A MORGAN-GRAMPIAN PUBLICATION

# DIGITAL DESIGN

SYSTEMS ARCHITECTURE, INTEGRATION AND APPLICATIONS APRIL 1984

## DESIGNER'S GUIDE TO THE MULTIBUS



- DIGITIZERS
- HARD DISK DRIVES
- SOLID-STATE MEMORY
- ENGINEERING WORKSTATIONS

# ANNOUNCING THE WY-50.

# PRETTY BABY

## A NEW GENERATION OF LOW-COST TERMINALS FROM WYSE.


Never before has anyone put so much into something so good looking. Or so compact. It took revolutionary design to do it. Design a lot of people couldn't accomplish for the price. But we did.

In fact, the birth of the WY-50 introduces a new standard for low cost terminals. It was conceived to give you 30% more viewing area. Developed to meet the most advanced European ergonomic standards. And best of all, delivered for a surprisingly low price.

The WY-50 sells for only $695.00.

**BORN WITH ADVANCED FEATURES:**

- 14″ screen.
- 80/132 column format.
- Soft-set up mode.
- High resolution characters.
- Low-profile keyboard.
- Industry compatible.
- Only $695.00.

For more information on the revolutionary design, outstanding features and unique good looks of our Pretty Baby, contact WYSE TECHNOLOGY and we'll send you a brochure filled with everything you need to know.

The WY-50. It's a real beauty.

**Write 2 on Reader Inquiry Card**

WYSE *Make the Wyse Decision.*

**WYSE TECHNOLOGY,** *3040 N. First St., San Jose, CA 95134, 408/946-3075, TLX 910-338-2251, in the east, call 516/293-5563, call toll-free, 800/538-8157, ext. 932, in CA 800/672-3470, ext. 932, in the midwest, 313/227-5011, in So. CA, 213/340-2013.*

Q U A L I T Y


# The Class of '84

At Brown Disc, we have spent the last two and a half years developing sophisticated flexible disc coating formulations, processes and quality methods. We have timed our developments to coincide with the growing maturity of the flexible disc industry.

Volume users of flexible discs are becoming increasingly aware of the need for a higher quality flexible disc. End-users are demanding more out of their systems. This means you need the best diskette, at a competitive price. With Brown Diskettes, you can be sure you have the best. If you've evaluated our products, you know our quality.



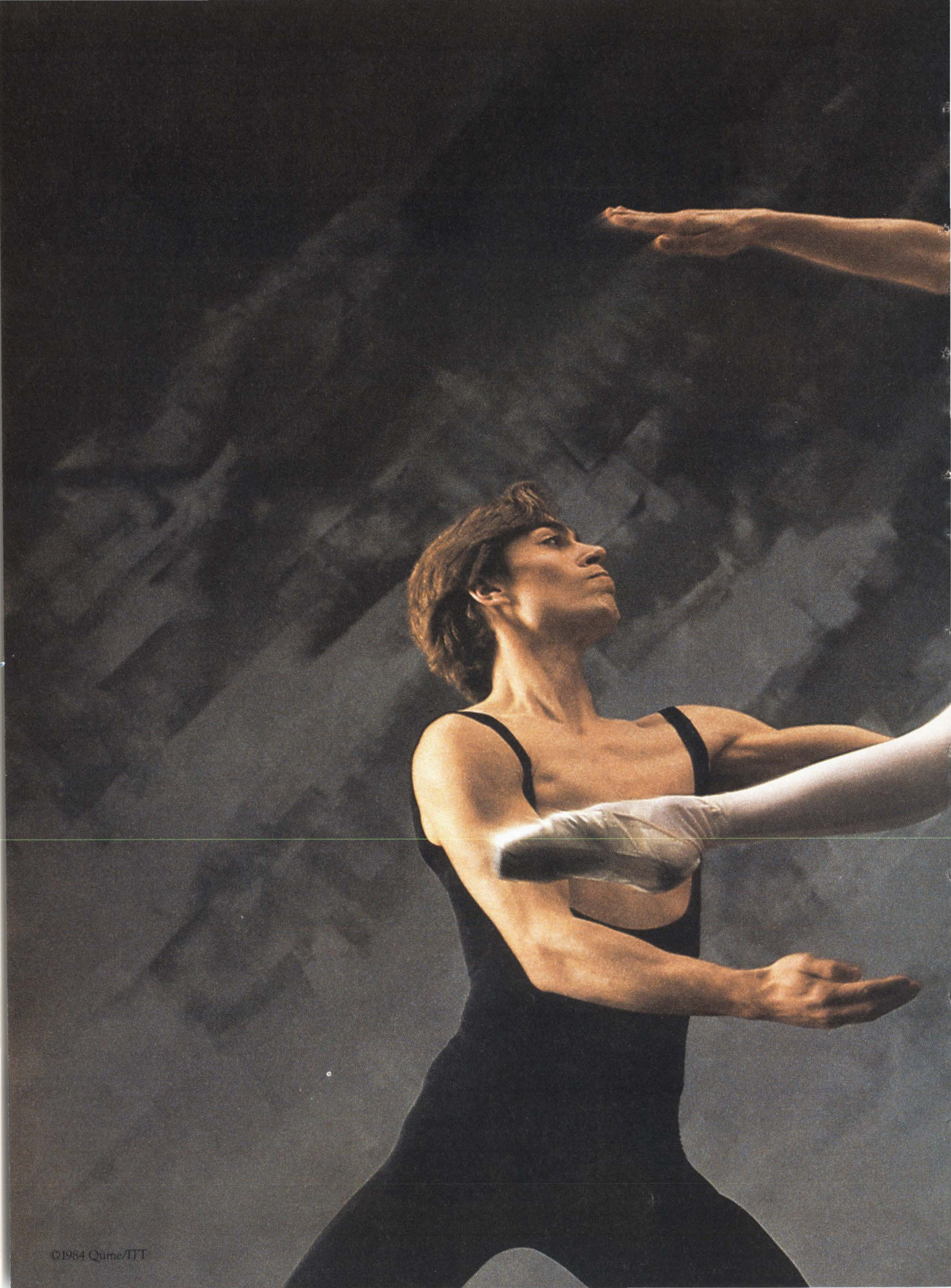

In our new 106,000 square foot manufacturing facility, we produce 3¼", 3½", 5¼", and 8" media with capacities up to 6.34 megabytes. With our advanced spin-coating technology, we can also help you develop future systems that utilize high density flexible disc drives.

Put Brown Disc's advanced technology to work for you. Give us a call at 1-800-654-4871...we'll be happy to talk straight with you. 1984 is our year. Make it yours, too.

bdm inc. **brown disc**

We're driving the drive market.

Brown Disc Manufacturing, Inc., 1110 Chapel Hills Drive, Colorado Springs, CO 80918, Telex 450827

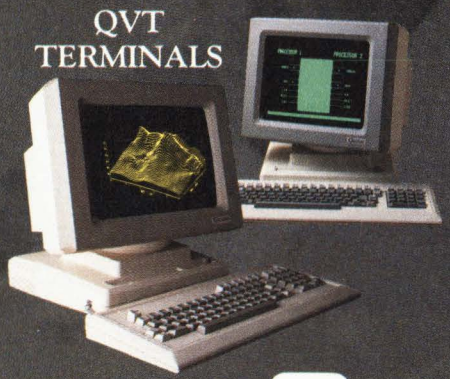


# We'll be there.

When you commit yourself to a purchase of computer terminals, you need a partner you can trust 100 percent. Not only for superb performance today, but for premier service and support in the years ahead. That's why so many companies are choosing Qume QVT™ terminals for everything from simple data entry to sophisticated editing and graphics workstations. In both ASCII and ANSI, Qume QVT terminals assure you of superlative performance at more affordable prices. And because Qume is a member of the ITT family of companies, you can be sure we'll always be there with solid support.

For complete details on Qume QVT alphanumeric and graphics terminals, call **(800) 223-2479.** Or write Qume Corporation, 2350 Qume Drive, San Jose, CA 95131.

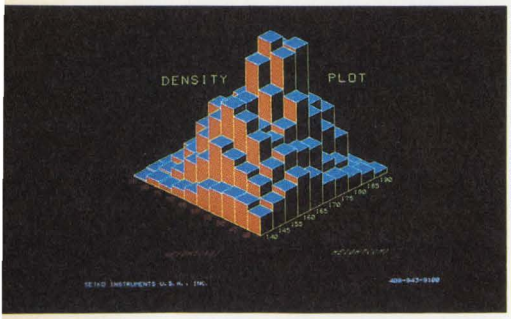
QVT TERMINALS



**Qume**®
A Subsidiary of ITT

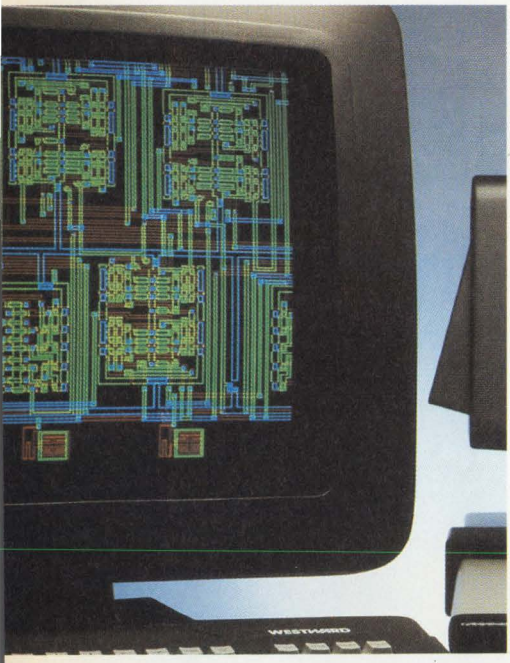
# DIGITAL DESIGN

APRIL 1984 VOL. 14 NO. 4

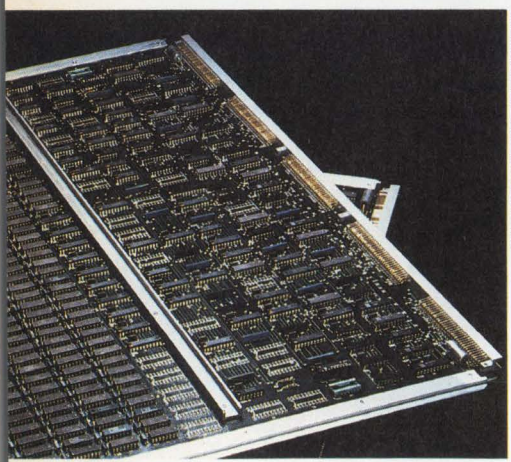

COURTESY SEIKO INSTRUMENTS

**28** Desktop color graphics



COURTESY WESTWARD TECHNOLOGY

**50** Workstation intelligence upgrade



COURTESY FLOATING POINT SYSTEMS

**86** PC workstation design

## DEPARTMENTS

# TABLE OF CONTENTS



COURTESY INTEL CORP.



## FEATURES



## ON THE COVER

This month's cover features three peripheral storage controllers designed and manufactured by Xylogics, Inc. (Burlington, MA) which provide direct memory access transfers from disks and tapes to Multibus Systems. The new Xylogic's 421 Multibus Controller allows the simultaneous operation of a QIC-2 interface tape drive with ST506/412 disk drive. Also shown is the 450, a Multibus SMD disk drive controller and the 472, a ½" streaming tape controller. Original photography by William L. Smith Photography, Boston, MA. Cover design by Benjamin Morse, Inc., Boston, MA.

Published monthly thirteen times a year with two issues in November.  Second class postage paid at Boston, MA and at additional mailing offices. POSTMASTER: Send address changes to Morgan-Grampian Publishing Company, 1050 Commonwealth Ave., Boston, MA 02215 ISSN 0147-9245.

# MEET THE STRONGEST

here's a lot more to a Fujitsu gate array than glass, gold, and aluminum; it's the human element that really sets our product apart.

When you order a Fujitsu gate array, you become part of a team. You work through your objectives with a highly-skilled design engineer who knows silicon the way you know logic.

That way, you combine your expertise with ours to shape the subtleties of silicon into product advantages.

Instead of glitches.

This approach is a good part of the reason that since 1974, Fujitsu has produced more than 3,000 gate array designs – and every one of them has worked according to plan.

Our engineers can help you execute designs in a complete range of technologies – CMOS, TTL, ECL – you name it. Because the Fujitsu team's incredible versatility comes from a solid background within each of those technologies.

That's how you get numbers like these:

CMOS

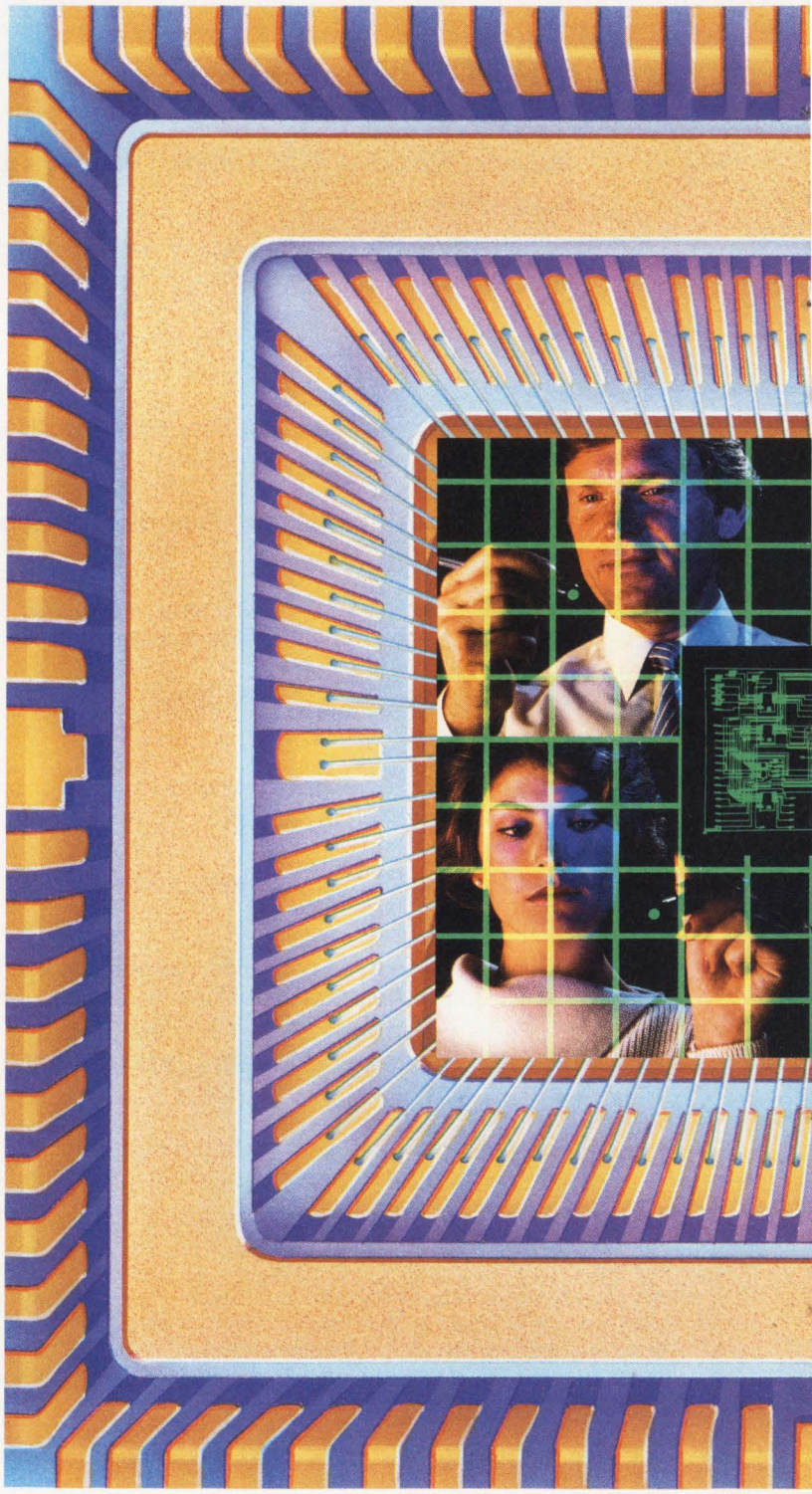
| TECHNOLOGY | GATE LENGTH | PROP DELAY TIME* | GATE COUNT |
|---|---|---|---|
| STD CMOS | 3.6 $\mu$ | 7.0 ns | 700-3900 |
| H CMOS | 2.8 $\mu$ | 5.0 ns | 440-3900 |
| VH CMOS | 2.3 $\mu$ | 2.5 ns | 2600-8000 |

*2-Input NAND Gate, F/O = 2

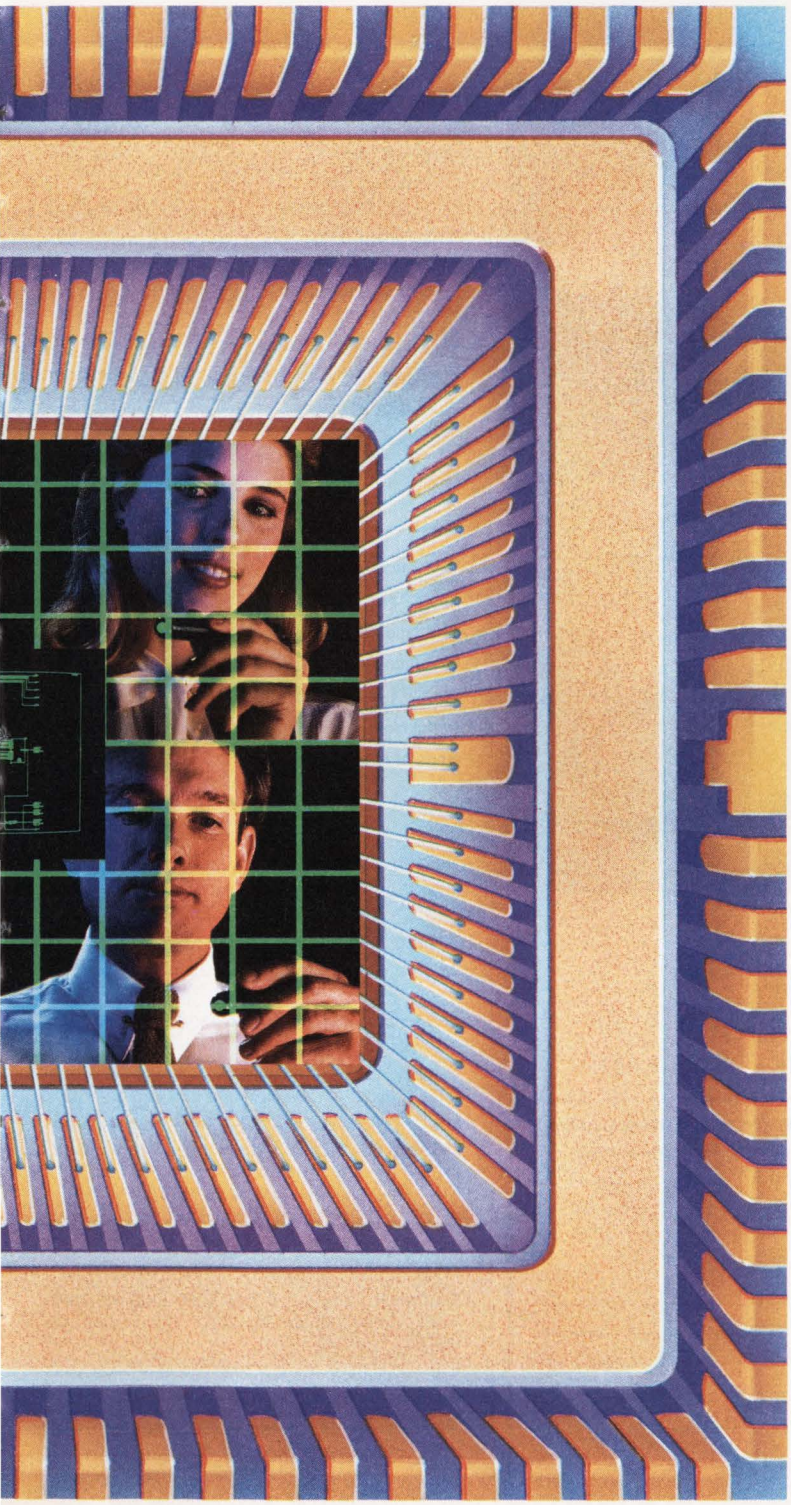
BIPOLAR

| TECHNOLOGY | PROP DELAY TIME* | GATE COUNT | POWER DISSIPATION PER GATE |
|---|---|---|---|
| LSTTL | 1.8 ns | 500 | 2.3 mW |
| LSTTL | 1.9 ns | 240-1100 | 0.8 mW |
| LSTTL | 0.95 ns | 2000 | 0.65 mW |

*3-Input NAND Gate, F/O = 1



# TEAM ON THE CIRCUIT.



There are now three fully equipped Fujitsu Gate Array Design Centers in the U.S.; in Boston, Dallas, and Santa Clara. There's a sophisticated telecommunications network between centers, and high-speed leased-line and satellite communications with FMI host computers in Japan. All that, and a first-class gate array design team, too. With you as star player.

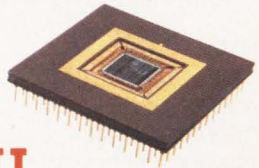
Call the FMI Design Center nearest you. We'll show you how to get our team on your circuit.

Boston Design Center
57 Wells Avenue
Newton Centre
Massachusetts 02159
(617) 964-7080

Santa Clara Design Center
3320 Scott Boulevard
Santa Clara, CA 95051
(408) 727-1700

Dallas Design Center
1101 East Arapaho Road
Suite 225
Richardson, TX 75081
(214) 669-1616

Literature request line: 800-556-1234 (ext. 82)
In California, 800-441-2345



**FUJITSU**
**MICROELECTRONICS, INC.**
**Technology that works**
3320 Scott Boulevard, Santa Clara, CA 95051 · (408) 727-1700

**Write 8 on Reader Inquiry Card**

# DIGITAL DESIGN

| | |
|---|---|
| Publisher | James R. DiFilippo |
| Editor-in-Chief | Jerry Borrell |
| Editor | Debra A. Lambert |
| Senior Technical Editor | Dave Wilson |
| Directory Editor/ Editor | Julie Pingry |
| Technical Editor | Ronald E. Collett |
| West Coast (213) 981-3300 Technical Editor | Mike Cashman |
| West Coast (408) 356-0405 Technical Editor | Gregory MacNicol |
| Departments Editor | Mary Rose Hanrahan |
| New Products Editor | Andrea Coville |
| Copy Editor | Winnie Jenkins Rubino |
| Assistant to the Publisher | Terri Lamneck |
| International Electronics Editor | Ron Neale |
| International Computers Editor | Eric Wignall |
| Contributing Editor Data Communications | Walter Bolter, Ph.D. |
| Contributing Editor Graphics Systems | Thomas DeFanti, Ph.D. |
| Contributing Editor Peripherals | Bob Hirshon |
| Washington Correspondent | Anne Armstrong |
| Publication Services Manager | Charlotte King |
| Production Manager | Paul Dadarria |
| Art Director | Maureen Bernardini |
| Production/Graphics | Martha Watjen<br>Judy Osburn,<br>Joan Scheffler, Vete Saulenas,<br>Don Schaaf, Paul Christo, Gary Byrne |
| Promotion Manger | Elaine Bull |
| Research | Helen Obermayer, Peter Micheli |
| Circulation Director | Hugh J. Dowling |
| Circulation | Maggie Hayes-Miville, Miriam Hlister |
| Reader Service (413) 499-2550 | Rose Wetherell |
| Direct Mail | Deborah Goldstein |
| General Administration | Karen Melanson<br>Nancy Deveau<br>Dianna Lynn Reed<br>Kathryn Kopple<br>Debra James |

**President**
Ronald W. Evans

## Advertising Sales

**Northeast:** Doug Miller **(617) 232-5470,** 1050 Commonwealth Avenue, Boston, MA 02215.

**Middle Atlantic/Southeast:** Sharon Greenberg (In PA) **(215) 592-1895,** (Outside PA) **800-223-7110,** 703 A South Street, Philadelphia, PA 19147

**Midwest, South Central:** Hank Bean, Rob Robinson **(312) 346-4611,** Morgan-Grampian Publishing, 2 North Riverside Plaza, Chicago, IL 60606

**Northwest:** Ralph Petersen, Pam Rock **(408) 356-0405,** 15951 Los Gatos Blvd., Suite 7, Los Gatos, CA 95030

**Southwest:** Kelly Lloyd, Bob Meth **(213) 981-3300,** 15910 Ventura Boulevard, Suite 705, Encino, CA 91436

**Telemarketing/Northwest: (408) 356-0405,** 15951 Los Gatos Blvd., Suite 7, Los Gatos, CA 95030

**Telemarketing/Southwest: (213) 981-3300,** 15910 Ventura Boulevard, Suite 705, Encino, CA 91436

**National Postcard Sales:** Jon Binder **(617) 232-5470,** 1050 Commonwealth Avenue, Boston, MA 02215

# The Lundy UltraGraf® is absolutely the fastest draw in the West or anywhere else.

**This is the fastest, most intelligent 3-D computer graphics workstation available. The superlatives would seem to indicate a high price, too. But the Lundy UltraGraf workstation is surprisingly low cost considering its unmatched performance features.**

At Lundy we don't develop technology for its own sake; we develop it to meet your needs. In the case of 3-D computer graphics workstations, you needed more speed, higher IQ, larger display and easier operation. UltraGraf delivers all four.

### The Lundy UltraGraf is first when it comes to speed and IQ.

Keys to UltraGraf's instant response are a high speed microcomputer and a high resolution vector display, both developed by Lundy.

Besides these features, we've designed more intelligence into the workstation, so UltraGraf places fewer demands on your host computer.

The result is unmatched interaction while freeing up your host computer to concentrate on other operations.

### 19 × 15 inches sets a new screen standard.

UltraGraf's 21-inch CRT has the largest viewing area—19 × 15 inches—in the industry. Fast vector drawing and minimum operator time produce easy-to-read, flicker-free images. Spot size is only one ten thousandths of an inch, which produces remarkable crispness and clarity.

*Lundy UltraGraf sets 3-dimensional standards.*

Furthermore, UltraGraf is easier to use. You send a picture only once, instead of resending over and over as with many other systems. And you have local storage of all control functions for the interactive input devices. This provides maximum input flexibility, with minimum keyboarding.

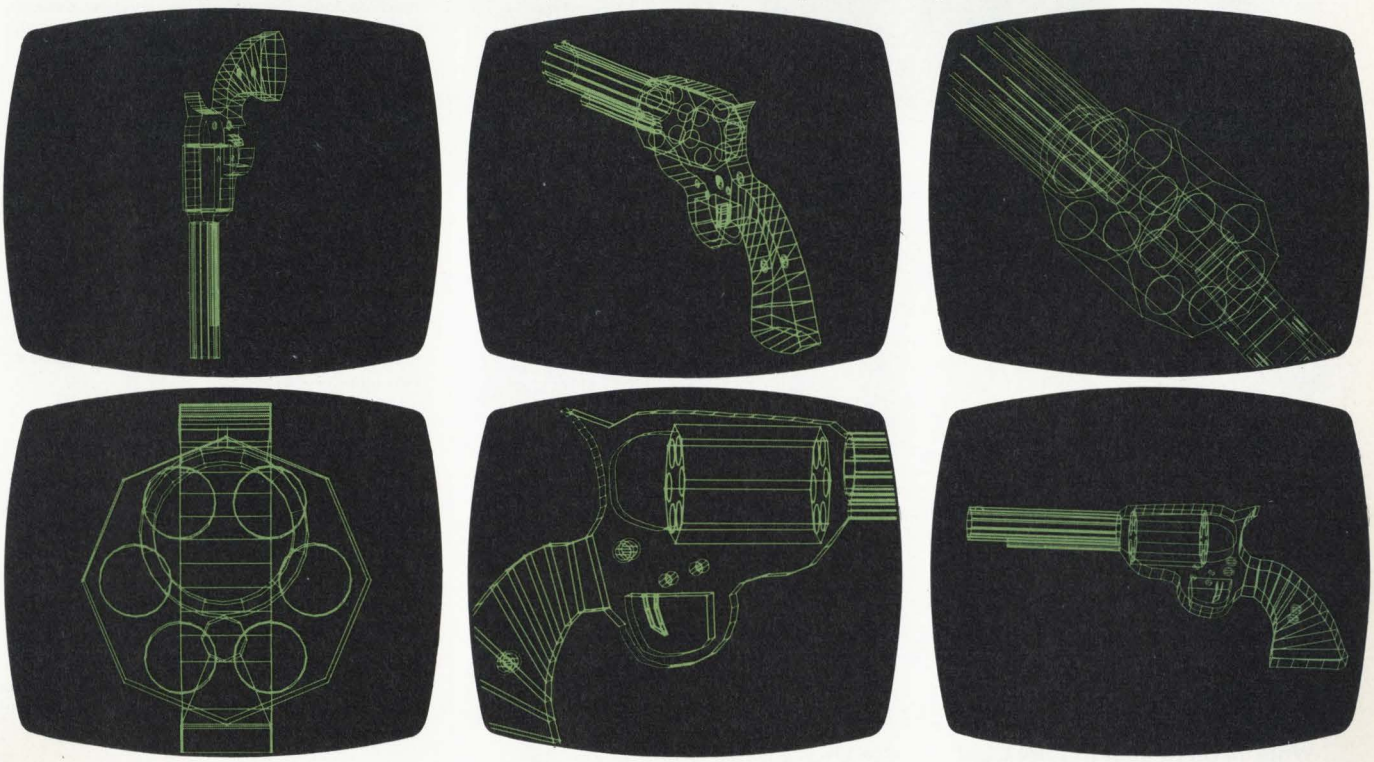
### Lundy helps you see more in graphics.

When you take a close look at our graphics terminals, service, support, software, systems capability, enhancements—and our company—you'll understand why Lundy can help you see more in graphics now and in the long term.

For more information about our 3-D UltraGraf, or other CAD/CAM products, write Lundy Electronics & Systems, Inc., Glen Head, New York 11545, or call: (516) 671-9000.

LUNDY®

*Get the draw on sluggish productivity with Lundy's UltraGraf. Shown here are six views of a six shooter generated in just a matter of seconds.*



Write 7 on Reader Inquiry Card

# DIGITAL DESIGN

**EDITORIAL AND SALES OFFICES**
Digital Design
1050 Commonwealth Avenue
Boston, MA 02215
Telephone: (617) 232-5470

**MORGAN-GRAMPIAN**

**CORPORATE HEADQUARTERS**

Morgan-Grampian Publishing Company, 1050 Commonwealth Avenue, Boston, MA 02215, (617) 232-5470. Brian Rowbotham, Chairman; Ronald W. Evans, President; Charles Benz, H. G. Buchbinder, Robert Poggi, Vice Presidents.

**EXPOSITIONS GROUP**

Morgan-Grampian Expositions Group, 2 Park Avenue, New York, NY 10016 (212) 340-9700.

The following is a list of conferences sponsored by the Expositions Group:

| | |
|---|---|
| ATE West | CADCON East |
| CADCON West | ATE Central |
| ATE Northwest | CADCON Central |
| ATE East | |

In addition to Digital Design, Morgan-Grampian publishes the following in the United States: Circuits Manufacturing • Electronic Imaging • Electronics Test • Computer & Electronics Marketing

Morgan-Grampian also publishes the following in the United Kingdom: Electronic Engineering • Control & Instrumentation • Electronics Times • What's New in Electronics • What's New in Computing • Business Computing and Communications.

DIGITAL DESIGN serves the manufacturers of computer-related OEM products. This includes primary computer and systems manufacturers, systems integrators, components and peripheral manufacturers, integrating OEM's and commercial end users. These companies manufacture products used to control machinery, equipment and information in manufacturing, material processing, machine tools, packaging, health care, defense, data processing, communications, instrumentation, and scientific and business operations.

ABP BPA

**SUBSCRIPTION POLICY**

DIGITAL DESIGN is circulated only to qualified research, development and design engineers and engineering managers primarily responsible for computer products and systems in OEM plants. To obtain a complimentary subscription, request (on company letterhead) a qualification card from Circulation Director. For change of address, attach old address label from recent issue to new company letterhead or note. Send this plus request for new qualification card to:

Circulation Department
**DIGITAL DESIGN**
Berkshire Common
Pittsfield, MA 01201

Subscription rates: non-qualified subscribers (US and Canada) — $35/yr; foreign — surface mail — $45; air mail — $70. Single copies — $4.

DIGITAL DESIGN solicits editorial material and articles from engineers and scientists. Contributors should submit duplicate manuscripts typed with two spaces between lines. All illustrations should be clear; components on all schematics and line drawings should be labeled. The editors assume no responsibility for the safety or return of any unsolicted manuscripts.

# A BIG CHANGE THAT HASN'T CHANGED OUR PRODUCTS IS OUR NEW NAME.

GENICOM


Normally, you might not trust a product with a new name. But while all of our products have a new name, they also have a proven history of quality and reliability.

That's because Genicom was formerly the Data Communication Products Department of General Electric. Now an independently owned company, Genicom will continue the same product line we established with GE...only the name has changed.

Our Genicom 3000 family, for instance, still offers the same performance features already preferred by users and the design flexibility so important to OEM's, distributors, retailers and dealers. Speeds from 40 to 400 cps. Single or dual mode printing. Type quality from EDP to NLQ. Multi-color printing. Graphics. Selectable type fonts, American craftsmanship and more.

Of course, we'll also offer Genicom 2000 teleprinters and the soon to be introduced 4000 shuttle matrix printers. You'll find we have the same complete product line that we had with GE. We have the same corps of experienced employees, the same facilities, and the same nationwide service network.

But above all, we have a new commitment to excellence. Which means, while we continue to serve existing customers with established products like our 3000 family, we plan to introduce more products to meet growing needs.

At Genicom, we've changed our name and we're planning to change the future with more innovations, and more of the quality you've come to expect from us under any name.

Genicom Corporation, One General Electric Drive, Dept. M321, Waynesboro, VA 22980. In Virginia, call 1-703-949-1170.

GENICOM™

For the solution to your printing needs call

TOLL FREE 1-800-437-7468

(Them)

RACAL

(Us)

Most electronics CAE companies are just starting up. But we have been developing CAE systems for the last 18 years. We were the first to use interactive graphics for PCB design. The first to use them on a minicomputer. And the first to use them on a micro. So if you are looking for a solution to your CAE needs, give yourself the advantage of experience. Look at us.

**Racal-Redac**

**The world's most advanced CAE company.**

4 Lyberty Way, Westford, MA 01886 (617) 692-4900

# EDITOR'S COMMENT

Throughout the course of the past year we have introduced changes in *Digital Design* intended to benefit our readers. In this issue we have completed several organizational and design changes. The new contents page reflects not only a more easily understood format, but our expansion of the information found in departments. In this and future issues, the Departments Editor, Mary Rose Hanrahan, directs a more comprehensive treatment of trends and events. We believe the engineering planner or manager finds these events vital in understanding the industry in general. These stories are obviously distinct from the evaluative examination of design issues represented by our features.

The most important, but least evident change is in the approach to our features. To serve a readership whose work and life centers around the computer industry, our editorial must not only demonstrate excellence in reporting, but reflect the issues influencing our readers. We all recognize the high level of change inherent in computer technology, but often expect our traditional patterns of observation to keep us abreast of these changes. We are making efforts to both provide a forum for topics and report on digital design. At the same time, we want to indicate the nature of the ongoing change; the ways in which design is progressing.

Our title remains, but our focus has changed from covering the design of computers, peripherals and components to coverage of the design issues, tools and techniques from the chip to the system level. We sacrifice some types of coverage if our primary focus is towards the design process. There will still be articles on specific innovations that are particularly noteworthy, but for the most part you will find objective evaluations of design. In one monthly article, The Industry Review, we present a survey of one especially fertile area of design innovation. This month, for instance, large format disk drives are evaluated. The remainder of our articles reflect more in-depth research and inquiry centered on design.

With this editorial approach, we address two levels of design expertise: architectural and design task oriented. The first have the title of "Systems Architect," known otherwise as the Director of Engineering or Advanced Product Planner. In working with systems architects throughout the industry, we recognize that they are the minority. They interface with the majority: computer designers, programmers, manufacturers, and corporate managers. The architects arbitrate between the market driven goals of the company and the concepts of the engineer to insure that a product suitable for the intended user can be designed and manufactured.

Looking at the universe of publications today we see no other magazine which adequately serves this reader; no other publication which can bridge the issues of design brought about by management and engineering. While the architect needs this broad forum, the designer is also interested in what forces shape their environment. The designer assigned to integrate memory into a system, for example, requires an understanding of the issues that shape the type of product he specifies, issues such as: the processor environment, the type of internal communications, the demands foreseen by the systems users and others.

*To serve a readership whose work and life centers around the computer industry, our editorial must not only demonstrate excellence in reporting, but also reflect the issues influencing our readers.*

Thus, while we do not desire to serve the pure research audience of the professional journal or a technology-specific audience, we can strive to give insight into the issues of architecture (the thousand processes of design); the issues of integration (such as standards) and the applications (putting those tools to specific ends).

An insight into our method of performing this task is evident in our editorial staff. Each of our editors has at least one area of expertise that allows a thorough enough knowledge to be critical of that aspect of design which they cover. David Wilson has covered the issues of system communication and integration, Ron Collett, our new Boston Technical Editor, is focusing on VLSI design; Julie Pingry covers data communications; Gregory MacNicol, our new Los Gatos (Northern California) Technical Editor, examines the graphics industry; Mike Cashman in Encino (Southern California) covers systems and software. In addition, we have three regularly contributing editors: Bob Hirshon who writes exclusively on memory products, Ram Appalaraju who specializes in semiconductor design, and Anne Armstrong who reports on computer industry related activities from Washington, D.C.

The focus of these staff members combined with the broad, more timely coverage of Mary Rose Hanrahan in Departments and Andrea Coville in our surveys and new products gives additional coverage of interest to our readers.

With these improvements, our work begins in earnest. We hope that you, our readers, will help direct our focus through our upcoming reader survey, and that we can continue to grow with our industry.

**Jerry Borrell**
**Editor-in-Chief**

# Design Our Gate Arrays On Your Workstation


Now you can design and verify gate arrays in-house on your own Mentor Graphics IDEA 1000,*™ Daisy LOGICIAN*™ or Valid Logic SCALDsystem*™ engineering workstation.

## Powerful New Software From LSI Logic Corporation Gives You The Freedom

Our new SOFTWARE DATA BOOK™ series of macrocell libraries gives you all the documentation, data sheets and array design rules needed to begin design of LSI Logic Corporation logic arrays. Installation is simple, straightforward and takes only minutes. Using the SOFTWARE DATA BOOK means your time can be used more productively on the workstation for *design creation*—without concern that logic models are outdated or incorrect.

Our new DESIGN VERIFIER SOFTWARE™ turns your Mentor Graphics IDEA 1000 workstation into a complete system for designing our LL5000/LL7000 series gate arrays. Used in conjunction with the SOFTWARE DATA BOOK you can enter your circuit description, then proceed to logic verification, performance simulation and output of a network description file compatible to the LDS-II™ design system at any LSI Logic Corporation Design Center.

Together, the SOFTWARE DATA BOOK and DESIGN VERIFIER SOFTWARE give you the most complete in-house design and verification capability available. Call or write for complete information today.

LSI LOGIC CORPORATION,
1601 McCarthy Blvd., Milpitas, CA 95035.
Call (408) 263-9494 or Telex: 172-153.

*IDEA 1000, LOGICIAN and SCALDsystem are trademarks of Mentor Graphics, Daisy Corporation and Valid Logic, respectively.

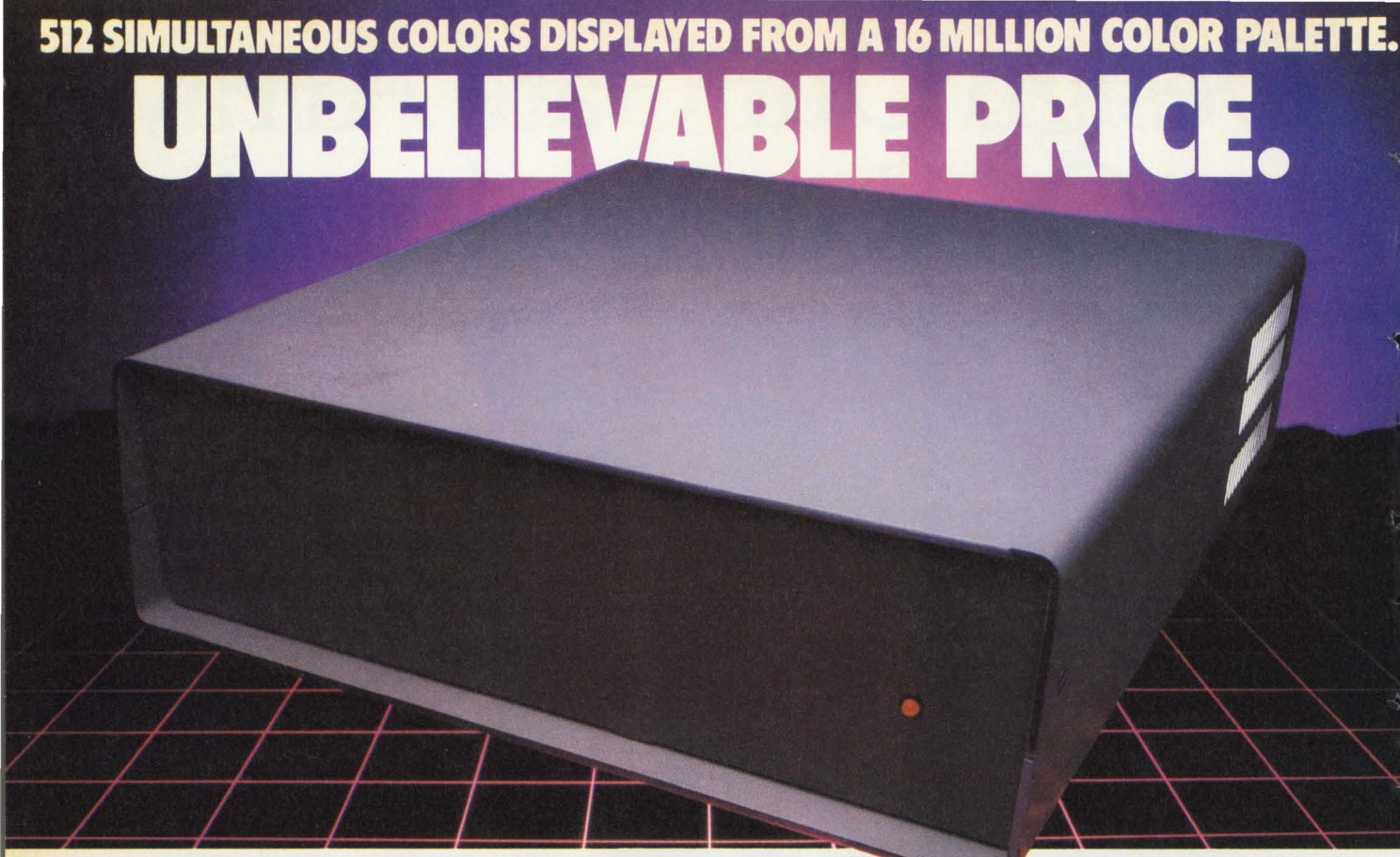
## No one delivers Gate Array Design Software like we do... No one.

**LSI LOGIC CORPORATION**

Write 10 on Reader Inquiry Card

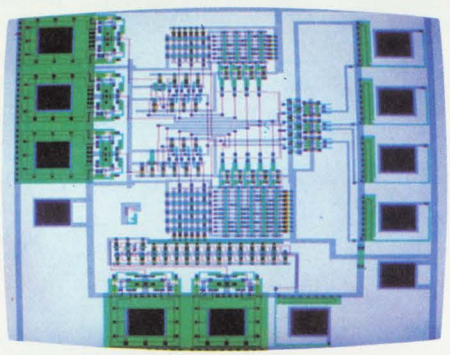
512 SIMULTANEOUS COLORS DISPLAYED FROM A 16 MILLION COLOR PALETTE.

# UNBELIEVABLE PRICE.

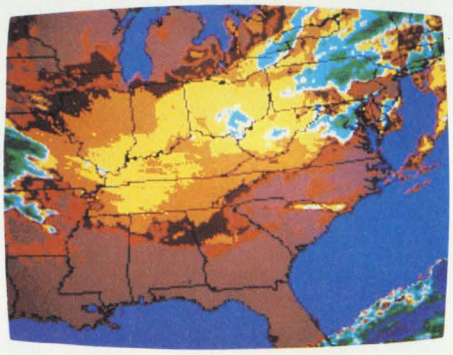


# UNBELIEVABLE GRAPHICS.

*"In The Beginning"* By Richard Katz, Vectrix Corporation



*"Integrated Circuit Design"* Courtesy of Floyd J. James, University of North Carolina at Chapel Hill



*"Weather Satellite Image"* Copyright WSI Corporation

**VX384** • VERY HIGH SCREEN RESOLUTION 672 by 480 pixels
• 512 COLORS PER PIXEL, 384K bytes of graphics RAM
• COLOR LOOK UP TABLE with 16 million colors
• ON-BOARD 16 BIT MICROCOMPUTER
• 3D GRAPHICS SOFTWARE PACKAGE, including rotation, scaling, translation, perspective, clipping, viewport, polygon and filled polygon
• HARDWARE LINE AND ARC GENERATION
• ON-BOARD AND USER DEFINABLE CHARACTER SET
• SERIAL/PARALLEL INTERFACE: most computers

**VX128** • 8 COLORS PER PIXEL, 128K of graphics RAM
• INCLUDES ALL FEATURES OF VX384 without color look-up table

**OPTIONS**
• VXM HIGH RESOLUTION RGB COLOR MONITOR
• COLOR GRAPHIC PRINTER with interface cable
• FOR ADDITIONAL INFORMATION call or write VECTRIX Corporation, 2606 Branchwood Drive, Greensboro, NC 27407 (919) 288-0520.

Vectrix
*THE COMPUTER GRAPHICS COMPANY*

NCGA Booth #1235

Write 6 on Reader Inquiry Card

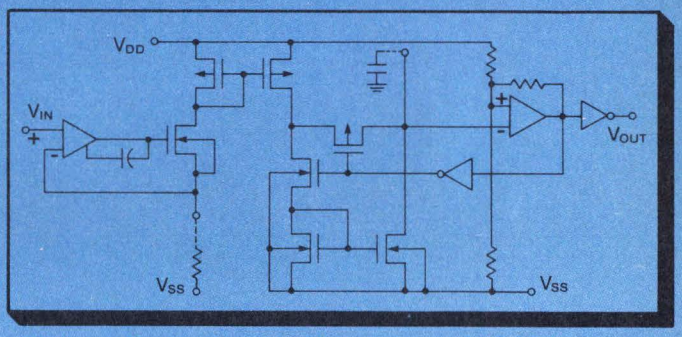

# Planet's only Precision CMOS Analog/Digital Semicustom is fast, easy, and proprietary.

Are you out in orbit because you can't design your precision analog/digital circuits fast enough? Come down to the real world with the industry's first ever precision analog/digital array family, the Telmos TMG6000 Series. This series is now one year old and already it has six star performers:

- TMG6001, instrumentation
- TMG6002, sensor subsystems
- TMG6003, switched capacitor applications
- TMG6004, data acquisition
- TMG6005, signal processing
- TMG6006, signal processing

Many others have used the TMG6000 Series to get to market quickly with a proprietary product—so can you. Telmos offers economical solutions for: modems, medical instruments, peripheral support devices, video/audio systems, man/machine interfaces, radio sonde, and much more.

Get our design manual ($70.00) and designer kits (currently 25), and design with advance features like: SiGate CMOS, <5mV offset, 90nV/$\sqrt{Hz}$ and 8-bit resolution on-chip. Call Al Kadis, *Telmos Marketing*, at (408) 732-4882, and he'll put your feet back on solid ground—fast.




**Voltage Controlled Oscillator (one of 25 kits)**

**DOMESTIC REPRESENTATIVES:** AZ, Tempe: Cantec Sales, Inc. (602) 829-0191; CA, Campbell: Becos Industries, Inc. (408) 866-2644; CA, Santa Ana: C.E.M. (714) 835-2702; CO, Louisville: X-O Sales Inc. (303) 666-7690; FL, Largo: Electrocraft Inc. (813) 530-4749; IL, Des Plaines: Synmark Sales Co. (312) 296-0180; IN, Ft. Wayne: Denton Marketing Inc. (219) 627-5525; MD, Baltimore: Micro-Comp Inc. (301) 247-0400; MN, Bloomington: High Technology Sales (612) 888-8088; NH, Salem: Electronic Marketing Associates (603) 893-5378; NY, Buffalo: The Robert F. Lamb Co., Inc. (716) 864-4900; NY, So. Hauppauge: TAM (516) 348-0800; OH, New Lebanon: J.N. Bailey & Assoc. (513) 687-1325; TN, Greeneville: Dimark Inc. (615) 639-0113; TX, Dallas: Marcom (214) 351-4532; WA, Bellevue: Thorson Company Northwest (206) 445-9180; CANADA, Point Claire, Quebec: Elcom GBM, Inc. (514) 697-4556.

**INTERNATIONAL REPRESENTATIVES:** Denmark: ITT Components Group (0) 2 45 18 22; Finland: Turion Oy (90) 372 144; France: Microel (6) 907 0824; Israel: Telsys Ltd. (03) 494881-2, (03) 494891-5; Japan: Dainichi Contronics Inc. (03) 265-7381; Norway: Eurodata (02) 80 28 92; Sweden: AB Nordquist & Berg (08) 69 04 00; Switzerland: Dimos AG (01) 62 61 40; United Kingdom: Pascal Electronics Ltd. (09327) 87418; West Germany: Bacher GmbH (089) 52 70 51.

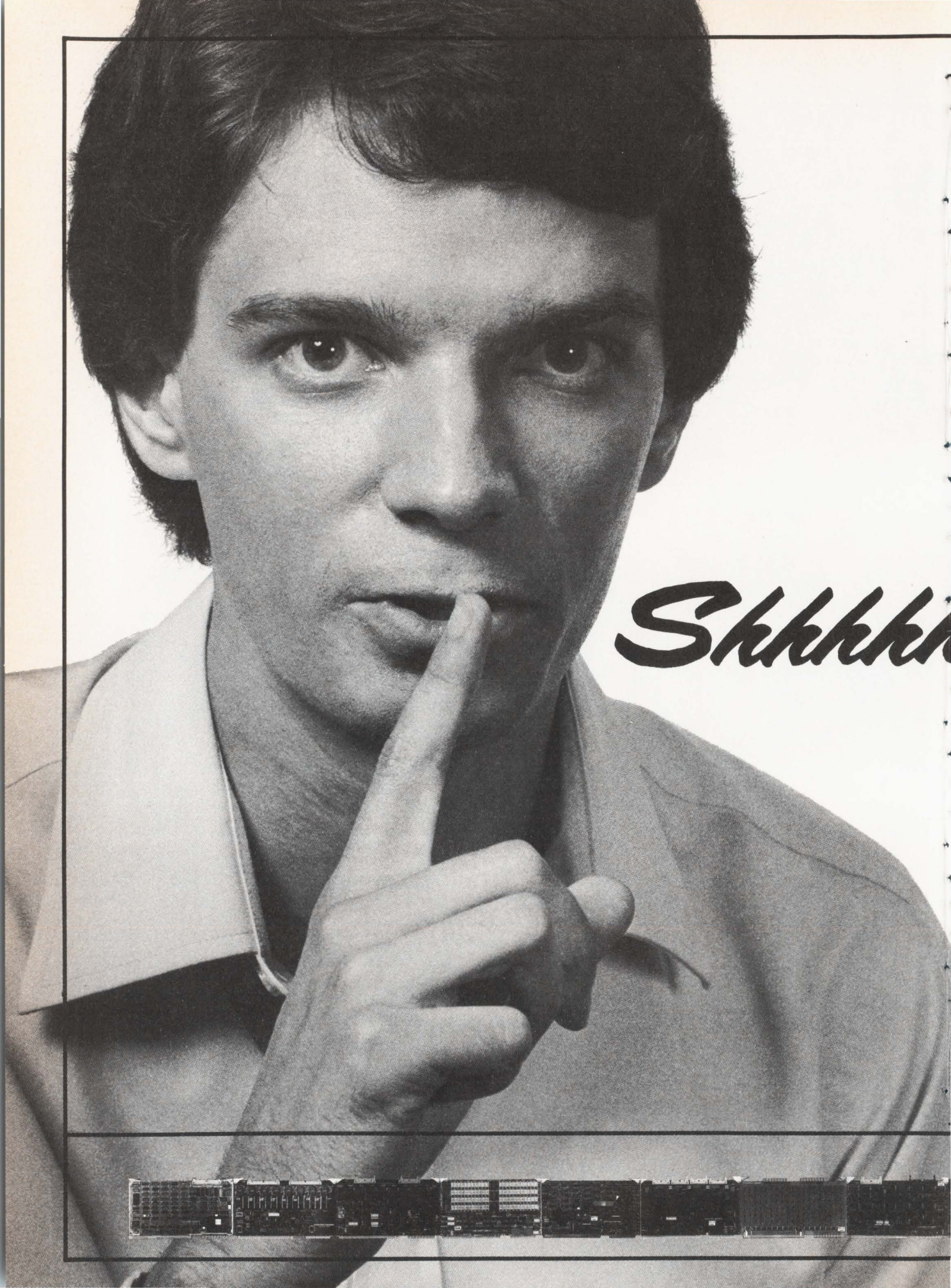
**SATELLITE DESIGN CENTERS:** California (Northern): Kashtronics, Inc. (408) 730-5944; California (Southern): Sunshine Semiconductor (714) 675-6171; Japan: Dainichi Contronics Inc. (03) 265-7381; West Germany: G.M.E. (089) 431-2602.

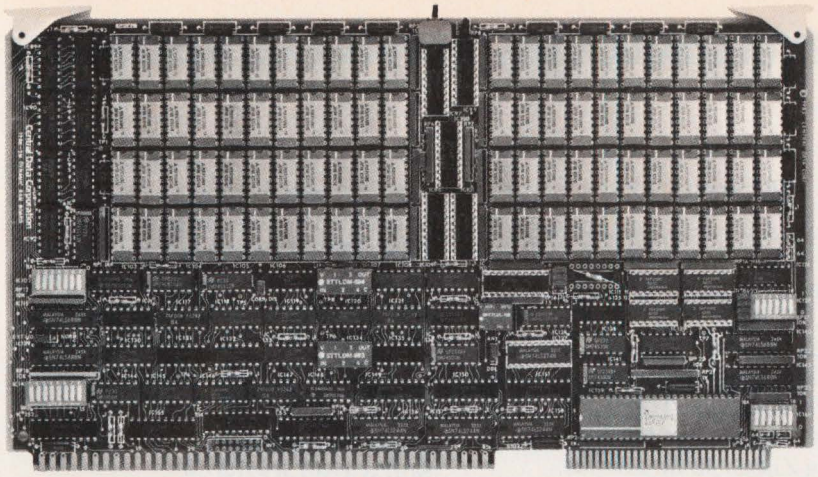
**EUROPEAN OPERATIONS AND DESIGN CENTER:** West Germany: Telmos Inc., Berg-Am-Laim - Strasse 127, 8000 Munchen 80, Tel: (089) 43 20 04.

Telmos

*...The Interface Company...*

**Telmos Inc. • 740 Kifer Road • Sunnyvale, CA 94086**


Shhhhh



# The industry's fastest Multibus* memory boards (and the quietest) are at work.

AND THEY JUST GOT FASTER!

## The new 128K-2MByte Dynamic RAM Boards from Central Data.

Shhh!

215ns AND 240ns PLUS 135ns AND 140ns FOR OUR FASTER VERSION

- **Parity Only or Error Detection/Correction (EDC) versions**
- **High-Reliability Sockets with built-in decoupling capacitors**
- **4- and 6-layer construction**
- **~~230ns~~ and ~~265ns~~ access time**
- **Upgradable to 2 MByte on one board**

**Engineered for you**
You told us that you wanted more speed and fewer noise problems from a complete line of Dynamic RAM boards. Central Data's EDC and Parity Only boards deliver just that and more. Our primary design objectives were speed and reliability, and we've achieved that by the unique combination of features engineered into these boards.

**Spectacular speed**
We can provide you with the fastest board available today. Our use of Garry Sockets™ has saved 12% of the board space, allowing room for a discreet RAM Controller that delivers incredible speed. In addition, the critical timing paths and the RAM array drivers are almost exclusively comprised of FAST IC's which provide up to 30% more speed.

**High noise immunity**
Dynamic RAM Boards are especially susceptible to noise problems. It is therefore essential that a heavy power and ground plane be run throughout the board and that an adequate number of bypass capacitors be used. Central Data's Dynamic RAM Boards have 4-layer and 6-layer construction, with at least 2 of the internal layers dedicated to power and ground.

**Enhanced reliability**
Our extensive use of Garry High-Reliability Quiet Sockets is one reason these boards stand out from the rest. They provide a 40% reduction of RAM associated noise as compared to any other conventional means of decoupling. Quiet sockets are used for the RAS, CAS, WE and address driver IC's to the RAM array and for all Dynamic RAM chips. Their machined pin "swiss screw" mechanisms eliminate failures from poor mechanical connections. They also allow field upgrading to the 256K RAM chips for a 2Mbyte Multibus Dynamic RAM Board.

**Quality from the inside out**
A tough dry film solder mask coating totally encapsulates all fine-line circuits and protects the board from handling abuse. And like Central Data's full line of Multibus boards, these new Dynamic RAM boards pass the industry's most rigorous diagnostic testing and burn-in before they're delivered to you.

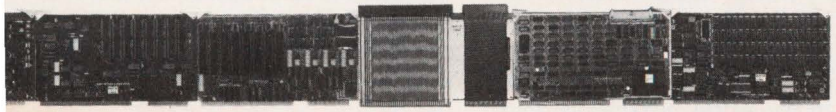
You'll find these quality features and more on the new 128K-2MByte Dynamic RAM Boards from Central Data. This commitment to performance, quality and reliability is the reason more and more successful OEMs are depending on Central Data as their complete Multibus source. Make Central Data your choice—call or write today for more information on our full line of quality Multibus boards.

# Central Data

**Central Data Corporation**
**1602 Newton Drive**
**Champaign, IL 61821-1098**
**(217) 359-8010**
**TWX 910-245-0787**

Your Complete Multibus* Source

**Quality from the inside out in a full line.**



*Multibus is a trademark of the Intel Corporation.

# NEWS UPDATE

## Electronic Design Interchange

Seven organizations, including Daisy Systems, Mentor Graphics, Motorola, National Semiconductor, Tektronix, Texas Instruments, and the University of California at Berkeley, have agreed to create a standard interchange format for electronic design information. The proposed interchange format is called the Electronic Design Interchange Format (EDIF).

According to a source, the need for the unified approach has risen steadily with the growth of semicustom circuit foundries. A wide variety of languages is used to design circuitry, and when designs pass from one environment to another, expensive, time consuming, and error prone conversions are required. For now, EDIF will be concerned with semicustom circuits, gate arrays, standard cell arrays, and macro cell arrays.

## R&D Incubator

GE's Calma Company will form a research and development organization within Rensselaer Polytechnic Institute's (Troy, NY) "incubator program," a venture providing space and support for new high-tech businesses. Calma Advanced Systems will develop advanced technologies for CAD/CAE/CAM systems.

## Personal CP/M For ADAM

Digital Research, Inc. (Pacific Grove, CA) will provide its Personal CP/M, designed for the personal, home and portable computer markets, to Coleco Industries (West Hartford, CT) for their ADAM Computer System. Under the agreement, Coleco will manufacture Digital Research's Personal CP/M for ADAM on both digital data packs and floppy disks.

## Japanese Chart $8.5 Billion In Semiconductor Sales

According to the Japan Electronics Industries Association, Japanese semiconductor device sales in 1982 were $4 billion and are expected to reach $8.5 billion in 1984. Integrated Circuit sales in 1983, including hybrids, showed a 32% increase over 1982 for a total of $4.7 billion in 1983. Digital IC sales alone are expected to reach $4 billion in 1984.

## Zilog, NEC Settle

A settlement has been reached between Zilog, Inc. and NEC Corp. in their disputes involving Zilog's Z80 8-bit $\mu$P and NEC's claim to patent rights concerning Zilog's entry into the 32-bit arena with the Z80,000 $\mu$P. Under the terms of the settlement, filed with the U.S. International Trade Commission, NEC is second sourcing Zilog's 32-bit Z80,000.

## Nixdorf Goes Public

Nixdorf Computer AG, an international manufacturer of computer systems, disclosed that it will offer 20 percent of its share capital in the form of preference shares by May or June, 1984. Founded in 1952, the Paderborn, West Germany-headquartered firm has also been in operation in the U.S. since 1968.

## Circuit Technology Exchange

A technology exchange agreement which encompasses alternate sourcing and co-development of CMOS gate arrays and three-micron double-metal CMOS standard cells has been jointly announced by AMI (American Microsystems, Inc.) and Mostek Corporation. The companies' long-term cooperative effort is to develop and totally support complete semicustom product families with emphasis on both silicon and software.

## Zendex Acquires Multibus Division

The Multibus Board Division of NEC Electronics has been sold to Zendex Corp., a manufacturer of Multibus boards and systems. NEC states a change in marketing direction led to their decision to sell the board division.

## IEEE Celebrates Centennial

The Institute Of Electrical And Electronics Engineers, first formed on May 13, 1884 under the auspices of the American Institute of Electrical Engineers (AIEE), recently celebrated its Centennial year with a conference on U.S. Technology Policy in Washington, D.C. "ElectroTechnology and Innovation: Challenge 21" focused on steps necessary to retain the competitive position of U.S. high technology in the world marketplace into the next century. Featured panelists included: Dr. Simon Ramo, Director, TRW; Dr. George Keyworth, Director, White House Office of Science and Technology Policy; Dr. Richard DeLauer, Under Secretary of Defense for Research and Engineering; and Donald P. Hodel, Secretary of Energy.

## State To Enforce Software Licensing

Louisiana will be the first state in the U.S. to prevent the unauthorized duplication and distribution of computer software through enforceable licensing agreements. The bill, introduced in the current state legislative session, is intended to strengthen significantly the ability of software publishers and distributers to enforce their rights under trade secret and copyright law, which now includes software products. The unauthorized duplication of computer software cost publishers $360 million in 1983 in lost wholesale revenues, according to conservative industry estimates. The same source projects losses of almost $.5 billion in 1984's $2.5 billion software revenues.

## Federal Computer Crime Fighters

The Computer Crime Prevention Act of 1984, introduced by Senator William S. Cohen (Maine), is designed to protect personal, business, and government information from the threat of computer-related crime. The bill covers three types of computers: those owned or operated by the federal government; computers owned by federally guaranteed financial institutions; and all networks operating in interstate commerce. The bill is pending Congressional approval.

## X.25 Certification

Western Digital Corp. has received certification from GTE Telenet Communications Corp. for Western Digital's X.25 Packet Switching Communications controller, the WD2511, to operate as an interface device on the link level of Telenet's public data network. Certification by Telenet allows systems manufacturers who desire to make their equipment Telenet compatible, may use the WD2511 controller to interface to the Telenet network while meeting the X.25 Link Level standards.

# ALL SMD'S LOOK THE SAME TO THE MDB DISK CONTROLLER

Our disk controllers can interface with any of the most popular SMD disk drives for Q-bus,* Unibus* and VAX* computer systems.

Designed to accommodate future advances in disk technology, the controller's firmware interrogates a single switch for information regarding the disk drive types in use and emulation modes. Then it automatically structures its firmware to identify the drives by number of cylinders, sectors and heads as well as number of blocks in each logical unit. Future disk technology advances may be handled by changing one inexpensive prom rather than entire firmware prom sets.

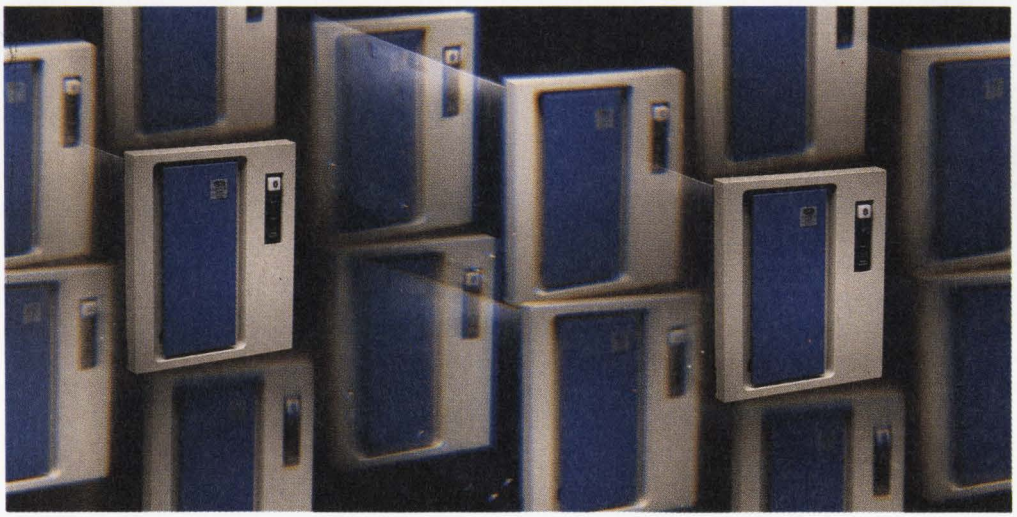
Emulating DEC's RM02, RM03, RM05 or RK06/RK07 drives, the MDB controllers are software driver and diagnostic transparent to all DEC operating systems plus UNIX** and TSX;*** without requiring any modification. Available in both Quad and Hex size boards, true, transportable media compatibility is maintained with DEC RM series drives.

MDB's SMD controller line includes models capable of handling up to 4 physical drives and 8 logical drives and capacities up to 2 gigabytes, along with a Unibus model on a single quad size board, all capable of simultaneously mixing drive types or emulation modes.

This means that over 75 different model SMD disk drives from more than 15 manufacturers are available to the DEC user without software modification.

Feature for feature you cannot mask our superiority in the field. Call us today for complete information.

*Q-bus, Unibus and VAX are trademarks of Digital Equipment Corporation. **UNIX is a trademark of Bell Laboratories. ***TSX is a trademark of S&H Inc.



MDB SYSTEMS INC. *THE WORLD'S LARGEST INDEPENDENT MANUFACTURER OF COMPUTER INTERFACES.*

**Corporate Headquarters**
1995 N. Batavia Street, Box 5508
Orange, California 92667-0508
714-998-6900 TWX: 910-593-1339
FAX: 714-637-4060

Available on GSA contract #GSOOK8401S5502

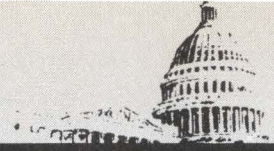
**MDB Systems Europe, Inc.**
9 route des Jeunes
CH-1227 Geneva Switzerland
Tel (41) (22) 439410 Telex 421341 mdb ch
FAX (41) (22) 439414

**MDB Systems, U.K., Ltd.**
Everitts House
426 Bath Road
Slough, Berkshire England SL1 6BB
Tel. (06286) (67377) Telex (847185) WWTSLO
FAX (41) (2812) (3507)

**MDB Systems, Australia**
P.O. Box 384
Neutral Bay
NSW 2089 Australia
Tel. (612) 929-6526 Telex 25631 (DULKA)
FAX (612) 957-6126

Write 3 for Unibus
Write 4 for Q-Bus
Write 5 for VAX

# WASHINGTON REPORT



## DoD Cracks Down On Suppliers

**by Anne A. Armstrong**

In what observers believe is an attempt to send a message to the industry, the Department of Defense has begun its long rumored crackdown on military parts suppliers. The first target was Schlumberger's Fairchild Camera and Instrument Division, which has had 31 linear type devices removed from the Qualified Products List by the Defense Logistics Agency. The military informed Fairchild that the products in question did not comply with military standards for high reliability circuits nor with the regulations for testing military products. A criminal investigation by the Defense Criminal Investigative Service that focuses on the documents accompanying the products is still ongoing. Government inspectors have alleged that test documents were altered.

At press time, National Semiconductor Corp. indicated a tentative settlement agreement had been reached that would end the two-year long grand jury investigation into alleged inadequate and fraudulent testing of computer chip by National between 1978 and 1981. Details were not available and formal charges have not yet been brought. The agreement is said to be based on National pleading no contest to the charges when they are announced and paying damages to DoD as well as punitive fines.

Defense's "get-tough" approach is seen as a warning to other manufacturers that DoD will hold them to the military specifications and standards governing integrated circuits and that shortcuts will not be permitted in the burn-in phase of testing.

### Japan To Limit Software Protection

In a move that has U.S. computer manufacturers worried, the Japanese Ministry of Trade and Industry is considering a proposal to replace the copyright protection of computer software with a new and unique form of protection which would shorten the time a program can be protected from 50 to 15 years. Also included in the new proposal would be a forced licensing provision that would require the originator of a program to grant a license even if he wished to keep the program exclusive.

"What that means," said Vico Henriques, president of the Computer and Business Equipment Manufacturers Association (CBEMA), "is that if you have a software program that you want to sell in Japan—like spreadsheets or operating systems—you could be forced to license—and therefore disclose the entire code to a Japanese company. It's clearly a way for the Japanese to force Americans to teach them how to write software and to close the gap in Japanese software development."

CBEMA has pointed out that the term of protection proposed is less than the commercial life of the software and therefore, originators will not be able to get full returns on their investment in software research and development.

American trade negotiators, spurred by heavy pressure from firms such as IBM, Burroughs, Control Data and Honeywell, have promised to pursue the matter with the Japanese.

### Commerce Tightens Export Licenses

In the wake of several last minute interceptions of computer equipment headed for Communist bloc countries, the U.S. Department of Commerce has indicated that it may tighten the export licensing procedure for a whole range of computer parts. The new proposal would sharply curtail the use of distribution licenses and would require individual export licenses in order to ship semiconductor production and test equipment to many countries in the free world.

Since the new system would add another bureaucratic layer to the exporting process and would increase the time and the cost of shipping items overseas, all the major electronic industry associations vigorously opposed the action. Among those segments expected to be hardest hit are semiconductor firms that ship chips and wafers manufactured in U.S. plants to their overseas plants for assembly in finished products.

The new procedure is significant because it extends the licensing requirement for many products to not only Communist countries, but also to all countries not members of the voluntary consortium called CoCom. Products which would now require individual licenses include advanced semiconductor chip and wafers, all electron-beam systems and masking equipment used to make advanced integrated circuits, home and small business computers with a processing rate greater than 2 million operations per second, certain oscilloscopes, lasers, and certain analog and high-density digital recorders.

### HP, Vitalink Satellite System

A satellite communications systems that allows high-speed, long-distance information exchange between Hewlett-Packard computers was announced at the Communications Networks conference in Washington. A joint venture between HP and Vitalink Communications Corp., the system is designed to operate with the HP 3000 minicomputer. A number of computers at two or more locations can bypass the phone system entirely and exchange data via a satellite link between earth stations.

An important feature of the new system is Vitalink's patented transmission system DATA-TRAC which establishes two independent paths through the earth station and the satellite. The approach doubles the system's capacity and protects the user against equipment failure.

### U.S. & Japan Sign Trade Deal

As a result of the renewed trade agreement signed recently between the United States and Japan, U.S. companies will have better access to important research underway in Japan and improved status to compete for business from Nippon Telegraph and Telephone.

"Signing agreements does not automatically lead to more sales," said Special Trade Representative William Brock. However, the agreement does address several points which should make bidding easier for U.S. firms. Japanese procurement documents will be translated into English and bids in English will be accepted. Standard contract forms will be used and purchase specifications will be designed to encourage foreign firms to participate.

# The fastest...the largest memories... the easiest to program...


**MARS-432 Array Processor Speed**
A high-speed programmable arithmetic processor used as a peripheral to a general purpose computer.

**MARS-432 Array Processor Memories**
Program and data memories compatible with programs written for today's array processor applications.

**MARS-432 Array Processor Software**
An architecture specifically designed to support a FORTRAN compiler and other software development tools.

The state of the art in 32-bit floating point array processors. Direct addressability of up to 16 million words (64 megabytes) of data memory and direct access to the high-speed internal data bus assure the user of highest throughput rates.

**MARS-432 Array Processor Features Include:**

- Add and multiply times of 100ns
- Computational power of 30 megaflops
- Computes a 1024-point complex FFT in 1.7ms
- DMA transfers at I/O bus rates of 20 megabytes/sec
- Data memory read or write in 100 ns
- Memory paging for uninterrupted processing during I/O transactions.

**Program Memory**
Virtual and physical address space of 4K words – standard. Expanded configuration uses a 4K cache memory to extend total memory to 64K words.

**Data Memory**
Data I/O is supported by DMA transfers into data memory with a physical address space of 16 million words. A data memory page-loading feature provides the option of zero overhead background loading of data during time critical program execution. No DMA cycle stealing overhead is incurred. Uninterrupted processing can occur simultaneously with high-speed I/O transfers.

**FORTRAN Development System (FDS)**
FORTRAN compiler, linker, and trace/monitor provide high-level language access to the MARS-432.

**Microcode Development System**
Off-line development package includes macro-assembler, microcode diagnostics, and a unique utility for automatic microcode optimization.

**AP Run Time Executive Support Package (AREX)**
As the interface to the MARS-432 at run time, AREX provides processor initialization, I/O operations, and array function execution.

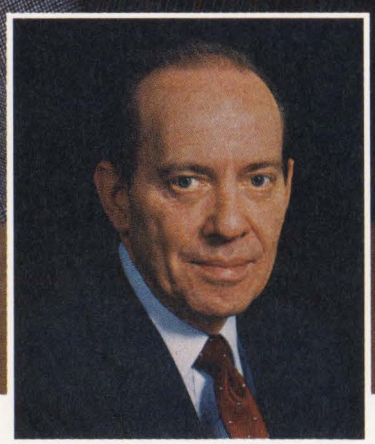
**Applications Libraries**
Extensive applications libraries include math, signal processing, and image processing.

**NUMERIX**

For additional information on the MARS family of high-speed Array Processors, write or call:
Numerix Corp., 320 Needham Street, Newton, MA 02161 Tel. 617-964-2500 TELEX 948032

**CDI gate arrays & Ven-Tel modems — Another CDI partnership pays off**

# "...And the Modem's



*Ven-Tel president, Dick McVicker*

***Challenge:*** *to create an on-board modem for the IBM-XT. (Though many manufacturers had produced modem cards to fit the IBM-PC, nobody had yet been able to design a card narrow enough to fit the XT slot.)*

***Solution:*** *Ven-Tel, the leader in innovative modem technology, solved the need with advanced design and space-saving gate arrays from CDI.*

Ven-Tel president, Dick McVicker, says:

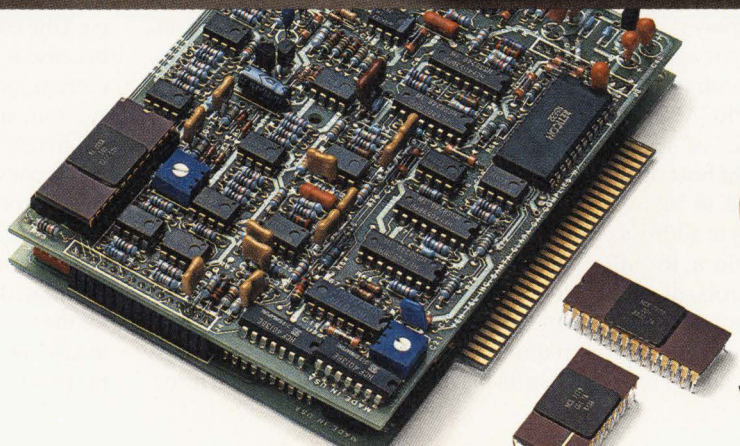
"The XT modem was a major challenge in small space design. We needed gate array technology and the commitment of a superior supplier to make the design work. We also needed high-volume deliveries on short notice.

"After talking with several semicustom houses, our director of engineering decided to put CDI's 'partnership' claims to the test—and I'm glad we did. CDI came through with bright, practical ideas and a depth of engineering commitment and support rarely found in a supplier anymore.

"The net result was a sleek, double-layer modem that got us through a narrow market window and into the XT first. The full impact of this engineering/sales achievement will be felt by Ven-Tel for a long time to come. Believe it—CDI is every bit the *partner* they claim to be!"


# on Board!"

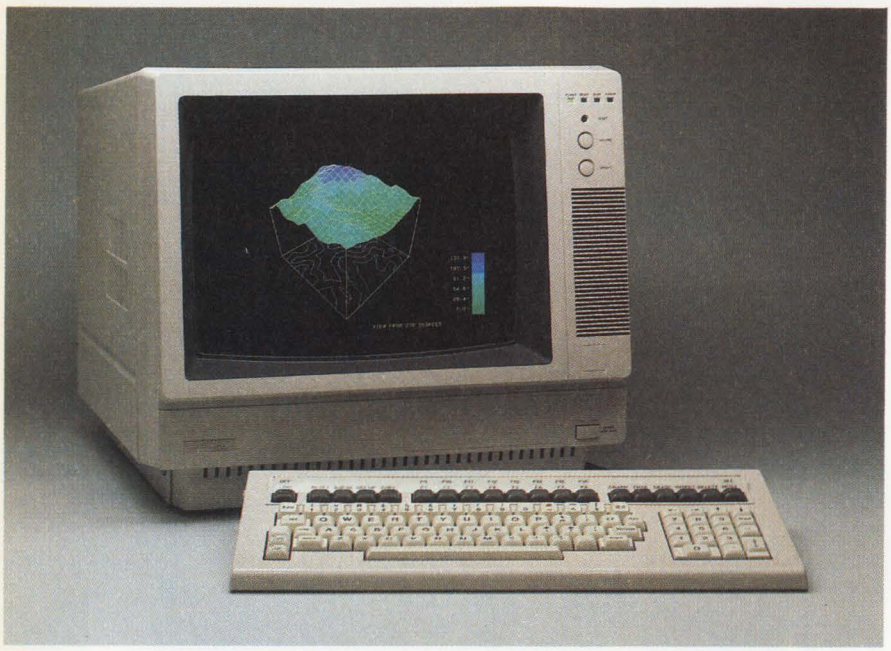
If you have a semi-custom design challenge, we'll do the same for you. California Devices, Inc., 2201 Qume Drive, San Jose, CA 95131; or phone: (408) 945-5000; Telex: 176928.



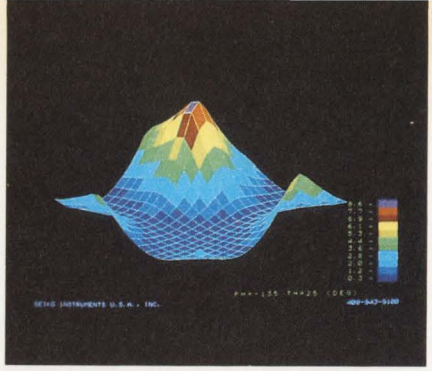
CDI

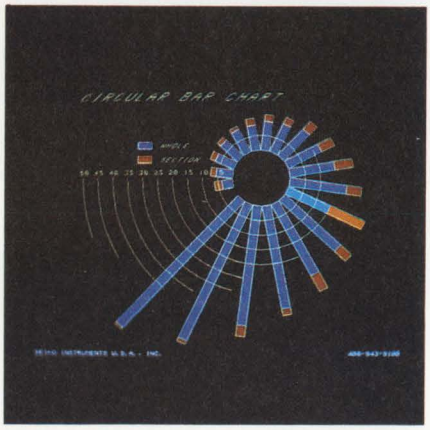
Write 11 on Reader Inquiry Card

# Intelligent Use Of Distributed Architecture Produces High Resolution Desktop Color Graphics



*Seiko Instruments' GR-1104 desktop color display terminal.*




*a) Topology application, b) Density plot and c) circular bar chart generated on the GR-1104.*

The arrival of new technology in VLSI design and advances in microprocessor architectures offer today's user significant improvements in both functionality and price/performance of desktop color graphic terminals. These intelligent terminals are implementing large scale integration electronics and more powerful microprocessors to achieve faster drawing speeds, higher resolutions, and greater degrees of user friendliness than ever before, at a lower cost.

The architecture for Seiko Instruments' GR-1104, a desktop color display terminal, incorporates a command stream processor with a 16-bit 8086 running at 5 MHz with 112 Kbytes of EPROM program memory and 16 Kbytes of static RAM, including 2.4 Kbytes of host buffer. The 8086 CPU employs a 16-bit instruction set, utilizes a 1 Mbyte address space, and communicates via a 16-bit multiplexed data bus. It controls all terminal processes and peripheral devices, interprets data streams received from the serial host port, keyboard, or tablet, and emulates existing graphic and alphanumeric devices such as the Tektronix 4010 Series and DEC VT100. The 8086 also generates the initial command/parameters that describe a figure for the Graphic Display Controllers (GDC 7220's).

The Graphic Display Controllers perform all the necessary calculations to write data into the refresh memory. This data is typically organized into graphic entities such as points, lines, arcs, and rectangles. In addition, the GDC's continually access the refresh memory at high speed to provide the refresh to the CRT.

Data from the refresh memory is then passed through a series of shift registers and presented to an LSI video formatter. The video formatter assigns both color and intensity to the data from one of eight positions in the color look-up table. It is then mixed with both character and cursor data and shifted again at the video rate required to drive the monitor. The data is then displayed on a 1024 × 780 high resolution monitor at 60 Hz noninterlaced for a bright, stable, flicker-free image. LSI and VLSI have increased speed and lowered the cost. The NEC 7220 was chosen because it handles graphics/display generation, performs vector-to-raster conversion, arc-to-raster conversion, and is efficiently interfaced with a microprocessor. It converts high-level commands received from the command stream processor into images by placing the proper data into the correct bit plane. Once a drawing is initiated in the GDC's, the parameters for the next figure can be determined and loaded into a FIFO buffer while the drawing process continues, so the highest sys-


# High resolution never looked so good.

One look tells you it's different. Microgrid. The new family of digitizers from Summagraphics. Thin. Lightweight. With rounded edges. And tracks on either side that put cursor, stylus and alpha-numeric display at your fingertips. Microgrid is easy on the eye. Easy on the user. And easy on the budget.

But looks aren't everything. Microgrid also delivers 1000 lines/inch resolution, the reliability of modular design, and superior accuracy (up to ±0.005 in. or ±0.125 mm).

Microgrid is smart too. With an extensive array of host programmable functions that sharply reduce program integration time. Coordinate system relocation. ROM-based diagnostics. Plus a configuration menu that allows users to select power-up default modes without fumbling with DIP switches.

And Microgrid is compatible with the world's largest base of installed digitizers. Ours. Upgradable, too. With laser tested accuracy standards traceable to the National Bureau of Standards.

Microgrid. A beauty with a brain. From the company that knows how to deliver high quality, on time, and in volume. Us.

For information, contact Summagraphics Corporation, 35 Brentwood Avenue, P.O. Box 781, Fairfield, CT 06430. Telephone (203) 384-1344. Telex 96-43-4348. European Sales Office, 14 Rue de 1'Ancien-Port, 1201 Geneva, Switzerland. Telephone: 022-31-39-40. Telex: 27622 Summa CH.

Summagraphics® CORPORATION

Draw on our experience.

Write 28 on Reader Inquiry Card

tem throughput is achieved.

In color systems where a single GDC is performing all drawing tasks, a difficulty arises as each pixel is represented by a multibit value usually stored in multiple planes. The standard approach has been to process each bit plane sequentially, but this means the GDC can draw into only one bit plane at a time. Seiko Instruments USA, Inc. employs four GDC 7220's; for character and graphics display mode. In graphics display mode, three GDC's are used for distributed graphics processing. They are positioned between the CPU and video memory and perform the tasks needed to generate the raster display and manage the video memory. They execute commands issued by the CPU through a FIFO buffer. Each GDC consists of a number of adders, shift registers, and counters organized as a Digital Differential Analyzer (DDA). The DDA implements complex figure drawing algorithms for lines, circles, or area patterns, and generates these figures by executing their appropriate differential equations. These algorithms are used extensively and the speed at which they are executed has a direct effect upon overall system performance. With the GDC, figure drawing time is significantly faster than if the burden of algorithm processing were performed entirely in software by the CPU.

To control operation of the GDC's with further reduced processor overhead, 8-bit commands/parameters are presented to the GDC's via an 8-bit data bus. Each GDC has an internal 9-bit × 16-word FIFO to store the unexecuted commands issued by the CPU. The 9th bit of each word identifies the stored 8-bit data as either a command or command parameter. While the GDC's are busy drawing an object, the CPU can send command/parameters until each FIFO is filled, without having to wait for the GDC to finish current processing. As a result, the GDC's performance is optimized by this pipeline processing method.

Parallel organization of the GDC's involves chip-to-chip synchronization of the GDC's with the CRT. The chip generating the fundamental vertical sync signal is declared the master and all others are defined as slaves. This is accomplished by connecting the vertical sync pins of the three GDC's together. During the synchronization process, the master GDC video sync generator produces and outputs both horizontal and vertical sync pulses, while the slave GDC's use their vertical sync pins as input for the externally generated vertical sync pulses. At the end of each received vertical sync pulse, the slaves will reset their sync generators to coordinate with the external signal from the master GDC.

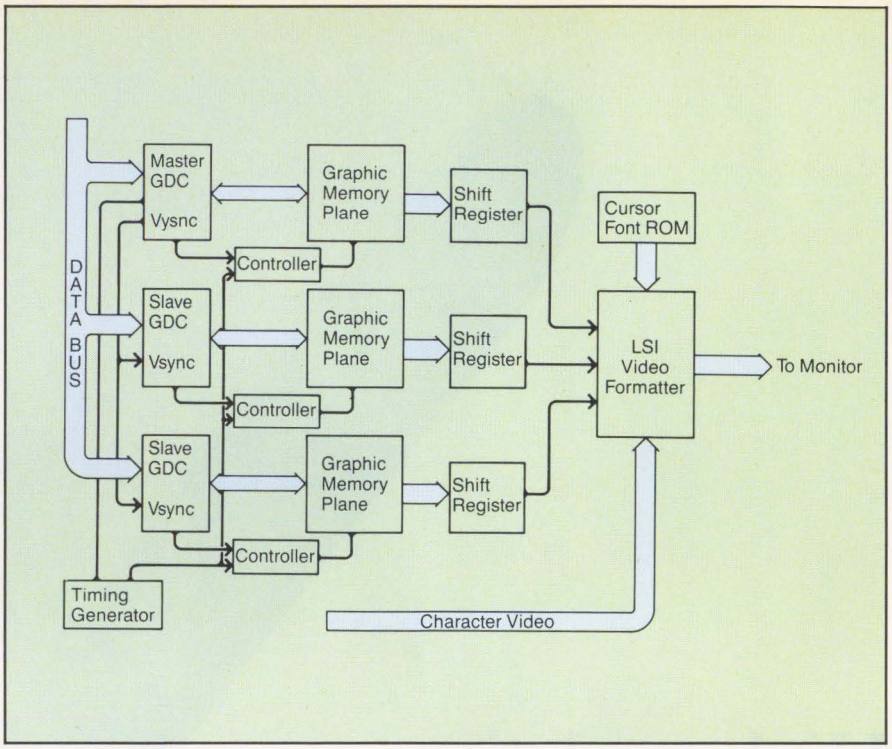



*Figure 1: Graphics Display Controllers Configuration.*

In character display mode, the fourth GDC manages a 4K word × 13-bit video memory. This video memory is configured as 80 characters × 48 lines (3840 characters). Character data is comprised of 8-bit code and 5-bit attribute; i.e. color, inverse, and blink. The character font patterns are read out to the alphanumeric video generator, combined with the attributes, and sent to the video formatter.

The graphics memory consists of 384 Kbytes of dynamic RAM and is partitioned into three bit planes. Each GDC supports 1 Mbit (1024 × 1024 pixels) of display RAM in graphics mode at a 60 Hz refresh rate. In this case, the graphics memory is larger than the CRT display itself (1024 × 780 pixels). Data is read out of the graphics memory in parallel format, converted to serial via the shift registers, and sent to the video formatter (**Figure 1**). Horizontal and vertical video signals are also generated by the master GDC and sent to the display. In the dedicated LSI video formatter graphics data is converted to color signals (R=red, B=blue, G=green) and mixed with character and cursor color signals. The digital video information is then converted to high speed emitter coupled logic (ECL) levels. Three output bits are used for each primary color to create a palette of 512 colors.

The video formatter is a proprietary LSI, 2000 gate array chip in a 138 pin package. It reduces power consumption and board space, while increasing component reliability and is the key element in providing the 67 MHz video bandwidth needed to drive the 1024 × 780 display.

The display is a 14″ in-line color CRT with superior quality features such as a .31mm pitch shadow mask and 1024 × 780 viewable resolution. It combines graphics and text into a single image at 60 Hz noninterlaced for a stable, flicker-free display. Added to this is a contrast enhancement filter to eliminate screen glare and improve image visibility in normal office work environments.

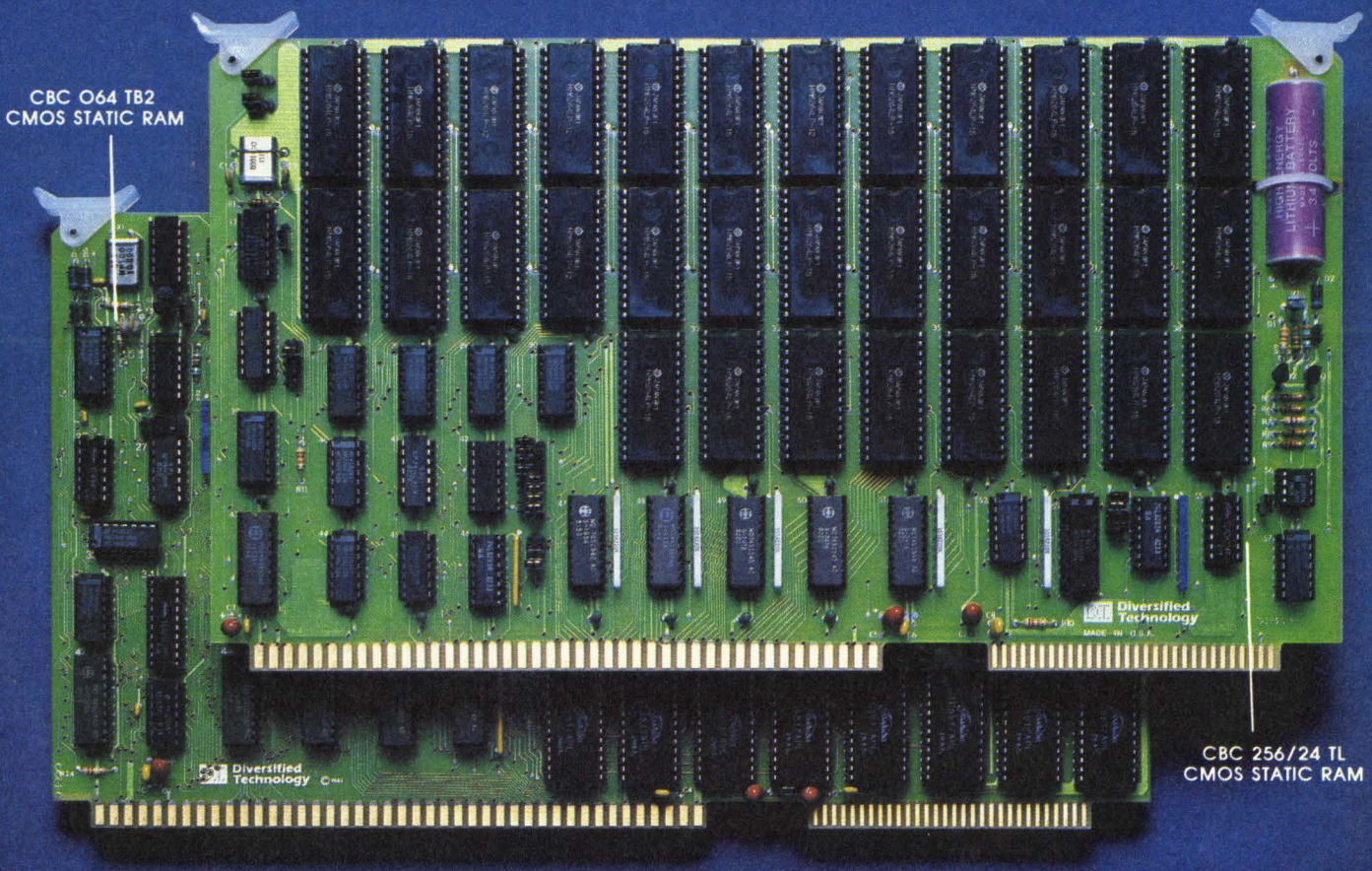
**Write 230**

*—Michael Warner, Product Manager, Seiko Instruments USA, Inc.*

*VT is a registered trademark for Digital Equipment Corp.
*Tektronix is a registered trademark of Tektronix, Inc.

# NONVOLATILE CMOS RAM BOARDS

## Better Performance than Bubble - at a Comparable Price




## Compare these Key Features:

| | INTEL iSBC*254 - 2A BUBBLE MEMORY BOARD | DTI CBC 256/24 CMOS STATIC RAM BOARD |
|---|---|---|
| Bus | Multibus* | Multibus* |
| Memory Size | 256K bytes | 256K bytes |
| Operating Voltages | 5 V, 12 V | 5 V |
| Operating Currents | 3.0A, 1.4A (max.) | 100mA (max.) |
| Cycle Time | 48 milliseconds avg. | 300 nanoseconds typ. |
| Card Slots Required | 2 | 1 |
| Operating Temperature | 0°-55°C | 0°-70°C |

**ADDITIONAL FEATURES OF DTI'S CBC 256 INCLUDE:**

- All - CMOS technology.
- Flexible addressing options: 16 bit with on-board bank select or 20/24 bit contiguous.
- On-board automatic memory protect.
- 8 or 16 bit data words.
- 3-year cumulative data retention time.
- 512K, 256K, 128K, 64K, 48K, 32K and 16K byte versions.

For more information regarding the CBC CMOS RAM boards, or any of our other all-CMOS MULTIBUS* boards, call or write Bill Long, CBC Product Manager at **(601) 856-4121**.

**Write 86 on Reader Inquiry Card**

*Multibus and iSBC are trademarks of Intel Corp. Above specifications taken from manufacturers current published data.*

**Diversified Technology**
An Ergon Co.

P. O. Box 748, Ridgeland, MS 39157
Telex 585326.

# Powering Electronic CAE/CAD With PCs

Engineering and design functionality are now becoming available on the personal computers that are increasingly common tools on engineers' desks. A handful of firms now offer software or software/ hardware packages for electronic circuit, gate array or board engineering and schematic entry by PCs. These systems increase the value of a designer's personal computer, by providing another type of tool in the same "real estate" now potent for producing documentation, storing files, interoffice mail and calculations.

Though all of these PC-based CAE/CAD systems put real engineering functions on the desk, there seem to be at least two philosophies on how many functions a PC can effectively handle. In one camp, start-up Personal CAD Systems (P-CAD) (Los Gatos, CA) is going head-to-head with larger systems, offering schematic entry, layout and logic simulation on an IBM or IBM-compatible PC.

FutureNet (Canoga Park, CA) aims to work with, and not compete with, larger CAD system suppliers. Their Dash-1 is a schematic entry system, designed as a front-end to larger CAD system suppliers. Current agreements include interfaces to Gerber (South Windsor, CT) and Universal Semiconductor (San Jose, CA) CAD systems.

On the same idea, Control Data's Cybernet Services (Minneapolis, MN) now allow microcomputers at customer sites to perform schematic entry, documentation and utilities like netlist extraction. Communications between the CDC/PCAD workstation (**Figure 1**) and Cybernet or other design services' mainframes allow circuit schematics input at the PC to be simulated, analyzed and verified by a powerful CAD system.

The same sort of integrated PC-to-mainframe circuit design is provided by Universal Semiconductor's UNICAD-1 for gate arrays. An agreement with FutureNet covers schematic capture on the micro. UNICAD includes design and simulation software to run on the IBM PC/XT, Universal's ISO 3/5 library of macrocells, terminal emulation and communications, a graphics driver board, a mouse and a printer.

Other vendors are also exploring the potential of microcomputers for CAD functions. Autodesk (Mill Valley, CA) and T&W Systems (Huntington Beach, CA) offer several software packages for general CAD functions, especially drafting, on various microcomputers. Engineering software has also been advertised by CASE Technologies for PCs.

Going another route, Chancellor Computer (Mountain View, CA) built a workstation around a PC for electronic design. These workstations, though based around an IBM PC, are modified for the system. Though this has advantages, the loss of compatibility can hamper flexibility of the PC for other tasks.

Real cost-savings with PC systems show in the UNICAD and CDC/PCAD, at $15,000-$16,000. These packages give very low-cost access for direct schematic input to extremely powerful CAD. Especially for circuit design, which can often be best finished at the manufacturing facility for a major design house, individual access at this price is valuable. And for all of the engineers with an IBM or compatible PC already on their desk, an additional $7,000-$8,000 converts that power to an engineering tool. P-CAD's software packages for schematic capture (PC-CAPS) logic analysis (PC-CARDS) and partially-automated board layout and design (PC-CARDS) (**Figure 2**) sell for $9,000, as a total package. The netlist extractor (PC-NODES) sells for another $500. Though these software prices are a bit higher than the software costs of the schematic entry front-end systems, the P-CAD software is to replace, and not front-end CAD systems that sell from nearly $40,000 to well over twice that.

The trade-offs include constrained manipulation and lower screen resolution for the P-CAD system, since it uses the standard IBM hardware and monitors. As a menu-driven system, it also requires more mouse moving. But the variety of engineering functions provided does allow extremely small operations to design circuits and boards at a fraction of the investment of traditional CAD systems.

Even adding good front-end engineering capabilities at the desktop is a new idea. As other functions formerly per-

*Figure 1: Circuit designs from the CDC/PCAD system are directly transmitted to Cybernet Services' mainframes for advanced analysis and verification.*

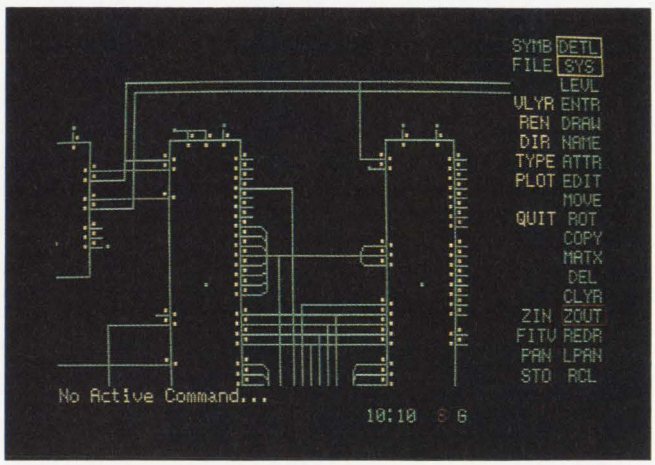



*Figure 2: The PC-CARDS board design system, along with packages for schematic capture, logic analysis and net list extraction allow PCs to be used in place of larger CAE/CAD systems.*


**YOU MADE IT. LET QUADRAM HELP YOU MAKE IT BIG.**

After months of working nights and weekends, you finally turned your dream into a reality. Now comes the hard part. How do you get the computer enhancement you created out of the basement and into the stores?

It takes business saavy, marketing expertise, and advertising support. Not to mention the capital to make it all work.

That's where Quadram comes in. We've been down that road before with our own designs. Since then we've put together a team of experts with the experience and the know-how to take a product to market.

We test it. Determine a pricing structure. Design the packaging. Create an advertising campaign. Introduce it to the trade. And to the public.

**SHARE OUR SUCCESS.**

Quadram has a reputation for quality. And a track record to match. Quadboard, Quadlink, Quadcolor, and Microfazer are just a few of the products our outstanding engineering and marketing staffs have developed in-house. If your design meets our high quality standards, we'd like to add it to our list of success stories.

QUADRAM QUALITY™

If you're a "basement engineer" don't let your design die on the drawing board. Join forces with Quadram. We can light the way for your success. We'll be waiting for your call. Contact Charles Harris at (404) 923-6666.

QUADRAM™
An Intelligent Systems Company

4355 International Blvd./Norcross, Ga. 30093
(404) 923-6666/TWX 810-766-4915 (QUADRAM NCRS)



**Write 22 on Reader Inquiry Card**

formed by slave terminals to mainframes, the more capable PC working on engineering and design gives users flexibility to work with designs without burdening a host. The other tools that personal computers provide give systems running on popular micros the advantage of readily available software for these tasks.

Just as CAE/CAD has become possible on several minicomputers, there are now choices at an even less expensive level. How engineers' offices are operated now may be important in which PC system a firm chooses, if, indeed, the cost tradeoff is sufficient incentive. Those who have IBM PCs on every desk have inexpensive options, and the choice of how many functions a package should provide will be critical. Working with larger design houses is standard for many firms, and this direct access could improve accuracy and turnaround times of designs considerably. Personal computers for CAE and CAD will virtually erase the cost issue that now allows manual design to continue. *—Pingry*

## DEPARTMENTS/ Test

# Cause And Effect Of Inadequate Drive Testing

The most expensive component in a computer system, its mass media storage, is also the most prone to failure due to its electro-mechanical nature. In a climate of increased production volumes and pressure to reduce cost while improving performance and quality, it is critical that disk and tape drive manufacturers perfect their testing procedures. For with few exceptions, the testing of drives has not been a major priority in the production process.

The number of disk drive manufacturers alone has increased some 200% during the past three years. Market pressures for higher capacity disk drives and for faster access times demand a continuing evolution of better products.


*(Photo courtesy Applied Circuit Technology)*

*ACT's Intelligent Test Systems test up to 100 drives simultaneously.*

To meet these mounting pressures, testing must assume greater importance in the production cycle. Each drive, not just one in 10 or 20, must be tested to the most exacting criteria. This means either continually updating in-house drive testers, or evaluating appropriate automated test systems.

Testing is considered a necessary evil, and a time consuming and expensive chore. Many marketing and engineering personnel believe that the long hours spent going through tests could be better put into design and production. This is especially true when the competition introduces a comparable product at a lower price.

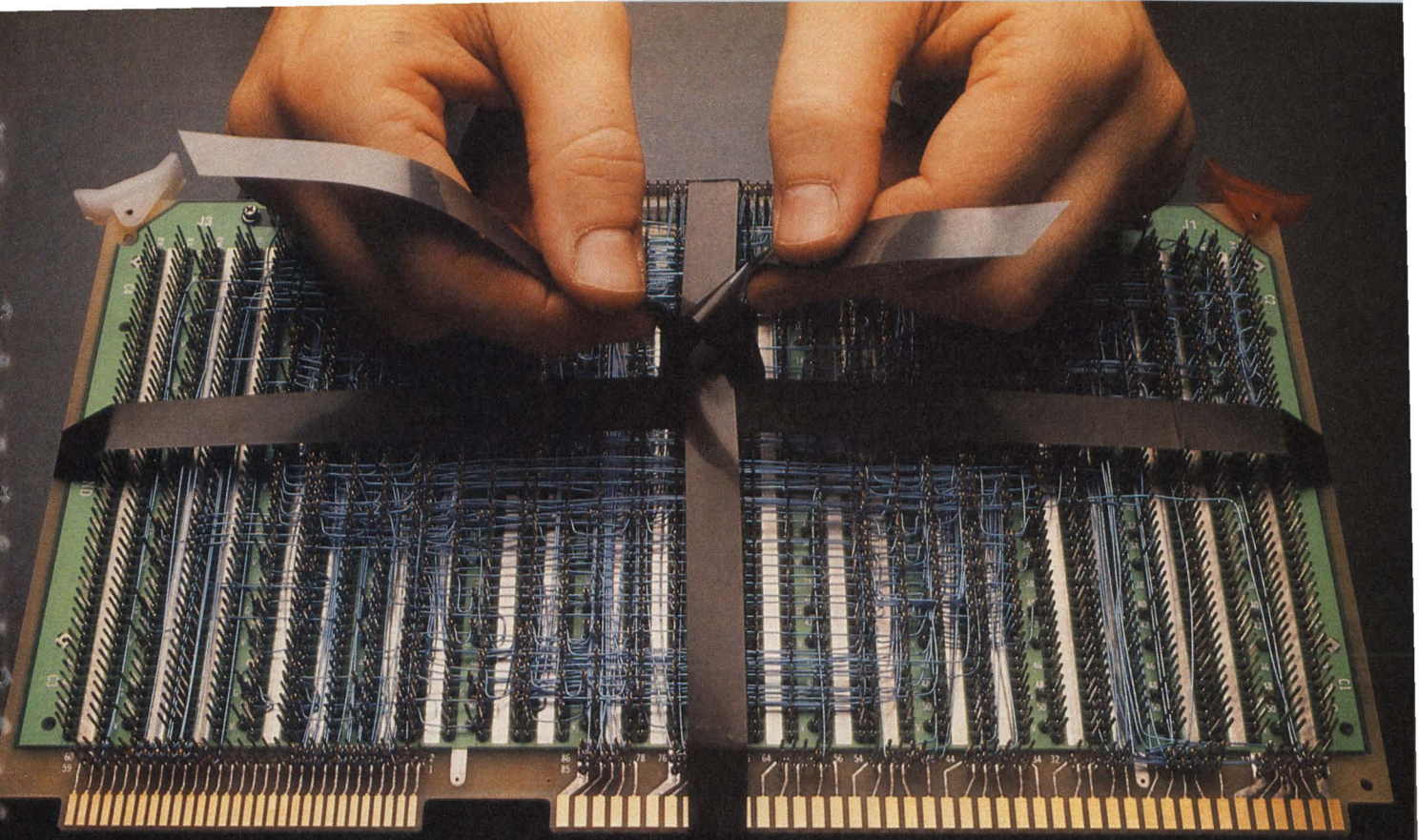
As an example, testing and quality control account for at least 20% of manufacturing cost and 50% of production cycle time. As production volumes increase, testing becomes more crucial in order to maintain the highest standards.

### New Designs Need Updated Tests

Every drive manufacturer has some type of test equipment. However, efficient equipment is not enough if the tests themselves are inadequate. Many testers which are designed in-house are built to test prototype drives and are not always updated to reflect subsequent design changes.

So testers, which have traditionally been difficult to reprogram with new parameters, remain unchanged. The result is that updated drive designs are too often tested to the manufacturers' now-obsolete criteria. The result is drives that may not work to their full capacity.

In contrast to most in-house testers, automated test systems incorporate as many as 20 test parameters to ensure highly accurate results. Parameters can easily be modified by altering the system's



# IT'S A WRAP.

## Augat's wire-wrapping services get your product to market, faster, for less.

At the heart of Augat's Datatex wire-wrapping services is the state-of-the-art D.E.C./VAX 11/750 system. It makes us compatible with more engineering groups. And it provides the most reliable and cost-effective method of wire-wrapping panels from prototype to production in less time than you can probably do it yourself.

Especially if you're using Augat socket panels.

If you are, all you have to do is send us your magnetic tape. We'll program the panel for free. Then we'll wire it and inspect it for approximately ten cents per wire. We'll analyze each signal and furnish total cross references, too.

Datatex wire-wrapping techniques include automatic for sensitive circuits, minimal wire lengths and production wiring. Also semi-automatic for twisted pair, special routing, off-grid terminals and low-volume production. Automatic wiring is orthogonal. While semi-automatic is point-to-point. With respect to reliability, our Wire-Wrap™* connections have been approved for military and other high reliability applications.

So if you'd like to wrap up your production in record time, contact Augat's Datatex Service Centers: 10935 S. Wilcrest Drive, Houston, TX 77099 (713) 495-3100, or at 40 Perry Avenue, Attleboro, MA 02703 (617) 222-2202. For more information, call toll free 1-800-526-7443, ext. 996. In the New Jersey area, call 1-800-522-4503, ext. 996.

*Trademark of Gardner-Denver Co.

AUGAT® Quality and Innovation

software. Automated systems which test numerous drives simultaneously further speed the test process.

### Defects Appear in the Field

As a result of insufficient testing, even the supposed error-free drive can fail early in the field. Higher quality products and sophisticated test equipment will not prevent disk drive failures in the field if proper attention isn't given to the overall process. Without consistently applied testing and detailed error-tracking at each step of the production cycle – not at the end – a drive may pass through the entire cycle and experience a high rate of errors in the field.

For instance, one frequent problem that is difficult to detect without sophisticated testing is a high rate of soft errors. A soft error is typically defined as a read error that occurs only once at the same cylinder, head, sector and byte count. If such marginal defects are not detected in the test cycles at the manufacturing stage, no doubt they will appear at some point later on, resulting in higher returns. A reason may be that one component is operating at the high end of its spec while another is operating at the low end. Such a situation is not at all uncommon but almost impossible to detect early without adequate testing procedures.

### Heading Toward a Solution

Systems integrators and large OEM customers can assist in the overall preventative maintenance process. As with traditional component testing, drives and drive subsystems should be tested on the incoming side of major production phases before further integration occurs. Due to storage under extreme temperatures of poor handling during shipping, the performance of disk drive parts over time can drastically change, even though the product left the plant in working condition.

*Drives and drive subsystems should be tested on the incoming side of major production phases before integration occurs.*

If problems are not isolated before integration with other subsystems, later symptoms of marginal performance may be difficult to trace.

A successful strategy for staying out in front of this growth curve would be to increase testing throughput while maintaining the desired pass/fail standards. Implementing this strategy is a delicate procedure because of reluctance to add still more time to the already perceived time-consuming testing process. Planning for testability and application of test methods with reliable automated test equipment capable of testing multiple drives simultaneously requires an understanding of long-range benefits attributed to the neglected test process.

Evaluating the reputation and reliability of the test equipment supplier is a factor that cannot be overlooked. Consistency of performance of course, also depends on the continuity provided by a stable, reliable supplier with a commitment to objective industry standards.

*– Wes Theriault,*
*V.P. Applied Circuit Technology*
**Write 231**

## DEPARTMENTS/Supermicros

# Operating System Options Allow Multiple Graphics

The speculation continues over the possibility of 32-bit microcomputers eventually replacing mainframes and superminis. The challenge is to prove that multiple, tightly coupled microcomputers with state-of-the-art software technology are superior in performance and price to superminis like the VAX 11/750 and the VAX 11/780 or low-end mainframes like the IBM 4300 series.

Syte Information Technology, founded in 1983 by Peter Shaw, President, and Dale Roark, formerly President and Director of Engineering at Megatek, has introduced its first generation product line

# FOR A REFRESHING NEW LOOK AT COLOR GRAPHICS PUT A GENISCO G-2200 IN YOUR SYSTEM. IMPELL CORPORATION DID!

The G-2200 is truly a refreshing approach to raster color graphics. It combines vivid colors, flicker-free picture clarity, and big screen readability with high speed graphics and extensive software support. The result is the most cost effective system on the market. That's why Impell Corporation selected it as the perfect color graphics companion to CAEMIS, their Computer Aided Engineering & Management Information Services package.

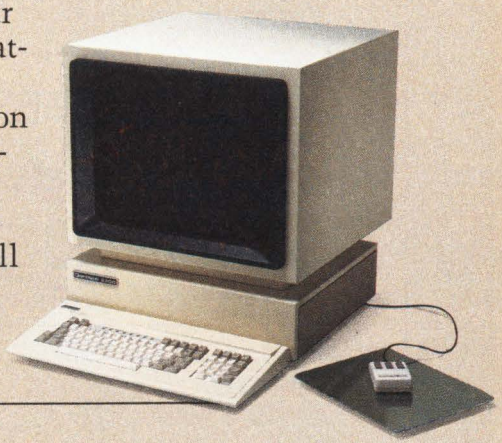
Impell is a major supplier of computer software and computer based management and engineering services to the utility industry worldwide. CAEMIS is a modular, three dimensional engineering design and data base management system which provides simultaneous access for all design functions and on-line access to design information. And, the Genisco G-2200 is its window to the world.

The G-2200 has all the features desired for CAD/CAM, CAE, scientific and business graphic applications including built in peripheral support for mouse, tablet and printer. It is software compatible with the Tektronix 4014 and supported by third party software. It will also emulate the DEC VT100 for text editing and data entry.

But the best reason to put a G-2200 in your system is picture quality. Up to 16 colors can be selected from a palette of 4,096 hues with a unique black matrix glass bringing them vividly to life. Graphics are displayed on a big 19 inch screen that is refreshed at 60Hz for flicker-free viewing while the 1024 x 792 resolution ensures sharpness and clarity. No comparably priced system can match the picture quality of the G-2200.

The G-2200 is available as an attractive, ergonomically designed desktop terminal, or it can be integrated in your own system as a board or as a controller. Whatever the configuration, you can be sure of Genisco's commitment to design and production excellence and to on-site support by its international network of offices.

For details on how the G-2200 can color your system, call us for a demonstration. It will be a most refreshing experience.



**Genisco**

GENISCO COMPUTERS CORPORATION
3545 CADILLAC AVENUE
COSTA MESA, CA 92626
(714) 556-4916
TWX 910-595-2564

**Write 32 on Reader Inquiry Card**

*Figure 1: The Syte Series 3000.*

of 32-bit supermicros based on National Semiconductor's 16032. The Syte Series 3000 Micromainframe runs proprietary software allowing supermicrocomputers to run multiple operating systems on the same processor at the same time.

The 3000 series, shown in the photograph, is built as either desktop of pedestal terminal workstation with a stand-alone or tower microcomputer. While the system backplane is a 25MB proprietary design with 4 or 8 slots, there is an integral Multibus backplane which allows an OEM integrator to add modifications to the system with a 5 card capacity. The high speed bus was designed to allow the system to handle up to 8 of the 32-bit microprocessors which are single board computers. Memory can be configured with a 3½ MB floppy disk, Archive 45 or 65 MB tape backup, and from 26 to 550 MB of hard disk.

Roark and Shaw point out that the key feature that distinguishes their system from other UNIX systems is the use of multiple processors to handle distributed processing. The Syte design uses an 80186 to handle bus arbitration tasks, and an 8051 for communications. At present the CPU itself is made up of the 16032, the 16081 Floating Point Unit, and the 16082 Memory Management Unit as a team. The GEM or Global Environment Manager offers the unique capacity of running different operating systems simultaneously. GEM creates "virtual environment," giving each user immediate access to the computing power of other stations as well as to all other resources on the network, including peripherals.

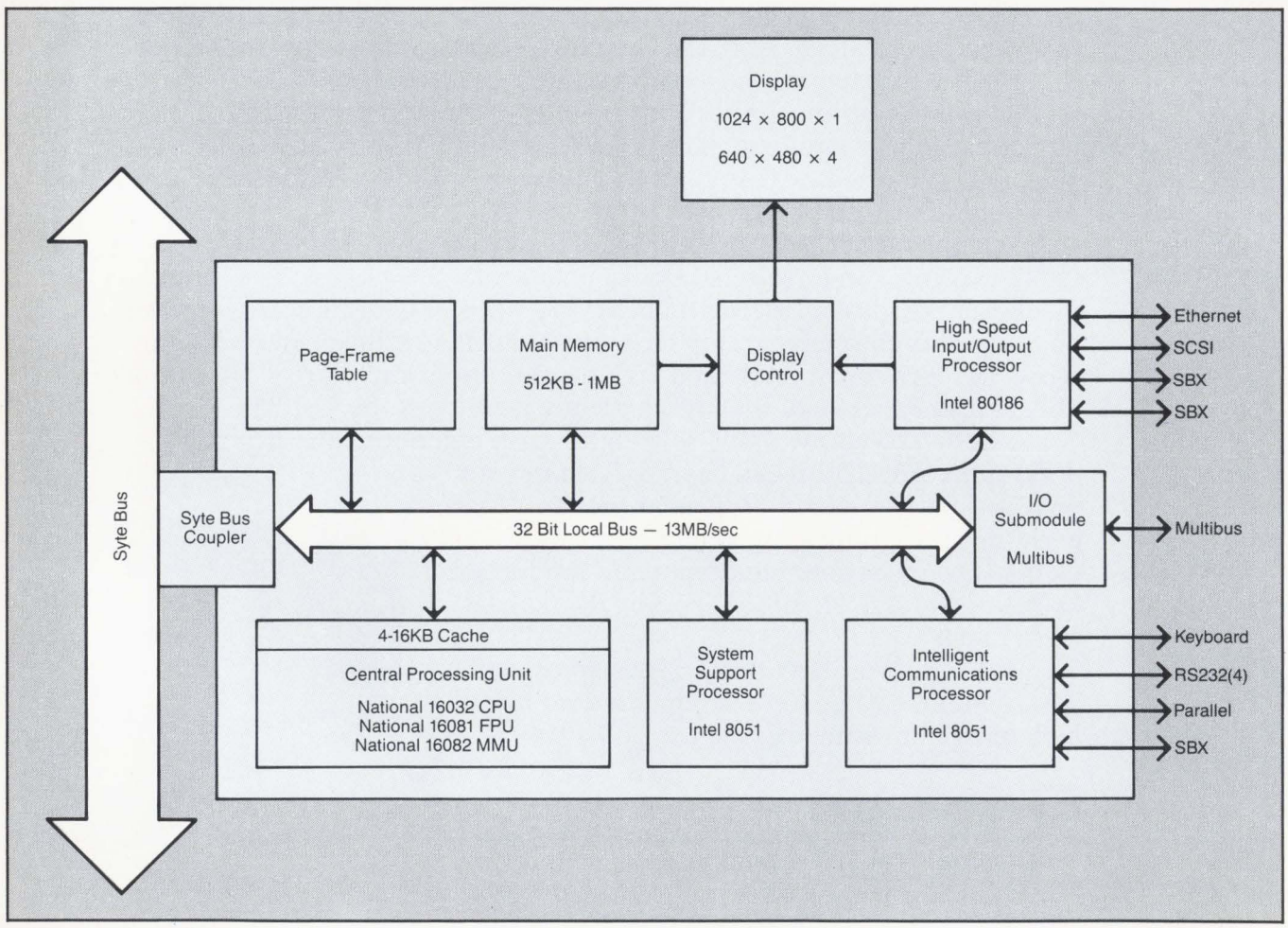
## GEM Software

The GEM permits the simultaneous use of different programs running on separate operating systems, with multiple windows displayed on the screen.

The proprietary window management software in the 3000 series allows vector graphics, bit-mapped graphics and interactive alphanumeric text within an unlimited number of windows on the display screen. For example, a user can write documentation in one window for a printed-circuit-board displayed in another—even if the software for each application runs on different operating systems. A user can move smoothly and rapidly between operating systems or programs by simply moving a "mouse" or another pointing device into the window of interest.

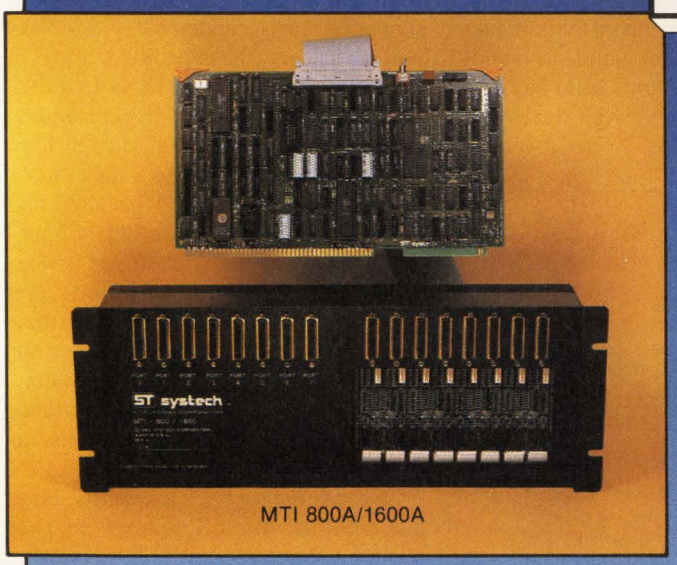
The power of the software lies with GEM's object-oriented architecture, which provides a uniform interface to all the diverse network resources, be they data, peripherals, files or operating

*Figure 2: Processor Module Block Diagram.*

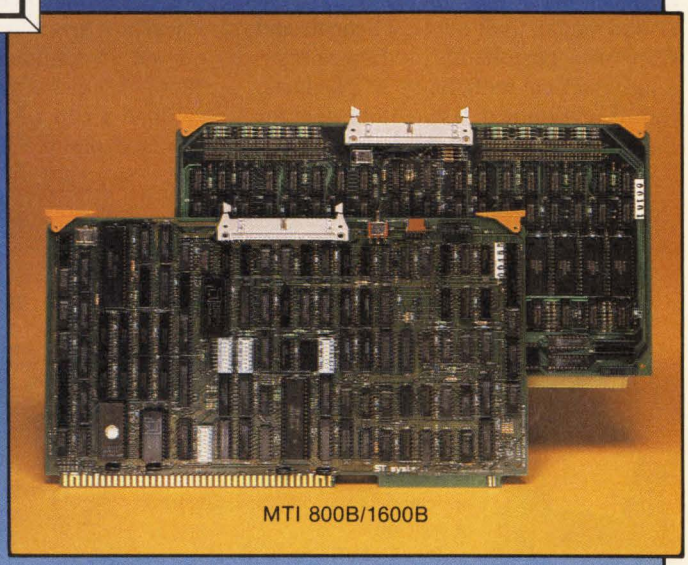


# RESPONSIBLE MULTIBUS* SUPPORT

## WE PROVIDE + THE PLUSES




MTI 800A/1600A



MTI 800B/1600B

## DMA Communications Controllers

+ UNIX* DEVICE DRIVERS to licensed users
+ TIME DIVISION MULTIPLEXING FIRMWARE
+ Personalized engineering support
+ Eight or Sixteen Channels
+ 12 month warranty
+ 24 hour warranty exchange

ST™ systech

SYSTECH CORPORATION
6465 Nancy Ridge Drive
San Diego, CA 92121
619-453-8970
TWX 310-499-0507 "SYSTC"
Intnl. ITT 499-0507 "SYSTC"

*Multibus is a trademark of Intel Corp. *Unix is a trademark of Bell Labs.

systems. It also allows system software changes or additions to be easily incorporated, and allows files and information to be shared between operating systems.

GEM also ensures software transportability among all the Series 3000 models as well as future Syte computers.

Syte's implementation of the UNIX standard, AT&T System V, is called /syte/UNX. It is available for the system, as are the Fortran, Pascal and C languages. Syte is commited to supporting future AT&T releases, and the latest updates of Berkeley UNIX will soon be added. An additional operating system will be released within 30 days, with more operating systems to be released during the next 12 months.

Despite the company's claim to not be in the graphics, but the computer arena, the addition of a powerful graphics card for the system is certain to cause some consternation in the workstation marketplace. The tower chassis will allow multiple graphics cards to be added so that a single system can support one, one to two, or two to four graphics terminals. With one user the system offers 1024 × 800, or 640 × 480 × 4 display quality. The organization of the system is shown in **Figure 2**. *—Borrell*

**Write 239**

## DEPARTMENTS/Floppies

# The Force for 3¼" Media

The battle for microfloppy standard acceptance rages on, with the coalition of Dysan media, Tabor drives, Seagate and Concorde Peripherals' add-on subsystems attacking with their 3¼" products. Sub-5¼" floppy disks are important for the growing portable computer market, because they are small, light weight and rugged. Strong forces are also supporting 3" and 3½" drives as standard for portable micros. In conjunction with Dysan and Tabor, Seequa (Odenton, MD) has developed a new portable with dual 3¼" drives, called the 325.

The 3¼" forces have learned lessons from others' battles, and may have a good shot at gaining acceptance. Dysan's disks will have nearly the capacity of a 5¼" in the 1 Mbyte single-sided version, unlike the limited capacity of 3" disks promoted by Hitachi, Matsushita and Maxell. Joint development between the computer manufacturers like Seequa and the media and drive companies should prevent the boondoggle that the 3½" microfloppy is wading through with Hewlett-Packard's, and now Apple's specs for 3½" drives on their computers not matching each other nor the original drive of the supplier, Sony, was already making. It appears that Tabor will not have to make three products, as Sony now does in 3½" form.

One major drawback to that diversity, and for all the microfloppies, is that not enough volume is being sold of any one size and type for software developers to find recording on a particular size and type of disk a safe bet. Dysan is directly addressing that problem by getting into software publishing themselves.

With 11 software vendors and 80 popular microcomputer software packages on 3¼" media at introduction, Dysan is entering their Series Software as a broad contender. The goal of creating easier-to-use versions of the most popular applications in a library ensures that the lack of applications plaguing non-standard drive machines is avoided. Improving the user interface, especially through standardizing and simplifying documentation, as well as providing support, are charters of Dysan's Software Services Division.

Another advantage to the 3¼" systems is plug compatibility with 5¼" products.

Since they operate at the same speed, the basic electronics of standard 5¼" drives can power a 3¼" as well. At about half the weight of a 5¼", the 3¼" consumes about one-third the power and fits in a true half-weight package. In addition to the basic ruggedness of small floppies, the Dysan disks come to avoid wear and error problems of hard jackets in a flexible jacket, and the inner lining wipes the disk as it rotates.

As a range of products developed together and for working with each other, the 3¼" coalition is a strong force. Seequa's new IBM compatible 8088 and Z80-based products, the portable Tabor drives it incorporates, with Seagate's cooperative efforts, Concorde Peripherals' add-on 3¼" drives, and the Dysan media, indicate the hardware products are from firms with strong histories. Dysan's software library on the media further extends the range of capabilities and the viability of 3¼" as a microfloppy standard. – *Pingry*



# VLSI Implementation of VAX Line

For the past two years, the availability of 16-bit microprocessors has made possible the design of low-cost multi-user systems that have challenged the role held by DEC's VAX Line.

To preserve its large customer base, DEC has already introduced the microVAX 1, a two-board Q-bus implementation of the VAX architecture (*Digital Design*, November, 1983).

At this year's ISSCC held in San Francisco, further disclosures indicated that the company may provide two design alternatives for the implementation of the VAX/11/780 in VLSIC technology.

The first design has not subset any of the 304 instructions, 17 data types or the 4 Gbyte virtual memory management architecture. Microcode optimizations were obtained by a large control store, internal and external 32 bit datapaths, microlevel and macrolevel pipelining and specialized hardware assists. The chip set supports an integral 8 Kbyte cache, 13.3 Mbyte/sec system bus, and multiprocessing (**Figure 1**).

All chips communicate via a 32-bit ad-

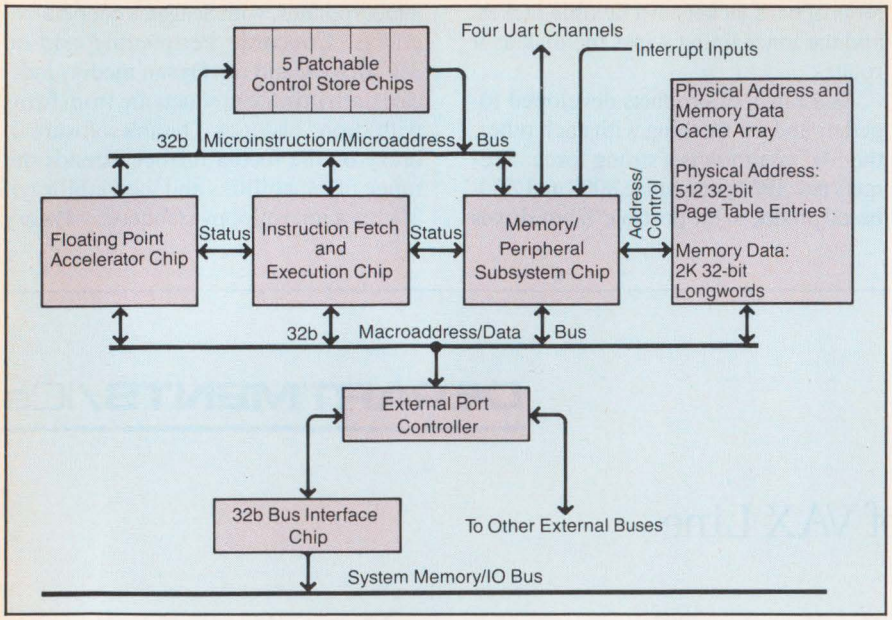



*Figure 1: Block Diagram of the VLSI CPU chip set.*

dress/data bus and a 40-bit microinstruction/microaddress bus with miscellaneous dedicated signal lines. Custom CMOS gate arrays and various commodity parts have been used to implement the data arrays for the large address and data caches, and to interface the CPU to its multiple external interfaces.

An optional Floating Point Accelerator chip uses parallel 67b fraction and 17b exponent datapaths and a 100ns microcycle to accelerate the performance of 61 floating point instructions on three different data types, as well as integer multiply/divide. Internal microprogramming permits operation of this chip as a true co-processor.

The second design, a 32-bit microprocessor with on-chip virtual memory management, implements 175 instructions, leaving 70 to a companion floating point unit, 27 to microcode assisted macrocode and 32 entirely in macrocode. The memory management architecture provides demand-paged virtual memory management with a virtual memory of 4 Gbytes, divided into four 1 Gbyte regions. Operating at 20 MHz for a +5V supply, the chip's 200ns microcycle and 400ns I/O cycle permit dynamic RAMs to be interfaced without wait states.

With the high-end microprocessor market still in its infancy, the availability of such a 32-bit machine from Digital will no doubt go a long way to influence many design decisions, especially when one considers the large installed software base associated with the VAX architecture. *—Wilson*

**Write 238**

## DEPARTMENTS/Operating Systems

# Machine Independence Through Modular Operating System

Key features to the operating system of the future will very likely include its portability factor, a complete modular design, high functionality, and high speed with low overhead. According to Charles J. Lombardo, CEO, and its developer, Robert Knight, the S1 operating system from MultiSolutions (Lawrenceville, NJ) was developed specifically with these features in mind.

Lombardo stresses "machine independence" as the solution to the incongruities suffered in hardware advances and lagging software development. Existing microprocessor operating systems are all related to the original machine on which they were implemented. A computer running S1 looks the same whether the microprocessor is a Z80, a 68000, or any other 8, 16, or 32-bit machine. The command language is identical on all machines as are the file structures. Applications can be moved from processor to processor simply by recompiling the source. MultiSolutions promises S1 allows all languages and all applications supported on the system to be ported to a newly announced chip architecture and running at full compiled speed within 5 months.

S1 is written in a middle level programming language, SL which is specifically written not only for the operating itself but for all other languages supported. Configuration dependencies are isolated in one small section.

The system's modularity is based on a building block construction whose parts are not tightly coupled. Unnecessary system components may be omitted and if interchanging is necessary, the parts can be added without disrupting the system. Removed components produce a "not available" indication, not a system failure. Real-time facilities are achieved through multitasking and a dynamic scheduler.

Moving S1 to a new computer architecture only requires writing the code generation for the system language. New "versions" of the system are not required for each new machine running the system.

Adding or removing parts of S1 is facilitated through commands which create a new copy of the system which can include or exclude parts of the system.

The multiprocessing capabilities support up to 256 processors simultaneously with any task running on any CPU including full screen or bit-mapped displays, bit-mapped printers, multiple windows, etc.

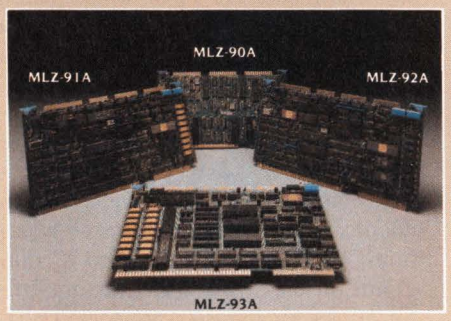
S1 presently runs on the 68000, the Z80, 8080 and 8085, 8086/88 and the 80186, as well as the 16032. *—Hanrahan*

**Write 247**

# THERE IS MORE THAN ONE GOOD REASON TO CALL HEURIKON

Make HEURIKON your source for Multibus microcomputers and sytem components.

Since 1972 Heurikon has been working hard to make life a little easier for those who "put it all together." Powerful Z-80™ and MC68000™ based Multibus™ microcomputers like MLZ-92A and HK68 have helped Heurikon customers find economical solutions for their problem applications.

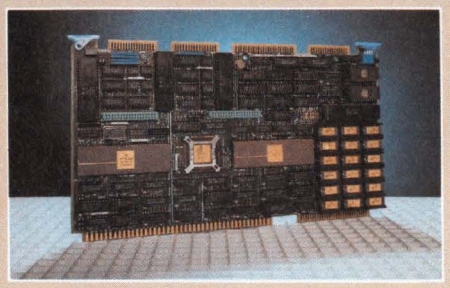



**MLZ-90A** single board microcomputer with nine byte-wide memory sockets for use with RAM or ROM (AM9511 and floppy disk drive controller optional).

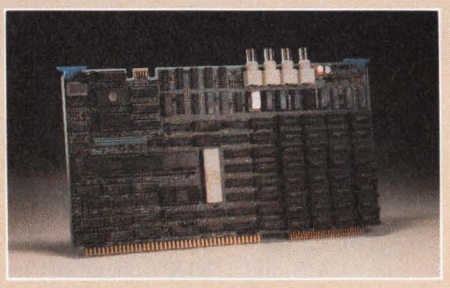
**MLZ-91A** single board CP/M™ system with on-card floppy disk drive controller, winchester interface, optional AM9511, streamer tape interface, two serial ports, one parallel port, 64K bytes RAM with parity, two EPROM sockets, and GPIB CONTROLLER.

**MLZ-92A** single board CP/M™ system with four serial ports on-card, floppy disk drive controller, winchester interface, optional AM9511, Centronics printer interface, 64K bytes of RAM with parity, and two EPROM sockets.

**MLZ-93A** single board CP/M™ system with 128K bytes of dual ported RAM, four EPROM sockets, floppy disk drive controller, optional AM9511 and powerful serial port features including SDLC and HDLC protocol support and modem controls.



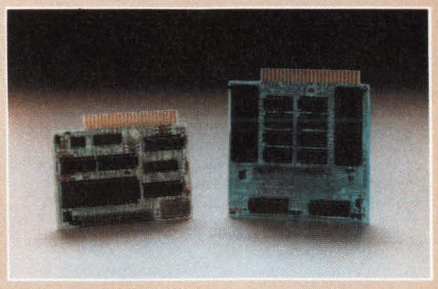
**HK68**™ powerful and versatile single board UNIX™ or CP/M-68K™ system with MC68000 CPU, MMU, quad channel DMA, four serial ports, 128K or 256K bytes of on-board RAM with parity (expandable to 1M byte on-board!), and two iSBX™ connectors for I/O expansion.



**MLZ-VDC** intelligent 640 x 480 x 4 color graphic controller based on the NEC 7220 controller chip with on-board Z-80 CPU, DMA controller, and user definable FIFO interface to Multibus.™ Users may display up to 16 colors from a 4K palette. Up to 1024 x 1024 x 3 interlaced also available.

**iSBX Expansion Models**
Heurikon also stocks iSBX™ modules for I/O expansion on its HK68 and MLZ-VDC. These modules may be used on any other board complying with Intel iSBX specifications.

Presently available are the SBX-FDIO floppy disk controller module and the SBX-SIO serial port expansion module.



The SBX-FDIO can control up to four single or double sided, single or double density 5¼ inch or 8 inch floppy disk drives. A software toggle allows both 5¼ inch and 8 inch drives to be intermixed on the same cable!

The SBX-SIO is a quad serial port expansion module utilizing Zilog SCC controller chips with built in baud rate generators. The SBX-SIO is available in synchronous and asynchronous models.


**Systems**
Heurikon also supplies completely integrated systems with your choice of CP/M-80™, MP/M-80™, CP/M-68K™, and "Berkeley enhanced" Unix operating systems.

Systems are available with four, six, and fourteen slot enclosures with 5¼ inch or 8 inch dual floppy or floppy winchester drive combinations.

HEURIKON CORP.

3001 Latham Dr. Madison, WI 53713 Telex 469532

Hannover Messe'84
CeBit Booth #201/701-41

Call Heurikon Direct 1 800 356•9602 In Wisconsin 1 608 271•8700 **Write 37**

# Standardized Programmable Logic For CAD Language


*Programmable logic devices can now be compiled in a common syntax using ABEL, a CAD language.*

Fuse maps for all programmable logic devices can now be compiled in a common syntax using a CAD language called ABEL™. ABEL (Advanced Boolean Expression Language) is called a second-generation language by its developers, Data I/O Corp. ABEL is intended to supersede Monolithic Memories' PALASM® for PAL®s, and Signetics H&L for IFL devices. ABEL generates logic for either target device.

ABEL is available for the DEC VAX line (VMS and UNIX™ operating systems), and more significantly, the IBM PC under MS-DOS. Thus, ABEL joins the growing list of engineering-oriented software that operates on relatively low-cost (under $7,500) workstations. ABEL comprises approximately 40K lines of the C language.

ABEL essentially takes the designer's machine state diagram, truth tables, or Boolean equations – or any combination of the three – and translates logic into a verified fuse map which is downloaded to Data I/O's programmable logic development system. Design debugging aids include a debugging simulator with trace and breakpoints, diagnostic error messages, and debugging list files. Design documentation includes lists of equations, variable names, labelled IC diagrams, fuse maps, and test vectors. Implications for industry are that ABEL may make it possible for designers to concentrate on device design and to delegate specific device programming to lower-level personnel. *– Cashman*

**Write 244**

# Develop Vertical Application Packages On Micros

After 18 months of field beta tests, it seems safe to say that applications software development, once the realm of only large systems, is now possible on a variety of microcomputers. By combining a powerful DBMS with program generation systems, utilities, and business modules for a multi-user environment, the JET III package from Jetsoft Inc. (East Falmouth, MA) allows systems houses to create complete vertical applications and documentation on microcomputers.

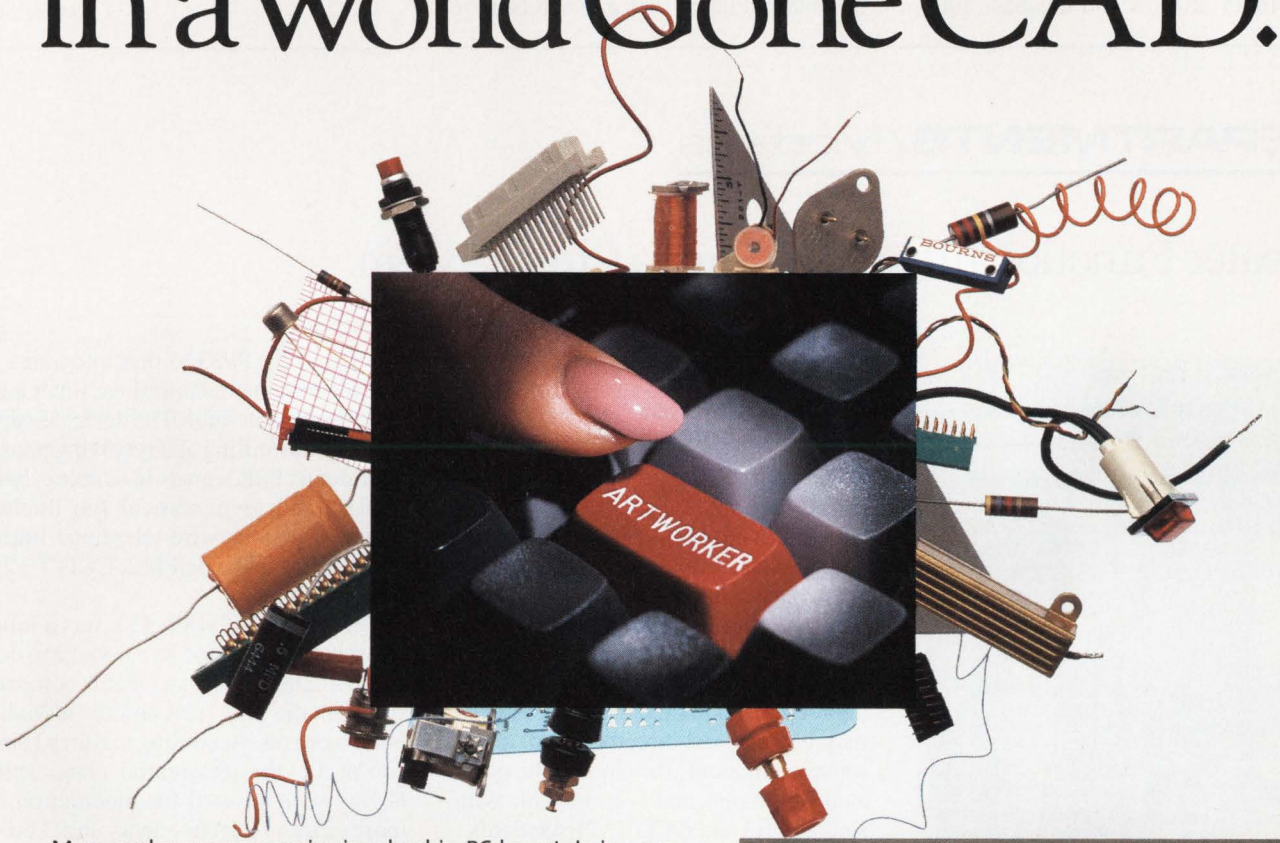
Jet III can be used with many popular micro operating systems, including CP/M, MP/M, MS-DOS, PC-DOS and CCP/M. There are plans to include UNIX and XENIX in that list soon, as well. All of the applications code is generated in CBASIC, and with Cross-compiling, any number of language bases can be used. Relocatable modules in any language can be linked into run time programs. Applications are not generated with assembly; all of the machine-dependent code is stored in one central file, so no cross-assemblers are needed.

The menu-driven JET III package, including DBMS, menu generator, report and program writers is designed for a six-user environment and is said to improve the productivity of programmers in software development houses by a factor of ten to one. At $40K for the six-user program on microcomputers, this system could prove a great boon to companies developing vertical applications. Packages developed on JET III also can incorporate many of its multi-user, menu-driven attributes.

All Jet III components include record lockout, assuming multi-user environments. The security important to systems with multiple users is provided by passwords, log-on and access levels for fields as well as data files and programs. Tools for menu generation, placement and screen set-up are also provided to the application developer.

The database management system can handle relational hierarchical or network database organizations, or even a mixture of these. In addition to basic DBMS utilities, tool for data compression are included with the manager. And all of the

# The Rational Answer in a World Gone CAD.




More and more companies involved in PC board design are going CAD. Now, Wayne Kerr introduces Artworker™: the computer-aided design system engineered to meet the most important requirements of today's PCB designers...at a price that's attractive to any operating budget.

Computer-aided design systems have proven their worth as valuable time and money savers. But high performance in CAD PCB design has been available only at an equally high price.

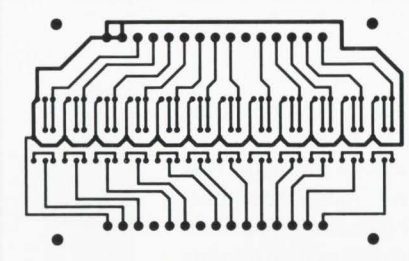
Until now.

Until Artworker™.

Wayne Kerr has produced a dedicated, stand-alone system with a full array of features designed for speed, accuracy and ease of use. Features generally available only in high priced systems. Yet Artworker™ — complete with all necessary design software — provides high priced capabilities for less than $25,000. Just as important, Artworker™ carries the Wayne Kerr name with its 37 year reputation for quality, reliability and advanced engineering.

And since Artworker's™ functions parallel the steps used in conventional layout techniques, even a new operator can produce quality output within a few hours of installation.

For small companies where the ideal price/performance ratio is critical. For larger companies involved in expansion of PCB design capabilities into multiple installations. For any company that's looking for the perfect combination of high performance, low cost and outstanding reliability, Artworker™ from Wayne Kerr is the rational answer. In a world where going CAD is the only way to go.



WAYNE KERR

**Wayne Kerr, Inc.,** 400 West Cummings Park, Woburn, MA 01801. Telephone: 617-938-8390 Telex: 6817257 WKERR WOBN
Wayne Kerr Datum Ltd., Woolborough Lane, Crawley RH102UG, UNITED KINGDOM. Telephone: (0293) 543266/7 Telex: 87201 DATUM G
Wayne Kerr GmbH, Domstrasse 58-62, D 6050 Offenbach/Main, Federal Republic of Germany. Telephone: (0611) 810778/9 Telex: 4185470 WAYK D

DBMS and program generation features are integrated with each other and with Jetsoft business and accounting packages.

Through its integration of program development utilities and database functions, JET III generates a large portion of the code in applications it generates. For houses creating a library of applications, the standardization seen in packages created through a single generator can be an advantage. Putting such a comprehensive generator onto microcomputers could allow drastic increases in the range of firms who can afford to create applications and how many packages these smaller houses can offer. *—Pingry*

**Write 243**

## DEPARTMENTS/Modems

# Greater Functionality On A Single Chip Modem

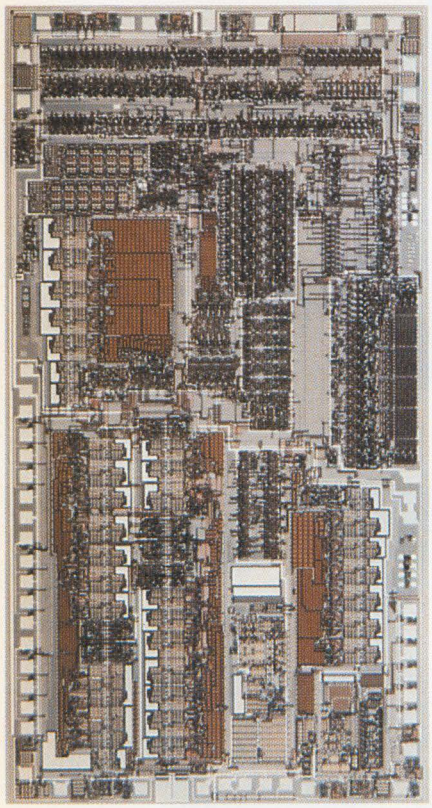


*Figure 1: Modem chip from National Semiconductor.*

The rapid changes in integrated circuit technology and the use of MOS VLSI and switched capacitor techniques to perform analog signal processing has led to increasingly more complex functions being implemented in silicon. In the telecom area, the Filter/codec was one of the first examples of this trend. Today, the emphasis has moved to the data communication field and interest has focused on the data modulator, or Modem.

At the ISSCC four single-chip Modems were presented by American Microsystems (AMI), Oki Semiconductor, National Semiconductor and Texas Instruments, that included analog circuit sections built on the same chip as the digital circuit section.

In 300-baud Frequency Shift Keying, two approaches were described. The AMI device has an automatic gain control function controlled by an energy detect-circuit and uses pulse width modulation for demodulation. Designed for use in stand-alone applications and where the modem may be designed directly into data terminal equipment, the chip can be operated full duplex and is compatible with Bell 103/113 and CCITTV21 standards.

A limiter, digital phase-lock loop and an adjustable carrier detector are the key features of the second device from Oki Semiconductor. Consisting of a clock generator, modulator, filter, demodulator and Data Terminal Equipment Interface, the device is again a stand-alone type that conforms to CCITT recommendations.

In a description of a 1200 baud FSK CMOS MODEM for operation of from 75 to 1200 b/s, National Semiconductor previewed its TP3320 that integrates a modulator/demodulator, filter, timer and a baud-rate generator. The device is capable of transmitting and receiving phase continuous FSK signals in simplex, half duplex, and asymmetrical full duplex modes over four wire telephone lines, and working to the Bell 202; CCITT V23 specifications.

The part, the TMS99533, was a joint effort between TI and Racal-Vadic to develop a 1200 bit/sec part that is compatible with the Bell 212A and Racal-Vadic 3400 modems. According to Kerry Hanson at TI, the differential phase shift keying scheme used for modulation is more efficient than frequency shift keyed modulation used in other designs.

The use of an automatic gain control as part of the receive filter to provide a carrier detect indication and to control the amplitude of the signal into the demodulator should be noted. The chip also supports both local and remote analog loop back test modes and has built in test circuiting to allow the user to check operational status and to improve manufacturing testability. *—Wilson*

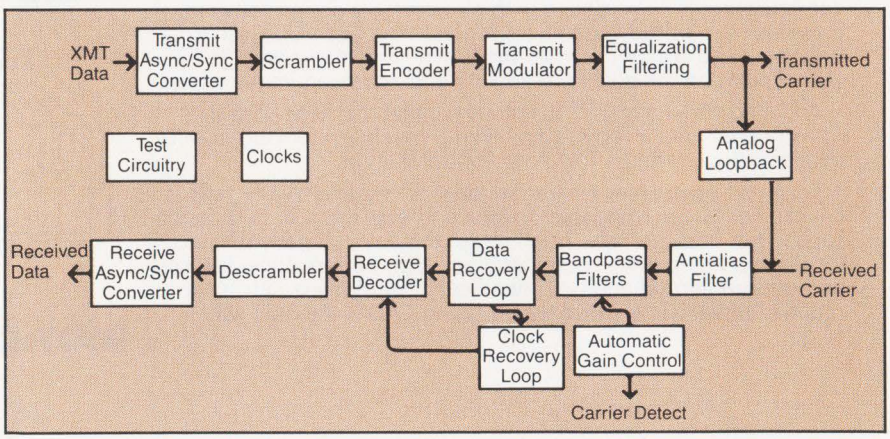



*Figure 2: Block diagram of Texas Instruments' NMOS chip. The data to be transmitted is converted from asynchronous to synchronous format by inserting or deleting stop bits.*

# HOW TO BOARD THE MULTIBUS* WITH BETTER MEMORIES

## A guided tour of superior Multibus memories from the folks who know the route best. Plessey Microsystems.

Making the Multibus all that it can be requires memories that do more than just meet the specs. That's where Plessey Microsystems comes in. We can help you board the Multibus with much better memories. For example:

**1/2 Mbyte Dynamic EDC Multibus Memories.** Our PSM 512A gives you 512K x 8 bit dynamic memory on a single board to save slots in your system . . . low power consumption to save operating dollars . . . EDC to save your data! Single bit error detection and correction assures complete data integrity. Our options let you tailor the interrupt system to your system's needs. Standard features include on-board circuitry for all refresh functions, 8MHz optimization, byte/word control, selectable address ranges, start-up error override and a lot more.

**1/2 Mbyte Dynamic Parity Multibus Memories.** The Plessey PSM 512P gives you all of the features and options of the 512A with the exception of EDC. With the 512P, parity single bit error detection protects your system from undetected RAM errors. At a cost even less than our EDC memory.

**Non-Volatile Multibus Memories.** The new PSM 6663 non-volatile memory with interrupting real-time clock/calendar and on-board battery back-up offers capacity ranges from 16K fast static RAM to 1 Mbyte of EPROM with 256K bytes of RAM/EPROM mix.

**Multibus . . . the Plessey Way.** All Plessey Multibus memories are produced to the most demanding specs . . . tested on equipment so advanced that it reveals flaws which go unnoticed on other devices . . . double sourced by Plessey both here and abroad . . . priced with boards of less-than-Plessey quality . . . and guaranteed for a full year.

Board your Multibus with better memories. From Plessey Microsystems. For details, call or write Plessey Microsystems, Inc., One Blue Hill Plaza, Pearl River, NY 10965. (914) 735-4661. Or toll-free **(800) 368-2738.**

* ™ Intel.

**PLESSEY MICROSYSTEMS**

*The Plus in Your System.*

# Rounding Up Microcomputer Networks

It is now clear that no single network topology or protocol is ideal for every communication environment. In the arena of microcomputer networks alone, several systems have large and growing bases installed, each with its own hardware, protocols and configurations. Several firms have written network software systems to run with various LANs. Novell (Orem, UT) has an operating system called NetWare that they hope will unify networks and be popular enough to be a de facto standard. By providing services to and about the industry, Novell is putting Netware in a good position and, if they are successful, allowing the LAN industry room for explosive growth.

The first industry benchmarks comparing the performance of several popular networks were carried out by Novell early in the year. The preliminary results (**Figure 1**) cover speed and price/performance tests on seven networks. These are just the first scheduled tests: more networks and different parameters will also be tested. In the future, functionality, usability and security of microcomputer networks will be tested.

By comparing popular LANs both with and without their operating system, Novell is pointing out both the stabilizing effect Netware has on performance and the strengths and weaknesses of various networks, including their own Netware/S star topology LAN. The others compared include bus topologies in OMNINET from Corvus, G-Net from Gateway Communications, Orchid's PC-Net and 3-Com's EtherLink; an ARCnet-style token passing logical ring is Davong's Multi-Link and Proteon's proNET is a connected star topology.

For a network to provide the full range of communication services, application software also needs to be designed for network use. To help this process, Novell has begun another service that aids both the network purchaser and Novell. Their NetWare Affiliates DIO (Do It Once, as in "once and for all") program provides application software houses with LAN hardware on which to develop multi-user applications, which are then offered with NetWare.

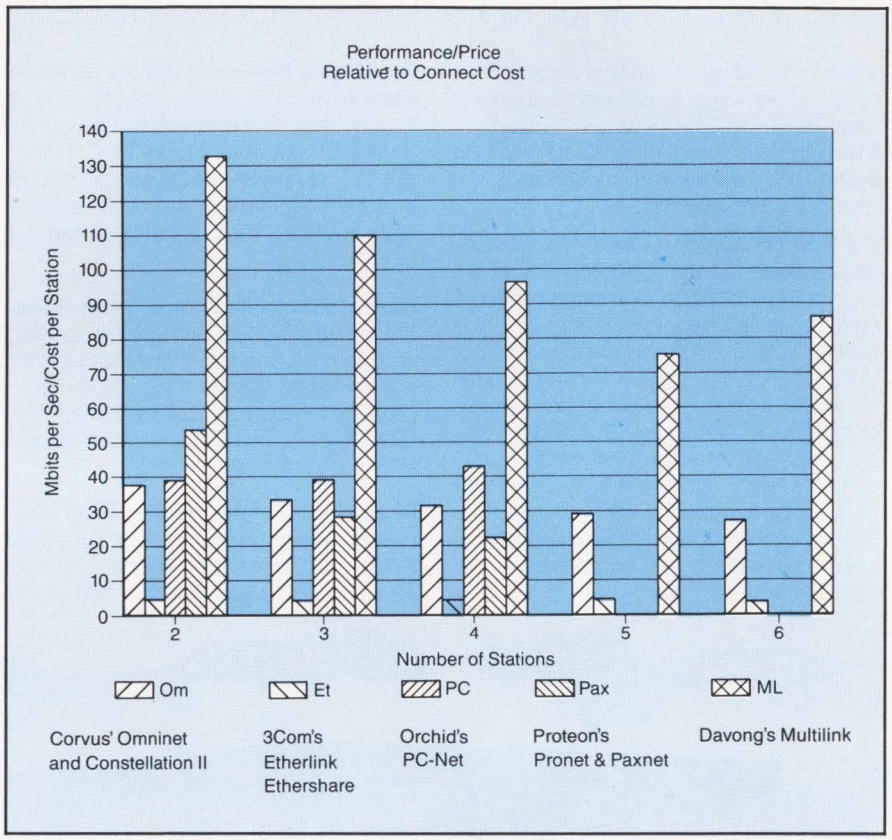
Corvus Omninet boards are currently distributed to the software developers in the program. Other hardware could be used, since Novell has written drivers for all the networks in the benchmark. This joint development could save an applications publisher from the decisions and risks of writing packages that operate one of the many networks now popular.

As the differences between benchmarks with and without the overlaid Novell operating system show, NetWare tends to even out and standardize network performance. This system uses a minicomputer-style file server instead of the disk servers developed for the primitive PC languages like P-system and DOS 3.3. Using a file server allows simpler, less specific commands to be a server instead of each PC, allocation can be relatively efficient.

By comparing the most popular PC networks and having a hardware-independent operating system to map onto these nets, Novell has not lessened the fierceness of competition or any 1 LAN's chances for success. The variety of network topologies and protocols for microcomputers springs from the range of environments they are to serve. With broadened understanding of the systems and more applications written specifically for networked micros, all of the networks involved should become more useful.

A more complete report on the preliminary benchmark studies is to be released in May. Meanwhile, if their strategy works, more applications for PC networks will be developed, the strengths of many popular LANs will be clearer, and the NetWare operating system will be widely used with many vendors' LANs; providing some measure of standardization. *–Pingry*

**Write 240**




*The graph illustrates the relative price/performance ratio for each native network. The costs used for calculations include the cost of the interconnect hardware for each station and the cost of an IBM XT. The higher bars show greater value; the numbers on the left of the graph do not reflect any particular unit, they are a simple ratio.*

# Universal Communications Through Software, RS-232 Ports

Companies and other interests adding thousands of microcomputers in facilities already using minis and mainframes need ways to communicate between these asynchronous desktop tools and the main computing facilities. Many terminal emulation products are available, but these address only part of the problem. Error-free file transfer, text up and down loading and facilities like electronic mail and interactive screen editing on remote computers are also important. Some more complete communication products are available, but typically only for the IBM PC and/or Apple micros.

Using the RS-232 port common to most computers as the interface, BLAST software, for *BL*ocked *AS*ynchronous *T*ransmission, from Communications Research Group (Baton Rouge, LA) allows many communication facilities between machines equipped with the program.

Unlike many micro-to-mainframe communications products, no hardware needs to be added to the PC; a protocol conversion box is only needed for IBM mainframes, which cannot directly support full duplex asynchronous communications. Providing asynch links allows relatively inexpensive and easy to implement communications for many micros, minis and mainframes.

With the RS-232 port as its interface, BLAST can run on many computers – it is licensed on over 60 computers of all sizes and native operating systems. The software package includes documentation on the protocol concept, plus object code on whatever media the machine to be connected uses. For IBM mainframes, a BLAST box converts half-duplex asynchronous to full-duplex asynchronous format.

Using a sliding window technique similar to SDLC makes the protocol more efficient than traditional asynchronous ACK-NAK protocols (**Figure 1**), combining the best of both synch and asynch transmissions. Propagation delays up to 500 ms, often found on satellite or local area network transmissions, slow the protocol very little, since data blocks and ACK blocks are sent on different channels of the full duplex link.

At up to 19.2 Kbaud full duplex, BLAST is faster than even the newer 4800 bps modems for asynchronous transmission over phone lines. This speed allows the protocol to be used over direct connections and LANs. BLAST has also been certified by the Tymnet public network.

Logon and Logoff confirmation, line quality monitoring on screen, control functions and terminal emulation or error-free file transfer modes are part of the package. These facilities are available between any of the machines supporting BLAST for $250 for micros, $495 to $1395 for minis and $2495 for mainframes. Several computer manufacturers are OEMing the product, from TeleVideo to Data General. CRG hopes that with that foothold, BLAST will become a de facto standard for communications.

The universal RS-232 port does, indeed, provide a common interface for communication between all sizes and types of machine. A large number of users of various computers can be linked this way for normal communications. The universal nature of BLAST should make it useful, particularly for connecting the proliferation of PC workstations to larger computers. *– Pingry*

**Write 241**

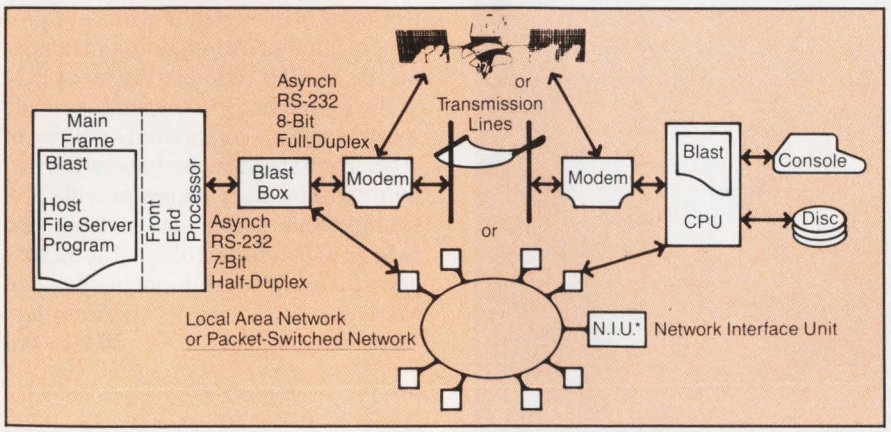



*Figure 1: The BLAST box RS-232 asynchronous line adapter.*

# Graphics Manager Upgrades Workstation Intelligence

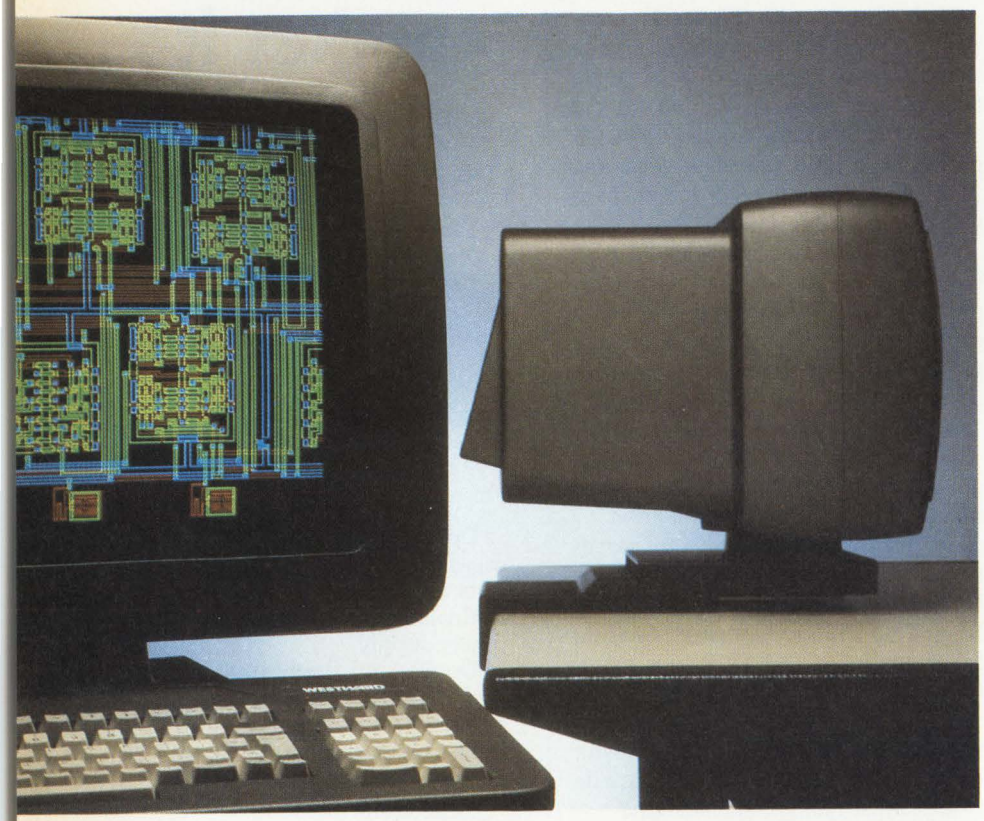



*Figure 1: Westward Technology's 3220W Color Workstation.*

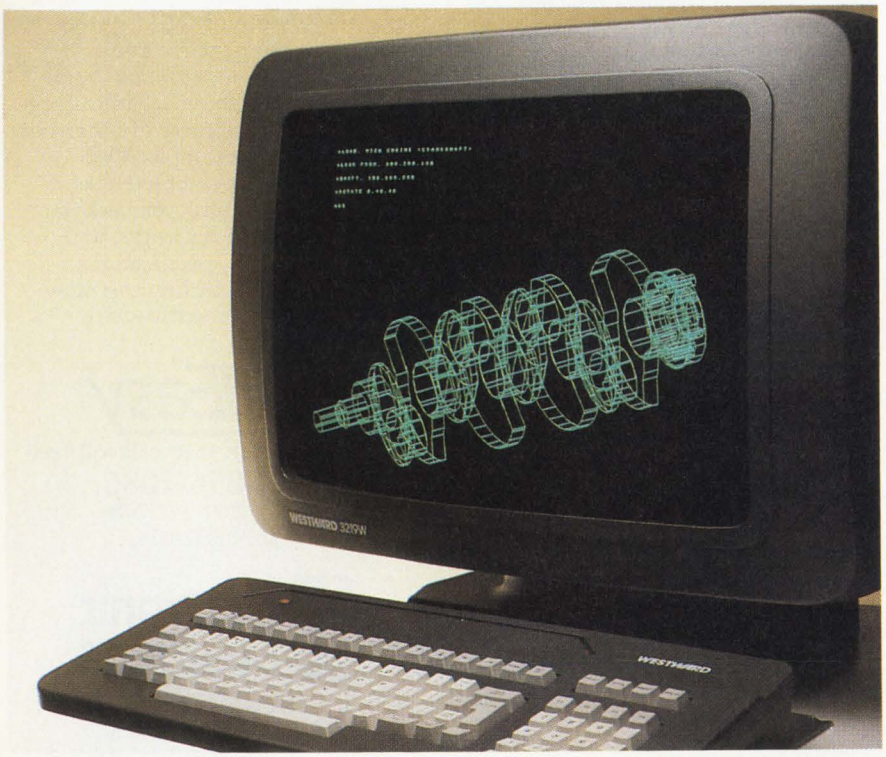



*Figure 2: The 3219W Monochrome Workstation.*

Westward Technology, the Boston based subsidiary of the Telemetrix Group of the U.K., has staked a claim in the graphics workstation market with the 3219W (monochrome) and 3220W (color) workstations aimed at the CAD/CAM professional. Both are driven by a dedicated graphics processor, "the Graphics Manager" which provides a progressive upgrade path to intelligence. Combining both local storage and processing power, the Graphics Manager takes over routine graphics processing work previously performed by the computer.

The 3219W monochrome unit is built on a Motorola 6809E and offers large screen (19″) ultra high resolution raster scan monochrome display of 2048 × 1568. The non-interlaced display using P31 phosphor is refreshed at 57 Hz. An RS232C/ V24 interface operates at up to 38.4 Kbaud. John Roberts, Westward's Sales Development Manager, stated "we think it's the highest resolution display in the world," stressing the 3219's extra memory plane which allows twin buffering and an anti-aliasing technique which provides a solid "no flicker" image. Ergonomic features include tilt, rotate, viewing distance and DIN standard low profile keyboard. The display is software compatible with Tektronix 4014 enhanced by arc, circle, polygon fill, and rubber banding capabilities. The Graphics Manager can accommodate or upgrade to zoom, pan and structured display file management. Options offered for the 3219 provide a second memory plane, 3 levels of gray scale, and two planes; one for display and one for drawing anti-aliasing and software transport. The 3219 is priced at $14,950 which should make it a viable contender in the workstation market.

Westward's 20″ high resolution color workstation is consistant with their promise of ultra-high resolution with its non-interlaced 57Hz refreshed display at 1024 x 784 resolution. Four bit planes provide 16 simultaneous colors from a pallette of 4096. High speed vector generation and four extra memory planes provide 256 simultaneous colors and extends the pallette to 16 million colors. The 3220 is priced at $15,450 and shipments begin in May '84. *–Hanrahan*

**Write 246**

# Tek Emulator With Custom Options

A Canadian entry into the graphics terminal market confirms Canadian manufacturers' intent on participating competitively in the U.S. computer industry. In the graphics terminal area, success differentials are based on resolution and true emulation as opposed to mere compatibility.

Cybernex Ltd. (Ottowa, Ontario) has joined the Tek emulation force with their 1014 Graphics Terminal, a replacement for the Tektronix 4010 12/14/15. The 1014 provides full Tektronix features including 1024 × 780 displayable, 1024 × 1024 addressable resolution.

In addition to features such as Plot 10 compatibility, the 1014 offers a full one megapixel display memory, extra intelligence, and raster scan operation. Cybernex emphasizes the reliability of raster scanned operation and its elimination of flicker with a 60Hz refresh interlacing scheme.

The display itself is a 14″ P39 green phosphor non-glare mesh tube on an optional tilt and swivel stand. Graphics input modes offer cross hair display, a Summagraphics Bit Pad or input from an MCS mouse.

Based on dual processors, the 1014 uses a 6809 for I/O and formatting and a 7220 for graphics drawing.

Hardcopy capabilities allow full resolution output to dot matrix printers with Centronics 352, Epson MX100, and PRISM 132 support. The 1014 also supports a NSCI 3.64.

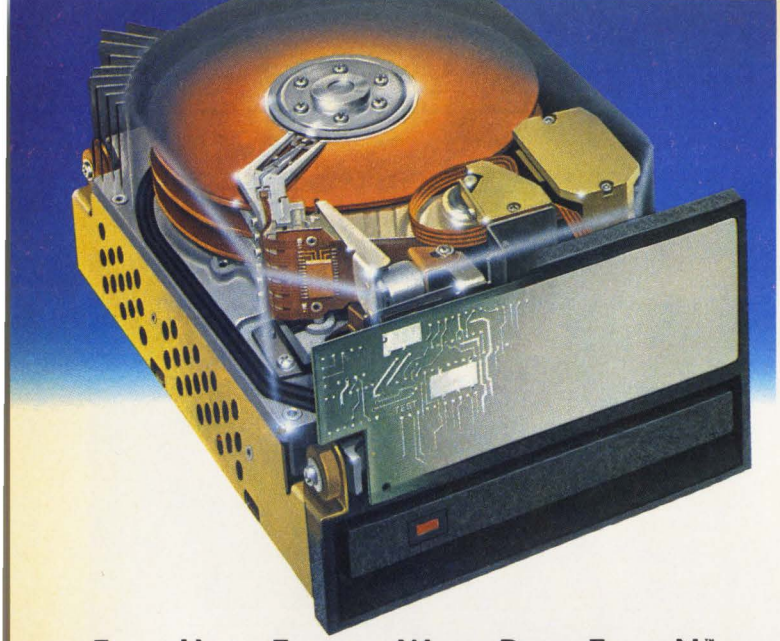
Cybernex has priced its 1014 at $2,795 (qty 1) including additional features at the same Tektronix price. The APL version, Tektronix 4015 emulation, is available as a factory option.

Cybernex also has a line of asynchronous emulators including the SA-830, a Burroughs emulation, and the XM3270, combining IBM and DEC compatibility in one terminal.

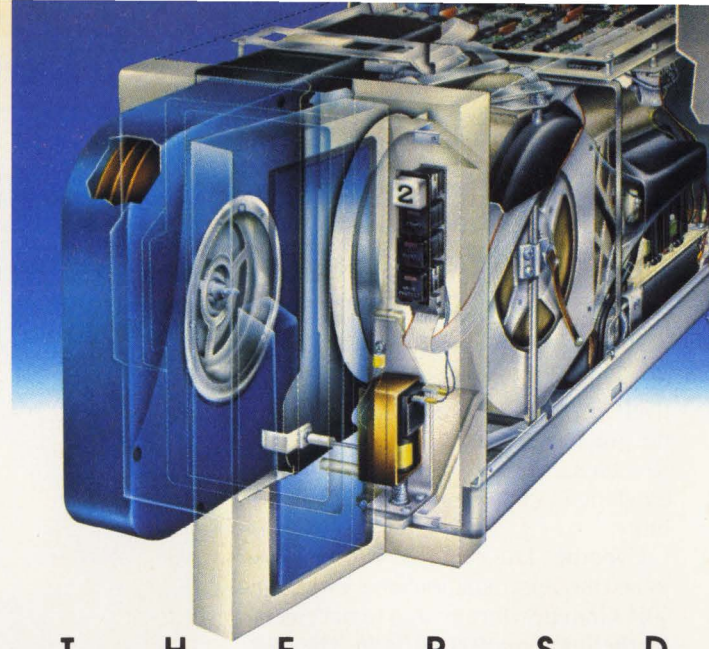
According to Bruce Fox, Director of Marketing, Cybernex will continue to target the plug compatible and system house markets and remain exclusively in intelligent terminals with an emphasis on custom orders. The firm hopes to announce a color graphics terminal at this Spring's CADCON. —*Hanrahan*

**Write 245**

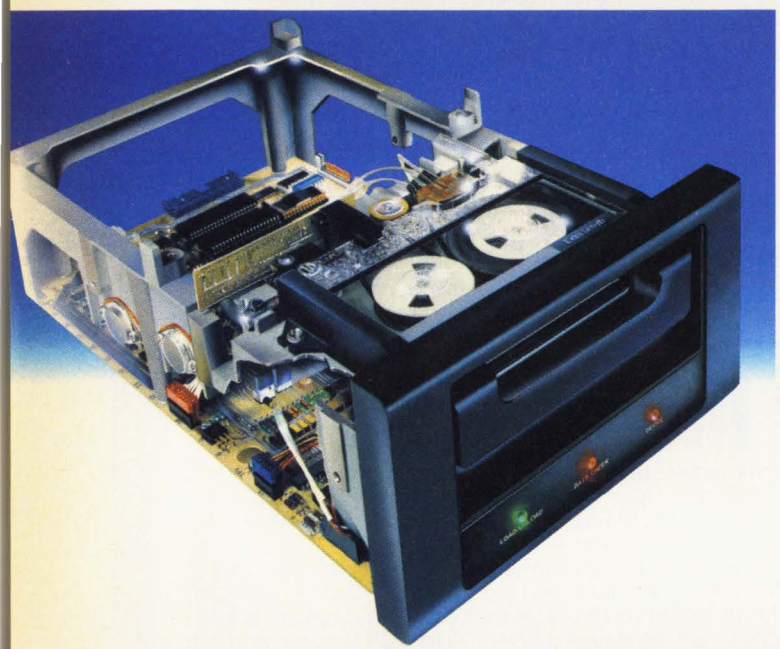
*The Cybernex 1014 is a full replacement for Tektronix 4010/12/14 terminals.*



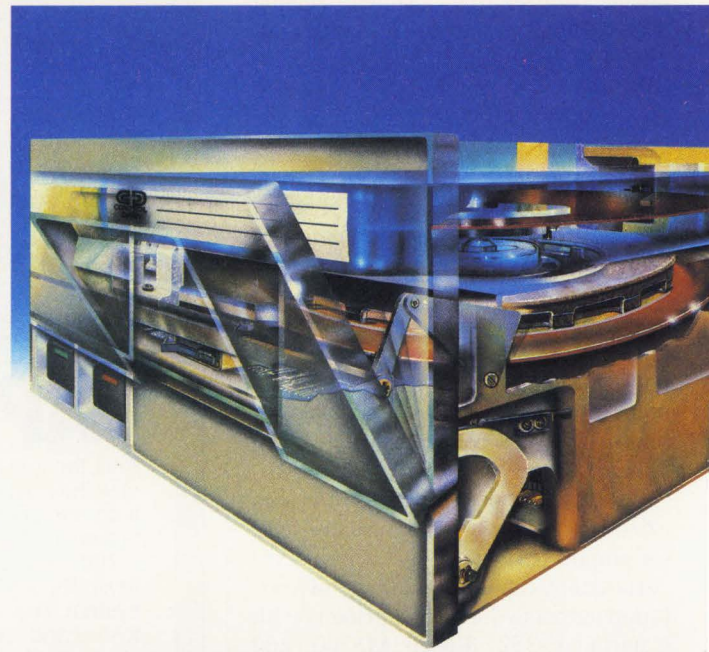
THE WREN™



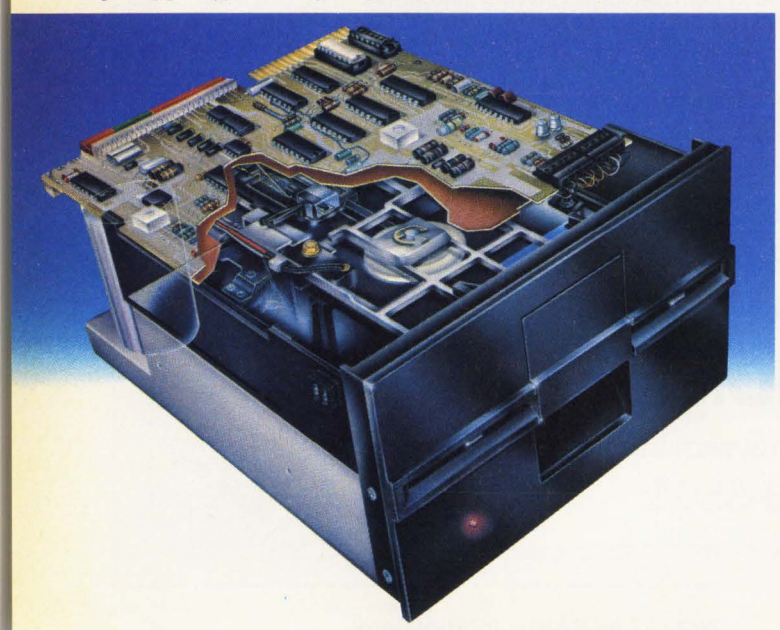
THE RSD



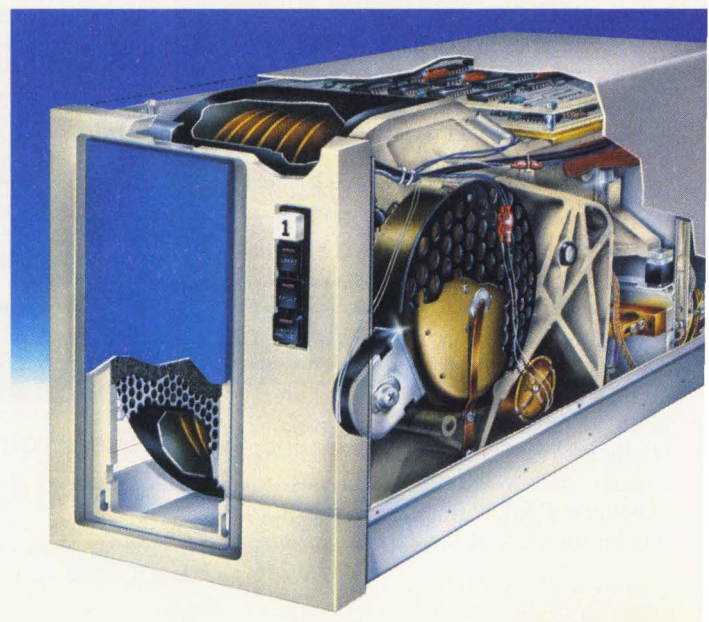
THE SENTINEL



THE LARK™



THE 5-1/4" FDD



THE ESD

# CONTROL DATA: AFTER 25 YEARS, STILL THE LEADER IN THE PERFORMING ARTS.

Designing peripherals with exceptional performance is as much an art as a science. We know. We've been doing it since 1962. From the beginning, we've been dedicated to giving you solutions to on-line and back-up storage needs. Example: the Storage Module Drive (SMD) we introduced became the industry standard for removable media disk drives. The SMD is just one of the high-performance products that helped make us the world's leading independent supplier of storage peripherals.

**We're still adding star performers to our product family.** The LARK with a combined 50 Mbytes of fixed and removable media. The WREN high-performance 5-1/4" winchester drive. The Sentinel 1/4" cartridge streaming tape drive and the RSD that provides 80 Mbytes of removable media in a unit one-half the size of the original SMD.

Today there are more than 35 different products designed to help you meet any storage or back-up requirement, with maximum reliability and low cost of ownership built right in.

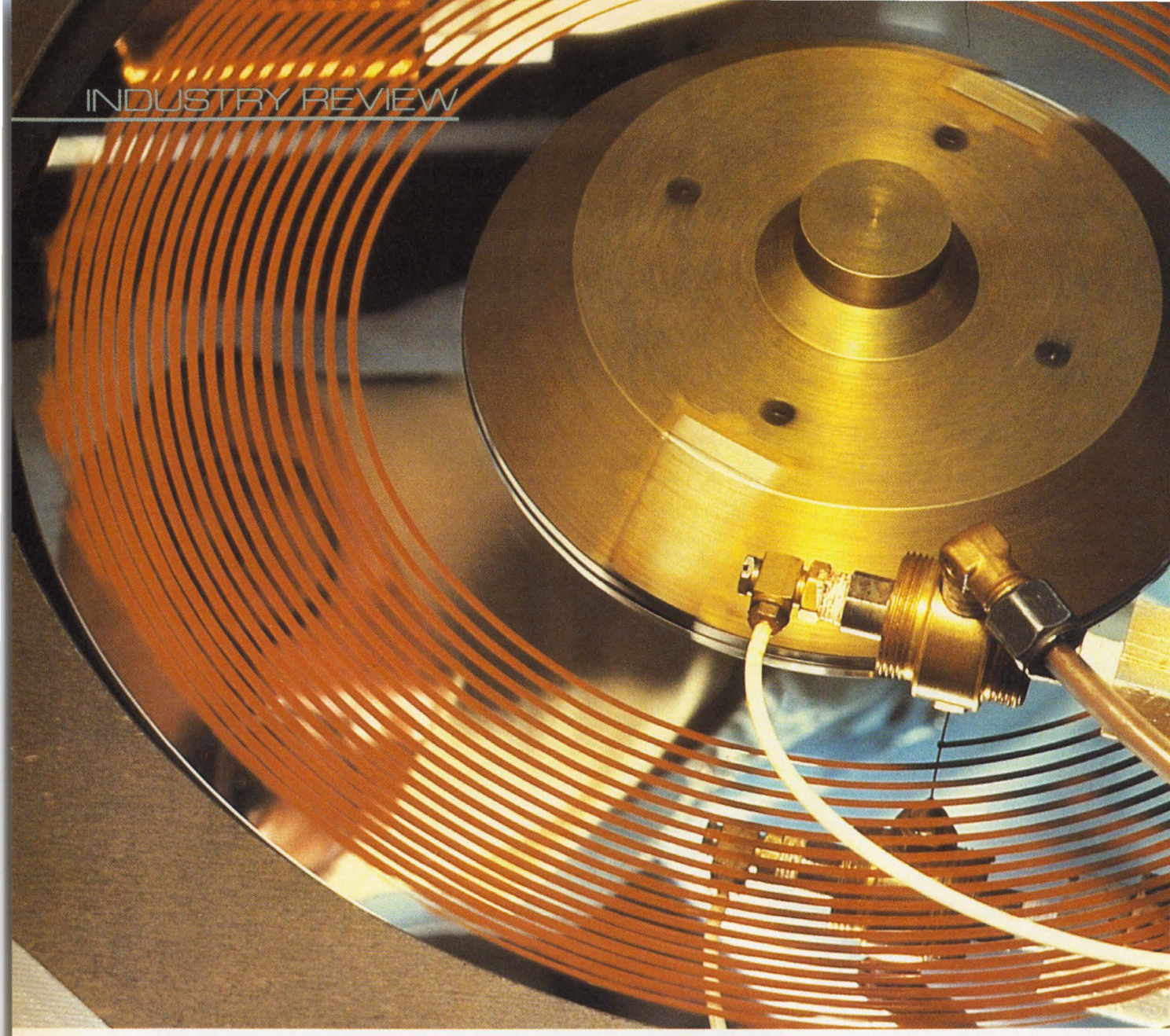
**There's more—the direct support that Control Data offers.** We can deliver maintenance on everything we make. So wherever your customers are, Control Data peripherals can be counted on for less downtime and more productivity than unsupported products. Our spare parts programs help ensure that your reputation for excellent service with your customers is backed to the hilt, 24 hours a day, 365 days a year. In the United States and around the globe.

Add to this the commitment to research, to development and to manufacturing quality that a corporation the size of Control Data contributes, and you're looking at precisely the kind of performance that makes our OEM peripherals top-rated in independent preference studies year after year.


**Every performance needs a program.** We'll send you one **free:** our new 48-page OEM products catalog. Write OEM Product Sales, Control Data Corporation, P.O. Box 0, HQN08H, Minneapolis, MN 55440.

CONTROL DATA

Write 25 on Reader Inquiry Card



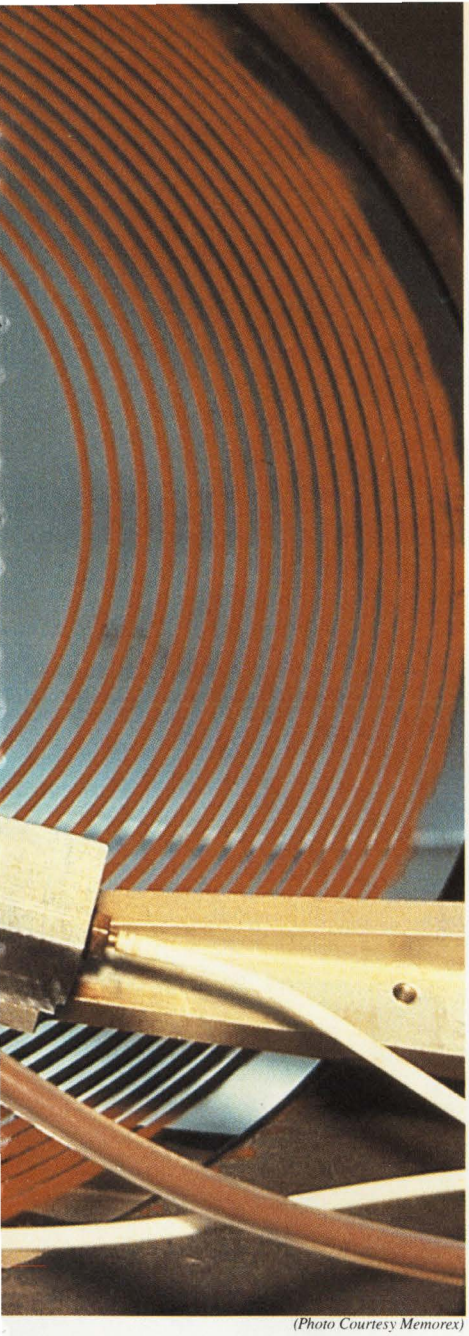
# PCMs Track The Leading Edge Of Winchester Technology

**by Bob Hirshon**

When it comes to mass memory technology, IBM traditionally is at the forefront. From the first flexible disk drive, to their Project Winchester, IBM sets the standard in computer storage.

Rarely, however, can IBM meet the needs of the entire market. In three key areas – price, delivery and technology – plug compatible manufacturers (PCMs) compete with IBM for both end-user and OEM market share. Eighteen months after IBM introduced its last generation mainframe disk drive, the 3350, PCMs were shipping their own enhanced versions of the drive, the 3350, at a reduced price. As a result, they took significant market share from IBM.

But with the 3380, IBM's current generation disk drive, things have been more difficult for the PCMs. "They don't have a lot to offer as far as features beyond the 3380, and since they're so late, about the only thing they'll be able to offer over the 3380 is price," says James Porter, a leading consultant in the field, and author of Disk/Trend reports (Mountain View, CA). "And since they're not going to make nearly as many as IBM," he adds, "and since they're struggling to get into production, they're go-



(Photo Courtesy Memorex)

*Figure 1: Thin-film heads are batch fabricated in lots of up to 500 on a single silicon wafer (Photo Courtesy Memorex).*

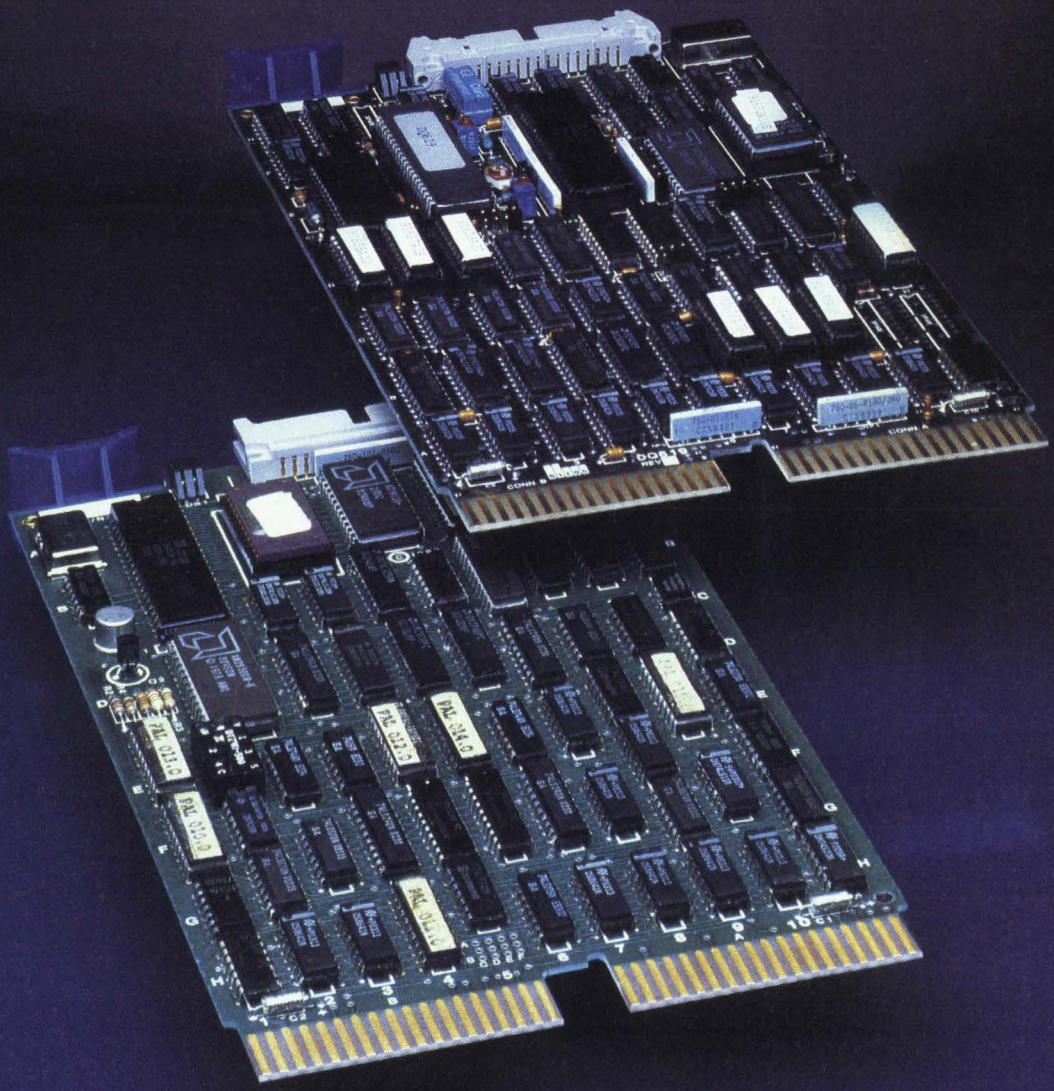
*Plug compatible manufacturers (PCMs) are attempting to follow the lead of IBM's high performance 3380 Winchester.*

ing to have a shorter product life cycle, and that's going to be hard to do."

It has proven more difficult to improve upon or even to duplicate the 3380 than the 3350 for a number of reasons. The use of new technologies – particularly thin-film heads – has made the 3380 difficult to imitate, especially in volume. The economic recession over the past two years, when the 3380 was introduced, is perhaps the most important factor. The new technologies used in 3380-style drives require enormous and expensive changes in production facilities. Even the largest PCMs, because of economy, couldn't afford to make the equipment investments necessary to ramp up 3380-type drive production as quickly as they ramped up 3350 production.

*Bob Hirshon is Contributing Editor, Peripherals, for* Digital Design, *and Editor-in-Chief of* Memory Update *(78 Oldham St., Pembroke, MA 02359), a bi-weekly news journal of memory technology.*

# THE BETTER CONTROLLERS



# AND FOR GOOD REASONS.

**NO OTHER 5¼" OR 8" FLOPPY CONTROLLERS MATCH THEM.**


First, they're both low cost. Yet they employ powerful control and interface electronics for full emulation and operating system compatibility. All completely self-contained on a single dual height PCB. The DQ619 controls the 5¼", SA450 I/O floppy and the Model DQ419 is for the 8", SA850 I/O floppy.

Next, they share standard features you'll need ▪ complete DEC RX02 emulation ▪ RT-11, RSX-11 and RSTS compatibility ▪ and 22-bit addressing for up to 4-megabyte memory access.

And they both include an exclusive feature that extends both media life and drive reliability. It's a DC motor control and associated electronics that unloads the read/write heads and turns off the drive motor following access periods beyond 15 seconds.

There are numerous other features to make your life with a floppy easier, like on-board diagnostics, full sector data buffer, media present monitor, 4-level interrupt that's jumper selectable, on-board bootstrap loader and write precompensation.

Write or call to discover for yourself all the features and benefits these better controllers have to offer.

DILOG

**DISTRIBUTED LOGIC CORPORATION**

12800 Garden Grove Blvd. ▪ Garden Grove, CA 92643 ▪ (714) 534-8950 ▪ TLX 681399
64-A White Street ▪ Red Bank, NJ 07701 ▪ (201) 530-0044
12 Temple Square ▪ Aylesbury, Buckinghamshire, England HP 20 2QL ▪ 44 (0296) 84101 ▪ TLX 837038

**Write 36 on Reader Inquiry Card**

As a result, after two years, some PCMs are just beginning to produce their versions of IBM's 3380 in volume. Others haven't yet gotten off the ground.

## 3380 Technology

IBM introduced their 3370 disk drive in 1979, and the refined higher-capacity version, called the 3380, in 1981. The drives incorporated significant advances in Winchester technology – so significant that some referred to the technology used in the drives by a new name: Whitney technology, after the project's code name. More commonly, it is referred to simply as "latest generation Winchester."

Among the enhancements introduced in the 3370/3380 drives were thin-film heads, low-mass sliders (the assembly that holds the read/write heads), and a data encoding scheme called Run Length Limited Coding (RLLC).

The 3370/3380 series was the first to use thin-film transducer heads. These heads offer performance benefits over standard ferrite heads, and potentially offer lower manufacturing costs, since they can be easily batch fabricated.

The deposited copper "windings" in thin-film transducers are tighter and more consistent than windings done manually on conventional heads. This, plus other improvements in the geometry of the tiny thin-film transducers, results in improved bandwidth, higher resolution, higher signal to noise, and less head fringing (picking up the signal of adjacent tracks). All of this adds up to more bits per linear inch.

Thin-film transducers are deposited directly on sliders by a process similar to semiconductor deposition. One wafer can produce as many as 500 heads (**Figure 1**). As yields have improved in thin-film fabrication, the process has become considerably more cost-efficient than conventional head fabrication, and produces a more consistent product. But starting up a thin-film fabrication line is extremely capital intensive. Consequently, incorporation of thin-film technology was one of the more time- and capital-consuming tasks faced by PCMs, and one big reason they've taken so long to ramp up production.

While thin-film heads had their biggest performance effects on linear bit density, use of extremely stable low-mass sliders and suspensions made it easier to decrease head flying height and increase track density. The 3380 head suspension (**Figure 2**) is far more rigid than conventional head suspensions. This stability means that the heads can be flown closer to the disk surface without fear of a head crash. Flying the heads closer results in a stronger signal with less interference from adjacent tracks.

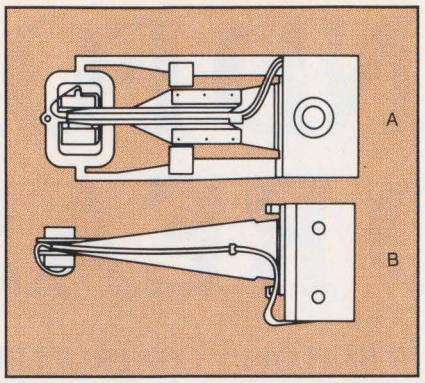



*Figure 2: The Whitney head suspension used in 3380-class drives (A) is lighter, stiffer and more stable than conventional Winchester suspension (B) used in previous drives (Courtesy Amcodyne).*

Encoding techniques help 3380-style drives concentrate more information into a given number of flux changes per inch. By using a scheme called two of seven Run Length Limited Code, 3380-style drives store 1.5 bits per inch for every flux change per inch. Run length limited codes have a limited number of nontransition lengths. Two of seven refers to the minimum and maximum number of consecutive clock cells without a transition.

The results of these technological improvements were a nearly four-fold increase in capacity of the 3380 over the 3350, and a 2.5 times improvement in data transfer rate (**Figure 3**).

## Tracking IBM

PCMs have had their hands full keeping up with these quantum leaps in technology. In 1981, the technical and economic problems associated with following IBM made bedfellows of two rivals PCMs: Memorex and Control Data Corp. The two companies signed an information exchange agreement covering thin-film head technology, to enable them to "more quickly bring to market advanced, cost-effective, data storage products using thin-film head technology," according to the press release announcing the agreement.

A little over a year later, in March 1982, Memorex, CDC, and Magnetic Peripherals (a CDC subsidiary) formed joint venture companies to develop heads and media, chiefly for 3380-class drives.

Memorex and Magnetic Peripherals formed Peripheral Components, Inc., to manufacture thin-film heads. Memorex and CDC started Disk Media, Inc., to research, develop, and manufacture recording media for the drives. The new media would be a thick, heavy substrate platter for greater stability.

By the end of 1982, both Memorex and CDC introduced 3380-class drives and subsystems. And today, after IBM has been in full production for a year and a half, the PCMs are finally ramping up. While Memorex and Control Data decline to give exact figures for the number of drives they'll ship in 1984, they do indicate that the numbers will be in the thousands (over 1000, less than 10,000). Storage Technology claims that they will ship 5000 of their 8380 drives this year (**Figure 4**). Ibis has put its plug-compatible 3380-class drive on the back-burner, but is looking for an OEM willing to help put the drive back in production.

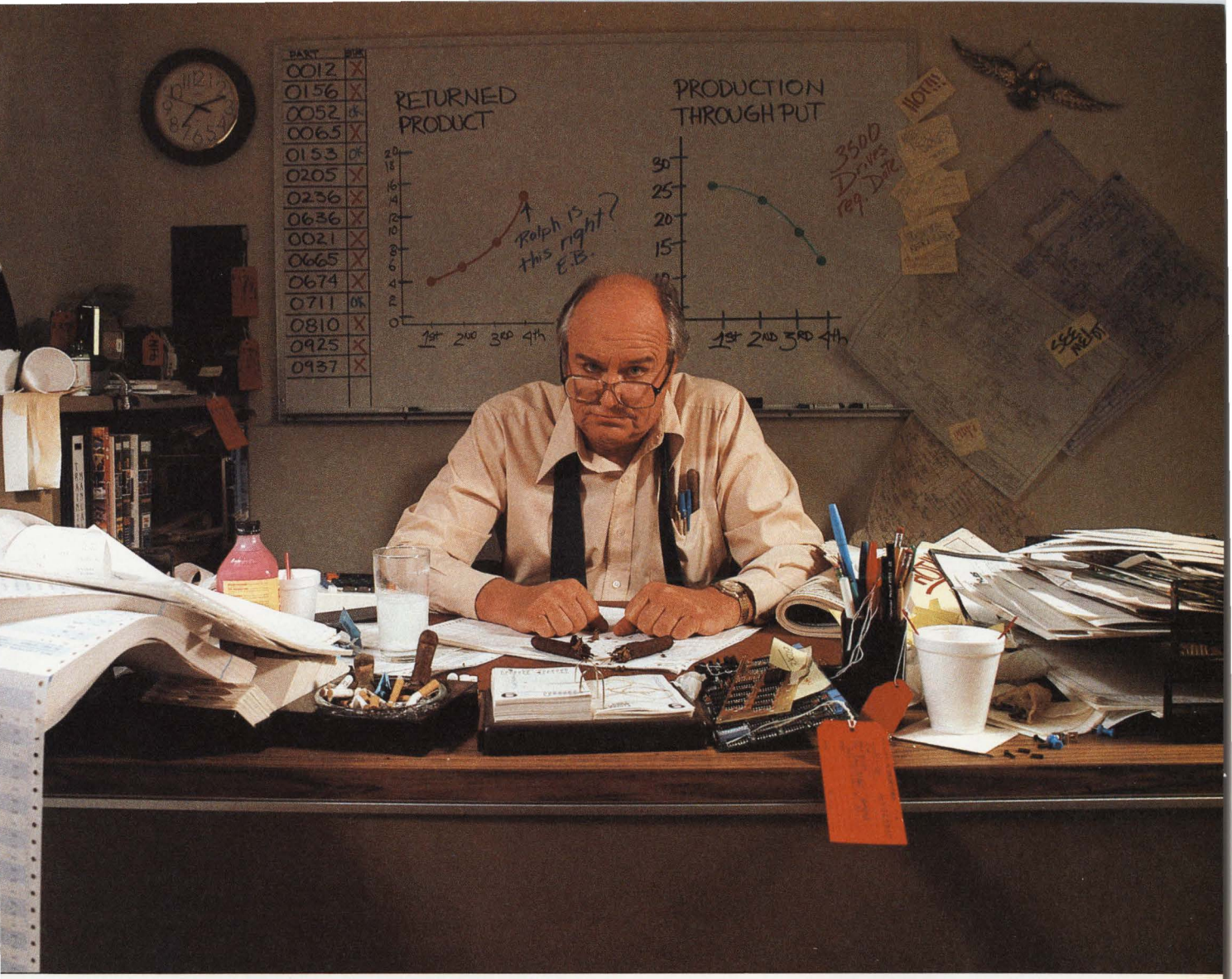
## Why Go PCM?

The question remains, however, why go with a PCM drive when IBM's drives are more readily available? Although all of the PCMs concede that IBM's drives will be more available for an indefinite period, they all claim that they offer price and/or performance benefits that make their drives worth the wait.

To maintain compatibility, all of the PCM subsystems have the same functional specifications as IBM's. All of

*Figure 3: Improvements in technology, such as the use of thin-film heads, low-mass sliders, and RLLC recording, resulted in a nearly four-fold improvement in capacity in 3380-class drives over the earlier 3350-class drives (Courtesy Amcodyne).*

| | Whitney (3380) | Winchester (3350) |
|---|---|---|
| Bits per inch | 15,000 | 6,425 |
| Tracks per inch | 800 | 480 |
| Areal density (Mbits/in$^2$) | 12.0 | 3.08 |
| Mbytes per spindle | 1,260 | 317 |
| Transfer rate (Mbytes/sec) | 3.0 | 1.198 |
| Average access time | 16 | 25 |
| Head flying height ($\mu$in.) | 10 | 18 |




# Why Buy Peripheral Test Equipment?

As Production Test Manager, are you tired of test room bottlenecks? Intermittent test results? Excessive field returns? *Having your Development Engineers building test equipment instead of designing products that* ***produce revenue*****?**

Applied Circuit Technology can provide you with solutions to these and other testing and manpower problems! Our family of easy-to-operate Floppy and Winchester disk drive test equipment can test from 1 to 50 devices *simultaneously*. And, with our user friendly software, you can be assured of consistent product verification.

If you are ready now to break your testroom bottleneck and improve production throughput, call Applied Circuit Technology today!

***WHY WAIT?***

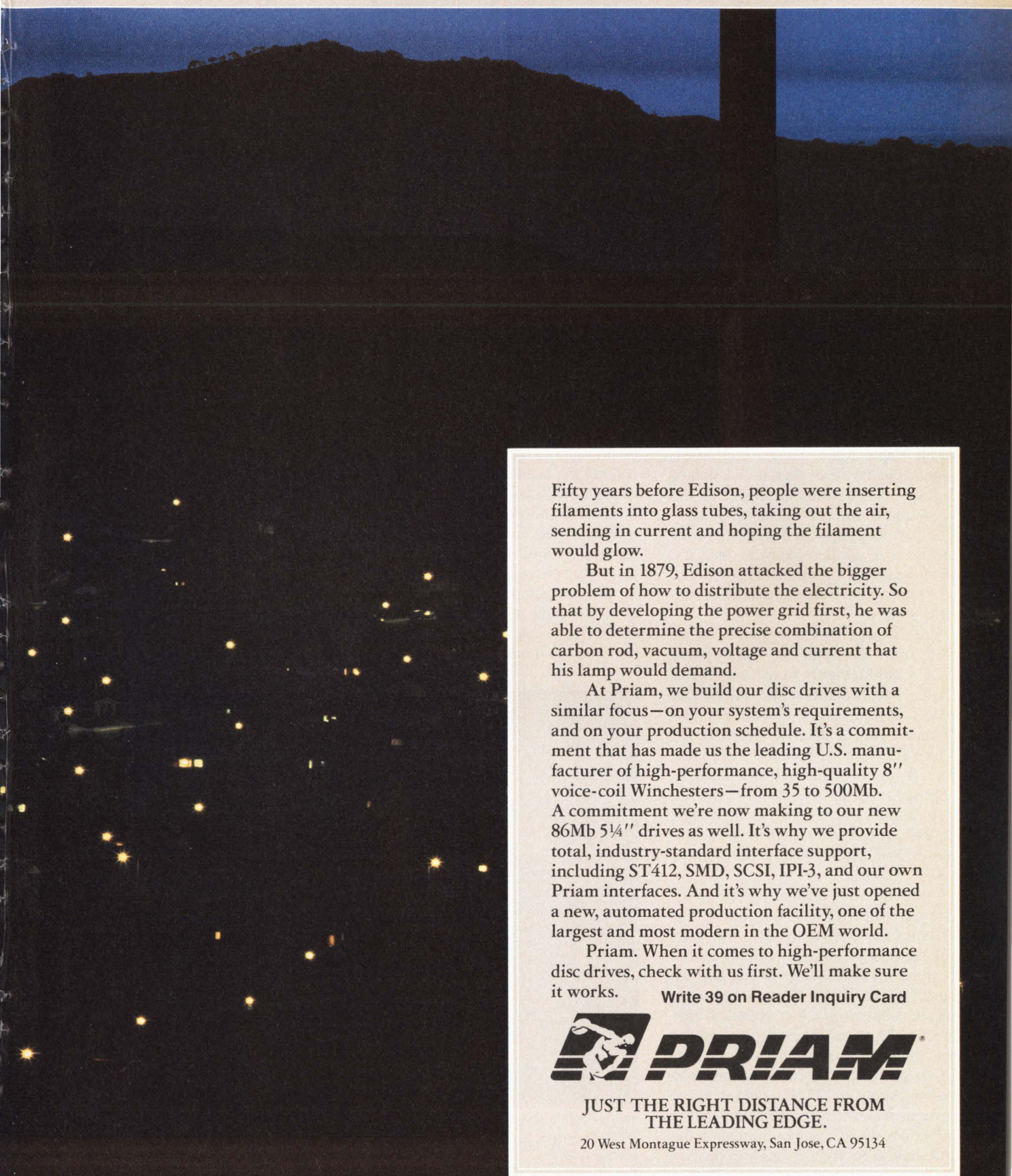
**ACT** **Applied Circuit Technology**

**2931 La Jolla Street, Anaheim, CA 92806**
**714/632-9230 Telex 683466**

**Regional sales offices: San Jose, CA (408) 287-8720; Boulder, CO (303) 466-1763; Boston, MA (617) 272-7370**

# THOMAS EDISON DIDN'T
# HE JUST MA

# INVENT THE LIGHT BULB. DE IT WORK.



Fifty years before Edison, people were inserting filaments into glass tubes, taking out the air, sending in current and hoping the filament would glow.

But in 1879, Edison attacked the bigger problem of how to distribute the electricity. So that by developing the power grid first, he was able to determine the precise combination of carbon rod, vacuum, voltage and current that his lamp would demand.

At Priam, we build our disc drives with a similar focus—on your system's requirements, and on your production schedule. It's a commitment that has made us the leading U.S. manufacturer of high-performance, high-quality 8" voice-coil Winchesters—from 35 to 500Mb. A commitment we're now making to our new 86Mb 5¼" drives as well. It's why we provide total, industry-standard interface support, including ST412, SMD, SCSI, IPI-3, and our own Priam interfaces. And it's why we've just opened a new, automated production facility, one of the largest and most modern in the OEM world.

Priam. When it comes to high-performance disc drives, check with us first. We'll make sure it works.

**Write 39 on Reader Inquiry Card**

PRIAM®

JUST THE RIGHT DISTANCE FROM THE LEADING EDGE.

20 West Montague Expressway, San Jose, CA 95134

the storage modules have capacities of 1.26 Gbytes per spindle, access times of 6 msecs, and data transfer rates of 3 Mbytes/sec. Memorex and Control Data, however, claim that their subsystems offer considerable performance benefits over IBM in high transaction environments.

Memorex' 3680 subsystem (**Figure 5**) features a dual path string controller that, when combined with a feature they call Maximum Availability Path Selection (MAPS), permits simultaneous transfer of data to or from any two actuators in a string. With IBM's 3380, only one actuator per double spindle box can operate at a time, according to Memorex. Although the performance advantage resulting from this feature is environment-dependent, and therefore difficult to quantify, Memorex claims that their benchmark tests have shown increases as high as 20% or more.

Memorex also claims that they have an improved communications architecture with lower overhead, and improved diagnostic capabilities. Diagnostics down to the actuator level permit isolation of failures with a minimal impact on the operation of the rest of the subsystem. The Memorex system also has a lower profile and smaller footprint than the IBM system. Pricing of the Memorex 3380 subsystem is the same as that of the IBM 3380.

Both Storage Technology and Control Data offer discounts for their drives. CDC's 33800 (**Figure 6**) sells for 95% of IBM's 3380. In addition, they offer a dual access option, and a feature they call Dynamic Path Select Extended (DPSE), which is similar to Memorex' MAPS feature. By use of 16 internal data paths, as opposed to IBM's four, performance can be increased considerably in high transaction processing, according to Jim Pastor, Product Marketing Manager for CDC's 33800.

"With the IBM design, you have four internal paths. If any one of the four volumes are translating data, the other volumes in that same internal path cannot be transferring data because the paths are busy," claims Pastor. "Now take a case where volumes one, two, eight and nine are on the same internal path, you're reading from volume zero with the next I/O request, and the data set happens to be on volume one. Their request is going to be queued, because the internal path is busy. In our particular environment, the I/O request in volume one can be executed via the alternate path, because it is in a separate distinct path." Performance benefits claimed by Control Data for their DPSE feature are about the same as those claimed by Memorex for their MAPS feature.

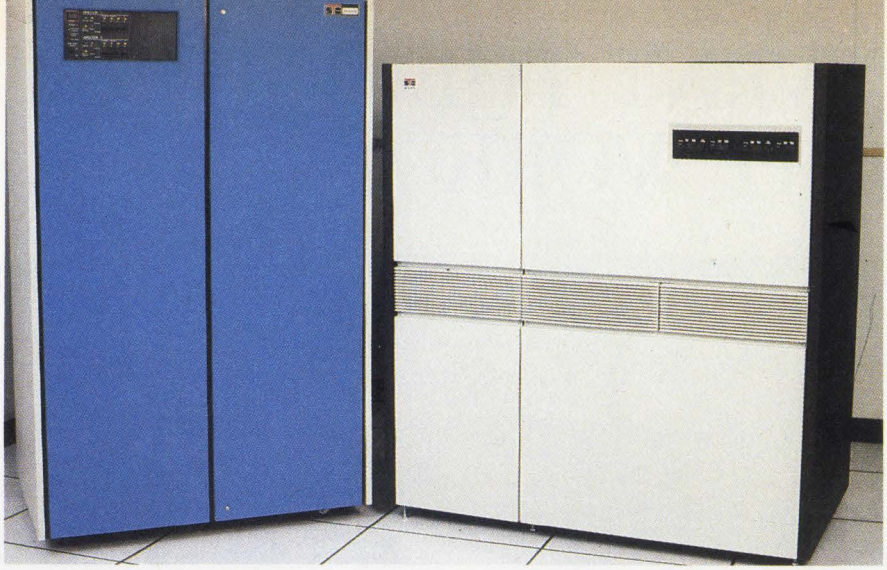


*Figure 4: Storage Technology plans to sell 5000 of its 8380 drives and 8880 controllers in 1984.*

Control Data also claims to have increased reliability and data integrity in their drives. For example, rather than cooling the head disk assembly (HDA) with filtered computer room air, as is done in IBM's 3380, they seal their HDAs in a clean room, and cool them with cooling fans. According to Control Data, this helps keep out contaminants and humidity, providing improved reliability. They also have dual power supplies in their controller – one for each storage director – so that if one supply fails, the second storage director can still function.

## Dual-Density Versions?

Traditionally, after production for a new drive ramps up, either IBM, the PCMs, or both offer a higher density version of the drive. Odds are, the 3380-class drives will be no exception.

It's not clear whether the next iteration of the 3380-class drives will be double-density, or merely increased density drives, according to James Porter. The problems associated with doubling density beyond the already extremely high density of the current 3380-class drives are not trivial. "There are three ways you can achieve double-density," explains Porter. "You can double bits per inch (bpi), double tracks per inch (tpi), or a

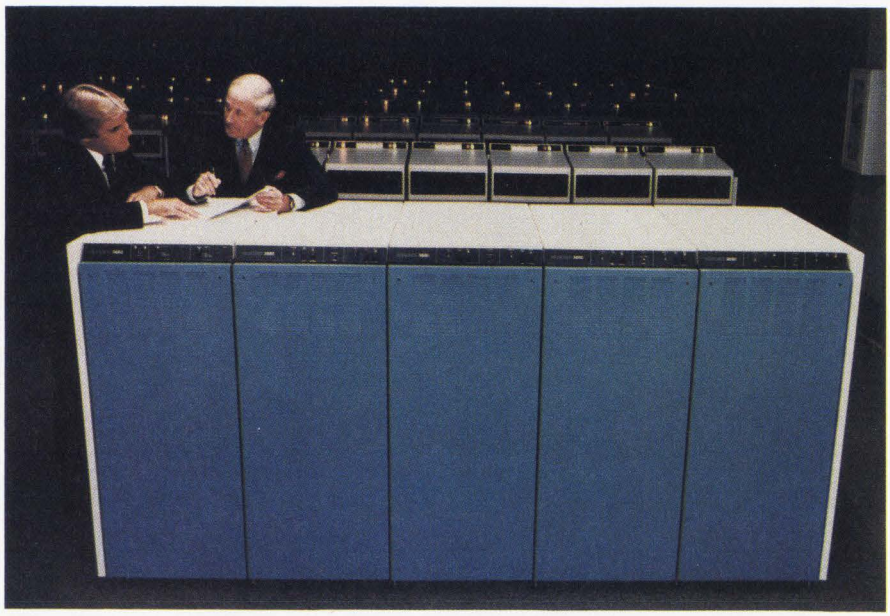


*Figure 5: Although functional specs for Memorex's 3680 subsystem are identical to those of IBM's 3380 subsystem, Memorex claims that their drives offer higher performance in high transaction environments.*

# SyQuest Removable and Fixed Disk Drives Doing more in more applications.

SyQuest Winchester drives—with removable cartridge or fixed media—are working in more applications than any other half-height Winchester. They are giving microcomputers and add-on storage systems a competitive edge. Increasing the utility of portables. Adding another dimension to telecommunications systems. Giving database systems unlimited off-line storage. Helping local networks and multi-user systems share resources.

Increasingly, OEMs and systems integrators are specifying SyQuest half-height drives. Because they get reliable Winchester performance—with fixed disk drives or cartridge disk drives. They fit almost anyplace and are designed to work most anywhere. They use standard Winchester controllers and interfaces.

SyQuest can help your system applications do more for less. For product information, circle our reader's service number. For delivery and pricing information, call us direct.

**SyQuest Technology**
47923 Warm Springs Blvd.
Fremont, California 94539

Telephone: 415-490-7511
Telex: 910-381-7027

Distributed by Hamilton/Avnet

*To maintain compatibility, all of the PCM subsystems have the same functional specifications as IBM's.*

combination of two." Each of these methods has its advantages and disadvantages.

Doubling bpi means changing the media to sputtered or thin-film, says Porter. In addition, the higher linear density will result in a correspondingly higher data transfer rate, which will make the drives incompatible with existing controllers.

Doubling tpi would maintain compatibility with current controllers, but would require a leap beyond the state-of-the-art in head positioning accuracy. "The industry's state-of-the-art today of production drives is 1000 tpi, in advanced drives," says Porter. "There's some talk of going to 1200, but to go to 1600 terrifies most mechanical engineers."

A combination of increased bpi and tpi would be the easiest to accomplish technically, but it carries disadvantages of both methods: incompatibility with current controllers, and less insurmountable but still considerable problems with head positioning.

Because of these difficulties, Porter believes that IBM may elect not to double density, but rather to increase it by some percentage – perhaps 40% or 50% – in their next offering. Certainly, with the PCMs taking so much time to ramp up production of standard 3380-class drives, there's little pressure on IBM to offer an enhanced version.

Although the PCMs are not currently eager to produce a double-density version of the drives, once they increase their production of the standard drives sufficiently, they may be in a better position than IBM to go double-density. They seem to have designed their drives with double-density in mind. "If you look in our controller, you see acres of open space. You realize immediately that the thing was designed to go double-density," says one PCM spokesman. "Either you've put room in there to hang your coats on, or your planning something else."

But all of the PCMs are waiting to follow IBM's lead. If IBM offers a 40% increase, they claim they'll offer a 40% increase. If IBM goes double-density, they'll go double-density. Would anything prompt the PCMs to try to beat IBM to the gun? "No," says CDC's Pastor. "Not unless our patience wears out." □

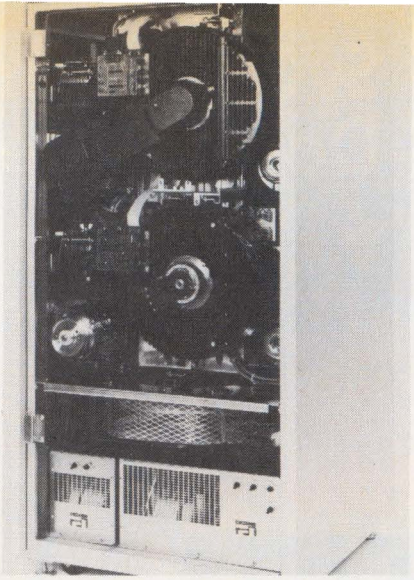


*Figure 6: Each CDC 33800 unit holds up to 2.52 Gbytes of direct access data. Each of four actuators (shown) accesses 630 Mbytes, and is separately addressable.*

## 3380-Class Disk Drives

For more information on 3380-class disk drives, write in the appropriate number on the *Digital Design* Reader Inquiry Card.

| | |
|---|---|
| **Amdahl Corp.** | Write 304 |
| **Control Data Corp.** | Write 305 |
| **Fujitsu America** | Write 306 |
| **Ibis Systems** | Write 307 |
| **IBM** | Write 308 |
| **Memorex** | Write 309 |
| **National Advanced Systems** | Write 310 |
| **Storage Technology Corp.** | Write 311 |

**How useful did you find this article? Please write in the appropriate number on the Reader Inquiry Card.**

| | |
|---|---|
| Very Useful | 612 |
| Useful | 613 |
| Somewhat Useful | 614 |

A DRAMATIC ADVANCE IN HALF-HEIGHT WINCHESTERS...

# STRAIGHTALK

With all the claims and counter-claims regarding capacities, availabilities and shipments of half-height 5.25" Winchesters, it's sometimes difficult to determine the facts.

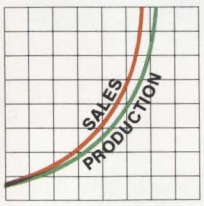
**FACT.** In early 1983, Microscience asked over 40 OEMs to participate in a 120-day evaluation program of our HH-612 10 MB half-height drives.

We randomly selected 150 drives for these field tests.

The evaluation proved that Microscience has the performance, quality and price today's small business and portable computer manufacturers demand.

**FACT.** Microscience ended 1983 with a significant order backlog. We could have shipped more, but we will not sacrifice quality for quantity.


Our returns are less than 1%. Every drive undergoes rigorous testing in our advanced, computer-controlled test facilities.

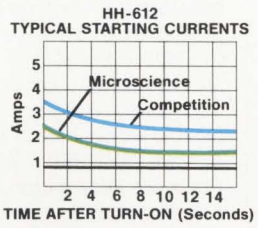



**FACT.** Microscience is rapidly expanding its highly automated manufacturing operation in California.

By the end of the first quarter, 1984, we will be able to meet more of the demands of large OEMs and distributors. And by the end of the year we will have expanded production by a factor of five.

Until then, when we commit to a quantity and shipment date, those commitments *will be met*. No ifs... no ands...no buts.

**FACT.** Microscience disk drives have extremely low voltage requirements...the lowest in the industry.



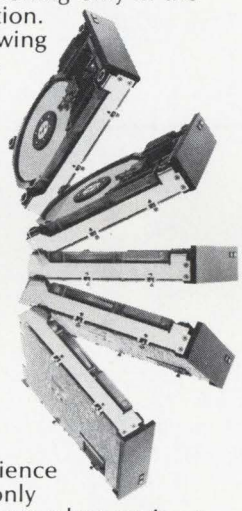

Small business and portable computers don't have the luxury of a lot of excess power capacity.

In every stage of our design we used procedures and components that would be misers with power yet still provide long-term performance and reliability.

**FACT.** Microscience drives aren't limited to functioning only in the horizontal position.

With the growing use of portable computers and increasingly compact packaging, we designed our stepper motor and head carriage assembly to permit flexible placement of the disk drive.

Positioning that is best for you, not us.



**FACT.** Microscience engineers use only proven technology advances in an innovative manner to produce disk drives that perform reliably.

That's why we incorporated plated media, microprocessor-controlled spindle motors and servo-positioning, embedded guard bands, extensive self-diagnostics and optional signal processing.

Plated media will stand up to the rigors of portable computer usage.

Microprocessor-controlled servo-positioning keeps the heads precisely on track by reading servo information written in the gaps on both sides of each data track.

Microprocessors constantly monitor drive performance and report irregularities to the user. They make repeated checks during operation and test themselves during Power Up.

Media-embedded guard bands keep the carriage head from exceeding pre-determined limits and protect the drives against "wall crashes."

Microscience uses only standard, off-the-shelf mechanical and electronic components in our drives so we can meet your demands as your system sales grow.

And, every component is second-sourced to ensure tested and approved availability.

**FACT.** In addition to our 10 MB half-height Winchesters, we have several other major advances in development.

But we will not announce them until they have been thoroughly tested and proven in our manufacturing and test operations as well as in the field.

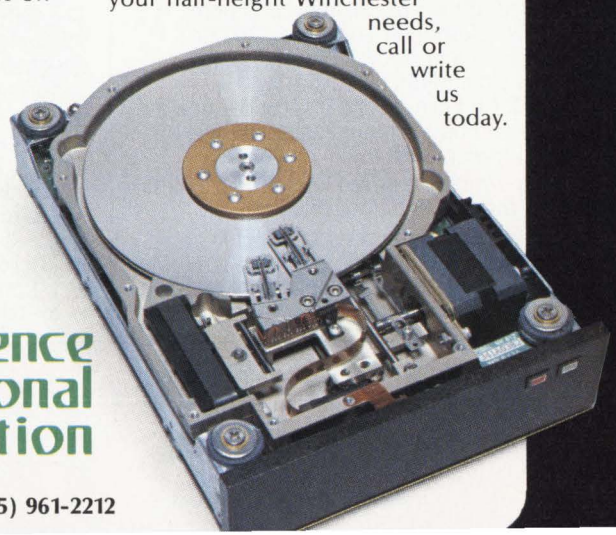
When we say they are available later this year, they *will be* available.

**FACT.** Microscience has one of the best, most responsive support teams of engineers available in the industry today.

We will not vie for your business on price alone.

We are concerned with providing a product that is reliable... a product that has extensive capabilities and expanded performance... a product we can deliver in volume... and a product we can produce for you at a fair price.

For more straight talk regarding your half-height Winchester needs, call or write us today.



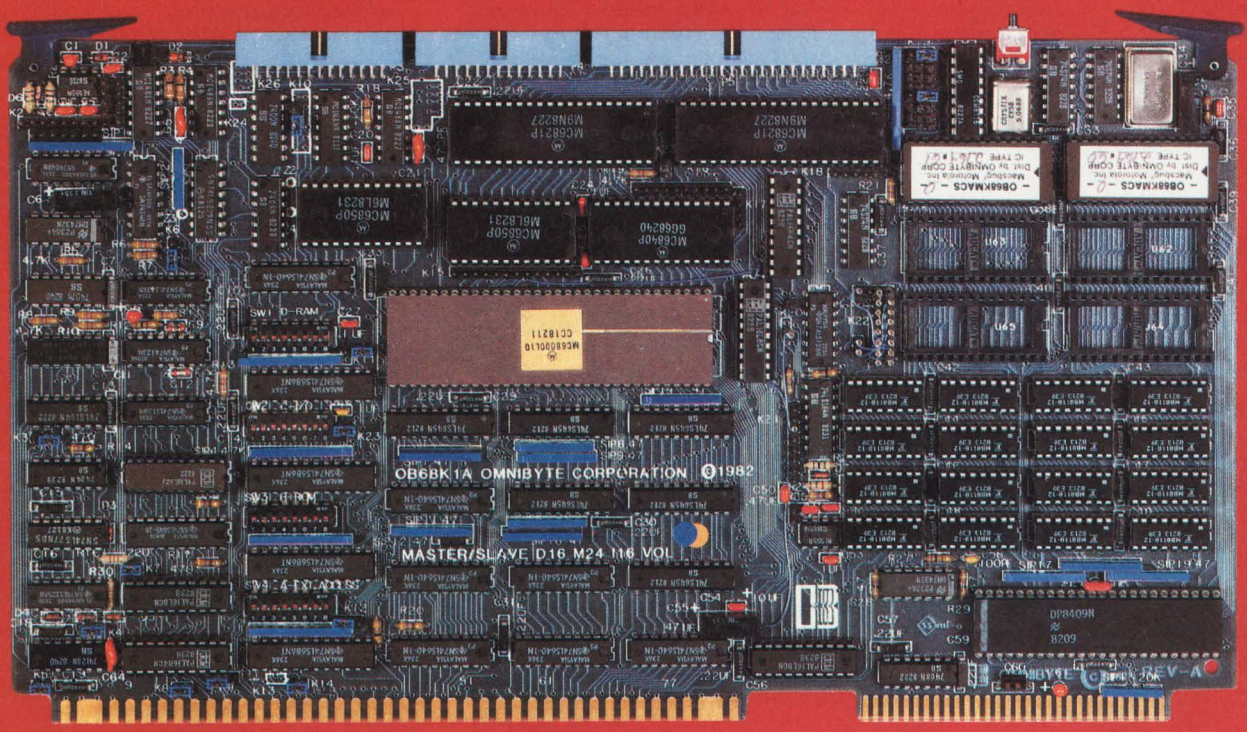
**Microscience International Corporation**

**575 E. Middlefield Road**
**Mountain View, CA 94043 (415) 961-2212**

**Write 55 on Reader Inquiry Card**

# OMNIBYTE™

## Performance so reliable we back it with a 2-year warranty.




OB68K1A – 10MHz, 16/32 BIT

### How Can We Do It?

Our confidence in the product you receive from Omnibyte begins with a solid, well thought-out design. All non-socketed components are pre-burned-in and pre-tested.

All our boards pass these extensive tests:

- A thorough visual inspection of all completed P.C. board assemblies.
- Bed of nails testing on our Zehntel Troubleshooter Automatic Testing Equipment (more complex boards).
- In-circuit Functional Testing.
- 72 hr. burn-in at 65 °C. under power.
- A second in-circuit Functional Test following Burn-in.

Each Omnibyte board level product must pass these tests before shipping.

Is it worth it? The results speak for themselves.

- Less than 1% of our boards are returned for repair.
- In over 90% of the cases where a return is necessary, your board is repaired, tested and sent back to you within 24-48 hours.

Reliability is only one of the benefits of our board level and system products. They are loaded with state-of-the-art features like those on our OB68K1A shown above.

The OB68K1A is an extremely powerful stand-alone microcomputer board. It is designed for applications requiring high performance at lowest cost.

Important features include:

- 10MHz 68000 16/32 BIT CPU.
- 32K/128K/512K-bytes of dual-ported zero wait state on-board RAM.
- Up to 192K-bytes of EPROM.
- (2) RS232C serial ports.
- (3) 16-BIT timer/counters.
- (7) prioritized-vectored interrupts.
- Switch selectable memory mapping.
- Software/hardware selectable baud rate generator (50-19.2K Baud).
- Directly addresses 16M-bytes.
- IEEE-796 (MULTIBUS)** compatible (MASTER/SLAVE D16 M24 I16 VOL).
- Low noise multilayer design.

### SOFTWARE SUPPORT

A variety of software packages are available for the OB68K1A. They range from the optional VERSABUG* or MACSBUG* monitor/debuggers to Realtime Executive and Target Operating Systems in silicon.

At Omnibyte, quality control is extremely important, resulting in performance so reliable we back each and every board level product with a 2-year warranty.

For more information, ask for our free summary sheets or send $10 for a detailed technical manual. Contact Sue Cochran, Sales Manager.

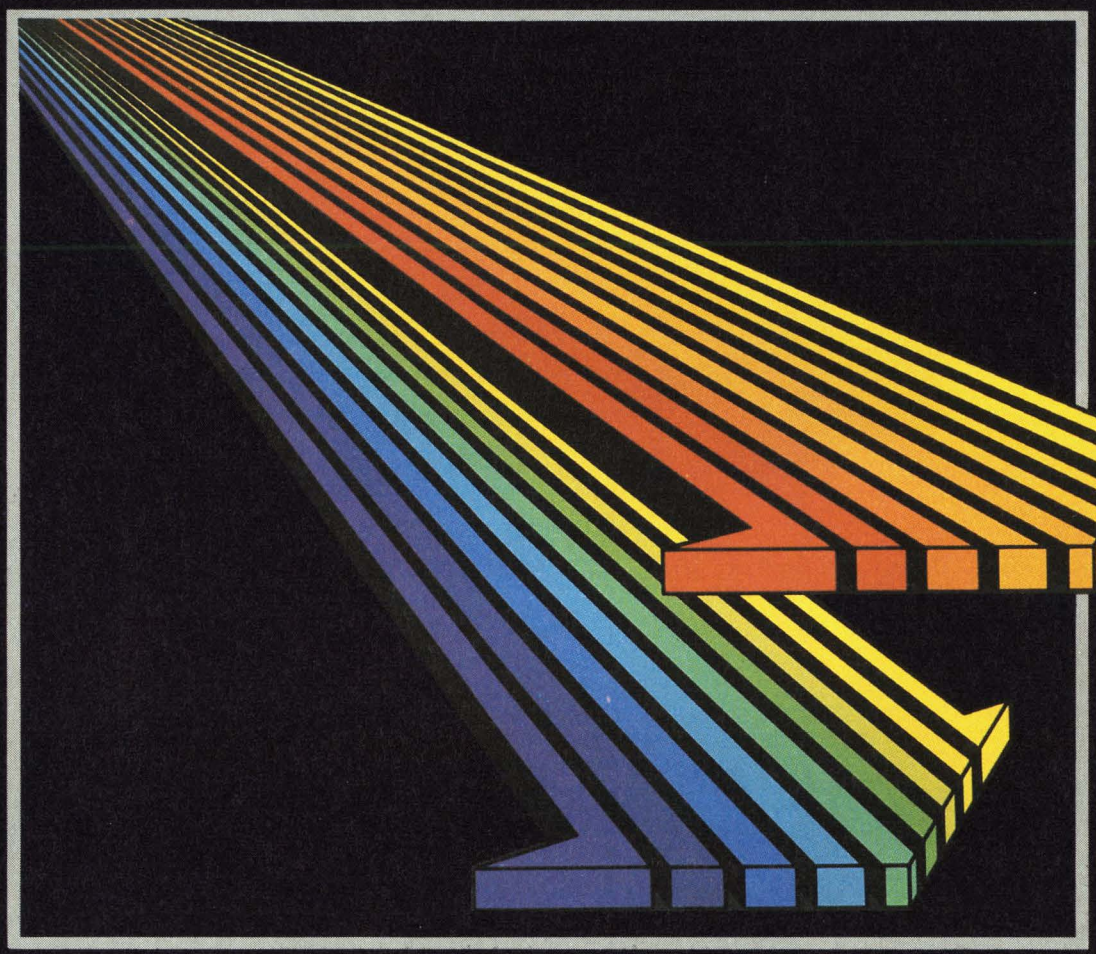
*A Look at Today. . .*
*A Vision of Tomorrow.*

**Write 51 on Reader Inquiry Card**

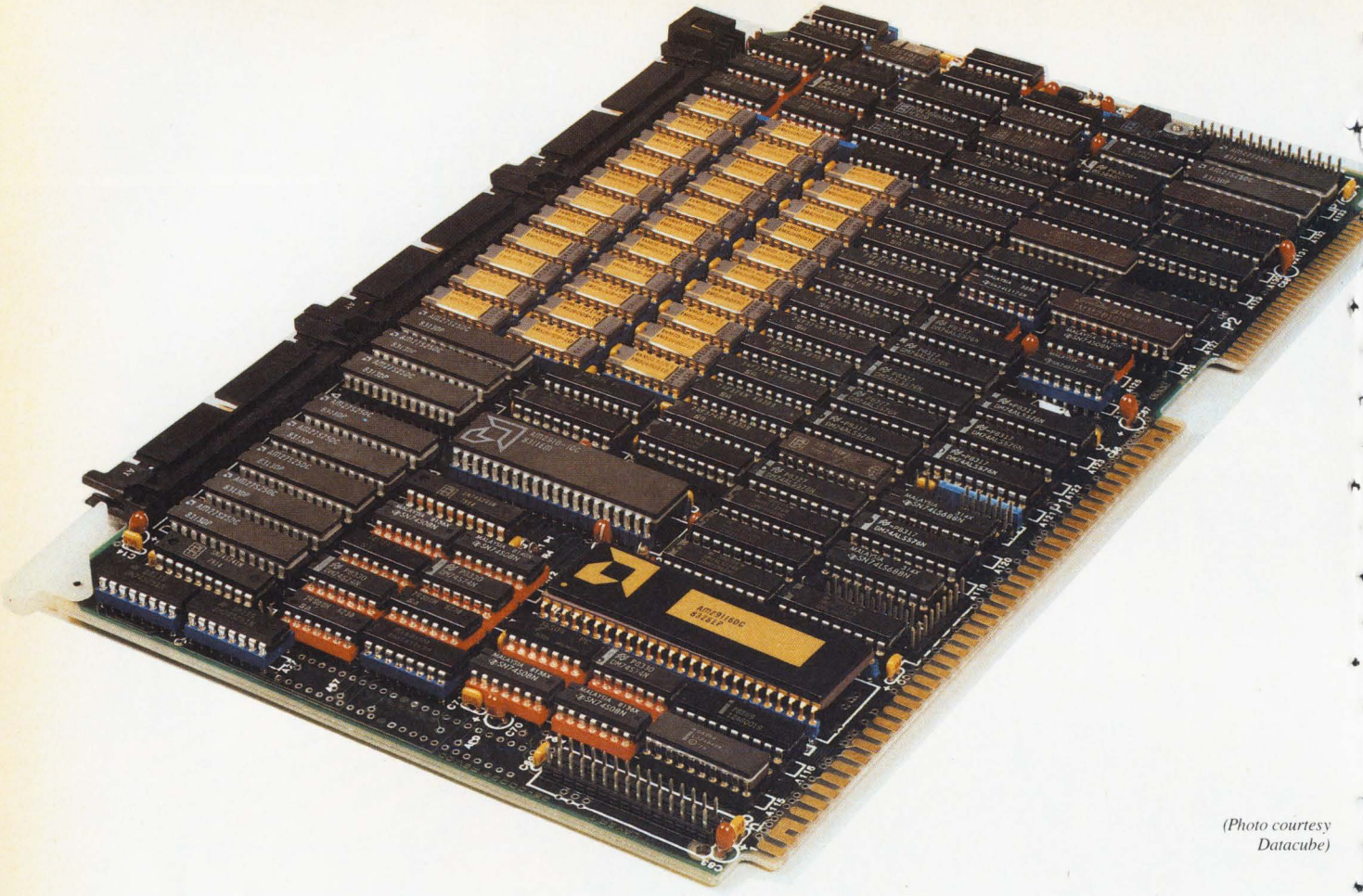

™OMNIBYTE CORPORATION
245 W. Roosevelt Rd.
West Chicago, IL 60185
(312) 231-6880
Intl. Telex: 210070 MAGEX UR


*MACSBUG, VERSABUG & MC68000 are trademarks of Motorola, Inc.
**MULTIBUS is a trademark of Intel Corporation. 

Designer's Guide Series



# MULTIBUS



*(Photo courtesy Datacube)*

# Designer's Guide To The Multibus

*(Preceding page photo courtesy Intel Corp.)*

**by David Wilson, Senior Technical Editor**

Even before the dust settled on the specification for Intel's Multibus II, some manufacturers started to design products around the new architecture. As a result, some computer systems are expected to be introduced later this year that will beat Intel to market on their own bus. This unprecedented embracing of the new bus is no less phenomenal than the recent activity that has produced a plethora of products – both at the board and system level around Multibus I – making it the most popular in the 16-bit world today. Part of the success is due to the acceptance of the Multibus in both the industrial/scientific and commercial environments – two distinct application areas.

In the industrial world, highly integrated board level solutions provide for both increased reliability, decreased cost and greater functionality, albeit at a lower performance than the commercially partitioned approach to systems design. Aimed at the process control and industrial automation environment, Intel's latest announcement of a 186-based CPU board that incorporates a SASI controller, endorses this philosophy and should go some way to protect the company against third parties who may have been offering SASI controllers as a separate item.

*In the industrial world, highly integrated board level solutions provide for both increased reliability, decreased cost and greater functionality.*

# Who gets blamed when your applications grow and your single board computer doesn't?

Choosing a Single Board Computer (SBC) isn't easy. First, you've got to make sure that the SBC you choose is right for the job you're doing now. With enough speed, memory and flexibility to do what you want.

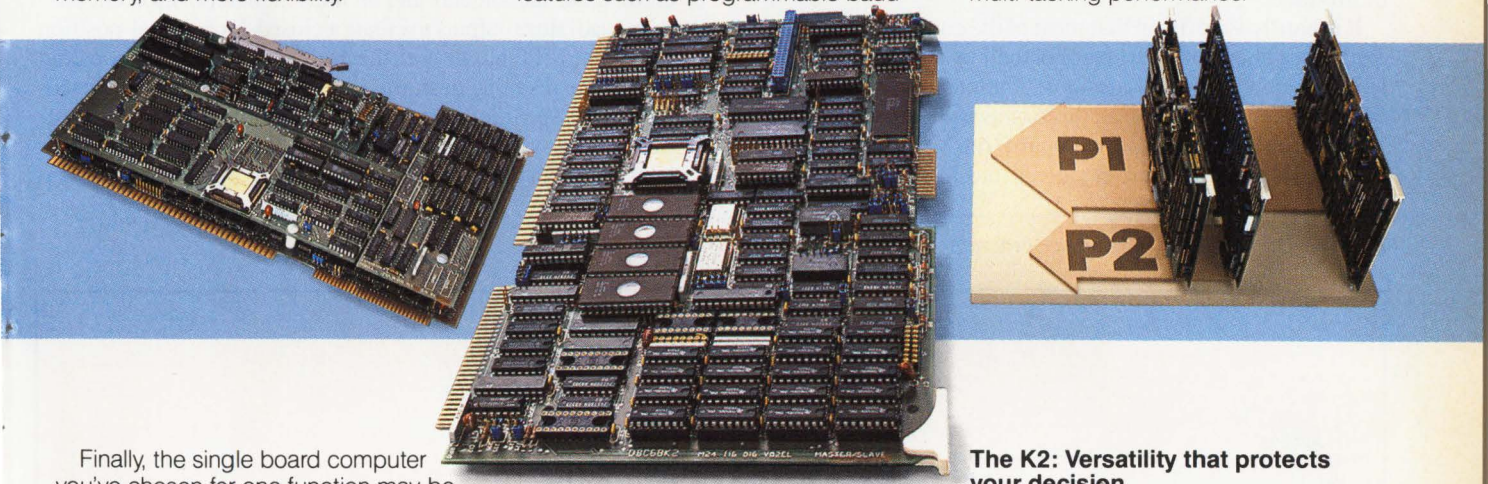
Next, you've got to make sure that you look far enough ahead, because what may have seemed like a simple enough application at the start can grow very quickly. Suddenly, you need more speed, more memory, and more flexibility.

Multimodule interface, capacity for 128K bytes of PROM, and Microbar's unique Dual Bus™ architecture. That's the basic DBC68K2, the K2.

You'll also get–standard with the K2–features such as programmable baud rates, two 16-bit timers, two RS232C serial ports with asynchronous and synchronous protocols, and dynamically-selectable byte-swapping and word reversing.

munication between the CPU and all that off-board memory on the P2 connector. With data transfer between memory and other processors handled on the P1 path.

Which means you can "add off"–add more memory boards that back up the K2's on-board memory. Or add other SBCs, with their own processors and memory, for very high-powered computing applications that demand multi-user, multi-tasking performance.




Finally, the single board computer you've chosen for one function may be called on later to handle completely different tasks as well–not just word processing, for instance, but graphics computation, communications, process control or data base management.

In other words, the computer that's at the heart of your system must be the right choice for now, the right choice as your applications grow, and the right choice as your applications change.

**Begin with high performance**

You won't go wrong starting with the powerful Motorola MC68000 microprocessor, in 10 or 12 MHz versions, 128K bytes of dual-ported on-board memory, the iSBX™

**The K2: The SBC with Add-Ons**

Then add on RAM modules that boost on-board memory to 256Kb or 512Kb, the SBX-compatible parallel I/O module from Microbar, or any of the wide variety of available SBX modules. And, you can add on your choice of memory management options–either a segment-oriented (68451) or 2-level page-oriented MMU. That means you can support high performance operating system software such as XENIX.™

**The K2: The SBC that also "Adds Off"**

Because of Microbar's clever use of the IEEE 796 bus architecture, you also get the advantages of direct high speed com-

**The K2: Versatility that protects your decision**

So if you've got the responsibility for choosing an SBC that's right for today's *and* tomorrow's systems, choose Microbar's DBC68K2. With its add-on and add-off flexibility, and its performance versatility, you'll know the K2's the board that will grow as your applications grow. Call or write **Microbar Systems, Inc. 1120 San Antonio Rd., Palo Alto, CA 94303, 415/964-2862, Twx: 910 373 2047**

MICROBAR SYSTEMS, INC.

iSBX is a trademark of Intel Corporation
Dual Bus is a trademark of Microbar Systems, Inc.
XENIX is a trademark of Microsoft Corporation

Indeed, the area of disk controller design will become an increasingly important area to system performance enhancement in the near term. Some Multibus designs already on the market have achieved increased performance by the adoption of new intelligent peripheral interfaces.

Distributed Computer Systems (Waltham, MA), for example, offer a system product, the DCS 86, based on standard Multibus modules, several different software environments and I/O interfaces. In the low-end disk environment, DCS utilizes the SASI standard interface, and in the larger disk environment (above 36 Mbytes), the Control Data Intelligent Standard Interface is implemented. The new interfaces allow the user to upgrade the system by adding a new disk drive with little or no change to the remaining system hardware or software as the technology of disk drives improves. Other controller and subsystem houses are preferring to hold back before committing to designs, until market forces determine which of the new interfaces will gain the greatest acceptance.

Until recently, the industrial systems integrator may have had to rely on in-house expertise to produce some custom board products to complete his design, especially in the analog or I/O area. On the Multibus, however, this requirement is decreasing and a wide variety of boards exist to alleviate some, if not all of these problems. In the analog world, for example, Analog Devices, Burr-Brown and Data Translation offer a wide variety of products.

It is hardly surprising that most of the conventional discrete analog suppliers take advantage of their own in-house products to complement Multibus designs. Analog Devices (Norwood, MA), for example, has used three of its own AP1216 devices in its new three channel resolver board (the MCI-1794) that converts Inductosyn or resolver signals into 12-bit resolution data words for computer-aided numerically-controlled machine applications.

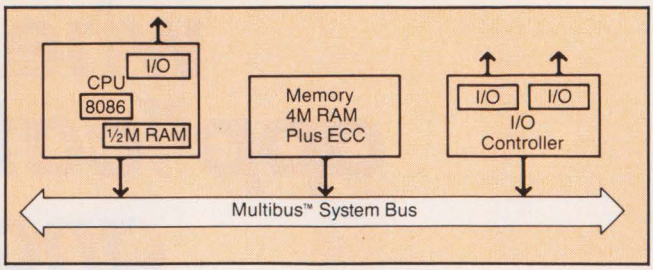
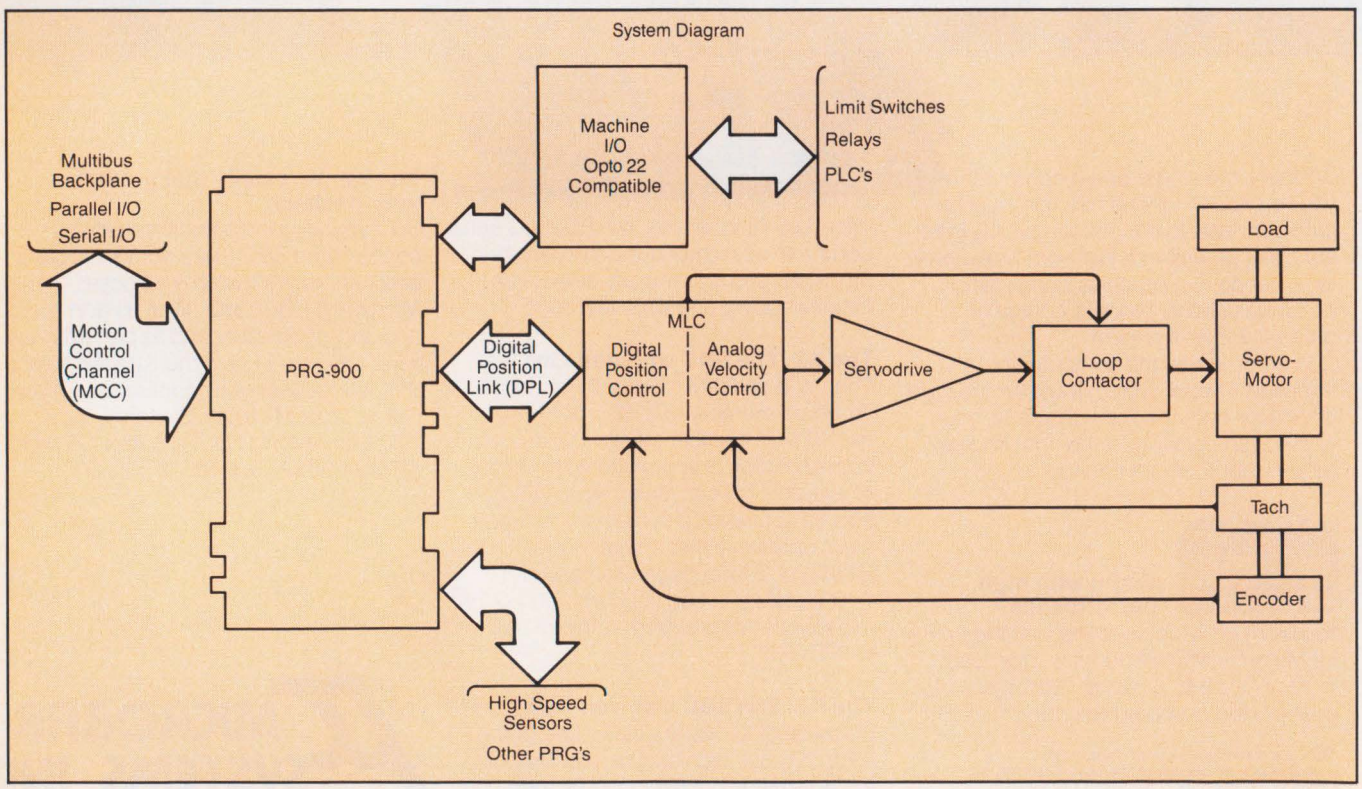


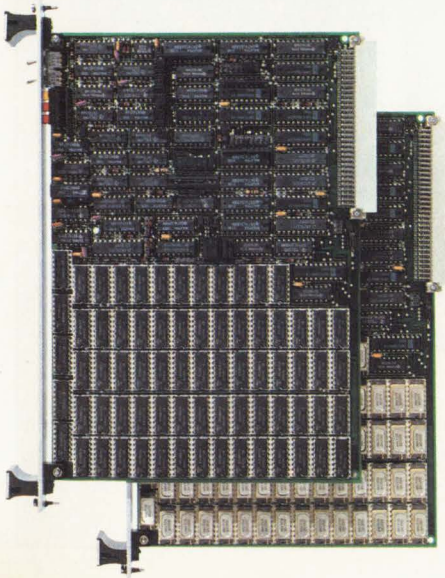

*Figure 2: Basic Multibus system configuration.*

In most industrial applications, the systems integrator would prefer to add specialized capabilities to a system without acquiring the knowledge associated with the operation of a single board, and many recently introduced products have addressed this problem. One of these, a Position Reference Generator (**Figure 1**) from Ormec Systems (Rochester, NY), offers Multibus users a single-board, microprocessor-based interface for use in motion control applications. The PRG is the master control module in a typical servo-positioning system and interfaces with Ormec's Motor Loop Controller, a servomotor, a servodrive, a DC tachometer and an incremental position encoder with quadrature outputs to create a closed-loop digital-position servo. The MLC closes both the position and velocity loops and enables the resulting position control system to create a closed-loop digital-position servo. It also enables the resulting position control system to work much like a stepping motor/translator system in that it converts TTL level command pulses into

*Figure 1: Ormec's position reference generator.*



# In the VME board race get the pole position with FORCE

## Our Racing Team: DRAM-1, DRAM-2

**512KB Dynamic RAM VMEbus Board SYS68K / DRAM-1**

- Storage capacity: 512 kbyte (two banks of 256 kbyte each) with byte parity
- Special error recovery mode: using the two banks in a software programmable tandem-like security arrangement
- Access time: write: 210 ns max
  read: 320 ns max
- Control/status register provides read/write, run/local, error, and parity check information
- Fully VMEbus compatible
- Run / Local function and parity check Enable / Disable switch and error indication
- Price/Performance ratio: 3.28 $ / kbyte

**2 MB Dynamic RAM VMEbus Board SYS68K / DRAM-2**

- Storage capacity increased to 2 Mbyte (two banks of 1 Mbyte each)
- Other features same as SYS68K/DRAM-1
- Price/Performance ratio: 3.90 $ / kbyte

**Write 17 on Reader Inquiry Card**

Other FORCE products of the SYS68K VMEbus farnily:
3 powerful CPU's, Static RAM boards up to 512 kbyte, Floppy / Winchester Controller and SASI Interface, Multichannel Serial I/O, Power Supply, Backplanes and fully integrated Systems as well as powerful software.

For further information please contact one of our distributors / reps or directly FORCE Computers, the VMEbus specialists.

FORCE COMPUTERS®

FORCE COMPUTERS INC.
2041 Mission College Blvd.
Santa Clara, California 95054
Phone (408) 988-8686
TLX 172465

FORCE COMPUTERS GmbH
Freischützstraße 92
D-8000 München 81
Telefon (0 89) 95 10 41 - 44
Telex 5 24 190 forc-d

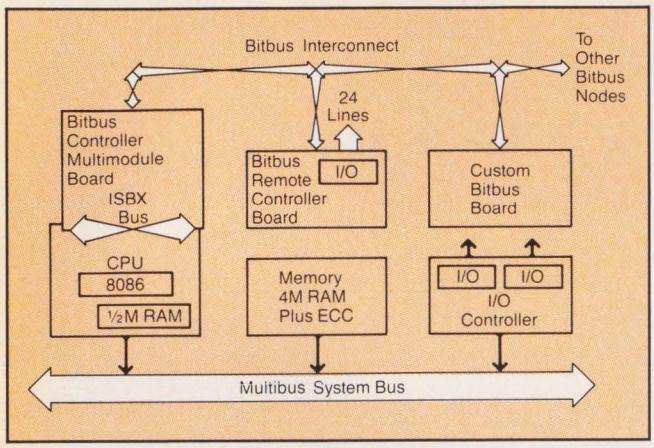



*Figure 3: Multibus system expanded with Bitbus interconnect and distributed control modules.*

incremental movement. The PRG translates ASCII commands at its Motion Control Channel into positioning pulse information with frequencies up to 192 KHz. This servo position reference information is transmitted to coodinate a wide series of motion controls.

In the current industrial environment, however, there are greater problems to be faced than the availability of boards for specific tasks. Presently, the distribution of control oriented devices is a major problem that is usually custom, slow speed and complex. Also, the current lack of a standard interface presents a major problem. Usually, interfaces are fragmented, performing unique activities and supplied by multiple vendors and systems integrators.

Developed to solve some of these problems, Intel's new distributed control Module (iDCM) products provide building blocks for the construction of a real-time distributed control system based on the Bitbus. This new serial bus architecture has applications in robotics, process control and data acquisition systems.

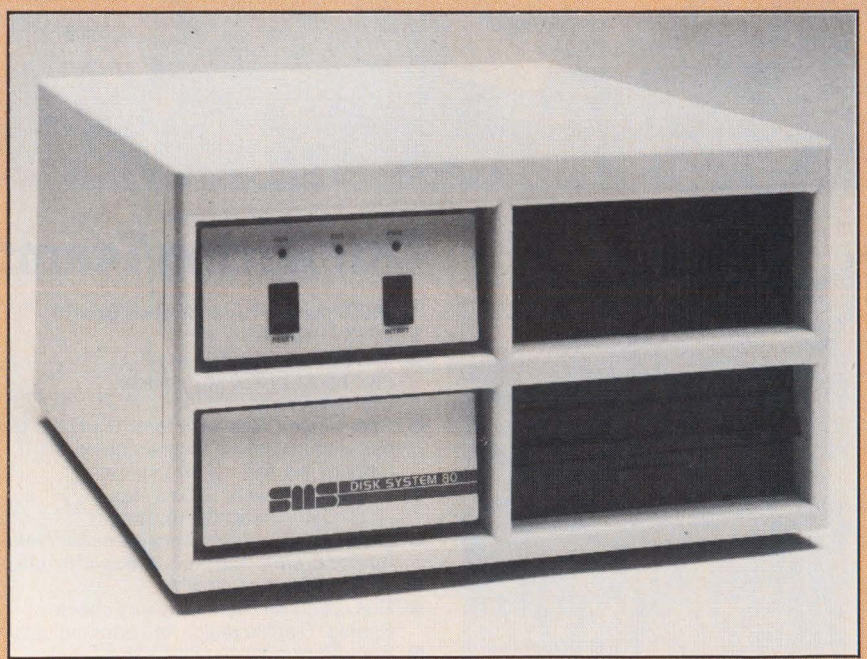
An example of how a Multibus system can be configured with iDCM modules is shown in **Figures 2** and **3. Figure 2** illustrates a basic Multibus system-processor, memory, and I/O controller. As **Figure 3** highlights, the burden on the central processor has been reduced, thereby increasing system performance, and system cost is realized because the Bitbus architecture removes the necessity for adding expensive centralized systems to handle increased performance demands. **Figure 4** shows Intel's new Bitbus expansion module.

For the microprocessor houses, the Multibus, more than ever, provides a vehicle with which the potential designer can evaluate newer CPUs and peripherals and get to market early with product. Out of the four major US microprocessor vendors – Intel, Motorola, National Semiconductor and Zilog – only Motorola has steered clear of the Multibus, preferring to endorse its own VME design. Zilog, a recent supporter of the Multibus with its new Z80H single-board computer with memory management and floppy disk controller (**Figure 5**), is also known to be working on a Z80,000-based design for the Multibus II that may be on the market as early as 1985. Untypically,

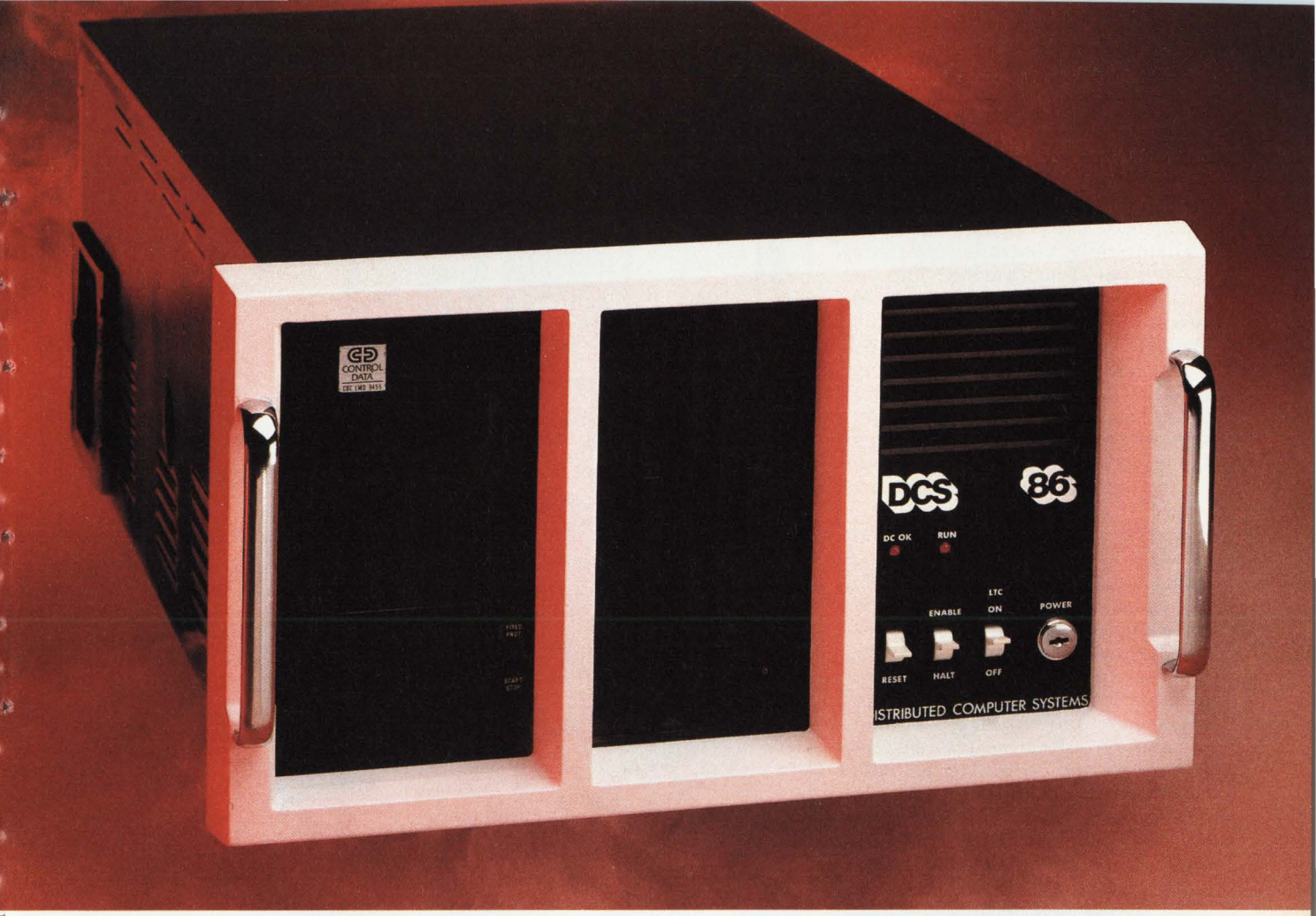
## Multibus Controllers Support Diverse Drive Technologies Through Memory-Driven Interface

The introduction of memory-message driven disk controllers to the Multibus computer market has reduced the cost of using improved disk drive technology. The expanding gap between software cost increases and supporting hardware reductions had made it unattractive for system builders to offer new or different drive types. The cost/performance improvements offered by new drives were offset by the cost of changing system software handlers. Memory-message driven controllers eliminate these difficulties by using their own microprocessors to communicate with the host system. Where older controller designs changed the interface as the drive characteristics changed, newer controller architectures anticipate changes in disk technology while maintaining a constant interface.

The result is an operating system and disk handler code which are mature and bug free. For the system programmer it means freedom from having to update disk handler routines to accommodate changes in drive characteristics such as capacity, speed, etc. In general,




*The DSX-80 from SMS is the most powerful of their multiuser Multibus microcomputer systems. Included are an 8 slot IEEE-796 backplane and a choice of Winchester and floppy disk storage up to 80 Mbytes. It can be rack mounted for convenience.*




# BORN TO BE ABUSED!

*Raised in a harsh environment, our DCS/86 16-bit Multibus compatible computer system can cope with industrial reality.*

### *Industrial Ruggedness*

*Designed for industrial applications, the DCS chassis is solid metal with no plastic, injection-molded parts. The front panel is an aluminum casting and our Multibus card cage is aluminum with a low-noise multi-layer backplane. Only the finest mechanical components are used to insure structural integrity in the most adverse conditions.*

### *Reliability*

*Industrial grade preburned-in chips are used. Our system modules are subjected to dynamic burn-in at 55°C for forty-eight hours in our environmental chamber. As a fully matured unit, every DCS system is completely tested for a minimum of 5 days with extensive system diagnostics. At DCS, reliability is not a slogan, it is our commitment.*

### *Unmatched Modularity*

*Our DCS systems are created to meet virtually any industrial application. They permit the user to mix and match operating systems, high level languages, interfaces, fixed and removable storage with a complete range of Multibus peripherals. Hardware configurations in our standard 19" rackmountable chassis can contain fixed and removable hard disks in 5¼" and 8" sizes as well as standard or slim line floppies. Operating systems supported are CPM/86*, MPM/86*, MS-DOS*, Concurrent CPM/86* and RMX-86*. "C", Fortran and Pascal are among the high level languages used. Whether your applications involve real-time data acquisition, multi-user software developments or data base management for factory automation, the DCS/86 family has a configuration to meet your budget.*

### *Support*

*Since 1979, DCS has been designing and manufacturing rugged industrial micro-computer systems for process/industrial control, data communications and software development. The DCS family has been abused in harsh environments the world over. DCS provides total systems support through our expanding network of direct regional sales/support centers in conjunction with our corporate customer support group.*

*For further information call: 617-890-8200 or write:*

**DCS** ***Distributed Computer Systems***
*330 Bear Hill Road, Waltham, MA 02154*

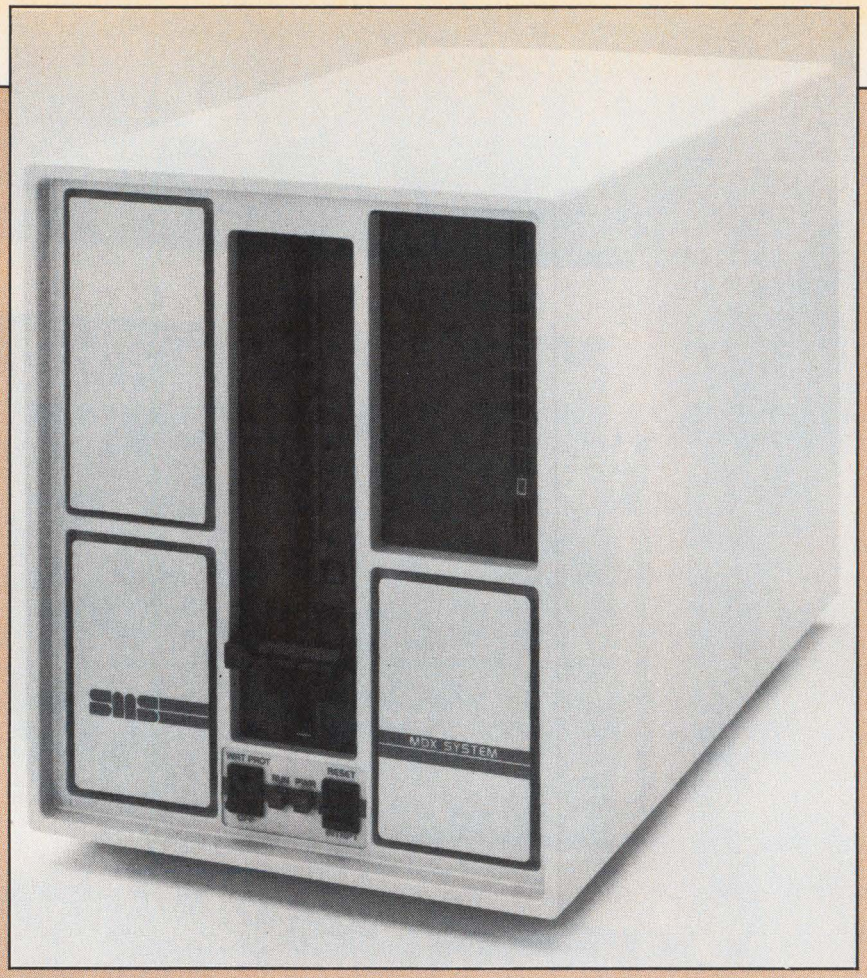
*Multibus and RMX trademarks of Intel
*CPM and MPM trademarks of Digital Research
*MS-DOS trademark of Microsoft

it means that investments made to enhance driver software may emphasize system features such as better error recovery, more detailed error reporting, or higher performance.

Historically, controller interface designs were tailored to the particular characteristics of the physical drive to be used. This approach minimized the number of hardware components and consequently cost, board space, and power consumption as well. Any hope of using the same interface and driver software on later designs was lost, as significant attributes of the drive itself were embodied in the controller interface.

Typically, interfaces were implemented as sets of hardware registers accessible by the host CPU via I/O Read or Write operations. These registers had dedicated functions determined by the specific hardware implementation. For example, a particular register might be written from the host CPU with the starting cylinder address for a disk read operation. In order to minimize the cost of implementing this register, its width might be limited to the number of bits required to specify any of the cylinders available on the drive being controlled. Such compact representation of the current drive's attributes meant that when a newer drive became available, perhaps with twice as many heads or many more cylinders, these larger values could not be stored in the register fields provided. To anticipate future requirements meant an increased cost for register extensions not initially used. Further, an amount of guess work was required to anticipate which portions of the register interface should be extended. A widened cylinder register field was wasted, for example, if the next drive to be supported had more heads but the same number of cylinders.

Modern disk controllers for Multibus based systems, on the other hand, are free of these difficulties. By shifting away from the I/O register-intensive interface to messages stored in shared Multibus memory, these systems take advantage of a low-cost microprocessor system within the controller itself, and also make use of the controller's DMA capabilities. Once a controller has been given a processor of its own and access to system memory, data transfer between it and the host CPU may be shifted from rudimentary bit/byte level hardware interfaces to powerful process-to-process communications. Since the information passed between the host and the disk storage system is stored in memory, the incremental cost of including wide fields for disk parameters is nominal. In fact, a significant portion of the disk control task may itself be moved from the host to the controller's processor. This offloading of such items as error recovery, sector counting, and disk formatting not only makes more host CPU power available to the application program but serves to further remove physical disk drive characteristics from the host's handler code.




*The MDX-80 from SMS is a completely integrated table-top multiuser Multibus microcomputer systems with up to 37 Mbytes of 5¼" Winchester and 1.2 Mbytes of floppy disk storage.*

*— Daniel Dawson, Director of Product Planning, Scientific Micro Systems, Mountain View, CA.*

**Write 302**

NEC Electronics sold its NEC Board Division recently to Zendex, doubling the Zendex product line. Those CPU houses that support the bus are actively looking to take advantage of the multiple bus structure of Multibus I that has already given performance advantages to some smaller vendors.

Microbar (Palo Alto, CA) already offers two generations of dual bus computers. The Microbar architecture, which is similar to the local bus extension (iLBx) announced by Intel in late 1982 adds a high speed bus for communication between CPU and memory. The standard PI interface is used for data transfer between memory and processors and controllers, while the P2 interface is used for high speed CPU to memory communi-

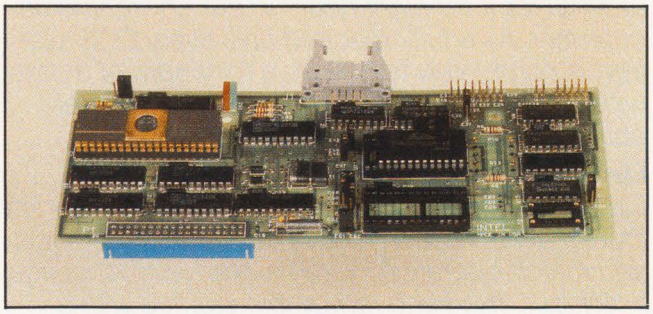
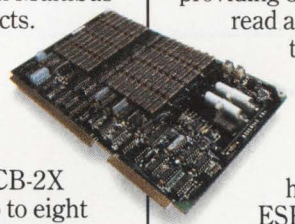


*Figure 4: iSBX 344 — a Bitbus iSBX expansion module.*

# The first thing Intersil Systems put on this new Multibus® card was 2 megabytes...

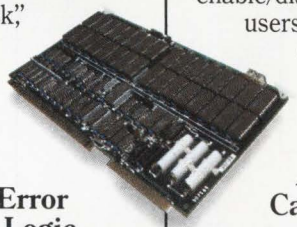
## And that was just the beginning.

Squeezing 2 megabytes of memory onto a single Multibus* card is quite an accomplishment in itself. But we believe it takes more than just memory to meet the increasing needs of today's systems. That's why our new MCB-2X Multibus card is designed with a number of significant special features. And why Intersil Systems is truly a leader in Multibus memory products.


MCB-364

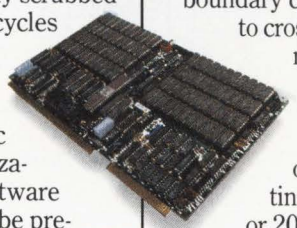
### Superior Dynamic Memory Relocation.

The new MCB-2X can relocate up to eight 64K or 256K blocks independently—making it a very powerful tool for "RAM disk," graphics display or multiple table look-up applications.


MCB-332

### Expanded Error Correction Logic.

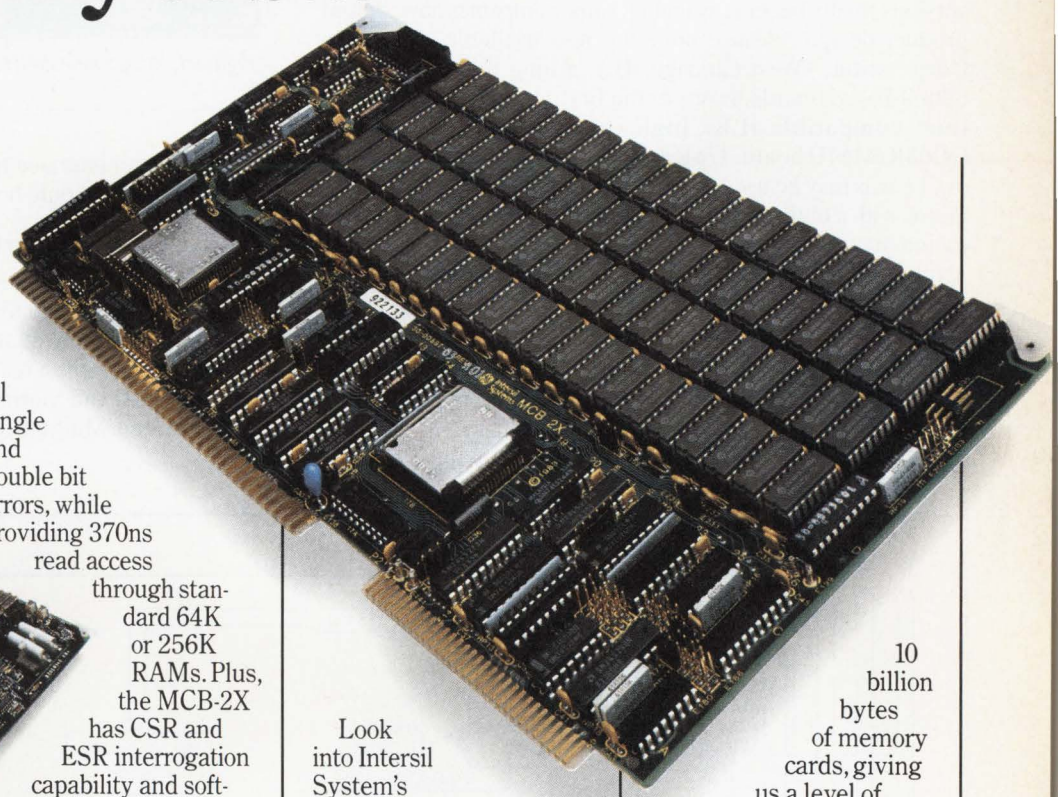
All single bit errors are automatically scrubbed during refresh cycles without system interruption. And thanks to the automatic memory initialization feature, software doesn't have to be preconditioned.


MCB-512

On-board ECC detects all single and double bit errors, while providing 370ns read access through standard 64K or 256K RAMs. Plus, the MCB-2X has CSR and ESR interrogation capability and software control of ECC enable/disable, allowing users to provide comprehensive system-level diagnostics.

### Flexible Addressing Capabilities.

Board addresses starting on any 4K boundary can be mapped to cross 1 and 4 megabyte boundaries. The MCB-2X can also occupy a continuous 512K or 2048K memory space within its 16 megabyte range.



Look into Intersil System's new MCB-2X. You'll find all the features you need... plus up to 2 megabytes of memory for the largest capacity available on a single card. Or, for non-volatile CMOS requirements, see our MCB-364 and MCB-332 modules. For simpler dynamic requirements, investigate our MCB-512.

Since 1970, Intersil Systems has shipped over 10 billion bytes of memory cards, giving us a level of experience that's hard to match. Put it to work for you. For systems needs just call us in the West at (408) 743-4442, in the East (201) 272-3920, or in the Midwest call (513) 890-6450. For off-the-shelf products, contact your nearest Intersil Systems distributor: Alliance, Anthem, Arrow, Future Electronics, R.A.E., Quality Components or Schweber.

*Multibus is a Trademark of Intel Corp.

Intersil Systems

1275 Hammerwood Avenue, Sunnyvale, CA 94089 • (408) 743-4442

Write 53 on Reader Inquiry Card

cations with no wait-state operations. According to Rich Boberg, President of Microbar, the efficiency of bus usage is increased dramatically, since in a system configuration the CPU can continue to execute out of iLBx memory while the disk controller is transferring data to another memory board over the PI connector.

Although Motorola does not support the Multibus, the number of 68000-based products in the marketplace runs a close second to the number of Intel processors found on the bus. Indeed, from an availability and performance standpoint, Intel's 286 has been such a disappointment, that the 68000's share-of-market may increase more than Intel's this year. Although the 286 will be extremely well received when 8 MHz versions finally become available, some companies have slowed product design because none are now available. Omnibyte Corporation, (West Chicago, IL), a long time supplier of 68000-based boards, is one of the first companies to offer the Intel compatible iLBx high-speed memory bus on its OB68K/MMU board. Up to four additional high-speed memory boards may be used on this bus providing the systems integrator with a high-speed arbitration-free extension of on-board memory.

Intel's other extension to the Multibus, the Multichannel, has not been as well received in the marketplace. A high-speed IEEE-488 or a SASI or SCSI look alike , the Multichannel has not been the focus of a strong marketing push by Intel. Part of the problem may be the 40-odd chips that are needed to implement an interface to the bus. Intel's own VLSI design, expected soon, should help the bus gain a wider acceptance.

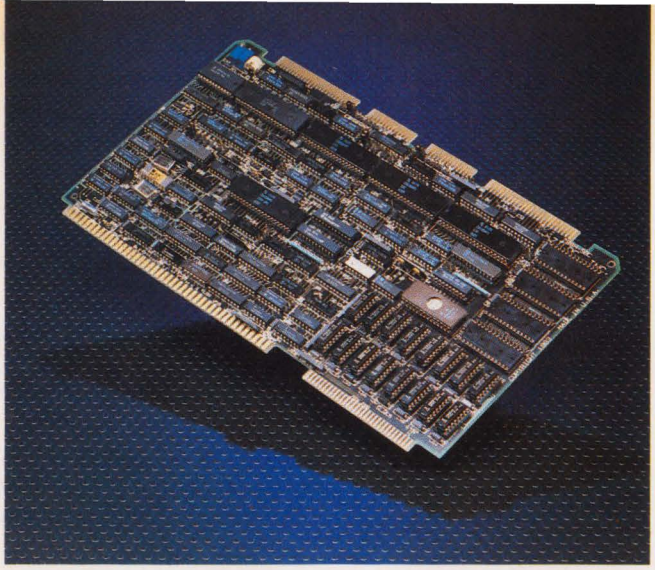
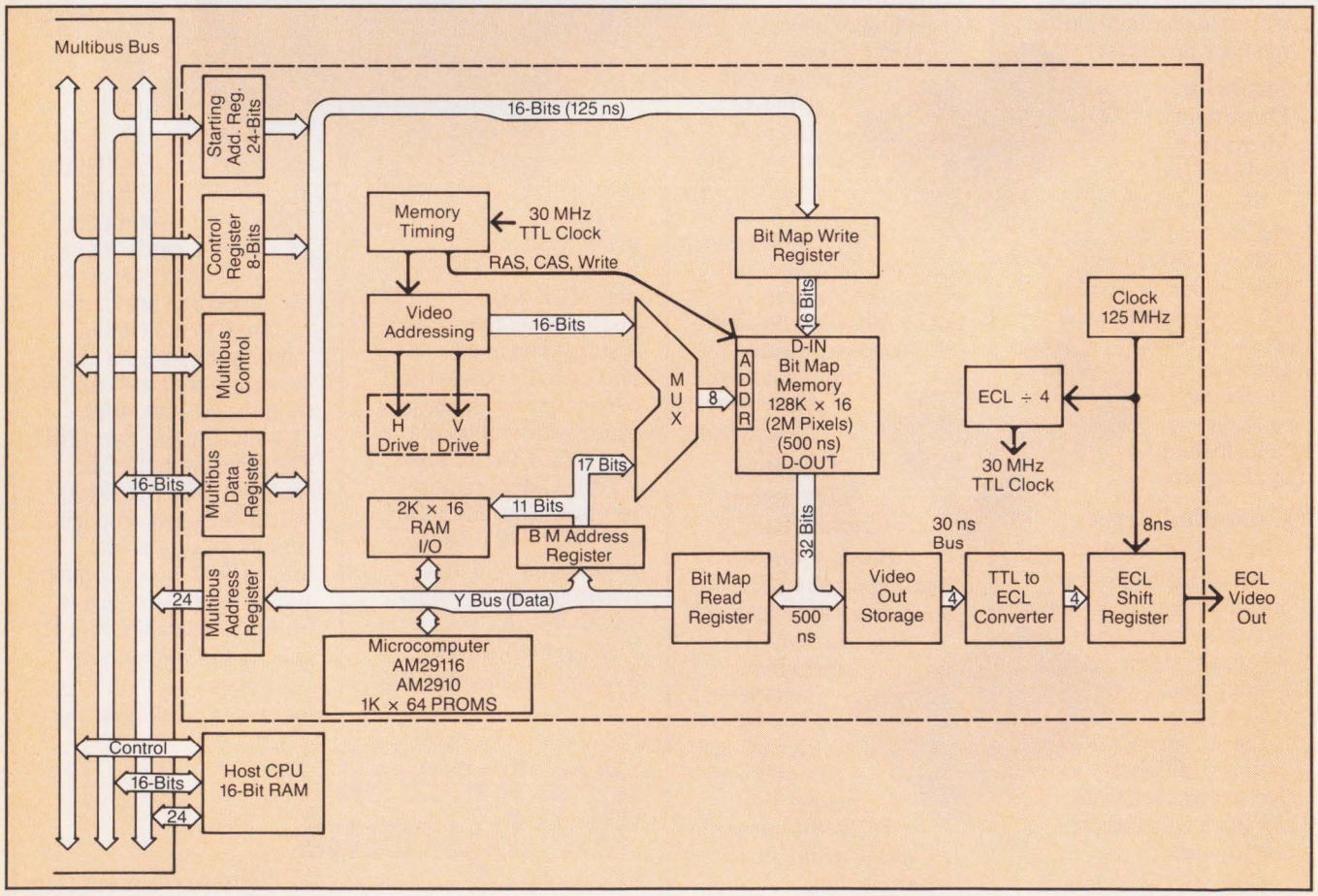


*Figure 5: Zilog's new Z80H single board computer.*

## Increased System Performance

Other efforts to increase system performance have given birth to bit-slice implementations on the Multibus that primarily emerge in the arena of array processing but are now finding applications in the area of graphics. Both Sky Computer (Lowell, MA) and Marinco (San Diego, CA) offer array processors for the Multibus, finding applications primarily in the

*Figure 6: Datacube's VGI50 board functional block diagram.*



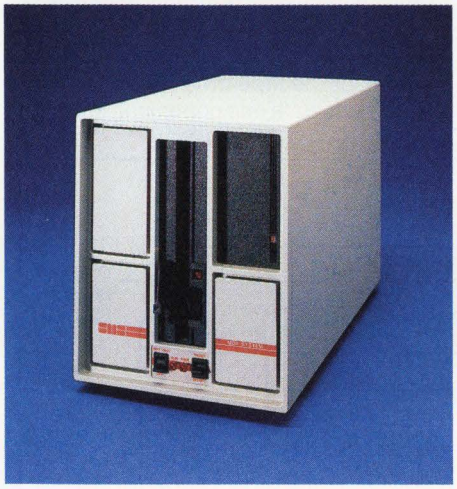
# Multibus® Microcomputer Systems Made Easy

OEMs get products to market faster with SMS Winchester controllers, storage systems and microcomputer foundation systems.

Whether you select 8086, M68000, Z8000 or another Multibus single board computer, you can choose the SMS product to fit your packaging needs.

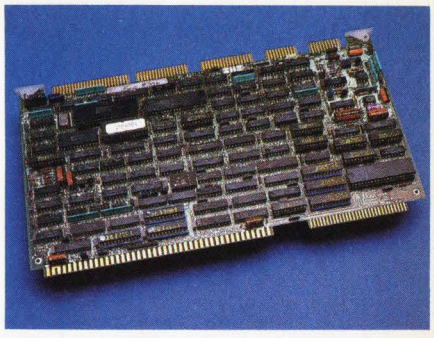
For large configurations, choose the DSX80000 foundation system with eight Multibus slots, 10, 20, 40 or 80Mb of Winchester storage plus an 8" IBM compatible floppy.

Small table top applications can use the MDX80000 foundation system with five Multibus slots, 10, 15, or 40Mb of 5-1/4" Winchester storage plus an 8" IBM compatible floppy.



If you have your own Multibus backplane, plug in the SMS FWT80000 storage system. It occupies only 5-1/4" of rack space and comes with either 10, 20, 40 or 80Mb Winchester storage plus an 8" IBM compatible floppy.

For high volume or unique packaging requirements, the SMS FWD8001/FWD8006 single board controllers are INTEL 215 compatible and support 8" Winchester/floppy or 5-1/4" Winchester and 5-1/4" or 8" floppy disk drives.



SMS

**Scientific Micro Systems, Inc.**

777 East Middlefield Road Mountain View, CA 94043
(415) 964-5700 TWX: 910-379-6577

SMS SALES OFFICES:
**Seattle, Washington** (206) 883-8303
**Boston, MA** (617) 246-2540; **Atlanta, Georgia** (404) 296-2029; **Morton Grove, Illinois** (312) 966-2711; **Yorba Linda, California** (714) 993-3768.

®TRADEMARK OF INTEL CORPORATION.

**Write 82 on Reader Inquiry Card**

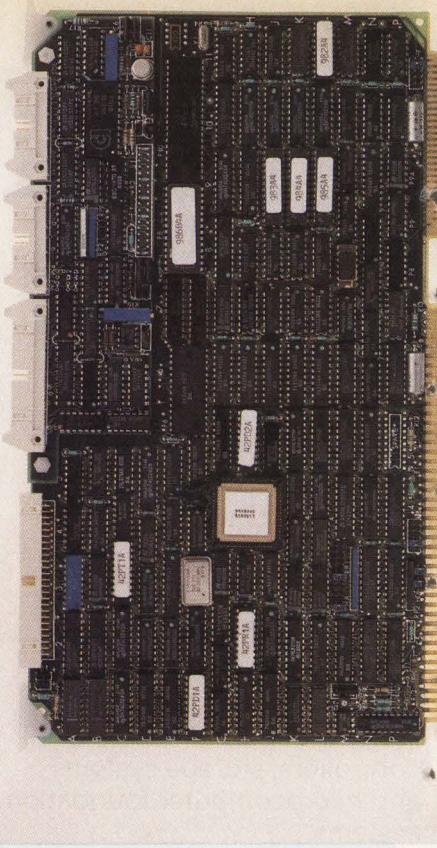
# Gate Arrays Ease High Performance Storage Controller Design

The designer of a high performance storage controller works with three performance goals in mind. These include optimizing bus utilization during data transfers, providing the highest possible utililzation of disk or tape capacity and speed, and reducing the workload of a system's CPU by providing sufficient intelligence for autonomous local control. In Multibus-based systems, a migration path from today's Winchester drives to higher performance drives soon to become available, also is an important design feature. The new generation of 5¼" disk drives will provide the performance currently only available on larger formats, but at lower costs, imposing a low-cost goal on high-performance controller design.

The use of gate arrays not only decreases board density but also supplies critical functions as pretested subassemblies. The performance of the gate array devices allows the use of low-cost logic families for other interface functions. The very high density of these boards (180 IC equivalents, though the generally accepted maximum for Multibus is 160 IC equivalents) must be achieved with a layout that allows extensive use of automatic insertion equipment and automated testing to minimize production costs.

Two controllers currently make up the Xylogics 420 family. Called the Xylogics 421 and 422, they allow the simultaneous operation of a QIC-2 interface tape drive and either an ST506/412 disk drive or an ESDI disk drive. Both controllers are based on a modular design that provides all Multibus and tape control functions on a common motherboard and implements the unique disk drive interface circuitry for each drive type on a flush-mounting daughterboard (thus the controller requires only one card slot).

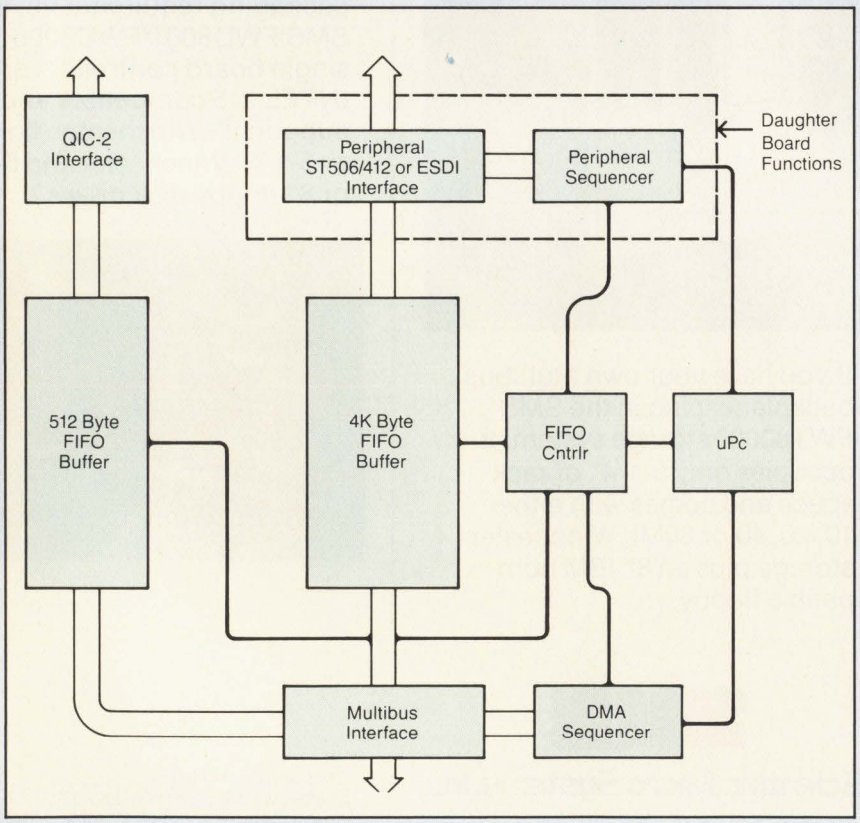
The controller provides a speed match between the high speed disk data path and the system bus via a 4 Kbyte FIFO buffer. A 512 Kbyte buffer is used for the tape drive. These buffers eliminate data late conditions for disks and tape, which allow operation during periods of heavy bus activity without losing disk revolutions. The separate buffers permit simultaneous data transfers on disk and tape. FIFO buffering also gives the controller the ability to perform DMA transfers directly, thereby reducing CPU overhead.



*Xylogics 421 allows the simultaneous operation of a QIC-2 interface tape drive and an ST506 disk drive.*

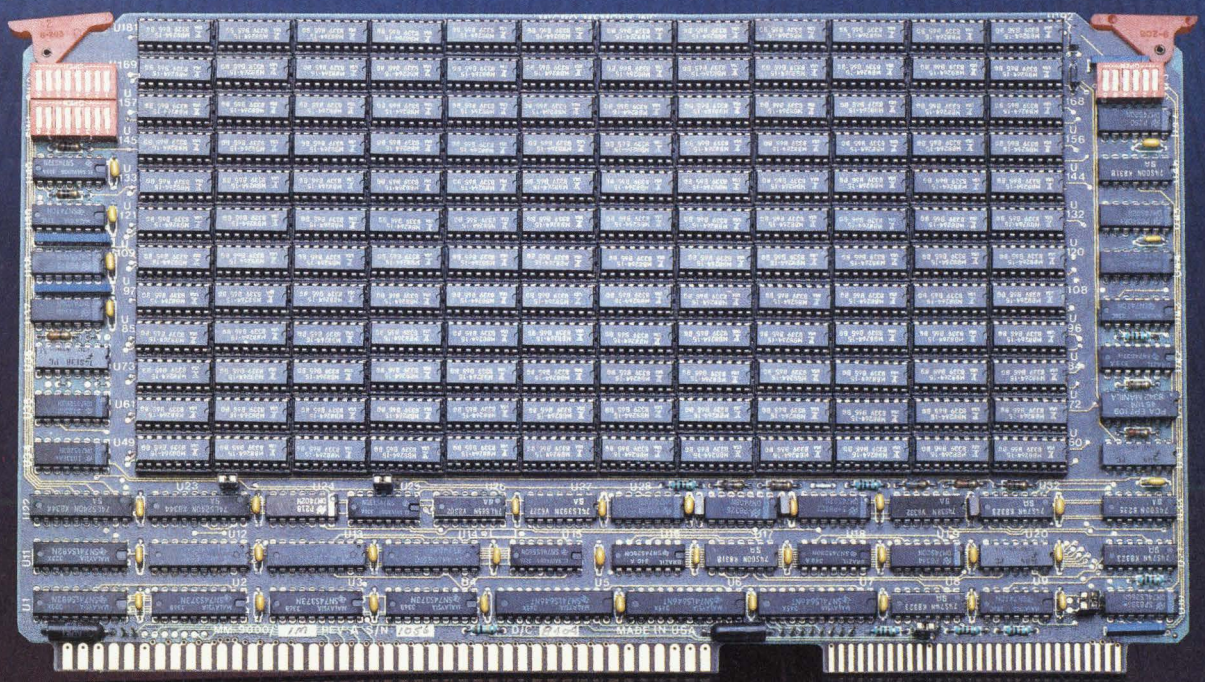
A proprietary DMA controller, implemented as a gate array device, allows DMA transfers at 2.5 Mbytes/sec. This rate approaches the transfer limit of the Multibus, which is theoretically 5 Mbytes/sec, but generally close to 4 Mbytes/sec in actual systems. The DMA controllers' bandwidth is far in excess of the combined transfer rates of the tape drive (about 100 Kbytes/sec) and the disk drive (625 Kbytes/sec for ST506 and 1.2 Mbytes/sec for ESDI). As a result, peak rate transfers with advanced Winchester drives only requires about half of the controller's bandwidth.

The high speed design allows simultaneous operation of disk and tape drives by simply alternating DMA bursts, for example, doing four or five DMA bursts from the disk and one from the tape. The DMA controller's bandwidth minimizes the time required for transfers over the Multibus, which tends to maximize the availability of the bus to other devices.




*The controller architecture of the 420 family.*

# THE MULTIBUS*-
# MEGABYTE CONNECTION



# MM-9000D

## 1M BYTE NOW... 4M BYTES LATER

If you want the highest capacity, best performance, and lowest price add-in memory for your Multibus* system, the MM-9000D is your best buy.

Compatible with Multibus* systems employing 8086, 68000, or Z8000 microprocessors, the MM-9000D provides the flexibility you need for future system upgrades. With 64K DRAMs you can get 1M byte now... when the 256K DRAMs are in production, you can get up to 4M bytes.

The MM-9000D is also a system enhancer because it allows you to extend memory capacity to keep pace with upgrading of your capability. For card slot limited systems, one MM-9000D replaces two 500K byte boards, so you pick up an extra card slot for other uses. Or, if you're power and memory limited, a single 1M byte MM-9000D uses as much power as one 500K byte board.

### • FEATURES •

- 64K DRAM Capacity: 512K, 768K, 1M bytes
- 256K DRAM Capacity: 2M, 3M, 4M bytes
- Cycle/Access Time: 350/240 nsec
- Parity generation and checking with the parity output stored in an Error Status Register whose output can be jumpered to any bus interrupt
- Module selection on $4000_H$ boundaries in the 16M byte address field
- 24 address bits to address 16M bytes
- 1-year warranty on parts and labor
- Temperature-cycled and burned-in during memory diagnostics

*Trademark of Intel Corp.

## MICRO MEMORY HAS A COMPLETE LINE OF MULTIBUS MEMORIES

| PART NO. | CAPACITY | TYPE |
|---|---|---|
| MM-8086E | 512K-128KB | DRAM, EDC |
| MM-8086D | 512K-32KB | DRAM |
| MM-8000C | 128K-64KB | CMOS |

| PART NO. | CAPACITY | TYPE |
|---|---|---|
| MM-8500C | 256KB | CMOS, Calendar/Clock |
| MM-8086C | 64K-16KB | CMOS, Calendar/Clock |
| MM-8086 | 32KB | Core |

Write 70 on Reader Inquiry Card

micro Memory Inc

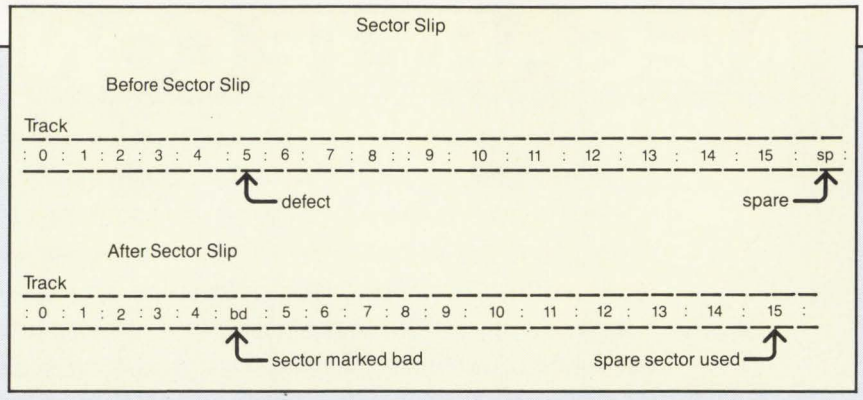
...FIRST IN MICROCOMPUTER MEMORIES

9436 Irondale Avenue • Chatsworth, California 91311 • (818) 998-0070

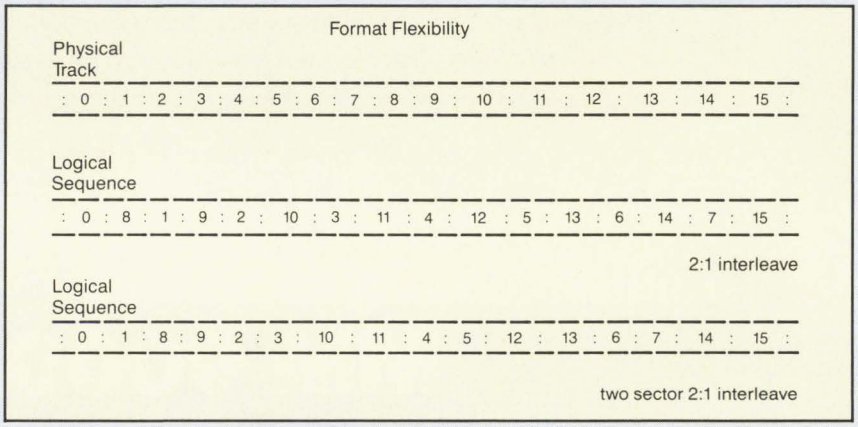
The high speed DMA controller is as important to tape operation as it is to disk. Controllers designed specifically for tape drives generally assume a low maximum data transfer rate, which is easily accommodated, and aim for the simplest possible DMA circuit. The resulting controller can require microseconds for each word being transferred and actually use up more bus bandwidth than high speed designs. In fact, a slow controller can require enough bus resource to prevent disks or utilities from running. It can also make it impossible to use the tape in a streaming mode.

A second gate array device provides the ECC logic to implement a 32-bit ECC algorithm capable of correcting up to 11-bits. Although controllers for ST-506/412 disk drives generally provide only 8 bits of error correction capability, the design of the Xylogics 420 series controllers was defined to be compatible with the newer Winchester drives. The use of plated media and thin-film heads is drastically increasing data density and transfer rates. Higher density makes data much more sensitive to media surface flaws and requires ECC operation at higher speeds. The technique chosen for ESDI drive compatibility is actually a version of one currently used in SMD interface controllers. The use of Input Output Parameter Block (IOPB) architecture requires fewer parts than register oriented architectures and results in a high degree of programming flexibility, via channel control and improved system performance.

Commands are issued from the operating system by creating an IOPB in memory and pointing the controller board at the IOPB (registers on the controller board store the pointers). Multiple IOPBs may be linked together to form command chains. The command is initiated by loading the IOPB into the IOPB address registers and setting the Go-bit in the command register. When the controller bus executes a command, it will set a completion status and controller ready-bit in the status register (this can generate an interrupt if they are enabled). Detected errors generate an error code which is returned in an IOPB for examination by the operating system. Chaining IOPBs can create a channel program that permits executing many functions sequentially with little or no host CPU involvement. The controller can DMA a number of IOPBs into the on-board buffer for execution to reduce calls to system memory and increase execution speed.




*The controllers allow an efficient form of bad sector handling by sector slipping.*




*A variety of interleaving sequences are possible.*

The controller's fast disk sequencer is designed to accommodate disk drives with data rates as high as 15-20 MHz. The sequencer requires fast response at the bit level to optimize format capacity and allow manipulation of strobe and control lines at bit speeds.

The speed of the data and DMA sequencers allowed the use of a slower, but more intelligent, microprocessor for higher level functions (**Figure 1**). The controller permits selection of DMA throttle control limits over a range of 2 to 128 DMA cycles to allow dynamic tuning of a system for optimum performance. For example, a system with multiple real-time devices can be tuned for fewer DMA cycles to minimize response time.

The controllers allow an efficient form of bad sector handling by sector slipping (**Figure 2**). Sector slipping can mark and skip a bad sector before continuing with consecutive sector formatting. This is transparent to system software and allows single revolution access to a full track of data for maximum throughput in the presence of defects. The cost of this technique is a spare sector per track.

The controllers provide format flexibility, a feature that disassociates logical sectors from physical sectors. This allows systems integrators to provide sector arrangements that are optimized for an application's requirements. A variety of interleaving sequences, such as 1:1, 2:1, or two sector 2:1 (**Figure 3**), are possible to further permit system tuning for bandwidth or response.

The 420 series controllers can handle multiple disk drives of different types as long as the sector sizes are the same. This makes systems configurations flexible and eases the evaluation of disk drives from various sources. Multiple disk drive operation, for drives that use serial mode head positioning, allows the controller to perform implied overlapped seeks without operating system intervention (some operating systems don't support explicit overlapped seeks at all).

Overlapped seeks can realize a 20-50% improvement in system throughput because seeking is the greatest contributor to access time (seek time plus latency time). As an example, an ST506 drive may require 30-100 ms to perform a seek. Overlapping this delay between two drives can provide much high throughput.

*— Howard Lev, Xylogics Inc.*
**Write 303**

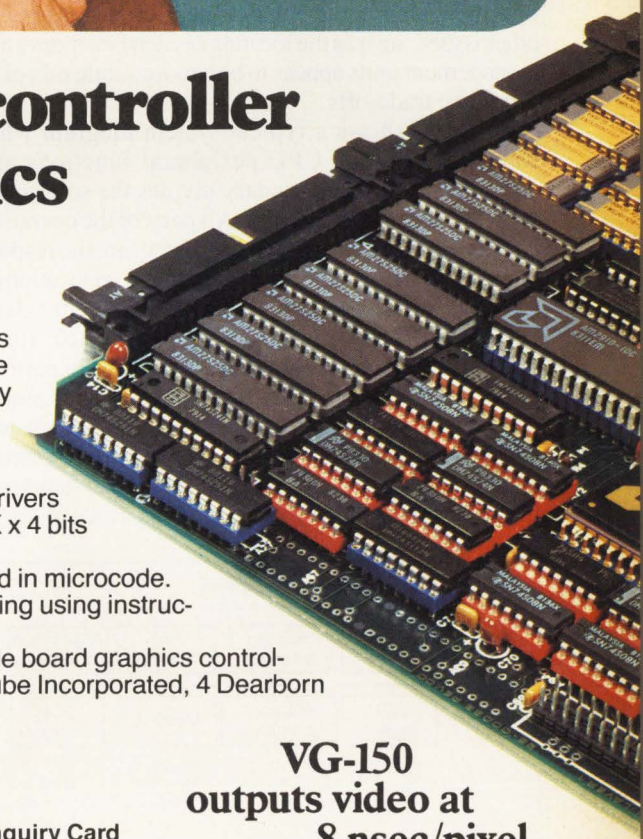
# Datacube single board controller paints glitch-free graphics fast as lightning.

Datacube's new VG-150 text-graphics display controller generates 16 pixels every 500 nsec. without glitching. It can generate or move the entire screen—1,500,000 pixels in under one second. There absolutely is no other single board controller that can match this for sheer speed.

The VG-150 is more than just fast. It's simple to use, interfacing easily with high-level language system calls. 8080, 68000 and 8086 drivers are available. Plus it's expandable with one additional board to 1K x 1K x 4 bits at 30 Hz or 60 Hz with line scan camera input options.

Graphic primitives such as line draw and BITBLT are implemented in microcode. And the VG-150 has its own microcode space for customer programming using instructions provided by Datacube.

If you're an OEM searching for speed plus performance in a single board graphics controller, the VG-150 will light up your life. Call or write for full details. Datacube Incorporated, 4 Dearborn Road, Peabody, MA 01960, Tel: (617) 535-6644.



**VG-150 outputs video at 8 nsec/pixel**

Datacube

Write 77 on Reader Inquiry Card

area of small system enhancements. For it's part, Sky recently signed a $2 million OEM contract with Sun Microsystems (Mountain View, CA) to supply the Sky Fast Floating Point processors for integration into the Sun 68010-based UNIX machines.

Some systems integrators (and some board manufacturers too) have made the mistake in the past thinking the integration of an array processor into a system is a trivial matter. It is not, and software support is critical. Marinco, for example, currently supplies a set of microcode development tools that include an assembler, monitor/debugger and formatting program. This allows users to program custom functions and configure a specialized set of algorithms in PROM for production environments. The arithmetic section of the APB-3024M contains a high-speed parallel 16-bit multiplier, the AMD29516, and AMD's new 16-bit slice controller, the 29116.

Bit-slice design around the AMD29116 is also beginning to find its way into some graphics applications. Datacube's (Peabody, MA) new Multibus graphics module, the VG-150 (**Figure 6**) uses the part to interpret and execute high-level graphics commands. Although the board can execute a standard library of microcoded instructions out of PROM, the systems integrator may also wish to develop proprietary microcode. This can be achieved with the use of several tools that include a microcode assembler, compiler, writable control store option board (the CM-196) and a UNIX-based development system. A display resolution of 1408H x 1100V noninterlaced has been achieved with the design that can move an entire screen display of 1.5 megapixels in less than one second.

Although it is evident that peripheral boards such as graphics controllers and disk controllers are becoming more intelligent and multiple bus architectures are playing an increasingly important role in the enhancement of systems performance, other issues, such as the location of cache memory and memory management units appear to be a more subtle mix of price/performance trade-offs.

**Figure 7** shows a typical system diagram where hardware/software and CPU peripheral functions are largely segregated. A clear boundary divides the software functions from the hardware functions. All parts of the operating system, kernal, human interface and file system are the responsibilities of the CPU, as are logical I/O drivers and application programs. In most instances, memory management is considered as part of the CPU board. On the Omnibyte board, for example, (**Figure 8**) each Motorola MMU is capable of partitioning the physical address space into 32-segments. Each segment may be defined as user or supervisor, data only or program only, or program and data. The segments can be write protected to ensure system integrity. One 68451 MMU comes standard with the board but up to four can be used, giving a total of 128 segments.

At one integration level higher, most microprocessor houses have placed memory management functions on-chip in their next generation products. An alternative approach, proposed by One/D (Mountain View, CA), is to decentralize and relocate many of the functions typically performed by CPU boards to dumb devices, such as memory and disk controllers (**Figure 9**). As a result, an intelligent disk controller in the system performs file management duties in addition to physically controlling the disk drives. Even the 64K bound CPUs can address up to 1 Mbyte of memory due to the built-in memory management in the memory board.

Indeed, there are some very practical reasons for the MMU to reside on the memory card. An existing 64 Kbyte system can be expanded to directly address more memory without redesigning or replacing the CPU module, thereby protecting both software and hardware investments. In a multiprocessor system, the memory manager is common to all CPU modules, and in fact, even non-CPU master modules, such as intelligent peripherals capable of DMA. This uniformity eliminates the complication of having to communicate the different mapping states of various CPU modules amongst each other. More significantly, all of the above are possible with standard off-the-shelf 8-bit as well as 16-bit CPU cards with no special addressing designs.

Since most systems are distributing the memory and I/O functions of the system onto separate boards, Central Data's (Champaign, IL) latest 68000-based product contains no RAM or serial I/O. The use of the iLBx interface, however, does allow the board to work with Central Data's cache memory board or with other iLBx products. The cache memory board will store the most recent 4 Kbytes of data that have been accessed through the iLBx bus and provide a fast response time for any subsequent accesses to the data. At any time when a cache miss occurs, the cache memory board automatically accesses the Multibus, updates its cache and provides the data to the host.

Caching to increase performance is also finding its way onto controller boards. Both Ciprico and Interphase have introduced boards to support the concept over recent months. Besides having RAM on board, an algorithm to determine what memory from disk is saved is also required and depending on the operating system the systems integrator plans to implement, that algorithm may change.

According to a spokesman from Data Systems Design, putting that algorithm in firmware lessens the flexibility of the design, and a more optimal approach would be to allow for the CPU board to download the algorithm on system initialization.

As the performance of CPUs increases, with some vendors indicating clock rates as high as 25 MHz, other innovative schemes may be proposed to improve upon performance of existing Multibus designs without the designer having to look

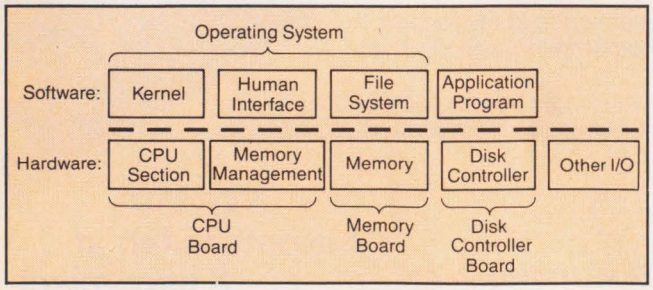



*Figure 7: Traditional approach to systems partitioning.*

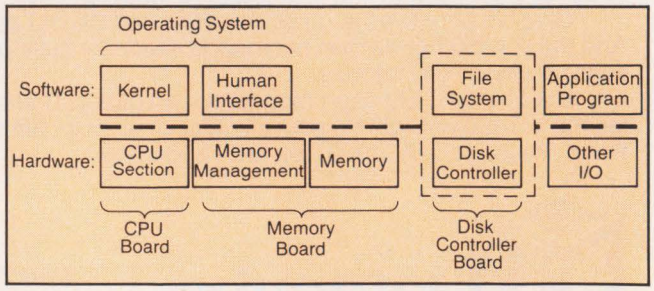



*Figure 8: One/D's approach to systems partitioning.*

# MULTI BOOST™

## XYLOGICS CONTROLLERS ADD THRUST TO YOUR MULTIBUS® SYSTEM.

### THE 450 SMD DISK CONTROLLER.

It simply outperforms any other high capacity Multibus disk controller.

With DMA speed up to 3.0 MB/sec. Non-interleaved data transfer up to 1.9 MB/sec. And 2 or 8KB FIFO buffering. The Xylogics 450. The fastest SMD disk controller available anywhere for Multibus applications.

And its unparalleled versatility and capacity make it the choice of OEMs. It supports as many as four SMD disk drives, is programmable to any configuration, and works with any 16, 20 or 24 bit address system.

All this power resides on a single IEEE-796 bus compatible board. Multiboost from Xylogics. Is it any wonder that Xylogics has sold more high performance Multibus peripheral controllers to more major OEMs than anyone else in the world?

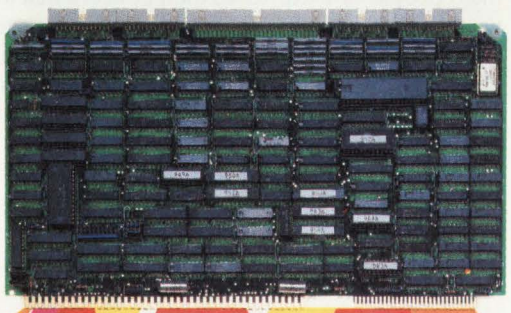
### THE 472 TAPE CONTROLLER.

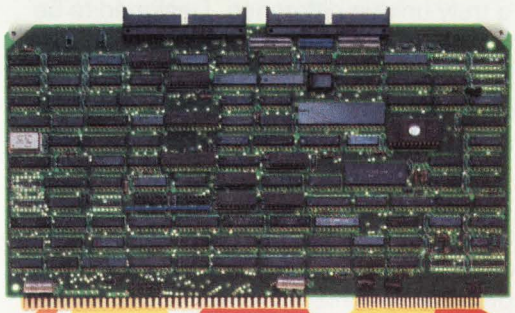
The state-of-the-art Multibus tape controller that outperforms all others in price and features.

Fast DMA up to 3.0 MB/sec. Channel control for true high-speed streaming with no repositioning. And 2 or 8KB FIFO buffering. The Xylogics 472. The fastest Multibus tape controller on the market.

And the most advanced. The 472 supports up to eight Pertec formatted streaming and start/stop tape drives. Runs at speeds up to 125 ips and at densities up to 6250 bpi GCR. Programmable to any drive mix. And it occupies only one backplane slot in any 16, 20 or 24 bit address Multibus system.

Expand the universe of Multibus microprocessing with Multiboost from Xylogics. The peripheral performance leader.





**Xylogics®**

*The Peripheral Performance Leader.*

144 Middlesex Turnpike, Burlington, MA 01803
Tel: (617) 272-8140 TWX: 710-332-0262
(800) 225-3317 outside of Massachusetts

Xylogics European Headquarters: (Slough, U.K.)
Tel: (0753) 78921 Telex: (851) 847978

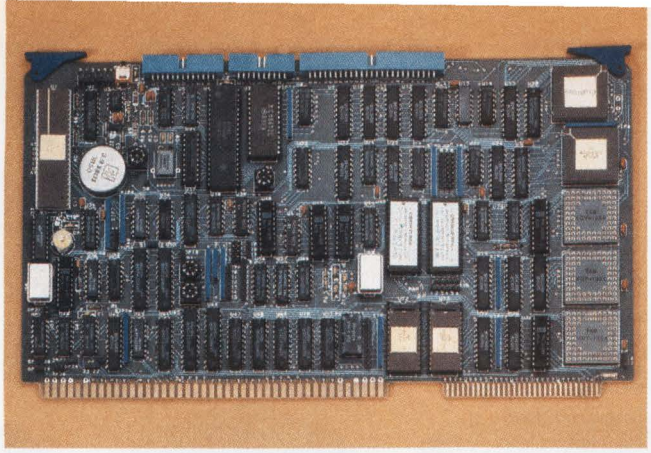


*Figure 9: Omnibytes OB68K/MMU supports Intel's iLBx bus.*

at faster buses like Multibus II. Increased pipelining, on-chip MMU's and cache may be one way to effectively relax the constraints on bus timing without compromising on performance. Zilog's Z80,000 and Z800 chips, for example, allow the designer to tailor the speed of the bus to his requirements through the use of bus scaling and programmable wait states.

Inevitably, to reach even higher levels of performance, a newer bus standard must be adopted. Intel's Multibus II (*Digital Design*, December, 1982, p. 71) offers designers some significant performance advantages that include a 32-bit parallel systems bus with 40 Mbytes/sec throughput, high-speed accesses to large amounts of off-board memory through the iLBx II Bus, a low cost serial system bus and effective support for multiprocessing. Most Multibus I manufacturers feel that the new bus will allow them to build on the experience they have already gained in the marketplace. Many have expressed their enthusiasm for the message passing protocol that allows two bus agents (i.e. boards) to exchange information in blocks of data from one functional module to another without worrying about memory management or synchronization problems at the bus interface.

Although the board provides almost as much surface area as its Multibus I counterpart (79.6 sq. in. as opposed to 81 sq. in.) many people have expressed their concern that too little space would be left on the board after implementing even a basic bus memory interface to support any of the more advanced features of the bus. The question of when VLSI implementations from Intel will become available to support such functions is of paramount importance at the moment.

"I was very impressed with the ease of partitioning into parallel processing that the system bus message passing structure supports," says Ron Brookes, President of Procise Corp. (Issaquah, WA), "particularly the use of the serial bus as a software transparent alternative to message passing over the parallel bus."

Perhaps even more than with the parallel system bus, the serial bus will require VLSI to allow designers to implement the function onto the boards. Since there are no interrupt lines on the Multibus II, message passing will be used for that function. An improvement over the eight Multibus I interrupt lines, certainly, but once again VLSI is implied before a processor can respond to interrupts on the Multibus II. □

**How useful did you find this article? Please write in the appropriate number on the Reader Inquiry Card.**

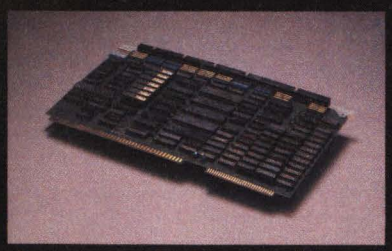
| | |
|---|---|
| Very Useful | 600 |
| Useful | 601 |
| Somewhat Useful | 602 |

# MULTIBEST™


## Make your Multibus® product launch successful.

Wespergroup's new Multibest™ tape and disk controllers have the right stuff to successfully perform on Multibus systems. The Multibus MB-SMD disk controller is software compatible with the Intel iSBC 220 disk controller while supporting up to 2 megabyte/sec. disk transfer rate, 4 SMD type disk drives and improving throughput.

The Multibest MB-506/1000 disk controls up to three (3) ST506 or SA1000 disk drives and four (4) SA400 type floppy disk drives. The MB-506/1000



also supports mixed capacity drives and overlapped seeks.

The Multibest MB-QIC-2 tape coupler controls up to four (4) ¼" cartridge tape drives with industry standard QIC-2 interfaces.

The MB-506/1000, QIC-2 and Multibest Companion Link—the winning combination that allows image backup and restores disks to tape *without host intervention.*

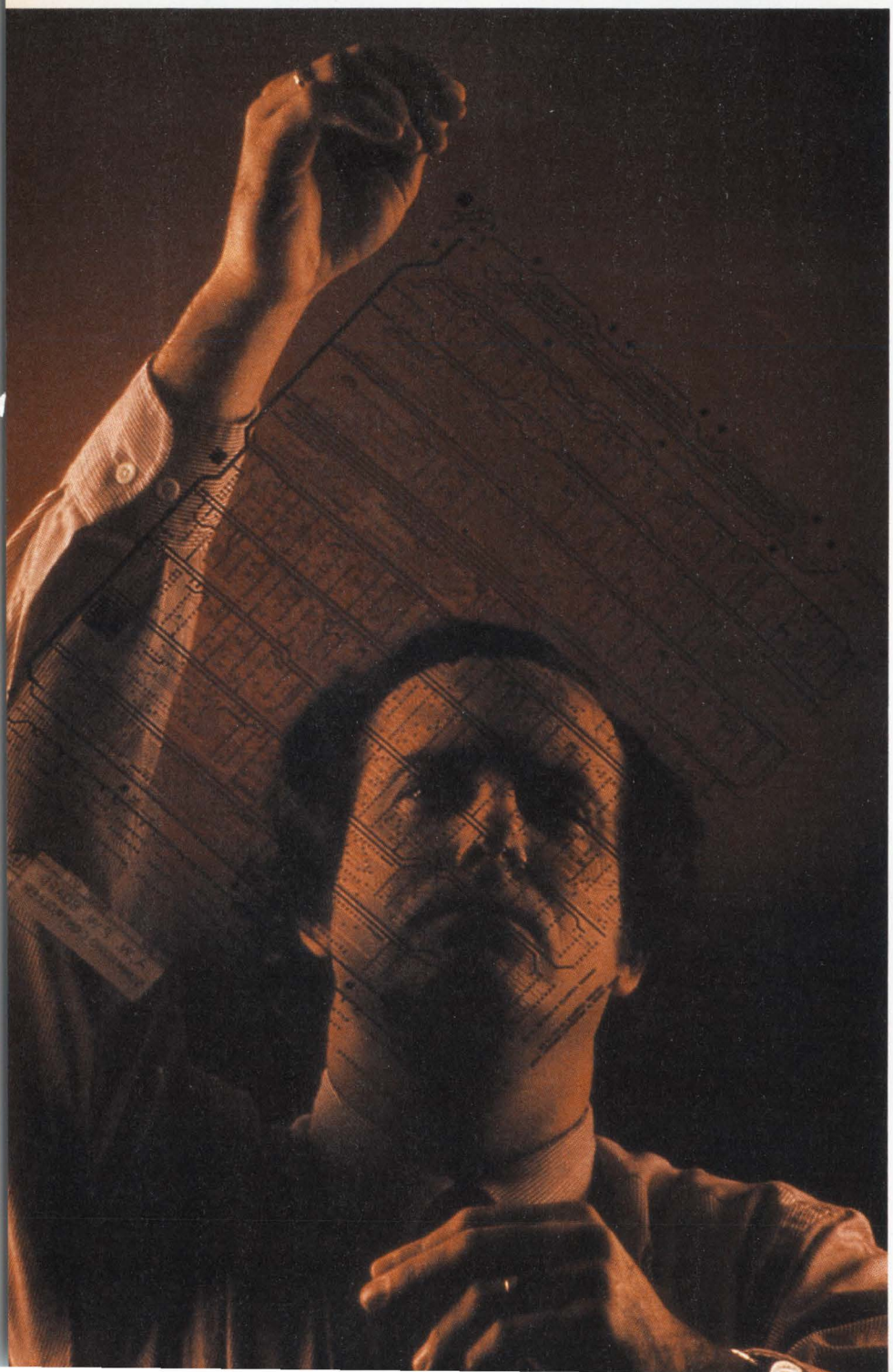
Call or write today for the complete Wespergroup catalog. WESPERGROUP, div. of WESPERCORP (USA), 14511 New Myford Road, Tustin, CA 92680, Tel: (714) 730-6250, Cable WESPER, TWX 910-595-1775, Telex 4720629. (Germany) GmbH, Tel: 089 982420. (U.K.) Tel: (44) 0276-20934.

Multibus is a registered trademark of Intel Corp.
TM—Multibest is a trademark of Wespercorp

**WESPERGROUP**

Write 73 on Reader Inquiry Card

# Designing Printed Circuit Boards From The Workstation



*Newer products optimize the use of not only computer power, but also the knowledge of the designer.*

*(Photo courtesy Summagraphics)*

**by Julie Pingry, Editor**

Computer aided design systems have long been important for the efficient design of printed circuit boards. Traditionally, large, powerful systems have been fed a schematic input and, after hours of automated design routines, they produce a 90 or 95% laid out and connected printed circuit board (PCB) design, saving days over manual layout. This automation can be invaluable to large manufacturing companies, but frustrating to talented design engineers. These systems have often been out of the price range of many smaller firms with equally challenging board design problems.

The newer generations of CAD products for PCB layout are designed to optimize the use of not only computer power, but also the knowledge and skills of the board design engineer. Balancing automatic functions with the interactive input from a designer not only makes designing easier but it improves the quality and manufacturability of board designs and actually shortens the time to 100% route a board.

Another factor in the success of CAD workstations is their comparatively low cost. By using newer processors and allowing standalone use, a workstation costing from $30,000 to $80,000 can now provide full CAD functionality to companies without $250,000 or more to spend. This allows smaller firms that were designing boards manually to automate with workstations.

With the complexity of today's boards, manual design is a bigger investment in time and salaries than most firms can afford. When designing multiple layer boards with hundreds of ICs, at densities up to .3, adding processing power and speed is essential. The 303 square inch array processor board shown in the photo

(**Figure 1**), designed on a 25 mil grid, has 525 equivalent ICs at a density of .57. Even working with a service bureau to do final design is eased with CAD, and at such low costs, all of the board engineering and design may be done in-house.

New CAD workstations are also designed to be easier to use than traditional systems. This is, again, important for smaller firms, as the time involved in training is reduced from months for initial proficiency, to a few weeks. This ease is partly due to workstation emulation of the way a designer works. Most new systems use English command menus, and are easy to use once learned. This allows more people to use a system, and further utilizes the power bought with a small investment.

## Design Steps

The systems properly called CAD for printed circuit boards perform layout and connection of a board design. With typical board manufacturing demands and growth, these CAD systems should, ideally, interface directly to CAE for input of engineering schematics and, at the other end, to CAM systems by generation of NC tapes and artwork of various types.

Some systems integrate CAE functions; others are optimized for the CAM interface. Only workstations optimized for board design are compared here. The powerful software packages available to run board design on general-purpose graphics systems, like SCI CARDS and for routing, Calais, compete with these workstations for market share, but then so do larger systems, notably market-leader Computervision, and service bureaus.

**Schematic/Net List Entry**—Manual or CAE functional design of a circuit generally produces a net list and a schematic drawing. This engineered circuit becomes the reference for the board throughout the design process, so its verification and accurate entry are crucial. Recent CAD workstations for board layout support either net list or schematic entry to generate the reference master circuit. Large built-in component libraries and schemes which allow blocks of components to be entered speed tedious data entry.

An existing schematic can be put on a digitizing table for input, or a digitizer can be used (**Figure 2**) to interactively create a schematic. The two can be combined, as well, to add anything not normally on a schematic, such as power and ground. The net list can be extracted from the schematic data, or entered directly.

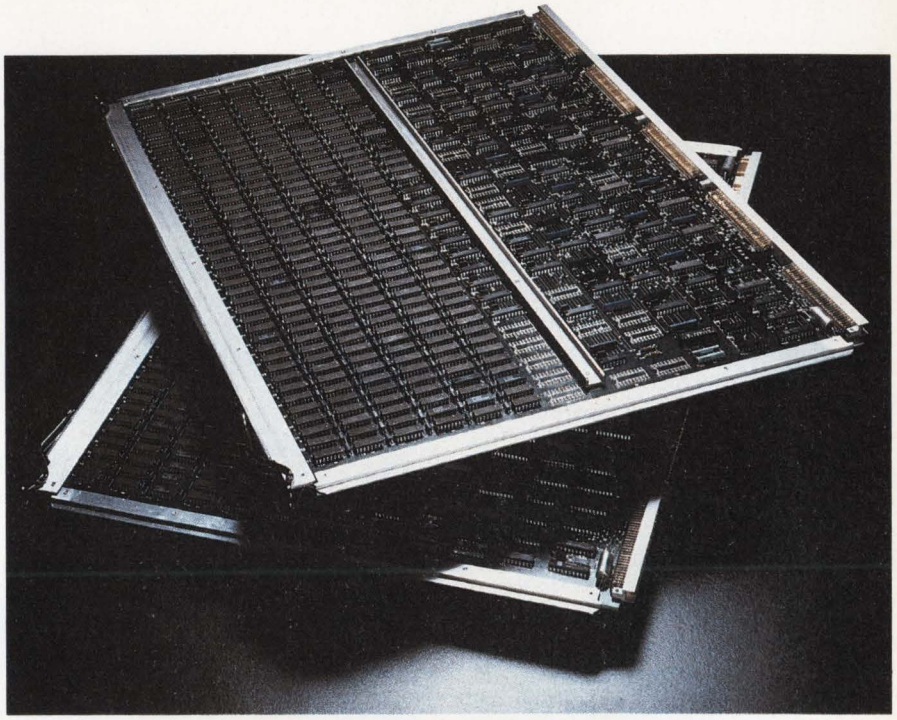


*Figure 1: With CAD, this Floating Point Systems array processor board was designed in 173 CPU hours over three weeks by a Racal-Redac system. The board has 525 equivalent ICs at a density of .57 on 8 layers with power and ground layers making 10.*

Several CAD system producers also support CAE to some extent. Versatec's (Santa Clara, CA) Expert and Racal-Redac's (Westford, MA) Cadet systems have schematic entry packages. Cadnetix (Boulder, CO) and others may also include schematic design on their workstations soon. Summagraphics' (Fairfield, CT) CAD systems include CAE netlist analysis for loads and drives. And Gerber (South Windsor, CT) has joined forces with FutureNet (Canoga Park, CA) for schematic input from personal computers.

**Packaging & Placement**—The first stage of physical design of the completed logic schematic includes not only placing components by board area requirements; manufacturing, height and special placement are important. Most newer systems, like EAS' (Wethersfield, CT) 700 Series, allow both components and blocks or areas of a board to be placed as a unit.

The grids by which these components are placed must also be set for the board, or preferably, for parts of the board. Standard 50 mil grids may work for most components, but flexibility to set other sizes for all or part of a board is useful, especially since most checking routines cannot handle off grid items.

Basic component characteristics and placement algorithms are used to initially place components in accord with the specified grid. Special mechanical requirements can usually be met by preplacement or specifying free sections on a board. Then, for density analysis, a histogram or a rats nest (as shown in **Figure 3**, the straight line connections of pins and gates) is generated.

This density analysis shows potential routing problems, and good CAD systems then go through a routine of changing the placement to analyze whether board density, or the actual percentage of the surface covered by components and copper, can be lowered. Programs for swapping pins and gates and pair-wise substitution of ICs and gates produce optimum board design, with as much spacing as is feasible.

Dense boards are not only manufacturing nightmares because of tight physical tolerances and prone to heat problems, they are also very difficult to route. A greater percentage of the board can be automatically routed if the density is kept low. The Summagraphics stations can, at this point, calculate how much of the design it can automatically route as currently laid out. If the percentage is

low, it can refigure the percentage, assuming added layers in which to place components.

**Routing/Interconnection**—The schematic input acts as a reference for density analysis and routing. Much-touted auto routing programs vary in their degree of usefulness in designing a 100% connected, manufacturable board. Newer routers allow some interactivity and combine algorithms to maximize the number of connections completed.

There are three main routing algorithms. The costed maze algorithm, developed for the phone company, is an exhaustive search beginning at one pin and examining an ever widening circle to find the destination. This route may wander some, but the "cost" or length, is always kept current. The line probe, or Hightower algorithm is more focused; routing begins from both points to be connected, and artificial barriers are put between them to continually head them in the direction of the other. The third, channel routing, generally uses spaces between components as open roads; this can be used to rapidly put X axis connects on one side of the board and Y axis routes on the other.

In addition to algorithms used, special requirements of connects between, for example, memory components (**Figure 4**) or power and ground are generally part of a comprehensive system's database. If features such as corner-clipping and orthogonals are built-in they reduce interaction time.

Other important factors in routing are minimizing vias (feedthrough holes), copper usage and blockage of unused pins. Often, the various routing algorithms are used in successive passes, and generally no vias are allowed on a first pass. Cadnetix' router has a "copper sharing" feature so indirect connection can be made through another IC connected to the same destination. This permits one copper channel to connect two components, instead of running two traces to one gate. Telesis has a special "pin keepaway" parameter, so a user can define a required distance for routes to go out before changing direction. This minimizes blockage of open pins.

Even as complex and dense as many boards are, CAD workstations can often auto-route over 90% of a design in short order. The routing sequences developed also improve chances of finishing the last 10% without totally re-working the design.

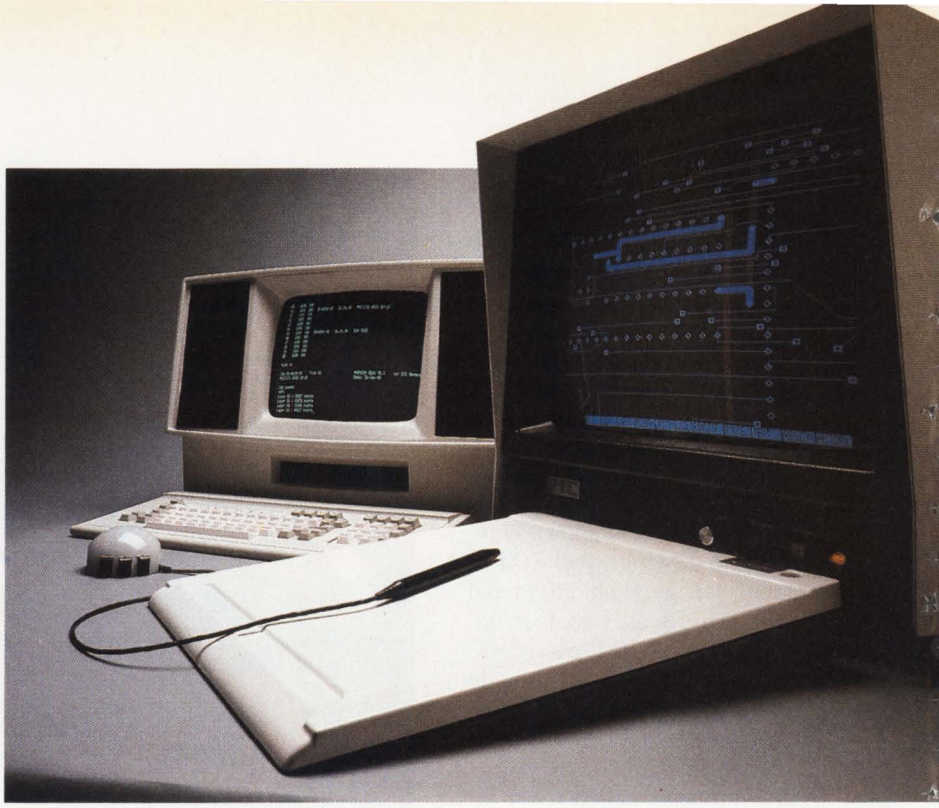


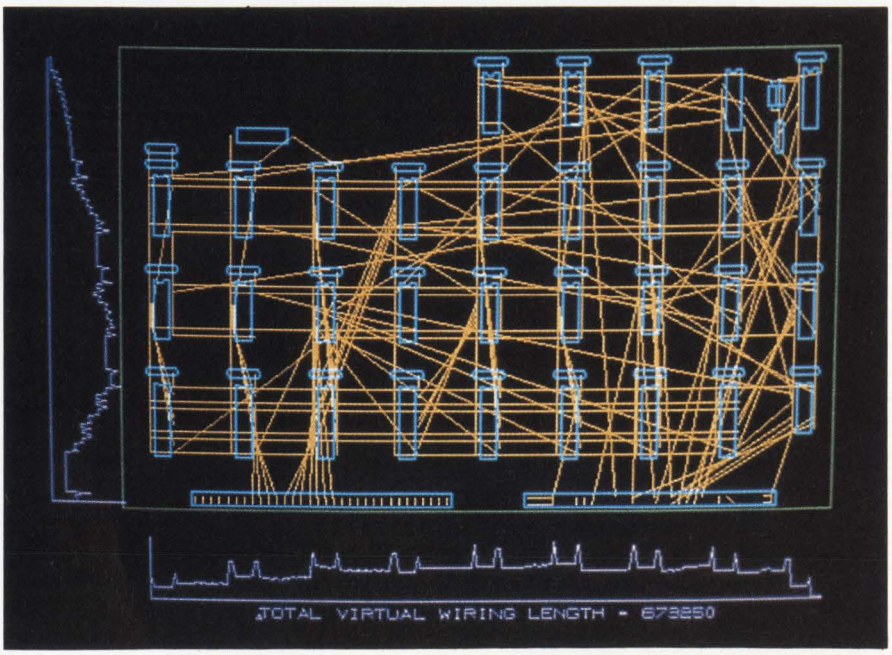
*Figure 2: Board schematics can be input via a digitizing tablet, as in this new system from Paragon Technology.*

Gate and pin swapping, segment swapping and continuing design rule checks all aid the interactive finishing touches.

**Verification/Documentation**—Despite ongoing checks against the original schematic and net list input and basic board design rules, the design verification step is crucial. A comprehensive net list check and compare routine is performed between the original design input and the layout and connection just produced.

When everything checks out, a large quantity of output documentation must be produced. Most CAD systems have NC tape output for PCB CAM drilling

*Figure 3: Density analysis on the Telesis workstation displays rats nested placement with straight lines showing all connections and, along the edges of the display, corresponding density histograms.*



Analogic News

BUSINESS NEWSPAPER

ONE DOLLAR

FEBRUARY 1984

ISSUE NO. 1

AP400 ARRAY PROCESSOR INSTALLATIONS PASS 1,500 MARK

INSIDE-

• New Analogic Houston Office to Support Array Processors In Oil Industry

• AP400 Series Now Interface Directly with HP A-Series Computers

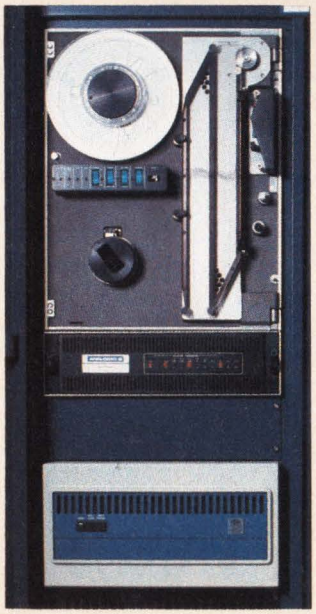
*AP500 Array Processor Offers Unique, Stand-Alone Super-Computing Capability*

WAKEFIELD, MA...The AP500 line of array processors has now joined the well-established AP400 line from Analogic. However, unlike any other array processor available, the AP500 has an on-board microprocessor that allows it to operate without a host

AP400 Installed Base Now Greater Than Any Comparable Machine

WAKEFIELD, MA...Analogic Corporation has shipped the 1,500th AP400 Array Processor from its Wakefield, Mass. facility. The AP400's high performance and low cost have generated such widespread acceptance that it now has the largest installed base of any array processor in its class. The AP400 has found application in such diverse areas as medical imaging, automatic test equipment, and seismic data analysis.

The availability of the AP400 in card-set form has made



*A major application of the AP400 is as a subsystem within automatic test systems such as this LTX... The AP400 offers a cost-effective means of adding powerful linear test capability to digital ATE systems.*

## The AP400 and ATE

The AP400 Array Processor's high-speed number-crunching power can make it a key component within an ATE system. It can serve a number of purposes in such a system, acting as an active signal filter, a high-speed data manipulator, or even as a waveform synthesizer.

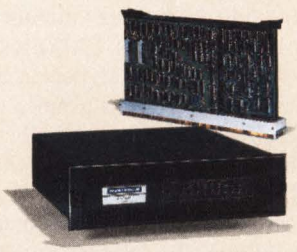
The AP400 brings the performance of computationally-intensive operations into the real-time domain. Transfer function analysis, convolution and correlation, and power spectrum calculation are but a few of the procedures which can be performed in just milliseconds with an AP400 — several hundred times faster than with an unaided minicomputer.

Minimizing host burden was a prime consideration in designing the AP400. Such features as direct memory access to the host, a powerful on-board control processor for internal housekeeping functions, and internal table storage and lookup ability mean that for many applications the host processor need only be involved in telling the AP to start and in picking up the processed data. The auxiliary input and output ports also help minimize host burden. Raw data can enter the AP400 directly, without host involvement, and processed data can be sent directly to peripheral equipment. This feature is particularly useful when the AP400 is used as a waveform generator. The AP400 can send the synthesized signal directly to a test bed without involving the host. The AP400 is currently in use in such diverse applications such as checking codec pairs and airborne radar testing. To find out more about how the AP400 can help you with your ATE problems, contact


Bruce Mackie
Analogic Corporation
Computing Systems Group
Audubon Road
Wakefield, MA 01880
**1-800-237-1011**
(In Massachusetts call,
617-246-0300, X2176)


## AP400 Performance Features

| | |
|---|---|
| 1024 point complex FFT | 7.4 ms |
| Real convolution (1024 data, 512 kernel) | 7.3 ms |
| 2048 point power spectrum (with Hamming window) | 13.5 ms |
| 1024 pcint, ensemble-averaged transfer function | 1.2 s |



ANALOGIC®

COMPUTING SYSTEMS PRODUCTS GROUP

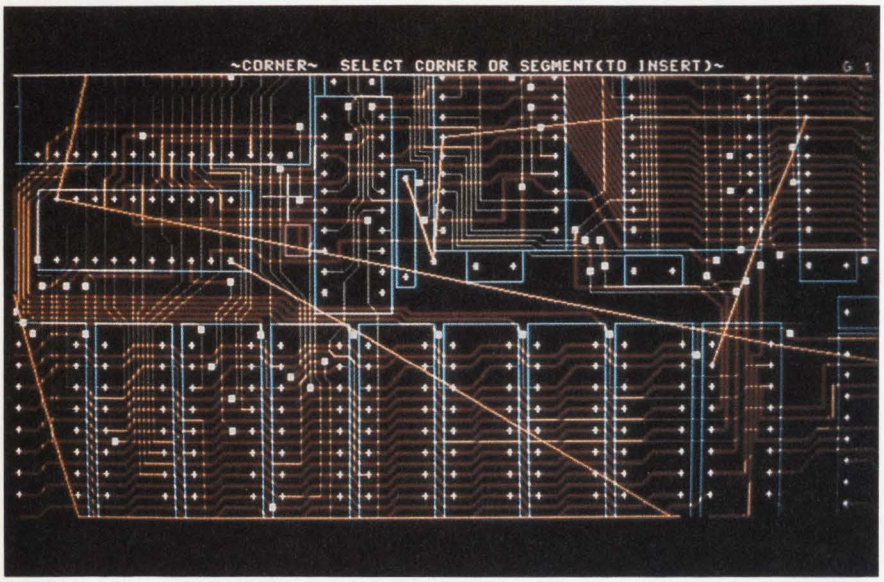



*Figure 4: Some workstations for PCB design recognize memory components and automatically route them pin-to-pin with 45° angles, as shown on this Racal-Redac system.*

and photoplotting. Gerber, who produces the industry standard photoplotter calls their PC-800 interactive (not automatic) digitizing system an artwork generation system. This is an apt name, since solder masks, silkscreen legends, drill, fab and assembly drawings, check plots and paper plots are all needed outputs. Wayne-Kerr's (Woburn, MA) interactive system, like EAS', allows by-passing the photoplotter, as it produces camera-ready plots on a Hewlett-Packard plotter.

In addition, documentation such as net list, block list, error list, bill of materials, placement analyses, summary of connectors, unused pins and gates and component or parts lists are essential. As EAS has emphasized with their OAX office automation software, a standalone workstation can provide engineers tools for other use such as documentation and report writing.

## Distributed Processing

These are the same design functions performed by large systems from Computervision, Applicon and Calma, with a single very large number-crunching host providing processing for many stations. Smaller systems for CAD present a distributed processing approach, even when a central, more powerful unit is part of the overall scheme, as with the Paragon (Pleasant Hill, CA) Series 300.

Dedicating a minicomputer to each workstation provides fault-tolerance and flexibility to the designer, as well as good speed, no matter how many CAD users are working simultaneously. Recent drastic drops in the price of computing power, especially of the processors used for graphics functions, allow workstations full CAD functionality for under $100,000, and in the case of Wayne-Kerr's interactive Artworker, under $25,000.

Complete, single user CAD workstations are attractive not only to small firms that cannot afford a larger system, but also to companies with a large system who need to add designers without significantly slowing down all of their CAD work. A network of workstations can be cost-competitive and furthermore, increase flexibility and expandability. The interactive graphics functions of the workstation can support much work if iterative tasks like auto routing, checking and documentation are performed by the central CPU.

Another approach to keeping a CAD graphics workstation working on what it does best is exemplified by Summagraphics' 8100S and 2100 configurations. This "one-and-a-half user" set up provides two workstations, but only one for graphics use; the other, with an equal amount of memory, can run non-graphics functions like routing or driving a pen plotter. Maximizing the percentage of time that workstations use their graphics capabilities provides cost-justification through efficiency.

There are two approaches to powering CAD workstations within the main group of contenders. Two of the newest CAD vendors, Engineering Automation Systems (EAS) and Cadnetix, have designed microprocessor-based systems from the ground up. Cadnetix uses the 32-bit, 10 MHz 68010 processor; they wrote their own software, including the operating system, to be optimized for electronic engineering and design applications. EAS' design, though their own, emphasizes standards, for portability. The EAS 68000 processor is on a Multibus system, with 8086/87 processors for graphics and Ethernet networking (**Figure 5**). The software is Xenix-based and written in C.

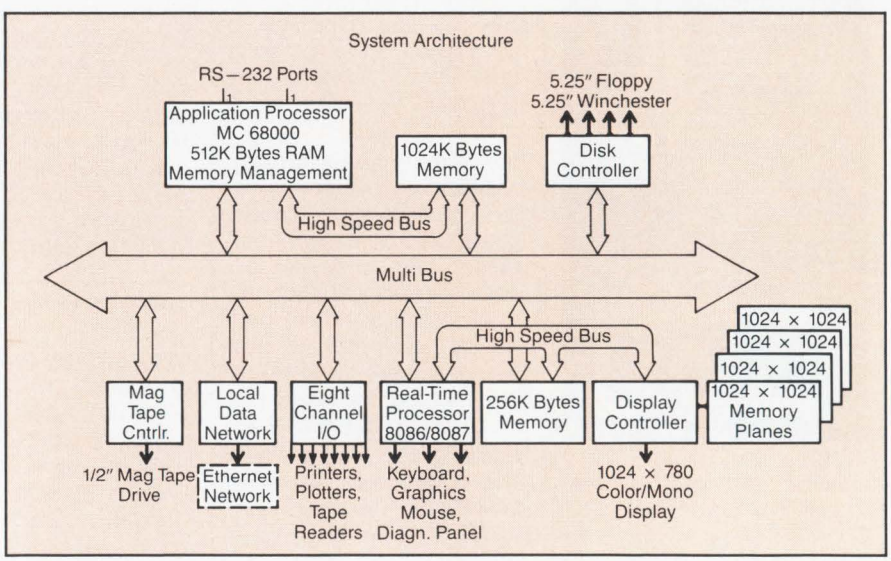
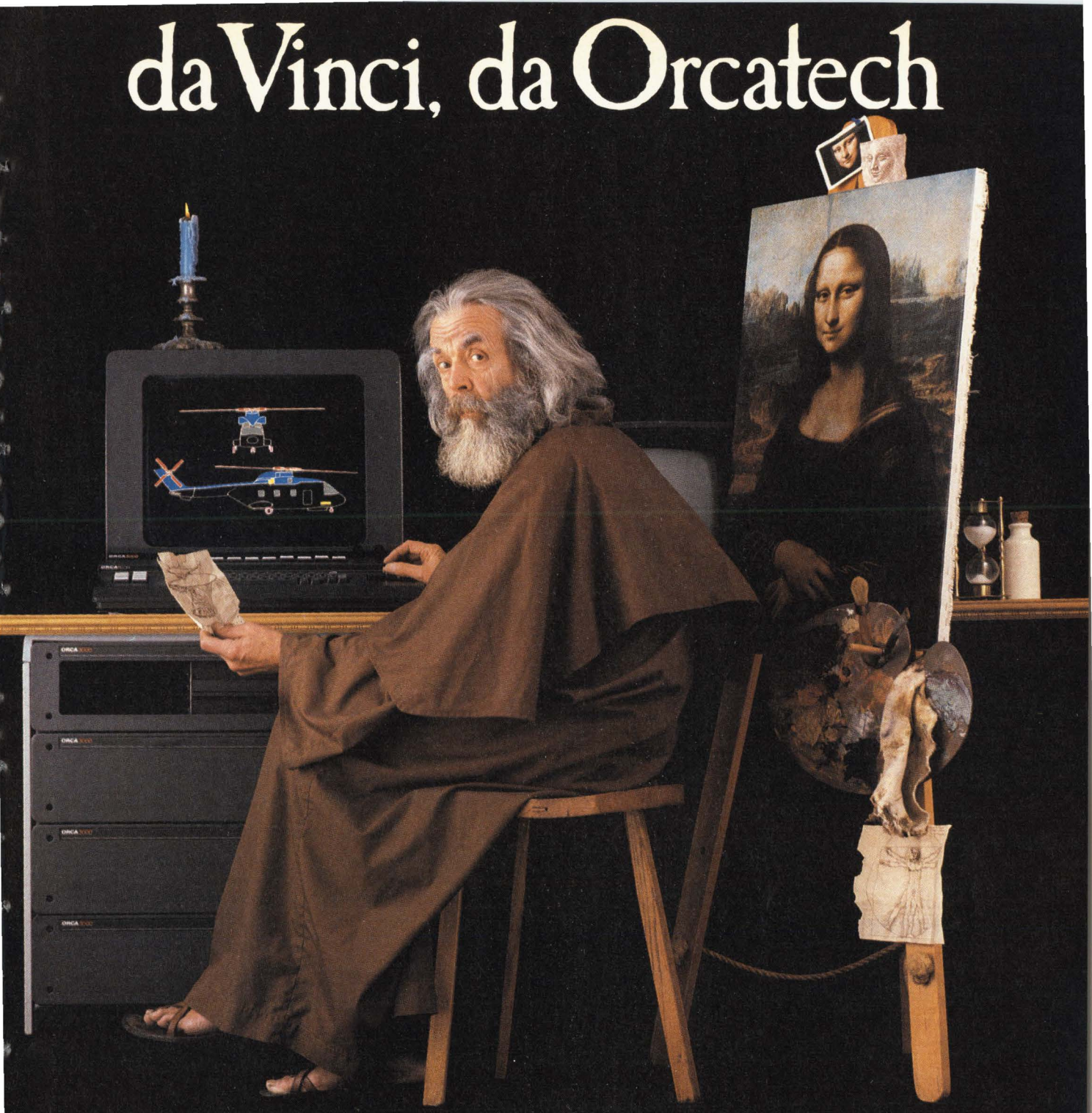



*Figure 5: The EAS/700 workstation architecture, though their own design, uses Multibus, 68000 and 8086/8087 processors and Ethernet, to increase industry compatibility.*

# da Vinci, da Orcatech



## Get your designs off the ground.

Leonardo da Vinci. One of the great designers of all times. But Leonardo's inventive thinking was so advanced that he became old before many of his concepts and creations could be realized.

Orcatech Graphic Computer Systems can quickly get your ideas off the ground.

With our family of powerful, high speed, programmable graphics workstations, your designs can be fast to production; first to market; foremost in your industry.

Orcatech. For the great designers of our times.

**Write 38 on Reader Inquiry Card**

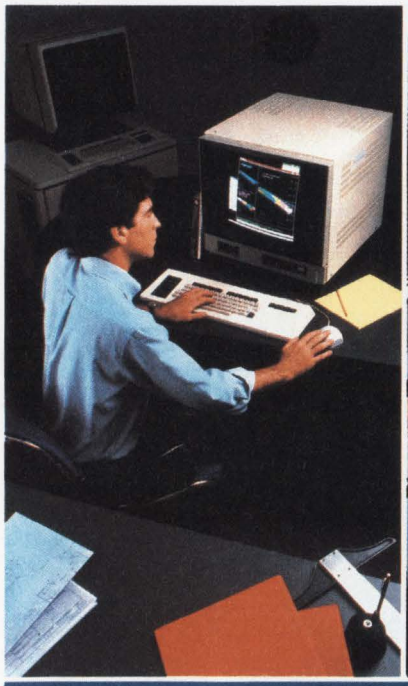
Offices throughout the United States, Canada and Europe.

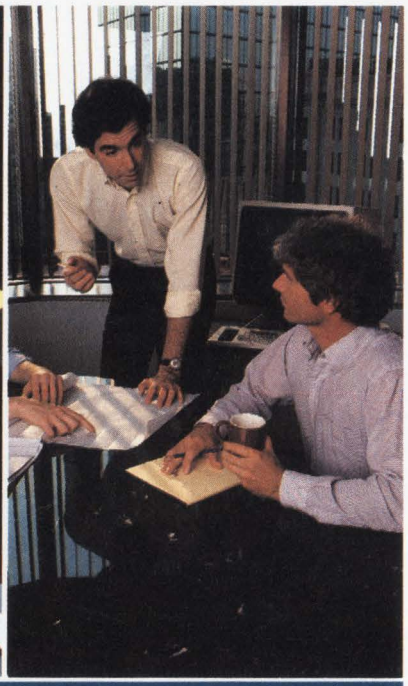
Orcatech Inc.
1000 Morrison Drive
Ottawa, Ontario, Canada
K2H 8K7
Telephone (613) 726-1600
Telex 053-3868

**ORCATECH**
Graphic Computer Systems

# Apollo recognizes the fact that there are two sides to every professional.

*There's a part of a professional that involves their profession.*



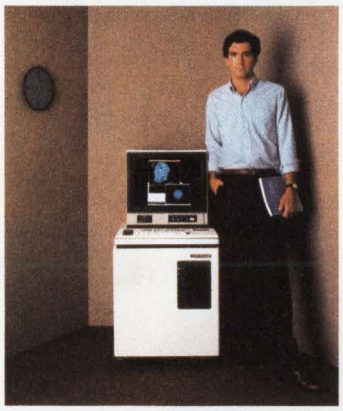


*Then there's the part that goes to meetings, makes presentations, does budget, prepares documents.*

According to recent reports, people who work with computers spend some 30% of their day working in their chosen profession. And 70% of their day just getting things done.

So we're announcing some ways for making better use of both sides of their day.

For starters, we've set some new standards in high performance workstations. By introducing a new set of Apollo computational nodes so fast you don't have to wait for them to figure out anything. Even when you're working on Solids Modeling, Image Analysis, Finite Element Analysis, and VLSI Design.



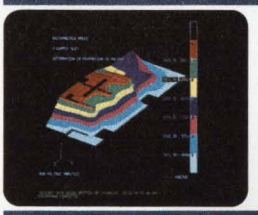
*The power of a high-end 32-bit supermini at your desk for a fraction of the price.*

The Apollo DN 660 and DN 460.

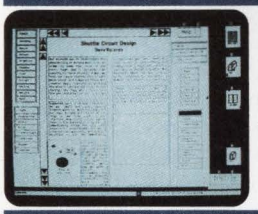
Inside you'll find up to 4 MB of main memory. With full 32-bit architecture and an integrated hardware floating point unit. And enough power to handle up to 24 concurrent processes, each with up to 256 MB of virtual address space. Plus high resolution bit map graphics that among other things, can do area fills at up to 320 million bits per second.

In other words, they've got all the power of a high performance supermini like the VAX* 11/780. Except that they sit at a desk. And go for a fourth of the price.

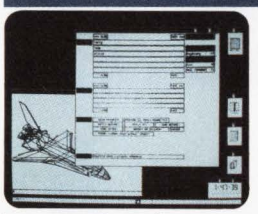
But even more important, each DN 660 and 460 workstation node you add to the Apollo DOMAIN network adds power instead of taking it away. Because each is a 32-bit workstation with network wide virtual memory that lets all Apollo nodes share data, software, programs, and peripherals transparently across the network.



*The DN 660 and DN 460 can do state-of-the-art Finite Element Analysis at state-of-the-art speed.*



*They work on documents the way professionals work.*



*They do Electronic Mail, Filing and Calendar Management.*

But we've also introduced software that helps professionals work with the other side of their work: DOMAIN Professional Support Services. With Document, Mail, Calc, Calendar and File. All based on the more complex needs of the professional. And fully integrated with your application programs. So you can do all your work on the same system.

All of which should come as a very welcome development to every professional. Because we at Apollo are not simply making computers. We're making workstations that work for professionals.

For more information call or write Marketing Services Director, Dept. P1, Apollo Computer, 15 Elizabeth Drive, Chelmsford, Massachusetts 01824 (617) 256-6600, ext. 4497.

apollo

**Write 46 on Reader Inquiry Card**

*VAX is a trademark of Digital Equipment Corporation.

# Workstation Design in the Engineering Environment

One of the purposes of workstations should be to enhance the productivity of engineers, designers, and other professional users, so they can directly produce documentation — with effort that has a minimum impact on the creative processes. The workstation of the future will be an extension of the user, able to multiply his talents and free his time for creative activities.

Access to the skills contained within the workstation should be immediate and uncomplicated. With no prior training of the user, workstations can accommodate casual users and their individualized needs rather than only CAE specialists.

Claims have been made that several display-based workstations have met these criteria, but the results rarely match the claims. The culprit is the general design approach in which the man-machine interface and the software interface force users to make all the compromises. Software can force the user to learn computer languages and techniques.

Many of these systems are physically awkward or even uncomfortable to use. They must be located in special areas of controlled lighting, for example, removed from the user's normal work environment. It is not surprising that most professionals have rejected these systems as hostile to their creative instincts.

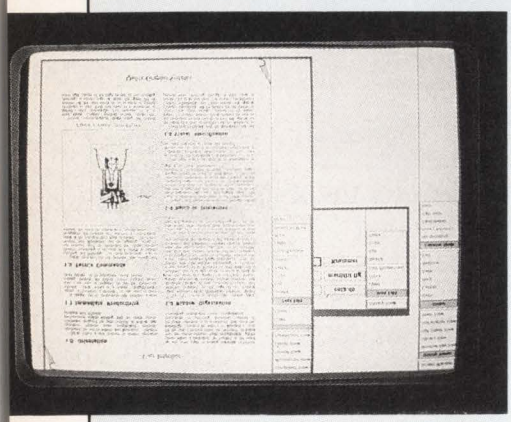


*Figure 1: A simple user interface permits even the casual user to take advantage of the workstations capabilities. Every window has its own menu to guide the user through each operation.*

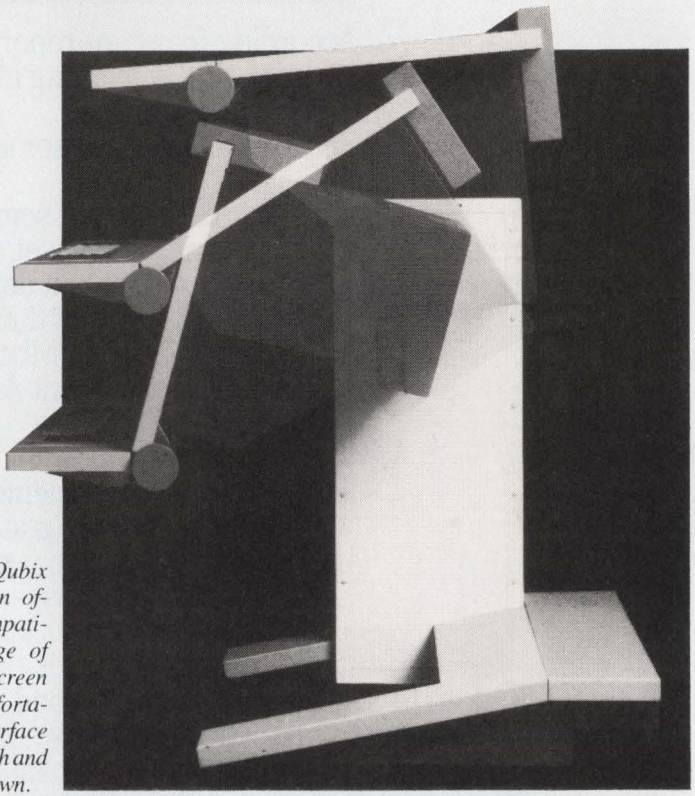


*Figure 2: The Qubix CAD workstation offers physical compatibility to a range of users. To make screen interaction comfortable, the worksurface tilts back and forth and moves up and down.*

It now takes time and commitment to capitalize on the advantages a workstation offers. Casual users can never master the system. To recoup its investment, management is forced to use intermediaries who understand the workstation, but often don't understand the content of the intended work. Overall productivity is reduced by the two-step process: errors occur more frequently, and priority queuing is likely.

The design of the workstation must permit engineers, designers and other professionals, to take full advantage of all of the functions they offer. Software interfaces should allow the user to utilize capabilities via the most elementary techniques; menus, touch panels or multiple selection schemes which eliminate the need for extensive documentation references. Training sessions should be eliminated in favor of built-in computer guidance.

**Figure 1** shows the software interface presented to the user by an advanced computer-assisted engineering workstation. The material under development is on the left; the menus are on the right. The user moves a pen-like stylus to the mode or function that's desired, and a selection is made. Users are led to further choices such as shape, line width, geometry or editing. No software knowledge is required; the operating system and application program are totally transparent. The labels used in the menus do not require familiarity with computer protocols or language. Programs have been designed *outward* from the professional user.

For physical compatibility the height of the combination viewing and working surface of the workstation in **Figure 2** can be raised or lowered and its angle can be changed from vertical to horizontal. The workstation can be tailored to perform specialized tasks.

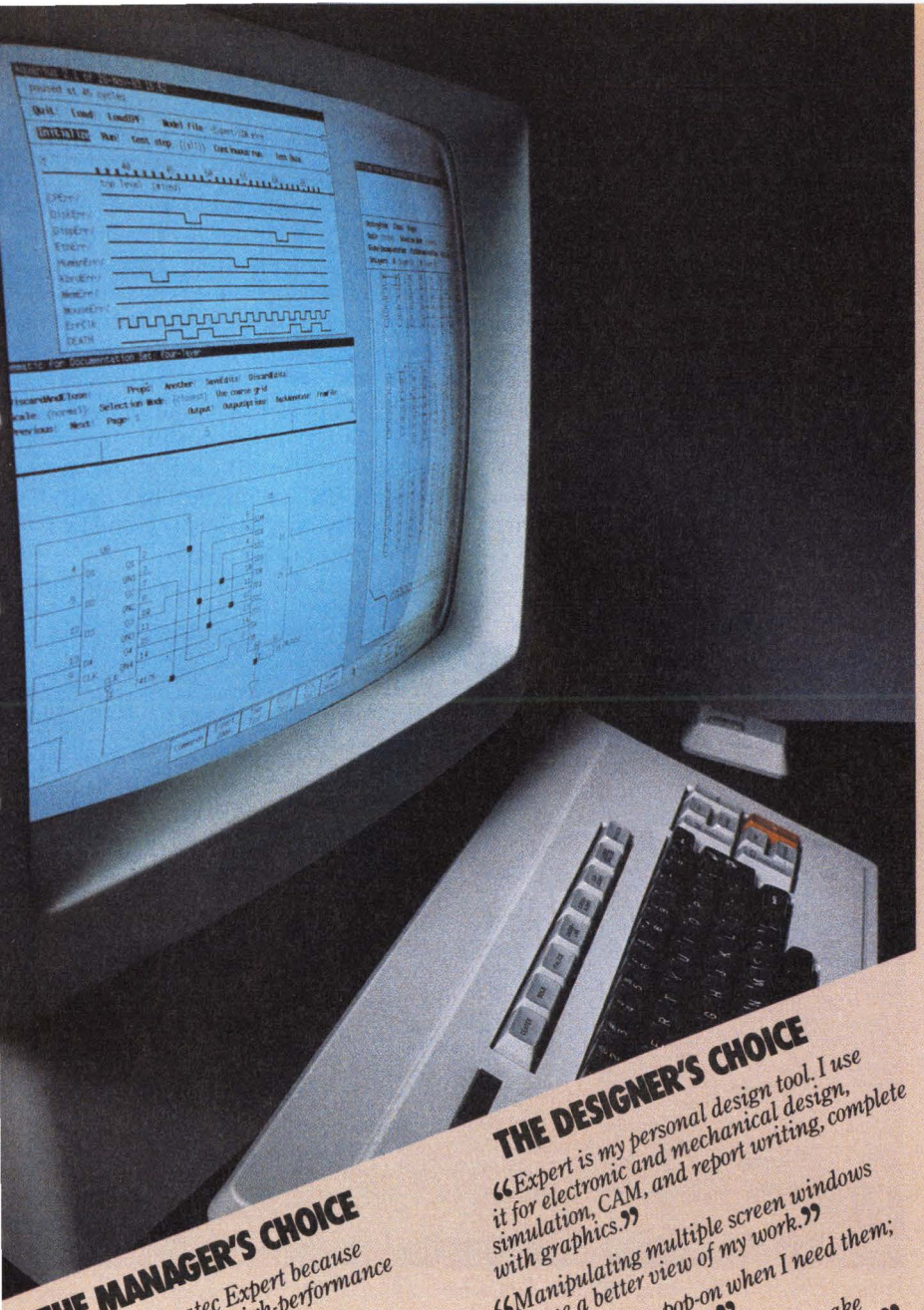
Increased display screen resolution permits users to view objects as naturally as possible. Displays must be presented in real time to provide the immediate feedback a user receives in his usual activities.

This workstation can be used in office or laboratory environments in the same way as any other tool. Normal lighting levels permit the reading of sketches, drawings, typewritten materials, and other printed materials.

The greatest of tools is useless if not utilized. The considerable potential of the workstation will be not achieved until the workstation adapts to the needs of its intended users.

*— Marie C. Cornez, Qubix Graphic Systems Inc., Saratoga, CA*

**Write 301**



# EXPERT.

# THE EASY CHOICE FOR PCB DESIGN.

VERSATEC
A XEROX COMPANY

## THE MANAGER'S CHOICE

*"We chose Versatec Expert because it cost less than other high-performance workstations."*

*"Expert integrates all the applications we need—design, simulation, auto placement and routing, CAM outputs, mechanical design/drafting, and documentation."*

*"With modular Expert software, we optimize price/performance for each station."*

*"Ethernet gave us a proven network for sharing resources and data."*

*"Low entry cost and affordable leasing plans made more workstations available to more engineers."*

*"You can't beat Xerox for support and service."*

## THE DESIGNER'S CHOICE

*"Expert is my personal design tool. I use it for electronic and mechanical design, simulation, CAM, and report writing, complete with graphics."*

*"Manipulating multiple screen windows gives me a better view of my work."*

*"Dynamic menus pop-on when I need them; stay hidden when I don't."*

*"Pre-defined component libraries make it easy to create complex drawing elements."*

*"True interactive simulation verifies my designs."*

*"I don't have to be a typist. Most operations are performed with the mouse."*

*"Expert's hierarchical design features let engineers work in a natural, comfortable way."*

*"I was designing complex PCBs in a matter of hours. Expert is truly easy to use."*

Whether you manage an engineering group or design PCBs, see why Versatec Expert is the easy choice for PCB design. Circle our readers' service number for more information. Better yet, call your closest regional demonstration center for your own hands-on demo.

| | |
|---|---|
| Atlanta, GA | 404-992-3198 |
| Boston, MA | 617-229-6747 |
| Chicago, IL | 312-885-2757 |
| Dallas, TX | 214-620-8694 |
| Indianapolis, IN (DSI) | 317-299-9547 |
| Newport Beach, CA | 714-851-8005 |
| San Diego, CA | 619-452-5611 |
| Santa Clara, CA | 408-244-5581 |
| Wayne, PA | 215-293-0920 |

**EXPERT. THE EASY CHOICE FOR PCB DESIGN.**

VERSATEC
ENGINEERING INFORMATION SYSTEMS
2710 Walsh Avenue
Santa Clara, California 95051
Telephone: (408) 988-2800
TWX: 910-338-0243
Telex: 334421

The other systems in this price/performance range use standard computers' power. Telesis, Racal-Redac and Paragon use DEC machines. Summagraphics is DG-based, and Versatec, of course, uses parent company Xerox's equipment. The advantages to this approach are that the vendor can concentrate on developing graphics functionality and service is widely available.

As standalone units, these workstations may appear unsuited to the large manufacturing/design environment. Most systems have networking capability built in, providing file sharing and the possibility of peripheral sharing between many stations. Standard Ethernet networking is used by Telesis, Cadnetix, EAS and Summagraphics. Paragon's 300 stations use a fiber optic network.

The modular nature of these standalone systems allows their efficient use in many configurations, while allowing gradual growth and expansion. With all of the functions and database needed to design a board, a station can be used singly by small firms with little to spend. This one station can be added to by local area networking of similar stations or by links to a central processing station.

## Interactive/Automatic Functions

The point of using computer aided design is to speed and expedite the tedious and exacting processes of layout and interconnection of a printed circuit board. Skilled electrical designers should have this power to facilitate their jobs, but conversely, the talent of the designer should be fully utilized, as well.

CAD functions should run either interactively or automatically, by the designer's choice, to maximize use of both computer power and design knowledge. Although CAD stations can be programmed to recognize many important general and specific design rules and physical characteristics, there are instances of an unusual part or application specific placement when the designer knows best. While common placement and "most" connection schemes, allowing a designer to prioritize placement in auto placement routines, pre-placement or reentry may be more effective in the long run. Human experience and knowledge may aid at any stage of the design process.

One premier feature for designer interaction is reentrance. This allows a designer to interrupt an automatic routine, interactively optimize a portion of the design and reenter the automatic routine at the point it was interrupted with the changes made interactively incorporated. Using interactive tools at tricky points can avoid major reworking later. The ability to interrupt and reenter keeps the process fast.

Another way to contend with exceptions or special components and areas of the board is to handle them first and then let automatic routines take over. This involves not only specifying certain features and board areas in the initial master design, but also pre-placement and pre-routing.

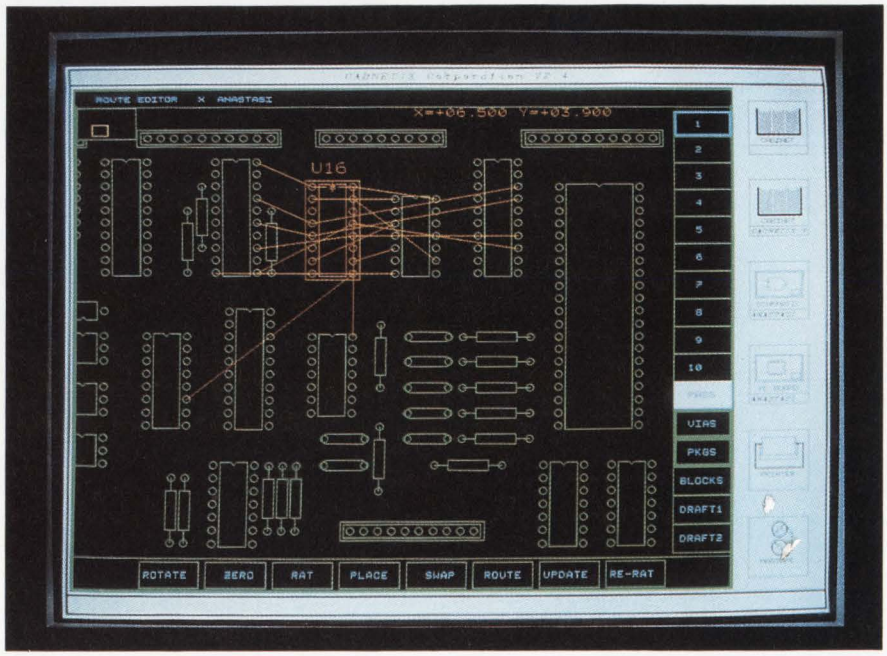



*Figure 6: When moving the highlighted component, rubberbanding would maintain the connections shown in this Cadnetix display during placement.*

Still, the more features a system's database recognizes, the better. Several newer systems automatically draw 45° angles and orthogonals and some know how to place and route memory components. Orthogonals may be entered even before routing by systems like Telesis', since it includes schematic drawing capability.

Users should be able to experiment with or change layouts and routing at several stages. Rubberbanding, as in **Figure 6**, continues to show a component's connections during interactive work. This is an important visual aid for changing placement but maintaining feasible routing.

Another key factor in optimal placement is in the original set-up of the grid of points by which components and connections are placed. Traditionally, only a 50 mil grid was available, which accommodates many, but not all, standard components. Systems from Racal-Redac, Summagraphics, Cadnetix and others allow variable grid set-ups, and the use of several different grids on one board. A choice of English or metric standards is fairly common. Telesis and Paragon are among those who allow .001" increment grid settings. This allows more automatic work, as fewer items must be "off-grid." This flexibility is especially useful for incorporating analog parts.

Routing is the most time consuming and processing-intensive of the design steps. Even with workstations, this is often sent off to a big machine to speed the process. Though a generally effective scheme, vendors like Telesis point out a potential problem in finishing the final 5-10%, after an auto-router has gone 90-95% to completion.

One-hundred percent routing of a board in minimum time is the real goal of any design system, not just getting a good percentage automatically designed. Beginning with the quality of the placement, which should be clear at the density analysis (rats nesting or histogram), many factors can effect the possibility of completing a 95% routed board. Advanced workstations allow the user to define how much of the routing is to be automated at once: single connections, nets, areas of

# SAFT STANDBY POWER SYSTEMS FOR SMALL BUSINESS COMPUTERS AT A SMALL BUSINESS PRICE.

Now there's a standby power system designed especially for the small business computer. At a price the small businessman can deal with.

It's from SAFT, the hottest name in the battery business today. And although it can provide emergency power for almost anything, it was designed specifically to protect personal and small business computers from data loss in the event of a blackout or brownout.

As soon as the power drops, a Saft Standby Power System cuts in within one-half cycle. There are two systems available. The 200VA, which provides standby power up to 20 minutes. And the 400VA with standby power up to 10 minutes. That gives an operator plenty of time to get off the computer safely. And during normal operation it acts as a line filter to protect against harmful spikes.


We can give you more reasons for depending on the Saft Standby Power System. Call us at (602) 894-9564. Or write SAFT Electronic Systems Division, 2414 14th St., Tempe, Arizona 85281.

SAFT

**MORE POWER TO YOU.**

Write 68 on Reader Inquiry Card

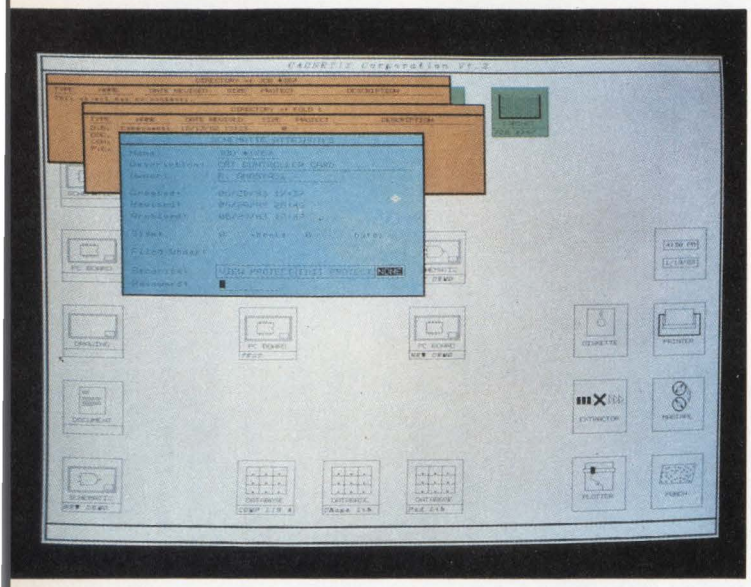


*Figure 7: Object oriented menus with English make commands easier to find and execute on the Cadnetix screen.*

board or blocks of one type of component, or an entire board may be most effectively auto-routed at one pass.

An extensive component library and design data base make auto-routers and auto-checking on these workstations more effective and special requirements of memory, power and ground should be included. The Summagraphics' stations use three routing algorithms in succession; checking is speeded by not checking spacing between pins within a component. Telesis has three user-selectable parameters for the router. Window expansion allows checking a defined area outside the normal window for possible routes; number of segments lets the user set how many X and Y axis segments a connection may have, to prevent undue wandering; and pin keep-away, mentioned earlier, ensures that unused gates are not blocked off.

The increasing sophistication of software for board design makes routine programs more effective. But a mix of interactive and automatic programs is ideal. Allowing interaction while devoting speedy automatic routines to repetitive and complex tasks optimizes CAD workstations as tools for a skilled board designer.

## Continuous DRC

An important feature of these newer workstations is continuous design rule check (DRC). Designers are not allowed to create an entire section of a board incorrectly, as with older checks on completed board sections. If errors were found in a block, the section had to be re-

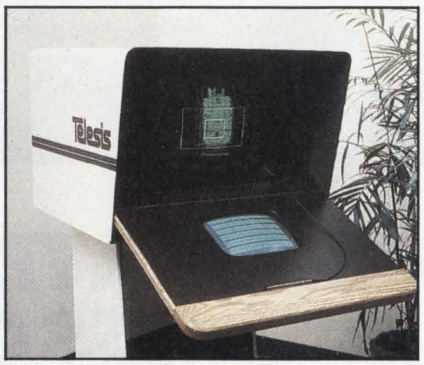



*Figure 8: The top screen of this Telesis system is displaying the world view. The lower screen is the function screen, carrying soft menus.*

routed or changed. Now, systems either flag or simply do not allow violations of basic board design rules.

There are two types of design rules to check: logical and physical. CAD systems have a large database of engineering knowledge against which moves are checked. Generally, automatic routines cannot violate design rules. Most systems do not allow logical errors to be made, even interactively. An error message appears on the screen, and the part or route in violation will not be entered into the design as long as it remains in error.

Physical DRC is trickier. For example, there are times when, to optimize a layout, closer than normal spacing is desirable. User ability to turn off the DRC, as in the Telesis system, can solve this problem. Perhaps more useful is to have an error flag generated with DRC off, to allow part or route placement, as in the Cadnetix and EAS systems. The error flag can be kept in the design file while allowing special parts to be used.

For fine-tuning and correcting errors, it helps to have error flags on screen and also on file. The Summagraphics' systems use a different error flag for each kind of violation. Line-to-line, line-to-pad and pad-to-pad rules are checked.

For spacing connections, it helps to see traces at their true width, as on the Cadnetix CDX-5000, EAS' 700 and Wayne-Kerr's Artworker. Though the information must be stored as part of the design for artwork generation, many systems do not display that parameter. Truth in pad, or flash, shape and size is also being incorporated. Traditionally, pads are assumed square or round, but some systems now recognize that pads can be several shapes. Again, this improves the accuracy of physical design rule checks.

## Using the CAD Tool

A major consideration in designing a board with a CAD system must be how easy the tool is to use. Ease of use and learning is a big selling point for vendors such as Telesis. Many factors go into the user interface, especially for graphics and complex design, that require that many commands be accessible.

Menus are, of course, essential. Cadnetix uses the "object oriented" menu (**Figure 7**), with symbols and English displayed on the screen. Telesis' "function screen" carries all-soft menus in English (**Figure 8**). Three standard soft menu screens are available, and since it is all in software, menus can be rewritten in another language for overseas markets or revised in the future with no hardware modification.

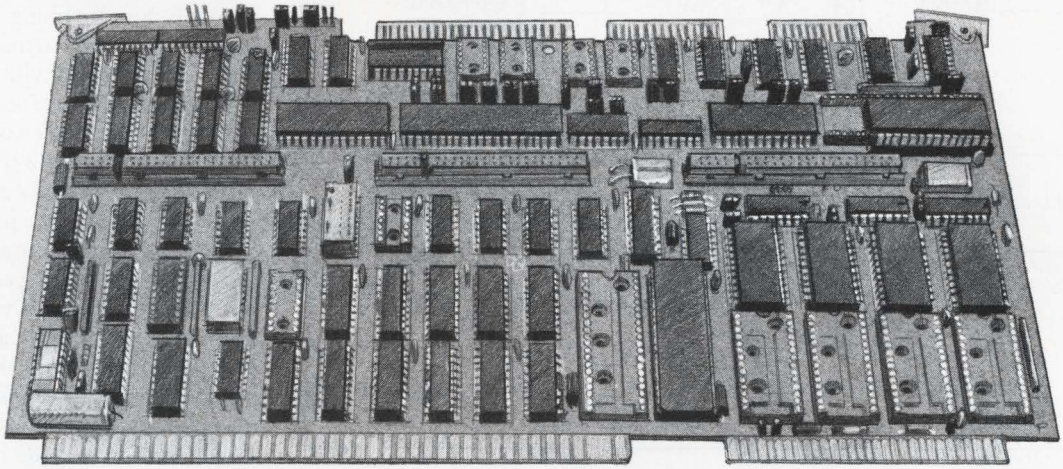
More traditional digitizer input with a mouse or stylus, used by other workstations, often combines menus on the tablet and on the screen. But moves toward menus in English and a capability for users to add macros to command menus are greatly speeding interaction and thus, the learning curve for CAD system operators.

As compared to the out-of-house training courses for larger systems which are weeks long and have an approximate 2-year learning curve, vendors claim that these workstations can be learned quickly enough to be productive in several weeks and mastered in a few months. Not only does this save the company money and frustration when losing a trained oper-

# THE BATTLE OF THE GIANTS GOES ON!

# Highly Versatile ZX-86 Single Board Computer

## For Your Next 8086/MULTIBUS Project



### Beats "The Giant's" SBC-86/05 Six Ways:

- On-Board Socket for the 8087 Numeric Co-Processor.
- 5, 8 or NOW 10 MHz OPERATION.
- Three SBX Connectors (to their *two*).
- Two Serial Ports Available On-Board (to their *one*).
- Multi-Layer Board Design for Low Noise Operation.
- New Memory Module Doubles On-Board Memory. Expands Memory from 8KB RAM, and up to 64KB ROM, to 16KB RAM and up to 128KB ROM with a single module.

The ZX-86 is a plug for plug replacement for the SBC-86/05 and is fully software compatible with the SBC-86/12A.

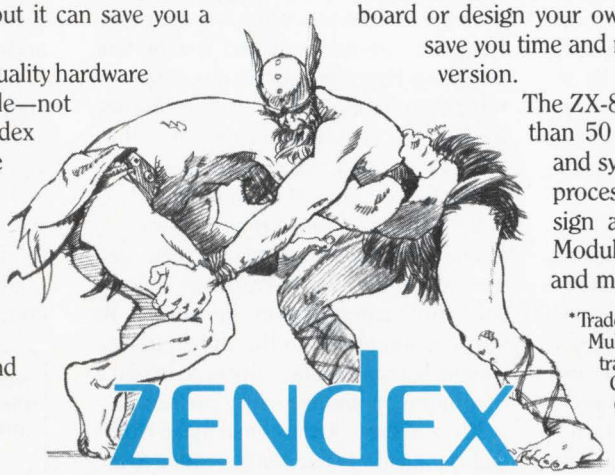
In fact, if you are considering working with any other 8086 processor board, look at the ZX-86. Not only is it highly versatile and highly capable, but it can save you a great deal of money.

But having a single piece of quality hardware is not enough to win the battle—not even if it is the ZX-86. So Zendex supports the ZX-86 with the software and other MULTIBUS products to create a *complete* 16-Bit "development thru target" ENVIRONMENT.

- We have RMX-86 and CP/M-86 COMPLETELY ported to the ZX-86 and floppy and Winchester controllers.
- We support the ZX-86's three SBX connectors with a complete line of ZBX Modules, including: Serial I/O, Parallel I/O, an IEEE-488 interface, a Centronics printer interface, an SBX display and a clock/calendar.
- With the ZX-86, you can use three of these modules, in addition to the two serial ports On-Board. This means as many as FIVE RS-232C ports on a single processor board. We also offer a ZBX Module floppy disk controller and have CP/M-86 ported to this controller with the ZX-86.
- We offer a complete line of Table-Top or Rack-Mount chassis for both your development system and your target system.

**COMING SOON:** THE ZX-186, a High Performance 80186 MULTIBUS processor board. If you are planning to use a 186 board or design your own, CALL ZENDEX NOW! We'll save you time and money, even if you want a custom version.

The ZX-86 is only one of ZENDEX's more than 50 MULTIBUS boards, subsystems and systems, including: 8-bit and 16-bit processor boards, disk controllers, design aids, PROM programmers, ZBX Modules, chassis, development systems and microcomputer systems.




*Trademark of Zendex Corp.
Multibus, RMX, Multimodule, SBC, SBX are trademarks of Intel Corp.
CP/M is a trademark of Digital Research Corporation.

**The Other Giant in the Multibus Market.***

**Zendex Corporation,** 6644 Sierra Lane, Dublin, CA 94568, (415) 828-3000. TWX 910 389 4009.

Send for our new expanded Product Catalog or **CALL 800-227-2634 Ext. 922** (outside Calif.)

Write 15 on Reader Inquiry Card

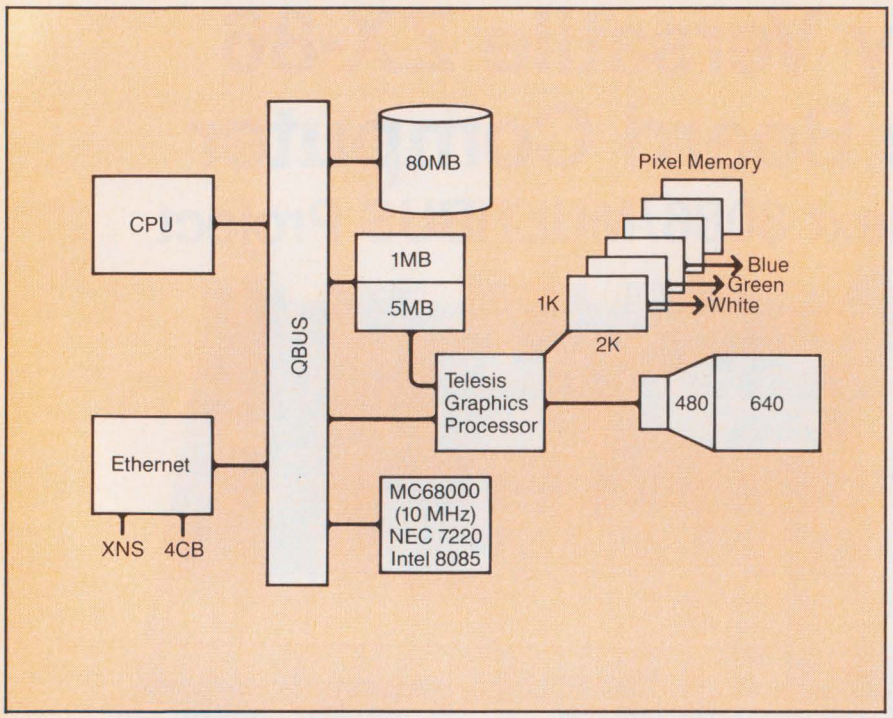



*Figure 9: Configuration of the Telesis workstation includes six 1K × 2K pixel memory planes and one 640 × 480 plane with a 640 × 480 monitor for zoom and roam as well as world view; 1/2 Mbyte of the 1½ Mbyte core memory is dual ported, to speed graphics processes.*

ator, it allows several people to become proficient, allowing better use of the system.

Varying windows and views on screen also help the user. Some systems allow views to change without software redraw time. Hardware zoom is very important as is roaming.

The Telesis design focuses on these functions by using six 1K × 2K pixel memory planes and one 640×480 plane (**Figure 9**). The display is 640 × 480. The plane that matches that dimension carries a "world view" of the entire board, while showing the areas of both the 1K × 2K in memory and the working 640 × 480 window (top screen, **Figure 8**). Having pixel planes larger than the display allows real time roam and zoom, as well as roam during an active command.

Speed makes a system easier to use because humans are accustomed to fast results to their actions. The multiple processors common to these workstations and dual-ported memory (**Figure 9**) are ways to speed a system's reactions. Racal-Redac's Cadet uses software modularity to put only those elements needed into core memory during an operation. The method of field organization and storage can also effect speed.

A common aid to users are help and undo keys. The Undo, or, as EAS puts it, Oops, key on a workstation keyboard allows just the last move to be deleted. Although this sounds basic, some systems make errors alone a series of extra steps.

Color or monochromatic monitors are available on many CAD stations, but color is preferable. Colors can be used to differentiate between board layers. Telesis uses "color priority" to show which layer is on top by not mixing on overlaps. Different colors are often used for pads, connections and component outlines. Highlighting a component or trace clarifies the design process (**Figure 6**). If cost is an inhibitor to buying color, upgrade to color is generally possible.

The ergonomics of two-monitor CAD systems is debatable, so many newer systems have only one display screen, and use part of it for software menus. Telesis' function screen (lower in **Figure 8**) seems comparable to the alphanumeric second screen, but is really used in place of a menu on the digitizing surface.

Most of these features that make workstations easier to use can be related to the manual design process. The more a CAD system emulates the way a board designer works, the more it becomes a tool and not an intruder on the designer's autonomy. From showing and using a bit bucket in placement to allowing roaming by stylus movement, printed circuit board design with a CAD workstation is no longer a foreign process to the user.

## Aids to Board Design

Engineering workstations can be powerful tools for designing printed circuit boards. Compared to manual layout and connection, design with computing capabilities is efficient, accurate and fast. And standalone CAD workstations are a flexible answer to powering design.

Interfaces to directly enter logical designs from manual or computer-aided engineering ensure accuracy. Placement, packaging, and routing algorithms combined with comprehensive component libraries for exact specifications of a range of parts provide a strong knowledge base in newer systems. In addition to the automated design functions this database allows, real-time DRC helps designers interact with the system for clean designs. And final NC tape and artwork output assures that the manufactured board matches the input circuit design.

The low cost and full functionality of single CAD workstations, as well as the option of automatic or interactive functions throughout the process, makes workstations tools for the designer. With networked stations, large operations can simultaneously provide individual designers with these tools and automate their entire board design department.

Not only the power and sophistication of hardware and software for PCB engineering workstations, but also their human interface speeds design. With English menus, undo keys, roam and zoom and color monitors, the process is eased.

All of these factors improve board design efficiency without costing huge sums. Workstations are tools, helping designers complete complex board layout and connection efficiently. Newer workstations' routines create optimum designs by automating repetitive tasks and allowing a designer's experience and skill to contribute in interactive use. □

**How useful did you find this article? Please write in the appropriate number on the Reader Inquiry Card.**

Very Useful . . . . . 603
Useful . . . . . 604
Somewhat Useful . . . . . 605


# Triad made line voltage regulators cooler and lighter.

Triad's Linestar™ voltage regulators and Powerstar™ uninterruptible power supplies operate up to 20°C cooler than competitive models...and they weigh up to 15 percent less!

Perfect for small or large computers, point-of-sale terminals, word processors or virtually any microprocessor-based industrial control, Linestar voltage regulators protect equipment and operation with accurate voltage control. Available in portable and hard wire models, the Linestar has output ratings ranging from 70 to 30,000 VA.

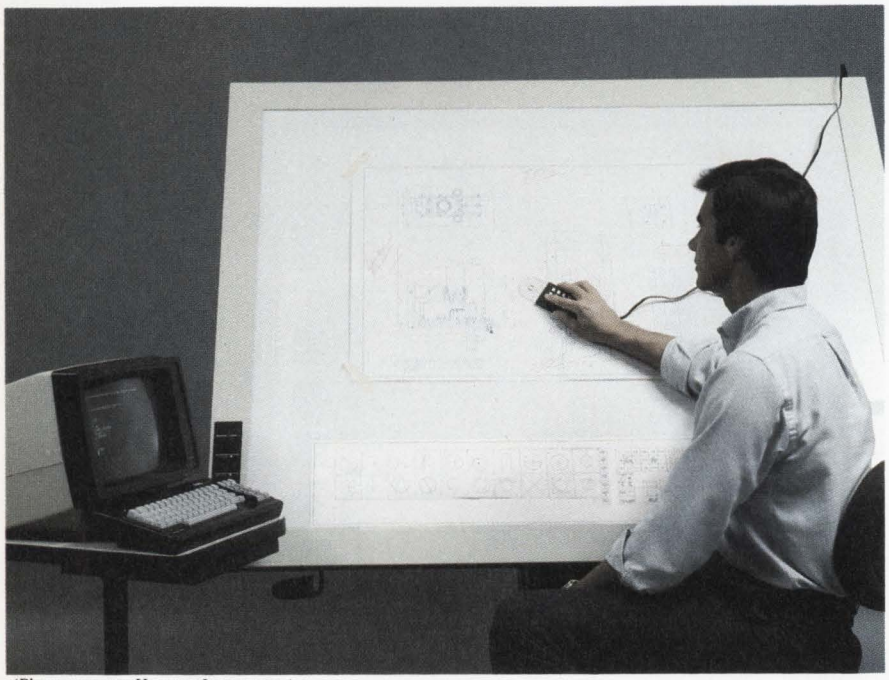
The Powerstar uninterruptible power supply ensures continuous power supply ...with up to an hour of valuable battery back-up time to prevent loss of entries or memory.

For unsurpassed quality, competitive price and fast delivery, contact your nearest Triad-Utrad distributor or write: Triad-Utrad Standard Products, 1124 E. Franklin St., Huntington, IN 46750, 219-356-6500, TWX 810-333-1532.

**Triad Winds Up The Best.**

Litton
TRIAD-UTRAD
Standard Products

# Inputting Graphics By Digitizer



*(Photo courtesy Houston Instruments)*

*Digitizers allow a broad range of graphic data to be directly input for manipulation and storage by digital devices.*

**by Julie Pingry, Editor**

The human interface to computers has become increasingly natural, and at the same time, more powerful. Data is now frequently input by means other than a long string of keyboard characters. For inputting graphic information, alternatives to keyboards have been important for some years and today manual digitizing is one of these fairly mature technologies.

The dropping cost of memory and 16 and 32 bit computers have led to a mushrooming number of installed computers capable of displaying and storing a full screen of graphic data. So despite the relative technological stability of manual digitizing tablets, they are seeing good sales and widening demand. Innovative combinations of modes and functions have further broadened the market.

Automatic, or scanning, digitizers are newer and provide different capabilities; they are ideal for very fast collection of graphic information. These devices are still going through the evolutionary stages of a new technology, and even the type of device used to capture the data is not yet standard.

Other features allow the input of dynamic and three-dimensional graphic information. Video digitizing inputs information to a system in real time allowing the motion of an object to be captured. A few systems using manual digitizers as a base, allow contour and 3-D information to be input, for another direct input of "real world" data.

CAE/CAD/CAM systems are becoming major factors in production processes, driving up the demand for accuracy and sophistication in graphic data capture. The addition of manual and automatic digitizers to these systems are making them easier to use and more flexible. Other fields in which accurate nonalphanumeric data input to a computer is essential range from the traditional mapping functions of digitizers to medical analysis, from printed page design and layout to robotic vision and industrial control.

Manufacturers of digitizers and subsystems incorporating digitizers, whether manual, scanning or video, are working to make input more intelligent and accurate, as well as allowing previously complex data to be input in a similar fashion.

## Manual Digitizers

Tablets for the manual input of graphic data have been evolving since the mid 1960s (**Figure 1**); several technologies are in use (see *Digital Design*, Oct. '83 "Graphic Digitizers Map New Territories"). Free cursor electromagnetic technology is fast gaining ascendancy even among pioneers of some other digitizing methods.

One of the advantages to electromagnetic digitizing tablets is the relative ease of calibration; magnetostrictive digitizers, still widely used, require a large magnet and much care and tweaking to be set properly for use, and must be recalibrated periodically. Newer tablets tend to use simpler technology, resulting in lower cost, more reliable and longer-lasting devices. Electromagnetic sensing also allows the digitizer surface and stylus to be used with other media between them, to hide the tablet or to allow the user to place an object to be digitized on top of the tablet.

By offering several modes of operation, many digitizers can act as a single point of entry for different types of data. Mouse-style cursors with buttons from two keys to a keypad (**Figure 2**)—permit a user to choose from several modes without using the other hand or repositioning the cursor. A pen-like stylus can also offer various modes, with one button (or even two) on the side, a two-position nib and proximity sensing. Important modes for most digitizing include point, stream and increment.

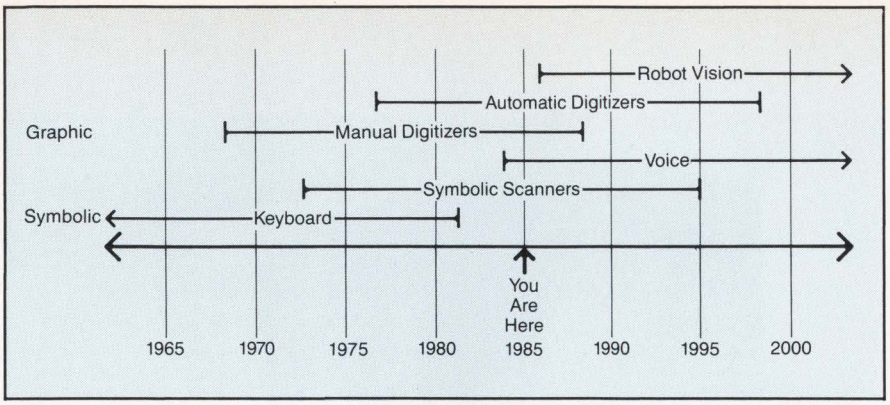



*Figure 1: Various types of input devices' lifespans; the ranges begin with the first marketable product and end with industry maturity.*

Some innovative digitizer designs use a see-through tablet or table with back lighting that permit the cursor to line up accurately over medical X-rays, photomicrographs or other film images. A range of sizes, from very small data tablets to tables several feet in either axis can accommodate various documents and user environments.

Cursor options from GTCO (Rockville, MD) include a stylus sensitive to pressure, and one that also inputs information about the pen tilt, called 4-D. The pressure pen allows a natural drawing interface, especially for paint programs; the user can change a line attribute such as width with the pressure applied. The 4-D stylus can be used as a joystick, to represent parameters from zoom to scale, rotation or even tone and shadowing.

A high-end table digitizer from Altek (Silver Spring, MD) can be configured with its own disk memory subsystem (**Figure 2**). With this system, digitizing can be a totally off-line function; when the digitizing is complete, a file on a floppy disk can be sent to the host.

Today, there are two general directions that manual digitizers are taking: one is towards lower cost tablets that take advantage of the booming personal computer market; at the other extreme, added intelligence is desirable for high-end digitizers. For very basic input, tablets are being challenged by the mouse. A mouse provides only relative coordinates, however, and does not have the accuracy to be much more than a pointing device, chiefly useful for menu selection. The Koalapad from Koala Technologies (Santa Clara, CA) is an extremely low-resolution digitizer, and, like the mouse, is limited mainly to pointing.

True graphics can be better input on a tablet, but the price must be low to convince users that they need the finer positioning of a digitizer. With a menu or menu overlay on part of the tablet surface (**Figure 3**), a digitizer can serve as a dual input device, for graphics and commands. Widespread use of microcomputers instead of dumb terminals allow digitizers to function with little intelligence of their own.

For demanding graphics applications like CAD, there are several key parameters of digitizers that contribute to accuracy and quality. Typical resolution of higher-end tablets is 0.001″, or 1000 points or lines per inch, but this alone cannot guarantee good performance. The linearity of the tablet, or the consistency of recording specified increments across the length, and the skew, or trueness of the 90° angle between the axes of the grid are often corrected in the digit[illegible] trolling electronics. This is fine, except that when the tablet is moved to work with another machine with a different bus structure or form factor, a different controller board is required.

Stability is generally good with electromagnetic digitizers. Repeatability can be a critical factor; every time the same point is chosen, the reading should be the same; higher-end digitizers often quote ± 0.001″ repeatability. Accuracy, the combination result, is a nebulous spec, determined differently by various makers. Generally, accuracy of ± 0.01″ or higher is quoted, but some investigation should be made as to how it was measured.

It is important to remember that high resolution and a fast sample rate is not always ideal. The amount of information that can be gathered on a sophisticated digitizer requires significant processing power to be captured and input. If such exact input is required for some but not all of the digitizer's tasks, look for selectable resolution and sampling rates. Increment mode can also limit the amount of data collected, by sampling less frequently.

Another potential problem with collecting data over small time and space intervals is that every little movement by the operator might be recorded, reducing overall accuracy. Altek's Apache cursor (**Figure 4**) uses a 16 bit processor with a diode matrix scanner and 0.1″ bullseye at the crosspoint of the cursor to reduce operator-induced error and thus speed up accurate digitizing. The product senses lines as fine as 0.004″ and will digitize to their center with ± 0.004″ accuracy. An important feature of the Apache is the ease of switching from automatic to manual modem to accommodate thick lines and intersections without repositioning the cursor.

As more and more digitizers are used

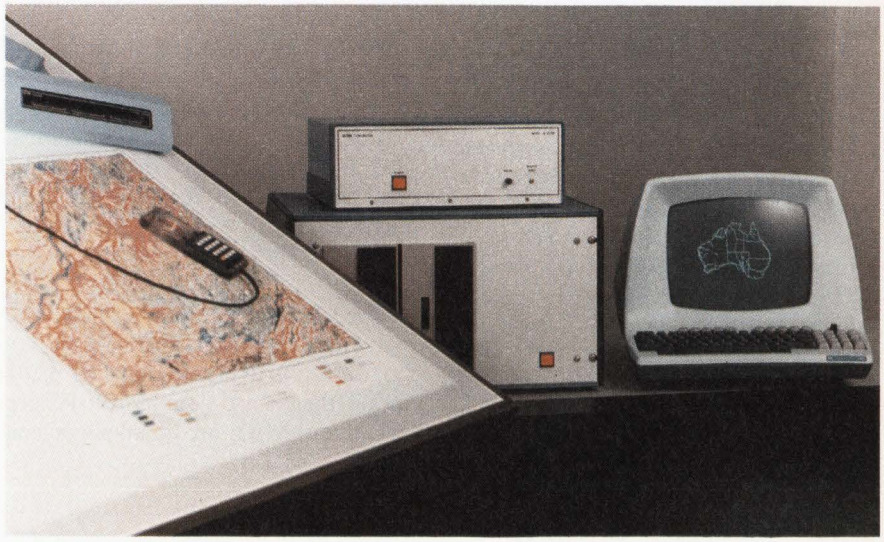


*Figure 2: Altek's Super-Disk II Workstation can be used off-line with its built-in disks.*

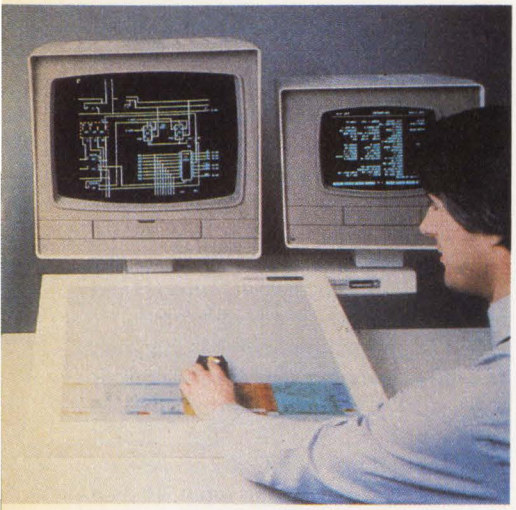


*Figure 3: The Summadraft system from Summagraphics uses a menu on the lower portion of the digitizer surface for commands.*

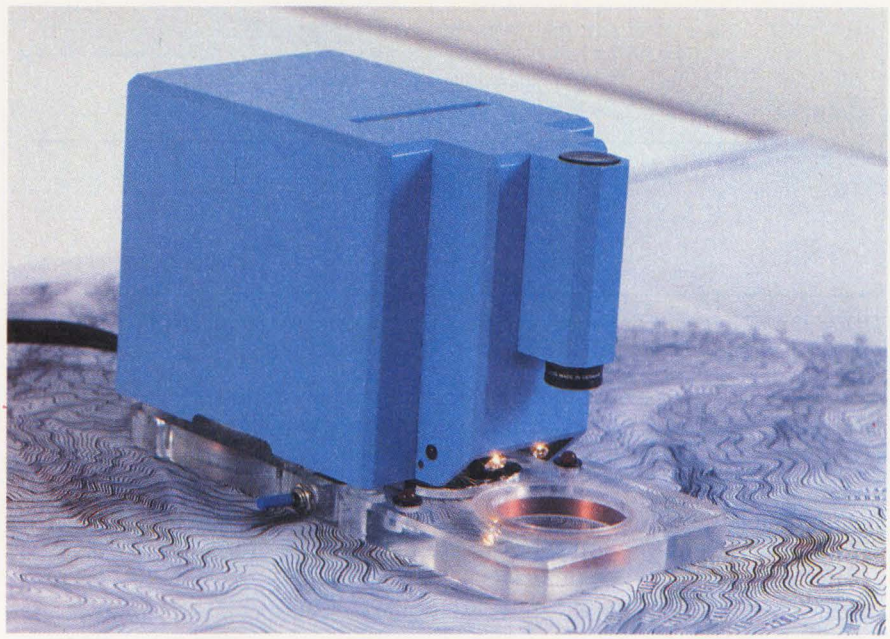


*Figure 4: Altek's Apache cursor reduces operator-induced error by recording the center of a line in the cursor bullseye.*

for inputting various types of graphic data, software for using digitizers in a wide range of situations is being developed. Traditional tablets and technologies will be used for some time with imaginative software steadily expanding applications.

## Manual Digitizing Subsystems

By bundling a simple digitizer with sophisticated software and/or incorporating it into an input subsystem, manual digitizers can become extremely powerful tools. A common place for digitizers to be incorporated is in CAD workstations (**Figure 5**), and these use part of the digitizer surface as a permanent menu of commands relevant to the workstation's use.

On a subsystem level, a digitizer with software and some added hardware allows more than simple x,y coordinate input. Many of the major digitizing tablet manufacturers provide controller boxes for some high-end systems, to add intelligence and allow more choices in mode, output data formats and interfaces. Data collection and analysis systems can be made by adding specialized software.

One interesting twist is three-dimensional digitizing. Both Science Accessories Corp. (Southport, CT), who make sonic digitizers, and Micro Control Systems (Vernon, CT) use a data tablet and add cursor functions at points on a movable arm for inputting information about a 3-D object or space.

Since digitizing in an electromagnetic system like that used by MCS depends on time delays of a signal sent between a cursor and tablet surface, potentiometers in each of the four joints of the mechanical arm allow their angle and position to be sensed and thus, x, y and z coordinates of the tip. **Figure 6** illustrates how this system can input surface information about an object. By attaching a data collection device to the stylus arm, yet another form of information can be input; a thermocouple, for instance, can read temperatures at various points in space or on the surface of an object. Two extra sample and hold circuits are included to accommodate such instrumentation.

3-D digitizing hardware/software packages for the Apple and IBM personal computers are available from MCS, as well as IBM PC-based workstations. A newer version will be RS-232 compatible, for use with nearly any host. It will also have a larger reach—nearly 30″ in any axis.

A different application direction for manual digitizing subsystems is to increase their ability to handle symbolic input, traditionally the realm of the keyboard. Using dynamic character recognition, the Penpad systems from Pencept (Waltham, MA), use an inking or non-inking stylus on a conventional digitizing tablet to recognize handprinting. This allows ASCII characters and graphic data, as well as menu-selected commands, a common input port without a keyboard.

*Figure 5: Calcomp's digitizing tablet is used here for input to a CAD system; much of the surface is devoted to menu boxes.*

# A Complete Graphics Department For Just $2295

Realize day-in and day-out solid performance from a quiet and capable desktop plotter. It's true. For only $2295* the Houston Instrument HIPLØT™DMP-29 will provide you with world-class multi-color hard copy graphics, and deliver a level of quality and performance that you would expect in a plotter costing three times as much.

It's a hard worker. The DMP-29 goes about its job with amazing speed and precision. Unbeatable resolution and repeatability are yours in both 8½" x 11" and 11" x 17" formats, and 8-pen capability assures you of fast attention-free flexibility when multi-color output is required. High pen speed combined with an addressable resolution of O.OO1" assures fast, accurate and stepless traces.

It's friendly. You can call 21 different functions directly from the front-panel membrane keyboard. It's tolerant too. The DMP-29 will modestly protect itself from user errors, as when attempting to place a pen in an already occupied stall.

And it's smart. An extensive set of firmware routines makes life easier for the user. A small sampling of the built-in talent inherent in the DMP-29 includes character generation, circle, arc and ellipse synthesis, line type variations, viewport/windowing, clipping and scaling.

For the name, address and phone number of your nearest representative, write Houston Instrument, P.O. Box 15720, Austin, TX 78761. Phone 512-835-0900, or 800-531-5205 if outside Texas. In Europe contact Bausch & Lomb Belgium NV., Rochesterlaan 6, 8240 Gistel, Belgium. Tel 059-27-74-45, tlx 846-81399.

## houston instrument

**Write 71 on Reader Inquiry Card**

* U.S. Domestic price only

™ Trademark of Houston Instrument

In conjunction with an IBM PC or compatible, the newest Penpad, the 320, uses its artificial intelligence, powered by a 10 MHz 68000, for character input, and other modes for mouse cursor control, touchpad commands and graphic digitizing. Such a combination of device modes used with a PC allows natural interaction for a non-typist.

Earlier Penpad models were optimized for forms data entry and required a set grid and menu. Forms input is a good use of the device's character recognition ability, as it could otherwise require typing the handwritten information into a computer and/or scanning a completed form optically for input. But with its greater flexibility, the 320 can totally replace a keyboard for a number of popular software packages, such as the Lotus 1-2-3 spreadsheet. Pencept provides menu overlays as well as command file and instruction software for several PC DOS programs to run unchanged with the tablet only. For further accuracy the 320 also registers any characters it does not recognize in real-time, so handwritten input characters are accurately converted into ASCII the first time.

## Automatic Digitizers

Manual digitizers optimize input of graphic information as it is being created, but already existing graphics may be somewhat distorted by the process. In addition, when the information to be input is particularly dense and/or in very large quantities, the speed of manual digitizing may present a major bottleneck to system throughput. As in many other fields, this human bottleneck can be eased by automating the process.

The mid to late 70s saw the development of commercial automatic optical scanning digitizers. By passing a scanning camera over a document (**Figure 7**), all of the information on even a very large surface can be captured rapidly with no operator-induced errors. Complex raster-to-vector conversion software has been developed to optimize the input for manipulation of graphics.

Originally developed for mapping applications, hardware and software designs are now focusing on engineering applications as well, so scanners can act as data collection front-ends on CAD systems. Engineering needs greater speed, but generally uses less dense graphic information on smaller areas than the sometimes enormous size maps. Systems for CAD scanning also could use geometric shape and character recognition facilities; these are in development now. Simple vector information is not sufficient for engineering drawings; the specifications of a vector are important. Simulating the way data would be entered into a CAD system (often keyboarding of dimensions to create images) is a challenge to digitizer makers.

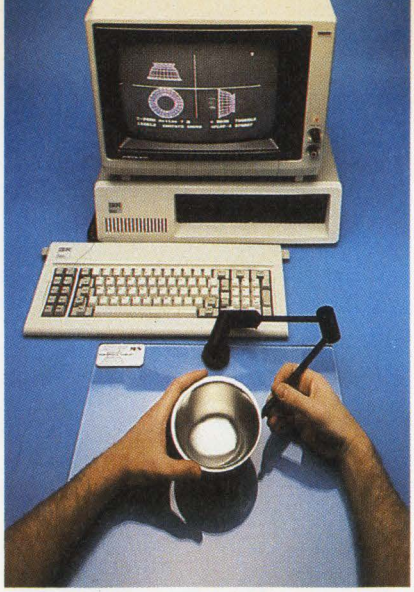


*Figure 6. Software provides three views of the contours of a bowl being input via Micro Control Systems' 3-D digitizer.*

Originally, scanning digitizers cost a quarter of a million dollars and up. These huge table digitizers are built around powerful computers and use laser scanning cameras with mechanical apparatus for moving the camera across the surface. Many systems in this price range, as well as scaled-down versions and drum configurations are now available. These are bringing automatic digitizing into the price range and size feasible for smaller operations that need the speed of scanning input. Drum scanners are smaller and, since the document moves instead of the camera, they can be lighter weight and less dependent on precise mechanics.

A trend for automatic digitizers is to use charge coupled devices (CCDs) rather than lasers for scanning/sensing. An array of as many as 3000 CCDs can scan a large document, with movement on only one axis with excellent resolution.

Some current automatic digitizers, like their manual counterparts, have variable resolutions up to 0.001", to accommodate the needs of various forms of graphics and differing applications. Broomall (Broomall, PA) is working on inputting information from aperture cards. Scitex (Bedford, MA) makes very high-end systems for the print industry; their ERAY's typical resolution is 1800 lines per inch, and Scitex has systems for precision color work.

Even with the extremely high resolution of these systems, the actual scanning process can be quite rapid. What currently takes time is the raster-to-vector conversion. Now that some software with conversion algorithms have been proven, look for the raster-to-vector function to be programmed into firmware. This will allow the conversion to be as rapid as the scan itself, further increasing the speed of automatic graphic digitizing.

Automatic digitizing, though it allows much greater throughput of graphics into digital form, has its disadvantages. First, the original document being scanned must be accurate, as the digitizing is without operator intervention. Any stray markings are also picked up and treated as part of the image. This can be a particular disadvantage with older documents; coffee rings and designer's doodles are a common part of long-used graphics.

The cost of these scanners can usually only be justified when astronomical amounts of data must be handled. When this quantity of data needs to be stored, there is sometimes little space left for manipulating them.

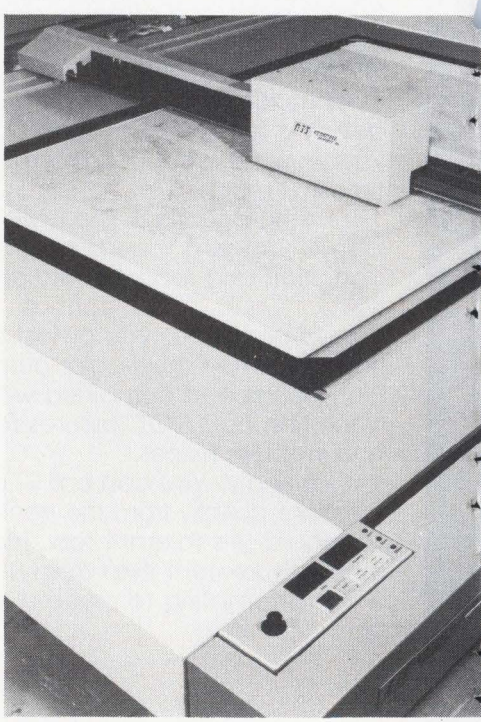
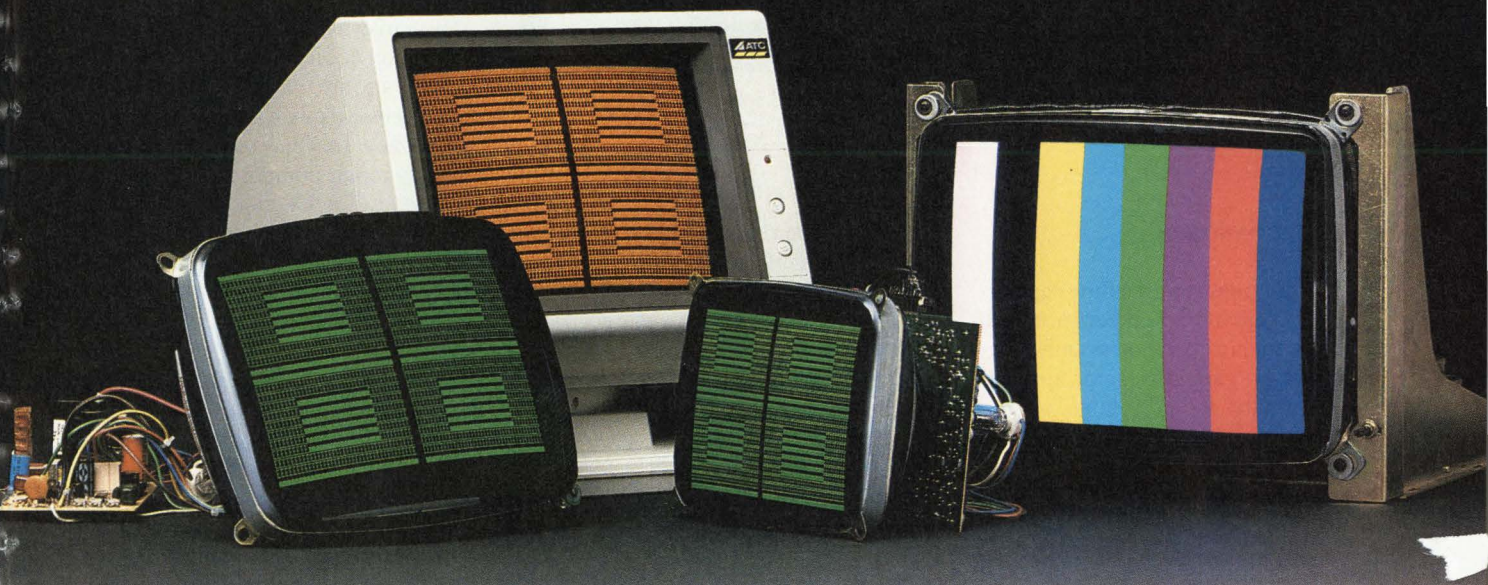


*Figure 7: A digitizing scanner camera automatically captures information on a large map on the surface of this Broomall digitizer.*

# WE SOLVE PROBLEMS!



## In all sizes, shapes, colors and configurations.

You need high performance, innovative design data displays. Contact Audiotronics. We have what you need. In 3″, 5″, 7″, 9″, 12″, 14″, 15″, 23″ and 5″ × 9″, monochrome and color, integrated (neck-mounted), chassis, kit or cabinet. And if we don't have what you need, we'll design it for you.

Using our basic displays, our engineers become your engineers. They custom design a display for your specific application, meeting your particular system design requirements.

Just give us your specifications and we'll solve all your display problems. And we'll deliver on time, when you want them.

Audiotronics has been solving problems for almost 30 years, designing thousands of custom data displays for important customers like you, both large and small. Call us today. Turn our engineers loose with your display system problems.

AUDIOTRONICS

North Hollywood
California 91605
(818) 781-6700

Write 84 on Reader Inquiry Card

*Figure 8: Freehand graphics being input by a Summagraphics MM Series digitizer are directly captured by the system.*

## Scanning Systems

To add editing and manipulation capabilities, these scanning digitizers are used with powerful host computers and sometimes built into sophisticated, application-specific digitizing systems.

Workstations for magazine and print production allow the high accuracy and resolution of a scanner input image to interactively be moved and manipulated for page layout. Scitex systems incorporate display monitors, a keyboard and keypad, and trackballs, as well as a manual digitizing tablet (**Figure 8**).

Work in character recognition may also be useful for scanning digitizers. For reading specifications and dimensions on a CAD drawing, very sophisticated character recognition, now under development, is needed. The orientation, font and page limitations of current character recognition programs must be overcome for full functionality.

Combining character recognition with automatically digitized input, Metagraphics (Woburn, MA) is developing a scanning/editing system specifically for creating CAD/CAM databases. The challenge of creating a database system to associate the symbolic characters for notational data and dimensions with the digitized graphic input, as well as geometry transport and character recognition has been a substantial software development effort. To optimize the workstation for CAD/CAM, the associative database is output in the form of IGES files.

By combining the accurate data capture of an automatic digitizer with the power to process and manipulate a large quantity of data, a powerful front-end input system is created. Software development to meet an individual application's needs could now create a market niche for an enterprising firm.

The market limits will still be set in part by the high cost of both scanning and processing equipment. However, the large operations that require flawless data input often have the quantity and speed requirements to cost-justify specialized systems. And certainly, the firms that have made the investment in an automatic digitizer would benefit by further incorporating it into a front-end system optimized for the sort of work they do on the accurate data captured by scanning.

## Video Digitizers

Another form of graphic information that could be useful for input is over time, or video. By stopping to digitize single frames from a television or other video camera, not only can that image be captured and stored, but subsequent views of the same area can be captured for input and comparison. A range of systems for video capture and digitizing are coming to market now, with greatly differing capabilities and technologies used. Some of the applications driving this development are robot vision, quality and process control and motion analysis.

Video digitizing has only become feasible with the availability of monolithic flash converters at a reasonable cost. With flash converters synchronized to the frame speed of traditional television cameras, output on systems like the Aydin Controls (Ft. Washington, PA) VDM-001 Video Digitizer Module matches a medium resolution computer display. Full color video frame capture is possible on these "frame grabber" systems from several companies. An eight frame per second video input system to run on the IBM PC has been developed by Chorus Data (Hollis, NH) for up to 640 × 480 displays.

For even higher resolution video digitizing, solid state cameras can be used. An array of CCDs in a camera can produce extremely high resolution images, a few thousand pixels on either axis. Solid state cameras are also more rugged than television equipment.

But there are trade-offs. First, the CCD camera uses a much slower scanning process; one frame may take a couple of seconds to input, compared to the 1/30th of a second of a TV camera. In addition, with CCDs the recording is, by nature, monochrome. To achieve color, filtering must be used, which at this stage of development may slow down the digitizing process even further.

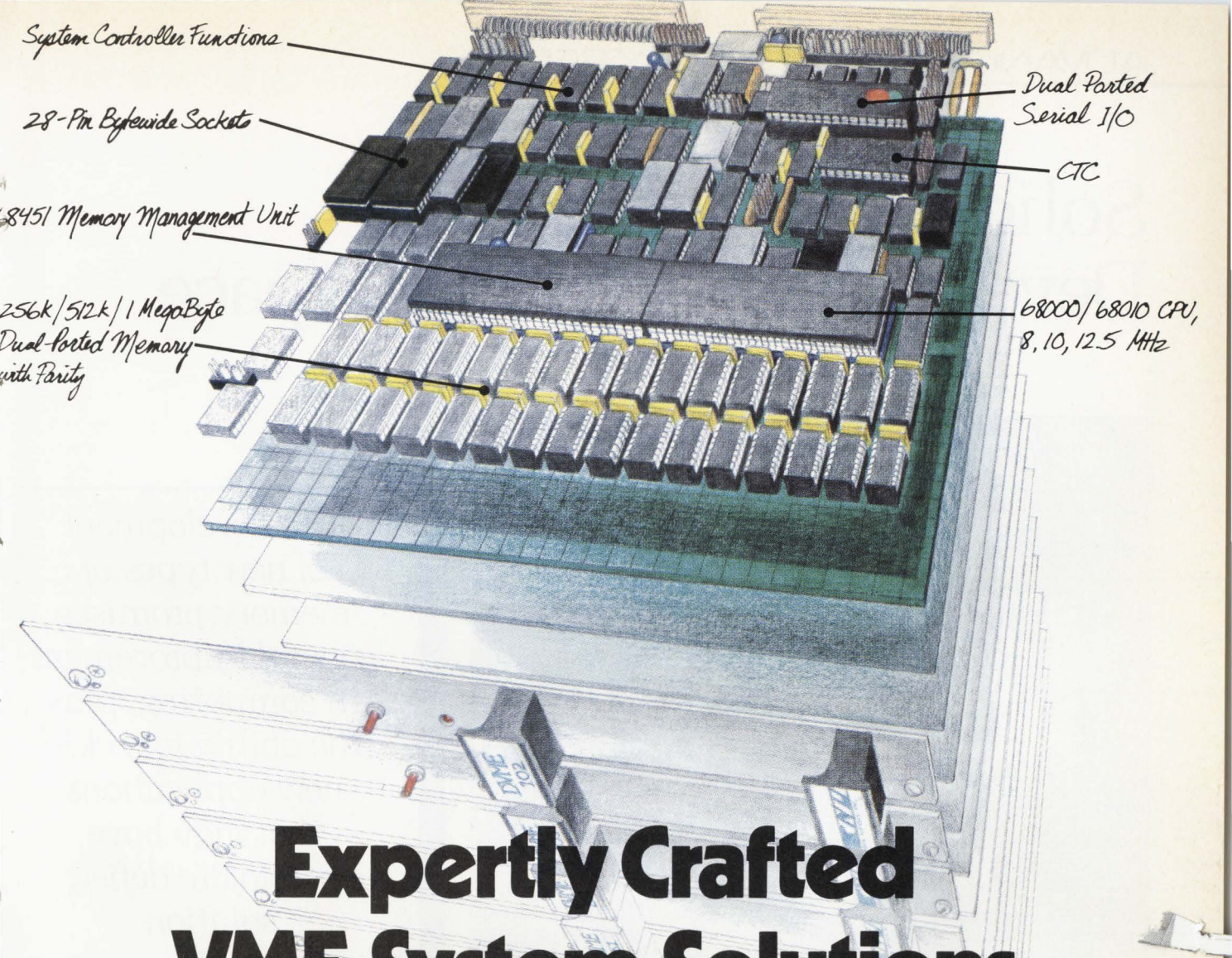
For very fine work in which images do not need to be input more than every few seconds, the resolution of CCD images as an advantage. As a front-end to certain types of image processing and analysis systems, solid state camera digitizers can provide an order of magnitude or more of additional information about a scene than a TV-based system.

## Digital Graphics

Digitizing graphic data directly, rather than converting it to information about the graphics in symbolic form (dimensions, attributes, geometric properties) is an obvious time and effort saver. Direct graphic input also eliminates a step prone to error and distortion.

Of course, with just a digitizer, extensive software development is needed to make the information captured useful. But front-end input systems incorporating digitizers are beginning to fill specific needs.

Authenticity of computer graphic input is matching up to graphic output and helping create an accurate and natural computer interface to the world in an expanding range of situations. □




# Expertly Crafted VME System Solutions

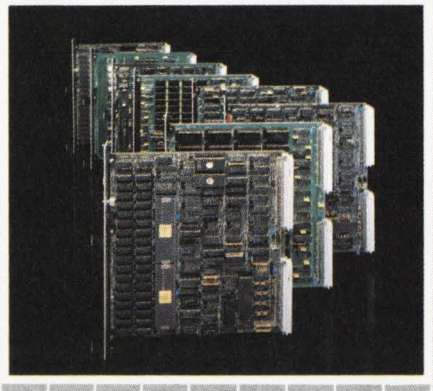
DY-4 SYSTEMS INC., one of North America's most successful producers of board level products, now offers a fine array of expertly crafted VME modules and UNIX based development systems – perfect for all your demanding 16/32 bit applications. Stringent manufacturing and quality control ensure a reliable product with maximum power and integrity.

DY-4 realizes the full potential of the powerful VMEbus architecture by using an extended depth Eurocard format of 233mm × 220mm. By increasing functionality and allowing processor, memory and I/O combinations, and bus controller functions on a single board, DY-4's format offers higher performance than competitors' equivalent configurations.

DY-4's commitment to R&D is reflected in its continuing new VME product development, including intelligent communications controllers, SMD/ESMD controllers and 9-track tape controllers. DY-4's VME series currently includes:

**DSM-*6816*** – a UNIX based development system.

**DVME-*102*** – 68000/68010 CPU with MMU, dual-ported serial I/O and 256K/512K/1Mbyte DRAM.



**DVME-*105*** – 68000/68010 CPU with dual-ported serial I/O and 14 bytewide sockets.

**DVME-*201*** – with 8 serial RS-232C/422 channels and 2 parallel I/O ports.

**DVME-*351*** – A 512K Byte memory board with 10Megaword per second raster video port. Supports 16/32 bit VMEbus read/writes.

**DVME-*503*** – Universal memory board with 32 28-pin bytewide sockets. Supports 16/32 bit VMEbus read/writes.

**DVME-*712*** – Intelligent Z80A peripheral controller with RS-232C/422 I/O, 64K DRAM with parity, floppy disk controller, SASI interface and DMA.

**DVME-*778*** – Colour graphics controller supporting 640 × 480 × 4 (1024 × 768 × 2), NEC 7220 GDC, look up table, 3 4-bit D/A converters, mouse input and parallel printer port.

**DVME-*909*** – A 19-inch rack-mountable system chassis with 9 slot VME card cage, power supply and forced air cooling.

**Write 19 on Reader Inquiry Card**

**UNIX is a trademark of Bell Laboratories.*

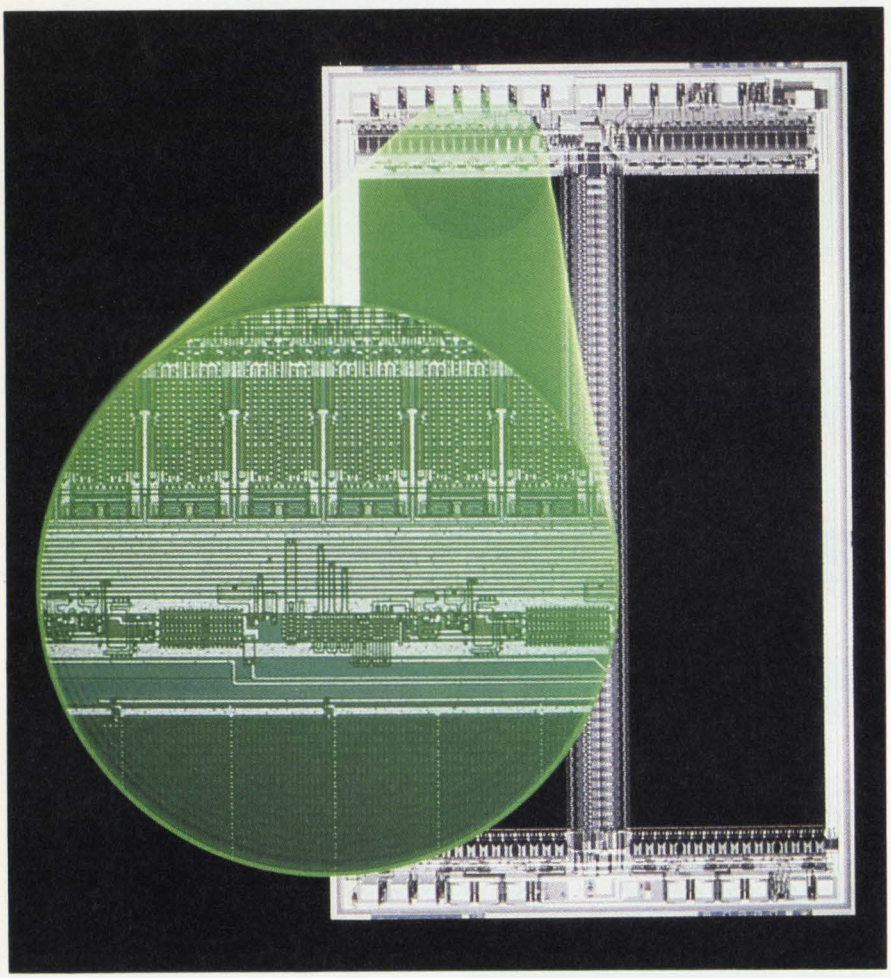
DY-4 SYSTEMS INC.

**SYSTEMS INC.**
S. Bascom Ave., Campbell, CA 95008 (408) 377-9822

**DY-4 SYSTEMS INC.,**
888 Lady Ellen Place, Ottawa, Ontario, Canada, K1Z 5M1 (613) 728-3711

**DY-4 SYSTEMS INC.**
Solbakken 48, DK-8450, Hammel, Denmark (06) 96-3624, TLX 60938 (Dandy DK)

# Solid-State Memory Developments Continue Apace



*The development of new types of memory promises general improvement in computing, plus the ability to tackle new applications that may have heretofore defied solution.*

*The Am27512 is claimed to be the industry's first 512 kilobit UV-light erasable EPROM. It is organized as 64K words by eight bits, with access times as low as 250 nsec. (Photo courtesy Advanced Micro Devices, Inc.)*

**by Mike Cashman,**
**West Coast Technical Editor**

Memory devices may be divided into two categories: volatile and non-volatile, or those devices that retain data only as long as power is applied and those that do not have this requirement for their operation. The generic term RAM has come to be synonymous with a volatile memory in which there is a constant rewriting of data. Two basic RAM types have evolved since 1970: dynamic RAMs, noted for high capacity, moderate speeds and low power consumption, and their static counterparts that are faster, require no refresh, but are behind dynamics in bit capacity due to their greater manufacturing complexity.

The availability of low-cost microcomputer implementations has brought with it an insatiable demand for dynamic RAMs that is pushing the devices to greater densities and faster access times (**Figure 1**). The very size of the market (**Figure 2**) has brought with it the opportunity for manufacturers to cater to small segments of the market only. In the 256K arena, this has led to some manufacturers offering parts in other than a BY ONE configuration; up until now, this option has been limited to SRAM designs.

By the time the 256K market peaks in the 1989-1990 time-frame, designers are going to be faced with important decisions regarding the 1 Mbit DRAM. According to a source at Motorola, this has been a focus for Japanese memory manufacturers with access to cheap government money. There are strong rumors that parts are already being shown. The primary problem associated with 1 Mbit memory devices are ones of organization and packaging; various memory organizations require different pin counts. At

# Memory Boards

## DEC* Compatible Memories

## UNIBUS* • LSI-11* • VAX*

CALL Toll Free for Price and Availability

# (800) 992-8744

In California Dial Direct (714) 540-9945 ext. 271

Plessey Peripheral Systems, Inc. • 1674 McGaw Avenue • Irvine, California 92714 • (714) 540-9945

**PLESSEY. ASK ANYBODY.**

*DEC, UNIBUS, LSI-11 AND VAX are trademarks of Digital Equipment Corporation.

Write 54 on Reader Inquiry Card

this years ISSCC, held in San Francisco, NEC's 128K × 8 DRAM addressed the problem by moving to a 30-pin package.

## The Emerging EEPROM

EPROMS have become the dominant nonvolatile memory in density and performance and may replace other types of mask programmable non-volatile devices. A key reason for this is that higher density EPROMs, through the use of redundancy and plastic packaging, will cost less than ROMs on a per-bit basis.

A recent EPROM announcement from Advanced Micro Devices, Inc. (Sunnyvale, CA) should be noted. The firm has just announced the Am27512, which is a 512 Kbit EPROM organized as 64K 8-bit words, with access times as low as 250 nsec. The significance of this device is that at this size, it can hold either of the two most popular microprocessor operating systems on a single chip. They claim that serious interest is already being shown in doing this. AMD states that a 1 Mbit version of this EPROM is in development.

At the ISSCC, NEC previewed a part of this density with 1.2 micrometers design rules assembled in a 40-pin package that could be used either as a 64K × 16 or a 128K × 8 organization by controlling the input signal.

EEPROMs are an especially exciting development, for they offer systems designers a new dimension in general systems design together with the opportunity to construct memory circuits with onboard intelligence. Readers must pay particular attention to developments in this new type of memory to ensure that opportunities to incorporate EEPROMs into evolving systems aren't lost.

EEPROMs must not be confused with their precursors, the EPROMs. While the EPROM had the advantage of being nonvolatile yet under certain conditions alterable, changes involved the physical removal of the circuit from the system which is almost always undesirable. Changing the contents of an EEPROM simply involves identifying the physical address of the byte whose contents are to be altered, and writing the contents into the cell.

As one would suspect, there is a price to pay for this capability and it comes in the form of disadvantages. First, writing new information into the byte is relatively slow, and there are finite limits to the number of rewrite cycles that can be applied to the devices. Rapid progress is being made to overcome these obstacles;

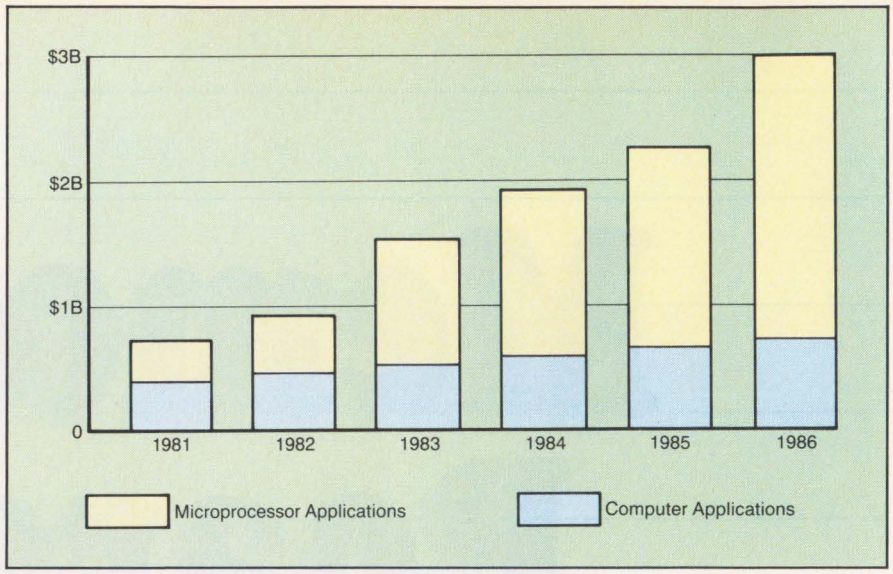



*Figure 1: Estimates of Dynamic RAM revenues by type of application.*

other barriers have been passed to bring the EEPROM to where it is today: a usable, practical device.

One firm that is focusing on this product type is Exel Microelectronics, Inc. (San Jose, CA), who claim to have developed the world's first high-speed (sub 100 nsec) 32K CMOS EEPROM, with a 64K CMOS EEPROM slated for announcement during this quarter. Close on their heels, however, is Seeq Technology, (San Jose, CA) with a 64K CMOS part with on-chip ECC. With an access time of 100 nsec, Seeq has pushed the programming time to as low as 1 msec. Other manufacturers of this product type, including Intel, Advanced Micro Devices, and others, are making it easy for systems designers to explore the potential of this relatively new memory type by packaging it to be compatible with existing ROM and EPROM devices.

"I really feel the EEPROM is about as exciting a product and design opportunity as has come along in a long, long time," states Sam Young, a founder and Vice President of Marketing and Sales at Exel Microelectronics. "Not only are they going to change the way in which computer systems are organized because of a different type of memory being contained in them, they will make it possible to take on new applications." According to Young, ready applications for EEPROM include uses in the following fields:

- Robotics, where the memory could be used to constantly and automatically adjust calibration settings;
- Automotive, where engines (or conceivably other parts, such as automatic transmissions) could automatically adjust themselves to changing weather or road conditions;
- Computer Games, where the memory would be used in a coin-driven device that would program the buyer's cassette;
- Computer Diagnostics, where EEPROMs would enable personnel to access the exact status of registers in a failing system; and conceivably in
- Medium- and Large-Scale System Cache Memories, where the ability to adapt and learn could be applied to algorithms so that their results would be more satisfactory.

Some of these applications may seem somewhat futuristic, but the marketing research firm Dataquest, Inc. sees the need for 1.5 million units in industry, with numbers rising dramatically to make it a $500-$600 million market in 1986, with $1 billion attained within a decade, according to Young. This is quite an accomplishment for a circuit type whose first application was in TV tuners only a few years ago.

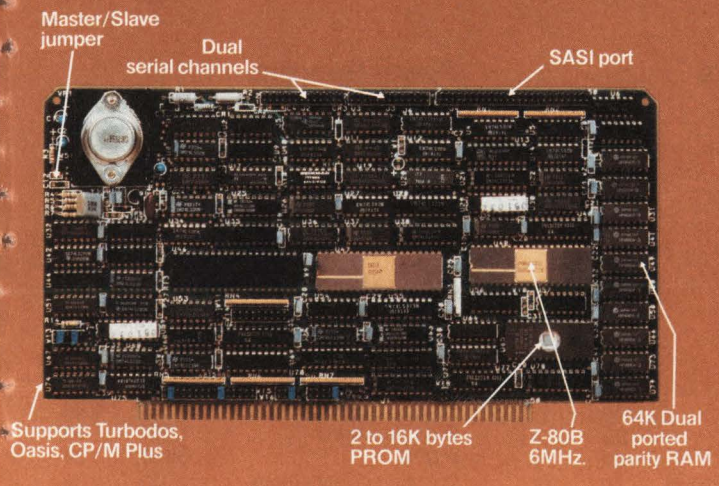
## The Move Toward CMOS

According to the research firm Strategic, Inc., (San Jose, CA), CMOS is rapidly gaining the upper hand over NMOS and bipolar as the process basis for IC circuitry. The firm notes an upsurge in demand, starting in 1983, that it predicts will lead to preference (60% of IC sales) if not dominance by 1993. "CMOS will soon match or better NMOS in chip area efficiency, wafer cost and probe yield. [It]

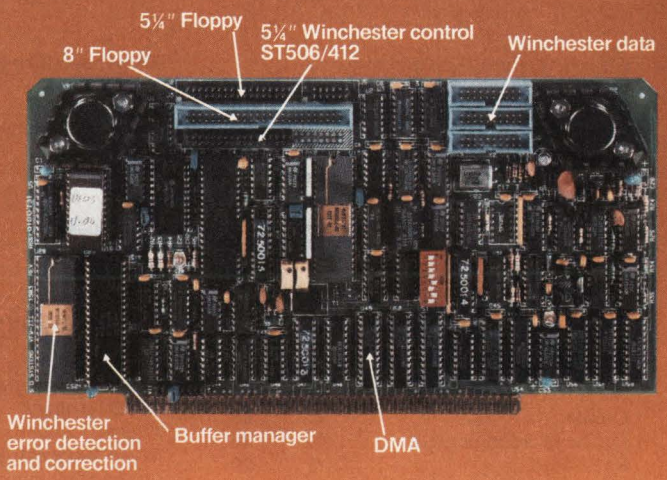
*(continued on p. 120)*

# THE ULTIMATE MULTI-PROCESSOR BUILDING BLOCKS

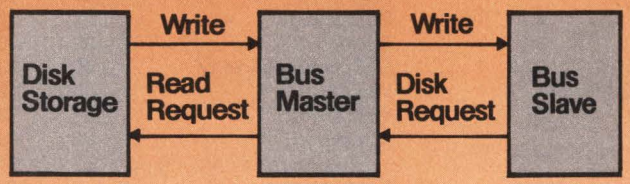
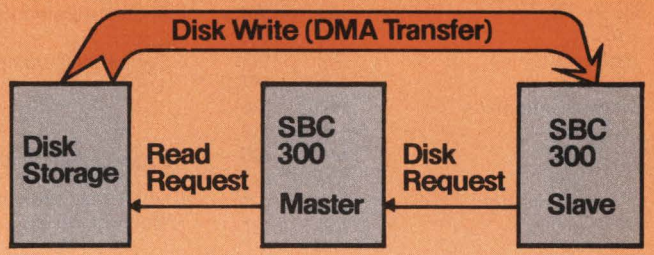
**SBC 300**
**single board computer**




**VFW-III**
**floppy/Winchester disk controller**




## AND HERE'S WHY!

| Our Competitors: | The SDSystems Advantage: |
|---|---|
|  |  |





The SBC 300 offers you 64K bytes of dual ported parity RAM. Dual porting allows DMA transfers from disk storage *directly* to an individual slave processor. This maximizes multi-processor system performance.

Performing the DMA transfers is the VFW-III peripheral controller. It is quite possibly the only S-100 disk controller you'll ever want to buy. With the VFW-III you'll have simultaneous control of up to three 5¼" Winchester drives and up to four 5¼" and 8" floppy drives.

Together they are the ultimate multi-processor building blocks. Systems integrators appreciate our strict adherence to the IEEE-696 specification and our complete line of high quality S-100 bus products. Evaluation hardware is available for qualified OEM's. Call, write, or circle the number below to receive technical information on these and other fine SDSystems products.



P.O. Box 28810 Dallas, Texas 75228 214-340-0303 Telex 682 9016

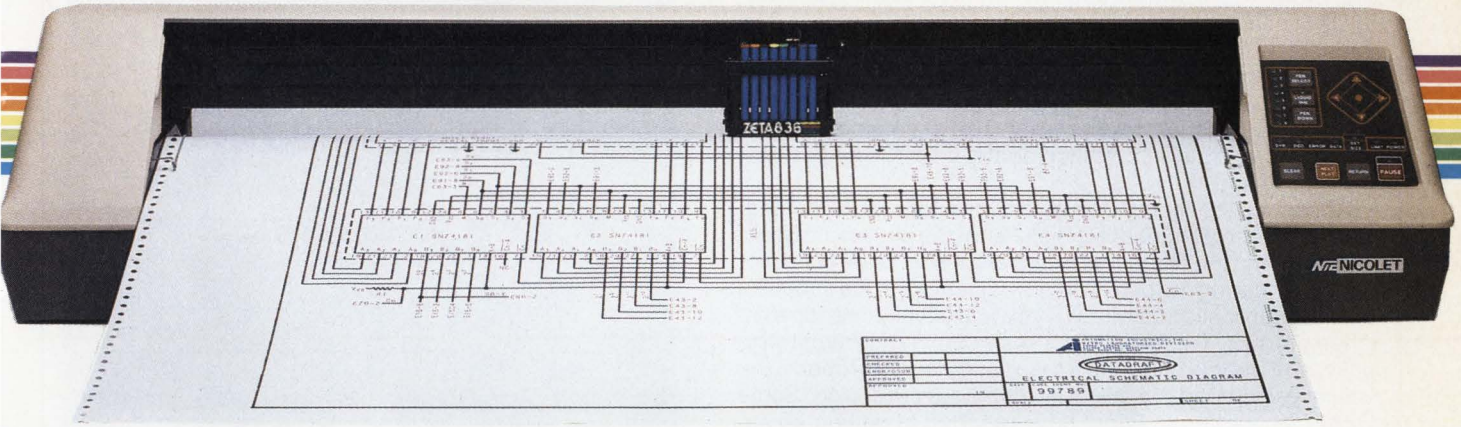
SDSYSTEMS

**Write 31 on Reader Inquiry Card**

# PRODUCT INDEX

To help you find the products that you need, we've compiled a subject index of the ads and new products that appear in this issue. Organized by general product area, the listings include the name of the manufacturer, the page on which the product appears and a write number for additional information on that product. Bold type indicates advertised products.

# CAD system integrators think our newest plotters were designed just for them.

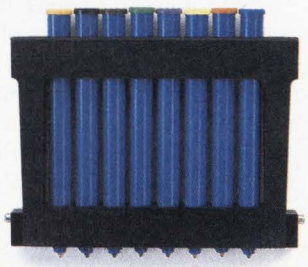



*A price/performance breakthrough on intelligent pen plotters.*

Take our newest, 8 pen 36" intelligent plotter, for example. We call it the ZETA 836 but you'll call it remarkable.

You'll be able to give your clients a vector independent plotting speed of 25 ips, 2g acceleration and resolution to one-one thousandth of an inch. Plus, the ZETA 836 can run both cut sheet or roll media. At a price several thousand below what you would expect to pay.

*Eight color, carriage-mounted pens eliminate time-consuming pen changes*



Incredibly, some plotters still grind to a dead stop to change pens.

Not ours. We've put all eight self-capping pens on the carriage. And this does amazing things for plotter throughput.

When you want to switch to liquid ink, simply snap in a four pen cartridge.

You'll have total user control over such variables as speed, pen pressure, acceleration and pen up/down delay times. Touch controls automatically adjust the ZETA 836 for perfect liquid ink plots.

*Compatible with virtually all computer protocols.*

Thanks to Nicolet's built-in intelligence our plotters can handle a variety of plotting languages and protocols to run virtually any existing software applications programs.

And you can use any of our plotters on-line, off-line or remotely via RS 232C or IEEE 488 interfaces.

*Save big on our new flexible pricing strategy.*

We've created a new discount program that lets you mix quantities, keep your inventory lean, and still earn the best price breaks in the industry.

Choose from our family of plotters designed for the CAD system market – the ZETA 8, an 8 pen 12" model, the ZETA 822, 8 pen 24.5" model or our newest ZETA 836, 8 pen 36" intelligent plotter.

*Call (415) 372-7568. Nicolet Computer Graphics Division, 777 Arnold Drive, Martinez, CA 94553 TWX 910-481-5951*

**Nicolet**

*Computer Graphics Division*

Write 47 on Reader Inquiry Card

# Bubble Memory Outfits PCs For Industrial Workstation Usage

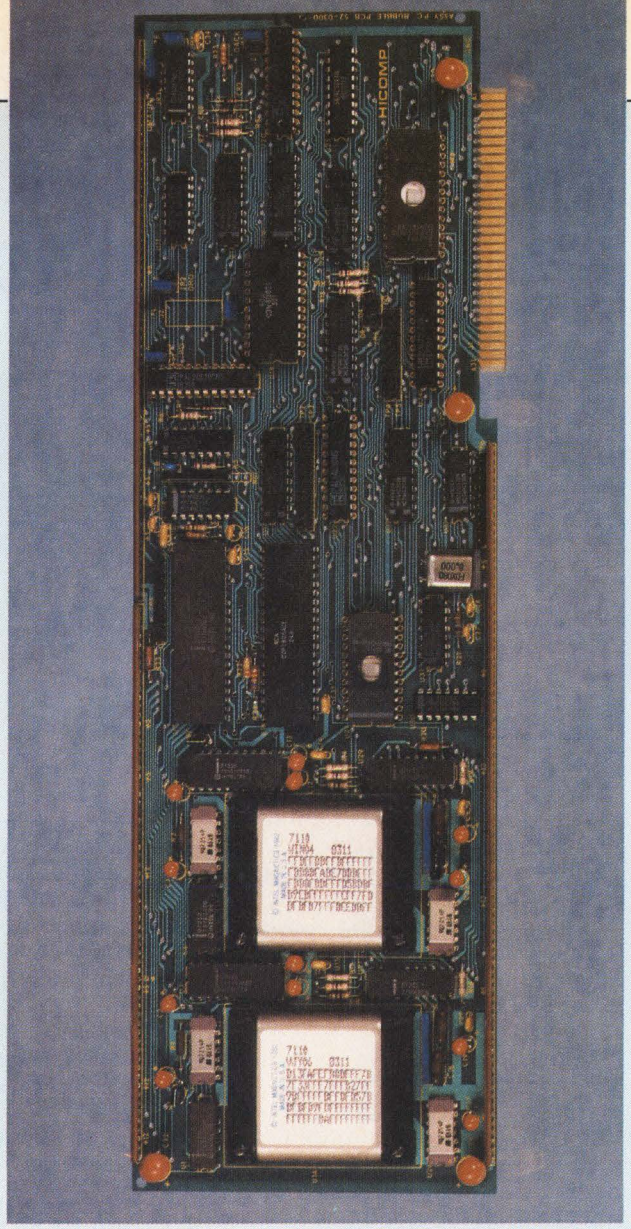
The MBM-500 is an Intel bubble memory board intended for the IBM personal computer and some look-alike versions. The intent of this product is to make the PC acceptable as a low-cost industrial workstation which can operate in relatively contaminated work environments. Both 256 and 512 Kbyte versions of the product are offered, and claims are being made that the solid-state disk replacement is up to five times faster than a floppy disk.

According to Hicomp Computer Corporation's (Redmond, WA) Director of Engineering Rick Penn, the largest problems in developing the product centered around software concerns and engineering the power on/off sequences. "One can't take the Intel application notes as written and directly develop a finished product. There are 16 software commands required to utilize the bubble chip, and if it isn't engineered properly, the software overhead can defeat the entire system design." Some OEMs, according to Penn, have resorted to putting an on-board controlling processor on the bubble memory board when software drivers were not carefully designed. This was necessary to keep the bubble memory from drastically slowing down host system micros.

Without giving away information he considers proprietary, Penn cautions other engineers who are considering designing bubble chips into their systems that particular attention will have to be paid to the correct power on/off sequence. "Lots of decisions will have to be made regarding bubble initialization, battery operation, and so forth."

Another point to be considered in attempting to move to a "diskless" bubble solid-state memory is compatibility with existing popular software systems. Some restrictions are imposed by software manufacturers because of copy protection features and default drive specification inflexibilities.

**Write 312**




*(continued from p. 112)*

is already exhibiting the lowest speed/power product of all the silicon-based processes," according to Yves Blanchard, Vice President of the Semiconductor Industry Group at Strategic. While CMOS has become popular in a number of relatively low-speed digital devices, Blanchard feels that the invasion of the high-speed digital systems market is underway. "CMOS has the potential for high-speed operation, low heat dissipation and higher reliability. It permits increased board packing densities, as well as smaller power supplies or batteries which, incidentally, could be combined ultimately as built-in uninterruptible power supplies in larger systems."

## Bubble Memory

Bubble memory has always been a technology in search of suitable applications. It hasn't enjoyed the acceptance of popular technologies, including EPROMs and DRAMs, where an improvement in speed/cost/reliability virtually ensured market acceptance.

This situation appears to be changing, for in some major application fields, such as manufacturing, bubble memories offer almost the only viable alternative to designers of systems that will operate in relatively contaminated environments. Again, low-cost, traditional peripherals such as floppy disks and their relatives may always be present on office and other relatively clean environment systems, but they are unacceptable for use in manufacturing or other unprotected environments. As digital systems make inroads to the outside world (such as in automated bank tellers, traffic control, etc.) the bubble memory really comes into its own. When one factors in the real costs of service calls on remotely based systems, bubble memories don't have to approach their maker's claims of being three orders of magnitude more reliable than floppies to justify consideration.

Among the leading companies currently in the bubble market are Plessey, Hitachi, Intel, Fujitsu, Motorola, and the French company Sysgem. Bill Doyle, Manager of Bubble Memory Engineering at Motorola, predicts steady, solid, if not spectacular growth in this technology.

"We are at a milestone now, with sample 4 Mbit devices going out the door. Clearly, we're heading for the 16 Mbit device, but with 4 Mbit devices, we're going to see some interesting uses for this technology."

Doyle sees bubble acceptance in four marketing sectors:

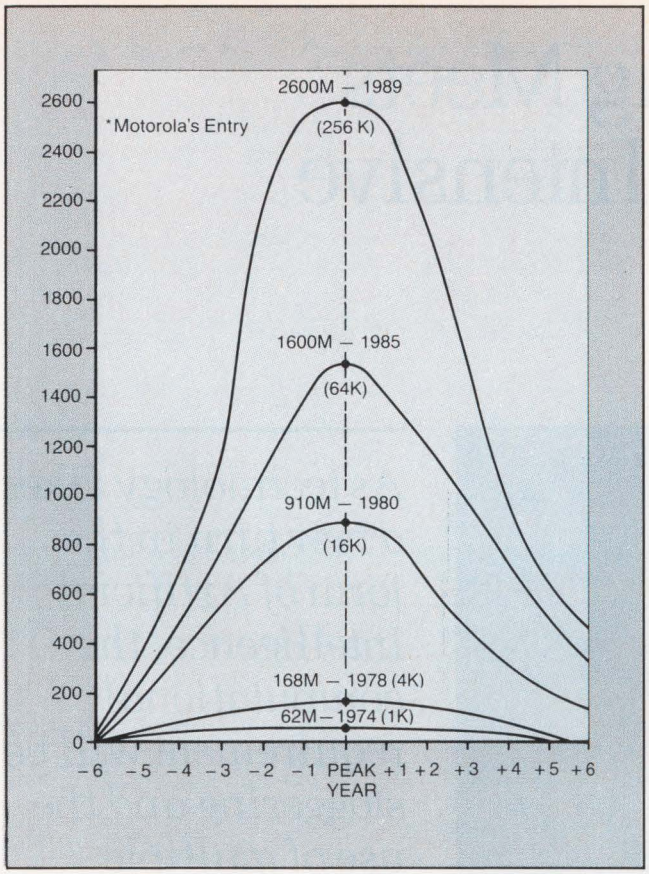



*Figure 2: Dynamic RAM market normalized to peak dollar demand.*

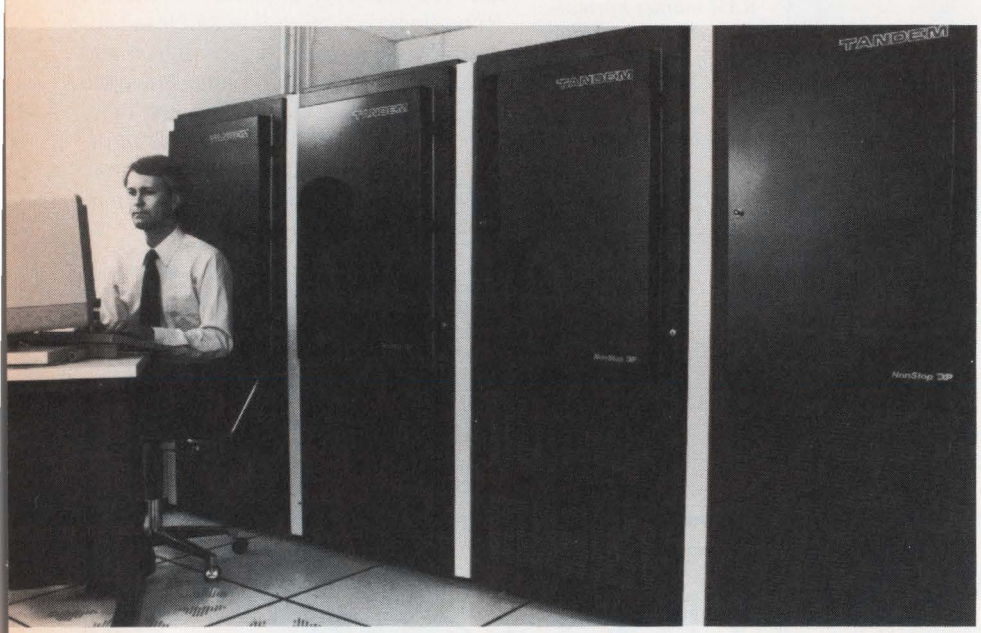
- New Applications, which include point-of-sale systems, due to the bubble memory's low per-bit price;
- Machine Tool Industry, for the aforementioned contamination aspect, combined with the need for vast amounts of data;
- Personal Computer Systems, where the bubble memory may be offered as a lower cost alternative to disks; and
- Military Applications, for the bubble's ability to replace magnetic tape.

"The physics of bubble development are still relatively unlimited, while the technology is getting less and less limited. We can clearly see .5 micron and 1000 angstrom bubbles coming down the line," according to Doyle. "For now, there appears to be a trend toward some microprocessor manufacturers to incorporate bubbles into the traditional memory hierarchy, just below RAMs." □

**How useful did you find this article? Please write in the appropriate number on the Reader Inquiry Card.**

Very Useful . . . . . 615
Useful . . . . . 616
Somewhat Useful . . . . . 617

# Parallel Processing Meets Computationally Intensive Requirements




*Tandem Computers' NonStop TXP system. Based on a 32-bit multiple processor architecture, it delivers two to three times more processing power than the NonStop II system, reduces the cost per transaction by up to 50%, and maintains full software and hardware compatibility with NonStop II systems.*

*As technology takes a new turn in the form of Artificial Intelligence, the computational requirement will be staggering and the use of multiple processors will be inevitable.*

**by Ram Appalaraju**

The performance of computers has been increasing since the early '60s, and developments at the IC level have inevitably resulted in faster machines. But high performance does not mean high speed alone; it has more to do with how the processor is tailored to the specific application requirement. It is an accepted fact that parallel processors perform better than single CPU machines, and although the concept is only recently finding commercial use, multiprocessing is not an entirely new concept. Even in the '70s, systems were designed around a central processing unit, I/O processor, and diagnostic processor. But multiprocessing architecture as defined today has more than one CPU performing at the same instant of time. This infers that the processors are running in parallel, transparent to each other. Multiprocessing as implemented by Honeywell has a supervisor CPU and two processors for computations – one for scientific and the other for commercial applications. Supported by the GCOS operating system, the supervisor processor assigns scientific instructions (like Fortran) to one processor and business instructions (like Cobol) to the other.

The scientific/commercial use in one application is not unusual. But the technology is taking a new turn in the form of Artificial Intelligence; the computational requirement will be staggering, and the use of multiple processors will be inevitable.

Vision systems are considered to be most likely application areas where initial designs may emerge. Machine vision is the outcome of four different aspects of technology: parallel architecture, image processing techniques, operating systems and fast algorithms.

The central processor for such applications has many processing elements configured in parallel, and the operating system assigns specific tasks to the individual processing element. The stringent requirements of machine vision systems are that the algorithm should be extremely fast to execute. This means that the algorithm also should be written in parallel form.

The School of Electrical Engineering at Purdue University, (West Lafayette, IN) has explored the concept of parallel architecture and parallel algorithms to process visual information. One of the important aspects of image processing is to extract contours of objects. The multimicro computer model designed has a system control unit and a parallel computation unit (PCU) containing $N = 2^n$ processors (**Figure 1**). The system has two modes of operation:

# SUPERMICROS NEED TAPE. HERE'S WHY.

**Let's talk about back-up.**

You're building a 16/32-bit MULTIBUS® supermicro with a high-capacity (20 Mb or more) 5¼" Winchester.

And you're thinking about your back-up strategy.

DSD would like to suggest that you can't back up that much Winchester with floppies.

Here's why.

It just takes too many floppies—20 or 40 (depending on capacity) to back up a 20 Mb Winchester.

Whether your customers back up hourly, daily or weekly, they'll have data spread across an unwieldy mess of floppies.

Then, consider the time they'll waste handling all those floppies.

A supermicro with floppy back-up may be an idea your customers won't buy.

Fortunately, you have a neat, quick alternative.

Tape.

To back up the same 20 Mb Winchester, you only need one ¼" tape cartridge and four minutes.

**Winchesters, floppies and tape—all on one board.**

Now. If you're ready to think about the tape alternative for your MULTIBUS system, you'll want to look at our three RAMTRAC™ controller boards.

**DEXPO® East 84**

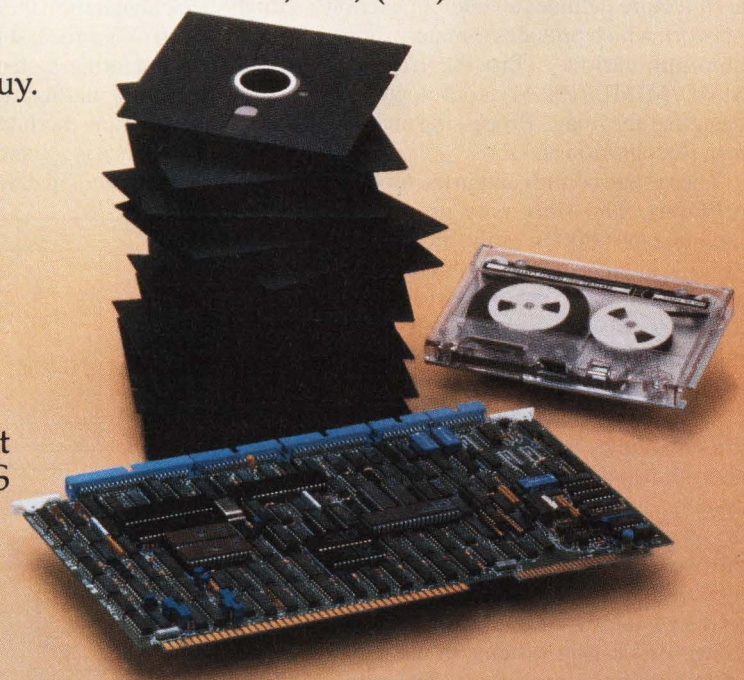
See Us at Booth 1404

Each high performance RAMTRAC board includes controllers for Winchesters, floppies and tape. You can choose models for 5¼" or 8" media. Or a combination of both. And, of course, all models include ¼" tape.

**Call DSD for details.**

There's a lot more we could tell you about the incredible performance characteristics of our RAMTRAC controllers. And we will. Just call the DSD Sales Office in your area for a copy of our RAMTRAC controller data sheet.

Eastern Region Sales and Service: Norwood, MA, (617) 769-7620. Central Region Sales and Service: Dallas, TX, (214) 980-4884. Western Region Sales: Santa Clara, CA, (408) 727-3163.



**DATA SYSTEMS DESIGN**

Write 64 on Reader Inquiry Card

INTERNATIONAL SALES: Australia 03/544 3444; Belgium and Luxembourg 02/720 9038; Canada 416/625 1907; Denmark 02/63 22 33; Finland 90/88 50 11; France 03/411 5454; Hong Kong and Peoples Republic of China 03/696231; Israel 52-52444; Italy 02/4047648; Japan, Osaka 06/323 1707, Tokyo 03/345 1411; Netherlands 02977-22456: New Zealand 04/693 008; Norway 02/78 94 60; Singapore, Malaysia, and Indonesia 2241077; Spain 01/433 2412; Sweden 08/38 03 70; Switzerland 01/741 41 11; United Kingdom 7073/34774; West Germany and Austria 089/1204-0; Yugoslavia 61/263 261. RAMTRAC™ is a trademark of Data Systems Design, Inc.
*MULTIBUS is a registered trademark of Intel Corporation.

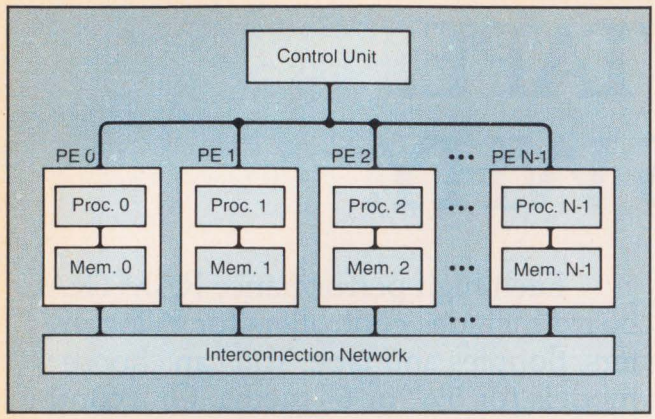



*Figure 1: Model of an SIMD/MIMD machine.*

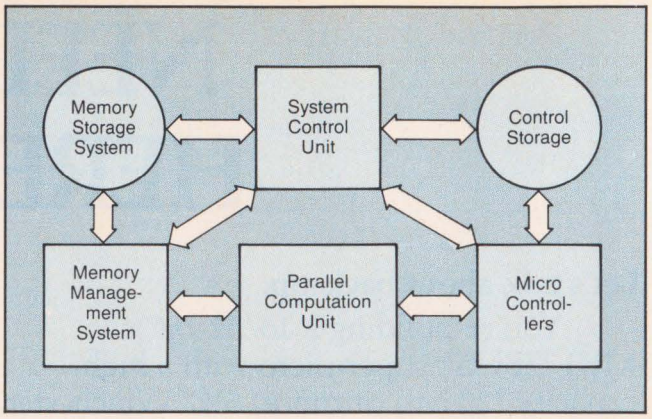



*Figure 2: Block diagram overview of PASM.*

- SIMD (Single Instruction stream and Multiple Data stream) mode and,
- MIMD (Multiple Instruction stream and Multiple Data stream) mode.

In SIMD mode the system control unit broadcasts instructions to all processors in the PCU, and each processor executes the instructions on the data in its own memory. When operating in the MIMD mode each processor fetches instructions from its own memory and executes them on the data in its own memory. In MIMD mode the control unit may coordinate the activities of processing elements. The architecture includes an interconnection network which provides for interprocess communication. This Partitionable SIMD/MIMD (PASM) is developed and designed for Image Processing and Pattern Recognition tasks.

The system control unit in the model is a PDP-11. The University proposes to incorporate 68000s in the PCU. Each processor in the PCU has its own memory units and the memory management system controls loading and unloading PCU memory modules from the mass storage (**Figure 2**).

Though the architectural requirements are satisfied by the PASM machine, fast algorithm and multi-functional operating systems still pose a challenge to the designers. Machine Vision systems like the one from Purdue University is at least a couple of years away from reality in terms of industrial applications. Most image processing systems in use today still utilize array processors. The multiprocessor systems like the ELXSI System 6400 and the Tandem Nonstop TXP use a maximum of 16 processors running in parallel. But the number of CPUs required for machine vision applications is as high as 1024 or even greater.

## Knowledge-Based Machines

Knowledge based machines sit at the higher end of multiprocessor systems. Those multiprocessing machines that are available now are mainly used for applications requiring fast computations, real time control, etc., and systems such as ELXSI System 6400 and Tandem Nonstop TXP are at least three or four times faster than conventional super minicomputers such as the VAX-11/780. Both these systems are bus oriented. The NonStop TXP system is also designed for fault tolerance. The high speed Dynabus in the system which supports up to 16 processors is designed to let the operating system perform in spite of a single malfunction or component failure. If any module or data fails, the fault tolerance is achieved through the use of a corresponding device or alternative data path. The system does not require a back up processor. (**Figure 3**).

In a multiple CPU organization if all CPUs are to perform effectively the operating system must play a crucial role. In a multiprocessing environment if the access to critical sections is not serialized a lot of time is wasted by the CPUs waiting for their turn. The EMBOS operating system in System 6400 is message-based and provides a networking environment to the CPUs. When an I/O unit requests a processor, the EMBOS automatically queues the request and sends it to a processor without regard for which of the processors will execute the task. Serialization of access to critical sections occurs because only one process may access a given location and the message system serializes requests for service from that server.

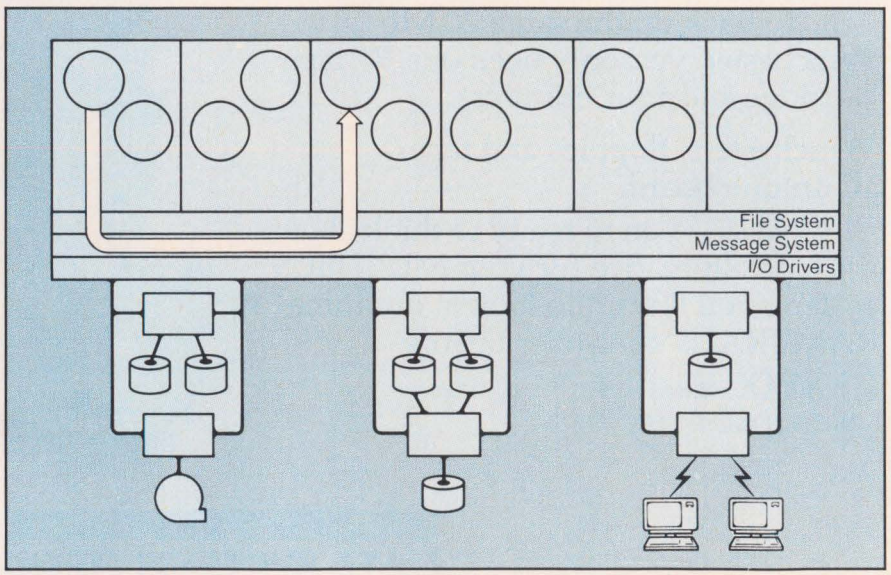



*Figure 3: A primary process sends checkpoint messages to its backup process in the tandem NonStop TXP system. This enables the backup to continue processing in the event of a failure that affects the primary processor.*

# 1024 x 780 for $2795

## Our Competitive Edge

### Their Edge

The Cybernex 1014 graphics terminal with standard 1024 × 1024 memory delivers outstanding performance at a refreshingly low price.

**A refinement you can see**

With our 1014, the 'aliasing' or staircase effect found with lower resolution terminals has been virtually eliminated. Our 14-inch screen produces refined graphic imagery of **1024 × 780 actual displayable pixels**. The result is instantly obvious: diagonal lines, arcs and circles now appear 'truer' to the operator.

**Goes beyond Tektronix 4014. . . except in price!**

As an emulation of the Textronix 4010/12/14/15, we build in all the features you demand in a top quality graphics terminal, including compatibility with PLOT 10* software and keyboard set-up of all parameters. We also provide many other useful features, such as smart drawing functions and support for various input/output devices, including mice and bit pads. And with flow control on the 1014s 9K communications buffer, you won't lose any screen data. . .no matter how complicated your drawing.

**Talks to your VAX***

At the touch of a key, you can transform the terminal from graphics to ANSI 3.64 mode and communicate with DEC and most other computers.

**Supports low cost printers**

Dot matrix printers are supported with our 1014. Full-screen images are printed, pixel to dot, so you can get actual hard-copy of what you've drawn on the screen.

To learn more about the Cybernex 1014 call Anne Eriksson, (416) 828-2810.

**Write 79 on Reader Inquiry Card**

Tilt and swivel stand and 1015 APL version are options

* PLOT 10 is a registered trademark of Tektronix

* VAX is a registered trademark of Digital Equipment Corporation

CYBERNEX LIMITED

**Making a good thing better.**

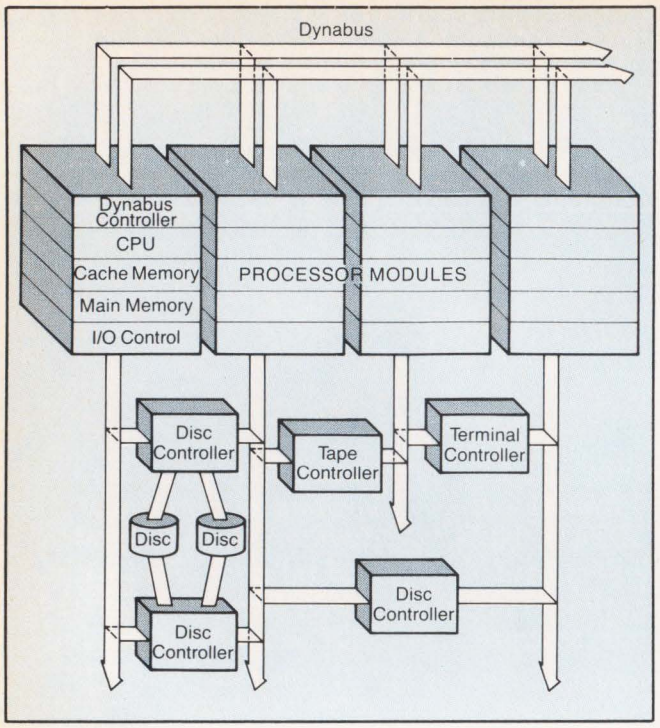



*Figure 4: NonStop TXP system architecture.*

Low end multiple CPU systems make use of more than one microprocessor on a single board. These are considered to belong to the next generation of loosely coupled systems. One important innovation in multiple microprocessor systems is the use of message-based operating system software. Based on this approach Convergent Technology has a design that permits up to three Motorola 68010s and three Intel 80186s to be organized on a single board. All these processors are coupled directly to an 11 Mbits per second bus. The architecture is such that each processor has fixed responsibilities such as application software, file processing, terminal processing, etc. Action Computers Enterprises Inc. has two different sets of processors; service processors (Z80A, Z80), and user processors (Z80A, 8086/8087) all on the IEEE 696/S-100 bus.

Although the multiple processors are designed so that processing elements perform transparent to each other, it is essential to have an inter-processor communication. Networking is provided by an additional communication processor or taken care of by the operating system as in a message based system. Communication through the system bus is via communication lines. In theory, the communication links between the processors are used primarily to bring data that highlights the state of the controlled process into a central area where they can be monitored.

*Low end multiple CPU systems make use of more than one microprocessor on a single board. These are considered to belong to the next generation of loosely coupled systems.*

Under those conditions where a central CPU monitors the system, a lot will depend on the switching speed of the device. Networking will become an important criterion to be considered in the design of the system. The design of the network will be as complicated as the design of the system itself, due to the independent nature of the processing elements. One such example is engineering workstation design. Individual processors will be used for design, simulation and real time control. Although the processors will perform independently, they must have a provision to communicate with each other. Since the amount of computations at each stage will be intense, it is inevitable that the parallel processing approach will be implemented. Artificial Intelligence applications have already started to utilize the new architecture. Perhaps the end of the '80s will see the first fully fledged Artificial Intelligence system. □

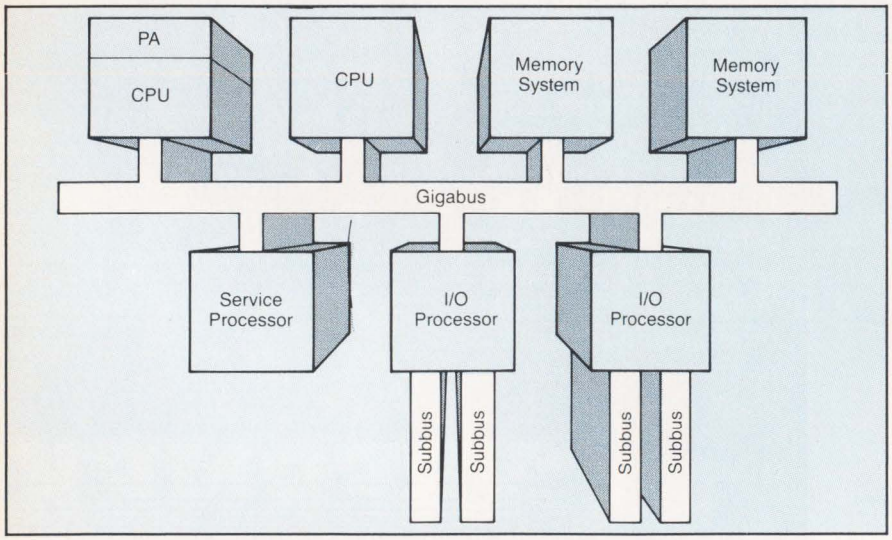



*Figure 5: The ELXSI System 6400.*

**How useful did you find this article? Please write in the appropriate number on the Reader Inquiry Card.**

Very Useful . . . . . 606
Useful . . . . . 607
Somewhat Useful . . . . . 608

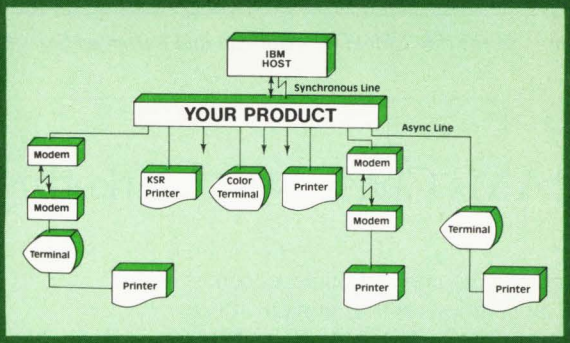
# . . . Your Second Wish?
# "To Add 3270 Compatibility to Our Products"


The Renex Single Board Protocol Converting Controller allows ASCII terminals, printers and personal computers to interface with SNA/SDLC and BSC 3270. With up to 18 logical units, the converter requires only 70 square inches of your board space . . . and no in-house development costs!

## And Your Third Wish?

"Increased market penetration of Our Products"

As you wish! The expanded capability that the Renex Protocol Converting Board adds to your product will take you into the established IBM marketplace. The result—more potential users and that translates to increased sales volume!




RENEX CORPORATION

6901 Old Keene Mill Road Springfield, VA 22150

**(703) 451-2200 TWX: 710-831-0237**

**Write 80 on Reader Inquiry Card**

# Renex has the solution.

Also available for Systems 34/36/38

# CMOS May Claim 60% of IC Sales

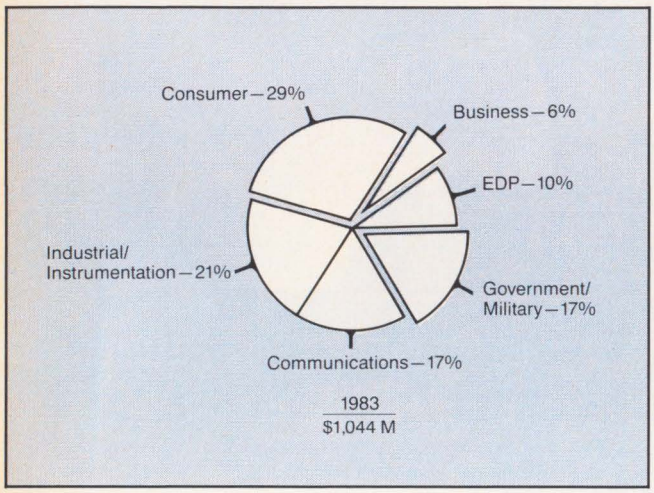
The upsurge in demand for CMOS started in 1983 has resulted in rapid expansion for CMOS Gate Arrays and CMOS logic, as an alternative for shortage-plagued Bipolar logic ICs. However, the short-term market conditions may only act as a catalyst; the potential impact of CMOS is found in a combination of technical and economic improvements related to the process itself, as well as the applications where CMOS turns out to be ideally suited.

Strategic Incorporated, a San Jose, CA market research firm monitoring the Semiconductor Industry, stresses the historical disadvantages, such as low functional density and relatively low speed, have been met with appropriate solutions and predicts that as feature size continues to shrink with time, CMOS will soon match or better NMOS in chip area efficiency, wafer cost and probe yield.

The research firm sees the market growth stimulated by the increasing number of applications requiring low power consumption and circuit performance. Applications in the Industrial/Instrumentation sector includes analog/digital and digital/analog converters, multiplexers, analog switches, etc.

CMOS and its penetration into the EDP market segment is based on its potential for relatively high speed operation, low heat dissipation and higher reliability. It also may allow increased board packing densities, as well as smaller power supplies or batteries which could ultimately be combined as built-in uninterruptible power supplies (UPSs) in the larger systems.

Strategic forecasts the worldwide sales of CMOS parts made by American and European suppliers to grow from $1 billion in 1983 to $58 billion in 1993 (**Figure 1**). The CMOS share of worldwide American and European IC sales will jump from slightly under 13% in 1983 to about 60% in 1993. —*Hanrahan*



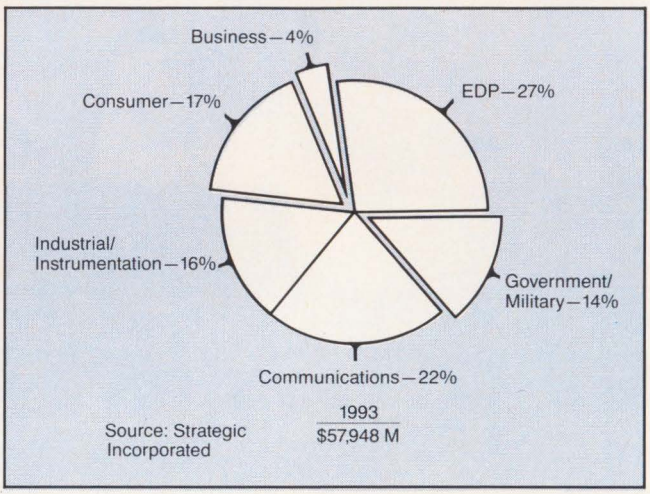




*Figure 1: Worldwide CMOS IC American and European Sales by major market segment.*

# DRAMs Chase New Marketing Niches

The increasing application dependency of VLSI solutions is beginning to affect designs of dynamic RAMs (DRAMs). Not only are different configurations of memory becoming available from 256K × 1 to 32K × 8, but a variety of different addressing modes designed for specific market niches are also starting to emerge. Since latest estimates (**Figure 1**) place the total DRAM marketplace at over $5,000 million by 1988, it is hardly surprising that, although competition is fierce, new semiconductor start-ups continue to enter the marketplace.

*Figure 1: Semiconductor Memory Market, 1983 and 1988.*

| | 1983 | 1988 |
|---|---|---|
| **Total Market ($M)** | $4580 | $16380 |
| MOS MEMORY | $4020 | $15483 |
| CMOS Share of MOS | 14% | 70% |
| DRAM or iRAM | $1818 | $ 8175 |
| DRAM Share of RAM | 65% | 76% |
| SRAM | $ 772 | $ 2287 |
| CMOS Share of SRAM | 55% | 90% |
| EPROM | $ 709 | $ 2167 |
| OTP Share of EPROM | 2% | 75% |

*Source: DATAQUEST February 1984*

This tremendous demand for more memory has come from both ends of the computer industry—from mainframes through minicomputers to the personal computer. **Figure 2** shows the amount of memory supported by a minicomputer (the HP 3000) over a ten year period. In 1972, the product was introduced with 64


# A Universe of I/O Solutions for Multibus™ Systems

Getting signals to and from your Multibus™ is our business. We've already done the design and engineering work to solve many of your microcomputer interfacing problems, so you can spend more time on total system integration and performance. We have over 40 Multibus™ analog, discrete, and serial I/O cards "on the shelf," ready to go to market in your systems right now.

These low cost boards give you the flexibility you need for a wide range of applications.

Benefits include:

- fast, simple programming
- memory or I/O mapped
- easy installation
- powered from system bus
- flexible system configuration
- fast system development

## Signal Types

- ±10V
- ±10mV
- 4 to 20mA transducers
- thermocouples
- RTD
- DC sense
- AC sense
- contact closures
- TTL
- discrete I/O
- pulse counter
- pulse width
- frequency
- period
- RS-232-C

Write or call for complete specifications and pricing information.

**Data Acquisition and Control Systems Division**
3631 E. 44th Street, Tucson, AZ 85713 • (602) 747-0711

BURR-BROWN®

**Putting Technology To Work For You**

**ALABAMA**, (205) 663-2831 - **COLORADO**, (303) 771-1530 - **DELAWARE**, (302) 478-8211 - **FLORIDA**, Tampa, (813) 885-1796; Jacksonville, (904) 268-1468 - **GEORGIA**, (404) 449-3382 **ILLINOIS**, (312) 579-9300 - **INDIANA**, (317) 257-7231 - **LOUISIANA**, (504) 887-8550 - **MASSACHUSETTS**, (617) 339-5522 - **MINNESOTA**, (612) 835-2044 -**MISSOURI**, (314) 647-8100 **NEW JERSEY**, (201) 785-4450 - **NEW YORK**, Albany, (518) 869-3355; Buffalo, (716) 874-4900; Rochester, (716) 323-1250; Syracuse, (315) 455-2469 - **OHIO**, Northern, (216) 247-3295; Southern, (513) 772-5544 **OREGON**, Medford, (503) 772-3187; Portland, (503) 283-2555 - **PENNSYLVANIA**, (412) 366-6664 - **TENNESSEE**, (615) 689-8513 - **TEXAS**, (713) 491-2000; Beaumont Area, (713) 842-5950 - **UTAH**, (801) 566-9251 **WASHINGTON**, Richland, (509) 943-6664; Seattle, (206) 762-6050 **WISCONSIN**, (414) 352-5777 - **CANADA**: (403) 458-4669; (416) 625-0600; (514) 774-5829; (604) 434-2611; (613) 725-0288

Other areas: **Burr-Brown,** 3631 E. 44th Street, TUCSON, ARIZONA 85713 USA - Tel: (602) 747-0711 - TWX: 910-952-1115 - Telex: 66-6491 - Cable: BBRCORP

Multibus™—Intel Corp.

Write 61 on Reader Inquiry Card

KBytes of main memory, and today that product line supports 8 MBytes, a doubling of memory over every two years. In the personal computer market, the demand has been even more dramatic. In 1978, most PCs only supported 32 to 64 KBytes of memory. Today, that figure has moved up to 640 KBytes and continues to grow. Several driving forces that dictate the need for more memory include the movement to high-level languages and the increasing use of graphics. From **Figure 2** it could be predicted that by 1990 a multi-user system could support up to 100 MBytes of main memory, and a PC up to 5 MBytes.

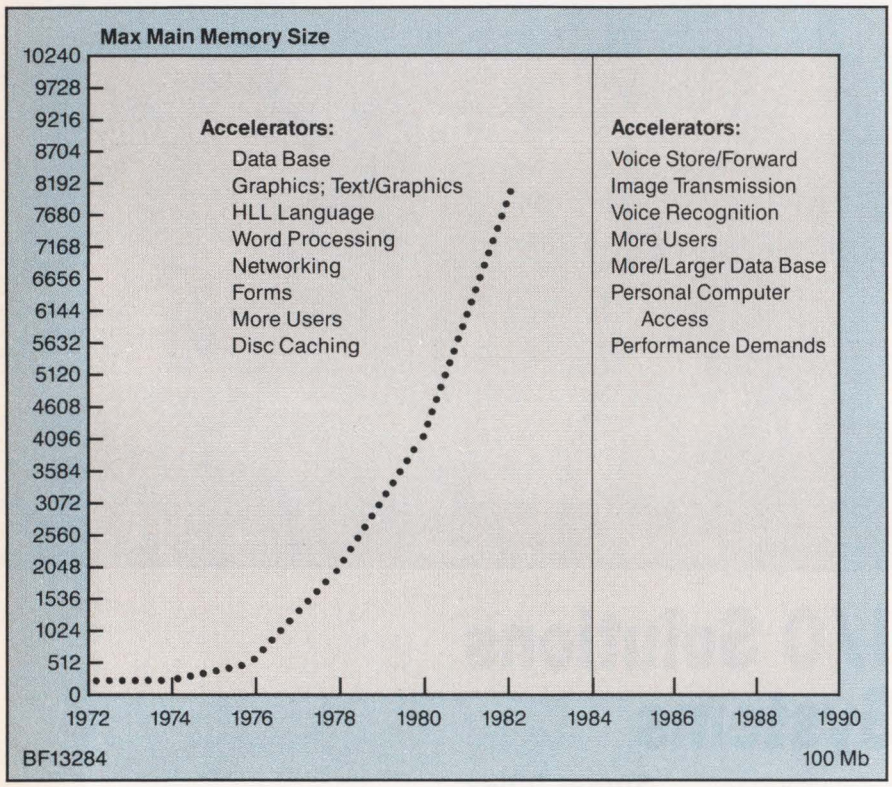
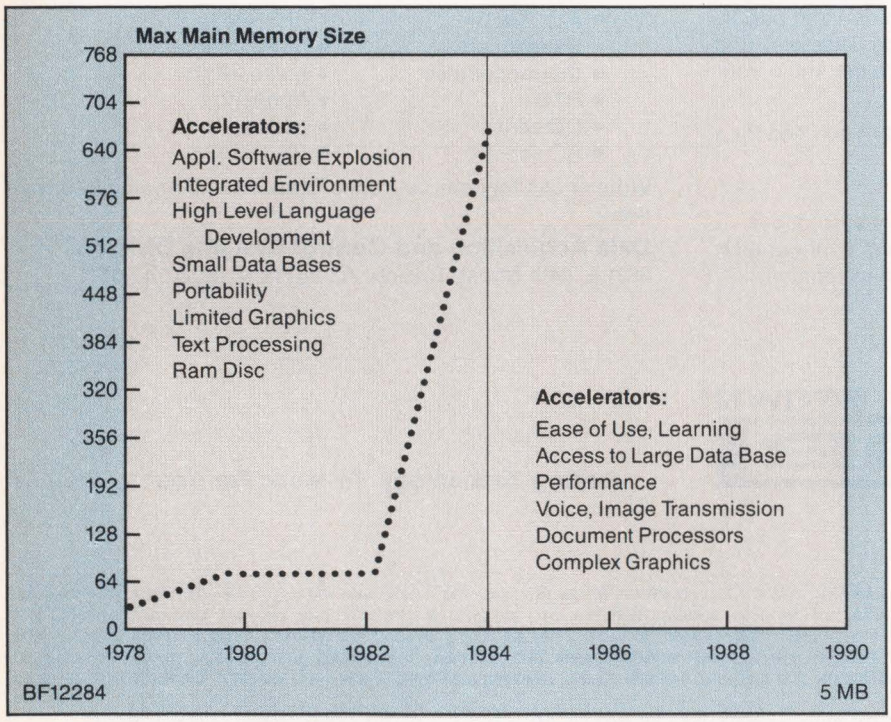



*Figure 2a: Multiuser systems are forced to accommodate soaring main memory requirements.*




*2b: The emphasis in personal computers is on huge quantities and huge memory appetite.*

One answer to this demand is the production of devices at increasing higher density levels. However, with the introduction of the 256K DRAM, the conventional 16-pin package has reached two practical limits—pin-counts and cavity size. Thus, the packaging question has become a key issue of the 1 MBit DRAM concept, according to Kurt Hoffman, chairman of the session on 256K 1 MBit DRAMs at this year's ISSCC. The existing multiplexed address-format may just be applied to the to the next larger package size, the 18-pin package, or the package change may enhance the introduction of chip carriers or the inclusion of an integral capacitor to cope with the increasing problems of noise and current spikes.

The redundancy concept has now been adopted by most of the memory houses, and it would appear that the incorporation of on-chip error checking and correction might seem a likely next step to reduce alpha-particle induced soft-error rate in 1 MBit designs.

If the 256K and 1 MBit DRAMs have an application as main memory store, then the increased push towards higher performance systems through the use of cache and virtual memory will create the need for fast static devices with below 25ns access times. Since the CMOS share of the static RAM market is expected to be 90% by 1988, it was not unexpected that many of the designs presented at the ISSCC used that technology.

The speed of MOS SRAMs has improved dramatically over the past few years with access times in the 40ns to 50ns range reported for 64K devices. This year, several designs were presented with access times well below that figure. Inmos presented a 30ns 64K × 1 design; NEC, a 25ns chip; and Hitachi, a 20ns part—all fabricated in CMOS. As an indication of what was on the horizon, Toshiba described a 256K CMOS RAM with 46ns access time.

According to Richard Pashley, Chairman of the Static RAM session, the next generation of scaled MOS technology will require a supply voltage lower than 5V. Many feel that this voltage should not be passed onto customers, but generated internally from a 5V supply. —*Wilson*

# Introducing UNICAD I™
# A $2,000,000 CMOS Gate Array CAD system (and more) for less than $15K!

**Incredibly Cost Effective.** There's no need to buy a $75K CAE terminal just to design CMOS gate arrays. Now, with the UNICAD-I system, the multipurpose IBM XT computer becomes an interactive design terminal. The UNICAD-I system includes schematic capture and net list generation software, the Universal high-speed CMOS macrocell library, a graphics card, a mouse, and all required instruction manuals. Pop the software and macrocell library into your XT and you're ready to design and capture your circuit and to prepare it for logic simulation.

**Our VAX is your VAX.** There are two ways to simulate your circuit. By far the most efficient is to transmit your net list directly to our VAX computer bank via telephone lines. Using powerful software, designed specifically for high-speed CMOS, we'll simulate your circuit and transmit the results back to you for printout on your XT. If edits are needed, retransmit the net list and we'll resimulate the circuit. As an alternative, you can send us your net list on a diskette. This slows down the design process a bit, but is perfectly acceptable. Incidentally, logic simulation costs are included in our overall integration charges.

**Our CAD is Your CAD.** After your circuit has been simulated, it's ready to be processed into a silicon chip. First, we'll simulate the speed performance of your circuit to make sure it meets your requirements. Then, we'll automatically place the macrocells you've used and automatically interconnect them. This involves a fool-proof computer program which insures that your circuit will perform precisely as you designed it. Concurrently, using the outputs of your logic simulation, we'll generate a prototype test program. No circuit leaves Universal untested.

**Our Fab is Your Fab.** Now it's time to convert data bases and number-crunching to hard silicon. This is where Universal has a unique advantage, since we have our own wafer fab, prototype assembly shop, and test facility. P.G. tapes and masks are produced, wafers are patterned and die sorted, and ten engineering samples are packaged, tested, and delivered to you via fastest air express. From the time you transmitted your approved simulated logic to us until the time you get test silicon back can be as quick as **4 weeks**.

**Not Just for Gate Arrays Either.** That's the beauty of UNICAD-I. In addition to our high-speed macrocells, the UNICAD-I parts library includes the 7400 Series, the Intel 8000 Series, discrete components, and a variety of memory components. Also, there are more than 1000 software programs designed to run on the XT—including word processing, program management, and cost analysis. UNICAD-I is the answer to most of your engineering assignments—not just IC design.

**Order UNICAD-I Today!** There's no sense waiting for your turn on the CAE system when you could be creating new designs and helping your organization with your own multipurpose design station. UNICAD-I is so affordable that any engineer can justify it simply on increased productivity. Call us at 408-279-2830 to order your UNICAD-I!

## UNIVERSAL SEMICONDUCTOR INC.

1925 Zanker Road, San Jose, CA 95112 • Tel: 408-279-2830 • TWX: 910 338 7617

# Analyzer Integrates Disk Drives With Controllers, Systems

One of the most significant problems in the integration of new computer systems is accurate evaluation of cost/performance tradeoffs for disk drives. Selecting the optimum drives for a specific computer system can be crucial to its success in the marketplace: too-high of a performance drive wastes money, increases sales price, reduces market share and cuts profits. Too-low of a performance results in costly field service problems, dissatisfied customers, reduced market share and low profits.

Applied Data Communications' Time Interval Analyzer Model 150 provides OEM system integrators with two new types of help in selecting disk drives, either Winchester or floppy.

First, TIA-150 connects directly to the drive-under-test, and it analyzes raw read data. Conventional drive testers connect remotely, via the tester's data separator. Drive testers analyze the drive's jitter indirectly, in terms of its relationship to the tester's data separator, while TIA-150 measures bit-shift jitter directly and absolutely.

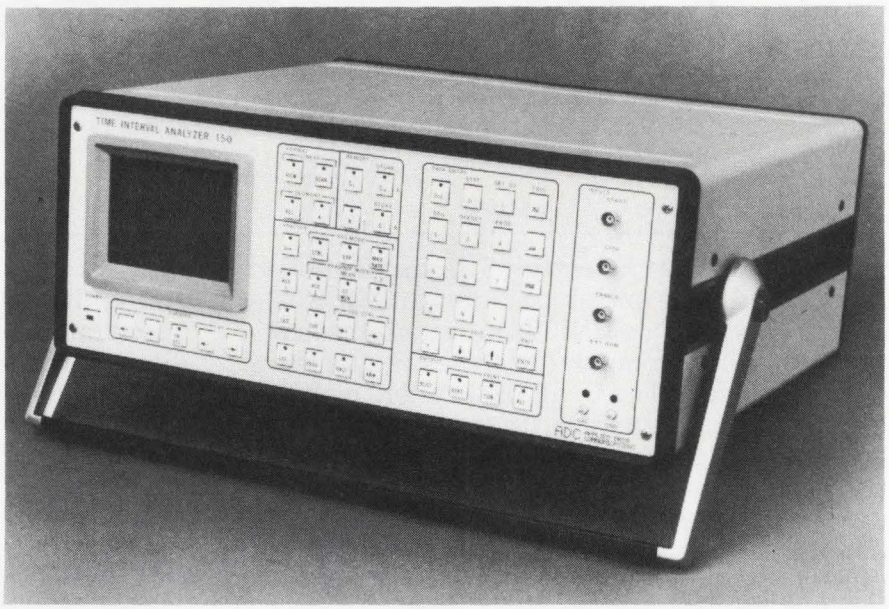


*Figure 1: Time Interval Analyzer Model 150 from Applied Data Communications Inc. (Tustin, CA)*

## Histogram Generator

TIA-150 connects like a passive, serial-bus analyzer, directly to the drive's Raw Read Data output (**Figure 2**). It operates by counting elapsed nanoseconds between successive RRD pulses. The pulses are generated by flux reversals passing by the drive's read head. These magnetic flux reversals typically interact with each other; add noise, and their physical positions appear to shift randomly. This undesirable "bit shift" is directly related to jitter at the drive's RRD output, and is captured by the TIA for analysis.

TIA-150's second benefit is that it displays output jitter as a family of histograms. Conventional drive testers provide only GO/NO-GO relationships between jittery RRD and the data separator's timing window. Detailed histograms, generated by TIA-150, allow OEM system integrators to quantify the absolute level and distribution of jitter for a variety of vendors' drives, then select the very best one for the money—without reference to a particular vendor's data separator.

In operation, TIA-150 counts nanoseconds in a counter for the time between successive RRD pulses. Then it uses the counter output as a RAM address. Each address represents a histogram cell, which is 24 bits deep. Every time a cell is addressed, its contents get incremented by one in an adder (**Figure 3**).

After the selected number of pulses (sample size) has been processed, their overall distribution in time is directly represented by the profile of accumulated cell-counts in the RAM. TIA-150 measures time to 1 nsec resolution over

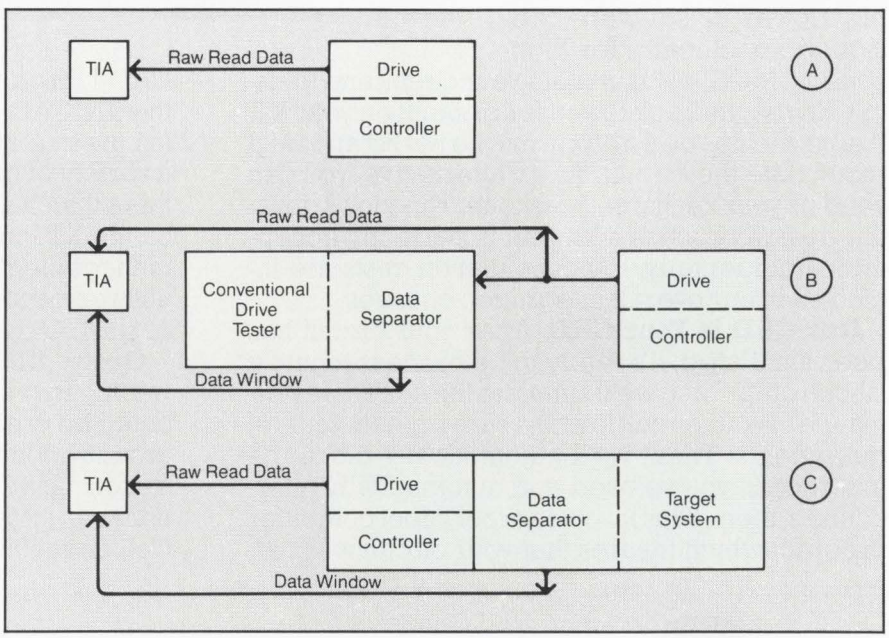
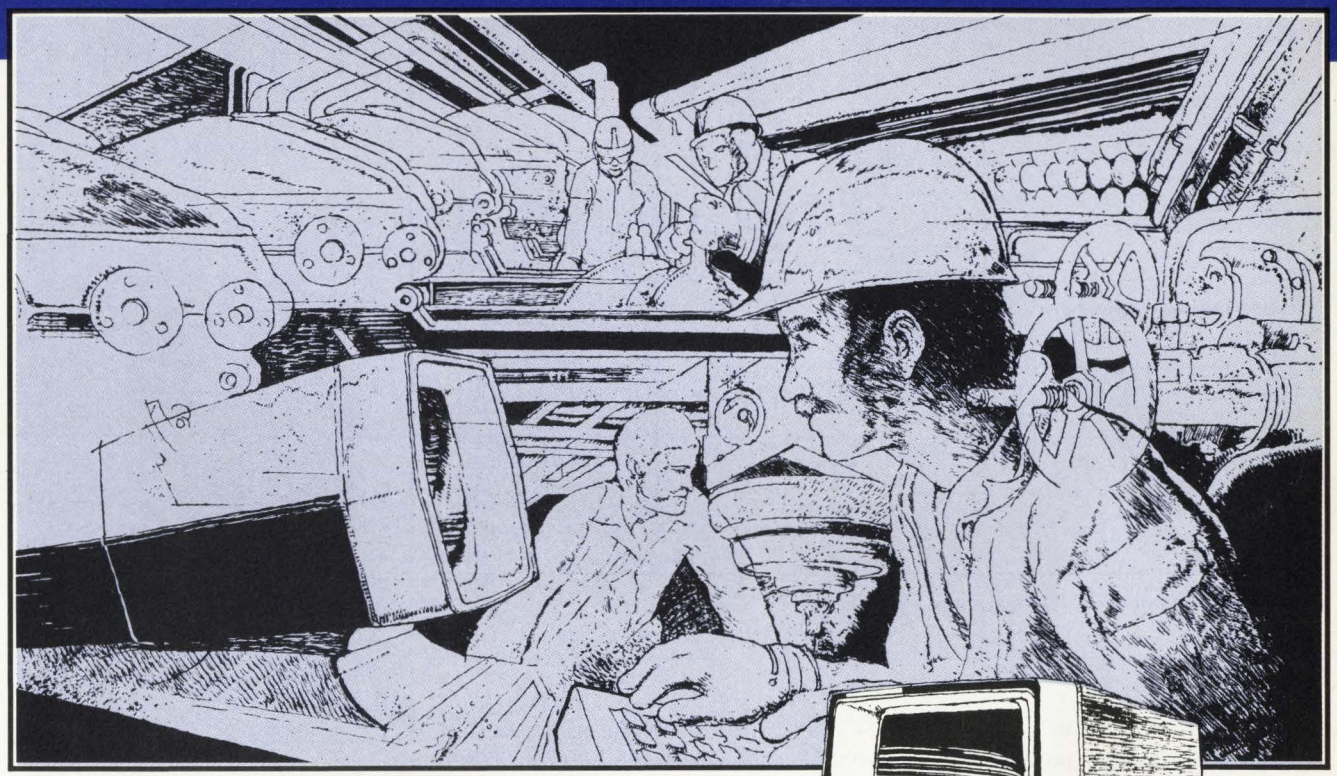


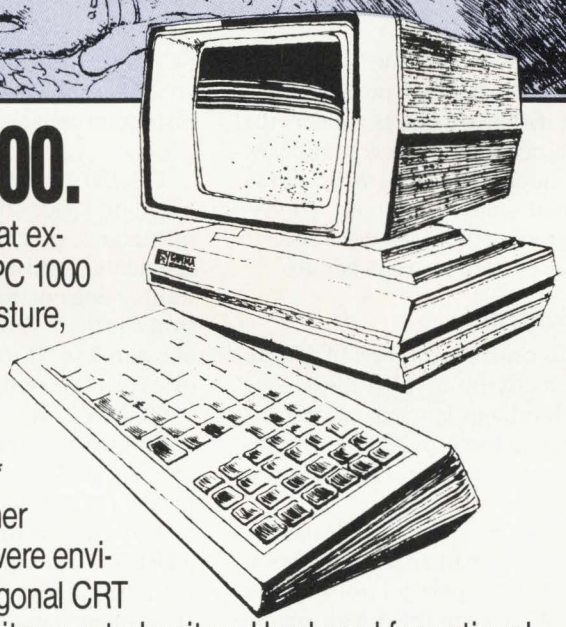

*Figure 2: TIA-150 shows absolute levels of Raw Read Data jitter (a); instrument correlates drive jitter and timing margins between data separator in drive tester (b) and separator in target computer system (c).*

# THE SEVERE ENVIRONMENT VIDEO TERMINAL:



## THE GPC 1000.

Designed with sealed, airtight enclosures that exceed NEMA 4X and 6P requirements, the GPC 1000 survives in environments where dirt, oil, moisture, heat, corrosives and airborne contaminants are the enemy. Its durable rugged design incorporates advanced technical specifications with smart ergonomics. DEC* compatible, the GPC 1000 outleagues all other video terminals in its ability to perform in severe environments with features like a sealed 14″ diagonal CRT with protective anti-glare filter; separate monitor, control unit and keyboard for optional bench top, wall, shelf or ceiling positioning; true bi-directional auxiliary port for two way communications—and much more—all backed with our one year warranty.



**The Severe Environment Video Terminal Engineered To Work Where You Work.**

GPC

**GAMMA**
PRODUCTS CORPORATION
7092 Industrial Loop
Shreveport, LA 71129 USA
(318) 686-1600 Telex 750469

**"Tough Products For Industry"**

For more information concerning Gamma Products, contact Sharon Russell, Marketing Communications.

*reg. TM-Digital Equipment Corporation emulates VT100 with AVO

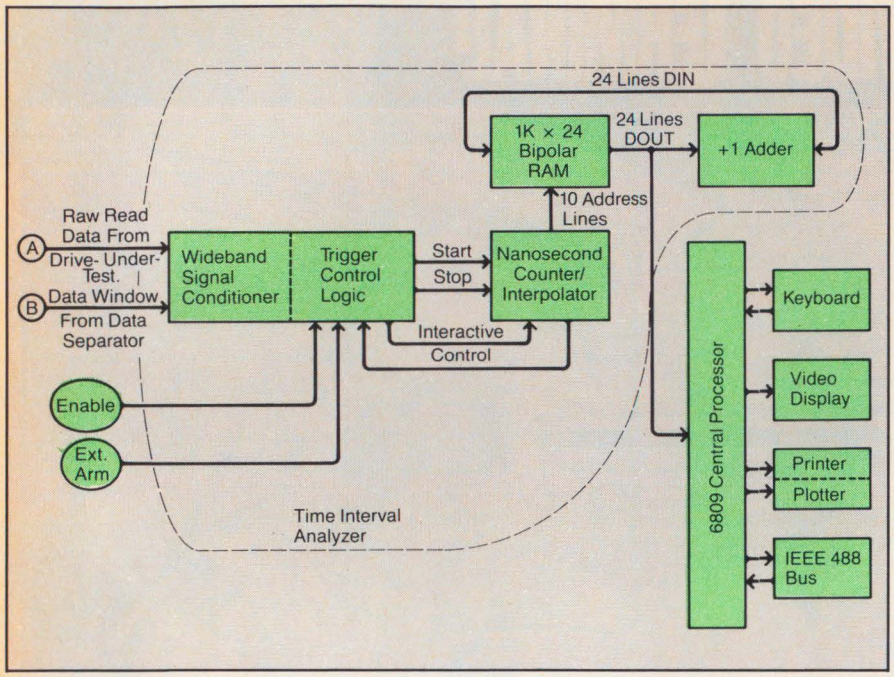



*Figure 3: TIA-150 functional block diagram.*

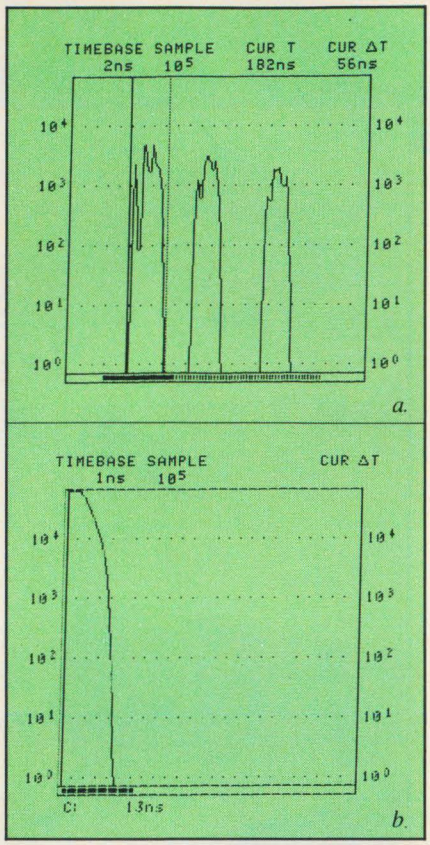



*Figure 4: (a) Histogram of absolute jitter in 5¼"Winchester disk drive (5 Mbits/sec, MFM encoded). Cursors are located at 182 nsec and 238 nsec. (b) SIGMA-2 error probability density curve for same drive as above, showing 13 nsec margin between data separator's window and limits of jitter.*

sample sizes from 100 to $10^9$.

TIA-150 generates jitter profiles in real time, and displays them as soon as the sample has been taken. There is no delay. This continuous-operating mode allows OEM system integrators to design systems that produce the lowest drive noise—that has never been possible before.

## Menu Control

Histograms generated by the TIA-150 are viewed directly on a video display, or printed as hard copy by a separate printer/plotter, or sent to a host ATE system for further diagnostics, life-test logging or lot-trend analysis.

TIA-150's keypad is arranged in menus. Keys are laid out in three logical fields—cursor control, display control and data entry. Most keys are fitted with status-indicating red LEDs.

Two sets of CURSOR control keys are used to position primary cursor and secondary cursor (CUR T & CUR △T) on the screen. The exact nsec location of any point on a histogram curve can be specified by moving a cursor to that point. Cursor positions are displayed in a horizontal readout panel at the top of the video screen.

The entire memory contents can be viewed as raw data by pressing a key labelled VIEW. Within the view mode, a SCAN key provides an intensified horizontal bar showing which 200 of the 1000 histogram cells will be displayed in full detail.

TIA-150's memory can be used as a common space for single-source jitter histograms, or it may be partitioned into segments, for histograms of leading and trailing edge margins. Current data are stored in the "C" memory; reference data are stored in "B" or "A." Any two memories can be displayed at the same time.

SIGMA-1 key sums the memory's multi-lobe histograms to a single lobe for analysis. SIGMA-2 key further processes the data to produce an error-probability density curve of the SIGMA-1 data. The STBL key invokes an arithmetic averaging mode to average the effects of transient phenomena, and EXP invokes a running-average mode.

LE and TE keys cause the leading edge and trailing edge margins to appear in the video display; MEAN causes the arithmetic mean of data bounded by two cursors to appear in the display. SEG and CUR keys select either memory segments or vertical cursors as delimiters for LE, TE, MEAN and SIGMA displays. LCL key selects local panel control or IEEE-488 bus control, and PROG is a utility control to store keyboard setups for rapid recall.

Since it "looks" at data jitter instead of logical content, TIA-150 can be used to evaluate the jitter content and distribution of *any* kind of high-speed data stream, regardless of its encoding format—NRZ, FM, MFM, MMFM, GCR, etc.

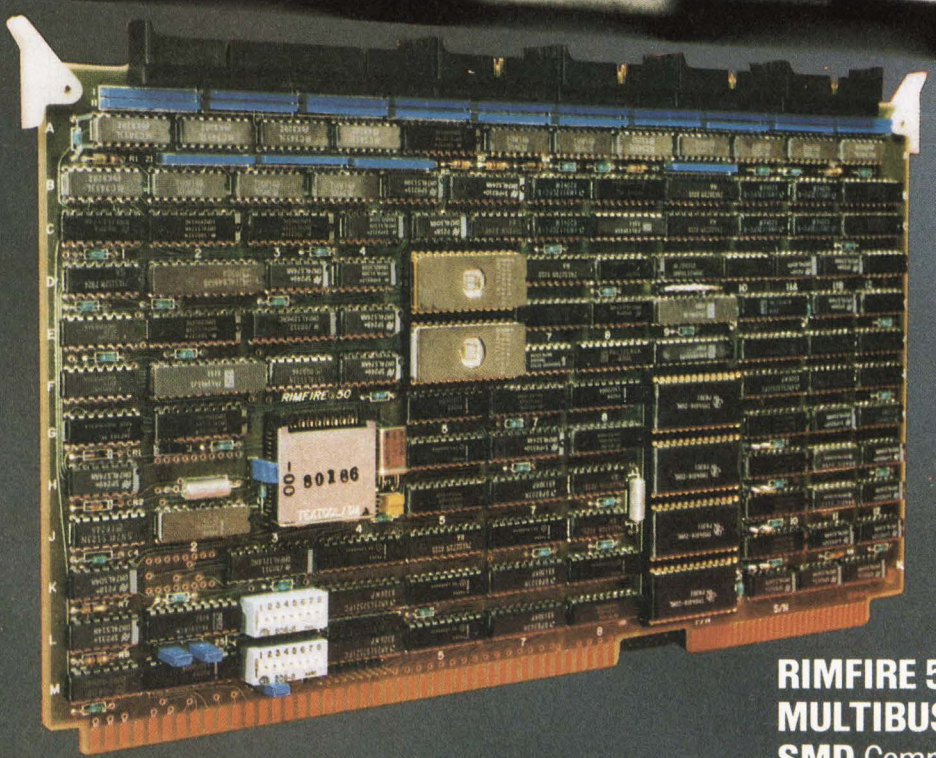
Beyond floppy and Winchester disk drives, TIA-150 is used for analyzing data and smear and jitter in all sorts of serial data systems and sub-systems including tape drives, optical disks, high resolution scanning systems, fiber optic links, standalone computer systems, local area networks, and even satellite telemetry links and neutron time-of-flight measurements. Data may range up to 10 Mbits/second.

*—Jesse Lerma, Product Manager, Applied Data Communications Inc., Tustin, CA.*

**Write 233**

# MORE HIGH PERFORMANCE FROM CIPRICO™

# RIMFIRE™ 50 SMD DISK CONTROLLER


**RIMFIRE 50,** Intelligent
**MULTIBUS* CONTROLLER** for
**SMD**-Compatible disk drives.

- Programmable sector sizes
- 24 bit DMA
- High-speed disc interface
- 1:1 Interleave
- 48 bit ECC

. . . and much, much more!

* Multibus is a registered trademark of the Intel Corporation

CPC

CIPRICO, INC.

rmerly Computer Products Corp.
05 Annapolis Lane
mouth, MN 55441
one: (612) 559-2034

Write 74 on Reader Inquiry Card

# 8-Bit A/D Converter Provides Complete Transducer to Microprocessor Interface

Few if any transducers have an output range that matches the full scale input range of an analog-to-digital converter. These converters require amplification and signal conditioning of the low-level transducer signals prior to conversion. Analog Devices' AD670 (ADCPORT) 8-bit A/D converter simplifies transducer interface applications with an on-chip instrumentation amplifier buffer (**Figure 1**). The buffer, combined with the converter's pin-selectable input ranges of 1mV/LSB and 10mV/LSB (least significant bit) allows direct connection of transducer-generated signals without the need for preamplifiers or other signal conditioning circuitry. The ADCPORT directly converts outputs from semiconductor strain gages, pressure transducers, load cells and RTDs, and easily interfaces to standard microprocessor busses.

By placing an instrumentation amplifier buffer, conversion circuitry, reference and bus-interface on a single chip, the AD670 requires no external trims or components other than a power supply by-pass capacitor. In addition, the ADCPORT operates from a single +5V supply and has an internal clock running at a less than 10 microsecond 8-bit conversion rate.

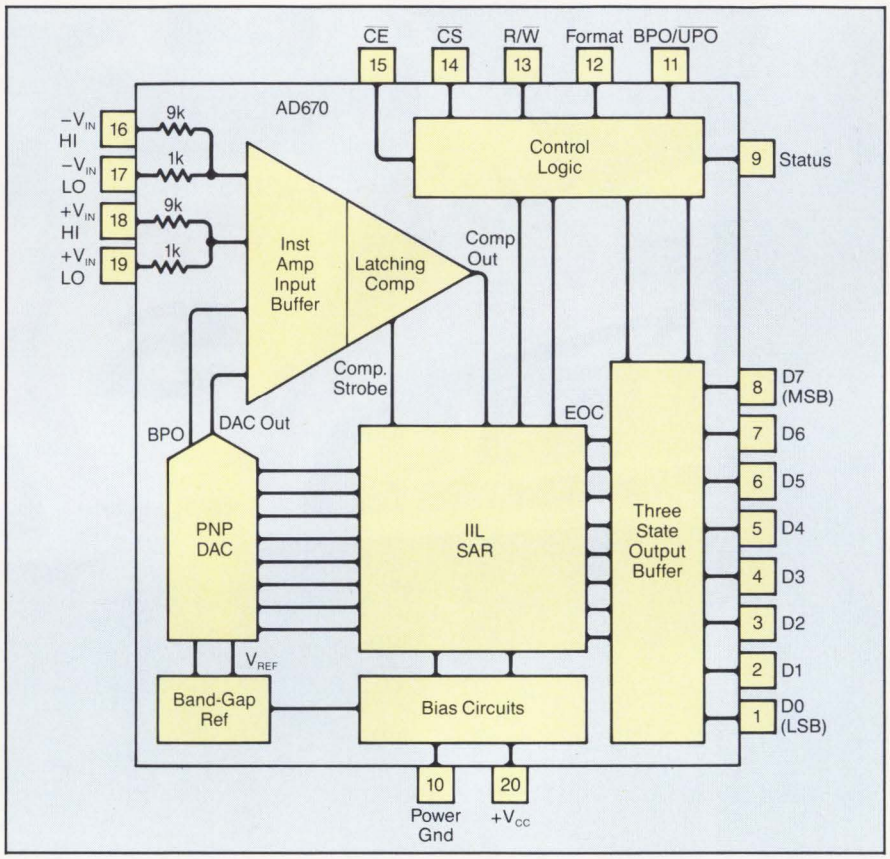



*Figure 1: The AD670 (ADCPORT) 8-bit A/D converter simplifies transducer interface applications with an on-chip instrumentation amplifier buffer.*

## Instrumentation Amplifier Buffer

Most successive approximation converters use a resistor to convert the input voltage to a current. This technique requires an external high-speed, low output impedance amplifier to handle the current requirements of the A/D. The AD670 replaces the external buffer with an on-chip instrumentation amplifier to buffer analog inputs with a common mode range which includes ground and up to within 3 volts of the positive supply voltage. This stage's high-impedance differential input (100K ohms for 1mV/LSB and 10K ohms for 10mV/LSB) allows a direct connection of low-impedance bridge circuits such as RTDs and strain gages. This input stage typically has only 200nA of input bias current and 5nA offset current which are well balanced on the plus and minus terminals. This buffer stage also provides latch-up free over-range protection for momentary shortages of ±30 volts on either input.

## Conversion Circuitry

The conversion circuitry of a successive approximation converter includes a comparator, digital-to-analog converter, reference and successive approximation register (SAR). The comparator is the critical element in the conversion process because it is impossible for the converter to be any more accurate than the comparator. For example a 12-bit A/D converter requires a 12-bit accurate comparator and an 8-bit converter requires an 8-bit comparator. This, however, assumes a full scale range of 10V. Since the AD670's full scale range (1mv/LSB) is 255mV, the comparator must have less than 200uV of code uncertainty to insure proper transitions. This requires a comparator with better than 8-bit performance. The AD670 uses the same comparator design as an Analog Devices' AD574 12-bit A/D converter to attain lower levels of error.

The AD670's DAC consists of eight

**Attention Readers. . . Free Samples!**

Analog Devices will provide a free sample of the AD670 to the first 300 readers who write in their requests on company letterhead. Only those who write in on company letterhead are eligible.

Direct requests to:
Converter Marketing
Analog Devices Semiconductor
804 Woburn Street
Wilmington, MA 01887

# An Array Processor this fast and flexible can't sell for only $4250.

## Or can it?

**Marinco makes it possible!**

*The imaging requirements of a geophysical research project at sea demanded intense mathematical calculations.*

*An array processor was the answer.*

*But space aboard the ship's computer was limited. Only a single Multibus* slot remained.*

*Marinco engineers, driven by necessity, pushed beyond the horizons of conventional array processor design.*

***A Single Board***

*They discovered how to shrink circuits to a single board — and to do so without sacrificing performance.*

*In fact, they enhanced it. Keeping signals within a single board actually made significant speed gains. Then they added other performance enrichments such as memory mapping and an auxiliary port for direct high speed I/O.*

***Easy to Program***

*Perhaps as important, the board is easy to program, even for someone with only high-level language experience. Standard routines may be adapted. Or new ones created. Marinco's assembler automatically generates the microcode and tracks the 48-bit control word.*

***Imaging Productivity***

*The speed and flexibility of the APB-3000 series can dramatically increase your imaging productivity. Use it for coordinate transformation, hidden line removal, vector-to-raster conversion, interpolation, image enhancement and many other operations.*

***Very Low Price***

*Even with all these advantages, Marinco innovations make it possible to offer the Multibus version for only $4250, quantity one, U.S. price.*

*IBM PC versions are also available.*

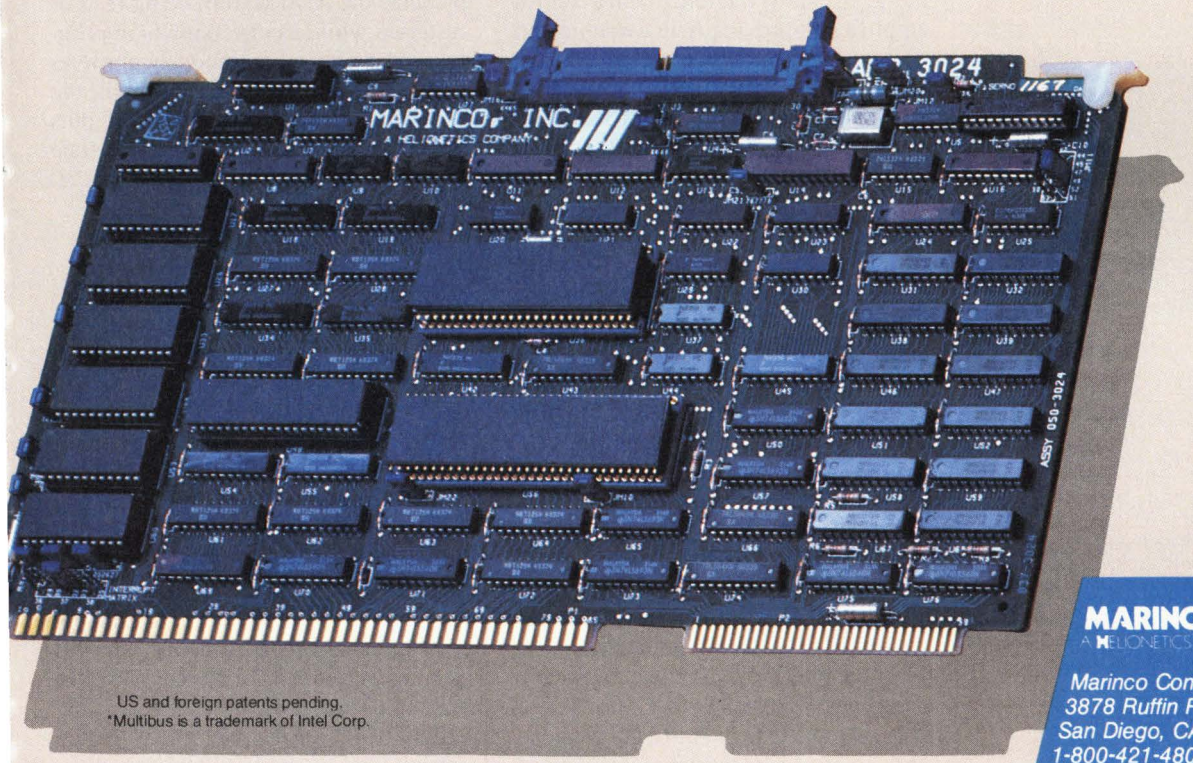
*Can an array processor this fast and flexible really sell for such a low price?*

*Thanks to practical demands and Marinco innovations, it can.*

*Call us toll-free for details.*

***Specifications***

***Program Memory** 2K X 48-bits **Data Memory** 8K words **Data Word** 24 bits long, 8-bit exponent, 16-bit mantissa (floating pt.) or 16 bits (integer).*




US and foreign patents pending.
*Multibus is a trademark of Intel Corp.

**MARINCO, INC.**
A HELIONETICS COMPANY
Marinco Computer Products
3878 Ruffin Rd.
San Diego, CA 92123
1-800-421-4807
in Calif. 1-800-421-4808
Telex 3719117
TWX 3103719117

A HELIONETICS COMPANY

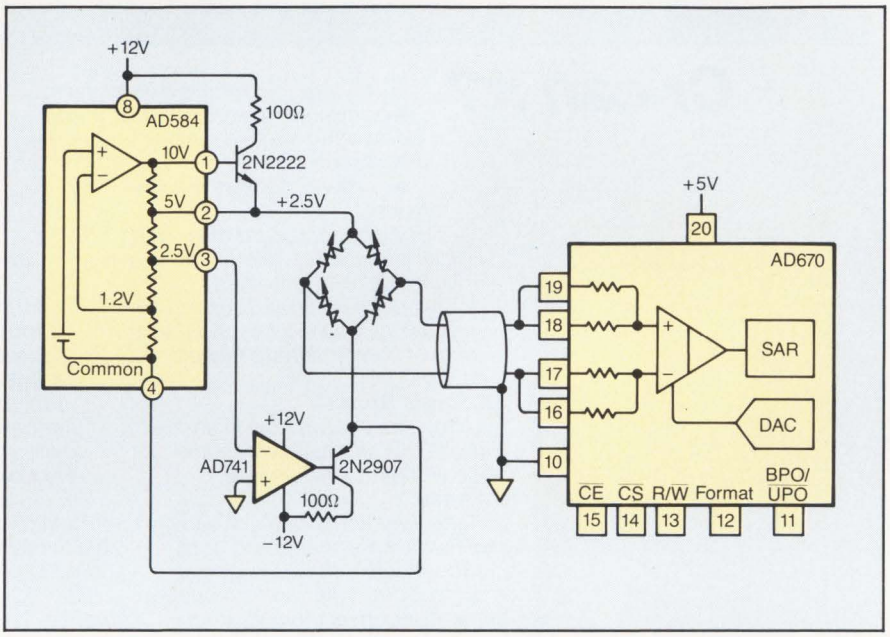



*Figure 2: Transducer interface.*

identical 100uA lateral PNP current sources feeding an R/2R ladder which binarily weighs each bit. The on-chip reference uses a band-gap technique and merges a classic reference with a control amplifier improving both dynamic and dc performance.

A one-shot delay line replaces a conventional shift register as the 670's SAR. A conventional shift register steps from bit-to-bit at the rate determined by an external clock. A one-shot delay line, however, relies on the inherent gate delay of the linear compatible $I^2L$ process and not external clocking. In the AD670, a string of 80 inverters (10 per bit) generate the various pulses to set bits, reset bits, and strobe the comparator. The delay line determines each pulse by combining different taps along the inverter string.

## Control Logic and Bus Interface

The microprocessor interface consists of eight high-speed three state output buffers, a STATUS output and five TTL, LSTTL and 5V CMOS compatible control inputs. The $\overline{CS}$ (chip select) and $\overline{CE}$ (chip enable) are active low and interchangeable. Both $\overline{CS}$ and $\overline{CE}$ must be low to either read data or start a conversion. They require a minimum pulse width of 300ns. The R/$\overline{W}$ pin directs the converter to read data back (R/$\overline{W}$ high) or start a conversion (R/$\overline{W}$ low). The STATUS output is wired internally as if to an input like another chip enable. When the STATUS is high during a conversion, the chip is disabled and will ignore all inputs. This prevents the AD670 from being read or restarted while a conversion is in progress. The device continuously converts until $\overline{CE}$, $\overline{CS}$ or R/$\overline{W}$ goes high while the STATUS input is high. The data outputs are normally in a high impedance state until the A/D finishes the convert cycle.

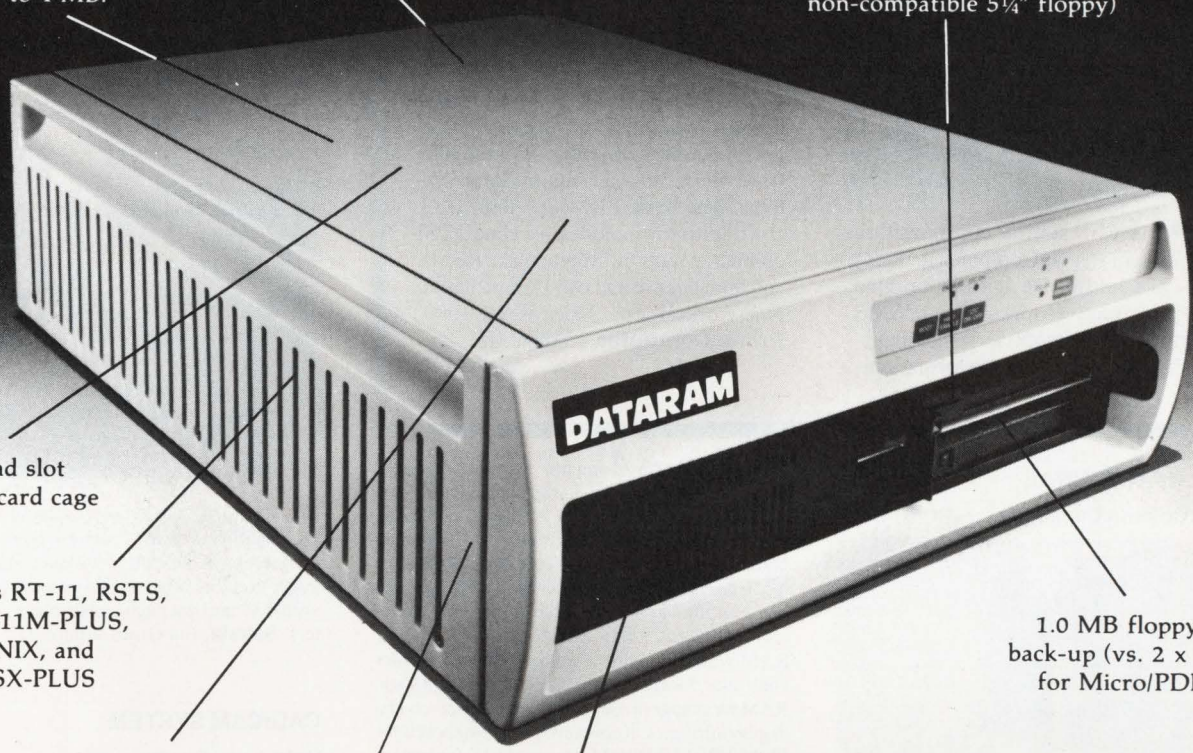
## Applications

The combination of a complete transducer and microprocessor interface makes the AD670 best suited to microprocessor-based systems using low-level transducers such as semiconductor strain gages, pressure transducers, and load cells. An example of this type of transducer interface is shown in **Figure 2.** By using a load cell, voltage reference and the AD670, a complete force-to-digital interface can be built. The reference provides a ±2.5V excitation voltage for the load cell and the transducer delivers ±150mV for a force of ±20 lbs. With this circuit resolution is 2.1 ounces per LSB, but can be scaled down to exactly 2oz/LSB by trimming the AD584's excitation voltage.

*—John Sylvan, Analog Devices, Norwood, MA.*

**Write 232**

# Like DEC's.




$8,845 system price*

256 KB minimum... up to 4 MB!

Media and software compatibility with DEC's RX02 8" floppy (vs. Micro/PDP-11's non-compatible 5¼" floppy)

8-quad slot Q-BUS card cage

Supports RT-11, RSTS, RSX-11M-PLUS, UNIX, and TSX-PLUS

1.0 MB floppy disk back-up (vs. 2 x 400 KB for Micro/PDP-11)

Two fans in card cage area (vs. one in Micro/PDP-11)

RL02-compatible 5¼" Winchester disk; 10 MB, 20 MB, or 40 MB capability

Cartridge tape capability

## Only better.

You can buy DEC's Micro/PDP-11 with its impressive array of features...or you can get Dataram's A22 —an LSI-11/23 based minicomputer that gives you a whole lot more...for a lot less dollars! Like an 8" RX02-compatible floppy. 40 MB 5¼" Winchester and ¼" cartridge tape capability. And two fans that provide push-pull air flow in the card cage area.

For more information, forward this coupon to us, or, for faster response, call (609) 799-0071.

DD484

☐ Send information. ☐ Contact me immediately.

Name

Company

Address

City State Zip Phone

**Dataram Corporation,** Princeton Road, Cranbury, NJ 08512

*$8,845 is single-quantity domestic price for A22 with LSI-11/23, 256 KB, 10 MB Winchester and RX02-compatible 8" floppy.

DEC, LSI-11, Micro/PDP, PDP, RSTS, RSX, and RT-11 are trademarks of Digital Equipment Corporation.
TSX-PLUS is a trademark of s&h computer systems, inc.
UNIX is a trademark of Bell Laboratories.

**DATARAM**

**Write 52 on Reader Inquiry Card**

**Dataram Corporation** ☐ Princeton Road ☐ Cranbury, New Jersey 08512 ☐ Tel: 609-799-0071

## CAD/CAM WORKSTATION

### Three Dimensional Design

This workstation configuration from Prime Computer includes a Cadtrak Design Station One (DS-1) interactive workstation, PDMS software and a Prime 50 series computer. The DS-1 workstation performs individual local processing where a network of Cadtrak DS-1 workstations can be linked to share access to PDMS. The DS-1 can design in three dimensions and views appear in color. With PDMS software designers can create a three-dimensional model in a digital data base. PDMS includes a library of components commonly used in plant design and can generate inventories of them at any stage in the design cycle. With project management tools users can track usage, monitor design changes, and control access to designs and design information. PDMS is compatible with other support software which runs on Prime 50 Series systems. The basic PDMS/Cadtrak DS-1 configuration includes a Prime 2250 computer with 68 Mbyte disk, PDMS software license and two Design Station One-Workstations. Price is $480,000. **Prime Computer,** Natick, MA

**Write 140**

## DISPLAY TERMINAL

### 80/132 Column Capability


The AVT+ series of terminals are ANSI standard and DEC VT100 software compatible. The AVT+ has 80/132-column capability, eight pages of memory, 46 programmable function keys, windowing and multiple computer connections. Price is $1,295. **Human Designed Systems,** Philadelphia, PA

**Write 150**

## MICROCOMPUTER SYSTEM

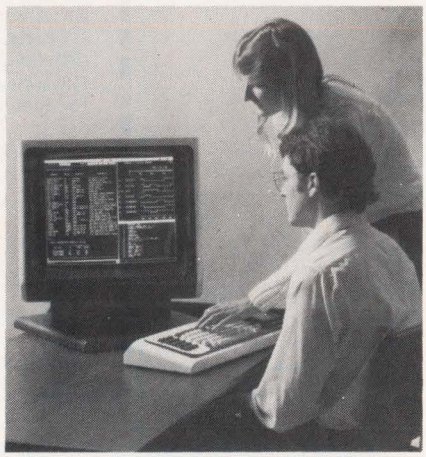
### For Motorola 8- and 16-Bit Families

The VME/10 Microcomputer System is a desktop designer's workstation for developing microprocessor-based systems using Motorola's 8- and 16-bit microprocessors, microcomputers and peripheral components. The system is customizable through VME bus and I/O channels for end applications and has muiltimode graphics hardware with monochrome and color options. It has 384K of dynamic RAM which is multiported between the graphics controller, local bus and VME bus and 8K of static RAM for storage of user definable character sets and display attributes. It contains two 28 pin sockets for ROM/PROM/EPROM storage of 64K for custom applications. Its mass storage system provides 5¼" floppy disk and 5¼" Winchester disk storage units. **Motorola,** Phoenix, AZ

**Write 126**

## ENGINEERING WORKSTATION

### For Graphics And Simulation Applications

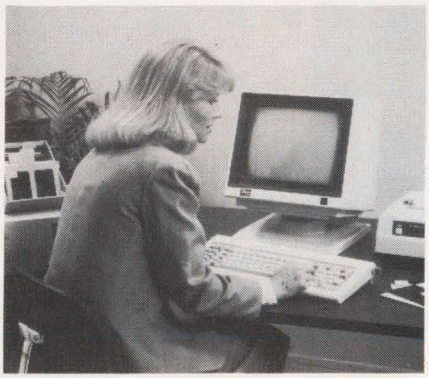


The Tegastation is an engineering workstation for the design, analysis and simulation of digital electronic circuits and components. The system is powered by the 32-bit Apollo Domain computer and features several software packages for applications, graphics, logic, waveform display and simulation. The workstation is available in two models; the DN300 with 34 Mbyte disk, and the DN420 with a 158 Mbyte disk. The DN420 system may be expanded with additional memory, peripherals, and communications capability to act as a file server and/or communications gateway for a ring of Tegastations. Prices begin at $50,800. **Calma,** Santa Clara, CA

**Write 129**

## COLOR MONITOR

### 640 × 240 Resolution

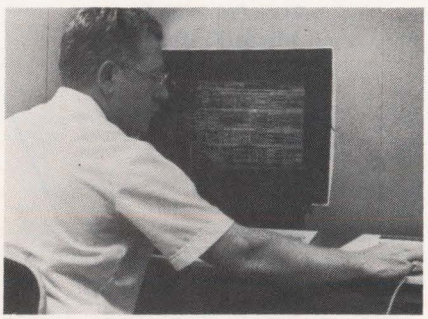


The SC-200 is a CRT color display monitor which is compatible with IBM personal computers. It has a resolution of 640 dots × 240 lines and can distinguish 16 colors. The monitor comes in a 13" format with 0.39 mm dot pitch and displays 2000 characters. **Sakata,** Elk Grove Village, IL

**Write 134**

## CAD/CAM SYSTEM

### Gate Array Design



The AutoMate 80 is a turnkey design automation system which designs PC boards, hybrids, and gate arrays. AutoMate accepts inputs from sources which include computer-aided engineering systems. It designs the board, generates documentation, and produces outputs to CAM equipment and ATE. Standard interface modules to CAM and ATE are available. The AutoMate 80 runs on Data General 16- and 32-bit computers. The standard configuration includes the computer, hard disks, magnetic tape drive, color CRT, alphanumeric console, line printer, four-pen plotter, large area digitizer, and PC board and gate array design software. Price is $230,000. **Automate Design Automation Systems,** Palo Alto, CA

**Write 127**

# Rx FOR HEALTH

INSTALLMENT FOUR

*By Lawrence Lee, MD*

Dr. Lee is a leading Southern California Internist, specializing in cardiology. He is a co-founder and board chairman of LH Research, Inc. This column is presented as a public service for better understanding of topical medical problems and possible solutions.

# HERPES!

## SIMPLEX TYPE 2 VIRUS

Diagnosis and Treatment

**DIAGNOSIS**

(1) Clinical observation is made of the typical small clusters of vesicles (blisters) — most common form of recognition. (2) Isolation of the virus in a cell culture usually takes 1-3 days before the typical cell changes become visible. (3) Scrapings taken from base of vesicles are then stained to see if there are typical cell changes. (4) Blood specimens during and after lesions are then analyzed. If *primary herpes* is suspected, Herpes Simplex (HSV) antibodies can be seen in the blood *after* the initial lesions but *not* during the lesions.

**TREATMENT**

**Primary infection** — If the patient can be treated *before* or *during* the typical vesicle development, it is possible to cure HSV by preventing it from entering the nerves. The patient usually waits too long to prevent infection into the nerves. Early treatment with anti-viral drugs is still recommended because it decreases the number of nerves invaded.

**Latent infections** are not affected by anti-viral drugs, since they act only during the duplication cycle and do not penetrate the nerve cells. There presently is no known treatment for this stage of infection.

**Recurrent mucous or skin lesions before vesicle formation** — Anti-viral drugs initiated before the vesicles develop may prevent the typical vesicular lesions. A person can be alerted by the classic signals of itching, tingling or pain, which usually precede the actual vesicle clusters (ref. Instal. 3).

**Recurrent skin or mucous lesions after vesicle formation** — Treatment during this stage with anti-viral drugs has little effect on the lesions, except to reduce the duration of the healing process and its associated symptoms, and possibly, decrease the number of *new* sets of nerves that may be affected. Using drying agents such as zinc sulfate solution, antibiotic ointments to prevent secondary bacterial infection and topical anesthetics for pain will help. Currently, there is no FDA approved drug for recurrent episodes.

The only licensed drug for Herpes Simplex Virus 1 or 2 in the United States is ACYCLOVIR, an anti-viral drug which comes either in an ointment form or by intravenous administration (all recent studies indicate IV is the much more effective treatment). However, this does not prevent transmission to another person or eliminate latent infections.

**IS THERE HOPE??** There has been much work done for specific vaccination of Herpes Virus. There is none available at this time. It is possible that a vaccine may help, or possibly some type of deactivated live Herpes Virus which may theoretically invade the nerve and thus prevent infection by the real HSV virus. But, in no way will this cure people who already have the herpes virus.

*This is the fourth in a series of columns by Dr. Lee on medical subjects of current interest, although perhaps not fully understood, by the public. If you have a question, please write Dr. Lee at LH Research, Tustin, CA 92680.*

## DESIGN SYSTEM

### Solid Modeling for IBM PC

The CS-5 design system allows three-dimensional, shaded-surface, full-color solid models to be created on IBM PCs and PC compatibles. The system consists of a display generator and solid modeling software. It operates as a terminal or as part of a stand-alone system incorporating an IBM PC, a color monitor, and a digitizing tablet. It offers simultaneous display of 4,096 colors. Applications for the design system include mechanical engineering, architectural design, film and video animation, and graphic arts. Modeling is facilitated by an interactive interface, and because it is a menu-driven system, models can be modified without any programming required. The CS-5's two image frames enable the user to alternate between displays of two models in progress. One model may be displayed while the other is being computed and stored in the back frame. Price is $9,700. **Cubicomp,** Berkeley, CA

**Write 133**

## CAE/CAD WORKSTATIONS

### 1.5 Mbyte Memory

The EAS/700 workstation combines CAE/CAD and office automation in a system with automatic and interactive functions. The EAS/700 has a 10 MHz Motorola 68000 microprocessor with 1.5 Mbyte of memory that is expandable to 4 Mbytes. Graphics are controlled by Intel 8086/8087 processors with 256 Kbyte memory. Each processor accesses its own memory through a high-speed bus and any bus master may access memory not belonging to it through a Multibus. Price is $40,750-$48,450. **EAS,** Wethersfield, CT

**Write 143**

## COLOR GRAPHIC SYSTEM

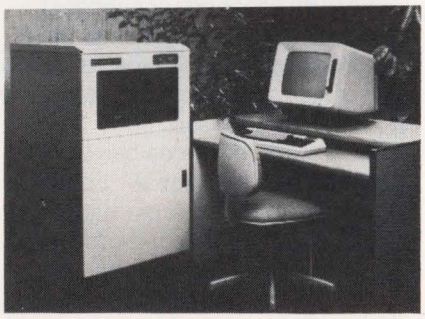
### CAD/CAM Applications

The G-6200 is a color raster display system which uses the Gencor operating system and has applications in CAD/CAM, Science, Command/Control and Imaging. Its basic configuration provides a 1536 × 1024 bit map refresh memory which selects 16 colors from a palette of 16 million hues. The system can be expanded with optional memory cards which provide additional overlays. The hardware includes a 19″ monitor, detached keyboard, pan, scroll, zoom and cursor control. Graph tablet, digitizing table, text terminal and color hardcopy are supported along with RS-232 serial interface. Price is $23,950. **Genisco Computers,** Costa Mesa, CA

**Write 149**

## DATA PROCESSING SYSTEMS

### 512 Kbyte to 2 Mbyte Memory Capacity

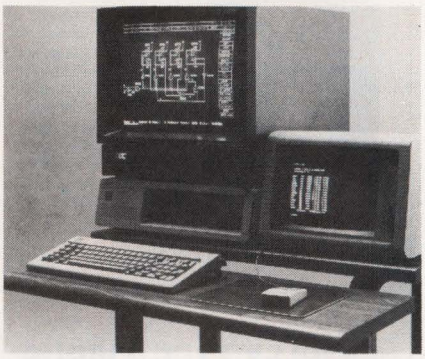


The Paradyne System 8400 is a data processing family of computers which utilize a UNIX-derived operating system with communications capabilities and a library of applications software. The Desktop 8400 provides attachment of 8 asynchronous terminal devices, has a 512 Kbyte memory and 26 Mbyte Winchester storage capacity. The Office System 8400 merges communication and office processing with applications such as data base inquiry and update. It has a 1 Mbyte memory capacity and can attach 16 Paradyne PDS intelligent terminals and printers. The application Development 8400 combines volume data storage, application processing and inherent communications in a design with a 2 Mbyte memory capacity. It can attach 16 terminal/printer devices, and has 160 Mbyte fixed disk with 9 track 1600 bpi tape. Users can upgrade systems because all models share a common board set. The main system processor for all models is a 16-bit microprocessor and memory is shared by DMA. All processors communicate through a Multibus. Prices are $12,000 (Desktop 8400), $22,800 (Office System 8400) and $79,850 (Applications Development 8400). **Paradyne,** Largo, FL

**Write 138**

## CAD/CAE Workstations

### Supports 50 Design Layers.

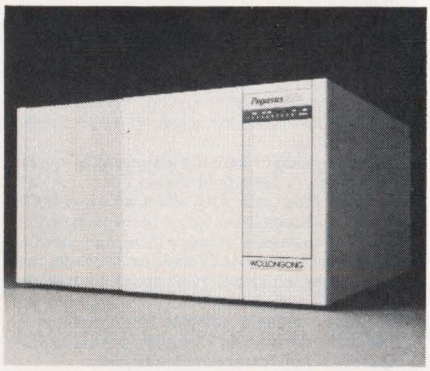


Two CAD/CAE workstations, the CAD 2000 and 1000, use the IBM XT Personal Computer for interactive design of schematics and printed circuit board layouts. With the CAD 2000, designers can enter logic schematics and multi-layer printed circuit board layouts using the 19″ color display, which has a resolution of 1024 × 758. The CAD 1000 differs only in that it has a 13″ screen with a resolution of 640 × 400. The CAD 2000's schematic editor is supplied with a library of TTL symbols. The system includes a netlist extractor for interface to tools such as simulators. When designing multi-layer printed circuit boards the system supports 50 physical design layers. The system is supplied with an optical mouse and a digitizing tablet is available as an option. Prices are $13,500 (CAD 1000) and $23,500 (CAD 2000). **Chancellor Computer Corp.,** Palo Alto, CA

**Write 135**

## OPERATING SYSTEM

### For VAX System Users




Pegasus is a family of products designed for VAX systems, 32-bit superminicomputers which operate under VMS, EUNICE, or UNIX. With Pegasus on a VAX system, the effective terminal I/O load is reduced by 60%. Pegasus off-loads interactive editing functions, which involve host system intensive context switching and terminal I/O communications, in a keyboard transparent environment. Communications facilities for distributed data processing applications include Ethernet and IP/TCP, which is based upon the ISO/OSI reference model. The Pegasus models are available with 1 to 2 Mbytes of memory, a 5.25″ floppy disk, and software. Prices are $30,000 to $35,000. **Wollongong Group,** Palo Alto, CA

**Write 144**


Intel liked the systems approach of our standard packaging hardware. It's modular, it's flexible and it's designed to work together as one integrated system to solve your special packaging problem.

These same features are offered in Multibus Compatible Packaging, making Mupac the ideal choice for your Multibus packaging needs.

Our family of racks can handle from 2 to 26 panels in easy to use modular increments. We provide panel guides on .600 and .750 inch centers, open rack design for ease of access to installed panels and hold-down bars to facilitate shipping.

With Mupac's GND/SIG-GND/GND backplane design, you'll eliminate or drastically reduce crosstalk and noise. You'll get standard features such as terminated bus lines, provisions for parallel priority, and gold plated expansion connector fingers.

Multiple solutions to Multibus packaging is just one example of Mupac's versatile approach to packaging systems. We also furnish Wire Wrappable Panels, Leadless Chip Carrier Adapters, Pin Grid Array and High Rel IC Sockets.

If you're a Multibus user, you should make Mupac Your First Choice in Multibus Compatible Packaging for the same reasons Intel chose us to help develop Multibus II.

Call today for prices and details on the complete line.

*Registered trademark of Intel Corporation

Please send your latest Multibus Catalog.

Name _____

Title _____

Address _____

City _____

State _____ Zip _____

Product Interest _____

My interest is:

☐ Immediate ☐ 6-9 Months

☐ Long Range ☐ Reference Only

MUPAC®

Integrated Packaging Systems

10 Mupac Drive, Brockton, MA 02401

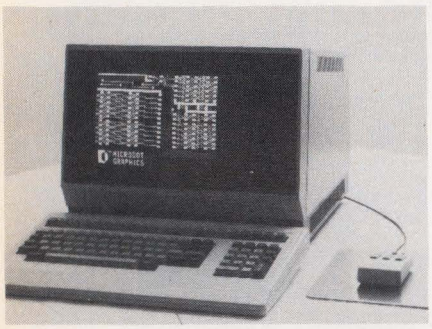
Tel (617) 588-6110 TWX (710) 345-8458

Write 88 on Reader Inquiry Card

See Us at Mini Micro Northeast, Booth 2144

## PCB DESIGN SYSTEM

### With Interactive Auto-Routing



The Toco 2000 is a PCB design system based on the Sanyo MBC-1250 graphics computer with a 640 × 400 pixel monochromatic display. Its software features include interactive autorouting with variable grid, step and repeat of patterns, and a symbol library which can be customized. The system includes a graphics computer with dual half-height 5¼" disk drives 640 Kbytes each, a detached keyboard with 15 function keys, a graphics mouse, design software, symbol library, word processing, and SBASIC. Price is $4,400. **Microdot Graphics,** Elgin, IL

**Write 128**

## EMULATING TERMINAL

### With Custom Mode


The Ergo 201 is a user-definable terminal which emulates the Televideo 925, ADM3A, VT52, and Micro-Term ACT-5A. With 16 host definable function keys and a custom mode the operator can define the terminal's control codes and escape sequences and save these designations in non-volatile memory. Through the custom mode the user can configure terminal functions to match existing software. The mode may be programmed for ADDS and Hazeltine applications. Optional features include amber phosphor, two pages of memory and an alternate character generator. A graphics board with Plot 10 and ReGIS capability is available. The function keys may be downloaded from the host with a sequence of 10 bytes. **Micro-Term,** Fenton, MO

**Write 139**

## HARDWARE/SOFTWARE PACKAGE

### Converts IBM PC To Gate Array Design Terminal

The UNICAD-1 is a software/hardware package that enables engineers to design and simulate gate array designs remotely using the IBM XT personal computer. In addition to design software, the UNICAD package includes the Universal ISO 3/5 library of macrocells, a printer, graphics driver board, mouse, a terminal emulation and communication package, and operating manuals. With UNICAD, a systems engineer can develop a logic design, capture it, and convert it to a network listing. This net list can subsequently be transmitted, via modem links, to the VAX-based Universal central CAD system where logic and circuit simulation, test generation, and fault simulation can be performed. After the simulations have been completed, the net list is entered into the back end of the Universal CAD system where the macrocells are automatically placed and interconnected. The circuit then enters the fabrication cycle. The time required to convert a simulated net list to fully tested engineering samples can be as short as four weeks. Price is $7000. **Universal Semiconductor,** San Jose, CA

**Write 136**

## PCB CAD SYSTEM

### Two Levels of Operation

The Artworker is a PCB CAD system in a standalone configuration. The system has two levels of operation. The Designer level provides a computerized version of a conventional drawing board. It functions with on-screen messages guiding the operator. Designer Plus is for more skilled operators and allows the user to input connectivity information as components are placed on the layout. By accessing the route function, the designer can interactively place the tracks on board where desired. The output from the Artworker's plotter can be used for PC board production. Artworker has a package style and PAD layouts for SIL and DIL PADS. The Artworker comes with a keyboard, numeric keypad, function keys, and a joystick or tablet. It has a dual floppy disk system with a capacity of 1 Mbyte. Price is $24,950. **Wayne Kerr,** Woburn, MA

**Write 137**

## MICROCOMPUTER WORKSTATION

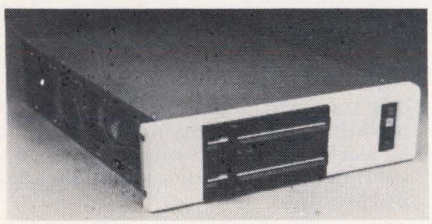
### For CAD Applications

The CDC/PCAD system was designed to automate the manual design, drafting schematics, and writing documentation processes of design engineering. CDC/PCAD designs circuits in hierarchical schematic form by using symbols that represent components. It can access Control Data's Cybernet data services computers for advanced simulation, analysis and design verification. The system will enlarge portions of a circuit and pan to portions not represented on the screen. CDC/PCAD includes an IBM-PC compatible microcomputer, software for schematic entry, netlist extraction to several design software packages, a dot-matrix printer/plotter, 10 Mbyte Winchester hard-disk drive, 360K floppy disk drive, and a mouse. Price is $15,825. **Control Data,** Santa Clara, CA

**Write 130**

## UNIX SYSTEM

### 512 Kbyte RAM



The MDB Micro/32 is a 32-bit computer system which has a MC68000 micro-processor and the Regulus operating system which accommodates all UNIX software. The Micro/32 has dual MC68451 memory managers with 64 segments of mapped memory and 512 Kbyte RAM parity memory. The system has four asynchronous serial ports, two of which have modem control, and a parallel Centronics interface printer port. System memory can be expanded by use of dual size 512 Kbyte memory modules up to a total of 4 Mbytes. Price is $11,995. **MDB,** Orange, CA

**Write 147**

# NEW PRODUCTS

## CRT DISPLAY TERMINALS

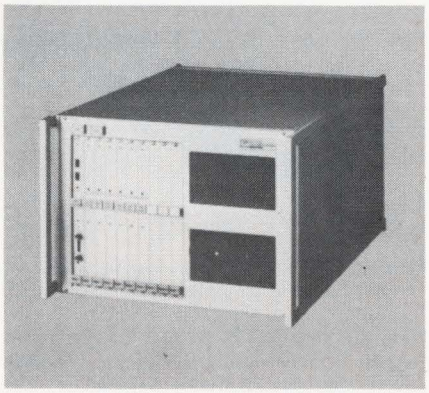
### 132 Column Capability

The WY-50 and WY-75 are alpha-numeric terminals which feature a 132 column capability on a 14″ display. The WY-50 communicates as a video display terminal that is compatible with most terminals, while the WY-75 conforms to a sub-set of the ANSI ×3.64 standard. The keyboard is detached and equipped with 101 keys. The board provides a typewriter section, numeric pad, cursor control keys and 16 programmable function keys with 32 control codes. Both terminals have nonvolatile memory which enables all terminal parameters such as cursor type, transmission speed and operating mode, to be entered from the keyboard. The WY-50 and WY-75 are priced at $695 and $795 respectively. **Wyse Technology,** San Jose, CA

**Write 132**

## MULTI-USER UNIX SYSTEM

### VMEbus-Based



Mostek Corporation introduces its first in a family of systems products that combines the expandable 16-bit VMEbus with the UNIX™ operating system, resulting in a versatile multi-user system. Designed around the powerful Mostek MK68000 microprocessor, this new Mostek system meets the requirements of both today's 16-bit and future 32-bit applications. The VME Matrix 68K is designed for use in VMEbus-based software and hardware development and in OEM systems applications. The system has a 10-slot card cage with three slots available for system expansion. The seven cards supplied with the system include the Mostek VME-MMCPU memory management CPU, the VME-SYSCON system controller, VME-SASI interface, VME-SIO serial I/O, two VME-DRAMs, and VME-FDC floppy disk controller. Boot-up firmware is also provided. The Matrix 68K system has 640 Kbytes of main memory (512 Kbytes on the DRAM boards and 128 Kbytes on the MMCPU) and five serial ports. Hard copy output is handled through a Centronics-type parallel printer port on the VME-SYSCON card. A 36 Mbyte Winchester disk drive and a 5¼″ double-sided, double-density floppy disk drive are supplied. Price is $16,500. **Mostek Corp.,** Carrollton, TX

**Write 148**



## Erratum

The opening photo to "Local Area Networking Becomes A Standard Feature" (p. 70, *Digital Design*, March '84) is incorrectly credited to Data Communications Associates. The photo is actually courtesy of Digital Communications Associates, Norcross, GA.

## PROTOCOL CONVERTER

### Reads and Writes PC Floppy Disks


The Altertext Communicator is a protocol converter that permits direct exchange of text, codes and commands between word processors, typesetting equipment and computers. The Communicator translates code and format commands so that information can be retrieved on equipment from different vendors. Incompatible computer-based devices, including the IBM PC, Wang and Lanier word processors, can communicate simultaneously through The Communicator. It can read and write floppy disks used on PCs running under the CP/M operating system. The Communicator consists of a Z80 microprocessor with 64 Kbytes of memory, a 9″ diagonal CRT with 24 lines of 80 characters each, a detachable keyboard, a proprietary communications program called "A" code, one 420 Kbyte, 5¼″ floppy disk drive, four parallel ports and three RS-232 serial ports. It receives data via communications using a modem, or from another computer-based device through connector cables. Options include a 12.5 Mbyte hard disk drive and a 5¼″ floppy disk drive. Both asynchronous and bisynchronous interfaces can be used with The Communicator. Price is $7,500. **Altertext,** Boston, MA

**Write 166**

## VOICE DIGITIZING OPTION

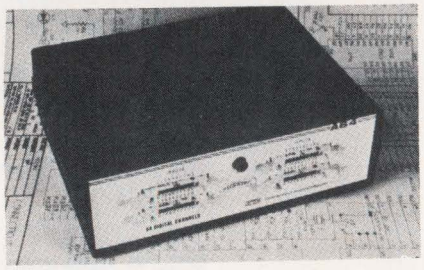
### Allows 48 Voice Channels Per T-1 Link

The voice digitizing option is designed for Timeplex's LINK/1, a T-1 Facilities Management System. The option allows analog voice input to be multiplexed in digital form as part of the data stream passing over a 1.544 million bps T-1 link. The LINK/1 can multiplex up to 48 voice channels on one T-1 link. In typical applications, the T-1 link replaces separate voice and data facilities, because digital data is multiplexed directly by the LINK/1. Analog voice is digitized within LINK/1, multiplexed as part of the composite bit stream on the T-1 link, then converted to analog again at the far end. The LINK/1 and the T-1 line are transparent to both voice and control signals. Voice connections to the LINK/1 are done at an E & M interface. The voice option is offered in multiples of four voice channels on a board that occupies one slot in the LINK/1 backplane. Voice modules may be mixed in any proportion with a four-port synchronous data card. **Timeplex,** Woodcliff Lake, NJ

**Write 157**

## DIGITAL INPUT MODULE

### With Built-In Timer and Buffer

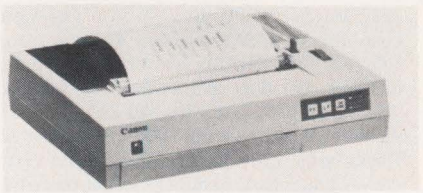


The BUSTER is a 64 digital line input module which is a self-contained RS-232 port compatible device. The module accepts commands from any host computer, reads and stores data from 64 digital TTL level lines and sends the information back to the computer. The A64R is programmed through Basic and a built-in timer and buffer allow data sampling and collection to occur simultaneously with other host computer tasks. Price is $495. **Connecticut microComputer,** Brookfield, CT.

**Write 178**

## INK-JET PRINTER

### Prints Color At 640 DPL

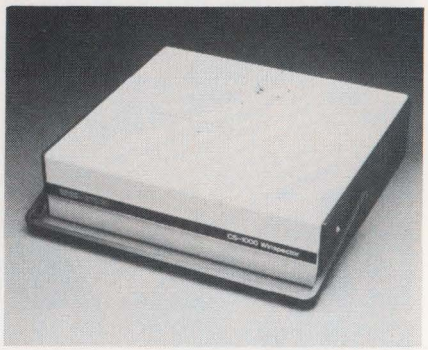


The PJ-1080A Ink-Jet Printer prints 7 colors at 640 dpi on both plain paper and overhead transparencies. It is compatible with most computers and utilizes four character styles. The unit prints at 37 cps with a noise level of 50 dB. The printer has two ink cartridges; one black and one tri-color. It has automatic vertical and horizontal tabulation with page-length-per-inch setting. International character sets are available. **Canon,** Tokyo, Japan

**Write 176**

## WINCHESTER DRIVE TESTER

### Measures Timing Window Margins



The Winspector CS-1000 is a Winchester drive tester which is designed to measure timing-window margins. It can be either rack mounted or used as a stand-alone device and for multilevel volume test applications, it is networkable. It has layered software and its CP/M environment is accessed via English language commands describing disk drive mnemonics. The 20 lb. Winspector uses a LCD to reveal two lines of data at a time. Twelve menus are stored in firmware. The keyboard has a calculator-style design and its keys are color coded according to mode and multiple functions. Price is $6,750. **Cambrian Systems,** Westlake Village, CA

**Write 177**

## INTELLIGENT MODEM

### Auto Dial/Auto Answer

The Mark XII is an Auto Dial/Auto Answer modem for applications where the Bell 212A and/or Bell 103 compatibility is required. The unit can be operated manually, through a keyboard, without computer coding; or automatically, to answer and originate calls at 1200 bps for Bell 212A compatibility and up to 300 bps for Bell 103. The Mark XII detects dial tone and busy signals, automatically displaying dialing status on the CRT. The Mark XII uses a standard RS232 serial interface with a built-in cable and comes equipped with two telephone jacks and cord, and is directly connected to a wall telephone outlet. Price is $399. **Anchor Automation,** Van Nuys, CA

**Write 158**

## KEYBOARD

### For Display Phone Terminal

The data entry keyboard is designed for Northern Telecoms Displayphone. The keyboard extends in front of the unit and can be stored inside the Displayphone base when not in use. Its keycaps can be changed to accommodate special key designations for other terminal types, such as an IBM 3278 online device. The Displayphone terminal supports a caps lock function that allows the users to lock the alphabetic character keys in the upper-case mode, while leaving the numeric keys unaffected. Users of the keyboard can dial a computer data service and perform log-on procedures by depressing a key. Price is $150. **Northern Telecom,** Nashville, TN

**Write 179**

## DISK DRIVE

### With Transparent Media Flaw Management


The AIM/300 is a 300 Mbyte disk drive for DEC PDP-11 and VAX computer users. The plug-compatible AIM/300 monitors data usage patterns and moves physical cylinders of data from one location to another to reduce access time. It incorporates transparent media flaw management which is data cache and read look-ahead buffering. The AIM/300 features read look-ahead which speeds up sequential data reads by making anticipatory retrievals from the magnetic disk to the semiconductor memory. Both single and multiple blocks of data can be transferred 1.2 Mbytes/sec from the magnetic media and 1.6 Mbytes/sec from the semiconductor memory. The AIM/300 has software and diagnostic compatibility with the DEC RM05 disk drive attaching to the MASSBUS of PDP-11 and VAX computers. It has built-in diagnostics and stand alone formatting utilities, as well as error detection and correction using a 32 bit polynomial. Average seek time is 29 msecs, cylinder-to-cylinder seek time is 3.6 msecs, and the average rotational latency is 8.33 msecs. **Acceleron,** Santa Clara, CA

**Write 171**

## LINE PRINTERS

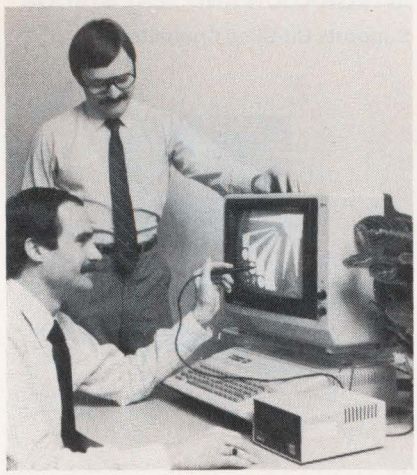
### For Data Processing Environments

The LW400 and LW800 Line Printers print at speeds of 400 and 800 lpm and operate at a sound level of 62dB. Features include a 80 yd cassette ribbon, control panel with touch switches and a four-character, alphanumeric display which reports status and any malfunctions. Print bands may be changed for different character sets and font styles. Price ranges from $5,950-$7,950. **Synergy Printer Systems,** Palo Alto, CA

**Write 165**

## LIGHT PEN

### CAD/CAM Applications



The Gibson light pen is an on-screen printing device which works in conjunction with the Apple II, IBM PC and Commodore lines of computers. The light pen lets users point or draw directly on a display screen. It comes with the Pentrack Language System, a graphics programming language, and Penpainter Software, a graphics program that lets users create and store high-resolution drawings, shapes, graphs, designs and animation. The light pen has applications in CAD, CAM, drafting, illustration and business graphics. The Apple II, II+ and IIe versions require 64 Kbytes of memory, a disk drive and a monitor or television screen. Price is $300. **Koala Technologies,** Santa Clara, CA

**Write 164**

## TAPE DRIVE SUBSYSTEM

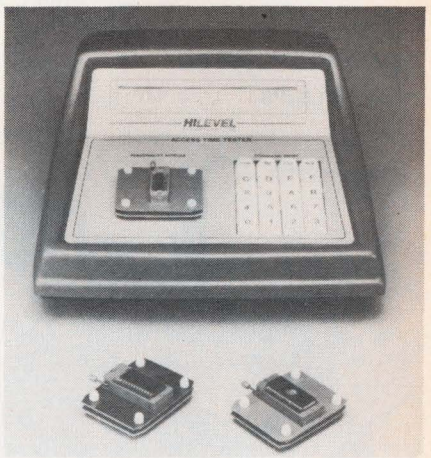
### IBM-PC Compatible


The PC/T-11 is a 1/4″ cartridge tape drive which provides 60 Mbtyes of formatted tape capacity on a DC-600A cartridge tape. It is suitable for applications where image back-up or pseudo floppy performance is required. It is supplied with software to make the device function as 11 floppy-like tape volumes. PC/T-11 has record-update capabilities with individual track directories for data manipulation. End users can back up individual files in a start/stop mode or copy total disk images to tape using a quasi-streaming mode. **Tallgrass Technologies,** Overland Park, KA

**Write 167**

## TIME TESTER

### Measures RAM, ROM & PROM Performance

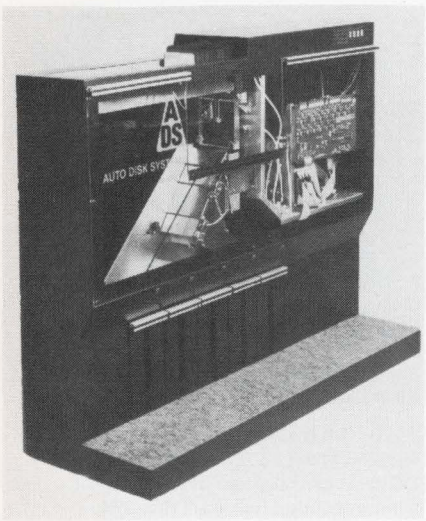



The model AT700 Access Time Tester is designed to check and measure access times of RAM, ROM and PROM and the delay times of gates and cables. The instrument compares devices before and after burn-in and is compatible with automatic handlers for testing applications. A plug-in module is used to calibrate the system before use and calibration values can be stored in memory for recall. Personality modules for the most common TTL types plug into a front panel connector. An alphanumeric LCD readout prompts the operator and presents test results as well as comparisons with desired parameters. The user can enter an access time of three decimal digits, a checksum of four hexadecimal digits and a memory size of four hexadecimal digits. Price is $2,850. **Hilevel Technology,** Irvine, CA

**Write 159**

## DISKETTE PROCESSOR

### For Duplication Environments

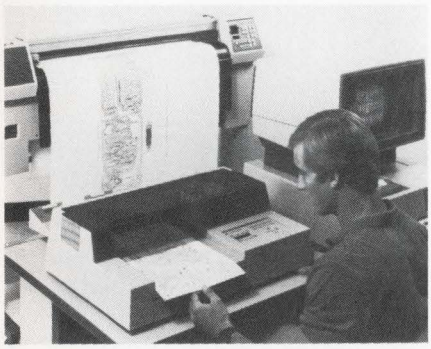


The Model 525 diskette processor supports 5¼" diskettes in high-volume certification, initialization or duplication environments. The 525 vertical-load, pneumatic-operated, micro-processor controlled device operates under command of a host computer. The 525 holds 360 open or closed jacket diskettes. The internal micro-processor has self tests to determine malfunctions and clear any rejected diskettes which cause jams. Communication with the host computer is via RS232 and the host computer connects directly to the internal diskette drive. **Auto Disk Systems,** Costa Mesa, CA

**Write 175**

## GRAPHICS PLOTTER

### Plots at 31.5 IPS

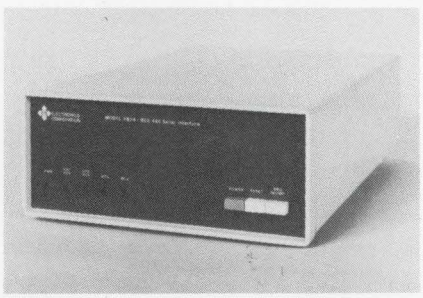


The HP 7550A is a 11 × 17" plotter which features 31.5 ips plot speed and 6 g acceleration. An LCD with function keys reports plotter status and program messages. The HP 7550A has a function called replot, which draws up to 99 copies of an original graph without rerunning the program. The HP 7550A plots on transparency film, vellum, polyester film and tracing bond and has an addressable resolution of 0.025 mm and a mechanical resolution of 0.006 mm. The plotter has point digitizing, self test, and block mode I/O error checking. The HP 7550A has HP-IB and RS-232-C/CCITT V.24 interfaces. The plotter can be connected directly to the computer or in series. Price is $3,900. **Hewlett-Packard,** Palo Alto, CA

**Write 161**

## INTERFACE UNIT

### Provide IEEE 488 Bus Compatibility

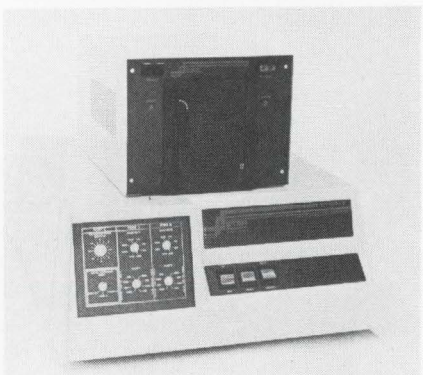


The Model 4834 Serial Interface connects devices having RS-232 or RS-449 serial data ports to the IEEE 488 BUS. The primary application for the 4834 is as a fully bidirectional interface between such devices and the 488 bus. It permits a variety of RS-232C and RS-422-compatible measurement/test/control instruments to be operated by the bus. The 4834 can be used to expand an I/O-limited host computer system, through the addition of serial computing-related peripherals via the 488 bus. The 4834 can operate as a bus Talker, Talker/Listener, or Listener. As a Talker, the 4834 accepts input from a serial transmitting device and outputs the data onto the bus. As a Listener, it accepts data from the bus and outputs it to a serial receiving device. The 4834 can store the data it receives from the serial device or the bus, and output it at the proper time as commanded by the IEEE 488 BUS controller. The 4834 is available with either one or two serial channels. Price is $895. **ICS,** San Jose, CA

**Write 156**

## INTEGRATION AND TEST STATION

### Supports Bit-Slice Computers

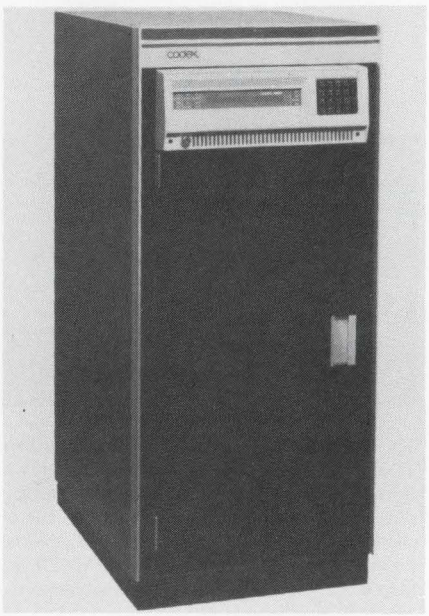


The STEP-7W is an engineering design tool that provides support for microprogrammed designs such as bit-slice computers, high speed controllers and digital signal processing circuits. STEP-7W hardware includes a Z80 microcomputer with 64K RAM, one 15 Mbyte Winchester hard disk, one floppy disk drive with 770 Kbytes of storage, serial communications ports and a parallel printer port. Six slots are provided for WCS or Logic State Analyzer boards. WCS cards can be organized to emulate two independent memory arrays or a single array out to 192-bits wide. STEP-7W programs execute under version 2.2 of the CP/M operating system. Price ranges from $11,000 to $30,000. **Step Engineering,** Sunnyvale, CA

**Write 174**

## MULTIPLEXER

### 124 Channels

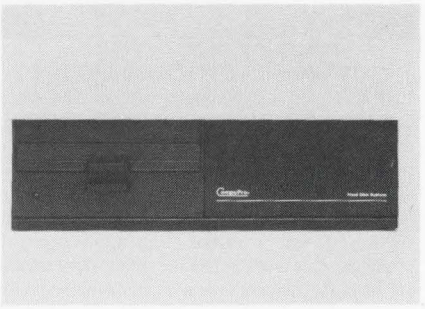


The 6035 INP is a statistical multiplexer which operates in point-to-point and multinode networking environments, including star and ring network topologies. The 6035 INP accommodates any mix of asynchronous or synchronous data rates and terminal types and offers error-protection and data compression features. Standard asynchronous speeds include 75, 100, 300, 600, 1200, 2400 and 4800 bps, while standard synchronous data rates include 1200, 2400, 3600, 7200 and 9600 bps. The 6035's maximum aggregate channel data rate is 19.2 Kbps. The basic 6035 INP configuration includes 16K RAM and supports 8 channels. Price is $4,500. **Codex,** Mansfield, MA

**Write 169**

## HARD DISK SUBSYSTEM

### 40 Mbyte Storage Capacity

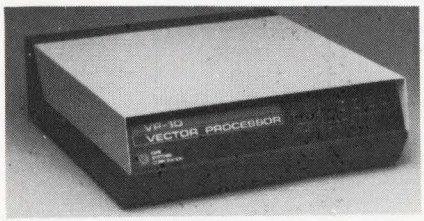


The H40 Hard Disk subsystem is a 40 Mbyte unit which includes a 8" floppy drive for use as a mass storage option for Compu-Pro's IEEE 696/S-100 bus compatible microcomputer systems. The H40 is comprised of a Quantum Q540 5.25" hard disk, CompuPro's Disk 3 DMA controller, and the CP/M-80 and CP/M-86 operating systems. The 842 floppy disk drive has a storage capacity of 2.4 Mbytes and accepts single- or double-density, single- or double-sided media. Price is $5,495. **CompuPro,** Newport Beach, CA

**Write 163**

## VECTOR PROCESSOR

**Provides Color Support**

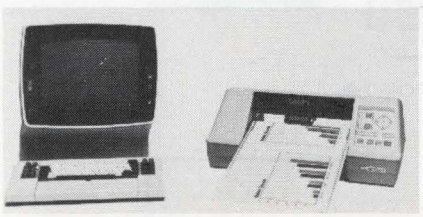



The VP-10 vector processor connects raster output devices to a mainframe computer. The VP-10 accepts random vectors, symbols and other graphics information from a host mainframe, translates the data at computer speed and drives the various output devices at rated speed. The VP-10 has a vector capacity of 200,000 vectors. Features include a 128 Kbyte semiconductor-based memory which is expandable to 2 Mbyte, color support for both intensity modulated and dithered devices, diagnostics and integrated communications. **KMW Systems,** Austin, TX

**Write 173**

## COLOR PEN PLOTTER

**20 IPS Plotting Speed**



The Zeta 887 is an 8-color pen plotter which connects to an IBM 3274 or 3276 cluster controller. The 887 operates in an SNA/SDLC environment and plots at 20 ips with 2g acceleration. The 887 utilizes continuous feed media and can create multiple plots without operator intervention. Plots appear on translucent bond, glossy bond, vellum, or clear inking film for overhead projections. Price is $7,950. **Nicolet Zeta,** Concord, CA

**Write 160**

## KEYBOARD

**IBM-Compatible**

The Key-2 Keyboard is a word processing replacement keyboard for the IBM PC. The function keys are positioned on the top of the 15" design. Shift keys are positioned like the IBM Selectric Typewriter to facilitate word processing. A built-in LED on the CAPS LOCK key and NUMS lock key indicates current status. The key-2 snaps onto the front of the Colby or IBM Personal Computers as well as models that are IBM compatible. price is $259. **Colby,** Mountain View, CA

**Write 162**

## DUAL-DISK DRIVE

**140 Kbyte**

The Duodisk is a floppy disk drive unit which contains two half-high, 140 Kbyte drives that reside side-by-side. Duodisk was designed for the dual-drive configuration needed for many software programs and is suited to business and developer markets. It has a disk eject feature and a head positioning mechanism for reading half-tracks. Duodisk comes with a controller card that connects it to Apple II, Apple II Plus or Apple IIe models. It is operationally identical to the disk II floppy disk drive and runs all Apple II software. Price is $795. **Apple Computer,** Cupertino, CA

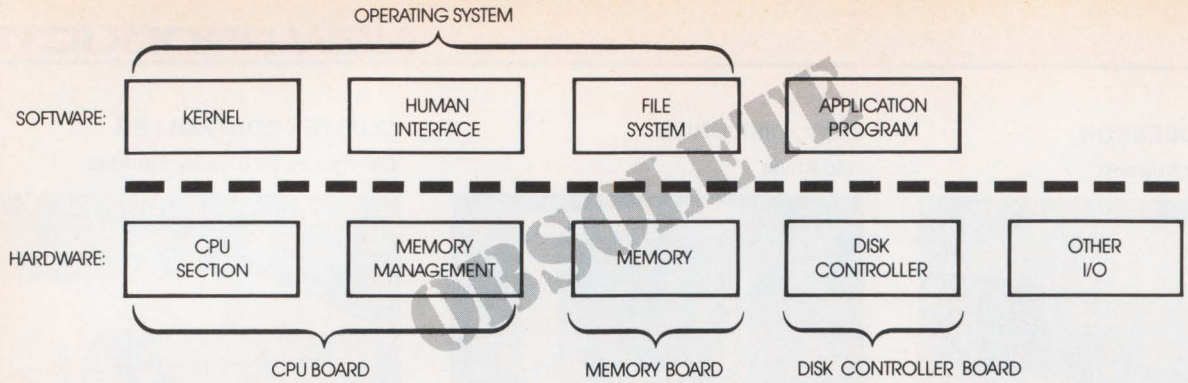
**Write 172**

## CLUSTER CONTROLLER

**Configures 50 Display Stations**

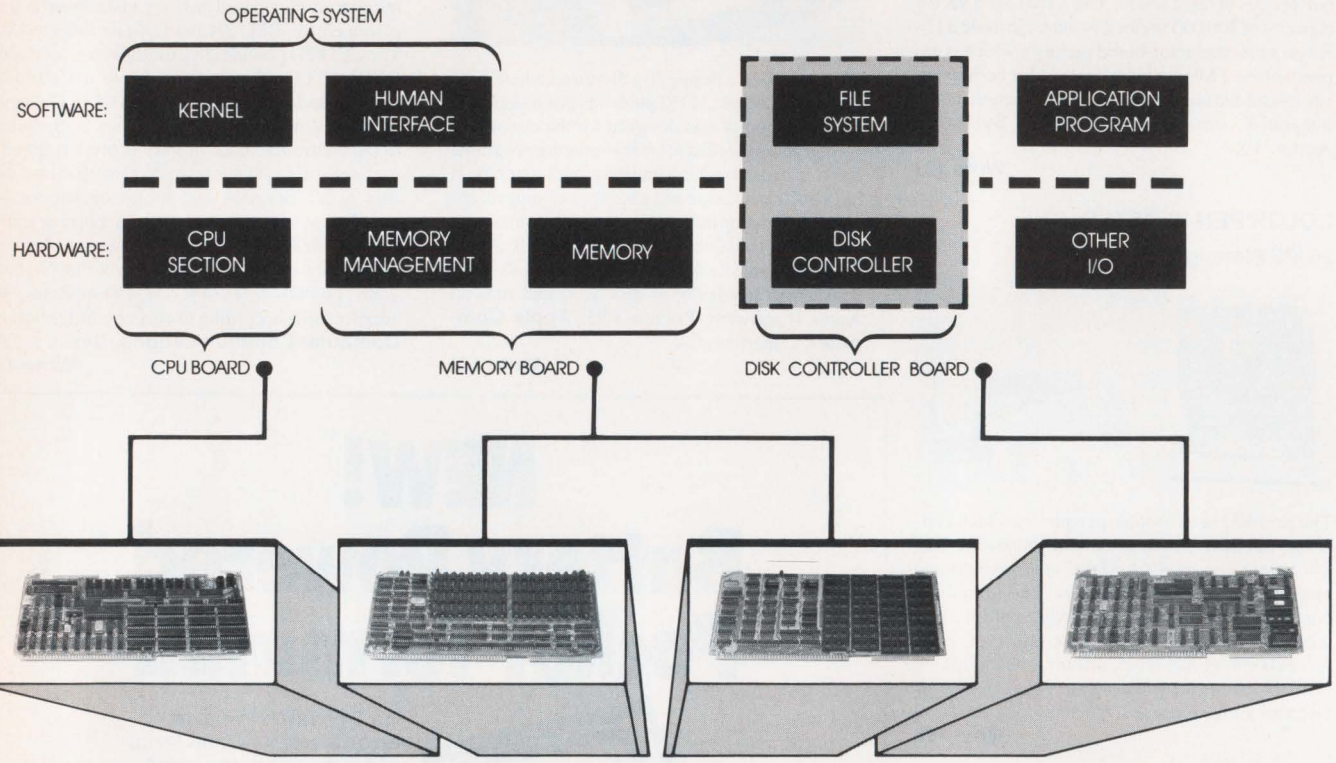

The CCI 8274C Remote Cluster Controller is a microprocessor-based instrument designed as a replacement for IBM 3274 and 3276 controller models. The CCI 8274 provides free multiplexing for its own CCIV 8178 Display Stations. Up to 16 CCI 8178's may be serviced from one port via CCI's Cabletalk protocol. A total of 40 CCI 8178's may be connected to the controller. Data link transmission speed is user-selectable at rates from 2000 to 9600 bps. The data switch operates half-duplex or full-duplex, switched or non-switched, point to point or multipoint at 9600 bps. The unit contains a Motorola 68000 microprocessor, 128K bytes of PROM, 64K, 128K, or 192K bytes of RAM, I/O modules, and adapter cards according to cluster configurations. **Computer Communications,** Torrance, CA

**Write 168**






# Performance by Architecture!




**CPB086 – Control Processor Board**

- 8 MHz 8086 CPU
- software compatible with iSBC 86/05
- 16 JEDEC universal sites
- 72 parallel I/O lines
- serial port
- supports iRMX86

**SRM512 – RAM Board w/ Memory Manager**

- onboard memory manager allows 64KB bound CPU to address 1 MB
- starting address on any 4KB boundary
- up to 512KB w/parity

**SPM – PROM Board w/ Memory Manager**

- onboard memory manager allows 64KB bound CPU to address 1 MB
- starting address on any 4KB boundary
- 32 JEDEC universal sites

**FCF088/I – Disk Controller w/IBM PC File Manager**
**FCF088/C – Disk Controller w/CP/M File Manager**

- onboard file server supports IBM PC file system
- onboard file server supports CP/M file system
- all disk I/Os via symbolic file names
- serial port for spooling or external communication such as Direct File Transfer
- SBX interface for custom I/O expansion

* iSBC and iRMX are registered trademarks of Intel Corporation.
CP/M is a registered trademark of Digital Research Corporation.
IBM is a registered trademark of International Business Machines, Inc.

Improve system performance–migrate operating system/CPU functions into peripherals/memories.

ONE/D

2286 Mora Drive
Mountain View
CA 94040

For fast response, please contact:

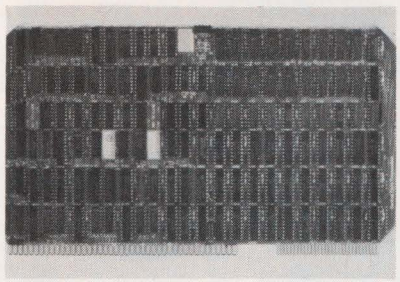
**Aim Technology**
3333 Bowers Ave, Suite 199
Santa Clara, CA 95051

Tel: (408) 727-3711
Telex: 705405

**Write 90 on Reader Inquiry Card**

## MULTIBUS CACHE MEMORY

**Images 16 Mbyte Address Space**



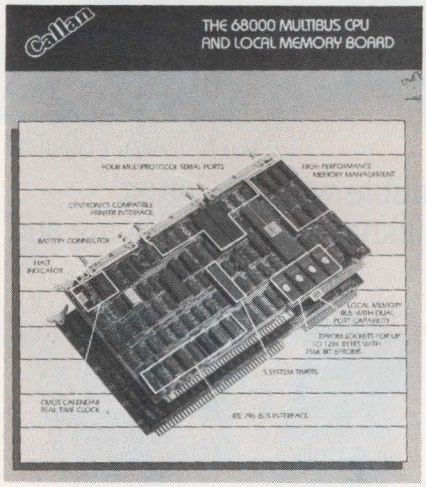
The processor independent cache memory board from Central Data Corporation allows Multibus and iLBX users to add fast memory to a system. This board images the 16 Mbyte Multibus address space through the iLBX extension to the Multibus. Access time is 100ns. The cache memory will store the most recent 4 Kbytes of data that have been accessed through the iLBX bus and provide a fast response time for any subsequent accesses to the data. At any time when a cache miss occurs, and the data is not in the cache, the cache memory board automatically accesses the Multibus, updates the cache, and provides the data to the host. This cache memory board can be used in lieu of dual-ported iLBX memory boards and is processor independent. For example an iAPX 186 will work with the board, as will a Z8000 or a 68000. The cache memory has parity checking on all of its data and tag memory. Any error conditions that the board detects cause the board to go into a soft shutdown, with the processor not seeing any effect other than slower accesses. In such a mode, all accesses are automatically directed to the Multibus, and the processor can be optionally interrupted to handle the error. The board contains a monitoring circuit for the Multibus, which buffers write cycles that are performed on the bus by other masters. A feature called Forced Miss Map breaks system memory into 1,024 pieces each 16K long. **Central Data Corp.,** Champaign, IL

**Write 200**



## MICROPROCESSOR BOARD

**Two Level Memory Management**

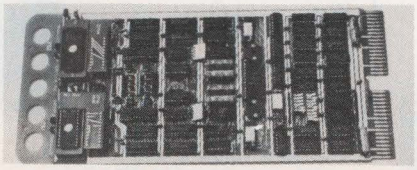



The CD68K microprocessor system board incorporates 256 Kbytes of RAM on its CPU. The board moves local memory from the CPU board to a separate local memory board. The memory is accessible through an auxiliary P2 connector bus. Up to two one-Mbyte local memory boards can be used per CPU board. The CD68K has four serial ports, calendar/clock and hardware dynamic RAM refresh with DMA capability to local memory. It incorporates a CMOS Real Time Clock/Ram chip. The board's two-level memory management architecture has separate segment and page maps with context selection register, which allows simultaneous mapping of up to 16 process contexts. An interrupt-driven Centronics compatible parallel interface is included, with 8-bit data and status ports. **Callan Data Systems,** Westlake Village, CA

**Write 187**

## EPROM PROGRAMMING SYSTEM

**Available in Byte and Word Modes**

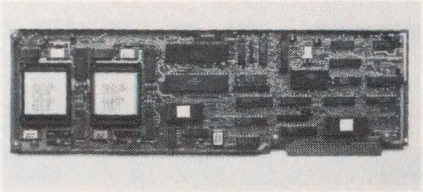


The PR77EX is an EPROM Programming System developed as a fully integrated LSI peripheral. Users can program a set of EPROMs from a disk file or individual cells from a terminal keyboard. A set of EPROMs can be copied to a disk file or to another set. The system includes a dual width PC board configured as two independent channels, command orientated software on a single density diskette, and two pairs of EPROM adaptor plugs. The PR77EX has a command orientated user interface, both byte and word modes, an interrupt driven programmable hardware timer and intelligent programming mode as applicable. **Interplex,** Mountain View, CA

**Write 198**

## BUBBLE MEMORY BOARD

**For IBM PC**

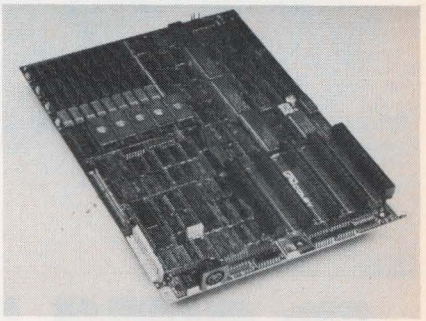


The Bubble Drive is a bubble memory board which provides 256 Kbytes or 512 Kbytes of non-volatile mass storage on a single card and plugs into any I/O slot in the PC. It functions as a floppy disk and is compatible with PC-DOS 1.1 and 2.0. The Bubble Drive can be used alone or in conjunction with floppy and hard disks. In the following modes it can store programs which are disk intensive; those with critical data and operating system, programs and data files when the operating environment precludes the use of mechanical disk drives. Standard features are write-protect and boot-enable switches. Price ranges from $995 to $1495. **Hicomp,** Redmond, WA

**Write 208**

## SINGLE BOARD COMPUTER

**IBM-Compatible**



The Colby single board computer has been designed to be physically identical to the IBM-PC board on an 8½″ × 11″ format. The board holds 256K of RAM or to 1 Mbyte of RAM. It contains 8 Kbytes of EPROM, an integrated floppy disk controller which can operate dual 5¼″ floppy drives, an integrated SASI Hard Disk Interface, as well as a 8088 processor. An 8087 co-processor is optional. Price is $569. **Colby Computer,** Mountain View, CA

**Write 199**

# "Who else could squeeze 512 analog input channels on 2 MULTIBUS™ boards? Or even 128 channels on one? We've done both."

Try this on for size.

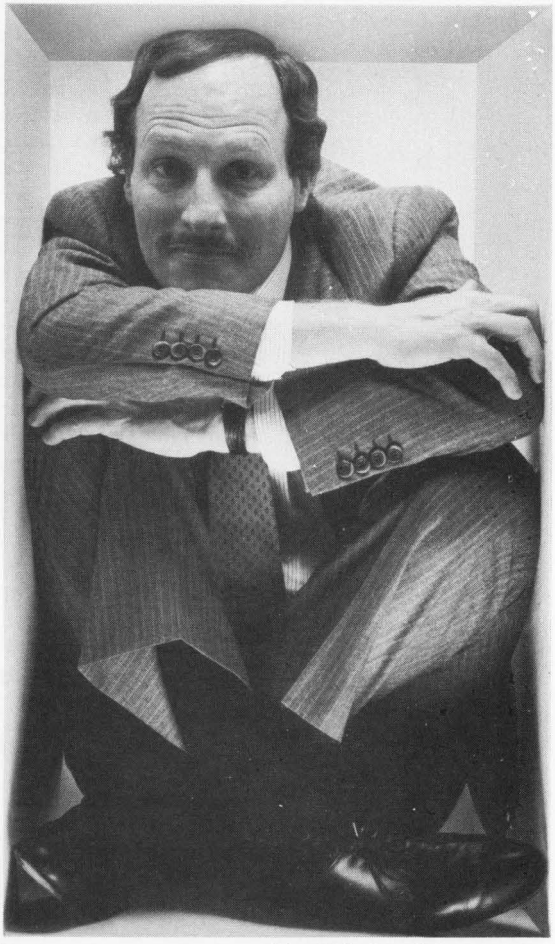
Data Translation's new DT712 has 128 analog input channels. More than any other A/D board on the market. Add the DT713 to get 512 inputs.

Engineers faced with a lot of analog sensor inputs no longer have to add on a ton of extra boards for industrial process control applications.

Now all they need is one. Ours.

The DT712 is also extremely economical. With more channels, the cost per channel is at least a third less than anything the competition can offer.

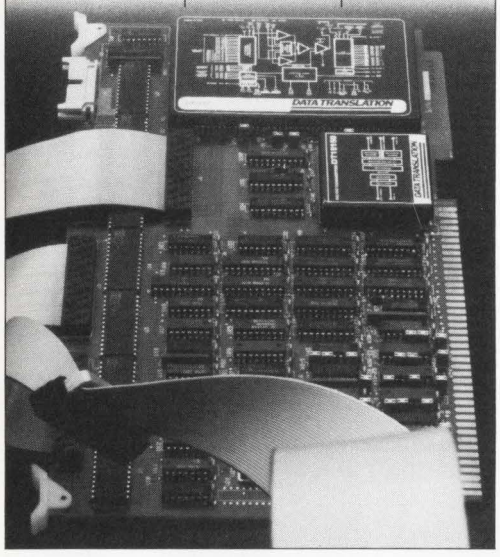
Besides greater cost efficiency, the DT712 also includes multiple triggering and scanning schemes, and an on-board programmable clock. Plus, a unique screw terminal panel lets you enjoy easy installation of analog signals, and a very clean, noise-free cabling connection.



Fred Molinari, President

**DT712 SERIES A/D BOARD DESCRIPTION**

| MODEL | TYPE | MAX NUMBER OF CHANNELS |
|---|---|---|
| DT712 | High Level A/D | 128SE/64DI |
| DT712 + DT713 | High Level A/D Expanded | 512SE/256DI |
| DT714 | Low Level A/D | 64DI |
| DT714 + DT715 | Low Level A/D Expanded | 256DI |



The DT712 provides for up to 128 A/D channels on a single MULTIBUS board.

And the DT712 is compatible with the latest MULTIBUS interface... including 24-bit addressing and 16-bit data transfers.

So before you get into a tight spot, call Data Translation.

We've loosened up the input problem 512 ways.

**Call (617) 481-3700.**


See our 192 pg. new product supplement in Gold Book 1984, Vol. III, and our 336 pg. catalog/handbook in Gold Book 1983.

# DATA TRANSLATION

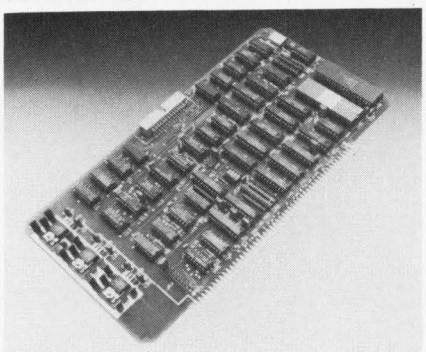
**World Headquarters:** Data Translation, Inc., 100 Locke Dr., Marlboro, MA 01752 (617) 481-3700 Tlx 951-646.
**European Headquarters:** Data Translation, Ltd., 430 Bath Rd., Slough, Berkshire SLI 6BB England (06286) 3412 Tlx 849-862.



**Write 95 on Reader Inquiry Card**

## CPU BOARD

**For S-100 Bus**

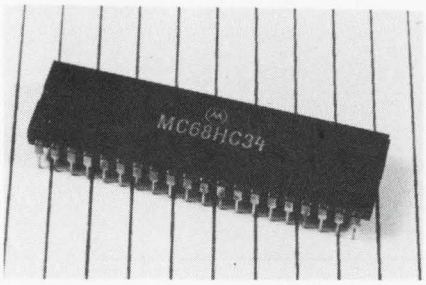


The Seattle Computer 8086 CPU board for the S-100 bus is available in two versions, 10 MHz and 8 MHz. The 8 MHz version works with the 8 MHz 8087 Numeric Data Processor. Both versions operate with either 8- or 16-bit peripherals and software support is available. MS-DOS is currently available and the Xenix operating system is scheduled for release later. The board's memory address range can be expanded to 16 Mbytes, and can be used as a stand-alone CPU, together with the SCP-301 CPU Support board, or as part of a three-card CPU/CPU Support/MMU set. **Seattle Computer Products,** Seattle, WA

**Write 188**

## DUAL PORT MEMORY UNIT

**256K RAM**

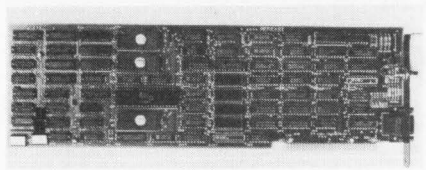



The MC68HC34 is an 8-bit HCMOS dual-port RAM which facilitates communications between microprocessors with different bus definitions and clock timings. It allows two processors operating on separate buses to exchange data. Interrupt registers are the mechanism by which the processors interrupt each other. The 256 Kbyte dual-port RAM may be accessed from either microprocessor. The MC68HC34 contains 6 read/write semaphore registers. Price in quantities of 1,000 is $25. **Motorola,** Phoenix, AZ

**Write 192**

## GRAPHICS DISPLAY ADAPTER

**For IBM PC and PC-XT**

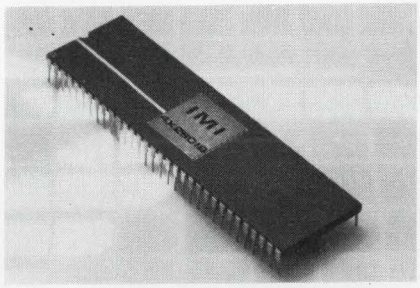


The BoB Display Adapter is a single board designed for the IBM PC and PC-XT. The adapter will interface with high resolution monitors, such as the 14" NEC models. The adapter provides support for either a color mode with 16 colors, or a black and white mode with 16 levels of gray. It has direct-drive and composite-video monochrome outputs and can display an 8 × 12 dot character in a 10 × 16 dot grid. The adapter provides a lightpen interface and supports IBM PC user selectable character attributes. It has two graphics screen modes and as options, two enhanced graphics modes. The new BoB board supports a 24.83 KHz horizontal rate to provide 400 vertical scan lines. Price is $425. **Persyst,** Irvine, CA

**Write 195**

## CMOS QUAD BIT SLICE

**TTL Compatible**

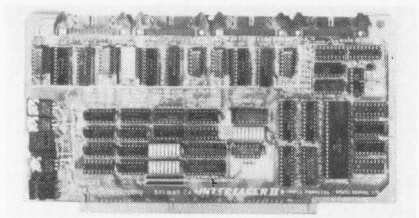



The IMI 4X2901B is a quad bit slice for use in CPUs, peripheral controllers and programmable microprocessors. Power dissipation is 175 mw and the device is TTL compatible on both outputs and inputs. The quad CMOS bit slice consists of a 16 by 16-bit two-port RAM, a 16-bit high-speed ALU, a 16-bit Q-register, and the associated shifting, decoding and multiplexing circuitry. The IMI 4X2901B is cascadable, has three state outputs, and provides various status flag outputs from the ALU. Each nine bit instruction word is organized into three groups of three bits each and selects the ALU source operands, the ALU function, and the ALU destination register. **International Microcircuits,** Santa Clara, CA

**Write 211**

## S-100 INTERFACE

**Supports 10 MHz Transfer Rates**



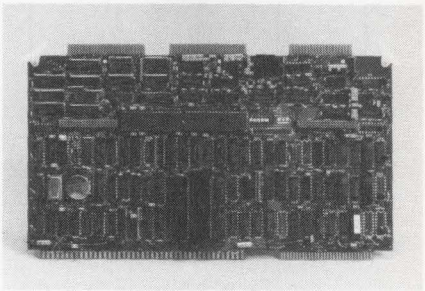
The 8800GF2 is an interface for IEEE696/S-100 bus systems which provides three full-duplex parallel I/O channels, an RS232C serial port and a selectable-rate interrupt timer on a single board. The board is designed for data-acquisition systems, process control, printers, or other I/O oriented systems. Each of the three parallel-data channels incorporates eight TTL latched input lines and eight Tri-State output lines with 24mA drivers. Additional lines provide strobe, enable or attention signals with selectable polarity. The board supports data transfer rates up to 10 MHz. Character frames can be 7-bits or 8-bits long with odd, even, or no parity and one or two stop bits. The data transmission rate is switch-selectable from 50 BPS to 19200 BPS. Price is $325-$399. **Vector Electronic,** Sylmar, CA

**Write 197**



## MULTIBUS COMMUNICATIONS BOARD

**Four Serial Channels**

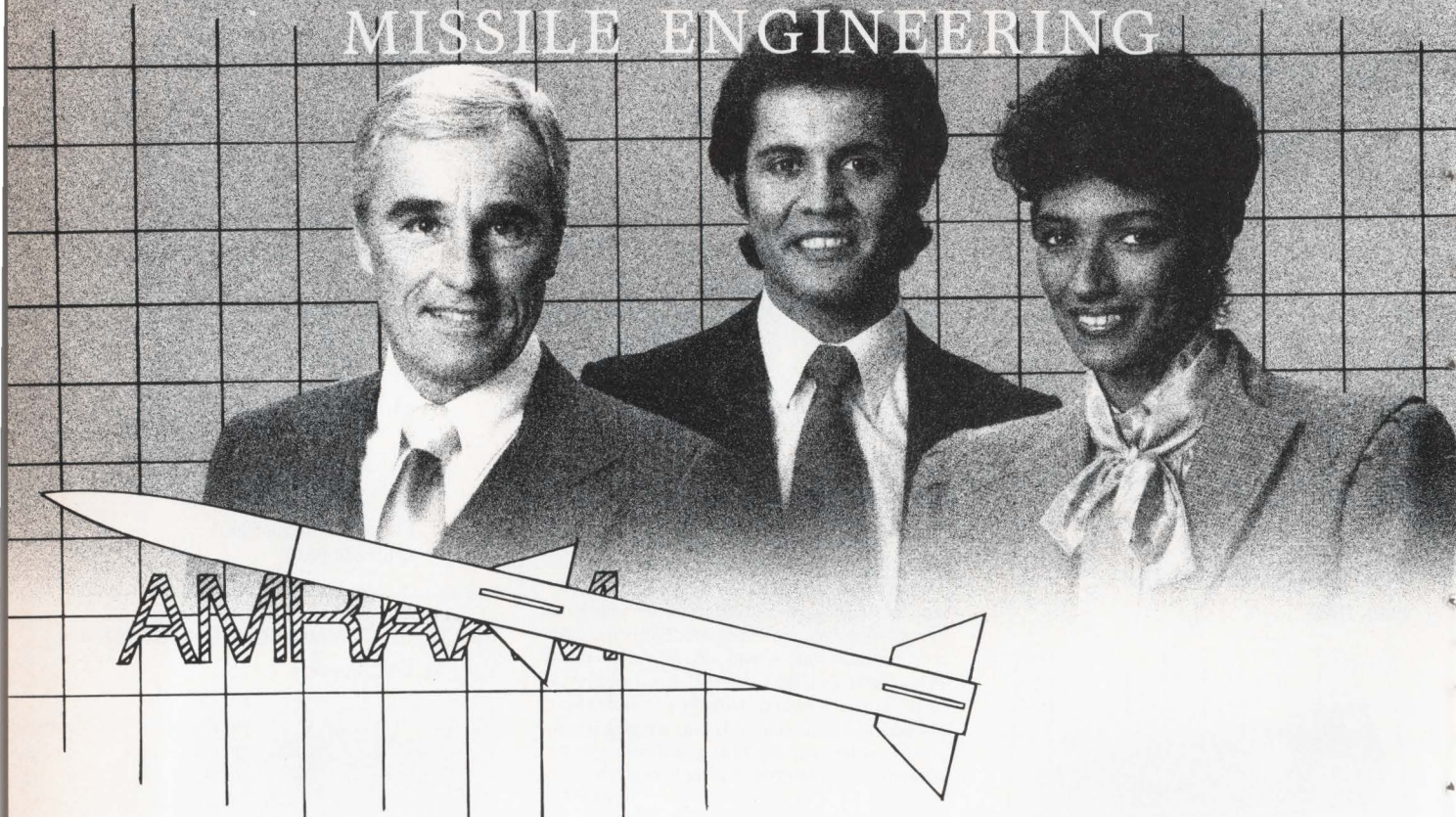


The COM-1 is a single board I/O communications controller, which is plug-in compatible with the IEEE-P796. It has an on-board bi-directional 16-bit parallel port that provides an interface to a DEC DR-11W, or equivalent, interface card. With this port, direct communications between the Multibus-based system and a DEC VAX supermini, PDP-11, or LSI-11 minicomputer can be achieved at data rates of 400K words/sec. Four serial channels are included on the Com-1. Three of these conform to the RS-232C interface standard and accommodate baud rates of 307.2K. The fourth serial port can be strapped for one of four modes. Each of the four serial channels can be independently programmed and two DMA controllers support DMA between Multibus memory and any of the on-board I/O ports. Eight DMA channels are provided, which can be strapped to provide DMA capabilities to eight of the thirteen on-board I/O sources. The Com-1 supports block transfers of 64 Kbytes anywhere within the 16 Mbyte IEEE address range. Price is $2495. **Matrox Electronic Systems,** Quebec, Canada

**Write 196**

# HUGHES

## THE PEOPLE BEHIND ADVANCED MISSILE ENGINEERING



## SEEK PERFECTION

Talented . . . determined . . . proud. The people behind Hughes Missile Systems Group challenge themselves at the leading edge of technology. In an environment that both stimulates and actively supports a diversity of technical contributions. Scientific resourcefulness . . . coupled with creative engineering. These people have made it an art.

At Missile Systems Group, Hughes people have been involved for over 30 years in the development of advanced tactical guided missile systems. They are implementing technologies to develop increasingly "smarter" weapons. Meeting national defense needs. And maintaining a strong leadership position in the guided missile field.

At Hughes, there is a stimulating relationship between the people and their work. Between the individual and the team. It's a relationship that provides opportunity for substantial individual contribution. A relationship that considers personal development to be a key ingredient. That's what Hughes Missile Systems Group is all about. People. People with integrity, vision and dedication. People participating in extraordinary ways.

People like you.

**Current openings:**

- **Electro-Optical Engineers**
- **Missile System Analysts**
- **Software Designers**
- **Radome Analysts & Designers**
- **High Power Transmitter Designers**
- **Power Supply Design**
- **Hybrid Process Engineers**
- **MIC Fabrication/Packaging**

Send your resume to: Hughes Missile Systems, Engineering Employment Dept. DD-4, Fallbrook at Roscoe, Canoga Park, CA 91304.

*Creating a new world with electronics*

**HUGHES**

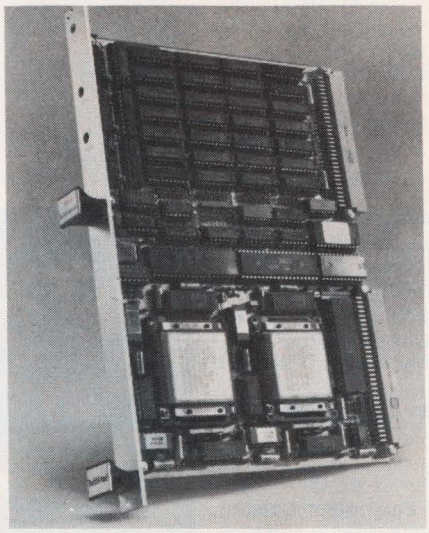
HUGHES AIRCRAFT COMPANY

Proof of U.S. Citizenship Required.
Equal Opportunity Employer.

## MISSILE SYSTEMS GROUP

## BUBBLE MEMORY SYSTEM

**For VME-Bus Microcomputers**

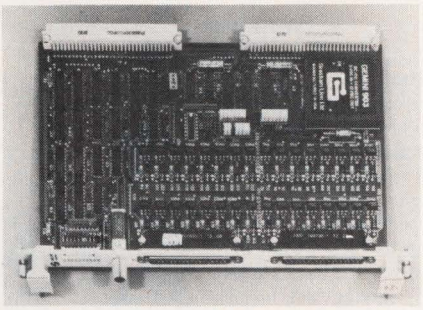


The VMI-1 is a bubble-memory system which allows VME-Bus machines to make use of solid-state mass storage in applications where electro-mechanical media such as disk and tape are unsuitable. The VMI-1 system provides 256 Kbytes of non-volatile mass storage and is expandable to 8 Mbytes with the use of expansion boards. A controller, designed around a Z-80 microprocessor, is provided on the VMI-1 printed-circuit module. The controller handles bubble-device formatting and control, interfaces the bubble-memory system to the VME-Bus bus structure, and provides for both soft- and hard-error detection and correction. Data transfer rate from/to the bubble devices is 130 Kbits/sec. Price is $1,799. **Bubble-tec,** Dublin, CA

**Write 207**

## VMEBUS BOARD

**Provides 32 Channels**

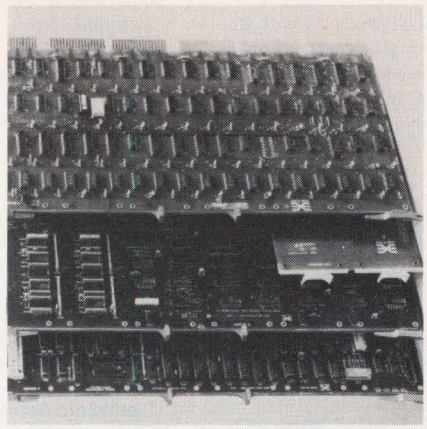


The DSSE32IN Digital Input Board is compatible with the VMEbus and gives the user 32 isolated opto-coupled input channels. Each digital input is debounced by CMOS circuitry and input states are displayed on the board's front panel by eight LEDs. The board appears to the system as four consecutive memory locations whose base address can be located anywhere in the 23-bit address field by means of jumpers. An onboard DC/DC converter provides a floating 12 volt power supply. Two 37-pin front panel connectors provide access to the input signals. Price is $895. **Data-Sud Systems/U.S.,** Tempe, AZ

**Write 201**

## DISK CONTROLLER

**Intermixes Disk Drives**

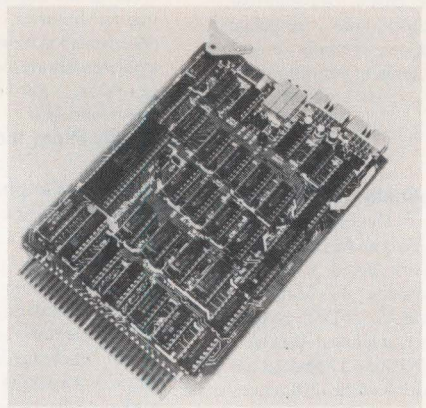


The SC72 Disk Controller permits intermixing of disk drive types, on DEC PDP-11/70 CPU's. With the SC72, any four industry-compatible disk drives, operating at data transfer rates of 2 Mbytes, can be integrated into a single subsystem. Data packs are compatible and interchangeable between DEC RM03 67 Mbytes, RM05 256 Mbytes, and RP06 174 Mbytes, drives and the compatible disk drive subsystems. The RH70 emulation allows software-transparent operation under RSTS-E, RSX11M, RSX11M+, and other DEC operating systems. It also has a 32-bit ECC for data error correction/detection on single-bit error bursts. Price is $7950. **Emulex,** Costa Mesa, CA

**Write 205**

## STD BUS GRAPHICS CONTROLLER

**With Software Support**

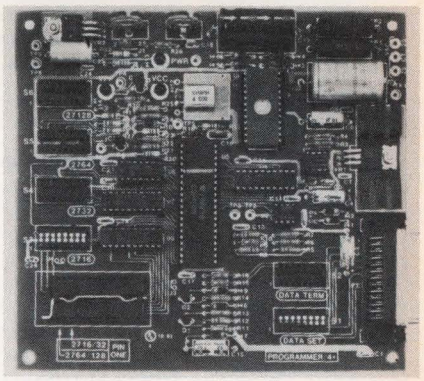


The ST4505 STD Graphics Controller is a 64 Kbyte video memory board which generates a display of 640 × 480 pixels. The controller has user selectable wire wrap options for TTL-compatible or composite video and sync selection, external clock input, and a combination of external video and sync from other video display products. Multiple ST4505 boards may be chained together to generate grey scale or color outputs. Other options permit I/O and memory residence addresses to be changed to fit system requirements. A CP/M compatible software support package is provided an 8" diskette with each unit. This software supports Plot, Draw, Label, character drawing, and associated functions. ST4505 is shipped with the software, source code, example BASIC programs, and a technical manual. Price in quantities of 50 is $450. **Applied Micro Technology,** Tucson, AZ

**Write 191**

## EPROM PROGRAMMER

**For 1-16K EPROMS**



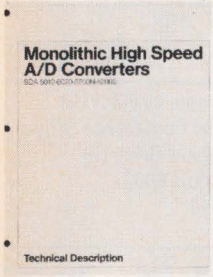
The PROGRAMMER 4+ is an EPROM programmer which features an RS232 serial interface and can be used with almost any computer or "dumb" terminal. The single board unit can handle 1K through 16K EPROMS and comes with manual, schematic, and floppy disk with software and source code. The unit will Test, Read, Program EPROMS, Save To and Read From disk in either ASCII, hex or object code. User may convert small EPROMS into a larger one and vice versa. No custom installation of software is needed if host system has a CP/M Punch and Reader installed at 1200 baud. Price is $199.95. **Periphco,** Santa Clara, CA

**Write 210**

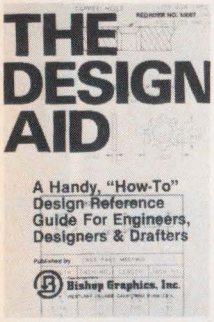
# NEW LITERATURE


**Intelligent CRT Programmer Bulletin.** This two-page illustrated bulletin from Reliance Electric Company describes the Model 45C100 portable Intelligent CRT Programmer. The CRT Programmer is given a "personality" that allows its use with all AutoMate PCs by downloading an executive program from a micro floppydisk into its main memory. The bulletin includes Intelligent CRT software and micro floppydisk features plus a modes table, specifications, and product illustrations.
**Reliance Electric** **Write 255**

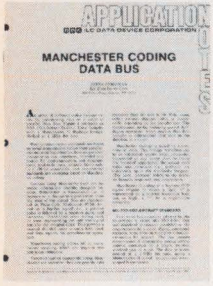

**Software Directory.** This 210-page catalog from Zilog lists vendors supplying software products compatible with Zilog's System 8000 family of 16-bit UNIX-based supermicros, and with the Z8, Z80 and Z8000 microprocessor families. Product data provided include product descriptions, price, source availability, language in which the software was written, date of first shipment, and number of installations.
**Zilog** **Write 257**



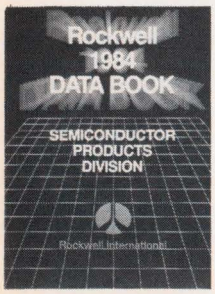

**A/D Converter Brochure.** This 18-page brochure discusses SDA 5010, SDA 6020, SDA 5200N, and SDA 5200S A/D converters. The brochure contains a general introduction to the product line and includes functional descriptions, technical specifications, block diagrams and applications criteria.
**Siemens** **Write 256**



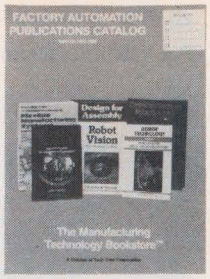

**Design Reference Guide.** This design reference guide from Bishop Graphics contains a comprehensive collection of tables, graphs, charts, formulas and other frequently used design information. Entitled, *The Design Aid*, technical reference information includes drill charts, components lead spacing formulas, decimal equivalent charts, logic information, metric conversion tables, bare wire gauge diameters, Ohm's law equations, symbols for geometric tolerancing and component definitions.
**Bishop Graphics** **Write 252**



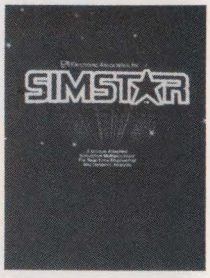

**Coding Data Bus Application Note.** This 12-page application note from Data Device Corp. (DDC) discusses various techniques for transferring data on a serial data bus network. Titled, "Manchester Coding Data Bus," the note describes Manchester Coding and its use in MIL-STD-1553, NARO SRANAG Standard, Ethernet, and Local Area Networks. The benefits of establishing a standard are noted along with an explanation of the differences between Manchester Coding and non-return-to-zero (NRZ) code.
**DDC** **Write 254**




**Semiconductor Data Book.** This data book from Rockwell International contains technical information concerning their products. The book discusses the R6800 microprocessors and peripherals, the R6500 microprocessors and peripherals, the R6500 microcomputers, memory products, intelligent display controllers, microcomputer development systems, the AIM 65 microcomputer family, the AIM 65/40 microcomputer family, the RM 65 microcomputer module family, integral modems and T-1 pulse code modulation devices.
**Rockwell International** **Write 264**



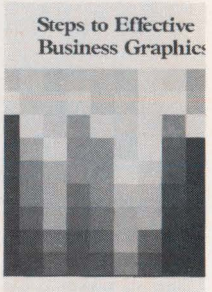

**Factory Automation Publications Catalog.** This catalog from The Manufacturing Technology Bookstore, a division of Tech Tran Corp., covers the latest publications on factory automation. The catalog features 30 titles on such subjects as industrial robots, flexible manufacturing systems, computer vision and assembly automation. Other topics, like automated inspection, product design for automation and numerical control are covered.
**Tech Tran** **Write 251**




**Simulation Multiprocessor Brochure.** Electronic Associates, Inc.'s six-page brochure on Simstar, its new-generation engineering simulation multiprocessor, gives the reader an overview of the automated simulation system, focusing on hardware, software, applications, new concepts, and the benefits derived from Simstar's real-time simulation capabilities.
**Electronic Associates** **Write 267**


**EPROM Erasing UV Equipment Catalog.** This 12-page color catalog from Spectronics Corp. features the company's line of EPROM Erasing Ultraviolet Equipment. Ten erasing systems are described, with capacities ranging from 9 to 336 chips. Also included in the catalog are ultra-high intensity grid lamps, digital UV radiometers, and UV-absorbing eye and face wear.
**Spectronics** **Write 253**

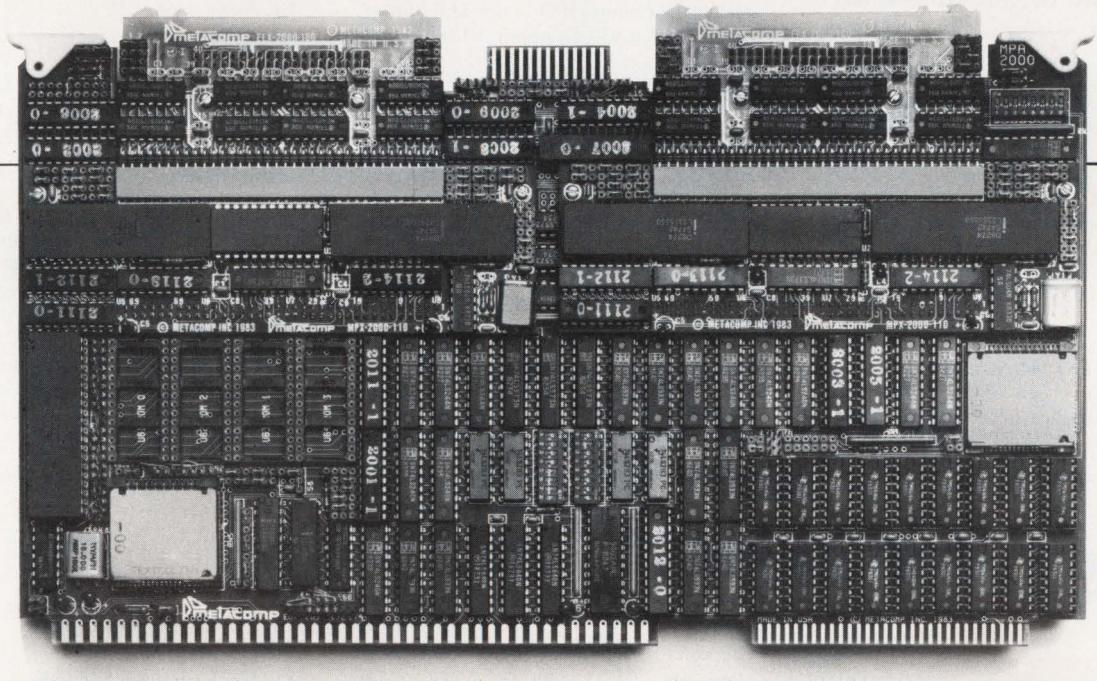

**Unix Guide.** This second edition of The Unix Guide from Pacific Micro Tech includes coverage of System V, System III, Version 7, UniPlus+, and Berkeley enhancements. The Guide provides an overview of available software, including microcomputer implementations. Coverage of commands, libraries, system calls, and reference documentation is included. Overviews are provided to relate software tools in areas such as text editing, graphics, networking and interprocess communication.
**Pacific Micro Tech** **Write 250**




**Business Graphics Book.** This 54-page book from Hewlett-Packard presents an approach to preparing business graphics. The book instructs readers on how to display information with 150 illustrations and four-color photographs. The book covers topics such as defining the audience, stating the objective, planning and scheduling time, choosing charts, following design principles, writing messages, and working with color. The book instructs readers on the mechanics of creating charts for presentations and reports.
**Hewlett-Packard** **Write 258**


**RSX-11M.** This application note from Gould has been written for users of the 9508S. It gives an overview of RSX-11M, a disk-based, real-time, multiuser, multi-tasking operating system and explains how to modify the terminal editing characters for the 9508S so they are the same as those used by the RSX-11M. It explains the programs which execute on the PDP-11 and communicate with the 9508S. There are step-by-step terminal sessions for each of the three programs which can be used to communicate with the 9508S.
**Gould** **Write 260**

# Chairman of the boards




## The first true Multibus single-board computer

The MPA-2000 is highly qualified for the top slot. It's the first to offer the iAPX-186 CPU. The first to offer 512KB of dynamic RAM. And, the first with architecture that allows plug-in modules with multiple DMA channel support.

That makes it the first CPU and I/O processor that combines: data processing, data communications, local area networking, disc I/O and similar peripheral functions. Standard data communications packages available include; 3270 BISYNC, 3270 SNA (LU 1, 2 & 3), X.25 (CCITT 1980), SDLC and HDLC (LAPB). Operating system portations include; iRMX-86, PC-DOS, MTOS-86 and VRTX-86. In all, it has sufficient performance and capability to replace 2, 3 or 4 board members in many applications.

With that outstanding resume, it's easy to see how the MPA-2000 became the unchallenged Chairman of the Boards.

For complete specifications and ordering information, call or write Metacomp, Inc., 9466 Black Mountain Road, San Diego, California, 92126, (619) 578-9840. TWX 910-335-1736 METACOMP SDG.

Ask for the resume of the Chairman of the Boards.

**METACOMP™**



**THE MULTIBUS BREAKTHROUGH PEOPLE**

See Us at Mini Micro Northeast, Booth 2144

Write 92 on Reader Inquiry Card

# CALENDAR

### May 1-4

**CAD/CAM Systems.** Los Angeles, CA. ICS 6305 Arizona Pl., P.O. Box 45405, Los Angeles, CA 90045. (213) 417-8888.

### May 1-4

**Designing with 16-Bit Micros.** Washington, D.C. Contact: ICS 6305 Arizona Pl., P.O. Box 45405, Los Angeles, CA 90045. (213) 417-8888.

### May 13-17

**Computer Graphics '84.** Anaheim Convention Center, Anaheim, CA. Contact: National Computer Graphics Association, 8401 Arlington Blvd. Suite 601, Fairfax, VA 22031. (703) 698-9600.

### May 15-17

**Electro '84.** Bayside Exposition Center, Boston, MA. Contact: Jerry Fossler, ECI, 8110 Airport Blvd., Los Angeles, CA 90045. (213) 772-2965.

### May 16-18

**International Conference on Modeling Techniques and Tools for Performance Analysis.** Paris, France. Contact: Conference Secretariat, INRIA, Domaine de Voluceau. Rocquencourt, B.P. 105-78153 Le Chesney Cedex, France.

### May 22-24

**SEMICON/WEST '84.** San Mateo, CA. Contact: Susan Castillo, Semiconductor Equipment and Materials Institute, 625 Ellis St., Suite 212, Mountain View, CA 94043. (415) 964-5111.

### May 22-25

**COMDEX/SPRING '84.** Georgia World Congress Center, Atlanta, GA. Contact: The Interface Group, 300 First Ave., Needham, MA 02194. (617) 449-6600.

### May 31, June 1-2

**Personal Computer and STD Computer Interfacing for Scientific Instrument Automation.** Virginia Tech, Blacksburg, VA 24061. Contact: Dr. Linda Leffel, C.E.C., Virginia Tech. (703) 961-4848.

### June 3-6

**Summer Consumer Electronics Show.** McCormick Place, Chicago, IL. Contact: SME, 1 SME Drive, P.O. Box 930, Dearborn, MI 48128. (313) 271-0023.

### June 5-7

**11th International Symposium on Computer Architecture.** Rackham Building, Ann Arbor, MI 48109. Contact: (313) 764-8157.

### June 5-7

**NEPCON EAST.** Bayside Exposition Center, Boston, MA. Contact: CEG, Dept. "M", P.O. Box 3833, Stamford, CT 06905. (203) 964-0000.

### June 5-7

**6th Symposium on Mass Storage Systems.** Marriott Mark Resort, Vail, CO. Contact: Bernard O'Lear, NCAR, P.O. Box 3000, Boulder, CO 80307. (303) 494-5151.

### June 11-14

**CADCON/East.** Boston, MA. Contact: Registrar, Morgan-Grampian Expositions Group, 2 Park Ave., New York, NY 10016. (213) 340-9780.

### June 11-14

**ATE East.** Boston, MA. Contact: Registrar, Morgan-Grampian Expositions Group, 2 Park Ave., New York, NY 10016. (213) 340-9780.

### June 12-14

**IBM User Show.** London, England. Contact: Online Conferences LTD. Pinner Green House, Ash Hill Drive, Pinner HA5 2AE, Middlesex, UK 01-868-4466.

### June 12-15

**Data Communications.** Boston, MA. Contact: Ruth Dordick, ICS, 6305 Arizona Pl., P.O. Box 45405, Los Angeles, CA 90045. (213) 417-8888.

### June 13-15

**Systems Analysis and Design.** Contact: The Institute for Professional Education, 1515 North Court House Rd., Suite 303, Arlington, VA 22201. (703) 527-8700.

### June 14-17

**C'84 International Computer Show.** Cologne, Germany. Contact: German American Chamber of Commerce Inc., 666 Fifth Avenue, New York, NY 10103. (212) 974-8830.

# ADVERTISER INDEX