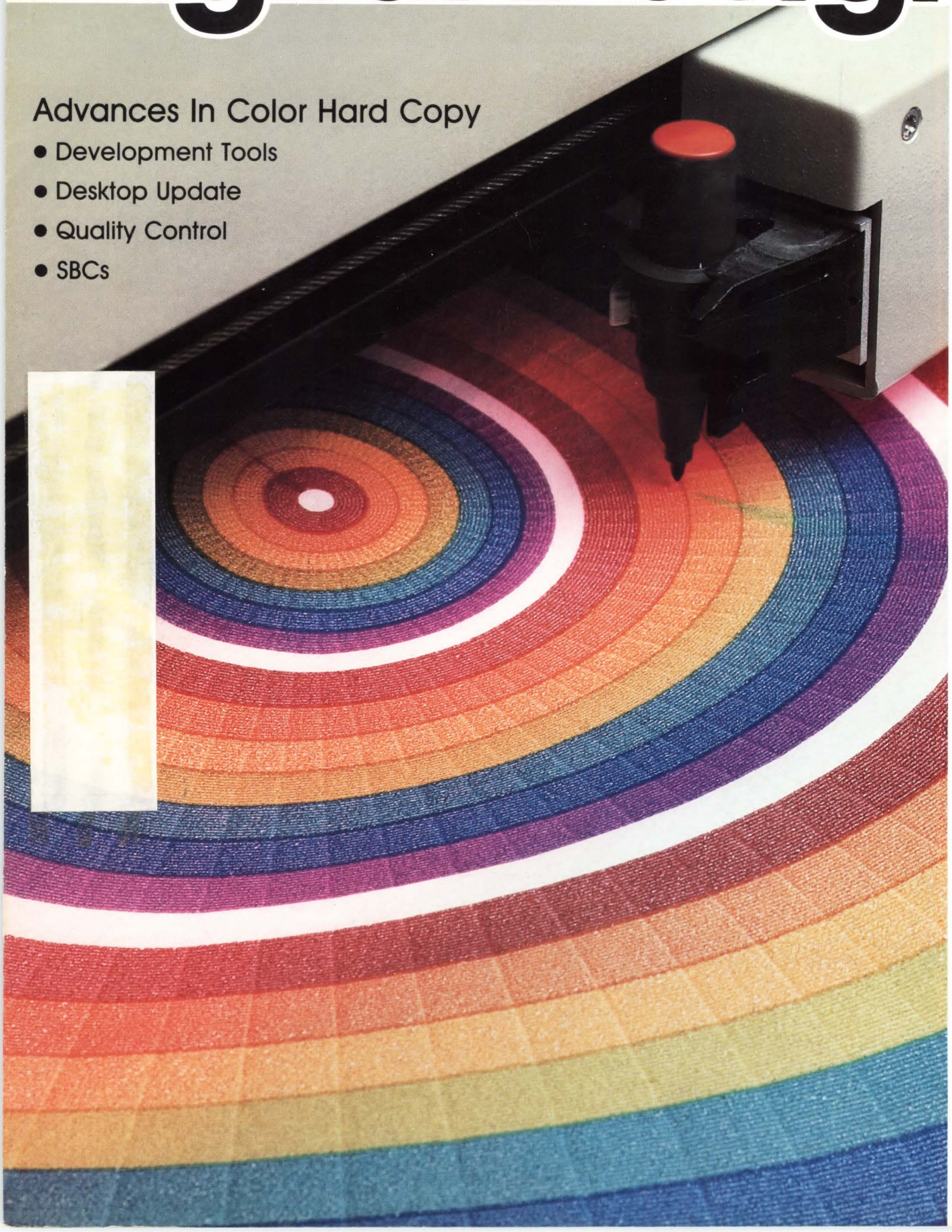
A MORGAN-GRAMPIAN PUBLICATION

Digital Design

Advances In Color Hard Copy

- Development Tools
- Desktop Update
- Quality Control
- SBCs



COMPUTERS/SYSTEMS · PERIPHERALS · COMPONENTS · 7/83

VOL. 13
NO. 7

You've concluded that you need the performance and capacity that only an 8 inch Winchester drive can provide. Which one should you buy?
There are 109 different models available.
Of this 109, only 39 are 8 inch floppy form-factor compatible.
28 of these 109 perform an average seek in 30 milliseconds or less.
And of this 109, only 17 offer true SMD compatibility.
Puzzled?

Only *one* company provides a disk drive with all the features —

Kennedy and Model 7300

with the right size, the right interfaces and the right price.
Write or give us a call.

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An Allegheny International Company
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(213) 357-8831 TELEX 472-0116 KENNEDY
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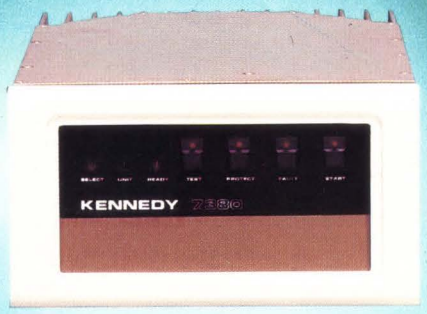
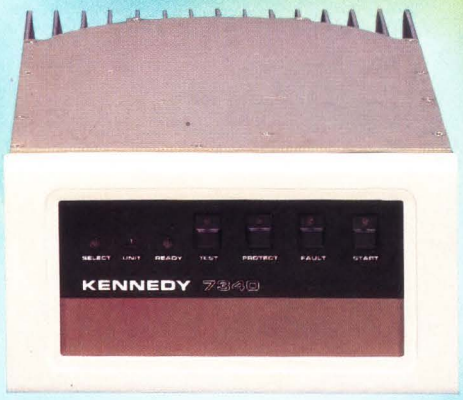
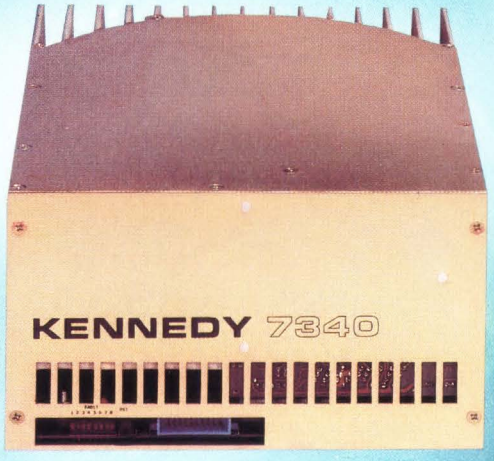




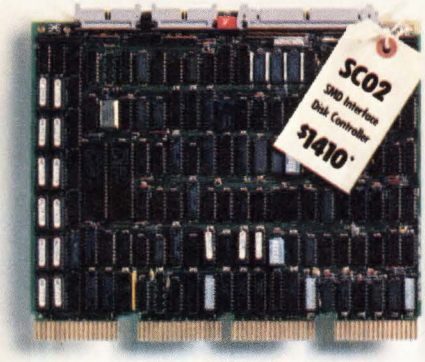


SPECIFICATIONS:
- 41 and 82 MB Capacities
- Rotary Voice Coil 30 msec average seek
- SMD, ANSI or PICO BUS Interfaces
- 1209 KByte/sec. transfer rate
- Available 30-45 days ARO
- Q100: $2,560/$3,195

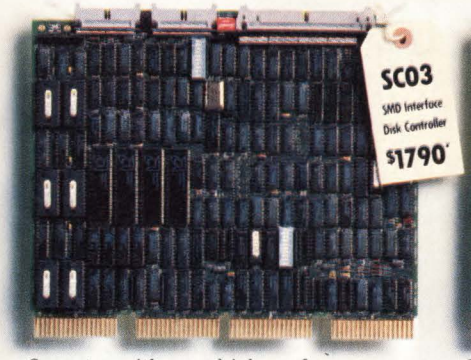
KENNEDY • QUALITY • COUNT ON IT

Write 7 on Reader Inquiry Card

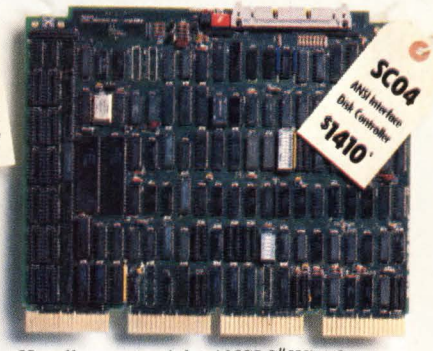
The LSI-11 controllers with features comptrollers love.



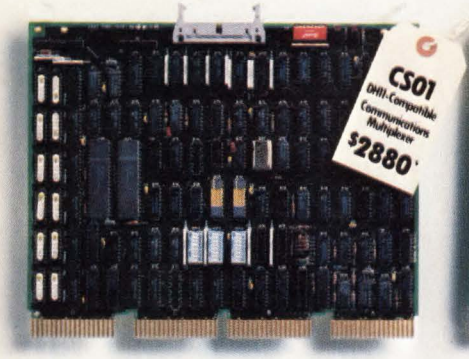
Handles small 12-80MB disks, emulates RP02/03, RK06/07 and RL01/02.



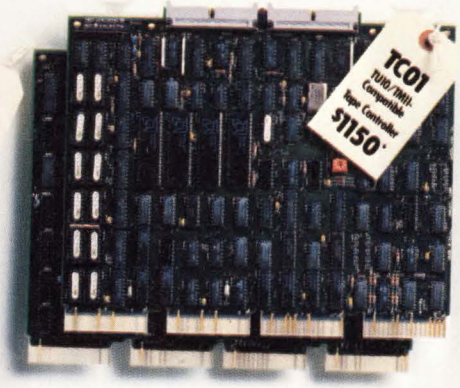
Operates with new high-performance 80MB and larger disks on LSI-11/23.



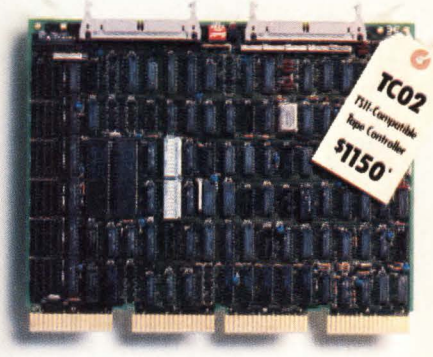
Handles up to eight ANSI 8" Winchesters, emulates RK06/07 and RL01/02.



Handles 8-64 channels, 16-bit word transfers (DMA), 22-bit addressing. (16-channel price)



Dual density at up to 75 ips, handles up to four ½" transports.



Coupler works with all NRZI, PE, GCR formatters at speeds from 12.5 to 125 ips.

*Quantity 100

Handles new cartridge Winchester disk drives, emulates RLV11/12.

Flinty-eyed finance types are push-overs for Emulex controllers.

And why not? Emulex controllers have great figures.

DEC LSI-11 users simply don't pay extra for higher Emulex quality, performance and reliability. In fact, Emulex controllers are priced to be highly competitive with the lower quality brands. And that's just the beginning.

There's no up-front investment because Emulex controllers are totally software transparent to LSI-11 CPUs. No special software drivers, handlers or tweaks required.

Smart comptrollers don't tie up cash in needless inventory. With Emulex's remarkably fast delivery, inventories can be kept economically small.

Quantity discounts are another opportunity for comptrollers with sharp pencils. With Emulex you can mix and match across a very broad product line of Q-Bus, Unibus & VAX controllers so it doesn't take long to bring prices down even further.

Knowledge that Emulex products work (at up to 72,000 hours MTBF) is important, too. But when support is necessary, comptrollers are pleased to know that nationwide applications assistance, training, and technical support is only a quick phone call away.

Great figures?

Write or call Emulex Corporation, 3545 Harbor Blvd., P.O. Box 6725, Costa Mesa, CA 92626. Telephone (800) 854-7112 toll-free. In California call (714) 662-5600.

EMULEX

The genuine alternative.

Write 31 on Reader Inquiry Card

Finally, a single source for multi-processor, designed for OEMs and systems integrators. Now that's intelligent.

Intelligent Systems introduces the Datavue multi-processor, multi-user computer system.

The Datavue system offers OEMs and system integrators a powerful solution for multi-user, multi-tasking, terminal-based environments—and all the advantages of single-sourcing.

With Datavue you configure just the right amount of computer power for current needs and deliver to your customers a simple, economical growth path from one to eight users.

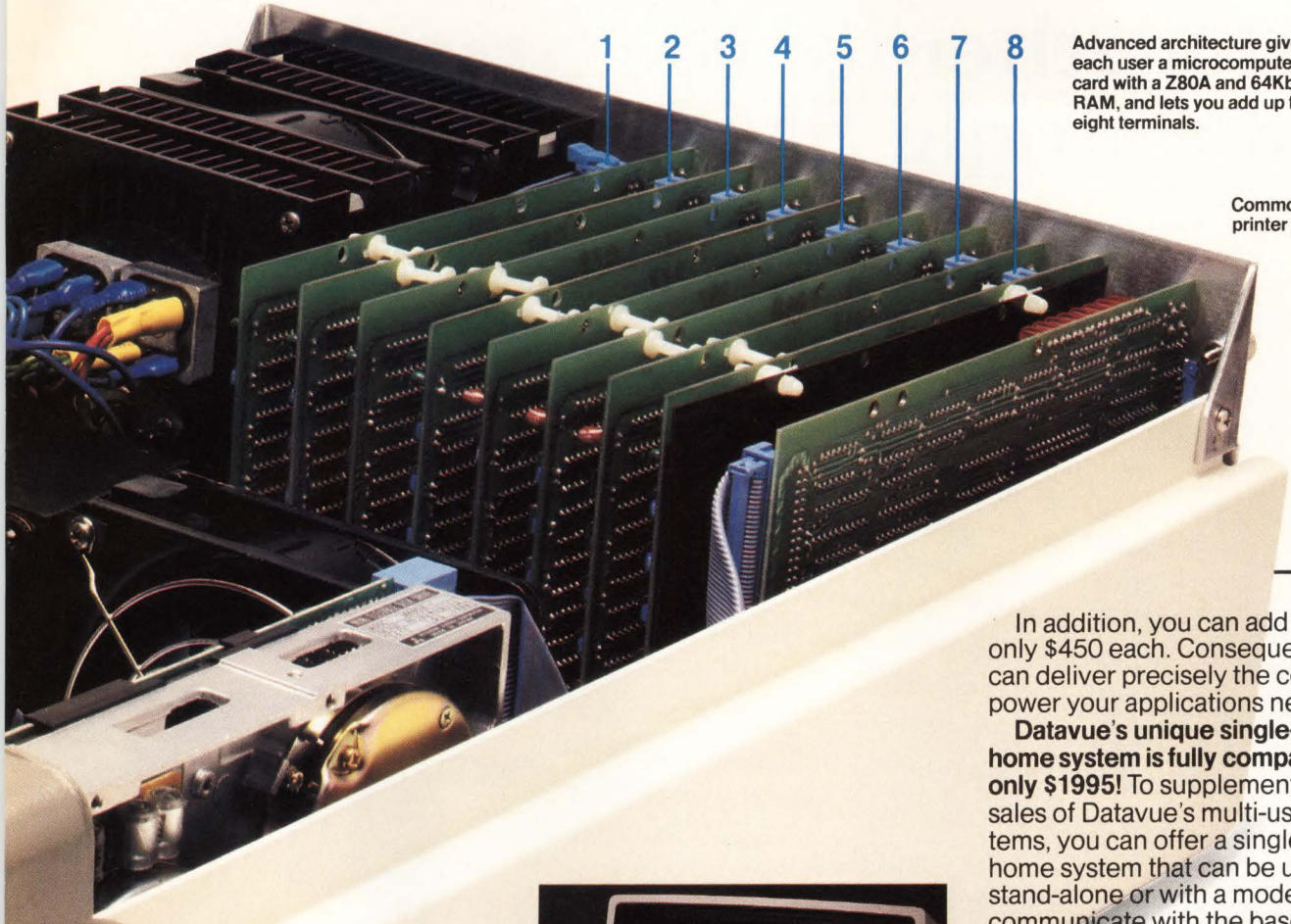
Advanced systems architecture delivers stand-alone performance. For advanced applications—decision support systems, office automation, management productivity, and even process control—Datavue provides a simple computing environment with a dedicated computer for each user (or control application).

Up to eight computer cards can be inserted in the Datavue system which resource shares mass storage and common I/O. Each user gets a full microcomputer with a Z80A, 64Kb RAM, and CP/M* 2.2. As a result, all users get stand-alone performance with the economies of a multi-user shared resource system.

Intecolor® 2405

Add intelligent terminals to meet your customers' needs. Since 1973, Intelligent Systems has been a world leader in designing and manufacturing color graphics terminals. Now, you can profit from our expertise with: The Intecolor 2405, the indus-

multi-user computer systems



Advanced architecture gives each user a microcomputer card with a Z80A and 64Kb RAM, and lets you add up to eight terminals.

Common Centronics printer port.

DATAVUE™ 132C

try standard ANSI color terminal; only $1295. The unique Datavue 132-column monochrome terminal for spreadsheet applications; only $1795. And the Intecolor 8301R, an advanced, dot-addressable, color graphics terminal; only $3995.

Since you contract with a single vendor, you can mix and match terminals and get excellent product discounts—increasing your profit margins.

Intecolor 8301

Datavue price/performance wins, especially with heavy compute requirements. For example, a four-user system with a full microcomputer for each user is only $7045—or *only $1762 a user!* This four-user system includes:

- 4 microcomputers, each with a Z80A, 64Kb RAM, 4Kb EPROM, and 2 RS232-C ports
- 12Mb 5¼" Winchester hard disk and a 1Mb floppy for back-up
- Shared resource management card for mass storage
- Centronics parallel printer port which all users can access
- CP/M 2.2 operating system, compatible with the world's largest library of off-the-shelf software.

In addition, you can add users for only $450 each. Consequently, you can deliver precisely the computing power your applications need.

Datavue's unique single-user home system is fully compatible and only $1995! To supplement your sales of Datavue's multi-user systems, you can offer a single-user home system that can be used as a stand-alone or with a modem to communicate with the base system.

The home system includes a Z80A, 64Kb RAM, 1 Mb floppy, two RS232-C ports and CP/M 2.2. And it's very competitive—in function and price—with personal computers.

Put it all together with Datavue. Stand-alone performance. Up to eight users. Price and profitable margins. Powerful options, from synchronous communications to 80Mb mass storage, and more. Color, graphics, and wide-screen terminals (or use your own). A huge library of off-the-shelf CP/M 2.2 software. Plus, the unmatched advantages of single-sourcing.

That's Datavue multi-processor, multi-user systems. That's Intelligent Systems.

More information. Datavue is shipping now. OEM contract discounts are available. And a limited number of dealerships are open. For details, contact Marketing Communications at 404/449-5961, TWX 810 766 1581.

DATAVUE™

AN INTELLIGENT SYSTEMS COMPANY
Intecolor Drive, 225 Technology Park, Norcross, Georgia 30092
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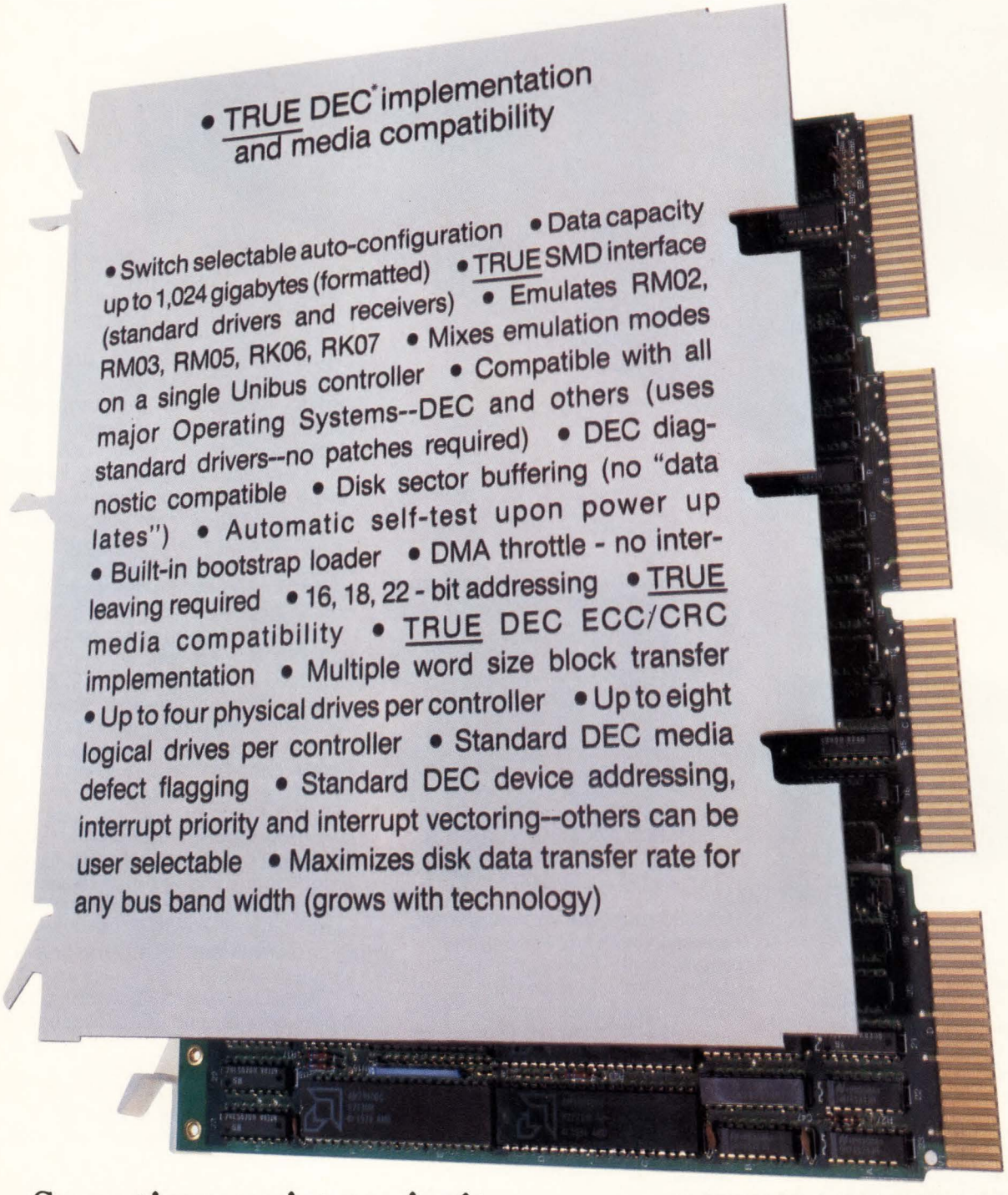
*CP/M is a registered trademark of Digital Research, Inc.

Write 16 on Reader Inquiry Card

20 major capabilities together for the first time on a single SMD controller!



Sometime a picture isn't as good as 10,000 words.

*TM Digital Equipment Corp.

MDB SYSTEMS INC.

THE WORLD'S LARGEST INDEPENDENT MANUFACTURER OF COMPUTER INTERFACES.

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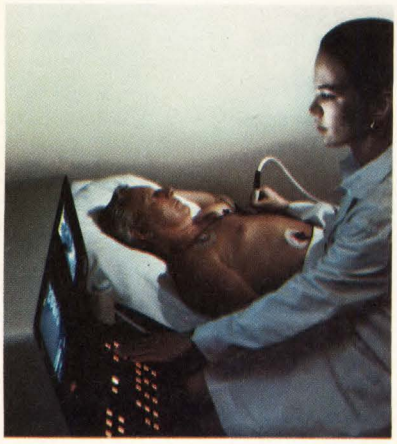
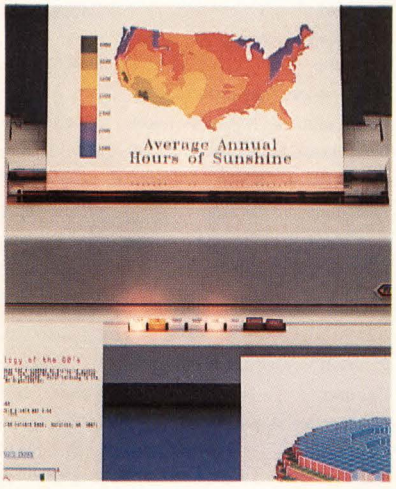
Circle **4** for LSI-11 Circle. **6** for PDP-11

JULY 1983/VOL. 13, NO. 7

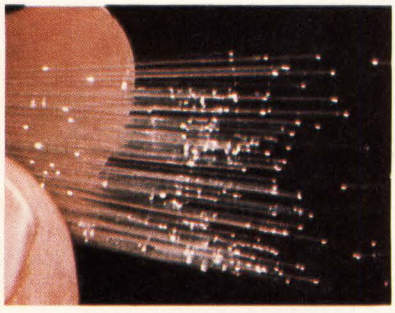
Digital Design



p. 35 *(Photo courtesy Ramtek Corp.)*



p. 48 *(Photo courtesy Printacolor)*



p. 76 *(Photo courtesy Western Electric)*

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COMPONENTS

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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.

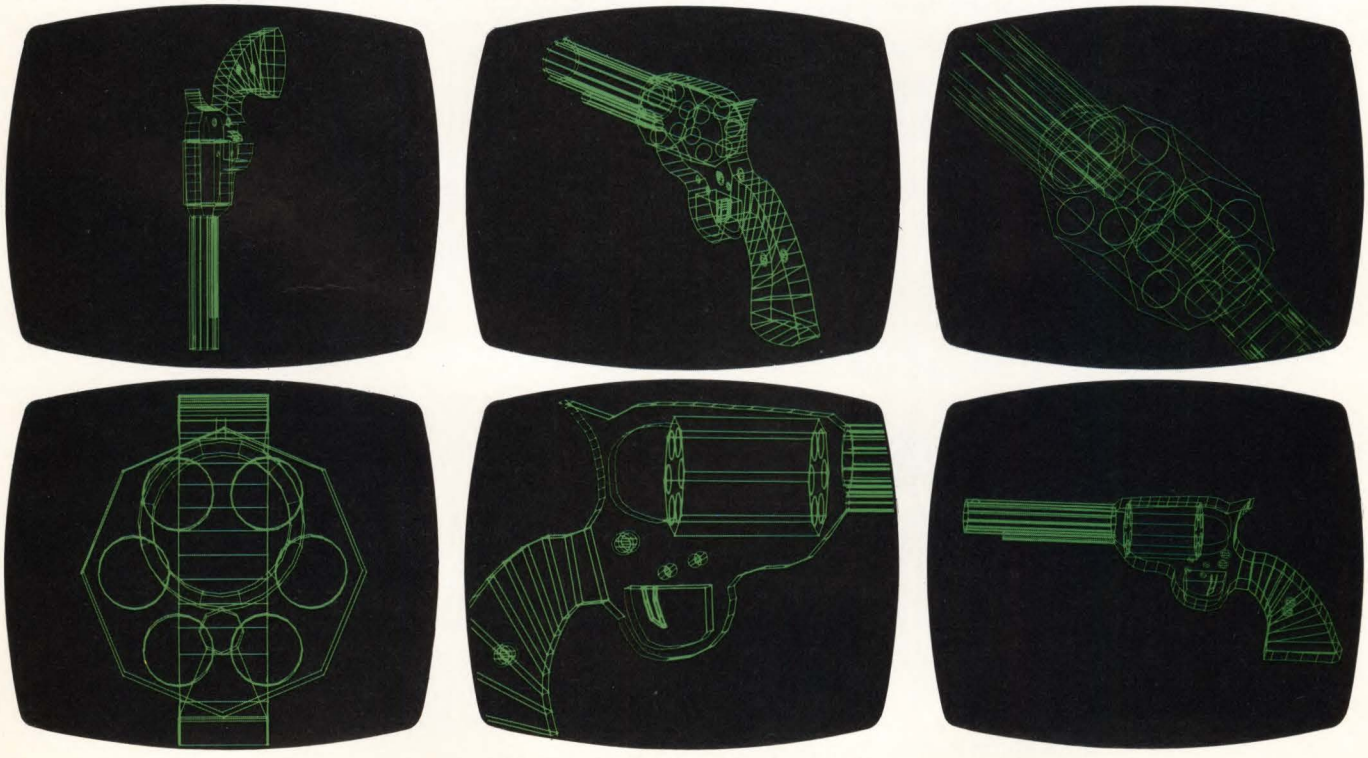
Lundy helps you see more in graphics.

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.



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Smart Graphics™ GX-100

The Modgraph **GX-100** is the first low cost graphics terminal to offer multi-page high resolution graphics and alphanumerics. Designed to be compatible with Plot-10® (4010/4014) and DEC's VT-100 and VT-52. We call it **Smart Graphics™** and with good reason — powerful graphics, multi-page alphanumerics and more.

GRAPHICS

As a graphics tool the **GX-100** is the smart choice; TWO pages of 768 x 585 viewable resolution on a 15" screen. Information from one graphics screen can be added and subtracted to the other with the push of a key. Circle, Rectangle, Vectors, Points, Patterns, Complex Area Fill and of course Plot-10® (4010/4014) compatibility.

ALPHANUMERICS

The independent alphanumeric plane allows alphanumeric overlay without overwriting graphics. Two independent pages store a total of 6 scrollable screens in 80 x 24 format with selectable scrolling methods including window scroll. This and VT-100, VT-52 compatibility, all designed to help you work smarter not harder.

- Direct access of microprocessor via host allows downloading of code for stand alone use.
- Optional Floppy Disc Drive with CP/M O/S.

To fully appreciate the Modgraph **GX-100** you have to see it in action. Drop us a line, or give us a call. We'll arrange for a demonstration and show you how powerful graphics can be yours with **Smart Graphics™**

® Plot-10 Trademark Tektronix
VT-100 Trademark Digital Equip. Corp.

See Us At SIGGRAPH
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Modgraph

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NEWS UPDATE

GTE Designs Defense Communication System

GTE announced receipt of a $1.5 million contract to participate in designing a global communication system for the U.S. Department of Defense. Awarded by the Defense Communications Agency, Washington, D.C., the contract calls for GTE's Communication Systems Division to provide systems engineering and technical assistance for the development of a private military network linking major headquarters throughout the world. The system, designated Defense Switched Network (DSN), will employ modern, stored-program digital switches as well as state-of-the-art microwave, satellite and submarine cable links.

Davong Signs for ¼" Tape Drives

Cipher Data Products Inc. and Davong Systems Inc. have signed a multimillion dollar agreement for the purchase of Cipher's ¼" streaming cartridge tape drives. The two-year contract calls for total delivery of over 20,000 Cipher tape drives. First shipments of the 420–CT tape drive to Davong began in April. The contract also calls for eventual delivery of Cipher's new 5¼" form factor products.

Basix Acquires SACS

Basix Controls Systems Corp. announced it has acquired the business development and certain assets of a division of TRW Inc., including the sophisticated computerized Secure Access Control System (SACS), developed for use by U.S. government agencies and industrial customers. Details of the acquisition were not disclosed.

DEC Joins Fortune 100

Digital Equipment Corporation (DEC) has broken into the top 100 of the nation's largest industrial corporations, according to a new listing published in the May 3 issue of *Fortune*. Digital's sales of $3.88 billion for the fiscal year ended July 3, 1982, ranked it No. 95. This year Digital also ranked No. 32 in net income at $417.2 million and No. 8 in earnings per share growth (at 31.15 percent) over a ten-year period from 1972–1982.

Intermetrics And Gould Introduce Cross-Compilers

Intermetrics, Inc. Software Products Div. and Gould, Inc. Design & Test Systems Div. introduced the first in a series of co-funded products, InterC and InterPas, which were announced recently by Intermetrics. Developed by Intermetrics, InterC and InterPas are C and Pascal cross-compilers for the 8086 and 68000 that run on VAX and PDP–11 minicomputers. The cross-compilers were designed specifically for the embedded μP systems builder.

RCA Moves Into Semicustom Logic ICs

After 15 years of manufacturing custom and semicustom integrated circuits for in-house and proprietary applications, the RCA Solid State Division has formed a separate group dedicated to designing and manufacturing semicustom LSI devices. RCA's semicustom logic capability features two types of CMOS semicustom circuits: gate arrays and standard cells. Both types are designed and manufactured under a unique user-friendly design automation software system. Semicustom devices can be produced for either commercial or military applications.

$1M Printer Contract

Centronics Data Computer Corp. (Hudson, NH) announced that it has entered into a one-year, $1 million plus contract with Interface Systems, Inc. (Ann Arbor, MI) for an undisclosed number of dot matrix and line printers. Up until now, ISI had been purchasing only the 700 Series of dot matrix printers.

CAD For Chrysler

Chrysler Corp. has invested more than $18 million in its computer-aided design and engineering program, and it expects to produce the world's first completely computer-designed car by 1986. Chrysler uses eight interconnected Control Data CYBER computers capable of processing 24 million instructions per second which serve design, engineering, manufacturing and personnel in 14 plants in the U.S., Canada, and Mexico.

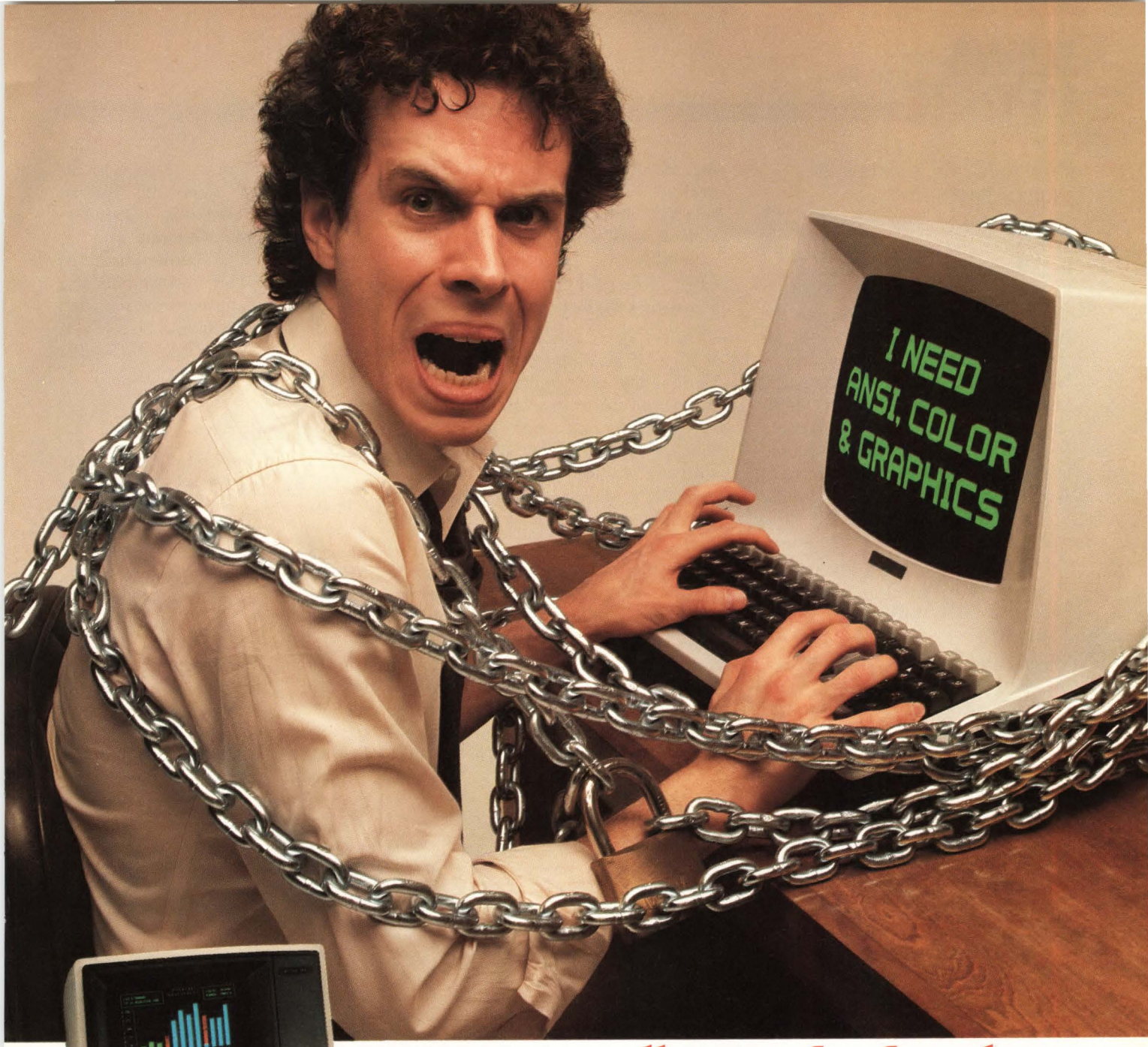
Second-Source Agreement

Western Digital Corp. and Texas Instruments announced an agreement allowing them to second-source various MOS/LSI peripheral ICs from each other's product lines. The agreement, signed between Western Digital and TI's Semiconductor Group, allows Western Digital to second-source five components from TI's family of universal μP peripherals. Western Digital also plans to second source future graphics processors from TI which are expected to be introduced this summer. TI has the option to second-source Western Digital's WD1933 and WD1935 communications controllers, WD2501 and WD2511 x.25 communications controllers, and the WD1510 first-in first-out (FIFO) buffer and WD1511 FIFO support chip. As part of the agreement, the two companies will transfer product data bases required to generate photomasks and test vectors.

Martin Marietta Acquires Mathematica

Martin Marietta Corp. and Mathematica, Inc., have signed an agreement in principle for Martin Marietta to acquire all of the outstanding stock of the Princeton, N.J., computer software company for approximately $30.8 million in purchases and securities.

Mathematica, which will be operated as a unit of Martin Marietta Data Systems, develops and markets computer software; its principle product—the RAMIS II family of data base management products and decision-support software—is the leading fourth-generation language and data management system.



$1295. A small price for freedom.

Help your programmers respond to new applications. Free them from the ASCII code trap with the ANSI Intecolor 2405. When your users are demanding color and graphics to solve their applications needs, adding more non-ANSI terminals to your system is like chaining the hands of your programmers. If your new terminals aren't ANSI X3.64, you may be locked into a generation of non-standard application programs and protocols. Your programmers may have to write translation codes for *each* application you want to update. And that means less flexibility, plus increased programming costs.

ANSI X3.64, color and graphics at an unbeatable price. Now you can make the break to ANSI—the industry standard protocol with unlimited control sequences—and color graphics with the Intecolor 2405 for $1295, single-piece price. Your Intecolor 2405 is completely ANSI compatible. (It also includes all ASCII codes.) Best of all, the Intecolor 2405's brilliant color graphics will help you convey more information, more quickly, and with greater comprehension than monochrome.

All the VT100 features you need in a conversational terminal. Terminal-based vector graphics on an 80 column by 24 line screen. Baud rates from 50 to 19,200. English language setup with non-volatile setup memory. Two full pages of screen RAM. A precision in-line CRT with auto degaussing. A 6MHz 8085 microprocessor with four hardware interrupts. Plus an option for defining and storing 72 functions you can recall with a single keystroke.

For only $1195;* you can get our compact, attached keyboard version. And you can mix and match, with quantity discounts starting at 25 terminals.

Act now. Get all the advantages of color, vector graphics and ANSI X3.64. Get the Intecolor 2405.

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NEWS UPDATE

Bubble Memory Alternate Source Pact

A long term agreement for magnetic bubble memory products has been signed by Motorola Inc. and SAGEM of Paris, France. The first step of this agreement concerns the production and marketing of the alternate sourced 256 Kbit and 1 Mbit bubble memory devices. The Motorola MBM-2256—256 Kbit and MBM-2011 1 Mbit Bubble Memory devices are now in volume production at Motorola's Tempe, Arizona facility. The compatible SAGEM MBS 2256 and MBS 2011 will be sampled during the fourth quarter of 1983 and in production at SAGEM in 1984.

MASSCOMP Acquires $10.6 M

Massachusetts Computer Corp. (MASSCOMP), a manufacturer of supermicrocomputers, announced that it has recently acquired $10.6 million in its third round of financing. Hambrecht & Quist placed the preferred stock, to be used for research and development and expansion of worldwide sales and service capability.

Oracle Forms Application Products Group

Oracle Corp. announced the formation of an Application Products Group. The new group will provide microcomputer versions of the ORACLE relational data base management system directly to software OEMs, systems houses, and others developing applications for end users.

Lufthansa Places $12 M Order With Sperry

A $12 million order has been received by Sperry Corp. from Lufthansa German Airlines, to develop the Lufthansa Integrated Information Network (LIFTNET) for the airline's worldwide computer communications complex. The new LIFTNET system is designed to enable terminal users and Sperry, IBM and Amdahl host computers to communicate with one another through a single communications network. LIFTNET will modernize the communications techniques and include gateways to the DATEX–L (X–21) and DATEX–P (X–25) public data networks.

Mid-Range LAN

NCR Corp. and Intel Corp., capitalizing on their expertise in communications, computer systems and microcomponent design, announced MIRLAN, an acronym for Mid-Range Local Area Network. The new offering addresses what is perceived by both companies as a void in the cost/performance spectrum of LANs currently on the market. Mirlan complements the higher performance, higher cost Ethernet which has already established itself as an industry standard.

Now you can escape the mouse trap.

Don't get caught in the trap of specifying a conventional mouse from an unproven supplier. Now with SummaMouse™ you can escape the trap with a reliable, all electronic mouse from a proven supplier of graphic input devices — Summagraphics. Based on solid-state optical technology, SummaMouse has no moving parts to wear out, jam or adjust. With no annoying skips or slips, the SummaMouse is easy to use and reduces operator frustration.

Designed to be cost-effective to OEM systems builders, the SummaMouse requires minimum power and easily interfaces to standard RS232 and TTL ports.

With its self-contained microprocessor, the SummaMouse facilitates two-way communication with the host computer to offer highly-responsive user interaction.

The SummaMouse is also format compatible with Summagraphics new MM™ Series digitizers and the industry standard Bit Pad™, so you can add full data tablet capability at any time with minimum integration costs.

So if you're looking for a low-cost mouse, don't get trapped. Specify SummaMouse so you know you'll get reliability, quality, on-time volume deliveries and worldwide technical support.

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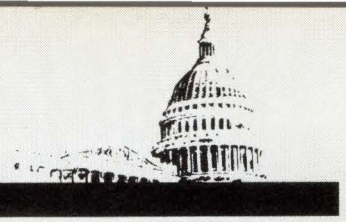
WASHINGTON REPORT



by Anne Armstrong

In an effort to head off attempts by several state legislatures to regulate the manufacture or use of visual display units, a Washington trade association has organized a task force to distribute information on VDUs and to provide expert witnesses to testify at hearings.

Although the federal government has decided not to regulate VDUs, six states—Connecticut, Maine, Massachusetts, New York, Oregon and Illinois—are currently considering legislation which would either restrict the units' manufacture and use or require frequent and expensive testing.

Citing concerns such as radiation, eye strain, back pain, and hazards for pregnant women, the various bills call for radiation checks on equipment, eye examinations paid for by the employer, frequent breaks for operators, and transfers without penalty for pregnant workers.

The Computer and Business Equipment Manufacturers Association is attempting to defeat the current bills and to persuade other states that such bills are not necessary. CBEMA president Vico E. Henriques says, "The VDU is one of the most studied pieces of equipment in today's office. It has passed environment and health tests with flying colors." Yet, Henriques acknowledges that proposals to restrict its design and use continue to appear.

In Massachusetts, hearings have been held on H.B. 2658 which calls for:

- six-month advance notice by employers of the installation of CRT terminals
- employer-paid annual eye exams for CRT workers
- adjustable, ergonomically correct chairs and workstations
- 15-minute work breaks every hour for operators who use CRTs continuously
- regular inspections of terminals to check for any excess radiation and to adjust screen clarity.

"I can only speculate on the reasons for this fight to restrict VDUs," says Henriques. "In some cases, there is misunderstanding of readily available information. In others, there may be fears that VDUs, like other computer tools, will eliminate repetitive jobs at the low end of the skills spectrum—jobs that may be unionized. Higher productivity in a particular area may also slow growth of new jobs; though we have seen consistently in the past that computerization creates, in the entire economy, more jobs than it eliminates."

The CBEMA campaign stresses the constant improvement in computer equipment design. "We ask the states not to freeze development of the technology by legislating today's standards," said Henriques.

CBEMA is printing information brochures that give the results of the many tests done on VDUs and they are providing expert witnesses to testify at various state legislature hearings.

Export Power

The Defense Department, in a bold move to increase its control over the export of high-technology equipment to eastern bloc countries, is seeking veto power over exports to allied and neutral countries. On the grounds that sensitive technology is frequently funnelled through those countries before entering communist bloc nations, Pentagon officials want to extend their veto, which currently covers only direct sales of strategic commodities to the Soviet Union, communist bloc countries, and the People's Republic of China.

Strategic equipment, for which special export licenses are required, includes computers, lasers, semiconductors, and some computer-readable databases. Licenses are issued by the Commerce Dept., which is not anxious to extend Defense jurisdiction. The Pentagon now reviews approximately one-third of the 8,000 export applications for eastern bloc countries, but more than 60,000 applications were processed for free-world countries. Commerce officials say if the Pentagon tries to screen those applications as well that intolerable delays will be injected into the licensing process.

The entire battle may be taken out of the administration's hands because the House Foreign Relations committee has reported out a bill which loosens considerably the export controls currently in effect under the present Export Administration Act.

Joint Venture Guidelines

Assistant Attorney General William Baxter detailed recently the Reagan administration's program to allow high technology companies to form joint research and development projects.

In a speech to the National Association of Manufacturers, Baxter said that the combined size of companies forming a research venture should be no more than one-sixth to one-fourth the size of the total of the remaining firms in the field that are not taking part in the venture. Baxter also said that there should be room for two to four similar joint ventures within each industry if this yardstick were applied.

Strict anti-trust laws have often been cited by businessmen as one reason why the United States has been having trouble in world markets, but Baxter cautioned against depending completely on less stringent anti-trust laws. Countries with liberal anti-trust regulations do not automatically do well, he said.

He indicated that the administration is considering proposing some changes in anti-trust legislation—such as the extension of patents on processes to include the products made by the process, and the granting of greater control by patent, trademark, and copyright holders over their intellectual property. To date, no administration bill has been sent to the Hill.

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 distributor/dealer, write Houston Instrument, 85OO Cameron Road, Austin, Texas 78753. Phone 512-835-O9OO, or 1-8OO-531-52O5 if outside Texas. In Europe contact Bausch & Lomb Belgium NV., Rochesterlaan 6, 824O Gistel, Belgium. Tel O59-27-74-45. Tlx 846-81399.

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So call us today.

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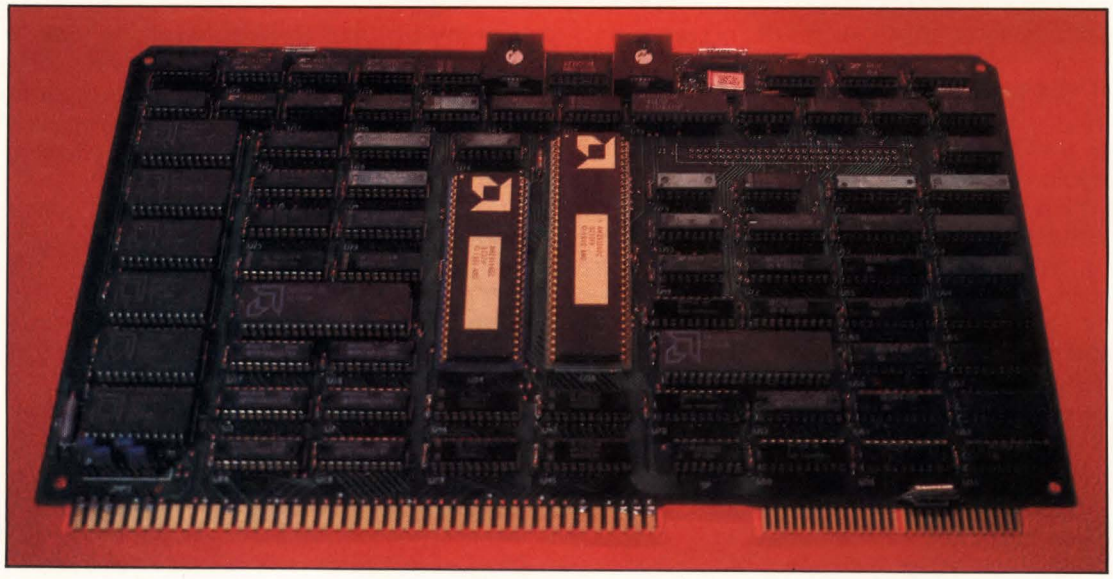

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Monochrome CRT Produces Color With Liquid Crystal Switch

A high resolution, field-sequential color display has been produced with a monochrome CRT and a liquid crystal "color switch." Key to the system is a liquid crystal optical switch developed by Tektronix, who feel it is ready for commercial application in their Liquid Crystal Color Display.

This system allows high resolution color in smaller displays, because no shadow mask or patterned phosphors are used. Monochrome CRTs are also more rugged than color screens, sport inherent convergence, and have good contrast in high ambient light.

The CRT has a simple phosphor with two emission peaks, typically red and green. Information written on the screen in a field appears only in the color selected by the electronic switch. All possible mixtures of the two colors in the phosphor are thus possible. Since each color is repeated at a 60-Hz rate, the two-field system runs at 120 Hz.

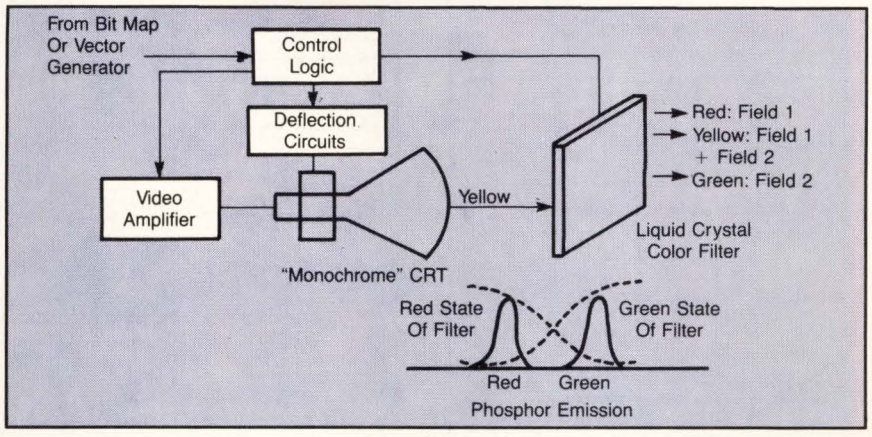

Figure 1: Block diagram of a liquid-crystal-switched, field-sequential color display.

Research is continuing to extend the system to three fields and three colors, to support a conventional full-color display.

—Pingry
Write 239

DVORAK Keyboard Endorsed by ANSI

On an average day, a typist's fingers move a distance of twelve miles over the terrain of the standard QWERTY keyboard. The majority of work is done by the fourth and fifth digits of the left hand, leaving the stronger and quicker right hand and middle fingers for the least frequently used characters.

Recently, the American National Standards Institute (ANSI) endorsed an alternative keyboard, the Alternate Standard (AS), which is designed with a home row of keys that can configure 3,000 word combinations, as compared to QWERTY's 100. The keyboard is popularly called the DVORAK (after its inventor August Dvorak) and utilizes the typist's more agile fingers by placing the most frequently used characters in the center of the board. It is being manufactured by Wang, Exxon, Olivetti, and Apple and some vendors are proposing that all keyboards have the capability to switch between DVORAK and QWERTY.

Skeptics claim that its cost (typewriters can be converted for approximately $50; DVORAK word processors start at $2,000) and the retraining factor (about two weeks) will hinder the new standard's success. But supporters say the speed, comfort, and low error margin of the DVORAK will revolutionize the work of typists and computer operators. For further information about DVORAK keyboards, write: *Quick Strokes, Box 643, West Sacramento, CA 95651.* *—Coville*

Ethernet Based Network Operating System And Virtual Protocol Machine For Multiuser Microcomputers

Plexus Computers, Inc., has released three networking and communications hardware and software products that allow their 16- and 16/32 bit multi-user microcomputers to: communicate over a local area network, be linked to mainframes through a Virtual Protocol Machine (VPM) facility and to support remote job entry (RJE). The networking system is designed as part of the UNIX op-

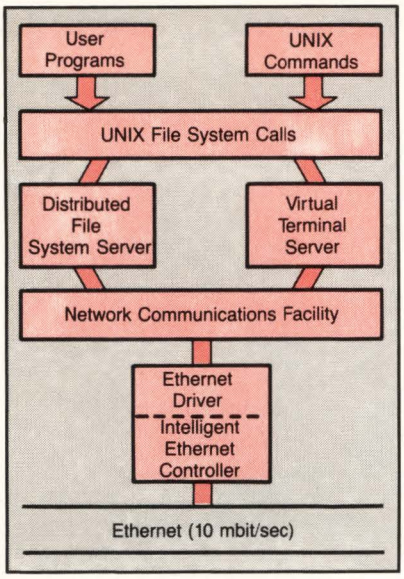

Figure 1: Plexus Network Operating System Software Architecture.

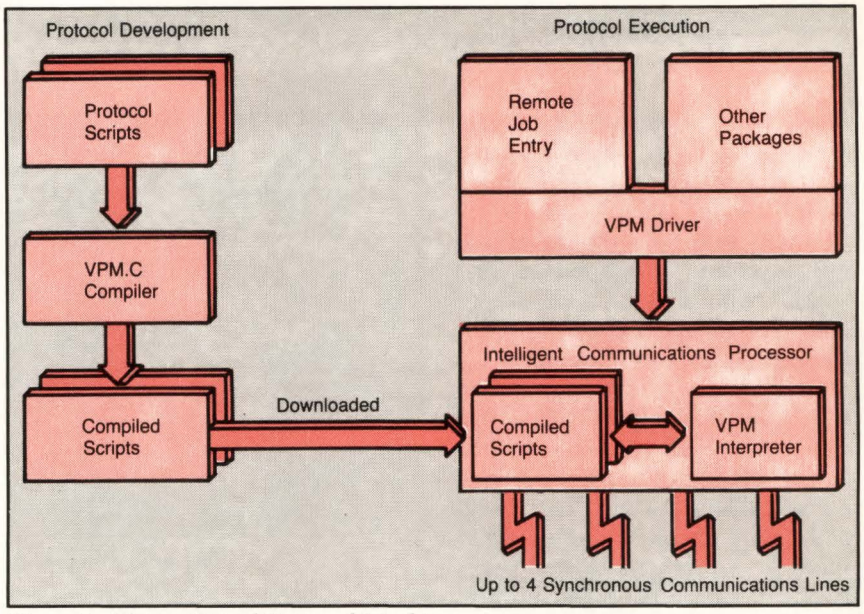

Figure 2: Plexus Virtual Protocol Machine

erating system with Plexus UNIX-based computers linked by a building block architecture on an Ethernet local area network. This scheme allows an array of computers to be constructed that reflects the distributed processing requirements of an organization, yet acts as a single system.

As part of UNIX, the Networking Operating System (NOS) provides users access to all data, programs and peripherals on the network. Resources appear to be local, giving users the impression of having direct, interactive access to a system much larger than any specific node. The user sees a "distributed file system" extending the network. Files can be shared completely across the network, locked for concurrent update or delivered subject to security constraints. NOS can also improve network integrity over traditional approaches because NOS does not require a dedicated file server, but instead allows one or more systems to be used primarily for file server functions.

Typical file transfer programs require users to access remote data by first copying a file to a local system, and then working with it locally. When finished, the operator again uses the networking utilities to copy the file *back* to the remote system. Under NOS, users have interactive access to data on remote systems. Unlike network file transfer programs, programs work exactly the same on local or remote files.

Since all the peripherals in the network fall under NOS control, any user can access an I/O or data storage peripheral in the network. This means that devices such as letter-quality printers, plotters, and high-capacity backup drives do not have to be duplicated locally. Virtual terminal capability allows any user in the network to log into any other system and process a job on that system. This capability is useful when one system has greater or different processing power than the local computer. NOS is licensed by Plexus Computers, Inc., at $1,500 per system. An Ethernet connection kit, including all hardware needed to attach a system to an Ethernet, lists for $3,450. First customer shipments are scheduled now.

The VPM communications subsystem is based on a proprietary intelligent communications processor (ICP). Interrupt-driven and time-critical communications software is offloaded to an ICP. The ICP supports up to four synchronous data communications lines each running its own line protocol. It handles communications interrupts, link-level protocol functions, and all low-level synchronous communications, freeing the system's job processor for computational tasks. The distributed multiple processor design enables users to add communications capabilities without severely degrading performance. VPM also cuts the time required to create and test data communications programs. Programmers write protocol scripts in a specialized C-type language using UNIX development tools. The language includes commands for buffer management, error checking, and data communications hardware control. The script is compiled and translated into modules that are downloaded and executed by the ICP. A set of debugging tools helps locate program problems.

The first protocol written using VPM is a part of the company's RJE package. It is a HASP multileaving, bisynchronous file transfer protocol giving users a connection to mainframes. VPM software is included in the Plexus implementation of the UNIX System III operating system, which is priced at $2,000. The RJE package is priced separately at $750. Both are available immediately.

—Eidsmore

Write 236

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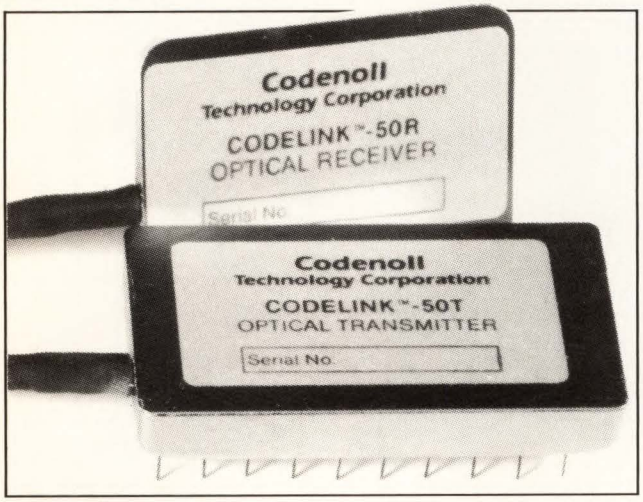

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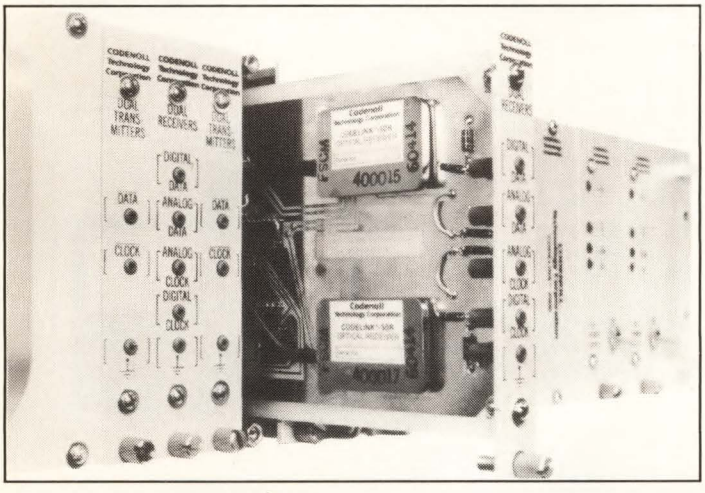

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16-Bit Portable Computer Goes Anywhere

Battery powered and weighing nine lbs., including an eight line × 66 character LCD display, 320-Kbyte floppy disk drive, 300 Baud direct connect modem, and standard 32 Kbytes of user RAM, Gavilan Computer Corp.'s 8088 based Gavilan is a truly transportable computer. The 11.4″ × 11.4″ × 2.75″ main computer unit can fit inside a standard briefcase and run off the rechargeable battery pack for up to eight hours. Other hardware features include an integrated touch sensitive panel for cursor control, a full keyboard and 10-key pad. An optional 11 × 16 dot matrix correspondence quality printer prints at 50 characters per second. The printer has its own battery pack. The unit can also run from a 110 or 220V outlet using an AC adapter.

Other options include: an

Continued on p. 22

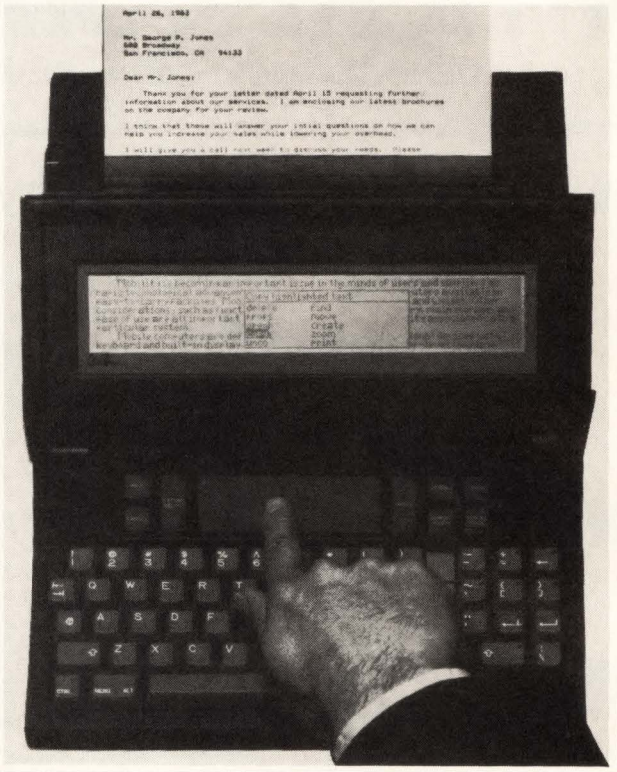

Figure 1: Gavilan portable computer. Cursor is controlled by touch sensitive panel. User selects items on display by moving pointer and tapping panel.

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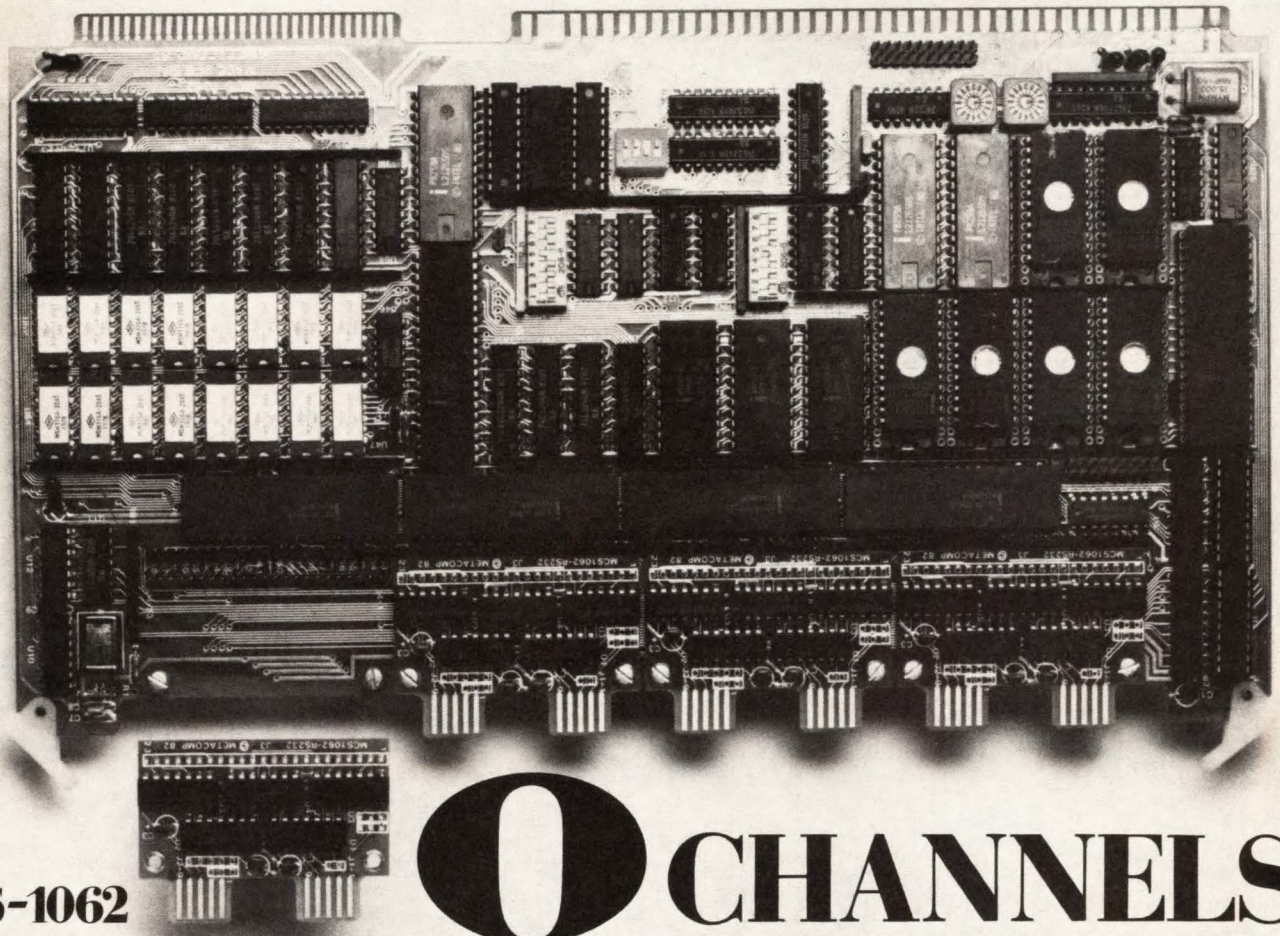

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- Standard MULTIBUS architecture
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The MCS-1062. The capacity has doubled, but the price remains the same. $1,485. ea.**

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**Quantity 50 price, including RS-232 interface modules. Price may vary, depending on interface module options.

acoustic coupler; a vehicle power adapter that permits operation from a cigarette lighter; plug-in memory expansion capsules each with 32 Kbytes of RAM or EPROM and their own lithium batteries which provide one year of storage protection, an attachable module combining 128 Kbytes of additional processor memory with a 3″ second microfloppy disk drive, and carrying cases. Standard software includes: proprietary built-in software; five internal, fully integrated proprietary application systems, including word processing, spread sheet, portable secretary, communications, and forms processing; BASIC and PASCAL; applications packages that run under MS/DOS; and application development system software that can run on the Gavilan main unit or the IBM PC.

The operating system kernel, interpreter, human interface software and data structuring software are contained in onboard ROM. The software is built to provide a uniform human interface across applications. Menu functions such as "help," "view," "select," and "command" allow the user to interact with the computer mainly through the use of the touch panel. "Help" is always available with context sensitive answers to questions. Applications are available on either plug-in capsules or diskettes.

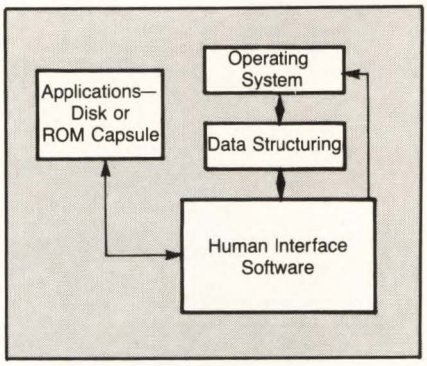

Figure 2: Gavilan software structure. Human interface (HI) software is intermediary between data structuring and application software. HI calls operating system and applications software for services. System allows cells to be moved from one application to another.

The portable's main memory is static, rather than dynamic RAM, because of the high power drain of dynamic 64 Kbit RAMs. In a portable system the RAM can use 50 percent of the system power. 64-K Static CMOS RAM would be an attractive alternative. Currently, 8 Kbit×8 CMOS memories are available from at least two sources with 16 Kbit×8 expected by 1984.

Quantity retail prices are $3995 for the basic unit, $985 for the printer with battery pack, and $695 to $1245 for additional floppy and RAM memory.

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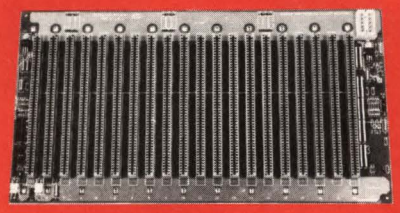

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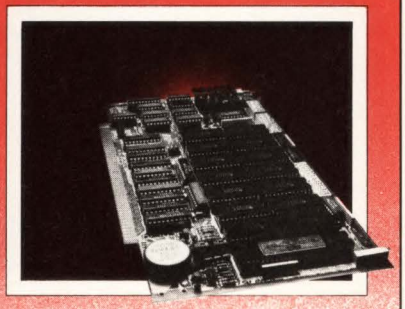

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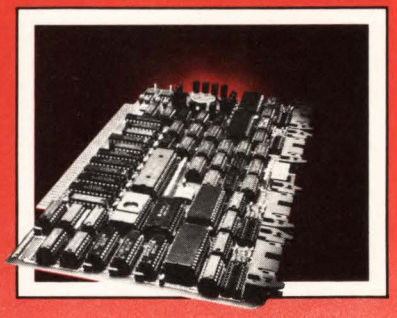

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OEM Factory Franchises

ATS Franchising Corp. (Fremont, CA) may be the first electronics franchise operation. For a $55,000 upfront fee, $10,000 training fee, and ten years commitment, a qualified franchisee obtains the rights and techniques required to establish a printed wiring board assembly facility. Huey Lee, the President of Advanced Technical Services, ATS Franchising Corporation's parent company, developed PWB assembly, management, production, quality control and training methods that he feels are transferable. He has qualified his first franchisee and others are being evaluated.

Lee's goal is to include the electronics industry in the booming franchise market place. Franchising, or licensed distribution, now accounts for about a third of the retail goods and services in the United States according to the U.S. Department of Commerce. Franchise sales of goods and services are estimated to have jumped $58 billion from 1981 to 1982, and may approach $500 billion by year's end. U.S. Department of Commerce statistics show the failure rate for individual franchises is over 75% lower than that of the national average for small businesses. That's because a franchise deals in and uses proven products, services and methods. Use of trade names, marketing expertise, purchasing power, standardization of operation, uniformity of products/services-and advertising support by the parent company frequently provides a competitive edge. **Write 237**

Figure 1: Huey Lee, President of ATS provides rights and techniques required to establish PWB assembly facilities to qualified franchise applicants.

SCION Enters New Markets

SCION (Reston, VA), formerly known as a manufacturer of S-100 board products for computer graphics, is developing products for the broadcasting/video, IBM Personal Computer, Multibus and S-100 markets.

The firm is making a shift from its earlier multiple CPU (Z-80) approach to computer graphics because of the intense competition from firms developing graphics engines based upon single microprocessors. While it will continue to support its Microangelo products, the new developments indicate future directions. One of the products is called "Superscreen" and is based on a Motorola 68010 with 64K of RAM. The superscreen project is seen as a 2 to 4 year growth product and will appear as either of two configurations: a 3 card format CRT. The 3 cards will include the 68010 as a CPU card, an interface card, and a 16 bit microprocessor based handshake card that will allow the system to operate on any bus (multibus, the IBM PC, and S-100 are among the first handshake cards to be developed). The product thus offers near term use for OEM's and serves as an avenue for entering the IBM PC office environment. In the latter configuration Superscreen is seen as allowing IBM to provide an Apple "LISA" type workstation. This implementation is being strengthened by the current work in developing a color graphics card for the IBM PC, establishing a niche for SCION in the PC market.

In the broadcasting market

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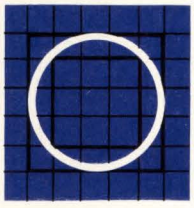

3. High Running Accuracy

The more perfect its raceway roundness, the more perfectly a bearing will run. Hoover-NSK establishes its prototype characteristics using equipment that detects runout deviations as small as 1 microinch. This equipment enables us to set manufacturing parameters that maintain or exceed ABEC 7 standards, even in large production runs.

4. Low Noise Level

Bearing noise can have a substantial effect on performance. Hoover-NSK employs an anechoic chamber to establish noise levels for its prototypes and to test production samples. The result is a disk drive bearing capable of performing to levels as low as 30 db.

5. Minimum Torque

Starting torque generated by most bearings can eventually ruin a DC brushless motor. Hoover-NSK has minimized this problem in two ways: first, through manufacturing techniques that produce a virtually frictionless bearing; and, second, through the use of an exclusive patented V Labyrinth Seal. This seal retains the lubricant without actually contacting the bearing inner ring.

6. High Lubricant Integrity

In some cases ordinary bearing-seal designs can permit the volatile compounds of a lubricant to evaporate. Hoover-NSK has developed a special contact seal for these applications. When paired with a V Labyrinth Seal, this combination provides excellent lubricant integrity and maintains low torque characteristics.

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SCION has developed an S-100 card that allows its color graphics system to "gen-lock" or mix RGB and computer graphics images to form NTSC composite images suitable for broadcasting.

In the Multibus market the company is modifying its Microangelo S-100 system and providing additional software for both Multibus and S-100 users in business graphics and firmware for rapid graphics rendering.

SCION's trend in developing graphics products will introduce it as a major competitor in several markets. *—Borrell*

Write 233

New Acquisition Leads To Integrated Board Expertise

Intelligent Systems Corp. (Norcross, GA) has recently completed the acquisition of Datavue, a 10-year-old manufacturer of multi-user computer systems based in Seattle, WA. The action is the second acquisition by the company in the last year; Quadram, Printacolor, Datavue, and Intercolor have all been joined under the ISC banner (although Printacolor and ISC only share board positions). The potential for the company having integrated board manufacture expertise in the IBM PC market, multiple terminal system, graphics, and hardcopy output is building rapidly. In addition, the company is implementing changes in its marketing and services areas. The firms continue to operate as separate divisions but have central management and a shared board of directors. Future directions are indicated by the acquisitions of a CAD/CAM system to be used in mechanical and electrical design by both ISC and lowcost marketplace, which will continue as its areas of expertise grow, however there is likely to be a shift in the types of products and systems that will be offered by the firm in the near future.

The response to acquisition by ISC has been so enthusiastic that the firm has not had to make use of its bankroll of $7 million raised in public offering of stock last year. Most of the business done to date has been supported by sharing or trade of stock.

—Borrell

Write 234

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Applicon Introduces 32-Bit CAD/CAM Development

Three and a half years in development, Applicon's first 32-bit product, dubbed BRAVO!, is a turnkey, VAX-based CAD/CAM system. The overall goals in development were greater power, lower cost per station, productive use for both novices and experts, and integration of design data into a factory automation system.

New systems software has a menu-driven Editor common to all applications, CODASYL-compliant Database Manager and AGL Graphics Language programming package, an enhancement of PL/I. Applications software allows surface modeling, interactive solids modeling, finite element modeling and bill of materials, flat pattern and NC tool path generation. BRAVO! software is offered on a turnkey basis with applicon Series 4000 graphics hardware and the VAX 11/751 or 11/730. And in a departure from Applicon's turnkey operation, the new software is offered "unbundled" to VAX 11/780 users.

The focus on software development is one that Applicon intends to continue. A new level of education will be required for users with application packages, although menus, help and the continuity of the Editor across applications eases use of the new system. Users can display menus and views in up to eight windows.

Applicon's software activity also includes an agreement to market Algorex PC design products on the Series 4000. The initial agreement covers two end-to-end PCB design products with schematic entry, automatic assignment and placement, routing and design verification.

BRAVO! is already being shipped, with turnkey prices from under $150K. A system with a cost per terminal as low as $45-50K should be available this summer, when new hardware with a smaller screen is introduced. Look for Applicon to enhance and create software for the 32-bit world from now on.

—Pingry

Write 238

EWS System Includes VAX LAN Connections

Cadtec Corp. (San Jose, CA) is providing their interactive engineering workstation (EWS) with system facilities that will support VAX 11 connection. This system architecture allows multiple workstation users access to mini and mainframe resident project oriented databases. The 68000-based CADTEC Workstation is supported by a 2901 graphics processor with 1 Mbyte of user RAM and 20 Mbytes of hard disk.

The local workstation database and VAX project database are linked via a CORD data system. This data system also includes a standardized object level interface to application programs. Data is stored in an extendable relational database, not a file structured database. The object-oriented high level interface to applications allows database modification and expansions to be made on a wholesale rather than file by file basis.

The system is designed for systems houses with a VAX investment. Use of Mainsail and UNIX helps insure software portability, for example. This philosophy is carried over to the logic design tools being offered. Project software will include design tools such as schematic network entry, waveform generation, simulation and network analysis and timing verification. A Cadtec Interface Format language is used to describe a design in an output file format, such as a net list, promoting use of VAX software.

The user interface is structured around a window manager, command language interpreter and display list formatter. This configuration is used to create a highly interactive environment with multiple user defined size and placement application windowing, dynamic menus, context dependent help files and pack/tablet, joystick and keyboard cursor control. This graphics and interface versatility is used to great advantage with the simulation analysis software. A logic analyzer waveform display is created with a logic probe reading out a digital state.

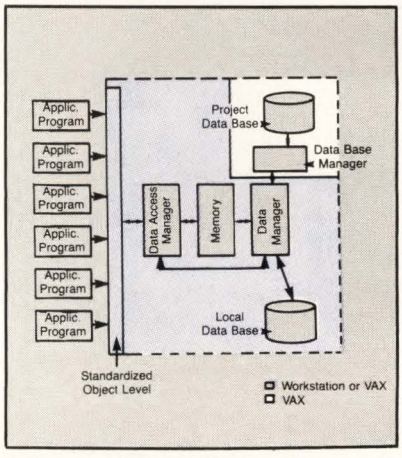

Figure 1: CADTEC Data System Architecture's project database manager runs on VAX. Workstation/VAX connection is an Ethernet or VR-11W UNIBUS connection.

This system, the company feels, will serve project management. Cadtec is incorporating a network status control structure covering access control, design access, notification and milestone and task attainment tracking.

—Eidsmore

Write 231

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Aydin Controls First With 256k DRAMS

Aydin Controls has announced a new series of standalone graphics display products. The devices, whose designation is AYCON 2000 is said to be directly competitive in price and performance with Ramtek 9460, Tektronix 4115, and Lexidata 8000 series products. The announcement comes as one of a series of new efforts by the Fort Washington, PA firm.

The AYCON 2000 incorporates technology that reestablishes the company in the ranks of the leaders in graphics display systems. The design efforts for the product were threefold: reducing the size/form factor and power requirements, improving price performance, and incorporation of the latest solid state electronics. Based on a new 6 card chassis

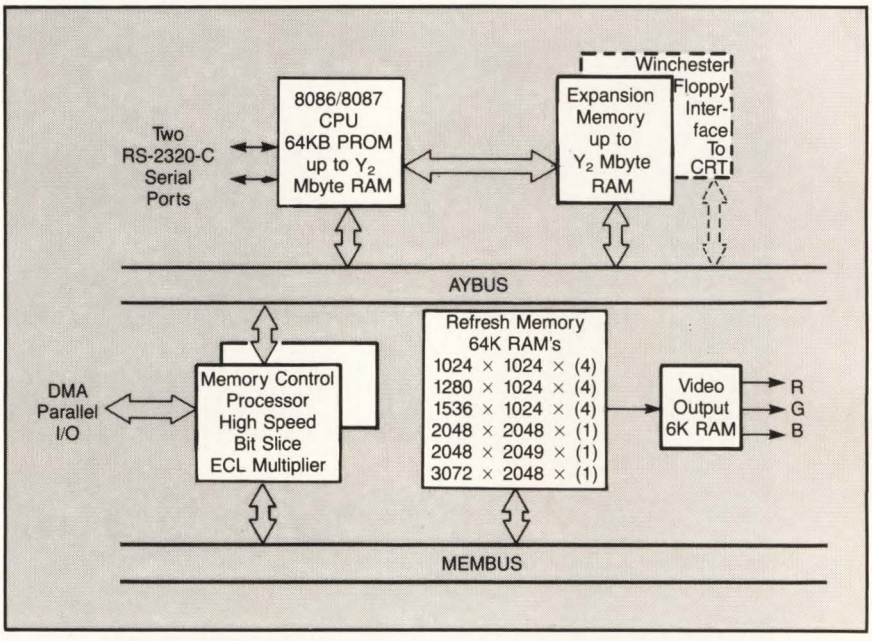

Figure 1: The AYCON 2000 example 6 card system hardware configuration.

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(Model 5226) with a proprietary bus, (the Ay-Bus is said to be quite close to multibus specifications) (**Figure 1**). Aydin has chosen the 8086/8087 processor/co-processor pair from Intel as the CPU. The display system configuration is unique in that it is said to be the first system of its form factor to make use of the full amount of direct memory accessible by the 8086—one megabyte—through the use of Western Electric's 256k DRAM chips.

Because the system has been designed for real time markets in graphics and image processing Aydin has provided high performance control of external data through its memory control processor (MCP). The MCP takes up slots 2 and 3 in the 6 card chassis, incorporates a DMA parallel interface and performs tasks of vector generation, hardware pan and zoom, memory flow, and signal synchronization. Up to 16 AMD 2901 (4 bit) bit slice-processors and TRW's ECL multiplier chip are implemented for these purposes. 29116's will be used as they become available.

The design of the refresh memory card demonstrates the type of flexible use of memory that is becoming a benchmark within the graphics field: the single module's memory planes of 64K RAMS can be configured as 1024 × 1024 × (4), 1280 × 1024 × (4), 1526 × 1024 × (4), 2048 × 2048 × (1) or 3078 × 2048 × (1) picture storage area. Actual viewable resolution extends up to 1536 × 1024. Multiple memory modules can be configured to expand Z axis bit depth.

The fifth slot is reserved for the video output module which contains color look-up tablets and CRT drive circuitry. The final card slot it intended primarily as an interface slot for Winchester or floppy disk drives, with an SMD interface. The space, however, may be reconfigured as an interface to other types of bus architecture. One of the initial supplementary products to be offered will be a multibus interface card.

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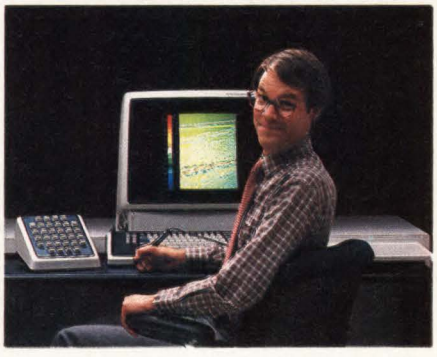
And two, give us a call for a demo of the 1500.

The hour or so you spend with us now can save you days of standing in line later.



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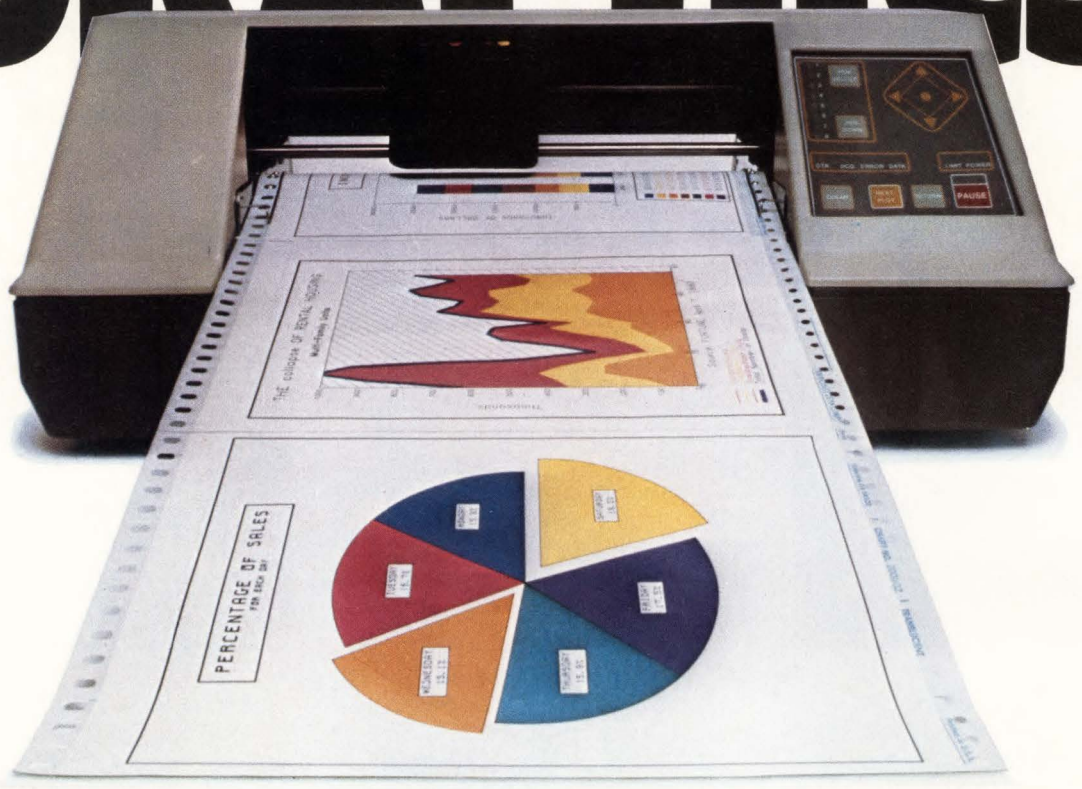

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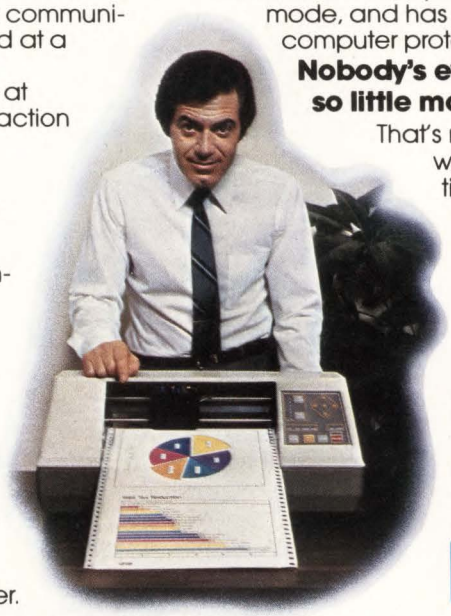

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Photo courtesy DigiRad Corp.

Medical applications today incorporate the fastest, most powerful computer systems available, but are restricted by memory limitations and lack of standards.

Industry Spotlight: Electronics To Meet Medical Needs

by Squibb Medical Systems Staff

Medical electronics spans a wide range of functions, from monitoring neonatal heartbeats to imaging the cardiovascular region of septuagenarians. To meet the demands of these applications, a near billion-dollar-a-year business is quickly adapting to contemporary electronics technologies and marketing practices. Most evidence points to a five-fold increase in doctors' hands-on experience with computers by 1987, though some information processing and electronics professionals would disagree.

Using state-of-the-art μPs like the Intel 8086 and Motorola 68000 families coupled with advanced software algorithms, systems in hospitals, clinics and doctor's offices rival scientific computing systems and the latest engineering work stations. Systems used to monitor patient status or image internal organs and muscle tissue require high MTBF ratings and often must perform multiple arithmetic functions such as sub-pixel image manipulation or concurrent signal processing.

Like other segments of the electronics industry, medical electronics is changing. Manufacturers are being forced to adapt to changing marketing conditions and take long term looks at their presence in key markets. Users are becoming more sophisticated, demanding increased equipment functionality, quicker turn-arounds from service departments and greater flexibility in meeting unit pricing.

Increasing capabilities and interfacing traditional stand-alone medical equipment to larger hospital mainframes are challenges that face all manufacturers.

Squibb Medical Systems Group, P.O. Box 6639, Bellevue, WA 98008.

Diagnostic Imaging

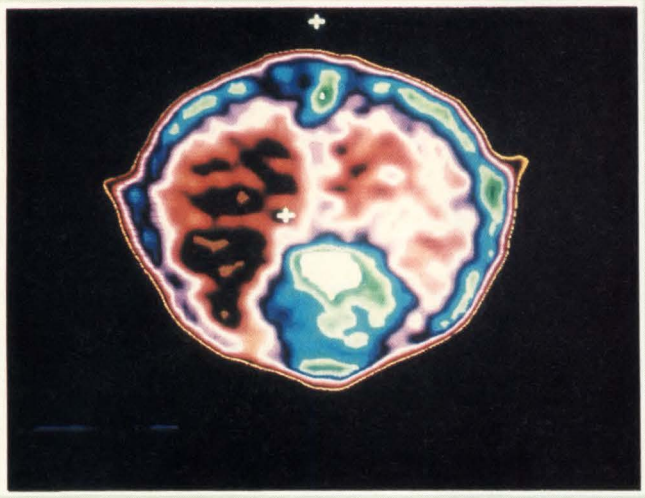


Figure 1: CT scan displaying top view of brain.

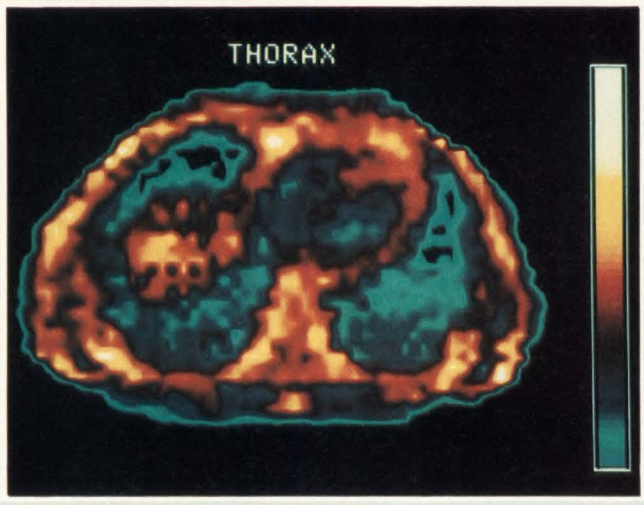


Figure 2: View of thorax using Fonar Corp.'s NMR scanner with Ramtek's 9351 display generator. Photos courtesy Ramtek Corp.

Largely due to advances in microelectronics and increases in processing power, a number of radiological imaging technologies have evolved for both clinical diagnosis and non-invasive medical research, such as "knifeless" biopsies. It has sometimes appeared that various technologies were in competition; however, with further development it has become clear that each measures different specific parameters.

Digital Radiography. Recent advances in integrated digital radiography systems bring the benefits of digital image processing to the standard radiographic procedure. Capabilities formerly associated only with modalities such as CT scanning are now available to enhance the diagnostic power of the conventional radiograph or x-ray.

One advanced application of digital radiography is *digital subtraction angiography* (DSA) which allows visualization of the blood vessels after injection of a dye and locates arterial narrowing. X-rays beamed through the patient before the dye is injected are detected by sensor and transmitted to a computer which displays the original image of the artery. After the dye has been injected, another x-ray is taken. To eliminate obscuring features, the computer "subtracts" the first image from the second and enhances its result by increasing its contrast.

Computed Tomography (CT). Tomography is a type of imaging that provides a "slice" or transverse plane image of the body. Conventional x-ray imaging, by contrast, projects all anatomy between the x-ray source and the film plate detector into a single image. Conventional x-ray imaging reliably detects differences in anatomical density in the range of 5 to 10%. CT (also known as Computer-Axial Tomography, or CAT) can detect differences as small as 0.5%.

CT scanning consists of two sequential processes. First, x-ray data from different views within a single cross-sectional plane must be acquired. Second, the data is input and converted to a displayed image. The image is derived from a fan beam of x-rays passed through the body from many different angles. The x-rays are partially absorbed or attenuated as they pass through various tissues and the variations produced are recorded by x-ray detectors. The electrical signal outputs from these detectors are amplified, converted from analog to digital form, and stored in memory.

Issues For Diagnostics

A key issue facing the manufacturers of diagnostic imaging systems is their ability to develop or find an economical method of mass storage to accommodate the sheer quantity of information gained from most PET (Positron Emission Tomography), Computer Aided Tomography (CAT) or Digital Subtraction Angiography (DSA) exams. A single DSA exam can generate as much as 10 Mbytes of digital information. Considering that some hospitals perform up to 15 DSA exams a day, 260 days a year, a hospital could need to store as much as 37,000 Mbytes of digital information in a single year. Compounding the mass storage problem is a legal requirement in some states requiring that patient records be stored for at least seven years.

Another issue facing suppliers of diagnostic imaging systems is the long-term identification of which technology will gain dominance in the marketplace. At present, five technologies are used in hospital radiology departments over and above existing X-ray systems.

Nuclear Magnetic Resonance (NMR), Computer Aided Tomography (CAT), PET scanning, Ultrasound and Digital Subtraction Angiography all offer specific advantages for individual imaging

From the stored data an image of a single slice of tissue is reconstructed by the computer through the solution of a series of complex equations. The brightness of each portion of an image is proportional to the degree to which the tissue absorbs x-rays. The image is displayed on a screen in shades of gray or colors, and is photographed for permanent recording. The image then can be manipulated to provide quantitative measurements of all regions.

Positron Emission Tomography (PET). Positron tomography appears to offer great potential for the study of possible chemical defects in the body. PET provides information on the source and intensity of the gamma radiation emitted by an isotope ingested by the patient. The availability of "radiopharmaceuticals," or ingestible drugs which emit suitable radiation for detection, coupled with algorithms for computed tomographic image reconstruction, led to the development of PET. PET has the ability to label and analyze compounds within body tissue that emit positrons, such as isotopes of carbon, nitrogen, oxygen, and fluorine.

Positron-emitting radioactive drugs, taken intravenously emit a positive electron, which, after traveling a few millimeters from the nucleus, interacts with a negative electron. The resulting annihilation yields two photons which fly off at 180° from one another and are detected by scintillation crystals mounted on one or more rings surrounding the patient. Most PET imaging devices use time coincidence to determine the line of position along which the positron emitter decayed, thus indicating tissue function disorders.

Ultrasound. Ultrasonic imaging systems are similar in principle to sonar or radar. A train of short pulses of high-frequency ultrasound is emitted by a piezoelectric transducer contained in a hand-held probe which is in contact with the patient's skin. As a packet of ultrasonic energy propagates through the body, most of it is lost through absorption by tissue, but a small amount is reflected at boundaries between tissues of differing acoustic potentialities. It is this reflected or scattered component that provides analog information. Arrays of microelectronic acoustic transducers and associated circuits are used in a computer-controlled time sequence for both electronic focusing and scanning in a sector pattern to produce a real-time cross-sectional image. Ultrasound's applications include: imaging mov-

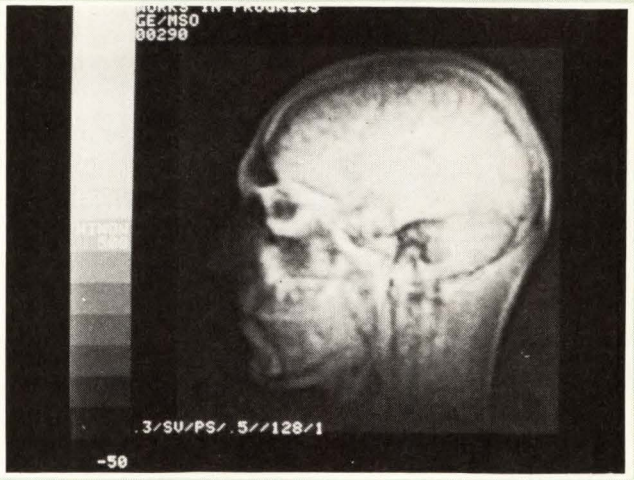


Figure 3: NMR image done on GE's Medical Systems Scanner.

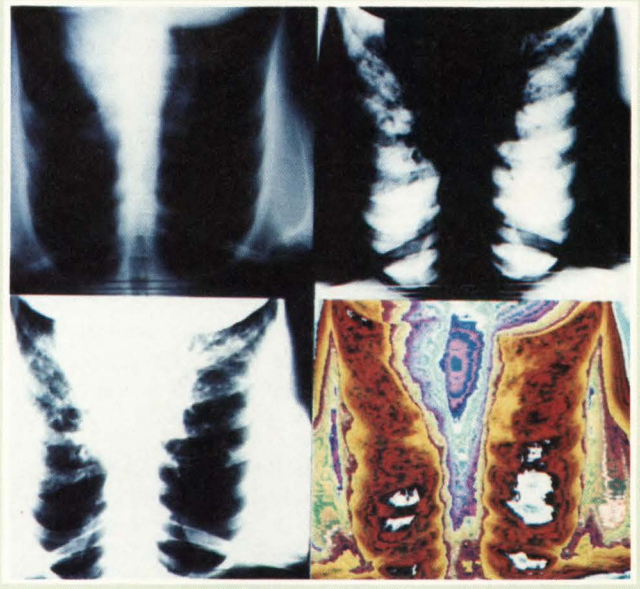


Figure 4: Contrast enhancement providing pseudocoloring of an original x-ray (bottom right) using Aydin Control's AY52000 Image-Processing System.

applications. Suppliers must service and sell to existing system users while remaining flexible enough to move into whichever technology emerges as the dominant choice of hospital radiology departments.

The Historical Choices

In the not-too-distant past, diagnostic imaging equipment was limited to two types: X-ray and ultrasound systems. Ultrasound (which uses high frequency sonar waves to image portions of the body that may be "obscured" by layers of tissue, other organs or bones) was the clear choice in watching organs in realtime, without the associated dangers of surgical procedures.

By the late 1970s, ultrasound systems had been refined to the point where they were used routinely for cardiology, fetal monitoring and some thoracic applications. Physicians, however, demanded more of their systems, forcing manufacturers to package both time and motion capabilities into single systems.

By responding to market opportunities with ultrasound systems that met or exceeded users' needs, certain companies helped etablish clear market windows into vertical applications like cardiology, surgery and other specialized medical applications.

Figure 5: GE's PASS (Phased Array Scanning System for Echocardiography) has two separate monitors displaying menu selections and the 2-D image.

Diagnostics Today

By the early part of this decade, users and manufacturers alike had profited from each other's experiences. Systems became increasingly functional and into the 1980s, gradually evolved into user-friendly computing hardware that help physicians better serve patients.

The evolution of ultrasound systems has resulted in medical diagnostic tools that help neurosurgeons precisely locate and remove tumors and lesions as small as 2 mm. Gone is need for a brain surgeon to make as many as four surgical passes through the field. Instead, he is guided precisely to the area of the brain affected by the tumor.

Other refined ultrasound imaging systems can be found in the veterinarian's office, where portable systems are used to detect the development of equine twins as early as 14 days after conception. Because of the value of most race horses, commercial breeders are using this breakthrough in animal care to protect their multimillion dollar investments.

Imaging systems today are typically stand-alone computing systems found in individual departments; little data is transferred from one system to another. But given the adoption of standards like Ethernet and the work of the IEEE 802 committee, medical professionals may soon enjoy interdepartmental communications capabilities.

With the advent of new signal processing technologies and more powerful software, it should be possible to get more information from non-invasive medical exams. This should bring the use of diag-

ing targets, such as the heart or a fetus; imaging the pregnant uterus, where minimal x-ray exposure is advisable; and imaging soft tissues, such as muscles and blood with similar densities but different acoustic properties.

Nuclear Magnetic Resonance (NMR). NMR holds the promise of becoming an integrated diagnostic imaging procedure. It provides, in a single study, both the physiological composition of tissue, and data describing the chemical composition of cells—data previously unobtainable *in vivo*. NMR provides vivid images in "slices" that resemble computerized tomography (CT) but does not use x-rays.

NMR imaging relies on the interaction of radio waves with hydrogen nuclei in the presence of a magnetic field. Four major elements are required to make a magnetic resonance imaging device: a computer to manipulate image data and control instrument operation; a radio frequency tranceiver to produce radio waves and to observe their interaction with hydrogen nuclei; a means of producing gradients in the magnetic field which provides the system with spatial discrimination; and a bias field magnet to produce a uniform magnetic field within the imaging volume.

NMR images made thus far are basically pictures of the distribution of hydrogen in the body. Hydrogen, whose nuclei consists of a single proton, gyrates in random directions, but when placed in a magnetic field, the spinning nuclei will tend to line up in the direction of the field. The nuclei can be tipped out of alignment in predictable ways if additional energy in the form of radio waves are beamed in at right angles to the magnetic field. The radio wave pulse starts the nuclei gyrating in unison (precessing) with the radio frequency tuned to both the resonance frequency of the species of atom being analyzed and to the strength of the magnetic field. When the radio waves are stopped, the resonating nuclei will "relax" back to their magnetized state. As they do, they emit a tiny radio frequency signal. With different chemical compounds, the nuclei resonate at predictable frequencies slightly different from the one

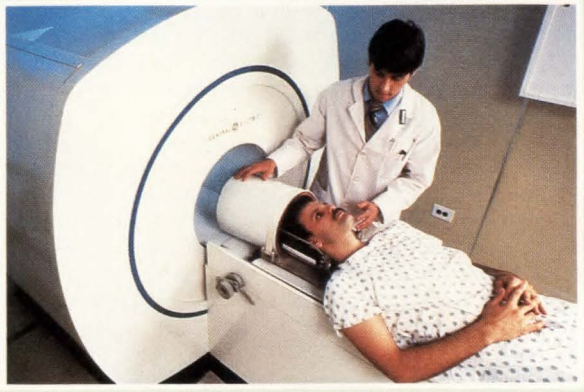


Figure 6: GE's NMR scanning system.

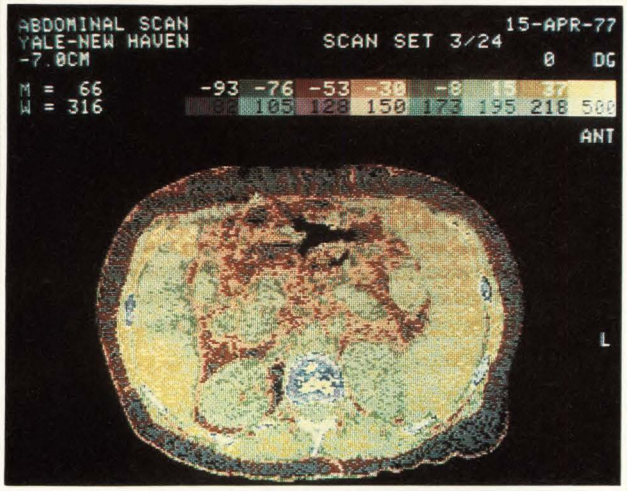


Figure 7: Abdominal CT scan. Photo courtesy Ramtek Corp.

characterizing the sample's pure state, thus indicating the sample's chemical composition.

Recent clinical trials with NMR have produced unprecedented euphoria among radiologists. Claims have been made that NMR provides superior contrast discrimination, and detects and diagnoses potential diseased areas not revealed by x-ray or CT. A potential weakness in NMR is its inability to discriminate solid tumors from cysts, because calcification cannot be detected. Also, environmental and siting problems may completely rule out NMR in many hospitals, and the technology has not yet received approval by the FDA.

Thermographic Imaging. Thermography maps the temperature distribution of the body surface. A high-speed photovoltaic detector scans the patient to measure infrared rays emitted from the skin. The thermal signal is converted into a skin temperature map displayed on a color monitor. Body temperatures are arbitrarily coded by chosen colors—usually blue and green to represent colder sites. Particular concentrations of heat isolation may indicate the presence of a malignancy which can be investigated through other means.

The major contribution of each of these new bioimaging technologies is not yet in day-to-day clinical diagnosis but rather in illuminary investigation into disease processes and natural life functions. Eventually, this will yield advances in diagnosis, prevention and treatment.

—Hanrahan

nostic imaging systems out of the area of retrospective diagnostics reliant on overt signs in a patient, and into the world of proactive medicine.

Patient Monitoring

Patient monitoring systems represent a substantial portion of the worldwide market for medical electronics equipment. Again, this type of equipment can benefit from a better relationship between semiconductor vendors and equipment suppliers.

Unlike medical imaging equipment, patient monitoring systems may move quickly in the direction of workable interconnection and communications standards. One example of this can be seen in Hewlett-Packard, where they have applied their own interconnection and communications interface standards.

Monitoring equipment users often have deep-seated equipment prejudices and are human factors oriented. Among the innovations that suppliers need from vendors are: refinements in raster-driven displays; color, high-resolution raster type tubes; and perhaps the development of custom liquid crystal displays designed specifically for medical electronics applications.

Needed Improvements

It is vital that chip designers and systems architects become more familiar with the needs of the medical electronics industry. Aside from the need to index and archive large amounts of digital data there are also other large-scale equipment needs. Among these are the need for sophisticated A/D converters, better high-speed memory and new high-speed 16-bit multiplexers.

Common requirements for A/D converters in medical electronics include improving and maintaining signal-to-noise ratios that are better than broadcast standards. Broadcast uses 6–8 bit A/D converters, whereas medical electronics requires 9–10 bit converters. And, in most medical electronics applications there is a need to handle from 30 to 60 information channels.

High speed memory is important for today's medical electronics suppliers. In some cases, data is pulled out of solid state memory at rates close to peak access times.

Special purpose CPUs also rank high on the list of common requirements for medical electronics. Typical requirements include fast execution cycles, special address functions and extreme versatility. In addition, power-drain is quickly becoming a major consideration; this may well point to a preference for NMOS devices over CMOS devices in many specialized applications.

The single largest barrier facing the medical electronics industry's total integration is the problems of mass storage and archiving for diagnostic images. On the patient monitoring side, the big push is towards the adoption of standards and a move towards LCD front-ends.

Much work is still needed to tailor hardware to the medical field. Eventually the industry trend will lead to physicians' workstations, which could bring improvements comparable to those engineers are enjoying now. □

Gate Array Controls Implantable Pump

A computer-operated implantable subcutaneous pump that delivers precise amounts of medication into the bloodstream has been developed at Johns Hopkins University. Based on semi-customized gate arrays, the Programmable Implantable Medication System (PIMS) has already been used in laboratory animals and should be used in humans later this year.

Developed by R. E. Fischell and W. E. Radford, of The Johns Hopkins University/Applied Physics Laboratory and C. D. Saudek, of The Johns Hopkins Hospital, the PIMS utilizes an Implantable Programmable Infusion Pump (IPIP) which provides the controlled release of medication, and an external unit that programs the IPIP via command and telemetry systems.

Potential applications include the treatment of diabetes, cancer, infertility, hypertension, chronic intractable pain, thrombosis, and the delivery of growth hormone. One likely advantage of this method would be the reduction of side effects in chemotherapy through localized delivery of medications.

The physician constructs a basal medication delivery schedule which repeats with a period of 24 hours. In addition, up to six different supplementary schedules can be programmed for self medication. To exercise control over the treatment, the patient uses a hand-held programming unit which communicates with the IPIP.

The physician's Medication Programming System (MPS) consists of a smart terminal (Medication Programming Unit) and a paper printer which provides a permanent record of the IPIP programming. Transmission and receiving between this unit and the implanted pump takes place via a Communication Head or through telephone transceivers.

"We used four different semi-custom gate arrays from International Microcircuits (Santa Clara, CA)," said R. E. Fischell, Assistant Head and Chief of Technology Transfer, Space Dept., of the Johns Hopkins University/Applied Physics Laboratory. "This was the most cost effective way to obtain the circuitry to make a medication delivery computer. This could be done in custom logic and be custom VSLI, but it would be very much more expensive."

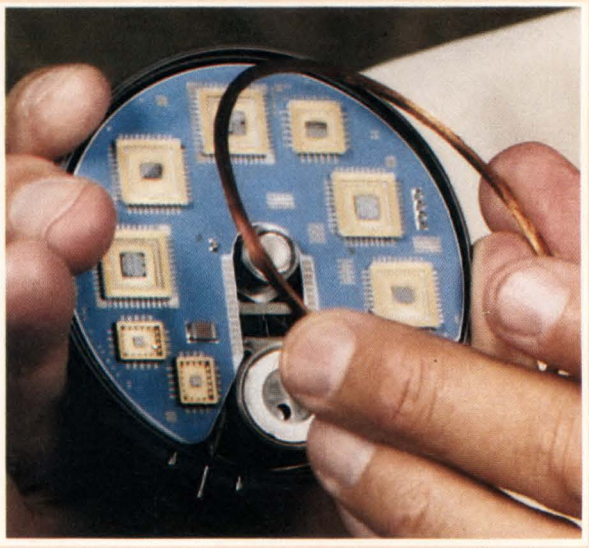
The IPIP has a CMOS 1802 μP-based microcomputer system. After implantation, it is programmed by means of the command and telemetry systems.

A physician can program a 2 microliter infusion pulse for each quarter-hour interval in a repeating 24-hour cycle—which can provide a normal blood sugar level in diabetics. In addition, supplementary delivery schedules can be programmed.

At the physician's option, the patient can use the PPU (Patient's Programming Unit) to shut off all medication flow for one to eight hours. At the end of the shut-off period, basal programming resumes.

The programmable implantable system offers definite advantages over oral or hypodermic administration of medication:

- Perfect compliance can be achieved if no patient interaction is programmed.
- Medication is delivered at a precise rate.
- Medication is delivered to target sites within the body.
- Software and hardware safeguards prevent accidental overdose.
- Decreased use of medication is possible. This is an advantage with medications that result in long term toxicity, and in the case of scarce substances, such as growth hormones.
- Applying the medication at specific target sites minimizes the possibility of side effects elsewhere in the body.
- Physicians precisely determine medication usage and obtain permanent records from computer printouts.
- Medication can be delivered to the body without first going through the digestive system. Medications which might be inactivated by the digestive process can thus be administered on an out-patient basis—significantly reducing hospital costs.



The telemetry and command antenna are shown being placed into the Implantable Programmable Infusion Pump (IPIP). The International Microcircuits Inc. gate arrays can be seen as squares on the top of the IPIP.

The reservoir capacity of the implantable pump is 10 ml. Filled with the proper concentration of insulin, this constitutes three months of insulin for most patients. Refills are accomplished by inserting a hypodermic needle through the skin into a special IPIP antechamber.

Johns Hopkins studies on a diabetic dog fitted with an implantable pump showed that computer controlled release of insulin achieved far better control of plasma glucose than that obtainable by two daily injections. All technical components in the system performed satisfactorily.

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A Four-Phase Approach To Implementing A Graphics Tool Package

A device-independent tools approach allows a program to be hardware compatible and take advantage of the capabilities of various devices without tailoring.

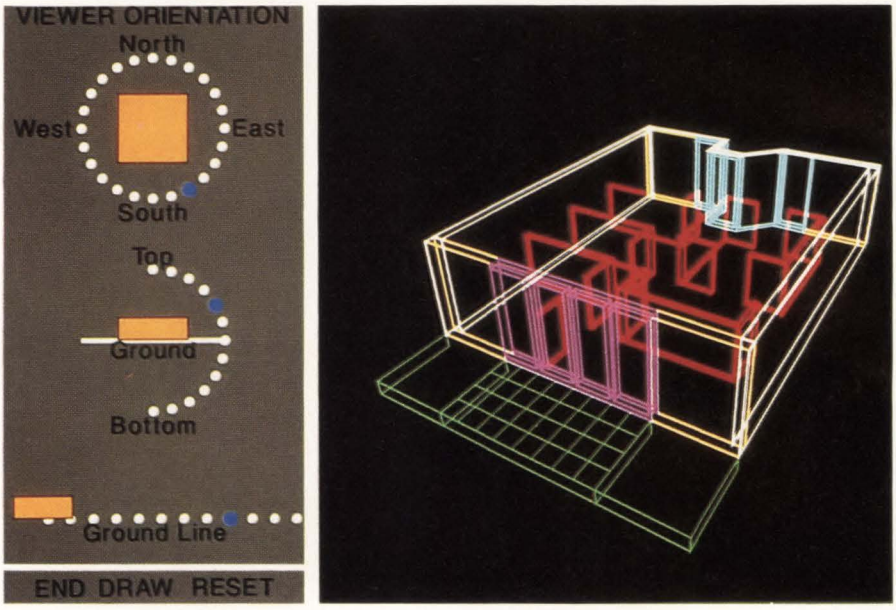

Figure 1: Metafile Hardcopy; CAD using DI-3000

by Nikolaus Kiefhaber

Engineers requiring graphics output, either from data originally captured in a real-time process or entered via keyboard, have several options. One approach is represented by turnkey systems and dedicated application packages, which allow users to begin immediately entering information and displaying it graphically.

Unfortunately, it's precisely this ease-of-use that makes these approaches too rigid for many engineering environments, where a great variety of applications must run on an ever-changing selection of output devices. The turnkey system that plots power throughput on a transformer, for example, is unlikely to accommodate a histogram comparison of heat transference, especially one targeted for a color raster display. Generally, the more a system is dedicated to a particular application or device, the greater the risk for quick obsolescence.

A tools approach, such as Precision Visual's DI-3000, favors flexibility by providing a library of user-callable subroutines that the engineer nests in a standard FORTRAN program. Each subroutine handles a specific function—for example, defining a "marker" on the display; specifying the current starting position; specifying colors, polygon fills, and text fonts; and defining such pictorial "primitives" as lines, polygons, and arcs, as well as higher level polygons including rectangles, circles, and sectors. Hence, each subroutine can be thought of as a building block from which the user constructs increasingly complex and tailored pictures.

Obviously, these subroutines cut programming time by saving the user from starting over with each graphic image. Another critical productivity factor, however, is device-independence. A device-independent tools approach allows a program to be hardware compatible and take advantage of the capabilities of various devices without special tailoring. With the appropriate device drivers—which are a part of the tools package—the engineer can use the same application program to generate graphics on a variety of hardware, including plotters, film recorders, and storage tube and refresh displays.

Virtual Coordinate Mapping

When using a tools package, the designer first constructs drawings in

Nikolaus Kiefhaber is Director of Research for Precision Visuals, Inc., 250 Arapahoe Ave., Boulder, CO 80302.

a three-dimensional world coordinate system with only absolute values. The software maps these images onto the coordinate system of an idealized "virtual" graphics device that combines the attributes of most physical devices. The device driver provides the final conversion into device-specific coordinates.

As a result, the designer is freed from one of the most taxing chores of developing graphics output: accommodating a specific device. This often requires so much hardware pretesting and immersion in the manuals that the actual coding process can be secondary. Device-independence allows applications to be developed independent of the number of colors a display device provides, its dimension in pixels, or whether the Y-origin is in the upper or lower left-hand corner, for example.

Such independence also permits the designer to develop applications *before* the output device is specified. This is especially important when the company is in the midst of considering several vendors or models. Instead of the entire project awaiting the outcome of a hardware selection or bid, programming can proceed with the graphics component temporarily targeted solely for the "virtual" device.

For engineers who require pictorial output, device-independence thus removes a major development hurdle, but admittedly not all of them. Some proficiency in the programming language hosting the subroutine calls is required, as well as time to develop and debug the code. As with any higher level language, a tools package can and should be mastered in stages. The following four steps constitute such an approach. The first step will produce a working graphics program with a minimum of time and effort; the other three refine that program for increased capability, applicability and speed.

Tailoring An Example

The first step entails the adapting of an existing program that incorporates graphic tool subroutines.

For example, the DI-3000 user's manual includes an appendix of example programs that produce common graphic output: a pie chart, histogram, and shaded line graph. Also listed are routines for creating slides with graphics arts quality text, a three-dimensional modeling program and one showing permanent retention of the pictorial elements with batch updating. Finally, a skeleton program is listed showing the general structure for any application programming invoking DI-3000 subroutines.

Each listing displays a subset of available graphics tools utilized in a standard configuration, and each can be tailored in rudimentary ways. For example, the user may alter the title by changing the character string and length specifications—both parameters of a single subroutine call. Other minor alterations include changing background color, shifting the placement of text, changing the symbol used for markers (i.e. "dots" on the world coordinate system) and creating (or eliminating) border around a filled polygon.

Thus, the designer simply takes the program, plugs in some values appropriate to the application, and compiles and executes it. The output provides a fast and simple means of confirming data accuracy and determining whether the picture is on the right track. This quickly-produced rough cut of a finished, presentation-quality drawing can be developed concurrently with the application program itself.

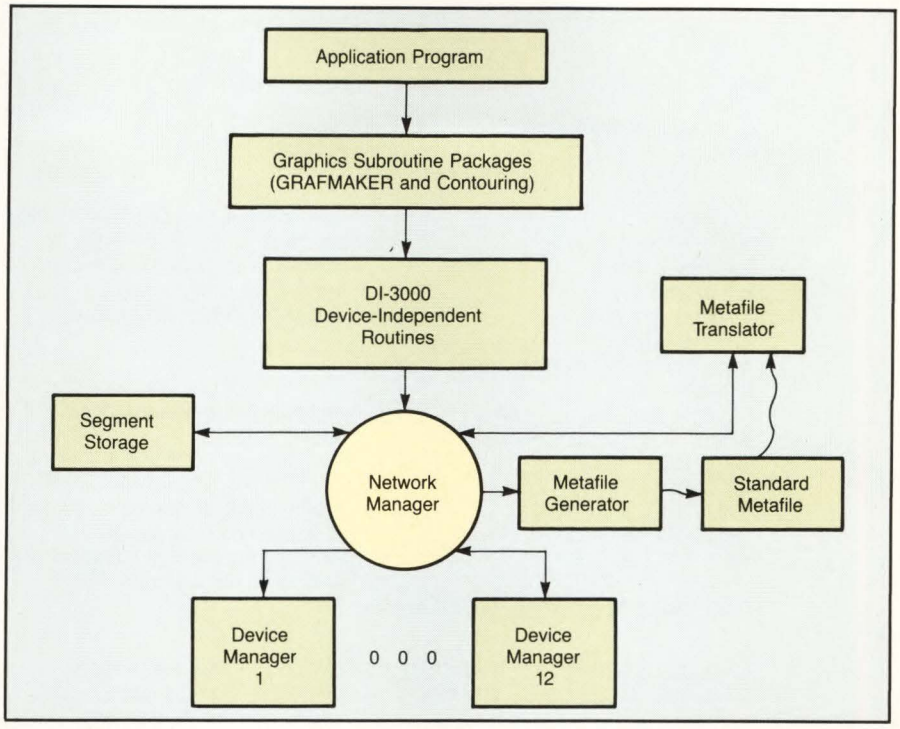

Figure 2: DI-3000 modular software network. Routines generate device independent graphics commands allowing program to interact with a virtual graphics device. The network manager coordinates between the device-independent subroutines and the device-dependent drivers. Output can be directed at a physical device or a sequential pictorial library called a metafile. Picture elements are also retained in memory during the development process in segment storage.

Further Modification

Once this rudimentary program has been produced, the engineer will want to refine it by adding other subroutine calls, altering the programming logic, and using "metafiles" for directing output.

Consider the generation of a simple pie graph chart (**Figure 3**). Each sector is produced by the subroutine call JSECTR, with the parameters X0, Y0, Z0, RADIUS, NSEG, A0, and A1. X0, Y0, and

```
      TOTAL = 0.0                                  * total the data
      DO 3000 I = 1,8
        Total = total + TOTYER(I)
 3000 CONTINUE
C
      CALL JOPEN                                   * open a temporary segment for the
        START = 0.                                 * pie chart sectors and labels
        CALL JSIZE (3.,3.)                         * define the character size and
        CALL JFONT (1)                             * font for the sector labels
        DO 5000 I = 1,8                            * output the 'exploded' sectors
          A0 = START
          A1 = TOTYER(I)/TOTAL * 360. + START
          START = A1
          AMID = (A1 - A0)/2. + A0                 * compute the midpoint of the
          ARAD = AMID * DTORAD                     * sector
          C1 = COS (ARAD)
          S1 = SIN (ARAD)
          CALL JPIDEX (I,I+30)                     * establish the sector color
          X0 = OFFSET * C1                         * or interior shading pattern
          Y0 = OFFSET * S1                         * let DI-3000 choose the number of
C                                                  * lines in the sector arc
          CALL JSECTR (X0,Y0,0.,RAD1,0,A0,A1)
C
          CALL JMOVE (RAD2*C1, RAD2*S1)            * draw a line from the midpoint
          CALL JDRAW (RAD3*C1, RAD3*S1)            * of the sector to the label
C                                                  * define label justification as a
C                                                  * function of the sector position
          IF (AMID .LT. 45. .OR. AMID .GE. 315.) CALL JJUST (1,2)
          IF (AMID .GT. 45. .AND. AMID .LT. 135.) CALL JJUST (2,1)
          IF (AMID .GE. 135. .AND. AMID .LT. 225.) CALL JJUST (3,2)
          IF (AMID .GE. 225. .AND. AMID .LT. 315.) CALL JJUST (2,3)
C
          CALL JMOVE (RAD4*C1, RAD4*S1)
          CALL JHTEXT (LABCNT(I), LABELS(1,I)) * output the sector label
 5000 CONTINUE
      CALL JCLOSE                                  * close the temporary segment
C
      CALL JPAUSE (1)                              * pause for operator action
      CALL JEND                                    * terminate DI-3000 with an implicit
      STOP                                         * new frame action; all devices
      END                                          * are deselected and terminated
eot
```

Figure 3: Generation of pie chart using DI-3000 graphics tool box. Approach relies on subroutine calls.

Z0 locate the center of the circle from which the sector is to be drawn in the world coordinate system (since only two dimensions matter here, Z0 is set at zero). RADIUS is the absolute value of the radius on the coordinate system. NSEG indicates the precision by which the arc is to be drawn, and A0 and A1 are the angles, in degrees, spanning the sector.

In the simplest case, a data item is read in, converted into a percentage of the total, and multiplied by 360—thereby becoming the basis for angles A0 and A1. Several data items can then be formed into a full pie graph by keeping track of where the last-drawn sector left off. Additional sectors on the graph are accommodated by redimensioning the variable and extending the DO-loop on the draw routine. The size of the entire graph is changed by altering the radius parameter. In addition, the sectors can be "exploded" by calculating the X0, Y0 offset based on the radius of the arc. Finally, the precision of the circumference can be specified explicitly, or left up to the software by making NSEG <1.

Viewing transformations present another opportunity for program refinement. It may be desirable to convert a routine that passively outputs a two-dimensional 5000-point plot into an interactive program allowing the operator to "zoom in" on specific 200-point portions. With DI-3000, this entails specifying a rectangular "window" outlining the particular graph segment. This window is then mapped onto a corresponding rectangle, called a "viewport," on the virtual device's coordinate system. The process is analogous to cropping a negative and enlarging it to match a specific paper size (except that, in this case, distortion will occur, perhaps intentionally, if the aspect ratios of the two rectangles differ).

Input functions that facilitate operator control are associated with one or more subroutine tools. Here, the eight values defining the two rectangles might be specified through the keyboard or more conveniently via a light pen or graphics tablet.

Related to the transformation process is the concept of "clipping," which, under DI-3000, can be enabled or disabled as required. Anytime a picture is "enlarged" or a graph is generated with unknown peak values, segments of that drawing may fall outside the display area. Depending on the device, this may yield various unwanted results: screen wraparound, off-paper plotting, or even equipment damage. Clipping ensures that the hardware will display or draw only those picture segments lying within range.

The designer can also alter text attributes. In the early stages of program development, a high-speed, low-quality font is appropriate. For finished copies, however, the quality can be raised to any of three other levels by substituting the applicable subroutine. Font size and character pitch are also adjustable. For uses such as the labeling of tic marks along an axis, the text plane can be tilted from the horizontal in order to position more letters.

Hardcopy may not be an immediate concern during program development. With the toolbox approach, users can route the proposed plot

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to the screen, switching to the plotter when the program is near completion. Alternatively, the output can be directed to a metafile—a sequential library of all graphics information related to a single picture. Several metafiles may then be concurrently positioned, scaled, and superimposed on a display terminal. Both approaches speed development, eliminating much of the lagtime between iterations due to a slow output device. Costs can also be reduced when using a costly plot medium such as mylar.

Specifying A Device

Once the refined application is running, attributes may be added to take full advantage of a specific output device. Any device that supports color, for example, is assumed to produce at least eight tones: black, white, red, green, yellow, blue, magenta, and cyan. In addition, there is generally a default foreground and complement background color for display devices. Each device driver supports a color table residing in hardware or software that maps color indices from 9 to 32767 into specific hues, lightnesses, and saturations. These three attributes can be controlled explicitly through a subroutine call. Hence, an application originally developed on a monochromatic device could be transported to a 256-color terminal by simply calling a subroutine. The device driver for a monochromatic device would ignore them, enabling the application to run successfully on both.

Similarly, with a raster display device, the concept of a "pen" applies as it would with a plotter, only here it refers to a definable combination of color, intensity, line width, and line style rather than to a physical entity. Nevertheless, lines drawn with different "pens" on a raster device appear distinct from each other.

The specification of the output device is generally made directly under the operating system. After the application is compiled, the engineer designates what device driver to access during the linking process. At some installations, this decision is intentionally put off until run time and can even be made available as a menu selection.

Increasing Throughput

In the final phase of the development process, the engineer makes allowances for a particular device to make the entire program more efficient. For example, several terminals lack the hardware capability to do a polygon fill, and ordinarily the device driver will produce cross-hatching in software. However, if speed is a factor, the default could be overridden so that no software-fill is attempted.

Similarly, the system will want to erase the entire screen when changing menus. On a raster device, however, where a superimposed image, including a blank, completely covers what was beneath it, no erasure need be made. □

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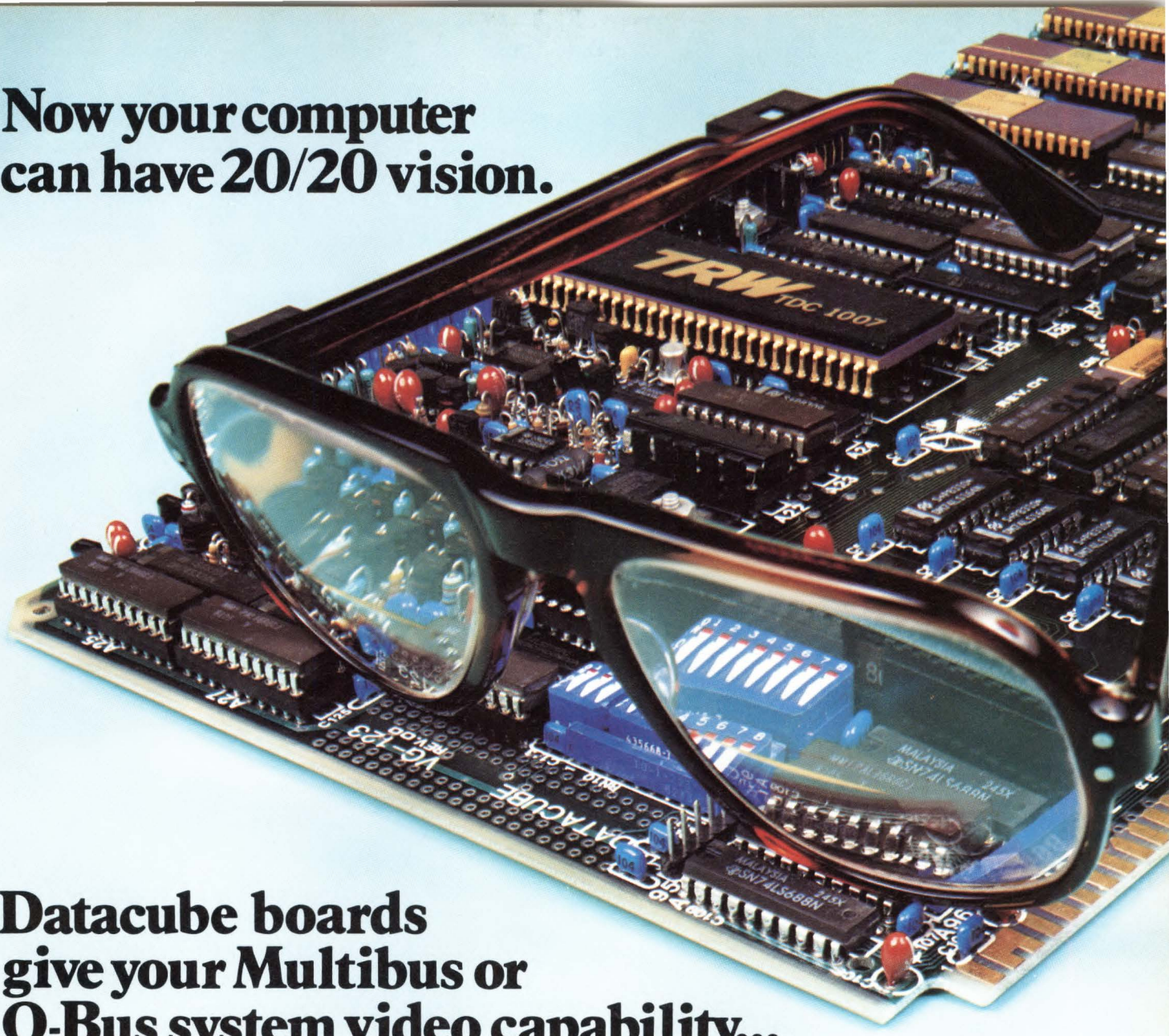

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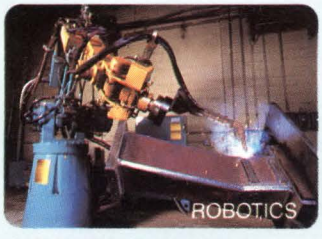

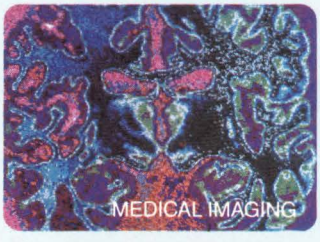

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Putting Color Graphics On Paper

by Bob Hirshon,
Contributing Editor

Most people assume that the purpose of computers in an engineering or office environment is to supply users with more information. Actually, quite the opposite is true. There is no shortage of raw data in most labs and offices. Ideally, computers reduce the quantity of absolute information by collating and interpreting that data into a form that is easily understood. For this purpose, computer-generated color graphics are ideal. And for making those graphics accessible to anyone away from a computer terminal, color hard copy is essential.

The trend is toward more sophisticated color hard copy devices for less sophisticated users.

Intense research and development efforts today focus on low-cost, compact, color hard copy devices for unsophisticated operators. This is a result of two general trends. First, engineers, scientists and executives are all increasingly expected to assume more responsibilities, including producing their own presentations and documentation. Second, by making their own graphics, they find they have more control over what information is presented and, most importantly, how that information is perceived. Graphics is an *interpretation* of raw data; direct control over that interpretation is a powerful tool.

As a result, demand for color hard copy units compatible with laboratory and office computers has increased, and a number of companies have introduced devices to meet that demand. These devices may use any one of seven color hard copy technologies.

Pen Plotters

For low-cost, high-resolution color hard copy, pen plotting is still the method of choice. In fact, pen plotters outsell all other types of color hard copy devices combined. Although they can be slow and require a high degree of user interaction, pen plotters provide draftsperson-quality graphics, low initial cost, wide selection of paper size, and extremely low cost per copy. In addition, the latest crop of software packages makes plot generation a simple matter for even the most unsophisticated user.

Choosing a pen plotter, however, is by no means a simple matter. Dozens of companies manufacture plotters that vary with regard to speed, intelligence, paper size, number of colors, types of pens, resolution and numerous other parameters.

Pen speed and acceleration are the two specifications that most directly affect plot speed. Pen speed is measured in inches per sec. (ips) and, for a small plotter, runs about 12 to 20 ips; large format plotters move at about 35 ips. Acceleration is equally important, for without quick acceleration, the pen may never reach its maximum speed, especially when plotting numerous small vectors. Measured in Gs, acceleration should be about 2 Gs for small plotters and 4 Gs for larger models.

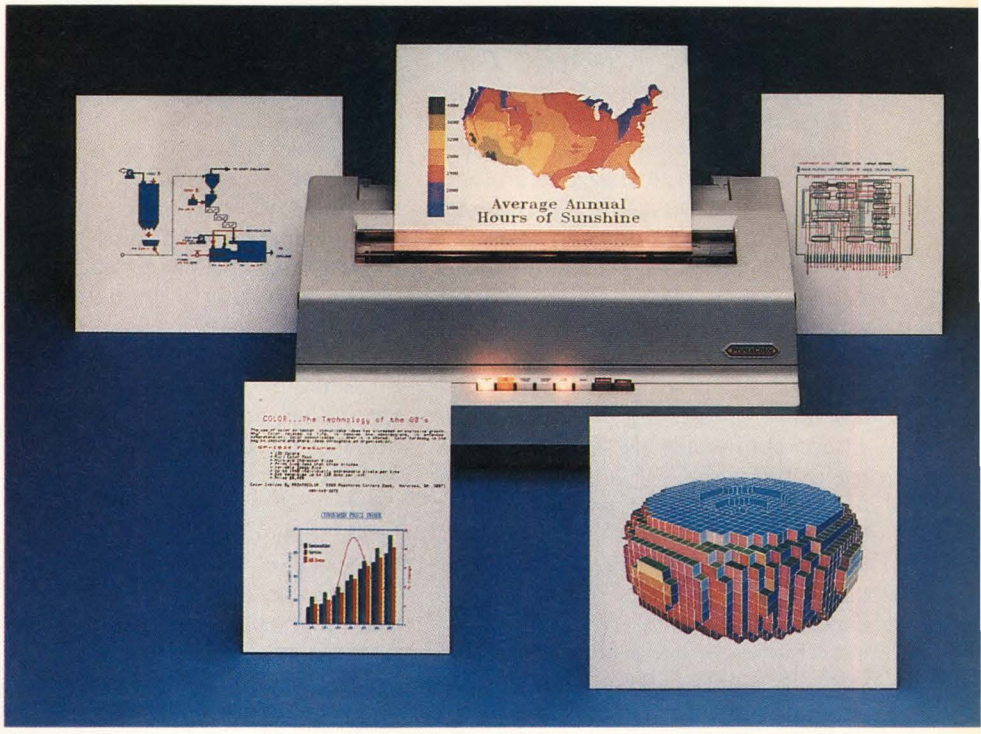

Figure 2: Ink jet plotters, like the Printacolor model above, are among the crop of new color hard copy devices filling the needs of both engineering and office environments.

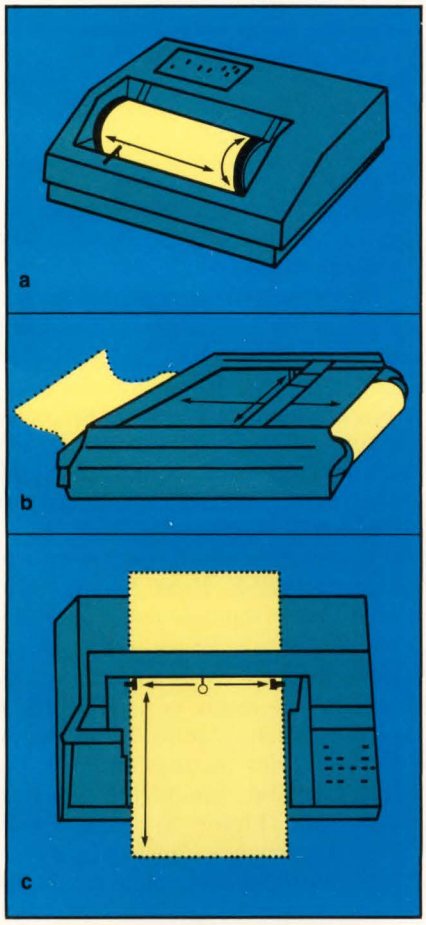

Figure 1: Pen plotters may incorporate one of three technologies: drum (a), flatbed (b) or hybrid (c).

Greater plotter intelligence lessens the need for CPU and user interaction. For example, an onboard μP can implement character sets, arcs and vectors without the host CPU. It can also change pens without help from the user. This may be invaluable in an environment where there's a constant demand for the CPU's, and the user's, time.

Paper size standards have been set by both the American National Standards Institute (ANSI) and the International Standards Organization (ISO). Although ISO is metric and ANSI uses British measurements, the two standards are equivalent, and are used interchangeably by most companies (**Figure 3**).

Multi-color plots require multiple pens, and most plotters available today accomodate a variety of ballpoint, nylon tip and/or liquid ink pens. Many plotters can use drugstore variety pens, but for precision drafting may be capable of using technical pens. Low cost plotters require the user to pause during a plot and change pens manually, while more intelligent plotters change automatically, selecting from between two and eight pens.

Repeatability is the precision with which a pen can return to a given point. Measured in fractions of a mm, this specification determines how well lines will meet and circles will close.

ISO	DIMENSIONS (MM)	ANSI	DIMENSIONS (INCHES)
A4	210 × 297	A	8½ × 11
A3	297 × 420	B	11 × 17
A2	420 × 594	C	17 × 22
A1	594 × 841	D	22 × 34
A0	841 × 1189	E	34 × 44

Figure 3: ANSI and ISO paper size standards are used interchangeably.

When comparing resolution specifications for different plotters, it is important to differentiate between *addressable* resolution and *mechanical* resolution. Addressable resolution is the shortest line a user can command the plotter to draw; mechanical resolution is the shortest line the plotter actually can draw. Addressable resolution should, of course, be at least as high, and preferably higher, than mechanical resolution. It's not much use to have a plotter that can accept commands it's incapable of performing.

Finally, plotters come in three types: drum, flatbed, and hybrid (**Figure 1**). Large drum plotters require less floor space and are less expensive than large flatbeds, but large flatbeds provide higher precision. In addition, plots can easily be removed and then replaced on flatbed plotters, with little loss of plot accuracy. Hybrid plotters occupy the floor space of drum plotters, and are even less expensive. They plot the X-axis by means of pen movement, and the Y-axis by moving the paper back and forth with pinch wheels that grip the edge of the paper.

Color Electrostatic

For large format plots (A0 – A2), pen plotting can be extremely time-consuming, especially for complex graphics. Electrostatic plotters are raster devices, and therefore print pages at a constant speed, regardless of complexity. For this reason, they have become popular for applications requiring large-format, complex, high-volume plotting. Only recently, however, has multi-color electrostatic plotting become available.

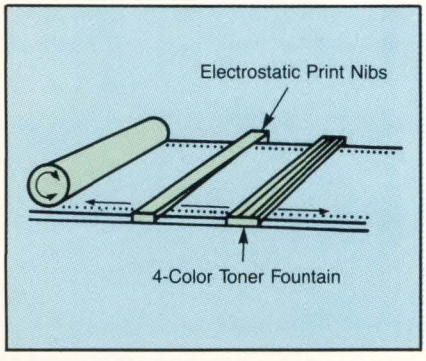

Figure 4: Versatec's color electrostatic plotter uses a series of electrostatic nibs that deliver dots of charge to the paper, to which colored toner adheres.

Versatec's Electron plotter is the first color electrostatic plotter. Like all electrostatic plotters, it has a line of electrostatic nibs running the width of the paper, each capable of delivering a spot of charge (**Figure 4**). As the paper passes under the print nibs, it travels through a fountain of oppositely-charged toner that adheres to the charged areas of the paper. To obtain color, Versatec repeatedly backs up the paper and runs it under the print head and toner, once each for black, cyan, magenta, and yellow. By interspersing dots of these primary pigments, over 400 colors are possible.

The difficulty in actually designing a multi-pass electrostatic system—or any multi-pass printer that requires bi-directional paper transport—lies in accurately registering each of the four one-color plots. With Versatec's Electron plotter, this registration problem was magnified by the plotter's large format paper (44″ wide) and high resolution (200 dots per inch). Their solution is a series of registration marks outside the plotting area, encoded by the machine before plotting. These allow the plotter to sense paper position at all times, and compensate for any error at an accuracy of 0.1 mil. This provides accurate registration, even in plots 50 feet long.

A number of smaller format color electrostatic plotters are in the development stage at several companies, but none have been officially announced.

Color Impact Printers

The first impact dot-matrix printer that could print in color was the Trilog Colorplot. Built around a standard Printronix line printer mechanism, Colorplot uses a special three-color (yellow, cyan and magenta) ribbon to produce multi-color plots. The chief advantage Colorplot had over other color hard copy techniques was that it was first and foremost a high-quality, high-speed line printer. This made it ideal for environments requiring lots of printing, plus a little color plotting.

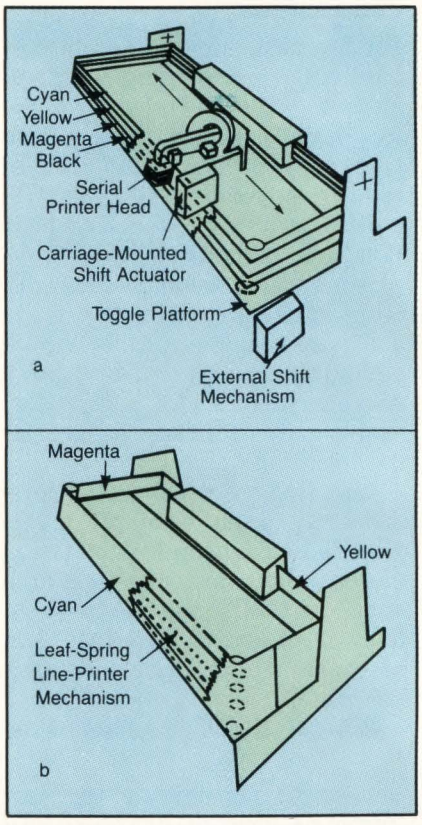

Figure 5: Color impact dot matrix printers use either serial (a) or line (b) impact print heads that strike a color ink ribbon.

Today's color impact dot matrix printers occupy that same niche carved out by Trilog several years ago. All are primarily character printers that can also print color graphics. Integral Data Systems developed the first desk-top model (the Prism Printer), followed by Anadex, Centronics, C. Itoh, Envision, Facit-Dataroyal, General Electric, IBM, Lear Siegler, Olivetti OPE, Ramtek and Seiko-Seikosha (whose Transtar 315 is, at $599, the least expensive color hard copy device available). All of these printers use solenoid-controlled ballistic print hammers that strike an ink ribbon, hammering it against the paper (**Figure 5**). Most serial-printing devices must make one horizontal pass for each color, but some shift the ribbon for each stike, allowing printing of all four colors in one pass. The line printers print an entire row of dots simulta-

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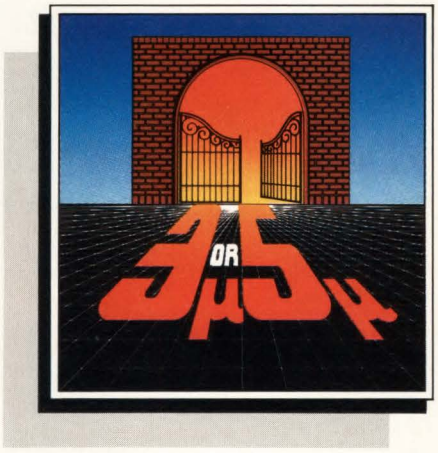

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1S03 or 5C	720	159 × 167	50 or 25 MHz	64
1S03 or 5D	960	161 × 208	50 or 25 MHz	70
1S03 or 5E	1200	188 × 208	50 or 25 MHz	74
1S03 or 5F	1500	188 × 244	50 or 25 MHz	80
1S03 or 5G	1800	202 × 230	50 or 25 MHz	92
1S03 or 5H	2400	232 × 252	50 or 25 MHz	110

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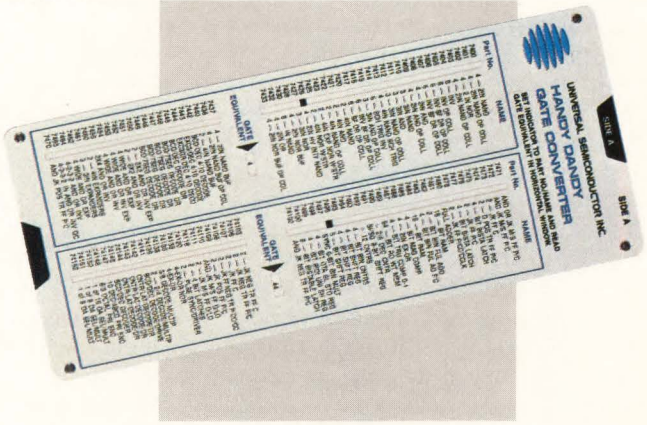

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neously, print the entire page in one color, and then back up the paper to print the next color.

Many companies now offer two multi-colored ribbons: one with black, red, green and blue for four-color printing, and one with black, cyan, magenta and yellow for seven-color printing (via mixing of primary pigments).

Color impact printer/plotters generally accept only raster input, but Envision's 430 Color Vector-Printer accepts pen plotter vector data without need of a vector-to-raster converter. Thus, it should compete with pen plotters for laboratory and engineering applications. It should be especially successful in cost-conscious environments that would welcome a single device to produce both high-quality printing and vector plots.

Ink Jet

Ink jet technology is really two separate technologies: Hertz technology and drop-on-demand. Hertz ink jet printers (such as Applicon's Satellite plotter) use print heads that spray a continuous stream of charged ink droplets at the paper (**Figure 6**). Control of an electromagnetic field between the ink jets and the paper determines whether the ink droplets reach their destination or are electrically deflected and siphoned away by a suction tube.

With drop-on-demand printers, the ink droplets are controlled at the print head—an ink droplet is emitted only when the print head fires (**Figure 7**). Printacolor was first with a drop-on-demand desk-top printer and first with an OEM-targeted drop-on-demand printer module. They recently introduced the TC1040, with a dot density of 85 or 120 dots/inch and 4913 possible colors, using built-in dithering. They also offer a $5K high resolution desk-top model for personal computers, and a number of other medium and high resolution color printers starting at about $4K.

Several other companies also produce desk-top, drop-on-demand color ink jet printers, including Advanced Color Technology, Canon, Diablo, Sharp and Tektronix. Advanced Color Technology is touting the reliability of their recently introduced ACT-II, with an MTBF specification of 6000 hours. The unit is also fast (90 secs per copy), provides 120 colors, has three available interfaces (RS-232, Centronics and RS-170 RGB), and prints on overhead transparency film. The overhead material was developed in conjunction with Polaroid, who is also supplying the media. A frame buffer to allow the ACT-II to store information from the host computer, freeing the host for other tasks during plotting, should be announced in September. Unit one cost of the ACT-II is $6400.

Canon's A-1210 ink jet features high print speed (40 cps) and very low noise levels (under 50 dB) at a cost of $795. Tektronix offers a high resolution, large format device for $12K, and a lower resolution desk-top model for $1950. They plan on announcing overhead transparency capability shortly. Diablo's 16-nozzle (4 nozzles per color) printer has a resolution of 120 dots per inch and 20 cps print speed. Its most notable feature, however, is its low price of $1250 (quantity one). Both the Tektronix and the Diablo desk-top printers use a Sharp ink jet printer mechanism.

Hitachi and Sanyo both should be shipping high resolution ink jet printers (up to 400 dpi) within a year and a half. Both products were discussed at this year's Society For Informational Display conference, as were ink jet technologies from NEC, Fujitsu, Tektronix and IBM. In addition to increasing resolution, new ink jet head designs could improve reliability and boost print speed to 150 cps.

Ink jet printers' chief features are low cost per copy, low noise, and multifunctionality (they can be used as regular printers as well as color graphics plotters.) Their colors, like those of color impact printers, tend to be flatter than those of xerographic, thermal or photographic devices. Which is more desirable is purely a matter of taste. Also, many of the ink jet devices either already are capable of

Continued on p. 56

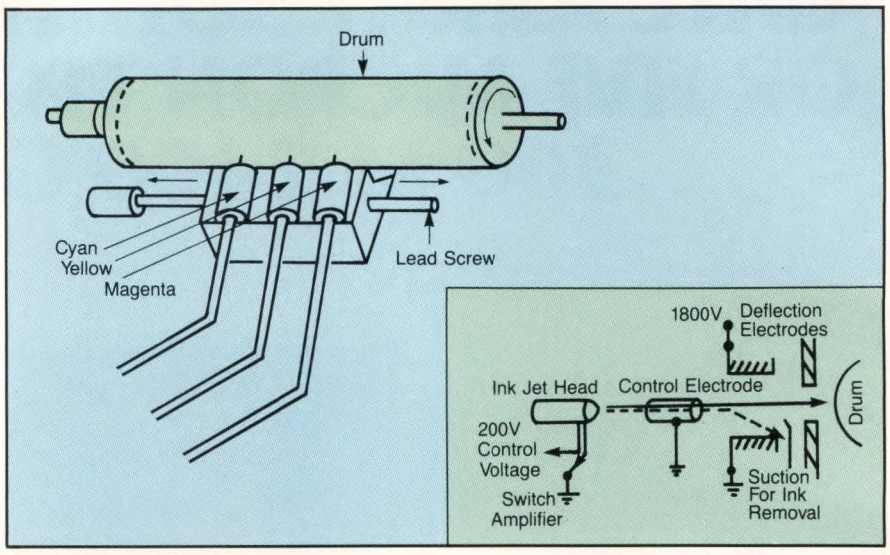

Figure 6: Print heads on Hertz ink jet printers spray charged ink droplets at the paper; a switching electromagnetic field determines whether or not the ink droplets reach the page.

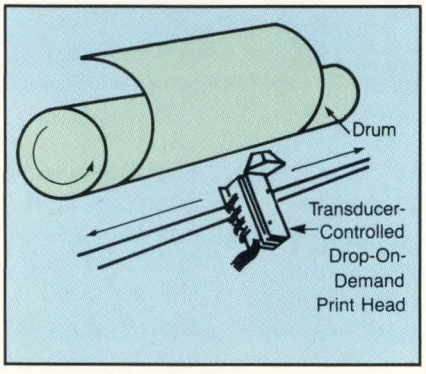

Figure 7: Drop-on-demand ink jet printers use solenoid- or piezo-electric-controlled print heads.

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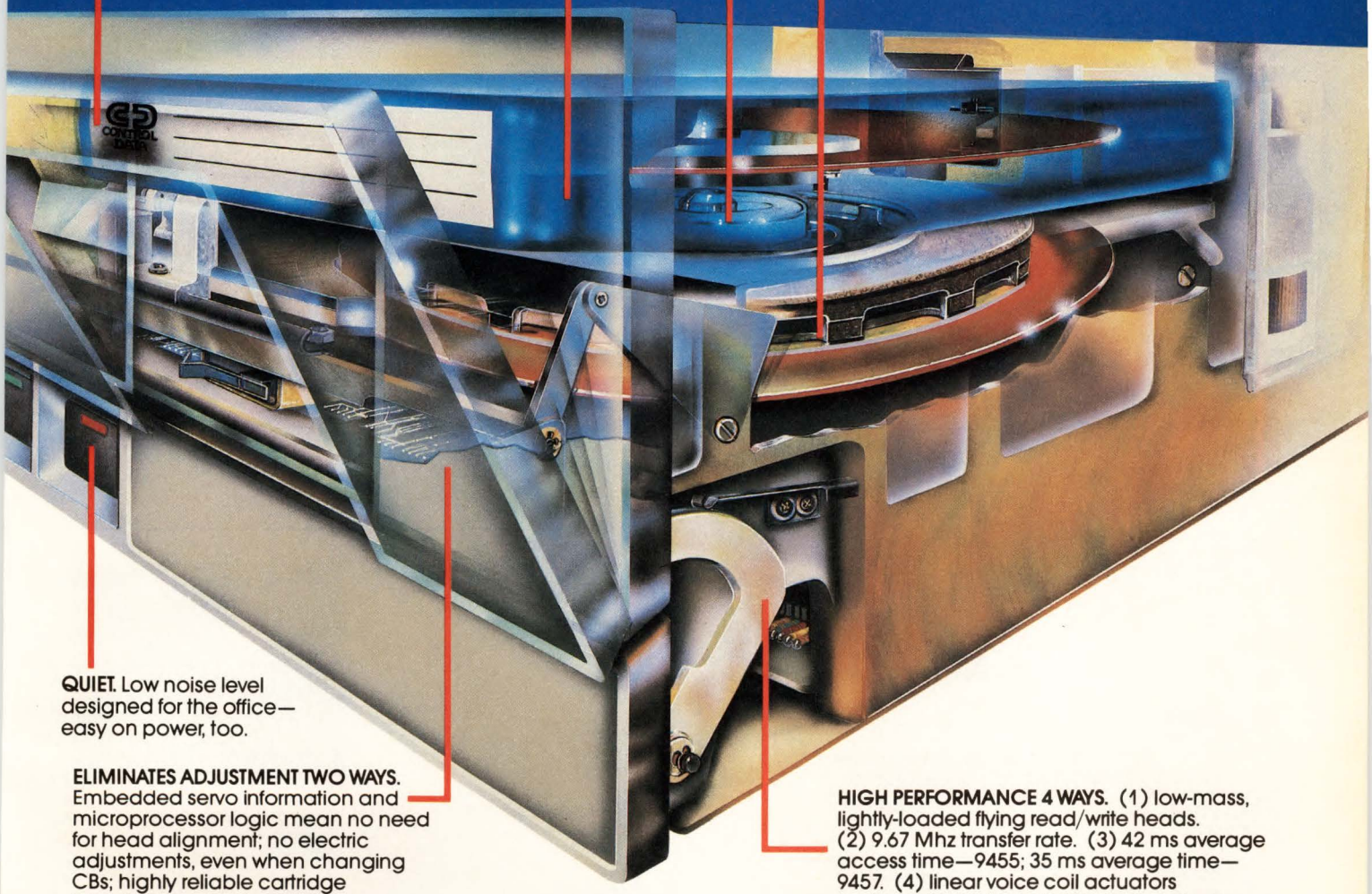

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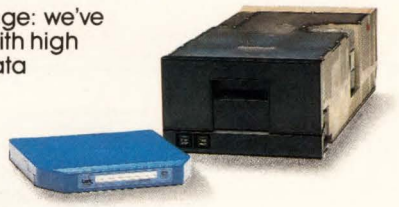

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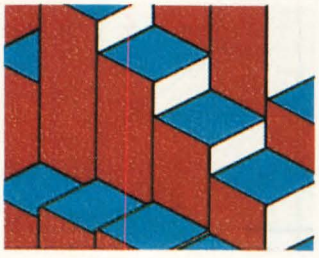

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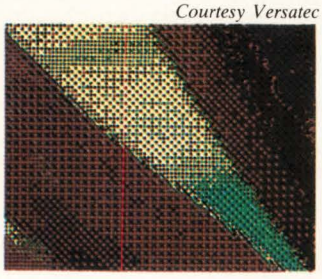

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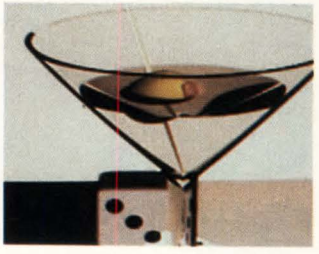

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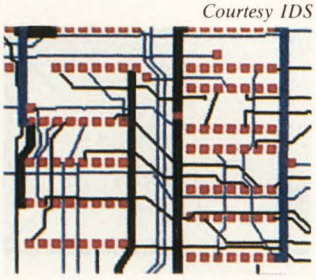

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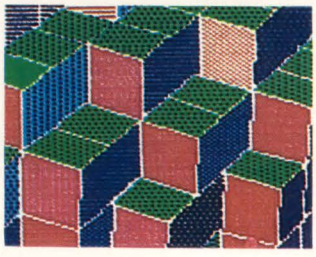

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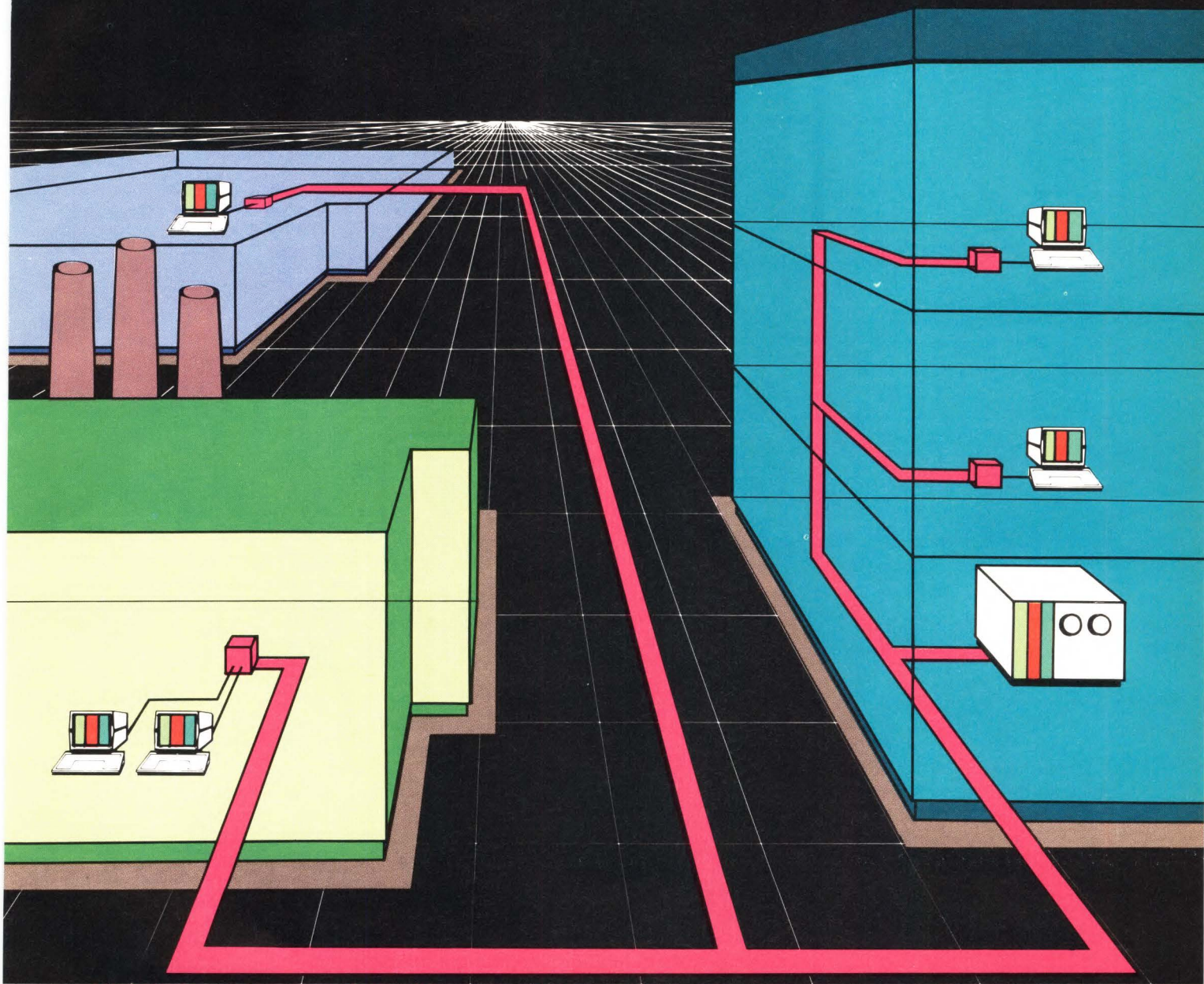

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Tektronix
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Write 406

Texprint
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Versatec
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Write 409

Watanabe Instruments
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Write 410

Xynetics
Santa Clara, CA
Write 411

Yokogawa Corp. Of America
Shenandoah, GA
Write 412

Continued from p. 52

printing overhead transparencies or soon will be, giving them a definite advantage over impact dot matrix printers.

Color Cameras

An easy method of getting hard copy from a CRT is merely to photograph the screen. This, however, is not as easy as it sounds. First of all, to get a sharp picture, either the room must be darkened or a hood must be placed over the terminal during the photo session. And of course the terminal can't be used during the photo session. This may be acceptable in an art production house, where the terminal is used expressly for making presentation graphics. However, it can be awkward in an engineering environment or office where hard copy production is only one of the many functions of the terminal, and where time-consuming photo sessions are at best inconvenient and at worst impossible. Also, photos taken directly off the screen are often poor in quality, due to distortion from screen curvature and color shifts due to the properties of the film emulsion. Finally, shooting the CRT directly requires photography skills often unavailable in a smaller company or laboratory.

A solution to the problem was introduced in 1980. Since isolating the terminal CRT from light in a work environment was the major difficulty, Dunn Instruments and Matrix Instruments developed a light-tight box containing a second, monochrome CRT facing a fixed-focus lens/film holder assembly (**Figure 8**). Between the CRT and the camera is a red, green and blue (RGB) color wheel separation filter. The monochrome CRT accepts red, green, and then blue information sequentially from the graphics terminal. First, red information inputs into the monochrome CRT, appearing as fields of white. The color wheel simultaneously rotates so that the red filter locks into place in front of the CRT, and the camera photographs the red data. The procedure is repeated for green and blue information, resulting in a full color, continuous tone photographic image.

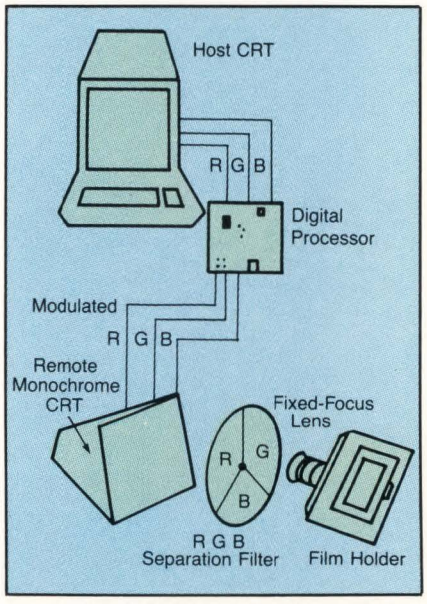

Figure 8: Color cameras use a monochrome CRT, a RGB color wheel and a fixed focus lens and film holder to reproduce color CRT images on film. In addition, some digitize the RGB output to provide multiple levels of grey-scale.

If instant 8×10 sheet film (print or overhead transparency) is used, the operator must now run it through a film processor, which takes about two minutes. SX-70 film develops automatically, and regular 35mm film can be sent out or processed in-house, if the chemicals and expertise are available. The units can now also be operated with new instant 35mm slide film that develops in five-minutes without special equipment.

The original, floor-standing color cameras sold for a base price of about $10K to $15K, with various format film holders extra. Image Resource soon introduced a lower resolution desk-top model for $5K. The trend over the past year has been towards lower price and smaller unit size for low end devices, and increased image quality and user interactivity in high end models. Celtic Technology, Lang Systems and Modgraph have all entered the field, Celtic and Lang at

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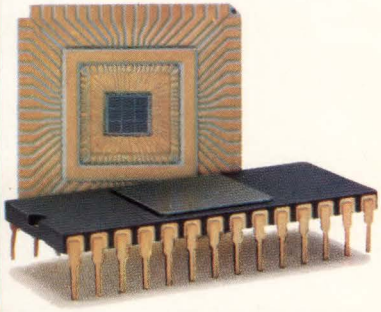

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the low end, with small format units in the $2K price range, and Modgraph at the higher end, with their Smart Graphics Color Camera.

Last year, Image Resource and Polaroid entered an agreement to jointly produce and market color cameras. In addition to a line of analog devices, they also produce models that digitize the video signal, and calculate gray-scale transfer functions for each color. Also, they match contrast, density and other exposure parameters to film type. Another model, introduced at this year's NCC, is an image processor as well as a camera. It allows the user to select from a palette of 72 colors to modify images, and offers graphics software package drivers for hidden-surface removal, enhanced color saturation, and multiple-image batch exposure.

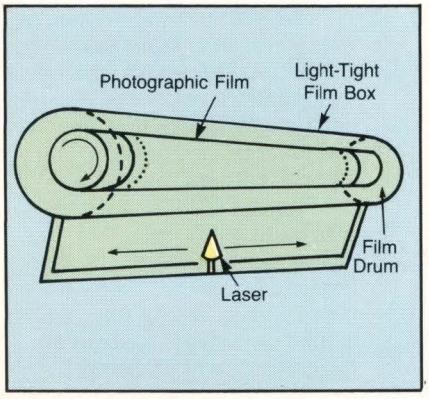

Figure 9: Laser scanners use a highly precise modulated laser to write on photographic film, producing an extremely high resolution image.

Color cameras are ideally suited for situations where color slides for presentations are desired, or where complex, multi-hued graphics require continuous-tone color. For 8×10 prints, however, the high quality of the image must be balanced against the high cost per copy ($5 to $7).

Laser scanners represent another photographic imaging technology (**Figure 9**). These devices operate in a manner analagous to wood lathes, but use film instead of wood, and lasers instead of blades. The film, mounted inside a light-proof drum, rotates rapidly. Simultaneously, a laser shuttles along the length of the drum, exposing the film with a highly precise, modulated beam of light. Laser scanners are used for high resolution imaging, often of satellite shots, where extremely high precision is essential.

There are difficulties in taking art production out of the hands of artists and giving it to computer users.

Thermal Transfer

Thermal ink transfer technology is an area dominated by Japan-based companies who offer the color hard copy device as an enhancement to their graphics terminals. The printing mechanism consists of a thermal print head positioned over an ink sheet roll segmented into consecutive, page-size bands of yellow, magenta and cyan wax pigment (**Figure 10**). This is positioned over a bidirectional plain-paper or transparency transport.

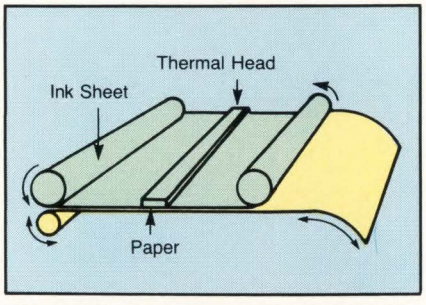

Figure 10: Color thermal printers melt dots of wax-based color pigment onto plain paper or transparency material.

The paper makes three passes under the thermal print head, one for each primary color. Nibs on the print head heat up and melt dots of pigment onto the paper. After the print head prints all of the yellow information, the paper transport reverses. At this point, the magenta segment of the ink roll is in position, and magenta dots are printed. Finally the transport reverses once again to accept cyan pigment. Superimposition of dots of different colors allows the device to produce hard copy with seven colors (plus white, or no pigment).

Seiko Instruments USA (daughter company of Daini Seikosha, Ltd., of Japan) offers a unit called the D-Scan CH-5201 Color Hardcopy Device. It features a local memory that accepts and stores a video image from a color graphics display in 0.5 sec. The display terminal is then free for continued operation while the CH-5201 generates up to 99 copies of the image. Dot density is 150 dots per inch, with a dot size of 0.167mm. Interfaces offered are RS-170 video, RS-343 video, and Centronics Parallel.

At about 100 lbs. and $9K, the devices may be heavy in both weight and price for most desk-top system applications. However, they are quite suitable for applications requiring large volumes of color hard copy at a relatively low cost per copy (25¢).

Color Xerography

Laser xerography uses a laser that "writes" on a photosensitive drum (**Figure 11**). Sensitized areas of the drum pick up toner, and the drum then rolls the toner onto a sheet of plain paper or transparency plastic. This process occurs three times, once for each of the three primary colors. Overlapping pairs of primary colors results in three more colors, and overlapping all three toners provides black.

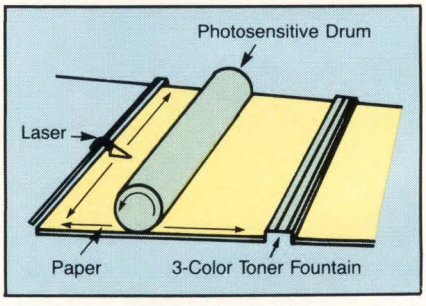

Figure 11: Laser xerography uses a laser to write on a photo-sensitive drum that transfers toner one color at a time.

Xerox's 6500 CGP produces high

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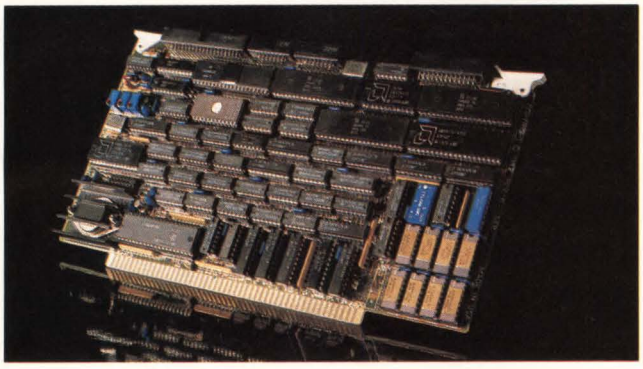

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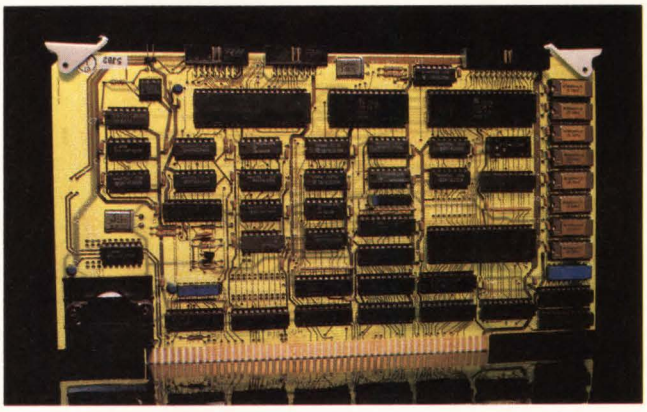

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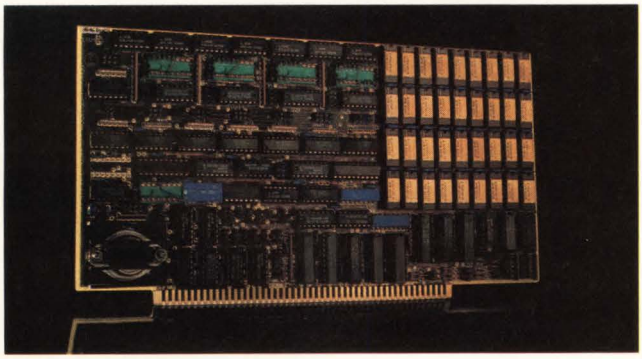

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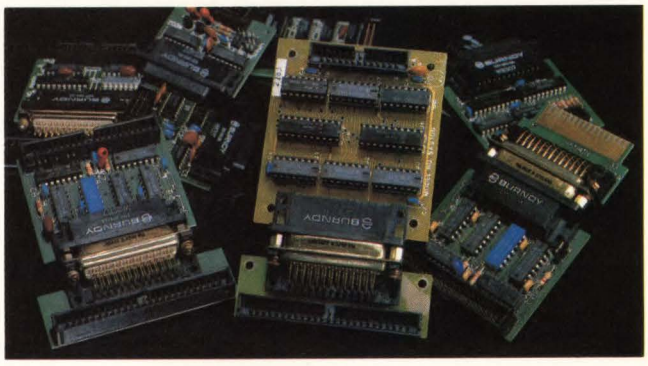

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quality, plain paper color hard copy or overhead transparencies from color graphics terminals at a very low cost per copy. However, its initial cost is high (over $30K) and Xerox doesn't supply the necessary interface electronics. Also, in the field, consistency of the image quality has been a problem, as has reliability.

Desktop Art

Each technology will find its way into its own niche: color impact printers will fill the need for high speed printing with limited graphics; ink jet printing will move into environments requiring quiet, multi-colored plotting with transparency capability; color cameras will meet the need for high-resolution continuous-tone photos and slides; thermal transfer will occupy the high-output, medium resolution niche; color electrostatic will provide fast, large-format plotting; and pen plotters will continue to generate slow, but draftsperson-quality line art. More and more, each of these technologies will occupy the desk-tops of engineers and executives.

Unfortunately, there are difficulties in taking art production out of the hands of artists and giving it to computer users, since even the most sophisticated device cannot provide artistic ability. Even something as simple as a pie chart requires a number of design decisions: frequently, cross-hatching or radial design is easier to read than solid colors; certain colors can draw attention to particular areas; and some color combinations are more effective than others. Plainly, an engineer or executive who relies on his wife to select his tie every morning can not be expected to produce a convincing color graphics presentation. Color hard copy manufacturers will continue to offer more sophisticated devices to less sophisticated users, and OEMs will continue to design them into systems. But it will be the ability of this entirely new spectrum of color hard copy users to implement these new capabilities that will determine how effectively these devices will actually be used. □

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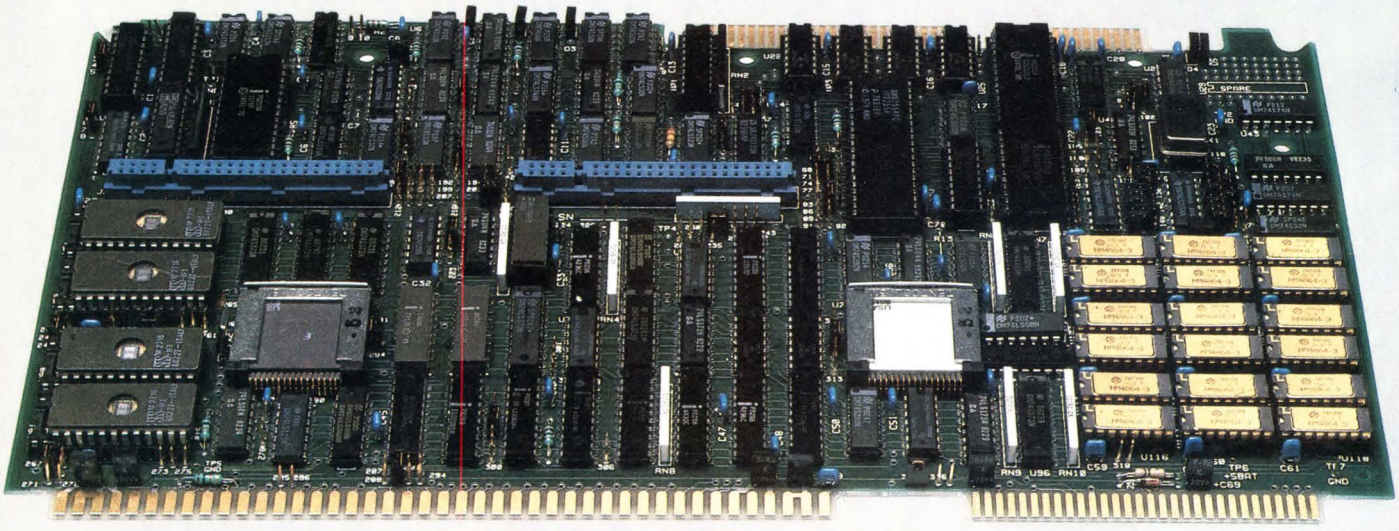

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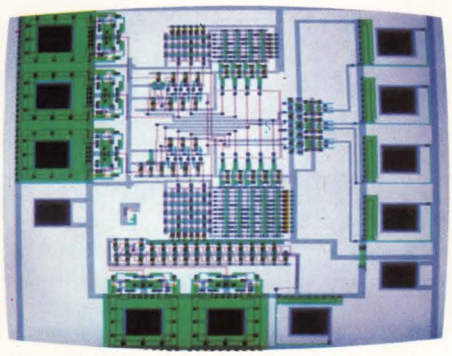

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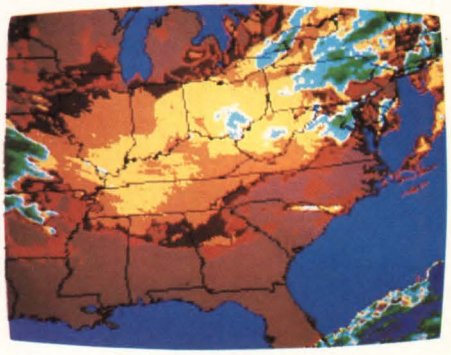

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SBC Links Multibus And IBM PC

by C.A. Burdet

A large segment of the μP-based small systems market is strongly influenced by a few facts which have established their dominance during the past year or so. One factor is that the personal computer market favors technically simple, well-packaged products (i.e., IBM's PC).

Another influence has been sound technical standards (e.g. IEEE-796 Multibus) promoting mutually beneficial cooperation rather than destructive competition among manufacturers, through enhanced confidence at the OEM/user level. And new industrial, scientific, and commercial applications are increasingly leaning on mass produced hardware, software, and personal computers to reduce costs, development time, and simplify training. Additionally, increasingly bellicose competitive strategies are being implemented at all levels (VLSI component families, PC board formats, operating systems, and packaged computers) in an attempt to irreversibly capture and "lock-in" applications markets one by one.

Bridging the IBM PC to Multibus Architecture offers new expansion capabilities to the system designer.

Banking on the appeal of a de facto standard and the wealth of add-on hardware/software products available for the IBM PC, a bridge is now available to the Multibus architecture. This marriage merges popular features from two radically different families, and offers some new expansion capabilities which broaden a system designer's range of options.

The DBC-18xx modular single board computer series is centered around Intel's iAPX 188 CPU. The on-board system architecture features a triple bus structure:

- An IBM PC compatible internal system bus, with on/off-board expansion capabilities, accommodates add-on boards designed for the IBM Personal Computer and related hardware.
- A multi-master Multibus interface permits configurations where DBCs participate in multi-processor architectures as a master, slave, or intelligent slave.
- A dual port memory bus communicates with the internal system bus *and* the Multibus. Up to 64 Kbytes may be shared in this manner by Multibus and IBM PC compatible hardware.

The architecture presents the system designer with a large selection of off-the-shelf hardware and software modules. Several IBM PC compatible subsystems may be linked in a Multibus-based multi-master architecture to form high performance configurations running popular low cost software. In addition to off-board expansion capabilities, the DBC Series includes substantial on-board resources, including serial and parallel I/O, floppy disk control, up to 64K ROM, and 256K RAM; an I/O expansion connector further allows a choice of Intel compatible expansion modules to plug into the main board, including IEEE-488, modem, data acquistion, and Win-

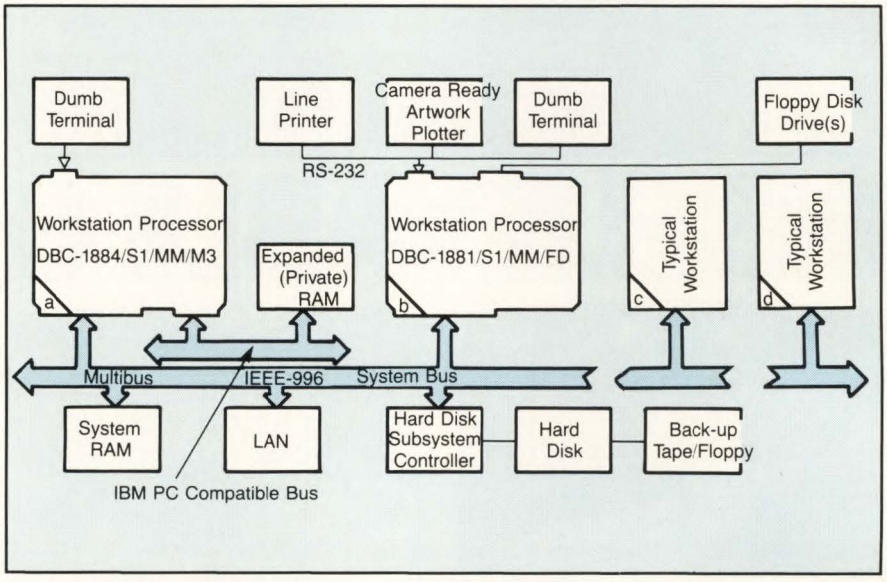

Figure 1: Multistation CAD84 installation; (a) processor intensive station: PCM80 compilation, sub-plot link and locate, route checking, parts list, etc., (b) system console and peripheral controller: print & plot spooling, back-up operations, external communications, (c) low-cost PC board design station: hard copy based development, (d) workstation with screen graphics capability.

C.A. Burdet is Executive Vice-President of SysteMathica Microprocessor Development Group, 4732 Wallingford Street, Pittsburgh, PA 15213; Tel: (412) 621-8362.

fiber has a large bandwidth that doesn't degrade rapidly over distance (**Figure 4**). Though computing won't soon push the 500 kbit — ½ Gbit/sec. rates now possible on fiber, remoting and multiplexing already put severe demands on copper cable.

Several examples of fiber links have appeared recently. Texas Instruments' OPTI 900 Model 931 video display terminal uses up to 3000′ of fiber at 19.2 kbits. Codenoll now offers a fiber optic interface that can link VAX and PDP-11s up to 6 km apart at speeds up to 1 Mbit/sec. ICS Electronics Corp. (San Jose, CA) has announced an IEEE 488 bus extender with a fiber optic option. Their data (**Table 1**) shows that use of fiber allows data transfer speeds as much as six times faster than is possible with coax.

Fiber options can override the 500 meter limit between nodes in the Ethernet specs. Xerox has a prototype, and a joint effort between Codenoll, Siecor (Hickory, NC) and Ungermann-Bass (Santa Clara, CA) has produced another Ethernet-compatible system, Fiber Optic Net/One. Each uses a different approach: Xerox uses an active star coupler, while Net/One's is passive. Active optical components are difficult to find or produce, but passive networks are more limited. In the Xerox system, transceivers can be up to 2.5 km apart; Net/One allows 1 km repeaterless spans. Another option on Ethernet is a fiber "backbone" that connects copper networks in a large system.

Certain high speed data transfers also demand more bandwidth/distance than copper can offer. The Cray supercomputers used in Los Alamos Labs use fiber links, as does the control and monitoring system for the Novette and Nova lasers at Lawrence Livermore Labs. Livermore's Novanet system operates asynchronously at up to 10 Mbits/sec to link a VAX 11/780 to LSI-11s and camera equipment.

Less esoteric needs for speed and bandwidth are in graphics systems (see "Fiber Optics in CAD/CAM Systems," page 84), a market targeted by Artel Communications Corp. (Worcester, MA). Canoga Data Systems' CBE-100 bus extender links a VAX 11/780 with a DeAnza 5000 Image Array Processor for a medical image network at the Hospital of the University of Pennsylvania. The system will eventually link a cluster including those two machines to a concentrator with a cluster of medical imaging equipment. Other very high speed peripherals such as mass memory can also be remoted with fiber.

The new Tandem Non-Stop II link, FOX, is a system-to-system link that carries signals at 1 Mbit/sec over each of four fibers. FOX can connect as many a 14 minicomputer systems, with nodes up to a km apart in a ring topology. Even faster mainframe-to-mainframe links will be ideal candidates for fiber.

Multiplexed signals need high bandwidths and speeds, as well. Fibronics International (Hyannis, MA) makes multiplexed systems for IBM and ITT machines in both fiber and coaxial versions. Their FM-1678 fiber optic multiplexer allows 16 terminals or printers to be connected to an IBM 3274 controller via a fiber cable up to a mile long; the multiplexed signal travels at 2.3 Mbits/sec over the fiber. Phalo OSD (Shrewsbury, MA), Valtec, Kaptron and others also have multiplexers on the market.

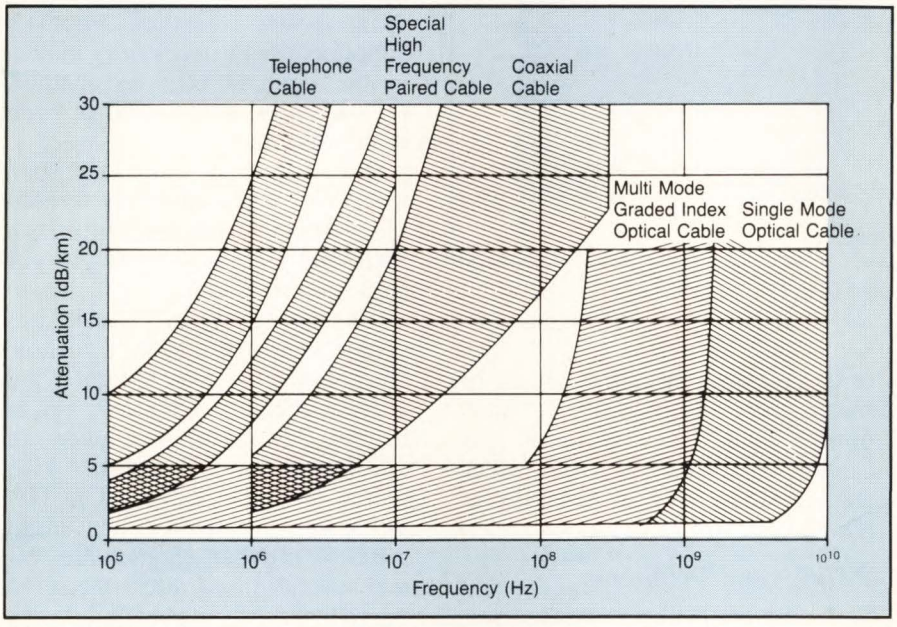

Figure 4: Typical ranges of attenuation versus frequency for several media.

Installation/Upgrading

With computer technology advancing rapidly, no one wants to be limited by bandwidth contraints. Manufacturing, analysis, test and management can all benefit by upgrading distributed access to computing facilities, and multiplexing is a good way to achieve this. But adding high speed signals from new equipment quickly exhausts the bandwidth of copper cable. Fiber cable, however, with its huge bandwidth, allows many upgrades over the same cable.

A fraction the size of copper cable, fiber cable can be installed in ducts too crowded to allow for more standard size cable. Optical cable can also connect directly to a terminal through office, lab or plant space, since it is bendable and unobtrusive. Minimum bend radius for fiber cable is typically from 200 mm to as little as 5 mm.

Fiber cable weighs about ⅓ as much as coaxial cable carrying equivalent signals. But despite the light weight, the cable is strong and can be pulled in with standard methods. Belden Corp. (Geneva, IL) supplied fiber cable for a Sperry Univac system for the city of Houston in what the city electri-

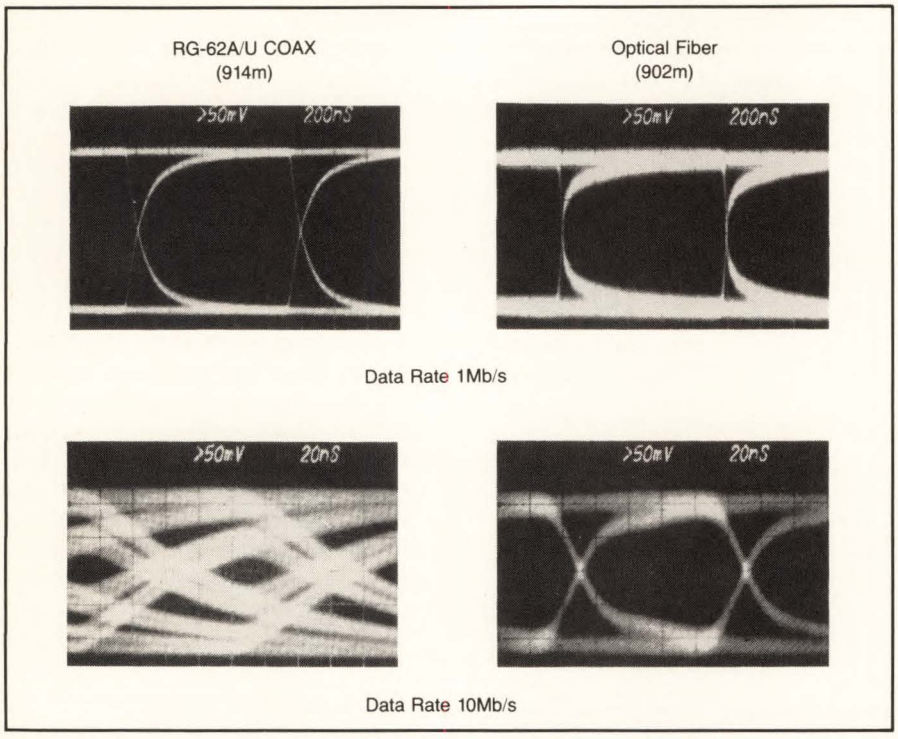

Figure 5: Eye patterns for coax and fiber optic links.

cian described as the worst pull he ever encountered. The cable withstood about 800 to 1000 lb. tensile stress without damage to the fibers.

Circuit Savings

As systems are designed with fiber optic links, and more truly board-mountable optical equipment is developed, transmission space on a card can be diminished. The degradation of square waves such as TTL over copper forces designers to add complex drive circuitry just to maintain TTL logic levels. Over high speed copper systems, TTL must be transmitted as truncated sine waves to be received correctly. High speed signals over fiber hardly degrade, as shown in the eye patterns of **Figure 5**.

Ethernet systems use +12 VDC through the network, and convert to and from +5 VDC TTL. Codenoll's 2020 Ethernet transceiver (**Figure 6**) has the same circuitry (lower half of diagram), but only to meet the needs of copper systems; an all-fiber system can handle straight +5 VDC TTL.

Error generation, both from degraded signals and from interference, is common over copper, and error detection circuitry can claim further portions of a PCB. Since optical signals remain purer and cannot be disturbed from other transmissions, BER is generally at least 10^{-9}.

Pitfalls and Problems

So far, no one with an installed system admits to problems with the optics. The problem, it seems, is understanding the parameters of optical systems well enough to choose an appropriate supplier. The fledgling fiber optics industry has almost no standards yet, since much of the optical data communication equipment has been relatively primitive.

Lack of standards makes system design much more difficult. Each supplier is pushing different methods, and devices from two sources that sound similar rarely perform the same, even when spec sheets show nearly identical numbers. Suppliers aren't necessarily making up the numbers; even test methods for deriving specs are not yet standardized.

Beware, too, of *component* specs that won't allow designers to accurately predict *system* performance. Many users are now opting to purchase entire optical systems, to avoid that problem. Either way, system level figures, like Codenoll's "flux budget" and Belden's link analysis diagram (**Figure 7**) can be helpful. Several other suppliers, including Siecor FiberLAN (Research Triangle Park, NC), HP's Optoelectronic Division, Canstar, AEG Telefunken (Somerville, NJ) and several others also concentrate on system performance and design.

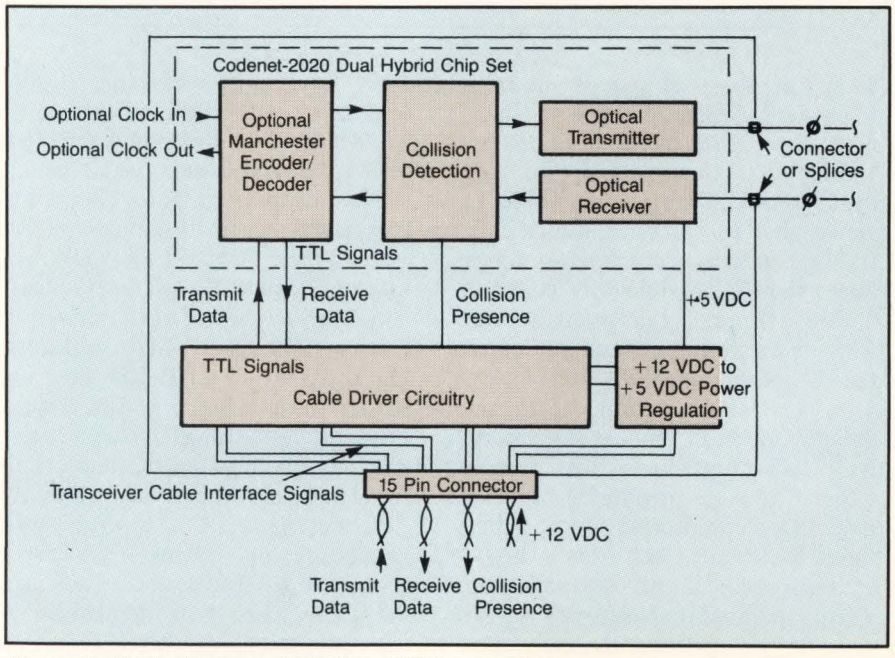

Figure 6: Block diagram of Codenet 2020 transceiver.

Link length	20 m	250 m	500 m	1000 m	1500 m	2000 m
Coaxial-cable data rate	100K	60K	18K	5K	400	100
Fiberoptic data rate	100K	75K	50K	30K	N/A	N/A

Table 1: Fiber optic-coaxial cable performance comparison.

With component specs, it is important to know that power out of a transmitter (and certainly out of an unpackaged emitter) is not the same as power into the fiber. Coupling into the fiber, lensing, and power out of the actual length of fiber are factors that component specs often do not indicate. When designing with components, an OEM designer should learn the right questions to ask of suppliers. Honeywell (Richardson, TX), for example, has been successful in supplying component-level products for prototypes, as have others.

In evaluating potential suppliers, a look at not only the product data sheets but also the actual product is essential. Some suppliers are still trying to reconfigure telecommunications products for the emerging computing market. The result: many large, bulky transmit and receive modules, often packaged in boxes that are rack or table mountable instead of card mountable.

In addition to problems with specs and total system performance figures, the very jargon of optical engineering may be a hurdle. The typical computer link or network designer has little training in optical engineering, so the initial design takes either hours of study or great coordination with the optics supplier.

Obvious requirements for many designs like DC coupling and duty cycle I/O matching do not always appear on spec sheets. An optical engineer can generally derive that information by calculations on the data provided, but the electrical designer usually must depend on the supplier.

Another problem with this new technology is that there are not many users to consult and reliability data is not always available. HP is one company that publishes reliability figures. Operating temperature ranges are critical to optical components' performance, and MTBF and failure rates increase by a factor of 10 to 20 at 85°C, compared to 25°C. To cope with the high temperatures generated in card racks, Fred Scholl and Mike Coden, founders of Codenoll, specially designed their own heat sinks for their transceivers.

Connectors And Other Parts

Connectors are one problem to which most optics suppliers readily admit. There are now connectors that lessen the time-consuming and

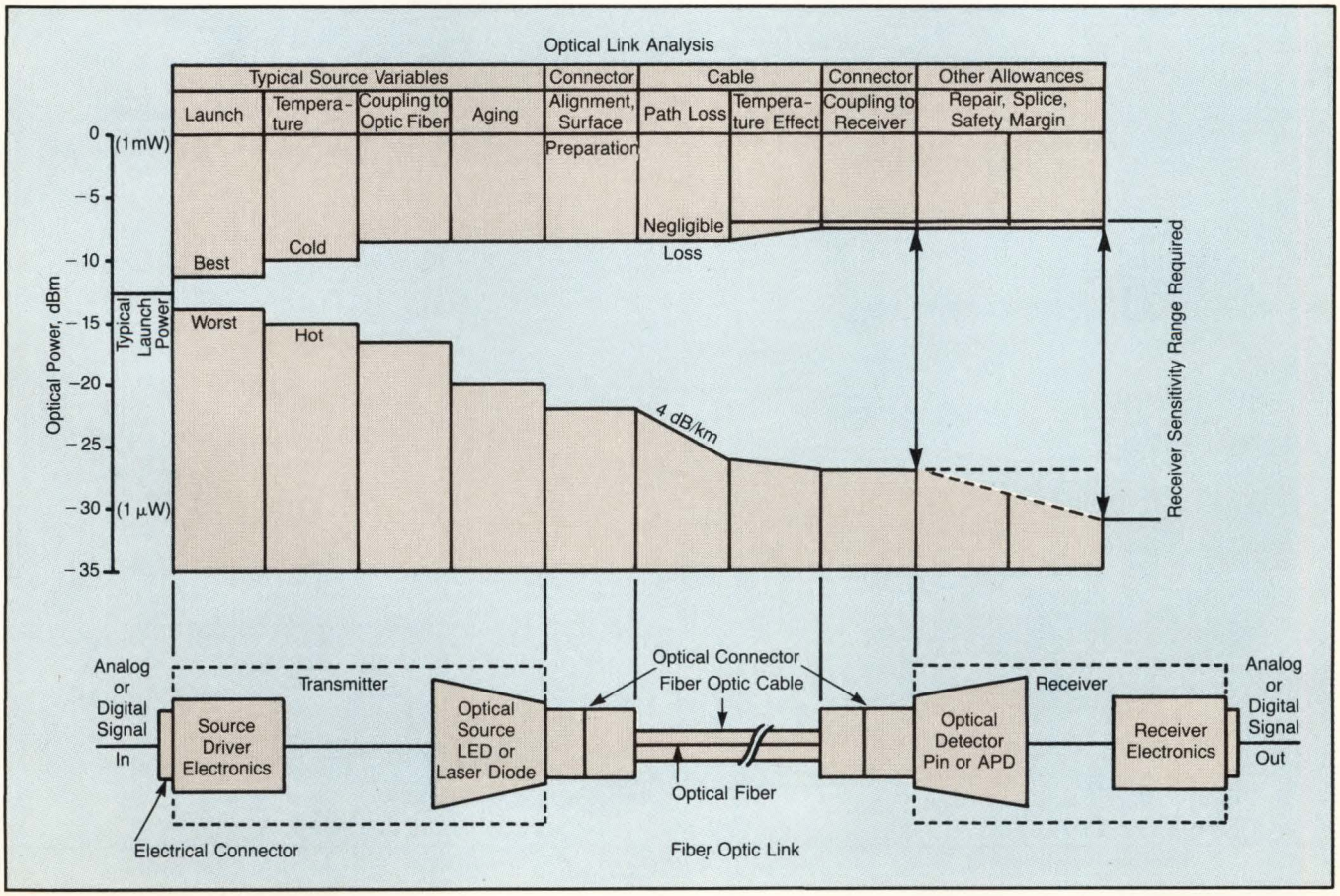

Figure 7: Optical link loss analysis diagram.

Fiber Optics in CAD/CAM Systems

The primary advantage of fiber optics in CAD/CAM systems is the ability to locate workstations right in the engineer's office, even miles away from the processor. In raster scan graphics systems where video is transmitted, the display generator and workstation monitor are interconnected by one (monochrome) or three (RGB) coaxial cable(s) and a wire data cable. With high resolution video, coaxial cable length is typically 50 ft (15m), or a maximum of 1000 ft. Fiber optics can extend this distance by more than a factor of 10. Artel's new Computervision-compatible CV-100 fiber optic system, for example, can accommodate up to a 60-MHz video clock rate more than a mile without signal degradation. A single multifiber cable can support full duplex communications for several workstations, replacing coaxial and/or ribbon cables. This translates to significant duct space and installation cost savings, since fiber cables are smaller and lighter than coaxial cables.

Computervision Fiber Optics

Computervision Corp's Designer family of CAD/CAM systems can now use the CV-100 system to locate Instaview workstations as far as two miles away from the graphics processor.

The system **(Figure 1)** consists of one Video Generator Unit (VGU) per terminal in the CGP-200 mainframe, and workstations interconnected by coaxial video cable and ribbon data cable. The VGU is a dedicated control unit with an integral 32k of 16-bit memory contained on a 15″ × 15″ printed circuit board in the CGP-200 mainframe. The Instaview display is a 19″ 1000-line high resolution raster scan CRT.

At the processor end, the CV-101 transceiver module multiplexes a video signal from the VGU (through a short coaxial patch cable) and two data signals (through the ribbon cable), and converts the electrical signal to light, which is launched into the fiber cable from the LED source through an optical connector.

At the workstation, the CV-100 modem reconverts the optical signal to video and dual data signals that are connected to the workstation via coaxial and ribbon cables.

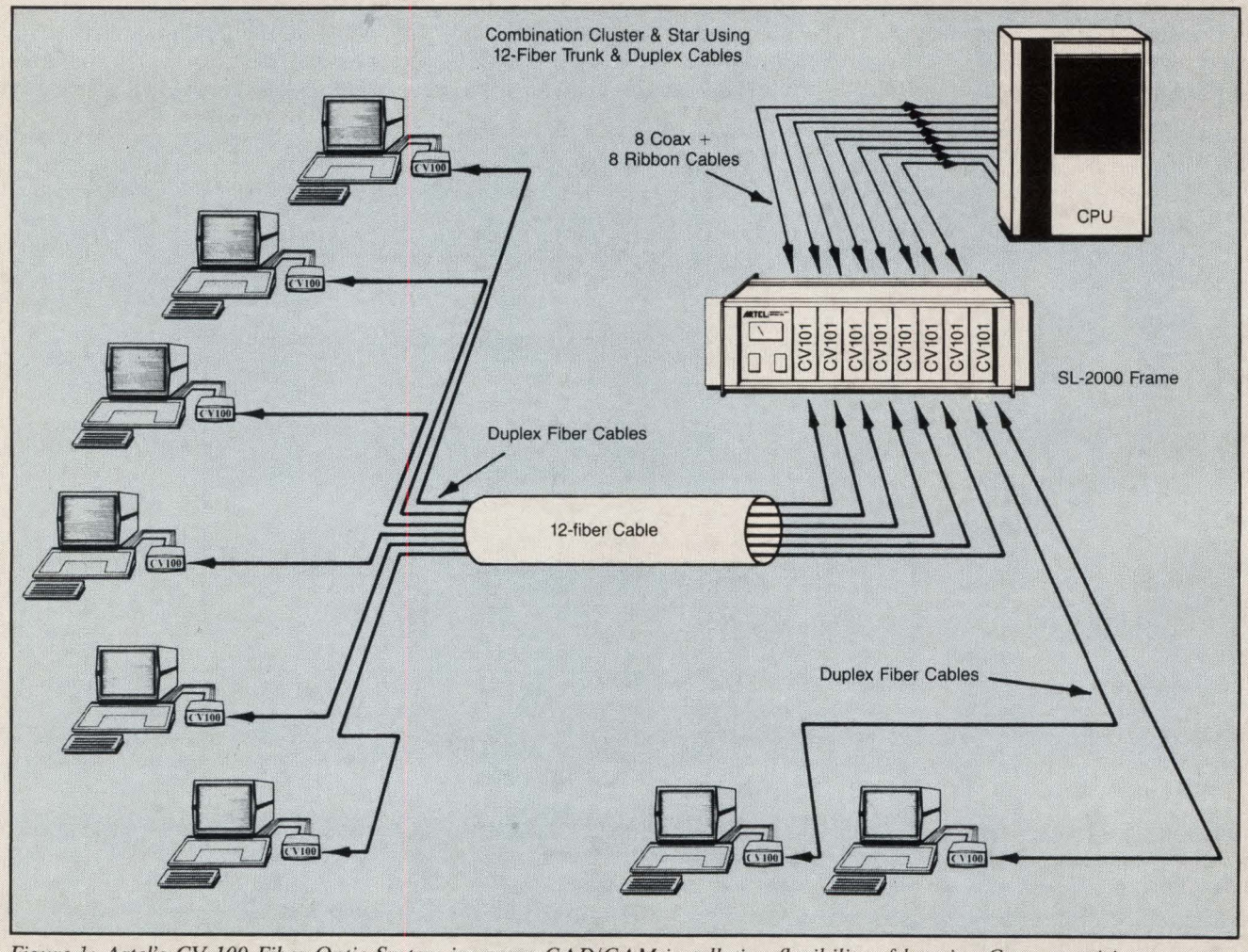

Figure 1: Artel's CV-100 Fiber Optic System increases CAD/CAM installation flexibility of locating Computervision Instaview workstations.

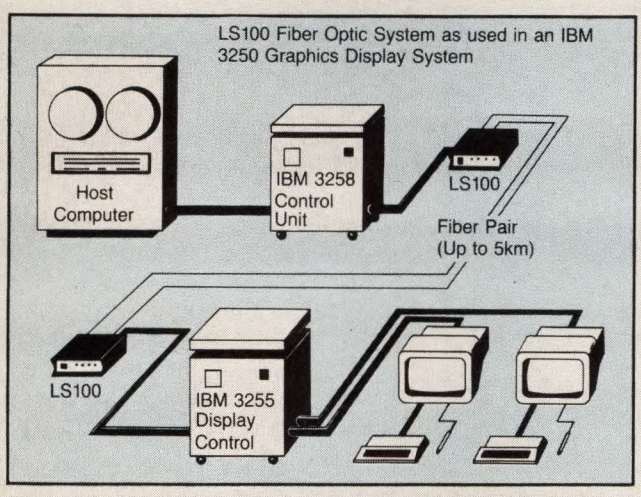

Figure 2: LS100 Fiber Optic system as used in an IBM 3250 graphics display system.

The CV-100 also accepts the return dual data signals, which are multiplexed and transmitted and sent back to the CV-101 over the second fiber in the cable. There, the optical signal is reconnected to the respective digital data signals and patched through the ribbon cable to the VGU.

IBM Applications

Interconnecting IBM's 3250 Graphics Display system via fiber optics **(Figure 2)** increases the CPU-to-workstation separation to three miles (5 km). Artel's LS-100 Fiber Optic Modem is designed to interconnect IBM Control Units used in 3250 CADAM applications, and is plug-compatible to 3258 and 3255 Control Units. FSK data is transmitted in half-duplex mode, with two fibers between modems. Each LS-100 guards against data collisions, communicating with its control units via 75Ω jumper cable.

critical nature of installation, but again, standards are not in place. SMA is a near de facto standard, but SMA connectors require polishing the fiber ends and using epoxy; newer connectors from GTE (Williamsport, PA), AMP, Inc. (Harrisburg, PA) and others allow easier connections, but are not usually interchangeable.

Some of the connector problem is merely conceptual, however. An untrained person can generally install epoxy/polish connectors well enough for specified link functioning after a few attempts. AMP even offers a machine to automatically put connectors on short lengths of plastic fiber cable, for true OEM use. There are now companies who will connectorize cable for about $10 per termination, and some component and cable suppliers will deliver products with connectors already attached.

Connectors are merely one component creating installation and training work in optical systems. Precisely aligning active devices with the tiny fiber cores is a difficult task of prime importance in system performance. A permanently mounted short length of fiber called a "pigtail", in optical alignment with the emitter or detector in a transmitter or receiver package, is a popular way to assure good light coupling. But the pigtail must then be spliced or connectored to the system, and this can cause problems, particularly if the pigtail fiber doesn't match the system fiber. Honeywell's components use a system they call "Sweet Spot", with a spherical glass bead in transmitters and receivers to couple light between active areas and fibers. This eliminates pigtailing and several other firms have adopted similar schemes to improve signal throughput.

Much of the news about fiber optics in computers is being made by companies with total system solutions and not just components. Although the component suppliers may be in the right place for eventual volume supply to OEMs, initial designs with fiber off-the-shelf components may be disappointing if the designer doesn't do his optical homework or have a good relationship with suppliers. It is becoming easier to use fiber components and documentation is improving but there are major pitfalls in designing around such a new technology.

Fiber Cost

For many computer applications, the cost of fiber links cannot be justified. But some of the factors entering into conventional copper design, such as tightening FCC regulations, higher speed peripherals, noisy environments and greater distribution of equipment, are increasing costs of copper designs. Certainly, upgrades needing new cable or more duct space for cable are expensive.

In the short term, fiber will be offered as a premium for links with special requirements. But as Fibronics' 1670 multiplexed distribution system brochure points out, with coax, "connecting 16 terminals and printers to your IBM 3274 one mile away will cost $25,000 . . . with FM 1670 . . . less than $14,000."

Cost savings were also behind a Siecor fiber system in a fast food chain's point-of-sale system. The noise created by fryers and microwave ovens would have required complicated installation and shielding, as well as conduit. The fiber system was inexpensive to install since cable is laid along the wall and no shielding is needed.

In network design, although the electronics of an optical system are costly, the portion of total costs attributable to the transmission system are quite small. BBN's Ted Baker estimated that in their latest addition to the network, the optical equipment, including cables, connectors and electronics, only amounted to about 9% of total costs. And costs on optical cable and components are dropping while the quality goes up. Already, highly specified and shielded cable, like Ethernet cable and the fiber that can replace it are close in cost. **Table 2** shows relative prices of copper and fiber cable from Belden.

But the cable and even the electronics prices are only a small portion of system costs. The most expensive part of new systems is installation. And the size, weight and noise immunity of fiber systems usually allow faster, easier installation. Already, low installation costs are offsetting the higher component and cable prices of fiber.

Other factors of system design will lessen the cost gap even more, as the signal purity and bandwidth/distance over fiber are designed in. Redundant circuitry and spare fibers now popular will disappear from designs as installed systems and quantity production improves reliability. This will further lower costs of fiber systems.

Coax	
RG-62	10¢/ft.
RG-59	13¢/ft.
RG-6	16¢/ft.
RG-11	27¢/ft.
Ethernet	58¢/ft.
Triax	
9232 (Video)	70¢/ft.
9192 (Data)	43¢/ft.
Twisted Pair, 24 Ga., Shielded	
2 pair	11¢/ft.
4 pair	12¢/ft.
Duplex Optical Cable	
50 um	52¢/ft.
100 um	79¢/ft.
200 um	69¢/ft.
300 um	96¢/ft.

Table 2: Price of fiber optic cable and conventional wire products.

Fiber Presence and Future

"The computer firms are firmly committed to fiber optics," according to Codenoll President Michael Coden. This is easy for him to say: Codenoll prototypes are in most of the major computer firms now, as are Honeywell and HP components. Recent announcements from many other fronts suggest that Coden is right.

Designers, armed with a few words of warning, do have options for integrating fiber now. Components, links and systems now appearing on the market increasingly speak to data transmission needs. Practical packaging, good documentation and support are becoming priorities for many companies. Complete lists of firms involved are long and complex; buyers' guides such as those from Information Gatekeepers Inc. (Brookline, MA), Laser Focus (Littleton, MA), and publications like AMP's "Designer's Guide to Fiber Optics" can aid greatly in ferreting out suppliers and understanding optical engineering jargon.

The growing role of the optical system integrator has even spawned a major firm for fiber optic network design: Siecor FiberLAN had installed five systems at the end of its first six months. W. Bart Bielawski, VP of FiberLAN, believes that "the big thing . . . is not that people are messing around with fiber optics, but . . . designing com-

bined transmission facilities for data, video and voice."

Others who are supplying integrated systems include M/A-COM DCC (Germantown, MD), whose multiplexed fiber system for Disneyworld's EPCOT center links 20 pavilions. The system carries 400 data circuits, 10 T-1 trunks, 600 telephone circuits, 400 2-state and 1000 3-state status and control signals. Even Western Electric is getting into the voice/data switching arena with fiber optics in their #5 ESS switch.

Fibronics' new FM-832 system similarly multiplexes as many as 128 channels of voice and data. Typically, the system is based on a single CPU, but the bandwidth of fiber would allow even multiple mainframe connection in a system.

Problems for link designers using coaxial cable are mounting. FCC emission standards will require costly, difficult shielding. Growing system capabilities and communication speeds are already putting limits on copper distances, and signal security can be a big problem in high-end links. The resolution of new graphics systems takes large bandwidths, and noise in industrial and medical environments complicates shielding. The boom in networking demands long links carrying large quantities of bursty data at high speeds, as well.

Advances in computer technology will increase the need to upgrade and expand. Simultaneously, the optical technology that can make that expansion simpler is becoming easier to use and less costly.

When the National Electrical Code includes fiber, U.L. approval, and eventually standards, will come about, making fiber designs a better known quantity. As the introduction of the telephone hasn't put mail services out of business, fiber won't replace coax and twisted pair entirely. But it is already advantageous in some cases and surely will become more valuable in the coming months. □

Special thanks to Information Gatekeepers for access to their files on the fiber optics industry.

Fiber Optics Suppliers

The following companies make fiber optic equipment for data communications. To obtain more information please write in the appropriate number on the *Digital Design* reader service card.

AEG Telefunken
Somerville, NJ
Write 301

American Photonics, Inc.
Brewster, NY
Write 302

AMFOX
Signal Hill, CA
Write 303

AMP Inc.
Harrisburg, PA
Write 304

Amphenol
Oak Brook, IL
Write 305

Artel Communications Corp.
Worcester, MA
Write 306

Belden Corp.
Geneva, IL
Write 307

Burr-Brown Research Corp.
Tuscon, AZ
Write 308

Canoga Data Systems
Canoga Park, CA
Write 309

Canstar Communications
Scarborough, Ontario, Canada
Write 310

Codenoll Technology Corp.
Yonkers, NY
Write 311

Dynamic Measurements Corp.
Winchester, MA
Write 312

Fibronics International Inc.
Hyannis, MA
Write 313

Focom Systems Ltd.
Leeds, U.K.
Write 314

Foundation Electronic Instruments, Inc.
Ottawa, Ontario, Canada
Write 315

Gandalf Data Inc.
Wheeling, IL
Write 316

GTE Corp.
Williamsport, PA
Write 317

Hewlett-Packard
Palo Alto, CA
Write 318

Hitachi Cable, Ltd.
Tokyo, Japan
Write 319

Honeywell Optoelectronics
Richardson, TX
Write 320

ICS Electronics Corp.
San Jose, Ca
Write 321

Information Gatekeepers, Inc.
Brookline, MA
Write 322

ITT Electro-Optical Products
Roanoke, VA
Write 323

Kaptron
Palo Alto, CA
Write 324

Laser Focus
Littleton, MA
Write 325

Lightwave Communications, Inc.
Ridgefield, CT
Write 326

M/A COM DCC
Germantown, MD
Write 327

Manage, Inc.
Chicopee, MA
Write 328

Marlee Switch
Upland, CA
Write 329

Math Associates Inc.
Port Washington, NY
Write 330

Mohawk Optical Group
Leominster, MA
Write 331

National Semiconductor Corp.
Santa Clara, CA
Write 332

Nissho Iwai American Corp.
Los Angeles, CA
Write 333

Optelecom, Inc.
Gaithersburg, MD
Write 334

Optical Information Systems, Inc.
Elmsford, NY
Write 335

Phalo/O.S.D.
Shrewsbury, MA
Write 336

Photon Kinetics, Inc.
Beaverton, OR
Write 337

Pirelli Cable Corp.
Wallingford, CT
Write 338

Plessey Optoelectronics & Microwave
Irvine, CA
Write 339

Raycom Systems, Inc.
Longmont, CO
Write 340

RCA Electro Optics & Devices
Lancaster, PA
Write 341

Scientific Radiation Corp.
Mountain View, CA
Write 342

Siecor Corp.
Hickory, NC
Write 343

Siecor FiberLAN
Research Triangle Park, NC
Write 344

SpecTran Corp.
Sturbridge, MA
Write 345

Tandem Computers Inc.
Cupertino, CA
Write 346

TRW Connector Div.
Philadelphia, PA
Write 347

Ungermann-Bass, Inc.
Santa Clara, CA
Write 348

Valtec
West Boylston, MA
Write 349

Versitron, Inc.
Washington, DC
Write 350

Whitmor Waveguides
N. Hollywood, CA
Write 351

Quality Control Slashes Desktop Failure Rate

by Doug Eidsmore
West Coast Technical Editor

Yokogawa Hewlett Packard (YHP) was awarded Japan's most prestigious industrial honor, the Deming Prize, in October of last year. The award is given each year to companies which have demonstrated outstanding improvements in quality control. YHP, a joint venture between Hewlett Packard and Yokogawa Electrical Works, builds computers and other electronic instruments. There is a lesson to be learned, as HP's American engineers discovered, in examining Japanese principles, methods and attitudes.

In their pursuit of the Deming prize, the Japanese decided they needed a vehicle to demonstrate improved workmanship. The product they selected was the several year old 9845B desktop computer. The product then represented 60% of the business of HP's Desktop Computer Division (DCD) (Ft. Collins, CO) and was also produced in Japan by YHP. DCD supplies components to YHP for their 9845B production as well as engineering expertise.

The 9845B incorporated all the elements of a complete computer system, including two built-in disk drives and a page printer. For HP, investing in a product nearing the end of its life cycle did not seem to be the best use of the company's resources. However, because of the urging of the Japanese and the company's commitment to improving the quality of all its products, management went ahead.

The first joint quality control meeting between YHP and American engineers was held at DCD in October 1981. The YHP engineers quickly discovered that DCD's approach to quality control was inadequate. They questioned the integrity of the QC data collected and were shocked to discover that no one at DCD was responsible for workmanship.

Relentless pursuit of quality in Japan has resulted in award-winning improvements.

The YHP representatives presented five principles as essential to quality control.

First and most important is a commitment to continually improving product quality.

Second, data must be detailed enough to reveal the cause of failures. Failures don't just happen. There is always a reason and even the smallest cause is discoverable. Collecting data does take time. At the outset of the program, one engineer complained he was spending 25% of his time just gathering QC data on a component he produced. The response was: improve quality, and as a result there will be fewer failures to report.

Third, there must be a clear management of responsibility for overall workmanship, documenting failures and repairs, and maintaining the integrity of the data. In a typical American manufacturing environment, the production engineer blames the production worker, the worker blames the procedures, and none of them are basing their criticism on valid data.

Fourth, information must flow from customer to vendor. Often a supplier doesn't know the impact his activity has downstream.

How these principles are applied under the umbrella of "quality improvement" is expressed by the Deming circle (**Figure 1**), divided into four steps: "Plan, Do, Check

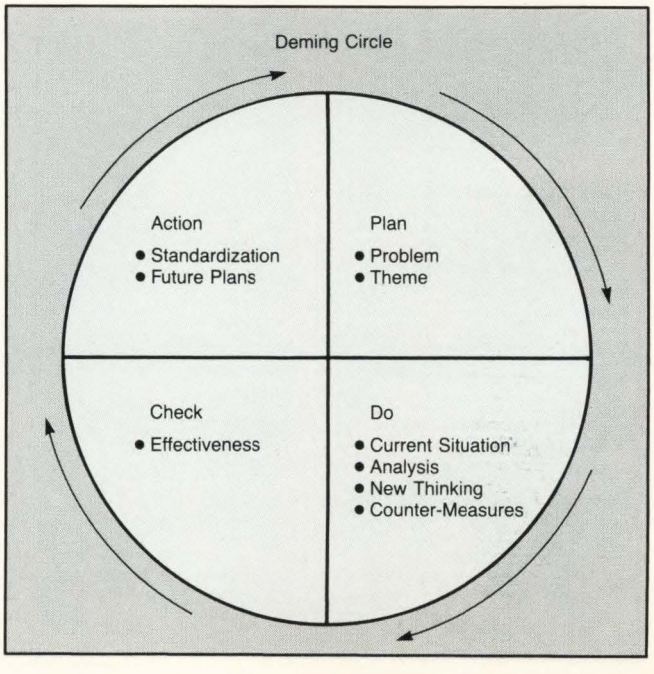

Figure 1: Deming Circle for quality control. Hewlett-Packard correlates each step in plan with management, materials, manufacturing, engineering, production and product assurance via a comprehensive quality information control system.

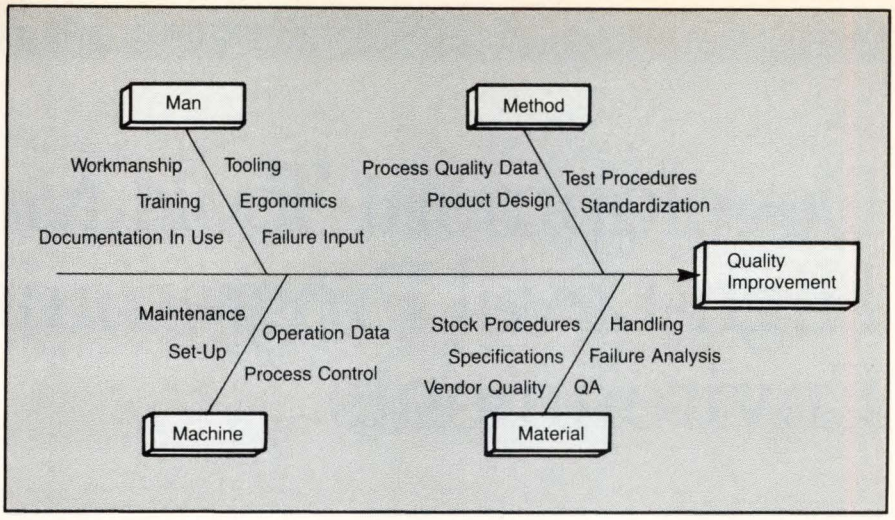

Figure 2: Ishikawa or Fishbone diagrams are used to pursue cause and effect failure relationships. The diagrams break quality improvement into the four M's: man, method, machine and material.

and Action." The "Plan" step is usually a statement about the problem or goal of the activity, and its solution. Many times the problem and goal statements are simply failure rates. The "Do" step focuses on solving the problem and includes an analysis of the failure. Failures are analyzed and given a probable cause, or causes.

For example, the 9845B often failed because of a malfunction with its internal power supply. In the past, the solution had been to replace the power supply with another one when it failed. Such a solution is only temporary to the Japanese. They feel an analysis requires asking "why" at least four or five times to get to the heart of the problem. A typical series of questions and answers might be:

Q. Why did the power supply fail?
A. It failed because of switching current components.
Q. Why?
A. Because the switches overheated.
Q. Why?
A. Because of duty cycle overlap.
Q. Why?
A. Because of an outdated design—a new power supply design is required.

There is nothing magical about the Japanese approach; the key is their devotion to it.

Step Three on the Deming Circle is to check the effectiveness of the solution. The final step is to install and standardize the solution into the production procedures. The circle doesn't stop at this point, but continues, and another "Plan" step is begun.

The Japanese decided attention should be paid to the 10 worst assemblies, focusing on the critical few, rather than the trivial many. YHP sent improvement requests describing a problem that needed to be traced and eliminated to DCD engineers who in turn developed and documented the required changes. A typical system change is illustrated below.

Japanese customers were complaining about intermittent sticky keys, a problem US customers did not seem to feel was significant. The trouble was with the keyswitch. The in-house keyswitch failure rate due to sticking was 1.5%. Since 55 of them are used on each keyboard, the failure rate was 83%. The goal was to reduce the keyswitch failure rate to 0.15%. This would reduce the keyboard failure rate due to keyswitches to 8.3%. The percent keyswitch failures were plotted as a function of the core cavity letter. There are 16 cavities in a mold, one letter for each cavity. The analysis revealed that 85% of the failed keys were G, M, N, or P.

Further investigation showed that another 5% of the failures had split cores. These cores would stick against the plunger causing it to fail. They tested 58 keyboards with the bad corehalves screened out. The failure rate was 0.39%. All of the failures were split cores. The key switch molder, ITW Cortron (Elmhurst, IL) agreed to ultrasonically weld the core halves together. The G, M, N, and P were found to be molded in faulty core cavities, all from the same mold. The mold was replaced. The improvement in quality was clear. Of the next 6056 screened and welded keyswitches run through the system, one failure (due to electrical problems) was detected. All of the other failures were old keys that had not cleared the production lines.

This routine was repeated over and over until the barrage of quality requests from Japan subsided. The next step is for HP to internalize these principles. They are already being applied to the HP 200 68000-based personal engineering workstation. Responsibilities for workmanship based on failure rates are assigned and data correlating failure type and part or assembly number is collected weekly.

Clearly there is nothing magical about the Japanese approach. The secret may be in the devotion they have to it. □

Development Tools Move Into High-Level Programming Environments

by Doug Johnson

In the short space of a decade, microcomputer software development tools have evolved from a very primitive state to a highly refined one. Code once developed by "hand" at the machine level is now produced via high-level languages such as Pascal and C, and then integrated with the target hardware through real-time emulators and sophisticated debugging software that translates trace information into a source code format. There is every sign that this high-level trend will move even further up the software design hierarchy until automated programming tools become embedded in the conceptual process itself.

Micro Programming Evolves

Microcomputer software programming techniques first became a matter of concern in the early seventies with the advent of the μP. During this phase, μP applications were largely confined to system control functions and most programming was done by hardware-oriented logic designers with little or no software background. Most programming was done by "hand" with code entered into the system memory via hex keypad. The only programming automation consisted of absolute assemblers developed in house and run on a resident computer. Codes could be debugged by executing the program on the microcomputer prototype and running it until it crashed.

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By the mid-seventies, certain programming tools long in use at the mainframe level began to filter down to the micro level; these included relocatable assemblers, linkers and the introduction of BASIC as the first high-level language. These tools were being housed in the first microcomputer development systems, which also included emulators to control code execution during debugging. At the same time, the programming proficiency of microcomputer engineers increased, and the need for more high-level programming support grew.

The trend in μC software tools is toward fully integrated high-level support which extends to the entire software development cycle.

The late seventies saw software begin to assume dominance as the most critical issue in microcomputer design. As a result, many engineers entering the microcomputer field had computer science backgrounds and strong preference for the high-level programming languages that are commonplace in the mainframe environment.

At the same time, software development tools expanded and evolved to include such items as symbolic debug support for assembly language programs, screen-oriented editors for faster code entry and multi-user operating systems for team-oriented coding projects. In addition, smaller firms began to supply microcomputer cross-assemblers to run on popular mainframes, such as the DEC PDP Series. By now, emulation had prevailed as the best method of debugging, although much debug work was still done by executing the code directly through the prototype processor. Other debug support then came from logic analyzers, which offer mnemonic disassembly of captured real-time software execution.

As we enter the eighties, the forces driving current and future trends in microcomputer programming tools have become fully established. One of these is the pronounced shift to 16-bit microcomputers and increasingly sophisticated applications that demand program of a size and complexity far beyond their early 8-bit counterparts. As a result, software development has now become the overriding issue in microcomputer design, and high level language programming support has become almost a necessity. Pushing this trend is the continuing influx of computer science graduates, who are well versed in high level languages, into the microcomputer field.

Pascal and C

Recently, Pascal has become the language of choice among many software engineers. One reason is that Pascal is a "structured" language which allows a large program to be subdivided into smaller modules that can be completed by individual members of a programming

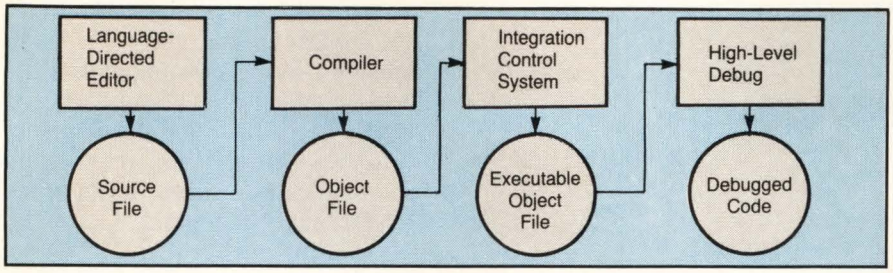

Figure 1: From source code entry through debugging and defining hardware/software interface with high-level language integrated tool set.

team. This feature of Pascal is fully compatible with the "top down" approach to microcomputer design, which subdivides a project into a hierarchy of functional modules. When working with complex 16-bit applications, this type of organization and control plays an important, if not crucial role.

Another plus for Pascal is its support for concurrent multi-tasking applications. Software of this type involves managing multiple processes all competing for system hardware resources. Pascal allows each process to be treated as a separate program (code and data), and can provide, through the run-time library, all the software mechanisms necessary to manage the interaction between programs, such as context switches and priority queueing.

Another structured high-level language gaining wide acceptance is C. One reason is that Bell Laboratories' popular UNIX operating system is written in C and the language has therefore been readily available to large numbers of engineers. Also, C provides a great deal of flexibility in writing code to perform machine-level manipulations, although many Pascal compilers now contain a large number of enhancements which also permit machine-level operations.

Much of C's flexibility comes from the absence of strict typing as found in Pascal. For instance, when working with a Pascal array (1..100) of integers, you could not read an ASCII character into the array, even though it decodes to a desired numeric value. C also allows highly compact "short hand" when coding. For instance, the Pascal incremental expression "A:= A+1" becomes simply "A++" in C.

There is a price to be paid for C's flexibility and streamlining. It is not as self-documenting as Pascal and provides little run-time error checking, which means most coding errors are passed along intact to the executable object code. Also, there is no ISO standardization, as with Pascal. Since Pascal and C each have their unique advantages, both languages will probably continue to co-exist.

High Level Tool Sets

Another basic trend in microcomputer software tools is the move toward fully integrated high-level support which extends to the entire software development cycle, instead of just the compiling phase. The advantage of an integrated high-level tool set is that programmers can work in a design environment that is almost entirely independent of the target processor and hardware. This means that a software team's programming skills are readily transferrable from one design project to the next, regardless of the hardware involved.

A fully integrated tool set for a language like C or Pascal extends from source code entry through debugging and defining the hardware/software interface **(Figure 1)**. The first major element is a language-directed editor that understands the syntax of the language in use and flags syntax errors upon entry. This prevents many errors from being passed on to the compiler and slowing the compiling process. Another major element is a compilers that includes enhancements for code operations at the machine level, such as bit manipulation within data bytes and direct access to I/O ports. Also required is a special software tool to define the hardware/software interface. This tool accepts the hardware interface parameters through a simple menu or file and creates all code necessary for linking, memory mapping, low-level interrupt handling and initialization/reset. Finally, a high-level debug tool that lets users perform debug operations and read the results in high-level source code terminology is needed. When all these microcomputer software tools are packaged as an integrated set, software engineers can work in a programming environment that is largely hardware-independent.

Another significant trend is the need for project management tools that organize and control the programming efforts of an entire design team. This need is exemplified by the widespread acceptance of Bell Laboratories' UNIX operating system, which includes a broad set of tools aimed directly at managing the evolution of files created by a programming team. One example would be version control, which guarantees that as a particular file evolves over time, any version of it can be reconstructed at any time. Another example is module build control, called "make." This tool retains all the interdependencies between source code modules in a structured program. If a particular source code module is modified and needs recompiling, "make" automatically ensures that all other modules dependent on this one are also recompiled. There is also a documentation tool, which permits documentation files to be entered using the same system interface and filing structure that supports the programming effort. As 16-bit hardware drives the volume and complexity of the microcomputer code into the kilobyte and megabyte range. UNIX-type project management tools will become absolutely essential to efficient, cost-effective software development.

Hardware Environments

All trends in microcomputer software tools are inextricably tied to the evolution of the hardware environments in which they execute. In recent years, two major hardware

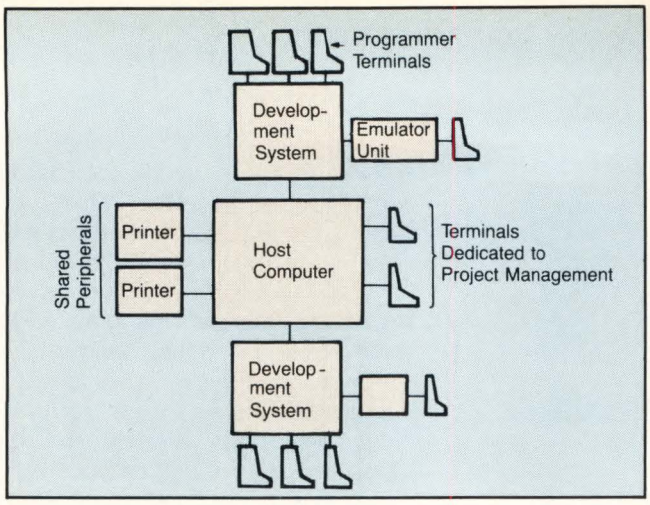

Figure 2: Hybrid mainframe/multi-user development system environment.

environments have formed. One is centered on the host computer, with software development done through terminals and debug/emulation accomplished through dedicated peripherals. The other is the stand-alone development system, which subdivides into single-user and multi-user versions.

In effect, many multi-user systems are quite similar to larger host systems, with multi-tasking operating systems such as UNIX, and debug/emulation handled through dedicated peripherals. The difference is that the multi-user development systems utilize microcomputer hardware and are usually dedicated exclusively to microcomputer software development.

A typical UNIX-driven development system contains a full complement of software development tools on a resident hard disk, and accommodates five terminals and two peripheral emulation stations. Source code is entered via the terminals, compiled and linked the main system and then downloaded to the program memory of an emulation peripheral, where it is run on the emulator processor under control of special debug software. The information acquired during debugging can then be uploaded to the main system for post-processing to reduce that data into a meaningful format.

One significant trend in microcomputer software debug has been the integration of logic analysis and emulation functions in a single system. An emulator will only yield trace information about software execution by intermittently yielding control of the emulator processor to the debug software, which means the code is not being executed in real time. Traditionally, real-time execution has been achieved through a stand-along logic analyzer. Recently, however, logic analysis functions are being made an integral part of the development system environment.

One method is to install logic analyzer circuitry on card modules which share the emulator/system bus and also have a number of probes to monitor random points of interest within the prototype circuitry. The other method is to develop a data communications interface between a sophisticated stand-alone logic analyzer and a development system. Under this arrangement, all logic analyzer functions are remotely controlled from a terminal associated with the development system. Data acquired by the logic analyzer can then be uploaded to the development system for post-processing and display.

The other major hardware environment, the host computer, continues to gain importance as more and more third party vendors enter the market with cross-compilers and other tools aimed microcomputer software development, and as advanced peripherals allow 16-bit emulation and debug. Due to these developments, a general purpose host computer can now easily accommodate a full complement of microcomputer software development and debug tools.

There is also increasing use of a "hybrid" hardware configuration that combines both multi-user development systems and host computers **(Figure 2)**. In this situation, the host serves as a central file resource and the site of project management or control. Each development system is then able to operate in a semi-autonomous fashion to accomplish specific software development tasks. An example of a hybrid configuration would be a UNIX-based host and development system which establish intersystem communications flow through the UNIX 'uucp' command.

Micro Programming Trends

Looking at the near future, the thrust in microcomputer programming techniques will move simultaneously in three directions. One is toward further automation of the software development process, a natural extension of the current move to high-level languages. Another is toward techniques which reduce the occurrence of errors throughout the programming process. Finally, more tools will be targeted at detecting errors when they do occur.

Much of the effort toward further automation will be aimed at the "front end" of the software development cycle, which is currently beyond the domain of most programming systems. This will include support for structured analysis employing a "top-down" hierarchial approach to microcomputer design. Tools of this sort will employ interactive graphics to define the functional blocks of the design and the relationships between them. When using this technique, the chances of fundamental software design errors are substantially reduced because thorough preplanning occurs before actual coding commences. Also, software teams will have a single, integrated tool set that supports the entire design cycle, from concept through debugging.

The drive toward error prevention and reduction will be supported by more tools aimed at automated testing of software. One of these will be performance analysis, which counts the calls to specific sections of code during real-time execution and tabulates them into histograms showing where the program spends most of its time. Such tools are already available through the post-processing of debug data extracted from the emulator processor's memory after execution. □

32 Bit VMEbus Combines With Single Board Computer Architecture

The VMEbus has capabilities designed into the bus' specification that current μPs are not utilizing.

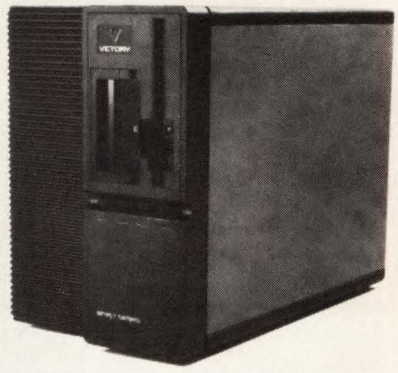

Figure 1: The Victory SPIRIT series computers are Intel iAPX 186 (80186)-based systems supporting the CP/M-86, MP/M-86 and CP/M-80 operating systems

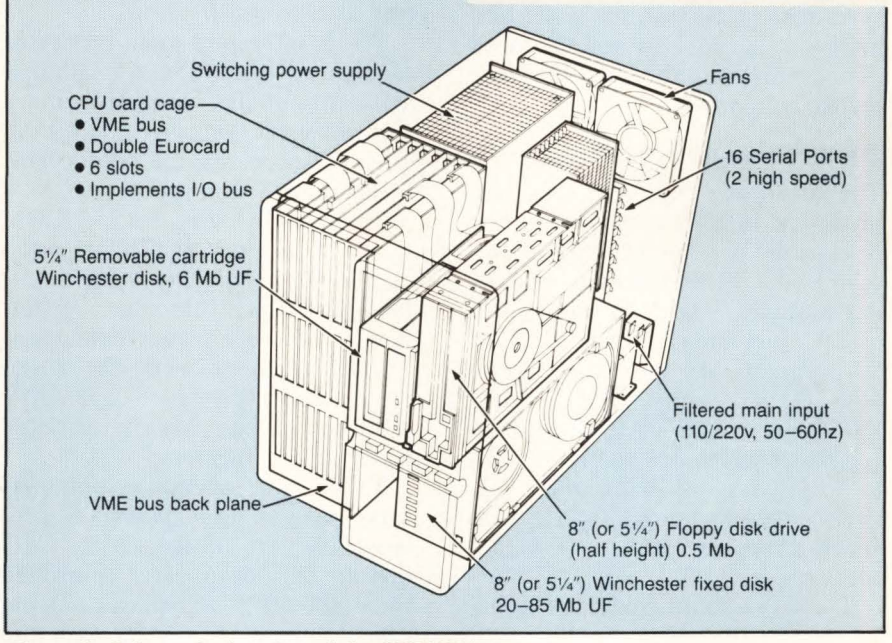

Figure 2: Schematic drawing of the SPIRIT box.

by Jim Willott

The marriage of single board computer architecture with the new VMEbus has led to a design for a powerful 16-bit microcomputer. Central to the system is the new Intel iAPX186 (80186) μP which supports CP/M 86 and MP/M 86 operating systems.

VME bus

The selection of the VMEbus offers distinct advantages over other buses, particularly for companies with European markets. A joint American-European standard supported by Motorola, Philips/Signetics, Mostek and Thomson-CSF, this high speed (16 MHz) bus permits the combination of multiple 8, 16 and 32 bit microcomputers with high performance peripherals in a modular, desk-top multi-user system.

Compatibility

The VMEbus utilizes the Eurocard packaging standard and dual 96 pin DIN connectors. The bus has 32-bit address and data paths, multiple status lines, interrupt and arbitration levels, and a high speed inter-CPU serial link. The VMEbus is also well suited to a user's future needs, such as more computing power per user and fault tolerant architectures.

Other buses do not offer the same design advantages. The Multibus, for instance, is limited in size and throughput, and is difficult to expand to 32-bits. The Versabus uses a large form factor and is less attractive to European users who prefer the Eurocard Standard packaging system.

The VMEbus allows the current bus master to signal that it is finishing a transaction while executing its last bus transaction. Therefore, arbitration can go on in parallel to the last bus transfer. The new bus master knows that it will have the bus as soon as the last signals are inactive. In a multiprocessor environment where there are two to six parallel SBCs, speed and performance are essential. With the VME bus, arbitration can take place during the transfer cycle, reducing delays.

The VMEbus has capabilities designed into the bus' specification that current μPs are not utilizing. For instance, the VMEbus specification supports sequential memory

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access; that is, a starting address is supplied to the memory, which stores it on the memory board. After this single address bus cycle, any number of data-only transfers can be made. It is the responsibility of the memory board to latch the initial address and increment it based on the data strobe information supplied during each of the data transfer cycles. On every data transfer, time is saved by not passing an address to the board. In other words, if a 128 byte block of memory is to be moved from main memory to local cache memory, only 64 data transfer cycles and one address cycle are needed. This saves 63 address transfer cycles and increases speed. By adding more processors and boards, performance is improved.

80186 Provides Flexibility

The 80186 was chosen as the main processor in the system because it is capable of running Digital Research's CP/M 86 family of operating systems. Many business programs, including upgraded CP/M 80 programs are thus made available for end-users. The 8 MHz 80186 has only a 1 Mbyte address capability which has been extended to 16 Mbytes with bank select registers, thereby providing a high speed processor with a large address space.

The CPU board contains five basic subsections shown in **Figure 3**. These five subsections are linked together by a "local bus" which consists of an address bus and a data bus along with sufficient control to cause all subsections to operate as a whole.

In addition to the VMEbus, there is a separate 2MHz I/O bus for low and medium speed peripherals. This bus, an implementation of the Motorola "I/O Channel" specification, provides a non-arbitrated bus dedicated to a single master. The bus is designed to accept commands to fetch or store one Byte of information per transfer. Transfers are initiated on this bus by the 80186 CPU. Its address and control bus is always active so no gating or timing is necessary. The data bus need only be controlled as to its direction.

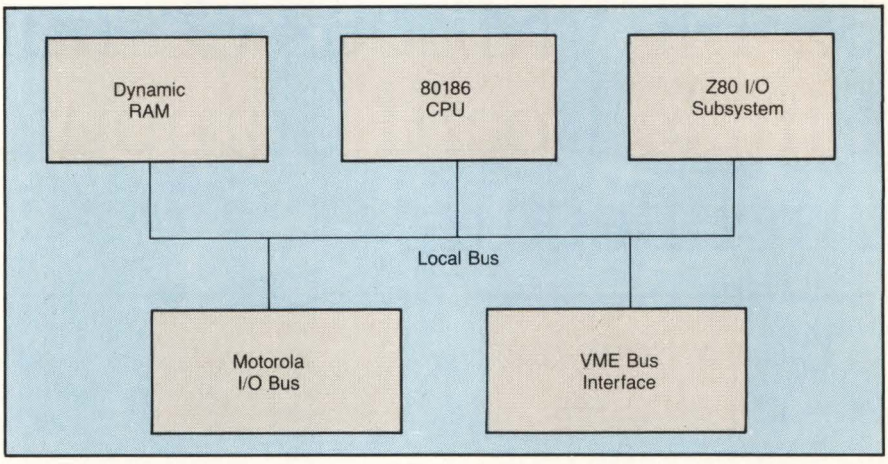

Figure 3: Block diagram of the SPIRIT 16-bit microcomputer.

The 80186 based main processor consists of the 80186 μP, address and data buffers, program memory and sufficient logic to control all other functions on the board. This is the main system processor.

The main memory is a 256 Kbyte space of memory, which is shared by the 80186 and the VME interface. The VME interface may reference the space as any contiguous 256 Kbyte block while the 80186 references it as Bytes 0–255K. Any VMEbus master has unrestricted access to this memory.

To improve overall system performance, an I/O channel is provided as part of the 80186 CPU board. This channel is controlled by a Z80 CPU and shares a separate 4K bytes of RAM with the 80186. All communications with this I/O channel are handled through this 4K RAM.

The Z80 based I/O processor has nine independent channels. One of these channels is an 8-bit parallel I/O port with handshaking signals, while the other eight are RS232 serial ports. All serial ports run asynchronously from 110 baud to 19,200 baud. One of the serial ports may be reconfigured to run synchronously at 800,000 bits/sec.

Multi-Board Set, High Throughput

A basic 8-user configuration requires only two double Eurocard extended (VMEbus) boards: an 80186 CPU SBC, and Winchester disk and floppy disk controller board. For applications requiring additional serial ports, an I/O expansion/co-processor board is available. This board adds 16 more RS232C I/O channels and uses one Z80 per 8 serial channels for interrupt handling. With this board installed 24 serial devices can be supported. The co-processor portion of this board adds four additional Z80 CPUs, each with 64K of RAM as execution engines for the CP/M 80 environment. This capability allows up to four CP/M 80 jobs to run concurrently with CP/M 86 or MP/M 86 programs.

The Winchester disk/floppy disk controller board includes a Zilog Z8002 (16-bit) processor with a full track buffer for cache operation. The board supports a high capacity 5¼" and 8" floppy and Winchester hard disks. This controller can preload 95% (31 sectors) of a 32 sector full track hard disk onto buffers, as directed by a pre-fetch algorithm.

Other boards that can be added include a 1 Mbyte memory expansion board and an intelligent Ethernet controller board. The memory board has been design to permit upgrading to a 4 Mbyte capacity in the future.

The intelligent Ethernet controller is handled by an 8088 and has 128 Kbytes of RAM for storing messages. Firmware contained on the board blocks messages into packets, assembles the packet with a header and tailer, and manages packet retry in the event of no acknowledgement. □

½" Streamer Backs Up 330 Mbytes at 200 in/sec

24 serpentine tracks on ½" streaming cartridge tape drives provide 330 and 220 Mbytes of unformatted data storage with Megatape Corporation's M300 and M200, respectively. The higher capacity of the "300" is a result of using a higher bit density than the "200"; the bit density of the 300 is 9600 bits/in, while the 200 is 6400 bits/in. Streaming speed is 200 in/sec and start/stop speed is 50 in/sec. At streaming speed, 330 Mbytes of data can be dumped in 24 minutes. The cartridge holds 100 ft of tape, the equivalent of eight 10½" 1600 bits/in reels.

Because of the 24-track design, the drive can perform in a random access manner. For example, the mean access to 300 Mbytes of data is 30 sec. Nominal access time is 500 msec and reposition time is 700 msec, both in the streaming mode. In the start/stop or file restructuring mode, the access time is 200 msec, and the reposition time is 300 msec.

The key element in the design is the two-track head stack. The head is stepped 12 times during a full length read or write transcribing 24,000 linear feet of recorded data. The head assembly consists of three inline cores: erase, write and read. Write operations use read-after-write techniques for write error detection and microprocessor-based formatters and data buffering are used to control error rates. If a write error is detected, rather than reposition the tape, the formatter will rewrite that data segment on a specific subsequent write operation. This rewritten data segment contains a flag bit in the I.D. byte to indicate it is a rewrite of a previous failed segment.

Figure 1: Megatape ½" streaming drive and cartridge. Cartridge holds 1000 ft.

If an error is detected during a read operation and the rewritten segment is not detected, then a true read error is indicated and a read retry is attempted. Transport speed is immediately dropped in preparation for reposition, then ramped up in the opposite direction and the segment read in reverse. Then the head is offset by two mils above the normal track position and a reread is attempted. If the retry is unsuccessful, then the head is repositioned two mils below the normal track position and a third retry is attempted. The tape drive reads and writes using Group Code Recording (GCR). Incoming data are organized groups. These data groups are transformed into longer code words, which are then recorded as NRZI. The parallel interface is Cipher/Pertac plug compatible. Up to eight drives can be daisy chained. OEM prices are about $2300 for Megatape 200 and $2800 for Megatape 300.

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Numerix Finds A Niche In The Fast Floating Point Array Processor Market

Numerix recently introduced a product they are hoping will fill a gap in the mid-range floating point array processor market. Their new MARS 432 32-bit floating point processor performs a 1K complex FFT in only 1.7 msecs, for a rating of about 30 Mflops. This speed positions it in a gap in the field of floating point array processors, between those that complete a 1K FFT in about 5 msecs (CSPI's Map 300, Floating Point Systems' AP 120 and Analogic's AP-500) and Star's ST-100 at 0.8 msec. The 432's Data Processor architecture contributes to the speed, with two adds and a

Product Index

To help you find the products 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.

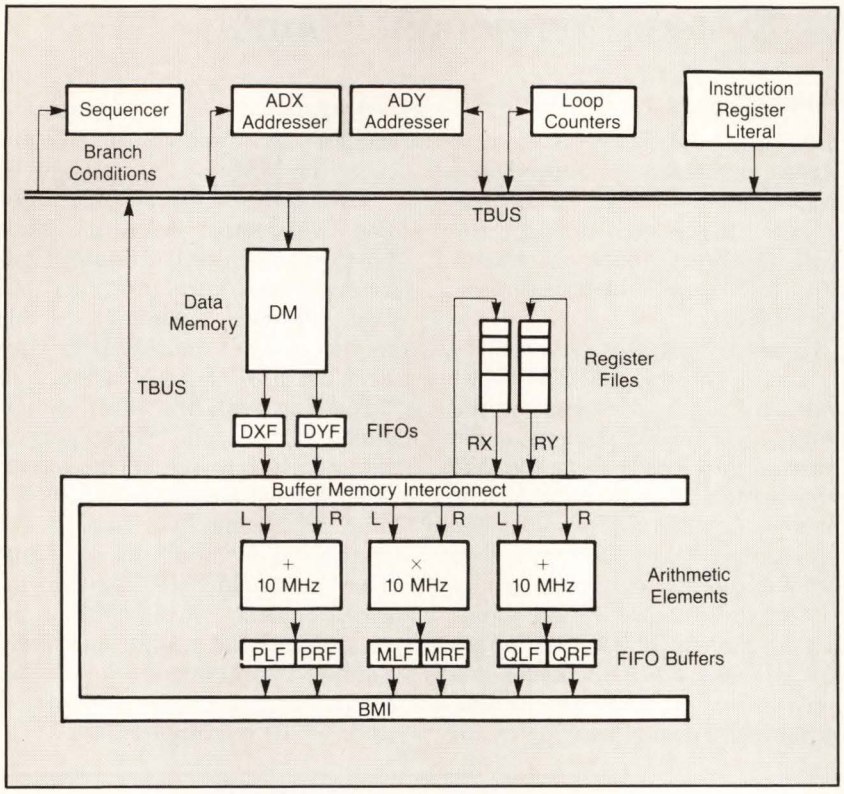


Figure 1: 432's Data Processor includes a multiplier and two adders that operate in parallel at the same 100 nsec rate as the data memory.

multiply element that operate on a 100-nsec cycle (**Figure 1**). DMA transfers are at I/O bus rates of 20 Mbytes/sec with true cycle stealing.

The new unit costs about $75K (typically $80–100K end-user configured and $50K OEM). This is more expensive than the CSPI and Analogic machines, but less than FPS' AP 120, which has enjoyed a good market share. The three-fold speed increase over these 5-msec mid-range products should assure the MARS 432 its own niche in the market. According to Numerix President Peter Alexander, there is already some backlog of orders, though production quantities are scheduled for October.

In addition to its high speed, the 10-board 432 has large data and program memories. Data memory is 100 nsec cycle interleaved, with 16M words of address space and up to 512K of 100 nsec RAM; the expanded configuration program memory uses a 4K cache with 64 word pages for 64K total address space. A program memory without cache is also available, with 4K physical and virtual address space.

The third bonus of the 432 is that it is designed to support software development tools. The Fortran Development System has a compiler that creates object modules for the 432 at the same time as for the host, forming one image file. It also includes a linker, trace/monitor for debugging and Macro-Assembler. Loom is an automatic code optimization utility that automates the writing of pipelined code at the assembly language level.

With fast hardware in place, Numerix will probably concentrate even more energy on software enhancements and programmability. The library includes over 200 routines now, and nearly as many more are to be added by the end of the year.

—Pingry

Write 241

A/D Converters Minimize System Component Counts

The most significant advantage of CMOS analog circuits is a result of the marriage of digital and analog circuits on the same chip. The incorporation of digital blocks such as EPROMs, full-adders, digital error correction, state-machine or microprocessor based intelligence have resulted in some super data-conversion products.

The industry's first monolithic 14-bit/40-microsecond A/D converter, the Intersil ICL7115, is an example of this CMOS digital/analog combination.

In addition to the standard successive-approximation register (SAR), an internal auto-zeroed comparator and an internal digital-to-analog converter, this IC contains an EPROM, full-adder, three-state outputs and several latches organized in a pipelined architecture. This A/D makes use of both digital and analog error correction techniques to obtain very high-speed, high-resolution conversions.

Figure 1 illustrates a typical interface to an 8-bit μC. The "start and wait" operation requires the fewest external components and is initiated by a low level on the WR input to the 7115 after the I/O or memory-mapped address decoder has brought the CS input low. After executing a delay or utility routine for a period of time greater than the conversion time of the ICL7115, the processor issues two consecutive bus addresses to read output data into two bytes of memory. A low level on AO enables the MSBs.

By adding a three-state buffer and two control gates, the End-Of-Conversion (EDC) output can be used to control a "Start and Poll" interface **(Figure 2).** In this mode, the AO and CS lines connect the EOC output to the data bus along with the most significant byte of data. After pulsing the WR line to initiate a conversion, the μP continually reads the most significant byte until it detects a high level on the EOC bit. The "Start and Poll" interface increases data throughput compared with the "Start and Poll" method by eliminating delays between the conversion termination and the μP read operation.

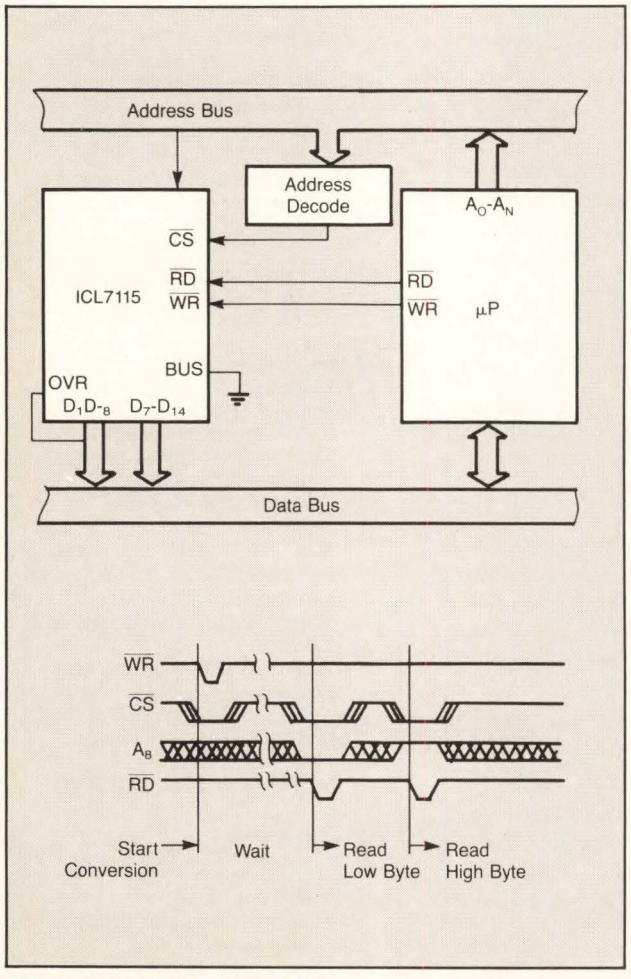


Figure 1: "START and WAIT" operation.

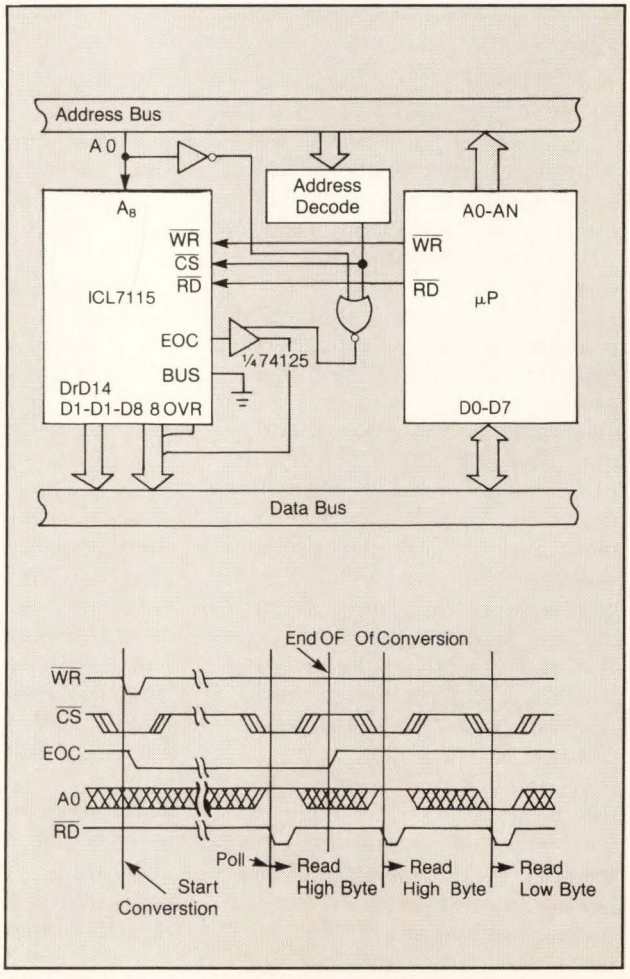


Figure 2: "START and POLL" operation.

CMOS HLA Technology Provides Economical Design Solutions

Today's gate array market is dominated by two approaches: high speed, high density bipolar gate array families, such as STL and ISL, and the wide range of custom CMOS gate array families. Both have similar densities (from 1,000 to 3,000 gates) and consume much less power than standard bipolar logic (1μW to 1mW per gate, compared to 100mW or more for standard 54/74 TTL devices).

Bipolar gate arrays are usually faster than the great majority of CMOS gate arrays. Bipolar programmable array logic (PAL) devices and the hardwired versions (HLAs) are a partial solution for users who want to switch to arrays. They compare well in speed to LSI/VLSI gate arrays, but use about ½W per IC, nearly as much power as the devices they replace. However, using a high speed silicon gate CMOS process, CMOS HLAs are now available with no loss in performance. Each part drives 10 low power Schottky (LS) loads, and offers typical propagation delays of 20 to 25 nsec at 5V.

In addition to equivalent performance of the bipolar versions, CMOS HLAs offer all the traditional advantages of CMOS as well: low power (10μW vs. 500mW), high noise immunity, lower noise generation, lower standby supply current (2μA vs. 100mA), and a wider supply voltage (2 to 6V).

The CMOS HLAs are configured in a matrix of basic cells, arranged in columns positioned side by side, with I/O cells in the device periphery. The columns of cells are designed so that there is ample area between columns to accommodate several wiring channels. The components of the basic cell include two or three p-channel and/or two or three n-channel transistors. For maximum device usage, and a reduction of propagation delays that could be caused by the higher resistance and capacitance of long polysilicon or diffusion type wirings, two layer metal interconnect can be used.

The basic cell configuration is designed to facilitate easy routing of the various PAL/HLA logic functions. These logic functions are constructed through specific contact masks and metalization patterns. Most of the routing for the device is in the predefined wiring area between the columns of basic cells.

At the device level, reduced power dissipation means that, at a given ambient temperature, the junction temperature for a CMOS HLA circuit in a ceramic package will be about 50°C lower than a comparable bipolar HLA/PAL device. The lower junction temperature will reduce the system's failure rate.

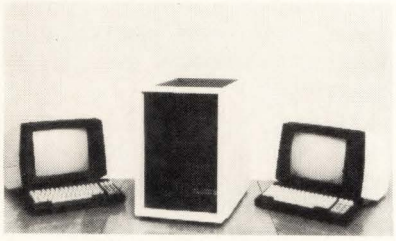
At the subsystem level, the low power dissipation of CMOS HLAs means that less costly packaging can be used if the external environment allows it. The reduced power requirements translate into reduced power supply capacity (battery operation is also possible), easier regulation and reduced venting. In some applications hermetic packaging would be possible for the first time, giving additional protection.

Tom Cauge, Semi-Processes, Inc., 1971 N. Capitol Ave., San Jose, CA 95132. **Write 240**

MINICOMPUTER SYSTEM

Winchester Disk Storage

The dataCase/5 includes five 5.25″ magnetic media devices and is available in both desktop and 19″ rack-mount models. In high-speed, real-



time applications, either a 64-bit parallel digital I/O card with AUTO I/O transfer rates up to 38K bytes/sec or a 32-bit general purpose intelligent distributed I/O cable with DMA I/O transfer rates up to 200K bytes/sec is available. For commercial users RS232 or RS422/449 serial interfaces provide speeds of 56K bytes/sec at up to 1200 meters without modems. Features include 256KB to 1MB of ECC RAM with 370 nsec read access and 0.7 MIPS to 1 MIPS CPU power. Winchester disk storage is available from 5MB to 608MB employing four high-speed 30-ms average-access head positioning actuators. It supports eight users simultaneously. Price—$13,675. **Computer Automation,** 18651 Von Karman, Irvine, CA 92713.

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SCHEMATIC DESIGNER

Print Spooling

The Dash-1 XT converts the IBM XT Personal Computer into a workstation that streamlines the preparation and updating of schematic diagrams and

captures schematic data for automatic generation and design documentation. The Dash-1 XT uses a 10 Mbyte Winchester hard-disk and one 5¼″ double-sided floppy. The hard-disk system allows the user to maintin extensive parts libraries on-line. It provides a print spooling feature that enables the user to off-load accumulated data and schematic printing while another drawing is being created on screen. The Dash-1 XT has eight card slots, four of which are available for user-configured expansion with other IBM PC compatible hardware and software. Price—$14,955. **Future Net Corp.,** 21018 Osborne St., Canoga Park, CA 91304.

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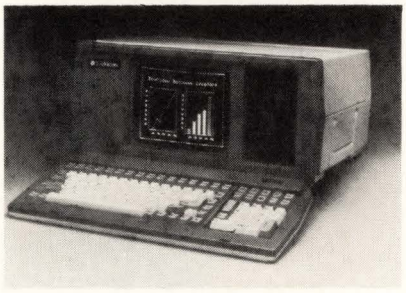
PORTABLE COMPUTER

SuperMouse Port

The TeleTote I portable computer has a 9″ video-display screen with 640 by 240 high-quality graphics resolution. The screen can display 24 lines of text with 80 characters/line. It is software-



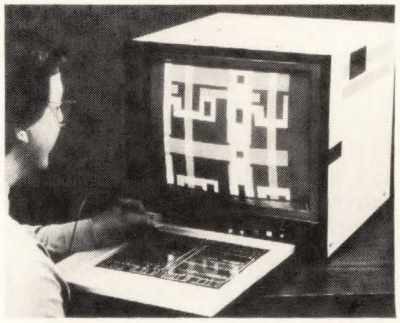
and media-compatible with Televideo's 8-bit desk-top professional personal computer, the TS803. TeleTote I has a Zilog Z80A CPU and 64 Kbytes of RAM expandable to 18 Kbytes. It has one 368.6 Kbyte (formatted) 5¼″ floppy disk drive, one SuperMouse port for quick cursor manipulation and two RS-232 printer/modem ports for hard copy and telephone connections. It comes with the CP/M operating system, the GSX-80 graphics extension, word processing, spread sheet and graphics software. Price—$1,499. **Televideo Sytems Inc.** 1170 Morse Ave., Sunnyvale, CA 94086.

Write 128

GRAPHICS INTERFACE

Two Display Memories

This graphics and character video display interface, called the VRH-Q, has features which include a dual-high card, 1024 × 1024 × 1 dot graphics and a 64 × 128 alphanumeric display. The unit is designed to plug directly into Q-bus series computers. Applications include CAD/CAM, robotics and vision systems, high resolution workstations, data acquisition and process control. The VRH-Q is a combined bit-mapped dot graphics and alphanumeric video interface which connects any Q-Bus series computer to a monochrome monitor,



producing a high resolution 1024 × 1024 bit-mapped graphic image along with optional overlaid alphanumeric characters. It is self-contained and has two display memories: a 64K × 16 bit graphics display memory and a 64K × 16 bit multi-page alphanumeric display memory. High resolution, 7 × 11 dot matrix characters are offered in an 8 × 16 character block. The system can include a 96 character USASCII set and 128 user defined symbols. Price—$2995. **Peritek Corp.,** 5550 Redwood Rd. Oakland, CA 94619.

Write 136

MICROCOMPUTER SYSTEM

8- or 16-Bit Configuration

Called the "Encore" this microcomputer system may be configured as either an 8-bit or 16-bit system with a range of storage devices. The 8-bit Z80B systems run with Digital Research's CP/M or MP/M II operating

systems. The 16-bit Z8000 systems are provided with Microsoft's Xenix operating system. The system integrates with a 10-slot motherboard with modified S-100 circuit boards, a power supply, and a mix-and-match selection of two or more mass storage devices. A combination of disk drives can be incorporated in one system that includes: 8″ floppy disk drives; 5.25″ floppy disk drives; and 5.25″ hard-disk drives with capacities up to 31M bytes. **Ithaca Inter-Systems, Inc.,** 200 E. Buffalo, Box 91, Ithaca, NY 14851.

Write 135

DESKTOP COMPUTER

Supports Four Users

The NEC Astra 220 is a desktop computer which can support up to four users. The system features 512 KB system memory, two 8″ Winchesters with a maximum formatted capacity totaling 126 Mbytes, two 1.0 Mbyte diskette units, cartridge magnetic tape for backup, a system printer and multiple station printers. Printer

speeds range from 35 cps to 600 lpm. The Astra 220 has a range of communications software such as Astra to Astra protocol, and emulation of IBM protocols (3740, 3780, 3270 Bi-synchronous, and 337X SNA SDLC). Availability of HDLC and x.25 protocols provide access to wide area networks and packet switching communication systems. **NEC Information Systems,** 5 Militia Dr., Lexington, MA 02173. **Write 134**

WORD PROCESSING OPTION

Automatic Reformatting

The WordPak is a word processor option for Micronet 25 terminals. The operator can replace, insert or delete words, characters or paragraphs; move blocks of text; center one or more lines, underscore and/or boldface sections of copy. For text access,

line up and line down keys move the screen one line at a time, while page up and page down keys move the screen 23 lines, leaving the 24th visible for reference. Substitutions can be made throughout a document with a global search and replace function. A search, STOP and replace function stops each time it reaches the word, and includes automatic page length and numbering, form protection and storage, a continuously displayed status line, and automatic reformatting for sending messages in different codes. **Sidereal Corp.,** 9600 S.W. Barnes Rd., Portland, OR 97225. **Write 133**

TERMINAL

Detached Keyboard

The Qume QVT-102 terminal, selected by MicroMate is a 12″, 80-column CRT, ergonomically designed with adjustable tilt/rotate screen and a low profile detached keyboard. Its features include four function keys, editing functions, local, line and page block transfers, and protected fields. The MicroMate uses the CP/M Plus operating system, which supports the MicroMate's 128K of RAM memory. The MicroMate comes complete with T-Maker III, an integrated software with word processing, electronic spreadsheet, graphics, list processing and file management. **Qume Corp.** 2350 Qume Dr., San Jose, CA 95131. **Write 132**

ATTACHED PROCESSOR SYSTEM

For Offloading From CPU

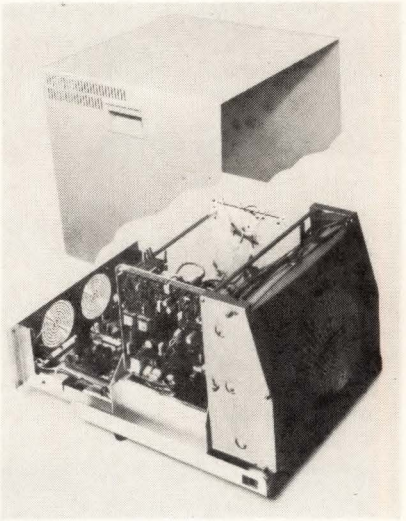
The new APS-1 is an attached processor system which operates as a slave to the main processor. The APS-1 consists of a peripheral processor link

and an LSI-11/23S computer, both contained in a 3½ × 19″, rack-mountable cabinet and connected to the host CPU via a 50-conductor ribbon cable. The attached processor may have from 64K to 256K bytes of its own memory, for calculations and I/O processing, and it can share as much as 256K bytes of the primary processor's memory for data transfer. A floating point chip is included with the APS-1 for handling calculation tasks and a floating point board is available as an option for very high speed data calculation tasks. The link between the host and slave processors is a PPL-1 for use with LSI-11 or PDP-11 hosts and a PPL-2 for use with VAX hosts. Price—$7,400. **Ranyan Computer Enhancement Systems,** 15239 Springdale St., Huntington Beach, CA 92649. **Write 138**

FIRMWARE

Trend Charting Capability

Two firmware from the 17/series product line feature a trend charting option and four shifting trends on each of two pages which can be con-



trolled by the user. Another firmware set provides software compatibility with the ISC 8001G protocol. This firmware supports identical foreground and background colors, large and small characters and symbols, protected fields, plot modes, all the editing and cursor control functions, page and scrolling, lightpen, various transmit modes and transmission controls, with transmission rates up to 38.4k baud. The protocols are available on the upgrades 5217A, 5217A-R and 5217A-CT model products as well as the new Model 5219 display system. Price: Protocol - $350, Model 5219 - $3,300. **Aydin Controls,** 414 Commerce Dr., Fort Washington, PA 19034. **Write 137**

COLOR GRAPHICS TERMINAL

Dual Processor Architecture

The GTC 214 is a high speed, dual processor color graphics terminal with two $^{8}/_{16}$ bit processors. The processors are housed on the graphics engine and I/O board. The I/O processor interprets and compresses the terminal's high level graphics command language (Tektronix 4027 compatible) into compacted binary primitives which are displayed by the graphics

engine. It has a compression factor greater than 2:1, coupled with a 3K byte command buffer. From a standard 12K ROM/2K RAM, the I/O board memory can be expanded to a total of 63K. The terminal has one standard ASCII character set, and allows for two user programmable sets in any cell size to 256 × 128 pixels to be downloaded from the host. The GTC 214 is controlled via a fully programmable keyboard. Thirty-two function keys control macro commands of up to 256 bytes. The screen is a high resolution 14″ color monitor with .31 mm dot pitch. Price—$4,900. **Psitech,** 2842-C Walnut Ave., Tustin, CA 92680. **Write 140**

DESKTOP COMPUTER

Apple Compatible

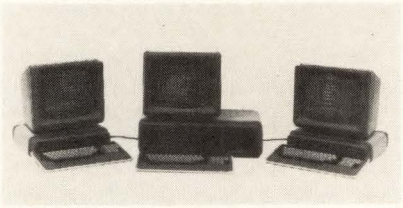
The "Albert" is an Apple compatible computer which provides RGB color graphics with a 256 color palette, using 6 colors at a time. Standard features include a 40 column format; A/D and D/A converters; a detached typewriter style keyboard; built-in communications for RS232, RS422 & RS423; and serial and parallel printer

ports. The system also includes a built-in speaker with amplifier and microphone input jack for record and playback of digitized voice or music; time of day clock to program timed reminders; plus five internal I/O expansion slots. Options for the Albert include an uninterruptable power supply, battery charger/back-up, joysticks and expansion to 192K memory without the use of expansion slots. Price—$1,595. **Albert Computers, Inc.,** 3170 Los Feliz Dr., Unit C, Thousand Oaks, CA 91362. **Write 139**

DESKTOP COMPUTER

Three Serial Ports

The Model 3205 is a 68000-based desktop computer that supports languages including Basic Four and SMC compatible BASIC, RM/COBOL and the IBM APL.SV compatible APL.68000. The programs can access a common data base managed by the operating system. The Model 3205



hardware configuration includes 256 Kbytes of RAM (expandable to a Mbyte), three standard RS-232 serial ports for printers and/or data communications, and a fully adjustable monitor with low-profile detachable keyboard. The integrated Z80A-based intelligent workstation offers 16K RAM (expandable to 64K), a standard 80 (or optional 132) column screen display and optional color monitor with 8 foreground/background colors. The basic configuration also includes two 5-¼″ (1 Mb) floppy disk units. **Pertec Computer Corp.,** 12910 Culver Blvd., Box 92300 Los Angeles, CA 90066. **Write 181**

MULTI-USER SYSTEM

Supports 16 Terminals

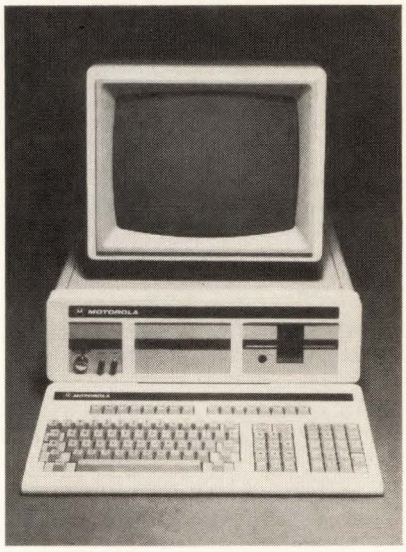
The OMNIX 186 is a 16-bit desktop system which can support from four to 16 terminals and printers in concurrent application processing operations. It utilizes a user-transparent, 16-bit I/O processor for disk and terminal management and an optional 8087 numeric processor extension for floating point operations up to 80-bits in length. OMNIX 186 systems offer a combination of either 1 Mbyte, 5.25″ floppy disk and one or two 5.25″ Winchester drives, or a Winchester drive

plus a ¼″ streaming tape drive. Winchester drives are available in 5, 10, 15 and 20 MB (formatted) capacities. All systems include 384KB of RAM and four serial ports, which are expandable to 16 in groups of four. Internal memory facilities can accommodate up to 1MB RAM when 256KB chips become available. Prices begin at $8,990. **Computer Automation, Inc.,** 18651 Von Karman Ave., Irvine, CA 92713. **Write 142**

DEVELOPMENT SYSTEM

Dedicated Target System Function

The VME/10 microcomputer system doubles as a development support system and an advanced dedicated microcomputer for OEM applications. The system utilizes a 16/32-bit microprocessor, the MC68010. The system is intended for three specific markets; for systems OEMs who require a complete development system for all Motorola 16-bit and 8-bit MPU/MCU chip sets, for system integrators, to serve as a front-end microcomputer associated with larger exter-



nal equipments as, for example, in factory automation systems or large complex medical diagnostic instruments, for OEMs who wish to buy complete microcomputer "engines" and add customized I/O and specially-developed application software to convert these into "turnkey" systems for dedicated applications. Features include 8-bit and 16-bit software, hardware and instrumentation development support, and a 15″ video display. **Motorola,** P.O. Box 20912, Phoenix, AZ 85036. **Write 126**

OPERATING SYSTEM

16-Mbyte Memory Addressing

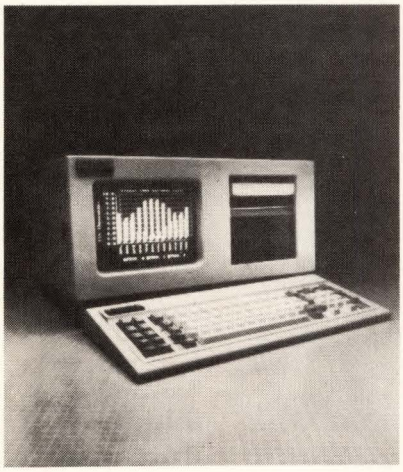
The Xenix 286 O.S. is a multitasking, multiuser μP derivative of Western Electric's UNIX Version 7 operating system targeted primarily to high-performance commercial original equipment manufacturer (OEM) applications. Features include on-chip memory management and protection plus 16-Mbyte memory addressing. Routines to let multiple users access the same data are built directly into

the high-speed VLSI chip. The Xenix 286 O.S. also features a record- and file-locking and power-fail disk recovery, and driver support for five Intel controller boards that range from terminal communications to tape support. Price is $3,000. **Intel Corp.,** 3065 Bowers Ave., Santa Clara, CA 95051. **Write 130**

MICROCOMPUTER SYSTEM

IBM Compatibility

The Columbia VP is a 16-bit microcomputer system that offers IBM hardware and software compatibility. It has 128/256 Kbytes of memory, and



additional storage capacity is available in dual half-high 320K floppy disk drives. The VP features one RS-232 port, a parallel printer port, and a 9″ monitor with graphics capability. Price—$2995. **Columbia Data Products,** 8990 Route 108, Columbia, MD 21045. **Write 131**

GRAPHICS SYSTEM

Multiple View Ports

The MULTI-STATION is a system of distributed high-performance computer graphics workstations. Available in either monochrome or color (16, 256, or 4096 simultaneous colors from palettes up to 16 million colors), the workstations' CRT is a raster-scan 1024 by 1024 high resolution display. Objects can be rotated, scaled and translated. Multiple viewports can be defined and transformed images clipped to their boundaries at real-time rates. Input peripherals such as keyboards, joysticks, data tablets, digitizers, programmable function switches and programmable function dials are available. The 1500 performs all graphics related functions. Groups of workstations can be placed up to 200 ft. from the controller, which in turn, can be configured for either local or remote sites. In a local configuration, the controller can be up to 200 ft. from the host computer. When configured with a Communication Controller, the System 1500 Controller can be up to two miles from the host computer. In this remote configuration, transmission can be with any of four transfer media: coaxial cables, fiber optics, microwave and T1 telephone. Each communications controller can support up to 62 workstations over coax and up to 32 workstations over other media. **Spectragraphics Corp.,** 10260 Sorrento Valley Rd., San Diego, CA 92121. **Write 141**

ALPHANUMERIC PRINTER

Self-Test Standard

The 20-column μP compatible thermal printers are designed to operate over a temperature range of −40°C to +50°C. Designated the MAP-20SL

series, one model is available for AC operation (specify 110V or 220V), while the other operates on DC voltage (from 11V to 40V). Either model features RS232C and 20 mA current loop interface, logic selectable baud rates from 75 to 9600, a print rate of 2 lines/sec, a full 96 character print set, programmable controls, a built-in self test program, standard and extended characters, text and lister printing, and electronic end-of-paper sensing. Both models are 4.44″W × 2.75″H × 7″D, with a front panel measuring 5.25″W × 2.81″H. **Memodyne Corp.,** 220 Reservoir St., Needham Heights, MA 02194. **Write 179**

DATA ENTRY DEVICES

Integrated Into Keyboard

An optical mouse, voice input, and Optical Character Recognition (OCR) are alternative data entry devices which are integrated with the Key

Tronic keyboard system. The voice input product is discrete-phrase, speaker dependent. Vocabulary size is dependent on memory and the unit can adapt to anyone's voice via a training session between the individual and the device. The OCR device recognizes printed characters on documents which are manually passed through a slot in the unit. Standard fonts recognized are E13B (MICR), OCRA, and OCRB, with others available on request. The electronics for the mouse, voice, and OCR products are integrated into a low profile enclosed keyboard. **Key Tronic Corp.,** Box 14687, Spokane, WA 99214. **Write 176**

MODEM

Auto-Dial

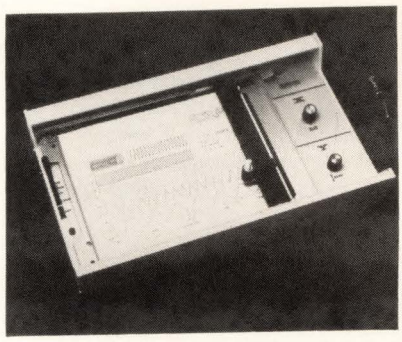
The Model 6212 modem is a 1200-Baud free feature, auto-dial, direct connect, full duplex FCC-approved device. It automatically senses and selects the correct dialing mode, operates in the CPU mode, and has a

stored memory directory of up to 10 numbers. The 6212 employs a standard EIA RS232C interface, local analog loop test through EIA interface, user programmable hang-up code, speed dialing from memory, and user friendly prompt routines. Priced at $495. **Omnitec Data Inc.,** 2405 S. 20th St., Phoenix, AZ 85034. **Write 174**

RECORDER

For Analog Recording

The OPTION 30 is a Z-80 μP board mounted inside the model number 705 XY recorder which allows the recorder to be addressed as both a digital plotter and as an analog recorder. Digital inputs are via both standard 8-bit parallel TTL printer interface and a standard RS-232C serial port. Analog inputs are the same voltage signals that can be recorded by the host recorder without Option 30. Prom memory is available for up to 4000 characters of customized user memory. Applications for the Option 30 include: evoked potential measurements, particle size distribution plotting, spectrum analysis, blood cell distribution plotting, rheometry, liquid



and gas chromatography, tensile testing, vibration analysis, sound measurement, cathodic protection measurement, thermal testing, spirometry, biological scanning, etc. Price is $1325. **Allen Datagraph Inc.,** 2 Industrial Way, Salem, NH 03079. **Write 173**

CLUSTER CONTROLLER

Modular Design

The 2074 is a large cluster controller that supports IBM's SNA/SDLC communications protocol. It operates in a point-to-point or multipoint environment at transmission speeds up to 56K bps, and will communicate with IBM System 370, 303X, 308X and 4300 series processors. It is fully compatible with data links controlled by IBM 3704/3705 and 3725 communications controllers, and with the integrated communications adapter on the 4331. The 2074 employs a modular design where each functional component is separated into independent hardware and firmware modules. These modules communicate and interact with each other via a high-speed, parallel bus. The 2074 uses multiple 8086 μPs and is designed to be installed and customized by the user. For customization, users complete a Memorex-provided configuration worksheet, then key in that information via a display station. Throughout the procedure, users are prompted by a series of menus displayed in English along with the appropriate sequence codes. Price—$13,595. **Memorex,** San Tomas at Central Expressway, Santa Clara, CA 95052. **Write 167**

DISPLAY TERMINALS

Detachable Keyboards

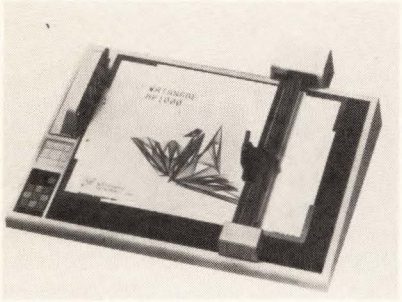
Models 915 and 924 are two video-display terminals with features such as detachable keyboards; high-resolution, tilt and swivel screens; one-button off-line editing; split-screen mode and non-volatile programmable func-

tion keys. The 924 has four pages of memory, while the 915 has two. Both have built-in printer ports, editing capabilities that include line insert and delete and 16 to 32 non-volatile function keys. The 924 has a block and character graphics mode and can display double-width characters. Price: $695 (915) and $895 (924). **Televideo Systems,** 1170 Morse Ave., Sunnyvale, CA 94086. **Write 165**

PLOTTER

Portable

The MP 1000 has a plotting speed of 6″/sec and can operate with oil or water base fiber tip pens or ink drafting pens. Six pens can be automatically



selected during the plotting process. The user may select from three built-in interfaces, serial RS-232C, GPIB-IEEE 488 or parallel seven or eight bits. The plotter is portable and has a built-in character instruction set. **Watanabe Instruments Corp.,** 12 Chrysler St., Irvine, CA 92714. **Write 161**

TELEPRINTER

Automatic Printing

"EASYWRITER" is a compact, portable teleprinter designed to provide the user with a direct-connect device for transmitting information to and from a variety of sources via a telephone line. It enables the user to have access and retrieval of information from the data base via the connection of a standard telephone jack or built-in 300-Baud Acoustic Adapter. Standard features include a standard typewriter keyboard which allows the user to send and receive messages from another teleprinter, computer or computer-type device. It is also capable of storing these messages in its electronic memory for transmission at a later date. "EASYWRITER" can automatically receive and print incoming messages without an operator. Price starts at $250. **STC Systems,** 4 North St., Waldwick, NJ 07463. **Write 166**

HP-COMPATIBLE TERMINAL

80-Column Display

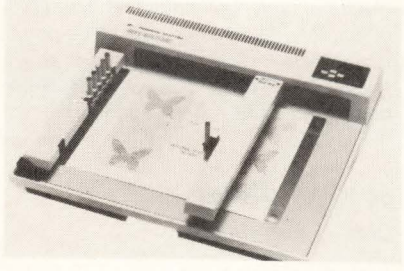
The 800 Series of video display terminals includes an entry-level, block-

mode terminal that is fully compatible with Hewlett-Packard's 3000 and 1000 systems. Features include two pages of display memory, video enhancements, and on-screen program function keys. Users can run HP software application programs including V/3000, MM/3000, and VPLUS. Additional 820 features include a standard line drawing set, an 80-column display, and screen intensity and scroll rates that can be modified from the keyboard. Price: $1,495. **Direct Inc.,** 4201 Burton Dr., Santa Clara, CA 95050. **Write 163**

FLAT-BED PLOTTER

With 31 Commands

The Iwatsu SR-6602 is a flat-bed Intelligent Plotter which works at a speed of 7.9″/sec and comes with optional 6-color pens. It provides en-



riched commands and has a built-in interface with Centronics (Standard) GP-IB and RS-232C (Optional). The unit draws on size B paper and uses three kinds of pens including a water-based sign pen. It features high-precision of $\pm 0.1 + {}^{3N}/_{10000}$ mm with 31 kinds of commands and abundant character sets. Axis Scale Plotting, Circle, Circular, Arc, Spinal Plotting, Notice of Pen Position and Status Information are included. **Iwatsu Instruments Inc.,** 120 Commerce Rd., Carlstadt, NJ 07072. **Write 164**

DISK STORAGE SUBSYSTEM

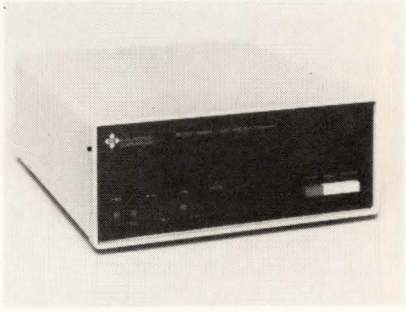
Two Head-Disk Assembly

The NAS 7380 disk storage subsystem is compatible with the IBM 3380 and operates with NAS, IBM, and IBM-program-compatible mainframes equipped with 3-mbytes/sec data streaming channels. The 7380 consists of the 7880-3 storage control unit and the 7380 Models A4 and B4 disk drive units. Each disk storage unit incorporates two head-disk assemblies (HDAs), providing a total of 2,520 Mbytes/unit. Each HDA has two independently addressable rotary actuators, accessing 630 Mbytes. The minimum access time is 5msecs, average time is 16msecs and the maximum access time is 33msecs. The 7880-3 storage control unit attaches to 3MB/sec data-streaming channels and has optional channel switches. Prices are: $65,000 (7880-3), $95,000 (7380 Model A4), $65,000 (7380 Model B4). **National Advanced Systems,** 800 E. Middlefield Rd., Mountain View, CA 94042. **Write 160**

PRINTER

96 Characters/Sec

Model EX1620 is an electrosensitive printer capable of printing 960 characters/sec because of a mode which prints two rows of characters with a



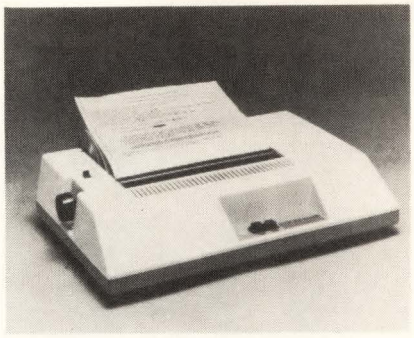
single pass of the print head. In the normal mode, the EX1620 prints characters at 240 cps. It is a high speed, high resolution graphics printer with a density of 144 dots/in. both horizontally and vertically. The EX1620 prints the full 96 character ASCII set, plus an optional 64 extra characters and special symbols on 8½″ wide paper. Standard interfaces include industry-standard parallel, RS-232C and 20mA serial with "busy" and X-ON-OFF protocols. Price is $795. **Axiom Corp.,** 1014 Griswold Ave., San Fernando, CA 91340. **Write 168**

New Products • PERIPHERALS

BUS EXTENDER

Automatic Reporting

The Model 4886B IEEE 488 bus extender, which features reverse auto-dial capability, permits the establishment of 488 buses at sites remote from the local site, but under command of the local-site bus controller/computer. The reverse auto-dial feature of the 4886B extender allows the remote systems to request servicing by the local controller whenever they find an out-of-limit condition or equipment failure. It includes an



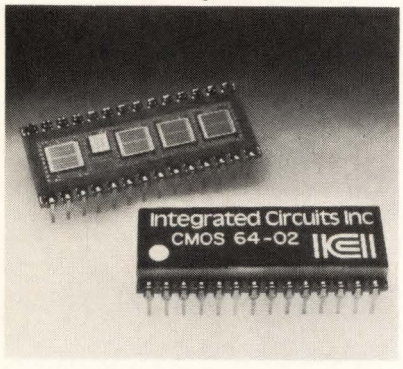
auto-dial capability and a local controller. 124 remote sites, each having a 4886B, can be linked back to the local site's 4886B and, through it, to the local controller. The 4886B has an EEPROM memory that stores up to three 32-digit user-programmable telephone numbers and will try every number in the sequence three times. The modems needed (one local, one at each remote site) can be any FSK-type (103- or 212-equivalent) full-duplex asynchronous units. Price is $1,895 each (without modems) in quantities of 1-4. **ICS Electronics Corp.,** 1620 Zanker Rd., San Jose, CA 95112. **Write 157**

New Products • COMPONENTS

64K CMOS STATIC RAM

64K-Bit EPROM Compatible

The Model CMOS 64-02 Static Ram features output enable, and combines four Hitachi HM6116 RAM chips with a decoder chip in an 8 bit word



by 8K CMOS RAM packed in a standard 28 Pin, 0.6″ wide ceramic DIP. Using the JEDEC approved pin-out for 28 Pin Byte-organized memories, the hybrid is pin-for-pin compatible with the industry standard 64K Bit EPROM as well as the single 64K Bit CMOS RAM monolithics. Operating from a 5V supply at 250 mW typical, the CMOS 64-02 provides memory access time of 100 nsec. $88. (100). **Integrated Circuits Inc.,** 13256 Northup Way, Bellevue, WA 98005. **Write 190**

BUS MONITOR

Address Range Comparison

The MD68SC49A Bus Monitor has internal circuitry that allows direct interfacing with 6802, 6809, 68000 and 6502 μPs in single or μP systems. It is useful for μP software debugging and system logic analysis. Functions performed include address range comparison, data and address pattern matching with bit masking, and bus

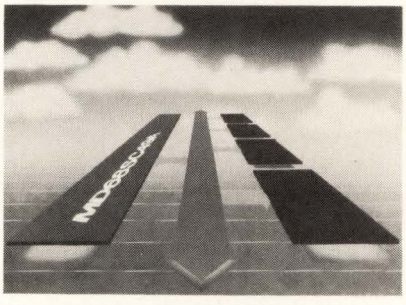
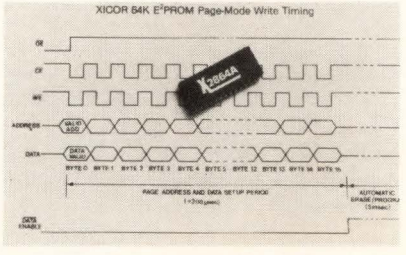


image storage (freeze or continuous). All functions are available in single or multi-pass operation. This IC is sold in a 40 pin plastic or ceramic Dip for use as a built-in component that replaces a large PC board. It has static operation from a single 5V power supply and will support systems clocking up to 2 MHz. $29.49. **Mitel Semiconductor,** P.O. Box 1663, Buffalo, NY 14203. **Write 189**

64 K-BIT PROM

Data Polling Feature

The X2864A E^2PROM, fabricated with floating-gate n-channel technology, operates from a 5-volt supply. Packaged in a 28-pin JEDEC approved configuration, the X2864A

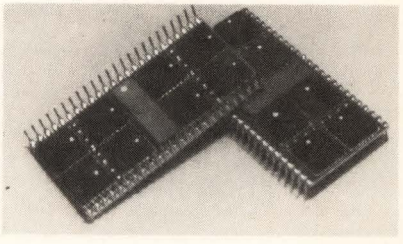


has an 8k × 8 bit organization arranged in 512 16-byte pages, and is equipped with a host of ease-of-use features. Conforming to the JEDEC approved byte-wide memory pinout, the X2864A is compatible, both operationally and pin-for-pin with existing RAMs and with 8k × 8 EPROMs that require high-voltage programming and erasure by exposure to ultraviolet light. The X2864A has a Data polling feature that enables the device to signal the processor when a write operation has been completed. The X2864A allows remote modification of software in μP-based systems. Applications include military, aerospace, commercial, consumer, automotive and communications industries. $89. **Xicor Inc.,** 851 Buckeye Ct., Milpitas, CA 95035. **Write 197**

CMOS SRAM

Two Independent Memory Systems

The DP256KB is a 262,144 bit CMOS SRAM which is organized 32K × 8



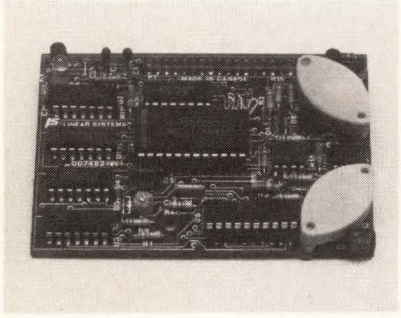
or 16K × 16 external jumper selectable. It is a hybrid assembly consisting of 16 DP5516AP 2K × 8 bit CMOS static RAMs, and 2 DP3440951 CMOS memory support chips. The DP256KB consists of two independent 16 Kbyte memory systems, sharing address lines, power

and ground. I/O pins may be externally tied together to provide a 32K × 8 memory or kept separate for a 16K × 16 organization. The DP256KB is a 32 Kbyte static memory system. Buffering is provided for address lines and R/W. Eight of the address lines may be latched with MPU's utilizing multiplexed address lines. If all 16 address lines are available in parallel, the latch may be operated in a transparent mode by holding ALE high. The DP256KB may be specified in commercial, industrial or military grades with a -C, -I or -M suffix. **Dense-Pac,** South Anaheim Blvd., Anaheim, CA 92805. **Write 195**

CALENDAR/CLOCK CONTROLLER

For ISBX Module Users

The LS 7482 Calendar Clock is designed for all iSBX compatible systems. The board allows general purpose timekeeping and features an onboard battery power supply that protects time data without CPU overhead. Outputs include thousandth of



seconds, hundredths of seconds, tenths, seconds, minutes, hours, day of the month, with corresponding latches for alarm type functions. An interrupt to a host can also be generated at preset times. Price $325. **Industrial Modules,** 1400 Coleman Ave., Suite 24G, Santa Clara, CA 95050.

Write 187

MODEM

Auto Dial, Auto Answer

The component, called the CH1760 is an 8-square-inch, intelligent 212A-type component modem for integration into data products. The integral modem mounts directly onto the host's printed circuit board and provides a Bell 212A compatible 300/1200 BPS full-duplex modem, including an FCC registered telephone line interface and auto-dial, auto-answer capability. The CH1760 features an auto-dialer which provides automatic

selection of DTMF tone or pulse dialing and the implementation of 6 dialing procedures. Other commands include 8 diagnostic test modes, and voice/data switching. **Cermetek Microelectronics,** 1308 Borregas Ave., Sunnyvale, CA 94086. **Write 194**

INTERFACE

Compatible With Joy Sticks

The MU-2 Interface allows a Mouse pointing device to be used with any computer terminal or personal workstation and is compatible with digital joy sticks, track balls and shaft encoders. The Mouse moves the cursor on a computer display screen and the random access interface is inserted in the serial line between the host and terminal by means of a DB-25 connection. The intelligent interface can be profiled from either the terminal or host. Direct, usable displacement data can be programmed to be sent to host or terminal. On-demand or on-motion transmission modes are profilable; transmission can be turned on and off under program control. Resolution of the system is 200 pts/in, with the motion bounded to the limits of

the screen. Hardware options include 16 Baud rates and 8 serial frame formats. **Random Access, Inc.,** 246 Highland Rd., Pittsburgh, PA 15235.

Write 188

STREAMING TAPE SUBSYSTEMS

IBM And DEC Packaging

These two streaming tape subsystems are ½", 9-track, 1600 cpi, IBM/ANSI/ECMA and ISO compatible for Digital Equipment Corporation Unibus

and Q-bus computer systems. The subsystems utilize the IDT Series 1012 Virgo which operates at 100 ips (2.54 meters) streaming and 12.5 ips (0.318 meters) "start/stop." The tape transport is available in vertical, horizontal, or desktop mounting. Data recording is 9-track (P.E.), 1600 bytes/in. All drives support up to 10½ reels. $6,495. **Innovative Data Technology,** 4060 Morena Blvd., San Diego, CA 92117. **Write 186**

SINGLE BOARD μC

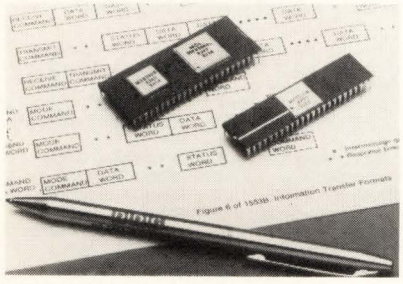
Two Serial Ports

A single board microcomputer called the FE Model 64, features 256 Kbytes of memory, two serial ports and one parallel port on an 8½" × 12" board size. A support package is available allowing users the option of purchasing the Model 64 separately, or as part of two complete packages, a 19" rack system or a portable system with a 9" screen. $275. **Faraday Electronics,** 1029 Corporation Way, Palo Alto, CA 94303. **Write 193**

LSI CHIP SET

Wrap-Around Self Test

The LSI chip set provides a dual redundant MIL-STD-1553B Remote

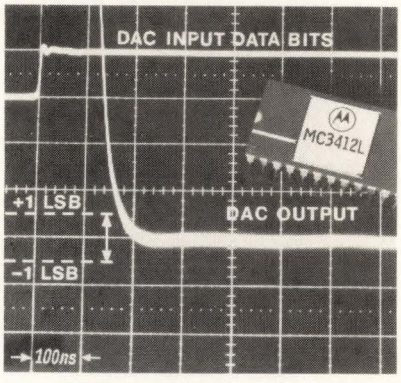


Terminal Unit (RTU), and includes two encoder/decoders (MT32008) and one protocol sequencer/FIFO (MT32007). The DDC chip set provides the functions required of a terminal interface between a dual redundant MIL-STD-1553B serial data bus transceiver and a subsystem tri-state data highway. The resulting RTU is compliant with MIL-STD-1553B. Features of the MIL-STD-1553 LSI chip set include; implementation of all mode codes, wrap around self-test, 32 word FIFO buffer memory, and low power dissipation. If the FIFO is not required the encoder/decoder and protocol sequencer functions can be supplied as individual chips. The LSI chip set is available in three package configurations; dual-in-line (DIP), flat pack (FP) and leadless chip carrier (LCC). The forty-eight pin DIP encoder/decoder is 0.62 × 2.30 × 0.08" (15.7 × 58.2 × 2.2 cm) while the sixty four pin DIP protocol sequencer/FIFO is 0.92 × 3.11 × 0.08" (23.4 × 79.0 × 2.2 cm). All units operate over the temperature range from −55°C to +125°C. $285. **ILC Data Device Corp.,** 105 Wilbur Pl., Bohemia, NY 11716. **Write 192**

12-BIT D TO A CONVERTER

Bi-Polar Offset

The MC3412/3512 is a high speed D to A converter with active laser trimming of thin film ladder network, reference, span, bipolar offset and band-

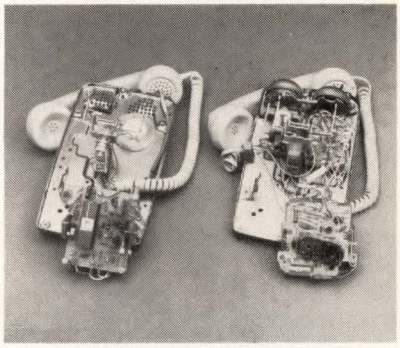


gap reference resistors at wafer level that permit limits of gain and offset errors to ±0.25% FSR (full scale range) and ±0.05% FSR respectively, without external adjustments. Integral non-linearity is specified to ±½ LSB of 12 bits with monotonicity guaranteed over the full temperature range. The converter includes an internal precision 10 volt bandgap reference and span/bipolar offset resistors. With the addition of one external op amp, the precision span and bipolar offset resistors provide calibrated unipolar or bipolar full scale output voltage ranges of 0 to 5.0, 0 to 10, ±2.5, ±5.0 and ±10 volts. A CMOS/TTL threshold control pin permits selection of either CMOS or TTL logic levels at the data inputs. Packaged in a 24-pin ceramic DIP, the MC3412/3512 is pin-compatible with the AD563 and AD565 D to A converters, and is available in commercial and military temperature ranges. $17.95 (MC3412L), $63.50 (MC3512L). **Motorola,** P.O. Box 20912, Phoenix, AZ 85036. **Write 191**

TELEPHONE CIRCUIT

Internal Speech Muting

The MC 34011 is a monolithic integrated circuit which includes a dual-tone multi-frequency dialer (DTMF), tone ringer, speech network and a dc

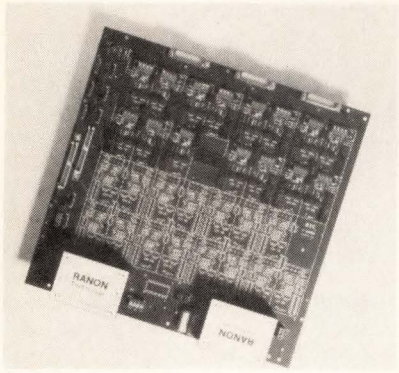


line voltage regulator. A frequency synthesis technique (0.16% maximum error) allows use of a 500 KHz ceramic resonator and the generator uses a keyboard comprised of SPST switches in an X-Y configuration. It features internal speech circuit muting and operates at a line voltage of 1.4V. **Motorola,** Semiconductor Products, P.O. Box 20912, Phoenix, AZ 85036. **Write 196**

DAC BOARD

Interfaces With Any Process Control Computer

The Model U-8680 Analog Output Board converts digital commands on an optically isolated dual 8-bit parallel bus into 30 independent analog output channels. Each channel contains its own addressed 10-bit latched DAC, equipped with 20-turn precision zero and full-scale adjust potentiometers. Primarily intended for process control applications, each channel is equipped with a screw-type four-terminal block, providing a 4 to 20 mA current loop output plus a switch selectable choice of either a −5 to +5V or a 0 to +10V output. The 30 DACs and their support circuitry are contained on a single 13¾"

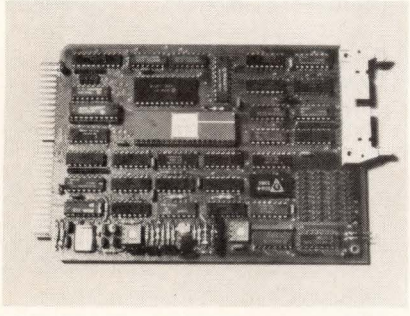


× 14½″ board that fits into any standard 19″ enclosure, and are supported by driver programs. The board is powered by a built-in 115 VAC encapsulated power supply and provision has been made for cascading a second board to obtain 60 independent analog outputs controlled by a single 32-line (4 × 8 bit) parallel interface. $2,995. **Ranon Technology Corp.,** 1420 E. St. Andrew Pl., Santa Ana, CA 92705. **Write 205**

STD BUS CARDS

Control For Winchesters

The Winchester Disk Controller Card, model WDC-501, is a single STD card that can control up to four Winchester-type drives with multiple R/W commands. The controller is designed to work with almost any STD Bus system and is compatible with many Winchester-type disk drives, including those made by Seagate, SyQuest, and Tandon. The multi-layer card allows for unlimited interleave factors and software selectable sector sizes to



1024 sectors. It includes on-board interfacing so that the user adds cabling from the card to the drives. The 68000 CPU card, model SB68-01, uses the 68000 processor by multiplexing 8-bit words into 16-bit format to conform with STD Bus operations. It is supplied with 2K or 4K EPROM and has UNIX available as its primary operating system. WDC-501, $495; SB68-01 68000, $595. **Jonos,** 1835 Dawns Way, Fullerton, CA 92631. **Write 201**

DEBUGGER

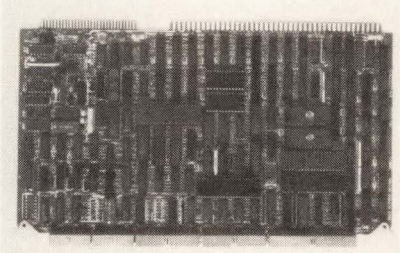
Robotics Application

Tracer, a debugging tool, performs with the VRTX operating system, a real-time multi-tasking silicon software component for embedded systems. Embedded system applications include communications, instrumentation, process control and robotics. Tracer and VRTX components support all custom and standard boards and can be used with any high-level language or development system. With Tracer, designers can obtain current system state information and determine the status of application tasks in real-time. In addition, Tracer allows designers to display I/O buffer contents and examine or modify the contents of memory and registers at critical moments. $650. **Hunter & Ready,** 445 Sherman Ave., Palo Alto, CA 94306. **Write 198**

TAPE BACKUP

File-Oriented

The DSD X217 family of three multifunction boards allows file-oriented transfers and image backup using a QIC 02-compatible ¼″ streaming

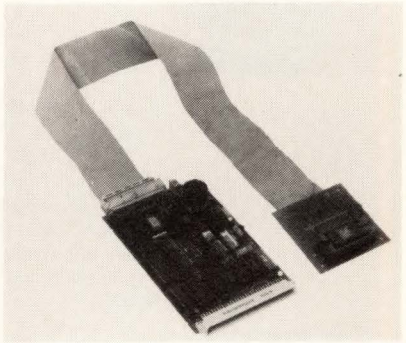


tape. Each board occupies one Multibus card slot. The DSD 5217 handles two ST506-type 5¼″ Winchesters, two SA460-type 5¼″ floppy drives and a ¼″ tape drive. The DSD 7217 combines two SA-1000-type 8″ Winchesters and two SA800/SA850-type 8″ floppy drives and a ¼″ tape drive. The DSD 6217 interfaces to two 5¼″ Winchesters, two 8″ floppy drives and a ¼″ tape drive. The single-board DSD X215 interfaces to two 5¼″ Winchesters, two 8″ floppy drives and a ¼″ streaming tape drive. All DSD Multibus controllers simultaneously interface to two Winchesters, two floppy drives and one ¼″ tape drive. They feature fast, non-interleaved data transfer, on-board data separation, 32-bit error correction code (ECC) and self-diagnostics. $1,020. **Data Systems Design,** 2241 Lundy Ave., San Jose, CA 95131. **Write 200**

PROM PROGRAMMER

With DC/DC Converter

The RM65-2901E PROM programmer programs 1K, 2K, 4K and 8K byte EPROMs as well as 2 Kbyte E^2PROMs, handling both 24 and 28

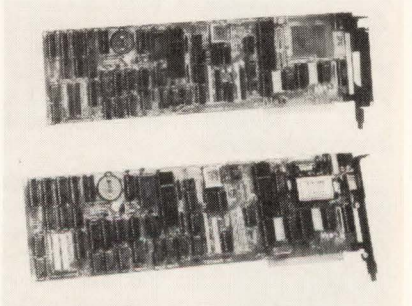


pin devices. It is a Eurocard-size module fitting standard RM 65 card cages with a cable-connected PROM socket. This module may also be used with Rockwell AIM 65 or AIM 65/40 microcomputers. Program development can be accomplished directly on these microcomputers with the resulting information written to PROM using the RM65-2901E. An on-board DC/DC converter in conjunction with a D/A converter controls programming voltages. The RM65-2901E supports 2758, 2758L, 2508, 2716, 2516, 2732, 2732A, 2532, 2764, 2564, 68764 and 68766 EPROMs and 2816, 5213 and 48016 E^2PROMs. $295. **Rockwell International,** 4311 Jamboree Rd., P.O. Box C, Newport Beach, CA 92660. **Write 199**

FUNCTION BOARDS

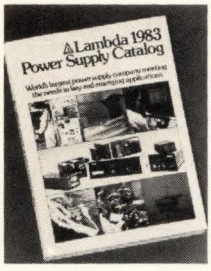
For IBM PC

The 2ndMATE and 3rdMATE are two multifunction cards for the IBM PC. 2ndMATE provides two serial ports, two parallel ports, a real time

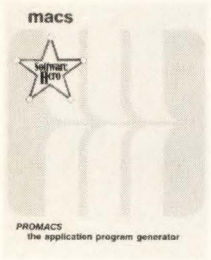


clock/calendar with system-independent battery power, a serial cable, a parallel cable and support circuitry for an optional PAL (programmable array logic). 3rdMATE offers a 300

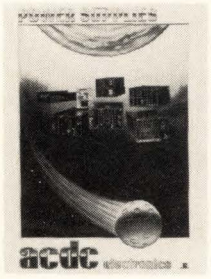
New Literature



Power Supply Catalog. The 128-page 1983 Power Supply Catalog contains detailed specifications, outline drawings and prices of all current power supplies, power systems and accessories. Listed are 50 new Lambda power supplies.
Lambda Electronics **Write 270**



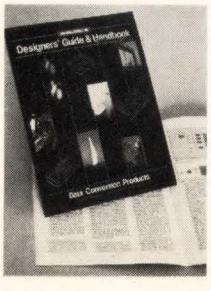
Application Program Pamphlet. The brochure is a 12-page technical overview of PROMACS, the Application Program Generator. It includes examples of capabilities for application generation, utility functions and report writing. It is written as an introductory training manual, illustrating tasks and work flow.
MACS **Write 276**



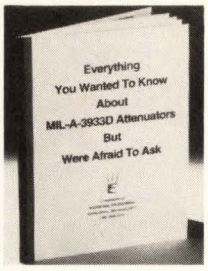
Electronics Catalog. The catalog covers technical data and power supply ordering information for ACDC product lines including: open frame linear and sub-modular switching supplies, as well as DC-DC converters, and power supply test instruments.
ACDC Electronics **Write 261**

Mechanical Design Brochure. The booklet describes how Computervision Corp.'s Designer CAD/CAM system can be used in mechanical applications such as design modeling, computer-aided engineering, drafting and documentation.
Computervision Corp. **Write 256**

Monitoring Equipment Catalog. The catalog of computer interface and testing equipment contains photos and descriptions on a range of RS-232 products. It details a surge protector which protects RS-232 ports from damage by large voltage peaks as well as a multi-adapter. Functions include, an RS-232 tester, a wiring adapter, and a data tap. Also featured in the catalog are the components needed to build custom RS-232 cable connectors.
B & B Electronics **Write 267**

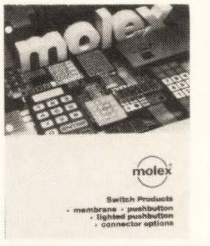


Designer Guide and Handbook. The guide lists formulas, definitions, and application considerations for data conversion products. The 32-page book includes specifications and selection criteria for a broad range of A/D and D/A converters, sample-and-hold circuits, and ancillary devices (analog multiplexers, filters, isolation amplifiers, power supplies, and modular subsystems) useful in creating precision signal-handling circuits and systems.
Analogic Corp **Write 269**

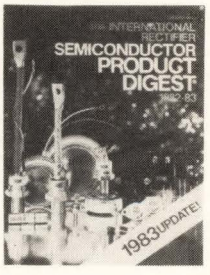


Attenuator Brochure. The 10 page pamphlet details the aspects of specifying attenuators in accordance with MIL-A-3933. It lists the requirements of the MIL-A-3933 such as: First Article Inspections, Screening Inspections, Group A Inspection, Group B Inspection, Procurement Examples and Test Flow Charts for CLASS I, II, III and IV Attenuator Inspection.
Weinschel Engineering **Write 275**

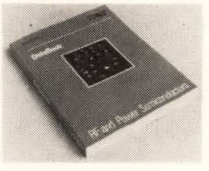
CMOS Gate Array Brochure. The HI-3000 series of gate arrays range in size from 150 to 1020 equivalent gates and from 30 to 68 I/O pads, with 4 to 60 dedicated Type D flip-flops. Peripheral cells are provided for both CMOS and TTL compatibility. All I/O cells contain bonding pads, input protection and output transistors. Chips are available for digital and A/D applications, and come in plastic DIP, ceramic DIP and chip carrier packages.
Holt **Write 253**



Molex Switch Catalog. The 20-page switch product catalog includes photos, 3-dimensional drawings, technical data and features as well as ordering information for membrane switches, both standard and custom designed. Also covered are push-button switches, combination switches, receptacles, and electrical/electronic connectors. **Molex Inc** **Write 268**



Semiconductor Brochure. Product digest gives ratings and performance characteristics for the line of power MOSFETs as well as Schottky rectifiers, bipolar transistors and Darlington pairs. Also included are thyristors, silicon rectifiers, molded bridges and power circuits. Other sections in the 28-pp. short-form catalog cover semi-conductor fuses, optoelectronic devices and special semiconductor assemblies with JAN, JANTX, JANTXV devices.
International Rectifier **Write 252**

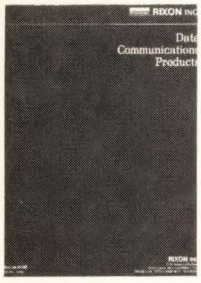


Semiconductor Data Book. "RF and Power Semiconductors" contains 600 pages of product photos, complete electrical specifications, and parametric performance characteristics on 360 RF and power devices. Products listed range from LVA Zener and Shottky diodes to broadband microwave transistors to RF linear hybrid amplifiers. Applications for TRW Semiconductor devices are CATV, mobile and microwave transmitters and receivers.
TRW **Write 251**

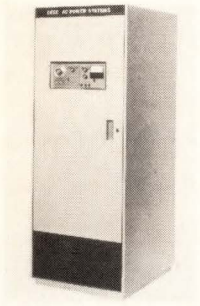
Wordprocessing Catalog. Misco's catalog covers products for computer and wordprocessing systems that range from cables to acoustic coupler modems. The catalog has 1000 listings and includes accessories for printwheels, thimbles, flexible disks, and magnetic tapes.
Misco **Write 264**

New Literature

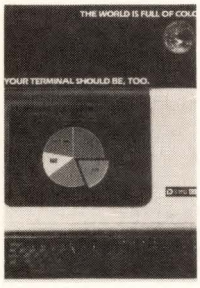
Video Product Catalog. Video monitors, multi-image programmers, tape recorders and listening systems are profiled in this catalog from Audiotronics. The catalog contains photographs, specifications and prices for each audio-visual and display product whose applications include industry, education and communications.
Audiotronics **Write 263**



Data Communications Products. This brochure from Rixon describes their line of DDD and private line modems, DDD backup units and statistical multiplexers. Profiled are the PC212A card modem for IBM PC, a communications diskette with automatic log-on and a standalone with a ten number storage integral auto dialer.
Rixon **Write 250**



Power Systems Brochure. DECC, known primarily for their military power systems, has introduced a line of commercial AC power sources. The sources are portable and available in single and three-phase versions with 12 to 72 kW of power. The units have fixed or variable frequency (45 to 500 Hz) operating modes and 150% surge capability. The temperature range is 0–55°C.
DECC **Write 259**



Graphics Terminals. The literature explains how ID Systems can convert customers' monochrome VT100 terminals to high-performance color graphics terminals. The terminals are capable of displaying corporate data in the form of graphs, bar charts, curves and graphic comparisons in eight colors. They are compatible with most existing software and can be interfaced with hardware which includes printers and plotters.
ID Systems **Write 257**

Components Product Guide. The 8-page brochure from Siemens outlines the company's component product line of semiconductors and optoelectronics. It includes a list of Siemens sales locations throughout the United States, and a section on special products. Applications include communications, data processing, entertainment, automotive, measurement control and aerospace.
Seimens **Write 255**

μP Power Supplies. Acopian Corp.'s bulletin describes their line of single, dual, and triple output power supplies suitable for powering logic circuitry, op amps, and μPs. Output voltages range from 1 to 28 volts, with current ratings of 30 ma to 60 amps. Many of the multiple output supplies are available in customer-selected output combinations, and in PC-mounting, plug-in, screw terminal, rack mounting, and metered benchtop configurations.
Acopian **Write 254**

Calendar

August 1–3

Quality Improvement Seminar. Washington, DC. Contact: Continuing Engineering Education, George Washington University, Washington, DC 20052.

August 2–5

Computer Graphics Seminar. L.A., CA. Contact: Integrated Computer Systems, 3304 Pico Blvd., P.O. Box 5339, Santa Monica, CA 90405. (213) 450-2060.

August 4–5

The Engineer as Manager. Lenox Hotel, Boston, MA. Contact: Battelle, 4000 N.E. 41st St., P.O. Box C-5395, Seattle, WA 98105. (206) 527-0542.

August 7–9

Advances in Impactless Printing. Monterey Bay, CA. Contact: Institute for Graphic Communication, 375 Commonwealth Ave., Boston, MA 02215. (617) 267-9425.

August 7–11

International Computers in Engineering Conference and Exhibit. Chicago, IL. Sponsored by the Computer Engineering Division of the American Society of Mechanical Engineers. Contact: Mary S.H. Benedict, ASME, 345 East 47th St., 13 M, New York, NY 10017. (212) 705-7100.

August 14–16

Multi-Media Teleconferencing. Andover, MA. Contact: Richard Murray, IGC, 375 Commonwealth Ave., Boston, MA 02115. (617) 267-9425.

August 31–September 2

Eurographics '83. University of Zagreb, Zagreb, Yugoslavia. Contact: Atlas, P.O. Box 17, YU-41001 Zagreb, Yugoslavia.

August 31–September 2

IGARSS '83. San Francisco Hilton, San Francisco, CA. Contact: Dr. D. G. Rea, Jet Propulsion Laboratory, M.S. L-156, Lawrence Livermore National Laboratory, P.O. Box 5504, Livermore, CA 94550. (415) 422-7888.

September 1–3

Internepcon/Semiconductor International. Royal Hong Kong Jockey Club, Sha Tin, Hong Kong. Contact: Cahner Exposition Group, (312) 299-9311.

September 6–8

Electronic Displays. Frankfurt Intercontinental, Frankfurt, West Germany. Contact: Network Exhibitions LTD., Printers Mews, Market Hill, Buckingham, MK18 1JX, England (028 02) 5226.

September 11–13

Multifunction Workstations. Monterey Bay, CA. Contact: Institute for Graphic Communication, 375 Commonwealth Ave., Boston, MA 02115. (617) 267-9425.

September 11–16

Midcon '83 High Technology Electronics Exhibition and Convention. O'Hare Exposition Center & Hyatt Regency, Rosemont, IL. Contact: Kent Keller, Electronic Conventions (213) 772-2965.

September 12–14

1983 International Conference On CAD. Santa Clara, CA. Contact: Dr. William J. McCalla, Hewlett Packard, 11000 Wolfe Rd., Cupertino, CA 95014.

September 13–15

Mini/Micro Midwest. Contact: Jerry Fossler, Electronic Conventions, 8110 Airport Blvd., Los Angeles, CA 90045. (800) 421-6816.

September 13–15

Autofact-Europe. Palexpo, Geneva. Contact: Society of Manufacturing Engineers (313) 271-1500.

September 14–15

Failure Analysis. Sheraton Scottsdale, Scottsdale, AZ. Contact: Pat Fruscello, ICE (602) 998-9780.

September 14–16

Word Processing and Office Technology. San Jose Convention Center, San Jose, CA. Contact: Cartlidge & Associates (408) 554-6644.

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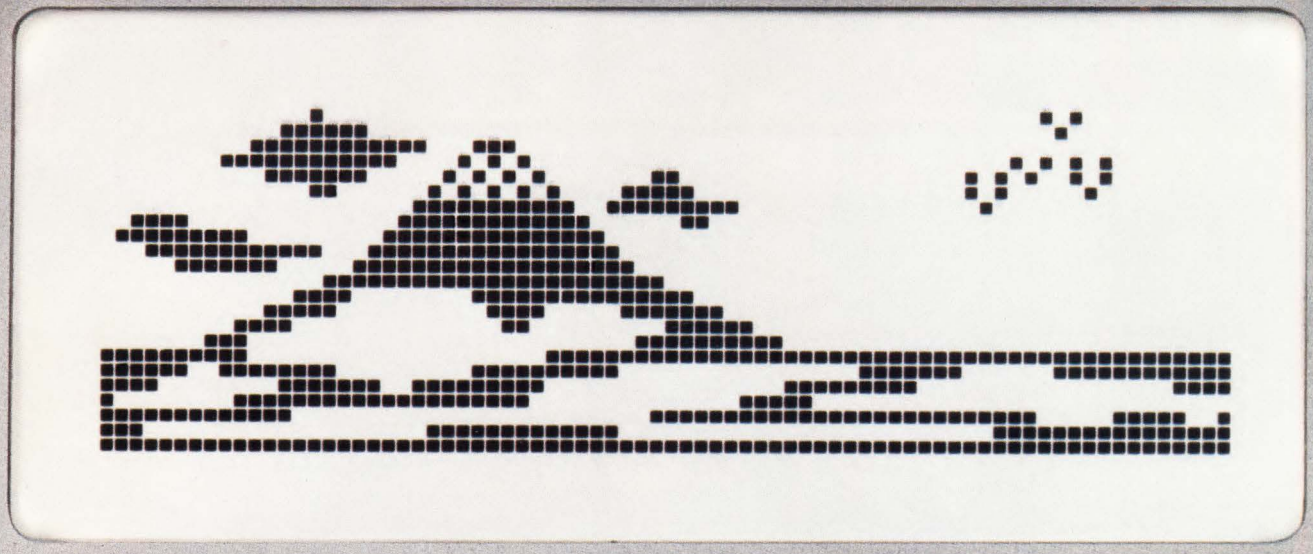

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