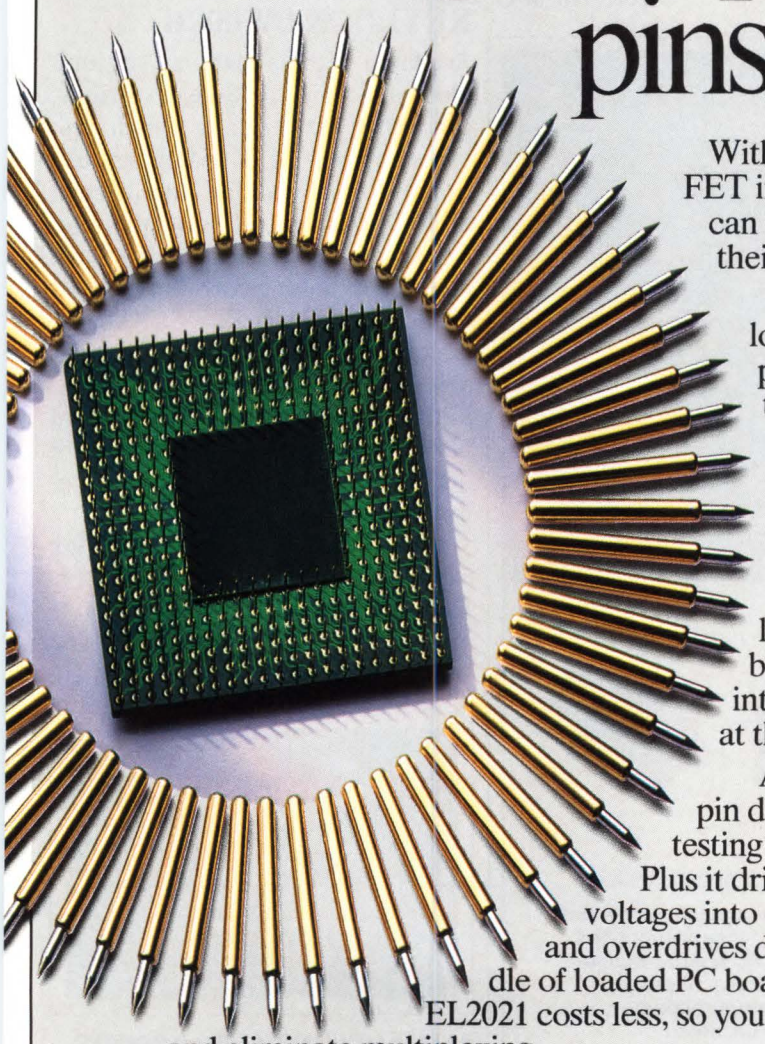
Circle No 660



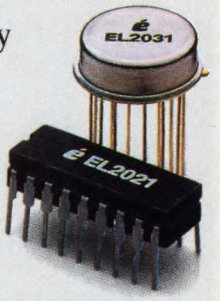
HYBRID AMPLIFIERS

Available in five performance ranges, the 90178X line of RF hybrid amplifiers features screening that's in full compliance with MIL-STD-883. The manufacturing facility is certified to MIL-STD-1772.

Thanks to Elantec, ATE design engineers are no longer kept waiting on pins and needles.



With Elantec pin drivers and FET input buffers, the ATE industry can stop sitting on the edge of their seats.

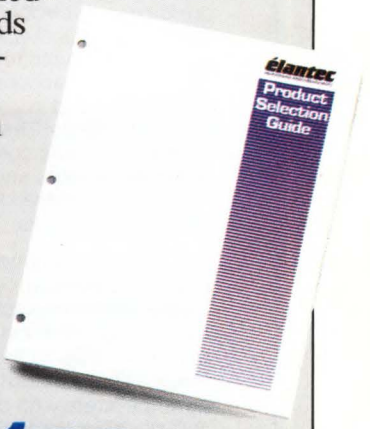


Whether it's for IC or loaded PC board testers, our parts are higher performing than the competition. Not to mention more affordable.

As are Elantec analog ICs for all applications—from ATE, video and LANs, to instrumentation, disk drives, and more.

One product that pins down the fastest logic devices is our FET input EL2031 buffer amplifier. It drives 7000V/μs signals into 100 ohm loads. Or buffers those signals at the pin receiver.

Another example is our EL2021 monolithic pin driver. It supports in-circuit and functional testing with a programmable slewrate to 250V/μs. Plus it drives externally programmed voltages into difficult and reactive loads and overdrives device outputs in the middle of loaded PC boards. Best of all, the EL2021 costs less, so you can afford a part per pin and eliminate multiplexing.



For all high-performance applications, look to the full family of Elantec high-speed analog products. Everything from amplifiers and buffers, to comparators and transistor arrays. Each backed by the industry's only two-for-one guarantee. Elantec, analog that's ahead of the times.

There's No Wait For A Selection Guide. For your free copy, circle the bingo number or write Elantec.

Because when it comes to designing PC board or IC testers, you'll never need to be needled again.

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HIGH PERFORMANCE ANALOG INTEGRATED CIRCUITS

Elantec: 1996 Tarob Court, Milpitas, CA 95035. Telephone: (408) 945-1323, Fax: (408) 945-9305 © 1989 Elantec
European Sales: 87 Jermyn Street, London, SW1Y6JD, England. Tel: 44-1-839-3841, Telex: 917835, Fax: 44-1-930-0751

The amplifiers, which are manufactured using thick-film technology, are cascadable 2-stage devices with transformer-coupled outputs to provide high output power under low bias-current conditions. Operating from a 12V supply, the 90178X hybrids offer gains of 24, 30, and 31 dB from 1 to 30 MHz, and gains of 21 and 31 dB from 2 to 150 MHz. The power output at 1 dB of compression ranges from 0 to 17 dBm. $125 to $140 (small qty).

CTS Corp, Microelectronics Div, 1201 Cumberland Ave, West Lafayette, IN 47906. Phone (317) 463-2565.

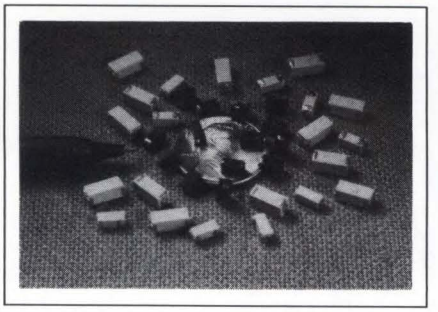
Circle No 661

KEYLOCK SWITCH

Available with as many as six tumblers and in 1- or 2-pole versions, the Series 500 keylock switch provides as many as 12 switching positions. Rotational life can exceed 25,000 rotations at low currents. The sealed, explosion-proof switch has a firm detent with indexing at 30, 36, 45, and 90°. Five-disk keying is standard; 6-disk keying is available. Terminal contacts are silver alloy on copper alloy and gold plated. Single-pole version, $8.50; double-pole version, $13 (1000). Delivery, 12 weeks ARO.

Oak Switch Systems Inc, Box 517, Crystal Lake, IL 60014. Phone (815) 459-5000.

Circle No 662



MINIATURE INDUCTORS

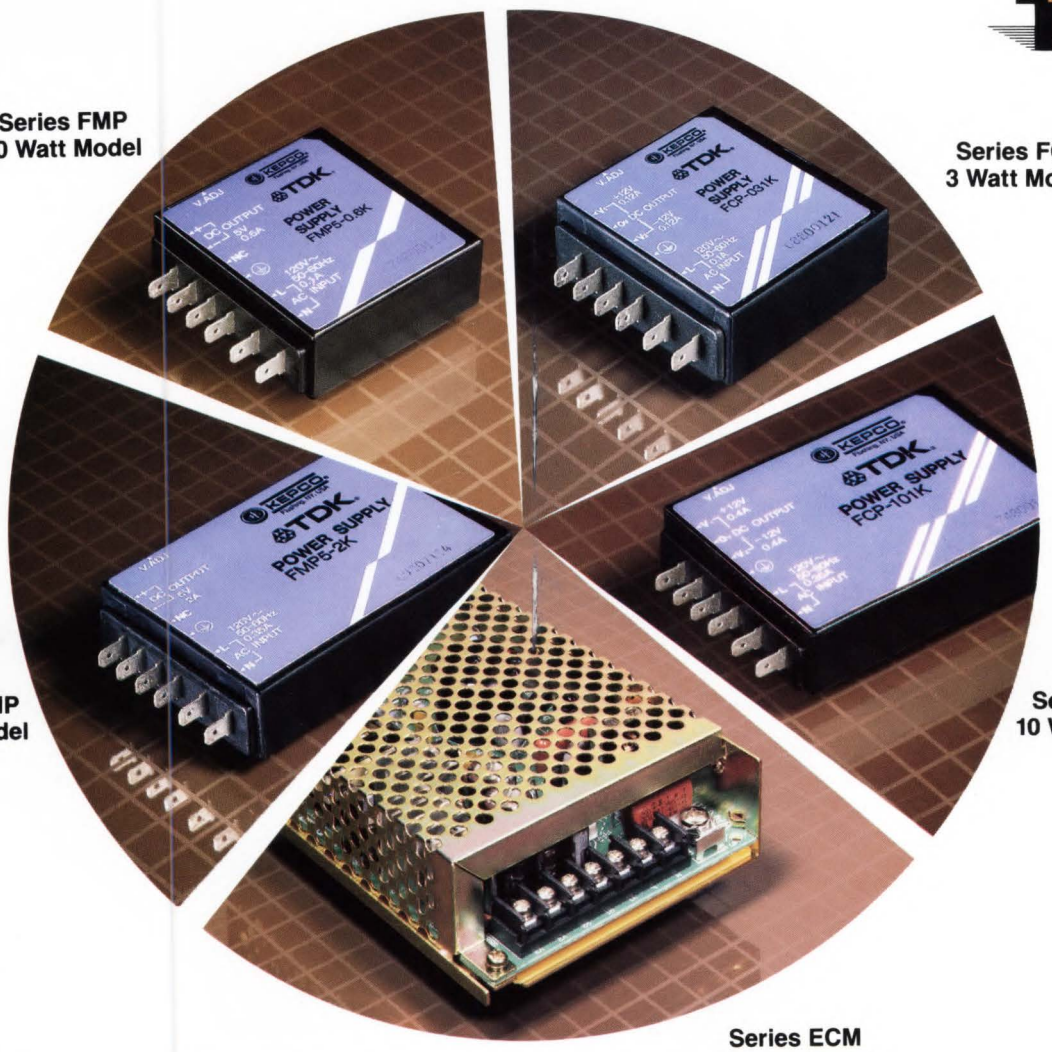
Following the industry trend toward smaller-size inductors, Series 1808 surface-mount inductors provide inductance values from 0.01 to 150 μH. The devices have a standard tolerance of ±10%, with closer tolerances available on special order. Manufactured on either phenolic, iron, or ferrite coil forms, the inductors are molded in flame-retardant epoxy in a rectangular configuration, which simplifies pick-and-place assembly. All parts are

TEAR ON DOTTED LINE TO REMOVE AND SAVE.

KEPCO LOW-COST, MINIATURE, LOW-PROFILE a-c TO d-c SWITCHING MODULES.

SERIES FMP, FCP, ECM POWER SUPPLIES

This KEPCO product is backed by a firm 1-YEAR WARRANTY



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KEPCO, INC. • 131-38 SANFORD AVENUE • FLUSHING, NY 11352 USA • (718) 461-7000 • FAX: (718) 767-1102 • Easylink (TWX): 710-582-2631

SERIES FMP

Plastic encased (not encapsulated) 3- and 10-Watt single output a-c to d-c flyback voltage stabilizers, producing 5V, 12V, 15V, or 24V.

FEATURES:

- **±10% voltage adjustment.**
- **Voltage limited** by zener diode across output.
- **Rectangular current limiting** so you can drive nonlinear loads.
- **Low profile:** Only 3/4" thick.

SERIES FCP

Plastic encased (not encapsulated) 3- and 10-Watt flyback a-c to d-c switchers producing a dual output (±12V or ±15V).

FEATURES:

- **Principal (plus) output adjustable ±10%:** auxiliary (minus) tracks it with an accuracy of ±2% using a 3-terminal (linear) regulator.
- **Rectangular current limiting on both outputs.**
- **Low profile:** Only 3/4" thick.

SERIES ECM

Triple output, 16-Watt metal enclosed switching power supplies featuring simplicity and high reliability.

FEATURES:

- **Adjustable voltage:** (+5V) set by internal trimmer.
- **Auxiliary outputs:** (±12V or ±15V) use 3-terminal stabilizer.
- **Metal enclosure** reduces the radiated noise and provides protection.

ALL MODELS FEATURE:

- **a-c input 85-132V; d-c input 110-170V.**
- **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.
- **Safety:** All models recognized by UL, certified by CSA.

UL RECOGNIZED CSA CERTIFIED

SINGLE OUTPUT PLASTIC ENCASED SERIES FMP

Specification	Output Voltage		Output current	Current limit	Ripple (source & switching)	Noise (spike)	Efficiency
Units	Volts		Amps	Amps	mV	mV	percent
Condition	Factory set, nom input, max load 25°C	Adjustment range	0-50°C	Setting at 25°C nom input	Nom input max load p-p max	d-c to 50MHz nom input, max load p-p max	Nom input max load typ
3 WATT MODELS							
FMP 5-0.6K	5.1	4.5- 5.5	0-0.6	0.7 ~1.2	50	100	68
FMP 12-0.25K	12.1	10.8-13.2	0-0.25	0.3 ~0.5	80	150	70
FMP 15-0.2K	15.1	13.5-16.5	0-0.2	0.25~0.4	80	150	70
FMP 24-0.13K	24.1	21.6-26.4	0-0.13	0.15~0.3	100	150	74
10 WATT MODELS							
FMP 5-2K	5.1	4.5- 5.5	0-2.0	2.2 ~3.3	50	100	75
FMP 12-0.85K	12.1	10.8-13.2	0-0.85	0.9 ~1.4	80	150	78
FMP 15-0.7K	15.1	13.5-16.5	0-0.7	0.75~1.2	80	150	78
FMP 24-0.45K	24.1	21.6-26.4	0-0.45	0.5 ~0.8	100	150	81

DUAL OUTPUT PLASTIC ENCASED SERIES FCP

Specification	Output Voltage		Output current	Current limit	Ripple (source & switching)	Noise (spike)	Efficiency
Units	Volts		Amps	Amps	mV	mV	percent
Condition	Factory set, nom input, max load 25°C	Adjustment range	0-50°C	Setting at 25°C nom input	Nom input max load p-p max	d-c to 50MHz nom input, max load p-p max	Nom input max load typ
3 WATT MODELS							
FCP 031K							
Output #1	+12.1	10.8-13.2	0-0.12	0.14~0.25	80	150	64
Output #2	−12.1(1)	(2)					
FCP 032K							
Output #1	+15.1	13.5-16.5	0-0.1	0.12~0.2	80	150	64
Output #2	−15.1(1)	(2)					
10 WATT MODELS							
FCP 101K							
Output #1	+12.1	10.8-13.2	0-0.4	0.45~1.0	80	150	77
Output #2	−12.1(1)	(2)					
FCP 102K							
Output #1	+15.1	13.5-16.5	0-0.32	0.35~0.9	80	150	77
Output #2	−15.1(1)	(2)					

(1) Output #2 is ±2% of the Output #1 setting. (2) Output #2 tracks ±2%.

TRIPLE OUTPUT METAL ENCLOSED SERIES ECM

Specification	Output Voltage	Output current	Current limit	Ripple (source & switching)	Noise (spike)	Efficiency
Units	Volts	Amps	Amps	mV	mV	percent
Condition	Factory set, nom input, max load 25°C	0-50°C min max	Setting at 25°C nom input	Nom input max load p-p max	d-c to 20MHz nom input, max load p-p max	Nom input max load typ
16 WATT MODELS						
ECM 021K-CB						
Output #1	+ 5	0.5 2.0	2.2	120	2% of output voltage +50mV	67
Output #2	+12	0.0 0.3	0.4	60		
Output #3	−12	0.0 0.2	0.3	60		
ECM 022K-CB						
Output #1	+ 5	0.5 2.0	2.2	120	2% of output voltage +50mV	67
Output #2	+15	0.0 0.3	0.4	60		
Output #3	−15	0.0 0.2	0.3	60		

Contact factory for OEM discounts

For complete specifications send for Switcher Catalog 146-1605

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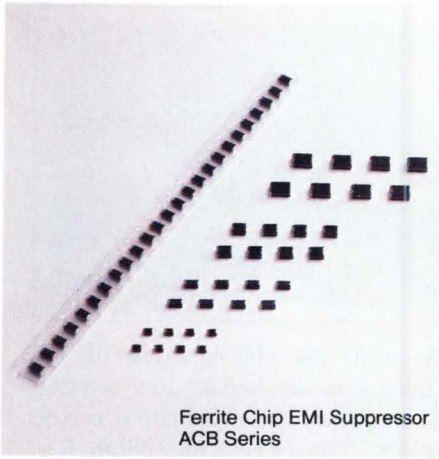
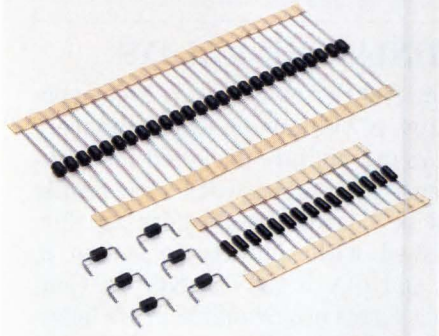
TDK Ferrite Technology Blocks out EMI/RFI



Ferrite Chip EMI Suppressor
ACB Series

Ferrite Bead Cores
BB Series



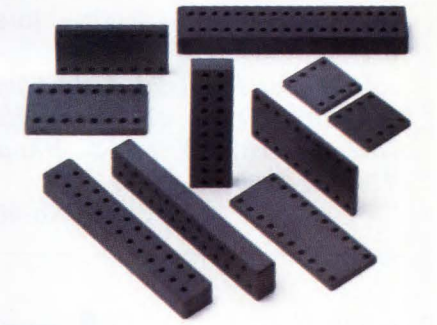
Ferrite Beads
Axial-lead taped type

Ferrite Core for EMI/RFI
For electronic equipment electromagnetic interference is a major concern. That's why so many turn to TDK for assistance. TDK, the ferrite expert has been researching EMI for years. And now, backed by the full complement of TDK ferrite material technology, our products are ready to protect your products from EMI/RFI.

With its phenomenal EMI absorption properties, ferrite was destined to lead the charge against EMI/RFI. And TDK ferrite cores comprise a rich μ_{iac} 45—2700 material composition. They also come in multiple configurations for maximum protection over a wide range of frequencies.

TDK offers you a wide selection of ferrite products from which to choose, ferrite bead cores, chip-type bead cores, a newly developed multi-hole ferrite substrate MH series, and angular cores for flat cables. All are highly effective in eliminating EMI on circuit boards and between interfaces, as well as preventing undesirable signal feedback and interfering oscillation. All of TDK's EMI/RFI products boast high quality materials, and are fabricated according to integrated production processes. Naturally, all of our ferrite products carry the TDK guarantee of reliability, and are suitable for a variety of applications, including advanced computers, automobile electronics, and OA and FA equipment.

If you're ready to fight noise in the electronic environment, it's time you got to know TDK!



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For cables
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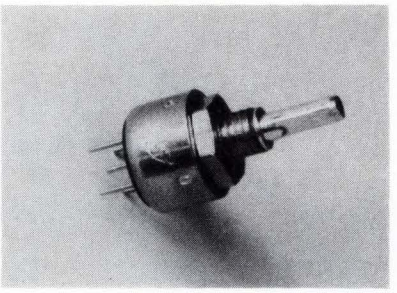
laser marked for easy identification and are available in bulk or in 12-mm tape-and-reel packaging. $0.40 to $0.60 (100).

American Precision Industries, Delevan/SMD Div, 270 Quaker Rd, East Aurora, NY 14052. Phone (716) 652-3600.

Circle No 663

BINARY-CODED SWITCH

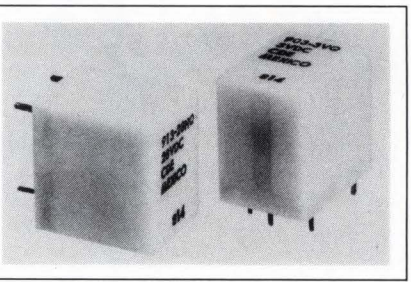
The Series 26 ½-in.-diameter, binary-coded-output rotary switch is rated for 25,000 cycles when switching logic-level loads. Although the switch has 16 positions, its adjustable stop feature lets the user create a 10-position, BCD-code output or an 8-position, octal-code output.



By adjusting the location of the stops, you can isolate any portion of the binary code and use it as the output. The Series 26 switch features a shaft- and panel-seal and shorting-type contacts. $6.52 (100). Delivery, four to six weeks ARO.

Grayhill Inc, 561 Hillgrove Ave, La Grange, IL 60525. Phone (312) 354-1040.

Circle No 664



MINIATURE RELAYS

The 900 Series miniature relays occupy a volume of approximately 0.58 in.^{3} and are designed for high-density packaging with a low profile on pc boards. Stock units are furnished with contacts to switch 2, 5, and 10A at 120V ac/28V dc. Contact forms are available in 1A (spst-NO), 1B (spst-NC), and 1C (spdt). Stock relays come with 1C forms and are available with 6, 12, or 24V dc coils. The 900 Series relays offer four different footprints and coil sensitivities of 360 and 180 mW. Covers are available in nylon and Flamex material. $1.25 to $1.50 (1000). Delivery, four to six weeks ARO.

Cornell Dubilier Electronics, 2314 M L King Ave, Calexico, CA 92231. Phone (619) 357-3441.

Circle No 665

NVG COMPATIBILITY FROM THE PILOT'S POINT OF VIEW.

Day or night, pilots see exactly the information they need with Korry's new NVG-compatible switchlights and panels. Clearly and comfortably, without hot spots or light leaks. All thanks to the most uniform brightness—and the truest red—in the entire industry.

Today, Korry NVG-compatible switchlights are being used by pilots flying the Black Hawk HH-60H, the world's first production-version MIL-L 85762-compliant Helicopter Combat System.

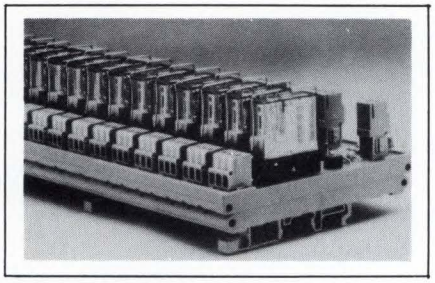
Even in direct sunlight, pilots see sharp, high-contrast legends of green, yellow, and red, through ANVIS *or* Cat's Eyes goggles.

Look at NVG-compatible switchlights and panels from the pilot's point of view. We think you'll agree on Korry, today the leader in NVG—and for over fifty years the leader in all customized illuminated cockpit information and control systems. Call (206) 281-3563 today for additional information.

CRITON KORRY

CIRCLE NO 125

Components

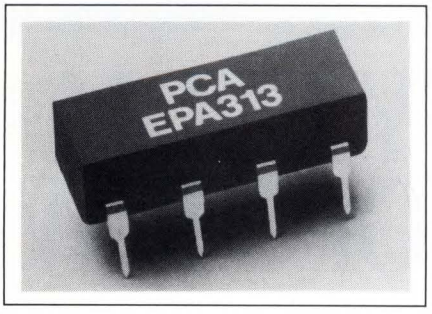


RELAY MODULES

Series 20.000 relay interface modules simplify the design and packaging of programmable-controller output circuits. Available with 4, 8, or 16 plug-in relays, the modules snap-mount onto DIN-1 and DIN-3 mounting rails. Relay input coils, rated for both ac and dc voltages, operate at 24, 48, 110 to 127, and 220V. Each relay in the module has one spdt output contact rated at either 10 or 16A. Built-in LEDs provide relay status and indicate the ac or dc input voltage. 8-relay module, $138.32 (5).

Entrelec, 2 Ram Ridge Rd, Spring Valley, NY 10977. Phone (914) 425-7460. FAX 914-425-8108.

Circle No 666

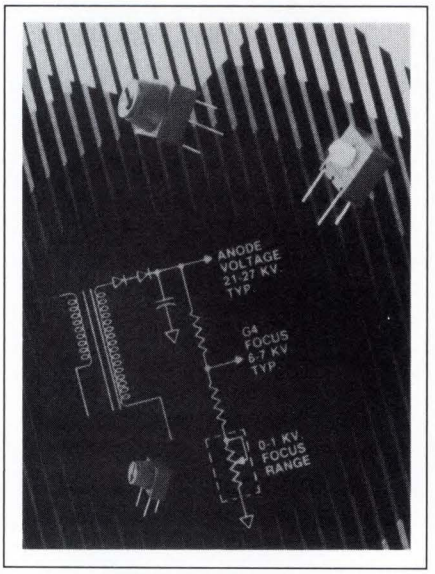


DELAY LINES

EPA313 Series delay lines provide three separate TTL-compatible delay lines in a single 14-pin DIP. Each of the delay lines in the 42 standard units have identical delay times ranging from 5 to 250 nsec ±5% or ±2 nsec, whichever is greater. Each delay line includes an input and an output buffer. Fan-out for the output buffer equals 20 TTL loads for the high level and 10 TTL loads for the low level. Output rise time measures 4 nsec max. Operating range spans 0 to 70°C. Custom units with special buffering and delay times are also available. $2.26 (1000). Delivery, stock to six weeks ARO.

PCA Electronics Inc, 16799 Schoenborn St, Sepulveda, CA 91343. Phone (818) 892-0761. FAX 818-894-5791.

Circle No 667



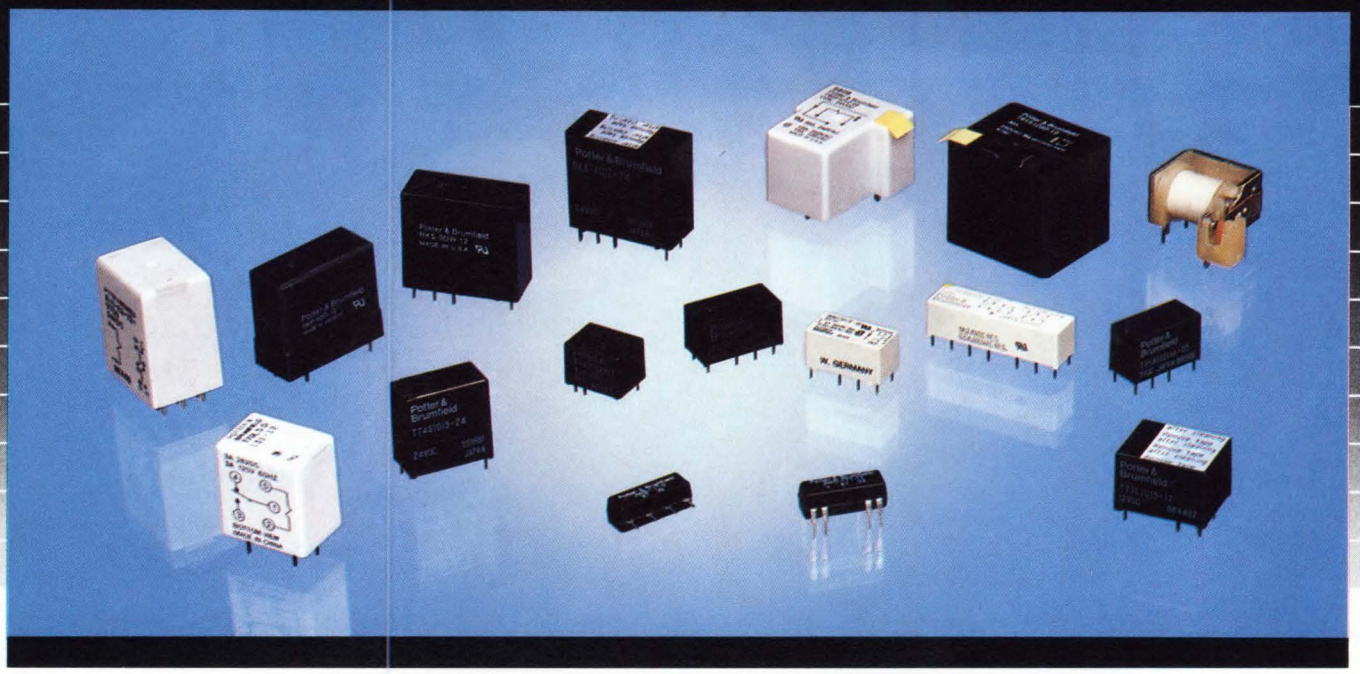
TRIMMERS

Designed for CRT adjustment applications, Model 3386-HV1 trimmers have a 1-kV max voltage rating. They feature an O-ring seal to provide reliable operation under dusty and humid conditions. Standard resistance values are 2.5 and 5 MΩ. Key specifications include a ±150-ppm/°C temperature coefficient, a 1% max contact resistance variation, and a 200-cycle min lifetime. Adjustability in the voltage divider and rheostat modes equals ±0.5 and ±0.15%, respectively. Standard knobs are available in white or blue; red knobs are optional. $1.01 (1000). Delivery, stock to eight weeks ARO.

Bourns Inc, 1200 Columbia Ave, Riverside, CA 92507. Phone (714) 781-5500. TLX 676423.

Circle No 668

Specify P&B for dry circuit to 30A load switching on your P.C. board.



New Models Expand Offering

Potter & Brumfield's expanded line of printed circuit board relays provides the features you need – whether you're switching dry circuits or 30A loads. New products, traditional P&B quality and unbeatable service combine to help solve your toughest relay design-in problems in telecommunications, appliance, industrial control and other applications.

Miniature Relays Switch 1mA to 10A

New T73 and T74 series miniature P.C. board relays join the T70 series as Potter & Brumfield's low-cost SPDT units for general purpose applications. Various contact materials permit these immersion cleanable relays to switch from 1 mA through 10A. Sensitive coil models are available.

Expanded Line of 4,000V Isolation Relays

Extensions to the line of RK series relays feature 8mm coil-to-contact spacing for 4,000V isolation. SPDT models switch loads to 20A, while DPDT models switch up to 5A. Both sealed and unsealed types are now offered with either AC or DC coils.

T90 & T91 – 30A Workhorses

T90/T91 series relays have SPDT contacts for loads to 30A. The DC coil T90 is offered as an open-style or sealed relay. The T91 is available with a DC coil, and it's offered with quick connect terminals for load connections. An AC coil T91 will be available soon.

More Models for Low Signal Switching

The growing line of P&B low-signal relays features units with single or multiple contacts to provide dependable switching of 2A and under loads. Both polarized and non-polarized units are offered in various coil sensitivities. Included are immersion cleanable DIP and SIP types.

Stock Availability

Many models are available off-the-shelf from your authorized P&B distributor. Of course, distributor stock is backed by Potter & Brumfield's extensive factory inventory.

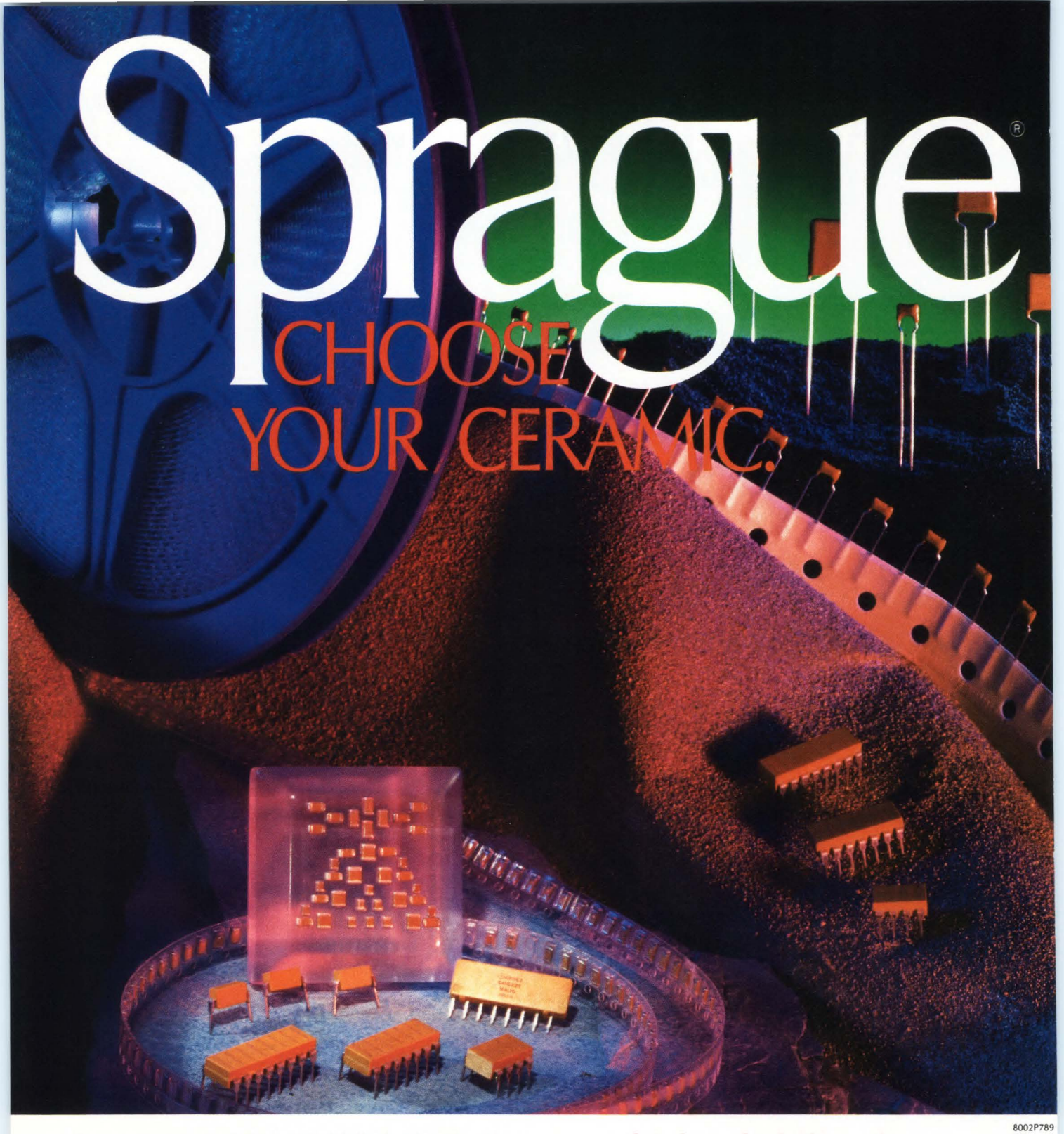
Find Out More

Contact us today for information on our complete line of P.C. board relays. Potter & Brumfield, A Siemens Company, 200 S. Richland Creek Drive, Princeton, Indiana 47671-0001.

Call toll-free 1-800-255-2550 for the P&B authorized distributor, sales representative or regional sales office serving your area.

Potter & Brumfield A Siemens Company

8905



8002P789

Sprague MONOLYTHIC® Caps . . . high reliability, low-cost.

MONOLYTHIC® Multilayer Ceramic Capacitors from Sprague: a complete line of ceramic caps featuring economy, high-performance and reliability in a variety of popular ratings and EIA temperature characteristics. Get fast delivery on multilayer ceramic chip caps for general purpose, high-voltage, high-temperature and high-frequency applications. Sprague ceramic chips are supplied on tape and reel to EIA 481A. Also available: molded-case DIPs and SIPs supplied in plastic carriers. Conformally-coated radial-lead capacitors are also available in quantity, supplied in bulk pack or on tape and reel. For technical data, write for the new Sprague Catalog WF-100A to Technical Literature Service, Sprague Electric Company, P.O. Box 9102, Mansfield, MA 02048-9102.

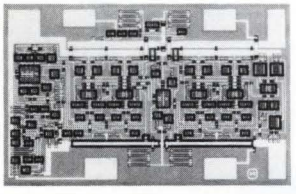
SPRAGUE®

NOW PUT A LITTLE AVANTEK MAGIC IN YOUR SYSTEM

Avantek MagIC™ High Speed ICs Enable Superior System Designs

magIC™

The new MagIC™ series of silicon bipolar MSI integrated circuits offer the best performance available from silicon ICs yet. The broadband, high frequency performance of these high-speed silicon ICs make them cost-effective alternatives to more expensive GaAs ICs. Avantek MagIC silicon ICs are manufactured with Avantek's proprietary 10-15 GHz F_t, 25 GHz F_{max} Isosat™ process for unsurpassed integration and performance at microwave frequencies. Avantek's MagIC series ICs presently consists of four product families: low noise amplifiers, active mixers, variable gain control amplifiers, and prescalers. These low-cost, high-speed silicon ICs are Avantek's magic solutions to your RF, microwave and lightwave system performance and cost problems.



High Performance, High Speed, Low Cost...

The INA-series of two-stage low-noise amplifiers presently consists of three models, offering:

- 3 dB bandwidths to 2.8 GHz
- Gains as high as 32 dB
- Noise figures as low as 1.7 dB
- Prices as low as $22.00 each* in hermetic 70 mil surface mount package

The IAM-series of active mixer/amplifiers presently consists of two models, offering:

- RF and LO frequency range of .05 to 5.0 GHz
- Conversion gain as high as 15 dB
- LO power as low as −10 dBm
- Prices as low as $16.00 each* in hermetic 180 mil surface mount package

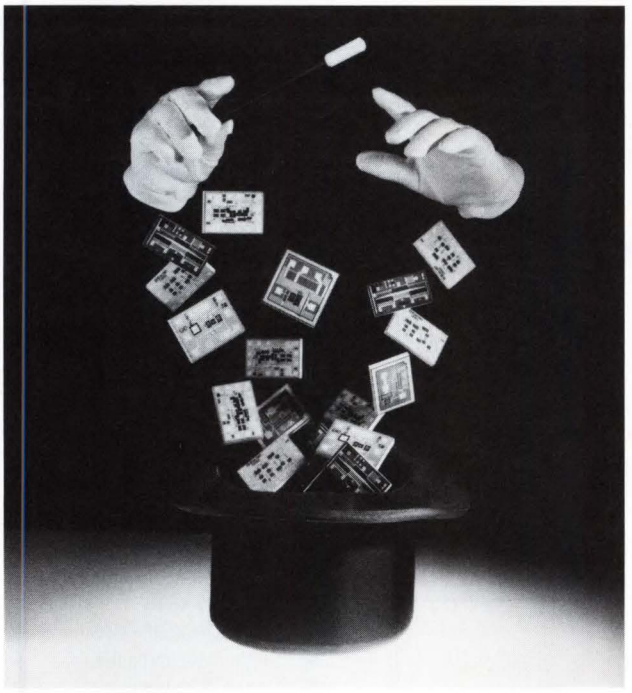
The IVA-series of variable gain control amplifiers presently consists of two models, offering:

- 3 dB bandwidths to 3.0 GHz
- 30 dB gain control range
- Gains as high as 26 dB
- Prices as low as $28.50 each* in hermetic 180 mil surface mount package

The IFD-series low phase noise static prescalers offer:

- Divide-by-4 to 5 GHz
- Low 125 mW Power Consumption
- Prices as low as $18.50 each* in hermetic 100 mil surface mount package

*Price for 1000 piece quantities



MagIC™ ICs Are Available in Quantity for Volume Applications

Avantek presently produces more than 1,000,000 MMICs per month. So you can be assured the MagIC high speed ICs you need will be available to support your volume production programs. And, all MagIC silicon ICs are in stock at your local Avantek distributor.

For additional information, or the name and address of your local distributor, contact the regional sales office nearest you.

Regional Sales Offices
North America
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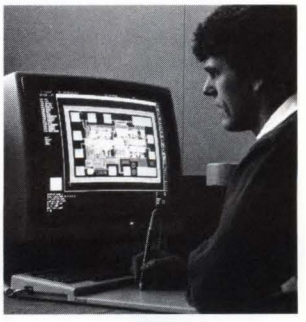
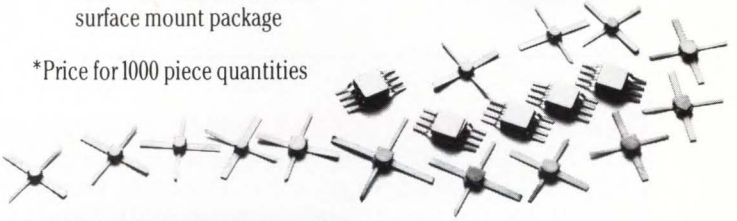
Central: (312) 358-8963
Western: (805) 373-3870
European: (44) 276-685753





Magic Solutions in Silicon

AVANTEK

Up to 0.3 μF

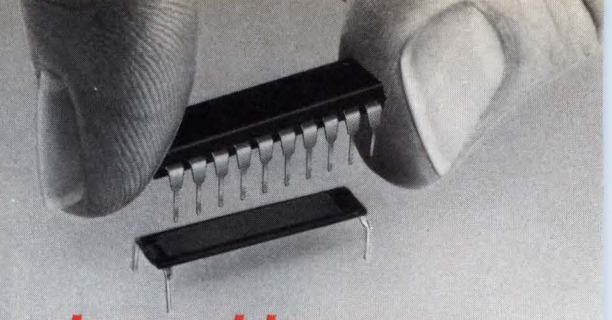
MICRO/Q 2000 capacitors have available capacitance levels from 0.01 μF to 0.3 μF. Reduce board level noise up to a factor of 10. And MICRO/Q 2000's molded construction seals out moisture and humidity.

Improve existing board performance

MICRO/Q 1000 capacitors can be retrofitted to solve noise problems on existing boards. Because MICRO/Q 1000 caps share mounting holes with existing IC pins, no board redesign is required. Effective decoupling becomes a matter of adding one insertion step.

Simplify board layout and get a choice

MICRO/Q 1000 ceramic decoupling capacitors share board mounting holes with IC pins. You don't have to waste space on additional holes, as you do for standard caps. Simplifying board design opens up two very attractive options. Add more active devices with increased packaging density in the same space, or design the same package on a smaller board. Either way, you win with MICRO/Q 1000.



noise problems... space problems... EMI/RFI problems...

TOP THIS.

Rogers MICRO/Q® decoupling capacitors reduce voltage noise spikes in IC s, often by as much as a factor of ten. And since they're easily mounted *underneath* the IC, MICRO/Q capacitors conserve valuable board real estate, too. A range of configurations makes MICRO/Q flat capacitors especially effective at reducing noise on:

- 256 K RAMs
- Video RAMs
- EPROMs
- Static RAMs
- Microprocessors
- Bus drivers/buffers
- Other ICs where noise spikes create performance problems
- Boards that need EMI/RFI fix
- CAD/CAM/CAE
- Telecommunications
- Minicomputers
- Printers and copiers
- Single-board computers

Find out how MICRO/Q capacitors reduce noise and provide better board density. Get the full story and a free sample. Call a Rogers MICRO/Q Product Specialist today, at (602) 967-0624. Fax (602) 967-9385.

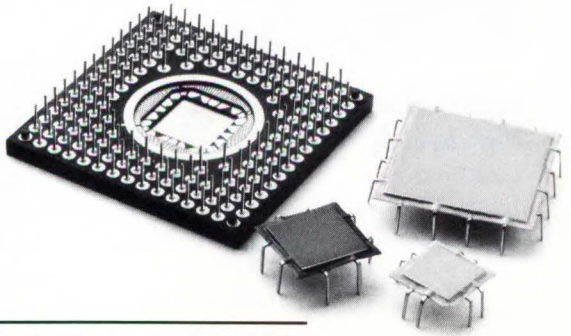
ROGERS

Rogers Corporation
Circuit Components Division
2400 South Roosevelt Street
Tempe, AZ 85282

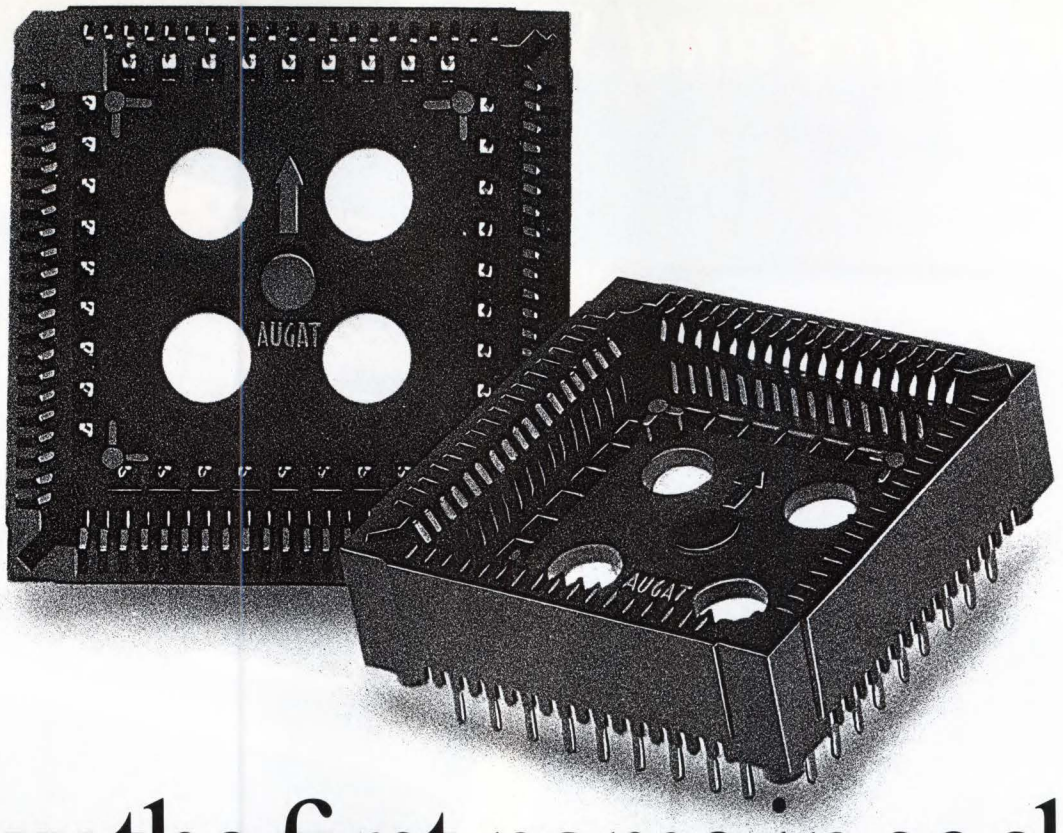
DISTRIBUTION: Europe: Mektron NV, Ghent, Belgium
Japan: Rogers Inoue Corporation, Nagoya **Taiwan, Singapore, Hong Kong:** Dynamar
Korea: Far East Trading, Seoul **Brazil:** Rogers Coselbra, Sao Paulo.

Design noise out of PGA and LCC packages

MICRO/Q 3000 capacitors provide effective solutions to noise problems with VLSI PGA packages and LCC sockets. Design effective decoupling on complex multi-layer board layouts by fitting MICRO/Q 3000 capacitors under PGA or LCC sockets. They occupy no additional board space and provide the low-inductance, high-frequency decoupling required by today's VLSI packages. Available in a range of pinout configurations.



For information on all of these Rogers products **CIRCLE NO 131**

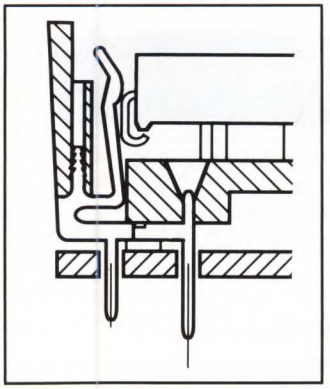


Now the first name in sockets has the last word in PLCCs.

Introducing the PCS Series from Augat, world leader in IC sockets. The design, performance and positions you prefer. With the quality, delivery and pricing you expect – only from Augat.

Interchangeable with your current supplier's product, the Augat PCS Series is available in 68 and 84 positions.

Accepts Jedec Type "A" PLCCs on .050" (1.27mm) centers.



Every feature you requested from Augat.

Solder-tail design to allow through-hole board patterns on .100" (2.54mm) grid.

Offers a high normal force of 200 grams per contact.

Contact positively retains package.

And large drain holes aid cleaning.

The new PCS Series from Augat. Your single source supplier for a world of quality IC products.

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We'd like to be first to receive the new PLCC data sheet, test report and product sample for ☐ 68 (or) ☐ 84 position (please specify).

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Attleboro, MA 02703
(508) 699-9800
Fax: 508-699-6717 **EDN072089**

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CIRCLE NO 132

Get surface mount news that probes beneath the surface!

Read all about it!

The sensational new Mepco/Centralab Surface Mount Device Catalog tells you everything you need to know to select and specify America's broadest line of SMD® passive components:

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- **Monolithic ceramic chip capacitors**
- **Aluminum electrolytic capacitors**
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P.O. Box 10330
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Please send me the following:

☐ Surface Mount Device Catalog
☐ Leaded Resistor/Capacitor Data Book
☐ Please have a sales representative call

Name/Title _____
Firm/Dept./Div. _____
Address/MS _____
City/State/Zip _____
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EDN 07/20/89

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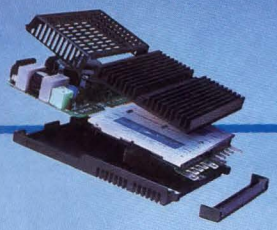

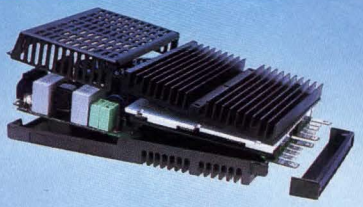

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● VI-MF0-CS 5V @ 300W **$293**	● VI-QF01-CSU 5V @ 300W 12V @ 200W **$473**	● VI-RF022-CVVV 5V @ 150W +15V @ 150W −15V @ 150W **$491**
● VI-NF0-CP 5V @ 450W **$420**	IMMEDIATE DELIVERY	● VI-RF013-CVVV 5V @ 150W 12V @ 150W 24V @ 150W **$491**
● VI-LF1-CU 12V @ 200W **$185**		
● VI-NF1-CP 12V @ 450W **$420**		
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The models listed above will be available at a 30% discount through August 31, 1989.

- 115/230 VAC strappable
- 7 Watts/cubic inch
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- Over 10,000 **standard** models
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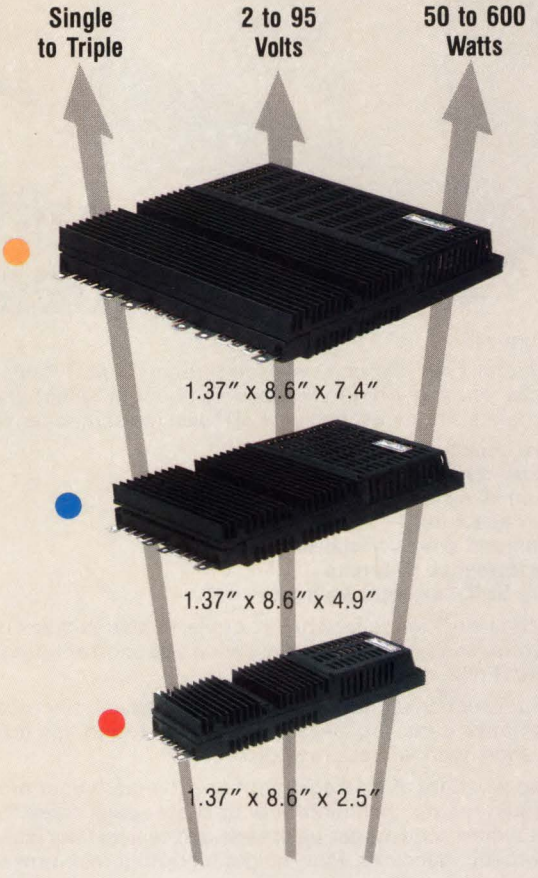

Call 1-800-735-6200 MasterCard VISA

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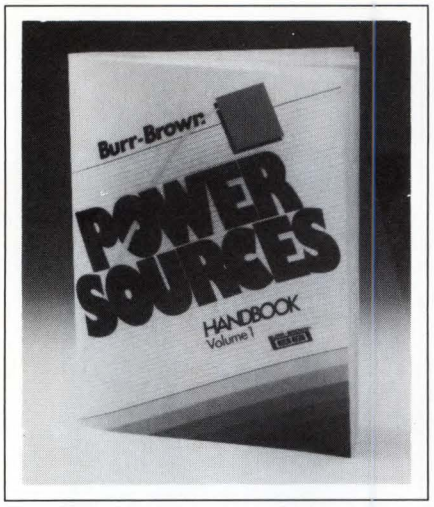
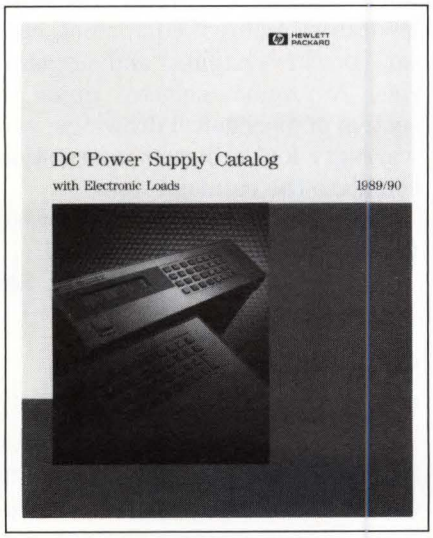


Power sources covered

Power Sources Handbook presents more than 450 single-, dual-, and triple-output power supplies in a wide range of modular packages and DIPs. The 96-pg guide provides product data sheets for the vendor's power-conversion products. Supplementary data includes a selection guide, a discussion of advanced reliability programs, a glossary of power-conversion terms, and application notes.

Burr-Brown, Box 11400, Tucson, AZ 85734.

Circle No 724



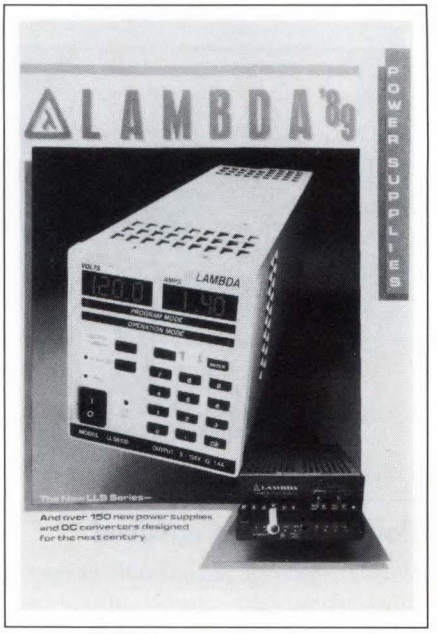
Booklet presents power-supply line

The vendor's 144-pg catalog provides information about its complete 10W to 11-kW power-supply line, including analog-programmable, laboratory-bench, HP-IB-system, and special-purpose power supplies. Each section starts with an introduction and selection guide to that particular power-supply line. The booklet also talks about the vendor's single- and multiple-input dc electronic loads for power-supply testing. It contains photographs, drawings, a glossary, specifications, and ordering and application information.

Hewlett-Packard Co, 19310 Pruneridge Ave, Cupertino, CA 95014.

Circle No 725

LITERATURE



Comprehensive listing of power supplies

This 1989 catalog covers more than 150 power supplies and dc converters that come in commercial, industrial, and military versions. The 200-pg publication describes the vendor's LLS Series power supplies for test equipment; LMS Series remotely programmable power supplies; and MLW Series isolated dc/dc converters for military or civil aerospace applications. Other sections of the 9-part catalog deal with laboratory and test equipment, custom power systems, and accessories. A product selector guide, a section of mechanical drawings, and warranty and ordering information complete the catalog.

Lambda Electronics, 515 Broad Hollow Rd, Melville, NY 11747.

Circle No 726

Switching power supplies and services detailed

This 4-color leaflet provides data for 28 power-supply models, including electrical and mechanical specifications, special features, output currents, MTBF, I/O voltages, options, and agency approvals. The 12-pg brochure briefly describes the company's customer-support services

NEW MICROLITHIUM™ BATTERY SERIES JOINS THE DURACELL® XL™ POWER FAMILY!

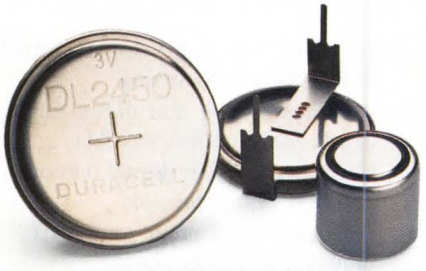
Today Duracell is your best source for all your lithium battery needs.

First with high-power consumer-replaceable lithium batteries, Duracell now introduces the MicroLithium Battery Series for long-life, low-drain applications. These new lithium/manganese dioxide cells have the same quality and dependability as our popular High Power Series, but have been optimized for micropower equipment. UL recognized, they're available in a wide-range of coin and cylindrical sizes, with or without pin terminations.

DL123A — First 3-volt, high-power consumer-replaceable lithium batteries.

Our sales engineers listen to your engineers.

World-wide, you can count on our field sales engineers for



Assorted cell sizes and PCB pin types. Shown are DL2450; DL2032 with chip-straddle pins; DL1/3N.

expert applications assistance, battery samples, and test information, when you need it. From form-fit evaluation to component sourcing, we can help match the optimum lithium cell to your requirements.

Custom assemblies. . . standard solutions.

Our national network of Authorized Value-Added Assemblers can supply you with special terminations and battery packs. And Duracell will coordinate the effort and assist in the design work too!

Popular-size cylindrical configurations: DL1/2AAL; DL2NSE; and DL2/3AL.

SPECIAL 10% INTRODUCTORY DISCOUNT!

We want you to try the new DURACELL XL MicroLithium Series of batteries. That's why we're offering a special discount on all orders placed and shipped before September 30, 1989.*

DL2/3AL with single pins (polarized pins available).

Velcro-mountable DL223AR computer clock battery.

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The Duracell Team is just a phone call away to help you in fulfilling your battery requirements, from technical information to competitive pricing and quick deliveries. With Duracell, satisfying your lithium battery needs is easier than ever!

Call us today at one of the toll-free numbers listed below and lock in your 10% introductory discount.

*Discount applies to cells with and without PCB pins purchased directly from Duracell: DL2450; DL2430; DL2032; DL2025; DL2016; DLAAL; DL2/3AL; DL1/2AAL.

DURACELL INC.
OEM Sales and Marketing Group
Berkshire Industrial Park
Bethel, CT 06801

FOR INFORMATION AND TO GET YOUR 10% DISCOUNT CALL:

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Central	1-800-525-8457	(In Illinois, 312-954-2714)
West	1-800-331-3923	(In California, 800-225-1962)

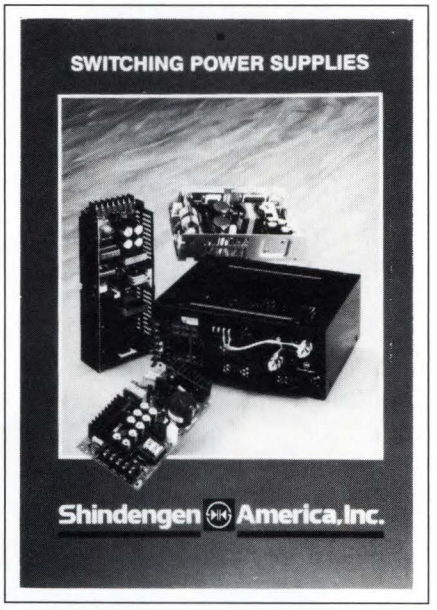
CIRCLE NO 139

LITERATURE

and its capabilities for designing and manufacturing complete engineered assemblies.

Brown Applied Technology Inc, 3520 De La Cruz Blvd, Santa Clara, CA 95054.

Circle No 727



Guide profiles five power-supply series

A comprehensive 62-pg guide features the company's five series of switching power supplies. The 4-color, spiral-bound booklet includes a selection guide for single- and multiple-output models and mentions the vendor's family of uninterruptable power supplies.

Shindengen America Inc, 2649 Townsgate Rd, Westlake Village, CA 91361.

Circle No 728

Brochure lists switching power supplies

This 4-pg leaflet covers the VF Series switching power supplies and the DVF Series switch-mode power supplies. The brochure indicates specifications, options, dimensions, and prices.

Deltron Inc, Box 1369, North Wales, PA 19454.

Circle No 729

SIEMENS

SAMSAN™ Displays. Our Technological Superiority Has Certain Visible Advantages.

Working with Small AlphaNumeric (SAN) displays used to impose certain compromises.

You had to put up with the high power consumption and heat dissipation of bipolar technology, which required expensive heat sinks and PCB designs. And you paid dearly for the high cost of ceramic packaging and the lack of price competition.

Now the company that brought you the first CMOS SANs expands the family of Siemens Advanced Model SAN (SAMSAN) displays in a plastic package. These pin-for-pin replacements for Hewlett-Packard SANs offer a wider range of operating temperatures than HP's commercial bipolar ceramic device. For as little as half the price.

And SAMSAN LED displays are built with CMOS technology. So their lower power consumption and heat dissipation make thermal management simple.

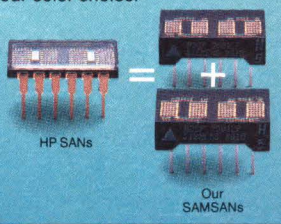
Siemens Components, Inc. Optoelectronics Division, 19000 Homestead Road, Cupertino, CA 95014. (408) 725-3423.

SAMSAN Features

- .15" and .20" character heights in red, HER, green, and yellow.
- Commercial plastic package: −40°C to +85°C.
- Drop-in replacement for many existing ceramic applications.
- CMOS driver offers 30% lower power consumption and 25 times less quiescent power than bipolar. Heat sink not required for most applications.
- Half the cost of competitive packages.
- Small package saves valuable real estate.
- End stackable.
- Also available in hi-rel/military hermetic ceramic package versions.

Siemens Super SAN Display Swap.

We're sure you'll agree that our SAMSANs are the perfect replacement for HP SANs. So sure that if you'll send us a ceramic HDSP 2000 type display, we'll send you *two* plastic SAMSANs to replace it. Mail your request on your letterhead to R. Waltonsmith. Be sure to specify your color choice.



Distributors: Advent Electronics, Inc., Almo Electronics, Hall-Mark, Insight Electronics, Marshall, Summit, Western Microtechnology.

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Practical Solutions by Design.

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Based on its fully integrated capabilities and new substrate technology, AT&T offers hybrid ICs with record-breaking density.

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AT&T reliability extends to service and delivery. We currently produce half-a-million devices a week, with capabilities to meet urgent production schedules. We'll provide on-site support from AT&T field application and Bell Laboratories engineers. And we'll deliver full operational samples within eight weeks. Whatever it takes to help ensure your success.

For more on how AT&T can meet your thin film and thick film multilayer hybrid needs, just call **1 800 372-2447.**

AT&T
The right choice.

CIRCLE NO 143

Broad range of computer kits, peripherals, and ICs

The vendor's 1989 catalog presents a wide variety of electronic products, from computer kits and IBM PC/XT-, PC/AT-, and Apple-compatible peripherals to ICs. It introduces several new products, including AMI 80386, 16- and 20-MHz mother boards and the New Enhanced AT (NEAT) mother board. The 76-pg, 4-color publication also features a 2-pg insert of useful TTL and μP pin-out data.

Jameco Electronics, 1355 Shoreway Rd, Belmont, CA 94002.

Circle No 730

Data book features CMOS static RAMs

The company's 1989 Data Book describes its high-speed, high-performance military monolithic static RAMs. The publication also announces the company's intention to produce megabit-density monolithic SRAMs by 1990.

EDI, Literature Dept, 42 South St, Hopkinton, MA 01748.

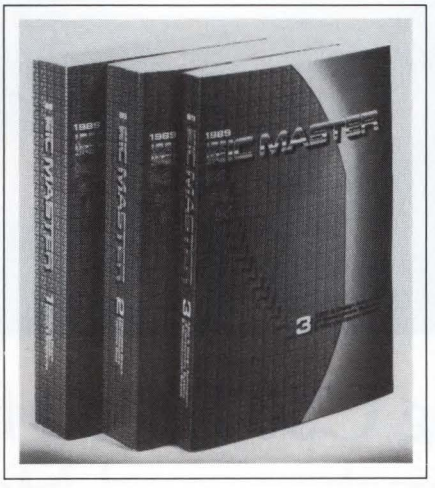
Circle No 731

Listing of analog ICs

The vendor's product guide contains an assortment of proprietary and enhanced alternate-source analog devices. The 24-pg publication offers standard products for hard-disk-drive, computer/peripheral, telecom, communications, military, industrial, and automotive applications, as well as detailed descriptions of ASIC development and tile-array specifications. The booklet provides selection guides for each product line, and its alternate-source cross reference lets design and component engineers specify direct replacement components.

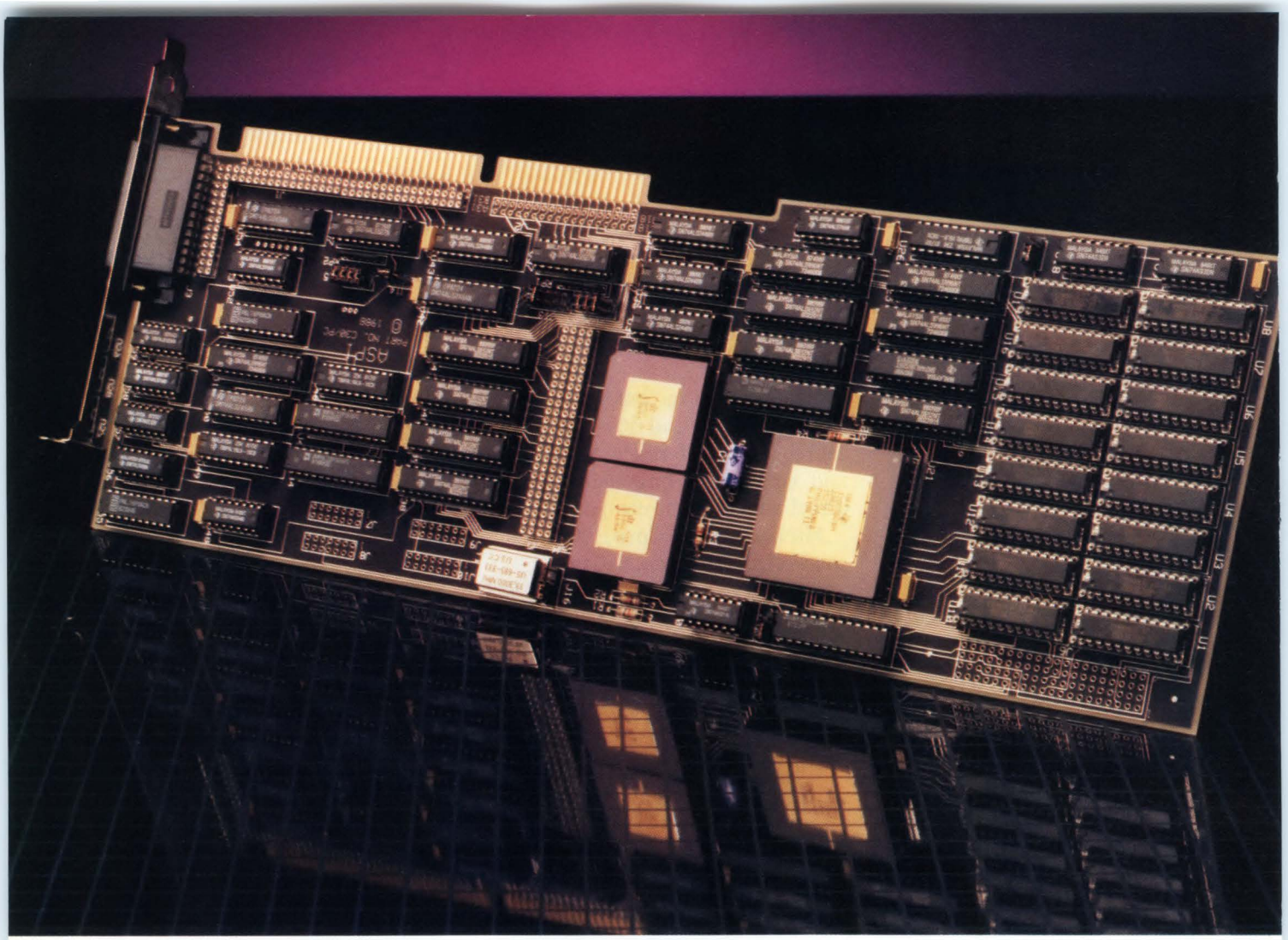
Micro Linear Corp, 2092 Concourse Dr, San Jose, CA 95131.

Circle No 732



Three-volume set covers IC design specifications

The 1989 *IC Master* 3-volume softcover set includes 12,000 new ICs and over 150,000 alternate source devices. Volume 1 covers 80,000 standard ICs grouped by basic categories—digital, microprocessor, linear, interface, and memory. This volume includes an alternate source directory, a parts number index, a parts number guide, an application note directory, and an expanded military section. Volume 2 is a stand-alone reference providing technical data for more than 1200 manufacturers' data sheets. It also contains a directory of manufacturers and distributors. Volume 3 is a systems-level reference for custom and semicustom ICs, including gate array, cell-based ASICs, and programmable logic. A design-automa-



For Screaming C30 Speed from Your AT, Buy Banshee™ and Hang On!

The new Banshee System from Atlanta Signal Processors, Inc., can turn your AT or compatible into a full-blown C-language processing engine.

Banshee includes the first commercially available co-processor mother board based on TI's TMS320C30 microprocessor chip. The result is blinding 33 MFLOP speed that qualifies your AT for high-volume, high-speed calculations and C30 DSP system development.

The ASPI flexible memory approach further enhances AT performance. The mother board contains 64 to 512 Kbytes of *dual access* RAM and 8 Kbytes of *dual port* RAM. An optional bulk-memory daughter board can add up to 16 Mbytes of DRAM to the system.

Other options include a wirewrap board for your custom hardware applications; a 16-bit, dual-channel, 200 kHz A/D-D/A daughter board; a multiprocessor board and a host of other daughter boards under development.

Banshee also provides a sophisticated, user-friendly software environment. The basic system includes SPOX™ (a C30 operating system), a program for loading and linking C30 code on the AT host, a full-featured C30 program debugger, and a proprietary shell program to make it all easy.

For detailed specifications and prices, contact Atlanta Signal Processors, Inc., 770 Spring St., Atlanta, GA 30308. Telephone 404/892-7265.

aspi

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AT is a trademark of International Business Machines, Inc.

tion section provides extensive listings of CAE and CAD design tools. $140.

Hearst Business Communications, 645 Stewart Ave, Garden City, NY 11530.

INQUIRE DIRECT

Designing circuits for batteries or remote sites

The 24-pg application note, *AN-23: Micropower Circuits for Signal Conditioning,* considers circuit design for conditions that require low power consumption, such as battery operation, remote locations, or thermal requirements. The note provides schematics and component values for signal-conditioning circuits that you use with strain gauges, thermocouples, strobed-power strain bridges, thermistor-based current loops, thermostats, A/D and V/F conversion, micropower switching regulators, and battery backup regulators.

Linear Technology Corp, 1630 McCarthy Blvd, Milpitas, CA 95035.

Circle No 733

App note explains overvoltage protection

This 2-pg application note, *Overvoltage Protection for the ADG5XXA Series of Multiplexers,* analyzes the problems involved and the protection required in two typical multiplexer applications. It features the vendor's ADG5XXA Series multiplexers and describes protection circuitry that allows analog input signals to exceed the supply rails from −40 to +85°C. Topics covered include protecting typical multiplexer application circuits, and the advantages of external protection.

Analog Devices, Literature Center, 70 Shawmut Rd, Canton, MA 02021.

Circle No 734

A 40¢ component can stop what nature throws at you.

Every so often, nature throws your system a surge. And whether it's lightning, static or a simple crossed line, it can destroy the most expensive system with a single blow.

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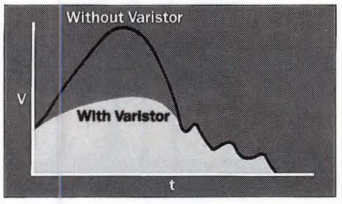
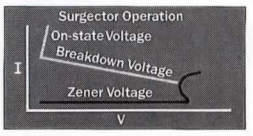


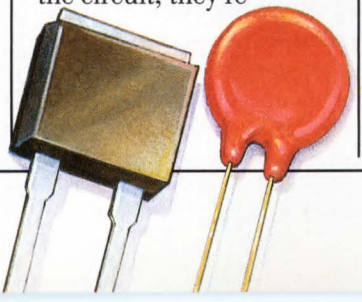
They're widely used for incoming AC protection and clamping circuits. And they're available in a wide range of packaging—axial leaded, radial leaded, leadless surface mount, high-energy modules and connector-pin configurations.

Inventor of Surgector.

Surgector devices combine a thyristor and a zener into one reliable cost-effective device. At low voltages the Surgector device is off. But the instant its clamping voltage is exceeded, the Surgector turns on. Within nanoseconds, the surge is shunted safely to ground, protecting your circuit from sure destruction.



Because Surgector devices respond so quickly and can shunt lots of energy away from the circuit, they're perfect for protecting expensive components from all kinds of transients. Lightning strikes, load changes, switching transients, commutation spikes, line crosses—all the things nature throws your system's way.



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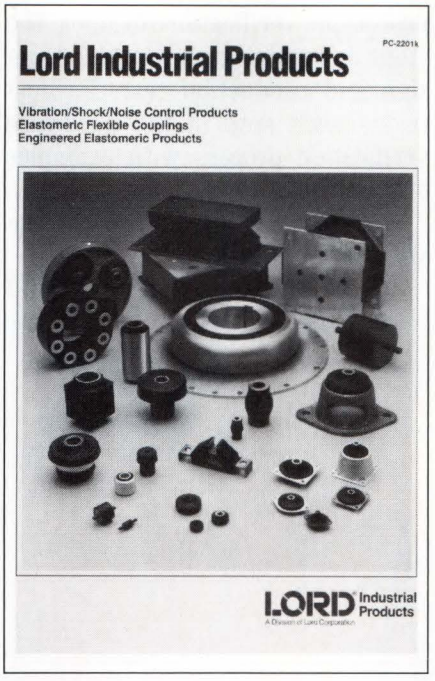
CIRCLE NO 149

LITERATURE: HARDWARE



Booklet explores industrial products

This illustrated 132-pg catalog gives detailed information about the vendor's selection of rubber bonded-to-metal industrial products. Among the instructional sections of the book are a designer's guide that includes engineering theory; a section that provides the data required for an industrial application analysis; and selection guides for general mounts and shipping container mounts. The book features drawings, selection and performance data, dimensions, typical applications, and installation details.

Lord Corp, Industrial Products Div, Box 10040, Erie, PA 16514.

Circle No 741

Directory of ESD-control products

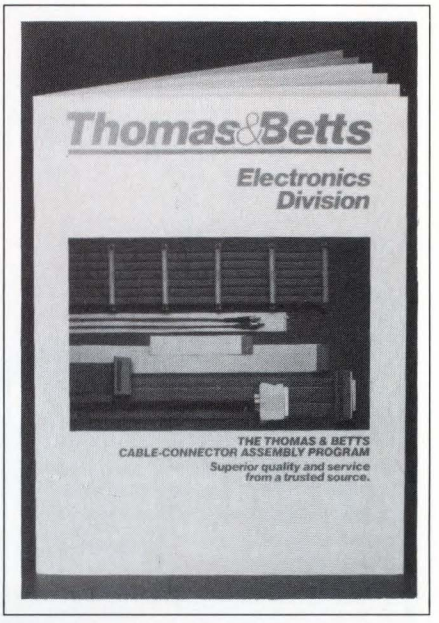
Three 4-in.-post binders contain the vendor's "yellow pages" of the CPF (Control Products File) Consulting Service for ESD-control products. The reference work is updated quarterly and is organized for comparative analysis of products. It's arranged in seven major categories: chemicals & raw materials; ionizers; meters and instruments; packaging; personal protection; workstation products; and miscellaneous (tools, tapes, etc). More than 2000 pages of data sheets, indexes, directories, and selection tables are included in the document. In US, first-year subscription, $335; renewal, $195. In Canada, $375 and $225, respectively; elsewhere, $425 and $260, respectively.

SAR Associates, 1212 E Dominick St, Rome, NY 13440.

INQUIRE DIRECT

Pamphlet sums up cable-connector assembly

The vendor's brochure VA-3 explains its cable-connector assembly program, which provides custom preassembled flexible-cable interconnections, fiber-optic assemblies, and mass-termination systems. The publication stresses how the vendor's authorized centers allow OEMs to cut costs in the areas of assembly tooling and production space, testing, waste, personnel, and inspection, and how the centers allow OEMs to ensure system stability.



Thomas & Betts Corp, 1001 Frontier Rd, Bridgewater, NJ 08807.

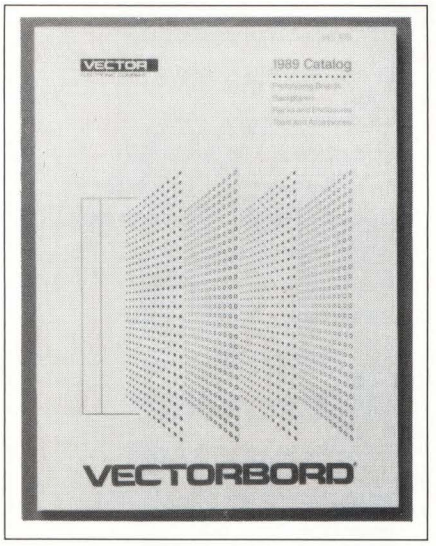
Circle No 742

Using a prototype hardware verification of ASICs

The 118-pg book, *Verification Solutions: A Guide to Design Verification and Test*, helps you with IC design and test, as well as prototype hardware verification of ASICs and semiconductor parts. The paperback book explains how prototype verification bridges the steps between computer-aided design and production test. It illustrates each step in the hardware verification process with examples of specific tasks and solutions.

IMS, 9400 SW Gemini Dr, Beaverton, OR 97005.

Circle No 743



Catalog presents prototyping products

The vendor's redesigned catalog provides a concise and easy-to-use source of prototype electronic circuits. The 102-pg, illustrated book examines general-purpose Vectorbord prototyping boards and bus-specific prototyping boards (IBM, Apple, STD Bus, S-100 Bus, Motorola Excerciser, Multibus, Commodore, and DEC). It also includes Eurocard metric prototyping boards, packaging (Vector-Pak), and general-purpose backplanes. The publication features selector guides and index tabs to help you make your selection.

Vector Electronics Co, 12460 Gladstone Ave, Sylmar, CA 91342.

Circle No 744

Updated guide to precision drive-train components

This 224-pg revised catalog of precision drive-train components features both inch and metric products such as precision gears, brakes, ball bearings, couplings, and specialty hand tools. The booklet includes specifications, diagrams, and application and ordering information.

Precision Industrial Components, Box 1004, Middlebury, CT 06762.

Circle No 745

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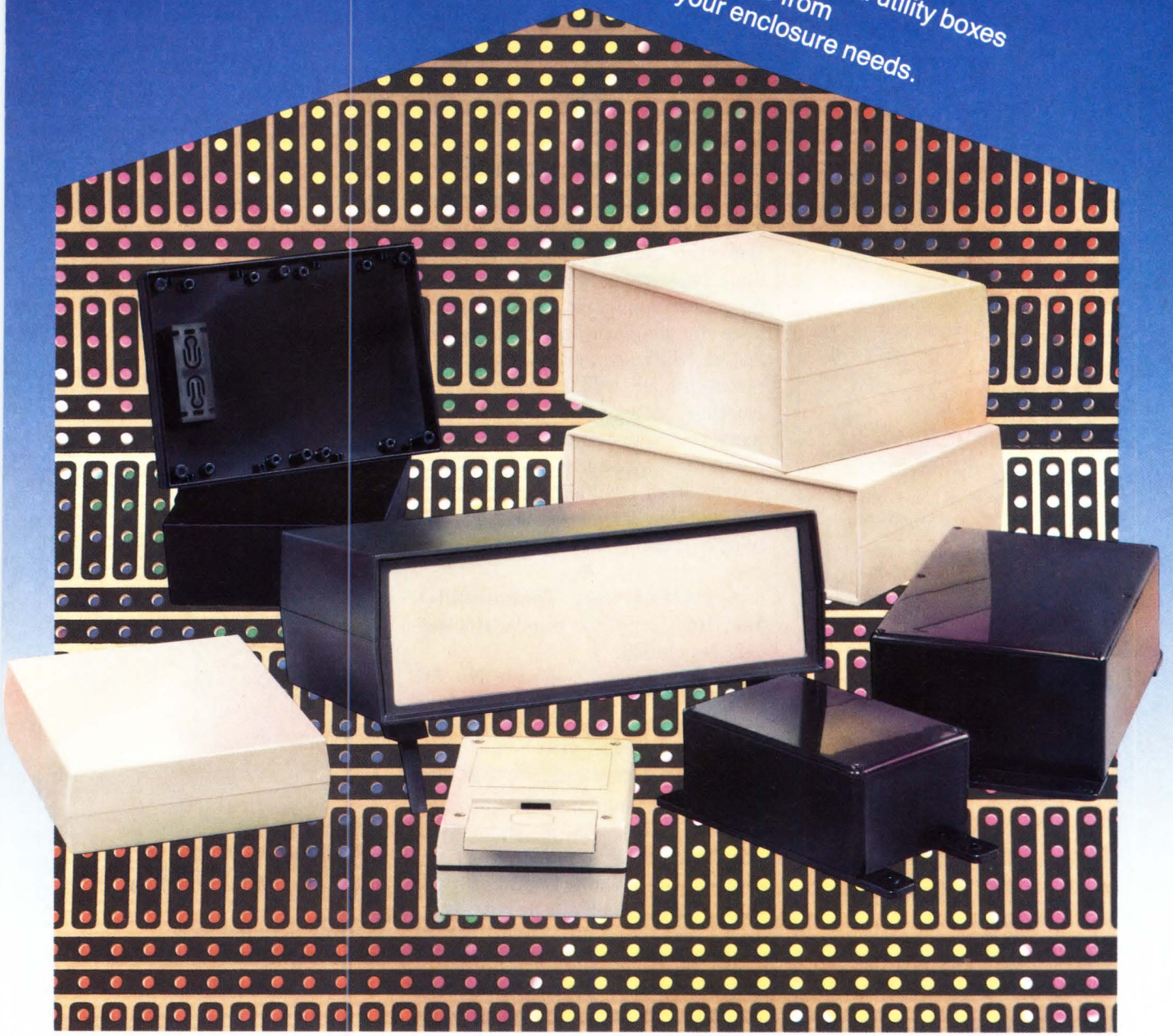

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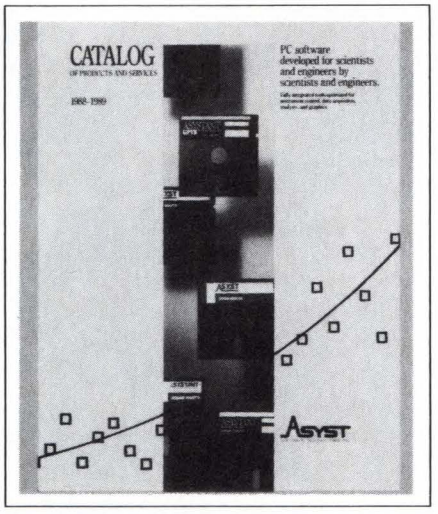
FAX: 602-878-5371

CIRCLE NO 152

For Bud's "House of Plastics" catalog request Form Number HP-89.

LITERATURE: SOFTWARE



Scientific and engineering PC software

The vendor's 20-pg catalog provides a tutorial for PC-based data acquisition and analysis. The publication describes both menu-driven and fully programmable software packages for analysis, statistics, graphics, and data acquisition, and for instrument interface and control. Further, it provides a list of subjects and applications that use the company's products. Comparison charts of all products are included. The catalog also explains the company's training and support services.

Asyst Software Technologies Inc, 100 Corporate Woods, Rochester, NY 14623.

Circle No 735

Package helps you evaluate circuit-design series

This kit for qualified design engineers contains software and a 60-pg illustrated tutorial guide, which describes the Series II Tango-PCB and Tango-Route design-software programs. The guide details features such as pop-up menus, user-definable macros, on-screen prompts, context-sensitive help, and "Hot Spot" and "Speed Palette" aids.

Accel Technologies Inc, 7358 Trade St, San Diego, CA 92121.

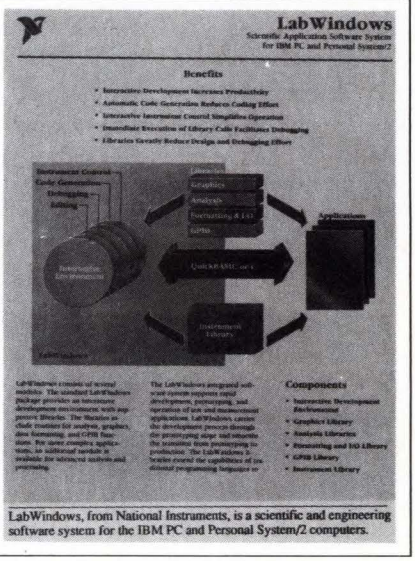
Circle No 736

Book tells you how to simulate with Spice

According to the vendor, *Simulating With Spice* is the most comprehensive book available for learning the analog-circuit simulator, Spice. It contains a complete syntax reference guide for all Spice (Berkeley Spice 2G6) commands, elements, statements, and analysis capabilities. The tutorial section contains 12 problems and guides the user through each simulation. The section on advanced techniques and debugging allows the simulation specialist to delve deeper into Spice's operation. Finally, the book features an entire section of application notes, appendices containing netlists for each example in the tutorial section, an index, and a bibliography of more than 130 related references listed by topic. $65.

Intusoft, Box 6607, San Pedro, CA 90734.

INQUIRE DIRECT



LabWindows, from National Instruments, is a scientific and engineering software system for the IBM PC and Personal System/2 computers.

Brochures present instrumentation software

Two brochures describe the company's icon-based graphical programming systems: LabView 2 for Apple Macintosh personal computers and LabWindows for scientific-application software that runs on the IBM PC, PC/XT, PC/AT, and

compatibles and the IBM PS/2. The LabView publication presents the system's features, including its instrument driver library, hierarchy, and block-diagram programming. The pamphlet about LabWindows illustrates and explains its multiple windows.

National Instruments, 12109 Technology Blvd, Austin, TX 78727.

Circle No 737

Booklet unveils vision systems

Featuring the vendor's 3000 Series single-board vision systems, the 6-pg foldout brochure highlights the gray-scale image processing feature, which, according to the company, allows the systems to perform image analysis and pattern recognition in varied light conditions. An applications section lists uses for the systems in the semiconductor, electronics, aerospace, pharmaceutical, and general manufacturing industries.

Cognex Corp, 72 River Park St, Needham, MA 02194.

Circle No 738

CNC for factory-floor environment

Excerpted from the vendor's 5-volume *Manufacturing Automation Series*, the 42-pg report, "Numerical Control Overview," reviews the use of CNC (computer numerical control) systems in factory-floor environments. Comparison columns cover applications; control, operating, and programming features; diagnostics; and physical attributes of 47 numerical controllers from 18 vendors. The publication also outlines numerical control programming languages and systems, helps you select a CNC system, and analyzes how CAD/CAM systems effect a CNC system in a computer-integrated manufacturing environment. $35.

Datapro Research, 1805 Underwood Blvd, Delran, NJ 08075.

INQUIRE DIRECT

Pamphlet surveys software for IBM PC and PS/2 Series

The vendor's brochure introduces Lotus Measure data-acquisition and instrument-control software for IBM PC, PC/XT, PC/AT, PS/2, and compatible computers. The 6-pg foldout pamphlet illustrates how Measure acquires data, and how you can manipulate and present the data once it is acquired. The publication also details the technical background information, illustrated with screen displays.

National Instruments, 12109 Technology Blvd, Austin, TX 78727.

Circle No 739

Guide to IEEE-488.2 command interface

The vendor's application note, *Getting Started With IEEE-488.2,* presents this IEEE-488.1-standard extension, which focuses on the software aspects of automated systems. The note is principally intended to support the company's 1281 Selfcal DMM, one of the first instruments to incorporate the IEEE-488.2 command and message-exchange interface. The guide is expected to be of primary interest to users who are already familiar with IEEE-488 (1978) systems.

Datron Instruments, Wavetek Corp, Box 85434, San Diego, CA 92138.

Circle No 740

Exploring the benefits of network licensing

The 300-pg report, *License Servers: New Pricing and Marketing Possibilities for Software on a Network,* examines the new technology of network licensing that allows applications (or licenses to use applications) to be easily moved around on a network. According to the vendor, this report is the only source with so much information so clearly defined on this technology. The paper shows that by using network licensing, users are no longer restricted to using software on a single, predefined computer; instead, users can easily share software, thus freeing up software budgets for the purchase of new types of software, or for hardware products, such as workstations. $5000.

Marketshare Inc, 21 Cochituate Rd, Wayland, MA 01778.

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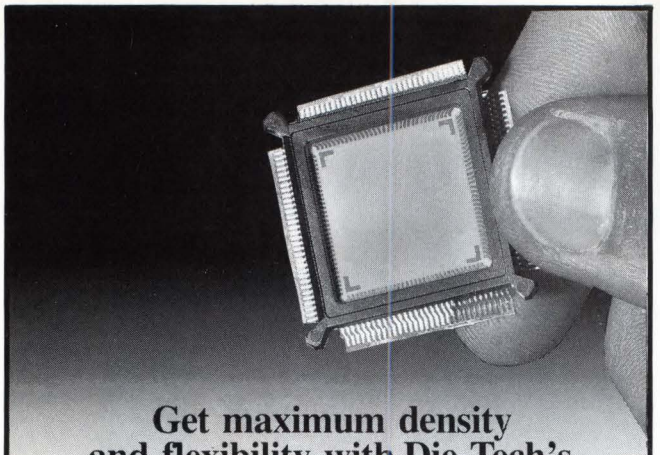

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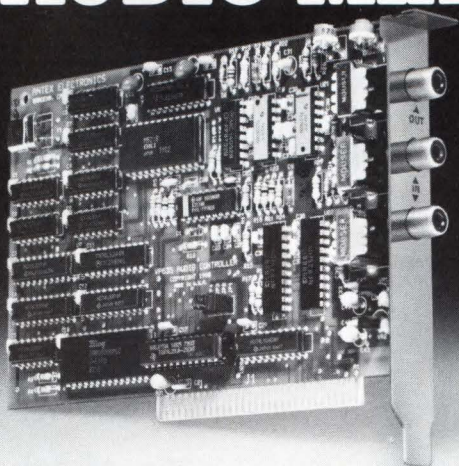
CIRCLE NO 155

AUDIO MIX



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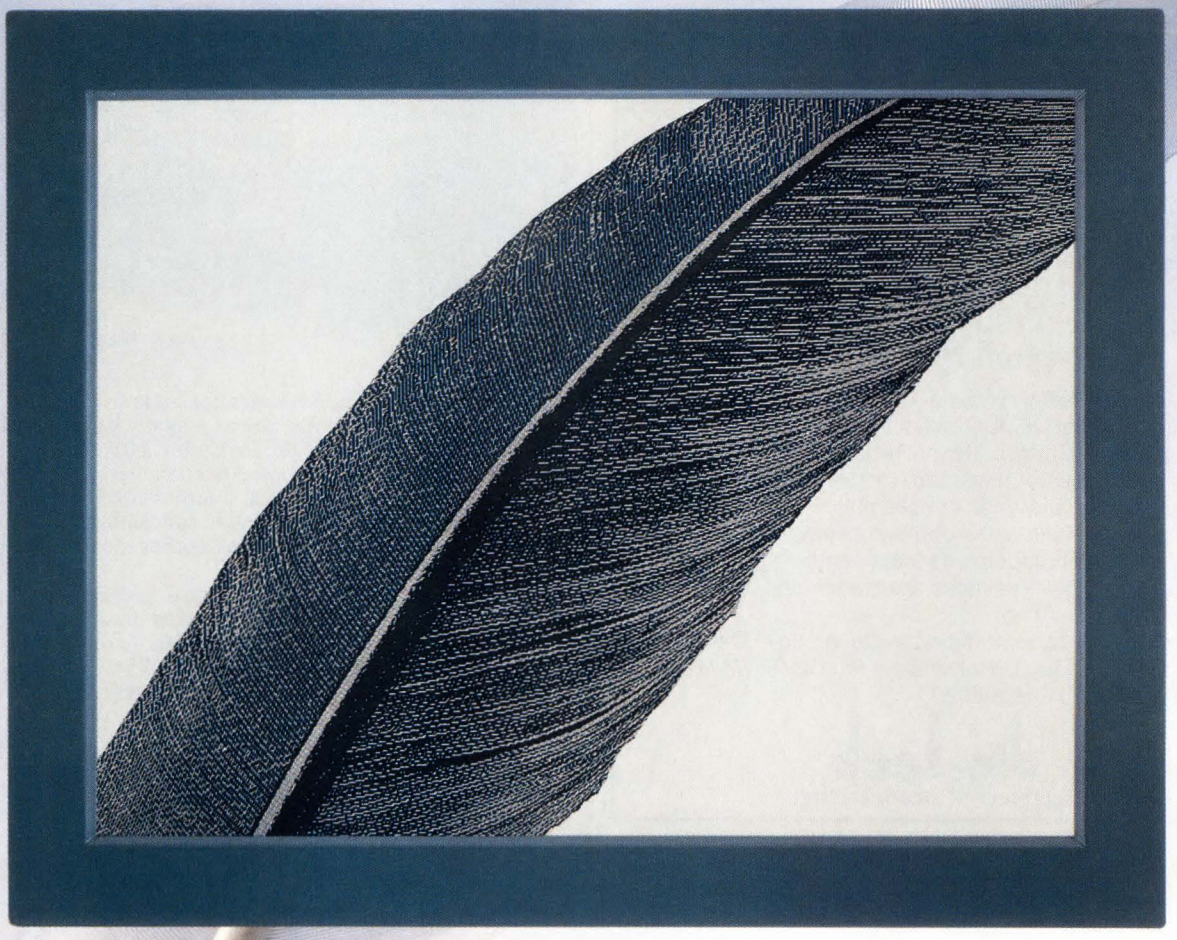

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CIRCLE NO 158

EDN PRODUCT MART

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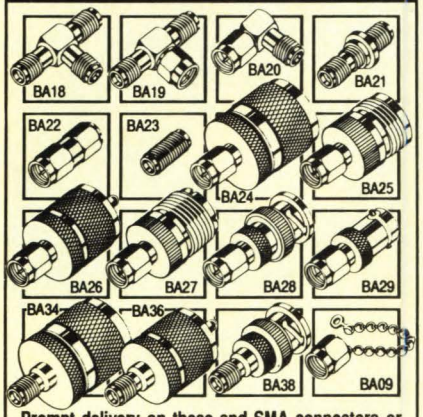

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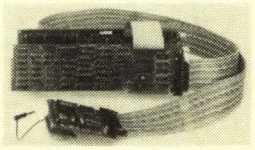
CIRCLE NO 325

68HC11

PC-based emulator for 68HC11



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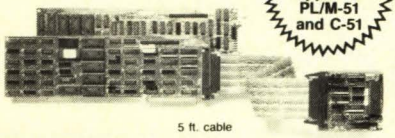
☆ ☆ ☆ ☆ "The Best 8051 Emulator"

NEW Source Level support for PL/M-51 and C-51



5 ft. cable

8051

See EEM 88/89 Page D-1304

PC based emulators for the 8051 family
(8051/51FA/52/31/32/44/152/451/452/535/552 + CMOS + more ...

- PC plug in boards or RS-232 box
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- Execution time counter
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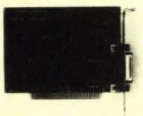

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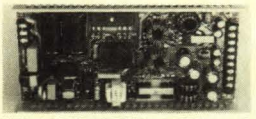

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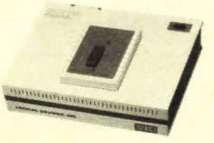

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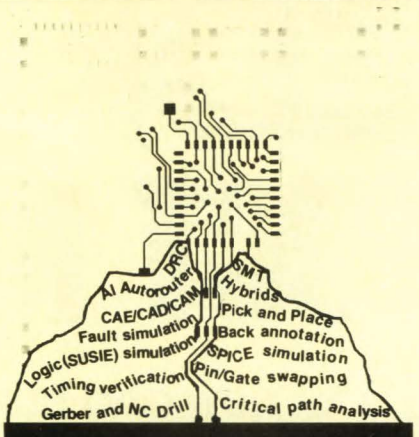

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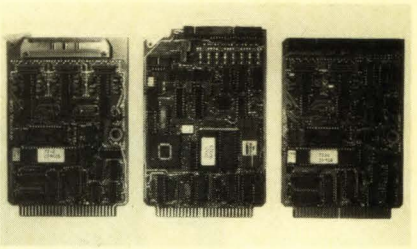

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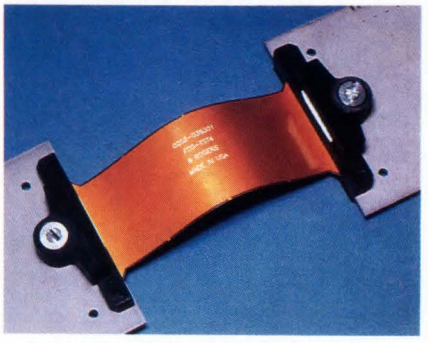

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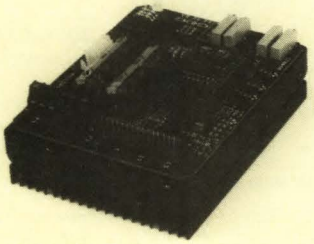

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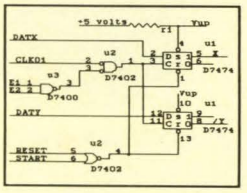

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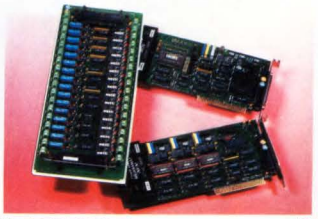

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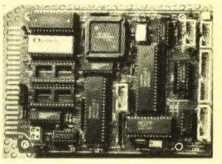

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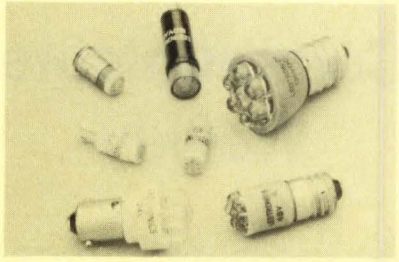

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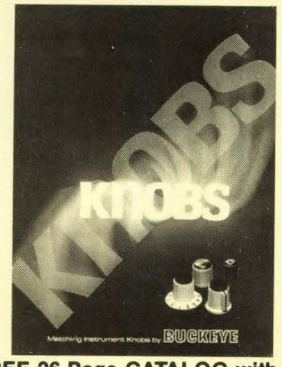

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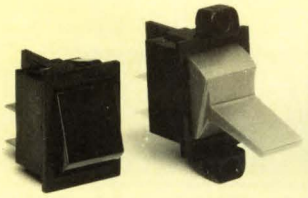

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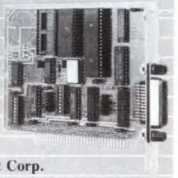

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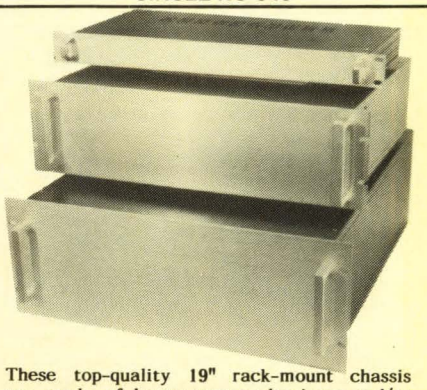

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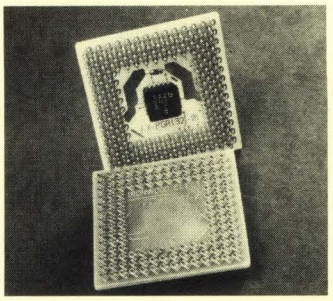

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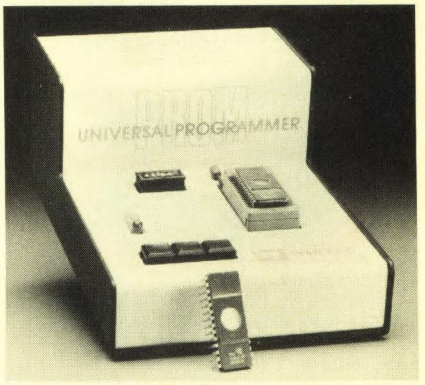

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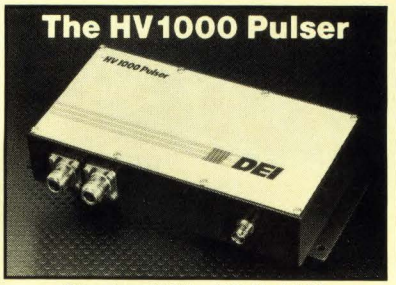

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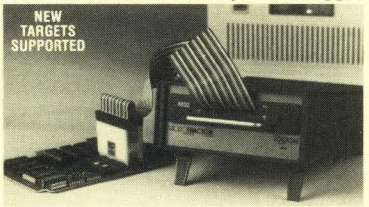

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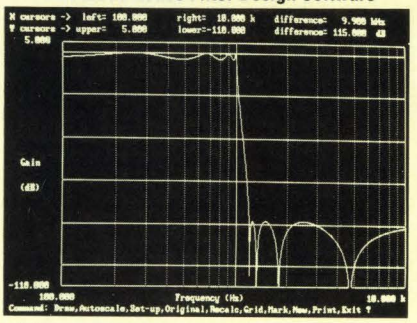

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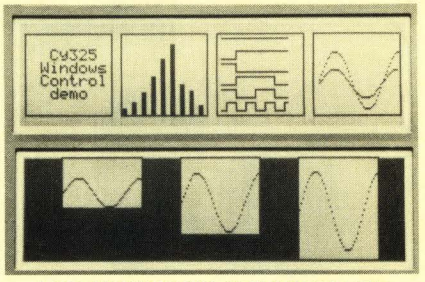

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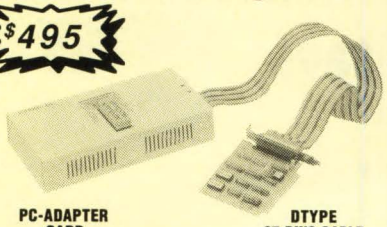

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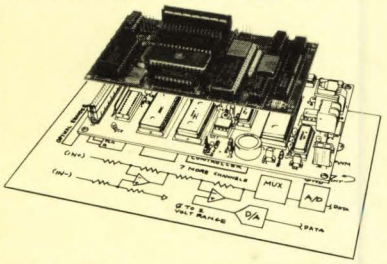

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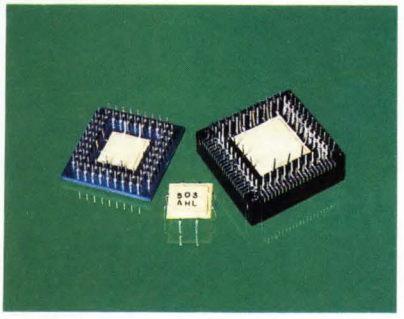

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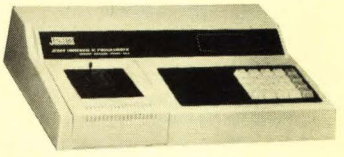

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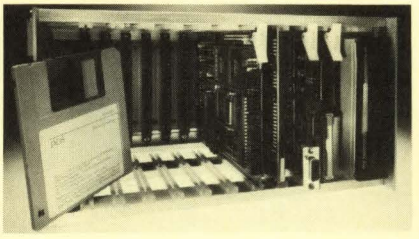

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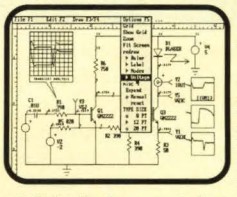

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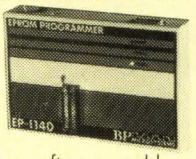

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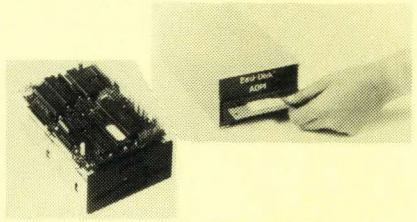

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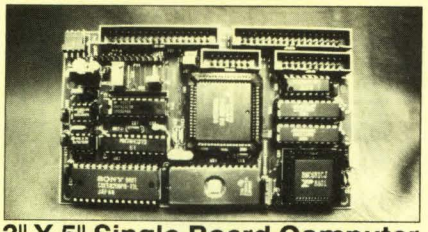

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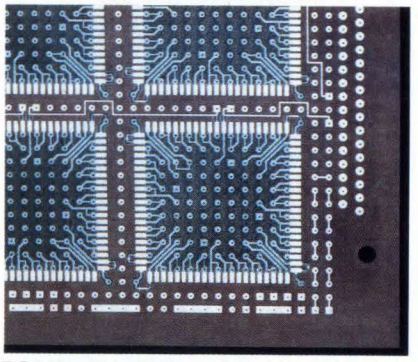

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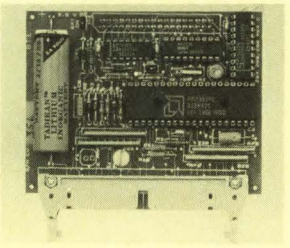

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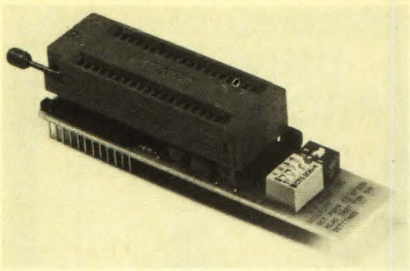

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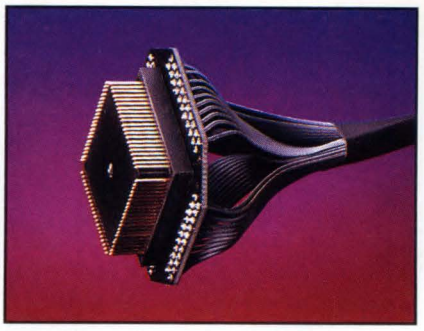

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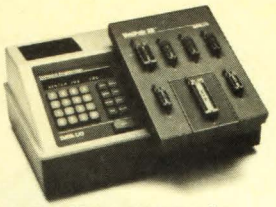

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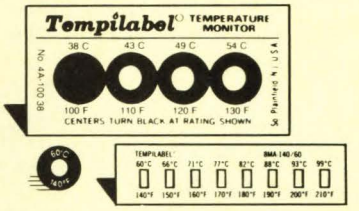

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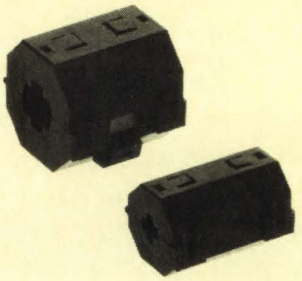

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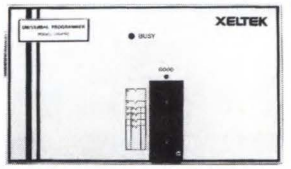

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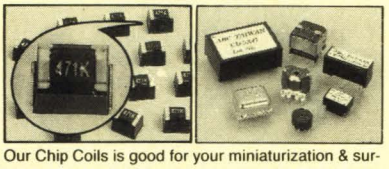

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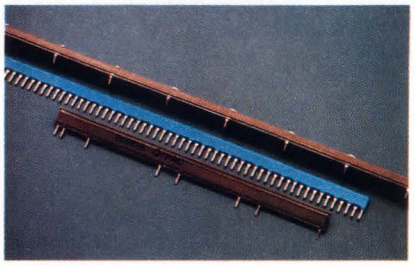

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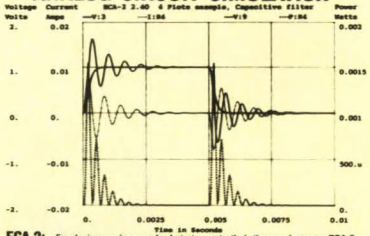

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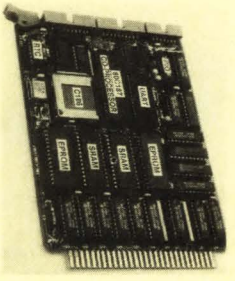

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EDN

Issue Date	Recruitment Deadline	Editorial Emphasis	EDN News Edition
July 20	June 29	Product Showcase — Volume II, Components	Closing: July 21 Mailing: Aug. 10
Aug. 3	July 13	Integrated Circuits, Computer Boards	
Aug. 17	July 27	Military Electronics, Special Issue Military Software	Closing: Aug. 4 Mailing: Aug. 24
Sept. 1	Aug. 10	Test & Measurement, Integrated Circuits	Closing: Aug. 18 Mailing: Sept. 7
Sept. 14	Aug. 24	Industrial Product Showcase, Digital ICs	Closing: Aug. 30 Mailing: Sept. 21
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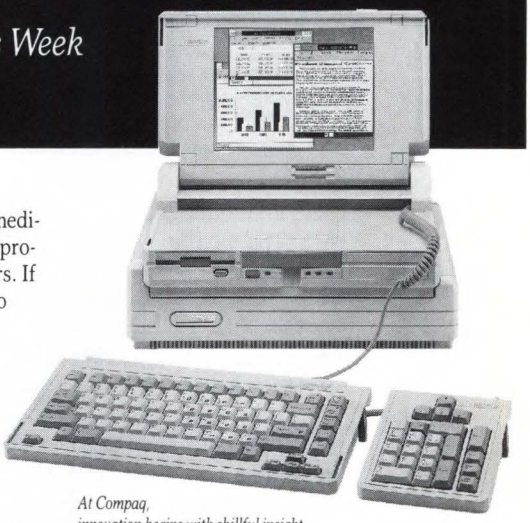

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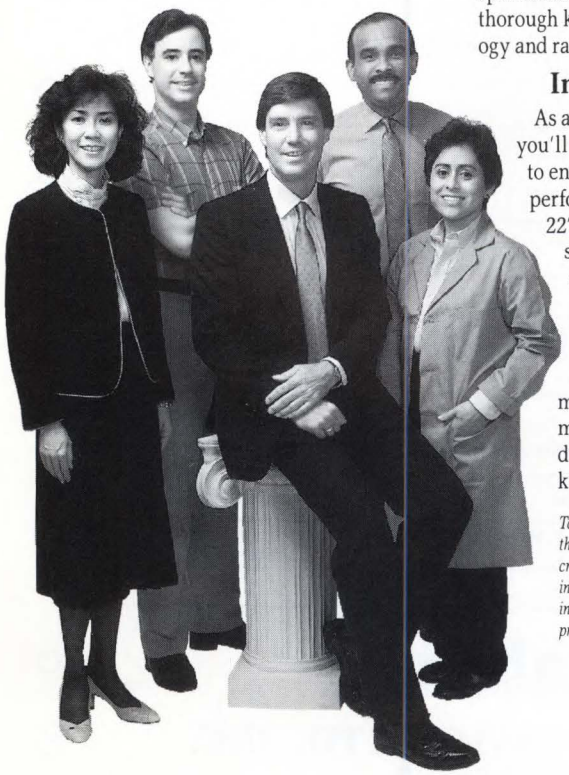

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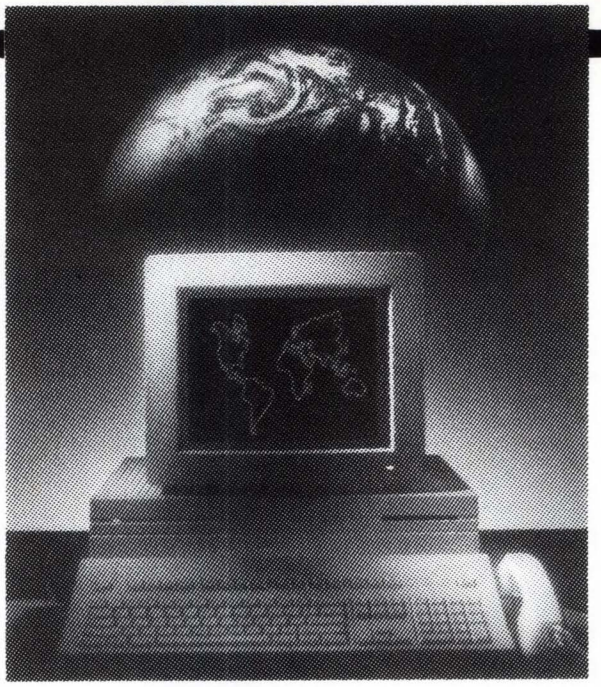

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"I'm not a writer who writes about engineering; I'm an engineer who writes."

Anne Swager, EDN Magazine Edition Associate Editor

Anne's been reading EDN since she became an electrical engineer. And as an engineer, she has always counted on EDN to keep her up to date on new products and technology in the electronic markets. "As an engineer, I found myself always focusing on one project. I read EDN to find out what was going on in other areas of electronic engineering. Becoming a technical editor gave me greater exposure to the entire spectrum of electronics."

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EDN Magazine Edition / News Edition

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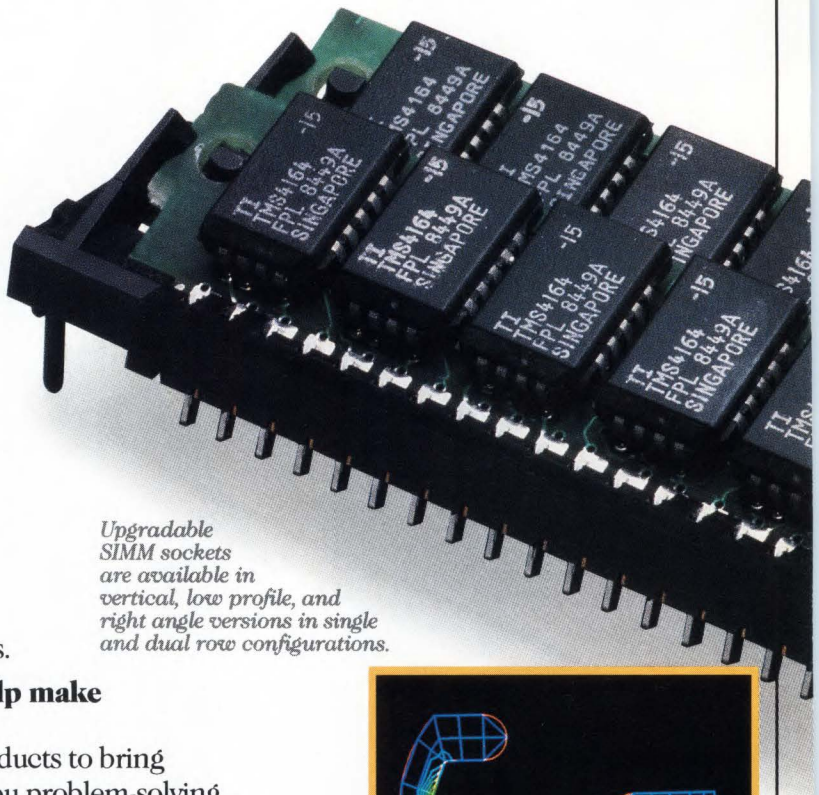

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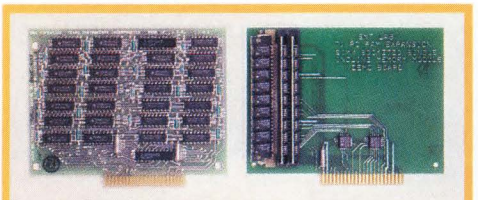
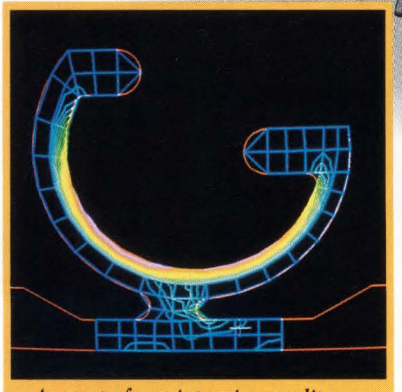


Molex SIMM socket (right) takes up dramatically less board space than DIP packaging (left).



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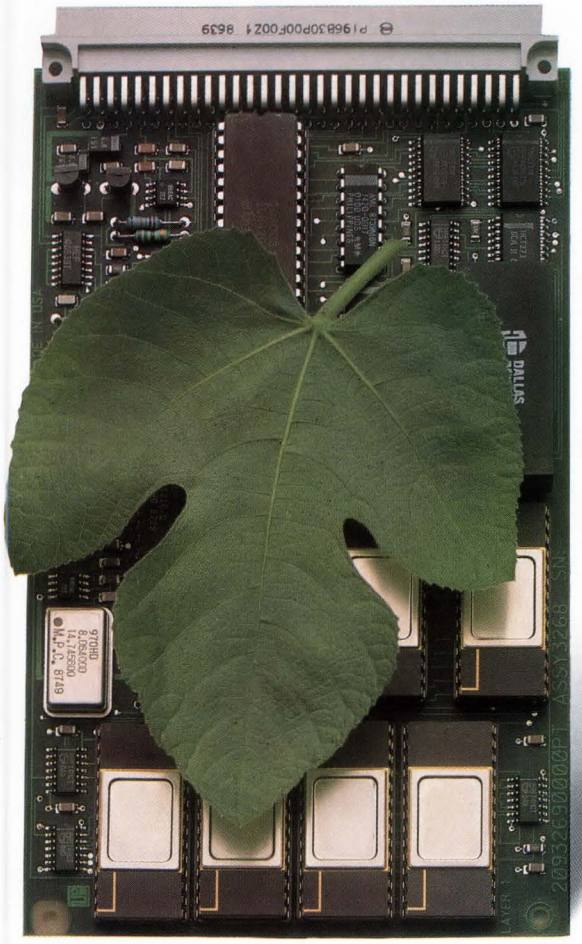


V.32

Stripped to the Bare Essentials

ONE EUROCARD is all it takes to accommodate the fully featured V.32 data pump from Universal Data Systems.

The device is a *true* V.32. It is fully compliant with the CCITT standard for 9600 bps, full-duplex data communications. It operates on dial-up, two-wire private or four-wire private circuits. It handles synchronous or asynchronous data. It offers auto dialing through the AT command set, auto answer and adaptive line equalization. To preserve data integrity under degraded line conditions, it even has a trellis coded mode. An impressive set of diagnostics is also on board.

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.

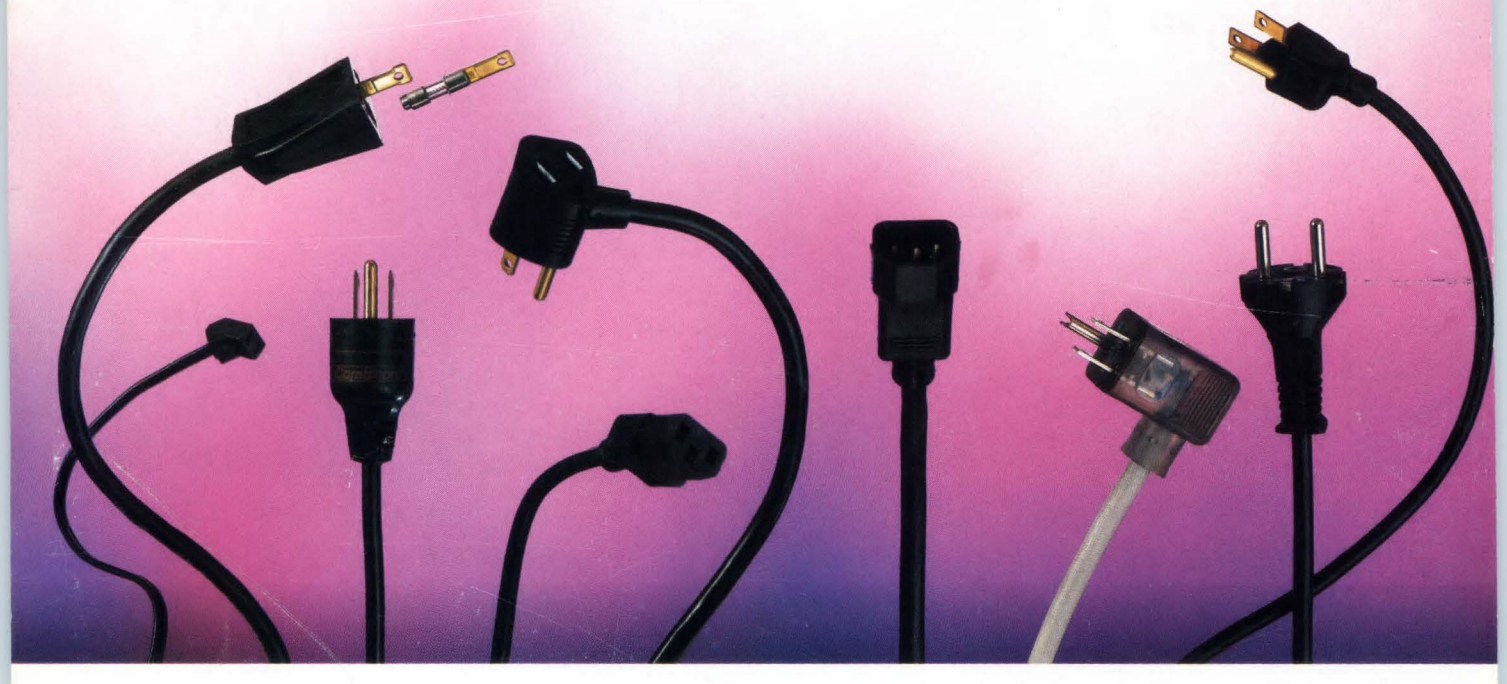
Universal Data Systems

MOTOROLA INC.

Created by Dayner/Hall, Inc., Winter Park, Florida

CIRCLE NO 161

BELDEN REDEFINES POWER CORD TECHNOLOGY



NEMA 1-15 with Molded-In Field Replaceable Fuse, top

NEMA 5-15P Add-A-LIne Plug, top

IEC-320-C14 Shrouded Jumper, top

NEMA 5-15P Plug, top

SPT Cooling Fan Cord, bottom

Filtered Power Supply Cord, bottom

IEC-320-C13 Connector, bottom

NEMA 5-15P Hospital Grade Plug, bottom

European Cord with CEE 7 Std. Plug, bottom

Innovation drives market applications, and those who supply today's manufacturers must themselves be committed to innovation. Belden's understanding of this can be seen in its industry standards — standards it continues to set today.

Belden offers one of the industry's broadest lines of power supply cords. Our standard product offering includes:

Belden innovation brings product designers a broad range of cost-effective cords

- OEM Power Supply Cords
- Special Purpose Power Supply Cords
- Extension Cords
- International Power Supply Cords
- Portable Cordage
- Receptacles

Available with a large variety of design options—including the industry's most advanced array of shielding options and jacketing materials—Belden® power supply cords are tailored to your specific application. In everything from life support systems to personal computers, Belden cords are specified because of outstanding performance.

For those who market their products worldwide, our international power cords make it easy to comply with international standards. Our Custom Design Center specializes in developing cords for new and unusual applications, and our OEM Sales Staff is prepared to serve all your needs. And, as always, the quality of our standard domestic product is unsurpassed.

For more information on Belden power cords, call or write for the Belden Master Catalog. Your need for innovative options makes it an essential tool.

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