A question for designers who aren’t yet using high-performance \(\mu\)PLDs.

Why the big delay?

Ever feel like your system designs aren’t quite up to speed, so to speak? It’s probably not your fault. Because PLDs have typically forced designers to sacrifice performance to achieve higher integration. But not any more.

Now, with Intel’s \(\mu\)PLD family of programmable logic devices, you can finally achieve the higher integration you need—with the low total propagation delay you want.

In fact, with total propagation delay as low as 10ns, Intel’s 16-macrocell 85C060 and 24-macrocell 85C090 are, without question, the fastest integrated PLDs in the industry.

So what are you waiting for? Call (800) 548-4725 and ask for Literature Packet #IA81.

We’ll send you everything you need to know about how to improve system performance. Without delay.

\(\mu\)PLD Performance

<table>
<thead>
<tr>
<th>PLD</th>
<th>(t_{PD})*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intel 85C060</td>
<td>10ns</td>
</tr>
<tr>
<td>PALCE610</td>
<td>15ns</td>
</tr>
<tr>
<td>20RA10</td>
<td>15ns</td>
</tr>
<tr>
<td>EP610</td>
<td>16ns</td>
</tr>
<tr>
<td>Intel 85C090</td>
<td>15ns</td>
</tr>
<tr>
<td>EP910</td>
<td>33ns</td>
</tr>
</tbody>
</table>

*Propagation Delay

© 1991 Intel Corporation. All product names are trademarks of their respective owners.
ALLPRO-88™ Universal Software Driven Device Programmer
Supports Virtually Every Device On the Market!

Logical Devices offers you a truly pin driven "DAC-Per-Pin" programmer with electronic ground and Vcc, 4MHz clock, current mode source, high-speed programmable slew rate, and up to 10 amps of peak current on each pin.

All of this from a 24 pin version with logic configuration. Easily field upgradable to 88 pins. Supports the latest of low to high-pin count devices such as the AMD Mach and Altera Max devices, National "D" PALS, Signetics PLHS Series and other devices your current programmer cannot program!

Supports programming, verifying, and functional testing for PLDs, EPLDs, GALs, PALs, PROMs, EPROMs, EEPROMs, FPGAs, LCAs, MAX, MACH, ASPL, P-Sequencers, and FPLAs.

ALLPRO is certified by key semiconductor manufacturers to provide excellent programming yield and reliable operation.

No copy protection in ALLPRO-88 software and updates. Buy one copy for all your units. Updates are complete and comprehensive, each version includes all supported devices.

ALLPRO-88 is supported by CUPL®, the world's most popular logic design software, with high level behavioral hardware language (CHDL), multiple PLD design, ATVG and simulation capability.

If all of this gives you an upset stomach over your Data I/O® investment, then call us for a FREE DEMO and a generous trade-in offer.

1-800-331-7766

LOGICAL DEVICES, INC.
1201 NW 65th Place
Fort Lauderdale, FL 33309
Fax: (305) 974-8531 Phone: (305) 974-0967

* Quoted price for US delivery only, F.O.B. Fort Lauderdale, FL.

The brands or product names mentioned are trademarks or registered trademarks of their respective holders.

© 1996, Logical Devices Inc.

Circle No. 2
Recently, the purchasing experts at several hundred of the world's largest electronics companies were asked by Dataquest, a leading international research firm, to rate semiconductor suppliers. The rating applied to the very specific and demanding areas of price, on-time delivery, quality, technical support and attention to customer service.

Of all the mid-size suppliers these people could have chosen as best in all five areas, one company consistently came out on top — Analog Devices.

We're proud of that, and of the Dataquest Globe that symbolizes being named Supplier of the Year.

But we're not resting on our laurels. We're working just as hard as ever to keep our customers happy. Because after all, they mean the world to us.
Our new function generator has all the bells and whistles.

In fact, it has any kind of waveform you can imagine. Because the Model 95 combines a high performance function generator with a powerful arbitrary generator.

As a function generator, Model 95 produces remarkably pure square waves, triangles and sines, from 1 mHz to 20 MHz with synthesized accuracy up to 0.001%. It has the power to output 15 Vp-p into 50Ω, and includes sweep, pulse and modulation modes plus four user-selectable output impedances. There’s even an internal trigger generator for trigger, gate and burst.

If you’d rather be arbitrary, Model 95 gives you up to 128k of waveform memory to work with, and a sample rate of 20 MHz. Four different editing modes help you produce even the most complicated waveform shapes quickly and accurately, while analog and digital filters allow you to create the purest output possible.

For information about all the other bells and whistles you’ll find on the Model 95, call Wavetek San Diego, Toll Free at 1-800-874-4835 today.
What do p-channel load switches give battery powered systems?

LIFE
EVERLASTING

Life everlasting. Well, not quite. But it may seem that way to users of your battery-powered system.

Double battery life during normal operation! And increase it by 1000% (ten times) in standby mode! How? With Siliconix' Si9405 load switches. Devices that let you shut down unneeded sections of your system. Now you can turn off the display, disk drive, internal FAX/modem, coprocessor, extra memory, transmitter and other analog functions when they are not in use. Then activate them instantly from your standby mode.

Added value. This improved power management empowers your system with (almost) life everlasting. It's a compelling competitive advantage that will significantly increase your product's market share and profit margin.

LITTLE FOOT™ packaging. The 5-V logic compatible p-channel Si9405 has an incredibly low 120-mΩ on-resistance that allows simple switching of high currents. And it comes in a space-saving LITTLE FOOT SOIC 8-pin package — assuring your portables will be truly portable, your laptops lap-size, and your notebooks notable. Other small footprint solutions are listed below.

### Siliconix P-Channel & N-Channel Load Switches

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>On-Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Si9400DY</td>
<td>Single P-channel, 250 mΩ</td>
<td></td>
</tr>
<tr>
<td>Si9405DY</td>
<td>Single P-channel, 120 mΩ</td>
<td></td>
</tr>
<tr>
<td>Si9953DY</td>
<td>Dual P-channel, 2 x 250 mΩ</td>
<td></td>
</tr>
<tr>
<td>Si9956DY</td>
<td>Dual N-channel, 2 x 100 mΩ</td>
<td></td>
</tr>
<tr>
<td>SMP60N03-10L</td>
<td>Single N-channel TO-220, 10 mΩ</td>
<td></td>
</tr>
</tbody>
</table>

These SO-8 IC devices can be driven directly by 5-V logic. This SO-8 IC device is ideal for higher current loads. A great solution for switching between batteries.

Get more compact and power-saving designs! Call our toll-free hot line now. 1-800-554-5565, Ext. 960. Ask for our “Power Management” Design Kit. And remember, at Siliconix we're committed to achieving a seamless interface between the power and digital worlds.

Siliconix
2201 Laurelwood Road, Santa Clara, CA 95056

© Copyright 1991 Siliconix, LITTLE FOOT is a trademark of Siliconix
DESIGN FEATURES

Hardware and Interconnect Devices

High-density connectors solve tough pc-board interconnect problems

The high signal speeds and tight packing densities found in today's active components would be of little value without the interconnect technology to support them. Novel connector designs let system designers take advantage of the improvements in today's components.—Tom Ormond, Senior Editor

Integrated Circuits

Neural-network IC architectures define suitable applications

Neural-network technology offers promise in embedded applications. The varied architectures of neural-network ICs, however, limit the type of embedded applications any of the individual ICs best suit.

—Maury Wright, Regional Editor

Power Sources

Specialized ICs correct power factor in switching supplies

To meet upcoming standards, power supplies will need to use a form of power-factor correction. Designers are using integrated circuits specifically dedicated to minimizing the percentage of harmonics in the line current.—Dave Pryce, Associate Editor

Software

Development tools accelerate Windows 3.0 software development

Microsoft Windows 3.0 has rocketed into personal-computing history. A number of companies offer tools to help you make your application software soar within Windows' graphical user interface.—J D Mosley, Regional Editor
TAKE THE SPEED LEAD.

**PAL™ 22V10: 7.5ns.**

**World’s fastest programmable 22V10.**
Here is the logic for high-performance systems running up to 111 MHz. Set-up is just 3 ns. Fast logic for fast systems. You get the same high speed and low noise with the 22VP10. It offers additional flexibility, including an I/O feedback path to accelerate state machine applications.

**BiCMOS.** The first BiCMOS 22V10, from the company that delivered the first CMOS 22V10. ECL core path for record-setting performance. CMOS logic outside the speed path, for low power. The speed of smaller PLDs, the convenience of the popular, flexible 22V10 and field programmable too.

**Broad 22V10 PLD family and more.** Cypress's 15 ns CMOS 22V10 consumes less power than any electrically erasable alternative. It's just one of a broad range of low-power CMOS PLDs. Also get 28-pin applications-tailored PLDs, and our high-capacity MAX™ PLDs too.

Call Today. Order our PLD Kit and we'll ship it right away. Why wait?

**Hotline: 1-800-952-6300.** Ask for Dept. C4Q.
PRODUCT UPDATES

Motif-based Ada development system 49
Voltage-controlled amplifier with 118-dB range 51
VHDL-based design software 52
Spice-based tools for chip and board analysis 56

PRODUCT REVIEWS

Hardware and Interconnect Devices 73
Fiber-optic links, wire, cable, connectors, pc boards, enclosures, cooling devices.

Integrated Circuits 93
Microprocessors, RAMs, ROMs, power transistors, all monolithic function chips.

Power Sources 117
All types of power supplies, including batteries.

Software 143
Many types of software, from system to application packages.

DESIGN IDEAS

Ordinary DMM measures high resistances 165
Increased feedback stabilizes amp 165
Amplifier becomes glitch-free clipper 166
Program derives function from netlist 168
Feedback and Amplification 168

LITERATURE

Components 175
Computer-Aided Engineering 176
Computers & Peripherals 178
Instruments 180

DEPARTMENTS

News Breaks 17
Signals & Noise 29
Ask EDN 37
Editorial 43
Career Opportunities 189
EDN’s International Advertisers Index 195
The 90 Nanosecond Workout
An Exhaustive Look At High Tech Training Equipment

Virtual Reality
Close But No Cigar

PAGE 2B

PAGE 8H

FANTASTIC FL

AMD Ships 2 PLCC Flash

SUNNYVALE — The computer industry takes a giant leap forward in performance with the help of the new Flash memory family from Advanced Micro Devices, Inc. Flash memory is a high-density, reprogrammable, non-volatile technology that has a bright future in computation, laser printers, network and telecommunications hardware. Many military systems use Flash technology in radar and navigational applications. Flash memory also has the potential to eliminate mechanical hard disks and the need for cumbersome batteries. These are some of the biggest and heaviest obstacles in laptop and notebook computer applications.

Today, Flash memory is the most cost effective replacement technology for UV EPROMs and EPROMs in applications that require in-system programming. Flash memories can literally be reprogrammed in a flash — hence the name.

Standard, But With A Little More Flash
AMD’s Flash memory family effectively etches in silicon the de-facto standard for this burgeoning technology that is compatible with Intel’s initial Flash architecture. Because AMD Flash memories are pin-for-pin compatible with the now standard architecture, AMD is positioned as an alternate source for design engineers and purchasing agents alike:

“Alternate source may be an inadequate term,” said Jerry Sanders, chairman and CEO of Advanced Micro Devices. “Given our speed and feature set, our customers think of us as a superior resource.”

Indeed, AMD’s Flash memory family offers designers significant performance advantages (see chart), with speeds almost twice as fast as the nearest competitor.

How Fast Is A Flash?
A Direct Comparison

<table>
<thead>
<tr>
<th>Density</th>
<th>AMD</th>
<th>Fastest</th>
<th>Competitor</th>
</tr>
</thead>
<tbody>
<tr>
<td>256K</td>
<td>90ns</td>
<td>120ns</td>
<td></td>
</tr>
<tr>
<td>512K</td>
<td>90ns</td>
<td>120ns</td>
<td></td>
</tr>
<tr>
<td>1 Mbit</td>
<td>90ns</td>
<td>120ns</td>
<td></td>
</tr>
<tr>
<td>2 Mbit</td>
<td>90ns</td>
<td>150ns</td>
<td></td>
</tr>
</tbody>
</table>
Stop the presses!

Advanced Micro Devices makes big news again—this time with an enhanced family of Flash memory devices.

That's good news for veteran and new Flash users alike.

Because our Flash devices are pin-for-pin compatible with Intel's existing Flash memory architecture, they establish the *de facto* industry standard.

Our standards, however, are a bit higher.

And so are yours.

That's why our Flash Memory family offers densities, speeds and packaging options that improve performance and save board space. For instance, our advanced 2 Mbit PLCC part with a scant 90 nanosecond delay.

You can also choose from Flash devices in 256K, 512K and 1 Mbit densities. As well as packaging options that fit your design best, including CDIP, PDIP, LCC, TSOP, and PLCC.

And you'll find implementation faster and easier than ever, because we've included automatic programming algorithms on all our 2 Mbit devices, and soon on our 1 Mbit parts, too. So you'll spend less time writing code, and take less time getting products to market.

To keep up to date with all the latest and greatest in Flash memory, call AMD today at **1-800-222-9323**. And start making some headlines of your own.

---

**FOOD**

**Chips And Salsa**

A Business Person's Guide To Silicon Valley Restaurants

**ASHES!**

Megabit, 90ns, Memories

The AMD Flash family offers designers and purchasers many packaging options. Particularly popular is AMD's advanced 2 Megabit PLCC part. Other packaging options include PDIP, CDIP, and LCC in 256K, 512K, 1 Mbit and 2 Mbit capacities. TSOP packages will be available in the second half of this year. (LCC not currently available in 2 Mbit.)

AMD's 2 Mbit Flash memories come complete with embedded program and erase algorithms on board. These automatic algorithms speed the design process and considerably shorten time to market. Previously, engineers were required to develop tedious and time-consuming algorithms to implement in-system reprogrammability. AMD's automatic algorithms also allow several Flash memories to be written or erased at once, without tying-up the CPU. The system is now free to perform other tasks while these operations are in progress. AMD plans to include embedded algorithms in a future release of its 1 Mbit part.

**The Ultra-Violet Blues**

Flash technology is particularly suited to applications requiring reprogramming in place, because these devices can be reprogrammed in seconds, and within the system.

To update the code on a UV EPROM, the part must first be removed from the system. Once removed, the device can take up to a full 20 minutes. After reprogramming, the part is then plugged back into the system. The process can result in damage to other components, costly service calls, and headaches.

Flash memories, on the other hand, can be bulk erased in about one to two seconds, without system disassembly. Reprogramming can then be accomplished via floppy disk, over phone lines, or even ISDN (continued)
OUR CLASSIC™ EPLDs CUT

They also cut your product costs, with prices low enough to impact your bottom line.

As for logic delays, we've cut them down to a remarkably low 12ns.

So now you can cut something from your design: PALs and GALs. Because our Classic parts give you a combination of speed, density and flexibility you won't find in other PLDs.

All of which helps you cut the time it takes to produce a superior design.

For example, our 20-pin, 8-macrocell EP330 is the perfect replacement for over 20 types of PALs and GALs. It stretches counter frequencies to 125 MHz while sipping one-fourth the power of a standard PAL. And its quiet output switching circuitry allows the EP330 to run faster in-system than a 10ns 16V8.

Our 24-pin, 16-macrocell EP610 delivers 60% more logic density than a 22V10. And unlike a 22V10, the 15ns EP610 consumes a mere 20μA in standby. And its registers
can be programmed for D-, T-, JK- or SR-operation or for asynchronous clocks.

To replace multiple PALs and GALs with a single chip, try our 44-pin EP910 or 68-pin EP1810. Both offer superior logic density and greater I/O at a lower cost than any other mid-range CMOS PLD.

Our Classic EPLD family also helps you get to market faster. Thanks to a host of powerful logic development tools from Altera and third parties.

What's more, we offer the industry's broadest, most flexible line of CMOS PLDs. With devices ranging from 20 to 100 pins, and logic densities from 8 to 192 macrocells, there's an EPLD for every logic design task.

So call Altera today at (408) 984-2800 for more information. And discover programmable logic that's a cut above the rest.

And, for the fifth consecutive year, Conner is delivering a generation ahead of the competition. Helping major OEMs get new systems to market faster than they ever dreamed possible.


Before we design or build a product, our engineers work closely with the most respected experts in the industry—our customers. By asking the right questions, we identify specific needs. Sooner. And fill those needs with the right products. Faster.
OUR CUSTOMERS COULD DREAM UP.

So it's no surprise that more of the world's leading OEMs work with Conner. Because we consistently design the exact disk drives our customers need. Then build those drives—in volume.

Keeping You A Generation Ahead.

The results of this unique sell-design-build strategy have been remarkable. Using proven technologies, our high-performance 3.5-inch and 2.5-inch disk drives continuously set the standards. For all major segments of the market.

The fact is, Conner delivers disk drives for today's powerful systems. From high-end workstations and file servers to desktop, laptop and notebook PCs.

And Conner has sales offices and manufacturing facilities in Europe, Asia and America. Keeping us close to our customers around the globe.

So call Conner today. And we'll work together to turn your dreams into realities.
How Orbit's Forests
Out of IC Development
Foresight Takes the Bite Out of Mixed Signal IC Design.
Partition your analog/digital ASICs—and separately design and verify critical segments through fabrication—with Tiny Chips. You'll dramatically reduce NRE costs and move confidently and quickly from prototypes into production.

Foresight Makes Silicon Affordable.
Lower your ASIC development costs with Foresight, the multi-project wafer service with guaranteed quick turnaround.

Foresight is Available:
- In 36 different CMOS Processes
- With feature sizes down to 1.2 microns
- CCD Processes

Take the Bite Out of Mixed Signal IC Design.

Ready. Set. Fab.
Foresight runs start every two weeks, so you can meet even the tightest deadlines—whatever your design rules.

Foresight Run Schedule: 1991

<table>
<thead>
<tr>
<th>April</th>
<th>May</th>
<th>June</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr 10, 24</td>
<td>May 8, 22</td>
<td>Jun 5, 19</td>
</tr>
<tr>
<td>Jul 3, 17, 31</td>
<td>Aug 14, 28</td>
<td>Sep 11, 25</td>
</tr>
<tr>
<td>Oct 9, 23</td>
<td>Nov 6, 20</td>
<td>Dec 4, 18</td>
</tr>
</tbody>
</table>

Save Time and Money.
Call Orbit Semiconductor for the information you need to get started. Contact Technical Marketing, Orbit Semiconductor, 1230 Bordeaux Dr., Sunnyvale, CA 94089. Or call (408) 744-1800 or (800) 331-4617. In CA (800) 647-0222. Fax (408) 747-1263.

A subsidiary of Orbit Instrument Corporation.

What others promise, we guarantee.

CIRCLE NO. 9
MicroSim Corporation now offers a versatile schematic capture front end, called Schematics, to our popular Circuit Analysis programs, PSpice and Probe. Schematics provides a unified system for designing and editing schematics, running analyses using PSpice, and viewing the results using Probe, all without leaving the Schematics environment. Any mix of analog and digital components can be used when defining a schematic for simulation.

Schematics provides a menu-driven interface for specifying analysis parameters and running simulations directly from the schematic display. If device simulation parameters need adjustment after running a simulation, they can be easily modified and the simulation rerun. Netlists for PSpice are generated automatically and can be examined on the screen.

Schematics was designed and written as a native Windows 3.0 application for the PC and is also available as an OpenWindows application for the Sun-4 and SPARCstation. Both packages include the Schematics library with symbols for all parts contained in the PSpice libraries—over 3,500 analog and 1,500 digital components. An integrated symbol editor with full editing capability allows new symbols to be created and new part attributes to be defined while working on a schematic.

Schematics is sold as part of the Genesis package and comes with MicroSim Corporation’s extensive customer/product support. Our expert engineering team is always on hand to answer your technical product questions.

For further information on Schematics, or any other MicroSim Corporation product, call toll free at (800) 245-3022 or FAX at (714) 455-0554.
ALGORITHM SPEEDS DISCRETE-COSINE TRANSFORM

Ricoh Corp's California Research Center has developed an efficient algorithm for calculating the discrete cosine transform (DCT) required by some image compression standards. The algorithm, called the generalized Chen transform (GCT), takes advantage of symmetries found in trigonometric functions to reduce the number of multiplication steps required in the DCT calculation. Current algorithms require about 150 multiplications to transform an 8 x 8 data block. The new algorithm requires only 64.

By reducing the number of multiplication steps required, the DCT can speed software implementations of DCT-based image-compression standards and can reduce the silicon area required by hardware implementations. The company will use the algorithm in its image-handling products, but is also interested in licensing the technology. Contact Ed Onstead at (408) 281-1436. Ricoh Corp, West Caldwell, NJ, (201) 882-2000, FAX (201) 882-2506.—Richard A Quinnell

COUPLER CREATES CELLULAR RJ-11 TELEPHONE JACK

The Datacell cellular-phone coupler from Zirco gives wireless freedom for the cellular-telephone network through a variety of remote data and fax applications. The coupler fits between a portable-cellular-phone's handset and base unit. It furnishes an RJ-11 jack, which is compatible with conventional telephone equipment, including data modems and fax machines. The $299.95 coupler operates at data rates to 9600 bps. Like conventional telephone connections, the actual data rate depends on the cellular connection's noise level. The company offers cables that adapt the product to a variety of cellular phones. Zirco Inc, Wheat Ridge, CO, (303) 421-2013, FAX (303) 423-8346.—Steven H Leibson

DSP CHIP HAS BUILT-IN COMPLEX MATH FUNCTIONS

Sharp Electronics Corp joined the ranks of DSP-chip vendors with its fixed-point LH9124. The $700 chip's instruction set provides for built-in, real and complex FIR-filter operations, various radix-butterfly operations, windowing, and other DSP functions. The device's instruction set also lets you program scalar and vector operations. The chip supplies four independent data buses that operate with real and complex data. You can control the buses' widths from 8 to 24 bits for each of the real and imaginary data lines. All of the buses are bidirectional. The company separates the buses into two data buses, a coefficient bus, and an acquisition bus. The chip is available in sample quantities.

The manufacturer expects to offer a $70 (sample) companion DSP address-generator chip, the LH9320, later this year. The address generator will supply 155 preset address patterns for DSP implementations of FFTs, FIR filters, FFT data separations, decimations, and circular buffers. The chip will also furnish general-purpose addressing operations. Sharp Electronics Corp, Camas, WA, (206) 834-8700, FAX (206) 834-8611.—Jon Titus
CHIPS SIMPLIFY ENCODER INTERFACES

Four ICs from LSI Computer Systems provide simple interfaces for optical and magnetic encoders. The $1.40 (1000) LS7083 and LS7084 derive quadrature clock signals from encoders and provide a complete interface between the encoder and an up/down counter. The chips can produce one or four clocks per quadrature cycle. The $1.60 LS7082 provides quadrature clock conversion and index support for absolute count reference. All three chips have a maximum output frequency of 16 MHz. The $5.40 LS7166 combines the functions of a quadrature clock converter with a 24-bit multimode, 20-MHz counter. The counter has an 8-bit, 3-state output bus. Both chips can produce 1, 2, or 4 clocks per quadrature cycle. LSI Computer Systems, Melville, NY, (516) 271-0400, FAX (516) 271-0405.—Doug Conner

GATE-ARRAY FAMILY ALLOWS CUSTOM-RAM ARRAY ON DIE

The LEA200K family from LSI Logic combines standard-cell and gate-array techniques to bring high-density memory to gate arrays. You define how much memory your ASIC needs, then the company develops a custom gate-array masterslice for you. You get the memory density of a standard-cell ASIC with the production benefits of a gate array. Because your logic is in the gate-array section, you can make changes to your design by changing only the metal mask.

The family uses a 0.7-µm CMOS process with either 2- or 3-layer metal. You use the 2-layer metal to save costs if your design is pad-limited, and the 3-layer metal for dense designs. The family’s design library includes a variety of CISC (complex-instruction-set computer) and RISC (reduced-instruction-set computer) CPUs, system clock de-skewing circuits, and 3.3V and JTAG-scannable I/O drivers. NRE charges begin at $75,000. LSI Logic Corp, Milpitas, CA, (408) 433-8000, contact Lynn Le.—Richard A Quinnell

BLACK AND WHITE SCANNERS CAN PRODUCE FULL COLOR

The $169 Cat Color Converter from Computer Aided Technology Inc can produce a digitized image with more than 16 million colors. You give the converter all the information it needs by making three passes over a color picture with any 4-in., black-and-white or gray-scale hand scanner. Snapping your scanner into the converter's 12 × 10.5 × 1-in. scanner guide ensures scanning accuracy by holding both the scanner and the picture in proper alignment. The guide includes three built-in color filters and a light source—you use a different color filter during each scanned pass to produce the red-green-blue components of the digitized image. This conversion package includes image-processing software that combines the three filtered scans into a single color image. You can adjust the scanned image’s color palette, brightness, and contrast, and then save the image as a .PCX or .TIF file for exporting into your paint, presentation, or publishing program. Computer Aided Technology Inc, Dallas, TX, (214) 350-0888, FAX (214) 904-0888, contact Jina Lee.—J D Mosley

SEMICUSTOM, SINGLE-BOARD COMPUTERS OFFER FLEXIBILITY

Ziatech’s Application Specific Automation Processor is an option if you can’t find the right off-the-shelf single-board computer (SBC) for your embedded control application. You can select among a list of core modules, peripheral I/O modules, and custom I/O modules for the board, instead of investing the time and money to develop a custom SBC. Because 90% of the board comprises modules from previously tested
Dale® is the partner you need to convert surface mounting from concept to reality. We can save you time by providing a wide range of functions from one proven source. This includes the industry’s most versatile choice of surface mounted thick and thin film chip resistors and resistor networks. Plus wirewound resistors, chip potentiometers, thermistors, inductors, transformers and oscillators.

Partnering with Dale gives you broad compatibility with automatic placement equipment and standard soldering methods, plus ship-to-stock capability assured by strong emphasis on statistical process control.

For complete information, call:
Thermistors: 915-592-3253;
Thick Film Resistor Networks,
CIRCLE NO. 11

EDN July 4, 1991
and proven designs, the risk associated with a new design is minimized. The board is designed around the STD Bus form factor and uses a 16-MHz NEC V53 µP for 80286 performance and code compatibility. You select the RAM, PROM, Flash EPROM, counters, timers, DMA channels, peripheral I/O modules, and other features you’ll need. The initial contract for development and delivery of 25 boards is $45,000. Delivery is 12 weeks, but prototyping cards let you begin software development before you have the first boards back. The semicustom product is aimed at users requiring a minimum of 500 SBCs per year. Typical costs are $500 to $800 per board. Ziatech Corp, San Luis Obispo, CA, (805) 541-0488, FAX (805) 541-5088.—Doug Conner

DEFLECTION-PROCESSOR IC SIMPLIFIES DISPLAY DESIGN

The TDA8102 deflection processor IC simplifies the design of multifrequency CRT displays by accommodating 15- to 100-kHz horizontal and 30- to 120-Hz vertical scanning frequencies. Voltage-controlled inputs control the free-running frequency, horizontal phase shift, vertical S correction, and output amplitude. Vertical S correction is independent of frequency. The IC is packaged in a 20-pin DIP and costs $3.04 (100). SGS-Thomson, Phoenix, AZ, (602) 867-6100, FAX (602) 867-6290.

—Steven H Leibson

BIT-SLICE I/O BOARD HANDLES MILITARY COMMUNICATIONS

Antares’s Series 4000 VMEbus I/O processor board uses a 32-bit processor designed with 10-MHz, AMD 2901-family, bit-slice ICs. The board hosts a piggy-back module that contains the microcode, transceivers, and sequencers necessary to implement a specific communication protocol. You can buy modules that support the MIL-STD-1553 Multiplexed Avionics Bus, and the MIL-STD-1397 Naval Tactical Data Systems’ type A, B, C, D, E, and F protocols. The board can act as a VMEbus master or slave, and can simulate military computers that cost more than $1 million. Delivery of the $3525 board is four weeks ARO. Antares, San Diego, CA, (619) 223-4311.

—Maury Wright

SUPERCOMPUTER PRICES TUMBLE

The C3 Series of air-cooled, Unix-based supercomputers from Convex Computer range from $350,000 (low end) to $8 million (fully loaded). The fully loaded C3800 is the first supercomputer to use GaAs chips—as many as eight 45,000-gate GaAs processors for 2G-flops peak performance. The midrange C3400 is a BiCMOS RISC (reduced-instruction-set computer) implementation of the GaAs supercomputer and has an 800M-flops performance max. Midrange prices range from $650,000 to $2 million. The low-end C3200 offers 90% of the throughput performance of a single-processor Cray Y-MP with a 200M-flops peak performance. Convex Computer Corp, Richardson, TX, (214) 497-4230, FAX (214) 497-4848, contact Donna Burke.

—J D Mosley

CONVERTER BOARD TRANSFORMS RS-232C INTO RS-485

The $75 PC-485 serial converter from Octagon Systems changes an RS-232C port into an RS-485 serial port. The resulting benefits include an extension of the RS-232C port’s 50-ft range to 4000 ft and the ability to bus as many as 32 units on one multidrop network. The board measures 2.55×2.1 in. and requires 9 to 15V dc. Octagon Systems Corp, Westminster, CO, (303) 430-1500, FAX (303) 426-8126.

—Steven H Leibson
The tide is turning. More and more people are washing their hands of ordinary memories and looking to SGS-THOMSON for EPROMs and EEPROMs.

One big reason: our new King Size 4 Megabit device. It's specially formulated with high-performance ingredients to make your designs come out sparkling: CMOS low power, plus an 80ns super-fast access speed, ultra-short programming time and more.

SGS-THOMSON is big on selection, too. You can get 16K and 2 Meg devices, plus every density in between, right off the shelf. We won't soft-soap you with delivery excuses either. Backed by a list of distributors that reads like Who's Who, SGS-THOMSON ships on time.

Our serial EEPROMs feature guaranteed one million Erase/Write cycles and are available in F-C and MICROWIRE® bus versions.

No wonder we're now one of the world's top EPROM suppliers.

And we'll continue to sparkle in the memory business.

Full-feature serial EPROMs in 4K and 8K sizes are ready to hit the shelves. And our 16 Meg EPROM is in the works!

Let SGS-THOMSON's quality, selection and service wash away your memory problems once and for all.
the world's largest selection
2KHz to 8GHz from $4.95

With over 300 models, from 2-way to 48-way, 0°, 90° and 180°, a variety of pin and connector packages, 50 and 75 ohm, covering 2KHz to 8000MHz, Mini-Circuits offers the world's largest selection of off-the-shelf power splitter/combiners. So why compromise your systems design when you can select the power splitter/combiner that closely matches your specific package and frequency band requirements at lowest cost and with immediate delivery.

And we will handle your "special" needs, such as wider bandwidth, higher isolation, intermixed connectors, etc. courteously with rapid turnaround time.

Of course, all units come with our one-year guarantee. Unprecedented 4.5 sigma unit-to-unit repeatability also guaranteed, meaning units ordered today or next year will provide performance identical to those delivered last year.

OUR NEW PARTNERSHIP IS AS HOT AS IT GETS.
After all, it's Sun.

That's right, FORCE and Sun have teamed up to offer one of the brightest new products in embedded systems.

The SPARC™ CPU-1E engine. It's a complete implementation of SPARC™ station™ 1, fully supported by the powerful SunOS™ and the real-time expertise of FORCE.

For the first time, you can design with SunOS and real-time on the same VME backplane. With industry-standard SPARC technology, no less.

And that's just the beginning. FORCE will spark embedded systems for generations to come, based on our partnership with Sun. In fact, we're already designing the SPARC CPU-2E. Of course, our entire family of SPARC-based products is 100% SunOS-compatible.

So nothing stands between you and the most powerful development environment in embedded systems. With SunOS and the SPARC CPU-1E, you can program, debug and observe real-time code. All within the same development and target system, thereby slashing costs and development time.

The SPARC CPU-1E accommodates up to 80 Mbytes of DRAM. You can run real-time, UNIX®, Sun Windows™ and utility programs. Standard DMA-driven SCSI and Ethernet interfaces give you full network access. There's even an SBus™ interface for I/O expansion.

We also provide such leading real-time operating systems as VxWorks™, VADSWorks™, VRTX™, MTOS™, PDOS™ and OS-9/9000™ products. Along with over 2100 third-party applications from Sun's Catalyst™ program.

Finally, we can supply all your system components. Everything from SPARCstations and mass storage modules to expansion boards, monitors and keyboards.

But that's what you'd expect from the vendor with the broadest, most flexible line of embedded systems solutions. So call 1-800-BEST-VME, ext. 10 for more information or fax a request to (408) 374-1146.

And put the heat on your competition.

FORCE Computers, Inc. 3165 Winchester Blvd., Campbell, CA 95008-6557

All brands or products are trademarks of their respective holders.

© 1991 FORCE Computers, Inc.
People say boundary in low cost, high quality

Now you can test that

Increasing device complexity. Rising pattern development costs. High density packaging. Disappearing nodal access. These are the board test problems boundary scan was created to solve. Which is fine in theory. Only problem is there hasn't been any way to put boundary scan to the test. Until now.

VICTORY - the first software to automate boundary-scan testing.

Introducing VICTORY™ from Teradyne: the only software toolset ready to help you turn boundary-scan theory into a practical advantage. From the moment your first boundary-scan device is designed in, VICTORY starts to simplify the testing of complex digital boards. And the more boundary-scan parts you have, the more time and money you save.

Delivers high fault-coverage.

Whether you're testing one boundary-scan part or boundary-scan networks, VICTORY software automatically gives you 100% pin-level fault coverage. Using the IEEE 1149.1 and BSDL standards, it takes VICTORY only a minute or two to generate test patterns. It would take a programmer days, even weeks to deliver the same fault coverage for conventional designs. Now you can find stuck-at faults, broken wire bonds, wrong or missing components - even open input pins - all without manual diagnostic probing. VICTORY's fault diagnostics clearly spell out both fault type and fault location. And that's just the manufacturing process
scan is a breakthrough board testing. theory.

feedback you need to eliminate defects where it's most cost-effective—at the source.

Helps solve the test access problem.

With boundary-scan design and VICTORY software, you won't need bed-of-nails access on nodes where boundary-scan parts are interconnected. That means fewer test pads. Fewer test probes.

That's a compelling advantage to board designers. Which is why VICTORY's Access Analyzer was developed. With this concurrent engineering tool, designers get testability information early in the design process. They can easily see where test points are required for visibility and where they can be dropped, for optimized board layout without lowering fault coverage.

Good for the bottom line.

Shorter test programming time. Higher fault coverage. Lower PC board and test fixture costs. The bottom line on VICTORY is how positively it will affect your bottom line. And because VICTORY works with all Teradyne board testers, you're free to tailor a test process that's cost-effective for both your boundary-scan and non-scan boards. No matter what your test objectives. For example, with our new Z1800VP-series testers, a complete solution for in-circuit and boundary-scan testing starts at well under $100,000.

Make the next logical move.

Call today.

Boundary scan is the design-for-test breakthrough that promises lower cost, higher quality board testing. But don't take our word for it. Call Daryl Layzer at (800) 225-2699, ext. 3808. We'll show you how, with VICTORY software and Teradyne board testers, you can test this theory for yourself.
Only one of these bug killers runs on Sun.

Your deadline is looming. The budget stopwatch is ticking. The scope and the complexity of your project are mounting. To weed out your design problems, you need sophisticated system analysis and integration tools which run on your Sun workstation.

Hewlett-Packard's latest emulators provide just that. They control time-critical functions in your target system. Cover the Motorola chips 68020, 68302, 68331 and 68332. And their real-time analysis capabilities will make sure you catch the bugs in your software.

Because logic and performance analysis tools and code coverage are consolidated, and with C cross compilers, simulator/debuggers and branch validators also available, you'll never have to worry about bogging down when performing comprehensive evaluations.

And thanks to HP's LAN, you'll be platform independent. Now everyone on the network can share information and link up with essential team members.

So if you want an emulator with the service, support and reliability you've come to expect from Hewlett-Packard, call our Microprocessor Development Hotline at 1-800-447-3282, Ext. 104. We'll send you a free demo disk and information package. You'll see that with our emulators, killing bugs is a snap.

© 1991 Hewlett-Packard Company

CIRCLE NO. 16

EDN July 4, 1991
Send ideas for math and science in action

Thanks to Jon Titus for devoting some space to math education (EDN, April 11, 1991, pg 41). I run an after-school science and math program for the Boys’ and Girls’ Club of San Diego. I recently started making up fill-in-the-blank handouts of famous proofs and problems, such as the sum of the integers from 1 to 100 and the Pythagorean Theorem. I have students from age 5 through 18 in the same room at the same time. Surprisingly, the handouts are very popular, and I need more ideas. I’d appreciate your readers’ suggestions for simple, lucid examples of mathematics and science in action.

Ed Vogel
San Diego, CA
(Ed Note: Readers, mail or fax your ideas and suggestions to Signals & Noise, and EDN will forward them to Ed Vogel. We’ll also put them on EDN’s computer bulletin-board system (BBS). You can reach our BBS at (617) 558-4241 with modem settings 300/1200/2400, 8,N,1.)

Instrumentation amplifiers revisited

In the Special Report on Instrumentation amplifiers (EDN, March 14, 1991, pg 82), I was disappointed to see the 4-resistor differential amplifier referred to as an “instrumentation amplifier.” In the measurements engineering field, the term has been traditionally reserved for the true 3-amplifier (or 2-amplifier, with some contortions) instrumentation amplifier. The 2-buffer and differential-amplifier configuration and its variants, whether monolithic or discrete, are different animals and belong in a class by themselves.

Doug Conner does briefly mention the difference in input impedances, but this fact isn’t emphasized enough. The true instrumentation amplifier has infinite input impedance, whereas the input impedance of the 4-resistor amplifier is that of the input resistors. If large gains are required, they are usually quite low in order to keep the value of the feedback resistor reasonable. Thus, any network (filters, voltage dividers, etc) connected to such an amplifier will be altered by its input impedance, and some networks, such as low-frequency “washout” filters, may not even be realizable.

The paragraph on software scaling (pg 86) is confusing. It somehow leaves the impression that scaling can be magically performed without exact knowledge of the signal-path gain. Precise knowledge of the transducer and path gains are required for correct software scaling.

Gilbert C Willems
Head, Technology Dept
Naval Biodynamics Laboratory
New Orleans, LA
(Ed Note: An instrumentation amplifier accepts a differential input, multiples it by a gain, and provides a single-ended output. The definition of an instrumentation amplifier doesn’t depend on the implementation. For a particular application, a single operational amplifier with four resistors may not be inappropriate because of its low performance. On the other hand, if a single amplifier design does meet your design specifications, it will save money and will be the correct choice.

It’s true the single amplifier with four resistors typically has a low input resistance. Some transducers have low output voltages and a low output impedance, making them suitable for use with an instrumentation amplifier having low input impedance. As always, it’s up to the engineer designing the circuit to make the appropriate component decisions to meet the required performance.

The article didn’t mention the details of software scaling. The designer needs to know either the gain of the signal path or be able to apply a reference signal for software scaling.)
Memories, ASICs, and Logic ICs Deliver High-End Performance.

For high-end workstation and PC applications, Oki offers a range of ICs with the powerful performance features your high-level board designs demand.

**1-Meg Based VRAMs.** Oki's high-bandwidth video RAMs enable the up-front performance required for high-resolution graphic applications. Features include dual port memory and fast access times.

**0.8µm Gate Arrays.** Manufactured on our volume 4-Mb line, Oki's SOGs offer exceptional benefits: high-speed logic and I/O performance, high-density macrofunctions, high pin count packages, and more.

**Field Memory.** There's no better solution for a frame grabber design than Oki's high-performing 1-Mb serial memory. Features include an internal self-refresh control circuit, making this device appear fully static to the user.

**Speech Synthesis.** For high-quality performance you can hear, no one matches Oki's RealVoice™ speech synthesizers. With on-chip filter and D/A, these chips reduce design time and IC count while increasing system reliability.

**16-Bit MCU.** Oki's nX family of fast MCUs combines a three-program instruction pre-fetch queue to lower overall CPU cycle time down to 200 ns. Features include a variety of I/O options plus 16K of 16-bit word ROM and 512 bytes of RAM.

Start packing more performance into your system with Oki ICs. Call 1-800-OKI-6388 for the details.

<table>
<thead>
<tr>
<th>Oki High-Performance ICs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Part Number</strong></td>
</tr>
<tr>
<td>MSM514252</td>
</tr>
<tr>
<td>MSM514221A</td>
</tr>
<tr>
<td>MSM1050000</td>
</tr>
<tr>
<td>MSM6388</td>
</tr>
<tr>
<td>MSM67620</td>
</tr>
</tbody>
</table>

RealVoice is a trademark of Oki Semiconductor.
PERFORMANCE UP FRONT STARTS WITH OKI ON BOARD.
FILTERS
dc to 3GHz from $1745

lowpass, highpass, bandpass, narrowband IF

- less than 1dB insertion loss
- greater than 40dB stopband rejection
- 5-section, 30dB/octave rolloff
- VSWR less than 1.7 (typ)
- rugged hermetically-sealed pin models
- BNC, Type N, SMA available
- surface-mount
- over 100 off-the-shelf models
- immediate delivery

low pass dc to 1200MHz

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>PASSBAND, MHz (loss &lt;1dB)</th>
<th>fco, MHz (loss &lt;3dB)</th>
<th>STOP BAND, MHz (loss &gt;10dB)</th>
<th>STOP BAND, MHz (loss &gt;30dB)</th>
<th>VSWR</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLP-10.7</td>
<td>DC-11 14</td>
<td>19 24 200</td>
<td>1.7 18</td>
<td>11.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLP-21.4</td>
<td>DC-22 24.5</td>
<td>35 47 200</td>
<td>1.7 18</td>
<td>11.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLP-30</td>
<td>DC-32 35</td>
<td>47 61 300</td>
<td>1.7 18</td>
<td>11.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLP-50</td>
<td>DC-48 55</td>
<td>70 90 200</td>
<td>1.7 18</td>
<td>11.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLP-70</td>
<td>DC-60 67</td>
<td>90 117 300</td>
<td>1.7 18</td>
<td>11.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLP-100</td>
<td>DC-88 103</td>
<td>140 189 400</td>
<td>1.7 18</td>
<td>11.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLP-150</td>
<td>DC-140 155</td>
<td>210 300 600</td>
<td>1.7 18</td>
<td>11.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLP-200</td>
<td>DC-190 210</td>
<td>290 390 800</td>
<td>1.7 18</td>
<td>11.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLP-250</td>
<td>DC-225 250</td>
<td>330 400 1200</td>
<td>1.7 18</td>
<td>11.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLP-300</td>
<td>DC-270 297</td>
<td>410 550 1200</td>
<td>1.7 18</td>
<td>11.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLP-450</td>
<td>DC-450 440</td>
<td>580 750 1800</td>
<td>1.7 18</td>
<td>11.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLP-550</td>
<td>DC-520 570</td>
<td>750 920 2000</td>
<td>1.7 18</td>
<td>11.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLP-600</td>
<td>DC-580 640</td>
<td>840 1120 2000</td>
<td>1.7 18</td>
<td>11.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLP-750</td>
<td>DC-700 770</td>
<td>1000 1300 2000</td>
<td>1.7 18</td>
<td>11.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLP-800</td>
<td>DC-720 800</td>
<td>1080 1400 2000</td>
<td>1.7 18</td>
<td>11.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLP-850</td>
<td>DC-780 900</td>
<td>1180 1400 2000</td>
<td>1.7 18</td>
<td>11.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLP-1000</td>
<td>DC-900 990</td>
<td>1340 1750 2000</td>
<td>1.7 18</td>
<td>11.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLP-1200</td>
<td>DC-1200 1200</td>
<td>1620 2100 2500</td>
<td>1.7 18</td>
<td>11.45</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

high pass dc to 2500MHz

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>PASSBAND, MHz (loss &lt;1dB)</th>
<th>fco, MHz (loss &lt;3dB)</th>
<th>STOP BAND, MHz (loss &gt;10dB)</th>
<th>STOP BAND, MHz (loss &gt;30dB)</th>
<th>VSWR</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHP-50</td>
<td>41 200 37</td>
<td>26 40 20</td>
<td>1.5 17</td>
<td>14.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHP-100</td>
<td>90 400 82</td>
<td>55 80 40</td>
<td>1.5 17</td>
<td>14.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHP-150</td>
<td>133 600 140</td>
<td>95 120 70</td>
<td>1.5 17</td>
<td>14.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHP-175</td>
<td>160 800 140</td>
<td>105 170 70</td>
<td>1.5 17</td>
<td>14.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHP-200</td>
<td>185 800 164</td>
<td>116 190 90</td>
<td>1.6 17</td>
<td>14.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHP-250</td>
<td>225 1200 205</td>
<td>150 210 100</td>
<td>1.7 17</td>
<td>14.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHP-300</td>
<td>290 1200 245</td>
<td>190 250 145</td>
<td>1.7 17</td>
<td>14.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHP-400</td>
<td>395 1600 360</td>
<td>290 390 210</td>
<td>1.7 17</td>
<td>14.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHP-500</td>
<td>500 1600 454</td>
<td>360 540 280</td>
<td>1.8 17</td>
<td>14.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHP-600</td>
<td>600 1600 545</td>
<td>440 630 350</td>
<td>1.9 17</td>
<td>14.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHP-700</td>
<td>700 1800 640</td>
<td>520 720 440</td>
<td>2.0 17</td>
<td>14.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHP-800</td>
<td>800 2000 710</td>
<td>570 740 445</td>
<td>2.1 17</td>
<td>14.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHP-900</td>
<td>900 2100 820</td>
<td>660 920 520</td>
<td>2.2 17</td>
<td>14.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHP-1000</td>
<td>1000 2200 900</td>
<td>720 950 550</td>
<td>2.3 17</td>
<td>14.95</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

bandpass 20 to 70MHz

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>CENTER FREQ., MHz</th>
<th>PASS BAND, MHz (loss &lt;3dB)</th>
<th>STOP BAND, MHz (loss &gt;10 dB)</th>
<th>STOP BAND, MHz (loss &gt;30 dB)</th>
<th>VSWR</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PF-21.4</td>
<td>21.4 18 25</td>
<td>4.9 85 1.3 150</td>
<td>DC-220 14.95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PF-30</td>
<td>30 25 35</td>
<td>7 150 1.9 210</td>
<td>DC-330 14.95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PF-40</td>
<td>40 35 49</td>
<td>10 168 2.6 300</td>
<td>DC-400 14.95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PF-50</td>
<td>50 41 58</td>
<td>11.5 250 3.1 350</td>
<td>DC-500 14.95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PF-60</td>
<td>60 50 70</td>
<td>14 240 3.8 400</td>
<td>DC-600 14.95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PF-70</td>
<td>70 58 82</td>
<td>16 260 4.4 490</td>
<td>DC-700 14.95</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

narrowband IF

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>CENTER FREQ., MHz</th>
<th>PASS BAND, MHz (loss &lt;3dB)</th>
<th>STOP BAND, MHz (I.L. &gt;20dB)</th>
<th>STOP BAND, MHz (I.L. &gt;35dB)</th>
<th>VSWR</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBP-10.7</td>
<td>10.7 9.5-11.5</td>
<td>7.5 15 0.6 50-1000</td>
<td>1.7 18.95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBP-21.4</td>
<td>21.4 19.2-23.6</td>
<td>15.5 29 3.0 80-1000</td>
<td>1.7 18.95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBP-30</td>
<td>30 27.0-33.0</td>
<td>22 40 3.2 99-1000</td>
<td>1.8 18.95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBP-60</td>
<td>60 55.0-67.0</td>
<td>44 79 4.6 190-1000</td>
<td>1.7 18.95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBP-70</td>
<td>70 63.0-77.0</td>
<td>51 94 6.1 193-1000</td>
<td>1.7 18.95</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CIRCLE NO. 18

Mini-Circuits
P.O. BOX 350166, Brooklyn, New York 11235-0003 (718) 934-4500 FAX (718) 332-4681 TELEX 6852844 or 620156 WE ACCEPT AMERICAN EXPRESS

F132-2 REV. ORIG.
When It Comes To
Is Up To Speed In More
Ways Than One.

With high performance and high-volume production, Toshiba rolls out a winner. We're cruising along with the second generation of 4Mb DRAMs, just as we led the way with 1Mb. It's just a natural evolution, a further refinement of our revolutionary CMOS process. We achieved this by lowering the device feature size to 0.7 micron and decreasing die sizes, making possible 300 mil SOJ packages.

Toshiba's DRAM family is wider ranging and more flexible than ever before. We've improved the selection of access times to embrace 60, 70, 80 and 100ns. We've packaged DRAMs into convenient SIMM modules for easy systems upgrade. We've got all the organizations you've been wanting in quantity, including x8, x9 and x36. And on top of that, we offer Fast Page, Nibble, Static Column and Write-Per-Bit operating modes. Some day in the near future, we'll be hot off the loading docks with some of the first 16Mb DRAMs.

Another very important thing to remember about Toshiba 4Mb DRAMs is that they're in volume production right now. We can make high-volume commitments today, and be ready to serve as your partner on the production lines tomorrow...and well beyond.

It's enough to drive the savvy designer to call Toshiba today.

For technical literature, call 1-800-321-1718. Toshiba CMOS makes the difference!

In Touch with Tomorrow

TOSHIBA

© 1991 Toshiba America Electronic Components, Inc.
Introducing Fluke's 70 Series II, next-generation multimeters that meet the increasing demands of your job and your budget.

Consider. At the top of the line, the new Fluke 79 and 29 deliver more high-performance features — capacitance, frequency, a fast 63-segment bar graph, Lo-Ohms range, Smoothing™, faster ranges — than DMMs costing much more.

At the entry level, the new model 70, Fluke's lowest-priced DMM ever, delivers unparalleled Fluke quality at a price comparable to "disposable" meters.

And in between are all the models that have made the 70 Series the most popular DMM family in the world — updated, refined and delivering even more value than ever.

"BASICS" REDEFINED
No matter which 70 Series II you choose, you get simple, one-handed operation. High resolution. And built-in, go anywhere reliability.
Automatic Touch Hold™ — standard on every model — locks the reading on the display and signals you with a beep, automatically updating for each new measurement without a reset. Leaving you free to concentrate on your work, not on your meter.

YOUR BEST CHOICE
Best of all, every 70 Series II is a Fluke, backed by a worldwide service network and an industry-leading 3 year warranty.

So the next time you're in the market for a new meter, ask for the one that guarantees old-fashioned value. Fluke 70 Series II. For more information call 1-800-6789-LIT. Or call 1-800-44-FLUKE, ext 33 for the name of your nearest Fluke distributor.
These cards plug into the bus to let techniques to decouple a noisy IBM power supply from my circuit cards. Such cards might be EKG heartbeats and recording-quality signals. Using op-amps and trying to process signals in the millivolt and microvolt range, I get a lot of common-mode noise fed in by the power supply. Also, as programs execute, the noise increases, so I need a way to make the 5, 12, -5, and -12V power supplies clean while the data fly all over the place.

As you've probably guessed, I've tried a range of capacitors, resistors, and inductors without success. I suspect that besides the noise I can see on a 20-MHz scope, even more noise exists outside this band.

John Bercik
Covox
Eugene, OR

We suggest you start by looking in EDN's Technical Article Database, an annual or semiannual compilation of technical articles that have appeared in EDN and other technical magazines. Read all the articles you can on grounding and other standard practices. You can also check out the mechanical design of purpose-built instrument cards, such as those for VXI systems.

More than one young start-up ran into the laws of physics trying to make plug-in instruments for personal computers. The first Apples had no ground at all. One old-line instrument company bought a line of PC instruments and had to redesign them to be electrically safe and clean.

You should also study the catalogs and application notes published by the top analog IC companies. Analog Devices, Burr-Brown, Linear Technology, National Semiconductor, and too many more to mention here, have talented, experienced analog designers who have spent endless hours at the bench and on their word processors trying to make such practices available to engineers.

You should also contact oscilloscope companies. There's a 99% chance that, through improper probing techniques, you're causing as much noise as you're curing. Senior Editor Charles H Small says that every analog-IC application engineer he talked to while researching an article on sensitive scope measurements told him that when their customers thought they were having low-level noise problems, those customers were really measuring their instruments' noise, not that of their circuits.

Would-be PLD programmer gets cold shoulder

I'm trying to develop a small universal PLD (programmable logic device) programmer. Being an electrical-engineering student, I thought that developing my own programmer would be better than paying the exorbitant prices of some programmers. At the same time, I'd learn a lot about these programmers. Nevertheless, I've found that most manufacturers' data books don't have any references at all on how to program their devices—unlike the way you can find out how to program an EPROM from, say, a Texas Instruments' MOS Memory Databook.

When I phoned companies regarding this lack of information, I was told that the programming algorithm varies, depending on the specific device. I was given the cold shoulder when I asked if they could send me a copy of the algorithm. Some of the manufacturers said the algorithms to program their devices are proprietary, and they don't give it out!

What's the matter? I thought the idea behind data books was to make available to the general designer all the information he or she would need to use a manufacturer's ICs. Programming a PLA shouldn't be much different from programming an EPROM or a microcontroller. I'd hand out a trophy to Cypress Semiconductor, which puts the information about its EPLDs right in the devices' data books. Is there any way, other than being a "big company," to find out those programming algorithms and be able to develop a PLD programmer? Cypress's information was useful, but it doesn't cover the great majority of PLDs out there.

Javier Alexis Perez
Boston University
Boston, MA

Senior Editor Charles H Small reports that Mike Holley at Data I/O (Redmond, WA), a company that has programmed a device or two, says keeping up with changes in programming algorithms is just too big a headache to be done in catalogs and data sheets. Holley reports that Data I/O is in constant communication with all programmable-device manufacturers because the manufacturers' algorithms change constantly. Sometimes, Mike says, the companies change their processes for one reason or another. Sometimes, the characteristics of the devices change for no known reason.

Charles has been keeping informal track of companies that get into the device-programmer business. In the seven years he has been at EDN, he has seen more than 30 of them come and go. He guesses that the companies look at the electronics needed for a device programmer and say, "Hey, this looks pretty simple." Later, they discover the true cost of supporting all the changes in programming algorithms and go out of business. So, even if you design your own programmer and it works fine now, tomorrow your programmer could start blowing up parts or failing to program them.
Now there's a way to get FDDI systems to do what they're supposed to do. Run wide open, lightning fast and bottleneck free.

Introducing the Motorola FDDI chip set. The complete system solution in a 4-chip, fully ANSI-compliant design.

Led by the FDDI System Interface chip, it speeds data through the system at up to 200 Mbytes/second via two 32-bit ports. While 8 Kbytes of on-chip RAM provide more than 80 microseconds of bus latency. Freeing up your host for other system tasks.

Its partners are the FDDI Clock Generator, the Elasticity Buffer and Link Manager, and the Media Access Controller. Together, they handle all FDDI functions quickly and efficiently, without the hassle or expense of external memory or high-speed logic.

Not only is the Motorola FDDI chip set ideal for FDDI-networked systems, it's perfect in routers, bridges and concentrators.

And our partnership with Digital Equipment Corporation helps us ensure its compatibility with the FDDI protocol.

So you can stop waiting for the signal that FDDI has truly arrived. Because the Motorola FDDI chip set is here today. For more information and a free poster, call 1-800-845-MOTO.
Whether you fax it, fire it, send it, measure it, wire it, compute it, The Analog family of

Precision
With the AD840, AD841 and AD842, there's no need to trade speed for accuracy. All three settle to 0.01% within 100 ns (840/842) and 110 ns (841) — critical in data acquisition and instrumentation applications — and offer low offset voltages and drifts, and fast slew rates.

FET Input
For op amps requiring low input current, the OP-42, OP-44, AD845 and AD843 are all remarkably fast — slew rates are 58, 120, 100 and 250 V/µs, respectively. In addition, they offer offset voltages of less than 1 mV and extremely low current noise.

Transimpedance Amplifiers
The OP-160, OP-260, AD844, AD846, AD9617 and AD9618 all utilize a current feedback architecture to achieve slew rates from 450 to 2000 V/µs without compromising stability — even in hostile environments. Other benefits include low power dissipation and high unity-gain bandwidth.

If whatever it is you're trying to do involves high-speed op amps, Analog Devices is the company to call. With our current products and new introductions, we have the broadest line of high-speed op amps available. A line that gives you the right combination of speed, precision, noise and price. So chances are, we've got exactly what you need for

Authorized North American Distributors: Alliance Electronics 505-292-3360 • Allied Electronics 817-595-3500 • Anthem Electronics 408-453-1200 • Bell Industries 213-826-6778

EDN July 4, 1991
shoot it, launch it, land it, test it, display it or air it, we've got it.

high-speed op amps.

Buffers
If you're looking for extremely low distortion buffers, look at the specs of the AD9620 and AD9630—distortion at 20 MHz: —73 dBc and —66 dBc, respectively; fast settling time: less than 8ns to 0.02%; and extremely low noise: 2.2 nV/√Hz.

General Purpose
With the right combination of speed, precision, power dissipation and high output drive capability, the AD827, AD829, AD847, AD848, AD849 and OP-64 are ideal general purpose solutions. And they're ideally priced solutions—most singles are under $3, and duals are under $5.

Low Noise
It used to be you had to choose between speed or low noise. But with the AD829, you get both. It features voltage noise of 2 nV/√Hz and current noise of 1.5 pA/√Hz with a 50 MHz unity-gain bandwidth. Those specs, combined with the low price of $2.95/100s, make it ideal for both audio and video applications.

whatever application you're working in. Call us at 1-800-262-5643, or write to Analog Devices, P.O. Box 9106, Norwood, MA 02062-9106, for a complete high-speed op amp selection guide and a free copy of our SPICE model library.

Analog Devices, One Technology Way, Norwood, MA 02062-9106. Distribution, offices and applications support available worldwide.

EDN July 4, 1991
Introducing the wave of the future. The industry's first and only low-noise GAL devices.

Silencing device noise with our new GAL® Quiet Series™ family.

The tide of events for CMOS-based logic is sure to change course with the introduction of our new GAL Quiet Series devices. Because now you can design in high-speed logic devices without having to design out noise.

Through our advanced proprietary circuitry, we keep noise to a bare minimum. Our GTO™ (Graduated Turn-on Output) circuit, which retards the output buffers, results in smoother edge rates, diminished output undershoot, and greatly reduced ground bounce ($V_{OLP}$ max of 15V).

What's more, these devices utilize unique ground and power buses, which effectively isolate inputs from output noise and improve dynamic threshold.

<table>
<thead>
<tr>
<th></th>
<th>$V_{OLP}$</th>
<th>$V_{OLV}$</th>
<th>$V_{ID}$*</th>
<th>$V_{IS}$**</th>
</tr>
</thead>
<tbody>
<tr>
<td>National</td>
<td>1.18</td>
<td>-.62</td>
<td>1.40</td>
<td>1.78</td>
</tr>
<tr>
<td>Competitor A</td>
<td>2.06</td>
<td>-.66</td>
<td>1.10</td>
<td>1.83</td>
</tr>
<tr>
<td>Competitor B</td>
<td>1.58</td>
<td>-.66</td>
<td>1.39</td>
<td>1.62</td>
</tr>
<tr>
<td>Competitor C</td>
<td>1.46</td>
<td>-1.08</td>
<td>1.09</td>
<td>1.56</td>
</tr>
</tbody>
</table>

*V_{OL}—Dynamic Input threshold low; **V_{IS}—Dynamic Input threshold high

Building on our Quiet Series heritage.

When we designed our low-noise GAL devices we talked to the experts. National's team of ACMOS logic designers. After all, they invented FACT Quiet Series, which is globally accepted as the quiet standard. And now standard on our new GAL devices.

Delivering higher speeds at 1/2 and 1/4 the power.

What more would you want in a GAL device other than high-speed and low noise? Our answer is less. That's why we offer reduced-power versions of our 15ns devices. Which means now you can get half- and quarter-power GAL devices —in either 20- or 24-pin DIP and PLCC packages —that draw a max $I_{CC}$ of 90mA and 55mA respectively at 15MHz.

Minimizing system noise.

Not only will our high-speed GAL QS devices improve your system performance, they'll reduce your overall system noise. And that means extraneous noises like Electromagnetic Interference (EMI), crosstalk, and ringing, the effects of which often result in false clocking.

Riding the crest with National.

For samples, call or write us today. And find out why our new GAL Quiet Series devices are making waves.

1-800-NAT-SEMI, Ext. 125
National Semiconductor Corp.
P.O. Box 7643
Mt. Prospect, IL 60056-7643

Quiet Series and GTO are trademarks of National Semiconductor Corporation.
GAL is a registered trademark of Lattice Semiconductor.
©1991 National Semiconductor Corporation

EDN July 4, 1991
Most of us agree that we're experiencing an explosion of information. Photocopiers are ubiquitous, facsimile machines are a necessity, and almost any desktop personal computer can serve as a communication link with worldwide services and databases. The fruits of these devices yield an increasing flow of information. Along with the explosion of information comes the inevitable "fallout," or problems that such a free flow of information introduces. Here are some examples worth considering:

A US Senate proposal would require that telephone and computer companies give the government the keys to all scrambled communications. Even if this measure passes through Congress as part of the bill it's attached to, the proposal wouldn't be legally binding. However, it opens avenues for invasion of privacy. Many companies routinely use the Data Encryption Standard (DES) to encrypt and decrypt sensitive information. However, some people think this standard, which arose from the National Bureau of Standards in 1977, contains a "back door" through which agencies such as the National Security Agency can decrypt communications.

Earlier this year, several amateur-radio operators were cited by the Federal Communications Commission for violating FCC regulations that prohibit ham operators from transmitting commercial messages or information. In this case, a station originated a digital message that was sent to many packet-radio repeaters and then retransmitted to other packet stations throughout the USA. The short message urged support for a nonprofit group. Because each ham operator is responsible for every message that his or her station originates or "repeats," the FCC took action against many hams. Should such operators really be held responsible for the hundreds of thousands of bytes of data that their stations pass on to other operators?

In 1990, a group of computer hackers tapped into a Bell South computer and made a copy of a memo regarding upgrading and billing for 911 emergency phone systems. A grand jury indicted the hackers, who were charged with interstate transfer of stolen property worth more than $5000. (Bell South put a $79,449 value on the memo.) One of the hackers published an on-line newsletter, Phrack, which was seized, along with the hacker's disks, computer system, and subscription lists. These actions raise important questions. Can you steal a document when all you do is make a copy of it? (Recently, a British court ruled that making a copy of a document isn't the same as stealing it.) Are works published in electronic form subject to Constitutional protection?

As transferring information from place to place becomes easier, and as we increase our dependence on those paths of communications, we need to re-examine how we continue to protect our rights and how we assume new responsibilities. Unfortunately, new technologies often outstrip our ability to regulate them. Surely FCC regulations for ham operators didn't envision a station being able to communicate millions of bits of data to other stations in the course of a day. So, should we even attempt to regulate the flow of information, or must we protect ourselves as best we can? Obviously, the information age raises a lot of questions. As technical people who are involved with and depend on communications technology, we're in a unique position to make our ideas known. Now's the time to let us—and others—know what you're thinking.

Send me your comments via FAX at (617) 558-4470, or on the EDN Bulletin Board System at (617) 558-4241 300/1200/2400, 8, N, 1.
Solutions For A

Changes. You can't stop them, let alone slow them down. Especially in the highly competitive PC marketplace. Chips and Technologies stays ahead of those changes with the widest range of Total System Solutions available. So as your market segments evolve, you can respond with superior products — faster and more cost effectively than before. We're the leading supplier of highly integrated Total System Solutions: including PEAK/DM™ for 386/486 based personal workstations. PEAKsx™ for optimized entry-level PC's. SCATsx™ and CHIPSlite™ for
power conscious notebooks. We also have a complete line of CHIPSets for both flat-panel and CRT applications requiring VGA resolution and beyond. Plus PC Video™ for Multimedia, and PUMA™ for graphics acceleration. And we’ve got Data Communications and Mass Storage solutions too! Call us at 1-800-323-4477 x2355 or fax us at 408-434-0412 for the sales office nearest you and get started on your next design today.

Chips and Technologies, Inc.

CIRCLE NO. 28

© 1991 Chips and Technologies, Inc. 3950 Zanker Road, San Jose, CA 95134. CHIPS is a registered trademark, and PEAK/DM, PEAKos, SCATex, CHIPSline, PUMA, and PC Video are trademarks of Chips and Technologies, Inc. All other products or brand names mentioned are trademarks or registered trademarks of their respective holders.
We call it a FET Array.
She'd call it a Miracle.

Hammer. Anvil. Stirrup. Drum. Simple names for the complex natural “hardware” that allows us to hear. If it’s injured—or congenitally defective—the deafness that occurs can’t always be helped by conventional hearing aid.

A cochlear implant bypasses the damage, delivering filtered and processed analog signals directly to electrodes implanted deep in the inner ear. These signals stimulate the audio nerves in a natural way, allowing—in most cases—the deaf to hear.

The variety of applications for our new RFA120 never ceases to amaze us. But then, a linear array that combines both bipolar and JFET gain blocks can provide some pretty versatile characteristics:

<table>
<thead>
<tr>
<th>RFA120 FET Array</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Range:</td>
</tr>
<tr>
<td>Input Offset Voltage:</td>
</tr>
<tr>
<td>Input Bias Current:</td>
</tr>
<tr>
<td>Gain Bandwidth Product:</td>
</tr>
<tr>
<td>Slew Rate (Gain = +1):</td>
</tr>
</tbody>
</table>

The RFA120 is a low power device that’s ideal for signal conditioning applications. One of our favorites also takes advantage of its small size.

It’s a cochlear implant system that bypasses injured or congenitally defective “hardware” in the ear canal. The system converts audio signals to analog signals, routing them deep into the inner ear to stimulate the natural audio nerves that are “hardwired” to the brain.

We’re committed to analog technology.

And we’re committed to helping you develop creative, cost effective solutions.

Our Win-Win program is a good example. It lets you get to market quickly with a semicustom array, then shift to full custom as sales increase. It’s fast, flexible and makes good business sense because it eliminates the risk of going full custom before you’re really ready.

If you’d like more information on our analog arrays, give us a call at 1-800-722-7074. We’ll send you our new brochure.

Raytheon Company, Semiconductor Division.
350 Ellis St, Mountain View, CA 94039.
THE
MULTIPLE CHOICE
ANSWER FOR SMD TRIMMERS

New! New! New!
4mm Sealed 5-Turn

The all process compatible Bourns Model 3374 is the first electroless nickel chip-style device to offer a minimum 5-turn seal life. The Model 3374 shows field adjust capability after soldering while maintaining seal integrity.

Size: 3.6mm x 3.9mm x 2.5mm
Contact Resistance Variation: 1% max.
Resistance Range: 10 ohms to 2 megohms ± 20%
Temperature Coefficient: ±1000ppm/°C
Seal Life: 100 cycles
Rotational Life: 200 cycles

CALL ME
SENT LITERATURE

4mm Open-Frame Single-Turn
With a cost-effective chip style design, the Model 3364 features a cross-slot rotor that is ideal for automatic assembly and adjustment techniques.

Size: 4.8mm x 3.9mm x 2.4mm
Contact Resistance Variation: 3% max.
Resistance Range: 10 ohms to 2 megohms ± 20%
Temperature Coefficient: ±1000ppm/°C
Rotational Life: 20 cycles

CALL ME
SENT LITERATURE

3mm Sealed Single-Turn

Another size barrier has been broken with the Bourns Model 3313 trimmer which features 3mm size, a protective seal and solid construction.

Size: 3.5mm x 3.2mm x 2.2mm
Contact Resistance Variation: 2% max.
Resistance Range: 100 ohms + 2 megohms ± 20%
Temperature Coefficient: ±100ppm/°C
Seal Life: 100 cycles
Rotational Life: 100 cycles

CALL ME
SENT LITERATURE

3mm Open-Frame Single-Turn
The Model 3363 is the industry's smallest 3mm design meeting both EIAI and EIAJ footprint standards.

Size: 3.6mm x 3.9mm x 2.3mm
Contact Resistance Variation: 3% max.
Resistance Range: 100 ohms to 2 megohms ± 20%
Temperature Coefficient: ±500ppm/°C
Rotational Life: 20 cycles

CALL ME
SENT LITERATURE

4mm Sealed Single-Turn
The rugged Model 3314 trimmer is ideal for reliable performance in harsh environments. Top and side adjust styles provide excellent compatibility with pick-and-place assembly techniques.

Size: 5mm x 5mm
Contact Resistance Variation: 4% max.
Resistance Range: 10 ohms to 2 megohms + 20%
Temperature Coefficient: ±100ppm/°C
Rotational Life: 100 cycles

CALL ME
SENT LITERATURE

CALL 1-800-22BOURNS
For a FREE BROCHURE and the telephone number of your nearest sales office providing technical assistance.
Motif-based Ada development system targets Sun and other RISC workstations

The RISCAda software-development environment includes an Ada compiler and integrates a suite of development tools under the control of OSF/Motif. On a workstation, different windows can display an editor, a debugger, a network manager, and configuration-management tools. Initially, the system will run on Sun SPARC-based workstations, but the company also plans to port the software to other RISC-based systems.

The Ada compiler included in the development system can compile 1667 lines of code per minute in optimized mode and 2465 lines per minute with no optimization. The system can automatically perform global optimization across all modules in a large application program, including the Ada runtime package. Furthermore, the software system automatically eliminates any subprograms not required for a particular application, thereby reducing the size of the final executable program file.

The suite of development tools that accompanies the compiler, called the Arcs 2.0 toolbox, includes a graphical system browser. The browser shows the structure and dependencies of an Ada program, and also dependencies on C-or assembly-language modules. The browser uses diagram structures defined by software guru Grady Booch in 1983. Icons in the diagram distinguish between specifications, bodies, units, and subunits. The browser and other toolbox features allow a team of programmers to work on large Ada applications.

The Arcs 2.0 includes a language-sensitive editor that performs syntax and semantic checking. The editor's semantic completion service displays all possible completions after the first few characters of a procedure, function, or package name have been typed. A library manager allows programmers to examine and modify program libraries and sublibraries.

The RISCAda package also includes a set of testing tools. For example, the Adatracer package has a source-level debugger and a graphics-based profiler. You can debug code at the source level in one window and view an analysis of the debugged data the profiler displays in another window.

The SPARC version of RISCAda also features a set of bindings to industry standards. For example, the Xview binding allows you to develop Open-Look applications although RISCAda is Motif based. The company offers optional bindings to Sybase and Oracle database packages, and to X-Window and Motif standards. The package includes Posix bindings, and you can purchase the company's Teleuse package that lets you automatically generate programs compatible with the X-Window standard and OSF/Motif.

You can perform cross-development activities under RISCAda using the Triad family of products. The company supports the Motorola 68000 and 88000 µP families, Intel 80386 and 80960 µPs, and MIL-STD-1750A-compatible processors.

Depending on the specific configuration, the SPARC version of RISCAda costs from $6000 to $12,000 per workstation or server. The Teleuse graphical-user-interface generator costs $2000, and bindings to the database packages cost $895. The X-Window and OSF/Motif bindings sell for $2500. The company provides customer support directly.—Maury Wright

Telesoft, 5059 Cornerstone Ct W, San Diego, CA 92121. Phone (619) 457-2700. FAX (619) 452-1334. TLX 855300.

Circle No. 727
The Right Specs. Right Now.

Maxtor LXT-340

See for yourself. The Maxtor 340MB (formatted) 3.5-inch LXT-340 drive, a field-proven design, is available for shipment right now, in volume.

Proven design delivers unbeatable performance including a sequential data transfer rate that is 20% faster than the comparable 331MB Seagate ST1400.

Essential components are common in all drives within the LXT family. This commonality provides easy migration upwards or downwards making future qualifications for other family members happen quickly and efficiently.

Call and ask about our LXT family of high-performance, 3.5-inch AT and SCSI drives with capacities from 213MB to 535MB. Because right now can’t be soon enough. Call your nearest Authorized Maxtor Distributor.

<table>
<thead>
<tr>
<th>3.5 Inch Disk Drive Comparison Criteria</th>
<th>Maxtor LXT</th>
<th>Seagate ST14xx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shipping 300MB Class in Volume</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Full Range of Capacities from 213MB to 535MB</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Commonality in Family for Components and Manufacturing</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

We Drive Harder.

Maxtor®

© 1991 Maxtor Corporation
LXT is a trademark of Maxtor Corp.
PRODUCT UPDATE

VCA features 118-dB range and ≤0.025% distortion

The SSM-2018 is, according to the company, the industry's highest performance voltage-controlled amplifier (VCA) in monolithic form. Supporting this contention is the VCA's dynamic range of 108 dB in class-A mode and 118 dB in class-AB mode, equivalent to 18-bit and ≈20-bit resolution, respectively. In its class-A mode with gains of ±20 dB, the VCA has a maximum THD of 0.025% over the 20-Hz to 20-kHz audio band. In its class-AB mode under the same conditions, THD is 0.04%.

The classic tradeoff designers face is that a class-A device offers lower distortion, and a class-AB device provides a better signal-to-noise ratio. The advantage of this VCA over other devices is that it allows you to choose between either class of operation. A single external resistor programs the VCA's internal gain core for the desired operation. You can ascertain from the previous specifications that little difference in THD exists between the two classes.

Key to the device's ability to operate in either mode is an architecture that the company calls an operational-amplifier voltage-controlled element (OVCE). This architecture provides differential inputs and outputs that can operate in either the voltage or current domain. Conceptually, the differential-output OVCE uses various forms of feedback to create a range of functional configurations, including those suitable for preamplifiers, amplifiers, mixers, equalizers, and compressors.

The OVCE consists of three basic sections: the input differential pair and compensation network; a programmable current splitter that generates the bias current for the gain core; and the 4-transistor gain core, which is essentially a 2-quadrant multiplier. Easing design-in, the VCA contains a high-impedance input control port and an output op amp to eliminate the need for any external active components.

In addition to its low distortion, the VCA also features a 140-dB gain range, a 10V/μsec slew rate, 14-nV/Hz input voltage noise and a 12-MHz gain-bandwidth product. The SSM-2018 is available in 16-pin DIP and SOIC packages with operation guaranteed over the industrial temperature range of −40°C to +85°C. In a 16-pin SOIC, the device costs $3.25 (100).

—Dave Pryce

Analog Devices, Precision Monolithics Div, 1500 Space Park Dr, Santa Clara, CA 95052. Phone (408) 562-7513.

Circle No. 724
Spreadsheet-like interface replaces tedium of HDL code writing

If you can't write VHDL (VHSIC Hardware Description Language), maybe you can "Hum" a few bars. Rather than forcing you to write textual VHDL code, Hum uses a spreadsheet paradigm that allows you to describe the behavior of your circuit by entering Boolean-like descriptions in a matrix. The software then maps the spreadsheet description into behavioral VHDL.

After providing the software with a list of the model's I/O, which the software uses to generate a VHDL entity, you enter a spreadsheet-like table. This table consists of control, object, and a potentially infinite series of state columns. You place WHEN, IF, AND, OR, and DO operators in the control column to control the flow of events. You use the object column to list the signals or variables that result from or influence the operation of your model. Finally, the state columns contain the seven fixed signal states (RISES, FALLS, LOW, HIGH, CHANGES, X, Z), which cause operations to occur.

Pop-up menus prompt you for the proper input to each column in Fig 1; you can create your own data types simply by typing in your enumeration values. The object-column menu presents all I/O pins as potential objects. Unlike VHDL, which demands strict adherence to type consistency, Hum allows you to mix data types; the software creates data-conversion functions as needed.

The software also takes care of the assignment of signals and variables; variables can't exchange information between multiple WHEN blocks (equivalent to VHDL processes) or external models as signals can. After you've developed your models, the software compiles your tabular design into an intermediate format. You then compile the intermediate format into VHDL, which you can simulate using a third-party simulator.

To visualize the simulation of the VHDL code, conceptually "watch" the simulator enter each column at a WHEN operator and evaluate the values of the variables left to right across the row. When the simulator finds a true condition, the simulator executes the remainder of that column, unless a CONTINUE, BREAK, or RETURN statement redirects control. Therefore, most of the time, one column represents one time step.

Although Hum presents a more intuitive and easier-to-use front end for VHDL-based design than textual entry, the method is currently used only for simulation. The software doesn't support generics or packages but does use aliases and labeled DO loops, so you may have to massage or modify the VHDL output to allow synthesis. Although the software declares variables and signals of type integer, it doesn't put bounds on the integer. This failing will choke logic synthesizers but is relatively easy for you to correct.

The software's documentation isn't comprehensive; instead, it's conversationally written to walk you through the specification and generation of a very simple VHDL model of a J-K flip-flop. The draft copy of the documentation also promises a discussion of how to add timing to your models without actually delivering on that promise.

The software does support timing

<table>
<thead>
<tr>
<th>PROCESS</th>
<th>sn54109a</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHEN sd_</td>
<td>LOW</td>
</tr>
<tr>
<td>AND rd_</td>
<td></td>
</tr>
<tr>
<td>AND cp_</td>
<td></td>
</tr>
<tr>
<td>AND _</td>
<td></td>
</tr>
<tr>
<td>AND k_</td>
<td></td>
</tr>
<tr>
<td>&gt; q_</td>
<td>HIGH</td>
</tr>
<tr>
<td>&gt; q_</td>
<td>LOW</td>
</tr>
</tbody>
</table>

Fig 1—You can describe the operation of a J-K flip-flop in a 13×7 matrix. You read the matrix by starting at the control and object columns, reading across to the appropriate state column, and then down that column. For example, WHEN sd_ is LOW AND rd_ is HIGH, THEN q is HIGH and q_ is LOW.
Introducing Zilog’s Smart Access Controller...

Z180 intelligence and SCC communications together in one package.

The Z80181™ SAC™ Controller is the Smart Access Controller™ that combines two powerful standards. You get Zilog’s industry standard SCC™ controller for datacom connectivity together with the popular Z80 CMOS controller. And all that utility comes with the user-friendly Z80® code CPU compatible software.


The Superintegration™ SAC Controller packs the popular high performance Z80 architecture into a new cell suitable for many datacom and peripheral control applications. You get the SCC single-channel communication cell with two additional UARTS, a 4 x 8-bit counter timer (CTC) and onboard 16-bit I/O. The SAC Controller runs at 10 MHz and drives fast serial communications at 2.5 Mbits/sec. With the reduced 3 cycles per instruction, the SAC Controller gives you Z80® code performance 25% faster. That makes the SAC Controller the highest performance, low power embedded controller around.

The best cost/performance of any embedded controller out there.

Whatever your application — data communications, modems, FAXs, printers, terminals, industrial controls — the SAC Controller combination gives you the best cost/performance ratio. Everything you need for your system is on the chip. The SAC Controller brings you all the advantages of Zilog’s Superintegration technology. Off-the-shelf and backed by our solid reputation for quality and reliability.

To find out more about the SAC Controller, or any of Zilog’s rapidly growing family of Superintegration products, contact your local Zilog sales office or your authorized distributor today. Zilog, Inc., 210 Hacienda Ave., Campbell, CA 95008, (408) 370-8000.
UPDATE

via transport and inertial delays that you place by adding "@"<time> for transport delays and " "<time> for inertial delays. You can also use variables and expressions.

To its credit, the company includes partial copies of more complex models with the software for you to use as examples of coding style and the power of the tools. These examples include AMD29000 and Intel 8085 microprocessors.

The company assumes that users of the tool will be more interested in correctly specifying their designs than in the resulting VHDL code. As a result, the software puts both the entity and architecture descriptions into a single file. This procedure simplifies file management at the expense of making what-if analysis a bit more tricky.

The SPARC or VAX X-Window version of the software costs $12,000. A $3500 IBM PC version sacrifices the multiwindowing capability that's useful for displaying multiple tables and internally created waveform graphs.

The company has specified two future revisions of the code. One revision includes an option to create VHDL that you can synthesize. This option will result in larger files that will make VHDL less simulation efficient. The other revision will allow you to copy the necessary timing information right from the data book.

—Michael C Markowitz


Circle No. 737

---

4,000,000 HOURS MTBF

DEMONSTRATED

Today, system reliability is a demand. Field failures causing lost billings, data and time are expensive; causing tremendous damage to your bottom line and customer relations. All too often, the weak link in the system reliability has been the power supply.

Now Power General has the FLU-Series solution. The FLU's are a family of compact, cost effective 40 to 150 watt switching power supplies. Conservative component derating, robust circuit design and automated manufacturing/test result in ultra-high levels of performance and reliability.

Features include:
• 4,000,000 Hours Demonstrated MTBF
• Universal Input Voltage Range 85 - 265 VAC
• UL/CSA/VEE Safety Approvals
• FCC/VEE Class "B" Input Filtering

Power General manufactures these products in the USA (Canton, MA.) on statistical process controlled, JIT production lines. Call or write for the full technical literature or detailed MTBF data.
BEST OF THE '90s

NKK can show you exactly where the switch industry is headed because we're already there. We have over 917,000 different ways to improve your products' reliability and functionality — starting with the just-released break-through switch ideas on this page. Send for our free 400-page catalog.
Contact
NKK Switches,
7850 E. Gelding Dr.,
Scottsdale, AZ 85260.
Phone (602) 991-0942.

WORLD'S SMALLEST

NKK introduces the surface mount G3T with patented STC contacts, gull-wing terminals. VPS or infrared reflow solderable.

EASY DOES IT


ULTRA-MINI

New ND switch is half the size of ordinary binary coded DIP rotaries. Washable and universal footprint pattern.

LEGENDARY


40TH YEAR of Innovation

Million operations from unique LED illuminated JB keypad switch. Red, green or yellow LED options.

DOUBLE DUTY

Logic-level for PCB or power rating for snap-in panel mounting, from very low-profile UB pushbuttons with full-face LED illumination.

TURNING POINT

Washable Binary Coded DIP rotary DR-A switch can be PC or panel mounted. Crisp operation. Right angle or straight terminals.

100,000 CHOICES

YB pushbutton yields literally 100,000 + part numbers with variations in mounting, illumination, circuitry and color.
Spice-based tools speed chip and board analysis

Analog designers have a love-hate relationship with Spice. They generally love its accuracy but curse its speed, its capacity, its inability to converge, and its unfriendly interface. Two Spice-based tools take on some of these problems to improve Spice's utility.

At the chip level, Spectre from Cadence Design Systems is a circuit simulator that uses modified Spice-based algorithms to improve convergence. Spice-based simulators use an iterative analysis to zero in on voltage and current levels. Too often, on large circuits or circuits with many nonlinear elements, these analyses diverge.

Charge-conserving device models allow Spectre to produce more accurate results than Spice. The simulator accepts C-language user-compiled models. It also uses standard Spice models and input files so you can upgrade to Spectre from other Spice simulators, though proprietary models created in other third-party Spice derivatives may not run without modification. Among the models included are the Gummel and Poon BJT (bi polar junction transistor) model, five MOSFET models (MOS1, MOS2, MOS3, BSIM1, and BSIM2), a GaAs MESFET model, and standard diode models.

Spectre's algorithms, coded in C, are tuned for convergence, using benchmark circuits provided by the Microelectronics Center of North Carolina (Research Triangle Park, NC) and by companies associated with Cadence's Analog Alliance Partners. Tuning the simulator to converge on these circuits improves their benchmark performance.

Using the C language yields more efficient memory utilization than Fortran-based Spice implementations. The simulator also uses data structures whose efficiency allows you to simulate large circuits in half the memory of other versions of Spice. The company has simulated circuits as large as 53,000 transistors and claims no fundamental limitation to preclude the simulator from running larger circuits.

Three enhancements provide the circuit simulator with higher simulation speed than Spice. First, the simulator uses a more efficient sparse-matrix algorithm to calculate voltages and currents. Then, because the software uses a node-based algorithm rather than a device-based one, the simulator performs fewer calculations. Finally, the simulator uses automatic time-step control to minimize calculations when circuit voltages and currents are stable.

The simulator accepts C-language user-compiled models. It also uses standard Spice models and input files so you can upgrade to Spectre from other Spice simulators, though proprietary models created in other third-party Spice derivatives may not run without modification. Among the models included are the Gummel and Poon BJT (bi polar junction transistor) model, five MOSFET models (MOS1, MOS2, MOS3, BSIM1, and BSIM2), a GaAs MESFET model, and standard diode models.

The simulator runs on most workstations and is integrated in the vendor's Analog Artist design framework. As a result, you can use the simulator to design and analyze analog circuits as you create them. However, you can't use the simulator on mixed-signal designs yet; it has not yet been coupled to any digital simulators.

Cadence isn't calling Spectre an upgrade; both users and nonusers of its current Spice-derivative simulator pay the $30,000 single-user licensing fee.

Another Spice-based tool addresses simulation from the system and board perspective. Profile, from Valid, is a front end for the company's Analog Workbench II Spice-based simulation tool. Profile enables both graphical and textual entry of structural- and behavioral-level circuit descriptions.

Where Spice has classically been a text-based simulator, this front end allows you to build circuit mod-
The Most Diverse Family In Memory.

A Complete Line Of 1-Meg SRAMs.

Call Sony first. The largest selection of 1-Meg SRAM assures you can find the high performance, highly reliable memory you're looking for with just one call, so why go on a safari?

- Fast or slow. Hot or cold. Even your massive memory requirements are right here.
- And we can ship the package styles most in demand for your new designs today — and tomorrow. Our new production facility in San Antonio, TX will build on the reputation for timely delivery that has made us a breed apart.

The Best Selection Of New SRAMs.

-40° to +85°c, 3 volts and X9.20 nsec
- If your current designs incorporate the latest technology, call us. Virtually every new idea in SRAM will be here at Sony first. And our U.S. design team (with their 0.8 & 0.5-micron CMOS technology) stands ready to get you the right product for your design; whether it’s for a laptop or workstation.

Call Sony First.

We’ve got the product, backed by the Sony commitment to quality and service. And at competitive prices that make us the King of the SRAM Jungle.

Call today 714.229.4190 or 416.499.1414 in Canada. Or fax us your current requirements for a quick response from our technical staff 714.229.4285 (fax) or 416.497.1774 (fax/Canada).

1-Meg SRAM

<table>
<thead>
<tr>
<th>Model</th>
<th>Speed (ns)</th>
<th>Packaging</th>
<th>Data Retention</th>
<th>Special Features</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>128Kx8</td>
<td>100/120</td>
<td>DIP</td>
<td>L/LL</td>
<td>B/X</td>
<td>New</td>
</tr>
<tr>
<td>- 128Kx8 M</td>
<td>100/120</td>
<td>SOP</td>
<td>L/LL</td>
<td>B/X</td>
<td>Now</td>
</tr>
<tr>
<td>- 128Kx8 TM</td>
<td>100/120</td>
<td>TSOP</td>
<td>L/LL</td>
<td>B/X</td>
<td>Now</td>
</tr>
<tr>
<td>- 128Kx8 MM</td>
<td>100/120</td>
<td>TSOP</td>
<td>L/LL</td>
<td>B/X</td>
<td>Now</td>
</tr>
<tr>
<td>- 128Kx8 MP</td>
<td>70/85</td>
<td>DIP</td>
<td>L/LL</td>
<td>B/X</td>
<td>Now</td>
</tr>
<tr>
<td>- 128Kx8 MP</td>
<td>70/85</td>
<td>SOP</td>
<td>L/LL</td>
<td>B/X</td>
<td>Now</td>
</tr>
<tr>
<td>- 128Kx8 MP</td>
<td>35/45/55</td>
<td>SDIP</td>
<td>L/LL</td>
<td>B/X</td>
<td>Now</td>
</tr>
<tr>
<td>- 128Kx8 JP</td>
<td>35/45/55</td>
<td>SOJ</td>
<td>L/LL</td>
<td>B/X</td>
<td>Now</td>
</tr>
<tr>
<td>256Kx4</td>
<td>17/20</td>
<td>SOJ</td>
<td>Sync ASM</td>
<td>3/Q '91</td>
<td></td>
</tr>
<tr>
<td>- 256Kx4 J</td>
<td>25/30/35</td>
<td>SOJ</td>
<td>3/Q '91</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

L = Low    LL = Low,Low  B = 3 Volt  X = Extended Temperature

Sony Corporation of America, Component Products Company, 10833 Valley View St., Cypress, CA 90630
Sony Canada, 411 Gordon Baker Rd., Willowdale, Ontario M2H 256

Prices and specifications are subject to change without notice. The purchase of products is subject to availability and Sony’s standard terms and conditions of sale. Sony is a registered trademark of Sony Corporation.

EDN July 4, 1991 CIRCLE NO. 36
CUSTOM THICK FILM NETWORKS

Fast turnaround on U.S. made DIPs and coated/molded SIPs. • Unlimited schematics combining resistors, inductors, capacitors and diodes. • Complete capabilities from design through production. • Lead lengths up to 0.290''. • Special performance ranges, plus production and testing to M83401 levels.

Call or Fax your requirements to:
DALE ELECTRONICS, INC.
Techno Division
7803 Lemona Avenue
Van Nuys, CA 91405-1139

Phone (818) 781-1642 • FAX (818) 781-8647

CIRCLE NO. 37

UPDATE

EDN July 4, 1991

els from block diagrams that include such components as PLLs, differentiators, oscillators, and gain blocks. Although this front end also accepts standard Spice netlists, the components it accepts can be behavioral-level models, which contain differential equations, Laplace transforms, and basic arithmetics. The advantage of these components is that they simulate faster than more detailed structural models.

Because the simulation software allows distributed processing of multiple tasks across a network, certain multiprocess tasks can utilize excess processing capability. Such tasks don't include simple dc and transient analysis but do include statistical and parametric simulation.

The software expands Spice's capabilities and minimizes convergence problems by incorporating modeling extensions to Spice. Profile models can include such effects as hysteresis, memory, and conditional branching. The models also let you eliminate discontinuities in nonlinear models using piecewise-linear functions. As an example, a model can use the function $y = 1/x$, where $x \leq -0.1V$ and $x \geq 0.1V$; it can close the discontinuity with the function $y = x$, for $-0.1V < x < 0.1V$.

The language allows modeling of electromechanical devices such as motors, solenoids, and sensors. You can also build mixed-signal analog/digital models. An option to the company's $12,000 Analog Workbench II simulation and analysis tools, Profile costs $15,000 and runs on Sun, DEC, and IBM workstations.—Michael C Markowitz

Cadence Design Systems Inc, 555 River Oaks Pkwy, San Jose, CA 95134. Phone (408) 943-1234. FAX (408) 943-0513.

Circle No. 725

Valid, 2820 Orchard Pkwy, San Jose, CA 95134. Phone (408) 432-9400. FAX (408) 432-9430.

Circle No. 726
BNC Cable Assemblies

- Impedance matched
- High strength molded terminations

Meritec's BNC impedance matched cable assemblies are available in a variety of configurations, including cable end plug, cable end jack, front panel mount jack, front panel mount jack with isolated ground and rear panel mount jack. The connectors are terminated to subminiature coax cable and feature standard BNC and cable impedances of 50 and 75 ohms. High strength molded terminations make the assemblies ideal for critical applications requiring high reliability. The assemblies may be terminated with Meritec's SSI™, SSC™, SPI™ or PCB Solderable Interconnects on the opposite end.

Mark No. 40 on Inquiry Card

High-Performance Interconnects That Terminate High Cost.

Meritec has terminated the high cost of high performance interconnects for fast logic applications. We produce a full line of cable assemblies for applications in the 3ns to sub nanosecond range—engineered to meet your requirements for controlled impedance and propagation rate while minimizing crosstalk. We deliver assemblies of unparalleled quality on time, at a very reasonable price.

Our complete line includes Single Signal Interconnects (SSI™), Shielded Performance Interconnects (SPI™) and Multi Signal Interconnects (MSI™), terminated to a diversity of controlled impedance cables, including coax, twin coax, FEP, PTFE and our Filotex™ textile cable.

Call Meritec today at 216-354-3148 for more information and a free copy of our capabilities brochure.

.CP50™ Pitch Hermaphroditic Connectors eliminate the need for separate male and female parts

- Feature .050" centers
- 50 Ω impedance matched

Meritec introduces a new concept in board-to-board interconnects—CP50™ Hermaphroditic Connectors. Each mating half is identical in configuration, eliminating the need for separate male and female parts. Close pitch .050" centers minimize board space requirements. The 50 Ω, impedance matched connectors feature precision, high strength molded terminations for reliability in critical applications and are designed to meet IR or vapor phase reflow requirements. Contact tails come in SMT and through hole configurations, straight and right angle.

Mark No. 40 on Inquiry Card

Card Edge Connectors with .050" centers are available in SMT and through hole configurations

Meritec's CP50™ Card-Edge Connectors are designed with .050" centers to minimize board space requirements. The 50 Ω, impedance matched connectors are ideal for high density board-to-board applications. The connectors are designed to meet IR or vapor phase reflow requirements. Through hole and SMT contact tail configurations are available. Precision, high strength molded terminations provide reliability in critical applications.

Mark No. 40 on Inquiry Card
The next generation of IDC Interconnection:
Same performance, one-half the size.

System 311 is the next generation of reliable high performance IDC mass termination systems from Thomas & Betts, a pioneer in the development of IDC.

A natural evolution, the new System 311 combines the finest capabilities of our proven Ansley® IDC System, downsized and precision engineered to terminate .025 pitch cable.

Performance-oriented features make System 311 the new standard in IDC fine pitch systems – a beryllium copper contact with a dual mating beam that provides greater than 100 grams normal force (150 KPSI Hertz Stress), a unique "coined-slot" IDC contact joint, one piece housing design,
Contact-to-Conductor Relationship –
Thomas & Betts’ “coined-slot” contacts are designed to position the terminated conductors within a specified region for maximum conductivity and reliability.

Precision Lead-In Design –
assures that repeated connect/disconnect functions are consistently smooth and without pin damage.

Our Own Vertical Eject Design –
saves board real estate and ensures positive locking and easy disengagement of header from mating socket without stress to cable, contacts, or solder joints.

and high performance materials are combined to ensure excellent system integrity and maximum reliability.
System 311 incorporates these customer-requested features into a compact interconnect system with board space savings of up to 50%.
From cable to connectors to application tooling, System 311 is designed to meet or exceed the most stringent customer requirements for fine pitch IDC mass termination.
For complete information or help with a specific application, call or fax: Thomas & Betts Corporation, Electronics Division, 200 Executive Center Drive, Greenville, S.C., Phone: 803-676-2900, Fax: 803-676-2991.
For the new System 311 Catalog call 800-344-4744.
Designers in the small form factor arena have a lot on their minds when it comes to selecting connectors for today's emerging standards: compatibility, reliability, availability. And solid engineering support where they need it—anyplace in the world.

That's why so many are choosing AMP and the AMPLIMITE .050 Series of high-density interboard and shielded I/O connectors.

The .050 Series is compatible with SCSI-2, IPI-2, HIPPI, and EIA.
High-density shielded I/O and interboard connections.

RS-232 standards—standards that AMP helped define in the first place. Engineering distinctions: smoothed tuning fork contacts, high-temp polymer housings, true footprint position and packaging for robotic application, and a wide range of hardware and mounting options.

And AMP is there to help you, with design-level engineering and support worldwide, manufacturing capacity second to none, and the high-speed application tooling you need to meet any production requirements.

For more information on the AMPLIMITE .050 Series high-density connectors, call our Product Information Center toll-free at 1-800-522-6752 (fax 717-561-6110). In Canada call 416-475-6222. AMP Incorporated, Harrisburg, PA 17105-3608.
HARDWARE AND INTERCONNECT DEVICES

High-density connectors solve tough pc-board interconnect problems

The high signal speeds and tight packing densities found in today’s active components would be of little value without the interconnect technology to support them. Fortunately, novel connector designs let system designers take advantage of the improvements in today’s components.

Table 1 lists some of the key parameters for selecting high-density connectors. The companies have all used the range of pinout options to achieve the pinouts necessary to satisfy today’s system needs. AMP, Fujitsu, and Teradyne use a 0.1 x 0.05-in. pinout grid. Hypertronics, DuPont, and Cinch use the 0.1 x 0.1-in. grid, but also use more than two rows of contacts. AT&T, ITT Cannon, JST, and Molex use hard metric contact spacings of either 1 or 2 mm for their connectors.

The pin counts available in Table 1’s partial listing of high-density connectors should satisfy the needs of most system designers. For the most part, the connectors feature gold-plated contacts, which improve interconnect reliability. And most of the connector designs feature a wiping-action type contact mating.

However, connector manufacturers cannot arbitrarily continue to reduce contact spacings. There are a number of considerations they must address, such as maintaining signal integrity and minimizing the effect of insertion force. For example, as vendors try to cram more and more pins into smaller spaces, the pins must get smaller and the force necessary to insert the connector must increase. Zero-insertion-force technology is one way to minimize problems associated...
with increasing forces. Since signal integrity is so critical at high speeds, Augat, AMP, and Teradyne place clean signal transmission at the top of their design-goal lists.

Augat’s solution for the problem of interconnecting high-speed signals is the electronic invisible interconnect, a device that uses controlled-impedance Micro-Strip or stripline design technology. The unit is a compression, surface-mount, single-piece connector that routes signals from a mother board to a perpendicularly mounted daughter board. All signals pass through a short length of flexible circuit mounted within the connector’s housing.

In standard electronic invisible interconnect connectors, the flexible circuit has a 50Ω characteristic impedance; however, Augat will customize the impedance of the circuit to fit your needs. A contact assembly routes the signals from the mother board to the flexible circuit and then on to the daughter board. The flexible circuit features a ground plane.
To be truly international players in the connector market of the future, vendors will have to go hard metric with pinouts. Therefore, there is no need to dedicate any connector pins to ground points and thereby degrade connector density. The propagation delay for each signal line measures 30 psec, ±10%. The attenuation and signal skew parameters are 0.025 dB max and 10 psec max, respectively.

Each electronic invisible interconnect connector consists of 160-pin modules that you can stack to create larger devices. The unit's sequenced-mating feature lets you insert a daughter card during power-up. As you insert the card, the ground pins contact first. Power-pin contact follows, and then the signal pins mate. A 0.05-in. wiping action occurs during the signal-pin mating sequence. Part of the connector—a protective locking and aligning cover—resides on the daughter board. The cover properly positions the daughter board and the mother board's main connector. The card-mating action wipes the daughter board's contacts across spring-loaded contacts to ensure low-resistance connections.

Using borrowed technology

The AMP Micro-Strip connectors utilize the same Micro-Strip techniques used extensively in pc boards to control transmissions. The line includes three models: a board-to-board stacking connector, right-angle connectors that connect boards perpendicularly to one another, and a cable-to-board unit designed for system interconnect applications.

Transmission characteristics in the Micro-Strip connectors are controlled by adjusting dimensions, spacing, and dielectric properties. The units have a controlled impedance of 50Ω, ±10%, which minimizes impedance-related discontinuities during the sending and receiving of fast-risetime digital data pulses. Crosstalk is limited to less than 4% at 1 nsec. Connector design provides a lower inductance ground return that results in minimal voltage drops between grounds while signals are being switched simultaneously. This lower inductance makes dedicated signal and ground pins unnecessary. The connectors feature 40 signal pins and two ground-bus segments per linear inch.

Ground-bus segments are designed in increments of 20 signal pins, and each segment is approximately 0.5 in. long. This design lets users tailor the Micro-Strip connector to fit a specific application. In applications that require impedance control for the entire connector, you

### Table 1—Representative parameters for high-density pc-board connectors

<table>
<thead>
<tr>
<th>Company</th>
<th>Model</th>
<th>Number of contacts</th>
<th>Contact spacing (in.)</th>
<th>Contact current (A)</th>
<th>Contact plating</th>
<th>Lifetime (cycles)</th>
<th>Operating range (°C)</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMP</td>
<td>Micro-Strip</td>
<td>20 to 240</td>
<td>0.05 x 0.1</td>
<td>0.5 for signal 5 for bus</td>
<td>Gold</td>
<td>50</td>
<td>-55 to +125</td>
<td>$0.15 to $0.21/ mated line (OEM qty)</td>
</tr>
<tr>
<td>AT&amp;T</td>
<td>McTrel</td>
<td>456</td>
<td>0.079 x 0.079</td>
<td>1</td>
<td>Gold</td>
<td>200</td>
<td>-55 to +125</td>
<td>$0.08/mated line</td>
</tr>
<tr>
<td>Augat</td>
<td>EIL</td>
<td>160 to 960</td>
<td>0.050 x 0.050</td>
<td>0.5/21</td>
<td>Gold</td>
<td>100</td>
<td>-55 to +105</td>
<td>$0.60 to $0.80/ signal (1000)</td>
</tr>
<tr>
<td>Beta Phase</td>
<td>MS4-025-312-D-LTF</td>
<td>312 pairs</td>
<td>0.025</td>
<td>0.5</td>
<td>Gold</td>
<td>500</td>
<td>-65 to +125</td>
<td>$0.10 to $0.20/ pair</td>
</tr>
<tr>
<td>Cinch</td>
<td>CIC²</td>
<td>106</td>
<td>0.1 x 0.1</td>
<td>4</td>
<td>Gold</td>
<td>25,000</td>
<td>-55 to +125</td>
<td>$75 (10,000)</td>
</tr>
<tr>
<td>DuPont</td>
<td>HPC</td>
<td>40 to 600</td>
<td>0.1 x 0.1</td>
<td>1</td>
<td>Gold</td>
<td>Not specified</td>
<td>-65 to +105</td>
<td>$0.09 to $0.18/ mated line</td>
</tr>
<tr>
<td>Fujitsu</td>
<td>FCN790</td>
<td>10 to 40</td>
<td>0.05 x 0.1</td>
<td>1</td>
<td>Gold</td>
<td>500</td>
<td>-55 to +105</td>
<td>$1.67 (1000) for a 20-contact unit</td>
</tr>
<tr>
<td>Hirose</td>
<td>FX1</td>
<td>144, 192, 216</td>
<td>0.05</td>
<td>0.5</td>
<td>Selective gold</td>
<td>500</td>
<td>-55 to +85</td>
<td>$16/mated pair</td>
</tr>
<tr>
<td>Hypertronics</td>
<td>KA254</td>
<td>48 to 490</td>
<td>0.1 x 0.1</td>
<td>3 to 5</td>
<td>Gold</td>
<td>100,000</td>
<td>-55 to +125</td>
<td>$36 to $250 (1000)</td>
</tr>
<tr>
<td>ITT Cannon</td>
<td>Tempus</td>
<td>24 to 192</td>
<td>0.079 x 0.079</td>
<td>1</td>
<td>Gold</td>
<td>250</td>
<td>-55 to +125</td>
<td>$0.08/mated pair</td>
</tr>
<tr>
<td>J S T Corp</td>
<td>FPZ</td>
<td>7 to 25</td>
<td>0.039</td>
<td>0.5</td>
<td>Tin-lead</td>
<td>100</td>
<td>-25 to +85</td>
<td>$0.40 to $0.60/ line (OEM qty)</td>
</tr>
<tr>
<td>Molex</td>
<td>FFC/FPC</td>
<td>30</td>
<td>0.039 x 0.025</td>
<td>1/0.5</td>
<td>Tin</td>
<td>30</td>
<td>-20 to +85</td>
<td>$0.01/line (OEM qty)</td>
</tr>
<tr>
<td>Teradyne</td>
<td>VHISICon UHD</td>
<td>38 to 396</td>
<td>0.1 x 0.05</td>
<td>2</td>
<td>Gold</td>
<td>500</td>
<td>-55 to +105</td>
<td>$0.50 to $1/ mated line²</td>
</tr>
</tbody>
</table>

**Notes:**
1. Ratings for flex circuit/contact pin.
2. Controlled Impedance Connector.
3. For connector portion of system only.
can use the pc board’s ground line as a common interconnect point for the individual ground bus segments in the connector. However, if transmission protection is only required in part of the connector, you can use the remaining contacts to perform other functions, such as low-speed control-line interconnection or low power distribution between boards.

All three versions of the Micro-Strip connector are similar in design—a row of contacts is located on each side of a separable ground bus positioned in the center of each connector. When the connector halves mate, the ground connection is carried from one pc board to a second pc board by a metal ground bus. This eliminates the need to use signal contacts for the grounding function.

Interconnects go GI

Teradyne’s VHSICon UHD is a complete backplane interconnection system designed primarily for advanced VHSIC-based military/avionics applications. The system includes a controlled-impedance, multilayer, pc-type backplane (KS1050 Series) and a UHD connector system, which consists of a backplane segment and a daughter-board segment. The backplane half of the connector mounts via solderless, compliant, press-fit contacts. The bare pc backplane can contain as many as 30 layers.

Featuring connectors that measure $5.44 \times 0.58$ in., the VHSICon UHD conforms to the dimensions of SEM (Standard Electrical Module) format E. The connectors employ a miniature version of the tuning-fork and blade contact system. This contact technology, used in airborne, shipboard, and ground-based applications for many years, is qualified to MIL-C-28859, MIL-C-28754, MIL-A-28870, and WS6157. The daughter board and backplane connectors feature 10 modular sections; each section contains 40 tuning-fork or blade contacts. This modularity eases field repair. The modular insulator concept lets you easily construct connector patterns that are longer or shorter than the SEM format and incorporate fiber-optic or coaxial contacts to meet future system needs.

Daughter-board connectors are available in two versions: with flexible-circuit terminations (FM1050) or rigid terminations (M1050) at the connector/daughter-board interface. In both cases, the terminations are attached to each side of the daughter board using surface-mount techniques. The blade contact is also identical in both versions—only the terminating end that attaches to the module is different.

Running traces significant distances to reach a backplane can degrade system performance. Cinch gets around this problem by doing away with the backplane interconnect concept.

Cinapse, Cinch Connector’s interconnect technology, eliminates traditional backplane wiring techniques in high-speed systems. The technology can significantly reduce propagation delays by shortening interconnect paths between components.
The interconnect technology uses resilient, cylindrical wads of wire, known as button contacts, which are positioned in a dielectric substrate and interposed between the items that must be connected. You can position these button contacts anywhere on the substrate and achieve a direct interconnect between components or pc boards. There's no need for conventional mother-board/daughter-board techniques, and there's no soldering required.

The physical properties of the button contacts make them efficient conductors. The random nature of the wire structure provides a redundant contact at the interface surface, creating a high-pressure connection. In addition, button contacts provide a wiping action when compressed, ensuring reliable electric contact.

Currently, the company can manufacture these boards with as many as 625 connections/in.². The button contacts are available in diameters of 0.04 in. for use on 0.075-in. min centers and 0.02 in. for use on 0.04-in. min centers. The boards can use buttons in various materials to satisfy different environmental conditions. Materials include copper/silver for temperatures as high as 85°C, beryllium/copper for temperatures as high as 105°C, molybdenum for temperatures as high as 125°C, and copper/nickel/tin for temperatures as high as 200°C. The buttons are also available with either gold or other plating.

Once the signal-integrity issue is resolved, the designer must address the problem of insertion force. You can eliminate the problem by carefully considering the mechanical aspects of the connectors.

Shape memory alloy (SMA) metals have a physical structure that, through the application of heat, can be unlocked, rearranged, and programmed to take on new shapes. About 20 alloys have shape-memory properties, but only a few—copper zinc aluminum, copper zinc nickel, and nickel titanium—are practical for commercial applications. The nickel titanium alloys are the most promising because they offer the best overall performance. They have good memory capacity, they resist corrosion and cracking, and they are lightweight and elastic.

Beta Phase offers a line of pc-board connectors that use this nickel titanium alloy. These connectors offer a combination of impedance-matched high-density contacts, zero-insertion force (ZIF), and high contact force. They allow you to make ZIF connections on three edges of a pc board. In addition, you can remotely or locally ac-
METRAL. The New Universal Interconnection System From Du Pont.

METRAL is the next generation interconnect system that's meeting today's need for greater density, modularity, flexibility, and functionality. And that's just the beginning. METRAL cuts costs by shortening the design cycle. It reduces risk by being flexible enough to allow for design changes. And METRAL is universal enough to use in electronic packaging designs from modems to mainframes.

With all these advantages, it's no wonder METRAL was selected by IEEE as the interconnection standard for Futurebus+.

METRAL is designed for today's—and tomorrow's—high density requirements.

METRAL connectors are based on a 2.0 millimeter grid and provide up to 456 signal positions on a double Eurocard. Which means, in the same amount of space, METRAL packs more than twice the position density of DIN 41612.

Cost-effective density like that makes METRAL indispensable if you want the most value possible from real estate.

In other words, the more functions you pack on a board, the more you need METRAL.

METRAL is a trade mark of the Du Pont Company for its family of electronic connectors.

DuPont Electronics
Share the power of our resources.
HARDWARE AND INTERCONNECTED DEVICES

...tuate the devices electrically—there's no need to physically access the connector. The connector can also function as a card guide and stiffener, providing good mechanical support for the board.

The connectors consist of three basic parts: a shape-memory element, a closing spring, and flexible-film circuitry that includes the contact pattern and a built-in heater. When you trigger the heater, the shape-memory element moves toward its original flat shape, engaging and opening the contact-closing spring. After inserting the board, you remove power from the heater. The shape-memory element closes, engaging the contacts with high normal forces—100g/contact in a typical connector. The polyimide-film flexible circuitry meets military standards.

Beta Phase's connectors offer a number of features. The use of flexible circuitry makes it possible to mix trace widths and center spacings to accommodate signal, power, and grounding needs. The connectors are also compatible with surface-mount technology. Because plastic molded bodies are not required for strength or support, each connector's profile, size, and weight are low. The use of shape-memory alloys also makes it easy to tailor the connectors for specific applications. In an application involving -55 to 125°C operation, for example, the connector would employ an alloy that triggers above 125°C.

Historically, connector technology has shown very slow change cycles. However, there's little doubt that surface-mount technology and multichip modules will continue to put the pressure on when it comes to higher I/O density. To meet the needs of the future, connector vendors may have to abandon today's design techniques to provide interconnects that will not introduce signal degradation.

For more information...
One of the precise hand-held instruments that didn’t need one of our cable assemblies.

Annie never missed. Well, almost never. As long as she was ahead of second best, the room for error was there.

Not so in the critical engineering of micro-miniature cable and connector solutions at Precision Interconnect. Tolerances are getting tighter, desired sizes smaller, and development time shorter.

Working with exact electrical requirements, plus challenging mechanical parameters, we design and produce extremely reliable, long flex-life cable, with conductors terminated to standard connectors or active devices, and with protective flex-strain reliefs. These complete interconnect systems, usually using 30 AWG and smaller conductors, provide the critical link in hand-held applications on test and measurement equipment and medical diagnostic devices.

Our expertise, increasing with each unique problem we solve, ensures that reliability is designed in, built in, and tested. So we’re right on target. Every time.

PRECISION INTERCONNECT
16640 S.W. 72nd Avenue, Portland, OR 97224
(503) 620-9400
Offices in San Francisco, Boston, Wilmington and Düsseldorf

High frequency probe provides matched impedance and matched time delay for a Tektronix logic analyzer.
The recent alliance of Elco and AVX with Kyocera forms a solid business relationship that gives us even stronger connections to today's exciting world of technology.

These connections strengthen our own high quality standards and link us to new sources of innovation throughout the world.

Together we combine our talents, energies, and experience to provide you with an ever-expanding line of advanced connector products of unsurpassed value. These new connections also contribute to a fresh spirit of efficient service and delivery and assure you of timely response to your ever-evolving needs.

From a new source of energy emerges a powerful new Elco.

Elco Corporation
A Kyocera Group Company

World Class Connections

U.S.A. 814 643-0700 (FAX 814 643-0426)
Germany 49-2741-2990 (FAX 49-2741-299299)
U.K. 44-638-664514 (FAX 44-638-661233)
Japan 81-45-543-7185 (FAX 81-45-545-1499)
Korea 82-2-868-0147 (FAX 82-2-868-6600)
Singapore 65-353-8312 (FAX 65-353-8316)

Copyright 1990, Elco Corporation.
All rights reserved.
Futurebus+ wire-wrap boards conform to hard metric standards

The 031-128 and 031-129 multilayer wire-wrap boards are for prototyping Futurebus+ systems. The 12SU x 300-mm boards conform to the hard metric standards of the Futurebus+ specification. The boards have a bus interface section that contains premounted arbitration, data, and handshake transceivers from National Semiconductor.

The 031-128 and 031-129 boards have transceivers for 64-bit and 128-bit bus communications, respectively. The transceivers are packaged in 9-bit plastic quad flatpacks. The maximum line length on the boards is 2.3 cm, and the typical stub length is 1.4 cm. The boards use the Futurebus+ 2-mm bus connector and have five wire-wrapappable signal layers. You can order the board in wire-wrap pin lengths for two or three wraps and in a choice of platings. The 031-128 with all-gold pins for two wraps costs $1742.65.

Hybricon Corp, 12 Willow Rd, Ayer, MA 01432. Phone (508) 772-5422. FAX (508) 772-2963. Circle No. 734

Gasket material provides EMI shield and environmental seal

Gore-Shield gasket material provides a high shield against EMI and RFI while maintaining an environmental seal. The expanded polytetrafluoroethylene (PTFE) material provides more than 80 dB of shielding, and the shielding remains constant under vibration. The material provides 100-dB electric-field suppression at 100 kHz and 80 dB of suppression at 18 GHz. Plane-wave shielding is greater than 80 dB at 1 to 18 GHz. Volume resistivity is 0.5 Ωxcm.

The material has passed the deep-space outgassing test in accordance with the NASA specification ASTM-E-595-84. The material operates at -266 to +260°C and is soft and pliable, allowing you to form it around corners and place it on irregular surfaces.

The gasket material comes in thicknesses of 0.005 to 0.25 in. and widths of 0.125 to 24 in. The material is available in sheets, strips, and die-cut sheets, with or without conductive adhesive backing. Prices for form-in-place strips start at $156 for a 50-ft roll.

W L Gore & Associates Inc, 2401 Singerly Rd, Box 1220, Elkton, MD 21922. Phone (301) 398-6400. Circle No. 728

EDN July 4, 1991 73
100 CHANNELS. 100 MHz. 1 CARD.
YOU EITHER HAVE IT

OR YOU DON'T.

No other logic analyzer, rumored or real, can keep up with the single-card, 100 MHz sync/400 MHz async Tek Centurion, the comprehensive solution for RISC and high-speed CISC.

Compare its accuracy against multi-card 100-channel solutions. Discover its vast expandability for multi­microprocessor debugging. See the advantage of Tek analysis tools, backed by up to 128K/channel memory.

Disassembly support? Only Tek gives you the 80386, 80486, 80960CA, i860, 88100, 68020, 68030, 68040, R3000, R3000A, and AMD 29000. Not soon, someday, or maybe, but shipping now.

Don’t buy less without seeing Centurion first! See your Tek sales engineer for a demo, or call 1-800-426-2200 to get the facts.
The conventional attachment of a D-Sub connector requires excessive loose hardware and assembly time.

The "old way" involved many loose parts and time-consuming assembly. PEM Connect 'R Ware Standoffs dramatically speed assembly and secure the connector with six fewer parts.

For a true DFA product that is less expensive to install, offers increased reliability and improved quality performance, specify PEM Connect 'R Ware™ standoffs.

For a Connect 'R Ware product bulletin, circle the number below or call:

1-800-237-4736
or FAX: 215-766-0143

FREE SAMPLE!

Clinch it with PEM®
FASTENERS & PRESSES

Penn Engineering, P.O. Box 1000, Danboro, PA 18916.

©1991
Flamarrest-Jacket Cables
The LANlite and Bitlite families of cables are now available in Flamarrest jackets. Flamarrest, a low-smoke, flame-retardant compound, is 5 times more flexible than fluorocopolymer jackets. The cables lie flat and don't have a tendency to coil after removal from a spool. The Bitlite cables operate from 0 to 75°C; the LANlite cables operate from -10 to +50°C.

The single-mode Bitlite cables are available in 1- or 2-fiber constructions. The #221811 and #221812 cables feature an attenuation of 0.5 dB/km at 1310 nm and 0.4 dB/km at 1550 nm. The LANlite cables are designed for indoor applications to provide high bit-rate communications between mainframes. LANlite cables, $0.65 to $0.72/ft; Bitlite cables, $0.21 to $0.62/ft.

Belden Wire and Cable, Box 1980, Richmond, IN 47375. Phone (317) 983-5200 Circle No. 380

Industrial Enclosure
The Series 14 industrial enclosure for embedded systems contains as many as 20 VMEbus or optional Multibus II backplane slots. It offers the flexibility of defining the number and type of backplane slots as well as the form factor, which can be single-height, double-height, or a combination of both. Power supplies range from 140 to 700W. The enclosure comes with two fans, which provide 140 cfm of air flow; as an option, you can add two fans that generate as much as 400 cfm of air flow. Integrated floppy-disk drives have mounting and wire harnesses that let you configure the enclosure into a turnkey system. You can easily remove the power-supply subsystem as a complete unit via a rear access. From $2000.

Matrix Corp, 1203 New Hope Rd, Raleigh, NC 27610. Phone (919) 231-8000. FAX (919) 231-8001. Circle No. 382

Surface-Mount DIP Sockets
The ICF Series surface-mount DIP sockets have 3-finger contacts that are stamped and formed with soft beryllium copper. The slotted solder tails feature solder fillets for coping with the stresses experienced by surface-mount connectors during mating cycles. You can turn the tails under or away from the socket. Its liquid-crystal polymer insulators can withstand an infrared or vapor-phase soldering process at temperatures as high as 230°C for 30 sec.
The sockets come in 0.3-in. spacing with 8 to 24 pins, as well as 0.6-in. spacing with 24 to 40 pins. The units have a current rating of 1A, a contact resistance of 10 mΩ, and operate from -65 to +125°C. $0.08 (1000).

Samtec Inc, Box 1147, New Albany, IN 47151. Phone (800) 726-8329; in IN, (812) 944-6733. FAX (812) 948-5047. Circle No. 383

Quick Disconnects
The Avikrimp insulated quick disconnects provide a secure metal-support sleeve. They fulfill the double-crimp requirements of TUV, VDE, and other DIN specifications. In addition to their TUV license, they have passed TUV/VDE testing. The units feature molded-nylon insulating housing and a funnel en-
INTRODUCING PRISM CBISM
THE FIRST TRUE SURFACE MOUNTABLE LED INDICATOR.

The new surface mount CBI from Dialight is another breakthrough idea whose time has come. Instead of bending the leads on a through-hole version to make it look like a surface mount device, Dialight uses a patented high transmission prism and clear lens to bend the light from an upwards-facing surface mount LED. This approach offers a uniform illumination of the lens over a wide viewing angle. Finally, a truly leadless indicator developed for reflow-soldering and compatible with a wide variety of pick and place equipment.

The PRISM CBI is available in T-3/4 (1mm), T-1 (3mm) and T-1 3/4 (5mm) lens sizes. This unique product is offered in package sizes of 0.130 x 0.098 x 0.138 for the T-3/4, 0.240 x 0.185 x 0.200 for the T-1 and 0.250 x 0.245 x 0.282 for the T-1 3/4 size.

The introduction of the PRISM CBI means there is one less component on the board that has to be through-hole mounted because now a reliable surface mount version exists. Using this approach, an extremely high "post-process" reliability rate can be achieved.

Available in red, yellow or green, packaged in ESD-shielded tape on EIA standard 7" or 13" reels, the PRISM CBI is ready for a whole spectrum of demanding SMD applications.

For more information contact:
Dialight Corp., 1913 Atlantic Ave., Manasquan, NJ 08736; Tel.: (908) 223-9400 Fax: (908) 223-8788.

ALL INDICATIONS ARE
DIALIGHT
Hardware and Interconnect Devices

try that leads to a stress-relieved barrel having deep wire-grip serrations. The units are available for #10 to #22 AWG wire sizes, as well as hand crimping. They also come on Mylar tape for automatic crimping equipment. Loose pieces, from $110; tape-mounted parts, from $125 (1000).

Molex-Etc Inc, 4820 Park Blvd, Pinellas Park, FL 34665. Phone (800) 237-8905; in FL, (813) 541-4651. FAX (813) 541-4505. Circle No. 384

Optical Video Link
The LNK-50 device consists of an optical transmitter and receiver module, and an optical fiber cable. Depending on the quality of the fiber cable, it can transmit color video signals as far as 3 km. Both the modules and the cable have shielding for EMI and RFI. Built-in automatic gain control keeps the signal levels constant without re-adjustment.

The unit requires a 12V dc power supply and drives a nominal 1V p-p into video equipment having a 75Ω input impedance. Other specifications include a 30-Hz to 8-MHz transmission bandwidth; a 42-dB S/N ratio; an unbalanced 75Ω input and output impedance; a differential gain less than 8%; and a differential phase less than 5°. The standard optical fiber is GI 50/125 fused-quartz fiber. $995.

Turbocache 486 Socket
Developed specifically for Intel's Turbocache 486 module, the Microcache socket is molded from high-temperature thermoplastic and has 113 pins. Two different contact versions accommodate either lead variation on the Turbocache module—

Every connecting product for every kind
Hardware and Interconnect Devices

0.025-in. square-post or 0.020-in. round leaded modules. Both variations use 6-finger contacts, which ensure positive retention and minimize insertion and extraction forces. The screw machine contacts come in a variety of platings and are nonsolder wicking. Square-post socket, $9.79; round socket, $3.89 (1000).


Circle No. 386

Fiber-Optic Connector

The Mini-BNC multimode fiber-optic connector conforms to IBM's 8210 fiber-optic network specifications. You can polish its stainless-steel, radius-tipped ferrule for low back reflection. The connector's 3-µm fiber-hole tolerance results in an average connector loss of 0.21 dB for 62.5/125-µm multimode fiber. Mating durability tests, which conform to FOTP-21 specifications, record incremental losses of <0.2 dB for 500 connector insertions. The connector is available for both 125- and 140-µm multimode clad fibers. Maximum cable size for proper termination is 1.5-mm outside diameter for the fiber buffer and 3.2-mm outside diameter for the cable jacket. Preterminated cable assemblies, a polishing tool, and an installation kit are also available. $10.95.

Ofti, 2 Lyberty Way, Westford, MA 01886. Phone (508) 692-6606. FAX (508) 692-6620.

Circle No. 387

Self-Clinching Standoffs

You can use the DSOS Connector Ware standoffs for mounting D-sub connectors. The self-clinching standoffs replace much of the loose hardware associated with D-sub connector attachments. When installed, the standoffs become permanently fixed to the chassis to prevent them from dropping into the electronic circuitry. They come in 303 stainless steel in #4-40 and M3 threaded sizes. You install the standoffs from the rear of a panel, which can be 0.087 to 0.25 in. deep. The standoffs go into a punched or drilled hole and mount flush with the panel. The flush mount eases the installation of RFI and EMI gaskets. $0.10 each.

Penn Engineering & Manufacturing Corp, Box 1000, Danboro, PA 18916. Phone (800) 237-4736; in PA, (215) 766-8853. FAX (215) 766-0143.

Circle No. 388

That's AT&T "Customerizing."

AT&T is your one-stop quality source for everything from cable to splicing and test equipment. Whether it's data cable, composite cable, optical cable or fiber, AT&T has it all. Along with 110 Connecting Blocks, ST Connectors, FDDI Jumpers, and any number of other connecting products. Everything you need in copper and fiber optics for the transmission of voice, data, image, and remote sensing. Everything you need for all your applications, such as LAN and harsh environment, off-the-shelf or custom designed.

Technical support? We'll work side-by-side with you to design special situation connections. And we'll provide system as well as component solutions. You also have AT&T's assurance of product quality and reliability. Backed by the design and technology expertise of AT&T Bell Laboratories. And by a century of AT&T cable and apparatus manufacturing experience. Giving you everything you need. Exactly the way you need it. That's what we mean by "Customerizing."

For more information, just give AT&T a call at 1 800 344-0223, ext. 1053.
The competition
You can call us at

It's enough to make other VME board builders call us names. Or call it quits.
A new 23 MIPS VME single board computer based on the 88100 RISC microprocessor. Or a new 20 MIPS VME board based on the 68040 CISC microprocessor.
Both are built by Motorola. And each is offered for a modest sum.

A mere $3,995 per board.
For all you multiplication buffs out there, that comes out to just $174/MIPS for the RISC board.
A far cry from the $1,000/MIPS you've been asked to pay for somebody else's board.
And it's just $200/MIPS for the
CISC board. A whole lot less than you'll pay elsewhere.

The MVME187 (RISC) and MVME167 (CISC) boards employ VME D64 architecture. Boosting the VMEbus bandwidth to a full 40MB/s.

And both boards come with four 32-bit timers. SCSI and Ethernet connections. Plus

the Motorola name and all it implies.

For a free color brochure, call the 800 number above. And see why the competition undoubtedly wishes we'd call the whole thing off.

MOTOROLA
Computer Group
Surprisingly, it doesn't cost much to move into our 32-bit architecture.

You don't need a French Provincial budget to move into the i960™ SA/SB processors. Not even close.

In fact, at under $20, the i960 SA/SB processors are comparable in cost to a 16-bit system. And yet, with a full 32-bit internal architecture and a 16-bit data bus, they give you five to six times the performance of any other 16-bit embedded processors.

Or in other words, for almost nothing down you can own an impressive new home. With an architecture that's perfect for today's more demanding applications, such as entry-level page printers, I/O controllers, and communication products.

Naturally, when you move up to a 32-bit architecture, you want to be sure it's a place where you can stay and grow. Which is why you'll be happy to know that the i960 SA/SB processors
are part of a close-knit neighborhood of Intel SuperScalar i960 microprocessors. So you get software compatibility across the board as well as an easy performance path up to 100 MIPS.

And while great price/performance and compatibility are important, they're not the only reasons some very important companies have already moved into the i960 line. They were also impressed with the comprehensive array of development tools and the outstanding technical support that made them feel right at home with the technology.

So when you are ready to move into the i960 SA/SB line, call 800-548-4725 and ask for the 960 Welcome Guide. We'll not only make the move less expensive, we'll even help you set up.
Neural-network technology offers promise in embedded applications, such as vibration control and image recognition. The varied architectures of neural-network ICs, however, limit the type of embedded applications any of the individual ICs best suit.

Maury Wright, Regional Editor

Neural networks excel in applications such as character recognition, financial analysis, bomb detection, target classification, and just about anything else that requires pattern recognition on input data. Further, neural-network ICs promise to make cost-effective and physically small neural-based products possible. Only two companies currently ship such ICs, however, and two more will offer chips shortly. The ICs differ so greatly in architecture that you must match your application to the best architecture rather than comparing features of the ICs.

Neural networks, like the human brain, operate based on experience gained from a set of training data. Neural networks don’t require development of software algorithms or rules. Therefore, development cycles for neural-based products can be relatively short, providing that you have a suitable set of training data. Neural networks can also detect key data patterns that a programmer may never recognize as important.

By nature, neural networks employ an array of interconnected neurons to solve problems in a parallel manner. The parallel architecture allows neural networks to quickly handle pattern-recognition problems that traditional digital computers solve by sequentially comparing sets of data. (For more background information on neural networks, see Refs 1, 2, and 3.)

You can test the applicability of neural networks to a design problem by using a software simulator. A number of companies offer simulator programs for personal computers and workstations at prices ranging from approximately $200 to $10,000. You can also purchase hardware accelerators to increase simulation speed (Ref 1 includes information on simulators and hardware accelerators).

General-purpose computers and simulators, however, often fail to meet the size or cost constraints of designs that must be deployed in the real world. Some simulator vendors offer methods that let you generate dedicated code for traditional µPs, and the code generated uses neural-network algorithms. You may find that simulating a neural network on a µP in an embedded design works for simple neural-network topologies. But ICs that specifically implement neural networks provide the greatest performance for embedded applications.

Briefly consider the architectures of
available and soon-to-be available neural-network ICs. Intel leads the way with the 80170NX ETANN (electrically trainable, analog neural-network) IC. The ETANN chip includes 64 neurons and 10,240 synaptic weights. The chip is based on the company's floating-gate memory-cell technology used in EEPROM ICs.

The ETANN IC, as the name implies, uses analog circuits to multiply inputs times stored weights, sum the inputs to a neuron, and perform the sigmoid function on each neuron. Fig 1 depicts the architecture of the IC. You preprogram the synaptic weights in a manner similar to programming an EEPROM.

You can use the reset and feedback control signals to set up the ETANN IC in different neural-network topologies. The simplest operation provides 64 input and 10 bias vectors and 64 analog-signal outputs. You can expand the inputs to 128 vectors in place of on-chip feedback.

And, you can implement a 2-layer feed-forward neural network on a single ETANN IC using two operating cycles.

**IC takes bit-slice approach**

The Micro Devices division of Chip Supply offers the MD1220 NBS (neural-bit-slice) IC, which is completely digital in nature. Fig 2 shows the architecture of the MD1220. The IC includes eight neurons, each consisting of a digital processing element that can perform 16-bit multiply-accumulate operations. The IC accepts 256 16-bit synaptic inputs and reads 16-bit weight values from external memory.

Designers of the MD1220 faced trade-offs between pin count and chip setup time because of the 16-bit inputs. Therefore, the circuitry that surrounds the MD1220 must load the chip inputs in a time-multiplexed fashion. Once set up, however, the neurons perform in parallel.

The MD1220 was the first neural-...
Simple application characteristics such as analog or digital inputs can help determine if an IC suits your needs.

network IC available, but its future is not entirely certain. The engineers that developed the IC at Micro Devices no longer work for the company, but all now work at nearby startup American Neuralogix. Micro Devices plans to continue to offer the MD1220 IC and a $595 evaluation kit for IBM PC-compatible computers. The kit demonstrates neural networks by balancing a "broom stick."

Paul Basehore, vice president of engineering at American Neuralogix and formerly general manager of Micro Devices, has plans to ship a neural-network IC by the fourth quarter of 1991. Called the NLX420 Neural-Processor Slice, the IC will employ an architecture similar to the MD1220's, but with improvements such as 32-bit multiply-accumulate capability and support for an unlimited number of inputs.

Another company, Neural Semiconductor, should ship a neural-network IC this summer. The company had announced a 2-chip implementation of its technology last year but never got the chip to market. The NUSU32 will include 32 neurons, 32 inputs, and an array of 1024 weights. Neural Semiconductor uses digital circuits to perform multiply-accumulate operations, but does not use traditional multipliers. The logic model in Fig 3 demonstrates the way the company uses pulse arithmetic to multiply an input by a weight and sum it with other inputs at the wire-OR stage.

**Inputs can guide choice**

Your potential embedded neural-network application should guide you toward one of these technologies. For example, the Intel ETANN IC accepts analog inputs directly from real-world sensors and typically requires a minimum of signal conditioning. If the inputs in your application are digital, however, you will require a lot of data converters to connect to the 64 analog inputs on the ETANN IC.

The ETANN IC also has built-in weight storage. You can program the IC permanently, or you can design support circuitry that allows field updates. The ETANN IC also requires a minimum of support circuits for embedded applications. The IC doesn't require µP control for setup, and the analog outputs can drive CMOS or TTL logic.

The Micro Devices NBS IC requires digital inputs, a µP to control loading and operation of the chip, and external memory for weight storage. The MD1220 actually simulates a neural network, albeit with a parallel architecture. The µP control provides the opportunity to handle applications that require continuous training simply.

The Neural Semiconductor NUSU32 falls between the other two devices. You need a µP to control the IC. The IC will directly accept digital inputs and some properly conditioned analog inputs. The IC directly implements a neural network because there is a local processing element at each weight.

The NUSU32 doesn't perform analog multiplication and addition, but has a silicon-efficient way to do these operations digitally. The NUSU32 stores weights essentially in static RAM (SRAM) on chip. The design uses 40 transistors to store a weight with the equivalent of 8 bits of dynamic range and to implement the math functions. Furthermore, the company claims its technology will allow it to build mask-programmed ROM-based ICs requiring only five transistors per weight.

Ultimately, you match your application to an IC architecture based on price vs performance. Expect this task to be doubly difficult in the case of neural-network ICs. You can't really guess what the different ICs might cost next year because you really don't know how...
much success the companies will have selling the ICs and, therefore, increasing volume and lowering prices.

Based on software simulation, you should define a set of network specifications including number of layers, number of neurons in each layer, and number of inputs and outputs. All of the ICs can be cascaded to add neurons to any layer and to increase the number of layers. You can simply determine how well your network topology maps into ICs offered by Intel or Neural Semiconductor. Both technologies directly implement neurons; therefore, you can estimate the number of ICs necessary to hold your design.

IC simulates large network

Micro Devices' MD1220, however, gives you the option of making a single chip simulate a large network. The controlling µP handles storage of the values of signals in intermediate layers. Therefore, you realize less performance than an implementation that applies one neuron for every neuron in the network model.

So consider the following figures with care. Intel sells the ETANN IC for $940. The $11,000 development system is a virtual necessity unless you want to build a system to handle training and device programming yourself. Intel will also develop evaluation samples of programmed parts for customers based on simulations. This all the company plans to offer a multichip prototyping board with a wire-wrap area. The prototype board will cost $9750.

You can buy Micro Devices' MD1220 ICs for $50; expect American Neuralogix to sell its NLX420 for about the same price. You can experiment with the ICs using low-cost µPs.

Neural Semiconductor expects to sell samples of its chip for $500. The company offers a simulator that costs $500 and includes activation functions that accurately mimic the operation of its ICs. It also plans a prototype board, and you can control the NUSU32 with a standard µP.

The Intel ETANN IC offers (by a wide margin) the fastest neural performance. The IC performs 2 billion multiply-accumulate operations per second—also referred to as connections per second. Furthermore, the IC doesn't slow down on large networks; you just use more ICs. But, because the IC has 64 neurons, a single IC can perform tasks such as optical character recognition.

The Neural Semiconductor NUSU32 can perform 2 billion connections per second, but the accuracy the IC offers decreases as you increase speed. The company prefers to rate throughput as 100,000 patterns per second. Like Intel's ETANN, the speed of the NUSU32 doesn't slow on large networks—the number of chips required increases. Yet some simulator vendors quote the spec connections per second. And in the case of a simulation, the connections-per-second spec can mislead you because it doesn't reflect the real performance of a large network.

You can implement a 3-layer feed-forward network with eight neurons and 256 synaptic inputs.
neurons per layer using three of Micro Devices' MD1220 ICs and process an 8-bit input in 21.6 µsec. The ICs can perform 10M connections per second.

Looking forward, expect to see two trends in neural-network ICs. Some vendors will offer neural-network IC technologies conducive to customization. In fact, Neural Semiconductor has already discussed such technology. Company president Robert Bagby says that Neural Semiconductor's technological strengths include an efficient way to build nonlinear matrix multipliers and a way to connect thousands of the multipliers. Furthermore, Neural Semiconductor's technology can be implemented with standard CMOS fabrication techniques.

Neural Semiconductor can therefore implement custom neural-network ICs using its technology and standard ASIC techniques. A standard neural-network IC will always have neurons or weights that are not needed, just as there are always unused gates in a gate array. Neural Semiconductor's Bagby claims customers will buy the company's architecture because it will provide ways to simulate neural networks, implement low-volume applications in ICs, and implement high-volume applications in ASICs.

The second trend will be for companies to design neural-network-based ICs for specific applications. An example of the trend can be found in Adaptive Solutions' plan to build a neural-network compute server that will use a custom neural-network IC. The IC, called the N64000, includes 64 digital signal processors and measures slightly more than 1 in.² Each processing node includes a 16-bit ALU, a hardware multiplier, and a 4k-byte array of SRAM for weight storage. The system Adaptive Solutions plans will use four of the ICs, cost $55,000, and be available late this year.

Adaptive developed the IC with the help of Inova Microelectronics Inc (Santa Clara, CA). Inova had planned to sell the IC as a merchant product, but recently filed for bankruptcy. Adaptive has hired the Inova engineers that worked on the project and will finish development of the chip. Currently, however, the company hasn't formulated plans to sell the device to other companies.

Finally, semiconductor industry stalwarts such as Fujitsu, Hitachi, and Mitsubishi have demonstrated neural-network ICs destined for specific applications. Motorola and Texas Instruments have also shown interest in the technology. And a number of companies have work un-
You prefer to design your own disk drive servo control function, but doing so demands much of your time.

That's the beauty of our H4631 Servo Controller. It's a standard set of building blocks from which you can quickly, easily and flexibly configure the custom solution you're after.

If you're designing for the next wave of laptops or palmtops, keep in mind that the CMOS-manufactured H4631 has a notably low appetite for power. Plus, it integrates digital servo and motor speed architectures, and eliminates the need for Hall sensors. In short, it's desirably indiscrete.

The H4631 can comfortably interface with numerous types of microprocessors. Even DSPs. In fact, it equips you with such versatile capability, you might forget that it's right off the shelf.

Your next move is to call us for literature package SPD-9. We'll connect you with your nearest Silicon Systems representative and update you on our latest developments.

1-800-624-8999, ext. 151.

Silicon Systems, Inc.
14351 Myford Road, Tustin, CA 92680
Ph (714) 731-7110 Fax (714) 731-6925
European Hq, U.K. Ph (44) 79-881-2331
Fax (44) 79-881-2117
REPLACE MESSY GREASE WITH Q-PAD II®

The New, Improved Thermally Conductive Alternative to Grease.

• Q-Pad II replaces grease in applications where isolation is not required.
• Q-Pad II provides maximum heat transfer between interfaces.
• Q-Pad II is available in standard configurations and custom shapes.

For free samples of Q-Pad II or any of the Sil-Pad® Thermally Conductive Insulation Products Call Toll Free: 1-800-347-4572 Today!

BERGQUIST
5300 Edina Industrial Blvd., Minneapolis, MN 55435
TEL: (612) 835-2322 FAX: (612) 835-4156 TWX: 910-576-2423

CIRCLE NO. 53

INTEGRATED CIRCUITS

INTEGRATED CIRCUITS

ORDER WAY TO DEVELOP NEURAL-NETWORK ICs FOR DEFENSE ADVANCED RESEARCH PROJECTS AGENCY CONTRACTS. YOU CAN THEREFORE EXPECT TO HEAR ABOUT A NUMBER OF NEW ICs IN THE NEXT YEAR. THE NEWSLETTER NEURAL NETWORKS TODAY (REF 4) PROVIDES MONTHLY UPDATES ON MANY OF THESE IC PROJECTS.

References

Article Interest Quotient
(Circle One)
High 512 Medium 513 Low 514

HAVE YOUR SAY

EDN’s Signals & Noise column provides a forum for readers to express their opinions on issues raised in the magazine’s articles or on any topic that affects the engineering industry.

Send your letters to Signals & Noise Editor, EDN Magazine, 275 Washington St, Newton, MA 02158. Or, send us a message via MCI mail at EDNBOS. You can also reach us through EDN’s Bulletin Board System at (617) 558-4241 and leave a letter in the EDITORS Special Interest Group. You’ll need a 2400-bps or less modem and a communications program that is set for eight data bits, no parity, and one stop bit, or 1200/2400, 8N1 in shorthand.
How single-chip fuzzy logic can move your product to the head of its class

Need to make your product more intelligent? Fuzzy Logic is the solution of choice. Need to do it quickly and economically, with maximum flexibility? Then the NeuraLogix NLX230 Fuzzy MicroController™ is in a class by itself!

The NLX230 is a single-chip solution. One 40-pin package delivers Fuzzy Logic mastery to the most complex control problems.

The NLX230 is flexible. It can be easily configured for your specific control problem, usually in a matter of hours.

The NLX230 is fast. Its rule processing time is 30 to 40 times faster than typical software-based or software/hardware hybrid solutions.

The NLX230 is economical. In production quantities, this remarkable Fuzzy MicroController is priced under $4 per unit.

As the first true hardware based Fuzzy Logic controller, the NLX230 makes artificial intelligence available and simple. For most applications it can be an affordable high-performance replacement for 8-bit microprocessors. See how easily it adapts to your requirements; evaluate how the NLX230 can meet your demands with our low-cost Applications Development System.

Move your product to the head of its class with hardware-controlled Fuzzy Logic. Call now for specifications and price quotation on the NLX230 and other fuzzy logic and neural network devices.

NeuraLogix
American NeuraLogix, Inc.
411 Central Park Drive
Sanford, FL 32771
Telephone 407/322-5608
FAX 407/322-5609
Now just one chip does the work of many.

Micro Linear's ML2035 and ML2036 are the industry's first integrated programmable sinewave generators. They're easily programmable from DC to 25kHz (ML2035) or 50kHz (ML2036). Each delivers better than ±0.75Hz frequency resolution, and -45dB harmonic distortion.

Absolute error gain over the frequency range is better than ±1dB. And the frequency reference of the sinewave output is derived from either an external crystal or clock input.

The ML2035 is housed in an 8-pin DIP while the full featured ML2036 is available in a 14-pin DIP or 16-pin SOIC.

At prices starting at $5.95, the low-cost ML2035 and ML2036 are the perfect single chip solutions to efficient, precise sinewave generation.

So whether your application is in telecommunications, modems, motor control, uninterruptible power supplies, or any other, call Al Tremain at (408) 433-5200. Or write to Micro Linear, Dept. SWG, 2092 Concourse Drive, San Jose, CA 95131.

And ask for your copy of our 1991 Data Book, too.

Generating Precise Phase Controlled Sinewaves

60Hz Sinewave Output Using NTSC Color Burst Crystal

Generating Fixed 50Hz and 60Hz Sinewaves

ML2035 Block Diagram

CIRCLE NO. 56
Low-transistor-count 32-bit µP chip seeks embedded systems

The Hyperstone E1 µP, an 85,000-transistor chip, operates at a burst rate of 25 MIPS at 25 MHz. It requires no external cache and directly controls external dynamic RAM (DRAM) chips.

The E1 chip offers an address space of 4G bytes, and it has separate memory and I/O addresses. The chip supplies 19 global and 64 local 32-bit registers. Programs can directly address as many as 16 global and 16 local registers. You can also reconfigure the registers in a variable-length stack, using from 2 to 16 frames. Most of the chip's instructions are 16 bits long, although complex instructions can consume as many as 48 bits. High throughput results from a combination of pipelined load instructions, an internal 2-stage decode/execute pipeline, and a look-ahead instruction cache.

The company expects the chip's $150 price to drop to less than $50 (10,000) by the end of 1991. A development board, which provides an E1 CPU, 1M byte of DRAM, 256k bytes of EPROM, and an RS-232C I/O port, is available for $1699. You can load instructions and data into the development board through the computer's serial I/O port. A PC-compatible assembler costs $350, and a debugger costs $400.

In addition to selling the chip itself, the company has licensed non-exclusive rights to the chip to Zilog. Zilog will offer the µP chip alone and as a core for embedded applications in its Superintegration ASIC program.

Hyperstone Electronics, GmbH, Robert-Bosch-Strasse 11, D-7750 Konstanz, Germany. Phone 07531-67789. FAX 07531-51725.

Zilog Inc, 210 Hacienda Ave, Campbell, CA 95008. Phone (408) 370-8000. FAX (408) 370-8056.

Voice-storage chip supplies nonvolatile analog memory

The ISD-1016 voice-storage chip requires neither an A/D nor a D/A converter because it relies on analog memory. The device operates from a 5V power supply, and it requires few external passive components and no external crystal or clock signal. Distortion measures about 2%.

Nonvolatile memory cells, using a proprietary CMOS/EEPROM technology, store charge in random-access memory. Thus, the chip requires no backup power supply to maintain its analog information—the chip draws 10 µA of standby current only to supply power to additional circuitry.

The ISD-1016 stores as much as 16 sec of speech, and you can cascade as many of the chips as you need to extend a message's length. Because the chip uses a RAM structure, you can access portions of a message or divide the 16-sec interval into subintervals (eg, several shorter messages). To record a message, you connect a microphone directly to the chip. The chip's output drives a small speaker, although you might want to add an external audio-amplifier IC for some applications. You can order the voice-storage chip in a 28-pin DIP or in a 28-pin plastic leadless chip carrier.

The chip can deal with all types of analog information, not just speech or music. For example, it can store test waveforms, sample analog signals, store correlation data, and hold filter coefficients. The chips cost $16 (1000).

Information Storage Devices Inc, 2332B Walsh Ave, Bldg G, Santa Clara, CA 95051. Phone (408) 562-9550. FAX (408) 562-9559.

Circle No. 729

EDN July 4, 1991
Low-drift op amps incorporate switching input stage and loop

Max425 and Max426 CMOS op amps ($9.50 (100) in 8-pin plastic DIPs) equal or surpass the low-drift performance characteristics of bipolar and chopper input alternatives. The maximum specifications for input-offset voltage are $V_{io}$ of 5 µV, $V_{io}$ TC of 0.05 µV°C, and input bias current ($I_{bb}$) of 200 pA. $V_{io}$ noise in a 0.1- to 10-Hz bandwidth is typically 0.25 µV p-p, which represents a fivefold improvement on similar specs for the best chopper amps.

Both amps have 140-dB min open-loop voltage gain and common-mode and power-supply rejection ratios of 120 dB min. Internal compensation yields gain-bandwidth products of 350 kHz and 15 MHz for the Max425 and Max426, respectively.

The op amps achieve low-drift performance by using two independent and programmable on-chip nulling techniques. The first is an autozero loop, and the second is a commutating input stage.

You have a choice of programming either, neither, or both nulling methods for operation. The choices have performance tradeoffs, however. If you don't program the commutating switch, you won't cancel any 1/f noise. In addition, without implementing an occasional cycle of autozero-loop operation, the op amps' output signal may exhibit an increasing level of 300-Hz ripple.

Maxim Integrated Products, 120 San Gabriel Dr, Sunnyvale, CA 94086. Phone (408) 737-7600. FAX (408) 737-7194. Circle No. 732

FPGA features 3000 equivalent gates and 15-nsec logic propagation delay

The pASIC 8x12 is a field-programmable gate-array (FPGA) based on metal-to-metal antifuses that allow you to program the part with a 10V signal. The device, offering 96 macrocells in a 68-pin package, contains the equivalent of 3000 gates. Each macrocell includes six AND gates, three multiplexers, and a scannable flip-flop. The flip-flop is configurable, serving as a D, JK, T, or RS type.

The manufacturer offers a library of more than 200 predesigned functions that fit within a macrocell. These functions include gate elements with as many as 14 input terms, AND-OR logic blocks, multiplexers, and latches.

The <200Ω metal-to-metal fuses allow the device to offer a 15-nsec input-to-output propagation delay through combinatorial logic. The internal circuitry is even faster, allowing you to build, for example, an 8-bit counter that operates at 100 MHz.

The pASIC Development Toolkit includes schematic capture, function and timing simulation, place-and-route, physical viewer/editor, delay simulation, and automatic test-vector-generation software.

The tool kit also includes a programming station with RS232 interconnect cables and an antistatic wrist strap. The software and programming station require a PC running Windows 3.0.

The pASIC 8x12 will be available in sample quantities within twelve weeks; the device costs $75 (1000). The tool kit is available now for $3995.

Quicklogic Corp, 2933 Bunker Hill Lane, Santa Clara, CA 95054. Phone (408) 987-2000. FAX (408) 987-2012. Circle No. 733
The world's most powerful digital filter on a single chip.

The new Harris HSP43220 DDF (Decimating Digital Filter) packs more power into a single-chip digital filter than ever before. With features like programmable decimation to over 16,000, and up to 512,000 equivalent taps, it's a powerhouse of performance.

And despite its incredible power, our DECI-MATE™ software makes designing filters with the Harris DDF incredibly easy. Want to know more? That's easy, too. Just call 1-800-4-HARRIS, ext. 1220. And find out more about our complete line of industry-leading ICs for digital signal processing applications.

**DECI-MATE** is a trademark of Harris Corporation.

EDN July 4, 1991
Integrated Circuits

Configurable Microcontrollers
The four members of the H8/300 microcontroller (μC) family feature an 8-bit external bus and a 16-bit internal bus, although the ALU is 8 bits. You can configure the μCs' internal registers as 16 8-bit or 8 16-bit registers. Despite its 8-bit ALU, both 8- and 16-bit adds and subtracts execute in one instruction cycle (two clock cycles). At 10 MHz, these add/subtract instructions execute in 200 nsec. Hardware and software support include two real-time kernels, several C-language development tools, a fuzzy-logic compiler, assemblers, simulator/debuggers, librarians, and ICEs available from Hitachi or third-party developers. The < $10 (OEM qty), 10-MHz H8/310 features a 1-bit I/O pin for fast data transmission. The $15 to $25 high-end H8/350 features one 19-bit, two 16-bit, two PWM, and six 8-bit timers that you can configure under software control.

Hitachi America, Semiconductor and IC Div, 2000 Sierra Point Pkwy, Brisbane, CA 94005. Phone (800) 448-2244. Circle No. 351

Nonvolatile Static RAMs
The bq4011H and bq4011HY battery-backed, nonvolatile 32k × 8-bit static RAMs (SRAMs) have access times as fast as 35 nsec. Packaged in 600-mil DIPs, the circuitry includes power monitoring and control logic as well as a lithium power cell. If the module's supply falls out of tolerance—10% for the 4011HY, 5% for the 4011H—the control circuits write-protect the RAM contents and switch to battery power to preserve data. Write protection continues until system power returns and is stable.

Because they're SRAM based, the memories have standard timing specifications and offer unlimited read/write cycles. According to the vendor, the battery can protect data for more than 10 years without system power. In 28-pin DIPs, $60.30 (100).


18-Bit Audio DAC
The PCM67 dual 18-bit BiCMOS monolithic audio DAC combines an R-2R ladder DAC, a digital offset technique with analog correction, and a 1-bit DAC for high resolution and low zero-crossing distortion. Operating from a single 5V supply, the DAC features a THD +N of −92 dB at 0 dB, an idle-channel S/N ratio of 110 dB (20 Hz to 20 kHz, A-weighted), and a dynamic range in excess of 108 dB.

The DAC's level linearity at 90 dB is ±1 dB. Specified for a 352.8-kHz sampling rate, the DAC allows 8 × oversampling of the audio spectrum on each channel. The device is available in a 16-pin DIP or a 20-pin SOIC. $19.50 (100).

Burr-Brown Corp, Box 11400, Tucson, AZ 85734. Phone (800) 548-6132; in AZ, (602) 746-1111. FAX (602) 889-1510. Circle No. 353

V.32 Modem Chip Set
Containing the 16-bit fixed-point DSP16A, the T7525 high-precision linear codec and an interface controller, the DSP16A-V32 chip set, compose a low-power, V.32 modem data pump. The DSP chip receives and transmits data, performs echo cancellation, and offers automode capability to select the fastest data rate possible. The chip set implements V.32 9600 baud, V.22bis, V.22, V.21, V.23, Bell 212A, and Bell 103 modem standards. Operating power consumption is 450 mW typ, and the set consumes 50 mW powered down. $70 (10,000). Delivery, 12 to 14 weeks ARO.

AT&T Microelectronics, Dept 52AL300240, 555 Union Blvd, Allentown, PA 18103. Phone (800) 553-2447; in Canada, (800) 553-2448; in PA, (908) 771-2788. Circle No. 354

Pin-Compatible ADC With S/H Amplifier
The AD1674 pin-compatible ADC includes a S/H amplifier. The guaranteed conversion rate of the 12-bit ADC is 10 µsec. The S/H amplifier performs secondary sampling at the output. This additional sampling reduces hold-mode settling time, resulting in a 1-µsec acquisition time, a full-power bandwidth of 1 MHz, and 12-bit performance over the −55 to +125°C temperature range. The monolithic ADC also features a 10V reference, a clock, and 3-state output buffers.

The device's dc specifications include an integral nonlinearity of ±1/2 LSB and no missing codes at 12 bits. The converter has a minimum signal-to-noise and distortion ratio of 70 dB, a maximum THD of −82 dB, and a maximum intermodulation distortion of −80 dB.

Power-supply requirements are either 5 and ±12V or 5 and ±15V. Bus access time is 75 nsec typ, 150 nsec max. The device uses laser-trimmed scaling and offset resistors.
Harris puts all the most popular modulation techniques into one DSP chip.

The new Harris HSP45116 NCOM (Numerically Controlled Oscillator-Modulator) puts all the most popular digital modulation techniques on a single DSP chip. Including QAM, FM, AM, FSK, PSK, and complex down-conversion.

Sample rate: Up to 33 MHz
Frequency control: 32 bits
Phase control: 16 bits
Data input: 16-bit complex

So if you're still doing modulation the old analog way, it's time to change. Because with the NCOM in your design, there's no analog drift, just pure digital accuracy.

Plus, with the NCOM's microprocessor compatible interface, and its complex MAC, digital modulation is as easy as designing with one chip.

Want to know more? That's easy, too. Just call 1-800-4-HARRIS, Ext. 1213. Today.

Spurious freq. components: <-90 dB
Tuning resolution: 0.008 Hz

And find out more about our complete line of industry-leading ICs for digital signal processing applications.
to provide four calibrated input ranges: 0 to 10V, 0 to 20V, ±5V, and ±10V. The converters come in 28-pin plastic DIPs and SOICs and 28-pin ceramic DIPs. $18 (100).

Analog Devices Inc, 181 Ballardvale St, Wilmington, MA 01887. Phone (617) 937-1428. FAX (617) 326-8703.  

Circle No. 355

16-Bit Color Palettes

The SC11485, SC11487, and SC11489 16-bit color palettes provide as many as 65,536 colors in support of the XGA (extended graphics adapter) standard. The devices are downward compatible with the 15-bit, 32,768-color Targa format and 8-bit, 256-color VGA modes. Operating as fast as 80 MHz and working with VGA and Super VGA video controllers, the color palettes provide 1024 × 768-pixel resolution and flicker-free, 70-Hz noninterlaced refresh-rate video boards.

The SC11485 offers three 6-bit DACs. The SC11487 adds 15 overlay registers, which eliminate the need for software to overlay cursors, grids, and menus. The SC11489 uses three 8-bit DACs. The palettes come in 50-, 66-, and 80-MHz speed grades. $10 to $18 (10,000).

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

Circle No. 356

8-Bit DAC

The MB88346 device is a 12-channel, 8-bit DAC. An internal op amp buffers each output channel to drive 400-µA loads at throughput rates as high as 16.7 kHz. Conversion is via an R-2R ladder. Each channel of the DAC accepts 2.5-MHz serial data. This data is loaded into internal data latches before the device converts the digital information into analog dc voltages in 60-µsec settling time. The DAC provides a serial data output that allows you to cascade devices. In 20-pin DIPs and SOJs (small outline J-lead) plastic flatpacks, $4.50 (1000).

Fujitsu Microelectronics Inc, Integrated Circuits Div, 3545 N First St, San Jose, CA 95134. Phone (800) 642-7616; in CA, (408) 922-9000. FAX (408) 432-9044.  

Circle No. 357
New Transceivers Use Small 0.1 µF Capacitors

Push the limits of +5V RS-232 with Maxim’s new family of 116kBits/sec dual transceivers. The MAX222/232A/233A/242/243 typically run at data rates of 200kBits/sec and these limits are achieved while driving real loads (2500pF and 3k). They operate with only 0.1 µF charge pump capacitors, making them ideal for small, low power systems. Maxim’s new MAX233A operates on a single +5V supply with no external capacitors and the MAX243 lets you swap between 2-wire (Xon/Xoff) and 4-wire (CTS/RTS) interfaces without changing cables or adding jumpers.

**FREE Interface Design Guide**

Including: Application Notes + Complete Data Sheets + Cards For Free Samples

Simply circle the reader response number, contact your Maxim representative or Maxim Integrated Products, 120 San Gabriel Drive, Sunnyvale, CA 94086, (408) 737-7600, FAX (408) 737-7194.
Pseudostatic RAM

Organized as a $512k \times 8$-bit memory, the TC518512 is a 4M-bit pseudostatic RAM (PSRAM). The memory uses a 1-transistor dynamic-RAM memory cell and CMOS peripheral logic to internally generate its refresh signals. The chip uses internal timers to generate its 2k refresh cycles/32 msec. The memory comes in 70-, 80-, and 100-nsec speed grades. The 70-nsec device draws 385 mW during operation; refreshing current is 200 µA for all speed grades. Available in 32-pin 600-mil DIPs and 32-pin 525-mil SOPs (small outline packages), the memories use JEDEC standard SRAM pinouts for compatibility. Three speed grades, $34$ to $37.50$ (100).

Delivery, 8 to 12 weeks ARO.


Circle No. 358

SCSI-2 ICs For Synchronous Data Transfers

The Fas216, Fas226, and Fas236 family of SCSI ICs includes support for the 10M-byte/sec “fast” synchronous data transfers defined by the SCSI-2 spec. The chips perform SCSI operations without requiring intervention from a controlling µP. These chips feature a 24-bit transfer counter that supports long data transfers. (Older ICs incorporated a 16-bit counter.) The upper 8 bits of the counter reveal a part-unique ID code when read after NOP (no operation) commands.

The ICs' dedicated DMA channel links the SCSI bus with buffer memory. The three ICs support single-ended and differential transceiver options. The Fas216 supports single-ended applications. The Fas226 supports differential applications but requires external transceivers. Both the Fas216 and Fas226 come in 84-pin plastic leaded chip carriers. The Fas236 comes in a 100-pin quad flatpack and includes support for single-ended or differential applications. Fas216 and Fas226, $18.75; Fas236, $21 (1000).

Emulex Corp, 3545 Harbor Blvd, Costa Mesa, CA 92626. Phone (714) 662-5600.

Circle No. 359

Power distribution. Made simple.

Why settle for this...

...when you can have this?

You already know how complex a power distribution network can get. Wires, terminals, shrink tubing and cable ties, just to start things off. Then there’s the fixturing, testing, crosstalk and ringing. Top it all off with dents in the budget, quality certification headaches and a ferocious appetite for enclosure real estate.

The Bus Bar Division of Methode Electronics can custom design solutions to your power distribution problems. From bus systems that mount on circuit boards and backplanes to sophisticated laminated or powder coated bars, Methode’s bus bars provide reliability and economy.

If high current densities, low noise, designed-in capacitance and accurate termination locations are what you need, talk to us.

We’ll make power distribution simple.

Methode Electronics, Inc.

Bus Bar Division
4001 Industrial Avenue
Rolling Meadows, IL 60008
708/577-9545 • Fax: 708/577-9689

CIRCLE NO. 62
A SOLE SOURCED 1232
COULD SHUT DOWN
YOUR µP!

Spec A MAX1232 And Save $$, Space & Power

Maxim’s new MAX1232 µP supervisory circuit provides you with an enhanced second source for the DS1232. The MAX1232 saves you power and board area, at a reduction in cost. The MAX1232’s 50 µA supply current is 1/10th that of the DS1232. And the new MAX1232 is available in a space saving 8-pin surface mount package in addition to the standard 16-pin SOIC and 8-pin DIP packages.

- Improved Second Source to DS1232
- Reduced Supply Current – 50 µA!
- Also Available in 8-pin Mini DIP and SOIC Packages

Pick The Right µP Supervisor For Your Design

Maxim also offers the MAX690 and MAX700 families of microprocessor supervisory circuits which feature power-on reset, backup battery switchover, watchdog timing, CMOS RAM write protection, power fail or low battery monitoring, and manual reset.

<table>
<thead>
<tr>
<th>FUNCTIONS</th>
<th>MAX 1232</th>
<th>MAX690</th>
<th>MAX691</th>
<th>MAX693</th>
<th>MAX694</th>
<th>MAX696</th>
<th>MAX697</th>
<th>MAX699</th>
<th>MAX700</th>
<th>MAX701</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed Power-Up/Down Reset</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variable Power-Up/Down Reset</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Battery Backup Switching</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Watchdog Timer</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Programmable Watchdog Period</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Fail Warning</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Write Protect</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reset Threshold (V)</td>
<td>4.5/4.75</td>
<td>4.75</td>
<td>4.75</td>
<td>4.50</td>
<td>4.75</td>
<td>&gt;1.3</td>
<td>&gt;1.3</td>
<td>4.75</td>
<td>4.75</td>
<td>4.75</td>
</tr>
<tr>
<td>Reset Pulse Width (ms)</td>
<td>250</td>
<td>35</td>
<td>35/adj.</td>
<td>35/adj.</td>
<td>140/adj.</td>
<td>35/adj.</td>
<td>35/adj.</td>
<td>140</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Price*</td>
<td>$2.10</td>
<td>$3.33</td>
<td>$3.61</td>
<td>$3.61</td>
<td>$3.33</td>
<td>$3.55</td>
<td>$3.55</td>
<td>$2.13</td>
<td>$2.17</td>
<td>$1.96</td>
</tr>
</tbody>
</table>

*1000-up FOB USA

Call your Maxim representative or distributor today for applications information, data sheets and free samples. Or, contact Maxim Integrated Products, 120 San Gabriel Drive, Sunnyvale, CA 94086, (408) 737-7600, FAX (408) 737-7194.

Maxim is a registered trademark of Maxim Integrated Products © 1991 Maxim Integrated Products

Distributed by Arrow, Bell Graham, Elmo, Hall-Mark, Nu Horizons, Pioneer, and Wyle. Authorized Maxim Representatives: Alabama, (205) 830-0498; Arizona, (602) 730-8083; California, (408) 248-5300; (619) 728-4292; (714) 261-1213; (816) 704-1653; Colorado, (303) 799-3435; Connecticut, (203) 384-1112; Delaware, (609) 778-5353; Florida, (305) 426-4601; (407) 830-6444; Georgia, (404) 427-5914; Idaho, (208) 292-8840; Illinois, (708) 356-6802; Indiana, (317) 844-8462; Iowa, (319) 933-2323; Kansas, (816) 436-6445; Louisiana, (214) 238-7500; Maryland, (301) 644-5700; Massachusetts, (617) 329-3454; Michigan, (313) 325-3545; Minnesota, (612) 944-8545; Mississippi, (205) 830-0498; Missouri, (314) 329-0033; (816) 436-6445; Montana, (503) 292-8840; Nebraska, (402) 248-5300; New Hampshire, (603) 239-2454; New Jersey, (201) 428-0600; (609) 778-5353; New Mexico, (505) 235-6802; New York, (212) 428-0600; (607) 754-2171; N. Carolina, (919) 234-0010; New York, (212) 428-0600; (607) 754-2171; N. Carolina, (919) 234-0010; Ohio, (216) 659-9224; (513) 278-0714; (614) 855-1447; Oklahoma, (214) 263-7500; Oregon, (503) 292-8840; E. Pennsylvania, (609) 778-5353; W. Pennsylvania, (614) 566-1447; S. Carolina, (919) 251-0010; Tennessee, (404) 447-6124; Texas, (214) 238-7500, (512) 835-5822; (713) 799-2426; Utah, (801) 561-5099; Virginia, (301) 644-5700; Washington, (206) 823-9535; W. Virginia, (513) 278-0714; Canada, (416) 238-0366; (613) 225-5161, (604) 276-8735, (514) 337-7540.
Analog Devices can meet your needs, no matter what.

Custom Medical Instrumentation ASIC – Provides complete data acquisition on a chip. Replacing 30 separate ICs, it integrates a low-noise instrumentation amp with gains of 15 to 2,000, a 50/60 Hz switched-capacitor notch filter, 11-bit a/d converter, 7-bit d/a converter, and a serial UART communications interface.

Whether your market is a few thousand or a few million, there's one customer demand for your product that'll always remain high – the demand for high performance.

The best way to meet this demand is to follow what the leaders in the medical, military and instrumentation markets have been doing for 25 years, and what the leaders in consumer electronics have been doing for several years now. Call Analog Devices.

These companies call us because we offer a complete line of high-performance linear, digital signal processing and mixed-signal components. ICs that allow them to achieve higher levels of system integration, greater reliability, and
Digital Audio Converters — The SOUNDPORT™ family of data converters comes complete with output amplifier, reference and digital logic interface. These mixed-signal ICs for high fidelity digital audio and multimedia applications achieve SNRs as high as 108 dB and THDs as low as 0.0025%.

three of the top five Japanese electronics companies rely on us for their mixed-signal needs.

And as a global operation, we're able to respond to calls from any corner of the earth. In fact, international sales account for half of our $450 million in revenues. And

better performance in their products.

three of the top five Japanese electronics companies rely on us for their mixed-signal needs.

And as a global operation, we're able to respond to calls from any corner of the earth. In fact, international sales account for half of our $450 million in revenues. And

three of the top five Japanese electronics companies rely on us for their mixed-signal needs.

And as a global operation, we're able to respond to calls from any corner of the earth. In fact, international sales account for half of our $450 million in revenues. And

three of the top five Japanese electronics companies rely on us for their mixed-signal needs.

And as a global operation, we're able to respond to calls from any corner of the earth. In fact, international sales account for half of our $450 million in revenues. And

three of the top five Japanese electronics companies rely on us for their mixed-signal needs.

And as a global operation, we're able to respond to calls from any corner of the earth. In fact, international sales account for half of our $450 million in revenues. And

three of the top five Japanese electronics companies rely on us for their mixed-signal needs.

And as a global operation, we're able to respond to calls from any corner of the earth. In fact, international sales account for half of our $450 million in revenues. And

three of the top five Japanese electronics companies rely on us for their mixed-signal needs.

And as a global operation, we're able to respond to calls from any corner of the earth. In fact, international sales account for half of our $450 million in revenues. And

three of the top five Japanese electronics companies rely on us for their mixed-signal needs.

And as a global operation, we're able to respond to calls from any corner of the earth. In fact, international sales account for half of our $450 million in revenues. And

three of the top five Japanese electronics companies rely on us for their mixed-signal needs.

And as a global operation, we're able to respond to calls from any corner of the earth. In fact, international sales account for half of our $450 million in revenues. And

three of the top five Japanese electronics companies rely on us for their mixed-signal needs.

And as a global operation, we're able to respond to calls from any corner of the earth. In fact, international sales account for half of our $450 million in revenues. And

three of the top five Japanese electronics companies rely on us for their mixed-signal needs.

And as a global operation, we're able to respond to calls from any corner of the earth. In fact, international sales account for half of our $450 million in revenues. And
Now, up to twice the power of a standard battery.

Introducing Nickel-Metal Hydride and ULTRAMAX™ Nickel-Cadmium batteries, two new rechargeables from Gates that are certain to give you a lift.

Ni-MH offers up to 100% more capacity than a standard Ni-Cd battery, while our ULTRAMAX line offers up to 70% more capacity.

And, with this increase in power comes unequaled design flexibility, such as longer run time, additional features, or downsizing without sacrificing performance. To contact a sales engineer near you, give us a call at 1-800-67-POWER. And see for yourself why no other battery carries as much weight.
Specialized ICs correct power factor in switching supplies

To meet upcoming standards, such as IEC 555-2, power supplies will need to use some form of power-factor correction. To this purpose, designers are using integrated circuits specifically dedicated to minimizing the percentage of harmonics in the line current.

Dave Pryce, Associate Editor

As the need for power-factor correction in today's power supplies intensifies, several vendors of integrated circuits have introduced devices that perform this function. Compared with the passive methods traditionally used in such applications as electric motors, active power-factor correction in electronic power supplies is much more complex. Before discussing the complexities of active correction, it's worth reviewing the basic definition of power factor.

Power factor (PF) is the ratio of the real power (measured in watts) to the apparent power (measured in volt-amperes). For sinusoidal line voltages, PF equals the cosine of the phase angle between the voltage applied to a load and the current passing through the load. In the ideal case, when voltage and current are exactly in phase, PF is unity (1). In most uncorrected equipment, however, power factors of 0.6 to 0.8 are common.

When electric motors accounted for the major part of the load serviced by electric utilities, power-factor problems were easy to correct. Because motors are essentially inductive elements, you simply added an appropriate value of capacitance in parallel with the motor windings. The capacitor brought the lagging line current created by the motor's inductance back in phase with the line voltage. The result was a near-zero displacement angle between current and voltage and a power factor close to unity—usually about 0.95 using the capacitors then available.

With myriad electronic power supplies now in use in computers and home-entertainment equipment, power-factor correction requires a much more complex solution. Although linear supplies for laboratory applications generally use transformer coupling and sometimes use choke-input filters, most of today's power supplies are switching supplies. These high-efficiency supplies work directly from the ac line using bridge-configured line rectifiers and a capacitor-input filter (Fig 1a).

As shown in Fig 1b, these circuits draw current in a way that is certainly not sinusoidal. The full-wave rectifier charges the capacitor with pulses of current that occur only at the peak of each half cycle of the ac line voltage. The result is a severely distorted ac input current that generates multiple harmonic currents. It's these harmonics, rather than the displacement angle, that cause most of the reduction in power factor.
Because they don't deliver any power to the load, harmonics serve no useful purpose. Harmonics do, however, contribute to the total line loss, add to the current drain from the line, and dictate the need for higher-capacity wiring.

IEC specification 555-2 reinforces the need for some form of active power-factor correction in today's off-line supplies. Scheduled for implementation in Europe starting in 1992, IEC 555-2 provides harmonic-current limits for four groups of equipment: Class A, for balanced 3-phase equipment; Class B, for portable tools; Class C, for lighting equipment; and Class D, for equipment having an input current with a "special waveshape." In effect, the Class-D specification (Table 1) places strict limits on the allowable harmonic currents for two groups of power supplies: those that consume less than 300W of ac power and those that consume 300W or more. Europe isn't the only market that has strict power-factor-correction standards. MIL-STD-1399 specifies allowable harmonic levels for supplies in American military equipment.

Essentially, a power-factor circuit is a preregulator that uses circuitry similar to that used in a conventional switch-mode regulator. The difference is that the power-factor preregulator restores the input current to a near-sinusoidal state with an appropriate rms value that complements the line voltage; the conventional regulator only deals with the regulation of the output voltage. Like the conventional regulator, the power-factor regulator can use any one of three basic converter topologies, namely: buck, boost, and flyback (buck-boost). Each of these topologies (Fig 2) has distinctive characteristics.

The step-down buck converter (Fig 2a), for example, has major limitations. In order to regulate, the output voltage of a buck converter must be less than its minimum input voltage. Because there's a break in the input current when the input voltage falls below the output voltage, the buck converter cannot provide optimal power-factor correction. However, a buck converter may be satisfactory for low-output-voltage applications having moderate power-factor requirements.

Of major concern in a buck regulator...
Using today's integrated circuits, switching power supplies can obtain power factors of 0.99 or better.

is its chopped current, which can generate considerable line noise that is difficult to filter. Another disadvantage is that the maximum input voltage appears across the switch, and its base (or gate) drive usually requires level shifting to a floating reference. However, because the switch is at the input, the buck converter can control input surge current and also provide protection against an output overload or short circuit.

The flyback (buck-boost) converter (Fig 2c) can either step down or step up the input voltage. In a circuit that isn’t transformer coupled, a flyback converter inverts the output polarity with respect to the input. Advantages of the flyback converter include its adaptability to transformer coupling and its ability to accommodate current limiting and overload protection. Moreover, by controlling the switch on-time, you can—to some extent—make the input current follow the input voltage waveform. But, for the most part, the sinusoidal shape of the input voltage across the inductor determines the input current’s average value.

One disadvantage of the flyback converter is that the switch has to withstand the sum of the input and output voltages. Also, because the peak input current is 2 to 4× the average value, noise can be a serious problem. Because of the high peak currents, power-factor circuits using a flyback topology are generally limited to a maximum power level of about 150W. Fluorescent-lamp ballasts and personal-computer power supplies are typical applications.

Probably the most popular topology for a power-factor preregulator is the boost converter (Fig 2b), which steps up the input voltage. Because the continuous-boost converter does not chop the input current, and because the inductor itself acts as a line filter, RFI and EMI problems are greatly reduced. Also, having the inductor in the input circuit makes it easy to implement current-mode control.

Another advantage of the boost converter is its ability to maintain control over the complete input voltage waveform, thereby minimizing distortion—an important consideration in power-factor control. In addition, the switch’s common-emitter configuration makes it easy to drive the base of the switch with ground-referenced control signals. Moreover, the voltage across the switch is limited to the value of the output voltage. Because its peak current tends to be much less than in other topologies, the boost converter is particularly effective for use in high-power supplies. The major disadvantage of the boost converter is its inability to easily provide short-circuit protection.

Choosing a topology is not necessarily easy. You need to understand the allowable tradeoffs for your part-

![Diagram](image.png)

**Fig 1**—Power supplies using bridge-configured line rectifiers and a capacitor-input filter (a), draw current in a nonsinusoidal way (b). The full-wave rectifier charges the capacitor with pulses of current that occur only at the peak of each half cycle of the ac line voltage.
ticular application. In the case of a low-voltage supply that doesn't require the highest possible power factor, a buck converter may satisfy your needs. For power levels of 150W or less in designs where noise is not a major concern, a flyback converter may be just the ticket. For many high-power applications, however, particularly those that also demand superior power-factor control, a boost converter will probably be your best choice.

Complicating these choices are the differing characteristics of the available controller chips. Although most power-factor chips use either a boost or flyback topology, the specific operating modes of these chips vary. Of the few controller models available, the majority operate at a fixed frequency, and the remainder operate at a variable frequency. Because of potential stability problems, variable-frequency controllers tend to work best with a fixed load and a limited input range. But don't take this dictum too literally—there are always exceptions.

Chips also vary as to how they sense and control the input current. You can choose among voltage mode, average-current mode, peak-current mode, and hysteretic current mode. Chips that rely on peak-current detection need slope (ramp) compensation to correct for the difference in peak-to-average current as a function of pulse width. Such compensation is a compromise based on the expected line and load variations and can degrade performance at high line inputs and low power levels.

Before deciding on the use of a particular chip, look carefully at the data sheets and application information. Although you probably will find a suitable chip for your application, choosing the chip will not be simple.

Recognizing the existing and impending needs to provide a practical solution to the problem of active power-factor correction, several vendors of integrated circuits have introduced devices specifically dedicated to the task. Among these vendors are Cherry Semiconductor, Micro Linear, Silicon General, and Unitrode. As you might expect, all of these vendors have extensive experience in the power-conversion field.

Unitrode states its case for accep-
POWER SOURCES

tance with its UC3854, priced at $3.59 (1000). This sophisticated chip uses average-current control, so it can accurately maintain sinusoidal line current without resorting to slope compensation. Used in a boost topology, the chip provides power factors to 0.99 and limits line-current distortion to less than 5%. The chip operates in systems with line voltages of 75 to 275V and line frequencies of 50 to 400 Hz. When compared with other power-factor controllers, the UC3854's higher reference voltage (7.5V) and higher oscillator output (5V) can offer advantages in high-power supplies, which typically exhibit high noise.

The chip includes a voltage amplifier, a low-offset analog multiplier, a current amplifier, a fixed-frequency PWM, an oscillator, and a 1A totem-pole MOSFET gate driver. Also included is a 7.5V voltage reference, an enable comparator, and an overcurrent comparator. Based on the detailed application circuit in Unitrode's data sheet, the greatly simplified circuit in Fig 3 illustrates the UC3854's basic operation.

As shown, the circuit uses both a current loop and a voltage loop for control. The current loop samples the output waveform of the bridge rectifier through resistor R7, which converts the voltage to a current waveform at pin 6 of the UC3854. This input acts as a reference for the multiplier. To implement feed-forward line regulation, resistors R6, R8, and R9, together with capacitors C3 and C4, develop a dc voltage at pin 8 that is proportional to the rms value of the line voltage. The chip squares this dc voltage and applies it to the multiplies. To complete the voltage loop, resistors R1 and R2 provide a sample of the output voltage and apply it to the input of the voltage amplifier at pin 11. The output of the voltage amplifier goes to the multiplier.

The output of the multiplier is a current that is equal to the product of the voltage amplifier output and the input line voltage, divided by the square of the rms line voltage (\(I_M = AB/C\)). Acting as a control signal to the preregulator, \(I_M\) has an instantaneous value that follows the shape of the input voltage, and an average value that is inversely proportional to its rms value. Resistor \(R_9\) converts \(I_M\) to a voltage, which the current amplifier then uses to force an equivalent voltage across \(R_s\), the line-current sensing resistor.

---

Fig 3—Typical of many of the power-factor-correction circuits is the UC3854 from Unitrode. Shown here in simplified form, the circuit contains both a current loop and a voltage loop.
POWER SUPPLIES

SCR-REGULATED DC POWER SUPPLIES

SINGLE PHASE TCR
- 4 power levels 600 W - 1,000 W - 1,800 W - 2,800 W
- DC outputs variable over full range of 0 to 7.5 V DC through 0 to 2,500 V DC
- Regulated and metered (V and A)
- CV/CC with automatic crossover
- Fully programmable and remote sense
- Complies with VDE 875-N and VDE 871-A
- 5-year warranty

THREE PHASE TCR
- 3 power ranges 2,500 W - 5,000 W - 10,000 W
- DC outputs variable over range from 0 to 6 V DC through 0 to 600 V DC
- Regulated and metered (V and A)
- CV/CC with automatic crossover
- Fully programmable and remote sense
- Complies with VDE 875-N and VDE 871-A
- 5-year warranty

EMHP THREE PHASE
- Catalog units 20 kW through 60 kW, 30 to 3,000 A; modified/custom units to 5,000 A and 100 kW
- Fully programmable and remote sense
- Regulated and metered (V and A)
- CV/CC with automatic crossover
- Complies with VDE 875-N and VDE 871-A
- CV/CC with automatic crossover
- Fully programmable and remote sense
- Regulated and metered (V and A)
- CV/CC with automatic crossover
- Complies with VDE 875-N and VDE 871-A
- 5-year warranty

HCR 250 W DC POWER SUPPLIES
- 9 models 0 to 7.5 V DC through 0 to 300 V DC
- Regulated and metered (V and A)
- CV/CC with automatic crossover
- Fully programmable and remote sense
- ½ rack packing
- 5-year warranty
- Output power via rear mounted terminal boards or front panel binding posts

ATR LINEAR DC POWER SUPPLIES
- 3 100 W ½ rack models
- 3 250 W ½ rack models
- Voltages range from 0 to 32 V DC through 0 to 128 V DC
- Regulated and metered (V and A)
- Both models are fully programmable sources of constant voltage or constant current
- Output power via rear mounted terminal boards or front panel binding posts

EMS HIGH FREQUENCY SWITCHING DC POWER SUPPLY
- 48 models 600 W to 1,000 W to 2,500 W to 10,000 W
- Voltages from 7.5 V DC through 1,000 V DC
- High density packaging — up to 3.1 W/cubic inches at 5 kW
- Regulated and metered (V and A)
- Fully programmable and remote sense
- CV/CC with automatic crossover
- 5-year warranty
- U/L recognized

BIPOLAR OPERATIONAL SOURCE-SINK
- 3 power levels 100 W to 200 W to 400 W
- 4 modes of operation: (1) bipolar power supply (2) an operational power supply (3) sourcing power supply (4) sinking power supply
- DC output voltages of ±20 V DC through ±200 V DC
- IEEE-488 or RS232 digital control
- Regulated and metered (V and A)
The current amplifier provides the gain for the current loop, which controls the action of the pulse-width modulator (PWM). In turn, the PWM and gate driver control the on-off action of the MOSFET power switch, $S_1$, to force the input line current to follow the programmed value. The UC3854 implements average-current control; the compensation network comprising $R_4$, $R_5$, $C_1$, and $C_2$ performs the averaging. $R_{SET}$ programs the oscillator-charging current and the maximum output of the multiplier. $C_T$ sets the PWM oscillator frequency.

For brevity, much has been left out of the preceding circuit description, particularly with regard to the soft-start and enable functions. Unitrode’s Application Note U-125 (Ref 1) and the UC3854 data sheet provide more complete information.

Taking a slightly different approach to active power-factor correction, Cherry Semiconductor accomplishes essentially the same results as Unitrode. Like the Unitrode chip, Cherry’s CS-3810 uses a boost topology, but instead of average-current control, the Cherry chip uses hysteretic current-mode control. To implement this technique, a sinusoidal reference and an offset derived from the reference generate a hysteresis band (Fig 4). Turning the power transistor on and off causes the current to ramp up and down. The switching occurs when the current reaches the bounds of the hysteresis band. The average value of the waveform determines the inductor current.

In addition to the hysteretic current-mode, you can use the chip in constant off-time applications. Other features of the $2.54 (1000)$ CS-3810 include feedforward of the input voltage, undervoltage lockout, a shutdown comparator for fault conditions, and a $\pm 1A$ source-sink output driver.

Probably the leading supplier of power-factor-correction chips, at least in terms of the variety of its products, is Micro Linear Corp, which offers three different chips. The $2.85 ML4812$ is for use in a current-mode boost regulator at power levels of 75 to 2000W. Typical applications include computer systems that require optimum power-factor correction. The $1.80 ML4813$ is for use in a voltage-mode flyback regulator at power levels below 150W. Table 2 summarizes the typical characteristics of the two devices.

The third chip offered by Micro Linear is the ML4819, which combines a boost-mode power-factor circuit similar to the ML4812 with a conventional PWM controller circuit. You can use the PWM section for either current- or voltage-mode control for a second-stage converter. Fig 5 is a simplified diagram of the individual functions. Combining the two circuits in a single device minimizes component count and saves space. Because both circuits share the same oscillator, synchronization is inherent. Moreover, a large oscillator amplitude of 4.3V maximizes noise immunity.

The power-factor section uses peak-current sensing, and the programmable slope compensation is common to both sections. The PWM section includes cycle-by-cycle current limiting as well as duty-cycle limiting (for single-ended converters). Both sections feature individual 1A totem-pole output drivers, but the undervoltage lockout function is shared. The ML4819 costs $3.40, and all three chips are priced for 1000s quantities.

Completing this brief survey of power-factor controllers is the $1.30
NO OTHER LITHIUM BATTERY MANUFACTURER POWERS AS MANY DIFFERENT PRODUCTS AS EAGLE-PICHER. PERIOD.

Get The Fax!
Fill Out This Card And Fax It To (417) 776-2257

Name ___________________________ Job Title ___________________________
Company ___________________________ Phone ___________________________
Address ___________________________

☐ Have A Rep Call ☐ Send Me Information ☐ Commercial ☐ Military ☐ Both

EAGLE PICHER
Electronics Division (Lithium Batteries)
Military: P.O. Box 47 • Joplin, MO 64802 • (417) 623-8000 • Commercial: P.O. Box 130 • Seneca, MO 64865 • (417) 776-2256

EDN July 4, 1991
CIRCLE NO. 66
POWER SOURCES

(1000) SG3561 from Silicon General, the company that developed the first integrated PWM controller some 15 years ago. Optimized for electronic-ballast applications, the chip allows a discontinuous mode of operation over the entire range of line and load variations. This capability is particularly important in ballast applications where the nonlinear nature of the lamp could affect the stability of the preregulator. In addition to its use as a power-factor controller, you can use the chip in conventional switched-mode converters.

Although power-factor correction requires the addition of several active and passive components, which add to the cost of the supply, the power-factor controllers are relatively inexpensive. In 1000-piece lots, even the most complex controller ICs are available for about $3.60 apiece. Whatever the total cost, power-factor-controlled supplies will become the norm, heeding IEC 555-2 and other standards.

Because of the predictive schedule for enforcement of IEC 555-2 regulations, designers must add power-factor correction to their power supplies if they expect their companies to sell into the European market next year. Although only military applications dictate the present U.S. requirements for power-factor correction, this picture could change in the future as more efficient use of power is mandated. Clearly, however, vendors of integrated circuits are answering the need with chips that suit a variety of applications.

References
1. de Sa e Silva, Claudio, “Power Factor Correction With The UC3854,” Unitrode, Application Note U-125.

For more information . . .

For more information on the power-factor-correction ICs 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.

<table>
<thead>
<tr>
<th>Company</th>
<th>Address</th>
<th>Phone</th>
<th>Circle No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cherry Semiconductor</td>
<td>2000 S County Trail</td>
<td>(401) 885-3600</td>
<td>669</td>
</tr>
<tr>
<td>Silicon General</td>
<td>11861 Western Ave</td>
<td>(714) 898-8121</td>
<td>671</td>
</tr>
<tr>
<td>Unitrode Integrated Circuits</td>
<td>7 Continental Blvd</td>
<td>(603) 424-2410</td>
<td>672</td>
</tr>
<tr>
<td>Micro Linear</td>
<td>2002 Concourse Dr</td>
<td>(408) 433-5200</td>
<td>670</td>
</tr>
</tbody>
</table>


Article Interest Quotient
(Circle One)
High 515 Medium 516 Low 517

Fig 5—Combining PWM and power-factor controllers, the ML4819 from Micro Linear needs fewer components than other implementations.
Our Westcor division's family of configurable AC or DC input fan cooled StakPAC switchers reveals a new world of power density and output flexibility to the system designer...whatever your power needs. Each StakPAC is built with field proven robotically manufactured Vicor VI-200 Series power components providing you the flexibility of a customized supply combined with the off-the-shelf availability of standard catalog products..."first article" StakPACs are typically delivered in 2 weeks.

Compact, up to 6W/in³, low profile StakPACs set the standard for "box"or open frame switchers. Besides meeting conducted EMI standards, custom configured StakPACs are pre-approved to UL, CSA, TUV and VDE safety standards (DC Mini- in process).

Whether your application is OFF-LINE or DC INPUT, chances are we have a solution for you...we are designed into computer, telecom, and test measurement systems worldwide. Please call us to discuss your needs, then relax...bulky standards and risky long lead-time custom supplies belong to the past. Discover the new world of configurable supplies: StakPAC, MiniStakPAC and DC Mini.

Call VICOR EXPRESS for information and be sure to ask for a StakPAC or DC Mini Handbook: (800) 735-6200 or (508) 470-2900 at ext. 265. Or call Westcor (west coast) at (408) 395-7050.

---

Component Solutions For Your Power System
First, All Of Your DC Power Source Needs In One Small Package...

...And Now All Of Your DC Loads, Too!

Introducing Programmable DC Loads

The new AT8000A Programmable Loads are based on the new "instrument on a card" technology that became so popular with our AT8000 Power Sources. The AT8000A can house up to six 300W loads in one 5 1/4 inch drawer. By paralleling modules, you can increase the load of any single channel up to 1800W. And by adding expansion chassis, you can increase the system up to 16 channels!

Now You Can Meet Virtually Any ATE DC Source or Load Requirement

You'll appreciate the fact that the Elgar DC Loads and Power Sources can be used in any combination in the same AT8000A chassis. Plus, the option of Built-In Test (BIT) allows you to perform self testing and measurement of system parameters through the bus. The AT8000A can also include an embedded TMA and accept CIIL commands per MATE Interface Standard 28067633.

Elgar Power Is Preferred the World Over.

For over 25 years, Elgar has been the standard in AC Power Sources with over 50,000 programmable power sources and frequency converters in the world being used in science, industry and defense. With the introduction of the AT8000 DC Power Sources, Elgar applied that standard to DC Power Sources. Now, Elgar continues to advance the standard of excellence that has been applied to DC Power with the introduction of Loads for the AT8000A.

For more information about how the AT8000A Power Sources and Loads can help you solve your ATE testing needs, call:

1 (800) 73-ELGAR
Switching power supplies accept worldwide voltages

The US 50 series of 40 to 70W switching power supplies accepts input voltages ranging from 90 to 264V ac, at 47 to 440 Hz. The supplies measure 5 × 3 × 1.2 in. Boasting an efficiency of 70%, the supplies come in single-, dual-, triple-, and quad-output versions. The supplies feature line regulation of ±0.2% and load regulation of ±3%. Output ripple and noise is 25 mV rms, 50 mV p-p for the primary output, and 0.5% rms, 1% p-p for the auxiliary outputs. The supplies have current limiting set at 120% of maximum output.

The supplies have Molex connectors; they conform to FCC Class-A specs and are UL, CSA, and TUV approved. One low-leakage version meets UL544 medical requirements. All models run at full-rated power and minimal air flow. You can also use them with convection cooling at reduced power levels. The manufacturer can customize each model with the output-voltage and current combinations that your applications require. The supplies cost $50.

DC/DC converters’ dual sections provide completely isolated outputs

The K Triple series of 55W dc/dc converters have two separate power sections: one being a 5V (5A) section and the other being either a ±12V (1.25A) or a ±15V (1.0A) section. The two individual power sources within each converter develop isolated, regulated outputs. The power sections operate in antiphase to each other to reduce both ripple-current stress on input components and reflected input ripple.

The converters are 90% efficient and have 2:1 input-voltage ranges, double-shielded pot-core transformers, and toroidal magnetics. The converters’ cases are 0.4 in. thick. Transient-voltage-suppressor diodes protect the inputs and outputs from overvoltages. The outputs feature pulse-by-pulse current limiting.

The cases measure 3.5 × 5.5 × 0.9 in. Line and load regulation is 0.8%, and output noise is 20 mV p-p. Voltage stability is 0.3%/1000 hours. Input-to-output voltage isolation is 500V, and the converters’ operating temperature is −40 to +90°C. The converters cost $150.50 (100).

Digital Power Corp, 41920 Christy St, Fremont, CA 94538. Phone (415) 657-2635. FAX (415) 657-6634. Circle No. 735

Calex Mfg Co Inc, 3355 Vincent Rd, Pleasant Hill, CA 94523. Phone (800) 542-3355; in CA, (415) 932-3911. FAX (415) 932-6017. Circle No. 736
Programmable Linear Supplies
You can program the PD series linear power supplies with a 10-turn pot, an external control voltage, or an optional IEEE-488 adapter. The units feature overvoltage protection and current limiting. The supplies come with either LED or analog meters. $895 to $1550.

Contact East, 335 Willow St, North Andover, MA 01845. Phone (508) 682-9844. Circle No. 389

Hot-Plug Redundant Power Supplies
You can replace T Series hot-plug power-supply modules without powering down the system that they power. Thus the supplies suit \( n + 1 \) redundant-power systems. The T Series comprise the maker's existing single- and multi-output switchers repacked so that you can plug and unplug them from a company-standard power backplane.

The supplies have current sharing on all outputs and built-in isolation diodes. A mechanical interlock turns the supplies on and off. Standard backplanes accept one to six supplies per backplane. The backplanes mount in standard \( 3/4\)-in.- or 7-in.-high, 19-in. racks. Supplies, $409 (100); backplanes, depending on configuration, $115 to $515.

Unipower Corp, 2981 Gateway Dr, Pompano Beach, FL 33069. Phone (305) 974-2442. FAX (305) 971-1837. Circle No. 390

Quad-Output Switcher With Powerful Auxiliaries
The SQM225 quad-output switcher suits applications that require high-power auxiliary outputs for disk drives but minimal main-output power. The switcher's main output supplies 5V at 30A. The first auxiliary output supplies 12, 15, or 24V at 10A (12A pk); the other two auxiliary outputs produce 5, 12, 15, or 24V at 7.5A.

Standard features include international-voltage inputs of 90 to 132/180 to 264V ac, 47 to 440 Hz, overcurrent and overvoltage protection, and 3750V ac isolation. The built-in line filtering meets FCC Level B and VDE 0871 Level A. The supplies meet VDE, IEC, US, BS, and CSA safety standards. SQM225, $228 (100). Delivery, 12 weeks ARO.


Circle No. 391

Quad-Output 100W Switching Supplies
The Flu4-100 series 100W switching supplies offer a 5V main output and combinations of \( \pm 5, \pm 12, \pm 15, \) and \( +24V \) dc. The calculated MBTF is 165,000 hours min using MID-STD 217E. All models meet UL, CSA, and TUV safety and EMI specs. The units' auxiliary outputs will operate at no load. Efficiency is 65% min. Line regulation is 0.2% for the primary output and 0.5% for auxiliary outputs. Load regulation is 1%,
Power Sources

and output ripple and noise is 1% max. The units measure 4 x 8 x 2.2 in. and operate over a temperature range of 0 to 70°C with convection cooling. $159.

Power General, 152 Will Dr, Canton, MA 02021. Phone (617) 828-6216. FAX (617) 828-3215.

Circle No. 392

Ultrawide Input DC/DC Converters
The SIW series of 15 and 30W dc/dc converters have a 4:1 input-voltage range and 85% efficiency. The series accepts either 9 to 36V dc or 20 to 72V dc. The units come in single-, double-, or triple-output versions. All versions come in 3.0 x 2.56 x 0.04-in. cases and have standard pinouts.

The units have LC input filters and 6-sided shielding. They offer protection against overtemperature, input surges, short circuits, and reversed polarity. SIW series, $100 (25).

Wall Industries Inc, 5 Watson Brook Rd, Exeter, NH 03833. Phone (603) 778-2300.

Circle No. 393

Supplies For DC And Ringing Current
The rack-mounted 1200W PS-19 accepts plug-in power supplies that develop either dc or ringing current. The dc supplies develop either ±24V dc at 20A or ±48V dc at 12A. The ringing-current generators accept either 24 or 48V dc and develop 90 to 105V ac, 200 mA at 20 Hz. The dc supplies have power-factor-correcting circuitry.

The units accept 95 to 132V ac at 47 to 63 Hz. Applications include channel banks, fiber-optic equipment, and PBX systems. $1200 to $1500.

Power Conversion Products Inc, Box 380, Crystal Lake, IL 60014. Phone (815) 459-9100. FAX (800) 526-2524. Circle No. 394

VMEbus, VXIbus, And Futurebus Supplies
The VM series switching power supplies suit VMEbus, VXIbus, and Futurebus systems. The models supply 400 to 1500W and have one to seven outputs per package. Supplies have built-in cooling fans. Units meet FCC, UL, CSA, EN, and VDE specs. $382 to $1152 (100).

Acopian, Box 638, Easton, PA 18044. Phone (800) 523-9478; in PA, (215) 258-5441.

Circle No. 396

Screw-Terminal DC/DC Converters
These single- and dual-output dc/dc converters have screw terminals instead of common solder pins. Outputs range from 5V at 2.5A to 28V at 500 mA. The converters have a voltage-trim adjustment, and they accept inputs ranging from 5 to 28V. Load regulation specifies ±0.1%, line regulation is ±0.02%, and ripple is 1.6 mV rms. The units have an input filter and 6-sided shielding. $119 to $135.

Deltron Inc, Box 1369, North Wales, PA 19454. Phone (215) 699-9261. FAX (215) 699-2310.

Circle No. 395

Delivery, two to six weeks ARO.

Belden's new T-Mark rating is your ticket to the Orient!

Belden now has power supply cords for appliances and electrical equipment featuring a "T" Mark rating, conforming to the Dentori law which regulates appliance and materials control in Japan. Belden's "T" Mark cords are available in both standard and custom colors and lengths, and can be used on a variety of products manufactured anywhere in the world for export to Japan. It's another "first" from Belden.

For more information about Belden's complete line of international power cords for worldwide markets, call: 1-800-BELDEN-4

Copyright © 1991 Cooper Industries, Inc.

CIRCLE NO. 72
Power Sources

43W Switching Power Supplies
The 43W GLS series switching power supplies accept input voltages ranging from 90 to 250V ac at 47 to 400 Hz. Outputs are 5, 12, 15, or 24V dc. Output regulation is ±3%. All models exhibit 75% efficiency min and are burned-in at 48°C. The supplies meet UL, CSA, TUV, VDE, and FCC specs. $85.

Sola, 1717 Busse Rd, Elk Grove Village, IL 60007. Phone (800) 289-7652; in IL, (708) 439-2800. FAX (800) 626-6269. Circle No. 397

Rechargeable Lithium Cell
The Model AL series batteries are rechargeable 3V lithium cells. They use an electrically conductive polymer as a cathode, a lithium alloy as anode, and an organic compound as an electrolyte. The coin cells will withstand 1000 charge/discharge cycles and operate from -10 to +60°C. $2.25 (1000).

Seiko Instruments USA Inc, 2990 W Lomita Blvd, Torrance, CA 90505. Phone (213) 517-7700. FAX (213) 517-7709. Circle No. 406

Space-Saving Screw-Mounted Supplies
Series M power supplies suit applications served by plug-in power supplies. This series, however, does not plug directly into a wall socket. Instead, the supplies come with tabs for screw mounting and a single standard plug for power. Consequently, the supplies do not cover both outlets of a standard wall socket. The series comes in three sizes and has 60VA ac/ac models, unregulated 40W ac/dc models, and 15W regulated ac/dc models. $5 to $25. Delivery for production quantities, 10 to 12 weeks ARO.

Multiproducts International, 250 Lackawanna Ave, West Paterson, NJ 07424. Phone (201) 890-1344. FAX (201) 890-1677. TLX 219289. Circle No. 398

Low-Frequency Meter
The ELF (extremely low frequency) Alert line of handheld meters measures low-frequency magnetic fields generated by power lines, CRTs, home appliances, etc. The units measure magnetic-field strength from 1 to 2000 mG over the frequency spectrum of 30 to 300 Hz. Model 30P, $99; model 30S, which has NIST calibration, $139.

Teslatronics, 1 Progress Blvd, Suite 25, Alachua, FL 32615. Phone (904) 462-2010. Circle No. 399

Wide-Input 20W DC/DC Converters
The XWR series 20W dc/dc converters have 84% efficiency typ. The converters' packages measure 2×2×0.45 in. Input-voltage ranges are 4.6 to 13.2V, 9 to 18V, and 18 to 72V dc. Single- and dual-output models are available in 3.3, 5, 12, ±5, ±12, and ±15V dc. All units have a trim pin. The converters have overvoltage, surge, overcurrent, and overtemperature protection. $120 each.

Datel Inc, 11 Cabot Blvd, Mansfield, MA 02048. Phone (508) 339-3000. FAX (508) 339-6356. TLX 174388. Circle No. 400

Wide-Input 8W DC/DC Converters
The 800 series single-, dual-, and triple-output 8W dc/dc converters have a 2:1 input-voltage range. The converters' shielded packages measure 2×1×0.375 in. The con-

The best address for Siemens Semiconductors:

© Siemens Semiconductors:

Wien
Tel. (0222) 71711-5661
Melbourne, Vic. 3121
Tel. (03) 4207111
Bruxelles
Tel. (01) 833-2211
Mississauga L5T 1P2
Tel. (416) 584-1995
Zürich
Tel. (01) 495-3111
Berlin
Tel. (030) 3993-0
Düsseldorf
Tel. (0211) 399-0
Frankfurt
Tel. (069) 797-0
Hamburg
Tel. (040) 2889-0
Hannover
Tel. (051) 877-0
München
Tel. (089) 9221-4391/4138
Nürnberg
Tel. (0911) 654-0
Stuttgart
Tel. (0711) 2076-0
Ballup
Tel. (44) 774477
Madrid
Tel. (01) 5554062
Paris
Tel. (1) 4922-3810
Sunbury on Thames
Tel. (032) 752615
Amaroussio/Athen
Tel. (01) 6684-111
Hongkong
Tel. 5-8330222
Milano
Tel. (02) 6766-4241
Bombay 400018
Tel. 4938786
Dublin
Tel. (01) 302855
Tokyo 100
Tel. (03) 201-2401
Oslo 5
Tel. (02) 633000
Den Haag
Tel. (070) 333333
Alfragide
Tel. (01) 4183311
Buenos Aires
Tel. (01) 300411
Taipei
Tel. (02) 5234700
Seoul
Tel. (02) 275-6111
Kista
Tel. (08) 7033500
Helsinki
Tel. (0) 501061
Singapore 0513
Tel. 7760044
Istanbul
Tel. (01) 1510900
Izmir
Tel. (021) 906-4300 (Discrete)
Santa Clara
Tel. (408) 880-4500 (ICs)
Cupertino
Tel. (408) 725-7910 (Opto)
Johannesburg
Tel. (011) 407-4111
With the development of the new Enhanced Serial Communication Controller (ESCC2), Siemens has demonstrated a new genius in high-speed multi-protocolling. The ESCC2 (SAB 82532) offers an extraordinary range of protocol options at a high-speed transfer rate of up to 10 Mbit/sec in synchronous mode. Supporting X.25 LAPB, ISDN, LAPD, HDLC, SDLC, and both ASYNC and BISYNC, the ESCC2 offers outstanding capabilities for a wide variety of applications. And it is as adaptable as it is powerful. The ESCC2's flexible 8/16-bit bus interface allows it to easily adapt to either Intel or Motorola microprocessors. Plus, it provides direct 8/16-bit accessiblity to all registers, as well as DMA and both vectoring and non-vectoring interrupt modes. This ensures efficient data transfer to and from host system memory, for fast, accurate and reliable multi-protocolling.

For superior performance and flexibility, the ESCC2 features clock recovery up to 4 Mbit/sec, storage capability of 64 bytes in each of its four on-chip FIFOs and four encoding schemes: NRZ, NRZI, FMx and Manchester. In addition, it offers user-programmable features such as 16/32-bit CRC, time slot assignment, and an 8-bit parallel port. The result is an excellent CMOS device with only 40 mW power consumption for all kinds of multi-protocol applications.
PICO's New "AT" Series

0.2" Ht.

DC-DC Converters

Low Profile .5"×.5"×.2" ht., up to .75 Watt, Single & Dual Output

Low Current Consumption for Battery Applications

Optional Environmental Screening and Expanded Oper. Temp. (−55°C to +85°C)

• Up to .75 watt output at −25°C to +70°C ambient
• Encapsulated semiconductors conservatively rated for maximum reliability
• Ultra-miniature size (0.2" height)
• Input voltage ranges 3, 5, 9 and 12V DC
• 100 megohm @ 500V DC isolation
• Input/output isolation
• Single and dual output
• No heat sink required
Also PICO's A + AV Series
• Up to 1000V DC output
• Ultra-miniature.5"×.5"×.3"

45W Wide-Input-Range Power Supply
The ZPS-45 45W switching power supply accepts 85 to 265V ac; the unit measures 3×5×1.25 in. The supply's outputs specify 5V at 5A, 12V at 2A, and −12V at 0.7A. The unit can supply 40W with convection cooling, and 45W with forced air. The company calculates this commercial unit's MBTF at 200,000 hours, using MIL-HDBK 217E. The supply meets UL, CSA, and VDE requirements. $55.

Zenith Components, 1000 N Milwaukee, Glenview, IL 60025. Phone (708) 391-7733. FAX (708) 391-7078. Circle No. 402

Power-Factor-Corrected 1000W Switching Supply
The Max 1000 series 1000W switching supplies have power-factor correction and accept 90 to 264V ac. The open-frame supplies' power factor measures 0.99, and efficiency is 75% min. Thus the supplies can operate from standard ac receptacles and draw less than 12A, per UL, TUV, and CSA regulations. The units measure 8×12×3.38 in. Models are available with and without built-in cooling fans. Quad-output models are available. The units meet VDE0871 and FCC Class A EMI specs. $1150.

Todd Products Corp, 50 Emjay Blvd, Brentwood, NY 11717. Phone (800) 223-8633; in NY, (516) 231-3366. FAX (516) 231-3473. Circle No. 403

30W MIL-Spec DC/DC Converters
The MTR series 30W aerospace/military-grade dc/dc converters' package occupies 2.5 in.² of pc-board area and is 0.5-in. high. The converters have a MIL-KDBK-217 MTBF rating of 95,000 hours (AIT, 80°C). The converters accept inputs from 16 to 40V dc and offer single or dual outputs at 5, 12, 15, ±12, or ±15V dc. Efficiency specifies 80% min. Line and load regulation is 0.1% typ, and operating temperature runs from −55 to +125°C. The converters comply with MIL-STD-461 CE03 noise limits and MIL-STD-704A CS06 transient-suppression standards. $362 (100).

Interpoint Corp, Box 97005, Redmond, WA 98073. Phone (206) 882-3100. FAX (206) 882-1990. Circle No. 404

Universal-Input 43W Switcher
The UO series 43W switching power supplies accept 90 to 270V ac at 47 to 440 Hz. The supplies exhibit 75% min efficiency and operate over 0 to 70°C. All models have overvoltage and short-circuit protection. $88 (100). Delivery, four to six weeks ARO.

Total Power International Inc, 418 Bridge St, Lowell, MA 01850. Phone (508) 453-722. FAX (508) 453-7395. TLX 948617. Circle No. 405
V SERIES
OPEN FRAME SWITCHERS
68 models • Direct from factory stock • UL, CSA, TUV

Low Power Quads
- 200 - 325 watts
- All regulated units
- High power auxiliaries

Single Output Units
- 120 - 600 watts
- 4 watts/cu. in.
- Time tested design

High Power Quads
- 300 - 600 watts
- Up to 80A main
- Industry workhorse

Call Toll Free 1-800-523-2332
In PA: 215/699-9261

Deltron inc.
POWER PRODUCTS
SPECIFICATIONS

OUTPUTS
See table of models.

INPUT
90-152 VAC or 180-264 VAC, 47-440 Hz.
Consult factory for 400 Hz operation.

INPUT SURGE
17A peak from cold start for models up to 250 watts or less, 68A for other models, from nominal 110 or 220 VAC.

LINE REGULATION
± 0.1% for line change from nominal to min. or max. rating with 20% min. load on the measured output.
± 0.05% with post regulator and no min. load. Singles to no load.

LOAD REGULATION
| +5V main/singles | ± 0.2% |
| -5V aux. | ± 3% |
| +12V aux. | ± 2% |
| +15V aux. | ± 2% |
| +24V aux. | ± 1.5% |
\[\text{Post Regulated Outputs:} \quad \text{VP models—± 0.5%} \]
\[\text{Option 32—± 0.05%} \]
for load change from 60% to 20% or 100% max. rating. With post regulator to no load. Singles to no load.

CROSS REGULATION
± 0.2% for load change on the main +5V output from 75% to 50% or 100% max. rating with 20% min. load on the measured output. ± 0.05% with post regulator and no min. load. Not applicable to singles.

CENTERING
+ 5V main/singles ± 5% trim adj.
1st and 2nd aux. ± 5% trim adj. tracking
3rd aux.: -5V ± 3%
+12V ± 2%
+24V ± 1%
with all outputs loaded to 50% max. ratings and output #2 set precisely at its rated value. With post regulator—± 3% trim adj.

RIPPLE & NOISE
1% or 100 mv, pk.-pk., 20 MHz. bandwidth.

REMOTE SENSING
On + 5V main/singles which are fully isolated from all auxiliaries.

HOLDUP TIME
20 milliseconds after loss of nominal AC power.

EFFICIENCY
80% typ.

OVERVOLTAGE PROTECTION
Standard on main output/singles. Optional on auxiliaries.

OPERATING TEMPERATURE
0-50°C under the tabulated conditions.
Derate 2.5%/°C above 50°C to 70°C.

<table>
<thead>
<tr>
<th>Models</th>
<th>Forced Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>V225, VP200, V250, V270, V360</td>
<td>30 CFM</td>
</tr>
<tr>
<td>V600, V601, V325, VP300, V300, V400, V500, V501</td>
<td>60 CFM</td>
</tr>
</tbody>
</table>

REDDUNDANT OPERATION
Singles option provides for current sharing and redundant parallel operation. No isolation diodes are needed. Output good signal is provided.

TEMPERATURE COEFFICIENT
| +5V main/singles | ± 0.02%/°C |
| Auxiliaries | ± 0.05%/°C |
| With post regulator | ± 0.02%/°C |

OVERLOAD
Outputs short circuit protected by current foldback with automatic recovery. Post regulators have individual current foldback protection.

REVERSE VOLTAGE PROTECTION
All outputs are protected up to load ratings.

SAFETY
Units meet UL 1950, CSA 22.2 No. 220, CSA bulletin 1402C, EN 60 950, DIN VDE 0805/05.90.

LEAKAGE CURRENT
0.75 ma. at 115 VAC, 60 Hz. input.

SPACING
8 mm primary to secondary.
4 mm primary to grounded circuits.

DIELECTRIC WITHSTAND
3750 VRMS input to ground.
3750 VRMS input to output.
700 VDC output to ground.

EMISSIONS
Units meet FCC 20780 Part 15 Class A and VDE 0871/6.78 Class A for conducted emissions. Compliance with Class B limits by use of additional external filter.

AC UNDERTENSION
Proprietary proportional drive and low voltage lockout protects against damage for undervoltage operation.

SOFTWARE
Units have soft start feature to protect critical components.

DYNAMIC RESPONSE
Peak transient less than ±2% or ±200 mv for step load change from 75% to 50% or 100% max. ratings.

RECOVERY TIME
Less than 400 microseconds on main/singles output.
Less than 50 microseconds on post regulated auxiliaries.

INHIBIT
Optional TTL logic inhibit input.

THERMAL SHUTDOWN
Optional circuit cuts off supply in case of local over temperature. Unit resets automatically if excess temperature abates.

POWER FAIL MONITOR
Optional monitor provides a TTL signal 2 ms. min. prior to loss of output power with outputs fully loaded from 100VAC/200VAC line loss.

SHOCK
MIL-STD 810-D Method 516.3, Procedure III.

VIBRATION
MIL-STD 810-D Method 514.3, Category 1, Procedure I.

COVER
Optional cover for safety and EMI.

POST REGULATOR
Optional for output #4 on V300, V400, V500, V600 models. VP models have post regulators on all auxiliaries.

Specifications subject to change without notice.

OPTIONS – To order, replace XX in model numbers with sum of Option Codes desired.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>None</td>
</tr>
<tr>
<td>01</td>
<td>OVP protects all auxiliaries. Not for singles.</td>
</tr>
<tr>
<td>02</td>
<td>Power Fail Monitor</td>
</tr>
<tr>
<td>04</td>
<td>Thermal Shutdown</td>
</tr>
<tr>
<td>08</td>
<td>Cover. Fan placed for comparable flow as in uncovered units.</td>
</tr>
<tr>
<td>16</td>
<td>Logic Inhibit</td>
</tr>
<tr>
<td>32</td>
<td>Post Regulator, −5V@4A, +12V@3A, or +24V@2A. Not for singles, V225 or V325.</td>
</tr>
<tr>
<td>01</td>
<td>Redundant Sharing for singles.</td>
</tr>
<tr>
<td>V SERIES MODELS and RATINGS</td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>V SINGLES</strong></td>
<td><strong>Model</strong></td>
</tr>
<tr>
<td>V120AXX</td>
<td>5V/25A</td>
</tr>
<tr>
<td>V120BXX</td>
<td>12V/10A</td>
</tr>
<tr>
<td>V120CXX</td>
<td>15V/8A</td>
</tr>
<tr>
<td>V120DXX</td>
<td>24V/5A</td>
</tr>
<tr>
<td>V180AXX</td>
<td>5V/36A</td>
</tr>
<tr>
<td>V180BXX</td>
<td>12V/15A</td>
</tr>
<tr>
<td>V180CXX</td>
<td>15V/12A</td>
</tr>
<tr>
<td>V180DXX</td>
<td>24V/15A</td>
</tr>
<tr>
<td>V250AXX</td>
<td>5V/50A</td>
</tr>
<tr>
<td>V250BXX</td>
<td>12V/21A</td>
</tr>
<tr>
<td>V250CXX</td>
<td>15V/17A</td>
</tr>
<tr>
<td>V250DXX</td>
<td>24V/11A</td>
</tr>
<tr>
<td>V270AXX</td>
<td>5V/54A</td>
</tr>
<tr>
<td>V270BXX</td>
<td>12V/22A</td>
</tr>
<tr>
<td>V270CXX</td>
<td>15V/18A</td>
</tr>
<tr>
<td>V270DXX</td>
<td>24V/12A</td>
</tr>
<tr>
<td>V360AXX</td>
<td>5V/72A</td>
</tr>
<tr>
<td>V360BXX</td>
<td>12V/30A</td>
</tr>
<tr>
<td>V360CXX</td>
<td>15V/24A</td>
</tr>
<tr>
<td>V360DXX</td>
<td>24V/15A</td>
</tr>
<tr>
<td>V501AXX</td>
<td>5V/100A</td>
</tr>
<tr>
<td>V501BXX</td>
<td>12V/42A</td>
</tr>
<tr>
<td>V501CXX</td>
<td>15V/33A</td>
</tr>
<tr>
<td>V501DXX</td>
<td>24V/21A</td>
</tr>
<tr>
<td>V601AXX</td>
<td>5V/120A</td>
</tr>
<tr>
<td>V601BXX</td>
<td>12V/50A</td>
</tr>
<tr>
<td>V601CXX</td>
<td>15V/40A</td>
</tr>
<tr>
<td>V601DXX</td>
<td>24V/25A</td>
</tr>
</tbody>
</table>

(Non-standard voltages, e.g. 2V, 3.3V, 28V and 48V available on custom order.)

<table>
<thead>
<tr>
<th>V QUADS</th>
<th><strong>Model</strong></th>
<th><strong>Output 1</strong></th>
<th><strong>Output 2</strong></th>
<th><strong>Output 3</strong></th>
<th><strong>Output 4</strong></th>
<th><strong>Max Power</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>V300AXX</td>
<td>5V/40A</td>
<td>+12V/4A</td>
<td>-12V/4A</td>
<td>-12V/4A</td>
<td>-5V/3A</td>
<td>300W</td>
</tr>
<tr>
<td>V300BXX</td>
<td>5V/40A</td>
<td>+12V/4A</td>
<td>-12V/4A</td>
<td>-12V/4A</td>
<td>+24V/3(5)A</td>
<td></td>
</tr>
<tr>
<td>V300CXX</td>
<td>5V/40A</td>
<td>+15V/4A</td>
<td>-15V/4A</td>
<td>-15V/4A</td>
<td>+24V/3(5)A</td>
<td></td>
</tr>
<tr>
<td>V300DXX</td>
<td>5V/40A</td>
<td>+12V/4A</td>
<td>-12V/4A</td>
<td>-12V/4A</td>
<td>+12V/3(5)A</td>
<td></td>
</tr>
<tr>
<td>V400AXX</td>
<td>5V/50A</td>
<td>+12V/8A</td>
<td>-12V/8A</td>
<td>-12V/8A</td>
<td>-5V/4A</td>
<td>400W</td>
</tr>
<tr>
<td>V400BXX</td>
<td>5V/50A</td>
<td>+12V/8A</td>
<td>-12V/8A</td>
<td>-12V/8A</td>
<td>+24V/4(6)A</td>
<td></td>
</tr>
<tr>
<td>V500AXX</td>
<td>5V/60A</td>
<td>+12V/10A</td>
<td>-12V/10A</td>
<td>-12V/10A</td>
<td>-5V/5A</td>
<td>500W</td>
</tr>
<tr>
<td>V500BXX</td>
<td>5V/60A</td>
<td>+12V/10A</td>
<td>-12V/10A</td>
<td>-12V/10A</td>
<td>+24V/5(8)A</td>
<td></td>
</tr>
<tr>
<td>V500CXX</td>
<td>5V/60A</td>
<td>+15V/10A</td>
<td>-15V/10A</td>
<td>-15V/10A</td>
<td>-5V/5A</td>
<td></td>
</tr>
<tr>
<td>V500DXX</td>
<td>5V/60A</td>
<td>+15V/10A</td>
<td>-15V/10A</td>
<td>-15V/10A</td>
<td>+24V/5(8)A</td>
<td></td>
</tr>
<tr>
<td>V500EXX</td>
<td>5V/60A</td>
<td>+12V/10A</td>
<td>-12V/10A</td>
<td>-12V/10A</td>
<td>+12V/5(8)A</td>
<td></td>
</tr>
<tr>
<td>V600AXX</td>
<td>5V/80A</td>
<td>+12V/10(20)A</td>
<td>-12V/10A</td>
<td>-12V/10A</td>
<td>-5V/5A</td>
<td>600W</td>
</tr>
<tr>
<td>V600BXX</td>
<td>5V/80A</td>
<td>+12V/10A</td>
<td>-12V/10A</td>
<td>-12V/10A</td>
<td>+24V/5(10)A</td>
<td></td>
</tr>
<tr>
<td>V600CXX</td>
<td>5V/80A</td>
<td>+15V/10(20)A</td>
<td>-15V/10A</td>
<td>-15V/10A</td>
<td>-5V/5A</td>
<td></td>
</tr>
<tr>
<td>V600DXX</td>
<td>5V/80A</td>
<td>+15V/10A</td>
<td>-15V/10A</td>
<td>-15V/10A</td>
<td>+24V/5(10)A</td>
<td></td>
</tr>
<tr>
<td>V600EXX</td>
<td>5V/80A</td>
<td>+12V/10(20)A</td>
<td>-12V/10A</td>
<td>-12V/10A</td>
<td>+12V/5(5)A</td>
<td></td>
</tr>
<tr>
<td>V225AXX</td>
<td>5V/30A</td>
<td>+12V(8/12)A</td>
<td>-12V/4A</td>
<td>-12V/4A</td>
<td>-5V/4A</td>
<td>225W</td>
</tr>
<tr>
<td>V225BXX</td>
<td>5V/30A</td>
<td>+12V/6A</td>
<td>-12V/4A</td>
<td>-12V/4A</td>
<td>+24V/4(8)A</td>
<td></td>
</tr>
<tr>
<td>V325AXX</td>
<td>5V/45A</td>
<td>+12V/16/16A</td>
<td>-12V/6A</td>
<td>-12V/6A</td>
<td>-5V/4A</td>
<td>325W</td>
</tr>
<tr>
<td>V325BXX</td>
<td>5V/45A</td>
<td>+12V/8A</td>
<td>-12V/6A</td>
<td>-12V/6A</td>
<td>+24V/4(8)A</td>
<td></td>
</tr>
<tr>
<td>V325DXX</td>
<td>5V/45A</td>
<td>+15V/8A</td>
<td>-15V/6A</td>
<td>-15V/6A</td>
<td>+24V/4(8)A</td>
<td></td>
</tr>
<tr>
<td>V325EXX</td>
<td>5V/45A</td>
<td>+12V/16/16A</td>
<td>-12V/6A</td>
<td>-12V/6A</td>
<td>+12V/4A</td>
<td></td>
</tr>
<tr>
<td>VP200AXX</td>
<td>5V/30A</td>
<td>+12V/5A</td>
<td>-12V/1.5A</td>
<td>-12V/1.5A</td>
<td>-5V/1.5A</td>
<td>200W</td>
</tr>
<tr>
<td>VP200BXX</td>
<td>5V/30A</td>
<td>+12V/5A</td>
<td>-12V/1.5A</td>
<td>-12V/1.5A</td>
<td>+24V/1.5A</td>
<td></td>
</tr>
<tr>
<td>VP200CXX</td>
<td>5V/30A</td>
<td>+15V/5A</td>
<td>-15V/1.5A</td>
<td>-15V/1.5A</td>
<td>-5V/1.5A</td>
<td></td>
</tr>
<tr>
<td>VP200DXX</td>
<td>5V/30A</td>
<td>+15V/5A</td>
<td>-15V/1.5A</td>
<td>-15V/1.5A</td>
<td>+24V/1.5A</td>
<td></td>
</tr>
<tr>
<td>VP200EXX</td>
<td>5V/30A</td>
<td>+12V/5A</td>
<td>-12V/1.5A</td>
<td>-12V/1.5A</td>
<td>+12V/1.5A</td>
<td></td>
</tr>
<tr>
<td>VP300AXX</td>
<td>5V/45A</td>
<td>+12V/7.5A</td>
<td>-12V/3A</td>
<td>-12V/3A</td>
<td>-5V/3A</td>
<td>300W</td>
</tr>
<tr>
<td>VP300BXX</td>
<td>5V/45A</td>
<td>+12V/7.5A</td>
<td>-12V/3A</td>
<td>-12V/3A</td>
<td>+24V/3A</td>
<td></td>
</tr>
<tr>
<td>VP300CXX</td>
<td>5V/45A</td>
<td>+15V/7.5A</td>
<td>-15V/3A</td>
<td>-15V/3A</td>
<td>-5V/3A</td>
<td></td>
</tr>
<tr>
<td>VP300DXX</td>
<td>5V/45A</td>
<td>+15V/7.5A</td>
<td>-15V/3A</td>
<td>-15V/3A</td>
<td>+24V/3A</td>
<td></td>
</tr>
<tr>
<td>VP300EXX</td>
<td>5V/45A</td>
<td>+12V/7.5A</td>
<td>-12V/3A</td>
<td>-12V/3A</td>
<td>+12V/3A</td>
<td></td>
</tr>
</tbody>
</table>

**NOTES**

1. VP models have post regulators on all auxiliaries. Specifications are guaranteed to no load on auxiliaries.
2. Numbers in parentheses () are peak ratings for short duration service such as motor starting.
3. Output 1 is floating and can be either polarity.
4. Quads require 10% of maximum power distributed among auxiliary outputs for optimum performance.
5. Outputs can operate to no load with slight increase in specifications.
WHAT YOU COULD DO WITH A 4M-bit DRAM IN A REMARKABLY COMPACT PACKAGE.
Our 60, 70 and 80ns 4M-bit DRAMs are available in production quantities—right now—in 26/20 pin SOJ, ZIP, and TSOP. They feature fast-page, static-column and write-per-bit capabilities with a choice of refresh modes: RAS only; CAS before RAS; hidden; or self refresh.

Panasonic Industrial’s 4M-bit DRAMs are also ideal for today’s low-power applications. Standby current is 50µA at CMOS levels and 1 mA at TTL levels. Total active-power dissipation is only 550mW.

We are also your source for high-speed, low-power 1M-bit DRAMs and high-density DRAM modules.

Our long history in pick-and-place technology allows us to provide you with products that are designed to be easily integrated into production lines. We supply the equipment. We understand production problems. We know how best to avoid them.

If you are designing notebooks, laptops, or portables, or are confronted with space constraints and power concerns, select Panasonic Industrial as your global partner. We’ll help fulfill your visions of technical excellence.

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Organization</th>
<th>Speeds (ns)</th>
<th>Packages</th>
</tr>
</thead>
<tbody>
<tr>
<td>MN414100A</td>
<td>4 M x 1</td>
<td>60, 70, 80</td>
<td>300 mil SOJ, 350 mil SOJ, 400 mil ZIP, TSOP Types I &amp; II</td>
</tr>
<tr>
<td>MN414400A</td>
<td>1 M x 4</td>
<td>60, 70, 80</td>
<td>300 mil SOJ, 350 mil SOJ, 400 mil ZIP, TSOP Types I &amp; II</td>
</tr>
</tbody>
</table>

Panasonic Semiconductors
Panasonic Industrial Company
Division of Matsushita Electric Corporation of America
Headquarters • Two Panasonic Way • Secaucus, NJ 07094
Semiconductor Business Group
Main Contact: Milpitas, CA • Tel: (408) 946-4311 • Fax: (408) 946-9063
Secaucus, NJ • Tel: (201) 348-5291 • Fax: (201) 392-4652
Chicago, IL • Tel: (708) 981-7323 • Fax: (708) 981-4340
Atlanta, GA • Tel: (404) 717-6848 • Fax: (404) 717-6849
Houston, TX • Tel: (713) 449-6400 • Fax: (713) 449-6464

MEMORIES • MICROCOMPUTERS • ASICs • OPTOELECTRONICS

CIRCLE NO. 74
We Support Your HV Power Supply... All The Way!

- From your buy decision with a wide choice of 13 different series and over 200 standard models, from 1 kV to 500 kV DC, 15 W to 15 kW, and anything in between. All with advanced pulse-width modulation... for high efficiency, fast response, and reliability... and air insulation for light weight and serviceability. Competitive pricing always. And the best on-time delivery in the industry.

- To installation with complete documentation, test procedures, and responsive that is only a phone call away.

- Through trouble-free operation that results from a low parts count and carefully derated high voltage components... all backed by a no-nonsense 3-year warranty and factory service available on three continents!

We have a new 16-page short-form catalog crammed with useful information. Ask for a copy today and select Glassman for your next high voltage application. Mr. HV won’t let you down!

Innovations in high voltage power supply technology.

GLASSMAN U.S.A.
Glassman High Voltage, Inc.
P.O. Box 551
Route 22 East
Salem Industrial Park
Whitehouse Station, NJ 08889
U.S.A.
Telephone: (908) 534-9007
TWX: 710 480-2839
FAX: (908) 534-5672

GLASSMAN EUROPE
Glassman Europe Limited
Studio 4
Intec 2
Wade Road
Basingstoke
Hampshire RG240NE
England
Telephone: (0256) 810808
FAX: (0256) 810815

GLASSMAN JAPAN
Glassman Japan High Voltage Limited
Taira Building
1-17, Taira 1-chome
Miyamae-ku, Kawasaki 216
Japan
Telephone: (044) 877-4546
FAX: (044) 877-3395

CIRCLE NO. 68

EDN July 4, 1991
INTERNATIONALLY APPROVED CIRCUIT BREAKERS

When you're designing your product for global markets, take steps to protect it right. Choose Airpax. We build in the quality, performance and reliability you demand as well as the required international certification that will assist you in marketing your product anywhere in the world. From initial design through final shipment we can help you every step of the way.

Step-by-step help on three continents.

Engineers at our design/manufacturing centers in Belgium, Japan and the U.S. will assist in your design requirements by recommending the correct magnetic circuit breaker. When you're ready to manufacture, we're strategically located to provide on-time/just-in-time delivery anywhere.

50 milliamps to 100 Amps, 1 to 6 poles and more.

Consider your choices: SNAPAK® in rocker, toggle, paddle, baton, push-pull or push-to-reset styles; IEL, DIN rail mount in single or multi-handle;

Wherever You Design Your Product, We're With You Every Step Of The Way.

UL, VDE, CSA, TUV and SEV approvals.

For any international marketer, it can be a maze of acronyms out there. Not for Airpax, because ours is the broadest line of magnetic circuit breakers fully accepted for international applications in marine, instrumentation, medical systems, appliances, power supplies, information processing systems, industrial controls, HVAC equipment and other devices that demand reliable circuit protection.

IEG in a toggle and snap-in mount; and E-Frame branch circuit protectors. Designed to withstand shock, vibration and temperature variances.

The next step is up to you.

To find out more, write us. Or to secure prototypes fast for testing, built to your requirements at no extra cost, call our HOTLINE (301) 228-4600. Airpax, Woods Road, Box 520, Cambridge, MD 21613. FAX (301) 228-8910.

CIRCLE NO. 70

Wherever You Design Your Product, We're With You Every Step Of The Way.

EDN July 4, 1991
SOFTWARE

Development tools accelerate Windows-3.0 software development

With sales approaching 4 million units in less than one year, Microsoft Windows 3.0 has rocketed into personal-computing history. Although riding the tail of this shooting star may initially appear overwhelming, a number of companies offer tools to help you make your application software soar within Windows' graphical user interface.

J D Mosley, Regional Editor

Regardless of your opinion about the merits of Microsoft Windows 3.0, its current popularity undeniably offers a highly lucrative platform for software development. The present demand for Windows programmers is, understandably, very great, but the current supply is modest. For engineers moving to Windows programming, the downside to the potential windfall is having to learn how to code for yet another operating environment.

Despite its simplified graphical user interface (GUI), Windows is notorious for having a complex programming method. For example, just to make the words "Hello, Windows!" appear on a CRT, you have to type four screens of code comprising three different files. Programming for Windows is not a task for the meek. But many companies are working on making the transition to Windows programming much less painful.

Since Microsoft developed Windows, you might expect the company's Windows Software Development Kit (SDK) to be the ultimate development tool for Windows. The SDK probably is the most powerful, but it isn't the easiest tool kit to use. Because Windows is such a complex environment, programmers who are unaccustomed to writing for graphical interfaces may find the SDK itself overwhelming.

The $500 SDK includes a Codeview debugger, resource-editing tools, source-code examples, optimization tools, and on-line documentation. You also get a two-volume reference manual, a programming guide, a manual that describes all of the SDK tools, and an IBM Common-User Access (CUA) Style Guide.

Using the SDK is a multiple-step process. First you use a programming language such as C or assembler to create source files that contain your application's functions. You then use the SDK resource editors to create resource files that contain the application's visual elements. Next you must compile, assemble, and link the source files. Then you merge and compile the resource files. Finally, you add the compiled resource file to the executable file to produce the completed Windows application.

To help aspiring programmers become...
proficient in writing Windows applications, Microsoft conducts training classes at one of three facilities collectively named Microsoft University (MSU). These facilities are located in Bellevue, WA, Boston, MA, and Washington, DC.

If you already know how to program in C, you can sign-up at MSU for an introductory, hands-on Windows Programming Environment course. The course lasts five days and costs $1500. Microsoft also offers this course on five videotapes for $2995. You can call MSU at (206) 828-1507 to request a free evaluation kit, which includes an introductory tape.

After you’ve completed the introductory course—or have six months of SDK usage under your belt—you can register for MSU’s Microsoft Windows—Advanced Topics course, which provides an in-depth look at the SDK’s advanced features. This course also lasts five days and costs $1500. MSU has added a four-day, $1200 course called Sales Engineer. The course provides trouble-shooting training for employees of companies that develop Windows applications.

For further support, you can subscribe to an electronic bulletin board called Microsoft Online. Through the bulletin board, you can submit questions to an SDK support engineer who will research and answer them. The annual subscription fee also includes access to a database of technical information for all of Microsoft’s products, a software library of code examples and technical specs, a bulletin board for exchanging ideas and information, and an electronic-mail service that links you with other Online subscribers. Despite these support measures, it usually takes months to become proficient in writing application programs using the SDK.

Fortunately, Windows is now in its third incarnation, and a number of programming tools do exist that can make your coding task speedy and almost painless. Of course, the price you pay for
Just to make the words "Hello, Windows!" appear on a CRT you will have to type four screens of code comprising three different files.

such simplification is degraded program performance, speed, and flexibility. But if your goal is to get your product to market quickly, you may consider these penalties a reasonable tradeoff.

Even if you want to code your application in C to maximize its functionality, you can still use one of the commercially available tool kits to speed you through the graphical prototyping aspects of GUI building.

Let's go Windows shopping!

Any logical discussion of Windows 3.0 development tool kits must begin with a look at Asymetrix's Toolbook, the program whose runtime module and Daybook demo application is included with each copy of Windows 3.0. Perhaps even more impressive than this marketing coup is the fact that Asymetrix has already revised Toolbook, and is now selling version 1.5, whereas some competitors are still struggling to get their initial offering to market. You can buy this program for $395 or upgrade from version 1.0 for $75.

Toolbook 1.5 displays screen pages 30 to 40% faster than the original version because it now draws objects directly to the CRT. And for smoother and more realistic animation, Toolbook can now build objects offscreen for rapid and continuous display. Asymetrix asserts that searching 100 fields to find a text string in the last field is now 28 times faster in version 1.5. Entering text into fields is 15 to 40% faster, scrolling a 5000-character field is about three times faster, and selecting text lines in a field is more than 10 times faster.

Toolbook uses an object-oriented programming language called Openscript to control the behavior of objects you create with the included drawing tools. Although you can generate Openscript applications by writing scripts from scratch, Toolbook comes with an array of predefined software objects that you can quickly copy, manipulate, and modify. Version 1.5 also provides context-sensitive help, an Openscript tutorial, and an author's guide to building applications.

Furthermore, Toolbook simplifies your development task by building in certain behaviors to every object you create. For example, when you designate an object as a button, it automatically has the ability to flash and to display a centered caption; every object designated as a field can scroll text.

Each page of your application can contain 64k bytes of data defining

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Program name</th>
<th>Price</th>
<th>Description/features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asymetrix</td>
<td>Toolbook 1.5</td>
<td>$395</td>
<td>New version increases the speed of page-drawing, searching, and text operations as much as 28x.</td>
</tr>
<tr>
<td></td>
<td>Toolbook Author's Resource Kit</td>
<td>$450</td>
<td>License to distribute royalty-free copies of Runtime Toolbook; Script Remover; Booklook.</td>
</tr>
<tr>
<td>Blue Sky</td>
<td>Windowmaker</td>
<td>$795</td>
<td>Generates C code; simplifies task of porting existing C or Mac applications to Windows 3.0.</td>
</tr>
<tr>
<td>CaseWorks</td>
<td>Case: W</td>
<td>$995</td>
<td>Generates character-level edit masks and calls for data validation; produces C code.</td>
</tr>
<tr>
<td>CNS</td>
<td>C++/Views</td>
<td>$495</td>
<td>Object-oriented development platform based on C++.</td>
</tr>
<tr>
<td>Echelon Development</td>
<td>Windowcraft</td>
<td>$295</td>
<td>Hypercard-like application tool kit.</td>
</tr>
<tr>
<td>Knowledge Garden</td>
<td>Knowledgepro Windows</td>
<td>$695</td>
<td>Object-oriented, event-driven, message-based hierarchical language for Windows development.</td>
</tr>
<tr>
<td>Matesys</td>
<td>Objectscript Professional</td>
<td>$495</td>
<td>Menu-based Windows programming via a superset of Basic; C version sells for $899.</td>
</tr>
<tr>
<td>Microsoft</td>
<td>Windows Software Development Kit</td>
<td>$500</td>
<td>Debugger, resource-editing, and optimization tools, source-code examples, on-line documentation.</td>
</tr>
<tr>
<td>Protoview</td>
<td>Protoview</td>
<td>$695</td>
<td>Dynamic Link Library of objects and screen management/painting tools with C-code generator.</td>
</tr>
<tr>
<td>Raindrop</td>
<td>Software Engineer</td>
<td>$249.95</td>
<td>Lisp-based, lexically-scoped interpreter; on-line help; interactive object inspector.</td>
</tr>
<tr>
<td>Softbridge</td>
<td>Bridge Tool Kit</td>
<td>$695</td>
<td>Translates task-related keystrokes into development code; data sharing between DOS and Windows.</td>
</tr>
<tr>
<td>Spinnaker</td>
<td>Plus</td>
<td>$495</td>
<td>Hypercard-like object-oriented programming environment; runtime package costs an extra $495.</td>
</tr>
<tr>
<td>Whitewater Group</td>
<td>Actor 3.1</td>
<td>$495</td>
<td>&quot;Friendlier&quot; version of original object-oriented development language and tools.</td>
</tr>
<tr>
<td>Within Technologies</td>
<td>Realizer</td>
<td>$399</td>
<td>Superset of Basic for application development; with Windows objects and visual form designer.</td>
</tr>
</tbody>
</table>
Making Windows crystal clear

Even if you plan to write your application with a development tool kit, to build a program that will function well in this GUI environment you will need a basic understanding of how Windows 3.0 works. Windows programs are event-driven rather than sequential, and this fact alone demands that you renovate your approach to code design.

Microsoft's authorized guide to writing applications for Windows 3.0 is a 944-page volume entitled Programming Windows by Charles Petzold. In its text, you'll find a thorough discussion of the Graphics Device Interface (GDI) and how Windows handles data exchanges and links.

The GDI handles output drivers for video displays, printers, and plotters. This interface therefore acts as a buffer between your application and the vast assortment of raster and vector output devices that are currently available for PCs. The GDI also determines whether your hardware contains graphics coprocessing capabilities or if the GDI itself must provide the necessary calculations to produce figures such as polygons and curves.

You can execute a group of GDI functions by creating a Windows metafile. The metafile describes a picture as a collection of GDI calls encoded in binary form. In this way, you can create descriptions of images that take up less disk space and memory than actual bitmapped images.

Metafiles also offer greater device independence than bitmapped images can. As a result, metafiles provide a way to share pictures among applications via Windows' clipboard. The clipboard transfers data between programs, and although you ordinarily wouldn't transfer the metafile itself via the clipboard, you can use the clipboard to transfer metafile pictures, bitmapped images, text, and spreadsheet data.

Notably, you can't add anything to the existing contents of the clipboard. But as a Windows programmer, you can set the clipboard data several times and in different formats before closing the clipboard. In this way, you hold the clipboard open so you can combine graphics and text with distinctive fonts within the same clipboard contents.

However, you must remember that the clipboard's data stays in memory until it is replaced by other data. As a result, this data reduces the amount of memory available for your applications. To alleviate this waste of memory, Petzold recommends a technique called delayed rendering.

With delayed rendering, your application empties the clipboard, sets the clipboard data with a null parameter, and thus establishes "ownership" of the clipboard. When another application requests your program's data, your program can then replace the null parameter with the actual data handle—a 16-bit number that refers to the image you want to load into the clipboard.

Be a dynamic programmer

Besides the clipboard, Windows 3.0 uses two other interprocess communication mechanisms: Dynamic Data Exchange (DDE) and Dynamic Link Library (DLL). The DDE is a messaging system for communication between a client and a server program.

The server has access to data that the client wants to obtain, so the client must initiate the DDE "conversation" by broadcasting a message to all the Windows programs that are running. If a server has the requested data and responds, the conversation begins.

Several conversations can oc-
The SDK is probably the most powerful set of tools for Windows application development, but its complexity is notorious.

You can mix objects and scripts on a page, and you can make each script as large as 60k bytes. The script editor now has multiple-level undo and search-and-replace capabilities.

If you're interested in selling your Toolbook-based application, you'll probably want to order the Toolbook Author's Resource Kit (ARK). Besides providing screen design guidelines and a master copy of Runtime Toolbook, you also receive an application called Script Remover that removes the text from your application's scripts so that end users can't copy or read your source code.

The ARK also includes Booklook, an application that simplifies the task of editing object properties. And you can list your application free of charge in Asymetrix's Catalog of Books and Consultants. Selected developers will even have an opportunity to showcase their products at tradeshows and conferences. The ARK costs $450 and includes access to an electronic bulletin board reserved for Toolbook developers. An ARK upgrade from version 1.0 costs $75. For an additional $495, you can consult for one year with your own designated Toolbook support engineer.

At least one company is offering productivity enhancement utilities for Toolbook authors and developers. Syndetic Management Systems sells a $125 program called R-Spy, which lets you directly access and control variables and properties associated with any Toolbook object via a pop-up control panel. R-Spy lets you create and modify user-defined stacks or arrays, copy properties from one object to another, view and modify any script, and navigate anywhere in an object's hierarchy.

Syndetic's $135 R-Script lets you view a cross-referenced list that identifies where handlers and variables occur in a script. You can also use R-Script to compare any script to a list of defined system variables, thus avoiding potential variable-declaration problems. Syndetic is offering a $50 discount, for a limited time, if you order either product.

### Table 2—Windows 3.0 programming languages

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Program name</th>
<th>Price</th>
<th>Description/features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borland</td>
<td>C++ 2.0</td>
<td>$495</td>
<td>A dual C and C++ compiler for both DOS and Windows programs; precompilable headers.</td>
</tr>
<tr>
<td></td>
<td>Turbo Pascal for Windows</td>
<td>$249</td>
<td>Build applications without the SDK; create, edit, compile, and run programs from within Windows.</td>
</tr>
<tr>
<td>Digitalk</td>
<td>Smalltalk/V Windows</td>
<td>$500</td>
<td>Object-oriented programming platform for Windows.</td>
</tr>
<tr>
<td>Gold Hill</td>
<td>GC Lisp Developer 4.0</td>
<td>$1995</td>
<td>Lisp development platform that runs under Windows 3.0 and supports DDE.</td>
</tr>
<tr>
<td>Microsoft</td>
<td>C 6.0</td>
<td>$495</td>
<td>Now available bundled with the SDK; ANSI G-compliant compiler.</td>
</tr>
<tr>
<td></td>
<td>Visual Basic</td>
<td>$199</td>
<td>Graphical application-development package derived from QuickBasic; includes icon library and editor.</td>
</tr>
<tr>
<td>Multiscope</td>
<td>Modula-2 Development System</td>
<td>$249</td>
<td>Modula-2 development platform for Windows and DOS with editor, debugger, and utilities.</td>
</tr>
<tr>
<td>Watcom</td>
<td>C 8.0 Professional Edition</td>
<td>$495</td>
<td>16-bit C compiler for Windows 3.0, DOS, and OS/2.</td>
</tr>
<tr>
<td></td>
<td>C/386</td>
<td>$1295</td>
<td>32-bit C compiler for developing and debugging Windows applications.</td>
</tr>
<tr>
<td>Zortech</td>
<td>C++</td>
<td>$199.95</td>
<td>16-bit C compiler for Windows; compiles directly from C++ into object code.</td>
</tr>
<tr>
<td></td>
<td>C++ Developer's Edition 2.1</td>
<td>$450</td>
<td>32-bit C compiler for developing and debugging Windows applications.</td>
</tr>
<tr>
<td>Manufacturer</td>
<td>Program name</td>
<td>Price</td>
<td>Description/features</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-------------------------------------</td>
<td>--------</td>
<td>---------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Abacus</td>
<td>Becker Tools</td>
<td>$79.95</td>
<td>File- and data-management utilities such as undelete and disk formatting.</td>
</tr>
<tr>
<td>Application Techniques</td>
<td>Pizazz Plus</td>
<td>$149</td>
<td>Screen-printing utility for Windows 3.0; supports color printers.</td>
</tr>
<tr>
<td></td>
<td>Pictureeze</td>
<td>$149</td>
<td>Graphics file converter and image enhancer lets you rotate, mirror, and flip color or bw images.</td>
</tr>
<tr>
<td>Borland</td>
<td>Objectvision for Windows</td>
<td>$99.95</td>
<td>Tool kit for developing database front ends.</td>
</tr>
<tr>
<td>Cognos</td>
<td>Powerplay 2.0</td>
<td>$850</td>
<td>GUI database front end and analysis tool.</td>
</tr>
<tr>
<td>Dariana Technology</td>
<td>Winsleuth</td>
<td>$149</td>
<td>System diagnostic utilities for Windows 3.0; includes file viewer and network analyzer.</td>
</tr>
<tr>
<td>Delrina Technology</td>
<td>Perform Pro</td>
<td>$495</td>
<td>Tool kit for developing database front ends.</td>
</tr>
<tr>
<td>Drover Technologies</td>
<td>Toolbox for Windows</td>
<td>$295</td>
<td>200-function Data Link Library for SDK, Toolbook and SQL Windows; source-code option costs $865.</td>
</tr>
<tr>
<td>GUI Computer</td>
<td>3-in-1</td>
<td>$99</td>
<td>Low-cost development tool for C; C++ version costs $159.</td>
</tr>
<tr>
<td>HDC Computer</td>
<td>Fileapps</td>
<td>$129.95</td>
<td>Pop-up utilities let you undelete, encrypt, search for, and transfer files from within Windows.</td>
</tr>
<tr>
<td></td>
<td>Icon Designer</td>
<td>$59.95</td>
<td>Pop-up utility lets you create, use, and store icons from within Windows.</td>
</tr>
<tr>
<td></td>
<td>Windows Express</td>
<td>$99.95</td>
<td>Merging system associates applications and documents in &quot;folders.&quot;</td>
</tr>
<tr>
<td>Heizer Software</td>
<td>Convertitl</td>
<td>$99.95</td>
<td>Converts Hypercard stacks into Toolbook books.</td>
</tr>
<tr>
<td>Horizon Technologies</td>
<td>DDELib</td>
<td>$295</td>
<td>Application Program Interface provides DDE-compliance for your Windows software.</td>
</tr>
<tr>
<td></td>
<td>DDEWatch</td>
<td>$85</td>
<td>DDE-monitoring utility; also supports file logging.</td>
</tr>
<tr>
<td>Intersoft</td>
<td>Windows Application Programming Environment</td>
<td>$195</td>
<td>Library functions for window creation and registration, menus, and dialog boxes.</td>
</tr>
<tr>
<td></td>
<td>Winhelp</td>
<td>$199</td>
<td>On-line help system for programmers.</td>
</tr>
<tr>
<td>Magna Carta Software</td>
<td>C Windows Toolkit</td>
<td>$99.95</td>
<td>200-function user-interface C library; supports virtual screens and overlapping windows.</td>
</tr>
<tr>
<td>Microsoft</td>
<td>Windows Libraries for OS/2 Development Kit</td>
<td>$150</td>
<td>Provides tools for converting a Windows 3.0 application to run on the OS/2 operating system.</td>
</tr>
<tr>
<td></td>
<td>Windows Device Development Kit</td>
<td>$500</td>
<td>Tools for developing, testing, debugging, and modifying device drivers for Windows 3.0.</td>
</tr>
<tr>
<td>Moon Valley Software</td>
<td>Zip Manager</td>
<td>$21.95</td>
<td>Windows version of PKZIP file-compression programs; also supports .ARC and .LZH formats.</td>
</tr>
<tr>
<td>Okna Corp</td>
<td>Desktop Set</td>
<td>$149</td>
<td>Productivity utilities including calendar, calculator, phone book, and dialer.</td>
</tr>
<tr>
<td>Protoview</td>
<td>Protogen</td>
<td>$199</td>
<td>Interactive menu-design and field validation; interactive DDE support.</td>
</tr>
<tr>
<td>Revolution Software</td>
<td>VGA Dimmer</td>
<td>$35.95</td>
<td>Screen-blanking utility.</td>
</tr>
<tr>
<td>Rosesoft</td>
<td>Prokey for Windows</td>
<td>$99</td>
<td>Automates keystroke and mouse sequences for script-building; includes event scheduler.</td>
</tr>
<tr>
<td>Roykore</td>
<td>ABC Flowcharter for Windows</td>
<td>$295</td>
<td>Flowcharting tool for documenting Windows procedures.</td>
</tr>
<tr>
<td>Sage Software</td>
<td>Control PakIV</td>
<td>$595</td>
<td>Package of six predefined, reusable, and modifiable control objects; includes C source code.</td>
</tr>
<tr>
<td>Softsource</td>
<td>Drawing Librarian-Windows</td>
<td>$150</td>
<td>Utility for importing AutoCAD .DWG and .DXF drawings into Windows 3.0 applications.</td>
</tr>
<tr>
<td>Stirling Group</td>
<td>Dboxshield</td>
<td>$595</td>
<td>Dialog-box code generator for Windows that uses an interface engine and library.</td>
</tr>
<tr>
<td></td>
<td>Demoshield</td>
<td>$495</td>
<td>Creates visual demos of Windows applications.</td>
</tr>
<tr>
<td></td>
<td>Log Shield</td>
<td>$395</td>
<td>Session recording and playback library; linkable to applications for self-running demos.</td>
</tr>
<tr>
<td></td>
<td>Tboxshield</td>
<td>$295</td>
<td>Library of toolbox objects that you can add to applications.</td>
</tr>
<tr>
<td>Synappsys</td>
<td>Wincomm</td>
<td>$149</td>
<td>Produces communication scripts and front ends for data-transfer applications.</td>
</tr>
<tr>
<td>Syndetic</td>
<td>R-Script</td>
<td>$135</td>
<td>Cross-references variable and handler locations in toolbox scripts.</td>
</tr>
<tr>
<td></td>
<td>R-Spy</td>
<td>$125</td>
<td>Pop-up control panel for editing the scripts, variables, and properties of Toolbook objects.</td>
</tr>
<tr>
<td>Ventanaworks</td>
<td>Skylight</td>
<td>$99.50</td>
<td>Menu-building utility for Windows; lets you display any .BMP file anywhere on the screen.</td>
</tr>
<tr>
<td>Whitewater Group</td>
<td>Objectgraphics</td>
<td>$445</td>
<td>Library of object-oriented graphics.</td>
</tr>
<tr>
<td></td>
<td>Resource Toolkit for Windows</td>
<td>$195</td>
<td>Create, edit, and manage resources such as dialog boxes, cursors, icons, and bitmaps.</td>
</tr>
<tr>
<td></td>
<td>Wintrieve</td>
<td>$395</td>
<td>Data file management tool; interfaces with C- or Actor-based programs; unlimited indexing.</td>
</tr>
<tr>
<td>Xian</td>
<td>Winpro3</td>
<td>$895</td>
<td>GUI generator for C programs; requires SDK and Windows-compatible C compiler.</td>
</tr>
<tr>
<td>XVT Software</td>
<td>Extensible Virtual Toolkit for Windows 3.0</td>
<td>$795</td>
<td>Library provides a standard programming interface; libraries for other GUIs are also available.</td>
</tr>
</tbody>
</table>
Windows programs are event-driven rather than sequential, and this fact alone demands that you renovate your approach to code design.

edgepro language is an object-oriented, event-driven, message-based language that you use to create text files called knowledge bases.

Each knowledge base contains at least one topic—a collection of commands and functions. Topics perform tasks, describe object behaviors, or service hypertext requests. By linking topics you can create hyper-region topics that can open additional windows, display text, or pop-up message or dialog boxes. In addition, you can use Knowledgepro to create hierarchical classes of topics that derive their attributes from other base topics. You can use Knowledgepro to create independent executable applications, but you'll have to bundle a copy of the free runtime module for others to run them.

Keep it simple

Objectscript Professional from Matesys Corp is probably the easiest to use of all the object-oriented tool kits. This program offers approximately 50 built-in commands nested in drop-down screen menus. By selecting commands with your mouse, you can create an application without writing a script or even a single line of code.

However, you sacrifice flexibility for Objectscript's simplification of effort. The drawing facilities are limited, and the object menu lacks important items such as scrollbars. However, the impressive assortment of sample programs provided with this tool kit do provide a solid basis for understanding the kit's capabilities.

Objectscript's language is a superset of Basic, and you can purchase a $495 version of Objectscript that is compatible with Microsoft's Quick Basic. The C version sells for $899. An $899 companion product called Objectview lets you build Windows-based graphical user interfaces (GUIs) for database applications.

Actor is yet another development platform for Windows 3.0. However, Actor is closer to being a true object-oriented programming language than an intermediary tool kit. As a result, Actor has gained a reputation as a high-level package for serious programmers—neophytes who aren't comfortable with such concepts as polymorphism, encapsulation, and inheritance would probably be happier with some other tool.

To address this perception, the Whitewater Group has announced Actor 3.1, a version that they claim is "friendlier" than the original. The price has also dropped from $895 to $495. Whether these changes will provide sufficient incentive to overcome its prior reputation remains to be seen.

Another development environment called Software Engineer, from Raindrop Software, uses Lisp as its programming basis. Software Engineer contains a lexically scoped Lisp interpreter, a Lisp-aware text editor, on-line help, and an interactive object inspector.

Priced at $249.95, Software Engineer's main strength lies in its ability to support Dynamic Data Exchange (DDE) at a higher level than Microsoft's Windows Software Development Kit. In addition, this program is all you need to create Windows 3.0 applications—you don't have to buy the SDK or any additional interpreters. If you are comfortable programming in Lisp, this program would certainly provide one of the least expensive ways to write Windows applications.

Simplify your Windows

Meanwhile, other Windows development tool kits such as Blue Sky Software's Windowsmaker Professional and Caseworks' Case:W actually promise point-and-click simplicity for Windows 3.0 application development. The primary basis for this claim seems to lie in
For more information . . .

For more information on the Windows 3.0 development software 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.

Abacus
Dept B10
5770 52nd St SE
Grand Rapids, MI 49512
(616) 451-4519, ext 212;
in MI, (616) 498-0330
FAX (616) 698-6252
Circle No. 678

Applications
Techniques Inc
10 Lomar Park Dr
Pepperell, MA 01463
(978) 433-8464
Circle No. 679

Asymetrix Corp
Suite No. 717
Bellevue, WA 98004
(425) 933-8999, ext 2992;
in WA, (206) 637-1500
Circle No. 680

Blue Sky Software Corp
2775 E Tropicana Ave
Suite 230
Las Vegas, NV 89119
(702) 466-5685
FAX (702) 434-5580
Circle No. 681

Borland International Inc
1800 Green Hills Rd
Scotts Valley, CA 95067
(800) 505-0877
FAX (408) 429-9119
Circle No. 682

Caseworks Inc
1 Dunwoody Park
Suite 139
Atlanta, GA 30333
(404) 399-6366
FAX (404) 399-9516
Circle No. 683

CNS Inc
1250 Park Rd
Chanhassen, MN 55317
(612) 247-7000
Circle No. 684

Cognos Inc
67 S Bedford St
Burlington, MA 01803
(617) 229-6600
Circle No. 685

Dariana Technology Group Inc
6945 Hermosa Circle
Buena Park, CA 90620
Circle No. 686

Delrina Technology Inc
Box 290
Buffalo, NY 14207
(906) 268-0602
Circle No. 687

Digital Ink
9841 Airport Blvd
Las Vegas, NV 89119
(702) 439-6922
Circle No. 688

Digital Vision
845 E Arapaho Rd
Suite 105
Richardson, TX 75081
(214) 235-2511
FAX (214) 234-2674
Circle No. 689

Drover Technologies
660 White Plains Rd
Tarrytown, NY 10591
(914) 631-7013
Circle No. 690

Echelon
Development Corp
67 S Bedford St
Suite 400W
Cambridge, MA 02139
(617) 623-3300
Circle No. 691

GUI Computer Inc
6001 Fernshaw Dr
Dallas, TX 75248
(214) 250-3472
Circle No. 692

HDC Computer Corp
6742 185th Ave NE
Redmond, WA 98052
(206) 885-9770
Circle No. 693

Heizler Software
232019
Pleasant Hill, CA 94523
(415) 943-7667
Circle No. 694

Horizon
Technologies Inc
1745 Hamilton Rd
Suite 300
Okemos, MI 48864
(517) 347-0800
Circle No. 695

Intersoft Inc
5225 SW Meadowlows Rd
Lake Oswego, OR 97035
(503) 639-3055
FAX (503) 624-0700
Circle No. 696

Knowledge Garden Inc
473A Malden Bridge Rd
Nassau, NY 11721
(516) 766-3000
FAX (516) 766-3003
Circle No. 697

Magna Carta
Software Inc
Box 143584
Garland, TX 75043
(214) 226-6909
FAX (214) 225-0386
Circle No. 698

Matesys Corp
900 Larkspur Landing Circle
Suite 175
Larkspur, CA 94939
(415) 925-2900
FAX (415) 925-2909
Circle No. 699

Microsoft Corp
1601 NE 36th Way
Box 97017
Redmond, WA 98073
(425) 323-3777, Dept M24;
in WA, (206) 882-8860
FAX (206) 883-8101
Circle No. 700

Moon Valley Software
107 E Paradise Lane
Phoenix, AZ 85022
(602) 373-8502
Circle No. 701

Multiscope Inc
1235 Pear Ave
Suite 111
Mountain View, CA 94043
(415) 988-4892
Circle No. 702

Okina Corp
285 Van Buren St
Lyndhurst, NJ 07071
(201) 489-9777
Circle No. 703

Protoview
Development Co
333 Georges Rd
East Rutherford, NJ 07073
(201) 489-9888
FAX (201) 489-9884
Circle No. 704

Raindrop
Software Corp
845 E Arapaho Rd
Suite 105
Richardson, TX 75081
(214) 235-2511
FAX (214) 234-2674
Circle No. 705

Revolution
Software Inc
310 Rte 24
Chester, NJ 07930
(201) 879-8701
FAX (201) 879-8203
Circle No. 706

Rosesoft Inc
Box 1008
Bellevue, WA 98007
(206) 562-2225
Circle No. 707

Roykore
2215 Filbert St
San Francisco, CA 94123
(415) 563-5175
Circle No. 708

Sage Software Inc
1700 NW 167th Pl
Beaverton, OR 97006
(503) 547-4000
Circle No. 709

Softbridge Group
125 Cambridge Park Dr
Cambridge, MA 02140
(617) 576-2257
Circle No. 710

Sofsource
201 W Holly
Bellingham, WA 98225
(206) 676-0999
FAX (206) 671-1131
Circle No. 711

Spinmaker
Software Corp
201 Broadway
Cambridge, MA 02139
(617) 494-1200
Circle No. 712

Stirling Group
127 E Main St
Roselle, IL 60172
(708) 397-1917
FAX (708) 301-9340
Circle No. 713

Syncapps
401 W Main St
Norman, OK 73069
(405) 366-6633
Circle No. 714

Syndetic Management Systems Inc
15555 SE 184th St
Renton, WA 98058
(206) 228-8026
FAX (206) 228-8041
Circle No. 716

Ventanaworks
2111 S Industrial Park
Suite 108
Tempe, AZ 85282
(602) 968-3974
Circle No. 717

Watcom Group Inc
415 Phillips St
Waterloo, ON
N2T 3X2 Canada
(900) 265-4555;
in ON, (519) 886-3700
Circle No. 718

Whiteheart Group
1800 Ridge Ave
Evaston, IL 60201
(800) 889-1144;
in IL, (708) 328-3800
FAX (708) 328-0386
Circle No. 719

Within Technologies Inc
Laurel Corporate Center
Suite 2018
8000 Midlantic Dr
Mount Laurel, NJ 08054
(609) 274-8863
FAX (609) 231-8991
Circle No. 720

Xian Corp
625 N Monroe St
Ridgewood, NJ 07450
(201) 447-3270
FAX (201) 447-2547
Circle No. 721

XVT Software
1800 30th St
Boulder, CO 80306
(303) 443-4223
FAX (303) 443-0699
Circle No. 722

Zortech Inc
4-C Gill St
Woburn, MA 01801
(617) 937-0696
FAX (617) 937-0706
Circle No. 723

VOTE . . .

Please also use the Information Retrieval Service card to rate this article (circle one):
High Interest 506 Medium Interest 507 Low Interest 508
SOFTWARE

the fact that neither program uses an object-oriented language, thus relieving you of any need to learn a new language before learning to use the tools.

Windowsmaker Professional not only provides an interactive development platform, it also simplifies the task of porting your existing C-based DOS or Apple Macintosh programs to Windows. Because Windowsmaker generates C source code, you can use Windowsmaker to build a Windows user interface and then add your existing C program. During code regeneration, your existing code remains unaltered.

Unlike other development tool kits, Windowsmaker requires both the Microsoft Software Development Kit (SDK) and a Microsoft C compiler. So, its $995 price tag isn't the only monetary investment you'll make to use this package. However, the manufacturer does provide a 30-day money-back guarantee, and you'll pay no runtime royalties when you distribute your finished application.

Case:W also generates C code and also requires you to purchase the SDK. But Case:W maintains a file of all the prototype data accumulated as you develop your Windows application. This data file eases the task of porting your program to the IBM OS/2 Program Manager because you can use the file with Casework's Case:PM development tool kit.

Case:W also validates data in your edit fields, automatically generating character-level edit masks and calls to your field-level data-validation routines. Case:W also lets you toggle your screen between a build view used to construct an interface and a test view that lets you animate the interface without generating the program. In this way, you can see exactly how your interface will function after Case:W generates the code. Case:W sells for $795, and Case:PM for C retails for $1995.

Unfortunately, deciding among all these object-oriented, menu-driven, and conventional tool kits is similar to buying a pair of shoes—until you wear them around, you won't know whether you've found a comfortable fit or merely an attractive-looking source of pain. Unless you've had an opportunity to experiment with a tool kit at a tradeshow or seminar, it may be wise to look for companies that advertise a money-back guarantee.

Reference
OrCAD has introduced the greatest product upgrade in its history. Memory limits, design restrictions, even boundaries between products are all disappearing.

For years, OrCAD’s competitors have been playing a game of catch-up. With the introduction of Release IV, the race is over. No one will match our price/performance ratio on these features:

• Schematic Parts Library has been increased to over 20,000 unique library parts
• Digital Simulation process has been speeded up by an order of magnitude
• Printed Circuit Board Layout package offers autoplacement and autorouting at no extra charge
• Expanded memory capabilities

Best of all, OrCAD introduces ESP

ESP is a graphical environment designed specifically for the electronic designer. Software tools appropriate for different stages in the design process are now linked together to form a seamless flow of information. This easy-to-use framework relieves the designer of time consuming tasks and the inconvenience of moving from one tool set to another. You can now spend more time productively designing.

For more information . . .

You need to know more about Release IV and all of the benefits OrCAD has to offer. Call the telephone number below and we’ll send you a free demonstration disk.

For more information, call (503) 690-9881

or write to OrCAD Sales Department, 3175 N.W. Aloclek Drive, Hillsboro, Oregon, 97124
HMI development systems do it all!

HMI provides complete development systems—in-circuit emulator, window driven source level debugger and software performance analyzer—that address all aspects of the microprocessor system design cycle, from prototype to production:

**HMI Emulators Feature:**
- Run at real-time with no wait states.
- Complex events and sequences for break and trigger conditions.
- Two independent 4K deep trace buffers.
- 1 nsec resolution interval timer.
- Logic analyzer capabilities built into the emulator.
- 16 External Trace bits.
- RS232 Interface up to 115.2K.
- Parallel Interface for high-speed downloading.
- Work with IBM PC family and UNIX based machines including SUN and Apollo.

**SOFTWARE**
HMI's SourceGate ties it all together, so emulator features aren't sacrificed to gain source-level debugging.

**HMI SourceGate® Features:**
- Custom window configuration determined by user.
- Support for major C, PL/M, Pascal and ADA compilers.
- Source code in the trace buffers.
- C variable tracking.

Add our Performance Analysis Card to complete your development package.

**Performance Analysis Features:**
- Real-time hardware implemented software performance analyzer.
- 100 nsec resolution time-stamp in trace buffer.
- Setup trigger conditions to start and stop analysis.
- View covered and not covered pieces of code.

If you are looking for one development system that does it all, call (205) 881-6005, or write to Huntsville Microsystems Inc., 3322 South Memorial Parkway, Huntsville, AL 35801.

**AVAILABLE EMULATORS**

| 68000 | 68302 | 8051 Family |
| 68008 | 68332 | 805000 |
| 68010 | 68340 | 8096/80196 Family |
| 68020 | 6809/6809E | 8085 |
| 68030 | 68HC11 including | 64180/7180 |
| | Fl and D3 | Z80 |
| | 68HC001 | |

IBM is reg. T.M. International Business Machines, Inc. UNIX is reg. T.M., Bell Laboratories, Inc.

142 CIRCLE NO. 78 EDN July 4, 1991
Software

Real-time Unix-like operating system implements Posix 1003.4 extensions

Version 2.0 of the Unix-compatible Lynxos real-time operating system implements the complete set of real-time extensions specified in IEEE Posix 1003.4 (also called Posix.4). The Posix.4 standard makes possible real-time applications that can run on systems and processors from multiple vendors. Lynxos 2.0 also offers compatibility with threads, a form of lightweight tasks defined by Posix.4a.

Lynxos 2.0 provides the following features defined in Posix.4 extensions:

- Binary semaphores
- Process memory locking
- Shared memory
- Priority scheduling
- Asynchronous event notification
- High-resolution timers
- Interprocess communication
- Asynchronous I/O
- Synchronized I/O
- Contiguous real-time files.

The priority-scheduling facility provides several priority-driven scheduling policies, including first in/first out. The timers in Lynxos go far beyond Unix timers and have nsec resolution for both absolute- and relative-timing operations. Lynxos 2.0 fully supports the Posix.4a threads concept as well as the thread model implied by Ada tasking.

Although compatible with Unix and Posix.4, Lynxos is a real-time operating system developed with no Unix System Laboratories (AT&T) code. The operating system can respond to an external event in less than 450 µsec, worst case, when running on a 20-MHz 80386-based system. The specified worst-case response time includes interrupt disable, dispatch, interrupt routine execution, pre-emption disable, scheduling, context switch, and return system call.

You can buy Lynxos for a number of popular µP families including the Intel 860, 80386, and 80486; the Motorola 680X0 and 88000; and the Mips R3000 and R6000. A version for IBM PC/AT compatibles costs $1495.

Lynx Real-Time Systems Inc, 16780 Lark Ave, Los Gatos, CA 95050. Phone (408) 354-7770. FAX (408) 354-7085. Circle No. 738

Symbolic math package sports user interface for X Windows and Sunview

Release V of Waterloo Maple Software makes this interactive symbolic math package available for 80386-based systems, Sun workstations, and DEC RISC and Ultrix systems; it also provides many mathematical enhancements. You can now sort polynomials, and the D operator has been extended to handle partial derivatives. Meijer G, Airy Wave, and Dirac functions have been added, and improved facilities include Runge-Kutta functions for solving initial-value ordinary differential equations.

This package has grown steadily over ten years to now include more than 2000 mathematical functions. The relatively small kernel (less than 500k bytes of compiled code) performs arbitrary-precision arithmetic, polynomial manipulation, and interpretation of the Maple programming language. This language is Pascal-like, and it automatically generates procedures from expressions, aliases, and macros.

The X-Window user interface provides help and plot windows, allows editing of input expressions, and maintains a log of your Maple session. The X-Window and other user interfaces support three-dimensional graphics, such as surface plots. You can direct output to a variety of printers, including Postscript devices. The coordinate system can be cartesian, spherical, or cylindrical, and you can render surfaces as surface patches, as a wireframe plot (with optional hidden-line removal), or as a collection of plots.

Prices start at $695 for the PC/MS-DOS version for 80386/486-based systems. Other computers the software can run on include Sun, DEC, and MIPS workstations, IBM System/370 mainframes, and Cray supercomputers.

Maple, 160 Columbia St W, Waterloo, Ontario N2L 3L3, Canada. Phone (519) 747-2373. FAX (519) 747-5284. Circle No. 739
Local-operating-network developer's kit creates distributed control systems

A local operating network (LON) consists of a collection of nodes that interact with their physical environment and with each other. Each node has sufficient processing power to handle internode communications and control I/O functions. The nodes communicate over a variety of media, including optical, RF, and power-line carriers, using a common message-based protocol.

The core of each node is the Neuron IC. In addition to timers and I/O ports, each IC has three CPUs: one to control internode communications hardware, one to handle message processing, and one to handle the local control functions. The IC has built-in firmware for communications and message processing; you supply control software.

The $14,965 Lonbuilder starter kit includes a development station, two Neuron emulators, a software compiler, and a debugger. You use a PC to control as many as four development stations.

The development station has two built-in nodes and can accommodate six more. Nodes communicate through the station's backplane. You can also add transceiver cards to communicate through RF, twisted-pair, or power-line links, allowing you to test your network with various media.

The built-in nodes handle network management and provide a protocol analyzer. Network-management capabilities include configuring nodes, downloading node software through the network, and controlling individual nodes. The protocol analyzer allows you to monitor communications between nodes and measure performance statistics.

Echelon, 4015 Miranda Ave, Palo Alto, CA 94304. Phone (415) 855-7400. FAX (415) 856-6153. Circle No. 740

X-Window package provides user interface for embedded real-time applications

OS-9 real-time operating-system users can add X-Window-based graphical user interfaces to their 68000-based embedded systems. The OS-9/X-Window software package from Microware Systems provides a complete X-Window client implementation. You can use the software in OS-9-resident development environments and Unix- or MS-DOS-based cross-development applications. The X-Window implementation is compatible with various networked X-Window servers, and the company offers embedded X-Server support for OS-9 and specific graphics boards.

The package complies with X-Window version 11 release 4 from MIT and supports the MIT Tab window manager. The company expects to add an OSF Motif window manager to the package in the third quarter.

The X-Window development libraries include Xlib (X-window library), Xt (X tool kit intrinsics library), Xaw (X Athena widgets library), Xmu (X miscellaneous utilities library), and Xdmcp (X display manager control protocol library). Runtime client programs enable programmers to perform system-level functions, such as initializing and starting up the X-Window package or opening terminal-emulation windows.

The package provides X-Window-server support for OS-9 systems using MMI-250 graphics board from Vigra Inc (San Diego, CA). The package also includes sample X-Window-server source code that users can port to other boards.

The price is $995 for the full X-Window client development package and $195 for a runtime version. Source code for the client development package costs $15,000; the server source code package costs $150.

Microware Systems Corp, 1900 NW 114th St, Des Moines, IA 50322. Phone (515) 224-1929. FAX (515) 224-1352. Circle No. 741
You asked for a connector family that's ideal for both high-density signal and power applications.

We were listening.

Change your circuit size. Change the configuration. There's no re-qualification of connectors when you work with the Mini-Fit family, including Mini-Fit, Jr.™ and Mini-Fit, TPA™ connectors.

That can mean substantial savings in time and work, especially since the Mini-Fit family offers such a wide range of connection options for power, (up to 9 amperes/circuit), and signal applications, (10 milliohm contact resistance).

And now the new Mini-Fit, BMI connector makes assembly more efficient and fool-proof than ever. Blind Mating Interconnects are designed for fast, positive alignment in blind-mating situations requiring wire-to-board, panel-to-board, and board-to-board connections. They can even eliminate harnesses in many applications.

Ask your Molex representative for more information on the growing family of Mini-Fit connectors.
MEET OUR RUGGED TEAM

We've expanded our line of rugged microcomputers into a full team of products, all built rugged from the ground up. These are full rugged systems, versatile enough for military applications, and tough enough for the harshest environments.

• The KMS-4000—powerhouse '386 or '486 microcomputer. Direct access to four removable media. Larger 10.4" EL display. Low MTTR, dependable KMS rugged technology.

• The CP-1932(3)/UYK—rugged PC/AT-compatible micro, praised for performance and reliability during Desert Storm. '386 or '486 computing power. Internal EL display. Fixed and removable drives. Portable or rack-mount.

• The RCM-1900—tough 19" color monitor, fits standard rack for rugged graphics anywhere. Brilliant image, resolution to 1,280 x 1,024 pixels.


For more information on the complete KMS team of rugged hardware, call: 1-800-521-1524 or 1-313-769-1780. (FAX 1-313-769-8660)

GSA Schedule GS00K89AGS6289

KMS Advanced Products, Inc.
700 KMS Place, Ann Arbor MI 48106-1868
CIRCLE NO. 45

EDN July 4, 1991
Introducing the only linears approved to meet IEC 950 and Level B EMI.

CONDOR'S NEW INTERNATIONAL PLUS LINEAR D.C. POWER SUPPLIES MEET TOMORROW'S TOUGH STANDARDS TODAY!

Our International Plus linears offer you performance, price and one more important feature: the agency approvals you need for the 90's, including IEC 950 and VDE 0871 level B EMI. And Condor has more approved linears in stock than anyone in the industry (including more than 30 models in IEC 601 medical versions).

International Plus linears have what you're looking for:

- 115 models (single and multi-output)
- 7 power levels — 3 to 288W
- Worldwide AC input ranges
- OVP on all 5V outputs
- Hermetically sealed power transistors
- MTBF 200,000+ hours per Mil Hndbk 217E
- 2-hour burn-in with cycling (8 hours on medicals)
- Computerized testing (data sheets furnished)
- 3-year warranty — longest in the industry
- 30-day FREE evaluation (call us for samples)

If you need world class performance, quick turnaround, competitive pricing and full agency approvals, call Condor — the leader in linear D.C. power supplies.

EDN July 4, 1991

CIRCLE NO. 82
Software

Enhanced Plotting Tool For Scientific Data

Sigmaplot release 4.1 has improved features that make this plotting software easier to use than previous versions. The new version provides drop-down menus, which stay down when you click on them with a mouse, and an information bar at the bottom of the screen, which provides information on the options you select. A dynamic memory system uses smaller memory overlays and brings into memory only the needed items. As a result, this version needs 40k bytes less memory than previous versions and can run concurrently with TSR programs such as Novell network drivers.

The program automatically takes advantage of expanded or extended memory. You can define graph attributes, such as type of plot, line thickness, colors, and font choice, and save them in a file for future reuse. A driver for Hewlett-Packard Laserjet III printers supports the printer's scalable fonts. $495.

Jandel Scientific, Box 996, Corte Madera, CA 94925. Phone (415) 924-8640. FAX (415) 924-2850. Circle No. 360

Multiuser OS For 80386/486-Based Computers

DR Multiuser DOS replaces the vendor's Concurrent DOS 386 and incorporates technology from that product and from DR DOS version 5.0. This operating system lets a single 386SX-, 386-, or 486-based computer host multiple DOS applications as well as multiple, multi-tasking users linked to the host through a standard serial port. User stations may be dumb terminals or PCs running the emulation program that comes with the software package. The maximum number of users is 64. In practice, this number depends on the number of available ports and the need to maintain an adequate response time.

Disk caching speeds disk accesses, and a dynamic idle-detection system ensures that idle tasks do not tie up the processor. You can accommodate three users by using the standard COM1 and COM2 ports, or 10 users with the aid of the default menu selections for sev-

---

UNIVERSAL INPUT SWITCHING POWER SUPPLIES

FEATUREING:
- 90-264 VAC (continuous) UNIVERSAL INPUT
- FCC CLASS 'B', VDE 0871 'B' OPTIONAL
- HIGH SURGE CURRENTS ON +12V OUTPUTS
- PRICE, DELIVERY AND QUALITY

<table>
<thead>
<tr>
<th>WATTS</th>
<th>MODEL NUMBER</th>
<th>OUTPUT 1</th>
<th>OUTPUT 2 (Peak)</th>
<th>OUTPUT 3</th>
<th>SIZE in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>UPS20-5002</td>
<td>+5V @ 1.6A</td>
<td>+12V @ 1.0A (2.0)</td>
<td></td>
<td>3.0 x 4.0&quot;</td>
</tr>
<tr>
<td>30</td>
<td>UPS30-4003</td>
<td>+5V @ 1.5A</td>
<td>+12V @ 1.5A (3.0)</td>
<td>-12V @ 0.3A</td>
<td>5.1 x 2.8&quot;</td>
</tr>
<tr>
<td>40</td>
<td>UPS40-1002</td>
<td>+5V @ 3.0A</td>
<td>+12V @ 2.0A (4.5)</td>
<td></td>
<td>2.0 x 7.0&quot;</td>
</tr>
<tr>
<td>40</td>
<td>UPS40-2002</td>
<td>+5V @ 3.0A</td>
<td>+12V @ 2.0A (4.5)</td>
<td></td>
<td>3.0 x 5.0&quot;</td>
</tr>
<tr>
<td>40</td>
<td>UPS40-2003</td>
<td>+5V @ 3.0A</td>
<td>+12V @ 2.0A (4.0)</td>
<td>-12V @ 0.3A</td>
<td>3.0 x 5.0&quot;</td>
</tr>
<tr>
<td>50</td>
<td>UPS50-1002</td>
<td>+5V @ 3.0A</td>
<td>+12V @ 3.0A (5.5)</td>
<td></td>
<td>2.0 x 7.0&quot;</td>
</tr>
<tr>
<td>50</td>
<td>UPS50-1003</td>
<td>+5V @ 3.0A</td>
<td>+12V @ 3.0A (5.5)</td>
<td></td>
<td>3.0 x 5.0&quot;</td>
</tr>
<tr>
<td>65</td>
<td>UPS65-1002</td>
<td>+5V @ 3.5A</td>
<td>+12V @ 4.0A (7.0)</td>
<td></td>
<td>3.5 x 6.0&quot;</td>
</tr>
<tr>
<td>65</td>
<td>UPS65-1003</td>
<td>+5V @ 6.0A</td>
<td>+12V @ 2.5A (4.0)</td>
<td>-12V @ 0.5A</td>
<td>3.5 x 6.0&quot;</td>
</tr>
</tbody>
</table>

SINGLE AND QUAD OUTPUT MODELS ARE AVAILABLE.

AUTEC POWER SYSTEMS

CALL NOW...

818-341-6123

9301-101 JORDAN AVENUE
CHATSWORTH, CA 91311
FAX: 818-341-5726

CIRCLE NO. 83

148

EDN July 4, 1991
The secret to better Ethernet is NICE.
And simple.

Introducing NICE™ The new MB86960 Network Interface Controller with Encoder/Decoder from the Advanced Products Division of Fujitsu Microelectronics.

With the unveiling of NICE, Ethernet LAN technology reaches a new level of integration.

Now LAN system designers can have an Ethernet controller, buffer management unit and 10 Mbit per second Manchester encoder/decoder on a single chip. So you can now develop high-performance LAN boards more cost effectively than ever before.

For instance, design adapter cards for high-performance buses using just two Ethernet chips instead of the usual three. Simply combine NICE with our new MB86962 10BASE-T transceiver, the most advanced solution for twisted-pair needs. Or choose our MB8392A if you need a coax interface.

And used with our MB86353 PC Bus Interface Unit, NICE can further reduce costs and complexity when developing PC XT/AT™ adapter cards. Replacing the need for up to ten separate parts.

All in all, NICE has some impressive features to enhance your LAN’s entire performance. Such as a data bus transfer rate of 20 Mbytes per second. A low-power standby mode. And bus compatibility for most standard microprocessors.

But what’s really nice is our understanding of the marketplace. As Fujitsu’s American arm, we know what it takes to get you there a lot faster. With greater cost effectiveness.

So now that the secret is out, call us at 1-800-866-8808. And discover NICE. The world’s most advanced, highly-integrated Ethernet solution.

NICE is a trademark of Fujitsu Microelectronics, Inc. XT and AT are trademarks or registered trademarks of IBM Corp. © 1991 Fujitsu Microelectronics, Inc.

FUJITSU MICROELECTRONICS, INC., Advanced Products Division. 77 Rio Robles, San Jose, CA 95134-1807.

EDN July 4, 1991 CIRCLE NO. 84
eral 8-port plug-in cards. The package comes with drivers for 8- and 16-port intelligent cards and can support drivers for cards that have as many as 64 ports. $695.

Digital Research Inc, Box DRI, Monterey, CA 93942. Phone (408) 649-3896. FAX (408) 646-6248. Circle No. 361

### FFT Subroutine Library

Most FFT packages require you to use one of 16 data-set sizes, each of which is a power of 2. This restriction often forces you to truncate your test arrays or add bogus data, leading to inconsistency in your results. Prime Factor FFT is a library of FFT subroutines that makes available 815 data-set sizes with as many as 64,600 points in 1-D data. The library also allows rectangular dimensions in which m is not equal to n. This facility allows for 664,225 data-set size combinations. The library supports floating-point double-precision numbers (10 bytes) as well as 2-, 4-, and 8-byte integers. The library includes routines for amplitude and phase calculations, Hamming and Hanning windows, and complex forward and inverse FFT in one and two dimensions. To obtain maximum performance, the routines include automatic math-coprocessor detection and the enhanced features of the 80387 coprocessor and 80486 processor.


Alligator Technologies, Box 9706, Fountain Valley, CA 92708. Phone (714) 850-9984. FAX (714) 850-9987. Circle No. 362

### Ada Development System For CASE Tools

VADS APSE version 1.1 integrates the Verdix Ada Development System with commercially available CASE tools, such as Atherton Technology's Software Backplane, Cadre's Teamwork, and IDE's Software through Pictures. The system allows software development, requirements tracking, and design data management across heterogeneous nodes of a network. It also provides configuration management and version control while controlling the work flow. The tools include a self-hosted Ada compiler,
CB-C7
High Integration Level
Cell-Based ASIC Technology

Design Tools Technology

Systems on Silicon
Fast Turnaround Options
Advanced CAD-Environment

NEC
Putting intelligent systems on silicon has never been so easy. Using NEC's CB-C7 advanced CMOS ASIC technology you can integrate all your system elements - such as microprocessor or microcontroller cores, RAM, ROM, intelligent peripherals and analog I/O - into a single-chip solution. And it won't cost you a fortune in new design tools, because NEC CB-C7 ASICs can be designed using industry standard hardware platforms and EDA software - hardware and software you probably already have.

NEC's CB-C7 cell-based ASIC technology gives you other advantages as well. The sub-micron CMOS process used to implement it not only allows CB-C7 to achieve the high level of integration required for systems-on-silicon, it also provides you with 0.44 nsec gate delays and ultra-low power consumption.

To make things even better, NEC offers you two routes to finished silicon. If you require a fast turnaround, we can implement user-defined logic in your design as a sea-of-gates gate array. Alternatively, if you are aiming for minimum chip cost, we can produce the entire ASIC as a standard-cell solution.

For example, the library of megafunction blocks contains cores of our µCOM87, V20H and V30H microprocessors, plus intelligent peripheral functions such as those provided by NEC's 72-series and 82-series standard peripheral devices. And because most of these megafunction blocks are hard macros, derived directly from the chip layouts of our standard parts, they have fully characterized timing parameters and can be tested with the standard part test vectors.

Our hard macros are complemented by an extensive range of soft macros to provide additional peripheral device and system support functions, and by a library of over 300 standard logic functions available for both silicon realization approaches, the 'High-density' (CB-C7HD) and the 'Fast TAT'-option (CB-C7FT). And of course, all our RAM and ROM blocks can be compiled to exactly match your system requirements.

CB-C7 ASICs utilize an advanced CMOS process technology which features 0.8µm gate lengths. This technology achieves internal gate delays of only 0.44 nsec and power gate delays of 0.34 nsec (fan-out = 2, wire length = 2mm)

The high silicon utilization of the process allows us to achieve integration levels of over 180,000 usable 2-input NAND-gate equivalents per chip - more than sufficient to put high-performance systems into single-chip solutions. And although CB-C7 ASICs consume very little power - only 6.5 µW/gate/MHz - their 48-mA drive capability allows them to deliver power when it's needed.
Fast turnaround and low unit price are often conflicting requirements when it comes to implementing your ASIC designs – the first suggesting the use of a gate array solution, and the second dictating a standard cell approach. NEC's CB-C7 ASIC technology solves these cost/turnaround trade-offs – with combined gate-array/standard-cell solutions for fast turnaround, and full standard-cell implementations for low unit cost.

Whichever option you choose, the hard-macro, megafuction block and RAM/ROM blocks in your design will be floor-planned onto the chip in much the same way. If you need finished silicon in less than a month, we will then implement your customer specific logic in a ‘sea of gates’ gate array, laid down around these cells. Alternatively, if you are aiming for minimum piece price, we will implement the entire ASIC as a standard cell design – using sophisticated cell optimization algorithms to ensure we achieve minimum chip area.

**High Performance ASICs and Packages**

Both the fast turnaround and low unit cost versions of CB-C7 ASICs feature the same high performance - so there are no compromises with either solution.

To match this performance, we have an equally impressive range of packages in which to house them. You can choose between conventional plastic DIPs, quad flat-packs, PLCCs and high pin-count plastic or ceramic pin-grid arrays. NEC's state-of-the-art packaging technology provides CB-C7 ASICs with maximum protection from their environment, ensuring their long-term reliability.

**OpenCAD – flexibility in design**

NEC OpenCAD gives you maximum freedom in the CB-C7 design process. Freedom to perform schematic capture using popular EDA software such as DAZIX, Mentor, Valid and VIEWlogic, on industry standard workstations from DEC, HP-Apollo, IBM and SUN.

After schematic capture, your design is completed by compiling RAM/ROM blocks and optimizing user-defined logic. It is then floor-planned using ChipPlan, simulated with System Hilo or Verilog, and placed and routed using Cell-3 Ensemble. After post-layout simulation and design-rule checks, we pass pattern generation data to one of our wafer fabrication facilities in Japan, the USA or Europe.

To simplify your design task, logic optimization, simulation, and chip layout are normally carried out by a NEC ASIC design center on their SUN or DEC workstations. Providing access to NEC's Unified Design Environment – a suite of ASIC design tools which operate under DEC PowerFrame system management software – these workstations ensure a simple user interface and smooth data flow from one design process to the next.

However, OpenCAD also gives you the flexibility to install part or all of the NEC Unified Design Environment on your own system, so that you can perform as much, or as little, of the CB-C7 design process as you choose.
To handle the complexity of CB-C7 ASICs, and that of our next generation of ASIC technologies, we have taken some of the best ASIC design packages in the industry — such as VIEWlogic schematic capture software, Synopsys HDL compilers and logic synthesizers, Genrad System Hilo, and Cadence simulation, layout and routing software — and integrated them into the NEC Unified Design Environment.

At the heart of this design system lies the NEC Central Unified ASIC Database — a technology independent database which allows us to automatically generate new simulation models as new process technologies are introduced. So with NEC, you not only get ahead, you stay ahead.

Wherever you are in the world, there is a NEC design center close enough to support you in CB-C7 ASIC design. If you are already using industry standard workstations and EDA software to design ASICs, you probably have all the hardware and software design tools you will need. Simply install the CB-C7 ASIC libraries, and you can start on a CB-C7 design tomorrow.

Interested...? Then phone your local NEC office today.

For fast answers, call us at:
USA Tel:1-800-632-9531 Fax:1-800-729-6288 Germany Tel:0211-650302 Telex:519296 Switzerland Tel:041-445-845. Telex:51923.
Sweden Tel:08-753-6020 Telex:138399 France Tel:1-396-7800 Telex:699499 Spain Tel:1-396-4150 Telex:41316 Italy Tel:02-670908. Telex:315355.
Korea Tel:02-551-0450 Fax:02-551-0451 Singapore Tel:491881. Telex:39726. Australia Tel:03-267-6355. Telex:38343.
The FS700 LORAN-C frequency standard

10 MHz cesium stability

Cesium long term stability at a fraction of the cost
Better long-term stability than rubidium
Not dependent on ionosphere position changes, unlike WWV
Complete northern hemisphere coverage, unlike GPS.

The FS700 LORAN-C frequency standard provides the optimum, cost-effective solution for frequency management and calibration applications. Four 10 MHz outputs from built-in distribution amplifiers provide cesium standard long-term stability of $10^{-12}$, with short-term stability of $10^{-10}$ ($10^{-11}$ optional). Reception is guaranteed in North America, Europe and Asia.

Since the FS700 receives the ground wave from the LORAN transmitter, reception is unaffected by atmospheric changes, with no possibility of missing cycles, a common occurrence with WWV due to discontinuous changes in the position of the ionosphere layer. Cesium and rubidium standards, in addition to being expensive initially, require periodic refurbishment, another costly item.

The FS700 system includes a remote active 8-foot whip antenna, capable of driving up to 1000 feet of cable. The receiver contains six adjustable notch filters and a frequency output which may be set from 0.01 Hz to 10 MHz in a 1-2-5 sequence. A Phase detector is used to measure the phase shift between this output and another front panel input, allowing quick calibration of other timebases. An analog output with a range of $\pm 360$ degrees, provides a voltage proportional to this phase difference for driving strip chart recorders, thus permitting continuous monitoring of long-term frequency stability or phase locking of other sources.
Software

Chapter 13 functions, and a window-oriented source-level debugger. The tools support register variables, command history, and command editing. $7895 per user.

Verdix Corp, Sullyfield Business Park, 14130-A Sullyfield Circle, Chantilly, VA 22021. Phone (703) 378-7600. Circle No. 363

Image-Compression Software And Accelerator

Picture Packer is an image-compression subsystem for 80286-, 80386-, and 80486-based IBM PCs and compatibles. The subsystem consists of software and an optional half-size accelerator board. The software-only version runs under MS DOS 3.0 and later versions or Windows 3.0. It compresses full-color and gray-scale images using the proposed JPEG implementation standards and achieves compression ratios as high as 30:1. The software works with Targa, TIFF, PCX, and GIF file formats, and is compatible with existing desktop-publishing, presentation, animation, and word-processing programs. You can activate a memory-resident utility from within an application program to read a compressed file.

The accelerator board is based on Texas Instruments’ 320C25 DSP chip and makes image compression and decompression as much as five times faster than the software-only version. You can select 30:1 lossy compression or 5:1 no-loss compression. The lossy compression retains adequate image quality for noncritical applications; the 5:1 no-loss compression retains all pixel data needed for medical and scientific analysis. Picture Packer software, $79; accelerator card, $595.

Video & Image Compression Corp, 21311 Hawthorne Blvd, Suite 235, Torrance, CA 90503. Phone (213) 792-1659. FAX (213) 543-2117. Circle No. 364

X-Window Servers

Software X11R4 servers, which are based on X-Window System version 11 release 4, let you turn Unix and DOS PCs that have TMS340-based graphics accelerators into high-resolution X workstations and X terminals, respectively. The servers are 100% backward compatible.
To put VGA graphics on your motherboard, you need a cost-efficient, highly integrated, powerful solution that uses minimal board space. You need the new CL-GD5320 Enhanced VGA-Compatible Graphics Chip from Cirrus Logic.

Use it to incorporate full 16-bit or 8-bit VGA into low-cost personal computers. You only need two industry standard 256K x 4 DRAMs and as few as five other ICs. Whatever memory speed you select — 80ns, 100ns, or 120ns — you'll get a complete VGA display system with greater performance than systems using a more expensive solution with 64K x 4 DRAMs.

You don't sacrifice features. You get 16-bit and 8-bit support for the VGA graphics standard, and full, register-level backwards compatibility. For maximum performance, it has an 8/16-bit CPU interface, independent video and DRAM clocks, internal FIFOs, and page mode DRAM access. And it will interface to both analog (PS/2 and multi-sync) and TTL monitors.

You can also pick a ready-to-use solution that's right for you. Anything from a chip with full BIOS, drivers, utilities, user's manual, and documentation — to a complete manufacturing kit including everything you need to quickly move into high-volume production.

Make your PC more competitive and get all the speed, time, space, power, and expense. You still save time, space, and money. Call Cirrus Logic today.

Get on board. Call today for more information on our motherboard VGA solutions. Call 1-800-952-6300. Ask for dept. LM22.

This full 16-bit CL-GD5320 lets you implement 16-bit or 8-bit VGA capabilities on your motherboard with as few as 5 other chips and two 256K x 4 DRAMs. Get a complete solution that saves time, space, power, and expense. You still get all the speed, features and flexibility you're looking for.
with the vendor's X11R3 server and support all major windowing environments, including Motif, Open Look, and DECwindows. Proprietary enhancements optimize available X-server memory, boost performance, and improve overall system integrity.

The vendor has implemented the MIT Shape extension, which lets user applications create nonrectangular windows, and memory-paging extensions, which allow local regeneration of pixmaps. In addition to the X11R4 fonts bundled with the servers, you can obtain more than 200 supplemental X11R4 fonts by returning the product-registration card. Xsoftware for PC Unix, $595; Xsoftware for TIGA/DOS, $495.

AGE, 8765 Aero Dr, Suite 226, San Diego, CA 92123. Phone (619) 565-7373. FAX (619) 565-7460.

Circle No. 365

Nature equipped the armadillo with a shielding system designed for reliable protection.

General Devices' shielded enclosures employ that same principle.


Know exactly what attenuation your application requires? Temperate to Tempest, tell us your needs and we build to suit.

Standard solutions not applicable? Take advantage of complete custom engineering services from in-house EMI specialists — a valuable resource as EMI concerns grow more and more complex.

Go beyond the enclosure. Use construction options to answer your shock, vibration, cooling and equipment accessibility needs. Then equip the enclosure the way you want it with fans, slides, shelves and more from a complete cabinet hardware line — all from a single source.

The natural choice. More than 25 years of experience. Selection and response. Combined in a complete line of Vent Rak® shielded enclosures, from the natural choice for all your electronic packaging needs. Find out more, from General Devices.

Call 1-317-897-7009. Or write General Devices Company, Inc., P.O. Box 39100, 1410 S. Post Rd, Indianapolis, IN 46239.

Ada Compiler For 386 LynxOS

The Alsys Ada Software Development System now runs on IBM PS/2 Model 80, Compaq Deskpro 386, and selected 386-based compatibles under LynxOS, a real-time Posix-compliant operating system. The package includes the Ada compiler with high- and low-level optimizers; a binder; a multilibrary system with family, library, and unit managers; the Adaexec run-time executive; Adaworld, the interface common to all Alsys compilers; standard Ada packages; and an ISO-standard math library.

Other tools that come with the package are Adaprobe, a source-level debugger; Adaxref, a cross-reference generator; Adamake, an automatic recompilation utility; and Adareformat, a source-code standardization tool. The compiler implements Ada tasks as lightweight Posix threads, thereby allowing the LynxOS scheduler to maintain priority relationships across multiple application programs. The multilibrary system provides safe, efficient sharing of Ada libraries and lets you adapt the Ada library structure to your project. $7500.

Alsys, 67 S Bedford St, Burlington, MA 01803. Phone (617) 270-0030. FAX (617) 270-6882.

Circle No. 366
Some Notes About Digital Audio DACs

Tops!
Our new PCM63 D/A converter belongs in your top-of-the-line systems. Its unique Colinear™ dual-DAC design optimizes low-level linearity and eliminates the signal-to-noise, channel separation, and intermodulation distortion problems you often get with present sigma-delta and similar noise-shaping architectures. Result? The best sound your best systems can produce.

Three seconds of a horn instrumental from a score of classical music.

<table>
<thead>
<tr>
<th>SPECIFICATIONS</th>
<th>PCM63</th>
<th>PCM67</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>20-bits</td>
<td>18-bits</td>
</tr>
<tr>
<td>THD+N, Max</td>
<td>-96dB</td>
<td>-92dB</td>
</tr>
<tr>
<td>SNR, Min</td>
<td>116dB</td>
<td>110dB</td>
</tr>
<tr>
<td>Dynamic Range</td>
<td>108dB</td>
<td>108dB</td>
</tr>
<tr>
<td>Gain Error</td>
<td>±1%</td>
<td>±3%</td>
</tr>
<tr>
<td>Power Dissipation</td>
<td>225mW</td>
<td>75mW</td>
</tr>
<tr>
<td>Oversampling</td>
<td>16X</td>
<td>8X</td>
</tr>
<tr>
<td>Channels</td>
<td>Single</td>
<td>Dual</td>
</tr>
<tr>
<td>Price</td>
<td>$12.23</td>
<td>$13.97</td>
</tr>
</tbody>
</table>

Free Samples, Full Support

A Close Second
Our dual BiCMOS PCM67 D/A converter delivers high performance at low cost for your medium and low-end systems. A novel architecture combines the best features of "one-bit" and multibit designs for high SNR and glitch-free operation. It works from a single +5V supply, ideal for portable CD and DAT players.

PCM67 features the best of multibit and one-bit designs.

Burr-Brown Corp.
P.O.Box 11400,
Tucson, AZ 85734
Colinear™ - Burr-Brown Corp.
*U.S. OEM prices, in 1000s.
We're pleased to introduce optimum price/performance in a DPDT relay designed for very dense packaging in cost-conscious commercial applications.

Our 172 Centigrid® uses TO-5 relay technology to provide high overall reliability and excellent resistance to environmental extremes. It’s available at an unusually affordable quantity/price, thanks to vertical integration and automation in our manufacturing operations. Three models are offered in a basic DPDT configuration. Applications include telecommunications, test instruments, mobile communications, aeronautical electronics, attenuators and automatic test equipment.

Inherently low intercontact capacitance and contact circuit losses make the 172 Series an excellent RF switch for frequencies well into the UHF spectrum as shown above.

For complete technical information, application assistance and quantity pricing, call us at 1-800-284-7007 or FAX us at 213-779-9161 today.

TELEDYNE RELAYS, 12525 Daphne Avenue, Hawthorne, California 90250

*Priced at $6.00–$7.00 in quantities of 5,000 or more, depending upon specific model purchased. And, still very affordable in smaller quantities.
No Matter What the Application, **SBE Fits.**

Matching your high-speed data communications requirements with a quality supplier has never been easier. Whether you're a manufacturer of mini/superminicomputers, workstations or high-performance data communications products, only SBE provides a perfect fit.

Only SBE offers a complete line of intelligent high-performance communications controllers for all major interface technologies: FDDI, Token Ring, Ethernet and High Speed Serial. Only SBE adds premium features, without a premium cost, for the best price/performance in the industry.

Add integrated hardware/software solutions; availability in VMEbus, Multibus and SBus; plus legendary development assistance and continuing product support.

Discover how SBE's intelligent high-performance controllers can meet your LAN and WAN interface requirements. Turn to SBE today.

For fast action, call: 1-800-347-COMM
Germany: 0130-810588
United Kingdom: 0800-378-234

SBE, Inc., 2400 Bisso Lane, Concord, CA 94520

CIRCLE NO. 92
VR3600A
+ VR3010A
VR3600A
The Solution.

Add a floating point processor to a RISC CPU, and you get the singlechip solution for tomorrow's high-end systems.

NEC's new VR3600A combines the power of our 32-MIPS RISC CPU (VR3000A) with the speed of our 11.2-MFLOPS floating point processor (VR3010A). The result is a single-chip solution of unparalleled potential for high-end workstations, image processors and other advanced systems.

The VR3600A not only gives you hyperdrive performance, it also saves board space and simplifies your system. You can replace two chips — the VR3000A and the VR3010A — with one VR3600A and enjoy full hardware and software compatibility. For even greater space savings, use our cache SRAM and bus interface unit. The VR3600A comes in a 175-pin PGA package.

For your challenging system design, the one chip that puts it all together is VR3600A. For more information on this unique singlechip solution, contact NEC today.

For fast answers, call us at:
UK: Tel: 0908-69133. Telex: 826791. Ireland Tel: 01-6794200. Fax: 01-6794081. Hong Kong Tel: 755-9008. Telex: 54561. Taiwan Tel: 02-719-2377. Telex: 22372.
Korea Tel: 02-551-0450. Fax: 02-551-0451. Singapore Tel: 253-8111. Fax: 250-3583. Australia Tel: 03-267-6565. Telex: 38343.
CIRCLE NO. 93
Take your best shot.
For emulation, analysis or chip support, we’re the pros who’ll improve your score.

We’re American Arium, and we’ve created a winning combination: EZ-PRO® development software and emulators from American Automation and high-performance logic analyzers from Arium.

From the RCA 1802 to the Intel i960, the Motorola 68040 to the MIPS R3000A, we now deliver support for virtually any chip you select.

Our development systems will keep your embedded projects on course with compilers, assemblers, C source level debug, variable tracking, extensive triggering and selective trace. To give you an easy shot at debugging, our logic analyzers feature solid disassemblers, timestamp, symbolic debug, performance analysis and expanded memory with high-speed timing to 400 MHz.

And to keep you clear of hidden traps, we’ve developed a fully integrated set of relocating linkers, assemblers, language translators, disassemblers and more than 20 different cross compilers.

Make your next project an easy chip shot. Call the pros: American Arium.

Arium’s ML4400 configurable logic analyzer for 80486. Priced from $9,785

EZ-PRO Development System for 68302 Priced from $8,945

14281 Chambers Road, Tustin, CA 92680 Fax: (714) 731-6344
EZ-PRO Division (714) 731-1661 • Arium Division (714) 731-2138

© American Arium 1991

CIRCLE NO. 94
Ordinary DMM measures high resistances

Alfred E Hess
Consultant, Boulder, CO

Using a simple technique, you can extend the resistance-measurement range of your 3½-digit DMM from the usual 19.99 MΩ to 40 GΩ. Thus, you could measure, for example, the leakage resistances of transformers, motor windings, and capacitors.

For a 19.99-MΩ DMM range, select a stable 20-MΩ resistor whose value is slightly below nominal, say 19.99 MΩ. Simple math tells you that an unknown high resistance, \( R_x \), is

\[
R_x = R_p \times R_{px}/(R_p - R_{px}),
\]

where \( R_p \) is the high-value parallel resistor and \( R_{px} \) is the measured value of \( R_p \) in parallel with \( R_x \). An even easier way to determine the value of \( R_x \) is by using the graph in Fig 1.

A handy mounting tip is to connect the high-value resistor across the setscrews of a dual banana plug. Insert the dual banana plug into your DMM’s terminals and your leads into the banana plug.

EDN BBS /DL_SIG #982

To Vote For This Design, Circle No. 747

Increased feedback stabilizes amp

William A Gross
Linear Technology Corp, Milpitas, CA

Contrary to popular thought, you can optimize current-feedback amplifiers to drive capacitive loads. The usual method for using a current-feedback amplifier to drive a capacitive load isolates the load with a resistor in series with the amplifier’s output. The disadvantage of this method is that the finite output resistance will cause errors unless the load’s resistance is well defined.

A better solution involves only the amplifier’s feedback resistors (Fig 1). Because the feedback resistors determine the amplifier’s compensation, you can select the optimal value for these feedback resistors for almost any capacitive load.

EDN July 4, 1991
Amplifier becomes glitch-free clipper

Timothy F Darling
MariPro/SAIC, Goleta, CA

Adding a simple clamping circuit (Fig 1) to a Harris 2620 high-speed op amp produces a glitch-free amplifier/clipper. The op-amp pin that controls the device's bandwidth is a high-impedance, isolated input. This pin also tracks the device's output voltage.

Therefore, the circuit comprising D1, D2, R1, R2, and R3 will clamp the amplifier's output voltage only when the amplifier's input voltage exceeds your clamping-voltage limits. VD is the diode drop of D1 or D2. The two clamp voltages, VA + VD and VB - VD, are

\[ V_A = V_X \left( \frac{R_2 + R_3}{R_1 + R_2 + R_3} \right) + V_Y \left( \frac{R_1}{R_1 + R_2 + R_3} \right) \]

\[ V_B = V_X \left( \frac{R_3}{R_1 + R_2 + R_3} \right) + V_Y \left( \frac{R_1 + R_2}{R_1 + R_2 + R_3} \right), \]

where \( V_X \) and \( V_Y \) are the clamping circuit's bias voltages. Choosing \( R_1 \) lets you determine the val-

Feedback-resistor \( R_F \) sets the amplifier's bandwidth. Increasing \( R_F \) reduces the amplifier's bandwidth, significantly improving the amplifier's ability to drive capacitive loads. Feedback-resistor \( R_F \) sets the amplifier's gain.

You cannot get the data necessary to calculate alternate values for \( R_F \) from most data sheets. However, a few minutes at the bench with a network analyzer will generate the data you need to make a graph of the value of the feedback resistor vs the amount of capacitive load the amplifier can drive (Fig 2).

Start with the recommended data-sheet value for feedback-resistor \( R_F \) and measure the amplifier's frequency response without any capacitive load. Note the bandwidth and then add capacitive loading until the response peaks by about 5 dB. Record this value of capacitance; it is the maximum amount for that feedback resistor. Then increase the value of the feedback resistor and repeat the procedure until you develop a graph like the one in Fig 2.

EDN BBS/DL_SIG #979

To Vote For This Design, Circle No. 748

---

**Fig 2**—A few minutes using a network analyzer are all you'll need to develop a graph like this one. Using such a graph, you can determine the value of \( R_F \) needed for an amplifier's capacitive load.

---

**Fig 1**—By putting the 2620 op amp's isolated bandwidth-control (COMP) pin to a novel use, the resistor-diode clamping network transforms the amplifier into an amplifier/clipper.
When you use NAS solder and flux bearing edge clips, rework is virtually eliminated. Steps that yield high rates of rejects in other circuits assembly methods — solder paste, dipping and board clean-up — are replaced by simple, one-step lead attachment and reflow operations that consistently produce 100% solderability. Also, NAS clips can be bonded to conductor pads without raising the temperature of pre-populated boards to reflow levels and causing damage to existing connections. Most — or all — of the inspection procedures required by other methods are unnecessary, and expensive rework becomes a thing of the past.

Preforms on edge clip terminals contain precisely the right amounts of the proper solder and flux for each application, and the exclusive NAS "Claw" grip holds each preform. This unique grip design provides direct contact between solder and conductor pads, a beneficial wiping action as clips are attached, and positive control of solder flow.

A single reflow operation for top and bottom preforms — using any method that raises temperatures to reflow levels — produces perfect solder joints every time.

With no specialized labor skills to acquire and very little capital investment, you can quickly and easily convert to the NAS solder and flux bearing edge clip method. The immediate result will be a faster, far less costly circuits assembly process, and more reliable, better performing products.

NAS offers a large selection of edge clips, including .100, .075 and .050 centerlines for both through-hole and surface mounting of SIP, DIP, Quad and Multi-chip devices. Our surface mount clips are the most effective solution to the problem of thermal mis-match, and are available in a variety of types. Ask about our Compliant "J" surface mount designs with .025 and 1mm centerlines.

In addition to a complete line of edge clips, NAS offers economical semi-automatic SIP, DIP and Quad lead attachment machines, and bench-top and in-line reflow machines, all of which further enhance assembly efficiency and reliability.

For complete information about any of our products, please contact:

NAS Electronics, 381 Park St., Hackensack, NJ 07602.
Phone (201) 343-3156.
FAX (201) 343-4883.
ues of $R_2$ and $R_3$. Try a value for $R_1$ around 3 kΩ.

One example of this circuit had clamping voltages of $±3.7V$ and exhibited THD below $-75$ dB for a sinusoidal, 30-kHz input signal. When the input signal increased beyond the $±3.7V$ clamping voltages, the clipper symmetrically clamped the output voltage with no glitches in the waveform.

**FEEDBACK AND AMPLIFICATION**

**Keep your boss from worrying**

When your current project exhausts all normal design time plus allowable extra time, here are some tips to overcome management worries.

Blame problems on:
- Oscillation—High or low frequency, parasitic, load, layout, or heat related. Or, blame computer simulation that showed no stability problems.
- Feedback—Everything was working until you closed the loop. A complex pole for compensation may be required.
- Noise—Call attention to crosstalk that you could not have checked at the prototype stage. Note sagely that the problem is probably either intrinsic or extrinsic. Point out that adding optoisolators or shielding will take time.
- Jitter—Blame jitter on components, terminations, transmission lines, speed, interfaces—or just cite jitter without offering explanation.
- Heat—Blaming inadequate heat sinking or airflow is a good idea. “Typical drift” is a good excuse, too.
- Layout—If you did not do the board layout, then place the blame on mistakes in the ground plane, ground loops, etc. If using a multilayer board, buy more time by maintaining that mistakes in a hidden layer make a completely new layout necessary.
- Delivery—The samples and prototypes arrived late.

If these suggestions do not work, don’t give up. Try glitches, overshoot or undershoot, static charges, threshold, hysteresis, and power-supply problems (only if you did not design the power supply, of course). Then ask for the most expensive test instruments, computers, and software packages available. Failing all else, demand that management rewrite your project’s specifications because the specs are obviously too tight. Finally, let the software department develop workarounds for your hardware problems.

*Constantin Buta*

*Product Development Engineer*

*Pulse Instruments*

*1234 Francisco St*

*Torrance, CA 90502*

*(213) 693-2192*

EDN is proud to pass along to its faithful readers what are probably the most useful ideas ever presented in the Design Ideas section. We are also considering distributing the previous tips to graduating engineers because we suspect that their professors neglected to cover this vital component of a professional engineer's armamentarium.

*Charles H Small and Anne Watson Swager*

*Design Ideas Editors*
While others talk, Pioneer's customers are enjoying the benefits of power supplies with built-in .99 active PFC today.

In over 2400 voltage-current configurations, from 250 to 2000 watts, single or multiple output.

Pioneer can give you 1000 watts of DC power from a standard 115-V 15-A wall outlet and comply with UL's 12 A limitation. That's 300 more watts of usable power for system peripherals and accessories.

Plus, insensitivity to input voltage and frequency variations over a range of 90-264 VAC, DC-120 Hz eliminates strapping or switching.

You'll also get the added benefits of improved holdup performance, reduced line harmonics, less stress on system wiring, and decreased UPS size.

Because load current drawn from the line is a sine wave rather than a spike, conducted EMI filtering is simplified. In fact, these units meet the requirements of IEC 555-2 which limits third and higher harmonics. They also meet international safety standards, including UL1950, CSA 1402C and 220, IEC 380 and 435 and EN60950. All Pioneer standard and custom options are available.

Our 100% testing and 48-hour full-power burn-in ensures you of Hi-Rel, top quality supplies.

We've been building high-power switchers over 30 years and shipped over 350,000 worldwide.

So call us at 800-233-1745 or 800-848-1745 in CA. Or write to 1745 Berkeley St., Santa Monica, CA 90404.

Fax: 213-453-3929
Design Entry Blank

$100 Cash Award for all entries selected by editors. An additional $100 Cash Award for the winning design of each issue, determined by vote of readers. Additional $1500 Cash Award for annual Grand Prize Design, selected among biweekly winners by vote of editors.

To: Design Ideas Editor, EDN Magazine
Cahners Publishing Co
275 Washington St., Newton, MA 02158

I hereby submit my Design Ideas entry.

Name ____________________
Title ________________ Phone ________
Company ________________
Division (if any) ______________
Street ______________________
City ____________ State ______
Country ______________ Zip __
Design Title ______________
Home Address ______________

Social Security Number
(Must accompany all Design Ideas submitted by US authors)

Entry blank must accompany all entries. Design entered must be submitted exclusively to EDN, must not be patented, and must have no patent pending. Design must be original with author(s), must not have been previously published (limited-distribution house organs excepted), and must have been constructed and tested. Please submit software listings and all other computer-readable documentation on a 5 1/4-in. IBM PC disk.

Exclusive publishing rights remain with Cahners Publishing Co unless entry is returned to author or editor gives written permission for publication elsewhere.

In submitting my entry, I agree to abide by the rules of the Design Ideas Program.

Signed ____________________
Date ______________________

ISSUE WINNER

The winning Design Idea for the April 11, 1991 issue is entitled “Pause detector adapts to signal.” submitted by Tibor Szep and Andras Pomozi of Technical University of Budapest (Budapest, Hungary).

Your vote determines this issue’s winner. All designs published win $100 cash. All issue winners receive an additional $100 and become eligible for the annual $1500 Grand Prize. Vote now, by circling the appropriate number on the reader inquiry card.

Feedback and amplification

Reader Chews Prose

After reading “A/D board hooks to IBM PC printer port” by Bob and Mark Underwood (EDN, February 18, 1991, pg 184), which was a Design Idea for the MAX171 A/D converter, I reflected on my own experience with the device and was moved to compose this limerick:

Missing Codes

There once was a MAX171 chip,
That could make our design really zip.
But after eight months of waiting,
Thinking soon we would be creating,
We were told the chip would never ship!

I am amused to find that a Maxim employee submitted a design for the MAX171 A/D converter after we were told of the chip’s ultimate demise because of yield problems.

Brett M Jackson, Design Engineer
Beckman Instruments Inc
90 Boroline Rd
Allendale, NJ 07401
(201) 818-8900

Maxim replies that rumors of the death of the MAX171 are greatly exaggerated. The company says that building the chip involves a novel assembly technique. Some glitches in the process caused the company to suspend production temporarily. They assure us that the problems are now ironed out and that you can once again get the device.

Charles H Small and Anne Watson Swager
Design Ideas Editors

Corrections

In “Digital correlator defeats noise,” (EDN, May 9, 1991, pg 176), counter A clocks on a high-to-low transition, not on a low-to-high transition as shown. Similarly, the flip-flop clocks on a low-to-high transition. Also, counters A and B are synchronous counters. Thus when the output of counter B goes high, resets of counters A and B occur on the next clock transition, not immediately.

Readers have pointed out that if the AND gate and counter B go high simultaneously, the J-K flip-flop will not reset. You can cover this extremely rare eventuality by adding a D flip-flop, with the flip-flop’s input connected to counter B’s output, and the D flip-flop’s output going to the J-K flip-flop’s reset.

John D Charlton
42936 Cinema Ave
Lancaster, CA 93534-6231
(805) 942-4814
DC-DC Converters for Portable Computers – Design Note 52

Steve Pietkiewicz
Jim Williams

Portable computers require simple and efficient converters for +5V power and display driving. A regulated 5V supply can be generated from two “AA” cells using the circuit shown in Figure 1. U1, an LT1073-5 micropower DC-DC converter, is arranged as a step-up, or “boost” converter. The 5V output, monitored by U1’s SENSE pin, is internally divided down and compared to a 212mV reference voltage inside the device. U1’s oscillator turns on when the output drops below 5V, cycling the switch on and off at a 19kHz rate. This action alternately causes current to build up in L1, then dump into C1 through D1, increasing the output voltage. When the output reaches 5V, the oscillator turns off. The gated oscillator provides the mechanism to keep the output at a constant 5V. R1 invokes the current limit feature of the LT1073, limiting peak switch current to 1A. U1 limits switch current by turning off the switch when the current reaches the programmed limit set by R1. Switch “on” time, therefore, decreases as \( V_{IN} \) is increased. Switch “off” time is not affected. This scheme keeps peak switch current constant over the entire input voltage range, allowing maximum energy transfer to occur at low battery voltage without exceeding L1’s maximum current rating at high battery voltage.

The circuit delivers 5V at 150mA from an input range of 3.5V to 2.0V. Efficiency measures 80% at 3.0V, decreasing to 70% at 2.0V for load currents in the 15mA to 150mA range. Output ripple measures 170mVp-p and no-load quiescent current is just 135µA.

A –24V LCD bias generator is shown in Figure 2. In this circuit U1 is an LT1173 micropower DC-DC converter. The 3V input is converted to +24V by U1’s switch, L1, D1, and C1. The switch pin (SW1) then drives a charge pump composed of C2, C3, D2, and D3 to generate –24V. Line regulation is less than 0.2% from 3.3V to 2.0V inputs. Load regulation, although it suffers somewhat since the –24V output is not directly regulated, measures 2% from a 1mA to 7mA load. The circuit will deliver 7mA from a 2.0V input at 73% efficiency.

If greater output power is required, Figure 2’s circuit can be driven from a +5V source. R1 should be changed to

---

Figure 1. Two “AA” Cell to 5V Step-Up Converter Delivers 150mA

---

Figure 2. DC to DC Converter Generates –24V from 3V or 5V
47Ω and C3 to 47µF. With a 5V input, 40mA is available at 75% efficiency. Shutdown is accomplished by bringing the anode of D4 to a logic high, forcing the feedback pin of U1 to go above the internal reference voltage of 1.25V. Shutdown current is 110µA from the input source and 36µA from the shutdown signal.

Current generation portables require back lit LCD displays using cold cathode fluorescent lamps (CCFLs). Figure 3 provides 78% efficiency with full control over lamp brightness. 82% efficiency is possible if the LT1072 is driven from a low voltage (e.g. 3V-5V) source. Additional benefits include a 4.5V to 20V supply range and low radiated power due to sine wave based operation.

L1 and the transistors comprise a current driven Royer class converter which oscillates at a frequency primarily set by L1’s characteristics and the 0.02µF capacitor. LT1072 driven L2 sets the magnitude of the Q1-Q2 tail current, and hence L1’s drive level. The 1N5818 diode maintains current flow when the LT1072 is off.

The 0.02µF capacitor combines with L1’s characteristics to produce sine wave voltage drive at the Q1 and Q2 collectors. L1 furnishes voltage step-up, and about 1400Vp-p appears at its secondary. Current flows through the 33pF capacitor into the lamp. On negative waveform cycles the lamp’s current is steered to ground via D1. Positive waveform cycles are directed, via D2, to the ground referred 562Ω-50k potentiometer chain. The positive half-sine appearing across these resistors represents 1/2 the lamp current. This signal is filtered by the 10k-1µF pair and presented to the LT1072’s feedback pin. This connection closes a control loop which regulates lamp current. The 2µF capacitor at the LT1072’s VC pin provides stable loop compensation. The loop forces the LT1072 to switch-mode modulate L2’s average current to whatever value is required to maintain a constant current in the lamp. The constant current’s value, and hence lamp intensity, may be varied with the potentiometer. The constant current drive allows full 0-100% intensity control with no lamp dead zones or “pop-on” at low intensities. Additionally, lamp life is enhanced because current cannot increase as the lamp ages. Detailed information on this circuit appears in LTC Application Note 45, “Measurement and Control Circuit Collection.”

Figure 3. Cold Cathode Fluorescent Lamp Power Supply

For literature on our DC-DC Converters, call (800) 637-5545. For applications help, call (408) 432-1900, Ext. 456

Linear Technology Corporation
1630 McCarthy Blvd., Milpitas, CA 95035-7487
(408) 432-1900 • FAX: (408) 434-0507 • TELEX: 499-3977
Smash the Cache Barrier
IDT's 64K BiCEMOS™ TTL I/O Static RAMs are the ideal solution for high-density cache systems, and are the perfect match for optimizing the high-performance needs of RISC and CISC processors. These 8ns and 10ns SRAMs provide the highest system speed without sacrificing system chip count or increasing power consumption.

Smash the barrier to efficient cache operation at the highest clock speeds. Call today and ask for Kit Code 8041 for free samples of our new 16K x 4 and 8K x 8 TTL SRAMs.

COUNT ON IDT

35MIPS RISC COMPONENTS AND MODULES
R3000A, the most MIPS at any MHz. The R3051 integrates CPU, cache, and buffers on one chip. RISC modules, eval. boards, and software complement our family of mips-based RISC products. Your RISC solution is a phone call away!

4ns LOGIC: WORLD-CLASS SPEED
The industry leader. FCT-AT and FCT-CT CEMOS families achieve the fastest speeds with 40% less noise. Everything you need for high-performance designs can be found in the Logic Data Book.

HIGHEST-PERFORMANCE MEMORIES
Fast FIFOs, dense dual-ports, BiCEMOS ECL, and modules for every system. Over 120 of the fastest FIFOs and multi-port memories. 5ns ECL SRAMs, as well as standard and custom memory modules. Get the specs in the Specialized Memories Data Book.

12ns 256K SRAMS
Fastest cache solutions for RISC and CISC processors. More than 36 ultra-high-speed sub-micron SRAMs for 33MHz processing and beyond. Read all about them in the SRAM Data Book.

Call today for your new IDT data books with complete technical specifications and application information.

When cost-effective performance counts.

(800) 345-7015 • FAX: 408-492-8454
Once our Fast Statics met up with Hewlett-Packard, the attraction was obvious.

With new 256K BiCMOS devices, Motorola helped unleash the speed to empower HP's hottest workstations: The HP Apollo Series 700.

What made our 64K x 4 and 32K x 8 Fast SRAMs such a design-in favorite at HP? Performance for one thing. Availability for another.

With both 10 and 12ns versions already shipping, these TTL-compatible devices provide the sheer speed required by the world's fastest workstations.

Once again, Motorola has what it takes to enhance system performance. Like preeminent technology. Relentless product support. And a growing family of BiCMOS devices to accelerate your next design.

Want to give our BiCMOS Fast SRAMs a try? Just complete and send in the coupon on the opposite page. We'll introduce your design to powerful new friends. Faster than you thought possible.

If you like what's new, wait 'til you see what's next.
LITERATURE: COMPONENTS

Reference Guide For Thyristors
The GTO Thyristors Reference Guide is a useful tool for finding asymmetrical, high-frequency, reverse-blocking, reverse-conducting, and GTO (gate-turn-off) modules. The guide explains the numbering system and includes specification tables to help you with your search. Also included are outline drawings of each component.

Powerex, Hillis St, Youngwood, PA 15697.

Circle No. 375

Refined Motion Controls Introduced
Catalog MSCS, Slo-Syn Enhanced Motion Controls, presents open- and closed-loop preset indexers and enhanced programmable indexers for full-, half-, and microstep operation. It describes how to specify and install the closed-loop systems. The book also deals with all the functions of programmable indexers as well as additional features of the enhanced programmable indexers, such as smoother acceleration and deceleration.

Superior Electric, 383 Middle St, Bristol, CT 06010.

Circle No. 376

Foldout Features Antistatic Products
This package comprises a foldout pamphlet and data sheets. The pamphlet pictures and discusses the vendor's Staticide products and static-detection devices for avoiding static problems in the workplace and the clean room.

ACL Inc, 1960 E Devon Ave, Elk Grove Village, IL 60007.

Circle No. 377

Booklet Of Popular Switches
The 16-pg booklet covers the vendor's pushbutton, key-lock, oil/watertight, and illuminated switches. It provides product photos and specifications, and describes features. The publication is organized according to applications and categories. Also included are types of illumination, accessories, lens shapes, and colors.

EAO Switch Corp, 198 Pepe's Farm Rd, Milford, CT 06460.

Circle No. 378

Four Books Of Assorted Components
The catalog of pc-board and solder-mount switches covers standard types, such as power, toggle, leaf, and pushbutton switches. The catalog of transformers and adapters presents UL- and CSA-approved in-line, power, line-matching, telephone-coupling, and other types of adapters. In the catalog of buzzers and transducers, you'll find piezoelectric buzzers and elements in housings, electronic buzzers, and piezoelectric sirens. The fourth catalog deals with lamps and bulbs, such as incandescent, standard-voltage, neon, and fluorescent lamps. Specifications, schematics, and photos round out the catalogs.

Shogyo International Corp, 287 Northern Blvd, Great Neck, NY 11021.

Circle No. 379

MOTOROLA FAST STATIC RAMs

<table>
<thead>
<tr>
<th>Type</th>
<th>Name</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>256Kx4</td>
<td>MCM6239</td>
<td>25ns</td>
</tr>
<tr>
<td>128Kx8</td>
<td>MCM6238</td>
<td>25ns</td>
</tr>
<tr>
<td>256Kx1</td>
<td>MCM6207</td>
<td>15/20/25ns</td>
</tr>
<tr>
<td>64Kx4</td>
<td>MCM6120</td>
<td>10/12ns</td>
</tr>
<tr>
<td>32Kx8</td>
<td>MCM6700</td>
<td>10/12ns</td>
</tr>
<tr>
<td>32Kx9</td>
<td>MCM6206</td>
<td>15/17/20/25ns*</td>
</tr>
<tr>
<td>16Kx4</td>
<td>MCM6265</td>
<td>17/20/25ns*</td>
</tr>
<tr>
<td>8Kx8</td>
<td>MCM6248</td>
<td>12/15/20/25ns*</td>
</tr>
<tr>
<td>8Kx9</td>
<td>MCM6265</td>
<td>12/15/20/25ns*</td>
</tr>
<tr>
<td>4Kx4</td>
<td>MCM6269</td>
<td>20/25/30ns*</td>
</tr>
</tbody>
</table>

Synchronous Fast Static RAMs

<table>
<thead>
<tr>
<th>Type</th>
<th>Name</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>54Kx4</td>
<td>MCM6265</td>
<td>12/15ns</td>
</tr>
<tr>
<td>4x64Kx1</td>
<td>MCM6283</td>
<td>12/15ns</td>
</tr>
<tr>
<td>64Kx4</td>
<td>MCM6260</td>
<td>15/20ns</td>
</tr>
<tr>
<td>4x64Kx1</td>
<td>MCM6261</td>
<td>15/20ns</td>
</tr>
<tr>
<td>32Kx9</td>
<td>MCM6295</td>
<td>17/20/25ns</td>
</tr>
<tr>
<td>16Kx16</td>
<td>MCM6290</td>
<td>17/20ns</td>
</tr>
<tr>
<td>16Kx4</td>
<td>MCM6294</td>
<td>12/15/20/25ns</td>
</tr>
<tr>
<td>4Kx10</td>
<td>MCM6263</td>
<td>20/25ns</td>
</tr>
<tr>
<td>4Kx12</td>
<td>MCM6267</td>
<td>25/30ns</td>
</tr>
</tbody>
</table>

BurstRAMs™

<table>
<thead>
<tr>
<th>Type</th>
<th>Name</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>32Kx9</td>
<td>MCM6294</td>
<td>14/19/24ns</td>
</tr>
<tr>
<td>32Kx9</td>
<td>MCM6248</td>
<td>14/19ns</td>
</tr>
</tbody>
</table>

DSPRAM™

<table>
<thead>
<tr>
<th>Type</th>
<th>Name</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>8Kx24</td>
<td>MCM65624</td>
<td>20/25/35ns</td>
</tr>
</tbody>
</table>

Latched Fast Static RAMs

<table>
<thead>
<tr>
<th>Type</th>
<th>Name</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>16Kx16</td>
<td>MCM6295</td>
<td>12/17/20ns</td>
</tr>
<tr>
<td>8Kx20</td>
<td>MCM6292</td>
<td>17/22ns</td>
</tr>
</tbody>
</table>

Cache Tag RAM Comparators

<table>
<thead>
<tr>
<th>Type</th>
<th>Name</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>4Kx4</td>
<td>MCM4180</td>
<td>18/20ns</td>
</tr>
<tr>
<td>4Kx4</td>
<td>MCM6251</td>
<td>20/25ns</td>
</tr>
</tbody>
</table>

Fast Static RAM Modules

<table>
<thead>
<tr>
<th>Type</th>
<th>Name</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>326Kx32</td>
<td>MCM62572</td>
<td>25ns</td>
</tr>
<tr>
<td>256Kx8</td>
<td>MCM6266</td>
<td>15/20ns</td>
</tr>
<tr>
<td>64Kx32</td>
<td>MCM62642</td>
<td>15/20ns</td>
</tr>
<tr>
<td>2 x 32Kx36</td>
<td>MCM63322</td>
<td>15/20ns</td>
</tr>
</tbody>
</table>

* Fabricated in EOMSS Technology
* Also available in slower speed
* Production scheduled July 1991
* Production scheduled September 1990
* Registered outputs for two-stage pipeline

Return this coupon to Motorola, Inc.
P.O. Box 1466, Austin, Texas 78767

EDN July 4, 1991
Tired of wasting board space on an expensive, space guzzling DC/DC Converter? Check-out the new HPR7XX Power Convertible. It is unbelievably small and sleek with 5 Watts of isolated output power. This is a turbo charged SIP - only 2.22" long and .35" wide. You get 16 Watts per cubic inches of unregulated power under the hood.

The HPR7XX is no big ticket item either. It is priced less than DC/DC Converters twice it's size and with less output power capacity - only $240 in O.E.M. quantities. This high-performance model drives as great as it looks with an efficiency rating of 80%. Take it for a spin, you will have no trouble finding a parking spot on your board.

For the dealer near you:
Call 1-800-548-6132
Fax 1-602-741-3895
Write P.O. Box 11400 Tucson, AZ 85734

LITERATURE:

App Note Explains Emulation System
This application brief examines the vendor's installation and utilization of the RPM Emulation System; its title is Rockwell NTSD: ASIC Design Productivity Improvements. The focus is on ASIC hardware emulation. "Sneakernet," an excerpted version of this study, is also available.

Quickturn Systems Inc, 325 E Middlefield Rd, Mountain View, CA 94043. Circle No. 742

Handbook Examines World Of 3-D AutoCAD
The revised AutoCAD 3D Book offers an in-depth look at designing and drawing in three dimensions. This second edition, for Releases 10 and 11, includes applications for 3-D surfaces and meshes as well as an expanded section on solid modeling and presentation CAD under Release 11. More than 300 pages of text and color illustrations detail a step-by-step approach to basic and advanced 3-D commands, AutoCAD's user-coordinate system, and solid modeling with AME (advanced modeling extension). A chapter on animation concludes this edition. An accompanying disk complements the handbook with a special AutoCAD 3D Library. This library features AutoLisp programs that you enter directly into your computer. Handbook, $24.95; with disk package, $74.90.

Ventana Press, Box 2468, Chapel Hill, NC 27515.
INQUIRE DIRECT
Type MS Precision
Power Film Resistors

Power Rating up to 15 Watts
• Non-Inductive Design with power ratings from 2 Watts to 15 Watts
• Select from 17 Models
• Voltage ratings from 200 V to 6 KV
• Resistance Range 20 Ω to 30 Meg
• Tolerance of 1% (available to 0.1%)
• Max. Operating Temperature of 275°C

For Type MS data, circle number 98

Type MV Low Resistance
Power Film Resistors

Resistance Range of 0.1 Ω to 50 Ω
• Non-Inductive Design with power ratings from 1.5 Watts to 10 Watts
• Select from 5 Models
• Tolerance of 1%, 2%, 5% or 10%
• Max. Operating Temperature of 275°C

For Type MV data, circle number 99

Type MP Kool-Tab®
Power Film Resistors

20 Watts in the TO-220 Package
• Non-Inductive Design
• Resistance Range 1 Ω to 10 K
• 20 Watts at 25°C Case Temperature
• Tolerance of 1%, 2%, 5% or 10%

For Type MP data, circle number 100

CADDICK® Resistor Technology
High Performance Power Resistors and High Voltage Resistors
with a 25 year record for solving problems across the board!

Type MG Precision
High Voltage Resistors

Voltage Ratings from 600V to 48KV
• 80 ppm/°C, -15°C to 105°C, ref. 25°C
• Resistance Range up to 10,000 Meg
• Select from 23 Models
• Tolerance of 1% (available to 0.1%)
• Stability of 0.5% per 1,000 hours

For Type MG data, circle number 101

Type TG Low TC Precision
High Voltage Resistors

TC of 25 ppm/°C, -55°C to +125°C
• Resistance Range 1 Meg to 1,000 Meg
• 7 Models with Voltage Ratings from 4 KV to 48 KV
• Voltage Divider Match Sets with Ratio TC to as tight as 10 ppm/°C
• Tolerance of 1% (available to 0.1%)
• Stability of 0.25% per 1,000 hours

For Type TG data, circle number 102

Type MX Lab Grade
High Voltage Resistors

New Cost Efficient Design
• 80 ppm/°C, 0°C to 70°C, ref. 25°C
• Resistance Range 1 Meg to 2,000 Meg
• 7 Models with Voltage Ratings from 7.5 KV to 48 KV
• Tolerance of 1%, 2%, 5% or 10% (available to 0.1%)
• Stability of 0.5% per 1,000 hours

For Type MX data, circle number 103

More high performance resistor products from
CADDICK ELECTRONICS, INCORPORATED

These products are manufactured with Caddock's exclusive Micronox® or Tetrinox® Resistance Film Technologies. For your copy of the Caddock General Catalog call or write:
Applications Engineering
Caddock Electronics, Inc.
1717 Chicago Avenue
Riverside, California 92507
(714) 788-1700

The Caddock General Catalog includes specifications on over 200 models of high performance resistor products.
LITERATURE:
COMPUTERS & PERIPHERALS

Extensive Listing Of Industrial Computers
This 225-pg catalog covers a range of packaged industrial computer systems, rack-based computers, PLC (programmable-logic-controller) systems, single-board computers (SBCs), operator interfaces, and cards for mass storage, communications, and I/O interfaces. The book is divided into product groups and provides product features and specifications, as well as application notes and software products. In addition to other SBCs, new products include the 386SX/AT, which is software-compatible with the IBM PC/AT. An entire section covers the PLC, an integrated PLC that uses 80C256 processors.

Pro-Log Corp, 2555 Garden Rd, Monterey, CA 93940.
Circle No. 371

How To Solve Monitoring And Control Problems
These application notes explain how to use the Series 4000 Smart I/O Processor System for monitoring and control. The book's four sections deal with wireline systems; telephone communications systems; radio communications systems, and questions and answers. The appendix presents the Series 4000 product line.

Acromag, Box 437, Wixom, MI 48393.
Circle No. 373

Book Presents VMEbus
You can find a detailed listing of VMEbus products in the The VMEbus Full-Line Catalog, from real-time systems to single-board computers. The Systems and Software section covers real-time systems and supporting software, including Vxworks, OS-9, and pSOS. The Board-Level section contains 32-bit processors, expansion modules, memory modules, and a selection of I/O boards. Two overview sections introduce the vendor's line of rugged products and mention products currently in development. The section on Packaging and Accessories presents backplanes, peripherals, and a Fanpack cooling system. A general-information section explains custom products and consulting services.

Matrix Corp, 1203 New Hope Rd, Raleigh, NC 27610.
Circle No. 374

How To Solve Monitoring And Control Problems
These application notes explain how to use the Series 4000 Smart I/O Processor System for monitoring and control. The book's four sections deal with wireline systems; telephone communications systems; radio communications systems, and questions and answers. The appendix presents the Series 4000 product line.

Acromag, Box 437, Wixom, MI 48393.
Circle No. 373

Book Presents VMEbus
You can find a detailed listing of VMEbus products in the The VMEbus Full-Line Catalog, from real-time systems to single-board computers. The Systems and Software section covers real-time systems and supporting software, including Vxworks, OS-9, and pSOS. The Board-Level section contains 32-bit processors, expansion modules, memory modules, and a selection of I/O boards. Two overview sections introduce the vendor's line of rugged products and mention products currently in development. The section on Packaging and Accessories presents backplanes, peripherals, and a Fanpack cooling system. A general-information section explains custom products and consulting services.

Matrix Corp, 1203 New Hope Rd, Raleigh, NC 27610.
Circle No. 374
Type TN Lab Grade
Low TC Precision Resistors

- Actual Size
- 1 K to 1 Meg, Tolerance to ±0.01%
- Low TC to 5 ppm/°C, 0°C to 70°C
- Non-Inductive Design
- Tolerance of ±0.01%, ±0.025%, ±0.05%, ±0.1%, ±0.25%, ±0.50% or ±1%
- Low TC of 5, 10 or 20 ppm/°C, 0 to 70°C
- Space Efficient Radial-Lead Design

For Type TN data, circle number 105

Type TK Low TC Precision Radial-Lead Film Resistors

- Actual Size
- Low TC to 5 ppm/°C, -55°C to 125°C
- Non-Inductive Design
- Resistance Range 1 Kohm to 10 Meg
- TC of 5, 10 or 20 ppm/°C, -55 to 125°C
- Tolerance of ±1% (available to ±0.05%)
- Space Efficient Radial-Lead Design

For Type TK data, circle number 106

Type MK Precision Power Radial-Lead Film Resistors

- Actual Size
- 0.50 Watt (CK05), 0.75 Watt (CK06)
- Non-Inductive Design
- Resistance Range 100 Ohm to 100 Meg
- TC as low as 50 ppm/°C, -15°C to 105°C
- Tolerance of ±1% (available to ±0.1%)
- Space Efficient Radial-Lead Design

For Type MK data, circle number 107

**Caddock® Resistor Technology**

**Precision and Ultra Precision Resistors and Resistor Networks with a 25 year record for solving problems across the board!**

Type T912 and Type T914 Precision Resistor Networks

- T912 Schematic
- T914 Schematic
- 4 equal value resistors

Ultra Precise Ratios to 0.01%
- 14 Standard Resistance Values from 1 Kohm to 1 Meg (Custom to 2 Meg)
- Ratio Tolerance from 0.01% to 0.1%
- Ratio TC of 2, 5 or 10 ppm/°C, 0 to 70°C
- Custom ratios available, 1:1 to 250:1

For Type T912/T914 data, circle number 108

Type 1776 Precision Decade Voltage Dividers

- T912 Schematic
- T914 Schematic
- Voltage Division 10:1 to 10,000:1

- Ratio Tolerance 0.02%, 0.05%, 0.1%, 0.25% or 0.5%
- Ratio TC of 5, 10, 25 or 50 ppm/°C, from 0°C to 70°C
- Select from 39 Different Models
- Voltage Rating to 1,200 Volts

For Type 1776 data, circle number 109

Type 1776 Precision Ultra-Precision SIP Networks

- 39 Models
- Ratio Tolerance to 0.01%
- Resistance Range 0.5 ohm to 50 Meg
- Abs. Tolerance from ±0.025% to ±1%
- Ratio Tolerance from 0.01% to 1%
- Abs. TC of 15 ppm, 25 ppm, 50 ppm or 80 ppm/°C, from 0°C to 70°C
- Ratio TC of 5 ppm, 10 ppm, 25 ppm or 50 ppm/°C, from 0°C to 70°C

For Custom data, circle number 110

More high performance resistor products from Caddock Electronics, Incorporated

These products are manufactured with Caddock's exclusive Micronox® or Tetrinox® Resistance Film Technologies. For your copy of the Caddock General Catalog call or write:

Applications Engineering
Caddock Electronics, Inc.
1717 Chicago Avenue
Riverside, California 92507
(714) 788-1700

The Caddock General Catalog includes specifications on over 200 models of high performance resistor products.
Our Programming line includes:

- CP-1128 Combination EPROM/PROM/PLD Programmer: Supports devices up to 28-pins $1295
- PLD-1128 Logic Programmer: Supports PLDs up to 28-pins $995
- PLD-1100 Logic Programmer: Supports PLDs up to 24-pins $798
- EP-1140 E/EPROM Programmer: Supports E/EPROMs up to 40-pins and Intel Microcontrollers $895
- EP-1132 E/EPROM Programmer: Supports E/EPROMs up to 32-pins $695
- EP-1 EPROM Programmer: Supports E/EPROMs up to 28-pins $349

All of our programmers include: software, editor, interface cable, user's manual, one-year warranty (parts and labor) unlimited toll-free technical support, unconditional thirty-day money-back guarantee, and lifetime free software updates.

Measuring-Equipment Catalog
This 572-pg catalog details automatic test equipment/process controllers, signal generators, radio test sets, spectrum and network analyzers, and logic test equipment/recorders. The publication is divided into 13 sections. A choice of peripheral measurement devices appears in the appendix.

Rohde & Schwarz, 8000 Munchen 80, Muhldorfstr 15, Germany.

Index And Reference To Environmental Chambers
The EC Series reference is an 8-pg guide to the vendor's environmental test equipment. The handbook discusses specs and products for a variety of applications. Six new products listed in this guide provide various options and a range of standard features, including cost-efficient operation and access to the interior of chambers in situations where you can't move sensitive instruments or devices.

Sun Electronic Systems Inc, 1601 NW 38th Ave, Fort Lauderdale, FL 33311.

Reference Catalog For Test-And-Measurement Products
This 32-pg guide book catalogs power systems and components for commercial, industrial, and military applications. It covers ac and dc programmable power sources, plug-in oscillators, on-line uninterruptible power systems, and high-isolation transformers. The catalog offers cross-reference tables and new-product listings, such as digitally modulated ac power systems and electronic dc load modules.

Contact East, 335 Willow St, North Andover, MA 01845.

Call today
1-800-225-2102
713/461-9430
FAX 713/461-7413
High-Tech Solutions for Designing the Products of Tomorrow.

Available now at these fine stores

**ALABAMA**
Madison Books and Computers
Madison, AL 35758
(205) 772-9250
FAX (205) 461-8076

**ARIZONA**
Bookstar
Scottsdale, AZ
(602) 443-4909

**CALIFORNIA**
Stacey's Bookstore
Cupertino, CA 95014
(408) 253-7521

**ASUCLA**
Students Store
Los Angeles, CA
(213) 206-0763

**OPAMP**
Technical Books
Los Angeles, CA 90038
(213) 464-4322

**Technical Book Co.**
Los Angeles, CA
(213) 475-5711

**FLORIDA**
Bookstop
Altamonte Springs, FL
(407) 339-6555

**GEORGIA**
San Diego Technical Books Inc.
San Diego, CA 92111
(619) 457-7561

**University Book & Co.**
Dayton, OH
(512) 476-7211

**WASHINGTON**
McGraw-Hill, Inc. Professional Book Group

**HISPANIC**
Bookstop
(800) 635-5919

**NEW MEXICO**
San Diego Technical Books Inc.
San Diego, CA 92111
(800) 346-0071

**BOOKSTORES**
Washington, DC 20006
(202) 223-3327

**BOSTON**
FAX (202) 296-9103

**MARYLAND**
Bookstop
Altamonte Springs, FL
(407) 339-6555

**MICHIGAN**
Cucumber Book Shop
Rockville, MD 20852
(301) 881-2772
FAX (301) 468-2920

**OHIO**
Bookstop
Altamonte Springs, FL
(305) 327-3680

**TENNESSEE**
University of Pennsylvania Bookstore
Philadelphia, PA 19104-6212
(215) 898-7520

**TEXAS**
University Co-operative Society
Austin, TX 78705
(512) 476-7211

**Pennsylvania**
Bookstop
Dallas, TX 75230
(214) 363-5744

**Bookstop**
Atlanta, GA 30332
(404) 853-4090

**University**
Bookstop
Dallas, TX 75240
(214) 239-TECH

**SCIENCE & ENGINEERING**
McGraw-Hill, Inc. Professional Book Group

**EDN**
July 4, 1991

**McGRAW-HILL**
30 MS/s DSO PLUS A TEST BENCH OF FUNCTIONS TIED UP IN ONE PORTABLE PACKAGE.

Leader's new battery-powered DSO/DMM weighs only 2.6 lbs., yet performs the functions of four different pieces of test equipment. Two functions the Model 300 offers are those of a DSO and DMM, with simultaneous display of each—including channels 1 and 2 peak-to-peak voltage and frequency. Two additional functions are an 8-bit logic analyzer, which lets you compare 8 signals at once, and a data logger for recording long-term phenomena.

The 300 has a remarkable sampling rate of 30 MS/s, giving you the ability to observe 10-MHz signals. A powerful 1.8k word/channel memory provides a detailed view of rapidly occurring events. A 20-waveform capacity is standard, but an optional IC card lets you store an incredible 80 waveforms. The IC card is especially handy for saving information and forwarding it to a lab for analysis. Although our new portable DSO is compact, it's also feature-packed. Included are: HF rejection, add and subtract, and full auto setup for vertical sensitivity, sweep speed, vertical position, and trigger level. For documentation purposes the 300 can interface with an optional dedicated printer (Leader Model 710). A supertwist LCD display (a full 2 1/2" x 4 1/2") provides high contrast and a large viewing angle.

You'll find that the 300 makes the perfect traveling companion, letting you travel light without leaving a single vital function back in the shop. For our full-line catalog, in NY call 516 231-6900. Or call toll free: 1 800 645-5104.

1 800 645-5104

LEADER
FOR PROFESSIONALS WHO KNOW THE DIFFERENCE

Leader Instruments Corporation, 380 Oser Avenue, Hauppauge, New York 11788
Regional Offices: Chicago, Dallas, Los Angeles, Boston, Atlanta. In Canada call Omnitronix Ltd., 416 828-6221.

CIRCLE NO. 114
This advertising is for new and current products.

Please circle Reader Service number for additional information from manufacturers.

INTELLIDENT ROM EMULATOR $395
- Emulates EPROM through EPROM Emulator and Access 16k ROMs
- Connects to the standard parallel printer port (via standard printer cable)
- User-friendly software. Command set includes: Load, Clear, Write, Read, Set, Print, Save, Erase, Erase All, Copy, PROGRAM, Read, Print
- Touchscreen keyboard, or ASCII keyboard
- Address Generators with 8 Digit, Address Source (Synchronous or Asynchronous)
- Fast data transfer via parallel printer port (disk speed of less than 800 ms)
- Interchangeable 4-bit memory locations (Rel) and display width (24 or 72 characters)
- Connects to IBM PC or compatible

INTEGRATED, EASY TO USE SIMULATION ENVIRONMENT, FEATURING:
- A powerful SPICE (Isis) simulator performing AC, DC, Transient, Noise, Fourier, Distortion, Sensitivity, Monte Carlo, and Temperature analyses, Extensive model libraries, Schematic entry, and Waveform processing. Starting at $95 for Isis3, complete systems are available for $815.

MC/89A / ARCMICROSYSTEMS INC.
Telephone: 408/730-9251 FAX: 408/730-5521

CIRCLE NO. 325

$249. TERMINAL

Featuring:
• Standard RS-232 Serial Asynchronous ASCII Communications
• 28-key Membrane Keyboard with enhanced graphics
• 16-key numeric array plus 24-programmable function keys
• Nordic relocatable SETUP feature: baud rates, parity, etc.
• Has 6 Text Fonts and 6 Graphical Fonts (5x7, 7x11, 7x15, 11x15, 11x15, 17x17).
• 5 7/8- Line Display with underline cursor
• 64-Character ASCII SET (upper and lower case)
• Optional Code Word

CIRCLE NO. 328

Programmable Gate Array Logic Analyzer Probes For the HP 1600 and 16500 Logic Analyzers

PROGRAMMABLE GATE ARRAY LOGIC ANALYZER PROBES FOR THE HP 1600 AND 16500 LOGIC ANALYZERS

- PROBES AVAILABLE FOR XILINX, ALTEIRA. AND ACTEL DEVICES
- DIRECT CONNECTION OF LOGIC ANALYZER INTO PLCC OR PGA (44 TO 176 PIN SOCKET)
- QUICK AND EASY ACCESS TO ALL I/Os AND CLOCK LINES
- REAL TIME INTRUSIVE 100 MHz TIMING ANALYSIS
- INCLUDES SOFTWARE SETUP DISKETTE FOR THE HP LOGIC ANALYZER

FOR FURTHER INFORMATION CONTACT:

CORELIS
(714) 891-1138 FAX (714) 892-0930

CIRCLE NO. 329

Analog Circuit Simulation

SPICE FOR THE PC

• Schematic Entry • SPICE Simulation
• Model Libraries • Waveform Graphics
Intusoft has it all at an Affordable Price!
INTEGRATED, EASY TO USE SIMULATION ENVIRONMENT, FEATURING:
A powerful SPICE (Isis) simulator performing AC, DC, Transient, Noise, Fourier, Distortion, Sensitivity, Monte Carlo, and Temperature analyses, Extensive model libraries, Schematic entry, and Waveform processing. Starting at $95 for Isis3, complete systems are available for $815.

CIRCLE NO. 327

FREE 26 Page CATALOG with all styles and designs of matching Instrument knobs illustrated.

Fax us your specs—we will Fax you a quote...immediately!

Buckeye
556 Marion Road
Columbus, OH 43207
Fax: 614/445-8224 Phone: 614/445-8433
At the prototyping stage, use a PQFP Adapt-A-Board. This is a fully integrated PCB layout system with automatic component placement and autorouting in a single working environment. Its latest features will definitely push the price/performance of mixed technology PCB designs to the highest level, boost your design productivity, and deliver your products to the marketplace faster than your competitors.

- Integrated automatic component placement and autorouting
- On-the-fly library component creation
- 47, 90° and curve tracks routing
- Powerful user-defined macros
- Auto-panning
- PostScript® printing
- Switchable Meca, Imperial grids
- Intelligent Pad to Pad autorouting
- Automatic power/ground relief for SMD pads
- Automatic Copper Poor leaves clearance for tracks & pads from schematic design, manual and automatic PCB design, Rip up and Re-try autorouting, to Gerber viewing and editing, we offer free tech and ESD support. It is best 88 and 90-day money back guarantee and our prices start at $95.

Free Evaluation Package
Toll Free: 800-544-4186
Protel Technology, Inc.
50 Airport Parkway
San Jose, CA 95110
Tel: 408-437-7771
Fax: 408-437-4913

CIRCLE NO. 340

HALF THE TIME/HALF THE COST
- Affordable, 16 & 32 bit emulators
- Download 250,000 bytes/second
- Built-in performance analysis
- Full speed, zero wait state operation
- C, C++ & PL/M source level support

CIRCLE NO. 343

FULL LINE OF PQFP ADAPTERS
- At the prototyping stage, use a PQFP Adapt-A-Board. It extends leads for easy wire wrapping.
- For emulation, use an Adapt-A-Pod." like the ones shown here for an 80386 PQFP package. Just plug and play.
- For production testing, a Bug Katcher™ turns your PQFP into an IC so you can start testing ASAP.
- We stock all types of PQFP adapters. Quick turnaround on custom orders. Free Catalog.

Emulation Technology, Inc.
2344 Walsh Ave
San Carlos, CA 94070
Phone: 408-982-0660 FAX: 408-982-0664

CIRCLE NO. 346

LOY COST DATA ACQUISITION CARDS FOR PC/XT/AT


- 12 bit converter with 8-channel parallel TTL/CMOS drivers
- 12 bit D/A converter with 8-channels parallel TTL/CMOS drivers
- Monolithic microcontroller
- Conversion spec: 80,000 samples/second, 100K samples optional
- Resolutions: 8-bit, 10-bit, 12-bit
- 8-bit and 10-bit 12-bit analog inputs
- D/A converter: 12-bit resolution, 8-bit output range 0-10V, 8-bit output range 0-5V
- Serial IS8 97, 97A, 97B
- Serial IS8 82C54
- 12 bit D/A converter

Fast 12 Bit A/D & D/A [PCL718] $795

- 16 bit converter with 8-channel parallel TTL/CMOS drivers
- 16 bit A/D converter with 8-channel parallel TTL/CMOS drivers
- Monolithic microcontroller
- Conversion spec: 80,000 samples/second, 100K samples optional
- Resolutions: 10-bit, 12-bit
- 12-bit and 10-bit 12-bit analog inputs
- D/A converter: 12-bit resolution, 8-bit output range 0-10V, 8-bit output range 0-5V
- Serial IS8 97, 97A, 97B
- Serial IS8 82C54
- 16 bit D/A converter

CIRCLE NO. 344

TANGO-PDL IS THE PRICE/PERFORMANCE LEADER IN LOGIC DESIGN TOOLS.

"I regularly use this program through its price. It's inexpensive and works great. I'm telling as many friends as I can that Tango-PDL is the best value in programmable logic design." - John Wainwright, Oliver Higgins

Tango-PDL is a universal PDL design tool with sophisticated features including schematic entry or "C-like" language design options. Its affordable price includes great documentation and tech support and a money-back guarantee.

CIRCLE NO. 345

To advertise in Product Mart, call Joanne Dorian, 212/463-6454

EDN July 4, 1991

185
Consistency is key
to the power of EDN Product Mart

DEVELOPER'S TOOLS

NICE-51 satisfies you, who expects excellent functions, attractive price and easy to use. What a surprise, now you have it!

8051 IN-CIRCUIT EMULATOR NICE-51
PC BASED FROM $950
• Up to 12 MHz Real-Time without interrupting interrupts
• Serial Channel, I/O or Code Space
• Built-in programmer for EPROM & 6511
• Handles Binary, Hex. & Symbol file and down-loads data to external RAM
• With full screen editor, SPY, Code-External data, Internal data and Bit address can be directly viewed and edited
• Complete menu-driven software without any tedious commands
• 16 K byte buffer, 48 bit wide with ADD, DATA, PI, PS and status signals
• 64 K H/W breakpoints
• Extra 10 function keys operate routine tasks
• Call us today for complete product line
• Immediate technical support upon your phone call
• 1 year warranty and 30 days money-back guarantee

TRIBAL MICROSYSTEMS
Tel: (415) 623-8859 Fax: (415) 623-9925
44386 S. Grimmer Blvd, Fremont CA 94538

CIRCLE NO. 750

RELIABILITY PREDICTION SOFTWARE

ARE YOUR PRODUCTS RELIABLE?
The ReCalc 2 Software Package predicts the reliability of your system using the part stress procedure of MIL-HDBK-217E, and runs on the IBM PC and full compatibles. Say goodbye to tedious, time consuming, and error prone manual methods! ReCalc 2 is very easy to use, and features menu windows, library functions, global editing for what-if trials, and clear report formats. Try our Demo Package for $25.

T-CUBED SYSTEMS, 31220 La Baya Drive #110, Westlake Village, CA 91362. (818) 991-0057. FAX: (818) 991-1281

CIRCLE NO. 754

EDN July 4, 1991
MaxCAD
MT2000
Single-Chip Card Controller
& Card System

Products:
- Single Chip IC Memory Card Controller
- IC Memory Card Interface Module
- IC Memory Card Notebook PC
- IC Memory Card

MaxCAD TECHNOLOGY CO., LTD.
276, Chung-Hwa 1st Road, Kaohsiung, Taiwan, R.O.C.

MT2000
Single-Chip Card Controller

4 Color Product Mart Ads Are Now Available In EDN's Magazine and News Editions!
Call Joanne Dorian for more information (212) 463-6415

CIRCLE NO. 758
CIRCLE NO. 759
CIRCLE NO. 760
CIRCLE NO. 761
CIRCLE NO. 762
CIRCLE NO. 763
CIRCLE NO. 764
CIRCLE NO. 765
CIRCLE NO. 766

Just $495!*

ABEL-PLD:
Logic design for less.
- 150 PLD architectures supported (more than 4000 devices)
- Uses ABEL™
- Hardware Description Language (ABEL-HDL™)
- Intelligent synthesis and optimization
- Upgradable to full-featured ABEL Design Software

Call for your FREE ABEL-PLD™ Design Software start-up kit!
1-800-3-Data0 (1-800-332-8246)
*U.S. list price only.

CIRCLE NO. 764

Now $1495!*

Save $1000 on our entry-level logic system.
- Includes the 212 Multi Programmer with logic modules
- Optional EPROM and microcontroller modules
- Call today to order!
- No-risk, money-back guarantee!
1-800-3-Data0 (1-800-332-8246)
*U.S. list price only.

CIRCLE NO. 765

Transmission Line Problems?
Glitchy clocks? Overshoot and undershoot? Flaky system operation?

Now! LineSim Pro spots problem signals and helps find solutions before you build boards.

LineSim Pro features:
- extensive library
- circuit-board-impedance calculators
- extended-memory support
- extended-memory display

Or choose LineSim, a simplified version (2 lines).

LineSim Pro: $995 (U.S.)
Requires 386/486 PC, w/GA/VGA, min. 32 MB extended memory: mouse, 30 day money-back guarantee, w/$25 restock fee.

HyperLynx
 Tel. (206)869-2320
 Fax (206)881-1008

To advertise in Product Mart, call Joanne Dorian, 212/463-6415

EDN July 4, 1991

187
### 1991 Recruitment Editorial Calendar

<table>
<thead>
<tr>
<th>Issue</th>
<th>Issue Date</th>
<th>Ad Deadline</th>
<th>Editorial Emphasis</th>
</tr>
</thead>
<tbody>
<tr>
<td>News Edition</td>
<td>July 25</td>
<td>July 5</td>
<td>ICs &amp; Semiconductors, Peripherals**, Regional Profile: Massachusetts**</td>
</tr>
<tr>
<td>Magazine Edition</td>
<td>Aug. 5</td>
<td>July 11</td>
<td>CAE • ASICs, Test &amp; Measurement • Computers &amp; Peripherals • Technical Article Database</td>
</tr>
<tr>
<td>News Edition</td>
<td>Aug. 8</td>
<td>July 19</td>
<td>CAE, Datacom**</td>
</tr>
<tr>
<td>Magazine Edition</td>
<td>Aug. 19</td>
<td>July 25</td>
<td>Military Electronics Special Issue, Image Processing • Ultra High Speed ICs/ASICs • Computer Peripherals, Software •</td>
</tr>
<tr>
<td>Magazine Edition</td>
<td>Sept. 2</td>
<td>Aug. 8</td>
<td>ASICs Special Issue, Semicustom ICs • CAE, Packaging • ICs &amp; Semiconductors Data Converters</td>
</tr>
<tr>
<td>News Edition</td>
<td>Sept. 5</td>
<td>Aug. 16</td>
<td>Military Electronics Special Issue, Computer Architectures, Defense Electronics**</td>
</tr>
<tr>
<td>Magazine Edition</td>
<td>Sept. 16</td>
<td>Aug. 21</td>
<td>DSP/Microprocessors, ICs &amp; Semiconductors, CAE/ASICs, Environmental Engineering • Software</td>
</tr>
</tbody>
</table>

Call today for information on Recruitment Advertising:
East Coast: Janet O. Penn (201) 228-8610
West Coast: Nancy Olbers (603) 436-7565
National: Roberta Renard (201) 228-8602

---

**A Commitment To Quality Through Diversity**

As diverse as the people and industries that this country was built upon, so are the individuals that comprise SEMATECH. Where defense electronics and advanced weapon systems performance rely on electronic technology, SEMATECH’s mission is clear: World leadership in semiconductor manufacturing.

SEMATECH is where the best minds in the semiconductor manufacturing industry converge to develop advanced semiconductor processes, materials and equipment.

We have opportunities in our Engineering and Technical ranks from entry-level to Managers. A background in manufacturing is helpful; semiconductor experience is preferred. We also have positions in some areas of Administration.

Join a company where advancement and recognition is based on personal achievement. For more information, forward your resume to: Pat Cockburn, Staffing Manager, SEMATECH, 2706 Montopolis Drive, Dept. EDN, Austin, Texas 78741 or Fax your resume to: (512) 356-3086. An affirmative action employer committed to workforce diversity.

---

**MEMBER COMPANIES**

AMD, AT&T, DEC, Harris,
Hewlett-Packard, Intel, IBM,
LSI Logic, Micron Technology,
Motorola, National
Semiconductor, NCR,
Rockwell, and TI

---

EDN July 4, 1991
Everyone talks about affirmative action. But at Fujitsu America, we're committed to it. We believe there is real strength in diversity, and that the best work comes from the combined efforts of many different people with many different viewpoints. That innovation and technical achievement come from a variety of creative minds who know how to work together. That's why we're so successful, a national leader in telecommunications and computer peripherals. Our goal is a true multicultural work force, and we actively seek the widest possible spectrum of talented individuals.

So, when you're looking for your next, best career move, think of what you could achieve in a company like this. And keep our perspective in mind. For consideration, send your resume to: Fujitsu America, Inc., Dept. EDNM, 2801 Telecom Parkway, Richardson, Texas 75082. We are an equal opportunity employer, m/f/h/v.
SANTA CLARA POSITIONS

SOFTWARE ENGINEER

Develop UNIX O/S software, write periph. drivers for the R3000 32-bit µP. BS/MS in CS & 5+ yrs exp. req. C familiarity essential.

PRODUCT ENGINEERS

Conduct performance/failure analysis, device charac., & provide mfg/customer support.

Sr. Product Engineer—RISC
Req. BSEE/MSEE & 5+ yrs µP product, design, & process exp.

Sr. Prod. Engr/Gp Leader
Support development & production release of complex digital products for Memory Support & RISC/EC Support. Lead a group of product engrs & techs. MSEE & 5+ yrs exp. in CMOS digital ICs req. Supervisory exp. preferred.

TEST ENGINEERS

Design & conduct tests on our new/existing products using the latest techniques & equipment.

PRODUCT ENGINEERS

Conduct performance/failure analysis, device charac., provide yield improvement & mfg/cus-
tomer support. Openings in Specialty Memory and CMOS SRAM groups. BS/MS preferred.

MKTG ENGINEERS

Perform pricing & forecasting, & develop customer & product strategies. BSEE & 3+ yrs semi-
conductor mktg exp. required.

PROD. SUPERVISORS

Positions available in Fab and Test areas. Ensure production schedules & effective operations/ equipment management. BS/BA, mfg exp. & willingness to work off-shift schedules required.

MONTEREY COUNTY POSITIONS

Sr. or Staff Test Engineer
Write & debug ECL SRAM tests on Advantest & Sentry memory testers. Req. BS/MS in EE/ME & 5+ yrs experience.

Test Engineer
Generate test programs for memory test systems & design related hardware. Req. BSEE & 2+ yrs testing exp. using S-90.

MKTG ENGRS/MGRS

Oversee & implement tactical product mktg strategies, incl. forecasts, pricing, & intro./distribution. Req. BSEE & 3+ yrs semiconductor mktg exp. Openings in 3 divisions.

For Santa Clara positions, call Jeff Schoos at (408) 944-2129. Or send your resume to:
IDT
P.O. Box 58015
Santa Clara, CA 95052-8015

IDT is an industry leader in high-speed, high-performance semicon-
ductors. We have used our technical expertise to pioneer products like FCT Logic, Dual-Ports,
CacheRAMs™, and the R3051 RISController™, to meet the needs of system designers and provide a clear migration path for future designs. If you have innovative ideas, the desire to succeed, and the drive to make your ideas become reality, IDT has the opportunity you're looking for.

LINE MAINT. TECHS

Openings on all shifts in etch, diffusion, thin films, and photo areas. Technical AS degree req.

PROCESS ENGINEERS

Multiple openings in diffusion, thin films, & plasma etch areas. Work with state-of-the-art sub-
micron multilevel CMOS processes in a Class 3 clean room. All shifts, incl. weekends. BS req., MS preferred, as well as 1+ yrs exp. in a fab environment.

TEST ENGINEERS

Use your S-90 Sentry test expertise to develop test software and hardware.

For Monterey County positions, call Bill Litke at (408) 754-4559. Or send your resume to:
IDT
1566 Moffett Street
Salinas, CA 93905

An E.O.E.

EDN Magazine Edition

If you're looking for work, just look here.
Put the Power of Partnership To Work For You With EDN's Weekly Recruitment Package

Reach the best-qualified engineers in the electronic OEM weekly. And do it for less. Place equivalent space in both the Career Opportunities section of EDN's magazine edition and the Career News section of EDN's news edition in the same month and get a 30% discount off EDN's news edition rate.

Contact Roberta Renard, National Recruitment Sales Manager at 201/228-8602 for complete details.

Intermedics Pacemakers Inc. is a manufacturer of state-of-the-art microelectronics/micromechanical computer-based technology for use in implantable devices. Intermedics is THE Market Leader of THE most sophisticated pacemakers in the world and is headquartered in Angleton, Texas.

**SR. ELECTRONIC PRODUCT ENGINEER**
BSEE with 3-5 years of experience in analog and digital design, CMOS/TTL devices, and microprocessor based systems. Exposure to hybrid microelectronics involved in the manufacture of high reliability electronic devices and a knowledge of electronic test procedures very desirable.

**I.C. DESIGN ENGINEER**
Senior and Mid-level positions requiring a BSEE/MSEE/PhD with a minimum of 3 years experience in the design and development of analog and digital CMOS integrated circuits. Duties will include circuit design and technology development for low power implantable custom integrated circuits, including microcomputers, A/D converters, switched capacitor filters and DC-DC energy converters. We prefer candidate with knowledge of Verilog/Saber behavioral modeling and Cadence and Hspice tools.

**SR. ANALOG POWER ENGINEER**
Requires a BSEE/MSEE with 5+ years of experience in circuit design, prototyping, test, and debug of analog circuitry as it relates to switching power supplies/hybrid power circuits for implantable medical devices.

**SR. ELECTRONIC DESIGN ENGINEER**
Requires a BSEE / MSEE with 5+ years of experience in circuit design, prototyping, test and debug and documentation of analog (op amps, filters and transistors), digital CMOS and microprocessor-based circuitry for implantable medical devices.

**SOFTWARE ENGINEERS**
BSEE, BSCE or equivalent with a minimum of 3 years experience with embedded microprocessor and system level software design and development. Duties will be to design and develop system and application software in both assembly and “C” languages for realtime embedded microprocessor based pacemaker support products.

**PROCESS ENGINEER**
BSME, EE with 5 years experience with CNC machine control, diagnostics and repair of digital and analog circuits, mechanical fixture design. Machine design utilizing electro-pneumatic mechanisms, and processes involving YAG laser, welding, coil winding, etc.

**MANAGER OF COMPONENT RELIABILITY ENGINEERING**
Requires a BSEE and five years of experience in Reliability Engineering, Failure Analysis Techniques and Failure Rate Predictions. Must have knowledge of IC Physics and CMOS, IC and Hybrid Manufacturing Processes. Responsibilities will include review and approval of IC and Hybrid Design and Design changes, evaluation or qualification of IC's and Hybrids, establish test requirements, and evaluate test results.

**AUTOMATIC TEST ENGINEER**
Requires a BSEE with a minimum of 3 years of A.T.E. experience in the design and development of computer based automatic production test equipment. Position includes analog and digital circuit design, software development and test system integration.

Enjoy your choice of either urban or rural lifestyles, just 30 minutes to an hour south of Houston via expressway and a short drive from the Gulf of Mexico. The area boasts affordable housing costs in a rising economy, no state income tax and a mild climate for year-round recreational activities.

Intermedics Pacemakers Inc. provides an excellent compensation and benefits package. Qualified applicants for the positions should submit their resumes in confidence to:

Bob Race
INTERMEDICS, INC.
4000 Technology Drive, Angleton, TX 77515
1-800-231-2530 FAX (409) 233-5615
OUR BUSINESS IS LIFE

Intermedics Inc.
A company of SULZERmedica

We Are An Equal Opportunity Employer, M/F/H/V

EDN July 4, 1991
FLORIDA
Where Business & Pleasure Are Better Than Ever

Situated between the shores of Daytona Beach and metropolitan Orlando, talented professionals set the pace at Sparton Electronics, a Fortune 500 company involved in the design and high volume manufacture of expendable submarine tracking devices.

The following opportunities are currently open to qualified design engineering personnel for exploration:

- BSEE’s (no EET degrees) with 2 to 4 years current experience in board level audio/voice frequency (0-20 kHz) analog product design for a high volume manufacturer. Background must include microprocessor programming (i.e., 6800/assembly) and exposure to SMT (surface mount technology). U.S. citizenship required for clearance.
- BSEE’s (no EET degrees) with 5 years current RF (UHF/VHF) experience specifically in a.m. receivers and multichannel synthesized f.m. transmitters. Small stowable antenna design is highly desirable. U.S. citizenship required for clearance.
- BSME’s (no MET degrees) with 2 to 5 years current experience in the design of injection molded plastic, die cast metal, and stamped metal parts for a high volume/low cost manufacturer. Solid experience in finite element analysis (FEA) and knowledge of design for assembly (DFA) concepts is highly preferable. Tooling vendor interface and production floor support backgrounds are necessary. U.S. citizenship is required for clearance.

As a member of the Sparton Electronics team, expect a stimulating, career-building technical challenge, a high quality lifestyle with a low cost of living, no state income tax, proximity to exciting Florida attractions, and a fine compensation package that rewards your skill, knowledge, imagination, and performance. Relocation package is available.

To help you advance your career, Placement Services, Ltd., has formed the EDN Career News Databank. What is the Databank? It is a computerized system of matching qualified candidates with positions that meet the applicant’s professional needs and desires. What are the advantages of this new service?

- It’s absolutely free. There are no fees or charges.
- The computer never forgets. When your type of job comes up, it remembers you’re qualified.
- Service is nationwide. You’ll be considered for openings across the U.S. by PSL and its affiliated offices.

Your identity is protected. Your resume is carefully screened to be sure it will not be sent to your company or parent organization.

Your background and career objectives will periodically be reviewed with you by a PSL professional placement person.

We hope you’re happy in your current position. At the same time, chances are there is an ideal job you’d prefer if you knew about it. That’s why it makes sense for you to register with the EDN Career News Databank. To do so, just mail the completed form below, along with a copy of your resume, to: Placement Services, Ltd., Inc.

IDENTITY

Name ____________________________

Home Address ____________________________

City __________________ State ______ Zip ______

Home Phone (include area code) ______

PRESENT OR MOST RECENT EMPLOYER

Parent Company ____________________________

Your division or subsidiary ____________________________

Location (City, State) ____________________________

Business Phone if O.K. to use ______

EDUCATION

Degrees (List) Major Field GPA Year College or University

EXPERIENCE

POSITION DESIRED

EDN July 4, 1991
WORLD CLASS
TRANSFORMERS
FOR WORLD CLASS
CUSTOMERS
Signal International
Series Transformers
are VDE and CSA certified, UL recog­
nized and comply with applicable IEC
specifications. In an era of global
marketing, and the inception of the
European Economic Community in
1992, using Signal Transformers can
open up new trade routes for you.
We'll even give you a competitive
edge by customizing a JIT program
for you that will reduce your inven­
tories and provide you with only as
many Signal Transformers as you
need, only as you need them. While
our Pronto™ 24 hour service will ship
standard catalog transformers in just
one business day.
Naturally, with timing this critical
you've no time for reject replace­
ments. No problem. Our Total Quality
Control Program utilizes the indus­
try's most modern, automated test
equipment to verify that every single
unit meets with your specifications.
And, because we use cellular assem­
by lines dedicated to one project at a
time, nobody beats our quality in
producing quantities under tight
deadlines.
If you want to profit from a global
economy while saving money by
buying direct, call for more informa­
tion or a free catalog: Signal Trans­
former, 500 Bayview Avenue,
Inwood, NY 11696.
FAX (516) 239-7208
BUY DIRECT (516) 239-5777.

You can send a Signal
anywhere.
New SLICs cut the cost of on-premises/PBX subscriber lines

Lower cost chips that need fewer external components are the latest Subscriber Line Interface Circuit offerings from Ericsson.

Designed for cost sensitive applications such as general purpose PBX/Key systems, they give you three other major advantages over alternative solutions: wide supply voltage operation from -24 V to -58 V dc, on-hook transmission and a very low on-hook power dissipation of just 35 mW with -48 V dc supply or 20 mW when running from a -24 V dc supply.

So you can reduce the cost of your power supply circuit too!

Each SLIC includes loop current and ring trip detection, together with a ring relay driver. And they work with either a conventional or programmable CODEC/filter, all of which simplifies design.

Equally important, the new circuits are available in two versions: the PBL 3766 with a programmable constant loop current, and the PBL 3767 with programmable resistive battery feed and loop current limitation for short lines.

Both come in a choice of 22-pin plastic DIP or 28-pin PLCC packages with compliant 'j' leads.

Simply call us for full technical data or clip the coupon.

Ericsson Components Inc.
403 International Parkway, Richardson TX 75081
Tel: 214 - 669 - 9900 Fax: 214 - 680 - 1059

Please send me your latest PBL 3766 and PBL 3767 datasheets

Name
Company
Job Title
Address
Telephone
Fax

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Page Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCEL Technologies</td>
<td>185</td>
</tr>
<tr>
<td>Advanced Micro Devices</td>
<td>8-9</td>
</tr>
<tr>
<td>Airpax Corp</td>
<td>131</td>
</tr>
<tr>
<td>Altera Corp</td>
<td>10-11</td>
</tr>
<tr>
<td>American Arium</td>
<td>164</td>
</tr>
<tr>
<td>American Microsystems</td>
<td>91</td>
</tr>
<tr>
<td>AMP</td>
<td>62-63</td>
</tr>
<tr>
<td>Analog Devices Inc</td>
<td>2, 40-41, 102-103</td>
</tr>
<tr>
<td>AT&amp;T</td>
<td>78-79</td>
</tr>
<tr>
<td>Autec Power Systems</td>
<td>148</td>
</tr>
<tr>
<td>B&amp;B Microsystems</td>
<td>183, 185</td>
</tr>
<tr>
<td>Belden Wire &amp; Cable</td>
<td>118-119</td>
</tr>
<tr>
<td>Berquist Co</td>
<td>90</td>
</tr>
<tr>
<td>BP Micro</td>
<td>180, 186</td>
</tr>
<tr>
<td>Bourns</td>
<td>48</td>
</tr>
<tr>
<td>Buckeye Stamping Co</td>
<td>183</td>
</tr>
<tr>
<td>Burr-Brown Corp</td>
<td>159</td>
</tr>
<tr>
<td>Caddock Electronics Inc</td>
<td>177, 179</td>
</tr>
<tr>
<td>Cadisys</td>
<td>158</td>
</tr>
<tr>
<td>Cahners CAPS</td>
<td>184, 186</td>
</tr>
<tr>
<td>Capilano Computer Systems Inc</td>
<td>187</td>
</tr>
<tr>
<td>Capital Equipment Corp</td>
<td>90</td>
</tr>
<tr>
<td>Central Semi</td>
<td>98</td>
</tr>
<tr>
<td>Cermetek</td>
<td>185</td>
</tr>
<tr>
<td>Chips and Technologies Inc</td>
<td>44-45</td>
</tr>
<tr>
<td>Cirrus Logic</td>
<td>157</td>
</tr>
<tr>
<td>Communications Specialties Inc</td>
<td>184</td>
</tr>
<tr>
<td>Computerwise Inc</td>
<td>183</td>
</tr>
<tr>
<td>Condor</td>
<td>147</td>
</tr>
<tr>
<td>Conner Peripherals</td>
<td>12-13</td>
</tr>
<tr>
<td>Corelis</td>
<td>183</td>
</tr>
<tr>
<td>Cybernetic Micro Systems</td>
<td>29</td>
</tr>
<tr>
<td>Cypress Semiconductor</td>
<td>6</td>
</tr>
<tr>
<td>Dale Electronics Inc</td>
<td>19, 58</td>
</tr>
<tr>
<td>Data I/O Corp</td>
<td>C4, 187</td>
</tr>
<tr>
<td>Deltron Inc</td>
<td>123-126</td>
</tr>
<tr>
<td>Design Computation Inc</td>
<td>186</td>
</tr>
<tr>
<td>Dialight Corp</td>
<td>77</td>
</tr>
<tr>
<td>Du Pont Co</td>
<td>69</td>
</tr>
<tr>
<td>Eagle Picher</td>
<td>113</td>
</tr>
<tr>
<td>Elco Corp</td>
<td>72</td>
</tr>
<tr>
<td>Electronic Measurements Inc</td>
<td>111</td>
</tr>
<tr>
<td>Elgar</td>
<td>116</td>
</tr>
<tr>
<td>Emulation Technology Inc</td>
<td>185</td>
</tr>
<tr>
<td>Ericsson Components</td>
<td>194</td>
</tr>
<tr>
<td>Force Computers Inc</td>
<td>24-25</td>
</tr>
<tr>
<td>Fujitsu AP</td>
<td>149</td>
</tr>
<tr>
<td>Gates Energy Products Inc</td>
<td>104-105</td>
</tr>
<tr>
<td>GCOM Inc</td>
<td>186</td>
</tr>
<tr>
<td>General Devices</td>
<td>158</td>
</tr>
<tr>
<td>Glassman High Voltage Inc</td>
<td>130</td>
</tr>
<tr>
<td>Global PMX Co Ltd</td>
<td>185</td>
</tr>
<tr>
<td>Harris Semiconductor</td>
<td>95, 97</td>
</tr>
<tr>
<td>Hewlett-Packard Co</td>
<td>28</td>
</tr>
<tr>
<td>Huntsville Microsystems Inc</td>
<td>142</td>
</tr>
<tr>
<td>Hwang Pin</td>
<td>187</td>
</tr>
<tr>
<td>HyperLynx</td>
<td>173</td>
</tr>
<tr>
<td>IDT</td>
<td>173</td>
</tr>
<tr>
<td>Incredible Tech</td>
<td>184</td>
</tr>
<tr>
<td>Intel Corp</td>
<td>C2, 82-83</td>
</tr>
<tr>
<td>International Rectifier</td>
<td>C3</td>
</tr>
<tr>
<td>Intusoft</td>
<td>183</td>
</tr>
<tr>
<td>Ironwood</td>
<td>187</td>
</tr>
<tr>
<td>John Fluke Manufacturing Co Inc</td>
<td>36</td>
</tr>
<tr>
<td>Kikusui</td>
<td>150</td>
</tr>
<tr>
<td>KMS Advanced Products</td>
<td>74</td>
</tr>
<tr>
<td>Leader Instruments Corp</td>
<td>182</td>
</tr>
<tr>
<td>Linear Technology Corp</td>
<td>171-172</td>
</tr>
<tr>
<td>Link Computer Graphics Inc</td>
<td>184</td>
</tr>
<tr>
<td>Logical Devices Inc</td>
<td>2</td>
</tr>
<tr>
<td>MathSoft Inc</td>
<td>140</td>
</tr>
<tr>
<td>Max Cad</td>
<td>187</td>
</tr>
</tbody>
</table>

Maxim Integrated Products | 99, 101 |
Maxtor | 50-51 |
McGraw Hill Inc | 181 |
Meritec | 59 |
Metalink Corp | 185 |
Method Electronics Inc | 100 |
Microcfstal | 184 |
Micro Linear | 92 |
MicroSim Corp | 16 |
Mini-Circuits Laboratories | 22-23, 32-33, 196 |
Molex Inc | 145 |
Mosaic Industries Inc | 186 |
Motorola | 38-39, 80-81, 174-175 |
NAS Electronics | 167 |
National Instruments | 54 |
National Semiconductor Corp | 42 |
NEC Corp | 151-154, 162-163 |
NKK Switches | 55 |
Nohau Corp | 183 |
OKI Semiconductor | 30-31 |
Orbit Semiconductor | 14-15 |
Orcad Systems Corp | 141 |
Panasonic | 127-129 |
Penn Eng & Mfg Corp | 75 |
Pico | 122, 178 |
Pioneer | 169 |
Power Convertibles | 176 |
Power General | 54 |
Powertrands Inc | 156 |
Precision Interconnect | 71 |
Protel Tech Inc | 185 |
Raytheon | 46-47 |
SBE | 161 |
SGS-Thomson Microelectronics | 21 |
Siemens AG | 120-121 |
Signal Transformer Co Inc | 193 |
Siemens Systems Inc | 89 |
Siliconix Inc | 4 |
SMT Plus | 58 |
Softaid Inc | 185 |
Sony | 57 |
Stanford Research Systems Inc | 155 |
T-Cubed Systems Inc | 186 |
Tektronix | 146 |
Teledyne Relays | 160 |
Teltonica Corp | 149 |
Teradyne Inc | 26-27 |
Thomas and Betts Corp | 60-61 |
Toshiba America Inc | 34-35 |
Tribal Microsystems | 186 |
Two Technologies | 184 |
Waveletek | 3 |
Westcor | 115 |
Wintek Corp | 184 |
Xeltek | 187 |
Zilog Inc | 53 |
Z-Worlco | 184 |

Recruitment Advertising | 189-192

**Advertiser in US edition**

**Advertiser in International edition**

This index is provided as an additional service. The publisher does not assume any liability for errors or omissions.

---

### EDN REPRINTS

#### A Designer's Guide to Linear Circuits

**Volume I**

This original, 186-page collection by Jim Williams offers a wealth of analog design information. It includes practical and efficient ways to use op amps, comparators, data converters, and other analog ICs.

---

#### A Designer's Guide to Linear Circuits

**Volume II**


---

### Surface-Mount Technology Design Project

This 48-page, four-color reprint follows the progress of EDN editor Steve Leibson as he designs a 2M-byte memory board using surface-mount technology. He includes typical design decisions you might encounter and objectively reports about both good and bad design decisions made along the way.

---

**CALL NOW!**

Cahners Reprint Services
708/390-2240
### SPECIFICATIONS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>TOSW-230</th>
<th>ZSDR-230</th>
<th>TOSW-425</th>
<th>ZSDR-425</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freq. Range (MHz)</td>
<td>10-3000</td>
<td>10-2500</td>
<td>10-2500</td>
<td>10-2500</td>
</tr>
<tr>
<td>Insert. Loss (dB)</td>
<td>typ.</td>
<td>max.</td>
<td>typ.</td>
<td>max.</td>
</tr>
<tr>
<td>10-100MHz</td>
<td>1.3</td>
<td>1.9</td>
<td>1.1</td>
<td>1.9</td>
</tr>
<tr>
<td>100-1500MHz</td>
<td>1.8</td>
<td>2.7</td>
<td>1.8</td>
<td>2.5</td>
</tr>
<tr>
<td>1500-3000MHz</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolation (dB)</td>
<td>typ.</td>
<td>min.</td>
<td>typ.</td>
<td>min.</td>
</tr>
<tr>
<td>10-100MHz</td>
<td>60</td>
<td>40</td>
<td>60</td>
<td>40</td>
</tr>
<tr>
<td>100-1500MHz</td>
<td>40</td>
<td>28</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>1500-3000MHz</td>
<td>35</td>
<td>22</td>
<td>35</td>
<td>22</td>
</tr>
<tr>
<td>1dB Compression (dBm)</td>
<td>typ.</td>
<td>min.</td>
<td>typ.</td>
<td>min.</td>
</tr>
<tr>
<td>10-100MHz</td>
<td>17</td>
<td>6</td>
<td>17</td>
<td>6</td>
</tr>
<tr>
<td>100-1500MHz</td>
<td>27</td>
<td>19</td>
<td>27</td>
<td>19</td>
</tr>
<tr>
<td>1500-3000MHz</td>
<td>30</td>
<td>28</td>
<td>30</td>
<td>26</td>
</tr>
<tr>
<td>VSWR (ON)</td>
<td>typ.</td>
<td>max.</td>
<td>typ.</td>
<td>max.</td>
</tr>
<tr>
<td>Oper. Temp. (°C)</td>
<td>-55 to +100</td>
<td>-55 to +100</td>
<td>-55 to +100</td>
<td>-55 to +100</td>
</tr>
<tr>
<td>Stor. Temp. (°C)</td>
<td>-55 to +100</td>
<td>-55 to +100</td>
<td>-55 to +100</td>
<td>-55 to +100</td>
</tr>
<tr>
<td>Price (10-24)</td>
<td>$39.95</td>
<td>$59.95</td>
<td>$59.95</td>
<td>$109.95</td>
</tr>
<tr>
<td>(1-9)</td>
<td>$69.95</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10 to 3000MHz from $39.95

Now, high-speed, high-isolation switches 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.
Now you can replace a fistful of components, and drive power FETs and IGBTs with one cost-effective part: The IR2110 monolithic dual channel 2A gate driver with floating high side and ground reference low side.

Count your design time in hours instead of days. And cut assembly time to a fraction.

The IR2110 runs as fast as it designs. With operation above 1 MHz. On-chip bootstrap. Plus matched channel delay within 10 ns. That’s right. 10 ns.

It takes good care of your circuit too, with gate under-voltage protection.

And latched shutdown makes current mode control both simple and easy.

Is it rugged? 50 V/ns dv/dt at -55 to 150°C in plastic. Versatile? Operates off 12 to 500 V rails with 5 to 20 V input, in any circuit topology. Reliable? The IR2110 meets the same high standards as IR’s incomparable HEXFET® power MOSFETs.

Call (800) 245-5549 for more information. We’ll get it off the ground and on your desk in no time.

International Rectifier
Program your hot new parts here.

And Now. Just one thing stands between you and your "hot" new design: a device programmer that can handle it. That's why the UniSite™ Universal Programmer is the designer's first choice.

UniSite is always first to support the latest devices like the Altera Max, AMD MACH, and the newest FPGAs. It also supports more packages—including PLCCs and LCCs up to 84 pins, pin grid arrays, and SOICs. UniSite is designed for the future. Data I/O's universal pin-driver technology eliminates pinout adapters, for single-site programming of each device type. And its new PinSite™ programming module uses Data I/O's new Universal Package System to support all surface-mount packages from one site.

Adding device support is easy too, with UniSite's update diskettes. They're released quarterly, so you'll always have support for the latest devices—first.

FREE Programming Tutorial. For a FREE copy of our programming technology tutorial and more information about UniSite, call now.

1-800-3-DataIO
(1-800-332-8246)

The Personal Silicon Experts

DATA I/O Corporation