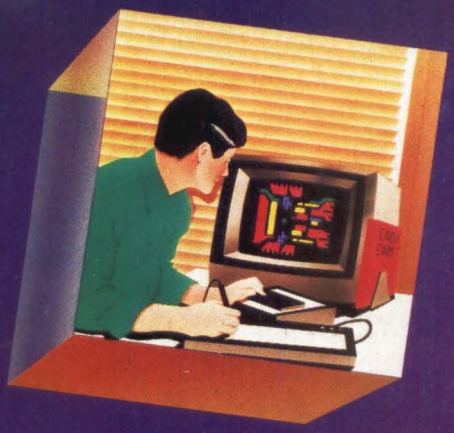
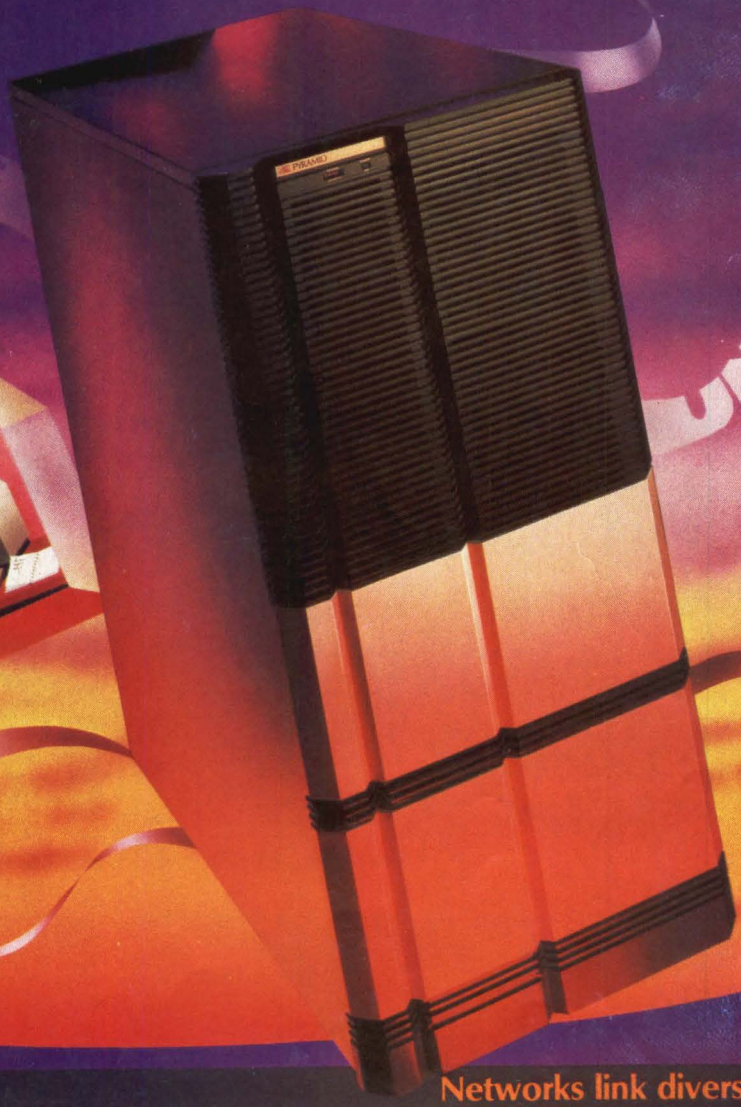
Mini-Micro Systems

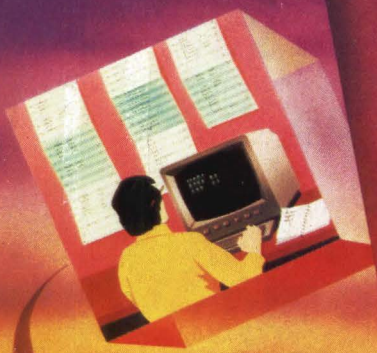
A CAHNERS PUBLICATION

AUGUST 1983



Unix mini uses reduced instruction set

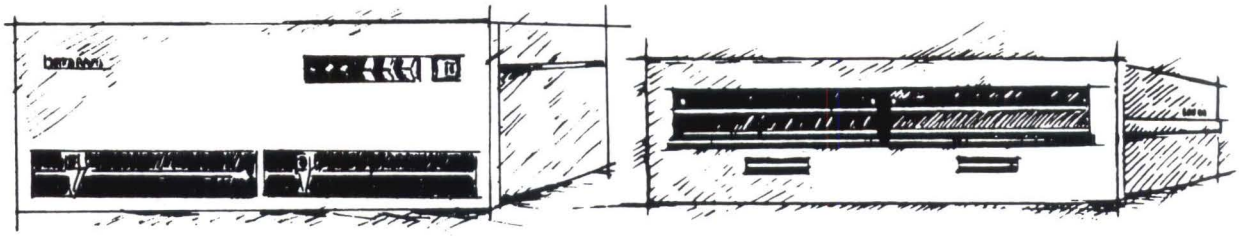




Networks link diverse factory devices

More computer power on one board

DEC-COMPATIBLE DISKS FOR LESS



Dataram has acquired Charles River Data Systems' DEC-compatible product line. We will continue to offer their popular FD-311 dual floppy subsystems and have added an exciting new floppy-based system, Dataram's A21.

Q-bus and UNIBUS compatible versions of the FD-311 provide dual RX02-compatible 8" floppy drives for $2,490. Our new 7" high A21 combines dual RX02-compatible 8" slimline floppies with an 8-quad slot Q-bus card cage for only $3,600. Both products are supported by the industry's widest range of LSI-11 compatible products. Call or write for details.

DATARAM

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CIRCLE NO. 2 ON INQUIRY CARD

With all the clamor about personal computers, a fundamental fact is often overlooked: some simply *work* better than others.

Consider the COMPAQ Portable.

A computer will make you more productive. A computer will make you more efficient. You hear it everywhere. But you don't hear much about which computer actually *works* best.

The COMPAQ Portable fits under a standard airline seat for business trips.

Works in more places

With the COMPAQ™ Portable, you can be as productive in your hotel room or your lake house as in your own office. It's a reliable companion on a business trip. It's a powerful sales aid in your customer's office.

You can move it from office to office to share its resources. You can move it into the conference room to answer questions.

What's more productive than a computer? A computer that works for you in more places.

Works with the greatest number of programs

The most important consideration when choosing a computer is "what programs will it run?"

The COMPAQ Portable runs more programs than any other portable. In fact, it runs more than most non-portables because it runs all the popular programs written for the IBM® Personal Computer without any modification. There are hundreds of them. They are available at computer stores all over the country.

Imagine the power of a *portable* word processor. There are dozens of word processing programs available for the COMPAQ Portable.

Planning, problem-solving, and "what-ifs" are a cinch with a variety of popular electronic spreadsheet programs. The COMPAQ Portable runs them all.

There are accounting programs for anything from computerizing your family budget to full-scale professional management of payables, receivables, inventory, and payroll.

There are programs for making charts and programs for communicating with other computers.

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The combination adds up to the most useful personal computer on the market today.

Add-on options make it work the way you work

Inside the COMPAQ Portable are three open slots. Most portables don't have any. Electronic devices called expansion boards fit those slots and give the COMPAQ Portable new powers. As with programs, expansion boards designed for the IBM will work. With them, you can make your personal computer more personal.

Want to check a stock price? One expansion board enables the COMPAQ Portable to handle those communications over ordinary phone lines.

Want to use your company's central computer files while you're on a trip? There are boards that allow the COMPAQ Portable to communicate with a variety of large computers.

Other boards let you hook up controllers for computer games, increase memory capacity, or connect several personal computers in a network.

The added usefulness is free

The COMPAQ Portable doesn't cost any more than an ordinary desktop computer. In fact, it costs hundreds less than a comparably equipped IBM or Apple® III. The COMPAQ Portable comes standard with one disk drive and 128K bytes of memory, both of which are usually extra-cost options.

The bottom line is this—you just can't buy a more practical, useful, productive computer. Compare the COMPAQ Portable.

All the popular programs written for the IBM PC run as is on the COMPAQ Portable.

For the location of the Authorized Dealer nearest you, call 1-800-231-9966.

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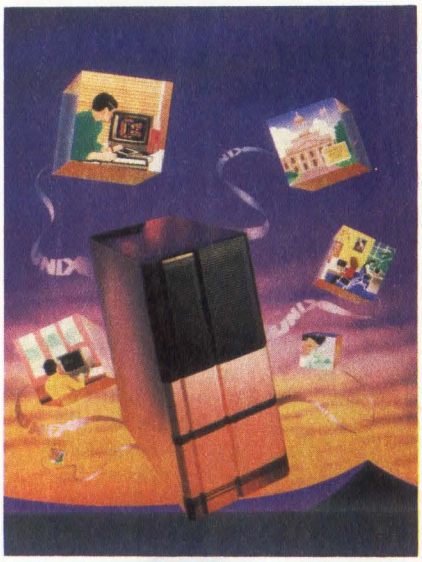
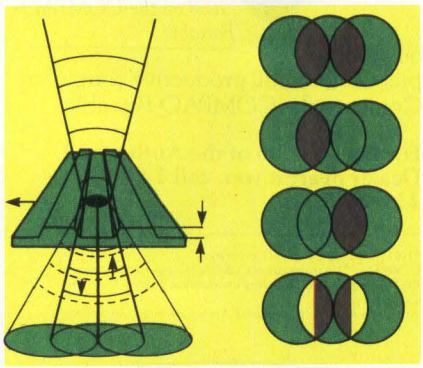
Common sense and uncommon design

Mini-Micro Systems



Pyramid I by Pyramid Technologies. Cover concept and art direction by Blankenship-Tavares Inc.; photo by Sollecito Photography: illustration by Dan Gilbert. UNIX is a trademark of Bell laboratories.



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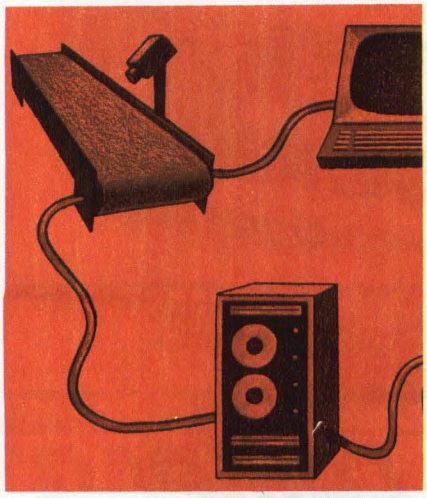

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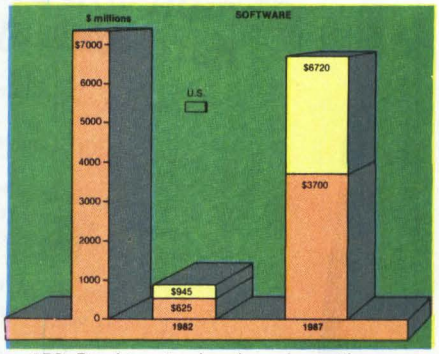

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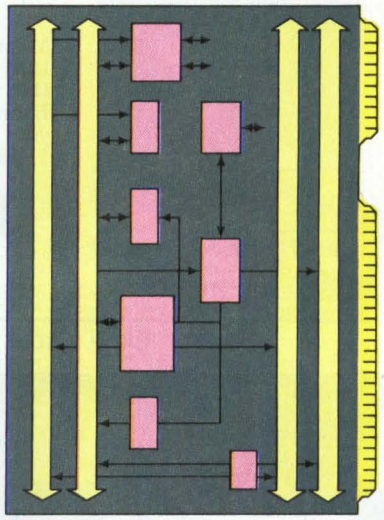

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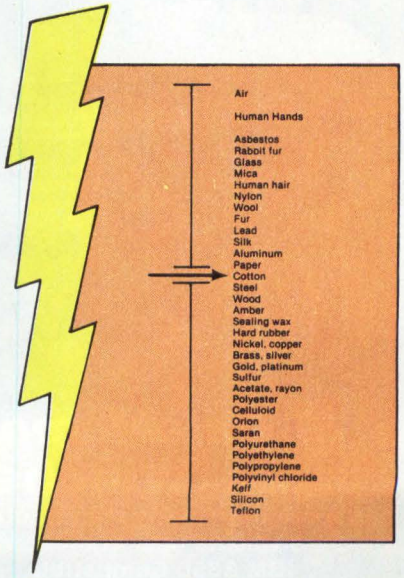

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DEPARTMENTS

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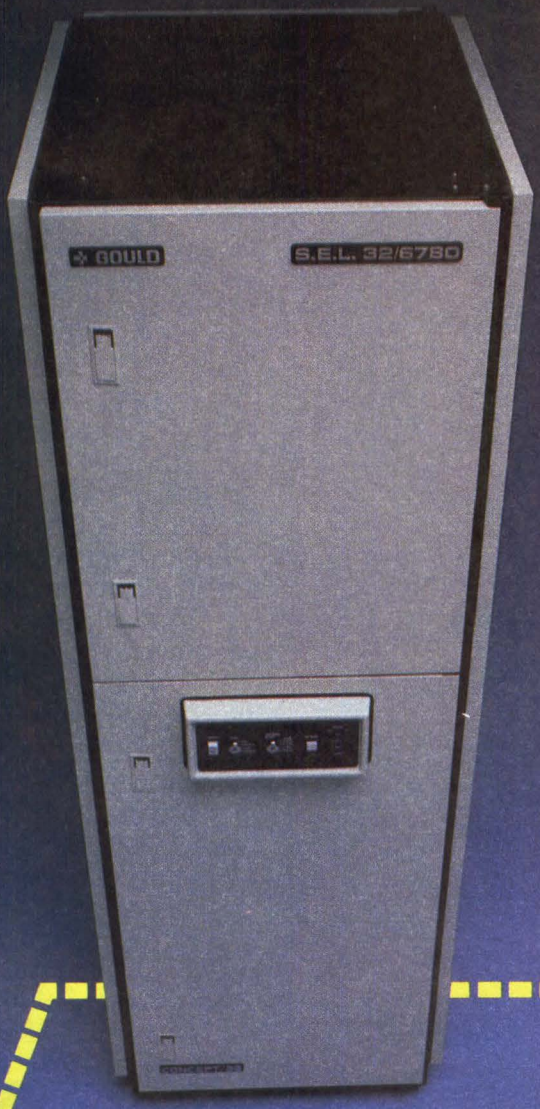
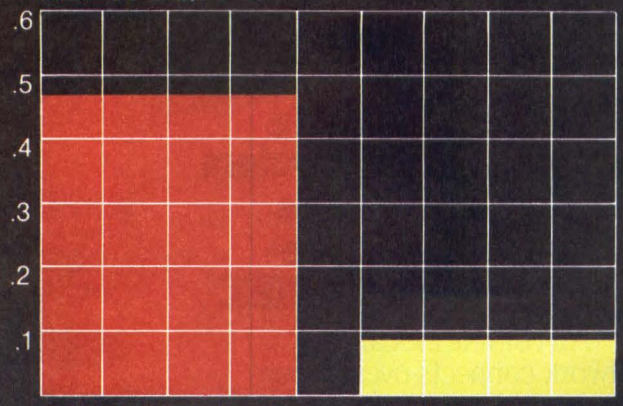
From the 32-bit performance leader comes yet another minicomputer product line other suppliers can only hope to duplicate. The 2-MIPS-class, cost and space-saving CONCEPT 32/67.

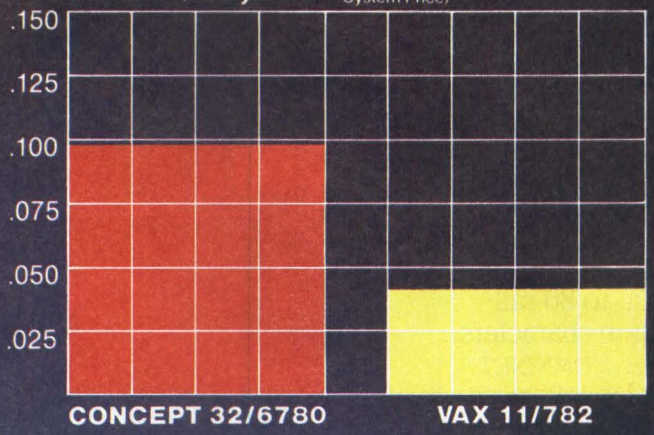
We scrimped on size, but that's all. The 32/67 gives you top computational power in 1/5 to 1/3 the floor space of the competition. And it's packed with features. Performance up to 2.6 MIPS. Largest cache in a mini...32K byte two-way set associative with separate 16K banks for data and instructions. And, 16M byte task addressing in a base register mode. All at a price that matches its size.



MIPS/SQ. FT.*



MIPS/$10,000* (Equivalent System Price)



* All chart data from published competitive information.

For more information about the new standard of minis, call or write: **Gould Inc., S.E.L. Computer Systems Division,** 6901 West Sunrise Boulevard, Fort Lauderdale, Florida 33313. 1-800-327-9716.

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CIRCLE NO. 7 ON INQUIRY CARD

HOW TO GET MORE DONE BY TYING UP YOUR PERSONAL COMPUTERS.

Now you can tie your personal computers together-and be more productive-with Corvus OMNINET.™

An OMNINET local area network connects over 60 personal computers, so you can share common equipment—even different computer brands.* More importantly, you can *share the costs* of high-performance peripherals, such as printers and Corvus hard disks storing up to 80 million characters.

OMNINET also improves productivity by letting you share common programs and data. That makes it cost effective to turn your stand-alone personal computers into multipurpose workstations. So now they can realize their full potential for both word processing and number crunching. And things as diverse as electronic spreadsheets, business graphics and electronic mail.

With OMNINET you can start small, and expand inexpensively by simply adding more workstations.

It's as easy as connecting a speaker to a stereo system. Plus you can keep on using your existing hardware and software, so you don't lose your original investment.

No wonder over 40,000 personal computers have been connected through Corvus networks in Fortune 1000 companies, small businesses, professional offices and educational facilities around the world. In fact, over the past three years, we've connected more people through microcomputers than anyone else.

So if you're ready to get down to business with your personal computers, try tying them up. Ask your local computer dealer how you can increase productivity—and divide your costs—through Corvus OMNINET. Or contact Corvus Systems, 2029 O'Toole Ave., San Jose, CA 95131. Phone (408) 946-7700.

CORVUS SYSTEMS

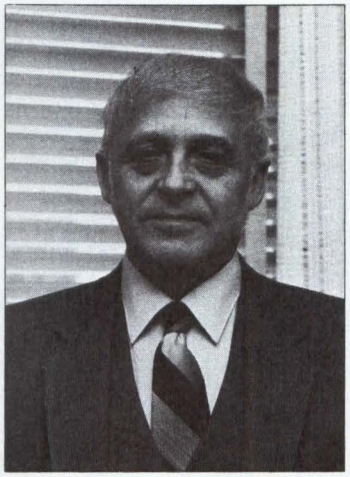
Tying it all together.

*OMNINET currently ties together Apple II, Apple II CP/M, Apple III, IBM PC, and the Corvus Concept,™ and soon the NEC PC8001, DEC VT180, Zenith Z89/90 and Z100, S-100 bus computers, and TI Professional Computer.

CIRCLE NO. 8 ON INQUIRY CARD

Publisher's Letter

A strong editorial team



Mini-Micro Systems magazine's growth has matched the growth of computer technology and applications over the last few years. As with any organization, growth produces personnel changes, and although it is sad to see associates leave, it is nice to welcome new ones. I'm happy to introduce our new editor-in-chief, George V. Kotelly. George comes to *MMS* from our sister publication, *EDN* magazine, where he was senior editor since 1979. Before working at *EDN*, George was technical editor of *Computer Design* magazine. George has a strong technical background beginning 30 years ago as an electronics engineer designing logic circuits, continuing engineering work at GenRad and Raytheon Co., subsequently fulfilling senior technical writing assignments at Baird Associates, RCA, Honeywell Inc., Raytheon, USM Corp. and Analogic Corp.

Also, I'm pleased to introduce James F. Donohue as the new managing editor of *MMS*. A journalist for 25 years, Jim has worked for daily newspapers and the Associated Press as both reporter and editor as well as for a number of business magazines. He was most recently associate editor of *Design News*, managing editor of *Business Computer Systems*, senior editor of *Plastics World* magazine and managing editor of *Purchasing* magazine, all Cahners publications. His experience with computers includes several years with the computer operation of Honeywell Inc., where he won a Silver Anvil, the highest award given by the Public Relations Society of America.

This issue also introduces two new editors in our field locations. Edward S. Foster, associate editor, working out of our Los Angeles office, brings years of experience in newspaper reporting, and free-lance writing for trade and general-interest magazines. He also worked as a correspondent in Tokyo for several years.

Our new Washington, D.C., reporter is Stephen J. Shaw. He will be covering the federal government, regulatory agencies and the Washington, D.C., computer industry. His prior experience includes *Electronic Business* magazine, where he served as the computer and communications editor, and *Satellite Communications* magazine where, as managing editor and associate publisher, he covered the commercial satellite communications industry. He has written extensively from Washington on various topics in the telecommunications and computer fields.

I believe these additions to our most talented editorial staff give *MMS* the most experienced and the most competent editorial team in the computer field.

S. Henry Sacks

S. Henry Sacks
Vice President/Publisher

Model 6455 Cartridge Tape System

Loaded with Features — Loaded with Benefits.

Kennedy products have always provided innovative new features. And these features have always provided added benefits and convenience for the user. For instance, our Model 6455 offers these features and benefits:

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The drive is effectively a ½" Tape Drive in a smaller package.

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Benefit: Best data reliability of any tape cartridge drive. Gives the user confidence in the integrity of the back-up medium.

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Benefit: Drive can be tested off-line with no test equipment required. Use of S.A. also lowers the MTTR.

Feature: Cartridge Jam Protection

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Feature: High Density Recording

Benefit: Storage capacity of 23 MB on a single cartridge.

Feature: Optional industry standard ½" tape interface.

Benefit: Operates with existing tape couplers and software. The drive operates as though it were a ½" tape drive without having to modify existing hardware or software.

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CIRCLE NO. 10 ON INQUIRY CARD

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Breakpoints

THE MARKETING OF CONCURRENT CP/M COULD BE MAJOR BOON TO DRI

The snarling over what company will emerge as top dog in the 16-bit operating-systems race presupposes that those companies are loyal to master IBM Corp. In mid-July, IBM was expected to announce in its in-house Ivory Letter international sales force letter that the company will market Digital Research Inc.'s Concurrent CP/M for its Personal Computer and XT models in conjunction with Wordstar, dBase II, Microplan, Micro Link and Milestone application programs from outside vendors. IBM already supports CP/M-86 on its PC. IBM will not distribute Concurrent CP/M from its facility in Boca Raton, Fla., sources say, but through its major account and retail groups. If IBM's approximately 9000 national marketing and accounts representatives sell even one operating system each, Digital Research could garner more than $1 million in revenues, says a source. Unlike agreements IBM has arranged with other independent companies, the Digital Research contract initially will not have a $1.5 million revenue ceiling. Digital Research is one of two vendors that reportedly attended a mid-summer meeting at IBM in Miami of 300 Fortune 1000 customers. After the meeting, United Airlines reportedly ordered Concurrent CP/M for evaluation as a standard for its white-collar workers. Digital Research hopes that IBM's blessing will afford it a stronger market share against Microsoft's MS-DOS. The source says that Digital Research could earn as much as $20 million in the next 20 months if market share for the operating system used on IBM PCs increased 25 percent. This figure is in addition to IBM's own Concurrent CP/M revenues. Other companies that may have signed for Concurrent CP/M include Digital Equipment Corp., Texas Instruments Inc., Fujitsu Ltd., Corona Data Systems and Eagle Computer. A Digital Research spokesperson declines comment.

APPLE'S MACINTOSH EXPECTED THIS MONTH

Apple Computer Inc. is giving up its wait for IBM Corp.'s "Peanut" personal computer. Apple will introduce its own low-end system this month. The long-awaited MacIntosh is expected to be simultaneously introduced to the press and security analysts in Cupertino, Calif., as well as in nationwide retail stores. Third-party software development has reportedly proceeded. Developers are using a high-end sister product, Lisa, to prepare the MacIntosh for its debut. Industry observers say Apple had expected to introduce MacIntosh during the June Consumer Electronics Show, but canceled the announcement when IBM had not introduced Peanut. Peanut is expected to make its debut this fall.

TELEVIDEO TO REPLACE 915 TERMINAL

TeleVideo Systems Inc. has placed a hold on production of its low-end 915 ergonomic terminal, which was scheduled for volume shipments in June. The company plans instead to make a new model, the 914, available for shipment in October, says TeleVideo executive vice president Mark Siegel. With a list price of $699, the 914 will have the same detached keyboard and tilt-and-swivel screen as the 915 but less intelligence and fewer function keys. Siegel says that TeleVideo found little demand for the 915's more extensive features among its distributors and therefore chose the less expensive 914 configuration. The 924 terminal, announced at the same time as the 915, is entering production and should be available this month.

STRATEGIC TECHNOLOGIES PLANS PORTABLE WITH DUAL 80186 CPUs

Strategic Technologies Inc., an Atlanta company established by former executives of service bureau/software house Computone Systems, is gearing up for production of its first product. The PC Traveler system is a 26-pound portable controlled by dual Intel 80186 microprocessors and is expected to include an Amlyn Corp. five-diskette storage system holding as much as 8M bytes of data. PC Traveler measures 15 × 19 × 5½ in. and will be manufactured in Taiwan. The system is expected to sell for less than $4000, including an 80-column × 25-line gas plasma display.

Breakpoints

ALTOS PLANS PRICE CUT ON 8-BIT SYSTEMS

Altos Computer Systems is not anxious to join the low-end, single-user 8-bit systems market in which products from Cromemco Inc., Morrow Designs Inc. and Kaypro are setting new price levels at around $1500. However, Altos marketing director Bob Bozeman is anxious to maintain the company's competitive position in the low-end, multi-user systems business in which newcomer TeleVideo Systems Inc. has been nipping at Altos's heels. To that end, the company is expected to announce a new price for a three-user model 580 system with a 10M-byte hard disk at $4990. At the same time, the company will announce a 580 with a 20M-byte disk for $5990. Meanwhile, the San Jose, Calif., firm is continuing its drive into 16-bit systems markets with a DIBOL package aimed at Digital Equipment Corp. commercial OEMs and its long-awaited (and in beta test) release of the Pick operating system.

IDT STRENGTHENS POSITION IN HIGH-SPEED RAM MARKET WITH ALL-CMOS DEVICES

Integrated Device Technology Inc., Santa Clara, Calif., continues its push into the market for high-speed static RAM devices with the scheduled introduction this month of a 64K × 1 CMOS (complementary-metal-oxide-semiconductor) RAM module. That module joins a family of 8K × 8 and 16K × 4 64K-bit parts. The company's previous products were combination MOS products. The new modules employ a proprietary CEMOS I (complementary-enhanced MOS) process and are packaged in leadless chip carriers. The 64K-bit CMOS parts offer high speeds, while having one-fourth the power consumption in active mode and a low heat buildup compared with NMOS (N-channel MOS) parts, IDT officials say. The 64K-bit products measure 2.5 μm. when manufactured with CEMOS I, but that size will be reduced to 1.5 μm. in forthcoming products using a CEMOS II process. The 64K × 1 device will be sampled this month, with production versions slated for September. Prices start at $260.

CANON PLANS REMOVABLE CARTRIDGE PRINTER

Reports are circulating that Canon Inc., which has shaken up the copier industry with its introduction of the PC-10 and PC-20 cartridge copiers, will do the same for electronic printing with a low-end removable cartridge printer. Canon officials confirm that the company is demonstrating in Japan an 8-page-per-min. printer with a removable cartridge. The printer provides resolution of 240 × 240 or 300 × 300 dots per in., and each cartridge prints 2000 to 3000 pages, depending on the application. Price and availability information for the U.S. market have not been decided, says Canon. Observers believe, however, that Canon could offer the printer to OEMs at a price competitive with that of high-end daisy-wheel printers for high-volume word-processing applications.

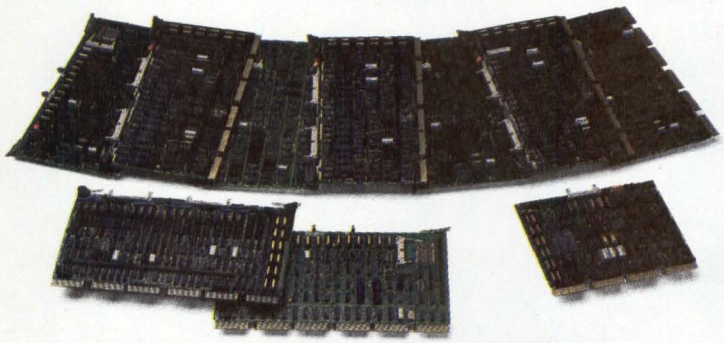
PROGRAM WILL TRANSLATE VAX BASIC TO C ON OTHER MACHINES

Clyde Digital Systems Inc., Provo, Utah, is developing a compiler translator program that will be used to transfer source code written in VAX/VMS BASIC to other machines and operating systems running in C, and possibly Pascal and Assembly languages. The system, called Application Language 1, is to be used with Clyde's CADCAP application generator. Price for Application Language 1 will be $1000, and beta testing will begin by year-end.

MICROBOL TO RUN ON MICRO PDP-11

Richard Call, president of Microbol Inc., Longwood, Fla., is considering selling his MICROBOL software packaged with various vendors' microcomputer systems directly to vertical markets. MICROBOL is an operating system/business programming language. Advanced Electronics Design Inc. markets the language with its Digital Equipment Corp. LSI-11/23-based multi-user system. Call expects MICROBOL to be ready for the DEC Micro PDP-11 this month. He says that the only modifications necessary are fine tuning of the device drivers. Call sees point of sale as the primary vertical market for MICROBOL. The software is scheduled to be ported to the DEC Rainbow and the IBM PC XT by year-end.

Five reasons why DEC users should buy Emulex communications controllers.

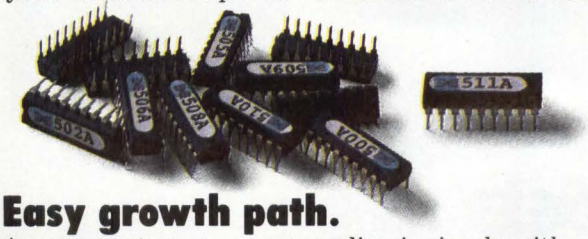


Broad product line featuring our new DMF-32 emulation.

Nobody covers LSI-11, PDP-11, and VAX-11 users' needs like Emulex. More than 15 software-transparent controllers emulating DH11, DZ11, DV11 and DMF-32. All deliver improved line-handling capabilities, in a smaller package, at lower costs.

More channels.

Emulex's new DMF-32 emulation is typical. One controller board handles up to 64 lines, vs. only eight per DEC module. And Emulex offers *all* lines with modem control, not just two. For even more lines, Emulex's Statcon Series is the answer. We simply add a low-cost port concentrator, so that with one controller board you can connect up to 256 remote *and* local terminals.



Easy growth path.

As your system grows, upgrading is simple with Emulex controllers. Just change PROM sets. Example: DH to DMF for $350. In addition, Emulex's advanced microprocessor architecture is consistent throughout the product line. Think of the inventory savings.

Fewer backplane slots.

Emulex communications controllers pack so much capability onto each board that fewer boards are needed. Take a 64-line DH11 emulation. Emulex does on one board what it takes DEC to do on 36. Think of the savings in rack space, to say nothing of price.

Lower prices.

For instance, a DEC DH11 controller lists at $8,950 per 16 lines, with expansion chassis costing $3,000 or more. Compare that to Emulex's CS11/H at $4,500 for the first 16 lines and $3,000 for each additional 16 lines. At 64 lines, you suddenly have savings of about $23,000 and a lot of extra slots to boot.

Don't speculate with your communications controller dollars. Invest in Emulex. Phone toll free: (800) 854-7112. In California: (714) 662-5600. Or write: Emulex Corporation, 3545 Harbor Blvd., P.O. Box 6725, Costa Mesa, CA 92626.

EMULEX

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Breakpoints

MONOLITHIC TO ADDRESS INDUSTRIAL MARKET WITH PORTABLE PC

Monolithic Systems Corp., Englewood, Colo., hopes to find a niche in the industrial-automation market. The company is introducing a portable personal computer designed for harsh factory environments. It is enclosed in a solid metal case that incorporates two 3½-in. Sony floppy disk drives and includes the C/PM operating system. Monolithic will sell the system to OEMs, which can adapt it through its four built-in Multibus slots. The system is priced at $3995 in single-unit quantities.

AMCODYNE TO DEBUT ITS FIRST FIXED CARTRIDGE DRIVE

Amcodyne Inc., Longmont, Colo., which introduced a 25M-byte fixed/25M-byte removable 8-in. cartridge last year, is expected to introduce its first fixed drive in October. The new 8-in. drive is expected to compete with new drives with capacities as large as 160M bytes from Control Data Corp. and Fujitsu America.

APPLITEK PLANS COMBINED CSMA/CD, TOKEN-PASSING LAN SUPPORT

A Wakefield, Mass., local-area-network start-up, Applitek Corp., is planning fall introduction of a 10M-bps LAN access method device. The device, called UniLINK, will support both CSMA/CD and token-passing devices on one network. UniLINK is designed to be installed using a bus or tree topology and can run on baseband, broadband and fiber-optic networks. Price per port, the company says, will be competitive with products in the $400 to $1500 range.

ROSSCOMP TO COUNTER TANDON'S 5¼-IN. TAPE DRIVE

Rosscomp Corp., a manufacturer of ½-in. tape drives, will answer Tandon Corp.'s recent announcement of an 8-in. tape drive with a 5¼-in. version of Tandon's product. The Rosscomp drive will store 160M bytes and has a recording density of 8000 bpi. Rosscomp will not use a cartridge as does the Tandon product, but instead a 4-in. reel like the one it uses in its 8-in. drive. The tape drive is expected to sell for $300 in large OEM quantities.

TECHFILES: A quick look at industry developments

Printer files: Patent watchers have noted considerable recent activity in thermal-transfer technology by IBM Corp. The technology is aimed at cutting the cost of consumables by allowing a resistive tape or ribbon to be continuously reinked from a dispenser. A thermal head then melts the ink to transfer the image to plain paper. Alternatively, a stylus array conducting electric current could be substituted for the thermal print head. **Oki Electric Corp.,** the Japanese parent of Okidata Corp., is said to be working on a similar technology. It uses an ink-roll substrate that can be reinked from a reservoir.

Software files: Language Resources Inc., Boulder, Colo., plans to begin deliveries this month of its Pascal compilers and assemblers to Motorola Microsystems. Motorola in turn will market and support the software for its 68000 microprocessors under a nonexclusive agreement. The $8500 compiler package from Language Resources runs on Digital Equipment Corp. VAX minicomputers and IBM Corp. 370 mainframe computers under VMCMS or MVSTSO operating systems....**A possible fertile area for software developers is notebook computers** such as the Epson America Inc. HX-20, the Hewlett-Packard Co. HP 75 and the Radio Shack model 100. **Quickview Systems,** Los Altos, Calif., is working on a Rolodex-like package that could be the basis of other notebook-sized applications. The software is written in FORTH.

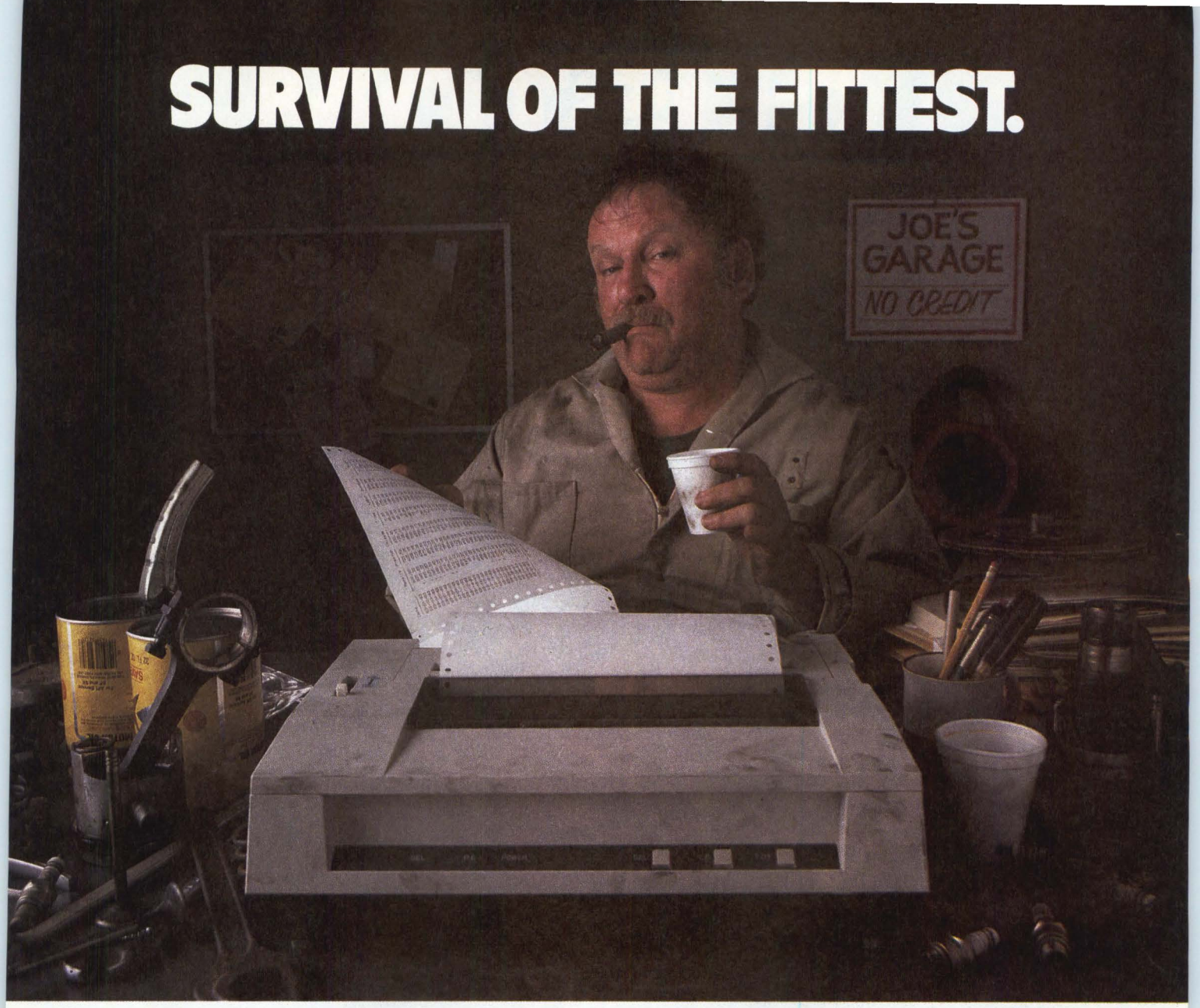
Systems files: IBM Corp. may also farm out its new low-end "Peanut" microcomputer to Hong Kong manufacturing company Atlas Ltd. Atlas, which last month announced it would manufacture IBM's 4-in. drive in its Hong Kong and Malaysian facilities (MMS, July, p. 7), is bidding to build the complete system incorporating the drive. The new system is said to be priced at less than $1000 and requires high-volume manufacturing to make it profitable.

Breakpoints

Random disk files: The small disk interface controversy has heated up again as **Priam Corp.**, one of the 26 signers of a document establishing the enhanced small disk interface backed by Maxtor Corp., has joined controller maker Xebec Corp. Priam and Xebec have announced a jointly manufactured product built to a 5¼-in. version of the American National Standards Institute's standard for 8-in. disk drives. In addition, Priam and Xebec planned an industry forum last month to which they hoped to draw uncommitted disk drive manufacturers IBM Corp., Digital Equipment Corp., Tandon Corp. and Seagate Technology. The invitation list also included almost every other manufacturer of disk drives and controllers—including Maxtor. Meanwhile, the companies backing the ESDI are still refining the interface to the satisfaction of its various users. Control Data Corp. is expected to give the ESDI a big boost this fall by announcing an ESDI interface on its 5¼-in. "Wren."....**Applied Information Memories,** Milpitas, Calif., which had planned a 500M-byte perpendicular-recording, 5¼-in. Winchester disk drive as its first product, will now concentrate on a less ambitious 140M-byte drive using a longitudinal linear actuator. The actuator will bring the average access time of the drive to less than 18 msec.

Notes from overseas: Officers at **Fortune Systems Corp.'s** long-established European subsidiary say they are within sight of landing their first private-label OEM contract. A letter of intent exists between Fortune and **Hermes Precisa Ruf Computer GmbH,** which controls about 5 to 6 percent of the German small-business-systems market. The agreement hasn't reached the contract stage yet; **Altos Computer Systems** caused a delay with a late bid on behalf of its 68000/UNIX machine. The synergy between Fortune and HPR can probably be traced to the fact that their managers are both alumni of **Nixdorf Computer Corp.** and **Computertechnik Mueller,** and are neighbors in a Frankfurt, West Germany, industrial park. HPR's terms reportedly call for less than 1000 machines over the next two-and-one-half years. HPR wants an upgrade for the Mercator 8086 units it resells....**Osborne Computer Corp.** chairman Adam Osborne confirms reports that his company quietly closed its European headquarters in Switzerland and fired its European general manager Fransisco Alburquerque. Reasons for the closing and the firing, Osborne says, were unbearable overhead and poor performance, respectively, but he provides no other specifics. Alburquerque will not be replaced, and Osborne/Europe will be decentralized, with each national entity operating independently. Osborne is uncertain whether the 25-man headquarters support team was laid off because, he says, "Day-to-day operations are in the hands of our president." Osborne also claims the company never intended to go public, and that the company is profitable now to the tune of 5 to 10 percent after taxes on a $110 million turnover....**Involved third parties say they have been told by IBM U.K. that the Personal Computer will become a Value Added Remarketer** product there, probably in September. IBM U.K. recently quashed its Series/1-only VAR program to pluck out undesirable dealers. However, IBM's special PC sales subsidiary, **IBM U.K. Product Sales Ltd.,** will administer the program under a concept likely to be extended throughout Europe. Whether Germany's PC subsidiary will get to oversee such a program is questionable. **IBM Deutschland Produktvertrieb GmbH's** power to appoint dealers has recently reverted to parent company **IBM Deutschland.** The subsidiary's sales manager, Hermann Caffier, claims it's because Produktvertrieb has too much work. However, other IBM sources say it's because the subsidiary mishandled the signing of Metro, Germany's biggest discount chain, catching some unfavorable publicity and alienating traditional dealers because of Metro's ability to undercut them severely without offering any support....Carl Jeremias, president of **Computertechnik Mueller GmbH,** the first German company to develop its own 32-bit minicomputer, says he wants a 16-bit microcomputer for the company's line. Computer purveyors such as Burroughs Corp. acknowledge that Computertechnik Mueller GmbH has been looking outside the company for an OEM microcomputer....British microcomputer manufacturer, **Torch Computers,** Cambridge, England, is suing Tandon Corp. for $10 million. Torch claims that it lost $10 million worth of business last year as a result of defects in disk drives purchased from Tandon.

SURVIVAL OF THE FITTEST.

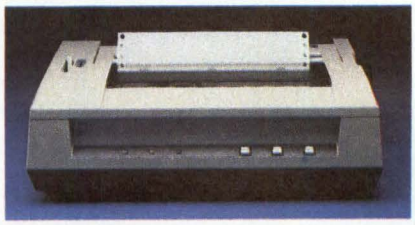


Ask major OEMS and they'll tell you that when it comes to reliable printers, the one they choose time and again is the C. Itoh 8510 Pro/Writer.

You see, many of today's printers achieve high speeds only by pushing their low-speed mechanisms to the limit of endurance. So what you seemingly gain in capabilities you lose in reliability.

C. Itoh's 8510 Pro/Writer, on the other hand, was designed from the very beginning to run at full speed (120 cps)—without breakdowns or noise. Its heavy duty stepper motor, base castings and synthetic-ruby print-head mechanism are built to take a lot of punishment. So you get superior print quality throughout its 100 million-plus character life.

The 8510 also offers advanced paper handling features. You get bi-directional tractor and friction feed capability to handle paper widths from 4.5" to 10." Positive paper positioning for rapid bi-directional paper motion without short repetitive motions. Manual form alignment—even with power on. And a print line that can be easily observed during printing.



Other features include built-in graphics with excellent resolution (144 x 160 dots per square inch). Five unique alphabets, eight character sizes. Mixed fonts during a single line pass bi-directionally. Variable form length, 6-channel electronic vertical formatting. The list goes on and on.

It's no wonder that so many major OEMs have selected the 8510 Pro/Writer design as their standard printer.

They know that in the real world, only the fittest survive.

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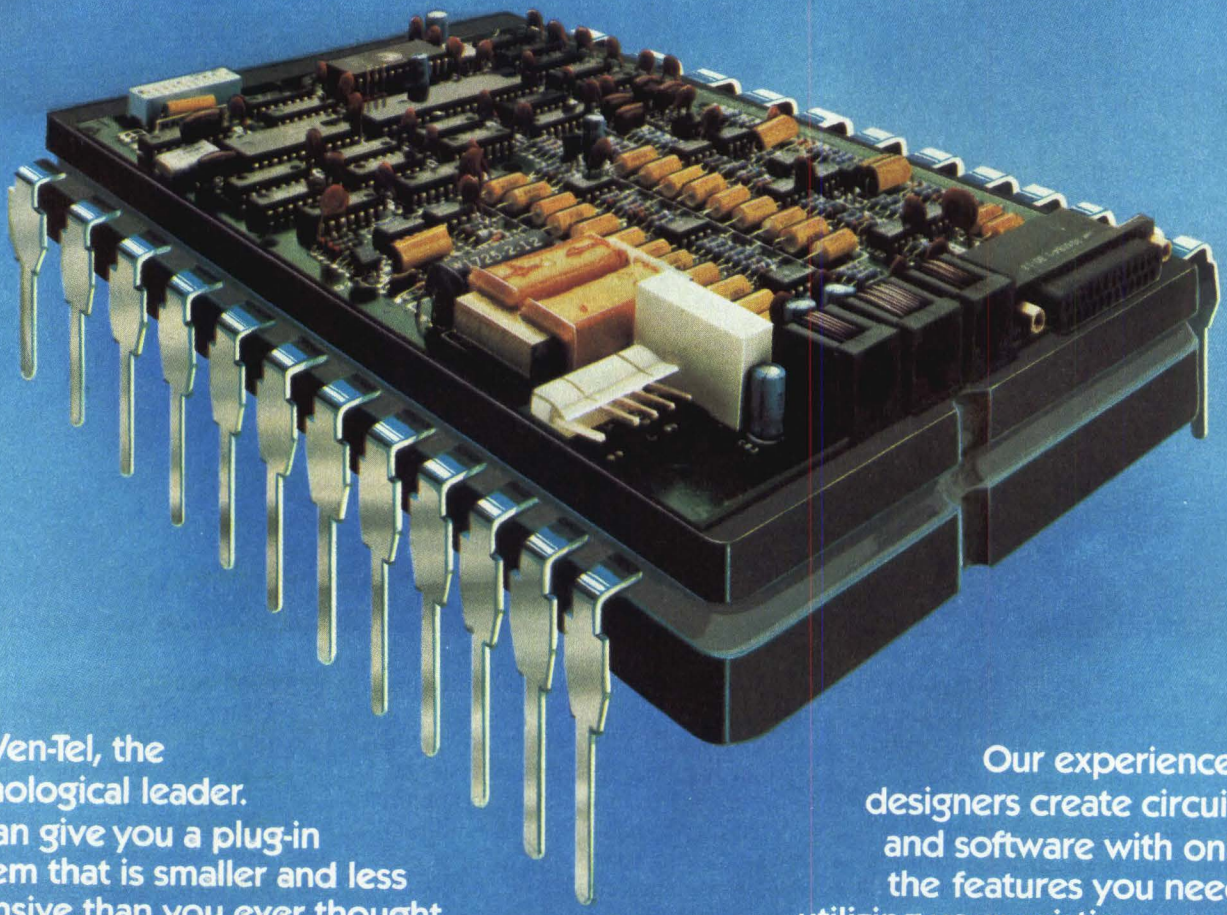

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CIRCLE NO. 15 ON INQUIRY CARD

The Pyramid 90X *is built around a three-board CPU with a 120-nsec. cycle time. The Pyramid 90X is comprised of instruction, execution and microcode sequencer units, employs reduced-instruction-set architecture and was designed to run UNIX.*

Pyramid builds UNIX supermini with reduced-instruction-set architecture

Pyramid Technology Corp. is, to say the least, an ambitious start-up. Playing David to Digital Equipment Corp.'s Goliath, the Mountain View, Calif., firm is loading its slingshot with a high-end 32-bit minicomputer aimed squarely at DEC's market-dominating VAX-11/780 and designed from the ground up to run Western Electric's UNIX operating system. To make the challenge more dramatic, Pyramid is basing its system on the commercially untried reduced-instruction-set computer architecture, an experimental design Pyramid engineers say will deliver improved supermini price/performance compared to complex-instruction-set computers like the VAX.

"We will be the first superminicomputer supplier totally dedicated to UNIX," says Pyramid founder and president Ed Dolinar. While Dolinar estimates VAX has 80 to 90 percent of all UNIX superminicomputer installations, he points out DEC has not yet sold or supported the Western Electric operating system. Although DEC has promised to do so by year-end (MMS, May, p. 47), Dolinar says the mounting demand for both UNIX and higher performance minis is creating opportunities.

"UNIX will make such a fundamental change in the computer industry it will be comparable to the advent of distributed data processing," Dolinar says. He estimates that by 1986 the market for superminicomputers running UNIX will swell to $2 billion annually—nearly half of the $4.8 billion that International Data Corp. forecasts for the entire supermini business then. Dolinar reasons that even if DEC and its competitors jump on the UNIX bandwagon, they will still have to devote most of their resources to an installed base running their proprietary operating systems. "We're like any young company; we're not carrying any baggage," he says.

That reasoning, and a development and marketing team drawn from top minicomputer companies, has at least convinced members of the venture-capital community. An

initial venture-capital offering of $6 million was led by Cable, Howse & Cozadd, a Seattle, Wash., firm that helped launch Convergent Technologies. Capital Management, Crown Associates, Harvest Ventures and Vanguard Associates also participated. A second round was scheduled to close last month, giving Pyramid a total of $20 million, the funding it needs through next summer.

Designed to deliver at least twice the performance of a VAX-11/780 running UNIX, the Pyramid 90X is built around a three-board CPU with a 125-nsec. cycle time. The CPU is comprised of instruction, execution and microcode sequencer units. It is implemented with fast Schottky TTL technology on 14- × 16-in. boards and includes 528 32-bit registers. In addition to 16 global registers, there are 16 levels of 32 registers each, which are stacked in such a way that half the registers on each level are accessible to the next level via a "window." Robert A. Ragan-Kelley, vice president of architecture and planning, says one of the benefits of this design is the efficient passing of parameters. The overlapping accommodates 16 levels of procedure calls without performing a save-and-restore operation.

The high number of registers and a large (8K-byte) microcode are basic to the reduced-instruction-set computer concept. The theory, which has been put forth in computer science research over the past few years, is that a machine that executes simplified instructions rapidly can perform better in high-level languages such as C than can machines with complex instruction sets, in which the machine instructions resemble those of a high-level language compiler. In addition to more efficient execution of high-level language programs, RISC enables a system designer to work faster and avoid design errors that Ragan-Kelley says often occur with complex-instruction-set projects. He predicts that a new generation of RISC machines will emerge in the late 1980s.

Pyramid claims the result of the RISC implementation is a 30-percent improvement in execution time compared to a complex-instruction-set computer system. In a comparison with 66 instructions for the DEC VAX procedure for an addition, Pyramid officials say, the RISC system requires only nine instructions. To enhance performance further, Pyramid has implemented its C, FORTRAN and Pascal compilers in a way that keeps local variables, procedure parameters and temporaries in the register stack.

The Pyramid 90X design also includes a three-tiered memory organization with virtual address space, physical memory and a high-speed, 4K-byte set-associative instruction cache. It can address as much as 32M bytes of physical memory and 4G bytes of virtual memory and can support 120 terminals. Pyramid uses stacking to piggyback 64K-bit RAM chips on 2M-byte boards, and marketing vice president Frank Madren says the design will also accommodate 256K-byte parts for 8M-byte memory boards.

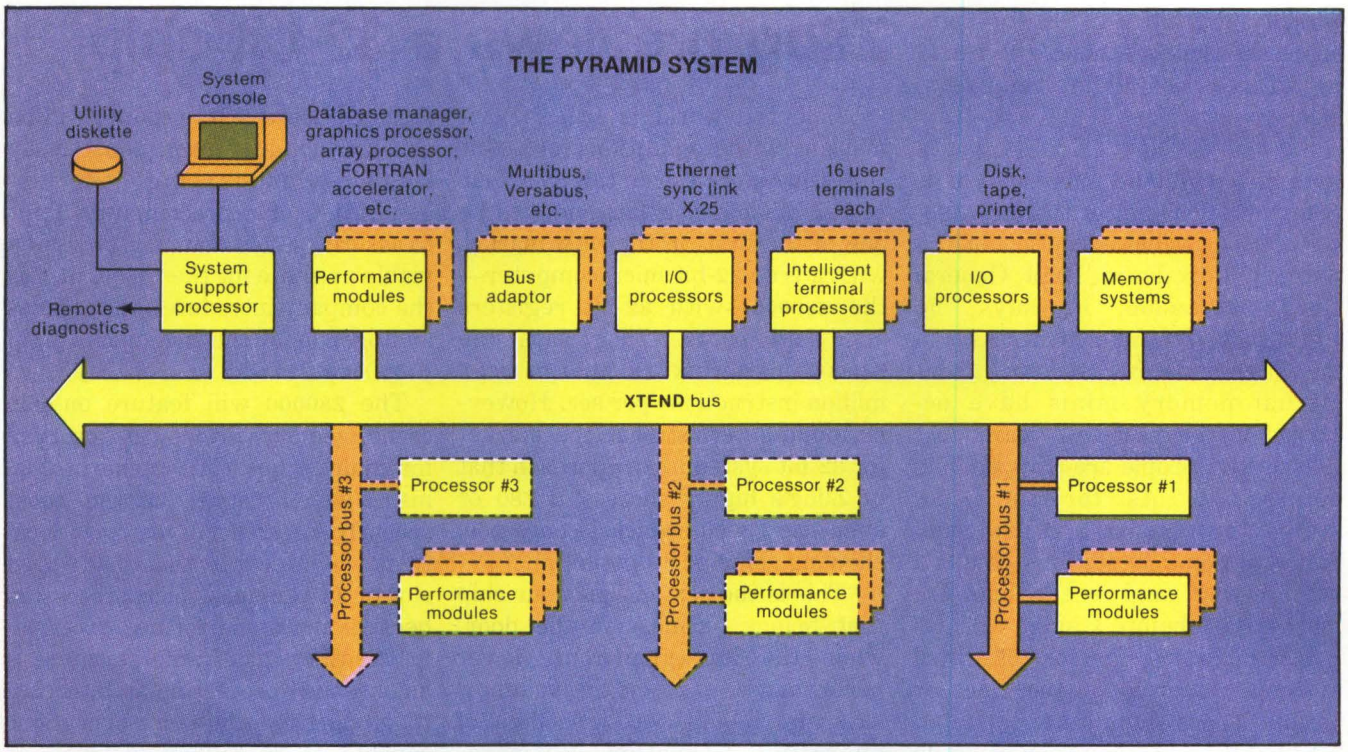
The company uses a proprietary 32M-byte-per-sec. Xtend bus, which was devised after the company abandoned an earlier design based on a licensed bus architecture. The Xtend bus ties the CPU and memory to intelligent I/O processors, which include TTL-based terminal controllers accommodating 16 CRTs each, MC68000-based disk and tape controllers and an MC68000-based Multibus adapter. An SMD interface supports 80M- and 474M-byte Fujitsu disks and 160M-byte Control Data drives.

The Xtend bus also supports "performance modules," which will be offered in later releases. The modules may include subsystems for array processing, database processing, graphics and Ethernet connections. The bus is also designed for a growth path to multi-CPU versions in which two more processor buses can be

PYRAMID BACKGROUND

Pyramid 90X is the product of a nearly two-year development that began when Ed Dolinar left his post as general sales manager for the Mil-Spec Computer division of Rolm Corp. in the fall of 1981 to found Pyramid Technology Corp. He was joined by co-founder Robert A. Ragan-Kelley, vice president of architecture and planning. Ragan-Kelley is a computer scientist who has worked for IBM Corp. and Hewlett-Packard Co. and has consulted for Amdahl Corp. and Apple Computer Inc.

Other members of the Pyramid team include Fred A. Ordemann, vice president of system development, a veteran of IBM and Control Data Corp. and designer of BTI Computer Systems' 32-bit mini. Vice president of software development H. William Gimple is a 10-year veteran of HP who helped convince management there to adopt UNIX. Frank Madren, vice president of marketing, held the same title at Plexus Computers Inc. and has been in product planning/marketing posts at Prime Computer Inc. and Data General Corp.



The Pyramid 90X's Xtend bus *ties the CPU and memory to intelligent I/O processors, which include TTL-based terminal controllers and an MC68000-based Multibus adapter. Future releases may include two more processor buses attached to the Xtend bus.*

attached to the Xtend bus. Future designs also call for backplane extensions.

Madren says an average Pyramid 90X configuration will support 32 users and carry a price tag in the $125,000 to $150,000 range. A typical $125,000 system would include 4M bytes of main memory, a 474M-byte disk, one 16-line terminal controller, a 1600-bpi tape drive, a cabinet, cabling, a CRT console and a UNIX license. List price of a comparable VAX-11/780 with 4M bytes of main memory, a 456M-byte disk, eight ports, a 1600-bpi tape and the VMS operating system is $208,000, a DEC spokesman says.

Madren says a typical large Pyramid 90X supporting as many as 64 users, three 474M-byte disks, 8M bytes of main memory, a 1200-lpm printer, a console, a UNIX license and a required second cabinet would be priced at about $280,000. For OEMs wishing to do significant hardware integration, Madren says the company offers a 1M-byte system without magnetic storage peripherals for around $80,000.

Pyramid's UNIX System V, called OSX was adapted in house for the virtual-memory system and draws on Berkeley BSD 4.1 extensions to the Western Electric product. Modifications include streamlined system calls and trap processing, demand paging and use of an MC68000-based system support processor to simplify system configuration. The support processor also performs diagnostics for the entire system, Madren notes.

Madren says the system will be in beta tests this month and is scheduled for end-user shipments next month. He reports that early orders for the system amount to about $10 million, but declines to identify Pyramid's customers. Pyramid expects to ship 100 to 200 systems in the first year. The products will be initially aimed at program-development applications in which VAXs are used. The company will then target traditional DEC OEMs, major computer companies looking for a UNIX engine and major end users. "Our target is people who want a large system and the safety of a standard operating system. The software is really the driving force," Madren says. Other markets for Pyramid hardware include business data-processing applications in which the supermini will be at the heart of networks of desk-top or cluster systems running UNIX and networked via high-speed communications facilities such as Ethernet. Ethernet is available with a $3500 hardware option and a $9000 software package. The current system is built with floating-point microcode, but future

versions will offer a floating-point processor that will enable Pyramid to address real-time markets, Madren says.

IDC analyst Aaron Goldberg says Pyramid would be successful if it really performs better than the 780. With the possible exception of the recently introduced Data General Corp. MV/10000, he says, no significant performance increases in the high-end market for 32-bit virtual-memory minis have occurred in the past few years. "At the top end people are trapped," he points out. As for the RISC architecture, he says, "You could run into some limitations, but I'd rather wait and see what the market says before I judge it."

Bill Rosser, director of small systems research for the Gartner Group, is also skeptical about RISC. "If RISC is valid, then they could do well, but I don't think the cards are in on RISC." He points out that some computer scientists are equally convinced that language-directed architectures with more complex instruction sets are the right designs for high-level language systems.

At Venture Development Corp., computer division manager Tim McMahon says, "I'm not sure UNIX is going to sell machines at the high end." He notes that high-end customers are looking for high computational powers for such applications as CAD/CAM and real-time processing, in which the appeal of transportable software is less than low-end commercial markets.

But Yates Ventures analyst Eileen Skrabutenas says UNIX will become the centerpiece of networking among microcomputers, minicomputers and mainframe computers and predicts that major supermini manufacturers will turn to UNIX over the next year.

—Geoff Lewis

Zilog previews a 32-bit chip

While the world is still experimenting with applications for 16-bit chips introduced over the past four years, Zilog Inc. is hastening to be one of the first on the OEM market with a true 32-bit microcomputer—the Z80000—with 32-bit registers and data paths. Zilog says the Z80000 performs as many as 5 million instructions per sec. However, doubts persist that the market for 32-bit systems can approach that of Zilog's highly successful Z80 or even the Z8000, which is only now showing some of its potential.

"This is the sex and glamour chip that brings business in the door, while the less glamorous, lower performance chips do the volume," says Jim Ready, vice president of operating - system software-development firm Hunter & Ready, Palo Alto, Calif.

Although Bell Laboratories, with its Bellmac 32, and Hewlett-Packard Co. have developed systems based on their in-house 32-bit chips, neither chip is available commercially. Industry observers speculate that Motorola Inc. has purposely withheld the introduction of its 32-bit 68020 chip because of concerns about the viability of the market. Motorola officials contend, however, that they have cleared the path for the full 32-bit chip with the acceptance of the 68000 and accompanying application software.

Intel Corp. and National Semiconductor Corp., the other two major players expected to figure in the 32-bit commercial market, have not made a product announcement. (Intel plans to compete with the 386, rather than the previously introduced 432.) Both are expected to enter production within six months of the Z80000, scheduled for the last quarter of 1984. Zilog says the first board-level product will be available in early 1985. Sources say Zilog is announcing its next generation of microcomputer chips to assure system manufacturers of a viable upgrade for the Z8000, just as the company introduced the Z800 as an upgrade for the Z80. (MMS, June, p. 23).

The Z80000 will feature on-chip cache memory, previously reserved for mainframes. The cache mechanism keeps copies of the most recently referenced memory locations, a function that had been slower in previous microprocessors because it was performed externally. Another mainframe attribute is an extended processing architecture to support floating-point operations capable of 30 million instructions per sec.

The Z80000 is said to be fully binary compatible with the Z8000, which, Zilog says, was planned. The Z80000 can use all hardware and software designed for the Z8000, says Dave Stevenson, vice president of marketing for the component division at Zilog. "The Z8000 was designed from the start to be evolved into a 32-bit machine," he says.

However, Ready believes software-conversion problems will cause a delay in software availability. "Even in similar chips, like the 68000 and 68010, there are subtle changes beyond the porting problem that is common," he says. As a result, Ready believes, it will be some time before application programs are developed for the Z80000.

Whether programmers occupied with meeting the high demand for 16-bit software will welcome the 32-bit chip remains to be seen. "Chip makers seem to be able to develop higher performance chips

faster than software writers can write software for them," Ready notes.

The primary market for the Z80000 is expected to be in CAD/CAM workstations, a market not nearly as high volume as the market for personal computers using 16-bit chips. The CAD/CAM workstations are expected to take advantage of the microprocessor's ability to identify and address from 1 bit to 32 bits as a bit string and manipulate that string for high-resolution graphics. System configurations are expected to require a minimum of 20M to 30M bytes of storage. The graphics are expected to boost the microprocessor into the video-game market. Zilog also expects to attract high-end personal-computer manufacturers with the Z80000's ability to address 4G bytes of memory directly.

Zilog estimates that the chip will sell for around $125 each, although prices may change drastically by the time production quantities of the chip are produced next year. The price is much higher than the less-than-$5 Z80 but lower than the $130 Motorola 68000. Analysts expect the price for the 68000 to drop by next year, however.

Zilog officials note that the Z80 was priced at $125 when it was introduced six years ago, and that the Z80000 is likely to repeat the Z80's price erosion.

—*Robert A. Sehr*

Western Electric and chip makers ally on UNIX System V ports

In an effort to promote a standard version of the Bell Laboratories-developed UNIX operating system among microcomputer systems, Western Electric has forged new alliances with major U.S. semiconductor manufacturers. The AT&T subsidiary has signed letters of intent with Intel Corp., Motorola Semiconductor Products Inc., National Semiconductor Corp. and Zilog Inc., under which the four microprocessor manufacturers would develop versions of the recent UNIX System V release. Those versions in turn would be tested and approved by Western. Source-code versions of the "ports" will be owned and resold by Western, while the semiconductor manufacturers will handle binary licensing and support for system OEMs.

The move, which came in the form of a joint announcement at the National Computer Conference, will extend AT&T support beyond Digital Equipment Corp.'s VAX and Bell's B3 computer architectures for the first time. In the past, microcomputer manufacturers have supplied their own UNIX ports or have relied on third-party houses like Microsoft Corp., Unisoft Corp. and Alcyon Corp. to develop UNIX microcomputer packages. Western Electric vice president of software systems, Tom Crowley, says the new microcomputer versions will carry the same license fees as the VAX ($43,000 for the source-code license and $25,000 for rights to sell binary copies).

David House, Intel Microcomputer Group vice president and general manager, *says of the agreement by the major semiconductor houses to support UNIX, "We'll continue to shoot at each other, but we've now agreed to use the same caliber bullets." Tom Beaver, vice president and director at Motorola Microsystems, and Tom Crowley, vice president of software systems at Western Electric, sit to the left of speaker Randy Parker, vice president of National Semiconductor's microcomputer division.*

The original announcement was made without the participation of Zilog, but the Campbell, Calif., Exxon subsidiary signed its letter of intent the following week. Vice president of marketing and strategic planning David J. Guzeman concedes that Zilog was caught off guard by the joint announcement, but maintains that it had been negotiating its own agreement prior to the NCC.

Zilog, which developed Zeus—its own version of UNIX—for the 16-bit Z8000 microprocessor in 1981, joined its competitors in hailing the Western Electric pacts as a way of advancing UNIX as a standard medium for supporting transportable software applications. Randy Parker, vice president of National Semiconductor's microcomputer division, says, "The result will be one common operating system. Software portability will be a reality."

Intel Microcomputer Group vice president and general manager David House quips, "We'll continue to shoot at each other, but we've now agreed to use the same caliber bullets."

Intel, which has been closely linked to Microsoft in that company's efforts to promote the UNIX-based XENIX package among Intel customers, will support both the UNIX System V iAPX 286 (as the Western Electric-based product will be designated) and the recently completed XENIX 286 package, House says. "XENIX 286 will be aimed primarily at commercial applications. The relationship between MS/DOS and XENIX will continue to provide a nice upward migration path from desk-top computers to larger systems," he says of his company's strategy.

The impact of the Western Electric contracts will not be known for some time, since the earliest Western Electric-sanctioned System V is not due until this month. It is promised by Motorola, which will make the first release on its Exormacs development system.

Suppliers of UNIX-derived operating systems, however, are predicting that the market will continue to demand their products and expertise—particularly in fitting UNIX into commercial environments.

At Microsoft, where considerable resources have been devoted to making XENIX the most popular microcomputer implementation of UNIX on commercial systems, the potential ill effects of the Western Electric alliance are being downplayed. Product marketing manager for operating systems software Mark Ursino maintains, "AT&T is where we were three years ago. It's one thing to get VAX UNIX to run on a microcomputer, but what we've done is to develop a microcomputer-oriented operating system with the right marketability."

XENIX, which runs on Intel 8086/88/286 family processors and on the Motorola MC68000, will continue to have advantages over the straight System V to be offered by Western Electric and the semiconductor manufacturers, Ursino claims. Among the XENIX advantages, he says, are lower OEM pricing and OEM support as well as enhancements such as a more commercially oriented user shell- and record-level locking. "We have 20 man-years invested in making XENIX a commercial product," he points out. Industry analyst Jean Yates of Yates Ventures adds, "In that respect, Ursino is right. In fact, Microsoft probably has a thousand years on Western Electric when it comes to figuring out what is needed in a standard operating system for multi-user small-business computers."

Yates predicts that XENIX will have to diverge from the standard UNIX path. While arrangements with the semiconductor suppliers will "ultimately drive the Western Electric product as the standard microcomputer version of UNIX," Yates says, "The business microcomputer user wants only a small part of System V, and that is what XENIX will provide." She explains that many of the UNIX facilities used by program developers won't be needed in commercial applications.

Both Intel and Microsoft spokespersons have confirmed that Microsoft has been retained to perform the official System V port for the 286. Despite industry reports that Motorola, National Semiconductor and Zilog would farm out their UNIX System V ports as well, the three companies maintain they will do their own. "It is incorrect information that says Unisoft (which takes credit for the bulk of the MC68000 implementations on the market) will do our port. We will have our own ready for August," says Florence Harteloo, Motorola product line manager for software. Harteloo says Motorola can meet the August delivery date while its competitors are shooting for the third and fourth quarter. This is because Motorola has been a beta test site for the new Western Electric release. National Semiconductor's Parker says his company will manufacture the System V port, but may seek outside help for certain portions.

At Unisoft, the Berkeley, Calif., UNIX "porting" house, marketing vice president Bernard Silverman says the Western Electric/Motorola pact will not threaten his business. "We have 80 to 90 percent of the MC68000 ports, and Motorola has asked for our continuing support. We'll lay our value added on top of System V," he says. Silverman says commercial users will still need Unisoft enhancements such as kernel performance speed and file-system improvements, and removal of the VAX machine-dependent features. "The thing it does do is make the market more confusing, but it will still be less costly for a system builder to come to us. At Motorola, they will have a source-code license and pay the nonrefundable $25,000 for resale rights," he points out. A Unisoft port, based on the Western/Motorola MC68000 product, will be less costly for OEMs and more adaptable to commercial systems, he predicts.

At Alcyon, vice president Bill Allen says the Western Electric/Motorola agreement at first appeared to be "somewhat traumatic" because his San Diego, Calif., company's Regulus product had been selected as a Motorola product last fall. However, he says the move does not close Alcyon out of the UNIX market. "Regulus was de-

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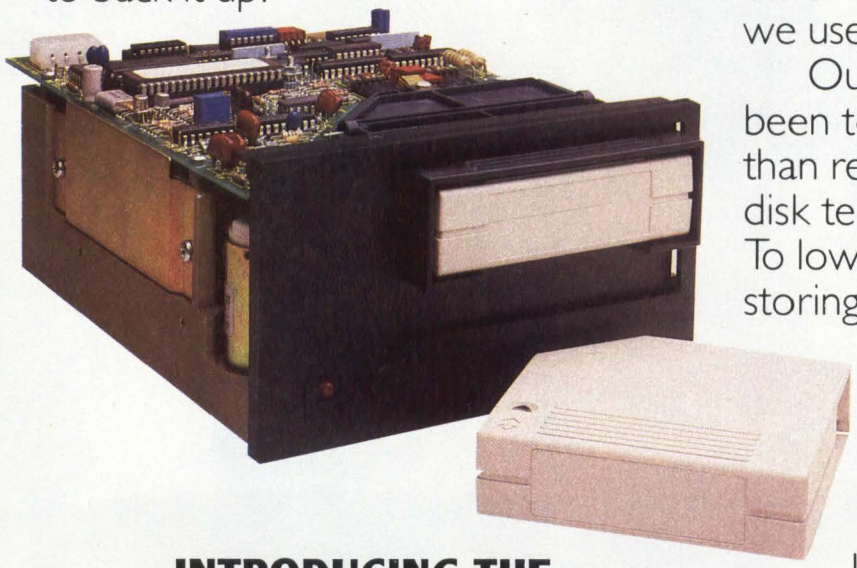

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signed as a real-time operating system that is compatible with UNIX and is not based on the $43,000 UNIX source code." As a result, Allen says, Alcyon can continue in the market as a low-priced UNIX-compatible product. "We will sell Regulus to OEMs for $37,000 for source code and rights to sell 4000 binaries. That works out to about $9.25 per copy at the end-user level," he explains.

Alcyon's product, which is also used in commercial products like CIE Systems series 680 computers, offers other advantages, Allen says. Regulus has the Berkeley C shell and supports peripherals not included in the Western Electric versions, he points out.

—Geoff Lewis

Digital Research touts PC-DOS support as move toward standardization

Digital Research Inc. claims the key to standardization in the microcomputer software world is transporting high-level languages among operating systems. DRI believes it has taken a major step toward that standardization goal by supporting PC-DOS with its high-level languages and productivity tools. The announcement is the first round in what DRI language division marketing manager Carmen Governale terms a "major retail thrust."

Due to be available this month for PC-DOS are DRI's CBASIC compiler with graphics, Pascal MT+; PL/1, C Level II COBOL and programming tools such as the Access Manager and the Symbolic Debugger. The Level II COBOL, which was developed by Micro Focus Inc., is the highest priced at $1600. DRI will be working with individual manufacturers on MS/DOS implementation, says Governale. For MS/DOS, some fine-tuning is necessary to iron out screen I/O peculiarities.

He stresses that the move provides a bridge to Concurrent CP/M-86 and strengthens DRI's commitment to third-party software vendors, enabling them to expand their markets without tailoring their application software to a new operating system. Governale says DRI will work closely with software developers to help them get their product to market quickly. Programs written for CP/M-86 can be recompiled in C to run on PC-DOS, and vice versa. Development work at DRI is done on VAX-11/780's and CompuPro micros.

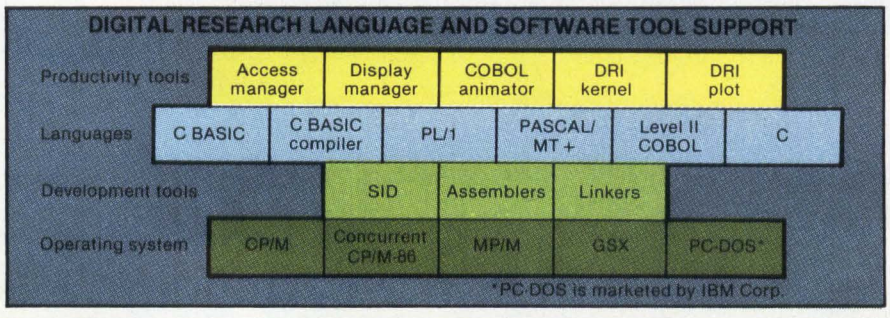
Since PC-DOS is clearly the standard operating system for the IBM PC (both Future Computing Inc. and Datapro Research Corp. say the PC-DOS-to-CP/M-86 ratio is at least 19:1), industry observers see DRI's announcement as wise. "They realize the reality of the situation—don't let pride get in the way of your business sense," says Egil Juliussen of Future Computing, Richardson, Texas.

MSA/Peachtree Software Inc. executive vice president Dennis Vohs also sees such coexistence among microcomputer operating systems as the only form of standardization. Since operating-system standardization didn't occur in the mainframe world, he says, it won't occur in the microcomputer world because so much diverse software already exists, especially in large corporations. Another example of this coexistence is the Peachtext 5000 program, which transfers files from such CP/M-86 programs as Wordstar and PeachCalc to the PC-DOS format.

Round two in DRI's efforts toward standardization was to occur late last month in the form of a Concurrent CP/M-86 that emulates PC-DOS. Governale says a full ANSI-77-compatible FORTRAN is due for beta testing next month and for release in December. Governale also acknowledges that DRI is collaborating with Digital Equipment Corp. on a down-sized VMS operating-system venture, which also may be released late this year.

UNIX support is in the works, and Governale says DRI will also attack the growing market for less-than-$500 home computers, for which software is sold in cartridge form.

—David A. Bright



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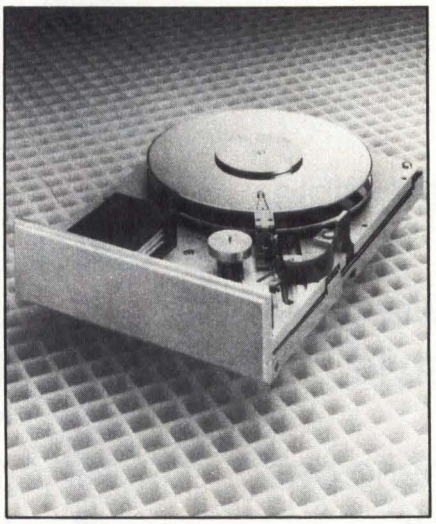
CIRCLE NO. 17 ON INQUIRY CARD

Start-ups Cogito, Microscience may succeed in market for half-height Winchesters

With their ability to increase storage capacity by 10M bytes or more over conventional drives, half-height Winchester disk drives could potentially dominate the low-end rigid disk drive market as system designers await the outcome of the standards controversy over sub-5¼-in. drives. Use of the drives provides the extra storage by allowing a user to insert one half-height Winchester and one half-height floppy disk drive into the space typically occupied by a single drive.

To take advantage of the market for half-height Winchesters, every major U.S. manufacturer of low-end Winchesters, including Seagate Technology, Tandon Corp., Miniscribe Corp. and Shugart Corp., as well as Japan's Mitsubishi and Toshiba, have scheduled deliveries of the drives for this fall. But despite the established competition, two start-ups, Cogito Systems Inc., San Jose, Calif., and Microscience International Corp., Mountain View, Calif., are seizing the opportunity to be the first on the market to ship production drives to OEM customers.

Why would new companies want to enter a market filled with established competitors? Andy Roman, vice president of marketing for Cogito and former disk drive industry analyst, says, "We're not dependent on taking business away from anyone. There's plenty of business around for all of us." Roman adds, "There were 250,000 drives shipped in this form factor industry wide last year, and supplies were not able to keep up with demand. I don't expect that to change soon."



The Cogito Systems Inc. 10M-byte half-height drive *uses oxide media. As a result, the drive achieves only 345-tpi track density and 8800-bpi recording density.*

Jeffrey Liu, president of Microscience, echoes those sentiments, and says, "There'll probably be more companies where we came from."

Both companies expect to be price competitive, maintaining the low-overhead, high-volume production facilities demanded by the price-conscious Winchester disk drive market. Cogito's 5M-byte drive is priced at $575, and the 10M-byte version sells for $600, both in 1000-unit quantities. Microscience's 10M byte drive is priced at $580 in quantities of 2500 to 5000.

One factor driving both companies is that their competitors are busy with products other than half-height Winchesters. "Companies like that set themselves in a conflicting position; they have to maintain the volumes of full high drives for their customers," says Roman. "As a result, it will be difficult to concentrate on half-heights like we do."

Neither start-up has invested in innovative technology, relying instead on the proven mechanical and electronic components used in other form factors. The companies are concentrating on making the half-heights durable for the rugged environments in which they will be used and on low power consumption for battery-powered portable applications.

Microscience's 10M-byte drive uses a plated-media platter with two heads on each surface. The drive uses a closed-loop, servo-positioning stepper motor and a linear actuator. Servo information is embedded on the track gaps to keep the head centered on the data track. The drive has a 5M-bit-per-sec. data-transfer rate and a 55-msec. average access time. It achieves a recording density of 9680 bits per in. and a track density of 648 tracks per in.

Cogito's drive will use only oxide-coated media for now because of inadequate supplies of plated media. "I'm very uncomfortable with the shortage of plated media," Roman says. "We plan to use only tried and true oxide media until the question of supply is settled." As a result, the Cogito drive achieves only 345-tpi track-density and 8800-bpi recording density, which oxide media can comfortably handle, Roman says.

The Cogito drive's use of two platters within its half-height box is a first, Roman claims. Because IBM Corp. set a new storage record for 10M bytes with its PC XT, announced three months ago, Roman expects Cogito's 10M-byte, two-platter version to attract more customers than

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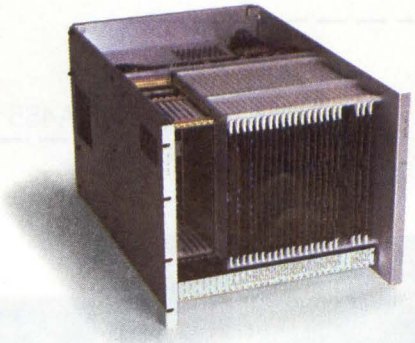

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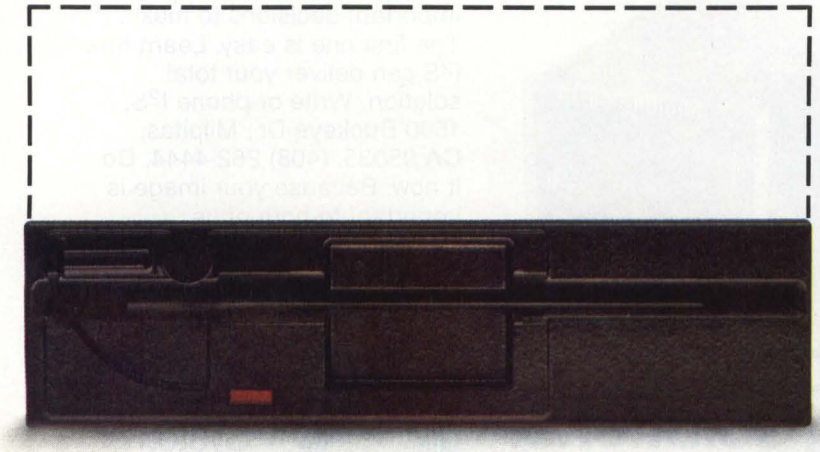

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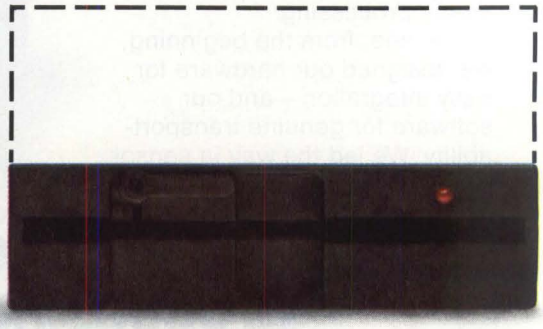

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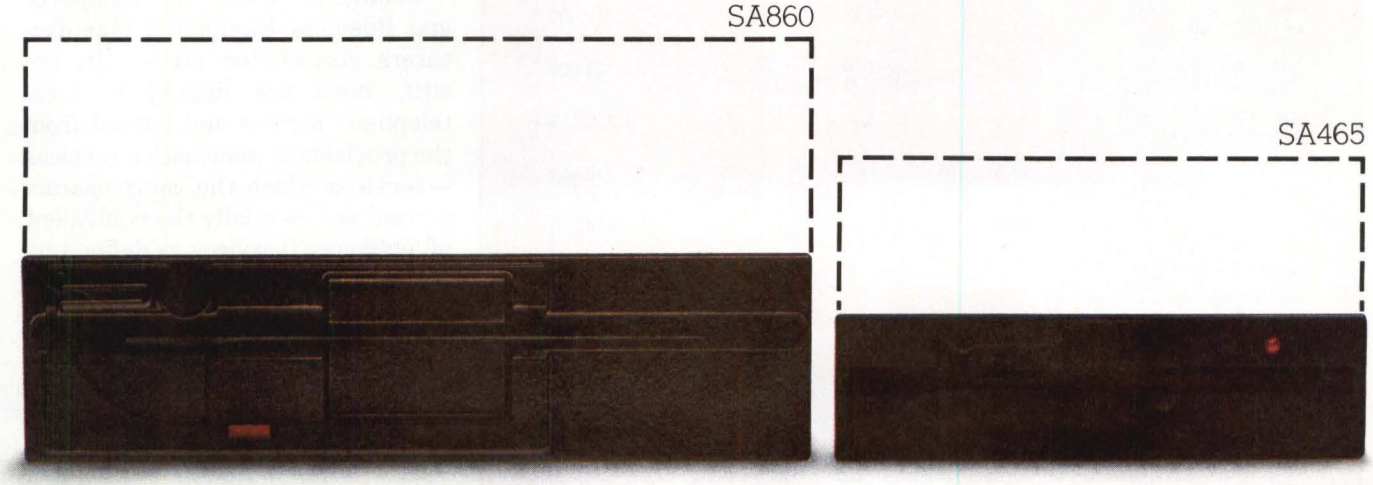

CIRCLE NO. 19 ON INQUIRY CARD

the 5M-byte, single-platter drive.

Microscience's Liu believes more sophisticated operating systems and graphics systems will generate a need for a 20M-byte half-height drive. Microscience can fill that need, he says, by adding another platter to the drive, and he expects the company to do so soon.

Both Cogito and Microscience plan high-volume production. Cogito is moving into a new 50,000-sq.-ft. facility that has a per-shift capacity of 100,000 drives per year. Microscience plans to add capacity to produce 200,000 drives per year per shift.

—Robert A. Sehr

FCC will rule on BOCs in third quarter

Ma Bell could be a grandmother soon—a real possibility as the Federal Communications Commission begins inquiry and rule-making proceedings to examine whether local Bell operating companies should be required to establish separate subsidiaries. The subsidiaries would offer customer-premise equipment, cellular radio and enhanced communications services.

Under the agreement reached last year by AT&T and the U.S. Justice Department in settling the antitrust suit against the telephone company, Bell's 22 local operating companies are scheduled to be reorganized into seven regional companies, each with assets between $15 billion and $22 billion, on Jan. 1, 1984. The FCC and Bell competitors fear that the BOCs will cross-subsidize their competitive offerings with revenue from local exchange services and attempt to stifle competition within their regions by restricting access to local telephone lines and switches.

The rulemaking proceeding is also a not-so-subtle move by the FCC to reassert its regulatory control over at least a piece of the Bell system and have a say in how the nation's telephone network looks after divestiture. The structure of AT&T has largely been shaped by the antitrust suit settlement and the court's conditional acceptance of the agreement as outlined in its Modified Final Judgement issued last August.

The MFJ would permit BOCs to offer cellular radio services and customer-premises equipment after Jan. 1, along with the basic local exchange telecommunications, exchange access and printed directory functions. The court's approval of the antitrust settlement, however, specifically prohibits the BOCs from offering what the MFJ termed "information services." Several comments received by the FCC point out that a fine distinction exists between what the commission calls "enhanced services," and what the MFJ defines as "information services."

Comments from the Computer and Business Equipment Manufacturers Association state, "In the MFJ, BOCs are limited to local telephone service and barred from the provision of information services —services which the court characterized as essentially the equivalent of 'enhanced' services as defined by the Computer II decision.

In its notice of proposed rule making (Docket 83-115), the FCC asserted that there was no clear correspondence between the court's view and the commission's definitions of, essentially, value-added telecommunications processing.

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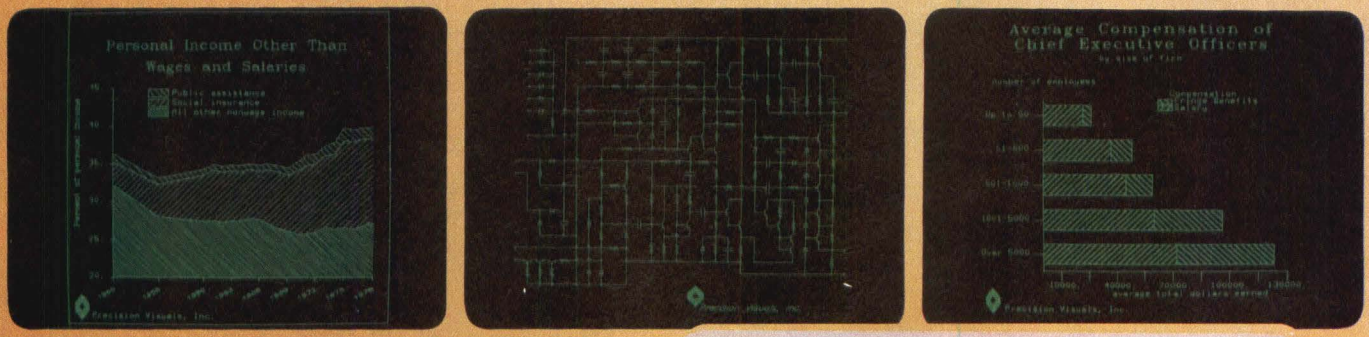
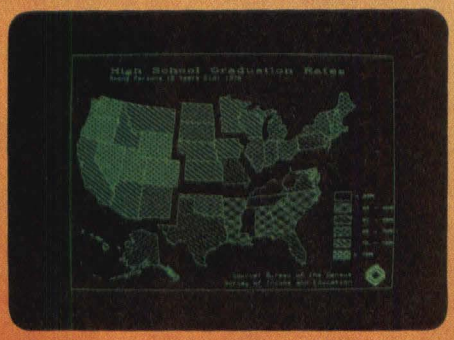
Company	Total assets ($ billions)	No. of access lines ($ millions)	No. of states operating in	No.of employees
Southeast Regional BOC†	21.8	13	9	137,500
General Telephone and Electronics	21.1	11.2	31	119,300
Northeast Regional BOC†	17.8	12.5	7	121,600
Mid-Atlantic Regional BOC†	17.3	13.7	7*	108,103
Midwest Regional BOC†	17.5	14	5	112,978
Far West Regional BOC†	16.6	10.4	2	114,700
Mountains & Great Plains Regional BOC†	16.1	10.4	14	104,900
Southwest Regional BOC†	15.9	9.9	5	97,600

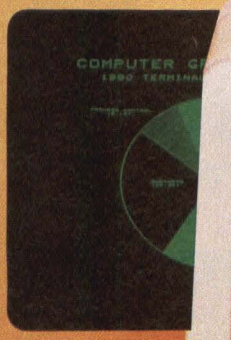
*includes District of Columbia.
†Bell operating company

Sources: AT&T Plan of Reorganization; General Telephone and Electronics Annual Report 1981.

High resolution, low cost graphics should be more than a retrothought.







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Dot Density Ratio	1:1	1:1	1:2	1:1	1:3	1:1	1:4	1:4	1:1
Screen Size	14″	14″	12″	12″	12″	12″	12″	12″	12″
Tektronix 4014 Compatible	STD	STD	NO	NO	NO	STD	NO	STD	STD
Data Tablet Support	STD	STD	NO	NO	OPT	OPT	NO	NO	NO
Multi-Vendor Printer Support	STD	STD	OPT	OPT	OPT	OPT	OPT	OPT	OPT
8 Dir. Cross Hair Cursor	STD	STD	NO	NO	NO	NO	OPT	OPT	OPT
Programmable Function Keys	STD	STD	NO	NO	NO	NO	NO	NO	NO
Tilt/Swivel Enclosure	STD	STD	NO	NO	NO	NO	NO	NO	NO
Compatibility	VT52 ADM3A H1500 D200	VT100 VT52 ANSI X3.64	VT100 VT52	VT100 VT52	VT100 VT52	VT100 VT52	VT100 VT52	VT100 VT52	VT100 VT52
PRICE (suggested list*)	$2,495	2,695	3,025	3,355	3,025	3,510	2,890	3,390	3,190

*Retrothoughts price includes DEC VT100® terminal based on published information as of 4/1/83.

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CIRCLE NO. 20 ON INQUIRY CARD


INTRODUCING
NEW XIDEX
XIDEX
PRECISION FLEXIBLE DISKS

THE SECOND GENERATION 96 TPI DISK

NO OTHER PRODUCT LINE IS EXPRESSLY DESIGNED FOR PRECISION 96 TPI PERFORMANCE.

What makes one computer a better buy than another?

How about a 96 tracks-per-inch drive? It can pack more than a megabyte on a single flexible disk.

Today, over 20 microcomputer manufacturers are marketing 96 TPI disk systems. And thanks to a new diskette engineered to standards previously unattainable, 96 TPI performance can now be as reliable as 48 TPI.

The product that makes this possible is the Xidex Precision™ Flexible Disk.

A TANGIBLY SUPERIOR DISK.

We had no choice. To turn out a highly reliable 96 TPI product line *in volume,* Xidex had to build the most automated and advanced disk manufacturing facility in the world. And we had to find ways to enhance current capabilities in materials, magnetic formulations, manufacturing and quality control.

The best substrate. We start with the most stable polyester substrate commercially available. We can command the best because we're the world's largest purchaser of polyester substrate. Using a superior substrate makes the disks less susceptible to distortions caused by temperature and humidity.

And that's just the beginning.

Tighter hub hole specs. We reduced the accepted tolerances on the center hole diameter by 50% (from .001" to .0005") to decrease the risk of head to track misalignment.

Improved signal strength. We coat with a unique magnetic particle that has a signal level almost 20% higher than average. (This was accomplished without any sacrifice in overwrite and peak shift properties.) The resulting "hotter" signal means you're less likely to lose your data if head alignment is less than perfect.

Better finishing. We use proprietary binders and lubricants, and we polish the disk to a higher luster than you're used to seeing. This significantly improves signal performance and assures longer life for the disk drive heads.

More protective jacket. Jacket construction is particularly critical to 96 TPI performance. Xidex has selected a 10 mil jacket that is 33% thicker than the industry average. The jacket not only feels more substantial, it offers greater protection from contaminants, extended handling and extremes in temperature and humidity. Its superior squareness and flatness allow it to slip more easily into the drive and improves double sided head compliance. The all-polyester liner helps the disk to rotate more quietly and with less torque.

Tighter quality control. Product testing must also be a cut above accepted standards. Xidex disks not only go through the most rigorous 100% test procedures, they are also required to pass an additional outgoing quality check of 18 tests.

Xidex disks are 100% certified . . . to a higher level than any other product. But many users don't realize that "100% certified" simply means that the disks are certified against dropouts. Disks can fail for other reasons, too. It's only because Xidex controls *all three* critical areas—coating, physical construction and testing—that we can produce a reliable 96 TPI product.

Naturally, our disks also offer a lifetime warranty against manufacturing defects.

HIGH VOLUME PRODUCTION CAPACITY.

Xidex's monthly shipments of disks have been soaring since mid-1982. And we're just barely tapping our capability. Our new coating facility will be able to turn out over 150 million disks a year.

Our product line also includes a full line of 48 TPI disks that are superior to anything on the market. Available in 5¼" and 8" sizes, they are made to the same exacting standards as our 96 TPI products.

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As one of the largest manufacturers of computer media products, we've been perfecting the art of precision, high speed, volume coating onto polyester since 1969. In fact, we currently coat more polyester media products than all manufacturers of flexible disks combined.

We're also the first vertically integrated American manufacturer of flexible disks in over five years.

If you'd like more information on the most reliable 48 and 96 TPI disks that money can buy, give us a call. We also have a technical paper on 96 TPI disks that's yours for the asking.

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XIDEX

PRECISION™ FLEXIBLE DISKS

CIRCLE NO. 21 ON INQUIRY CARD

Section 64.702(a) of the FCC's Rules and Regulations states that "the term 'enhanced service' shall refer to services offered over common carrier transmission facilities used in interstate communications, which employ computer processing applications that act on the format, content, code, protocol or similar aspects of the subscriber's transmitted information; provide the subscriber additional, different, or restructured information; or involve subscriber interaction with stored information."

The MFJ defines "information services" as "the offering of a capability for generating, acquiring, storing, transforming, processing, retrieving, utilizing or making available information which may be conveyed via telecommunications, except that such service does not include any use of any such capability for the management, control or operation of a telecommunications system or the management of a telecommunications service."

"The definition of enhanced and information services are virtually indistinguishable," says the Association of Data Processing System Organizations. "The MFJ limits BOCs to tariffed services; enhanced services cannot be offered pursuant to tariff."

Predictably, the BOCs and the Communications Workers of America, which largely represents Bell employees, vehemently oppose the imposition of separate subsidiary requirements. The Associated Bell Companies cite the costs of separation, the lack of manufacturing capabilities and other vertically integrated assets and the inability to use "large inter-city revenues that have been alleged to be the source of funds for cross-subsidization."

The Department of Justice, however, argues that the BOCs should not be allowed to offer cellular, CPE or enhanced services at all. Because of their regulated monopoly position in local telephone service, the BOCs "may have the ability and incentive to engage in cross-subsidization and discrimination" against competing suppliers. "The separate subsidiary mechanism is recognized to be an inferior remedy to divestiture between regulated and unregulated business," the department asserts.

Another issue is the relative size of the seven local exchange companies after Jan. 1 compared with potential competitors. The North American Telephone Association submitted information that compared the regional BOCs with GTE, the largest independent telephone company, in terms of assets, access lines, operating states and employees (see table). The BOCs overwhelm their largest carrier competitors on an intra-region basis. NATA cites figures to demonstrate the economic dominance of the BOCs for customer-premises equipment. In PBX installations, for instance, the largest of the GTE operating companies—California—has a market share for installed equipment in 1981 of only 14.6 percent of the number installed by the BOC for that region.

Less than a year after the birth of "Baby Bell"—American Bell Inc., a spin-off intended to offer advanced communications and computer services nationwide—the Bell System could be on the verge of giving birth to yet another generation of unregulated youngsters.

And the question remains of what sort of relationship the BOC offspring would have with American Bell, either as rival siblings that offer competing hardware and services or as additional conduits for American Bell equipment. The FCC, in its role as midwife for seven new potential powerhouses in telecommunications, is expected to make its decision during the third quarter of this year.

—Stephen J. Shaw

GE entry helps spur dot-matrix line-printer market

Printer manufacturers continue to promote their new non-impact entries. Nevertheless, one clear-cut trend at the recent National Computer Conference was the renewed vitality of the line printer. Many line printer manufacturers, including General Electric Co., made introductions, perhaps spurred by IBM Corp.'s early May introduction of the 4245, a high-end 2000-line-per-min. machine that replaces the outmoded 3211 chain printer.

"It's not really that surprising to see new products in this area," says Edward Webster, editor of printer industry publications for Datek Information Services Inc. "Many of the present generations of line printers were introduced quite a few years ago; in some ways, the new machines are overdue." Companies demonstrating 2000-lpm prototypes at the show included Hitachi Ltd. and Data Printer Corp. Centronics Data Computer Corp. drew favorable comments for the print quality of its new Linewriter 400 band printer incorporating linear print hammers that print at 300 to 500 lpm.

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CIRCLE NO. 22 ON INQUIRY CARD

The hottest news in the line-printer market is dot-matrix technology. GE tossed its hat into the ring at NCC with its new 4000 series matrix line printers. The GE 4030 and 4060, with print speeds of 300 and 600 lpm, respectively, are tentatively priced at $5500 and $8500, respectively, in single-unit quantities. The 4000 series employs a power-saving shuttle mechanism in which the bar holding the print actuators oscillates parallel to the print line. Both models also feature operator-replaceable print modules and resident graphics capabilities. The printers are scheduled for volume production beginning in the second quarter of 1984.

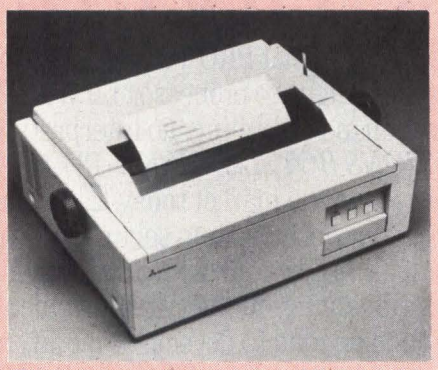
Other matrix line-printer activity at NCC included Hitachi's demonstration of its AD 30 and 60, Mannesmann Tally Corp.'s showing of the 600-lpm MT-660 and private demonstration of a 900-lpm prototype, and CIE Terminals' introduction of integrated graphics for its CI-300 and CI-600 printers. Printronix Inc., the traditional market leader for dot-matrix page printers, introduced a printer/plotter line matrix printer, the 4160, manufactured by Y.E. Data of

NON-IMPACT PRINTERS MAKE LITTLE IMPACT AT NCC

While impact printers continued to reign supreme at NCC, it wasn't from lack of numbers on the part of non-impact offerings. Ink-jet and thermal transfer printers were abundant, yet most of them were testing the market rather than entering the market as actual products. "Who knows how many of these things are going to be real products, or when?" asked one disgruntled observer. "Nobody wants to be the first to commit to one until we're sure the suppliers are serious about them."

A number of manufacturers are serious about ink-jet technology, particularly for color applications. Sanyo Business Systems Corp. demonstrated its CJ5500 color ink-jet printer and showed sample output from two high-end models, the CJ5600 and CJ5700. Employing drop-on-demand technology with 4 nozzles, the three models print at maximum resolution of 6, 8 and 12 dots per mm., respectively. The printers are in production for the Japanese market, with end-user prices around $12,000, $14,000 and $19,000, respectively. Konoshiroku also demonstrated a prototype of a color ink-jet printer, apparently adopted from an earlier black-and-white printer. The color version has 64 nozzles and throughput that averages under a minute per page. Price is not available.

One ink-jet printer on the market is the previously announced Diablo Systems Inc. Series c manufactured by Sharp Electronics Corp. Sharp showed its own versions of the printer with identical specifications. The same Sharp-produced ink-jet device is also the basis for Tektronix Inc.'s model 4695 color graphics copier.



The color printer from Mitsubishi Electronics America Inc. *uses a four-color thermal transfer ribbon to produce seven shades.*

The thermal transfer devices demonstrated at NCC were generally a year away from introduction. "Only Diablo seems to have actually established itself with a thermal transfer product," says Ian Mallander of research firm Advanced Technology Research. "The others are still worrying about such problems as the cost of ribbons and other consumables."

Companies such as Toshiba Corp., Ricoh of America, Fujitsu Ltd. and Mitsubishi Electronics America Inc. demonstrated thermal transfer units. The Mitsubishi four-color printer appears closest to introduction, with volume shipments expected by the fourth quarter of this year. Sharp demonstrated a thermal transfer printer as an option for its portable computer. Thermal transfer has an advantage over other printing technologies for portable computer applications because of its potential low cost and quiet operation.

NCC saw the introduction of few page printers which had not been seen before. Cynthia Peripheral Corp. gave the first public demonstration of the MP 6090 magnetic printer. While the speed and quiet of the device were impressive, some observers felt that edge definition could remain a problem for the printer and wondered if that was why the infrequent demonstrations of the printer were run on relatively coarse paper.

Several companies demonstrated printers employing the Delphax Systems ion-deposition imaging system. A new company, Anser Technology, Fort Worth, Texas, demonstrated a printer using a modified Delphax engine. It operates at speeds they claim can reach 120 pages per min. Quality Micro Systems and Imagen Corp. also displayed prototypes adding a variety of functions to the basic Delphax hardware. A number of other U.S. and overseas printer manufacturers are evaluating the technology.

IBM Corp. introduced the 4250 printer for producing camera-ready masters for publishing. The printer uses electro-erosion technology to remove an aluminum coating from special paper, forming images from a secondary black layer. At 600 × 600 dots-per-in., the printer is one of the first attempts to encroach on the traditional typesetting arena with digitized fonts. It carries a single-unit price of $21,000.

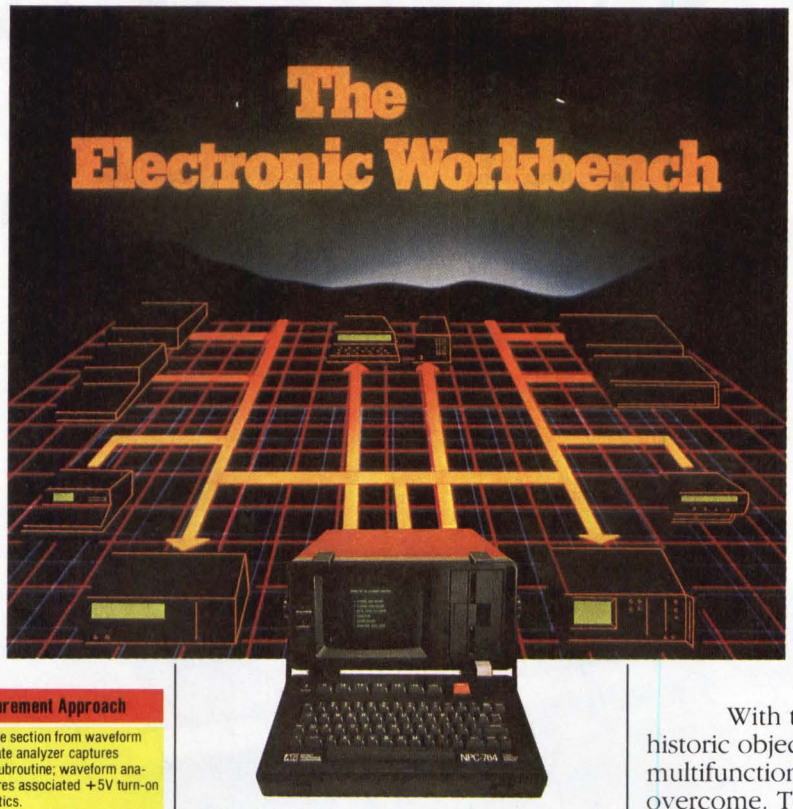
Designer Note #4

Focus on Cross-Domain Analysis: The Electronic Workbench!

Cross-domain analysis is a new test methodology that requires the combination of two or more distinct measurement functions to trace or quantify hardware and software interactions.

The table below describes some of the many analysis tasks that fall into the cross-domain category.

The need for cross-domain analysis has grown out of the increasing complexity of hardware and software functions. Although cross-domain analysis can be achieved by interconnecting individual instruments from different manufacturers—interfacing problems and operational complexities has made this approach impractical.



Analysis Task	Measurement Approach
1. Verify your system's power-up subroutine when +5V power is first applied.	Trigger state section from waveform section. State analyzer captures power-up subroutine; waveform analyzer captures associated +5V turn-on characteristics.
2. Monitor I/O hardware subsystem operation when I/O subroutine is executed.	Trigger timing section from state section. Timing analyzer captures I/O hand-shaking signals and data; state analyzer captures associated I/O subroutine.
3. Examine interrupt subsystem software execution.	Trigger state section from timing section. State analyzer captures interrupt subroutine; timing analyzer captures hardware interrupts.
4. Trace overall hardware/software interactions in a process controller product.	Trigger state section from timing section which in turn is triggered from waveform front-end. State analyzer captures process controller software; timing analyzer captures digitized transducer output when triggering by the analog input crossing a pre-set threshold.
5. Measure subroutine execution time.	Start counter-timer with subroutine entry address and stop it with exit address. Counter-timer's interval mode then reads execution time.

Because of this fact, a trend is developing towards the *Electronic Workbench*. An Electronic Workbench is defined as a multifunctional instrument system where all measurements are controlled through a single ASCII keyboard and all results are displayed on a single CRT. In its basic form, such an instrument system is typified by the NPC-748.

For more advanced tests and test automation, a floppy disk and an operating system are added as typified by the NPC-764.

The Electronic Workbench is not a new concept. Prior to the incorporation of the microprocessor into test equipment, the only advantage that early multifunctional instruments offered was compact packaging. For each test function, dedicated switches still had to be set, knobs still had to be rotated and readouts interpreted. There was no unified test methodology.

With the NPC-700 series, the historic objections that users had to multifunctional instruments were overcome. This was accomplished by using a single ASCII keyboard and CRT interface and a "start simple and build" test methodology that allows routine, independent measurements to be performed with little or no set-up. As increasingly complex measurements are needed, more powerful functions are accessed on an "as required" basis. For cross-domain analysis simple keystroke commands are used to link various internal analysis resources.

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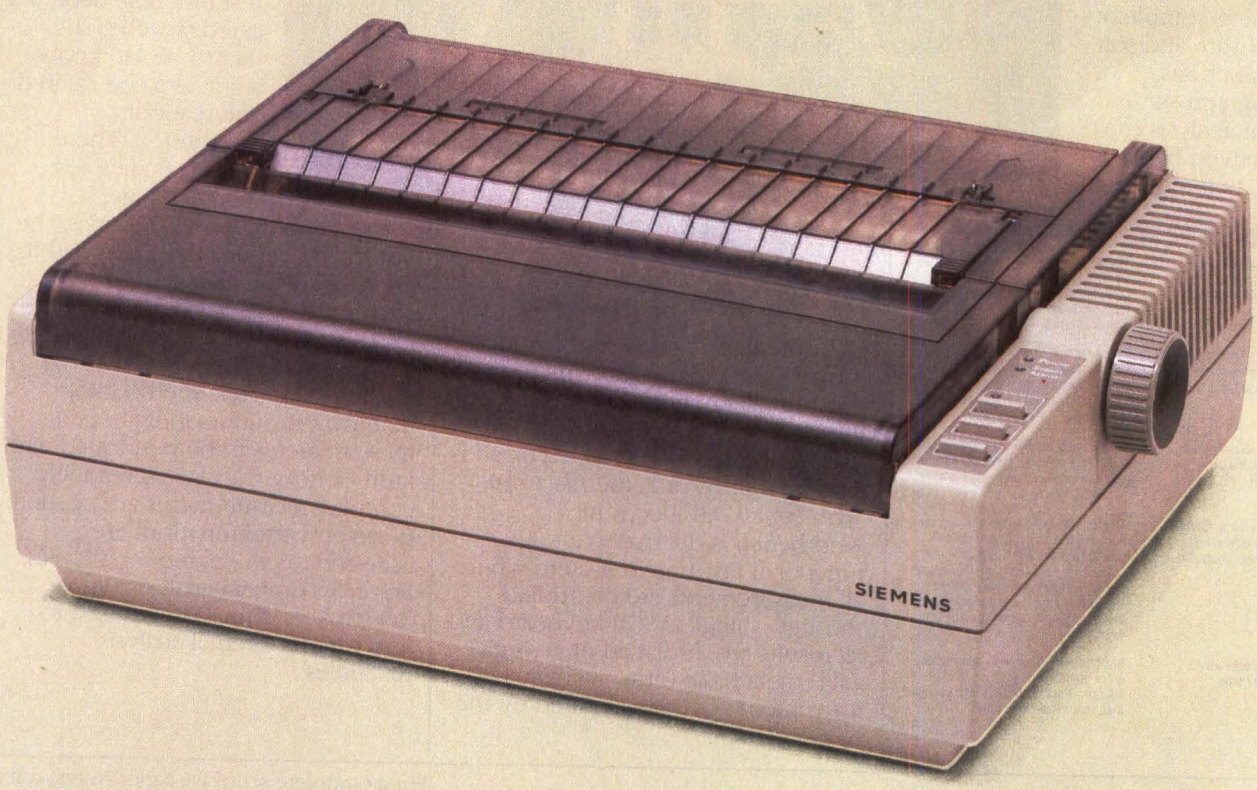
CIRCLE NO. 23 ON INQUIRY CARD

SIEMENS

Introducing the PT-88 jet printer.



Anything else is just a lot of noise.

In a market where noisy superlatives such as "incomparable", "second-to-none", and "the epitome of excellence" are casually applied to a wide variety of printers, Siemens has taken a more quiet and purposeful approach.

The PT-88 is our new jet matrix printer. Upon close inspection, you'll see that it is equipped with all the features your business can benefit from—consistent print quality in a variety of type styles, high speed (150 cps), tractor or single-sheet plain paper feed, full graphics capability, universal interface with personal or desk computers, and modular design for simplified service, if it is ever required.

But in addition to this, the PT-88 offers you something that many others simply can't... a QUIET working environment. Listen very carefully. The super-silent PT-88 whispers while it works, at less than 50 dBA. Compare it to those that operate at more than twice that sound level and clang, screech, rattle and shriek. Then think of how nice it will be to accept phone calls or conduct meetings while the PT-88 is hard at work...right next to your work place if you wish.

In short, the PT-88 puts it all together—reliability, flexibility, performance, and low-cost operation—all in one compact, super-silent unit. The result is a printer of exceptional long-term value. Now the question remains—Is it incomparable? Second-to-none? The epitome of excellence? We'd want you to decide for yourself. One thing's for sure. It's remarkably quiet. And in an increasingly noisier business environment, we think that's something you can appreciate.

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CIRCLE NO. 24 ON INQUIRY CARD

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You need it on the *first.*

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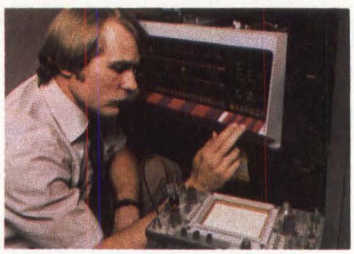

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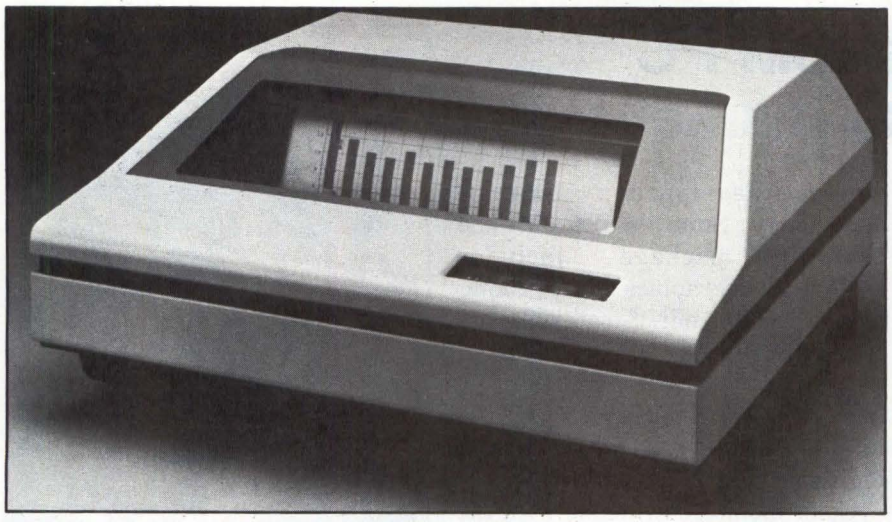
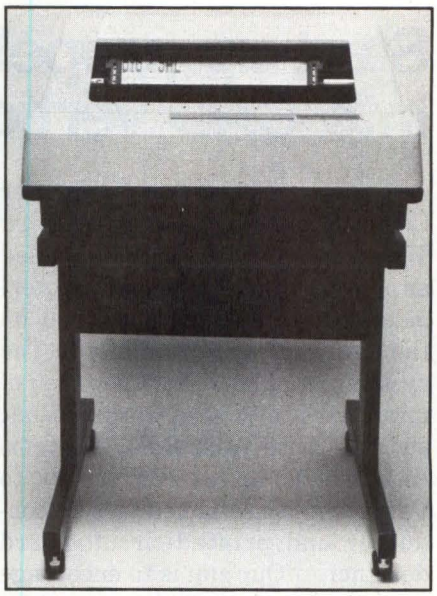
CIRCLE NO. 26 ON INQUIRY CARD

GENERAL ELECTRIC



The 4160 printer/plotter *is the latest entry from Printronix in the matrix line printer-market.*



CIE Terminals introduced new graphics capabilities *for its CI-600 line printer at the National Computer Conference in May.*

Japan. The 4160 prints 2300 rows of dots per min. Single-quantity price is $5380.

While dot-matrix line printers have not experienced tremendous sales growth in recent years, observers expect the market to be strong soon. "The matrix line-printer market is really a hot area," says Pete Steiner, associate director of research firm Dataquest's Electronic Printer Industry Service. "The new products have just about wiped out the market for the 150-lpm printers, but you are likely to see 600 lpm the focus of a lot of activity." Dataquest forecasts 15-percent annual growth in terms of units shipped for all dot-matrix line printers over the next five years and 22 percent for the versions that print at 450 lpm or more. Revenues will more than double in the same period, reaching an estimated $750 million, according to Dataquest. Band printers are expected to experience a slower compound annual growth rate of about 10 percent in units.

Manufacturers' estimates for the market for dot-matrix line printers are more optimistic than Dataquest's figures. Several companies project overall growth of 15 to 25 percent, and all agree that 600-lpm units will experience the most growth as serial matrix printers cut into the 300-lpm market. All feel that dot-matrix technology will play a strong role.

Manufacturers see several factors fueling the growth of the industry. "There is a higher interest in the multifunctional capabilities of dot matrix because system integrators are adding decision-support software and other graphics to systems [minicomputers] that used to be pure number crunching," says Art Hyzer, manager of product planning for GE's Data Communication Products Business Department.

Mel Posin, senior vice president of marketing for Printronix, agrees that requirements for graphics hard copy are becoming significant in the line-printer sector. "It's not just the ability to produce charts and diagrams, but the whole area of 'operational graphics' such as bar codes that customers want," says Posin. He sees line printers' ability to superimpose forms as they print as a valuable asset because it eliminates the need for batch processing and enables a user to do several things with the same printer. Posin believes that dot-matrix line printers will also see increasing use with 16-bit microcomputers, particularly as local-area networks become more widely used.

CIE Terminals also expects to see growing use of line printers with 16-bit micros. That market growth will precipitate a drop in prices. "You have to wonder if a $2000 micro is going to be connected to a $4500 printer, so we would not be surprised if things start changing very fast," says Lee Risner, line printer product marketing manager for CIE Terminals. With the financial influence of the C. Itoh trading group behind it, CIE Terminals is a major candidate to begin price slashing. Risner, however, says that CIE Terminals will "follow the dynamics of the market."

GE's Hyzer agrees: "We expect to see prices start coming down," he says. "Some of the prices that have been announced are already having that effect, and certainly the presence of Japanese companies like Hitachi and Citizen (which manufactures the two CIE Terminals offerings) with their manufacturing muscle makes the indications even stronger." *—Edward S. Foster*

Start-up propels IBM PC into CAD vertical market

Start-up Chancellor Computer Corp., San Francisco, an IBM PC Value-Added Dealer, has unveiled an Ethernet-compatible computer-aided-design workstation based on the IBM personal computer. The systems are about half the price of minicomputer-based workstations, such as those from Daisy Systems that have list prices from $45,000 to $75,000, and are aimed at semiconductor and printed-circuit-board designers. "Our aim is to encourage the proliferation of these stations throughout the design process by bringing down the cost barriers," says Bruce Chancellor, the company's founder and president.

In the past, Chancellor says, companies offering CAD stations have operated on the theory that demand for the equipment would exceed price concerns. Now, however, expansion of the CAD market depends on making the stations available to a larger share of the market through price reductions, he says.

The Chancellor CAD stations are priced from $21,000 to $34,800, including the basic IBM PC XT with PC-DOS, a 320K-byte floppy disk and a 10M-byte Winchester. All configurations include a Chancellor graphics board and a graphics software package developed by CADCAM Technology, Sunnyvale, Calif. The CADCAM package includes Cadgraph, a graphics editor; Skimcap, a netlist bill-of-materials extraction program; and Simulog, a nine-state, event-driven interactive logic simulator. All systems also include the IBM keyboard and a digitizing tablet.

Color monitors available with the system range in resolution from 320 × 200 to 1024 × 1024. The mid-range configuration, priced at $26,200, offers a 640 × 400 resolution.

Also included in the configuration are Ethernet hardware and software for tying the CAD station into a mainframe or supermini, such as the DEC VAX.

The stations will be sold through a direct sales force primarily to semiconductor and PC-board manufacturers. The stations are now in production. Mechanical CAD manufacturers and interactive graphics users will be targeted later. Within five years, the company plans to sell 20,000 of the workstations to what it feels will be a rapidly expanding market hungry for the equipment. "Simple multiplication will tell you we plan to be a very large company in a very short period of time," Chancellor says. Chancellor, which was founded in November, 1982, expects revenues of $2.4 million in 1983 and $12 to $14 million in 1984.

Color monitors for the Chancellor CAD workstation *range in resolution from 320 × 200 to 1024 × 1024. The graphics software package is from CADCAM Technology, Sunnyvale, Calif.*

The company's venture into the CAD market is the first IBM-supported entry into that vertical market for the PC. Other manufacturers make graphics boards or software for use on the PC, but Chancellor is the first to offer a turnkey package with IBM's sanction. Chancellor, not IBM, will provide complete service on the system.

—Robert A. Sehr

Manufacturers of 5¼-in. fixed/removable cartridges encounter production road blocks

Manufacturers of 5¼-in. fixed/removable cartridge drives are discovering that the road to high-volume production is often blocked with more mudslides than California's infamous Pacific Coast Highway. Among those encountering problems are Seagate Technology, SyQuest Technology and Cynthia Peripheral Corp.

Seagate cited an inadequate supply of plated media to produce drives in high volume. The company consequently suffered what many believe is a fatal setback to the ST-706 5¼-in. fixed/removable drive.

SyQuest Technology pioneered a

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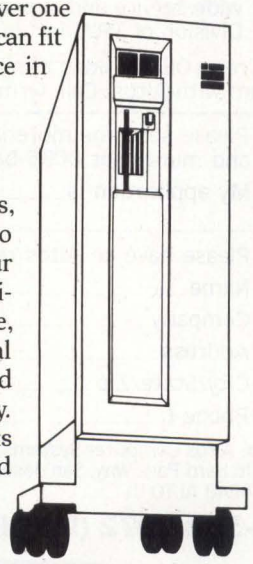

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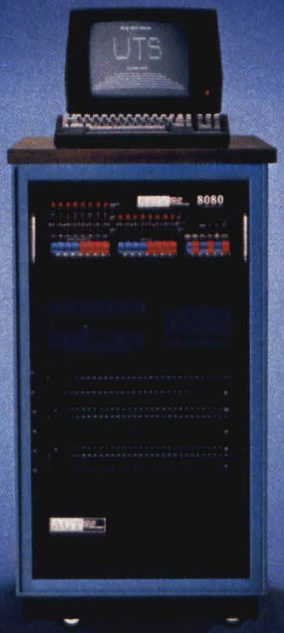

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new form factor with its 3.9-in. fixed/removable drive. But most of the drive's production volume was returned to SyQuest's Fremont, Calif., plant for technical modifications.

Cynthia, the U.S. marketing arm of Cii Honeywell Bull, France, still aims for July production of its 5¼-in. cartridge drive, but it also has discovered that making a 5¼-in. drive is more complicated than simply cutting a 10½-in. cartridge in half.

Only DMA Systems Inc., Santa Barbara, Calif., has begun successful volume shipments of its 5M-byte, 5¼-in. fixed/removable drives and expects to have volume production of its 5/10 (5M-bytes removable, 10M bytes fixed) and the 5/15 (5M bytes removable, 15M bytes fixed) by this summer. Even for DMA, which pioneered the 5¼-in. cartridge drive, production was not without problems and the need for more capital. With the help of a new licensing agreement and funding from the Memorex Division of Burroughs Corp., DMA appears ready to beat its struggling competitors.

"The key to DMA's success where others have failed is its embedded servo and recessed read/write head," says an envious official at a competing firm. He admits contamination introduced by the removable portion of the drive and media-interchange limitations have caused setbacks for his company's products. The embedded servo puts servo information on each disk surface rather than using one surface as a dedicated servo as in an open-loop system. The servo is crucial in removable drives in large form factors. Placing servo information on each surface can promote media interchangeability, since cartridges become worn after repeated use, and even new cartridges can vary in servo positioning.

The recessed head in the DMA drive allows a clean-room atmosphere within the drive to prevent contamination. When the cartridge is inserted into the drive, a door-actuator mechanism opens head-access and air-filtration ports. When it is removed, the door automatically closes.

The technology seems simple, and DMA has proposed it as a standard for all 5¼-in. cartridge systems. But it is not yet prevalent. Only the DMA and Cynthia cartridges use embedded-servo, recessed-head technologies, while SyQuest and Seagate use open-loop systems. "It takes a certain kind of talent to make an embedded servo work," says Richard M. Troutte, president and chairman of DMA. "Some of our competitors have backgrounds in the floppy disk drive field and consequently have no experience with closed-loop systems."

George Toor, executive vice president of Cynthia, echoes that sentiment. "The removable [drive] industry has suffered a lot of credibility problems," he says, "and open-loop systems are not going to help the situation." Toor says Cii Honeywell Bull has been manufacturing large cartridges with both the embedded servo and a recessed head in large volumes for several years. As a result, he believes, the company has the experience to compete in the market for 5¼-in. fixed/removable drives.

Seagate officials insist that the ST-706 was not a casualty of engineering, but of an inadequate supply of plated media, which is the only media the ST-706 can use. Each ST-706 drive would have used a minimum of 10 cartridges. "When you multiply that by our expected production of a thousand units per day, that's a lot of plated media," says Finis Conner, Seagate's executive vice president. "We can't ship a product like that to our customers and then leave it up to them to try and find cartridges."

Conner says Seagate's new half-height, 5¼-in. drive can use either plated or oxide media. Further, production numbers for that drive are not expected to be as high as those of the ST-706. Thus, there is less concern about meeting production volumes. Because of the contamination problem in removable media, the removable cartridge cannot use oxide disks, Conner says.

Scott Holt, Seagate's vice president of marketing, says that despite rumors that production units of the ST-706 could not function, the drive can be manufactured. It will resurface when manufacturing capacities of plated-media suppliers, such as Ampex Corp., increase. Meanwhile, design teams for the ST-706 have been reassigned.

SyQuest, which manufactures its own cartridges, is recovering from this year's nearly disastrous initial production run. Larry Sarrisky, vice president of marketing for the two-year-old Seagate spin-off, says drives had to be returned because of a simple mechanical error in the cartridge and not the failure to achieve interchangeability, as was rumored. "We think we've got the problem solved, and we are shipping in volume again," he says. "If we don't ship at least 40,000 to 50,000 drives this year, then we've got problems."

Like most of the other cartridge drive manufacturers, SyQuest relied on a fixed version of its fixed/removable drive to compensate for its lack of fixed/removable production.

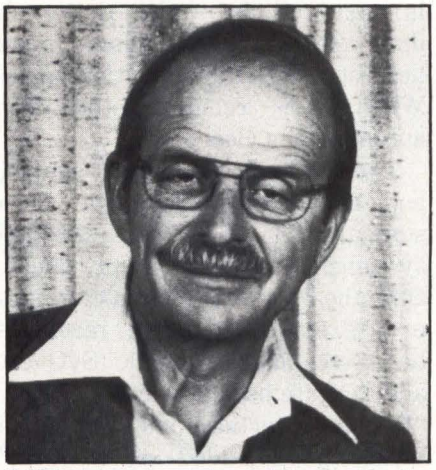
—Robert A. Sehr

Sanders print head could set new price/performance standard

The price/performance ratio for dot-matrix printers could improve dramatically over the next year due to new print-head technology developed by R.C. Sanders Jr. Sanders, founder of Sanders Associates Inc., and Santec Corp., claims printers using the technology will be able to double or triple their speed at the same price or offer the same speed for half the price. He foresees a variety of serial printers using one-, two-, four-, eight- or nine-pin heads and matrix line printers with as many as 64 pins.

Sanders has demonstrated a four-pin prototype that he believes could be the basis for a printer that would match the performance of low-end dot-matrix printers at two-thirds the cost or less. "Print-head manufacturing costs can be as low as $1 per wire in large volume, so the basic four-pin head plus a $2 jewel could be produced for $6," he says. Other models using different numbers of pins would have similar savings or performance benefits. A nine-pin printer capable of 500-character-per-sec. speeds in draft-quality mode could sell for less than $1000 at the retail level, he estimates. Dot-matrix line printers could easily reach a speed of 1200 lines per min., twice the throughput of machines on the market.

Sanders—no longer connected with either Sanders Associates or Santec—has a track record of both technological brilliance and financial controversy. Sanders Associates had sales of $436 million in 1982, while Santec survived a bankruptcy-protection period. But Santec has patent claims on some of the most sophisticated matrix technology on the market.



R.C. Sanders Jr. *claims printers using the four-pin print head he developed will be able to double or triple their speed at the same price or offer the same speed for half the price.*

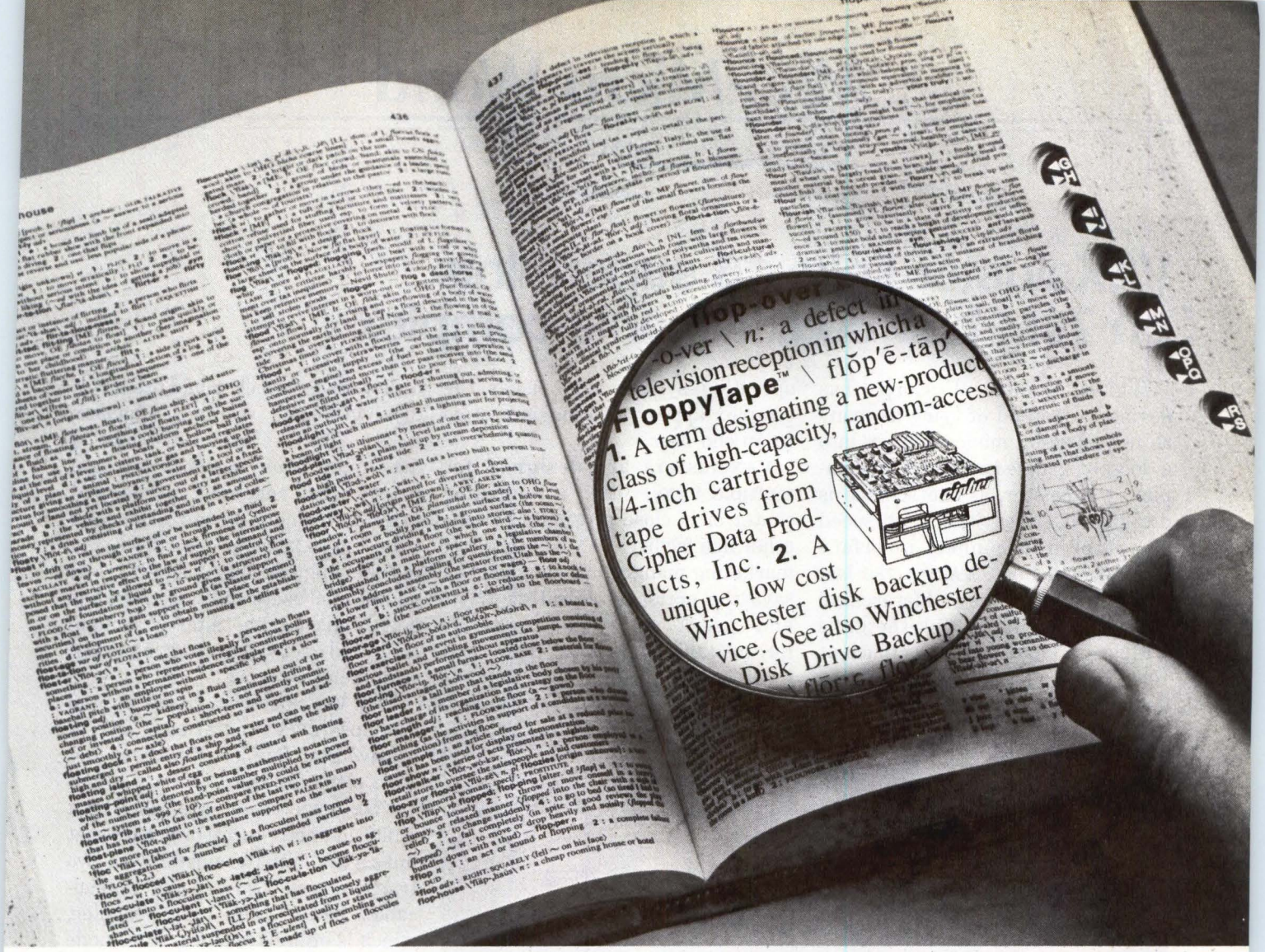
The four-pin print-head technology Sanders is licensing through his as-yet-unnamed company has been demonstrated at a refire rate per wire of 3125 dots per sec., and Sanders feels that production models of all but eight- and nine-pin models should exceed 3000 dps. The eight- and nine-pin models, which are limited by pin-to-platen spacing considerations, have exceeded 2500 dps refire rates, says Sanders.

Typical low-cost dot-matrix print heads function at 500 to 1000 dps. Printers with refire rates close to that claimed by Sanders—notably Florida Data Corp.'s OSP series—have end-user prices exceeding $3000. Sanders says that the major difference between his new print head and other dot-matrix technologies is that his approach provides a consistent dynamic response without electrical damping or stored-energy actuators. "We've made some very slight but important changes in a number of factors including materials and tolerances," says Sanders. "We've acquired a number of patents in these areas which make for a smaller, more efficient power supply, a lighter mechanism and cost savings."

Patents are a sensitive subject for Sanders, especially in regard to his relationship with Santec. He says his print-head technology does not infringe on Santec's patents. The Santec S700 model operates at speeds as high as 390 cps and sells for $2800 each in quantities of 100. A Santec spokesman has no comment on Sander's claims because the company has not seen the new print head.

Sanders believes that the print head avoids conflict with Santec patents in multipassing and incrementing the paper. It also avoids conflict with an Eaton patent for a staggered array because the Sanders array is slanted to achieve vertical fill in one pass. With the four-pin head, four passes create a line of characters with a half-dot overlap, and eight passes create a line with a three-quarter-dot overlap.

Sander's marketing strategy is to offer licenses of the technology to printer manufacturers to produce their own print heads. Shipments of units were planned to begin in late June after final patent applications were filed. Sanders expects that large printer manufacturers will manufacture the print heads themselves, and he expects to license the technology to a manufacturer that will produce the print heads in quantity for other manufacturers. "Printers actually using the print heads should start reaching the market by next year's NCC," he predicts. —*Edward S. Foster*



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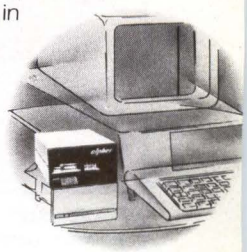

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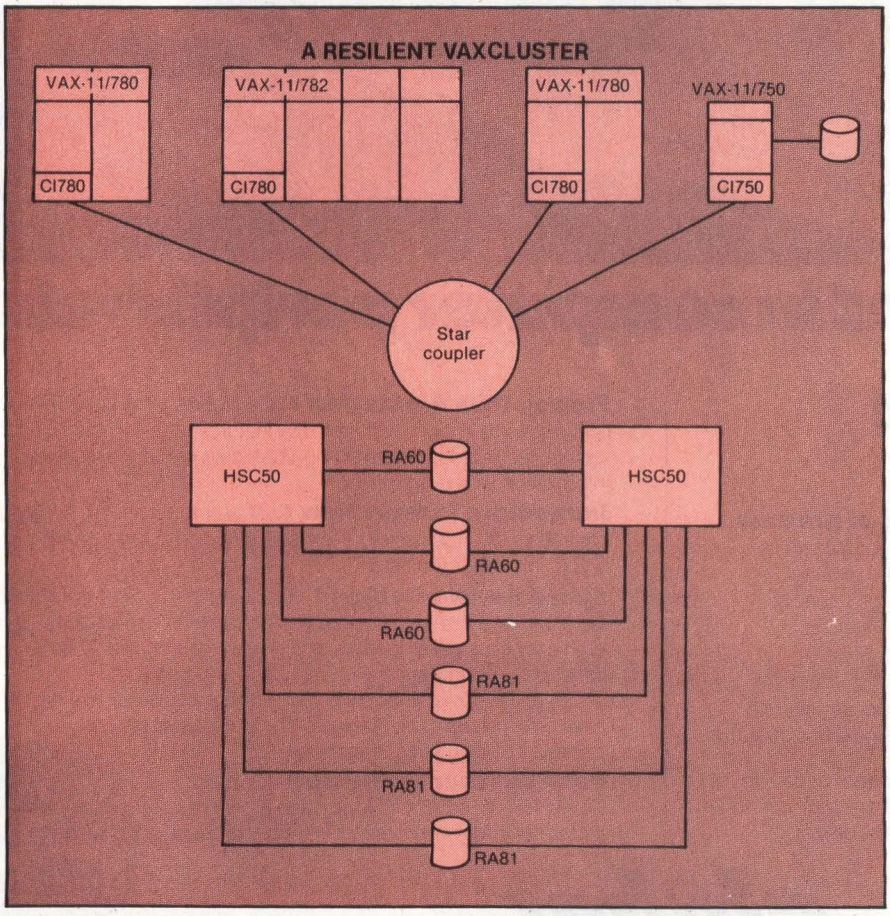
VAXcluster links 16 superminis on 70M-bps coaxial-cable complex

Digital Equipment Corp. has devised a method of tying as many as 16 VAX 32-bit minicomputers into a loosely coupled computing complex. VAXcluster, as the scheme is designated, uses the high-speed computer interconnect interface introduced for the VAX-11/780 last summer and a new hierarchical storage controller to link the CPUs with shared data files of as much as 100G bytes. The systems operate under a new release of the VMS operating system that makes the complex appear as a single system to an end-user.

VAXclusters are designed for multiple VAXs within a computing center or in close proximity to each other in a facility. VAX base product marketing manager David Chanoux says the option is aimed at major end users who want orderly, incremental growth of their VAX facilities. Normally, a VAX 11/780 is theoretically limited to 16G bytes of disk storage, which would produce a disk I/O-bound system, Chanoux says. The 11/780 now has a maximum main memory of 32M bytes with recently introduced 64K-bit memory parts. Chanoux expects VAXcluster customers to include engineering, scientific and educational users and says there has been considerable interest among financial services and banking customers as well.



A VAXcluster system *configured for high reliability may include dual-ported disk units connected between pairs of HSC50 storage controllers, providing a redundant link from each processor to stored data. Forthcoming versions of the VMS operating system, to be released beginning this summer, will provide data integrity and features to match the hardware potential of VAXcluster systems, such as automatic switchover of disk devices to circumvent an interruption of HCS50 operation.*

The VAXcluster is based on the 70M-bps CI7XX interface and a passive Star coupler. The CI780 and the CI750, for the VAX 11/780 and 11/750, respectively, are based on a multiple-microprocessor design that links a CPU into the cluster with two transmit and two receive coaxial-cable paths. The Star coupler, which is offered in eight- or 16-node versions, supports a combination of 16 devices, which can be CPUs or HSC50 disk storage controllers. Devices can be as far as 45m. (about 49 ft.) from the coupler. Chanoux says a two-node connection operates at 70M bps with the extra transmit and receive lines acting as backup. The cluster delivers an aggregate data-transfer speed of 140M bps with four connections, he says.

The HSC50 shared disk file controller is based on PDP-11/24 technology and includes separate port control microprocessors. Each of a maximum of six disk channels can support an RA series drive, which can be ordered in capacities ranging from 121M to 456M bytes. One HSC50 can support as many as four CPUs.

The network technology is proprietary to DEC, Chanoux says, but he acknowledges that there is ongoing internal discussion concern-

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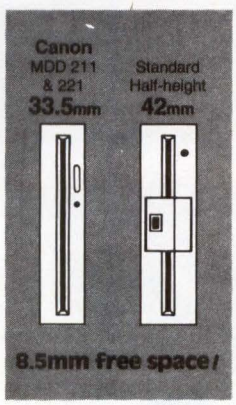

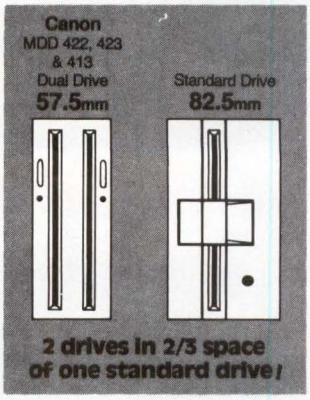

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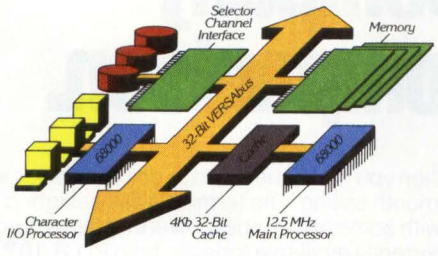

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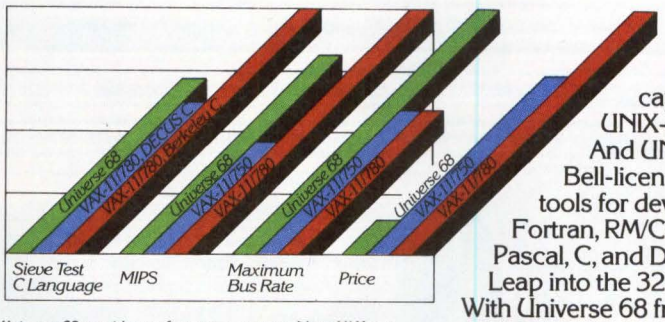

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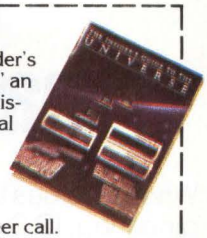

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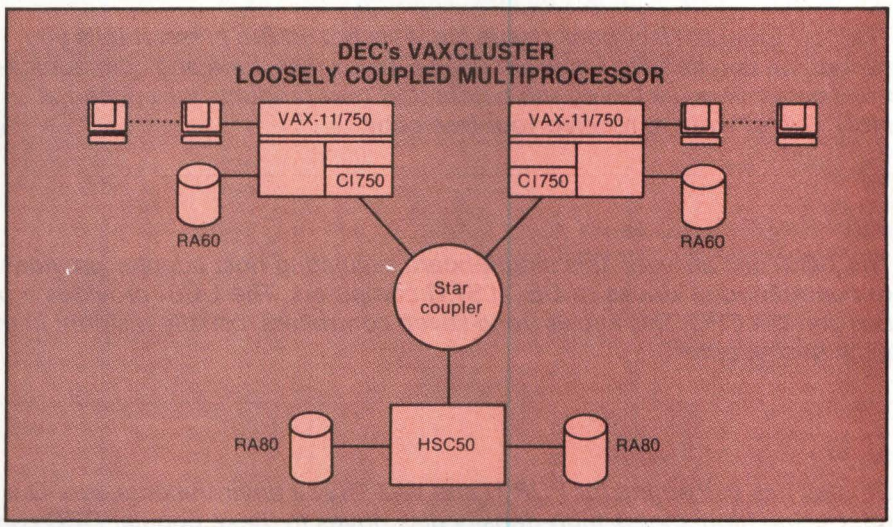
ing opening the system to other manufacturers' hardware. The VAXcluster software is compatible with the DECnet long-distance network scheme, and DECnet protocols can be implemented within the cluster using the CI7XX link.

While high reliability is one of the claimed benefits of the cluster, Chanoux says the system is not designed specifically as a fail-safe or redundant-processor scheme. However, he points out that the new 3.3 release of VMS enables VAXcluster customers to program fault-tolerant facilities on the cluster. "Our approach to high availability is an 'N' + '1' approach," he says, explaining that DEC users can program an extra system on the cluster to take over automatically when another fails. DEC leaves the implementation to end users instead of incorporating redundancy into the operating system to keep VMS a general-purpose operating system, Chanoux adds.

VMS 3.3 does provide data-integrity/backup features for VAXcluster users, however. A checkpoint/restart facility, which can be invoked by a system programmer, signals the end user if a process does not move to the next state. For lengthy computations, this facility can be used to restore files and restart a process that has been interrupted. A rollback facility is also included to recover a process that has been interrupted, such as an accounting system that requires both credit and debit operations. A volume shadow facility allows a physical disk to be duplicated on another disk in the cluster; the system can automatically update the shadow disk when the primary disk is updated. A distributed file-lock manager provides a record-level mechanism that locks out other users when a file is being updated. The system is organized



Entry-level configuration *for Digital's new VAXcluster system, a loosely coupled multiprocessor design, incorporates two VAX-11/750 processors and runs under Version 3.4 of the VMS operating system. The configuration includes CI750 interfaces and local, 205M-byte RA60 disk drives for each processor, CI cables, a Star coupler, an HSC50 mass-storage controller and two 121M-byte RA80 disk units. Prices begin at less than $300,000. VAXcluster system can grow from three to 16 nodes and encompass VAX-11/780 and VAX-11/782 processors and as many as 24 disks on each HSC50 controller.*

EMULEX TALKS DEC 5

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FOR THE RECORD...

The Emulex TC01 disk controller has a calculated MTBF of 41,000 hours. But in statistics compiled in field operations between 1980 and 1982, its actual MTBF was a whopping 164,930 hours! That's the equivalent of 31 years between failures, with the system in operation for 102 hours each week.

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CIRCLE NO. 35 ON INQUIRY CARD

on a first-come, first-served basis because DEC could not develop an acceptable priority access method, Chanoux says. The system also has a common journal facility that records all changes in a file.

Chanoux says a 3½-year effort went into the VMS 3.3 release. DEC spokesmen say future versions—due out in the next nine months—will include facilities to ensure cluster-wide data integrity even in the event of system failure. VMS 3.4, which will provide VAXcluster support for 750s, is due out by September, but the company does not plan to add the low-end 730 to the cluster, Chanoux says.

Chanoux says the company is not planning to offer VAXcluster for other operating systems, but reports that software developers at the University of California at Berkeley are interested in adapting VAXclusters to the UNIX operating system. VAXclusters have been installed within AT&T, a DEC spokesman says, but it is not known whether AT&T is working on its own UNIX version.

VAXclusters can be assembled for two 780s for about $200,000 including software updates, interfaces, connections and an HSC50 shared disk subsystem. A similar cluster with two 750s will sell for about $300,000, including the computers, a DEC spokesman says.

The CI780 interface for 780s and 782s is priced at $19,500, and the CI750 is $18,500. The Star coupler is $7500 in an eight-line version, and an expansion unit for eight lines more is $5500. The HSC50 storage controller is $32,500, and each disk channel interface is $7100. A VMS update including documentation and media is $2940, and a supported update is $7630, including a 90-day warranty and training credits.

—Geoff Lewis

Touch terminal vendor hopes to create markets for IBM PC

Although touch-sensitive CRT monitors, which have been on the market for 10 to 15 years, have never caught on in a big way, Touch Technology Inc., Annapolis, Md., is using that technology to jump onto the IBM PC bandwagon and possibly open another vertical market. The company has applied to become a PC Value Added Dealer, which would enable Touch Technology to buy PCs at a discount, add terminals and resell the packages to vertical markets.

Touch Technology is marketing three touch-sensitive monitors, along with a program that allows a user to generate programs for the IBM PC, running PC-DOS, the Apple II and IIe and other microcomputers running CP/M. The Program-That-Writes-A-Program accesses data or graphics from disk drives, videotape or laser disks. List prices range from $1450 to $1950. Monitors can be retrofitted with a touch screen.

Targeted applications include libraries, airport information services, banking, automated marketing surveys and other public uses, educational aids and point of sale. An Apple II version is being tested on a pier in Avalon, Calif., where it

provides Catalina tourist information in graphic form. Touch Technology hopes to address several other vertical markets. One potential OEM customer is considering offering the systems for film-editing operations.

The monitors and video interface boards are purchased from Interaction Systems Inc., Newtonville, Mass. The monitors use analog/digital capacitance panels mounted in front of the CRTs. When the glass panels are heated to 1000° Fahrenheit and bent to the curvature of the tubes, a layer of idium tin oxide is applied. Company officials at Touch Technology prefer capacitance panels over other touch technologies, claiming a coated panel can be damaged only by being struck by a baseball bat and therefore is an ideal protective barrier.

Three phosphorous monitors are available. A green, 12-in. monitor, with a video interface card, cables and the Program-That-Writes-A-Program, sells for $1450. List price for a 12-in., color composite monitor is $1550, and list price for a 19-in., color composite monitor is $1850. A red, green and blue, 12-in. monitor (for the IBM PC only) sells for $1950.

The monitor panels have 32 touch-sensitive areas. Company president Gary Barrett says the panels are being modified, and he expected the panels to accommodate as many as 100 × 100, or 10,000, touch-sensitive areas by May. With the improved panels, a full ASCII keyboard could fit graphically onto the screen.

The menu-driven Program-That-Writes-A-Program is written in compiled BASIC. Barrett says a 160K-byte floppy disk drive holds about 80 average frames of information. The program has a space reserved for BASIC programmers to insert instructions for the system to read from VisiCalc or other files supported by the operating system.

Industry analysts are reserved as to the chances of Touch Technology's gaining a large share of terminal market applications. "The concept has its place," says Ken Bosomworth, president of International Resource Development, a Norwalk, Conn., market research firm. But he sees the total market for touch-sensitive terminals as less than 20,000 or 30,000 units. If there were a tremendous demand for touch-sensitive terminals, Bosomworth insists, the explosion "would presumably have happened."

Touch Technology marketing vice president Jack Colburn is undaunted. He is certain that more applications will be discovered as the product gains momentum. He claims 15,000 to 20,000 units are sold each year in the market and expects his company to sell 800 to 1000 units this year.

Clive Smith, senior analyst with Boston market research firm The Yankee Group, also sees a demand for the product, but pegs the total 1983 market at only $5 million. Smith says Touch Technology's offering is priced too high. "The critical factor is how much better than other technologies [such as joysticks, mice and light pens] it can perform and what the price competitiveness is."

Barrett says the company is working on decreasing the price. Quantity discounts on purchases of 10 or more units are offered on all three monitors. The RGB version, for example, is discounted from $1950 to $1450.

—David A. Bright

CalComp introduces the MBA.

Every computer system has the business basics—accounting, finance, administration.

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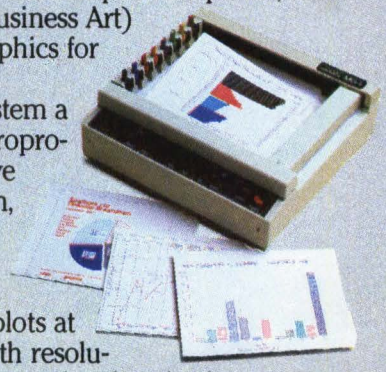

The M-84 actually makes your system a little smarter. It's based on the Z80 microprocessor and has built-in firmware for five line styles, selectable character rotation, six different character sets and circle, arc and sector generation. It can also work as a printer and digitizer.

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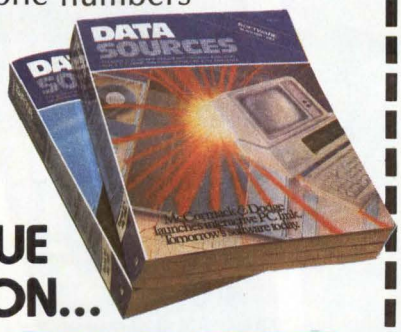

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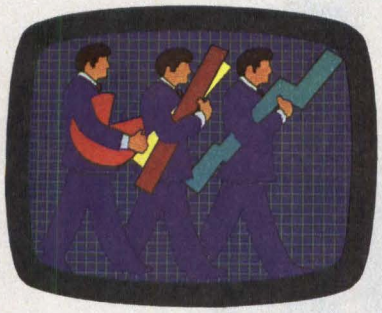

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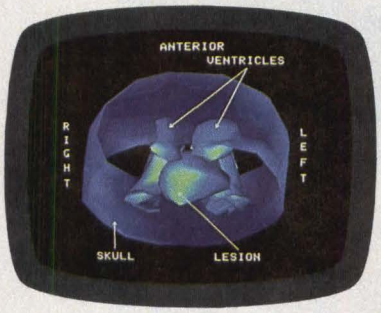
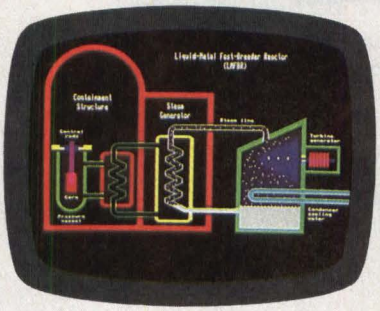


...for C&C and process control.



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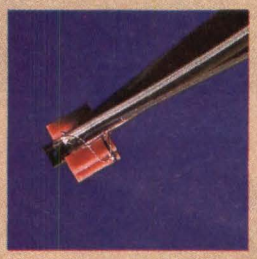

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Winchester Cleanliness

The Arapahoe 7110 does not compromise Winchester cleanliness and reliability just because it has a removable disk. When the cartridge is removed, the fixed-disk chamber is sealed by a proprietary active hub seal around the spindle. With the cartridge installed, only the cartridge interior is part of the clean air system. The HDA chamber is purged to a Class 50 environment within 45 seconds of power-up. Air quality within the positively-pressurized plenum chamber is maintained by a recirculating air filter that provides 20 times the scrubbing capacity of other fixed or removable drives.

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Although there are slight variations in the way ANSI-standard cartridges are seated on the spindle, absolute tracking accuracy and data reliability are assured by an embedded servosystem and an electronic centering technique that offsets the effect of disk runout. Thus, the user can confidently interchange cartridges from one drive to another.

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The Arapahoe 7110 is a reliable solution to some of the more challenging integration problems encountered with today's storage subsystems. One peripheral can do the work of three—data storage, file transportability/archiving, and backup. That yields compactness, fewer integration headaches and lower life-cycle costs.

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TELTONE®

Dataproducts begins retail thrust, eyes market for non-impact printers

While serial- and page-printer suppliers begin to cast covetous glances at the line-printer market, the leading OEM supplier of line printers is showing signs of wanting to enter other markets. Dataproducts' acquisition of Integral Data Systems Inc., not only brings the line-printer giant more firmly into the serial-printer market but gives it an established distributor network with which to enter retail marketing.

Dataproducts president and chief executive officer Charles A. Dickinson makes no bones about his company's intent. "Even without the IDS acquisition, we wanted to start moving products into the retail stores through distributors," he says. "IDS has a distributor network that has been serving the users of the low-end printer products and the retail outlets. They've had very limited direct selling capability on an OEM basis, but we feel we can develop some major business for the products IDS has. In that way, our two forces are quite synergistic."

Does this mean that Dataproducts agrees with industry soothsayers, who have predicted that the line-printer industry is dying? Dickinson doesn't go quite that far, but he does admit Dataproducts' traditional business is being squeezed between the upward encroachment of serial printers and the threat of non-impact technology. "Our line-printer business is in some jeopardy in that the rate of growth is relatively low, even though the base is quite large." He also admits that it would be difficult for the company to maintain its traditional growth rates of more than 20 percent a year.

Dataproducts president and chief executive officer Charles A. Dickinson *says that his company intends to push printers into retail stores through distributors. Part of that push was spurred by the acquisition of Integral Data Systems Inc.*

Since Dickinson believes that line-printer technology is mature in comparison with other printer technologies, he does not expect it to make any major advances. But he doesn't believe the market will disappear. "For data-processing capability, there isn't a competitor between 600 and 2000 lpm to the fully formed font band printer," Dickinson claims. He sees infringement from laser printers, but says there are still significant software conversions necessary in changing from band to laser printers. He also claims that laser equipment is less reliable than band printers, and maintenance costs must be considered.

Dickinson does not dismiss non-impact technology, however. He believes that non-impact printers will one day make significant inroads into the traditional line printer markets. Dataproducts is preparing for that. "We are behind because there are people out there with products already on the market," he says. He asserts, however that Dataproducts still has time to "do the job correctly."

In transition

Two senior executive appointments have been made at **Eagle Computer Inc.** as a result of the untimely death of that company's president and chief executive officer Dennis Barnhart in a car crash in June. Charles Kappenman, the company's founder and chairman, assumes the additional duties of chief executive officer. Ronald Mickwee, executive vice president and chief operating officer, is the new president. Barnhart's death caused a week's delay in the company's initial public offering, but all 2,750,000 company shares were reportedly sold within 5 min., followed by the sale of 275,000 additional shares.

Financings

Massachusetts Computer Corp.'s third round of financing drew $10.6 million. The money, which was gained through the sale of preferred stock, will be used to launch a worldwide sales thrust and for research and development. MASSCOMP manufactures 32-bit minicomputers for scientific and technical applications.

British-based Micro Focus Ltd. will use its recently acquired $5-million financing to expand U.S. marketing operations and to extend its line of COBOL development tools for commercial system integrators. The funds were raised on the London Unlisted Securities Market.

Mini-Micro World

CORPORATE AND FINANCIAL

BOX SCORE OF EARNINGS

This monthly table lists the revenues, net earnings and earnings per share in the periods indicated for companies in the computer and computer-related industries. Parentheses denote losses. Comments are from corporate summaries unless otherwise noted.

Company	Period		Revenues	Earnings	EpS
Adage Inc.	year	4/2/83	35,786,000	3,087,000	1.66
	year	4/3/82	25,779,000	1,872,000	1.27
Apple Computer Inc.	6 mos.	4/1/83	442,275,000	47,402,000	.80
	6 mos.	3/26/82	264,572,000	27,379,000	.48
CompuShop Inc.	6 mos	4/30/83	14,313,000	793,000	.31
	6 mos	4/30/82	6,577,000	108,000	.05
Datapoint Corp.	9 mos.	4/30/83	402,678,000	3,817,000	.19
	9 mos.	4/30/82	367,688,000	(899,000)	(.04)
Floating Point Systems Inc.	6 mos	4/30/83	44,766,000	4,852,000	.55
	6 mos	4/30/82	40,597,000	5,378,000	.62
Fujitsu Ltd.	year	3/31/83	3,300,000,000	157,000,000	.03
	year	3/31/82	2,800,000,000	95,700,000	.03
Honeywell Inc.	3 mos.	4/3/83	1,324,000,000	22,200,000	.98
	3 mos	4/4/82	1,261,000,000	55,500,000	2.48
ITT Corp.	3 mos.	3/31/83	3,467,380,000	134,329,000	.90
	3 mos	3/31/82	3,950,226,000	162,735,000	1.10
Management Assistance Inc.	6 mos.	3/31/83	179,616,000	3,131,000	.38
	6 mos.	3/31/82	184,507,000	5,015,000	.61
Modular Computer Systems Inc.	3 mos	3/31/83	16,858,000	(1,390,000)	(.25)
	3 mos	3/31/82	22,588,000	407,000	.08
Perkin-Elmer Corp.	9 mos	4/30/83	740,092,000	33,762,000	.77
	9 mos	4/30/82	766,860,000	46,213,000	1.07
Recognition Equipment Inc.	6 mos.	4/30/83	55,115,000	7,104,000	1.12
	6 mos.	4/30/82	55,430,000	(13,965,000)	(2.32)
Robotic Vision Systems Inc.	6 mos.	3/31/83	1,327,000	(306,000)	(.09)
	6 mos.	3/31/82	941,000	(446,000)	(.13)
Scientific-Atlanta Inc.	9 mos.	3/31/83	229,615,000	(4,368,000)	(.19)
	9 mos	3/31/82	256,265,000	16,451,000	.75
Science Management Corp.	3 mos.	3/31/83	13,538,000	(598,000)	(.32)
	3 mos.	3/31/82	10,413,000	(379,000)	(.17)
T-Bar Inc.	3 mos.	3/31/83	8,315,000	116,000	.04
	3 mos.	3/31/82	8,555,000	460,000	.14
TeleVideo Systems Inc.	6 mos.	4/29/83	80,494,000	10,464,000	.28
	6 mos.	4/30/82	38,238,000	4,946,000	.14
The Ultimate Corp.	year	4/30/83	39,236,069	4,613,762	.75
	year	4/30/82	29,817,331	2,900,518	.50
Wang Laboratories Inc.	year	3/31/83	1,417,828,000	134,993,000	1.08
	year	3/31/82	1,093,863,000	98,204,000	.82

Comments: Datapoint Corp. reports that domestic revenues increased over the second quarter while international revenues declined. Third-quarter revenues totaled $136.4 million, compared to $99.4 million for the same period a year earlier. Net income for the quarter was $1.6 million, or 8¢ per share. To focus on its office-automation and computer business, Datapoint has announced that it will sell its Communications Management Products Division to Teknekron Industries Inc. **Honeywell Inc.'s** first quarter pretax income was almost the same as that of the first quarter of 1982, excluding last year's capital gain of $51.6 million. The company says Information Systems posted a modest operating profit in the quarter, compared with a small loss a year earlier. Honeywell noted that U.S. computer orders were up significantly, while international orders were down. **Perkin-Elmer Corp.** notes improved order trends in U.S. and European government contract business and is expecting a recovery in the semiconductor industry. Data Systems Group revenues were $159.3 million for the nine-month period, compared to $152.9 million a year earlier. Semiconductor Equipment Group revenue was down to $114.8 million from $123.0 million a year earlier. **TeleVideo Systems Inc.'s** net income for the second quarter nearly doubled to $5.5 million, or 14¢ per share, from $2.7 million, or 8¢ per share, a year earlier. Sales for the same period rose to $41.6 million from $21.6 million a year earlier. TeleVideo says it raised more than $92 million from its first public offering in March.

Formations

Hewlett-Packard Co. has consolidated responsibility for personal computer and office software into two new divisions. The Personal Software Division covers both internally developed and third-party software activities and is based in Sunnyvale, Calif. The Office Productivity Division is in Pinewood, England.

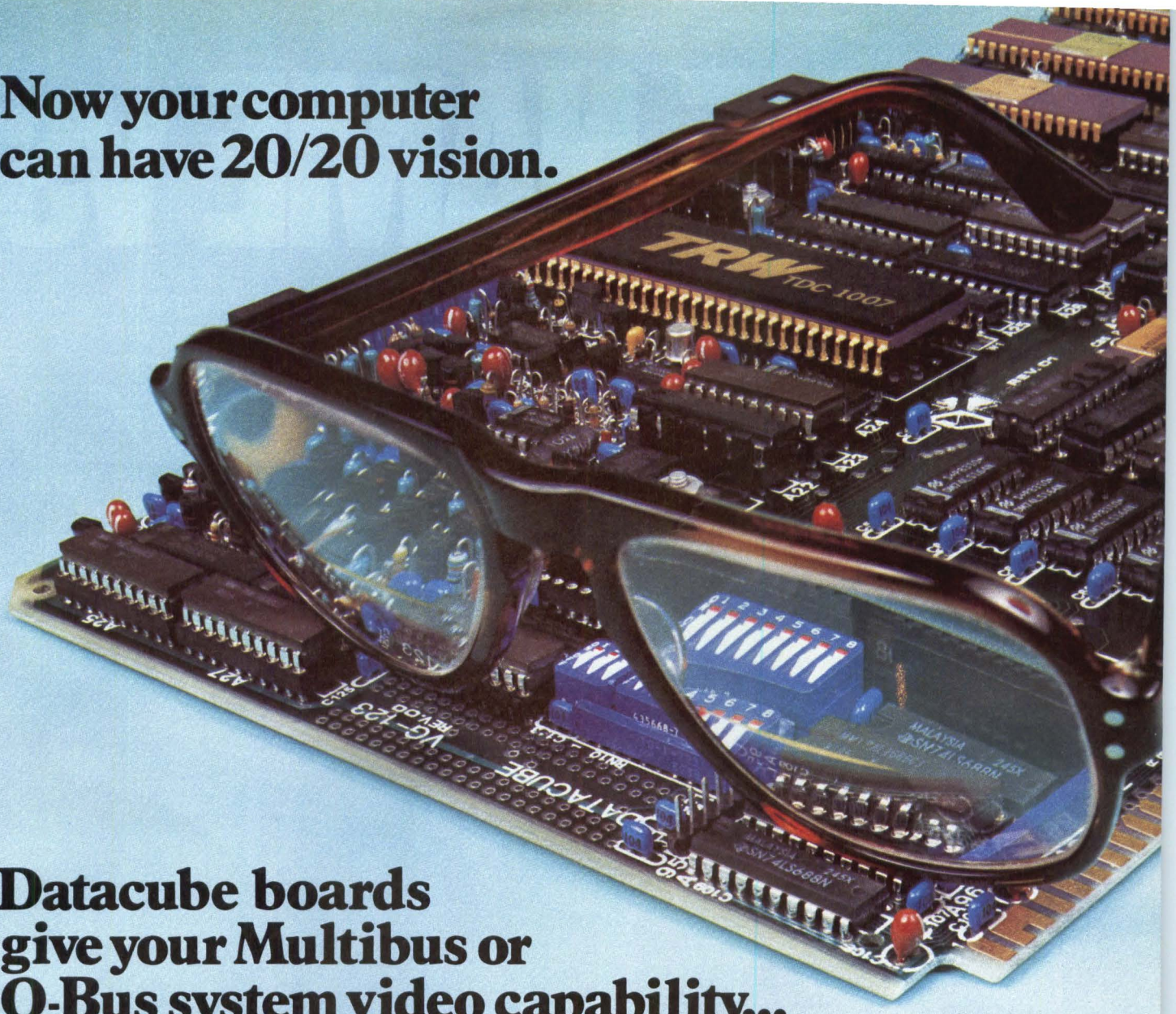
Distribution/service deals

Digital Equipment Corp. has signed an agreement with **Aregon International,** London, England to promote Aregon's videotex software, ISV-3, in the U.S. DEC says it also plans to promote similar software from **Steria,** a French software house. Both products support the North American Alphageometrics Graphics Standard as well as the European Alphamosiac Standard.

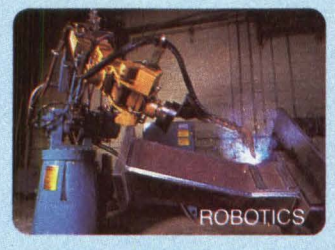
Wet ink

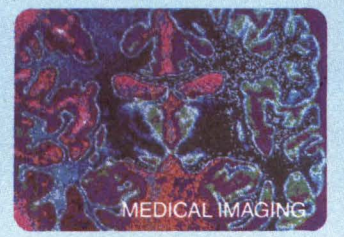
Sord Computer Corp., Tokyo, will buy at least $1.5 million worth of VectorPrinter color impact printers from **Envision Technologies Inc.,** San Jose, Calif. Under the terms of the two-year contract, the printers are to be incorporated into Sord's 32-bit personal computer for sale primarily in Japan....Philips Data Systems, West Germany, has signed a four-year contract with **Seagate Technology,** Scotts Valley, Calif., for Seagate's 5¼-in. Winchester disk drives. The 6M-, 12M- and 19M-byte drives will be used in Philips' Z80A-based Office Micro System....**Wang Computer PTY Ltd.** was awarded a contract to automate the Australian Department of Social Security. The four-year contract covers $70 million worth of equipment, with additional provisions for service and support.

Now your computer can have 20/20 vision.



Datacube boards give your Multibus or Q-Bus system video capability... economically.





Datacube boards aren't your run-of-the-mill graphics boards. These frame grabbers are built for performance... with high resolution and a host of other extra features. They digitize and display information in real time. And without host computer intervention.

The new VG123 is a good example. Resolution is 768H x 512V x 8 bits/pixel. Black and white or pseudo-color, RAM-based input and output translation tables, an alphanumeric overlay plus pan and scroll capabilities are only a few of its advantages.

Datacube boards provide reliable vision for robotics, medical imaging, surveillance, inspection, teleconferencing, animation, etc. And at surprisingly low prices.

Call or write for our new Product Guide of Multibus and Q-Bus Compatible Boards. Datacube Incorporated, 4 Dearborn Road, Peabody, MA 01960, Tel: (617) 535-6644.

Datacube

CIRCLE NO. 40 ON INQUIRY CARD

THE NAME VS.

Alpha Micro's 1042E has more power than an IBM® System 36.

It has more memory and more storage.

Fact is, there's only one area in which the IBM has a higher number than the Alpha Micro:

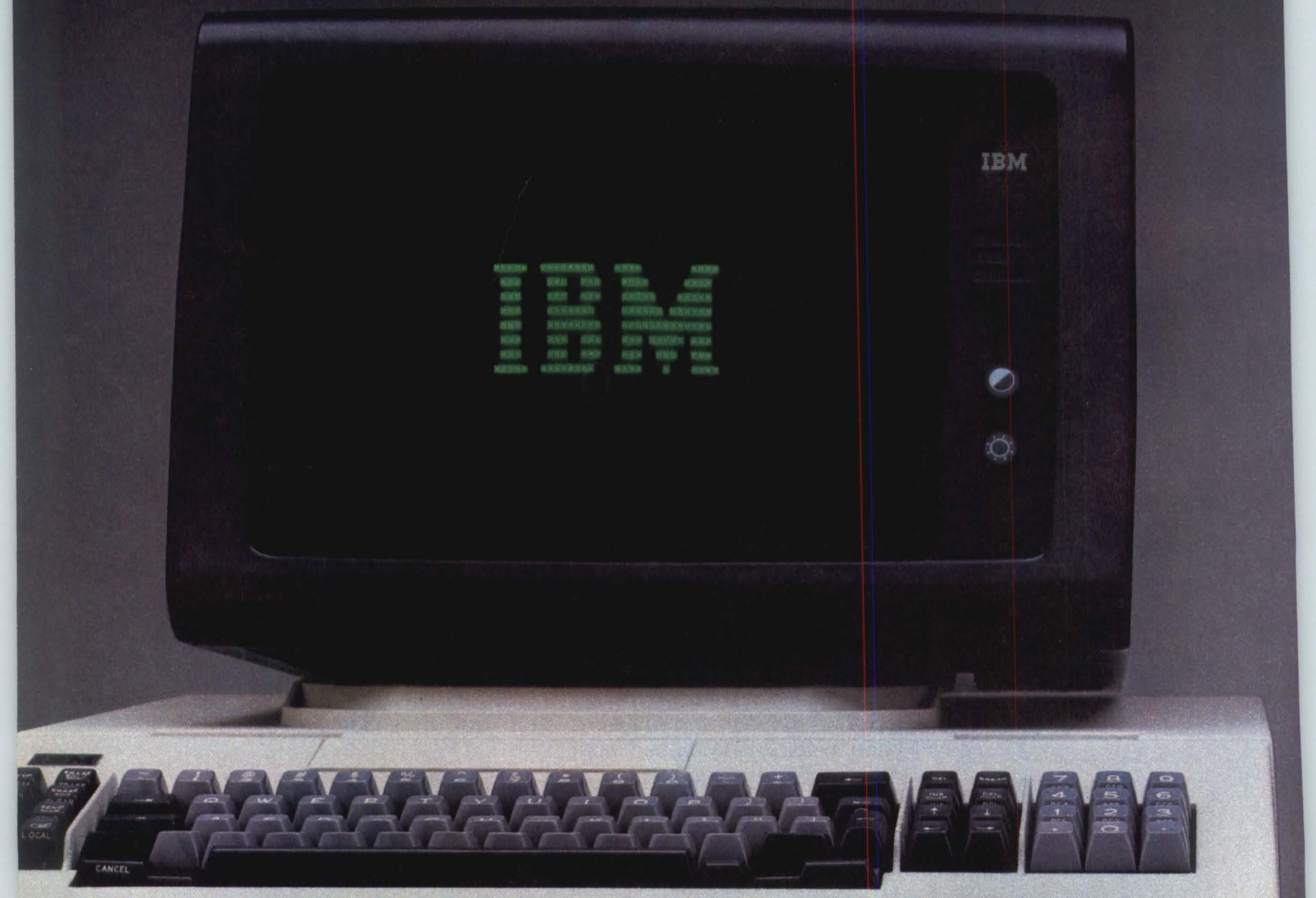
The price.

Of course, IBM is, well, uh, they're IBM. And we know how nice and safe and easy it is to go with a big, old company like that.

But we're not exactly new to this.

Alpha Micro's been making micro-computers longer than just about anybody else in the business. Including IBM.

We developed AMOS,® a multi-user and multi-tasking operating system that lets you go from one to over 40 users without changing software. (It's the ideal system for



THE NUMBERS.

word processing, inventory control, spread sheet, scientific research and more.)

And, we have an international network of dealers and factory-trained specialists to give you all the service and support you'll ever need.

So if you want a big name and a price to match, go ahead and call good old What's-Their-Name.

But if power, speed, expandability, and price mean anything to you, there's only one number you need to remember:

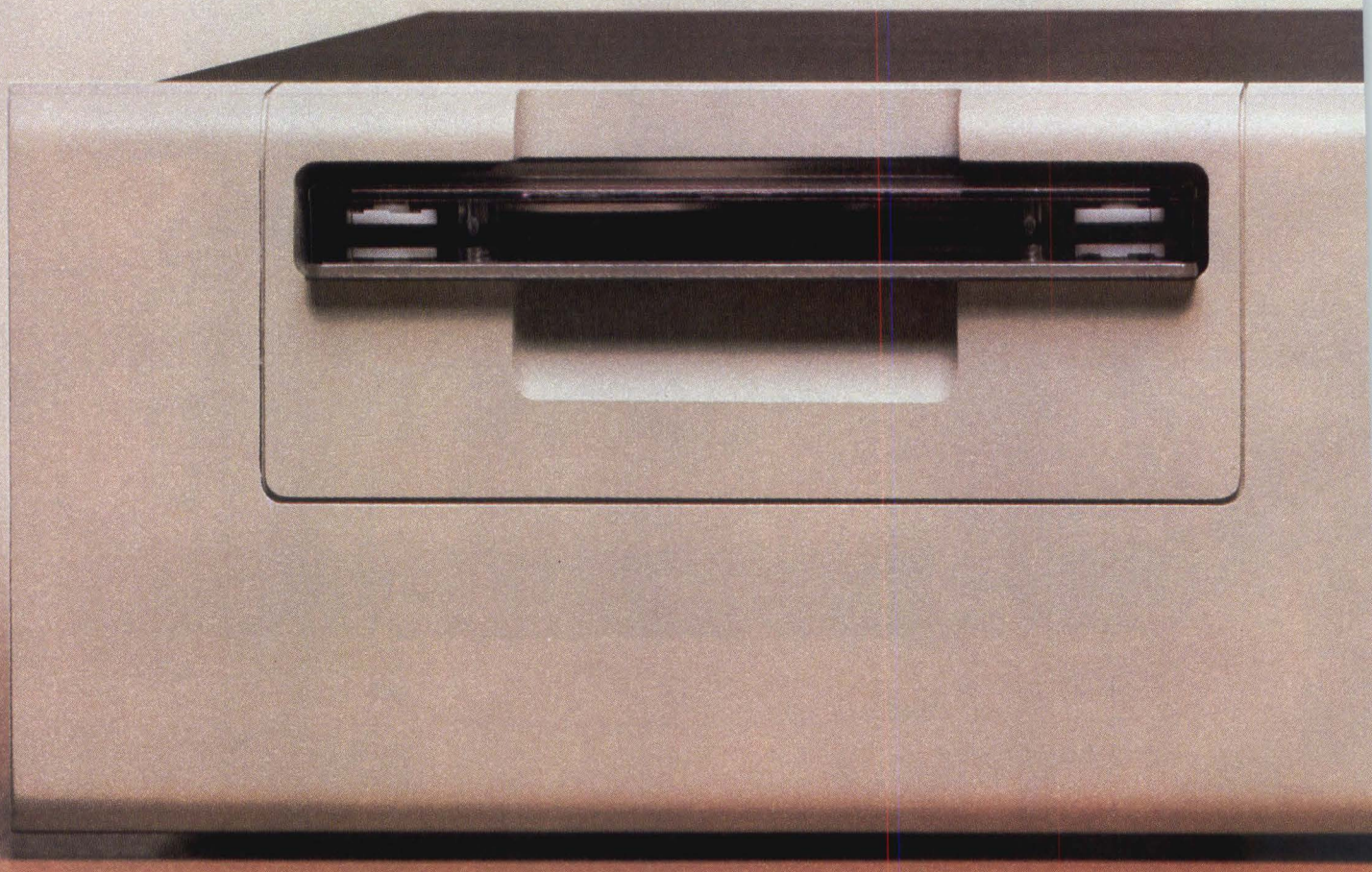
800-854-8406. (In California, call collect 714-641-0386.)

ALPHA MICRO

Everything a computer's supposed to be. Except expensive.

CIRCLE NO. 41 ON INQUIRY CARD

BUILT BY POPULAR DEMAND.



Introducing the DSD 890 DEC-Compatible Winchester/Tape.

Last year, Digital users made a big deal about our 880 Winchester/Floppy system, with its incomparable features, performance and price. And ever since then, they've been crying for more of the same, only with a tape back-up instead of a floppy.

So be it.

Witness the 890 Winchester/Tape. A 31.2 Mb Winchester and an ANSI standard ¼" cartridge tape drive for quick and inexpensive archival storage, back-up and software distribution. All in one neat package.

To get the same kind of capacity from Digital, you'd need a whole rack full of equipment.

Three RL02s and a TS-11, to be exact.

And you still wouldn't get the same kind of performance. The 890 is up to 15% faster than the RL02, thanks to our non-interleaved data transfer mode. (We can even handle simultaneous instructions to the Winchester and tape with no, we repeat, no degradation in performance.)

There's a big difference in price, too.

The 890 is about half the Digital alternative.

Yet it's just as compatible.

Our Winchester emulates the three RL02s you don't have to buy. And our tape emulates the TS-11 so that you can use all of DEC®'s handy back-up utilities. What's more, our emulation of the RL02 and TS-11 allows you to take full advantage of 22-bit addressing.

We've even designed our front bezel so it goes nicely with a PDP®-11/23.

And we've improved our HyperDiagnostics.™

Not an easy task to be sure, but on the 890, one button runs all self-diagnostics and testing. You don't even have to take off the bezel; there's a convenient little open/close front door instead.

Some things remain unchanged, though.

Like our Rapid Module Exchange,™ HyperService,™ and our nationwide sales and support network.

Because, quite frankly, we think they're already pretty good.

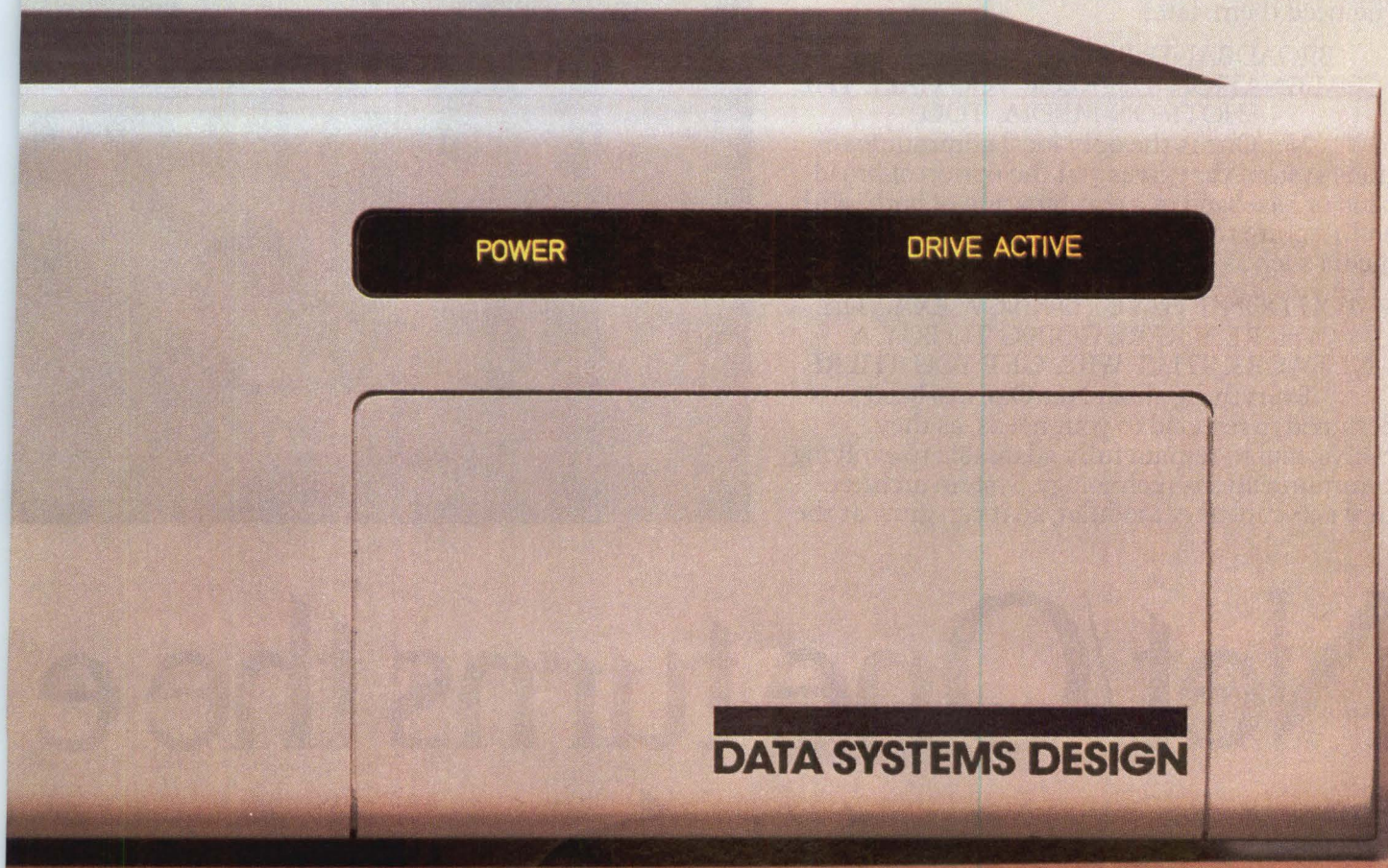
But if there's anything you think we can do to improve them, please let us know.

We don't want to say we're responsive, but when you say "jump," we leave the ground and wait for further notice.

Which explains why we're so high on the 890.

Corporate Headquarters: 2241 Lundy Avenue, San Jose, CA 95131. Eastern Region Sales and Service: Norwood, MA, (617) 769-7620. Central Region Sales and Service: Dallas, TX, (214) 980-4884. Western Region Sales: Santa Clara, CA, (408) 727-3163.

DATA SYSTEMS DESIGN



INTERNATIONAL SALES: Australia 03/544 3444; Belgium and Luxembourg 02/7209038; Canada 416/625 1907; Denmark 02/63 22 33; Finland 90/88 50 11; France 03/411 5454; Hong Kong and Peoples Republic of China 03/696231; Israel 52-52444; Italy 02/4047648; Japan, Osaka 06/323 1707, Tokyo 03/345 1411; Netherlands 02977-22456; New Zealand 04/693 008; Norway 02/78 94 60; Singapore, Malaysia, and Indonesia 2241077; Spain 01/433 2412; Sweden 08/38 03 70; Switzerland 01/741 41 11; United Kingdom 7073/34774; West Germany and Austria 089/1204-0; Yugoslavia 61/263 261

R&D had certain requirements that had to be met; manufacturing, accounting and marketing had others. Then microcomputers started showing up on desktops, with modems and printers here and there. Now you face the task of making it all work together. Sharing resources. Sharing information. And making more effective use of the information processing equipment you've already invested in.

NET/ONE LEAVES YOU IN CONTROL OF EQUIPMENT DECISIONS.

Net/One® is a general purpose communications system that turns equipment from different vendors into a fully functional, fast, powerful, information processing network. Because it can connect equipment from virtually any vendor, you remain free to choose equipment based on capability, rather than compatibility.

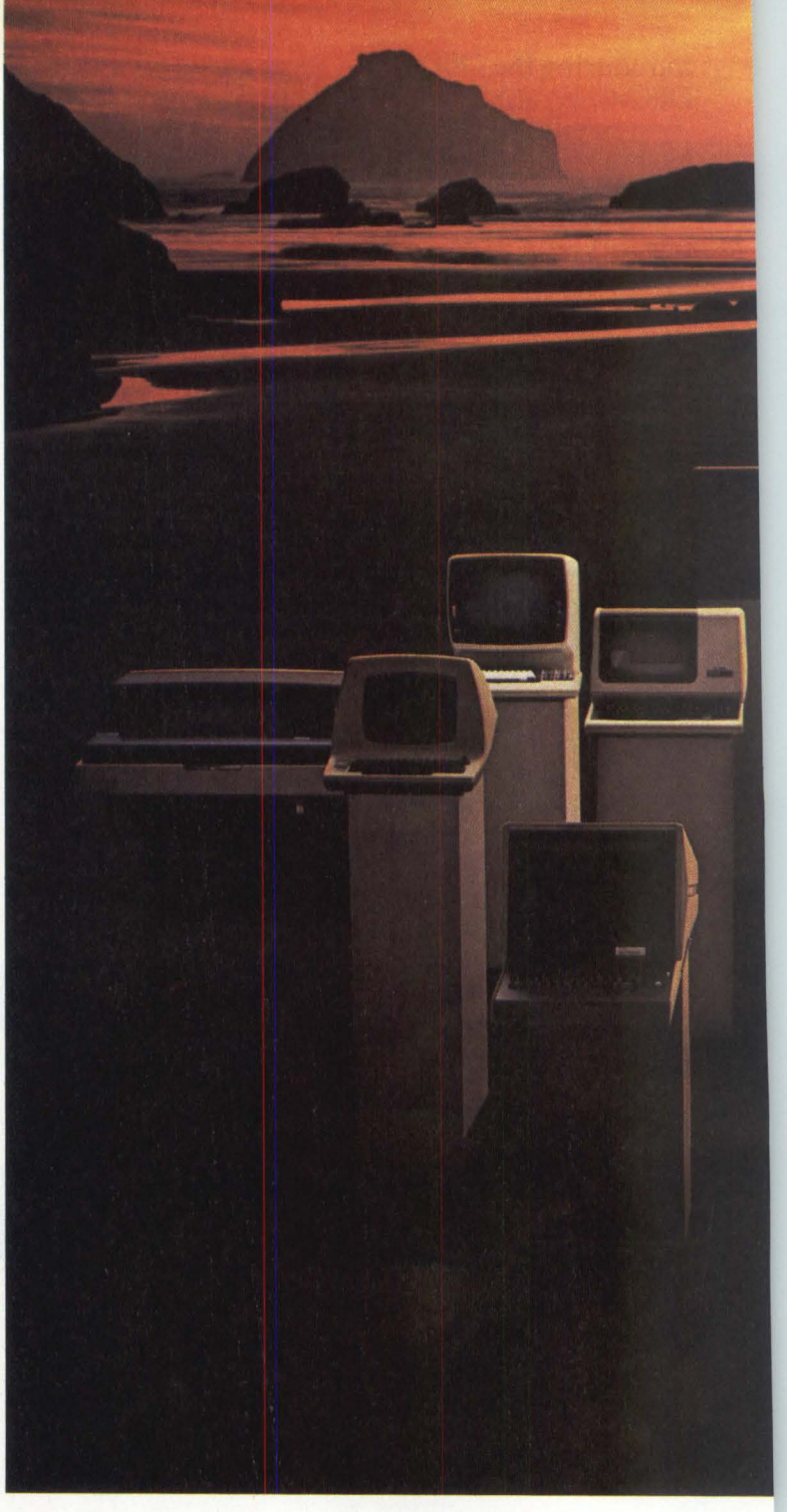
Off the shelf, Net/One supports industry-standard equipment interfaces—Async, Bisync, SDLC, through RS-232, V.35, RS-449 and IEEE-488 — as well as many high speed parallel interfaces. The list is expanding every month. But if you have special equipment that isn't in that list, Net/One is the only local area network that's fully programmable at every level so special interface protocols can be added now, or when you need them, later.

BROADBAND, BASEBAND, OR ANY COMBINATION THEREOF. YOU CALL THE SHOTS ON MEDIA, TOO.

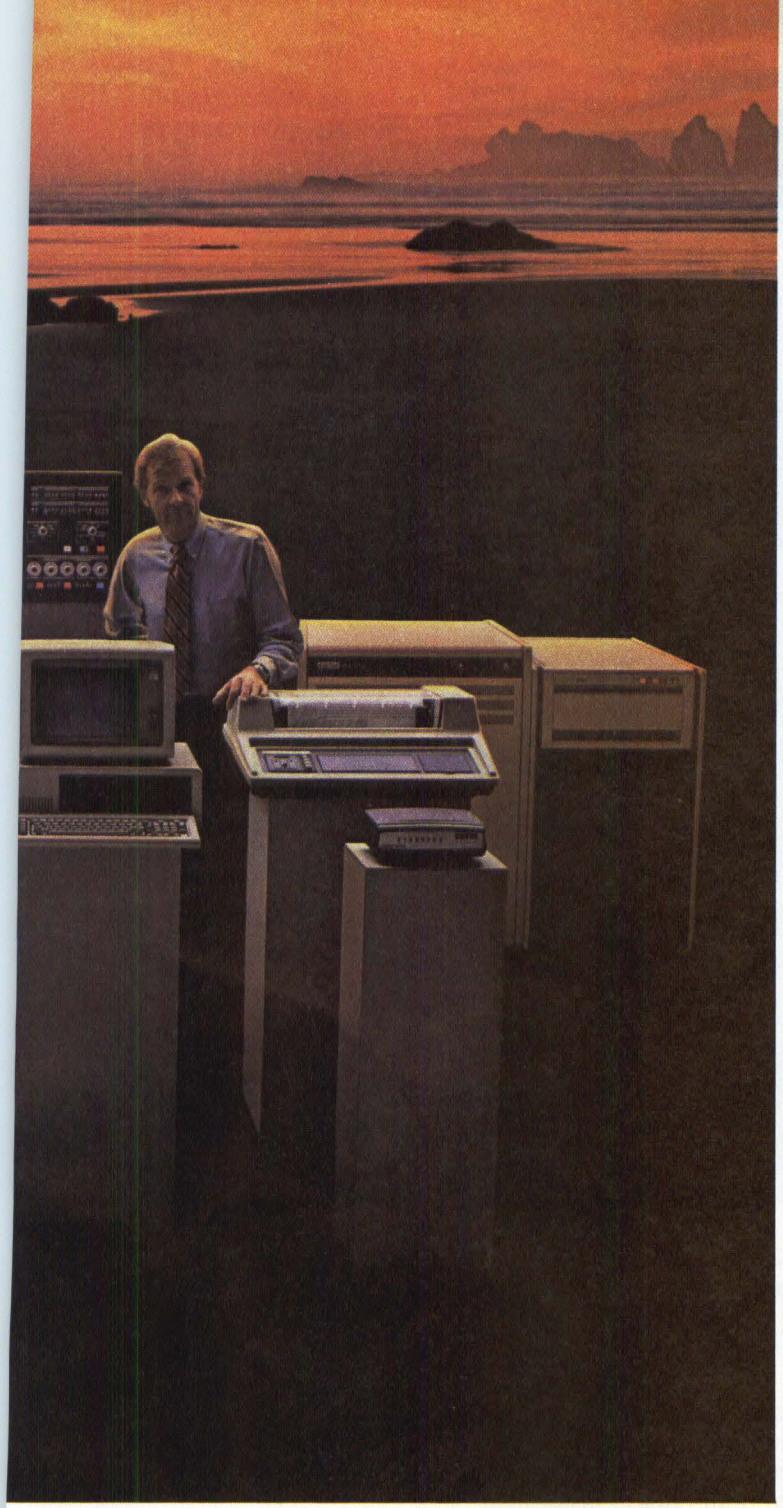
Net/One is the only local communications system that gives you the option of broadband or baseband or a combination of both, with architecture that will allow you to add other media such as fiber optics in the near future.

YOU DON'T HAVE TO KNOW EXACTLY WHERE YOU'RE GOING TO BUY A NETWORK THAT WILL GET YOU THERE.

Everything about Net/One has been designed to respond to your needs, as they evolve, and to remain fully adaptable to evolving communications technology. System architecture is completely modular, so it can grow at the

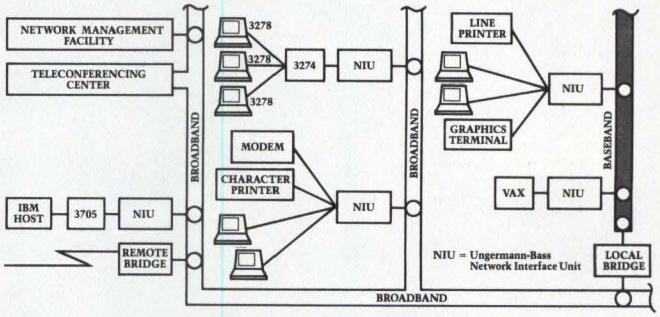


Net/One turns the e now into the netwo



same time and in the same direction you do. Regardless of the direction that turns out to be.

When separate divisions within a company or a campus need to share resources, one Net/One system can be bridged to others, and to remote networks. These bridges can interconnect baseband, broadband, or Net/One systems that include both. And like vendor independence and media independence, this bridging capability is available now from Ungermann-Bass.



NOW, THE IMPORTANT DIFFERENCE BETWEEN TALKING A GREAT NETWORK AND DELIVERING ONE.

We've been installing Net/One since July of 1980. Hundreds of our systems are already out there moving information for people like Control Data, Caltech, Fairchild, ITT, RCA, Boston University, U.S. Forest Service, and Ford Aerospace.

So we can do more than talk about what you need in a local area network. We can actually deliver one, now. And we can refer you to a long list of customers who are actually using one (or two or three) now.

Let's talk about how to turn the equipment you have, now—whatever it is—into the network you want, now. And the network that can take you wherever you want to go from here. Net/One.

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Net/One from Ungermann-Bass

quipment you have rk you want. Now.

CIRCLE NO. 44 ON INQUIRY CARD

NOW, A TASK FORCE OF ONE BRINGS REVOLUTIONARY NEW SKILLS TO DOT MATRIX PRINTING.

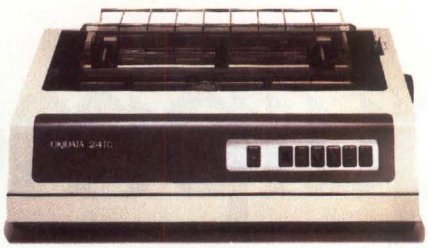
Outmaneuvers Lines and Daisies at 350 cps. Okidata's new multifunction Pacemark 2410 combines three printers in one remarkable machine. At 350 cps, it pumps out data at line speeds up to 420 lpm. Delivers drafts with extra-dense characters at 175 cps. Its 85 cps correspondence quality is three times faster than most daisywheels.

But that's just the opening salvo. This high powered dot matrix printer has an arsenal of extra features. Two-color printing. Dot addressable graphics. 96-character ASCII set, plus resident and alternate 96-character downline loadable sets. Column capabilities range from 136 to 233.

Tough As Nails. The 2410 won't suffer from battle fatigue or duty cycle limitations. It's armed with our long-life, stored-energy print head with 9 tungsten pins to crank out up to 500 million characters with ruthless precision. Add laser-welded, precision-controlled construction and a rugged, stamped steel frame, and this machine's virtually invincible.

Compatibility Plus. Teams up with all the big guns in high performance desktops and small business computers, plus most low-end minis. Available with standard parallel or RS 232C serial interface with current loop. Additional interfaces on the way.

Mean Machine. Nice Price. It's capable. It's tough. It should cost a bundle. But it doesn't. Suggested retail is $2995; $2695 for its data-processing-only partner, the Pacemark 2350. For more information, phone 1-800-OKIDATA. In New Jersey, (609) 235-2600.



OKIDATA

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A subsidiary of Oki Electric Industry Company, Ltd.

CIRCLE NO. 45 ON INQUIRY CARD

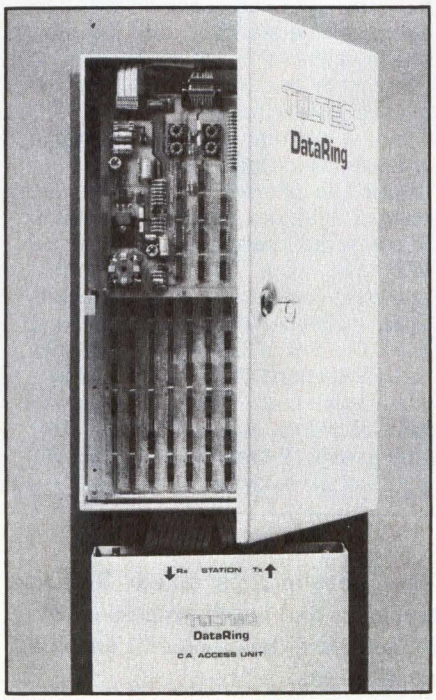
Gould S.E.L. interested in Cambridge Ring networks

While system integrators wait for IEEE 802 to adopt a standard for token-passing ring local-area networks, at least four European companies are selling rings based on an alternative technology—the Cambridge Ring slotted network. One such product, DataRing from Toltec Computer Ltd., Cambridge, England, may be made available to the U.S. by Gould Inc. S.E.L., which has acquired worldwide nonexclusive rights to the product by buying a 10-percent share in Toltec and contributing $300,000 to a $2-million capital injection. Toltec chairman Paul Reeve stresses that Toltec is seeking other U.S. outlets besides Gould.

Some of the money contributed by Gould may be used to develop components to support the proposed 100M-bit-per-sec. speed of an enhanced Cambridge Ring. The current standard specifies 10M bps and is being adopted by the British Standards Institution.

Interrupt-driven access hardware exists for the Digital Equipment Corp. Unibus and Q-bus, and direct-memory-access hardware is being developed. Also available is a terminal concentrator that can support as many as 16 RS232 ports. Two types of boxes must be attached to each node in the ring: one generates empty packets; the other is a station box with a repeater. DMA units are also under development for Intel Corp.'s Multibus, the S-100 bus, Data General Corp.'s Nova and Eclipse computers and Prime Computer Inc. and Gould S.E.L. systems.

On the software side, protocol-generating driver software exists for use with DEC's VAX/VMS, RSX-11 and RT-11 operating systems and is on the way for UNIX, DG's AOS and RDOS and the 8-bit version of CP/M.



Each node in Toltec's DataRing has two boxes. *The open unit incorporates a repeater; the smaller box is the access unit, containing hardware tailored to the host computer.*

The Cambridge Ring was developed at Cambridge University's computer laboratories nearly a decade ago. Some observers, such as analyst Kenneth Smith of The Yankee Group, Boston, believe the ring has a future, even though its multiple-fixed-length-packet approach differs radically from the token-passing method with its single variable-length packet. But Smith also believes token passing will be more widely favored because most users seldom transmit more than 100K bits and therefore do not hog the ring. Token passing advocates also point to the token tag timer incorporated in the protocols to eliminate such hogging. But Cambridge Ring supporters counter that additional overhead is required to support a token tag timer. They also contend that the Cambridge Ring is more predictable because a transmitting station is automatically forced to relinquish a packet position after the receiving station has accepted and returned the contents of the packet. (Packet length is fixed at 40 bits and includes 16 data bits.) A spokesman for the British government-supported Joint Network Team adds that the relative simplicity of the Cambridge Ring will make implementation of protocol logic in VLSI easier than with other LANs.

Toltec senior sales executive Joel Abramson concedes that most users of DataRing are research or academic institutions, but also cites the "real-life" nature of many applications. One major British user, Kingston Polytechnic, has equipment on its ring that includes four DEC VAX machines and three terminal concentrators. A file server configured around a DEC PDP-11/24 processor is being added. It will support 600M bytes on disk and can be accessed by personal computers with no local disk storage. Toltec will make the file server generally available, says Abramson. He says one of the first purely commercial users is a newspaper publisher in Brazil with a nine-station DataRing for copy generation and processing. The stations are based on a Computer Automation Inc. Naked Mini 4.

Prices of DataRing products vary greatly, but Toltec quotes around $14,000 for a ring that can support two VAX machines. For that price, a customer gets a station box, an access hardware unit and VMS driver software for each VAX, plus one monitor.

Mini-Micro World

INTERNATIONAL

ECMA LEADS IN TOKEN-PASSING STANDARDS WORK

In advance of the IEEE, the European Computer Manufacturers Association has formally adopted standards for token-passing ring and token-passing bus local-area networks. Driven by 15 major companies that want standards formulated quickly, ECMA has also led IEEE in networking standards related to carrier sense multiple access with collision detection, the Ethernet contention bus (MMS, August, 1982, p. 29). ECMA members include IBM Corp., Digital Equipment Corp., Hewlett-Packard Co. and, in Europe, Siemens AG, Olivetti, Philips S&I and Nixdorf Computer AG.

For token rings, IEEE's computer standards body is expected to adopt the same standards as ECMA by year-end, says Ingrid Fromm, the liaison between the IEEE 802 and the ECMA TC 24 technical committees. TC 24 covers data-communications protocols, including LANs. Fromm notes that the IEEE 802 committee has approved the standard, and the next phase, approval by the IEEE Technical Committee on Computer Communications, is imminent.

IEEE's token-passing bus standard will not only be later than ECMA's, but will also be different. Over the last few months, IEEE has been persuaded to make some changes, mainly in line with the work on the token-bus standard called Proway (Process Data Highway) by the International Electrotechnical Commission, Geneva, Switzerland. IEC is a worldwide standards body mainly concerned with electrical and electronic safety and quality. Fromm explains that the IEEE standard now being changed had passed the TCCC approval stage in March. Now it is back with 802, awaiting approval of the changes.

The IEC reportedly favors a token-passing bus structure rather than a token ring for industrial-control applications because a ring can go down completely if one node fails. A member of both TC 24 and IEEE 802 says the changes to the IEEE standard are not fundamental and relate to factors such as frame formats, immediate acknowledgement and direct data transmission. The member says it was too late for ECMA to change to meet Proway. But, under ECMA rules, the standard can be changed next year. The standardization process at IEEE for the revised token bus is not expected to be completed until 1984.

Another British company, Logica VTS Ltd., sells Polynet, a product similar to DataRing. Logica maintains offices in New York and San Francisco but has only one U.S. user, the University of New Mexico. According to Logica, the biggest Polynet user—and possibly the user with the most powerful LAN in terms of attached equipment—is British Aerospace Dynamics, Stevenage, England. The guided-missile manufacturer has three VAX machines and three PDP-11s with DMA interfaces attached to Polynet. The network is used for file transfers and batch process serving in software-development and CAD applications.

Another company, Scientific and Electronic Enterprises Ltd., Livingston, Scotland, offers the Transring 3000, a Cambridge Ring-based collection of LAN products. The Transring 3000 is available only in Great Britain.

Orbis, a sister company of microcomputer manufacturer Acorn Computers Ltd., is reportedly considering marketing its Cambridge Ring-based LAN in the U.S. Orbis, Cambridge, England, has a U.S. sales office in Boston, and has collaborated with the Massachusetts Institute of Technology's Lincoln Laboratories on the technology.

Racal-Milgo introduced Planet, a multiple-fixed-length slotted-ring product, last year. Planet resembles the Cambridge Ring (MMS, March 1982, p. 77), but, unlike the Cambridge Ring, Planet can bypass a break in the ring.

—Keith Jones

Philips low-end erasable laser disk may be offered in U.S. by CDC

As much as 200M bytes of erasable data on a disk measuring 4.7 in. in diameter is the goal of a laser storage-development project at the Hamburg, West Germany, research laboratories of electronics giant N.V. Philips.

While several companies are working on very high-capacity nonerasable laser-disk memories for archival applications, the Hamburg project aims to perfect a unit for the low-price/high-volume OEM market. With physical dimensions similar to those of microfloppy disk units, the Philips magneto-optic product will compete with both floppy and Winchester drives employing conventional magnetic recording, and with other low-cost erasable laser units expected from Xerox Corp.

IF YOUR LAN IS ON A COLLISION COURSE,

CUT IT OUT.

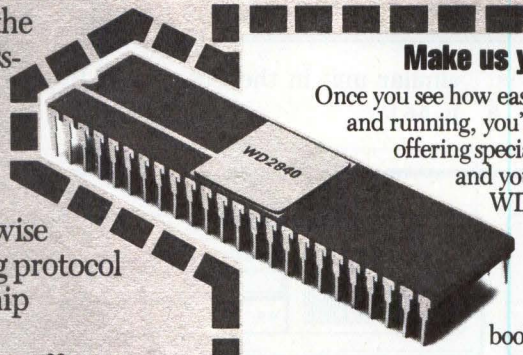
Everybody's talking about the performance of Token Passing Local Area Networks. Western Digital has done something about them. Our NetSource/40 is a local network solution that provides the otherwise costly and complex token passing protocol in a low-cost, easy-to-use one-chip VLSI controller.

So you can design and build an efficient token passing LAN. Without writing oodles of protocol software. Without complicated interface tasks.

NetSource/40 provides a flexible, reliable bus topology for up to 254 nodes. Plus it is

- media independent
- easily prioritized
- a memory miser, with sophisticated DMA, so long messages automatically span 64 byte buffers
- speed decoupled, so it doesn't wait for, or slow down, the CPU.

So if your real-time and critical process network requirements can't cope with collisions, or if you're looking for a more streamlined, cost effective approach, plug into NetSource. Call our NetSource hotline, 714/863-7828.



Make us your NetSource™

Once you see how easy it is to get NetSource/40 up and running, you'll be sold for certain. So we're offering special Evaluation Kits. This coupon and your check for $195 gets you four WD2840 NetSource VLSI controllers, a helpful design Application Note, a Network Template, plus a copy of our 1983 Network Products Handbook. Limit: One kit per customer.

☐ Here's my check for $195 (CA residents add 6% sales tax) for a NetSource/40 Evaluation Kit.

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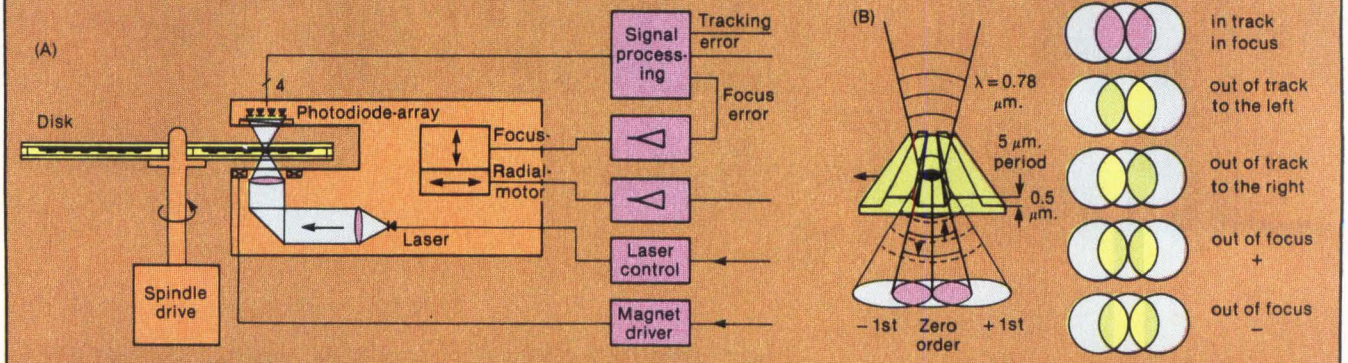
WESTERN DIGITAL
CORPORATION

A GLANCE AT THE ALLOY LAYER OF THE PHILIPS ERASABLE DISK



The alloy layer (A) is enclosed in a glass or plastic sandwich. *The alloy is formed on a plastic substrate, and tracks are written inside grooves pre-formed in the substrate. The alloy layer is only 800 angstroms thick, so some light from the laser passes through during write/erase operations. A photodiode array on the other side of the disk picks up the laser's light and feeds a servo mechanism with information for track positioning and focusing. The light beam is diffracted into overlapping circles of light by the groove (B). The patterns of light and dark caused by interference where the circles overlap indicate the head positioning to the servo system. Photodiodes are also used to read information. The laser light is polarized. The rotation of its plane of polarization, detected by the photodiodes, is determined by the direction of magnetization of the domain.*

and several Japanese sources. Matsushita has demonstrated a similar unit in the U.S. (MMS, July, p. 55).

Edward Rothchild, editor of the *Optical Memory Newsletter*, San Francisco, notes that Philips is the first developer of laser disks to plan such a low-priced unit. He believes the company must make the disk commercially available this year to avoid losing the race to introduce such a product to the Japanese.

He says Matsushita and Sony are both using a fundamentally different technique from the other companies working on erasable units using magneto-optics. The Japanese companies are using phase change, in which the reflectivity of domains for data is changed from one level to another by laser-induced amorphous-to-crystalline transition in the recording material. Rothchild says the technique achieves 10^6 phase reversals without deterioration of the recording material. As a result, the disks are more competitive than earlier products, which achieved a maximum of 10^4 phase reversals.

Dr. Ingolf Sander, leader of Philips's Hamburg project, says the laser disk drive under development has achieved 10^7 writes without deterioration. The drive employs

IF YOU'RE RUNNING SOLE-SOURCED ON i8275/76 CRT CONTROLLERS,

CUT IT OUT.

Demand is back in the electronics industry. And it is already chasing Supply. So if you're buying Intel 8275/8276 CRT Controllers, it's good to know there's an alternative source. Western Digital.

We're the first and only licensed alternate U.S. source for the 8275 Programmable CRT Controller and 8276 Small System CRT Controller. We're in production. With parts on the shelf. So you can confidently design in either part.

The WD8275 is a +5V 40 pin device, identical to the Intel part. Ditto for the WD8276. Both contain the necessary building blocks to refresh the display through character buffering and position tracking. They're programmable for both character and screen format, and are available in volume in the 2MHz and the faster 3MHz version, too.

The WD8275 is ideal for light pen applications. The WD8276 is perfect for low cost systems where it's important to keep device count to a minimum.

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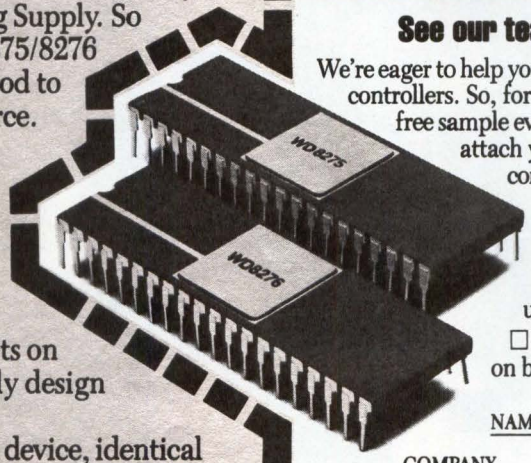

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media fabricated from gadolinium terbium iron, an alloy that enables data to be recorded using a thermomagnetic method (see, "A glance at the alloy layer, of the N.V. Philips erasable disk," p. 86). The polarity of a magnetic domain—representing a binary zero or one—can be changed only when heated.

The Philips drive's read/write head consists of a low-cost diode laser, the same as the laser in Philips's audio disk players, located above a magnetic coil. The highly focused laser beam provides not only the high temperature to change the polarity, but also the improvements in bit density that could make the unit strong competition for conventional technology.

Sander says that the laboratory prototype addresses domains measuring only about 12 sq. μm.—2½ × 5 μm.—compared with 2 × 30 μm. on IBM Corp.'s high-capacity 3380 drive, which Sander calls state of the art. The resulting density on the Philips unit is 10^7 bits per sq. cm. Sander believes this figure could be improved 10 times using data-encoding techniques and reductions in domain size. He says the domain size could be reduced to as low as 1 sq. μm. by using more expensive optics. He doubts if domains smaller than 1 sq. μm. will ever be used because semiconductor lasers can generate light only from the infrared part of the visible spectrum in which the wavelength is relatively long—0.8 μm. Sander believes IBM is aiming at domain sizes as low as 0.1 μm. using advanced magnetic techniques such as vertical recording and thin-film-head/thin-film-surface technology.

Compared with density levels on floppy disk units, the Philips laser drive looks impressive. The track density is 5000 tracks per in., about 30 times the best floppy densities. And Sander is confident that it can be improved threefold. The Philips prototype employs a disk platter that measures 5 cm. in diameter and provides a recording area of 10 sq. cm., which gives a 10M-byte capacity. Sander says it could sell for $300 if it was made available commercially. Sander is confident that capacity can be boosted to 50M bytes, and cites a proposed future model with a 12-cm. (4.7-in.) platter storing 200M bytes. Rothchild describes this figure as "very

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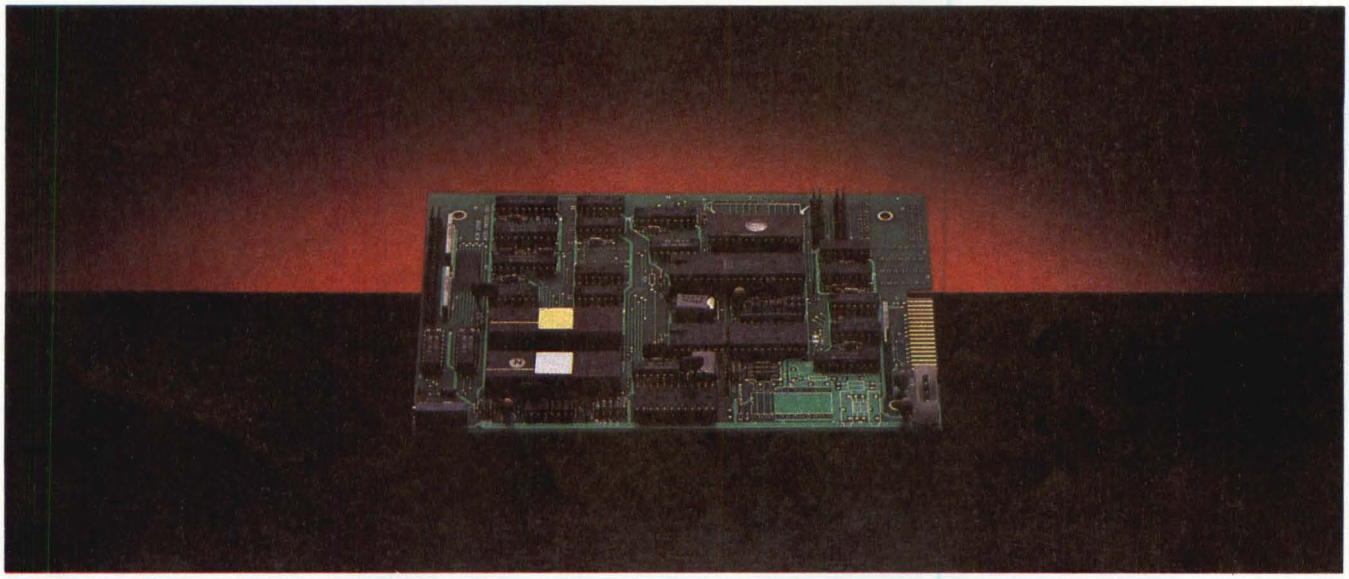

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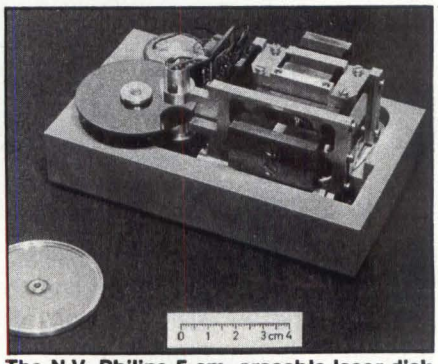
CIRCLE NO. 47 ON INQUIRY CARD

conservative" and believes that a 12-cm. Philips drive could store more than 600M bytes.

Data-transfer rates, at 250K bps, are less attractive than those of floppy drives. The rotation speed, and hence the rate at which data can be recorded and read, is limited by the speed at which domains can cool. If a domain has not cooled sufficiently and the magnetic polarity has been changed to give the next domain an opposite polarity, the first domain may erroneously have its polarity reversed. This is because the magnetic field is effective over numerous domains.

Sander says data-transfer rates could be boosted to the floppy range of 10M bits per sec. by using two head assemblies. One would erase by changing all domains to zero. The second, spaced at a safe distance of 2 or 3 cm., would write only ones. In this way, domains that should be zero would be left unheated by the write head, and therefore would be in no danger of being erroneously changed to ones. Because the second head would substantially increase the cost of the drive, Philips does not favor the two-head solution, Sander says. Another possible approach Philips is considering is to use a head that would erase in one revolution and write in the second.



The N.V. Philips 5-cm. erasable laser disk prototype *has a track density of 5000 tpi on media fabricated from gadolinium terbium iron. A proposed 12-cm. (4.7-in.) future model would store 200M bytes.*

Although the error rates of the Philips drive are high, they can be easily lowered, says Sander. He regards the current error rate of 10^{-4} bits for read and write as too high and blames imperfections in the recording layer alloy, such as pinholes. But he notes the alloy in the prototypes is fabricated relatively crudely. He believes that a higher quality alloy in a volume

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A compact drive package which includes all drive electronics, power supply and SASI controller within 8.5" wide by 7" high by 19.4" deep. The VRC 8520 gives you 11 megabytes of removable storage on a standard ANSI 8" cartridge, and 11 megabytes on a fixed disk in a one-over-one configuration. Designed to fit practically anywhere, the VRC 8520 is ideal to produce backup files on a single peripheral. It can also accommodate an ANSI standard interface. Disk drive, controller and fully-integrated power supply are contained in a small, high-performance package designed for hostile environments. With the VRC 8520, you eliminate design costs for mounting enclosures, the costs of a separate controller and power supply and messy interconnecting wiring which radiates noise.

For more information about the VRC 8520 or the VRC 8010 — a single, removable disk drive with 11 megabytes of storage, contact Vermont Research Corporation, Precision Park, North Springfield, VT 05150, Tel: 802/886-2256. TWX: 710/363-6533. In Europe call or write: Vermont Research Ltd., Cleeve Road, Leatherhead, Surrey, England, Tel: Leatherhead 376221. TLX: 23280.

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production operation would reduce the rate to 10^{-6}. He thinks that the use of error-correcting logic could bring the rate down to 10^{-10}.

Although Sander refuses to discuss marketing plans, Dr. Leonard Laub, president of Vision Three Inc., a Pasadena, Calif., laser disk consulting firm, claims Control Data Corp. is "hinting" about making the Philips drive available in the U.S. He points to ties between Philips and CDC, notably the joint development project for nonerasable archival laser disk units established by the two companies at Colorado Springs, Colo.

CDC is said to be interested in the application of laser disk units to systems of varying capacities, and expects the nonerasable archival units to be available first. CDC was expected to demonstrate such a prototype unit at NCC. Laub notes that the Matsushita and Sony units will store 700M and 1000M bytes, respectively, on 8- and 12-in. disks, but will be priced much higher than the proposed Philips unit. Sony's drive would be priced at about $5000.

—Keith Jones

NEXT MONTH IN MMS

Software will be the cover theme in the September issue of Mini-Micro Systems. Since spreadsheets were well received in our June issue, we've decided to address these second-generation packages again. This time, we'll concentrate on larger systems including packages for minicomputers.

Also featured will be an article on Modula-2, a new language, which combines all the advantages of Pascal, plus modular programming to provide a simple software design tool.

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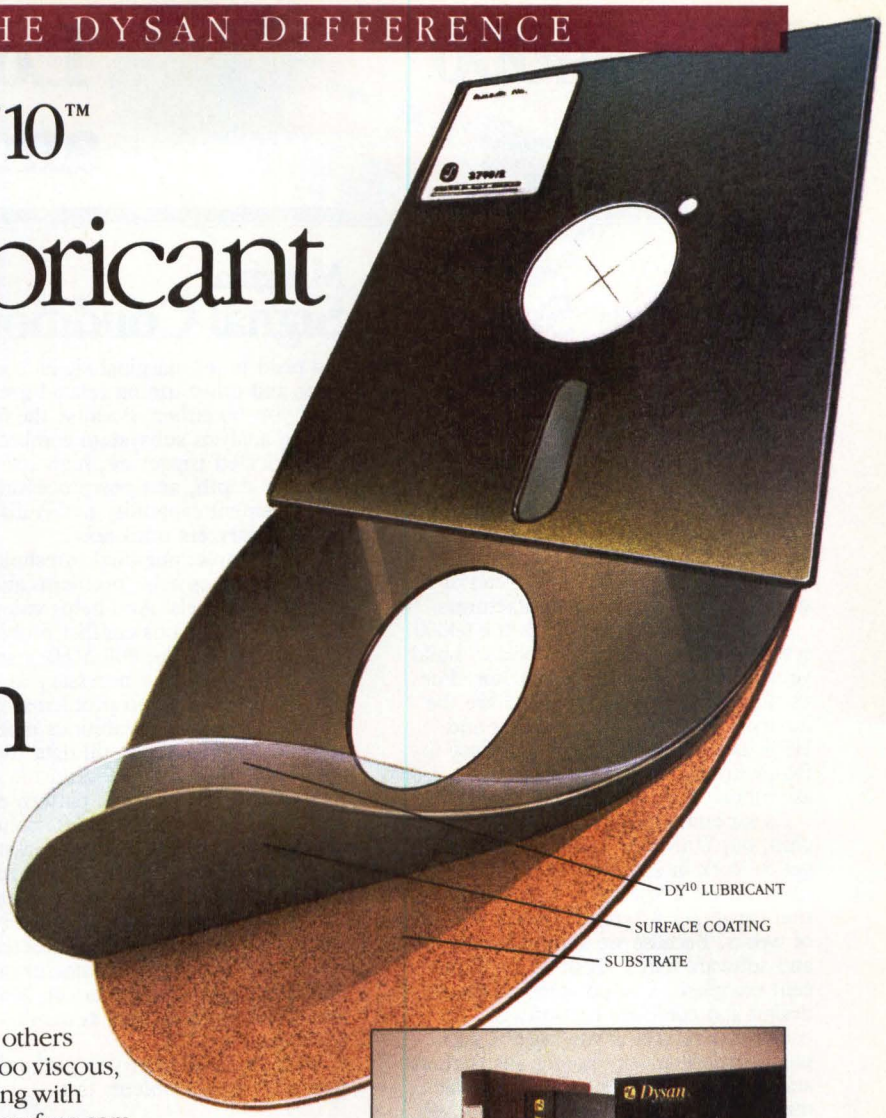

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DY10 eliminates abrasion and compliance problems. Here's how. Abrasive surfaces are possible even with a lubricated surface. Often lubricants can be too thin, creating an abrasive surface that can result in premature head wear and shortened diskette life. Still others may be too viscous, interfering with head-to-surface compliance and resulting in "bouncing" (resonating). This bouncing causes signal loss between the read/write heads and the diskette, resulting in soft errors. DY10 eliminates these abrasion and compliance problems with the most uniform, reliable lubricant in the industry.

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Dysan goes a bit further in the testing process, certifying that each diskette is 100% error-free both *on* and *between* the tracks: and more tested surface means greater data integrity and unsurpassed performance. Advanced burnishing techniques provide optimum head-to-disc interface by flattening even the most microscopic surface peaks. Dysan's exclusive "hands-off" auto-load certification system allows Dysan to test each and every diskette and eliminates any possibility of handling errors.

The true cost of a diskette equals the purchase price *plus* the time you spend to fully load the diskette. Reliability translates into cost savings.

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CIRCLE NO. 51 ON INQUIRY CARD

HP's 64000 Logic Development and you won't worry

Timely Processor Support

Ever have to settle for a second-choice microprocessor because language and emulation support wasn't available for your first choice? Put HP's 64000 Logic Development System in your lab and that frustration is gone.

That's because HP's microprocessor support strategy results in assemblers and emulators for virtually any 8- and 16-bit microprocessor...well ahead of the support available from manufacturers.

How is that possible? With the 64000 system, you can select the tools to build your own assembler and emulator. For assembler support all you need are the instruction set of your processor and HP's user definable assembler. Easy-to-follow instructions will have you assembling code in a matter of hours.

As for emulation, once you have the chip, our Universal Emulator lets you get to work in an execute-only environment in just a few days. And full emulation capability is typically just a matter of weeks. Because we supply hardware and software that's about 80 to 90 percent complete. You do some interface design and complete the software package. Everything you need is supplied, including step-by-step instructions and a design example using a popular microprocessor. Compare this approach to the year or two you'd wait for normal support...if you get it at all. HP also provides full support for a host of 8-and 16-bit processors , with more on the way. So don't let lack of support slow you down or compromise your designs.

Marginal Signal Conditions

No need to let marginal signal conditions and other timing related gremlins hold you up either. Because the 64000's timing analysis subsystem combines sophisticated triggering, high speed, 8k memory depth, and postprocessing for measurement capability not available in timing analyzers until now.

For example, our dual-threshold mode identifies noise problems and marginal signal levels. And helps you solve bus loading and bus conflict problems.

In the fast mode, 400 MHz speed yields the resolution necessary to resolve critical timing margin problems. New statistical analysis capabilities increase resolution and give useful data for system characterization. And the ability to trigger on transitions, pattern durations and post-processed data conditions give you valuable capabilities in studying control-signal timing relationships such as handshake related problems.

The 64000 Timing Analyzer sets new ease of use standards too. Directed-syntax softkeys simplify measurements. And label assignment lets you analyze results in terms of your system's nomenclature.

With this analyzer, you get to the root of timing problems fast.

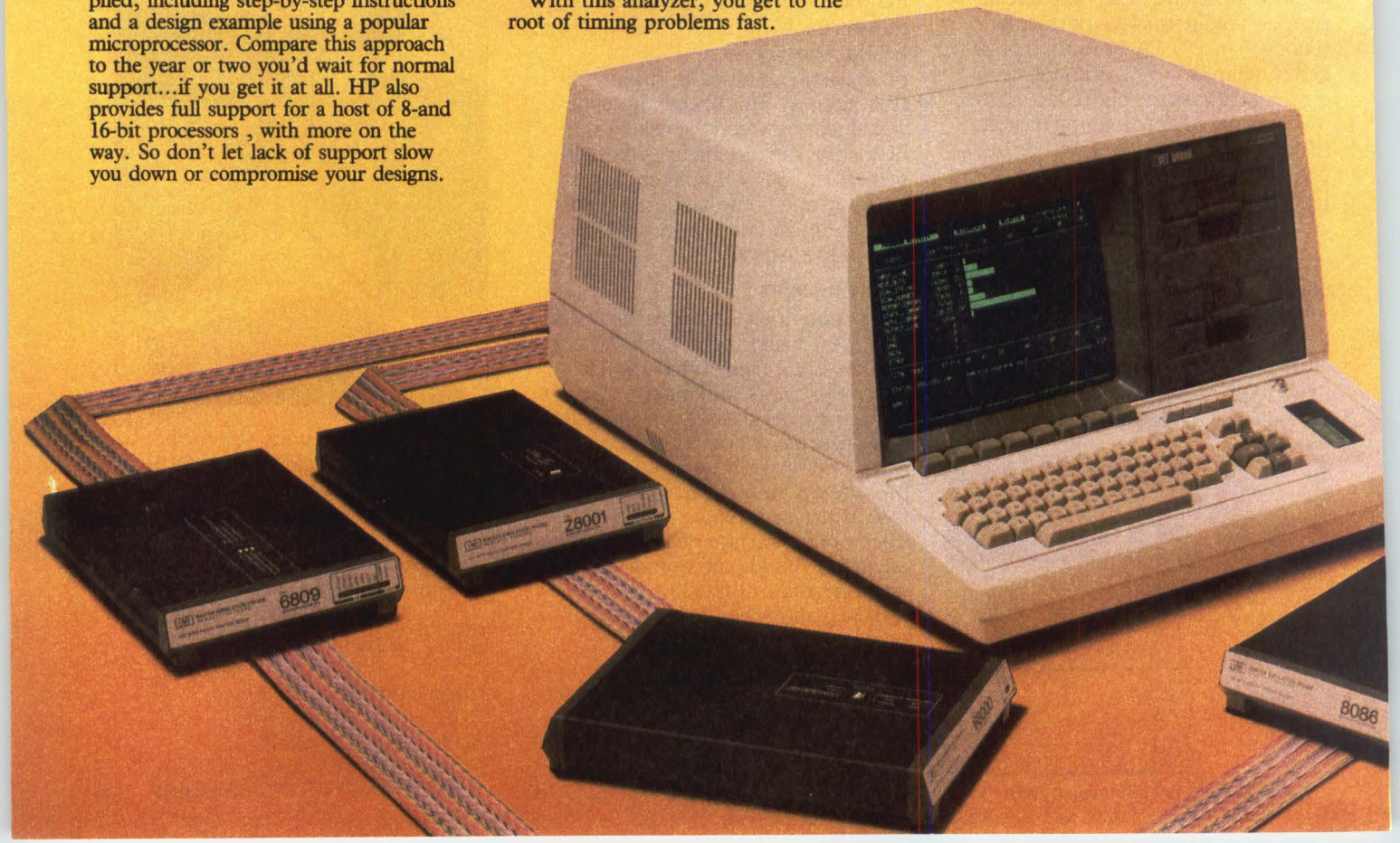
Hardware/Software Fingerpointing

Whose fault? Software or hardware? The 64000, with both timing and state subsystems, and even emulation, can resolve that quarrel in short order. That's because one subsystem can arm or trigger another for real-time interactive measurements.

For example, you can set the timing analyzer to trigger on a middle threshold that lasts too long. Then view state flow to see the affect. Or, you can trigger on state and view timing, which is useful for debugging I/O port malfunctions.

In analysis/emulation interaction, you might monitor software activity with the analyzer, then send a signal to the emulator to halt operation if a specific trace specification occurs. Now, you can study the analyzer trace listing around the suspected problem area. Or, use the emulator to examine register contents and control further operation.

Take this logical path in settling fingerpointing debates and you'll push those designs closer to production.



System...standardize on a system like this about problems like these:

Software Bottlenecks

The 64000, with software performance measurement capability, quickly eliminates these nightmares. Symbolic tracing makes measurements a programmer's dream. And histogram displays give you a graphic picture of bottlenecks and software inefficiencies. This new tool shows system activity as a function of software modules so you can see where the concentrated action is. You can determine how long it takes to execute a given module of code as you vary input parameters. See software traffic patterns. And compare software modules in terms of the percentage of time and occurrence they require in your programs.

These measurements are real-time, not post-processed trace data, which means you can interact with trace displays as well as perform overview measurements on single-shot events.

Software in the Weeds

That's where new software often ends up. But the 64000, with the state analysis subsystem, gets you back on track quickly. First, because this analyzer speaks a programmer's language. Symbolic tracing lets you define parameters in familiar source-code symbols and labels. For example, you can instruct the analyzer to find sequences and trigger points by module names and labels. And with HP's directed-syntax softkeys, defining a measurement is usually just a matter of a few keystrokes.

Inverse assembly means this analyzer speaks your microprocessor's language, too. That makes it easy for you to interpret displayed information, because now you don't have to convert analyzer displays to microprocessor mnemonics and symbols. All this in a real-time analyzer, not a simulator or intrusive run-until-search type of analyzer. But it's also important to be able to position the measurement window with precision. We do that too.

Extended trace specification features let you navigate through complex code to the portion you want...and display only pertinent information. That's because you can combine trigger, store and count functions in any combination, to a total of eight terms, each as wide as the number of channels installed (to 120). Add to that the ability to define up to 15 sequence terms, or a combination of sequence terms and enable/disable windows, and there aren't many nooks or crannies where software bugs can hide. That means you'll debug software pronto.

One System for Standardization

From start to finish of the development cycle, HP's 64000 Logic Development System can help you speed your designs along. It covers software development, downloading, emulation, hardware and software analysis, and system performance measurements. All with a single keyboard and display that speeds setups and simplifies measurements.

You can choose from two system stations, too. One benchtop station, with 10 card slots, gives you the most expansion capability. The transportable station, with 5 card slots, is a popular development unit for individual bench and field use.

Whichever station you choose, you can configure for dedicated function or combination measurements. You can use each in a standalone situation or as part of a multiuser, distributed processing network. It's a development system that makes sense for labs both large and small.

For details on the 64000 Logic Development System and available subsystems, call your local HP sales office listed in the telephone directory white pages. Ask for your HP field engineer in the Electronic Instruments Department.

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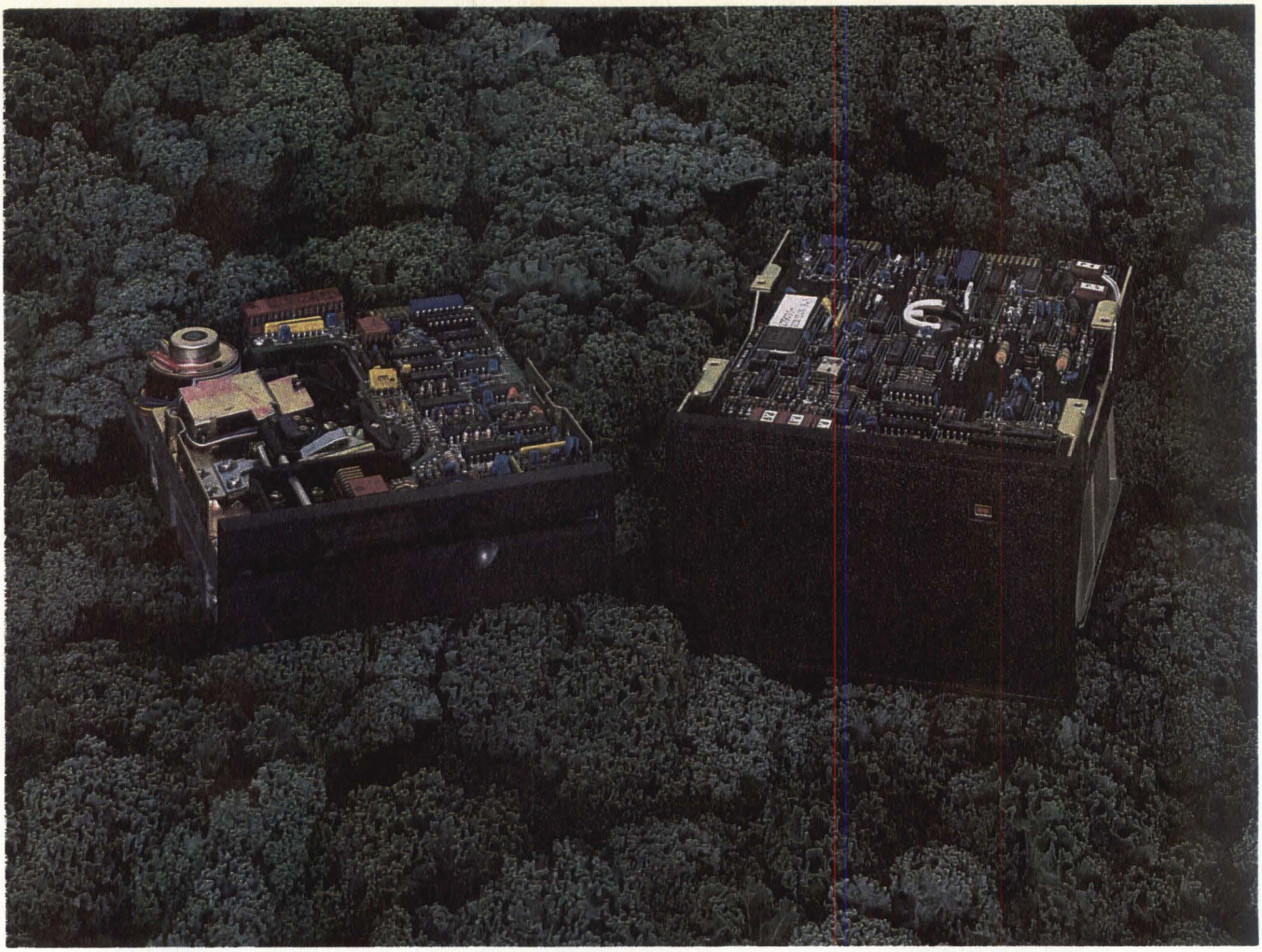

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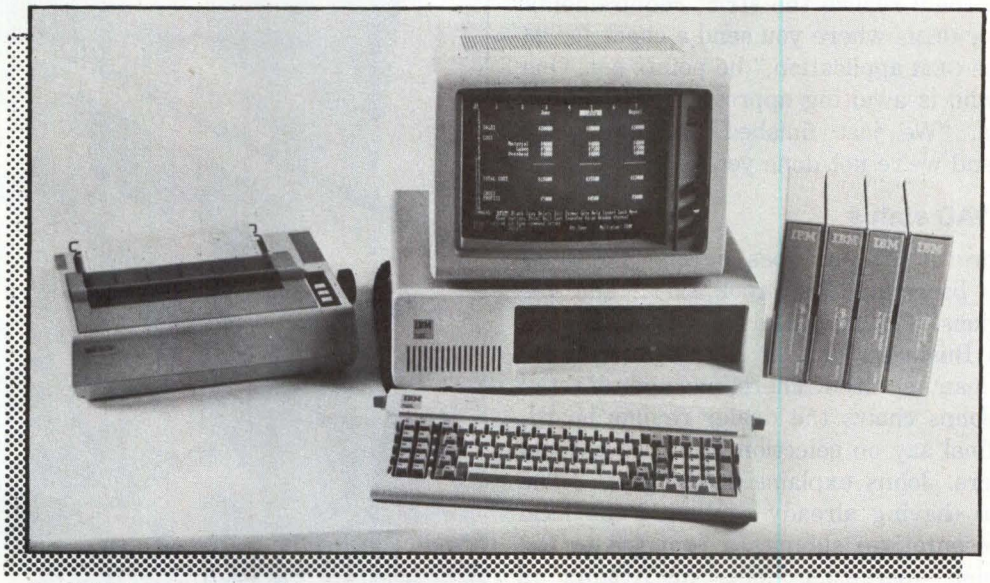
CIRCLE NO. 53 ON INQUIRY CARD

IBM takes cautious route to OEM market with Value-Added Dealer plan for PC



The IBM Personal Computer XT, *which has a storage capacity of more than 10.6 million characters and an optional color display, may be more attractive to IBM's Value-Added Dealers than the company's entry-level Personal Computer. Analyst Skip Bushee of InfoCorp, thinks VADs will become a more important part of IBM's overall marketing strategy as higher cost versions of the Personal Computer begin to fill the gap between the low-end PCs and the System/34 and System/36.*

By Geoff Lewis

In the two years since it entered the personal computer market, IBM Corp. has proven itself an adept merchandiser and a skillful exploiter of the computer retailing distribution channel. The company is now trying to prove its savvy as a purveyor of entry-level computers through the OEM/systems-house channel as well.

Six months ago, IBM began qualifying "Value-Added Dealers" for its market-dominating 16-bit personal computer, and by early summer, an estimated total of 30 independent sales organizations had qualified to wear the VAD mantle. A total of 50 other resellers considered too small to deal directly with IBM have qualified as dealer-affiliated value-added resellers under a limited two-tier distribution scheme via retailers. Both programs are modeled on the value-added reseller program pioneered with the Series/1 minicomputer and now including the 4300 mainframe, System/34, System/23 Datamaster and Displaywriter.

"What we're looking for is a way to market to people whom our people don't reach and to utilize the systems expertise out there," says Rod Larmee, manager of entry systems marketing for IBM's Distribution Channels business unit. In other words, VADs and DAVARs generally cater to end users whose needs exceed the capabilities of retail packages but who are too small to justify the attention of the IBM direct sales force.

A diverse group of resellers has signed as VADs with an array of value-added software and hardware. The group ranges from a division of mainframe software vendor Informatics General Corp., which sells an insurance agent package, to start-up Chancellor Computer, which packages an electrical-engineering CAD/CAM system. In between are vertical-market systems houses serving hostelry, agriculture, medicine, banking, education and other applications.

What these disparate companies share is the ability to pass IBM's stringent tests for financial soundness, technical know-how, market-support ability, geographic coverage and business planning. "We've heard there were more than 1500 applicants for the VAD program," says Chancellor Computer general manager John White. "Few of them realize the strict requirements. It's not like other OEMs where you send a check for 25 systems with the OEM application," he points out. One would-be VAD who is awaiting approval and requests anonymity adds, "We just finished filling out our 15,000th form, and we're not done yet."

Tough road to VAD status

The VAD approval process goes beyond Larmee's group, which is based in Rye Brook, N.Y., and has seven sales regions. The final decision rests with the Entry Systems Business Unit in Boca Raton, Fla., where the PC is manufactured. There, manager of retail support Doug Johns chairs the dealer review board, which has the final say on selection of VADs, DAVARs and retail dealers. Johns explains the process: "The prospective VAD (having already contacted the local VAD sales representative) submits a proposal to the alternate channels marketing folks in Atlanta (a support group for the Distribution Channels business unit). The people from Atlanta then visit the account to determine its worthiness. If it looks good, the candidate is invited to Atlanta for an extensive presentation, and if that looks good, they look at the specific value-added software product, because with a VAD we want to be able to warrant the product. Finally, if Atlanta determines the VAD's vertical market is an area we want to be in, they send a representative to our board meeting to present the VAD's case."

In Boca Raton, the board is composed of the director of retail sales, the director of software publishing, the director of international operations, the manager of marketing programs and a director of marketing from the Information Systems Group, IBM's headquarters marketing group. The board makes its decision after quizzing the presenter on all aspects of the proposed VAD's program—especially its ability to offer support comparable to that required by the dealer channel, Johns says.

For the more numerous DAVARs, the procedure is more informal. They are "small potatoes, selling 30, 40 or 100 systems a year," Johns says. The DAVAR applies to its local dealer, which sends the form to the regional manager from Entry Systems. The DAVAR is responsible for meeting the requirements of a dealer in terms of customer support and warranty work. Johns points out that the dealer review board periodically reviews the DAVAR contracts and hears presentations by regional managers. The board can disqualify DAVARs if it finds they don't meet the criteria, but Johns says that has not happened yet.

Chancellor Computer Corp. uses the IBM Personal Computer *as the heart of its low-cost CAD/CAM system for electrical engineering applications. Despite being a start-up, Chancellor has been able, along with about 30 other firms, to meet IBM's strict Value-Added Dealer qualifications.*

Larmee and Johns decline to specify the terms of the VAD contracts, but sources familiar with the IBM resale channel say the company generally requires VADs to sell at least 300 systems per year. At that level, the distributors reportedly enjoy discounts of around the 30 percent range. "It is very similar to the dealer contract," says Larmee. "The VAD must be trained by IBM to supply standard 90-day warranty service and must demonstrate value-added capability," he says, adding that the discount schedule is oriented more toward function than volume. "It is a functional discount so he (the VAD) is not pressured to achieve certain volumes. Therefore, there is no gray market," he says. Even if the VAD were tempted to unload excess inventory, however, Larmee says, the value-added requirement would prevent him from doing so.

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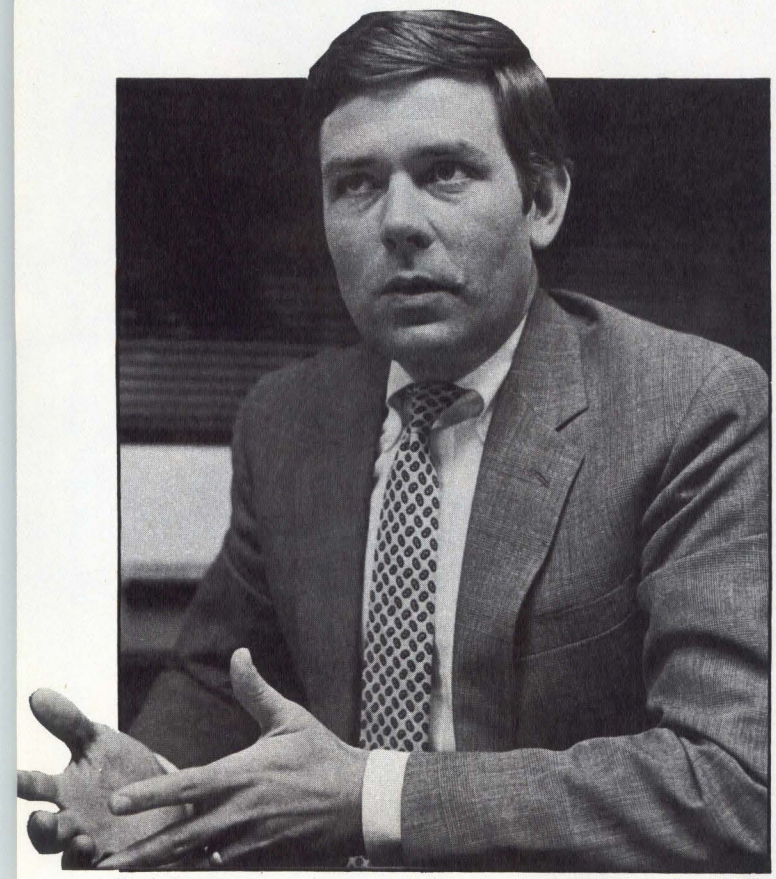

Rod Larmee, *manager of entry systems marketing for IBM's Distribution Channels Business Unit, notes that IBM restricts its Value-Added Dealers from reselling Personal Computers to other third-party vendors to avoid a two-tier distribution network. Some industry observers, however, question the legality of manufacturers limiting the markets to which their dealers can sell.*

Another condition of the program prohibits the VAD from reselling IBM PCs to another third-party that, in turn, sells to an end user. "Two-tier distribution is not the intent of the program, Larmee asserts. However, Charlie Boyd, reseller channel manager for Texas Instruments Inc. and Larmee's counterpart, says that it is unclear how legally to prevent two-tier distribution. "We want to encourage single-step distribution (for the TI Professional computer) as well, but there are some pretty strong legal questions as to how you can tell them who they can sell to," he says.

The DAVAR activity in the IBM program is the exception to the single-step distribution rule. While ultimate approval of DAVAR contracts resides in Boca Raton, IBM does not actually deal with the small reseller. Those companies buy their products from IBM dealers, and whatever discounts they can arrange come out of the dealer's margin. IBM does not give dealers an additional discount for handling the DAVAR, although the additional volume of the DAVAR contract may push the dealer into a higher volume discount bracket. A prospective DAVAR, who asks not to be identified, says, "The dealers are being very, very careful about this. They are terrified of losing their IBM contracts, so they proceed very slowly and follow the procedures (for signing DAVARs) very precisely." He adds that dealers are typically offering DAVARs a 20 percent hardware discount, but, he points out "They can't get the product as it is (due to production lagging behind PC demand), so they are really not concerned with taking on DAVARs at the moment."

Seymour Merrin, president of the $12-million-a-year Westport, Conn., Computer Works, handles several DAVARs, but is not overly enthusiastic about the program. "IBM took away the only good-sized one we had and made it a VAD," he complains. Many of the rest, which include some that do only a few systems a year, "pay damn near list," for the IBM hardware, he says.

Program's impact still limited

IBM's painstaking administration of the VAD and DAVAR programs has kept the growth of the OEM/systems house channel for the PC relatively slow, paralleling the controlled rollout with which the company entered retail channels two years ago. In addition to "minimizing channel conflict" through the lengthy review process, Johns points out, industry observers see the approach as laying groundwork for future marketing moves. They argue that even the best planned OEM/system house program has limited appeal, with hardware that retails for $3000 to $8000.

"I don't expect the program to amount to much until the PC becomes more expensive," says analyst Skip Bushee of InfoCorp, Cupertino, Calif. "Above $10,000, the retail store is no longer effective because you can't just give the customer canned software," he observes. Bushee points out that a major gap still exists in the IBM line between the single-user PCs and the System/34 and /36 models. "IBM will fill that hole with upgrades of the PC, and that's where VADs will be important," he predicts.

Egil Juliussen, chairman of Future Computing, Richardson, Texas, says, "I get the feeling they are testing the channel." He reasons that even if the VAD/DAVAR channel grows from 80 to 200 outlets next year, as some observers predict, the dealer channel will have grown to 1000 stores by that time. So, on the basis of estimated VAD/DAVAR volumes, the OEM/systems house channel will still not account for more than 10 or 15 percent of PC sales in 1984. He gives IBM high marks for minimizing conflict among its distribution channels. "They are working awfully hard to try to treat everybody fairly," he says.

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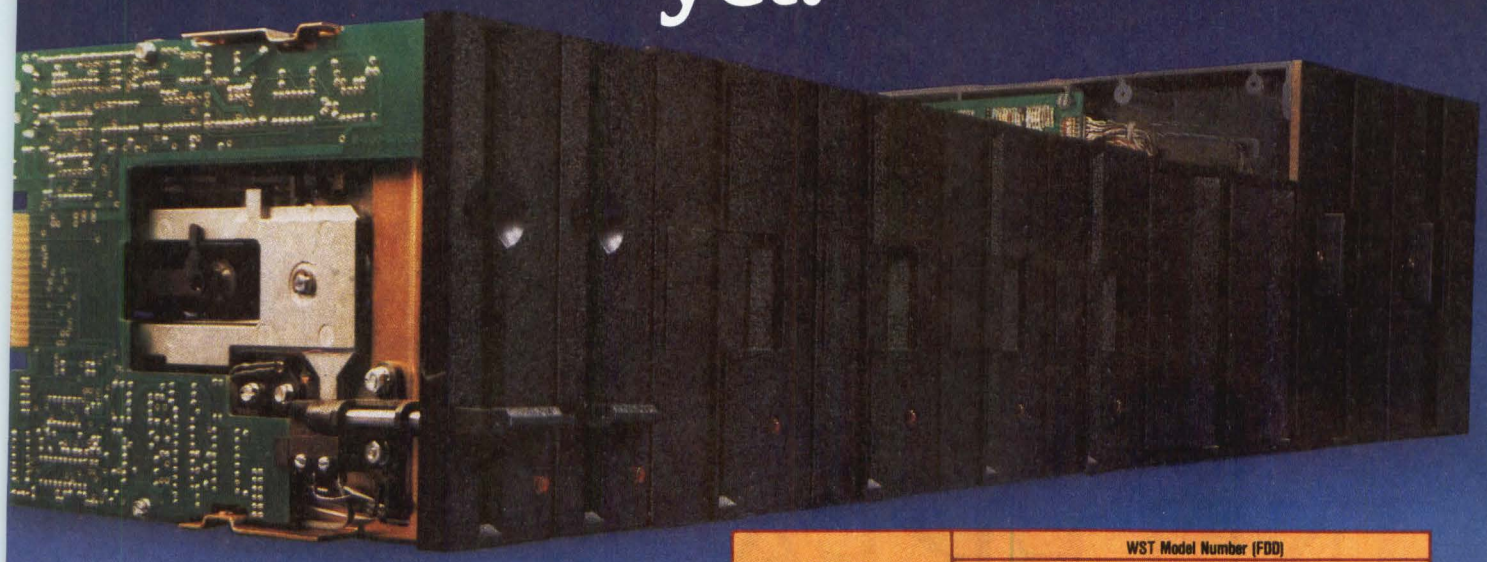

Specification		WST Model Number (FDD)									
		100-8	200-8	100-5	200-5	111-5	121-5	211-5	221-5	112-5	212-5
Media Size (in.)		8.0	8.0	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25
Heads (number)		1	2	1	2	1	1	2	2	1	2
Access:											
Track-to-Track	(msec)	3	3	20	20	5	3	5	3	20	20
Average	(msec)	91	91	275	275	80	110	80	110	275	275
Unformatted Capacity											
(Kbytes)	(FM)	400	800	125	250	125	250	250	500	125	250
	(MFM)	800	1600	250	500	250	500	500	1000	250	500
Track Density (TPI)		48	48	48	48	48	96	48	96	48	48
Drive Size (in.)	Height	4.5	4.5	3.25	3.25	3.25	3.25	3.25	3.25	1.62	1.62
	Width	8.55	8.55	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75
	Length	14.25	14.25	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0

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CIRCLE NO. 55 ON INQUIRY CARD

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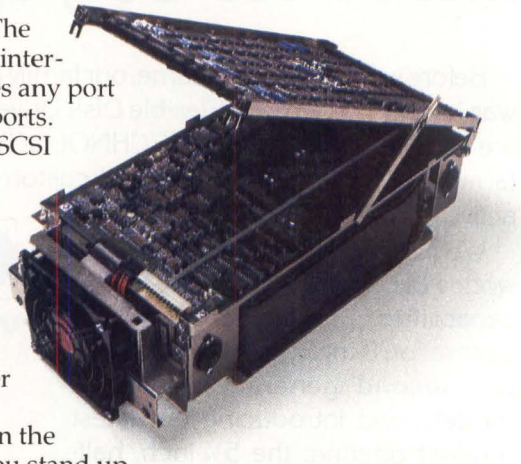

Fujitsu America now offers the state-of-the art SCSI interface option on the high performance 8" M2312 drive which has a capacity of 84 MB and an average positioning time of 20ms. Previously this drive was only available with an SMD interface.

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Despite IBM's best laid plans, however, Juliussen points out one area of potential conflict: "The only thing dealers (and other resellers) are concerned about is IBM coming back strong in direct sales. It seems that the IBM sales force didn't know what it had when the PC first came out but now has seen that the dealers have discovered the golden egg."

IBM's National Accounts division has had an impact at Computone Systems, Atlanta, an early VAD that markets a PC package for life insurance agents. Senior vice president of hardware and software development Jerry Wilson says Computone has recently lost one or two major bids to the IBM major-accounts sales force. "It's just one of the ways of doing business," Wilson says. He points out, however, that Computone still plans to ship 5000 PCs in the year ending next June. The Computone products are based on packages developed for its time-sharing business, and Wilson says the company will sell its complete PC software package separately for $3500 to PC users or to those who prefer to buy their hardware from IBM.

Harry Saal, chairman of Nestar Systems Inc., Palo Alto, Calif., a VAD since June, also cites conflict with the National Accounts division. Nestar, which adds local-area networking hardware and software to the IBM product, is particularly sensitive to this conflict since it tends to sell to major account customers. "We're faced with matching margins (offered by the National Accounts division) that equal our whole VAD discount," he says.

However, Dale Smith, branch banking project manager for VAD Ampersand, York, Pa., says he has no problem with IBM direct sales personnel handling hardware. "There's no conflict at all. We still have software to sell (a package that helps banks market services to depositors), and we charge $1250 for a single copy," he says.

Chancellor's White says, "If they are running into the National Accounts division, the VADs did not do enough value-added. If all you have is a $500 software package, hang it up. They'll undercut you on the 35 percent (margin) you're looking for, and you'll lose hardware deals all day long." But, he adds, "The VAD has to have seen that going in. That's why we positioned ourselves very specifically and vertically." Chancellor, San Francisco, is an exception to the IBM VAD profile in two significant ways. It is a start-up, and it has an extensive hardware value-added content that places the PC at the heart of a CAD/CAM station that retails for $21,000 to $35,000 (see "Start-up propels IBM/PC into CAD vertical market," p. 44).

Different shades of VADs

IBM's Johns maintains that the VAD program concentrates for the most part on value-added software directed at vertical markets such as the Computone and Ampersand models (also companies like On-Farm Computing, Indianapolis, for agriculture, and International Hospitality, Wichita, Kans., for hostelries). "Hardware value-added would be OEMs, and we are not doing an OEM program," Johns says.

However, Centec Corp., Reston, Va., which configures a high-resolution business presentation graphics system around the PC, functions like Chancellor, as a traditional hardware OEM. The company offers a $12,745 package built around a PC (or an XT) with a 5M-byte hard disk and also an upgrade kit including a special graphics board and a Mitsubishi monitor for $6500.

Another category of VADs includes Nestar and Davox Communications Corp. They provide horizontal market tools for the PC that would appeal to a broad range of companies rather than those in a particular vertical market. The Nestar Plan 4000 package, for example, provides a communications capability (local-area networking) not yet offered by IBM. "What I understand about what IBM really wants to do is distinguish between a dealer who sells boxes and those providing significant added functionality. Whether it is vertical or horizontal is not the issue," Saal says. "I definitely read it as an indication that there are a lot of customers who want a PC local-area network, and IBM realizes it won't have its solution rapidly enough for them."

In the case of Davox, which incorporated as Datavox in late 1980 but changed its name for legal reasons this year, IBM is surprisingly unprotective of its own communications products. Davox is a supplier of IBM 3270-emulating terminal systems that include voice-communications capabilities. Its VAD program involves a hardware/software package that ties the PC to 3270 clusters. The clusters compete with IBM's 3270 program, and the PC attachment competes with an IBM option for attaching the PC (MMS, June, p. 96). Alphonse M. Lucchese, Davox marketing and sales vice president, recalls, "I went down to Atlanta and asked them after our presentation, 'Do you guys realize what we're doing?' and they said yes. This is really the new IBM!" Lucchese, a former Raytheon Data Systems executive, says IBM's alternate channels personnel didn't seem to mind that the Davox PC connection is priced $500 less than IBM's or that Davox allows four terminals to share one PC instead of IBM's PC-per-terminal format.

The Interpreter

Because of their horizontal value-added, both Nestar and Davox hope to work with vertical OEMs that would package the PC with the communications systems and vertical-market application software. Lucchese and Saal have approached IBM about lifting the prohibition against reselling to vertical OEMs, but neither has succeeded in convincing IBM to do so.

Another anomaly in the PC VAD program is Safeguard Business Systems, Fort Washington, Pa. Safeguard is a $138-million New York Stock Exchange firm that has a customer base of 625,000 small businesses and professionals in diverse industries. Safeguard's 1000-person sales representative network sells pegboard accounting systems and batch data-processing services, some aimed at vertical markets such as construction and restaurants. Putting some of Safeguard's packages on the PC and reselling the hardware is hardly a vertical application because many of the company's packages are horizontal. The products Safeguard will offer starting early next year are generic accounting and inventory products that replicate the Safeguard manual and batch systems.

What Safeguard can deliver is access to a customer base that IBM wouldn't otherwise reach and that may not be sophisticated enough to shop for the PC at a retail store. Such access, says OEM and third-party sales manager Bill Broderick of Apple Computer Inc., is essential for an OEM program for a personal computer vendor. Broderick, who helped launch the Apple program in late 1980, says, "The key is that an OEM has to be incremental business and not predatory upon your other distribution channels, and that's a major challenge."

IBM's Larmee agrees. "Our screening process is pretty stringent because we don't want to do anything to detract from our existing programs," he concludes. With IBM PC sales headed for the 1-million-unit mark through the firm's various marketing channels, it is easy to understand IBM's caution. □

NEXT MONTH IN MMS

Software will be the cover theme in the September issue of Mini-Micro Systems. Since spreadsheets were well received in our June issue, we've decided to address these second-generation packages again. This time, we'll concentrate on larger systems including packages for minicomputers.

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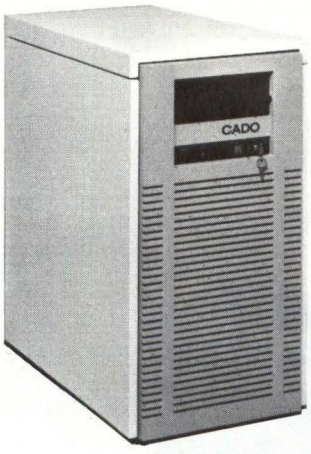

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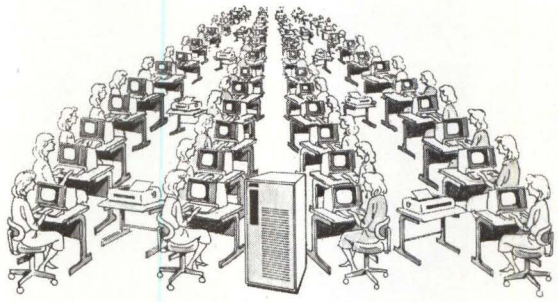

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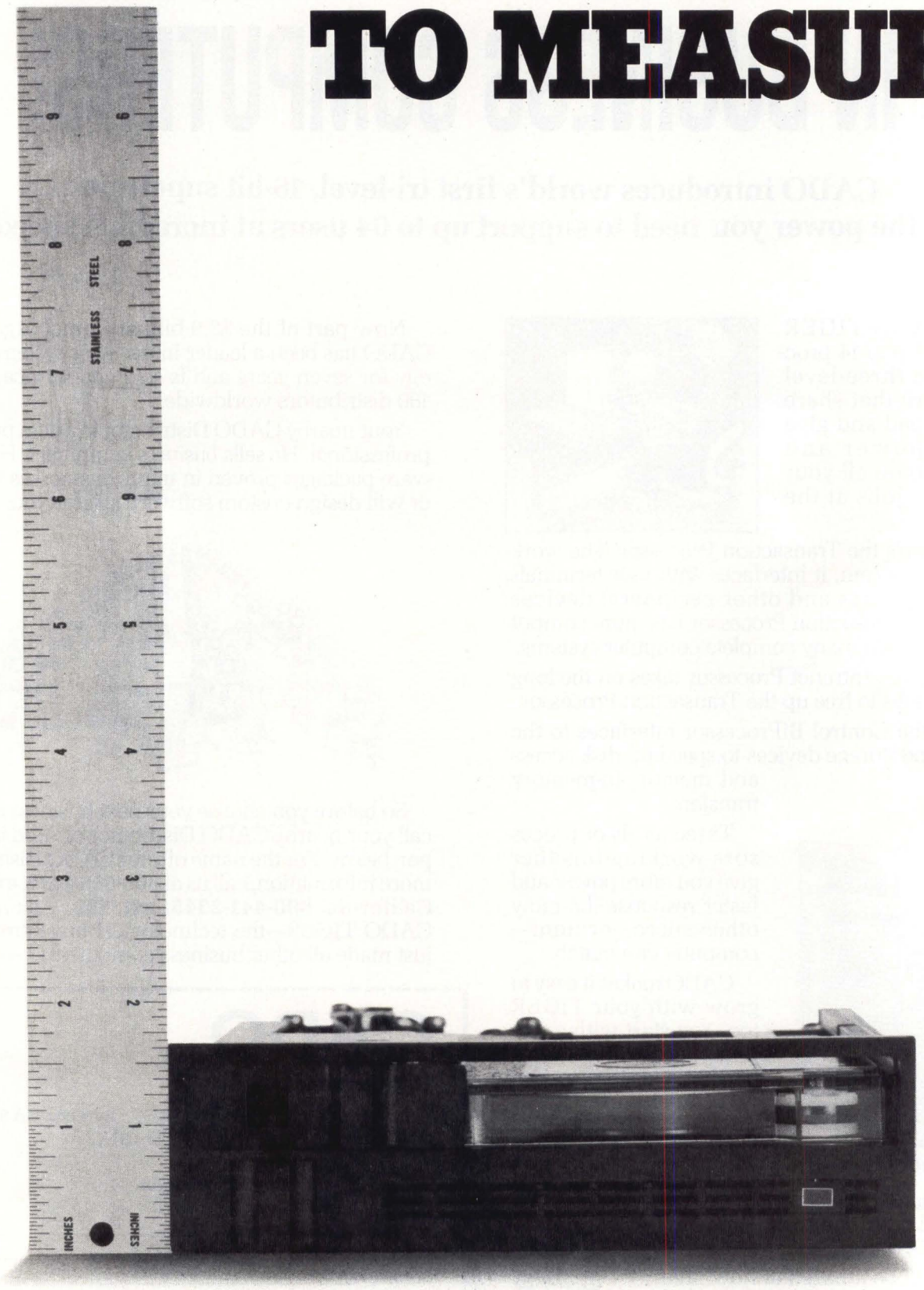

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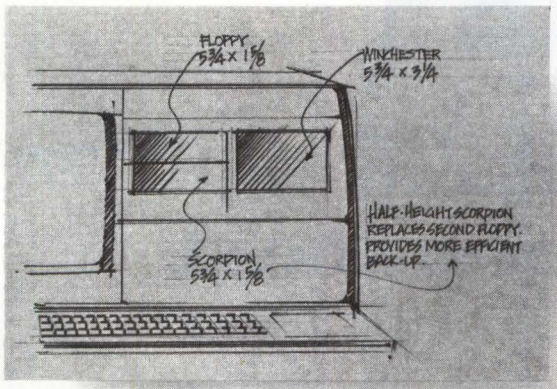

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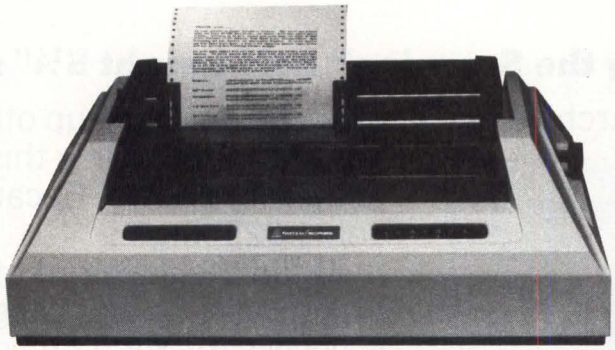

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Proportional	110 cps
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After a dreary start, DEC tries to restore Rainbow's glow

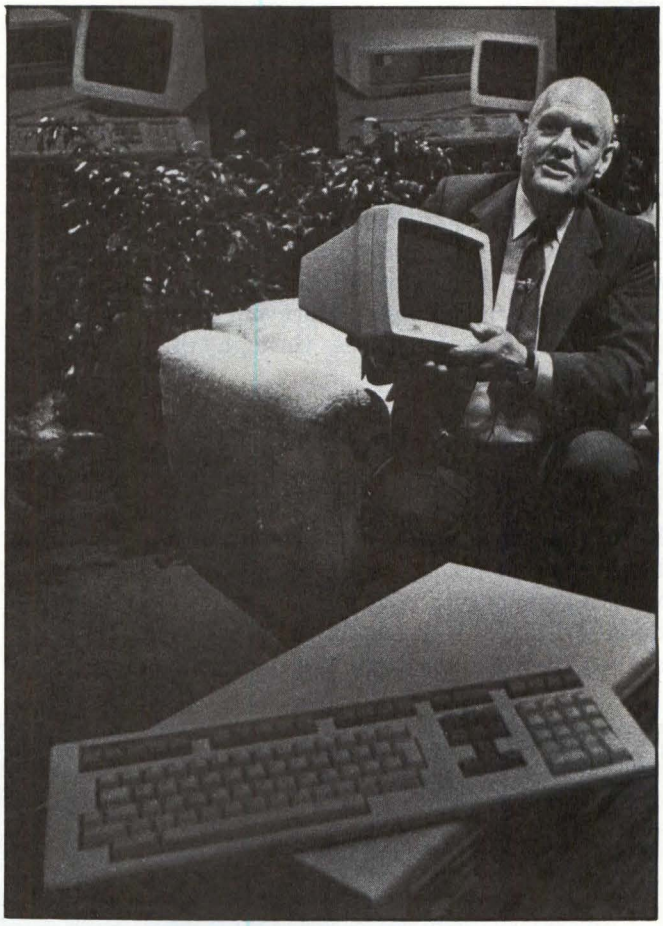
By Sarah Glazer

For the first year of its life, the Rainbow 100 was almost a forgotten stepchild in the Digital Equipment Corp. family of computers. But not so anymore, say key members of the Maynard, Mass., manufacturer, who describe the Rainbow as an entry-level personal computer positioned to compete directly against IBM Corp.'s personal computer, the IBM PC. In what Rainbow strategic marketing manager John Pryke terms a "significant change of attitude," DEC's top brass has targeted the Rainbow as a premier product for the company. DEC's goal is to pass market leader IBM and make the Rainbow the number one personal computer by 1986, Pryke adds.

However, many industry observers believe the goal is unrealistic. Although most observers predict the Rainbow will be a major product in the personal-computer market, many of them add that the IBM PC's snowballing popularity, combined with DEC's lack of marketing savvy in the consumer-oriented arena, will hold the Rainbow back.

With its $3500 price tag, the Rainbow 100 rings in as DEC's least expensive computer. It is based on dual microprocessors (an 8-bit Z80 from Zilog Inc., Campbell, Calif., and a 16-bit 8088 from Intel Corp., Santa Clara, Calif.) and has an 800K-byte dual minifloppy disk drive and a 12-in. monochrome video monitor. Its primary operating system is CP/M-86/80, a hybrid version of CP/M-80 and CP/M-86 that "automatically makes a bridge from 8- to 16-bit software," allowing a user to run either type without making adjustments to the machine, says Alan Goldsworthy, strategic planning manager for DEC's personal computers. Although in many ways an equivalent machine, the IBM PC is based on a single processor—an Intel 8088—and uses a version of the MS/DOS operating system called PC-DOS.

When the Rainbow was introduced in May, 1982, it was not touted by DEC as a top contender in the personal-computer market. It most often got third billing after the company's other personal computers, the Professionals and the DECmates. Pryke admits that the Rainbow was slighted because of what he describes as "DEC pride." Based on Zilog and Intel microprocessors, the Rainbow is DEC's first computer built around CPUs designed outside the company. Changing DEC's own attitude toward the Rainbow was "painful," Pryke says. He adds that the change in flagship status from the Professional—with its DEC-designed architecture and proprietary operating system—to the Rainbow began to take place only in early 1983.



Ken Olsen, Digital Equipment Corp. president, *held a video monitor for the Rainbow 100 at last year's introduction of several personal computers. DEC insiders say Olsen is behind the developing drive to make the Rainbow a key product in the DEC line. (Photo by Ted Fitzgerald)*

"DEC's worst problem used to be DEC," Pryke says of the company's attitude toward the Rainbow. "But we've gotten through most of these knotholes now." Changed attitudes and the results of an internal reorganization at DEC led to one-sixth of the company's entire marketing effort going into the Rainbow, Pryke adds. The new focus is aiding the company's entry into a market in which, he predicts, 75 percent of sales will be through retail stores. Sales are more successful than

DEC's projections forecast, he says, estimating them at 30,000 by June, 1983, approximately the first six months of volume production. This tallies with projections of 70,000 unit shipments for the Rainbow's first full year, by Future Computing, a Richardson, Texas, research firm.

Multilevel marketing strategy

The Rainbow marketing plan includes four channels of distribution, says DEC's Goldsworthy. The first channel is direct sales to the Fortune 1200 U.S. companies. The second is through wholesalers—ComputerLand, Hamilton/Avnet's microcomputer division and Entré Computer Centers—which then supply retail stores. The third is through DEC's network of authorized terminal distributors and industrial distributors. And the fourth is through DEC's chain of computer stores.

DEC's relationship with retailers has already come under sharp fire, however. "There are problems dealing with DEC," says a New Jersey retailer who carries the Rainbow through distributor Hamilton/Avnet. "We've had a good relationship with Hamilton, but when you have to start offering discounts, you can't afford to deal with a distributor." Ralph Gilman, senior vice president of InfoCorp, a Cupertino, Calif., research firm, agrees that dealers don't like middlemen, but postulates that using distributors may be only a first step for DEC. "Going through Hamilton was a way to get into the retail market quickly—they could decide who was a good credit risk, for instance," he says.

But Gilman believes that staying with distributors other than ComputerLand could spell trouble for DEC. "IBM has dominated the retail channel without using distributors, and it has a strong program of supporting dealers directly," he says. By staying with distributors, "DEC hasn't immersed itself completely," Gilman says. He also criticizes DEC's direct sales force's use of deep discounts to their big customers, saying this undercuts dealers' prices and freezes them out of large-volume sales. "Selling around dealers doesn't sit well with them," says Gilman. To beat IBM, he believes, DEC must support retailers more aggressively with advertising and with lower wholesale prices when necessary. He doesn't think DEC has the kind of customer, end-user awareness that IBM has.

Agreeing with this analysis is Myron Zimmerman, president of VenturCom Inc., Cambridge, Mass., a software house developing Venix (a UNIX-like operating system) for the Rainbow. "In the past, DEC appealed to engineering types," he says. "Their minis weren't consumer market products." He adds that inadequate profit margins for the Rainbow may make dealers prefer to sell the IBM PC.

WILL DEC IMPROVE THE RAINBOW?

Although Digital Equipment Corp.'s official comment is "no comment," rumor has it that an enhanced Rainbow will soon be unveiled to compete with IBM Corp.'s PC XT, which differs from the ordinary PC with such features as a 10M-byte Winchester disk, color graphics, expanded memory, improved communications and an updated operating system. A hard-disk version of the Rainbow would be no surprise to many DEC watchers, says Myron Zimmerman, president of Cambridge, Mass., software house VenturCom Inc. "As the Rainbow becomes more popular, it will have a hard disk," he says, adding that a 5¼-in. Winchester is already available for the Rainbow from Corvus Systems Inc., San Jose, Calif. In fact, initial plans for the Rainbow included an externally mounted 5M-byte Winchester (the RCD50-A), described in product literature as an "available" option. A DEC spokesman says Rainbow software engineers ditched plans for using the 5M-byte Winchester in favor of other optional systems still unannounced at press time.

Code-named the Rainbow 100X, according to rumor, the enhanced Rainbow will have a 10M-byte Winchester disk, added memory modules, improved graphics (including color graphics on a color display and multiple shades of gray) and multitasking capability to run as many as four tasks simultaneously. Alan Goldsworthy, strategic planning manager for DEC's personal computer group in Marlboro, Mass., admits, "There will be a hard disk in the future for the Rainbow," but he declines to be specific about when.

John Pryke, stragetic marketing manager for the Rainbow, says the disk in the Rainbow's future is the same as the 10M-byte Winchester announced in May for the Professional 350, DEC's high-end personal computer. It was a marketing rather than a technical decision to postpone announcing that the Winchester for the Professional can also be used on the Rainbow, Pryke says. VenturCom's Zimmerman hypothesizes that DEC has not yet introduced a hard disk for the Rainbow because it "may not want to undercut the Professional." Pryke confirms that this played a role in the decision.

In addition, Pryke points out, a color terminal is available for the Rainbow 100. It is inoperable, however, without the graphics driver, expected to be available in August, he explains. Pryke won't name other enhancements for the rumored 100X but says the Rainbow will have "complete product parity" with the IBM PC XT by fall.

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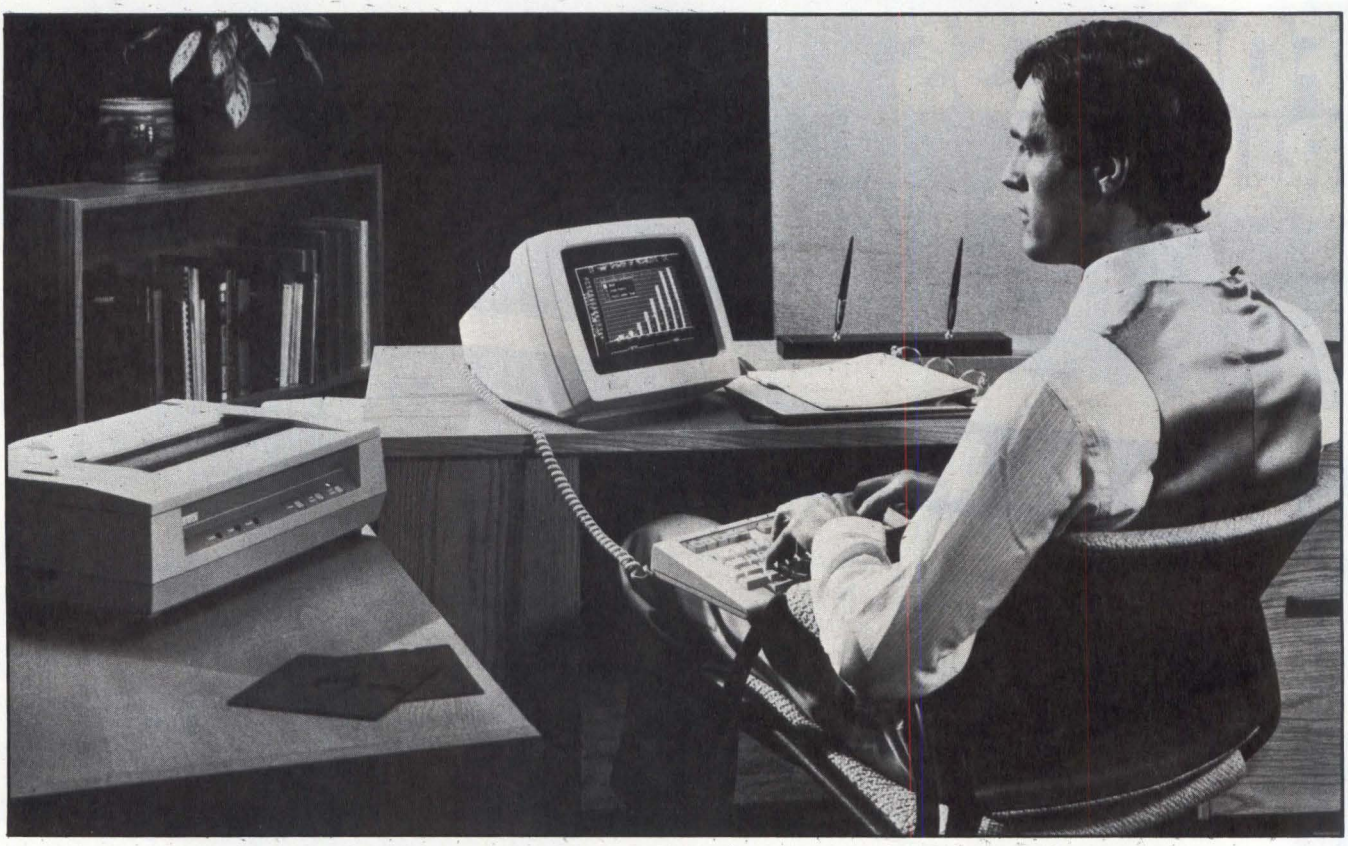

The Rainbow 100 *is aimed at professional workers. DEC executives in charge of marketing the product expect the bulk of Rainbow software to be for business and commercial applications. (Photo courtesy of Digital Equipment Corp.)*

DEC's Goldsworthy maintains that the Rainbow's profit margins for dealers are "competitive in the marketplace." Strategic marketing manager Pryke says he is aware that many dealers prefer to sell the IBM PC, but he insists it is not because of profit margins but because the Rainbow is newer. To counter this, he says, DEC is offering incentives such as free software and bundled extras to dealers. Pryke also acknowledges that DEC's orientation is toward the engineering market rather than the mass market. It's a problem the Rainbow marketing organization is wrestling with, he says, noting as an example, "We're not allowed to use technical terms."

Pryke also acknowledges advertising weaknesses, but attributes them to the Rainbow's being three months later to market than its November, 1982, target date. DEC planned to have its first "big splash of advertising" peak at Christmas '82, he explains, but the Rainbows weren't in stores yet. The second major ad campaign was not scheduled to kick off until June, leaving a barren period in the spring—just when the Rainbow became widely available.

Developing third-party software

Not only is the Rainbow DEC's first computer based on other companies' chips, but it is the first to use a third-party operating system (CP/M-86/80) and third-party application software exclusively. Plentiful application software is key to the personal-computer market, says Bill Ablondi, who heads market analysis for Future Computing. Although there's a tremendous amount of 8-bit software compatible with the CP/M-80 portion of the Rainbow's operating system, most of this was written for first-generation personal computers. Users of more expensive, higher power computers in the Rainbow's market segment will want 16-bit application packages, says Ablondi. He adds, this is an area in which DEC is swimming against the current because so few packages are based on CP/M-86. Future Computing estimates that 43 percent of all personal computers sold in 1983 will be IBM PCs or PC-compatibles with software that is based on the PC-DOS operating system—tough going for the Rainbow. "Of course, there can be more than one standard," he adds.

Gary Cole, a DEC software marketing manager,

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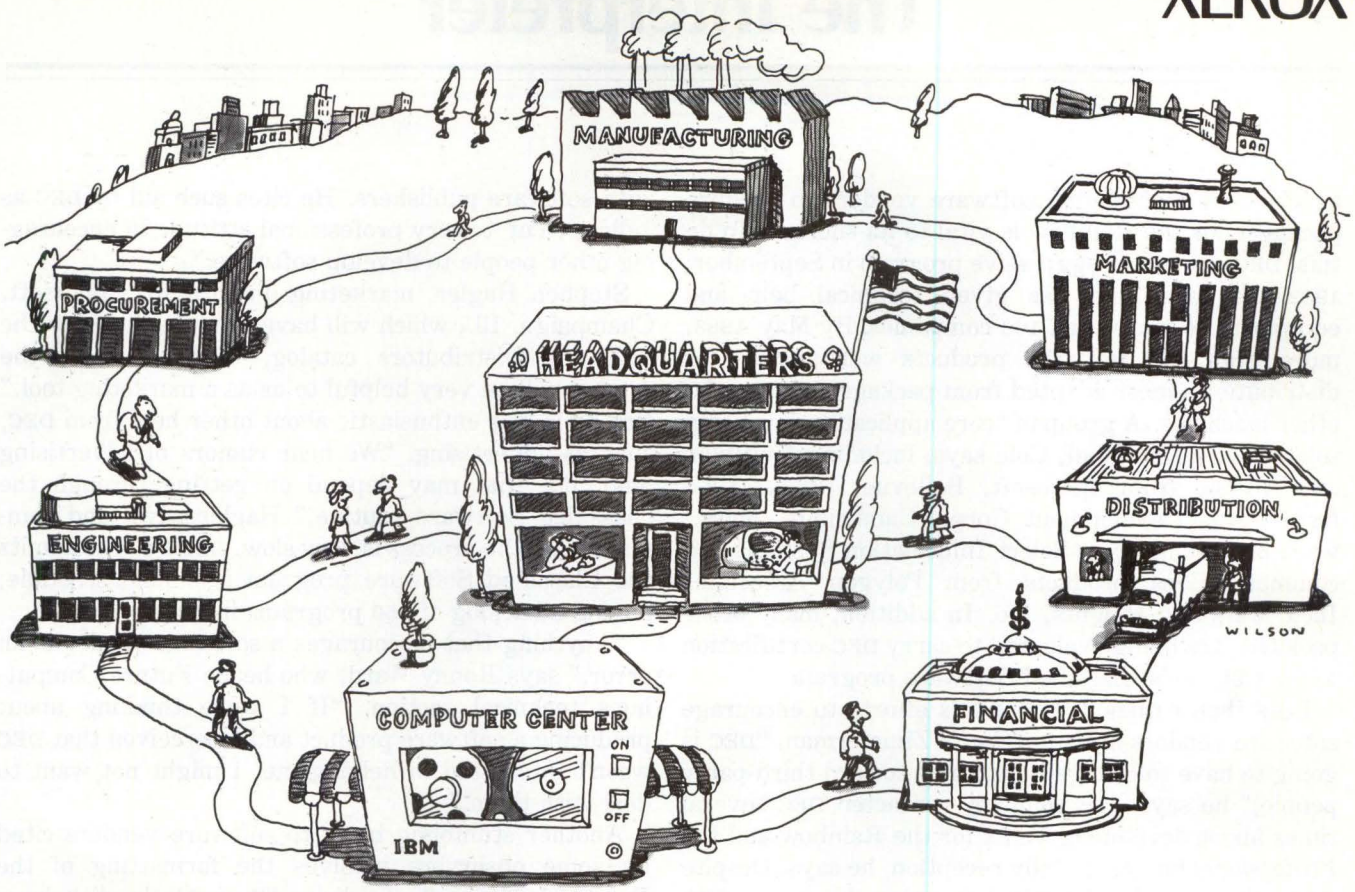

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agrees that encouraging software vendors to produce packages for the Rainbow is vital to its success. To do this, DEC started an aggressive program in September, 1982, he says, and has given technical help and equipment to more than 100 companies. By May, 1983, more than 300 software products were ready for distribution—most adapted from packages written for other machines. A group of "core applications" is being sold under a DEC label, Cole says, including Multiplan and MBASIC from Microsoft, Bellevue, Wash., 1-2-3 from Lotus Development Corp., Cambridge, Mass., word processing from Select Information Systems and communications products from Polygon Associates Inc., Maryland Heights, Mo. In addition, many other packages are being evaluated to carry DEC certification as part of DEC's Classified Software program.

Less than satisfied with DEC's efforts to encourage software vendors is VenturCom's Zimmerman. "DEC is going to have to change its attitude toward third-party people," he says. His company contacted DEC several times about developing Venix for the Rainbow and the Professional but got a chilly reception, he says. Despite difficulties, VenturCom is persisting because, with Venix available on other DEC computers, it wants to give its customers a downward migration path. This chilliness—or at the very least, a lack of strong encouragement—is evident in the comment of DEC's Goldsworthy about soliciting participation by third-party vendors: "We didn't have to solicit; people were coming to us."

In a more positive vein, DEC did participate actively with some third-party organizations. One of these, Software Distributors, Culver City, Calif., publishes a catalog, handles distribution for Rainbow software and has been working with other software publishers since last September, says vice president of marketing Christopher Daly. "Encouraging third-party software was one of our major functions," he says, and adds that DEC gave the company more than 30 Rainbows to place with software publishers. He cites such aid by DEC as indicative of "a very professional attitude in encouraging other people to develop software."

Stephen Hagler, marketing director for Supersoft, Champaign, Ill., which will have products listed in the Software Distributors catalog, confirms that "the catalog will be very helpful to us as a marketing tool." But he is less enthusiastic about other help from DEC, such as advertising. "We hear rumors of advertising help, but that may depend on getting through the Classified Software routine," Hagler says, and complains that the process is very slow. DEC's Pryke admits the Classified Software program is behind schedule, having a backlog of 150 programs in May.

"Anything that discourages a software vendor is an error," says Ronny Ward, who heads Future Computing's technical section. "If I were thinking about producing a software product and I perceived that DEC wasn't interested in helping me, I might not want to deal with them."

Another stumbling block to software vendors cited by some observers involves the formatting of the Rainbow's 5¼-in. floppy disks. Every 5¼-in. disk drive has a slightly different format for recording and reading data; there is no standard, explains Daly of Software Distributors. DEC designed a formatting utility that "encompasses both the hardware and software needed to create the format," he says. DEC and Software Distributors were the only organizations that could format disks for the Rainbow as of late May, says Daly. "We worked very closely with DEC a long time before it would allow us to do [the formatting]," he says. "We actually had to get permission from DEC to buy the hardware to format the disks."

DEC's Pryke concedes that this strict control created a "bottleneck" in making disks available to software developers early. Quality problems with several early shipments of disks convinced DEC that the only way to guarantee quality was to produce the disks itself, he

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Vendor	Model	No. of dealers now carrying product	No. of dealers not carrying product but who want it	No. of dealers considering dropping product	Average no. units sold by store in a month
Apple	Apple II	99	14	4	31.00
IBM	IBM PC	47	70	0	25.00
DEC	Rainbow	23	23	1	1.40
DEC	Professional	23	12	1	.25
Compaq	Portable Computer	15	50	1	4.50
Texas Instruments	TI Professional	11	16	1	2.80

Based on a survey of 135 independent U.S. computer retail outlets for sales activity in March 1983.

Source: Future Computing

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says. Although Dysan Corp., Santa Clara, Calif., and other companies are now producing floppy media for the Rainbow, DEC is still extremely quality-conscious, he adds.

Rating the hardware and operating system

Although the Rainbow is undeniably having some problems, it usually gets good marks in hardware evaluations. "People who have used the Rainbow like its design," says Gilman of InfoCorp. Peter Enot, manager of Tech Computer Store, Cambridge, Mass., which carries the Rainbow, says, "Hardware-wise, it's superior to the IBM PC." Another retailer reports performing his own benchmark tests to compare the Rainbow with the IBM PC. "The Rainbow was significantly faster in executing BASIC," he says.

In contrast, Ward of Future Computing says, "I would rate the IBM PC above the Rainbow primarily because when DEC chose CP/M as the Rainbow's operating system, it committed itself to 8-bit-world thinking." CP/M, the standard operating system for first-generation personal computers, is used to run most 8-bit application packages. Although the CP/M-86 portion of the Rainbow's operating system runs newer 16-bit software, the bulk of 16-bit packages available run on MS/DOS or on the IBM version, PC-DOS. Explaining the choice of operating system for the Rainbow, DEC's Goldsworthy says, "At the time the decision was made, there wasn't all the software on MS/DOS that's around today."

Although a version of MS/DOS has been adapted to run on the Rainbow's CP/M operating system, Ward says this doesn't solve the problem. "Most software being written for MS/DOS is being written around the IBM hardware standard," he says. It depends on hardware interfaces such as an 80-column × 25-line video display and a particular color graphics design. "For example, the Rainbow has an 80 × 24 display. Now to most people, that's an insignificant difference," Ward says. "But software developers use that 25th line for prompts, error messages and so forth, and it makes the interface nicer." It also makes most software written to run on PC-DOS incompatible with the Rainbow. "Application software that addresses the screen directly or makes use of graphics is dependent on the IBM hardware standard," he explains.

Even enhancements such as the introduction of a Winchester disk for the Rainbow (see "Will DEC improve the Rainbow?" p.112) wouldn't push it into the 16-bit world, says Ward. Under CP/M-86, there is only a speed advantage with a hard disk, not a file-system advantage, he says, because information sectors can be no greater than 256K bytes. In contrast, PC-DOS-2.0, written for the enhanced IBM PC XT, allows a user to choose any-size segments. "A 5M-byte directory would be fine," he says, and would facilitate certain advanced applications.

DEC's Pryke says one factor in the choice of CP/M over MS/DOS as the primary Rainbow operating system was a fear that IBM might change PC-DOS to make it proprietary. This would deal a staggering blow to the growing ranks of IBM PC-compatibles and others riding IBM's coattails by using MS/DOS, he hypothesizes. Ablondi from Future Computing terms this possibility "not in concert with IBM's strategy so far" and maintains that software developers could overcome most problems if it did happen.

Despite his appraisal that the installed base of MS/DOS and PC-DOS software will make life difficult for the Rainbow, Ablondi says, "The Rainbow will be one of the key personal computers." Future Computing estimates that if the Rainbow is sold in more stores, it could equal current sales levels for the IBM PC, which the research firm puts at 350,000 for 1983. "Long term," Ablondi says, "I think it has promise." □

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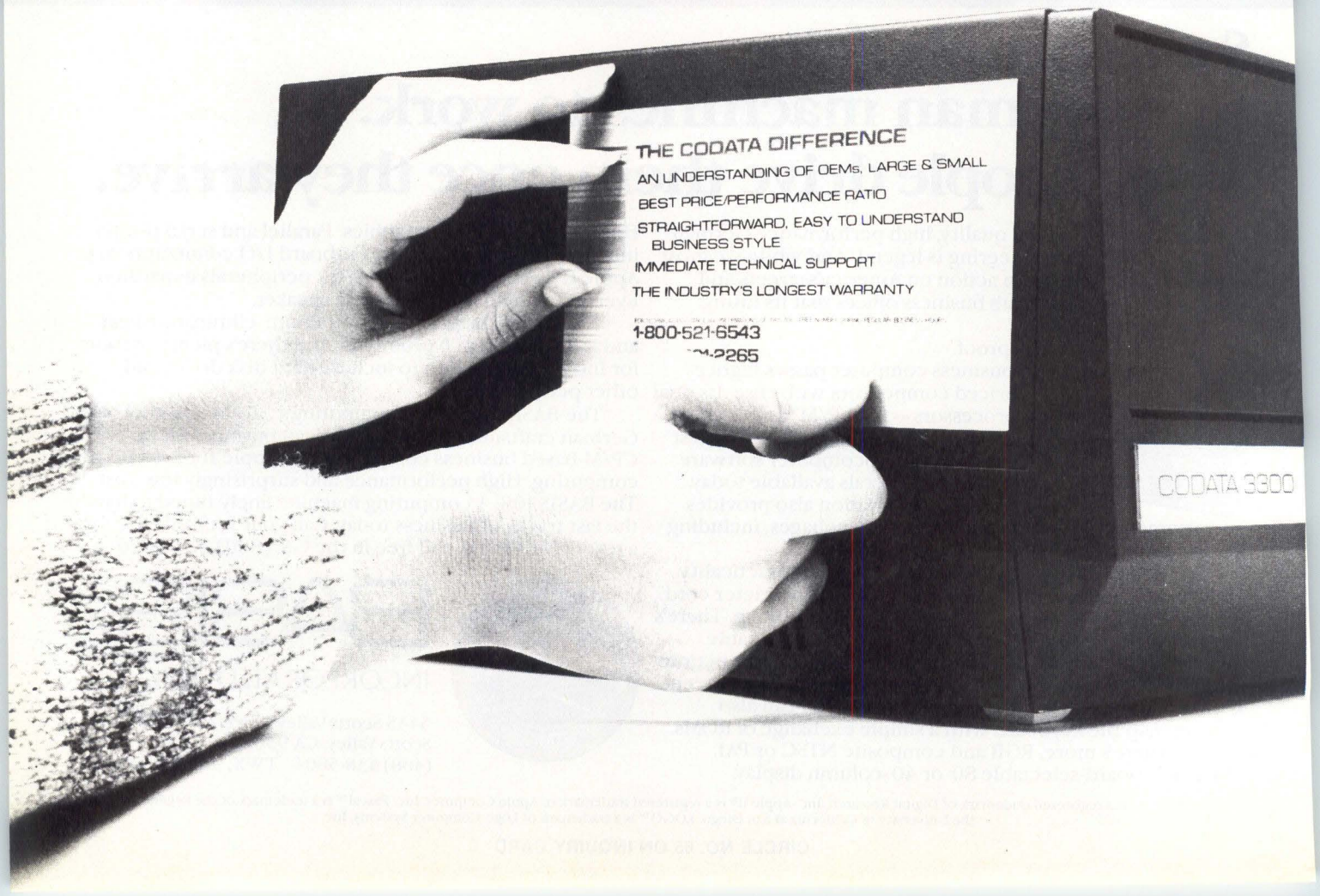

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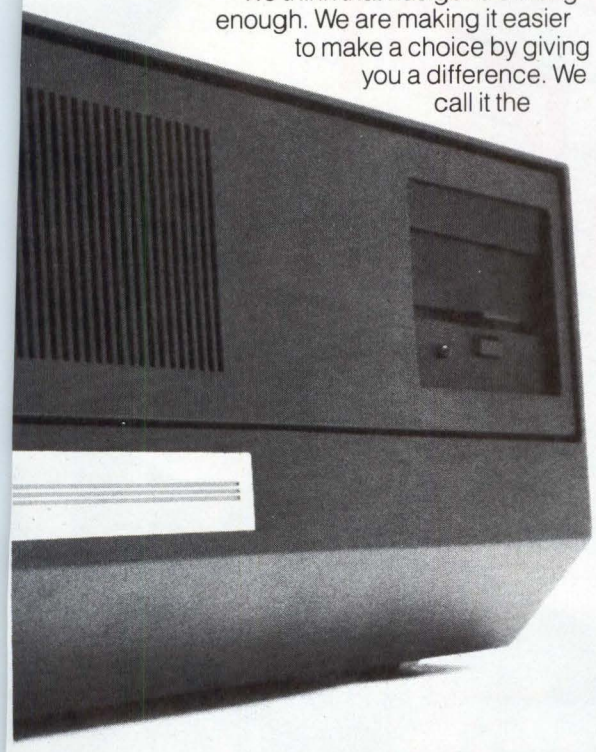

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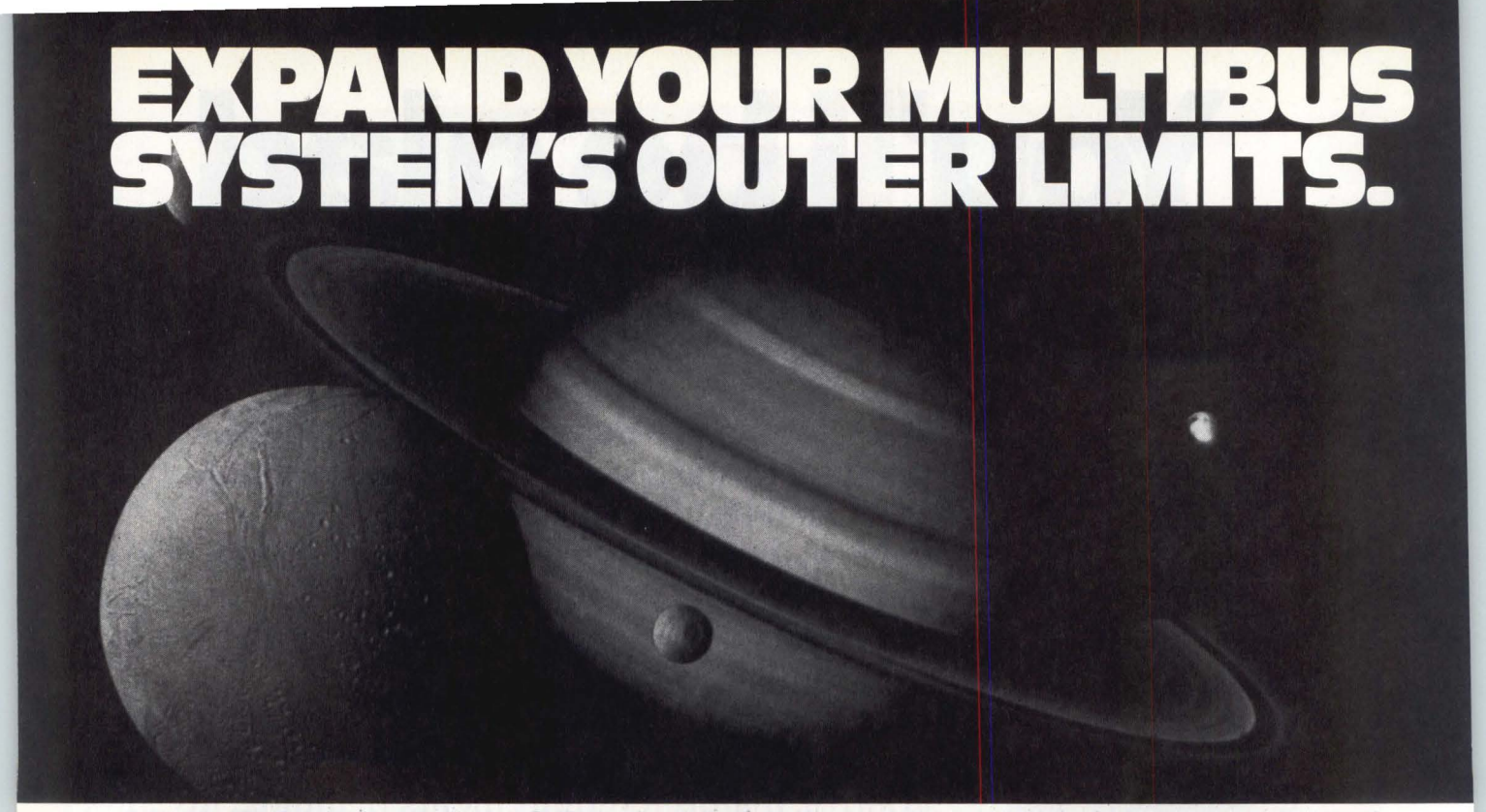

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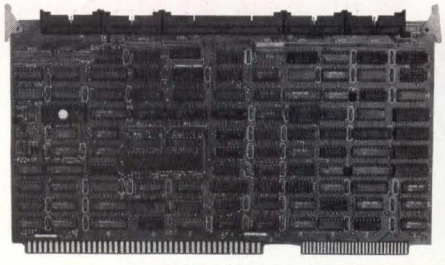

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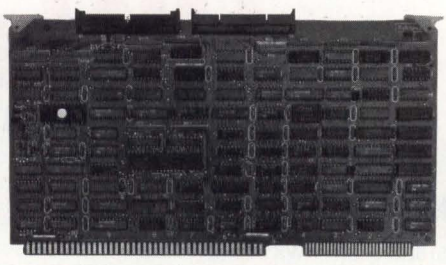
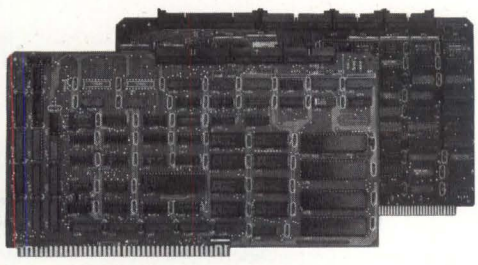


Xylogics 472 Multibus Tape Peripheral Controller.



Xylogics 440 Multibus Disk Peripheral Controller.

Can factory networks bring order to fragmented, nonstandard shop floors?

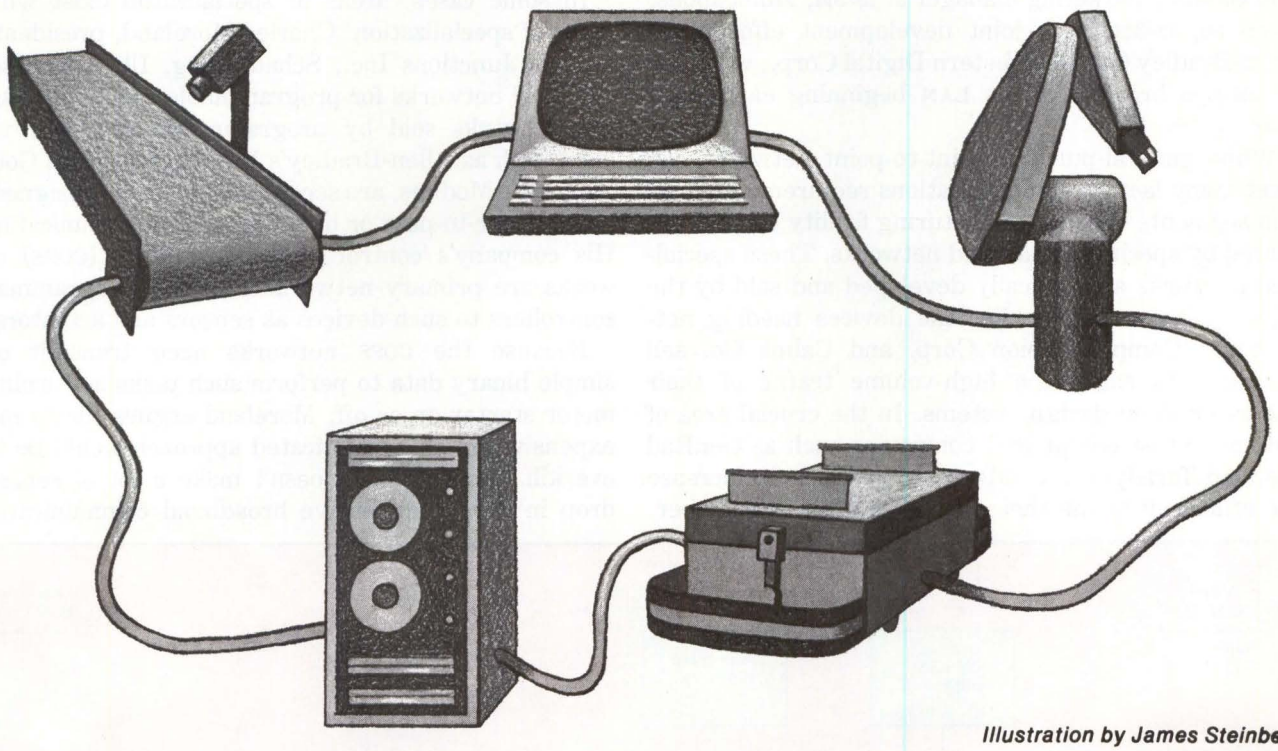


Illustration by James Steinberg

By Dwight B. Davis

Manufacturing plant staffs that have done some networking of their front offices probably aren't too thrilled about the prospect of bringing networks onto their factory floors. After all, choosing and implementing a local-area network to link computers, disks, printers and terminals is not simple. The manufacturing plant itself, with its myriad devices, harsh environments, safety requirements and real-time operations, is considerably more complex. To this environment, add innumerable languages and protocols—many of them proprietary—and comparing factory networking to office networking begins to seem as complex as comparing Chinese characters with the letters of the English alphabet.

No comprehensive factory-networking solution is just around the corner. It's unlikely that any single vendor will overcome all of the barriers to communications in the factory, although some will provide more global solutions than others. Even if these vendors offer a complete set of communications protocols, it still falls to others to standardize the protocols of the linked devices or to build protocol converters that would allow different types of devices to communicate.

Despite these obstacles, vendors and manufacturing end users are progressing on several fronts to unify plant-floor processes and data with communications. They understand that without effective plant-wide networks the full promise of factory automation will never be realized. Factory-networking advances are occurring in the same fashion as most manufacturing technologies—one step at a time.

Specialized networks fill niches

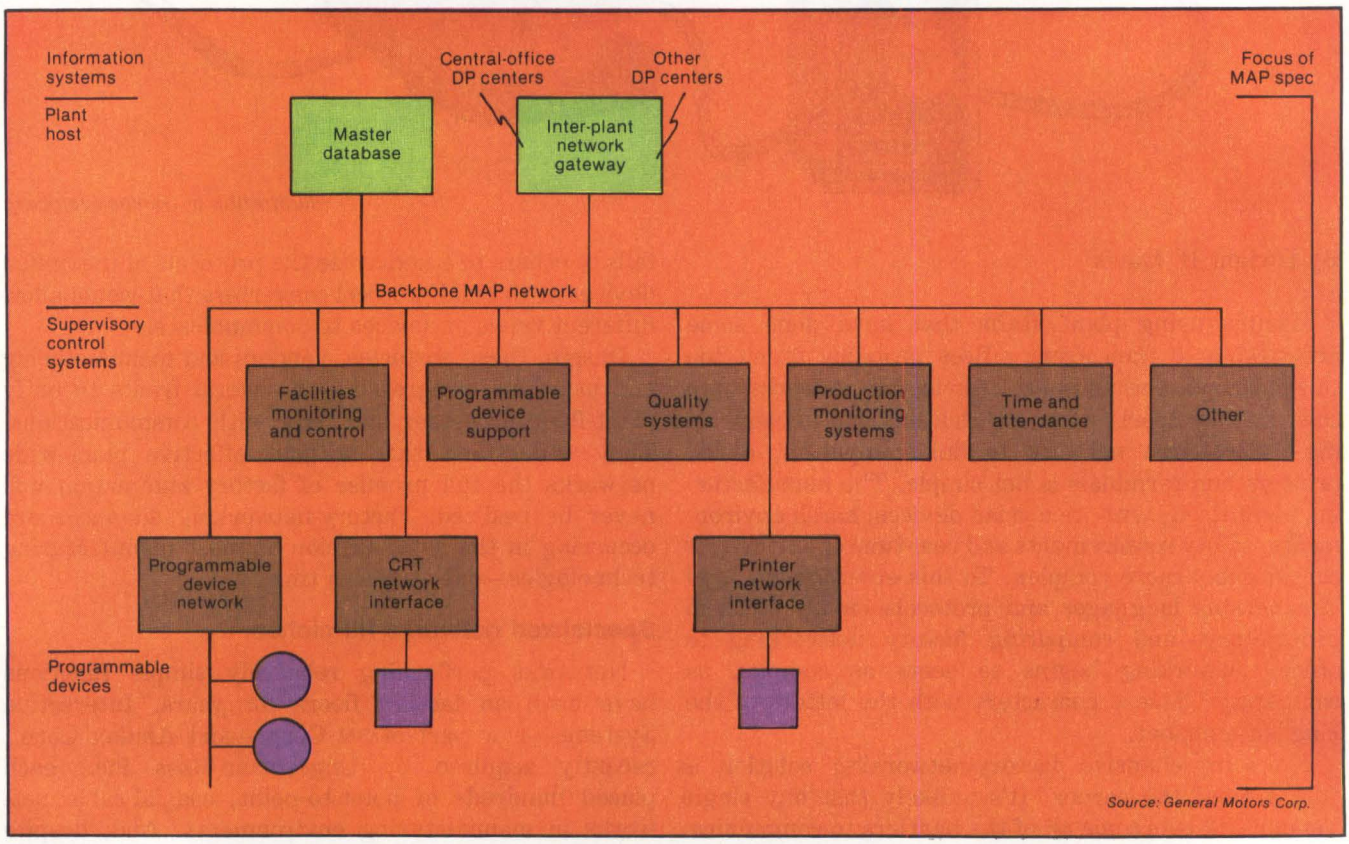
Networks performing relatively simple functions have been on factory floors for years. Interactive Systems—now part of 3M Corp.—and Amdax Corp., recently acquired by Ungermann-Bass Inc., each placed hundreds of point-to-point, coaxial-cable networks in manufacturing environments. And, despite the growing availability of more sophisticated networking architectures, such as bus and ring configurations, the market for point-to-point networks is unlikely

to disappear. "If you look at the research pieces that have been done on the factory environment and the needs of that user community, you'll find a very strong feeling among those folks that, for a lot of applications, point-to-point is all they're ever going to want," says Dan Gahlon, marketing manager at IS/3M, Minneapolis. Even so, IS/3M, in a joint development effort with Allen-Bradley Co. and Western Digital Corp., will offer a 10M-bps broadband bus LAN beginning early next year.

While general-purpose point-to-point networks can meet many factory communications requirements, certain segments of the manufacturing facility can be best served by specifically tailored networks. These specialized networks are typically developed and sold by the same vendors that market the devices needing networking. Computervision Corp. and Calma Co. sell networks to carry the high-volume traffic of their computer-aided design systems. In the crucial area of automatic test equipment, companies such as GenRad Inc. and Teradyne Inc. offer ATE networks to increase the efficiency of the their machines (MMS, December, 1982, p. 119). All the major programmable-controller manufacturers, including Gould/Modicon, Allen-Bradley and Texas Instruments Inc., sell networks that tie their dispersed controllers into single, cohesive systems (MMS, June, 1982, p. 177).

In some cases, areas of specializaton exist within areas of specialization. Charles Moreland, president of Control Junctions Inc., Schaumburg, Ill., which sells low-level networks for programmable controllers, says the networks sold by programmable-controller vendors, such as Allen-Bradley's DataHighway and Gould/Modicon's Modbus, are secondary networks designed to handle peer-to-peer or host-computer communications. His company's control system simplifier (COSS) networks are primary networks that link programmable controllers to such devices as sensors and actuators.

Because the COSS networks need transmit only simple binary data to perform such tasks as turning a motor starter on or off, Moreland argues that a more expensive, more sophisticated approach would be just overkill. "It certainly doesn't make a lot of sense to drop in a very expensive broadband communications



The Manufacturing Automation Protocol developed by General Motors Corp. *as the recommended LAN specification for its facilities is primarily intended for horizontal and vertical communications between plant computers and programmable devices throughout the factory. Part of the MAP recommendation supports the IEEE 802.4 specification for token-bus access, and MAP also recommends the use of multichannel broadband media.*

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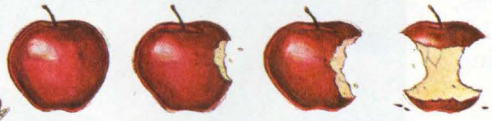
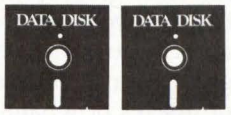
THEN  CAME ALONG & BEGAN TO EAT ALL THE  BUT NEITHER

NOR THE  COULD TRULY DISTRIBUTE THE 

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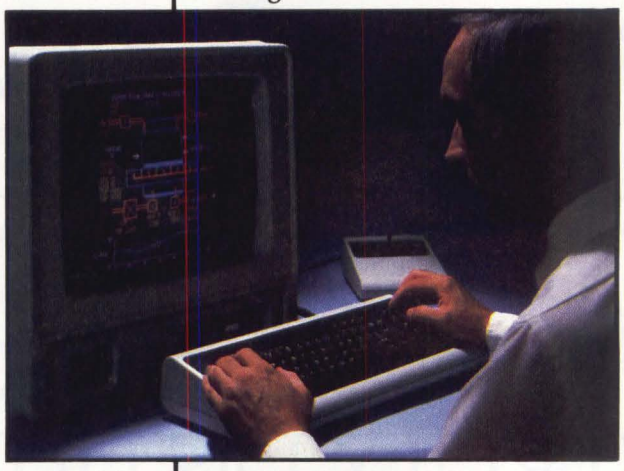

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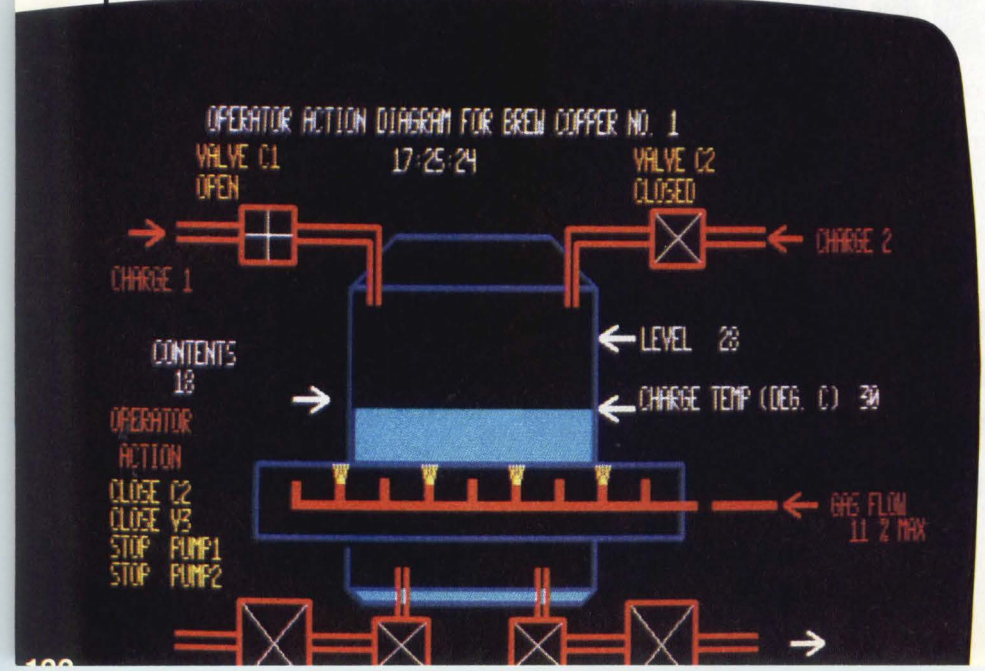


digital

system component if all you're trying to do is control a limit switch," he says.

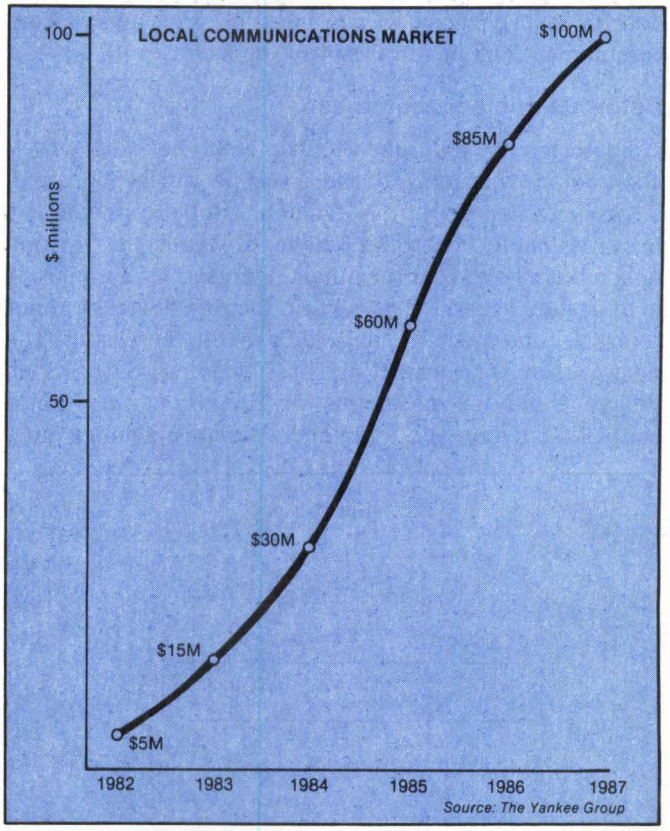
Most specialized network vendors including Moreland believe their companies' networks are the best and most cost-effective solutions for the problems encountered in their specific factory niches. These specialized networks don't have to be simple like the COSS; some incorporate very sophisticated technology and provide high-level communications functions. But, because they are tailored to meet the needs of specific application areas, the vendors argue, they will never be supplanted by a single general-purpose factory network. Even the people developing networks meant to operate plant-wide don't question the validity of this argument.

Wrangling with wires

Some vendors do, however, question the ability of multiple sets of wires—each dedicated to a specialized network—to survive in the factory. "Customers don't want to go through the expense and aggravation of wiring their buildings for every new application that comes on board," says Ross Seider, vice president of Concord Data Systems Inc., Waltham, Mass. Seider points out that, with broadband media such as that employed by his firm's recently announced Token/Net, factories can place multiple specialized networks on a single cable. By providing numerous channels, a broadband medium can carry multiple sub-networks, each with its own operating specifications (MMS, January, p. 81).

Now, attacking the goal of reducing the number of wires strung throughout a factory is almost equivalent to attacking motherhood, and no one does. However, there is no shortage of vendors that question the likelihood of attaining total media simplicity: a single medium servicing all the sub-networks in a factory. It's much simpler to market specialized networks with their own media and access devices than to jump into the market with a global solution. "If factories were not a product of evolution, you could choose one media and possibly establish it as a standard," says Ted Britton, vice president of product development at General Electric Co. subsidiary Intersil Systems, Sunnyvale, Calif. "But with all the different environments within a factory, it is extremely difficult to say that you will have only one medium out there."

Like Concord Data Systems and GE, Sytek Inc., Mountain View, Calif., also sells broadband networks. Sam Smith, associate director for technical support at Sytek, agrees that broadband could technically handle all a factory's communications, but, he says, "Anybody who's looking for a tightly coupled response time is making a mistake by putting it on a plant-wide network." Certain application areas, such as some with robots and programmable controllers, might function more efficiently and safely with a dedicated network and medium, Smith says. This sub-network might have a gateway into the plant-wide network, but "the reliability and response-time requirements of certain application areas are just too tight to put all their signals on a plant-wide network," he says.



The market for LANs in factories *will grow from about $15 million this year to approximately $100 million in 1987, according to figures from The Yankee Group. These figures don't include the value of customized work, such as that performed by software consultants who develop protocol converters for different factory machines.*

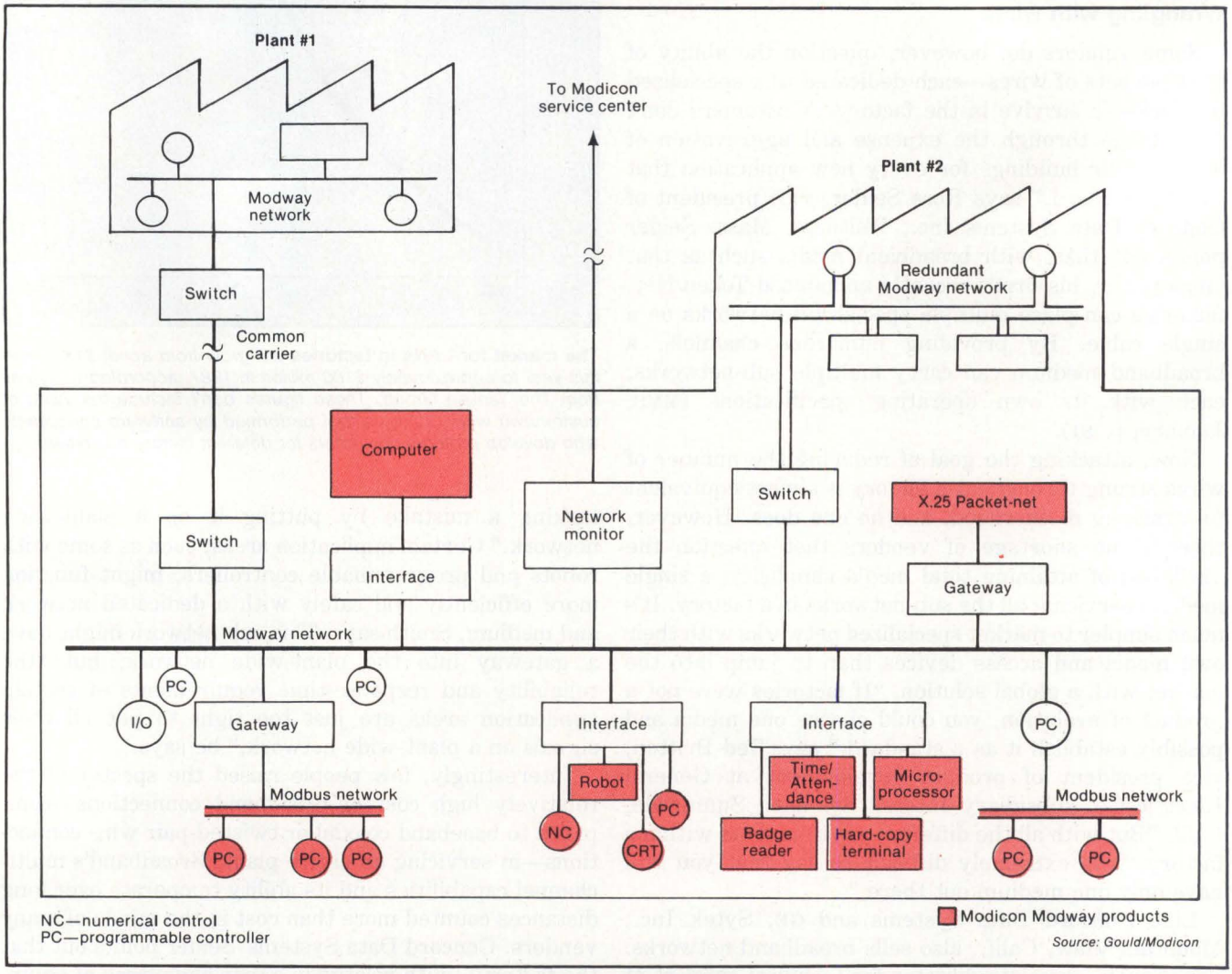
Interestingly, few people raised the specter of the relatively high cost of broadband connections—compared to baseband coaxial or twisted-pair wire connections—in servicing an entire plant. Broadband's multichannel capabilities and its ability to operate over long distances counted more than cost in the minds of many vendors. Concord Data Systems' Seider points out that the factory—with relatively expensive pieces of equipment to connect—is less price sensitive to networking costs than the office, Tony Friscia, a factory market analyst with The Yankee Group, Boston, agrees that

cost considerations are secondary. "If you're going to be overly cost conscious, you should stay away from communications in the factory," he says.

Deterministic access times

Factories not only need multiple sub-networks; they also require that many of these sub-networks operate in a predictable, real-time fashion. Robots driven by programmable controllers have different networking needs from keyboard terminals operated by humans. It is generally agreed that certain factory devices cannot tolerate unexpected long delays in accessing the network and transmitting or receiving data. Such delays could be disastrous or dangerous in tightly coupled environments, in which various machines must work in perfect harmony with each other.

The need for a guaranteed access delay that will never exceed a specified worst-case lapse is making the token-passing access scheme a popular protocol in factory networks. Token passing is playing catchup with the carrier-sense-multiple-access with collision-detection-access method, which has been implemented on a number of networks, including Xerox Corp.'s Ethernet, GE's GEnet and Sytek's LocalNet. CSMA/CD is a contention access scheme because all the network nodes contend with each other to gain access to the network transmission path. If two devices access the network simultaneously, their signals collide, an event recognized by the collision-detection part of the protocol. Without collision detection, CSMA network perfor-



The Modway industrial LAN *from Gould Inc.'s Modicon division provides a common bus over which all a factory's electronic devices can communicate. Devices connect to the LAN through various interface boxes provided by Gould. Configurations can also include gateways to other networks such as Gould's Modbus programmable-controller network and switches to other local or remote Modway networks. In the illustration, two Modway networks in Plant 2 connect via a common carrier to a single Modway network in Plant 1.*

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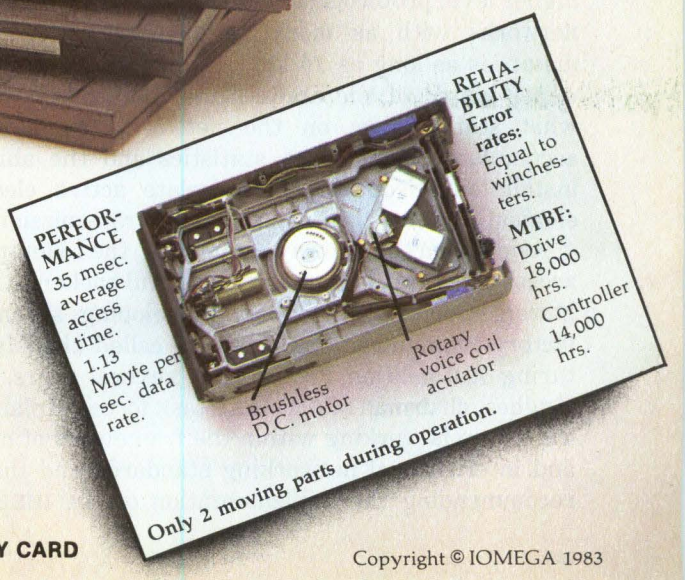

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mance quickly degenerates as more nodes are added. Even with collision detection, the access scheme cannot completely guarantee that long delays will never occur.

Token passing, on the other hand, is a peer-to-peer polling technique that gives all primary network nodes equal access to the network through continuous polling cycles to every node. As the number of nodes increases, so does the delay for the polling token to pass through a complete cycle, but maximum delay can always be determined. Token passing is also less distance sensitive than CSMA/CD and has received the support of two important factory-related backers. One proponent is the Proway committee, sponsored by the Instrument Society of America and Purdue University's Workshop on Industrial Computer Systems. Bob Crowder, chairman of the U.S. Proway committee and a senior research associate at E.I. duPont de Nemours & Co., Wilmington, Del., says his committee is working to produce a factory-specific token-passing-bus specification based on the work of the IEEE's 802 LAN committee. (The 802 committee's draft standard contains an 802.3 section detailing CSMA/CD specifications and an 802.4 section on token-passing specifications.)

The Proway committee is working directly with the 802 committee to draw up a factory-networking standard, but some modifications in the 802.4 specifications will be needed, Crowder says. "First, we must be able to recover from transmission errors as soon as they occur," he says. "That's done with the immediate acknowledgement and retry." Other modifications to the 802.4 specification include the ability to request the return of pre-defined data while the requesting station continues to hold the token, allowing simple stations that never receive the token to be interrogated, the ability to initialize and control a station remotely even if higher level protocols have failed, the ability to support networks with as many as 100 stations and with distances as long as 10 km., the ability to predict the upper bound of the access time, the ability to know what stations are on the network, the ability to accumulate performance statistics and the ability to install long drop cables to isolate active electronic elements from the main trunk transmission line.

Aside from the Proway committee, the token-passing access technique has another powerful backer—General Motors Corp. GM has been developing an in-house factory-communications program called the Manufacturing Automation Protocol for several years. Kevin Hughes, chairman of GM's MAP task force, explains that the group is working within the framework of national and international networking standards and that it is recommending the implementation of the IEEE 802.4 specification for token passing over broadband cables in its own plants.

GM is working with a number of vendors that supply token-passing network components, including Gould/Modicon, which has supplied the auto manufacturer with hardware and software from its Modway communications network. To date, these products have been designed for baseband token-passing networks, but Gould/Modicon intends to provide broadband communications controllers this year. GM is also working with Concord Data Systems, which will supply the manufacturer with products from its token-passing bus network, Token/Net, scheduled for delivery this fall.

CSMA/CD in the factory

Despite the growing support for token-passing networks in factories, CSMA/CD will still operate in some manufacturing applications, in the opinion of several network vendors. Hewlett-Packard Co., Palo Alto, Calif., is a major presence on the factory floor and is backing the 802.3 CSMA/CD standard for the bulk of its computer-based applications, says David Aune, product marketing manager in HP's Information Networks division. "We will use the 802.3 technology to interconnect all of the computers that we make, in all the application areas that we address," Aune says. He does note, however, that HP is evaluating the viability of more deterministic access methods, including token passing, for use in time-critical factory applications.

Likewise, GE Intersil Systems' Britton sees a need for different access methods in different factory environments. He divides the factory into three general areas: computer-aided design/computer-aided engineering, computer-aided manufacturing and maufacturing resource planning. Of these, only CAM requires a deterministic network-access method, Britton says. "GEnet, with CSMA/CD, would meet the requirements for the CAD/CAE and MRP networks," he claims, noting that GEnet will probably also support token-passing eventually to meet the real-time demands of the CAM environment.

CSMA/CD has one major advantage over token passing —the former is widely available, while the latter is just now coming into its own. Smith at Sytek, which offers CSMA/CD on its broadband networks, notes that factories installing LANs have so far had few token-passing products from which to choose. Most of Sytek's 250-plus installed networks operate in office and educational, not factory, environments, but Smith believes CSMA/CD will work well in most applications. Internal tests show that even 70-percent-loaded CSMA/CD channels operate efficiently, he says, although he doesn't discount the

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possibility that Sytek may later offer token passing. "In terms of the real performance," he says, "it's going to be difficult to find much difference between CSMA/CD and token passing. Where you'll find the most difference is in the upper-layer protocols, which are much more significant than the access-link protocol."

Scarcity of upper-level protocols

As Smith points out, the low-level protocols that handle network access are relatively straightforward and, along with the actual physical connection, have served as the focal point of most LAN standards activity. But to communicate between different types of networks, hardware and software effectively, higher level communications are required.

"When we looked at the market, we knew we could offer a network with just the bottom two layers of the communications protocols (physical and data link), but that really doesn't solve any problems," explains Ravi Ghai, group marketing manager of Gould/Modicon's Distributed Data Systems Group. "All that approach does is allow two devices to hook to the same cable, but they still can't talk to each other. So, with Modway, we decided to develop a fully layered network."

Like Gould/Modicon, some other factory network vendors sell turnkey networks that provide all or most of the communications capabilities needed to link various network devices effectively. But the higher one progresses in the seven-layer International Standards Organization's networking model, the fewer the agreed-upon protocols. Even if protocol standards are ratified at all levels of the communications model, network vendors and users still must deal with robots, programmable controllers, CAD systems and ATE systems that have their own nonstandard internal protocols.

Some network vendors, such as Gould/Modicon and GE, provide a limited number of protocol converters that can shift proprietary device protocols into the appropriate communications protocol. But these converters are produced only for the most popular brands. The simplest way to solve these protocol problems would be to reduce the number of proprietary protocols, for example, by establishing a single robotics language. But standards activity in such device-class areas is even less advanced than in communications. Thus, for the foreseeable future, proprietary devices will rely upon custom programming provided by network vendors, system integrators and end users for links to factory networks.

As if factory networks didn't have enough problems, they must also face the threats of harsh, dirty environments. Gould/Modicon's Ghai says Modway and Modbus components will be available in dust-, drip-proof enclosures and will operate over a temperature range of 0° to 60° C. Most other network vendors approaching the factory environment expect to offer such hardened devices, although some point out that standard networking equipment operates well in many factory applications; shielded broadband and baseband coaxial cables, for example, protect network signals from the radio-frequency interfence and electromagnetic interference generated by factory equipment.

The complexity surrounding networking in the factory explains why even vendors of powerful networks aren't predicting overnight success in their attempts to unify the market. Sytek's Smith notes, "We have identified factory automation as a market that we want to service, but we're well aware of what it will take to succeed. It just cannot be done by changing a single protocol or making other simple changes in our products. We don't want to go off on a two- to three-year development effort based on a couple of unproven ideas that may not pan out in the end." □

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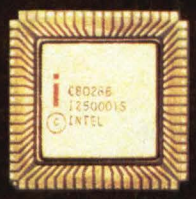

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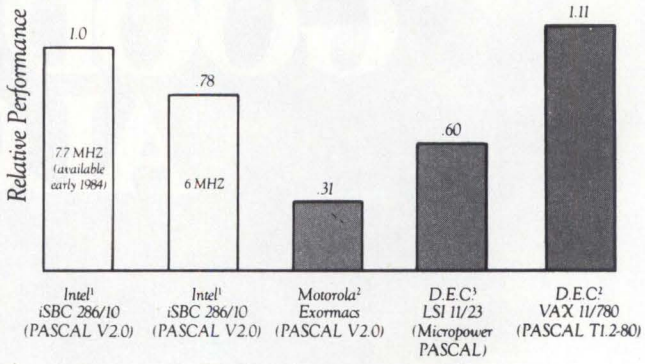

[1]*Based on Eratosthenes Sieve Benchmark in PASCAL. Details available from Intel's "Eratosthenes Sieve Prime Number Benchmark on the ISBC 286/10 Board," literature order number 210984.* [2]*"Eratosthenes Revisited," BYTE. Jan., 1983.*
[3]*"A System/Architecture Approach to Microcomputer Benchmarking." Digital Equipment Corporation. Sept., 1982.*

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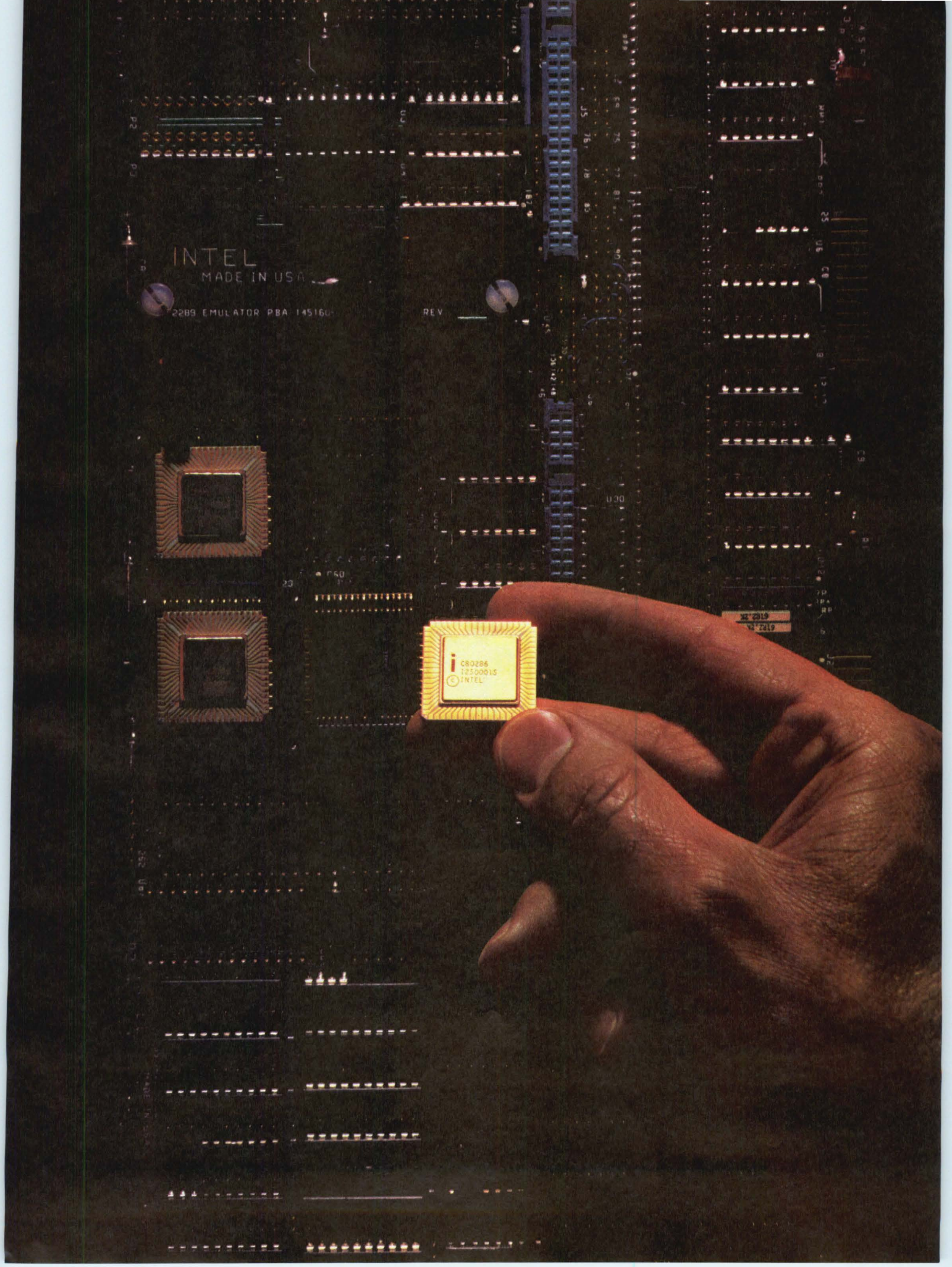
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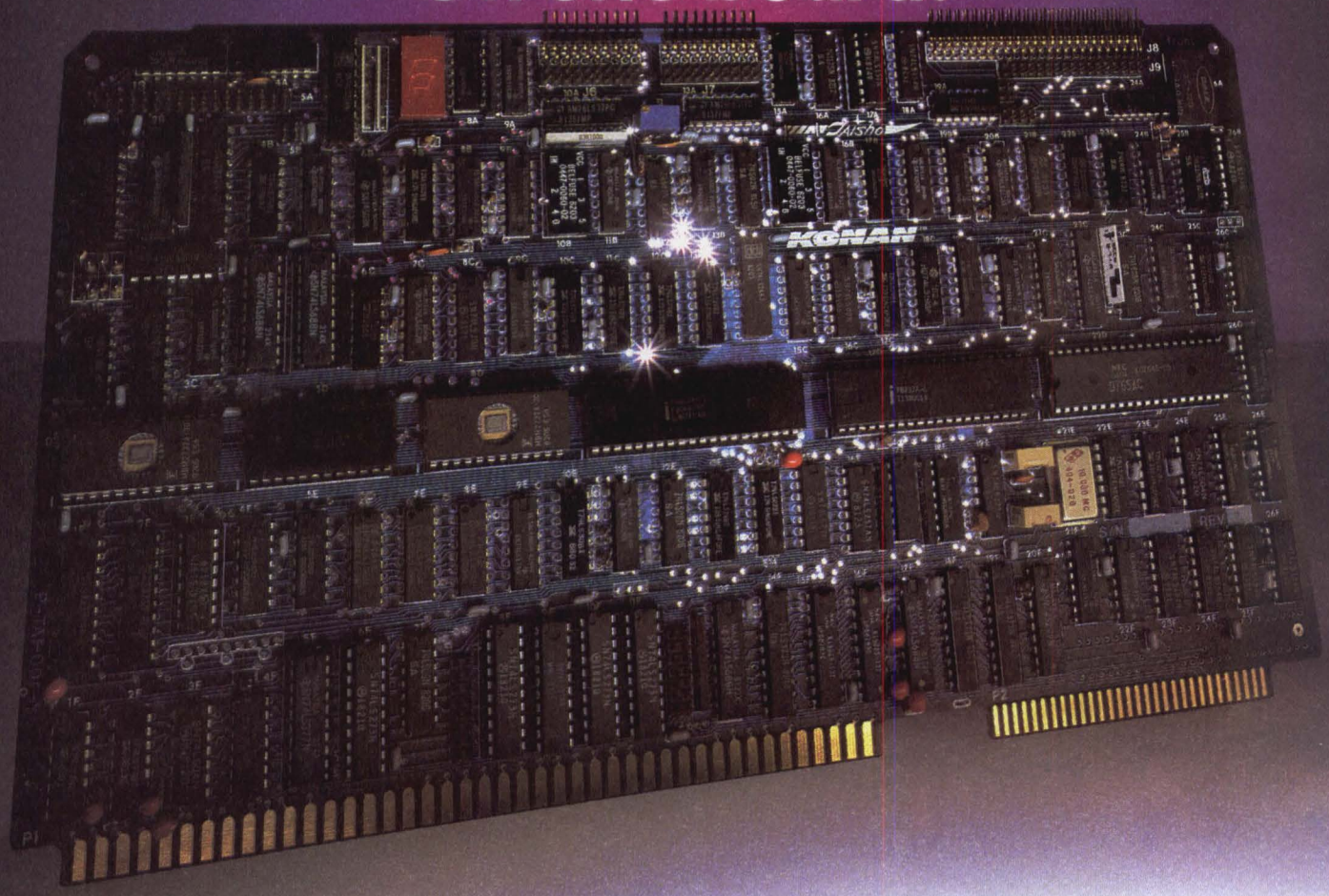

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CIRCLE NO. 73 ON INQUIRY CARD

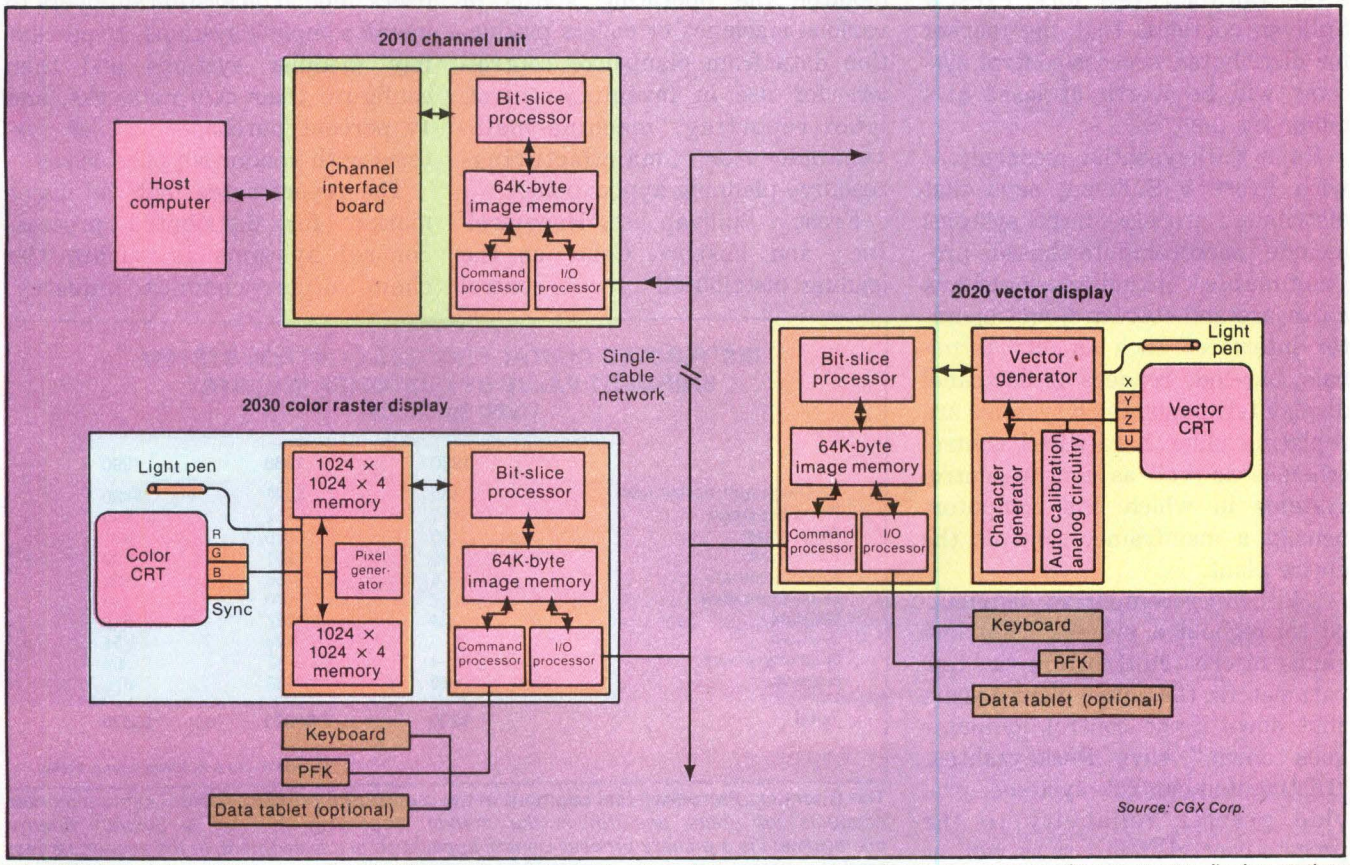
CAD/CAM workstation network disperses IBM host applications

System 2001 from CGX Corp., Acton, Mass., is a network of interactive workstations for computer-aided-design/computer-aided-manufacturing applications based on IBM Corp. or IBM plug-compatible host mainframe computers. Supporting a maximum of 16 workstations, the network allows users to choose a combination of color raster and monochrome vector terminals, says CGX. Because each terminal contains its own graphics processor, both color and monochrome units can plug into a single coaxial cable as much as 2 mi. long.

The basic system includes the CGX 2010 channel unit, the CGX 2020 monochrome (black-and-white) display station and the CGX 2030 color display station. The channel unit connects to any block multiplexer or selector input/output channel of the host mainframe. Within the channel unit, three microprocessors (an Intel 8088, an Intel 8089 and an AMD 2901) transfer information between the host and workstations along the coaxial cable.

The two display stations, which emulate IBM 3250 graphics display terminals, also use Intel 8088, Intel 8089 and AMD 2901 microprocessors, and they contain 64K bytes of buffer memory storage. Each has a light pen; a 32-key, programmable-function keyboard and an alphanumeric keyboard. A data tablet and a stylus for light-pen emulation and digitizing are optional.

On the monochrome vector unit, a 21-in. diagonal screen has 4K × 4K addressable-point resolution. On the color raster unit, a 19-in. diagonal screen has resolution of 1024 × 1024 pixels and can display 16 colors from a 4096-color palette. Both units can draw solid, dotted



The CGX graphics display system 2001 contains a channel unit and as many as 16 color raster or monochrome vector display stations connected to a coaxial cable as much as 2 mi. long. All components are microprocessor controlled, as detailed here. Each component uses the same processor boards, which can be swapped from unit to unit, if necessary.

dashed and dot/dashed lines, and the color unit can draw polygon fills as well.

Both terminals, says CGX, provide the interactive response speeds required by IBM-based CAD/CAM graphics software such as Lockheed Corp.'s CADAM and CADAM PRANCE, Northrup Corp.'s NCAD, Dassault Systems' CATIA and Structural Dynamics Research Corp.'s CAEDS.

A system 2001 configuration consisting of four model 2020 vector display stations, four model 2030 color raster display stations and a model 2010 channel sells for $299,000. Individually, channel units sell for $23,000, vector display stations sell for $27,000, and color raster display stations sell for $42,000. Quantity discounts are available for both OEMs and end users, says CGX. The company estimates a delivery time of 120 days.

Distributed process-control market growing at rapid pace

The distributed process-control market is growing at a 50-percent annual rate from $200 million worth of sales in 1980 to a projected total of $855 million in sales by the end of 1982, according to a study by Frost & Sullivan Inc., New York. Frost & Sullivan contends that the market for distributed process-control systems will be worth at least $1.9 billion by 1985.

Rajat Purkayashtha, a consultant with Frost & Sullivan, says that distributed process-control systems include microcomputer-based programmable controllers, network hardware and software, and operator interfaces such as CRT terminals, bar-code readers or flat-panel display terminals. Such systems are replacing older hard-wired control schemes as well as central-control systems in which one computer, usually a mainframe, controls the entire plant.

"With microcomputers distributed throughout a process plant and each micro controlling a few parameters, the entire plant doesn't shut down if the control computer goes down," says Purkayashtha. "Distributed-control systems provide greater reliability to the process-control industry as well as more localized programming flexibility."

Although distributed-control systems still tie into one central computer, that computer's role is not as integral to the various processes. The central computer can be used to down-load programs, monitor the operating status of various machines or collect production data from plant-floor controllers for use in inventory-control, labor-reporting, machine-maintenance or manufacturing-resource-planning applications.

Frost & Sullivan lists Honeywell Inc., and Foxboro Corp. as the leading distributed process-control system providers, together sharing two-thirds of the market. Other companies with prominent shares of the remaining market include Fisher Controls International and EMC Controls. While 58 percent of end users depend on system suppliers to install complete systems, 20 percent buy modular systems and then configure their own networks, and 17 percent purchase modular systems with vendor-supplied buses.

The report notes that the major market for distributed process-control systems is within the chemical/petrochemical industry,

DISTRIBUTED DIGITAL PROCESS CONTROL SYSTEM SHIPMENT VALUE BY CUSTOMER INDUSTRY
(1980 $millions)

	1980	1985	1990
Chemical/petrochemical	$35	$323	$620
Food/beverage	11	112	216
Pulp, paper	15	225	431
Petroleum	35	281	539
Primary metals	6	56	108
Rubber/plastics	7	70	135
Utilities	24	267	512
Textiles	3	28	54
Glass/ceramics	4	42	80
Exports	60	469	875
Total	$200	$1873	$3570

Source: Frost & Sullivan Report #1049

The Chemical/Petrochemical segment of the distributed process-control system market *accounts for about one-fifth of the market, according to Frost & Sullivan. Energy management is a primary process-control application in this segment. In the second largest market segment, petroleum, almost 90 percent of the distributed process-control systems are continuous-control units, and nearly 50 percent of the systems have limited-batch capabilities for auxiliary functions.*

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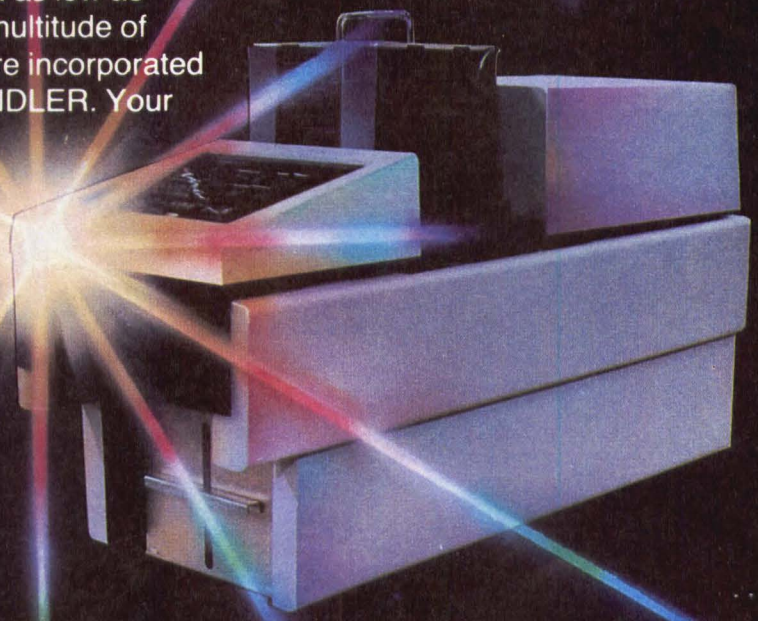


CIRCLE NO. 74 ON INQUIRY CARD

which accounts for one-fifth of all system sales (see table, p. 140). The petroleum industry is the second largest user, followed by public utilities and the pulp and paper industry.

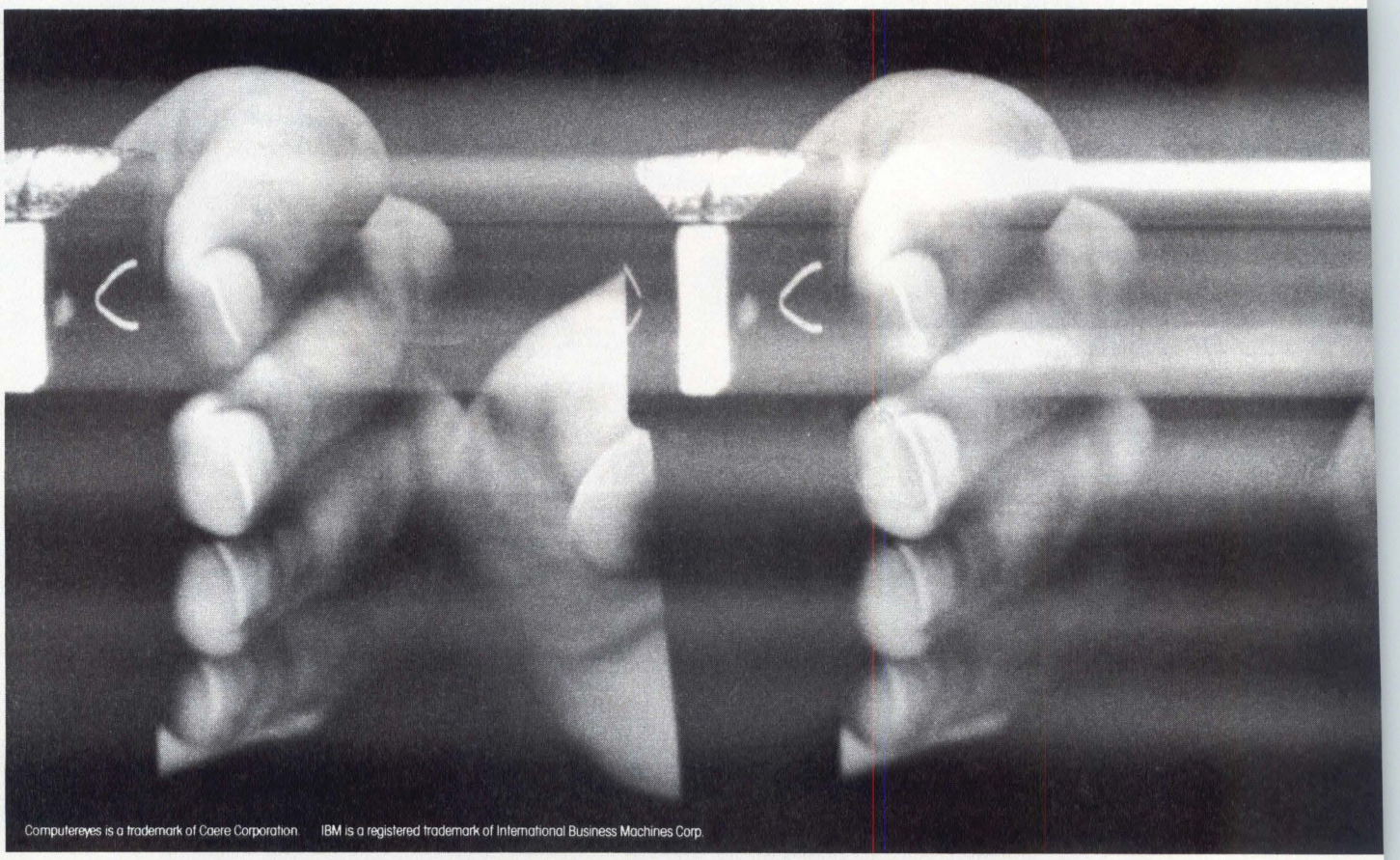
The report, entitled "Distributed Digital Process Control Systems," is available from Frost & Sullivan for $1350.

—Frank Catalano

Industrial microcomputer withstands harsh, wet environments

The first member of Gould Inc.'s "bullet-proof" family of industrial microcomputers is now available to OEMs. Developed by the Advanced Technologies Department of Gould's Electronic Systems Section, Nashua, N.H., the IMC4000 industrial microcomputer, which is based on the Motorola 68000 microprocessor, is so waterproof that it can operate even if completely submerged and is conservatively rated to withstand temperatures from 0° to 70° C.

Built of cast aluminum with O-ring seals, the IMC4000 is so rugged that "you can literally run a truck over it and it will survive," says product manager Jonas Landau. He says the product incorporates very high-reliability components, although they are not military-specified parts. Because of its hardening, the IMC4000 can function in environments that are too harsh even for many industrial computers, Landau says, and certainly beyond the tolerances of office microcomputers and minicomputers. Likely applications include process control in petrochemical



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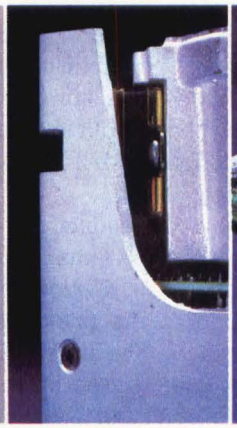
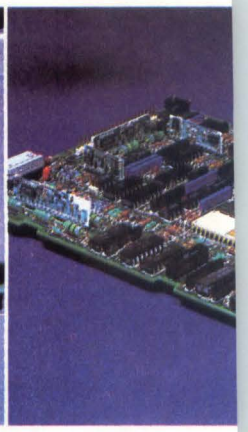
plants, in which reliability and immunity to fumes and spray are important, very hot and very cold factory floors, offshore drilling rigs and aboard ships.

With the IMC4000, product developers can write programs using Motorola's EXORmacs development system for applications previously beyond their reach. The microcomputer supplies 256K bytes of RAM and 128K bytes of EPROM. Landau says the product will be available with 1M byte of RAM next year. Serial I/O consists of four RS232C channels, each supporting baud rates as high as 19.2K bits per sec. Parallel I/O consists of 16 digital inputs and 16 digital outputs, all with handshaking. The IMC4000 also has one A/D input channel with a 14-bit data converter and one IEEE-488 channel with controller/talker/listener.

To keep its four-layer printed-circuit board approximately 10° C below the ambient temperature, the IMC4000 employs several thermoelectric coolers that require current on demand when the temperature rises above a certain point. The solder side of the PC board rests on an aluminum cold plate filled with thermally conductive silicon rubber. The cold plate, in turn, rests on the coolers, which pump generated heat into a large heat sink. To ensure that the heat flows only in one direction, the component side of the PC board is insulated with a heavy foam pad. Besides moderating the board's temperature, the cold plate and the foam pad sandwich the PC board, helping to protect it from vibrations, Landau says.

Although the initial release of the IMC4000 is directed at OEMs that work with the EXORmacs development system, Landau says Gould will also develop application software to run on the product. He expects Gould to offer turnkey packages based on the IMC4000 by late this year or early next year. The single-unit price for the IMC4000 industrial microcomputer is in the $11,000 to $12,000 range. This includes a ROM-resident software package for down loading and debugging application code and utilities for program control, math, data conversion and string manipulation. —*Dwight B. Davis*



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CIRCLE NO. 78 ON INQUIRY CARD

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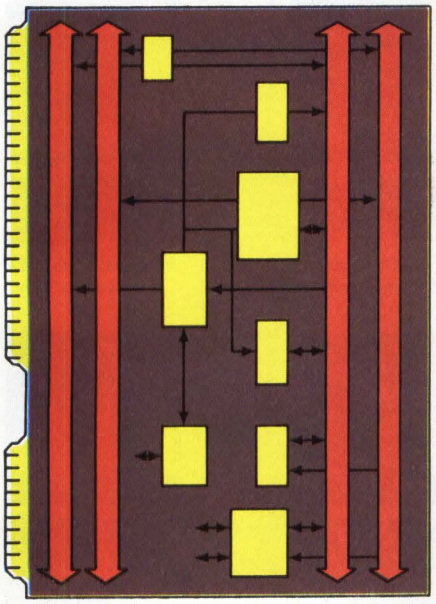
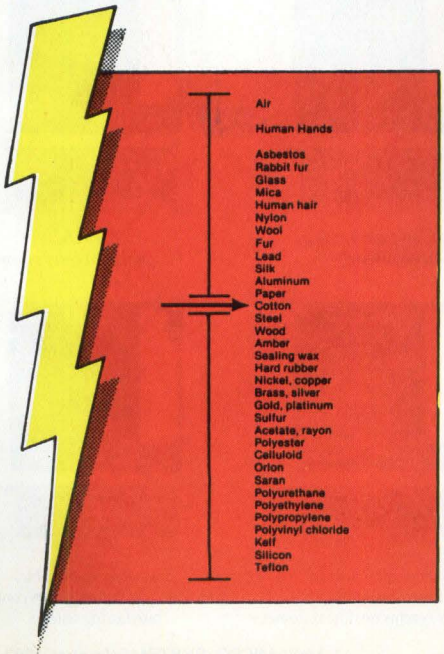
FEATURE HIGHLIGHTS



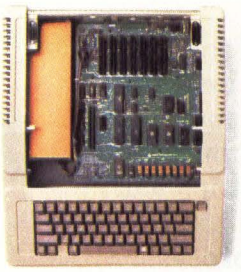
MICROCOMPUTERS: The market demand for **16-bit desk-top personal computers** continues unabated. This year's news concerns the emergence of more specially defined classes of the personal computer. MMS has compiled a table of more than 100 desk-tops with prices that cluster around $3500. Turn to p. 153 for more information...The next generation of microprocessors, 32-bitters, is expected to arrive in quantity during 1984 to 1985. Six are already available or in the advanced development stage, and end users can expect to have the power of a VAX supermini for about $5000 to $15,000. For a closer look at the new **32-bit chips,** see p. 187...Sixteen-bit processors are the base of nearly half of the 40 **single-board computers** profiled starting on p. 208. Industry sources project a 25-percent annual growth rate for SBCs and that, by 1988, sales will reach more than $7 billion. Memory capacities are on the rise, and vendors now provide full software support. Malcolm Stiefel presents a comprehensive report on p. 201.

DESIGN: The metal or plastic skin that surrounds a device can be extremely important when it comes to how a machine operates. Choosing the right materials and a design that provides cooling, electromagnetic-interference shielding and impact protection requires a basic understanding of the available options. For hints on selecting the right **enclosure** for your device, see p. 229...Most OEMs are familiar with FCC regulations concerning **electromagnetic interference.** What many are finding, however, is that the regulation is not merely a labeling requirement; it can often mean a costly and time-consuming overhaul of the product. To learn more about FCC specifications and how they can affect your product, consult p. 254.

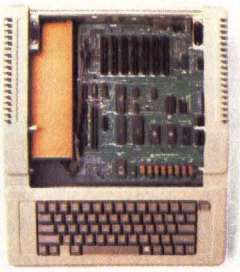


MAINTENANCE: Most users don't realize the need for protection against power failures in their office equipment. Seven kinds of disturbances can interfere with or even damage delicate computer equipment, and may cause loss of valuable data. See p. 245 for a look at the latest in **protection-equipment** technology...People generally survive a jolt of **electrostatic discharge** from touching a door handle, but computer machinery is not so hardy. ESD has inactivated terminals, damaged CPU components and caused sporadic problems, such as memory loss, pretriggering and function changes. Temperature and humidity control can reduce static charges, but not eliminate them. A study of static-control methods begins on p. 257.

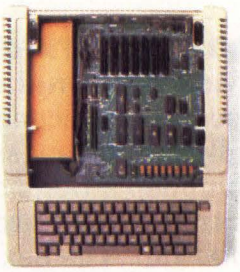
These people had the



Borg-Warner Educational Systems
Educational courseware

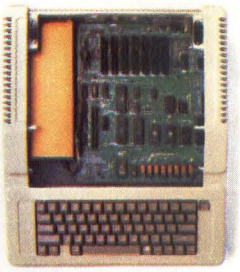


Advanced Information Systems
Computer aided drafting

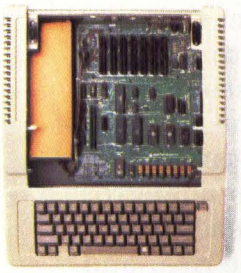


Varian Associates, Inc.
UV Spectrophotometry

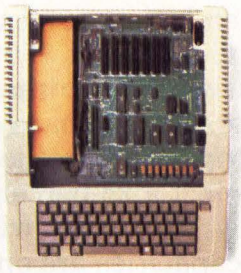
L & S Computers
Personnel Profiling systems



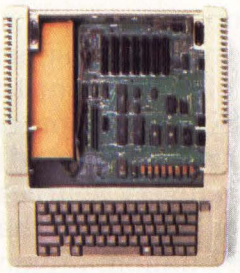
Rockwell International
Truck fleet management



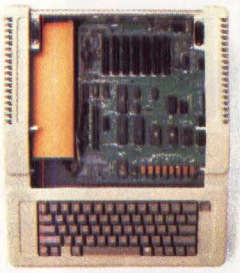
GenTech
Video training



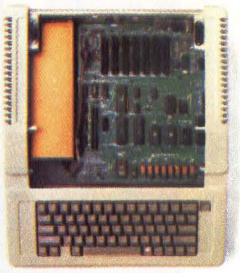
Farmplan Computer Systems Inc.
Agricultural software



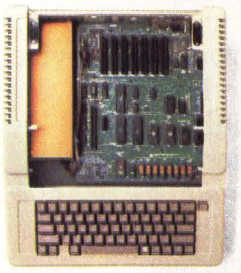
Core Technology
Burroughs terminal emulation



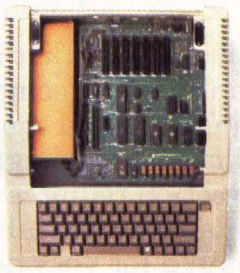
Gerber Scientific Products, Inc.
Computerized engraver



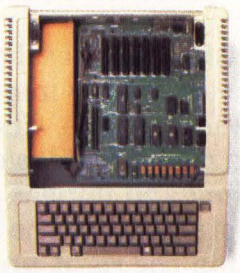
TSI Inc.
Particle sizer data analysis



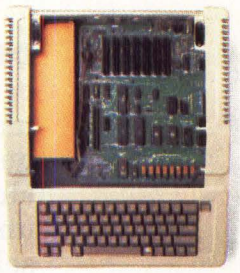
ISI Systems Inc.
Commercial lines rating



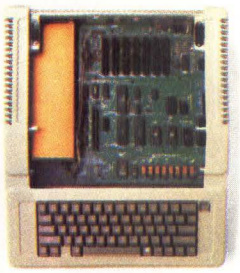
Rhino Robots, Inc.
Educational & research robots



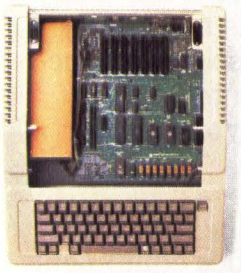
TCD, Inc.
Life insurance illustrations



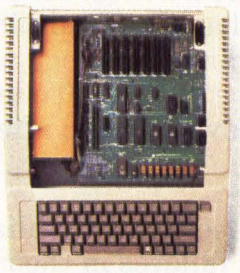
Cascade Graphics Development
Computer aided drafting



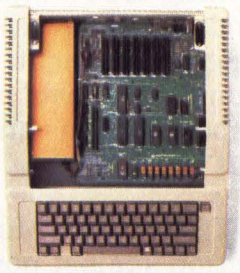
CompCoWare Inc.
Custom instructional software



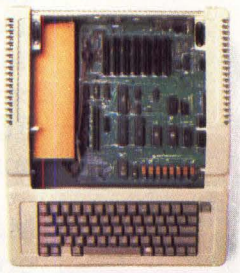
Autographix Inc.
Designs hi-res 35 mm slides



Software Resources, Inc.
Financial investment packages



American Zettler, Inc.
Hospital nursing station



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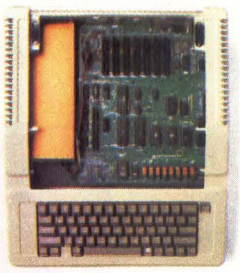
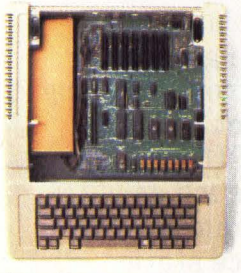
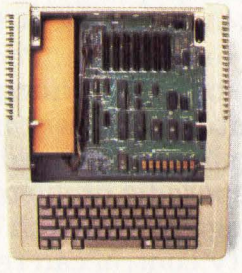


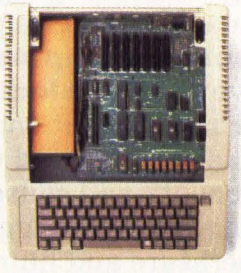
CPHA
Hospital data entry systems



Energy Management Service, Inc.
Residential/commercial
energy analysis

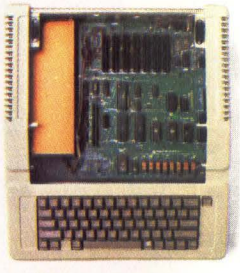


Transportation Concepts
& Services
Nationwide tariff rates



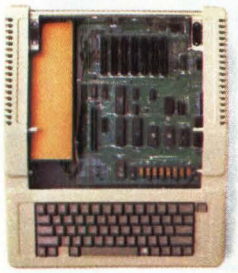
Jarrel-Ash Division, Fisher Scientific Co.
Intelligent color console
for mass spectrophotometer

Vitalograph Medical
Instrumentation
Pulmonary systems on-line spirometer

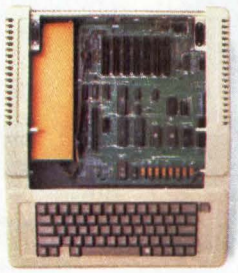


Enterprise Systems, Inc.
Hospital on-line inventory control
purchasing systems

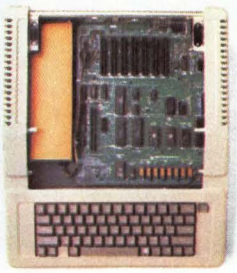
guts to be successful.



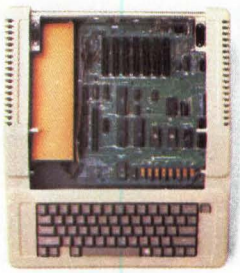
Alltech
Scientific instrumentation



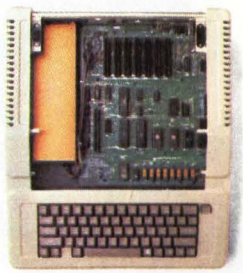
Kwik-Kopy Corporation
Computerized pricing



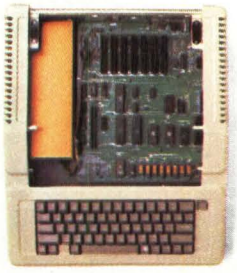
Warren E. Collins
Medical electronics



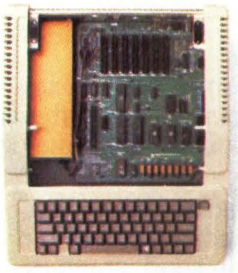
HCI Data
Agricultural software



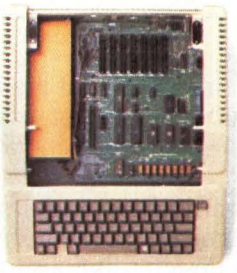
Northwest Instrument Sys., Inc.
Digitizing oscilloscope



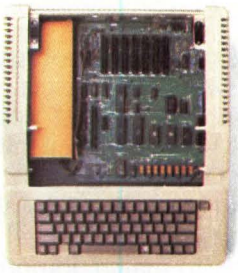
Federal Computer Systems Inc.
Pharmacy package



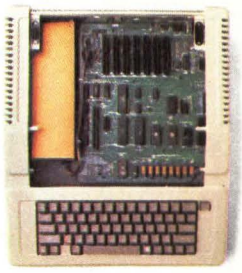
Cyborg Corporation
Lab data acquisition



First Software Corp.
Computer work station for children



Walman Optical
Optisystems



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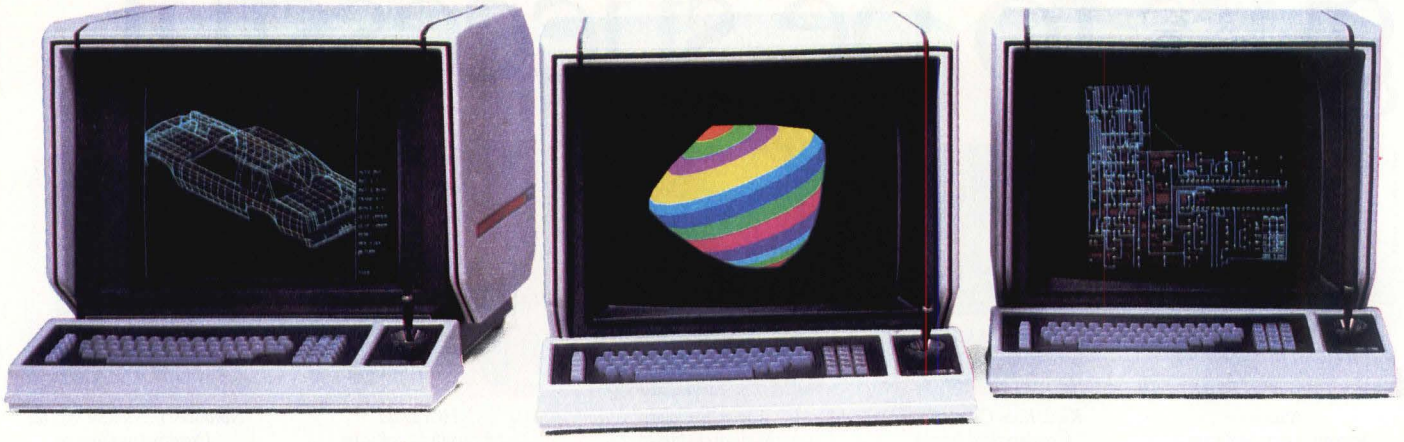

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Operating Systems – CP/M 86® MP/M 86®

Ergonomic Workstations
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DBS 16 Desktop stacked onto unique multi-processor expansion chassis

Multi-Processor Expansion Chassis
Processors – 1 to 4 Intel 80186
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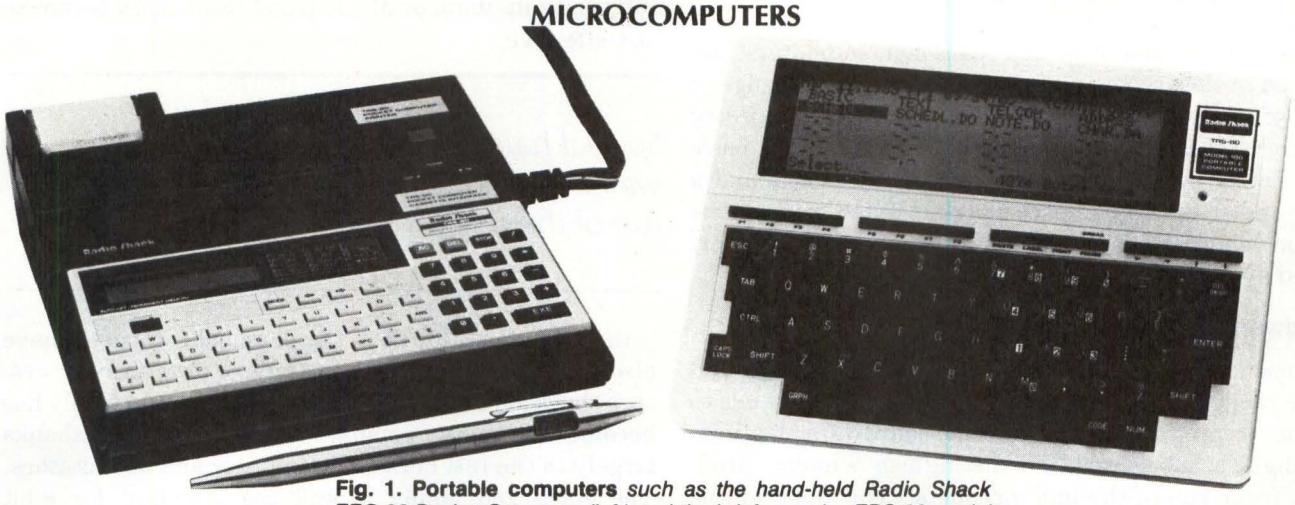


Fig. 1. Portable computers *such as the hand-held Radio Shack TRS-80 Pocket Computer (left) and the briefcase-size TRS-80 model 100 will someday match the storage and display capabilities of desk-top units. Portable units have the CPU power and memory capacities of early desk-top systems but are inherently unable to match their ergonomics.*

Product profile: desk-top personal computers

PATRICK KENEALY

The market settles on standards but technology is moving as quickly as ever

In the mainstream of personal computers—the market for desk-top systems—last year will be remembered as the year for 16-bit hardware. This year, technological microprocessor developments continue unabated, but the big news is still the desk-top market's acceptance of 16-bit machines. Standardization is the key. For the balance of the year, users should expect more defined classes of personal computers to emerge and more de facto hardware and software standards to solidify.

Solid definitions

Desk-top personal computers—sometimes called "professional computers"—are a cohesive class of microcomputer. They provide a user with stand-alone processing, storage and I/O for general-purpose applications. Unlike CPU-plus-terminal micros, such as those offered by Cromemco Inc., Vector Graphic Inc., Ohio Scientific Inc. and others, desk-top personal computers are primarily single-user systems. Unlike the home or "consumer" computers sold by Atari, Timex/Sinclair, Coleco and others, desk-top personal computers feature significant memory and storage in their base configurations and support wide varieties of commercial, scientific, industrial and office-automation software. And unlike the portable Sony Corp., Panasonic Co., Azurdata Inc., Sharp Electronics Corp. or Tandy (Radio Shack) Inc. offerings, even "transportable" desk-top systems don't sacrifice display capacity or other significant functionality for portability (Fig. 1).

The nearly 100 desk-top personal computers described in the accompanying table span a price range of tens of thousands of dollars, but prices cluster pretty tightly around $3500. A user can configure a basic dual-floppy system with 128K bytes of memory and a near-letter-quality impact matrix printer from all the major vendors today, and can assemble a Winchester-based system for roughly $2000 more.

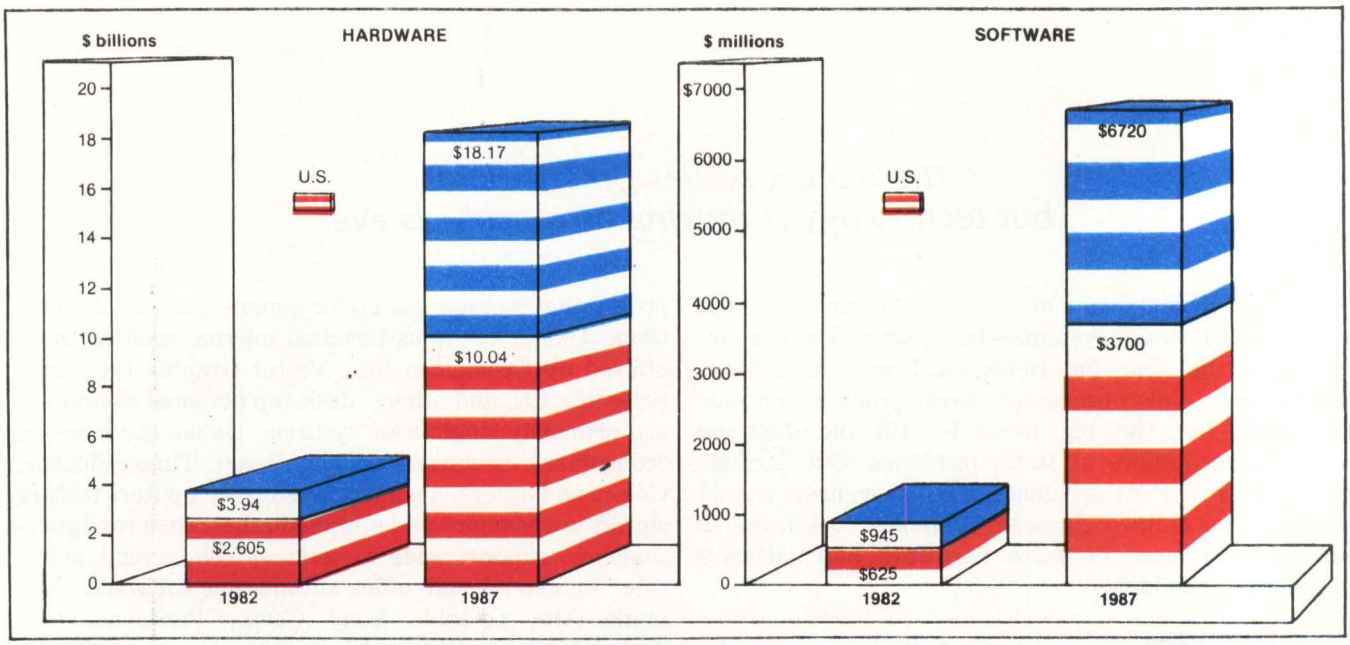
Hardware standards

Basic configuration, generality of application and price range are usually what market researchers use to define a product class. Specific hardware features distinguish subclasses and distinguish winning products from run-of-the-mill products. The data in the product table identifies some de facto hardware standards that were emerging when we last profiled the desk-top personal computer market after the 1982 National Computer Conference.

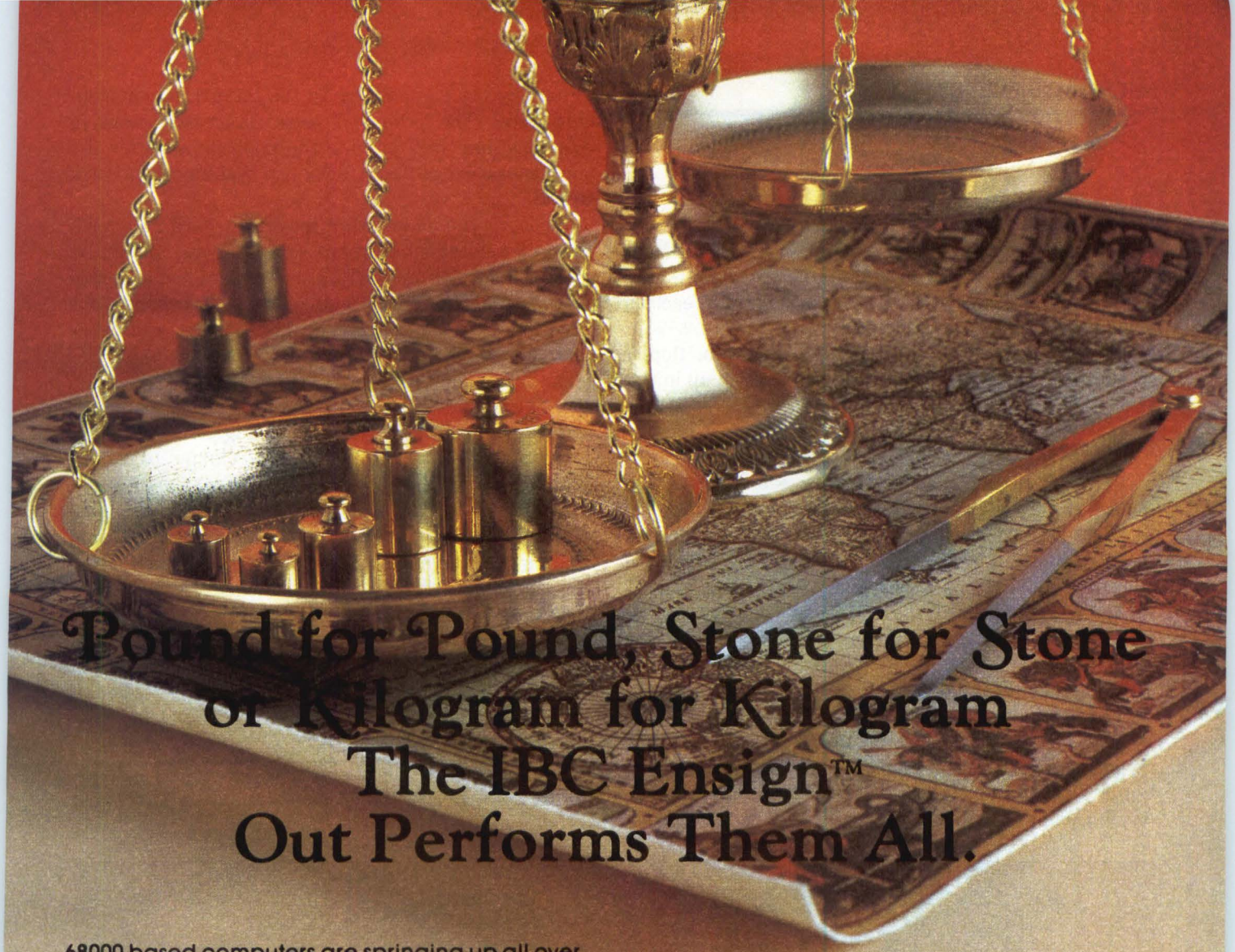
This year, the 12-in. (diagonal) green phosphor display screen remains the overwhelming choice of both users and vendors. The 5 × 7 dot character cell is fast becoming a thing of the past as vendors find that resolution sells systems—to unionized clerical workers as well as executives. Color has an unquestionable appeal in home (entertainment-oriented) systems but is still available only at the expense of resolution or price competitiveness. Color is available on only about a dozen of the systems listed in the table, and often as an option. Larger 15-in. screens are gaining popularity, especially in Europe, but they take up more desk space and are much more expensive subsystems than plentiful 12-in. units. It's likely that U.S. users will continue to favor 12-in. units until flat-panel technology becomes cost-effective.

Special hardware features distinguish winning products from run-of-the-mill products.

CPU standards for desk-top personal computers have also emerged, although the parade of new microprocessors shows no signs of ending. The Intel 8088 family has become the most popular 16-bit processor, thanks largely to the IBM Personal Computer and its imitators. The Zilog Z80 family is still the standard for 8-bit systems and offers a wide range of performance options. The Motorola 16/32-bit MC68000 is used in advanced desk-top systems from Fortune Systems, Wicat Systems and Radio Shack, but its status as "the chip" for state-of-the-art desk-top systems is being challenged by a wave of next-generation micros. Digital Microsystems Inc., Digilog Business Systems Inc. and Nokia Data Inc. are offering advanced 16-bit desk-top systems based around the Intel 80186, and Digital Microsystems also offers an 80286-based desk-top system. Although 32-bit chips are emerging from National Semiconductor Corp., Motorola Inc., Intel Corp., Hewlett-Packard Co., Western Electric and others, it's clear that 32-bit microprocessor standards are still a few years away.



Personal computer spending *(hardware and software) will grow at 44 percent per year through 1987 to reach $25 billion according to Input, a Mountainview, Calif., market research and consulting company. Input estimates that by 1987 more than 24 million personal computers will be installed in the U.S., and that more than 20 percent of the U.S. workforce will use computers daily.*



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68000 based computers are springing up all over the world. But, if you need a 16 bit microcomputer with performance to rival even the largest minicomputers, then you need the IBC Ensign, it out performs them all.

The Ensign is a high performance 16 bit microcomputer employing the most advanced VLSI techniques available along with the ultimate in expandability. The system features support for up to 32 users; up to 8M bytes of proprietary double bit ECC memory; over 1,000M bytes of SMD disk capacity; both cartridge and 9 track magnetic tape support; and operating system support for UNIX™ and OASIS-16™.

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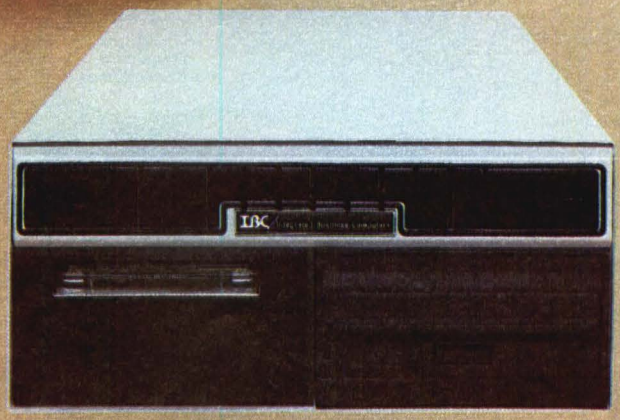

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Storage hardware has standardized around dual-sided floppy disks and low-capacity Winchesters. Most desk-top systems in the product table offer two floppy disk drives with capacities of 160K to 500K bytes each as standard equipment and offer a 5M- to 30M-byte, 5¼-in. Winchester disk drive as an option. Sub-4-in. floppy standards, like 32-bit CPU standards, are still up in the air.

Software standards

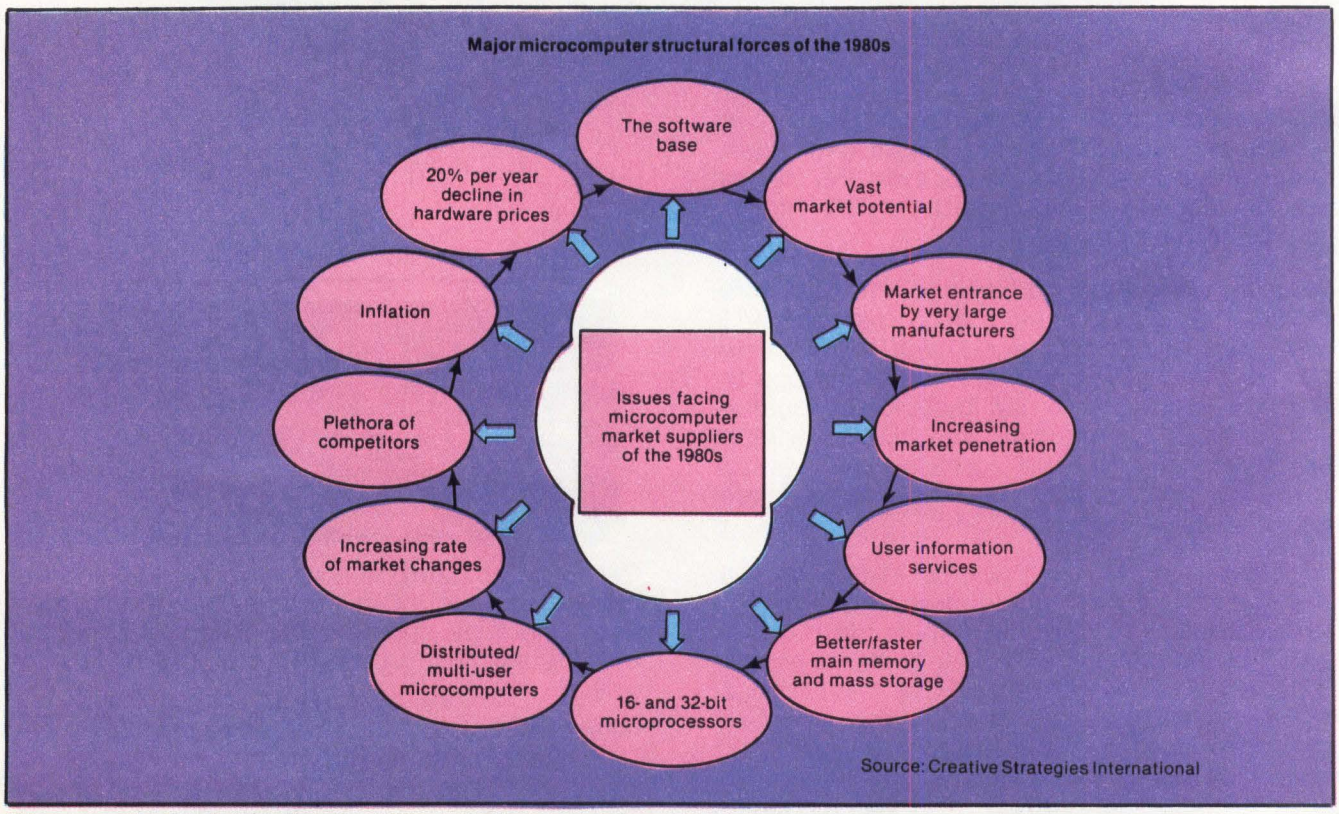
Digital Research's CP/M operating system is the closest thing to an overall standard in the desk-top world. It is the clear standard for 8-bit systems, and its 16-bit version, CP/M-86, is a strong challenger to Microsoft's MS/DOS in the 16-bit world. UNIX and its variants are rulers of the high end, but not to the extent they are in multi-user micro-based systems (MMS, June, p. 151).

A number of "integrated programming environments" are vying for market share in the 16-bit world and should become popular on 16-bit desk-top systems by year-end. Context Management Systems (MBA), Lotus Development Corp. (1-2-3), VisiCorp (VisiOn), Apple Computer Inc. (Lisa) and Microsoft (Microtools) are among the competitors in the integrated environment race. The power of these processor-intensive programs may well provide the main impetus for the new generation of 32-bit desk-top systems mentioned earlier.

Another type of software moving toward standardization is telecommunications software, exemplified by programs such as Cross-Talk, PC-Modem and a host of other commercial and public-domain packages for accessing Dow Jones, Dialog, The Source and other communications networks and databases.

The last major kind of software to affect desk-top personal computers is office-automation software for mainframes and minicomputers. Digital Equipment Corp. (All-in-One), Burroughs Corp. (OFIS-1), Datapoint Corp. (IEOS), HP (IO), IBM (DISSOS), Wang Laboratories Inc. (OIS/Alliance) and Prime Computer Inc. (OAS) are a few of the major data-processing vendors that have software designed to link desk-top personal computers to larger systems. As 8- and 16-bit desk-top personal computer hardware and software standards solidify, tying desk-top systems to minicomputers will become almost as easy as terminal integration is today. With luck, the 32-bit move—when it comes—will be a breeze. □

Patrick Kenealy is a former senior editor for *Mini-Micro Systems*.



Microcomputer developments in the 1980s *will reflect economic, competitive and technological pressures, according to Creative Strategies International, a San Jose, Calif., market-research firm. CSI's recent study identified a U.S. market potential for under-$15,000 microcomputers in excess of 25 million units, and predicted that between 1981 and 1986, microcomputer performance levels will quadruple. Over the same period, prices will fall 20 percent per year.*

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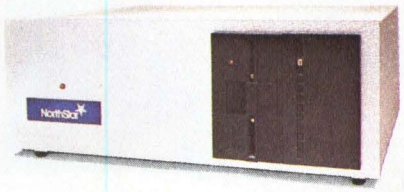

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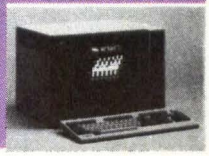
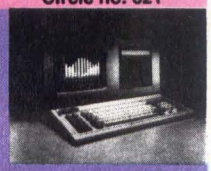
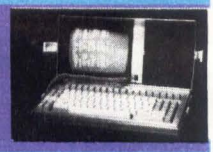
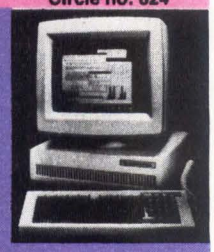
CIRCLE NO. 84 ON INQUIRY CARD

PERSONAL DESK-TOP COMPUTERS

Manufacturer Model	Screen	Auxiliary Storage*	Processor	Software	Price	Notes	
ADDS							**Circle no. 812**
Multivision	12-in.; B & W or green; 80 x 25 format	1 10M- or 15M-byte hard disk, 2 800K-byte floppy disks	8085A-2 with 64K- to 256K-bytes memory	CP/M-compatible OS; WP, inventory, financial planning packages	$3395 (2 350K-byte floppy disks); $10,700 (10M-byte hard disk)		
Apple Computer, Inc.							**Circle no. 813**
IIe	12-in.; green; 40 x 24 format	1 floppy disk	8 bit with 64K-byte memory	Apple DOS, Apple II compatible	$1395		
Apple III	12-in.; green; 80 x 24 format	2 140K-byte floppy disks	6502A with 128K- to 256K-bytes memory	Apple DOS	$2495 (128K); $2695 (256K)		
Lisa	12-in.; 132 x 40 format	2 160K-byte floppy disks	MC68000 32/16 bit with as much as 1M-byte memory	Lisa/calc,/list,/project,/write,/graph,/draw,/terminal	$10,000		
Atari Inc.	Company was announcing new products at press time						**Circle no. 814**
Basic Four Information Systems							**Circle no. 815**
S110	12-in.; green; 80 x 24, 132 x 28 format	2 600K-byte floppy disks	dual Z80s with 128K-byte memory	BB/M, CP/M	$3995	can be used stand-alone or with Basic Four System 210 through 810 computers	
BASIS, Inc.							**Circle no. 816**
Basis 108	80 x 24; 40 x 24 format	2 160K-byte floppy disks	6502, Z80 with 64K- to 128K-bytes memory	Apple II-compatible, CP/M, Pascal, Apple DOS 3.3	$2995	RS232, 1 parallel port; optional display	
BMC Systems							**Circle no. 817**
if800	12-in.; green or 8-color; 80 x 25 format	2 500K-byte floppy disks, optional hard disk	Z80A with 64K- to 256K-bytes memory	CP/M	$3995		
Callan Data Systems							**Circle no. 818**
CD 100M	12-in.; green	1 600K-byte floppy disk, 1 optional			$3450	bare package for OEMs, can be configured with a variety of peripherals	
UNISTAR family, models 100 & 200	12-in.; green	1 600K-byte floppy disk, as many as 3 10M-byte hard disks	68000 with 256K- to 2M-bytes memory	UNIX, C	$9950 (model 100); $13,950 (model 200)	UNISTAR 100 is a single-user version; the UNISTAR 200 supports as many as 4 users, and includes 512K-bytes main memory, a 600K-byte floppy and 20M-bytes hard storage	
STARMATE	12-in.; green	1 600K-byte floppy disk, 3 10M-byte hard disks	68000 with 256K- to 2M-bytes memory	Ryan-McFarland COF operating system, COBOL	$10,950		
Canon USA							**Circle no. 819**
AS-100	12-in.; green or color (8 of 27); 80 x 25 format	2 640K-byte floppy disks, 1 10M-byte hard disk	8088 with 128K- to 512K-bytes memory	CP/M-86, MS/DOS, OASIS-16	$2325 (green); $3025 (color)		

* Storage is 5¼ inches unless otherwise noted

PERSONAL DESK-TOP COMPUTERS

Manufacturer Model	Screen	Auxiliary Storage*	Processor	Software	Price	Notes	
CIE Systems, Inc.							Circle no. 820
680/20	12-in.; green; 80 x 24 format	1 500K-byte floppy disk, 2 10M-byte hard disks	68000 with 256K- to 512K-bytes memory	UNIX III, REGULUS, C	$10,410	includes CRT; keyboard; async controller; 3 RS232, 1 parallel port	
Columbia Data Products, Inc.							Circle no. 821
Columbia VP	9-in.; green; 40/80 x 25 format	2 320K-byte floppy disks	8088 with 128K-byte memory	MS/DOS, CP/M-86, Macro assembler, BASIC, Perfect Calc/Filer/Writer/Speller, Fast graphs, Home Accountant Plus	$2995	IBM compatible; RS232, parallel printer ports	
The Computerist							Circle no. 822
FOCUS	12-in.; green; 80 x 24 standard format, programmable to 150 x 37	2 320K-byte floppy disks	6809 with 64K-byte memory	FLEX, editor, Macro assembler, debugging monitor, compiled and interpreted BASIC	$3995		
Computershop							Circle no. 823
Star-Lite	9-in.; green; 80 x 24 format	2 400K-byte floppy disks	Z80A with 64K-byte memory	CP/M 2.2; Perfect Writer; FORTRAN; Pascal; modem, engineering programs	$2695		
Star-Lite-8	15-in.; amber; 80 x 24 format	2 1.2M-byte, 8-in. floppy disks	Z80 with 64K-byte memory	CP/M 2.2; WP; spread-sheet, modem programs	$3195		
Star-Lite Quad	9-in.; green; 80 x 24 format	2 1.5M-byte floppy disks	Z80 with 64K-byte memory	CP/M; FORTRAN; Pascal; accounting, architecture, engineering programs	$3495	optional special application boards for high-resolution graphics, robotics	
Star-Lite HD20	9-in.; green; 80 x 24 format	1 183K-byte floppy disk, 2 20M-byte hard disks	Z80A with 64K-byte memory	CP/M 2.2; WP; spread-sheet, modem programs	$4995		
Corvus Systems							Circle no. 824
Concept	15-in.; B/W; 90 x 72, 120 x 56 format	1 512K-byte, 8-in. floppy disk; 6M-, 11M-, 20M-byte hard disk (any combination of 2)	68000 with 256K- to 512K-bytes memory	68000 assembler, UC30-Pascal, FORTRAN 77, CP/M emulator, Omninet network package, Edword, LogiCalc	$9000 (includes 512K-byte RAM, 6M-byte hard disk)	system is available with a 73M-byte VCR back-up	
Data General Corp.							Circle no. 825
MPT/100	12-in.; green; 80 x 24 format	2 360K-byte floppy disks	MicroNova with 64K-byte memory	MP/OS, BASIC, FORTRAN, Pascal, editor, debugger	$5350	25M-byte hard disk, other DG peripherals optional	

* Storage is 5¼ inches unless otherwise noted

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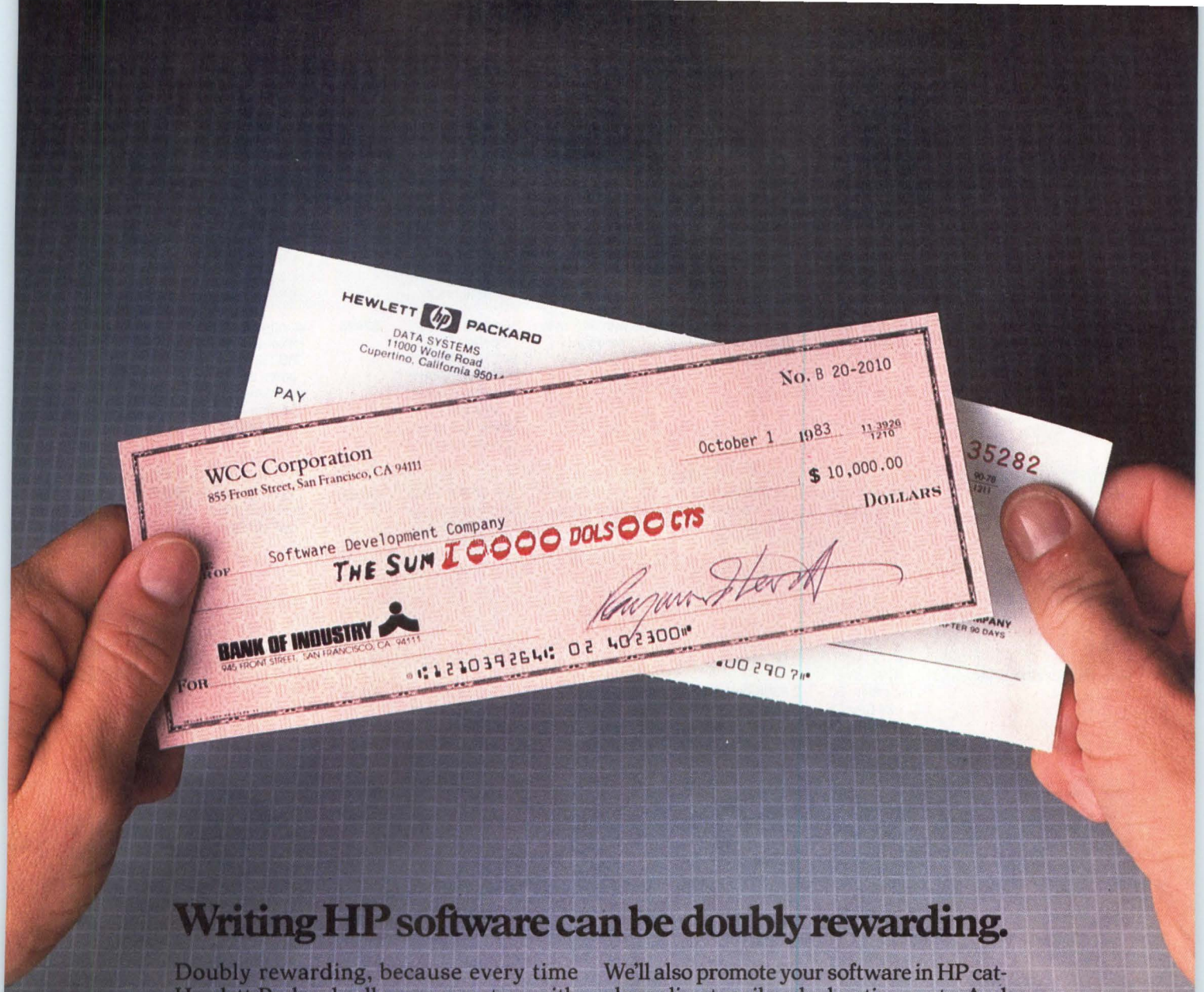
CIRCLE NO. 85 ON INQUIRY CARD

PERSONAL DESK-TOP COMPUTERS

Manufacturer Model	Screen	Auxiliary Storage*	Processor	Software	Price	Notes	
Digilog Business Systems							Circle no. 826
1000	12-in.; green; 80 x 24 format	2 350K-byte floppy disks	Z80A with 64K-byte memory	CP/M standard; Turbo DOS optional	$2995	optional 800K-byte floppy disks; network operation	
1016	12-in.; green; 80 x 24 format	2 350K-byte floppy disks	Z80A with 64K-byte memory; 80186 with 128K- to 256K-bytes memory	CP/M-8; Turbo DOS, CP/M-86 optional	$3995		
DBS-16	14-in.; green; 80 x 25 format	2 350K-byte floppy disks, 1 5M-byte hard disk	80186 with 256K-byte standard memory, 512K-byte optional memory	CP/M-86; MS/DOS, MP/M-86 optional	$3495 without terminal (box-level), $5495 with 5M-byte hard disk	multiuser, multitasking multiprocessor; as many as 16 users; display sells for $1095	
1500	12-in.; green; 80 x 24 format	1 820K-byte floppy disk, 1 5M-byte hard disk	Z80A with 64K-byte memory	CP/M, standard; Turbo DOS, optional	$4995		
1516	12-in.; green; 80 x 24 format	1 820K-byte floppy disk, 1 5M-byte hard disk	Z80A with 64K-byte memory; 80186 with 128K- to 256K-bytes memory	CP/M-80; Turbo DOS, CP/M-86 optional	$5995		
1800	12-in.; green; 80 x 24 format	1 820K-byte floppy disk, 1 5M-byte hard disk	dual Z80As with 128K-byte memory	Turbo DOS	$6995	stand-alone system or 16-user network controller; 10M-byte disk version optional	
1850	12-in.; green; 80 x 24 format	1 820K-byte floppy disk, 1 50M-byte fixed/removable hard disk	Z80A with 64K-byte memory; 80186 with 128K- to 256K-bytes memory	CP/M-80; Turbo DOS, CP/M-86 optional	$17,995		
Digital Equipment Corp.							Circle no. 827
Rainbow 100	12-in.; neutral, B & W; 80 x 24 format	2 400K-byte floppy disks	8088, Z80 with 64K- to 256K-bytes memory	MBASIC, Multiplan, FABS 86, Select 86, 50 packages	$3495	5M-byte hard disk, color monitor, additional floppies optional	
DECmate II	12-in.; monochrome; 80 x 24, 132 x 24 format	2 400K-byte floppy disks	6/20 (PDP-8t) (Z80 optional) with 96K-byte memory	COS 310, DECmate II/WP; CP/M optional	$3745	8-in. floppy disk optional	
Professional 325	12-in.; monochrome; 80 x 24 format	2 400K-byte floppy disks	LSI 11/23 (Z80 optional) with 256K-byte memory	P/OS, VisiCalc, TK! Solver, Fingraff, UCSD p system, 3276 emulator	$3995	standard unit-mapped graphics, standard interface	
Professional 350	12-in.; monochrome; 80 x 24 format	2 400K-byte floppy disks standard, 1 5M-byte hard disk optional	LSI-11/23 with 256K-byte memory	P/OS, 75 packages	$4995	color monitor; bit-mapped graphics; serial, parallel interfaces optional	
Micro/PDP 11	12-in.; monochrome; 80 x 24 format	1 floppy disk, 2 10M-byte hard disks	PDP 11/23+ with 256K- to 4M-bytes memory	PDP, RSX11,+ RT 11, RSTS/E, DSM 11, ZTS 300, Micropower/Pascal	$10,225	standard 256 runs w/VT100 terminals, floor-mounted but can be desk-mounted	

* Storage is 5¼ inches unless otherwise noted



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CIRCLE NO. 86 ON INQUIRY CARD

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BD-02301

PERSONAL DESK-TOP COMPUTERS

Manufacturer Model	Screen	Auxiliary Storage*	Processor	Software	Price	Notes	
Digital Microsystems, Inc.							**Circle no. 828**
DMS 3/F(ox)	9-in.; green; 80 x 25 format	2 307K-byte floppy disks	Z80A with 64K-byte memory	Perfect Writer, Speller, Calc; BASIC, COBOL, PL/1, FORTRAN, Pascal, Microplan, Word Star, DBMS II, payroll, general ledger	$3995	unit attaches to HiNet (LAN); can act as gateway to IBM Univac mainframe, public and private networks, portable	
DMS 15	9-in.; green; 80 x 25 format	1 640K-byte floppy disk, 1 15M-byte hard disk	Z80A with 64K-byte memory	Perfect Writer, Speller, Calc; BASIC; COBOL; PL/1; FORTRAN; Pascal; Microplan; Word Star; DBMS II; payroll; general ledger	$7495	stand-alone for HiNet (LAN), 3 RS232 serial ports, 30 x 3 programmable function keys, portable	
Docutel Olivetti, Corp.							**Circle no. 829**
M20	12-in.; white or green; 80 x 25 format	1 320K-byte floppy disk standard, 1 optional	Z8001 with 128K- to 512K-bytes memory	M20 BASIC-8000 (interpreted version of MBASIC), PCOS	$2965	8-color screen, 11M-byte hard disk optional	
Durango Systems, Inc.							**Circle no. 830**
Poppy	14-in.; green; 80/120 x 24 (plus 3) format	2 830K-byte floppy disks (plus 1 optional), 1 10M- or 20M-byte hard disk	80186 with 128K- to 64K-bytes memory	MS/DOS, CPM 186, MP/M 86, Microsoft BASIC, C, Microsoft Pascal	$4395		
800 series	9-in.; green; 80 x 24, 64 x 16 format	2 1.892M-byte floppy disks standard; 2 floppy disks, 1 7M- or 14M-byte hard disk optional	8085 with 64K- to 192K-bytes memory	DX 85M, CP/M-80	$7645		
900 series	9-in.; green; 80 x 24, 64 x 16 format	1 7M- or 14M-byte hard disk	8-bit with 65K-byte memory	DX-85M, CSTAR-BASIC	$9600	integral solid-font-or dual-mode matrix printer standard	
Poppy II	14-in.; green; 80/120 x 24 (plus 3) format	1 830K-byte floppy disk, 1 10M-byte hard disk standard; 1 floppy disk, 1 20M-byte hard disk optional	80286 (80186 as I/O) with 384K- to 1.158M-bytes memory	XENIX, MS/DOS, CP/M 86, MP/M 86	$9975		
Epic Computer Corp.							**Circle no. 803**
Episode series		as many as 2 floppy disks or 1 20M-byte hard disk	Z80A with 64K-byte memory	SUPER VYZ, CP/M	starts at less than $2000	RS232C port, 16-bit interrupt timer	
Exxon Office Systems							**Circle no. 831**
500 series	12-in.; green; 80 x 24 format	Model 510: 1 600K-byte floppy disk, Model 520: 2 600K-byte floppy disks	Z80 with 64K- to 256K-bytes memory	CP/M; Exxon word-processing, legal-account billing	$6295 (model 510), $9295 (model 520)		
Fortune Systems Corp.							**Circle no. 832**
Fortune 32:16	12-in.; green; 80 x 25 format	1 800K-byte floppy disk; 15M-, 10M- or 20M-byte hard disk	MC68000 with 256K-byte memory	UNIX, BASIC, Pascal, COBOL, FORTRAN, Multiplan	$4995		

* Storage is 5¼ inches unless otherwise noted

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With our new large-screen option, the advantages of Qume's QVT™ family of terminals are even easier to see.

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CIRCLE NO. 87 ON INQUIRY CARD

PERSONAL DESK-TOP COMPUTERS

Manufacturer Model	Screen	Auxiliary Storage*	Processor	Software	Price	Notes	
Franklin Computer Corp.							**Circle no. 833**
ACE 1000	no screen or monitor	1 143K-byte floppy disk, as many as 4 disks optional	6502 with 64K-byte memory	Apple DOS	$1095		
ACE 1200	no screen or monitor	1 143K-byte floppy disk, as many as 4 disks optional	6502, Z80 with 128K-byte memory	Apple DOS, CP/M	$1995		
Fujitsu Microelectronics Inc.							**Circle no. 834**
Micro 16S	RGB color monitor; 40/80 x 25 format	2 320K-byte floppy disks	8086, Z80 with 128K-byte memory expandable to 1M-byte	CP/M-86; WP; spread-sheet applications	$3995	640 x 200 dot-resolution color graphics; serial, parallel printer ports	
Heath Data Systems							**Circle no. 835**
H 89	12-in.; green; 80 x 25 format	1 100K-byte floppy disk	8080 with 48K- to 64K-bytes memory	H DOS, CP/M, FORTRAN, COBOL, Microsoft BASIC, compiler, interpreter	$1399	must be assembled	
HZ 100	12-in.; 8-color; 80 x 25 format	1 320K-byte floppy disk, 1 optional	8088, 8085 with 128K-byte memory expandable to 768K-bytes	ZDOS (16-bit side), CP/M (8-bit side)	$2349	all-in-one monitor, must be assembled	
Hewlett Packard Co.							**Circle no. 836**
HP-87xm	7.88 x 3 in.; B & W; 16/24 x 80 format	1 270K-byte, 3½-in. floppy disk standard; 1 5¼-in. floppy disk optional	HP 8-bit, 4-phase with 128K- to 640K-bytes memory	CP/M, BASIC, HP software	$2995	HPIV built-in interface	
HP-85B	5-in.; B & W; 32 x 16 format	1 32K-byte, 3½-in. floppy disk	HP 8-bit, 4-phase with 32K-byte memory	BASIC, assembly language	$2995	expandable to maximum of 544K bytes ROM	
HP-86B	9-in. or 12-in.; green; 16-24 x 80 format	1 or 2 3½-in. floppy disks	HP 8-bit, 4-phase with 128K-byte memory expandable to 640K bytes	WP, graphics, split-sheet analysis, engineering, statistical analysis, CP/M	less than $3000	HB-IB, Pascal/ FORTRAN key system, Peachtree accounting package optional	
HP-120	12-in.; B & W standard, green optional; 80 x 24 format	various configurations	dual Z80As with 64K-byte memory	CP/M; Series 100/ VisiCalc,/ Graphics,/Word,/ DSN/Link,/BASIC; Condor; Word Star/100; Spell Star/100; Mail Merge/100; Series 100/BPI general accounting,/payroll	$2775 (does not include disks)		
HP-125	12-in.; B & W standard, green optional; 80 x 24 format	various configurations	dual Z80As with 64K-byte memory	see HP-120	$2775 (does not include disks)		
Series 200, model 16	9-in.; 80 x 25 format		MC68000 with 128K- to 768K-bytes memory	BASIC, Pascal, HPL, graphics, CAD, CAE, mathematics, MultiFORTH, VisiCalc, forecasting		RS232C, HP-IB inter-faces	

* Storage is 5¼ inches unless otherwise noted

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CIRCLE NO. 89 ON INQUIRY CARD

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- Dual port RS-232-C.

These are a representative few of the multitude of combinations available. But the Series 7000 story isn't over yet. Consider four sizes from which to choose with active areas of 12"x12", 17"x24", 36"x48" and 42"x60" PLUS a complete border for user definable menus — no need for a separate extra-cost menu pad.

All CØMPLØT Series 7000 digitizers are translucent for backlighting. And while the 12-button cursor is standard, single-button cursor, inking/non-inking stylus or magnifying cursors are available. You also get the Houston Instrument commitment to accuracy, ±0.005" right to the edge of the active area. And no demagnetizing (biasing) is ever necessary.

CIRCLE NO. 90 ON INQUIRY CARD

Wouldn't you like to finish the CØMPLØT story? Get complete information on the CØMPLØT Series 7000's scores of user configuration controls.

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PERSONAL DESK-TOP COMPUTERS

Manufacturer Model	Screen	Auxiliary Storage*	Processor	Software	Price	Notes	
Series 200, model 20			MC68000 with as much as 3.9M-bytes memory	BASIC, Pascal, HPL		optional 12-, 9-in. monitors; graphics; keyboard	
Series 200, model 26	7-in.; blue on blue; 50 x 25 format	1 270K-byte floppy disk	MC68000 with 128K- to 2M-bytes memory	HPL, BASIC, graphics, MultiFORTH, FORTRAN, Pascal, assembler, CP/M-68K, C	$9080	300 x 400 dot-resolution graphics, disk drive, HP-IB interface, 8 expansion slots	
Series 200, model 36	12.2-in.; 80 x 25 format	2 264K-byte floppy disks	MC68000 with as much as 2M-bytes memory	BASIC, Pascal, HPL, graphics		HP-IB interface	
Series 200, model 36C	12-in; color; 80 x 25 format	2 270K-byte floppy disks	MC68000 with as much as 2M-bytes memory	BASIC, Pascal, HPL, graphics			
HP-9020B	12.2-in.; monochrome; 80 x 26 format	1 264K-byte floppy disk	32-bit HP 9000 with 512K-byte memory	optional HP 9000 BASIC, HP-UX	$28,250		
HP-9020C	13-in.; color; 80 x 26 format	1 265K-byte floppy disk	32-bit HP 9000 with 512K-byte memory	optional HP 9000 BASIC, HP-UX	$39,855		
HP-9020S	12.2-in.; monochrome; 80 x 26 format	1 264K-byte floppy disk, 1 10M-byte hard disk	32-bit HP 9000 with 1M-byte memory	BASIC; HP-UX; FORTRAN, Pascal compilers; AGP/ DGL graphics	$49,945		
HP-9020T	13-in.; color standard; 80 x 26 format	1 264K-byte floppy disk, 1 10M-byte hard disk	32-bit HP 9000 with 1M-byte memory	BASIC; HP-UX; FORTRAN, Pascal compilers, AGP/ DGL graphics	$65,585		
Hitachi America, Ltd.							**Circle no. 837**
MBE16,000	12-in. monochrome, 13-in. color; 80/40 x 25 format	1 20K-byte floppy disk standard, 1 optional	8088 with 128K-byte memory expandable to 384K bytes	MS/DOS, CP/M 86, Perfect software, Pascal, assembler, BASIC, FORTRAN, COBOL	$2600	640 x 400 dot-resolution graphics; RS232C, parallel printer interfaces	
IBM Corp.							**Circle no. 805**
PC	12-in.; green; 80 x 24 format	1 320K-byte floppy disk, 1 optional	8088 with 48K- to 256K-bytes memory	CP/M, IBM DOS, BASIC, accounting	$3395	variety of IBM and 3rd party software and peripherals available	
PC XT		1 floppy disk, 1 10M-byte hard disk	8088 with 128K- to 640K-bytes memory	DOS 2.0, BASIC, accounting, Multiplan	$4995	8 expansion slots, color or monochrome monitor available	
Intelligent Systems Corp.							**Circle no. 838**
Intecolor 3651-4	13-in.; 8-color; 64 x 32 format	1 90K-byte floppy disk; 2 5¼-in., 2 8-in. floppy disks optional	8088 with 32K-byte memory	FCS	starts at $2945		
ITT UK Basildon							**Circle no. 839**
3030	12-in.; green (color optional); 80/132 x 24 format	1 floppy disk	Z80A, 8086 with 64K- to 256K-bytes memory	CP/M, MP/M; BOS; Micro COBOL; Pascal; FORTRAN; MBASIC; business applications, WP packages		5M- to 60M-byte hard disks, 16-color display, graphics, light pen, foreign keyboards optional	

* Storage is 5¼ inches unless otherwise noted

PERSONAL DESK-TOP COMPUTERS

Manufacturer Model	Screen	Auxiliary Storage*	Processor	Software	Price	Notes	
Intertec Data Systems							**Circle no. 806**
Superbrain II	12-in.; B & W; 80 x 24 format	Superbrain II Jr: 1 175K-byte floppy disk; Superbrain II QD: 1 320K-byte floppy disk; Superbrain II SD: 1 750K-byte floppy disk	dual Z80As with 64K-byte memory	Microsoft BASIC, CP/M	$2495, (Superbrain II Jr.); $2995, (Superbrain II QD); $3495, (Superbrain II SD)	2 RS232 serial ports, keyboard, monitor	
Jonos Corp.							**Circle no. 807**
C2100	9-in.; green; 80 x 25 format	2 322K-byte, 3½-in. floppy disks	Z80A with 65K-byte memory	CP/M 2.2, BASIC-80, Multiplan, Spellbinder, Spellcheck	$3195	portable	
C2150	9-in.; green; 80 x 25 format	2 322K-byte, 3½-in. floppy disks	Z80B with 128K-byte memory	CP/M Plus	$3595		
C4100	12-in.; green; 80 x 25 format	2 322K-byte, 3½-in. floppy disks	Z80A with 64K-byte memory	CP/M, Spellbinder, Spellcheck, BASIC-80, Multiplan	$3995		
C4500	12-in.; green standard; 80 x 25 format	1 5M-byte, 3.9-in. removable hard disk; 1 5M-byte fixed hard disk	Z80B with 128K-byte memory	CP/M, BASIC-80, Multiplan, Spellbinder, Spellcheck	$5995		
Kaypro Division of Non-Linear Systems, Inc.							**Circle no. 840**
Kaypro II	9-in.; green; 80 x 24 format	2 191K-byte floppy disks	Z80 with 64K-byte memory	Perfect Writer, Speller, Calc, Filer; CP/M 2.2, S-BASIC, Profit Plan, MBASIC	$1795		
Lanier Business Products, Inc.							**Circle no. 841**
EZ-1/Computer eze	12-in.; green; 80 x 27 format	2 floppy disks	8-bit	CP/M, 3270/SNA, EZ-Task, Data Manager, BASIC II, Business BASIC, EZ Spell, WP package	$4995		
Micro Source							**Circle no. 842**
M6000 P	9-in.; green, color optional; 80 x 24 format	2 386K-byte floppy disks; 10M-, 20M-, 30M-byte hard disk optional	Z80, 68000 with 64K-byte memory expandable to 512K bytes	CP/M 2.2	$3900		
NEC Information Systems, Inc.							**Circle no. 843**
Advanced Personal Computer	12-in.; green, color optional; 80 x 25 format	1 1M-byte, 8-in. floppy disk standard; 1 floppy disk, 210M-byte hard disks optional	NEC 8086-compatible with 128K- to 640K-bytes memory	CP/M-86, MS/DOS, Accounting Plus, Benchmark, Microplan, dBase II, graphics, communications	$2748		
Nokia Data							**Circle no. 844**
Nokia PC	15-in.; white phosphor; 80/132 x 27 format	2 320K-byte floppy disks	80186 with 128K-byte memory expandable to 786K bytes	MS/DOS, network operating system optional		arithmetic co-processor, graphics optional	
North Star Computers Inc.							**Circle no. 845**
Advantage	12-in.; green; 80 x 24 format	2 floppy disks	Z80A with 64K-byte memory	CP/M	$2999		

* Storage is 5¼ inches unless otherwise noted

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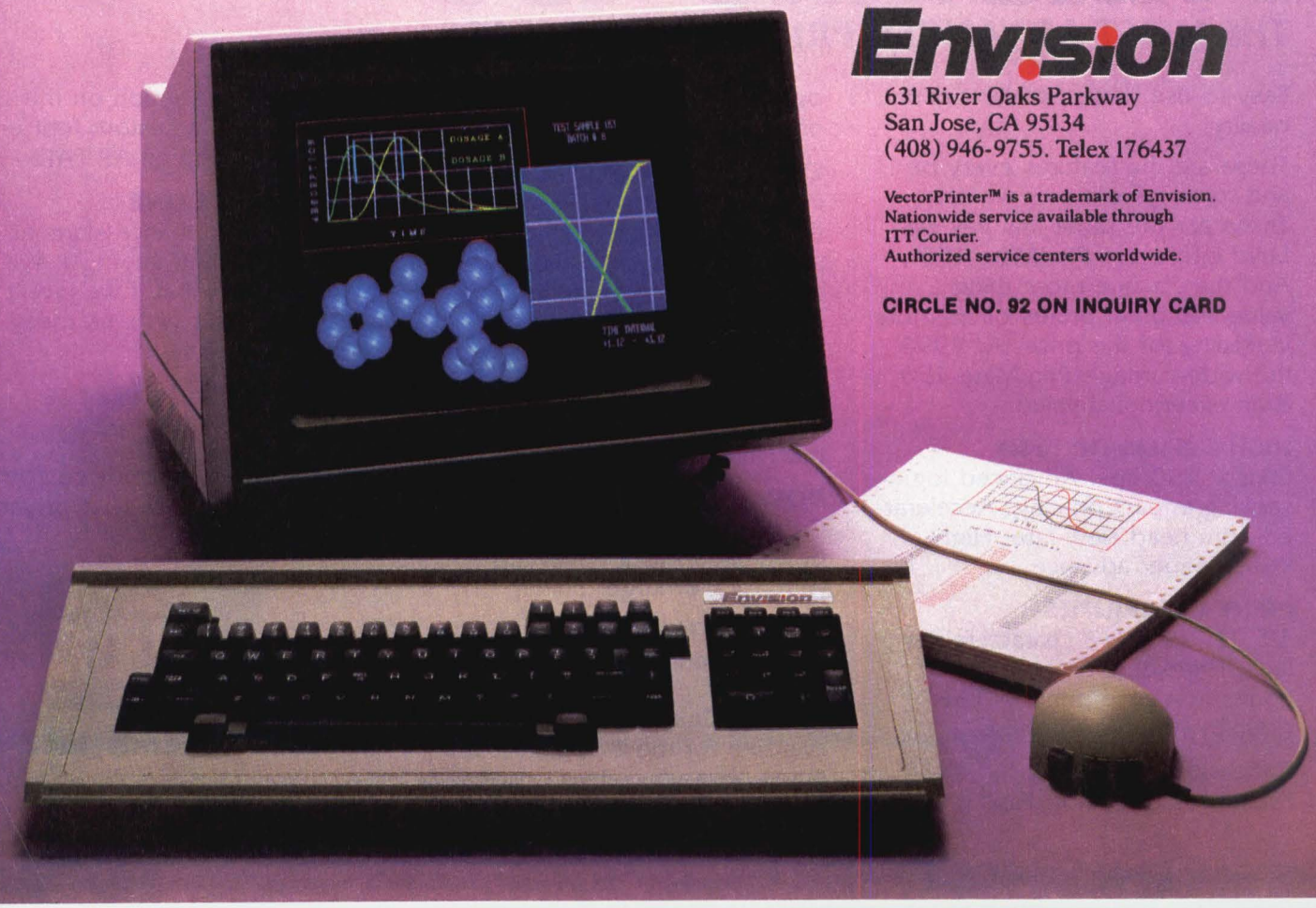

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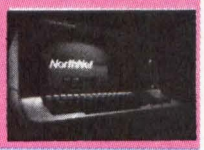
CIRCLE NO. 92 ON INQUIRY CARD

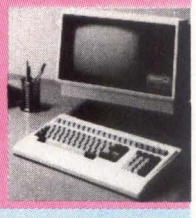
PERSONAL DESK-TOP COMPUTERS

Manufacturer Model	Screen	Auxiliary Storage*	Processor	Software	Price	Notes	
Advantage 8116	12-in.; green; 80 x 24 format	2 360K-byte floppy disks standard; 1 5M-byte floppy disk, 1 hard disk optional	8088, Z80 with 128K- to 320K-bytes memory	CP/M, GDOS/ BASIC, ASP, MS/ DOS, graphics	$3399		
Ontel Corp.							**Circle no. 846**
Visual/1050	12-in.; green; 80 x 25, 640 x 300 bit-mapped graphic format	2 400K-byte floppy disks	Z80A, 6502 with 96K-byte memory	CP/M, WP; spread-sheet, business graphics	$2695 (Q1)	VT100 emulation	
1505	15-in.; white, green, amber; 80 x 25 format	1 1M-byte floppy disk	8085A with 64K-byte memory	MDOS, HDOS, CP/M	$3000 (OEM price)		
Onyx Systems, Inc.							**Circle no. 847**
Sundance	12-in.; green; 80 x 24, 132 x 24 format	1 10M-byte, ¼-in. cartridge tape; 1 7M-, 14M- or 21M-byte hard disk	Z80A with 64K-byte memory	CP/M, OASIS, COBOL, BASIC, Onyx business-applications software	$6960	multi-user Sundance II also available	
Osborne Computer Corp.							**Circle no. 848**
Osborne 1	5-in.; green; 52 x 24 format	2 102K-byte floppy disks	Z80A with 64K-byte memory	CP/M, Word Star, Mail Merge, SuperCalc, CBASIC, MBASIC	$1795		
Executive	7-in.; amber on black or black on amber; 80 x 24 format	2 floppy disks	Z80A with 128K-byte memory	UCSD p system	$2495		
Otrona Corp.							**Circle no. 849**
Attache	5.5-in.; green; 80 x 24, 40 x 24 format	2 180K-byte floppy disks	Z80A with 64K-byte memory (plus 10K-byte dedicated graphics memory)	CP/M, Word Star, BASIC compiler, Charton, Pascal, FORTRAN, COBOL, FORTH, C, VALET	$2995	a 19.5-lb. portable computer; VDC power adaptor, battery pack optional; graphic, special character sets standard	
Paradyne Corp.							**Circle no. 850**
VIP Personal Computer	15-in.; green; 80 x 25 format	2 640K-byte floppy disks	8086 with 128K-byte memory	MS/DOS, BASIC, COBOL, FORTRAN, Pascal, assembler	$3500	light-pen, security key lock optional	
Radio Shack							**Circle no. 851**
TRS-80, Model 4	12-in.; B & W; 80 x 24 format	2 184K-byte floppy disks	Z80A with 64K- to 128K-bytes memory	TRSDOS, LDOS, CP/M, WP, accounting, spread sheet, Microsoft BASIC TRS-80 Model III software	$1999	RS232C, parallel printer interfaces standard; cassette-based system, reverse video feature, forms command optional	
TRS-80, Model 12	12-in.; green; 80/40 x 24 format	2 1.25M-byte hard disks, as many as 4 12M-byte hard disks optional	Z80A with 80K-byte memory	TRSDOS, TRS-80 compatible, accounting, WP, VisiCalc	$3199	1 parallel, 2 RS232 serial ports standard	
TRS-80, Model 16	12-in.; green; 80 x 24 format	1 1250K-byte, 8-in. floppy disk; 1 optional	MC68000; Z80A with 128K- to 512K-bytes memory	TRSDOS, TRS-80 ARCNET, TRS-80 Model II software	$4999	automatic scroller, slave terms, hard disks, other peripherals optional	

* Storage is 5¼ inches unless otherwise noted

PERSONAL DESK-TOP COMPUTERS

Manufacturer Model	Screen	Auxiliary Storage*	Processor	Software	Price	Notes
TRS-80, Model 100	LCD; 40 x 8 format		8-bit 80C85 CMOS with 8K-byte memory expandable to 32K-bytes	BASIC, WP	$799	built-in modem, software, calendar, phone directory, automatic dialer; RS232C interface; a 24K-byte version is available for $999
Sanyo Business Systems Corp.						**Circle no. 852**
MBC 1000	12-in.; green; 80 x 25 format	1 328K-byte floppy disk	Z80A with 64K-byte memory	CP/M, SBASIC II, Pascal/M, COBOL-80, FORTRAN-80, BASIC-80	$1995	Centronics printer port, RS232C port
MBC 1200, 1250	12-in.; green; 80 x 33/40 format	MBC 1200: 1 640K-byte floppy disk; MBC 1250: 2 640K-byte floppy disks	dual Z80As with 64K-byte memory	CP/M, SBASIC II, Pascal/M, COBOL-80, FORTRAN-80, Macro-80, BASIC-80	$2495 (model 1200); $2995 (model 1250)	Centronics printer port, RS232C port, 640 x 400 dot-resolution graphics
MBC 4000, 4050	12-in.; green; 80 x 25 format	MBC 4000: 1 640K-byte floppy disk; MBC 4050: 2 640K-byte floppy disks	8086 with 128K-byte memory expandable to 512K bytes	CP/M-86 with ASM-86; ED, DDT-86, BASIC; GOAL; MS/DOS optional	$3295 (model 4000); $3995 (model 4050)	Centronics printer port, RS232C port
Sharp Electronics Corp.						**Circle no. 853**
PC 5000	LCD; 80 x 8 format	2 320K-byte floppy disks	8088 with 128K- to 256K-bytes memory	MS/DOS 2.0, 6W BASIC	$2500 (without disks)	built-in printer optional; 128K-byte bubble module, WP package, flip-up display
Solo Systems						**Circle no. 854**
1116 workstation	15-in.; green; 102 x 47 format (lg. character), 144 x 70 format (sm. character)	2 5M-byte cartridge disks	68000 with .5M-byte memory	COBOL programming tools including editor, viewer, compiler, verifier, profiler, comparator, diagrammer, cross-referencer	$30,000	1024 x 704 bit-mapped display
Sony Microcomputer Products Division						**Circle no. 855**
SMC 70	12 in.; green or color; 80 x 25 format	2 280K-byte, 3½-in. floppy disks optional	Z80A (8086 optional) with 64K to 256K-byte memory, (38K-byte graphics memory)	CP/M, VisiCalc, C B80, Sony BASIC; WP, accounting, DBM languages	$1475	SMC 70 G version overlays graphics onto video
Sord Computers of America						**Circle no. 856**
M23	12-in. (14-in. LCD); green or color; 80 x 25 format	1 3½-in., 330K-byte floppy disk; 1 1M-byte, 8-in. floppy disk	Z80A with 128K-byte memory	SB-80 converter, BASIC, FORTRAN, UCSD Pascal, assembler	$2530 (green), 3075 (color)	portable with 3½-in. disk; PIP III programming language; high resolution graphics
M23 Mark V	12-in.; green; 80 x 25 format	2 1M-byte, 8-in. floppy disks	Z80A with 128K-byte memory	PIPS, BASIC, Sord operating system, COBOL, UCSD Pascal, FORTRAN	$3785	arithmetic processing unit, graphics capability



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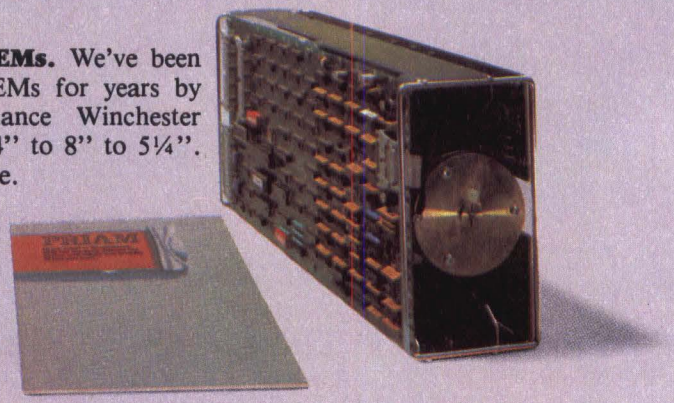

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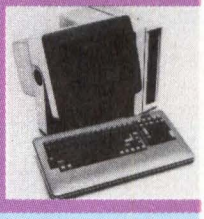
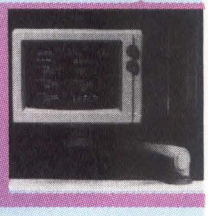
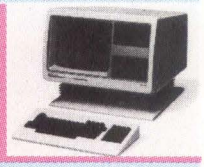
CIRCLE NO. 93 ON INQUIRY CARD

PERSONAL DESK-TOP COMPUTERS

Manufacturer Model	Screen	Auxiliary Storage*	Processor	Software	Price	Notes	
M23 Mark X	12-in.; green; 80 x 25 format	1 1M-byte, 5-in. floppy disk; 1 7.5M-byte, 5-in. hard disk	Z80A with 128K-byte memory	PIPS, BASIC, Sord operating system, BASIC, UCSD Pascal, FORTRAN	$6215	arithmetic processing unit, graphics capability	
M343 Series	12-in.; green; 80 x 25 format	2 1.2M-byte, 5-in. floppy disks	8086 with 256K-byte memory	RDOS, RMDOS, MBASIC, PIPS, FORTRAN-77, assembler, debugger	starts at $5800	4 RS232, 1 parallel port; 640 x 400 graphics, four models with different mass storage options, 8-color monitor	
M68	12-in.; green or color; 80 x 25 format	2 1.2M-byte floppy disks	Z80A, 68000 with 64K- to 256K-bytes memory	PIPS III	$4895 (includes PIPS III language, color monitor)	2 serial I/O ports, 1 Centronics-compatible printer port, 1 IEEE-488 interface	
Teleram Communications Corp.							**Circle no. 857**
T3000	8.25- x 1.1-in. LCD; 80 x 4 format	1 128K-byte to 256K-byte bubble	Z80L with 64K-byte memory	CP/M	$2495	attachable monitor, additional floppy disk	
TeleVideo Systems, Inc.							**Circle no. 858**
TS 1602	12-in.; green; 80 x 24 format	2 500K-byte floppy disks	8088 with 128K-byte memory expandable to 256K bytes	CP/M-86	$4495		
TS 802	12-in.; green; 80 x 25 format	2 500K-byte floppy disks	Z80A with 64K-byte memory	CP/M, Word Star, CalcStar	$3495	model 802H features 1 500K-byte floppy disk, 1 10M-byte hard disk	
TS 803	14-in.; green; 80 x 24 format	2 .5M-byte floppy disks	Z80A with 64K-byte memory expandable to 128K bytes	CP/M	$2495		
TS 1603	14-in.; green; 80 x 24 format	2 1M-byte floppy disks	8088 with 128K-byte memory	CP/M 86, MS/DOS	$2995		
Texas Instruments, Inc.							**Circle no. 859**
Professional Computer	12-in.; monochrome; 80 x 25 format	1 320K-byte floppy disk	8088 with 64K-byte memory	MS/DOS, CP/M, CP/M-86, UCSDp, accounting, financial modeling, DBM, WP, graphics packages	$2595	13-in. color display, 720 x 300 resolution graphics, voice management, natural language optional	
Toshiba America, Inc.							**Circle no. 860**
T-250	12-in.; green; 80 x 24 format	2 1M-byte, 8-in. floppy disks standard; 1 1M-byte and 1 5M-byte hard disk optional	8085A with 64K-byte memory	CP/M, MBASIC, GBASIC	$3995		
T-100	12-in. green standard, 14-in. color optional; 80 x 25 format	2 560K-byte floppy disks	Z80A with 64K-byte memory	CP/M, WP, financial planning, productivity software, T-BASIC, C Basic, T-disk BASIC	prices start at $1995		

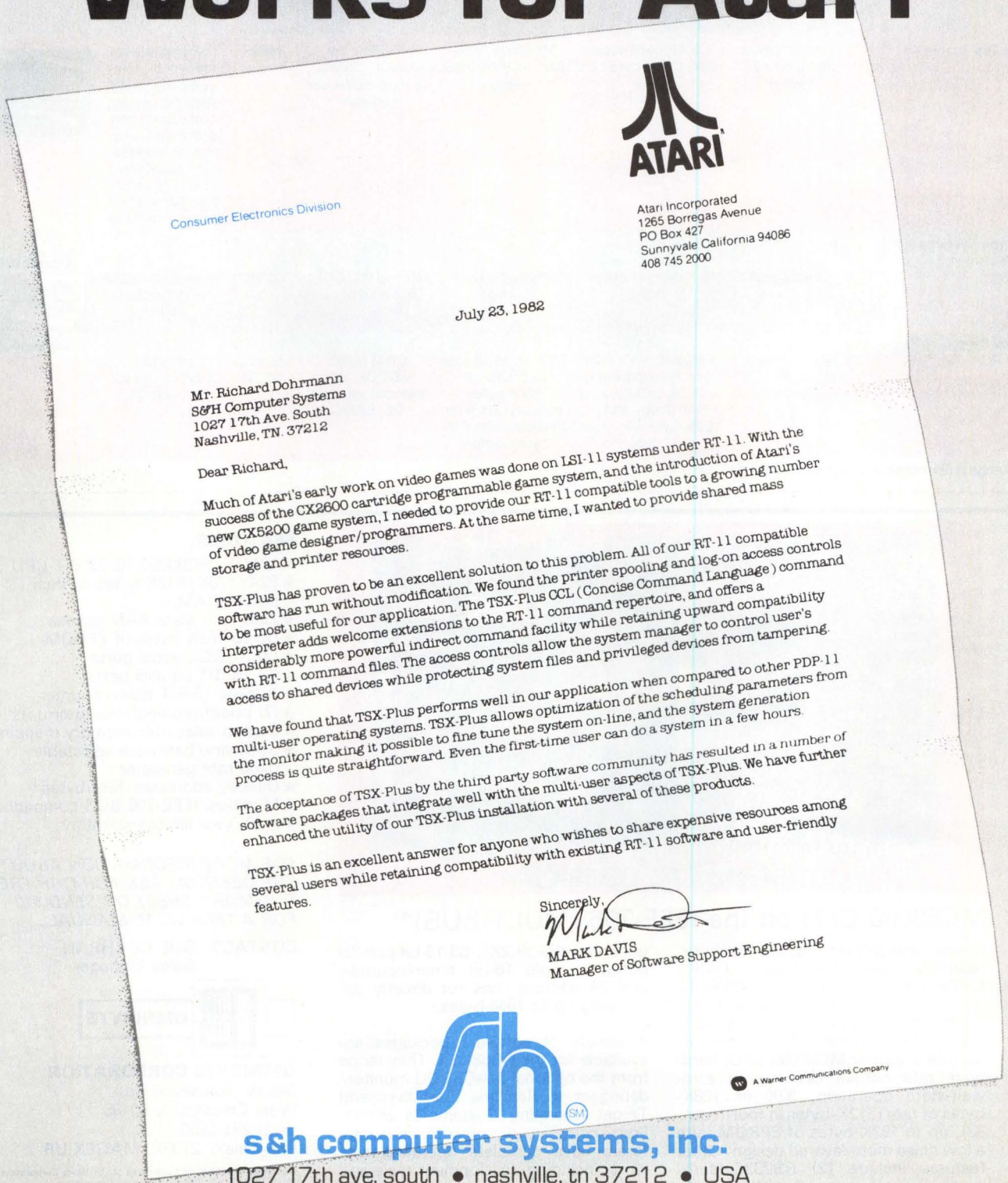
* Storage is 5¼ inches unless otherwise noted

PERSONAL DESK-TOP COMPUTERS

Manufacturer Model	Screen	Auxiliary Storage*	Processor	Software	Price	Notes	
T-300	12-in. green standard, 14-in. color optional; 80 x 25 format	1 640K-byte floppy disk standard; 1 optional	8088 with 192K-byte memory expandable to 512K bytes	CP/M, MS/DOS with T-BASIC 16, C-BASIC-86	prices start at $2495		
EW-100	12 in.; green; 80 x 24 format	2 1M-byte, 8-in. floppy disks	8085 with 64K-byte memory	CP/M, MicroPlan, Analyst	start at $5495		
Victor Technologies, Inc.							**Circle no. 861**
9000 series	12-in.; green; 80/132 x 32 format	2 600K-byte floppy disks or 1 10M-byte hard disk, 1 2M-byte floppy disk	8088 with 128K- to 896K-bytes memory	CP/M-86, MS/DOS, CBASIC, CISCOBOL, Pascal, FORTRAN, BASIC, Victor-writer, Word Star, VictorCalc, business software	$3495 to $5995	graphics capabilities, amplifier, speaker, CODEC (coder-decoder)	
Wang Laboratories, Inc.							**Circle no. 862**
Professional Computer	12-in.; B & W; 80 x 25 format	1 360K-byte floppy disk standard, 1 10M-byte hard disk optional	8086 with 128K-byte memory	MS/DOS, BASIC interpreter, diagnostics, DBM, CP/M-80, P system, graphics, WP, third party software	$2595		
Wicat Systems, Inc.							**Circle no. 863**
150 WS	12-in.; green; 80 x 24 format	1 960K-byte floppy disk; 1 10M-, 15M-, 33M- or 45M-byte hard disk	MC68000 with 256K- to 512K-bytes memory	MCS, UNIX, CP/M emulator	$9450	1-6 users, 6-slot chassis	
Xerox Corp., Office Products Division							**Circle no. 809**
820	80 x 24 format			CP/M			
820-II	12-in.; white on black; 80 x 24 format	2 346K-byte floppy disks	Z80A with 64K-byte fixed memory	enhanced CP/M			
Zentec Corp.							**Circle no. 810**
	12-in.	1 738K-byte floppy disk, 1 optional	8086 with 16K- to 1M-byte memory	UNIX		8087 arithmetic chip is optional	
Zenith Data Systems							**Circle no. 864**
Z89	12-in.; green; 80 x 25 format	1 100K-byte floppy disk	8080 with 48K-byte memory	MDOS, CP/M, FORTRAN, COBOL, Microsoft BASIC, compiler, interpreter	$1999		
Z90	12-in.; green; 80 x 25 format	1 160K-byte floppy disk	8080 with 64K-byte memory	HDOS, CP/M, FORTRAN, COBOL, Microsoft BASIC, compiler, interpreter	$2499		
Z100	12-in.; 8-color; 80 x 25 format	1 320K-byte floppy disk, 1 optional	8088, 8085 with 128K- to 768K-bytes memory	ZDOS (16-bit side), CP/M (8-bit side)	$3599	integral 5-slot S-100 expansion chassis, all-in-one monitor	

* Storage is 5¼ inches unless otherwise noted

TSX-PLUS™
Works for Atari



ATARI

Consumer Electronics Division

Atari Incorporated
1265 Borregas Avenue
PO Box 427
Sunnyvale California 94086
408 745 2000

July 23, 1982

Mr. Richard Dohrmann
S&H Computer Systems
1027 17th Ave. South
Nashville, TN. 37212

Dear Richard,

Much of Atari's early work on video games was done on LSI-11 systems under RT-11. With the success of the CX2600 cartridge programmable game system, and the introduction of Atari's new CX5200 game system, I needed to provide our RT-11 compatible tools to a growing number of video game designer/programmers. At the same time, I wanted to provide shared mass storage and printer resources.

TSX-Plus has proven to be an excellent solution to this problem. All of our RT-11 compatible software has run without modification. We found the printer spooling and log-on access controls to be most useful for our application. The TSX-Plus CCL (Concise Command Language) command interpreter adds welcome extensions to the RT-11 command repertoire, and offers a considerably more powerful indirect command facility while retaining upward compatibility with RT-11 command files. The access controls allow the system manager to control user's access to shared devices while protecting system files and privileged devices from tampering.

We have found that TSX-Plus performs well in our application when compared to other PDP-11 multi-user operating systems. TSX-Plus allows optimization of the scheduling parameters from the monitor making it possible to fine tune the system on-line, and the system generation process is quite straightforward. Even the first-time user can do a system in a few hours.

The acceptance of TSX-Plus by the third party software community has resulted in a number of software packages that integrate well with the multi-user aspects of TSX-Plus. We have further enhanced the utility of our TSX-Plus installation with several of these products.

TSX-Plus is an excellent answer for anyone who wishes to share expensive resources among several users while retaining compatibility with existing RT-11 software and user-friendly features.

Sincerely,

MARK DAVIS
Manager of Software Support Engineering

A Warner Communications Company

s&h computer systems, inc.

1027 17th ave. south • nashville, tn 37212 • USA
(615) 327-3670 • telex 786577 S&H NAS

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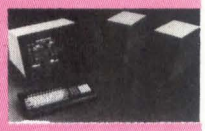
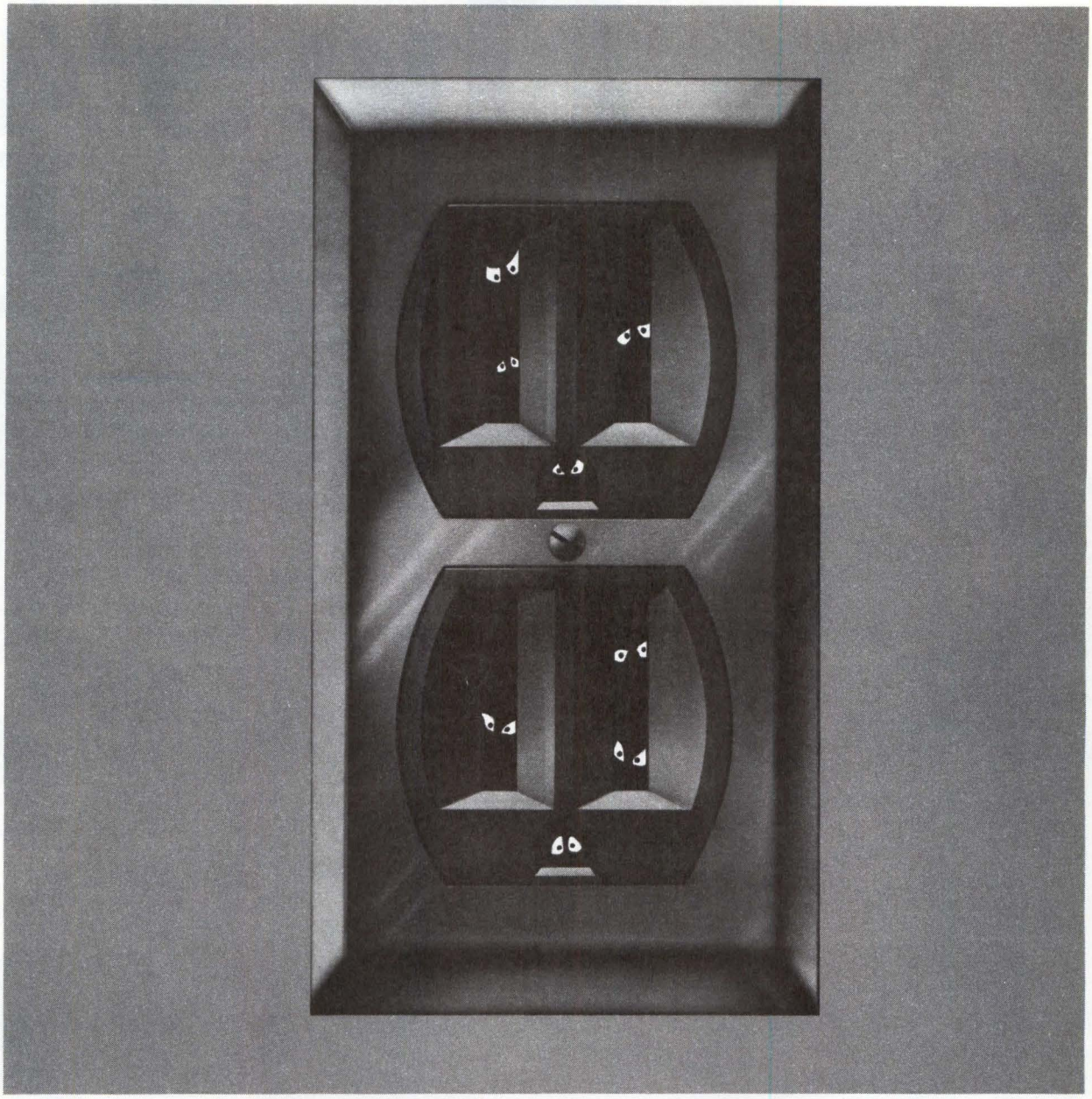
PERSONAL DESK-TOP COMPUTERS

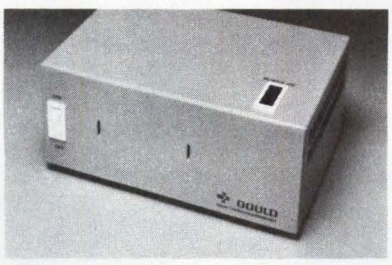
Manufacturer Model	Screen	Auxiliary Storage*	Processor	Software	Price	Notes	
Codex/Motorola Inc.							**Circle no. 754**
CDX-269, model 25	15-in; amber or or green; 80 × 25 format	2 650K-byte floppy disks	MC6809E with 192K- to 384K-bytes memory	UNIX-like OS, COBOL, BASIC, various mult-user software	$5995	can be expanded to multi-user, shared-logic system, communication with mainframe, remote workstation capability, shared file management system, printer interface	
CDX-268, model 45	15-in.; amber or green; 80 × 25 format	1 650K-byte floppy disk, 1 15M-byte hard disk	MC6809E with 192K- to 384K-bytes memory	UNIX-like OS, COBOL, BASIC, various multi-user software	$8995	expandable to multi-user, telecommunicating hatch processing, communication with mainframe, remote workstation capability, shared file management system, printer interface	
Monroe Systems for Business							**Circle no. 811**
OC8820	9-in., 24 × 80	2 320K-byte floppy disks	Z80A with 128K-memory	Monroe OS, CP/M, BASIC, Pascal	$3895	includes 3 RS232 ports, amber screen	
Xerox Corp.							**Circle no. 755**
16/8 PC	12-in.; white or black; 80 × 24 format	2 482K- to 980K-byte, 8-in. floppy disks or 1 48.2K- to 980K-byte, 8-in. floppy disk, 1 8.2M-byte, 8-in. hard disk	8086 on 16-bit side with 128K- to 256K-bytes memory; Z80A on 8-bit side with 64K-byte memory	CP/M-80/86, MS/DOS, WP, financial analysis, DB, BASIC	starts at $2300	simultaneous processor operation	

* Storage is 5¼ inches unless otherwise noted

PROTECT YOUR COMPUTER AGAINST GLITCHES, SPIKES, TRANSIENTS, AND DIPS.



Who knows what evil lurks inside the typical AC power outlet?
We do.



Voltages that fluctuate, sine waves that distort, and a wide variety of electronic noise caused by disturbances on the line.

For a computer memory, any one of those problems could be the end of the line. And for you perhaps the end of several hours of programming, calculations, or word processing.

That's why you need the Gould **Personal Conditioner.™** It's a compact, inexpensive version of the line conditioners we sell to large computer users.

The **Personal Conditioner™** eliminates voltage surges and dips, and filters out power line noise. Yet it's only 7½ inches wide, 3¼ inches high, and costs just $150.

A small price to pay for such important protection.

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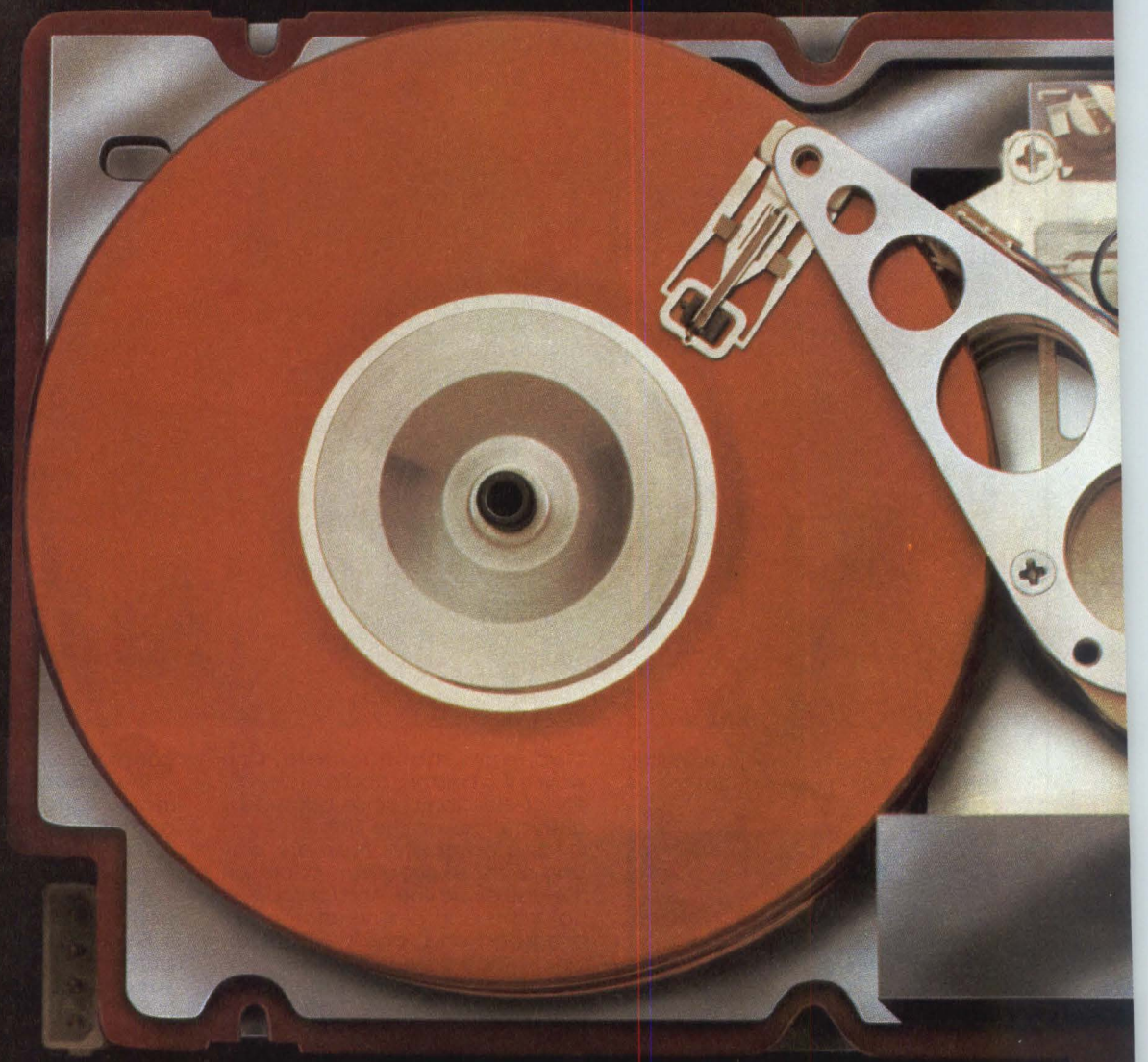
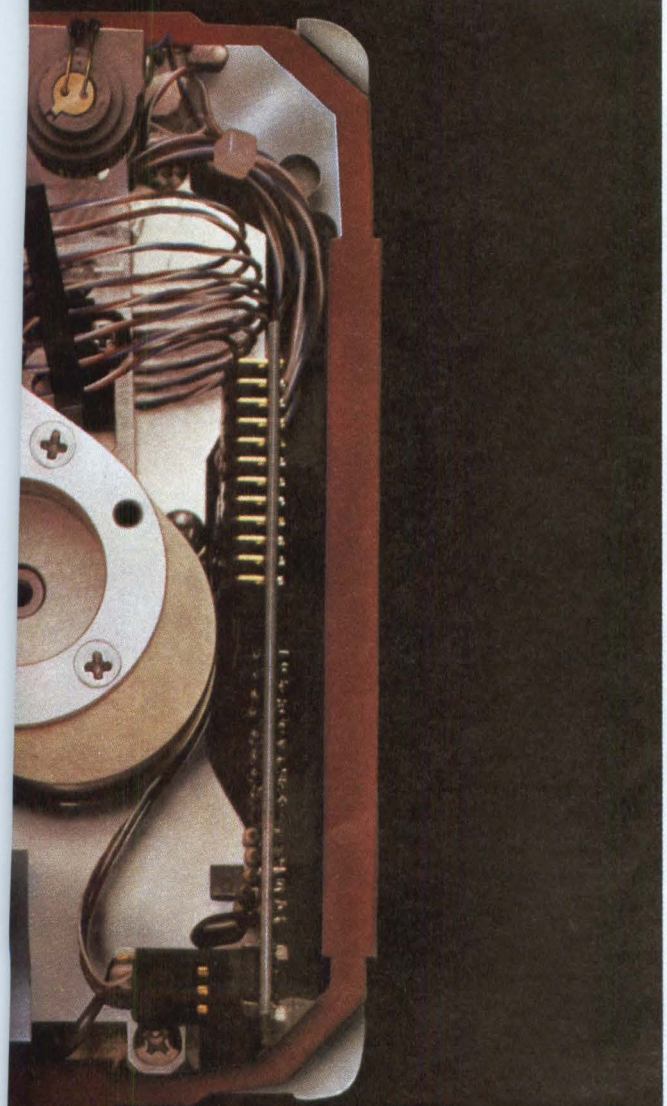
GOULD
Electronics

CIRCLE NO. 96 ON INQUIRY CARD

The 5¼" Quantum L



eap.



Not a totally unexpected jump.

After we designed, built, and delivered the most cost-effective and manufacturable 8″ Winchester on the market, most people figured it would only be a matter of time until we came out with a 5¼″ version. And they were right.

But while our Q500™ Winchesters are no giant step for us, they do put quite a bit of distance between us and the rest of the 5¼″ market.

You see, we didn't have to reinvent the wheel. Just make it a little smaller. And that makes a big difference.

For example, by using the proven technology we developed for our Q2000™ 8″ drives, we're able to offer our Q500 drives in 20–, 30– and 40–megabyte versions. Capacities that are extremely difficult to achieve with a stepper motor drive. But which are no trouble at all for our rotary torque actuator, optical encoder and temperature compensation servo combination.

We've also been able to build in the technical margin of our Q2000 series. And the speed of our new 85 megabyte 8″ drive. At 45 ms access time, our Q500 is ideal for the multi-user applications you're thinking about.

Finally, and perhaps most important, the Q500 series can be manufactured quickly, easily and in large volume, just like the other members of our Quantum family.

Our ability to produce as promised is one of the things that helped make us the leader in the 8″ market.

And it can help you, too. Especially when it comes time to fill orders.

Speaking of which, you really should find out more about our Q500 drives as soon as possible.

In fact, the sooner the better. There's a lot to be said for getting the jump on your competition.

Quantum Corporation, 1804 McCarthy Blvd., Milpitas, California 95035. Eastern Regional Sales Office: Salem, New Hampshire (603) 893-2672. Western Regional Sales Office: Santa Clara, California (408) 980-8555. International Sales Office: Milpitas, California (408) 262-1100. TWX: 910 338-2203.

QUANTUM

Our 8″ Slimline disk drives are the smallest and our 5¼″ half heights are rolling out by the truck load.

That's R&D you can bank on: Response and Delivery.

You say you need drives that are half the height but all-the-way reliable? From a source that's equally reliable? And you want a choice of configurations too?

Our response is a line of 5¼″ Slimline™ drives built with three different bezels and door styles, your choice of direct or belt drive motors, and either of two densities, 48 TPI or 96 TPI. But only one quality standard: the highest.

They come single or double-sided, with capacities from 250 Kbytes to 1 Mbyte. And for those who can do with a little less speed MPI responds with a consumer model at a lower price tag.

And when you wanted smaller, compact 8″ drives, we replied with the smallest ones there are. Our 8″ Slimline™ series. Only 2″ thick and 11.5″ deep. The selection doesn't end there. You can also get a 4.6″ bezel as well as a half size version at 2.3″.

To the cry for ever-smaller disks, MPI answered with the smallest disk drive ever. A 3″ micro floppy that interfaces with 5¼″ systems, handles 500 Kbytes of data and uses media protected by a hard shell so you can carry it in your shirt pocket safely.

That's how MPI operates. By responding with what you need. Then delivering. By the truck load from the West Coast. By the ship load from Singapore. Our own second source in the Orient that duplicates the precision production of our California plant. What's more, we are manufacturing our own heads.

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MICRO PERIPHERALS, INC.

Micro Peripherals, Inc., 9754 Deering Ave., Chatsworth, CA 91311. Phone (213) 709-4202. TWX (910) 494-1213
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CIRCLE NO. 98 ON INQUIRY CARD

Full 32-bit microprocessors: the next generation

GENE A. FINKLER, Silicon Valley Micro Inc.

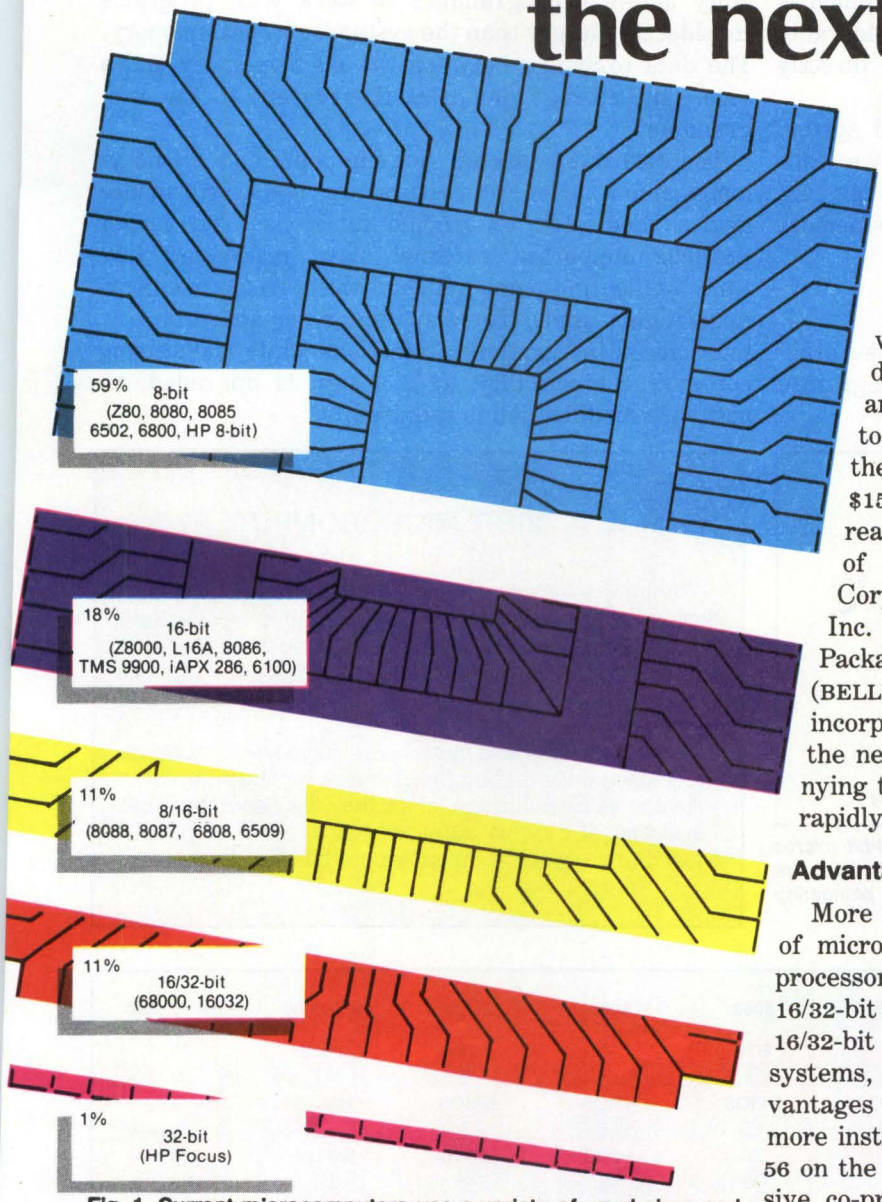

Fig. 1. Current microcomputers use a variety of word sizes and microprocessors. *A total of 59 percent of all microcomputers incorporate 8-bit processors, 11 percent use 8/16-bit processors, 18 percent are 16-bit machines, 11 percent are 16/32-bit, and only one micro—the HP9000—uses a 32-bit chip. Representative processors are shown in parentheses.*

The next generation of microcomputers will use full 32-bit microprocessors (32-bit data bus, 32-bit operands and registers) and are expected to arrive in quantity during 1984 to 1985. By then, end users can expect to have the power of a VAX supermini for about $5000 to $15,000. Many 32-bit microprocessors are already available from, or in the advanced stages of development at, National Semiconductor Corp. (NS32032), Motorola Inc. (MC68020), Zilog Inc. (Z80000), Intel Corp. (iAPX 386), Hewlett-Packard Co. (HP Focus) and Bell Laboratories (BELLMAC-32). System integrators planning to incorporate or support these chips must evaluate the new parameters and understand the accompanying technological advances to get a jump on this rapidly emerging market.

Advantages of 32-bit chips

More than 150 companies manufacture some form of microcomputer. Most of these use 8-bit microprocessors, but the real growth is in 8/16-, 16- and 16/32-bit microprocessors (Figs. 1, 2). Just as 16- and 16/32-bit systems offer clear advantages over 8-bit systems, 32-bit microprocessors provide distinct advantages over their predecessors (Fig. 3). They have more instructions—230 on the 32-bit HP Focus versus 56 on the 8-bit 6502—more registers and more extensive co-processor capabilities. As a result of recent technologies, 32-bit chips offer higher clock frequencies and higher operating speeds. The 32-bit Z80000, for example, operates at 25 MHz; the 8-bit Z80 operates at 2.5 MHz.

Six 32-bit microprocessors are already available or in advanced stages of development

An 8-bit machine can directly address as much as 256 bytes (2^8) using single-cycle (one-word) addressing. All of today's 8-bit machines, however, use double-cycle addressing and a 16-bit address bus and therefore can directly address a maximum of 64K bytes (2^{16}). A 32-bit processor theoretically can directly address as much as 4G bytes (2^{32}), but in reality, the range is considerably lower. The 32-bit HP Focus, however, can directly address as much as 500M bytes.

Another advantage to both end users and system integrators is speed: larger registers mean fewer calls to memory, and register-to-register transfers are typically five times faster than register-to-memory transfers.

Surveying the 32-bit chips

A closer look at each of the 32-bit chips reveals other advantages that will influence system integrators' decisions.

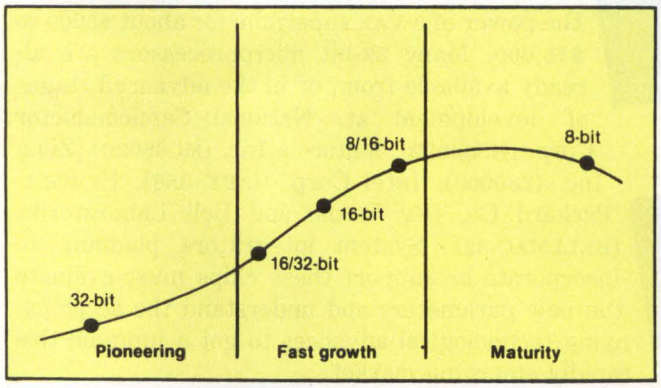

Fig. 2. Life cycle of microcomputers *indicates that 8-bit micros have matured and are declining; 8/16-, 16- and 16/32-bit micros are in the fast-growth stage; and 32-bit machines are in the pioneering stage of development.*

• The **National Semiconductor NS32032,** scheduled for delivery this year, is part of the 19-chip NS16000 family (Fig. 4), which combines 32-bit internal architecture with 32-bit address space management. The NS32032 can directly address 16M bytes.

The full 32-bit architecture yields dramatic throughput increases. For example, a 32-bit multiply takes only 8.3 msec. versus 4.5 msec. for an 8-bit multiply. (Four times as much data is processed in less than twice the time).

The NS32032's demand-paged, virtual memory capability allows a programmer to work with programs considerably larger than the system's physical memory. The data exchange between the main memory and a secondary storage device is transparent to the programmer.

The NS32032's on-chip floating-point and memory-management slave processors are high-performance devices dedicated to specific functions. The earlier NS16032 supported external slave processors (the NS16081 floating-point unit and the NS16082 memory-management unit). The slave-processor approach permits silicon integration of functions while maintaining software compatibility. If a design is upgraded, no software modification is required.

WHAT IS A 32-BIT MICROCOMPUTER?

Contrary to what some experts say, there is a clear distinction between microcomputers and minicomputers. A 32-bit microcomputer is based on a chip that uses 32-bit internal registers and a 32-bit data bus. It is not a 16/32-bit machine, which uses 32-bit internal registers, but a 16-bit data bus.

A 32-bit micro is also based on a single MPU. Therefore, processing units that employ bit-slice architecture do not fall into this classification, since they are based on a CPU consisting of multiple bit slices that process in parallel. Most of the new minicomputers are bit-slice machines.

Feature	Z80	6502	8088	8086	Z8000	MC68000	HP Focus
Category (bits)	8	8	8/16	16	16	16/32	32
Internal architecture (bits)	8	8	16	16	16	32	32
Chip technology	NMOS	NMOS	HMOS	HMOS	NMOS	HMOS	NMOSIII
Power dissipation (watts)	1	.575	1.5	1.5	.8	1.2	7
Clock frequency (MHz)	2.5	1/2	5	5/8/10	4/6/10	6/8/12.5	18
Pins per chip	40	40	40	40	48	64	83
Data bus (bits)	8	8	8	16	16	16	32
Data word size (bits)	8	8	8-16	8-16	1/4/8/16/32/64	16	32-64
Instruction word size (bits)	8	8	8-48	8-48	16/32/48	16	38
Instructions	158	56	134	134	110	56	230
I/O word size (bits)	8	8	8	8/16	8/16	8/16/32	32
Registers (arithmetic/ index/general purpose)	14/2/6	1/2/2	0/0/8	0/0/8	0/0/16	8/16/16	7/10/11
Direct address (bytes)	256	256	64K	64K	64K	16M	500M
Direct memory access	standard	no	optional	optional	standard	optional	standard
First delivery	Q1 1976	1977	Q2 1979	Q2 1978	Q4 1981	Q3 1979	Q1 1981

Fig. 3. A comparison of common microprocessors *from the varying word-size classes shows the advantages of the 32-bit chip.*

National Semiconductor will support Pascal, C, FORTRAN and BASIC on the NS32032. These higher level languages run at the speed of assembly-language execution. Efficient language translation is the result of architectural symmetry: each instruction can operate with any data type or addressing mode. Thus, software can be ported to all of the NS16000 family CPUs, as well as to future products, without modifications.

Dedicated registers and linkage tables allow software-module linkage without code editing. This allows programmers to work in parallel and to divide complex problems into smaller tasks. For example, programs can be tailored by drawing from a software library consisting of parts of an application program, or "modules," reducing development costs and programming time.

Feature	NS16008	NS16016	NS16032	NS32032
Category (bits)	8/16/32	16/32	16/32	32
Internal architecture (bits)	32	32	32	32
Chip technology	XMOS	XMOS	XMOS	XMOS
Power dissipation (watts)	1	1	1	1
Clock frequency (Mhz)	6-10	6-10	6-10	6-10
Pins per chip	48	48	48	60
Data bus (bits)	8	16	16	32
Data word size (bits)	8/32	16/32	16/32	32/32
Instruction word size (bits)	8-24	8-24	8-24	8-32
Instructions	86	86	86	86
I/O word size (bits)	8	16	16	32
Registers (arithmetic/ index/general purpose)	8/8/8	8/8/8	8/8/8	8/8/8
Direct address (bytes)	16M	16M	16M	16M
Direct memory access	standard	standard	standard	standard
Interrupt system	vectored priority <256	vectored priority <256	vectored priority <256	vectored priority <256
Second sourcing	Fairchild, Synertek, Eurotec	Fairchild, Synertek, Eurotec	Fairchild, Synertek, Eurotec	Fairchild, Synertek, Eurotec
Prototyping system	Starplex VAX	Starplex VAX	Starplex VAX	Starplex VAX
First delivery	Q4 1982	Q2 1983	1982	Q2 1983

Fig. 4. The NS16000 family *includes the NS16008, NS16016, NS16032 and NS32032 chips, representing a variety of word-size categories, data-bus widths and instruction and I/O word sizes. The NS32032 is a full 32-bit chip (32-bit data bus, operands and registers).*

Most 32-bit chips, such as the Z80000 can directly address as much as 32M bytes.

The NS32032's operating system support provides a supervisor mode and sophisticated memory protection. Semaphores, traps, interrupts, supervisor calls, easy context switching and procedure calls are all available. Separate user and supervisor stacks ease operating-system implementation.

- The **Motorola MC68020,** a full 32-bit implementation, will be available in early 1984 and is a member of the 26-chip MC68000 family. It is software compatible with Motorola's 8/32-bit MC68008, 16/32-bit MC68000 and 16/32-bit MC68010 microprocessors (Fig. 5).

The MC68000 has a 32-bit internal architecture with a

Feature	MC68000	MC68008	MC68010	MC68020
Category (bits)	16/32	8/16/32	16/32	32
Internal architecture (bits)	32	32	32	32
Chip technology	HMOS	HMOS	HMOS	HMOS
Power dissipation (watts)	1.2	1.2	1.2	1.8
Clock frequency (Mhz)	6/8/12.5	6/8/12.5	6/8/12.5	8/10/16
Pins per chip	64	48	64	84
Data bus (bits)	16	8	16	32
Data word size (bits)	16	8	16	32
Instruction word size (bits)	16	16	16	16-32
Instructions	56	56	58	65
I/O word size (bits)	8/16/32	8/16/32	8/16/32	N/A
Registers (arithmetic/ index/general purpose)	8/16/16	8/16/16	8/16/16	8/16/16
Direct address (bytes)	16M	1M	16M	256M
Direct memory access	optional	optional	optional	optional
Second sourcing	Hitachi, Rockwell, Mostek, Thompson	Hitachi, Rockwell, Mostek, Thompson	Hitachi, Rockwell, Mostek, Thompson	Hitachi, Rockwell, Mostek, Thompson
Prototyping system	Exormac	Exormac	Exormac	Exormac
First delivery	Q3 1979	Q4 1982	Q4 1982	Q1 1984

Fig. 5. Representative members of the MC68000 family *include the 16/32-bit MC68000, the 8/32-bit MC68008, the 16/32-bit MC68010 and the full 32-bit MC68020, which is software compatible with its predecessors.*

Feature	Z800	Z8003	Z8004	Z80000
Category (bits)	8/16	8/16	16	32
Internal architecture (bits)	16	16	16	32
Chip technology	NMOS	NMOS	NMOS	NMOS
Power dissipation (watts)	<2	.8	.8	>1
Clock frequency (Mhz)	10/18/25	4/6/10	4/6/10	10/18/25
Pins per chip	40/64	48	40	64
Data bus (bits)	8	16	16	32
Data word size (bits)	1/4/8/ 16/32	1/4/8/ 16/32	1/4/8/ 16/32	1/4/8/ 16/32
Instruction word size (bits)	8-48	16-48	16-48	N/A
Instructions	183	110	110	N/A
I/O word size (bits)	8	8-16	8-16	32
Registers (arithmetic/ index/general purpose)	7/2/7	16/16/16	16/16/16	32/32/32
Direct address (bytes)	16M	32K	32K	32M
Direct memory access	standard	standard	standard	optional
Second sourcing	N/A	AMD, SGS, Sharp	AMD, SGS, Sharp	N/A
Prototyping system	ZSCAN, 3rd party	Z8001/2, ZSCAN, ZLAB	Z8001/2, ZSCAN, ZLAB	ZSCAN, 3rd party
First delivery	Q2 1984	Q4 1981	Q4 1979	Q2 1984

Fig. 6. The 32-bit Z80000 evolved from the Z8000 family *and is related to the Z800, which will be introduced in the second quarter of 1984.*

23-line address bus and a 16-bit data bus. The MC68008, a 48-pin package is internally 32-bit code compatible with the MC68000 and has 8-bit external data paths. The MC68010 adds virtual-memory capability to the MC68000.

Feature	iAPX188	iAPX186	iAPX286	iAPX386
Category (bits)	8/16	16	16	32
Internal architecture (bits)	16	16	16	32
Chip technology	HMOSIII	HMOSIII	HMOSIII	HMOSIII
Power dissipation (watts)	2.5	2.5	2.5	2.5
Clock frequency (Mhz)	8	8	8	8
Pins per chip	68	68	68	68
Data bus (bits)	8	16	16	32
Data word size (bits)	8-16	8-16	8-16	8-32
Instruction word size (bits)	8-48	8-48	8-48	8-48
Instructions	95	95	111	111
I/O word size (bits)	8	8	8	8
Registers (arithmetic/ index/general purpose)	8/6/8	8/6/8	8/6/8	8/6/8
Direct address (bytes)	1M	1M	16M	32M
Direct memory access	standard	standard	optional	optional
Second sourcing	AMD	AMD	AMD, Siemens	AMD, Siemens
Prototyping system	Intellec MDS	Intellec MDS	Intellec MDS	Intellec MDS
First delivery	Q4 1982	Q3 1982	Q3 1982	Q3-Q4 1984

Fig. 7. Representative members of the Intel iAPX family *include the 8/16-bit iAPX 188, the 16-bit iAPX 186 and 286 and the 32-bit iAPX 386. The 386 is scheduled for delivery late in 1984.*

Feature	HP Focus	BELLMAC-32
Category (bits)	32	32
Internal architecture (bits)	32	32
Chip technology	NMOSIII	Domino CMOS
Power dissipation (watts)	7	4.05
Clock frequency (Mhz)	18	6.2/7.2
Data bus (bits)	32	32
Data word size (bits)	32-64	32
Instruction word size (bits)	38	N/A
Instructions	230	N/A
I/O word size (bits)	32	32
Registers (arithmetic/ index/general purpose)	7/10/11	9/9/6
Direct address (bytes)	500M	32M
Direct memory access	standard	standard
Second sourcing	none	none
Prototyping system	HP9000	BELLMAC-32A evaluation board
First announced	Q1 1981	Q1 1982

Fig. 8. The HP Focus and the BELLMAC-32 *were the first 32-bit microprocessors. Both chips are restricted to internal use.*

Besides its full 32-bit architecture, the MC68020 differs from the earlier Motorola microprocessors in its instruction-set enhancements, co-processor operations, improved operating-system support and instruction cache. The 150,000-transistor MC68020 will be implemented with 2.25-μm. HCMOS III technology and a 16-MHz clock. It addresses as much as 4G bytes of virtual memory, processes 1.5 million instructions per sec. and dissipates only 1.8W.

The MC68020 supports many data types and addressing modes, and includes structures and instructions to aid compilers and operating systems. The chip includes expanded ASCII and bit-field operations and many new instructions and system operations. It accommodates the MC68000, MC68008 and MC68010 as co-processors through a special co-processor interface. The use of co-processors extends capability beyond the limits of a single processor to that of multiple tightly coupled processing units, each of which can be tailored to a particular data type, task or instruction set.

The MC68020 also provides an instruction cache that increases system speed by accelerating instruction execution and further increasing performance by freeing the external data bus for use by co-processors or DMA controllers in the system.

The 32-bit microprocessors, such as the Motorola 68020, can process as many as 5 MIPS.

• The **Zilog Z80000** will be available in late 1984, and is part of the nine-chip Zilog family of microprocessors. The new chip evolved from the Z8000 product line (Fig. 6) and will be compatible with the Z80 line and the Z800. (The 8/16-bit Z800 will be introduced with the Z80000).

The Z80000 will support a memory-management unit, a DMA controller, serial and parallel I/O controllers and extended arithmetic units, and will be Z-bus compatible. It will have denser code, greater compiler efficiency and more support for operating systems and complex data structures. The chip will be closely related to others in the Zilog family.

The Z800 will run any software written for the Z80 and offers as much as five times greater performance through the use of on-chip peripheral processors, cache memory and instruction enhancements. The chip will operate at clock frequencies of 10 to 25 MHz (the fastest Z80 runs at 8 MHz) and will execute 1 to 5 MIPS.

The Z8000 chip is available in four versions: the Z8001 (48-pin, segmented MPU), the Z8002 (40-pin, nonsegmented MPU), the Z8003 (48-pin, virtual MPU) and the Z8004 (40-pin, virtual MPU). The main difference is the addressing range. The Z8001 can directly address 8M bytes; the Z8002 directly addresses 64K bytes. The Z8003 and Z8004 are the first of Zilog's 16-bit microprocessors to feature on-chip virtual-memory capabilities. They increase the Z8001 address range to 16M bytes. The Z8003 generates 23-bit segmented addresses

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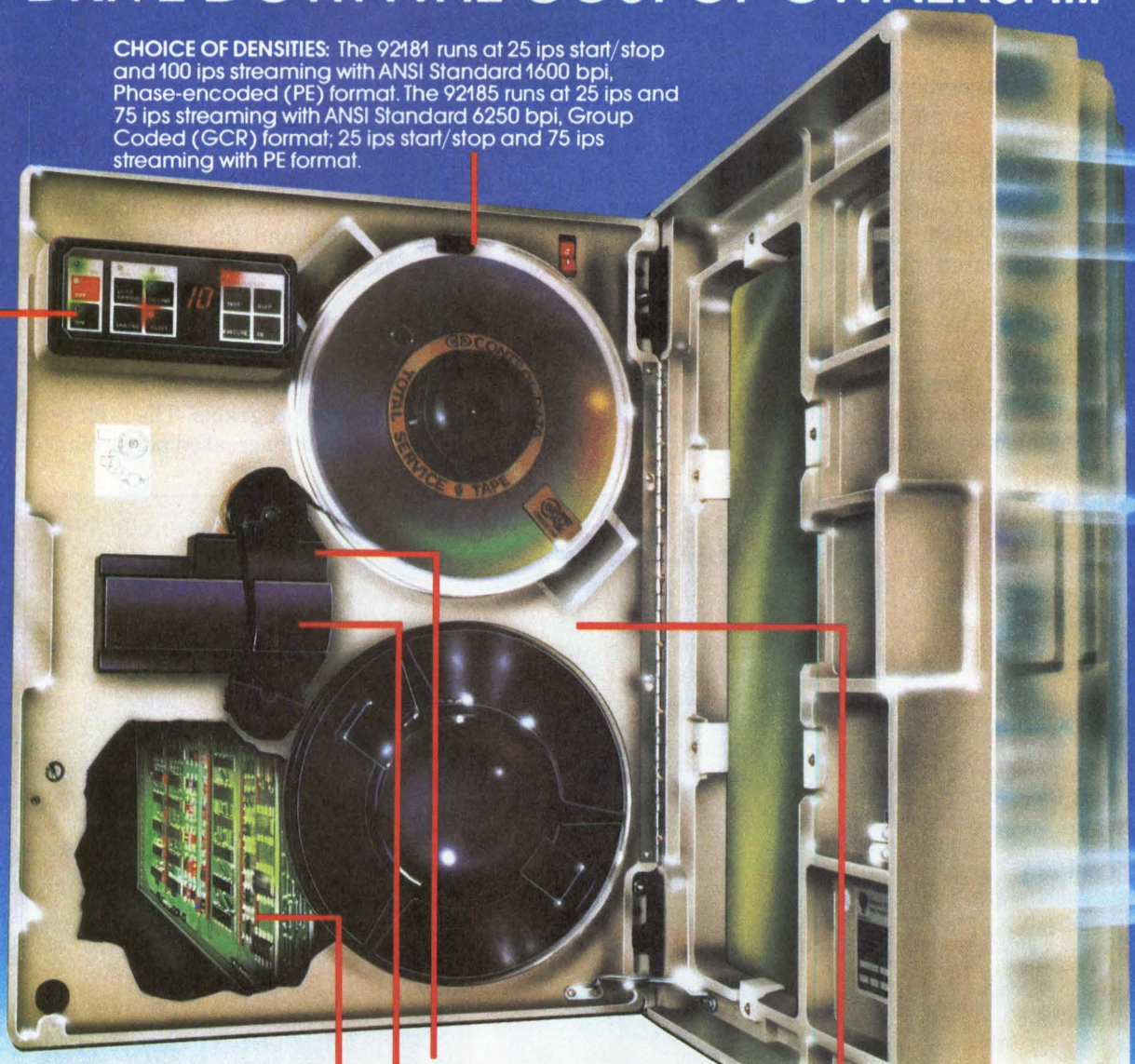

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organized into 128 segments, each as long as 64K bytes. The Z8004 generates 16-bit nonsegmented addresses. Both MPUs can be used in multiprocessor systems. The main architectural features that enhance throughput and processing power are 16 general-purpose registers, 414 instructions, eight addressing modes, multiple stacks, a sophisticated interrupt structure, seven data types and separate I/O address spaces.

The Z80000 will have 64 pins, clock frequencies of 10/18/25 MHz and a direct address range of 32M bytes. It will differ from its predecessors mainly because of its 32-bit internal architecture, data bus and I/O word size, and in its number of registers.

• The **Intel iAPX 396** is scheduled for delivery in late 1984. The chip evolved from the iAPX 186 and iAPX 286, and will be compatible with the Intel 8086 and 8088.

The 8086 and 8088 have 16-bit internal architectures and 8-bit external data paths for 8085 bus compatibility. Both chips can address 1M byte using segmented address-extension registers. The 8088 differs from the 8086 in that the 8088 requires extra fetch cycles and has lower processing speeds. Both chips are software compatible, however, and the 8088 can use the 8087 numeric co-processor and 80150 CP/M support processor.

The iAPX 186 and iAPX 286 are the second generation of the 8086 and 8088. As such, they offer a familiar and proven architecture, as well as compatibility with thousands of software programs. The iAPX 186 provides a lower system cost and increased performance through

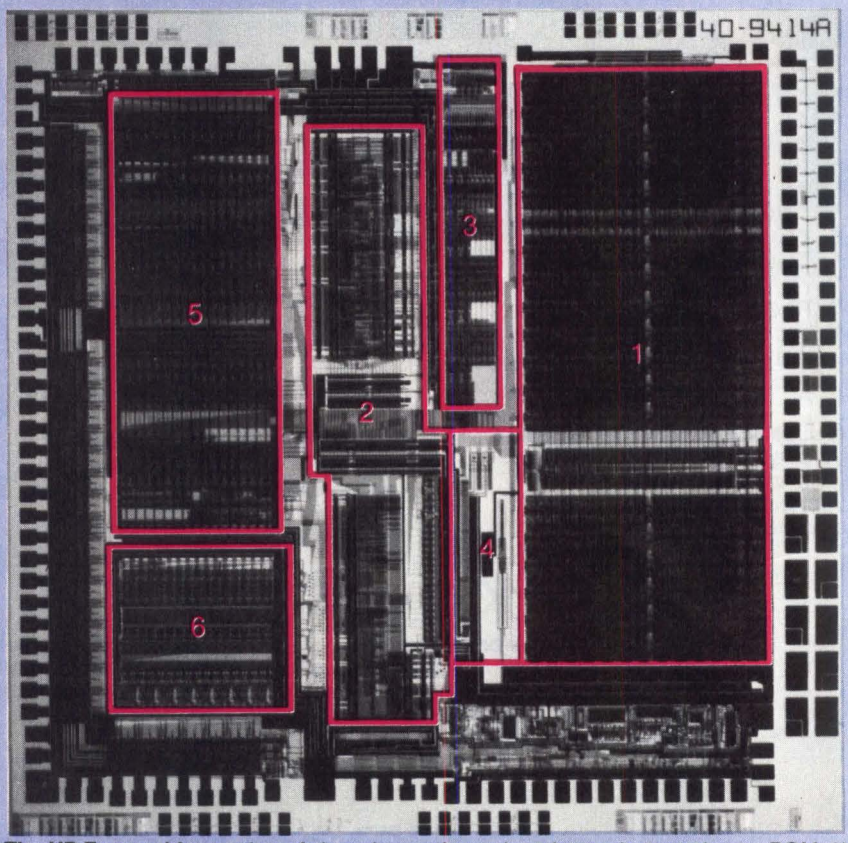
A CLOSER LOOK AT THE HP FOCUS

In the HP Focus, 9216 38-bit words of microcode ROM are arranged in 38 individual sections. (Hewlett-Packard Co. calls these sections bit-slices.) Each section is implemented as 32 × 16 18-bit series FET strings. Microinstructions are accessed from the ROM and transmitted to the program-logic array. The PLA decodes them and drives control lines that determine the operations of the 32-bit register stack and the arithmetic-logic unit.

The sequencing machine controls the flow of instructions from the ROM to the PLA and contains nine 14-bit registers. The sequencer contains a microprogram counter, a set of incrementers, three registers for microcode-subroutine-return addresses and a machine-instruction-opcode decoder. The decoder generates the starting address in control store for the microcode routine that implements each machine instruction. The test-condition multiplexer uses a 6-bit microcode field to select one of 55 qualifiers that originate in various portions of the chip. These qualifiers are used in conditional jumps and skips in the microcode.

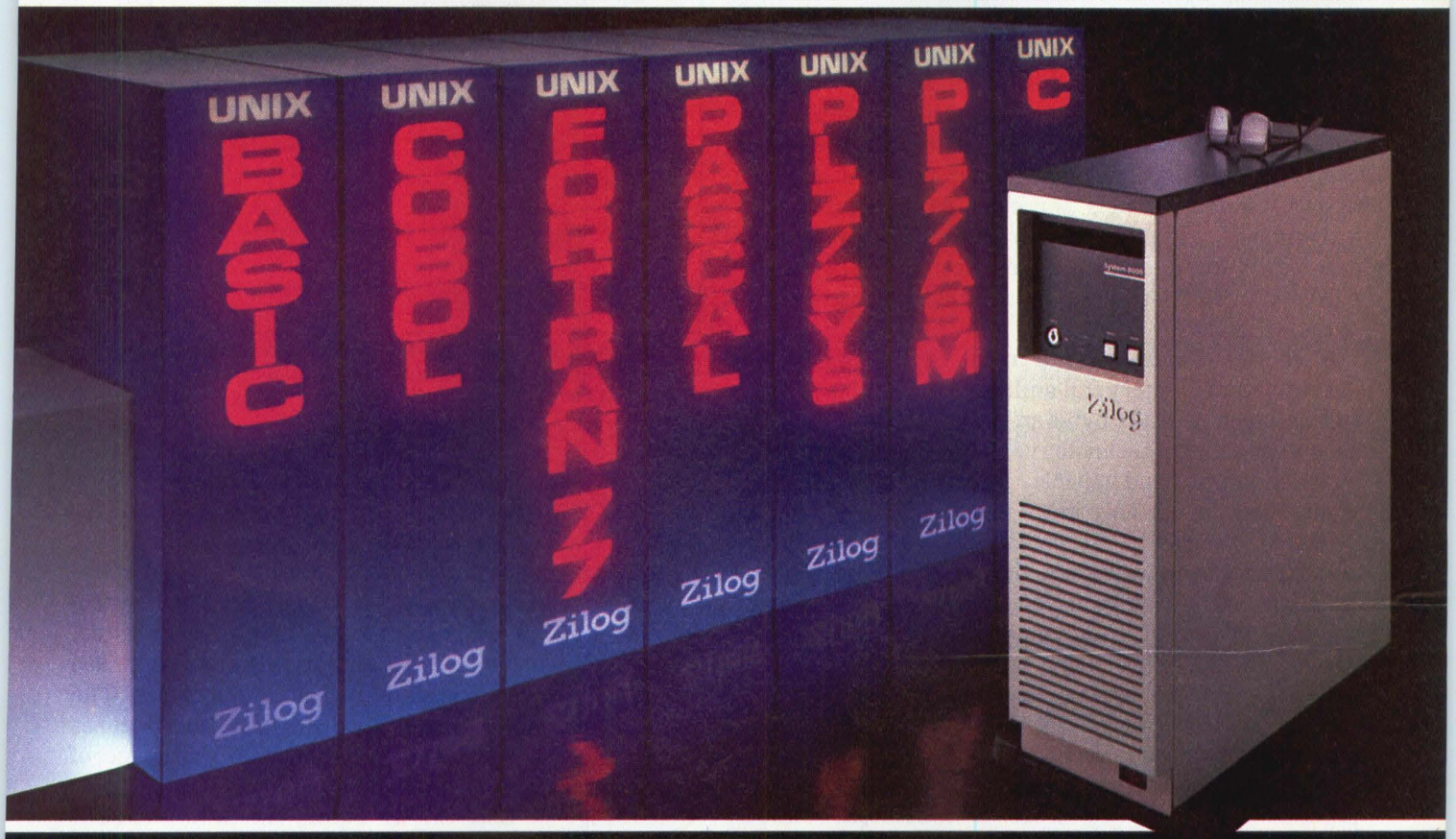
The register stack consists of a set of 28 identical 32-bit registers and two 32-bit, precharged, dynamic data buses. In addition, the register stack contains instruction-set logic such as top-of-stack and instruction registers.

The HP Focus ALU contains an n-bit shifter, a 32-bit, logical selector and a 32-bit, full-look-ahead adder. The selector can perform logical operations on 32-bit quantities in one processor state (55 nsec.). The adder also completes its operation in 55 nsec. and is used with special hardware for performing integer multiplication and division. The ALU results can be stored in four result registers inside the ALU. The memory processor bus interface is the communications channel between the internal and external data buses. The interface protocol is implemented with seven 32-bit registers for addresses and I/O data and special local control logic.



The HP Focus chip *consists of six major sections: 1) a microcode control-store ROM, 2) a programmed logic array, (3) a sequencing machine, 4) a test-condition multiplexer, 5) an extensive set of 32-bit registers and 6) a general-purpose arithmetic logic unit.*

Zilog's new System 8000 speaks seven languages. Fluently!



Now, there's a microcomputer that speaks seven high-level languages at a price that won't leave you speechless.

The Zilog System 8000 Model 11 is a general purpose, time-sharing computer that features the powerful UNIX* operating system, with enhanced System III capabilities. It is especially attractive to OEM's since all the software needed to make programming more productive is of the highest quality, and is accompanied by superb documentation.

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higher levels of functional integration than the 8086/8088 series. The iAPX 286 is an advanced, high-performance microprocessor optimized for multi-user, multitasking systems. It can operate in either real-address mode or protected virtual-address mode.

The iAPX 386 will be a full 32-bit microprocessor with demand-paged virtual memory, an address range of 32M bytes and on-line memory support of as much as 4G bytes. The chip will resemble the 16-bit iAPX 286 in its use of HMOS III technology, similar power dissipation (2.5W), number of pins per chip (68) and number of instructions (111). The main differences will be in data-bus width and internal architecture (32 versus 16 bits) and in direct-address capabilities (32M versus 16M bytes) (Fig. 7).

- The **HP Focus** is a full 32-bit chip with demand-paged virtual memory, an address range of 500M bytes and as much as 2.5M bytes of on-line RAM. The Focus uses NMOS III chip technology, an 18-MHz clock, a 38-bit instruction word and 230 instructions (Fig. 8). The chip is intended for use only in HP products and will not be available separately. It contains 450,000 transistors (120,000 is the industry standard) and is fabricated in an advanced silicon-gate technology with three and one-half layers of interconnect and 1-μm. spacing between the signal-carrying lines. It measures 5.7 mm. on a side, has 25 control lines and dissipates 7W of power (see "A closer look at the HP Focus," p. 192).

The 32-bit HP9000 microcomputer is based on the HP Focus chip. (See "HP9000—the first 32-bit microcomputer," left). The 9000 is a desk-top system said to have the power of a VAX supermini. It is designed for computer-aided-design equipment users and has a base price of $23,105 (MMS, January, p. 21).

- The **Bell Laboratories BELLMAC-32** microprocessor has more than 150,000 transistors or gates, more than 300,000 internal connections and nearly 600 in. of interconnecting wires in 1 sq. cm. of silicon. The chip was announced in the spring of 1982 and features demand-paged virtual memory, an address range of 32M bytes and on-line memory support of as much as 4G bytes (Fig. 8). Like the HP Focus, the BELLMAC-32 is intended for use only in Bell (Western Electric) products.

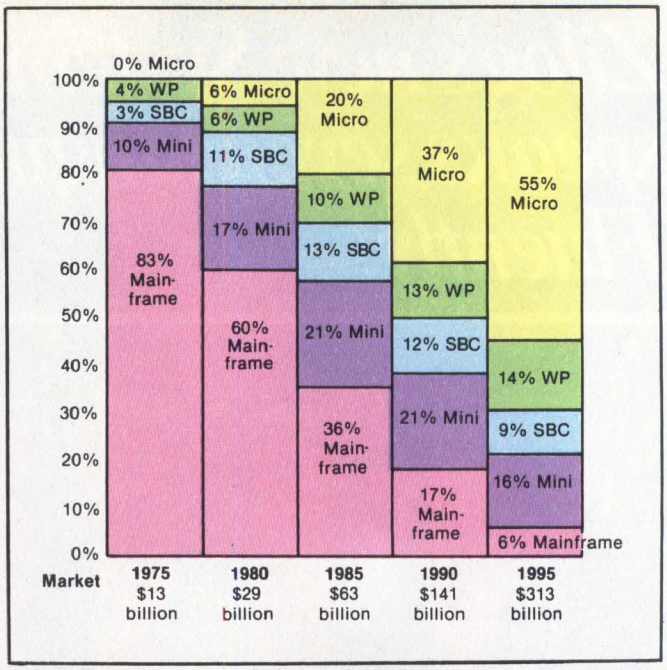

Fig. 9. The 20-year trend shows the total computer market *(value of worldwide shipments by U.S. manufacturers) for 1975 to 1995. Microcomputers will increase their market share by approximately 50 percent.*

A look at the future

Microcomputers will increase their share of computer market revenues by more than 50 percent between 1980 and 1995 (Fig. 9). To maintain their cost advantages, more microcomputer manufacturers will turn to offshore production, while others will rely increasingly on robot-assisted manufacturing in the U.S.

To increase performance, the semiconductor industry is moving toward wider word sizes, faster clock frequencies (greater than 12.5 MHz) and greater densities (more than 150,000 transistors). Other performance enhancements include more extensive use of pipelining, user-programmable microcoding, cache memory and co-processors for concurrent operations. □

HP9000—THE FIRST 32-BIT MICRO

The HP9000 is designed as an individual workstation for engineers and scientists in CAD/CAM environments. It can also be linked to other HP9000s or to host computers via the Ethernet local-area network. The system is available in desk-top, rack-mount or cabinet versions. Each model comes with 128K bytes of RAM and a 36M-byte-per-sec. backplane bus.

Software support for the HP9000 is limited. There are now two operating systems (BASIC and HP-UX), four compilers (BASIC, C, FORTRAN 77 and HP Pascal) and eight software packages (3D graphics or GRAPHICS/9000, IMAGE/9000-QUERY DBM or IMAGE/9000 DGL/AGP, an asynchronous terminal emulator, HP-FEM II, HP-DESIGN, HPSPICE, Marc S/W Muse and McMaster University statistical programs).

The system is based on the 32-bit HP Focus microprocessor and executes 1 million instructions per sec. It offers as much as 500M bytes of direct-address space, support of IEEE floating-point format (64-bit floating-point math in firmware), an instruction set of 230 operation codes, an 18-MHz clock rate, a 55-nsec. microinstruction cycle time and a 110-nsec. memory cycle.

Gene A. Finkler is the president and founder of Silicon Valley Micro, a start-up involved in the design and production of 32-bit microcomputers.

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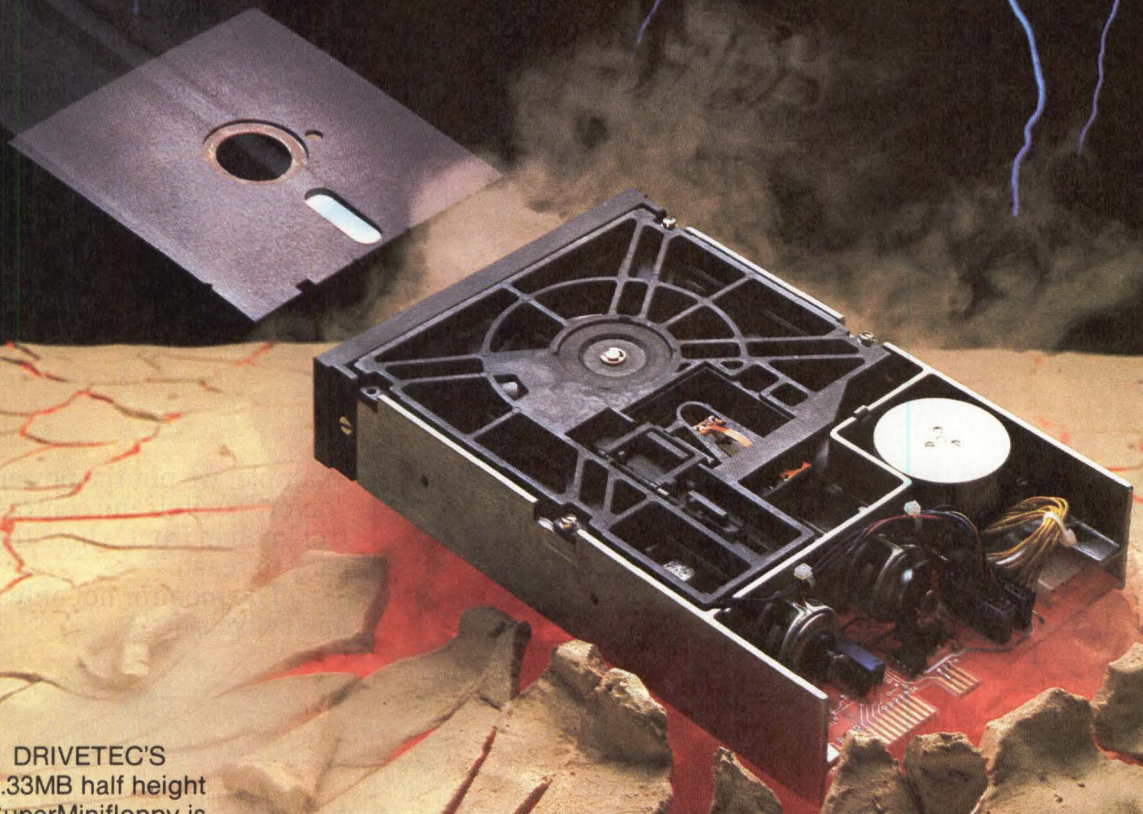
DRIVETEC'S 3.33MB Super Minifloppy



DRIVETEC'S 3.33MB half height SuperMinifloppy is much more than a redesign. It's the ever popular minifloppy completely re-created for the systems and applications of the 80's. And beyond.

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For more information about the SuperMinifloppy, contact Ivo Adam, vice president of marketing, at (408) 942-1515. Or write DRIVETEC, 2140 Bering Drive, San Jose, CA 95131. It could make your system a super success.

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ADM 24E

ADM 11

Have you ever noticed that the more high technology we put into the workplace, the more human touches the workers put in?

We noticed. Plants, pictures, macrame. Funny coffee cups.

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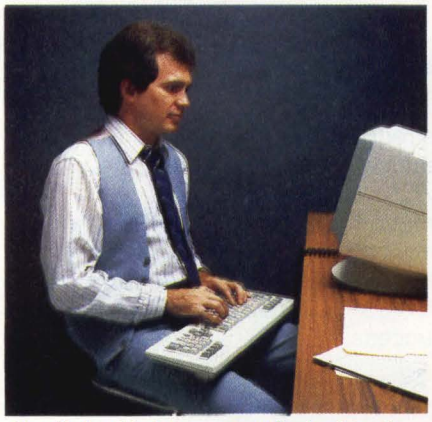

6' coiled cable lets you put the keyboard anywhere.

Because if our product doesn't feel good, you DP managers and OEMs don't look good.

There's more to ergonomics than simply tacking on a few faddish features as an afterthought. We put our thinking in up front. We spent a long time studying the way humans relate to computers. And we came up with a whole new way for computers to relate to humans.

No aspect of terminal design escaped our deepest consideration. Or reconsideration.

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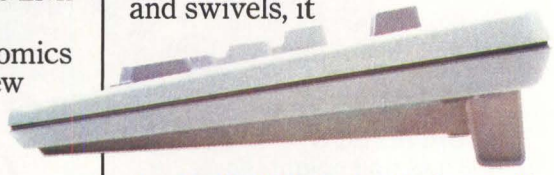
Because whether you're a DP manager or an OEM, the fact remains that the terminal represents your system. So High Touch terminals are made to feel as good as they look to the people who use them.

Dozens of little touches add up to the convenience and comfort of High Touch. For example, we put the power "on/off" switch and contrast control knob in front where they're easy to reach.

The monitor not only tilts and swivels, it stops positively in almost any position. With other tilt-and-swivel terminals, the cables always seem to reposition the monitor for you the moment you have it adjusted perfectly.



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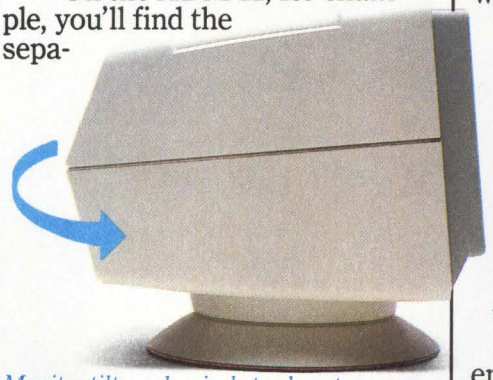
Because the only thing that should be difficult is making an error.

On the ADM 11, for example, you'll find the separate cursor control keys logically arranged in a cross for ease of use without looking.



Monitor tilts and swivels to almost any position. Both models available with 12 or 14 inch screens.

We placed the *control* and *escape* keys close to the alphanumeric keys, where people just naturally expect to find them.

And there are no keys at all next to the space bar, so no one can accidentally hit them.

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On the whole, we've taken the approach that if something isn't needed, it shouldn't be there. That's why the ADM 11 has just four function keys shiftable to eight.

And speaking of staying out of the way, our High Touch terminals' small footprint will fit as easily on a secretary's return as on an executive's credenza.

Because styling and comfort are just the first steps toward increased productivity.

No terminal has ever been so easy to live with. But don't get the idea that High Touch is the opposite of High Tech. It isn't.

The ADM 11, for example, is a High Touch conversational terminal that accepts data continuously at 19.2 kilobauds. Block mode terminals simply can't match this high throughput.

In addition there are four programmable function keys (shiftable to eight) with two levels of setup mode to reduce errors while still giving the operator maximum flexibility.

On the other hand, for a High Touch terminal that's more intelligent and has more functions and features, choose the ADM 24E. It features a moveable 24-line window you can use to look at 48 (or optionally, 96) lines of memory.

There are eight non-embedded attributes with embedded mode for existing applications, and 16 programmable non-volatile function keys (shiftable to 32) with legends on the status line (25th line). It runs in either conversational or block mode.

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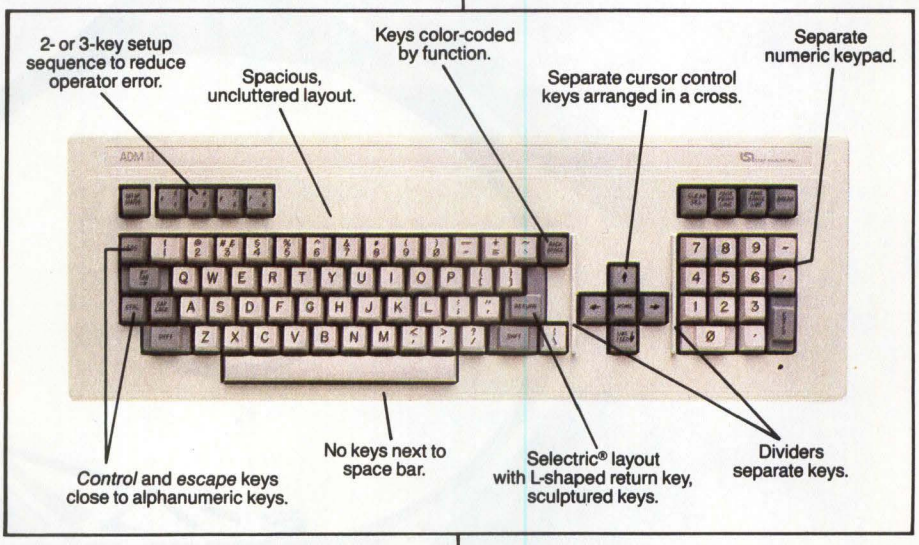
Our new High Touch terminals. Because it's high time.



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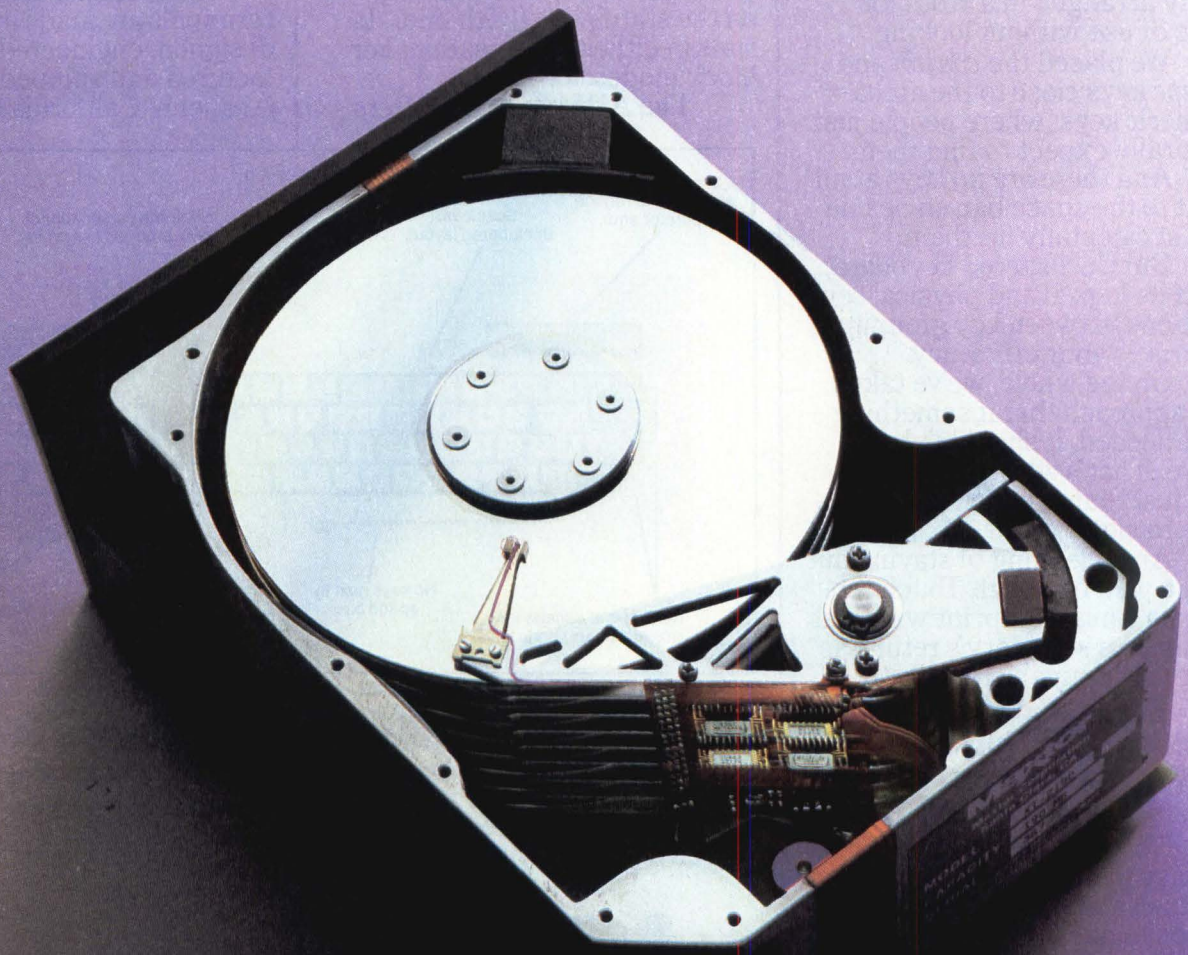

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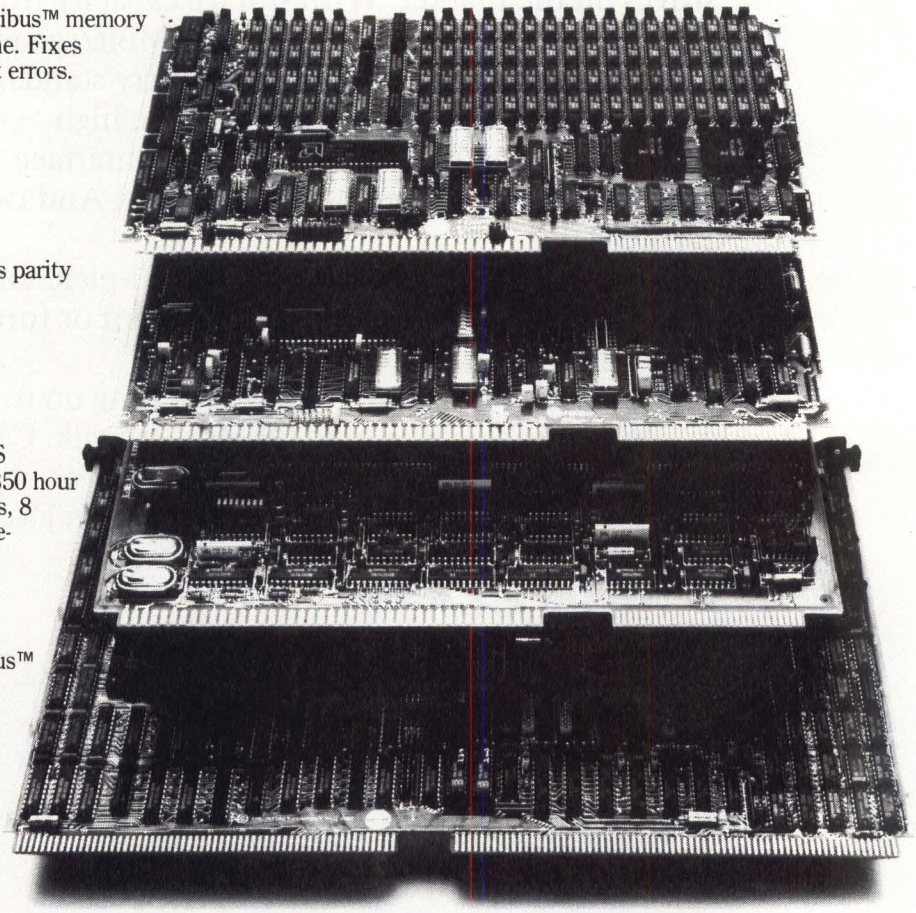

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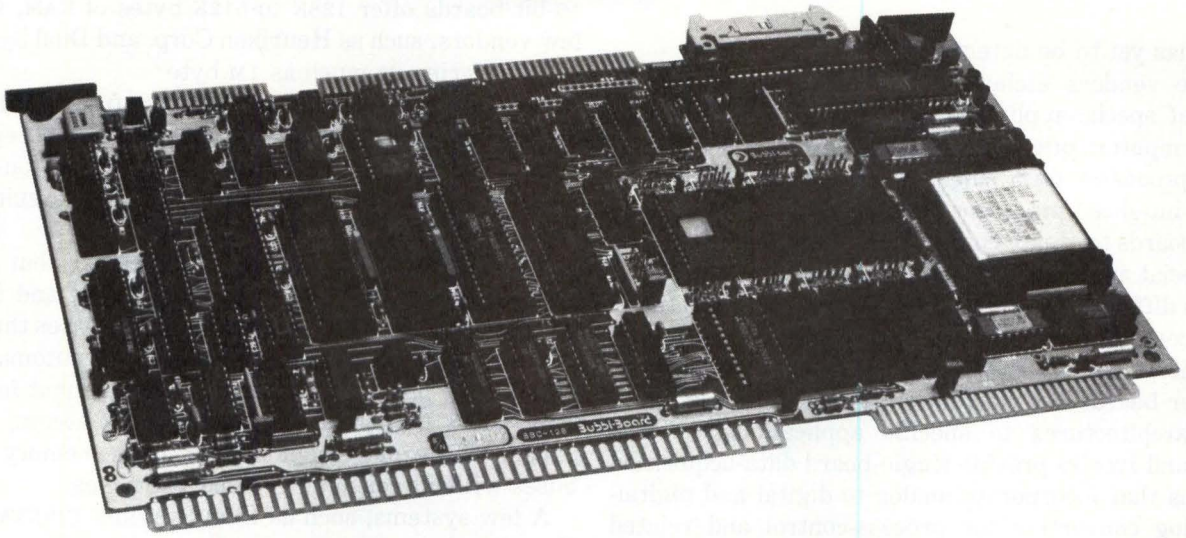


Single-board computers: keeping up with OEM requirements

MALCOLM L. STIEFEL, Contributing Editor

Boards boast large word sizes, more memory and software and greater flexibility

Industry sources peg 1983 revenues for single-board microcomputers at $500 million. At a projected 25-percent annual growth rate, 1988 sales to OEMs will be more than $7 billion. The continuing health of the single-board-computer industry is due to dramatic technology advances that increase board performance while decreasing costs, greatly facilitating the tasks of system integrators.

Nearly half of the boards in the product table (p.208) are based on powerful 16-bit processors. Memory capacities are also on the rise, with some vendors offering as much as 1M byte on board. In contrast to five years ago, most vendors now provide full software support. Similar advances are occurring in packaging and power requirements, and prices are steadily decreasing.

Processors and word sizes

The Z80 remains the most popular 8-bit processor, and nearly half the 8-bit systems listed in the product table offer it. The most popular 16-bit processor is the 68000. Some new chips, such as the 80286, are starting to attract a following, although their ultimate market

Fig. 1. The BBC-128 from Bubbl-Tec *(above) incorporates a Z80A, as much as 64K bytes of combined RAM and ROM, 128K bytes of bubble memory, two serial ports and two parallel ports. The board is priced at $1500 in single-unit quantities.*

share has yet to be determined.

Some vendors eschew the more common CPUs in favor of special-application processors. For example, Sky Computers offers a floating-point processor and an array processor on a single board that is based on a 32-bit, bit-sliced processor. A buyer can microprogram these boards to create custom-designed instruction sets for special applications. Advanced Micro Devices Inc. takes a different tack, providing a socket for an optional co-processor chip (the Intel 8087) for floating-point operations that works with an 8086.

Other boards use conventional processors but tailor their architectures to specific applications. Wintek Corp. and Ironics provide single-board data-acquisition systems that incorporate analog-to-digital and digital-to-analog converters for process-control and related applications. Diversified Technology Inc., produces "industrial-grade" boards with broad temperature ranges (−45° to +85°C) for use in hostile environments.

Increasing memory

Most 8-bit boards come with 8K to 128K bytes of RAM. The DBC-1880 from Systemathica C.G. Ltd., however, is available with as much as 256K bytes on board. Most 16-bit boards offer 128K to 512K bytes of RAM, with a few vendors, such as Heurikon Corp. and Dual Systems Corp. offering as much as 1M byte.

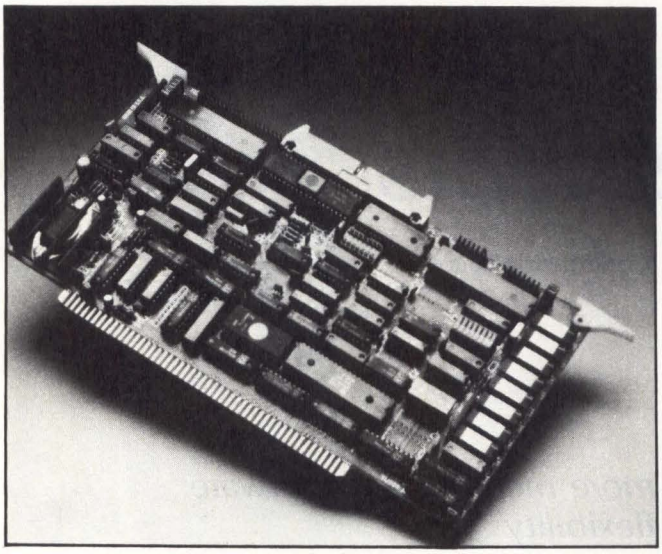
Several units, such as the BBC-128 from Bubbl-Tec, control as much as 8M bytes of memory on separate boards. Bubbl-Tec furnishes 128K bytes of on-board memory in addition to RAM and ROM. It is also suited for use in harsh environments (Fig. 1).

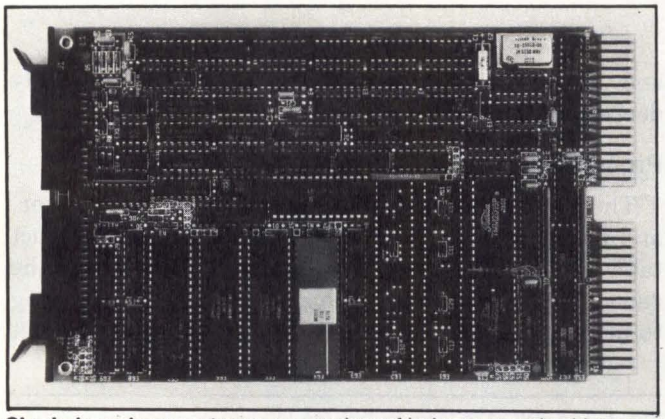
Many units include dual-ported memory that allows access to memory from a disk at one port and from a user terminal via another port. This increases throughput because display refresh can occur automatically without the processor. To increase throughput further, some units incorporate direct memory access, which expedites the movement of data from memory to I/O buses without consuming processor cycles.

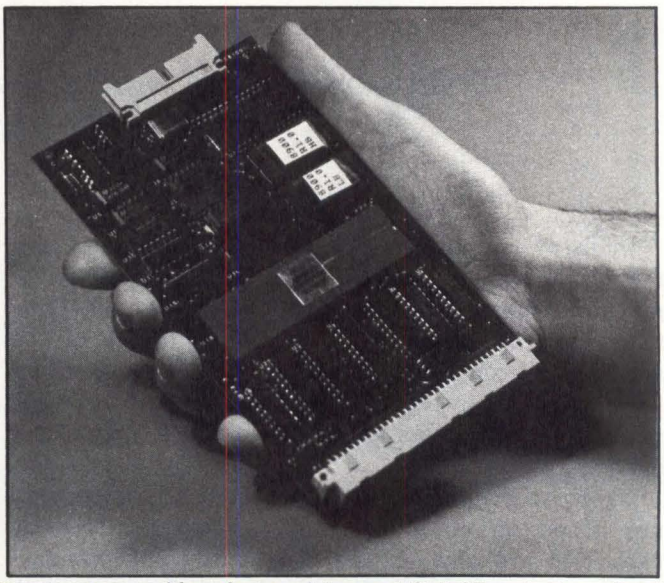
A few systems, such as Dual Systems' CPU/VME and Heurikon's HK-68, provide on-board memory-management units that simplify addressing schemes and permit designers to specify addressing ranges without jumpers. This reduces the number of steps in system fabrication and simplifies field maintenance.

Software and I/O benefits

Most single-board computers come with a set of development tools, including operating systems, high-level languages, utilities and powerful development hardware. All this support can be costly and unbundled. Consequently, designers may prefer to obtain software tools directly from software houses, and rely upon single-board-computer vendors for the hardware. The ubiquity of good software support gives designers







Single-board computers *use a variety of industry-standard buses, microprocessors and form factors. Advanced Digital Corp.'s Super Quad (upper left) uses a Z80A, is compatible with the S-100 bus and measures 5 × 10 in. The SBC-11/21 (bottom left) from Digital Equipment Corp. is based on the T-11 microprocessor, is compatible with the LSI-11 bus and measures 5.2 × 8.9 in. The 68000-based VME 8100 from Mizar Inc. (bottom right) is VME bus- compatible and measures 3.94 × 6.3 in.*

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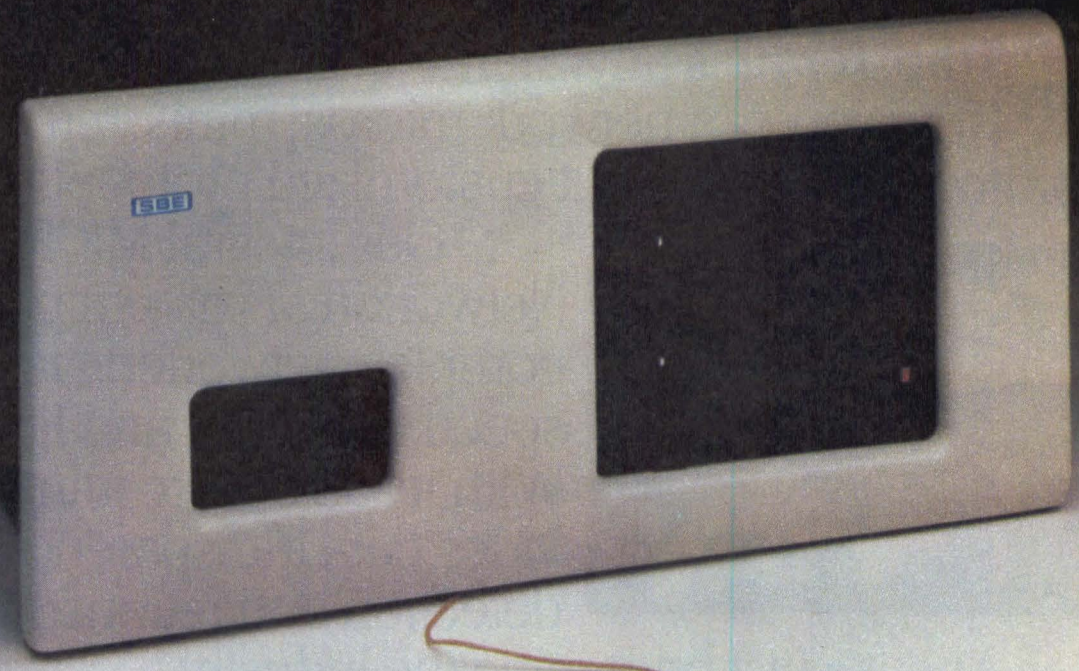

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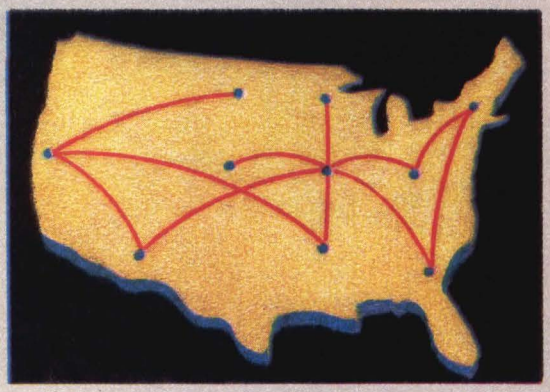

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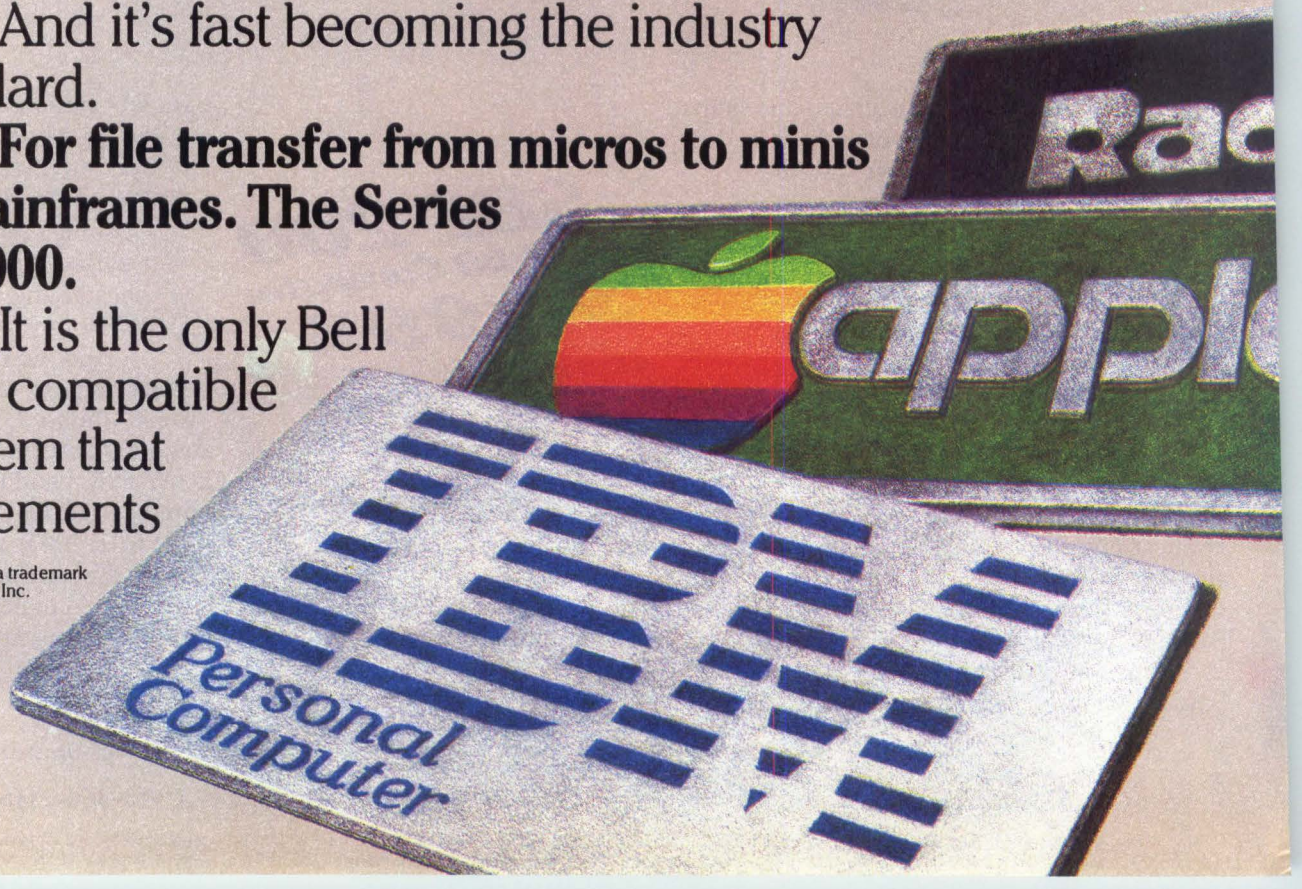

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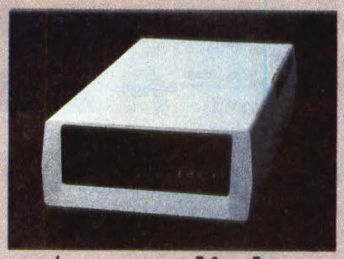

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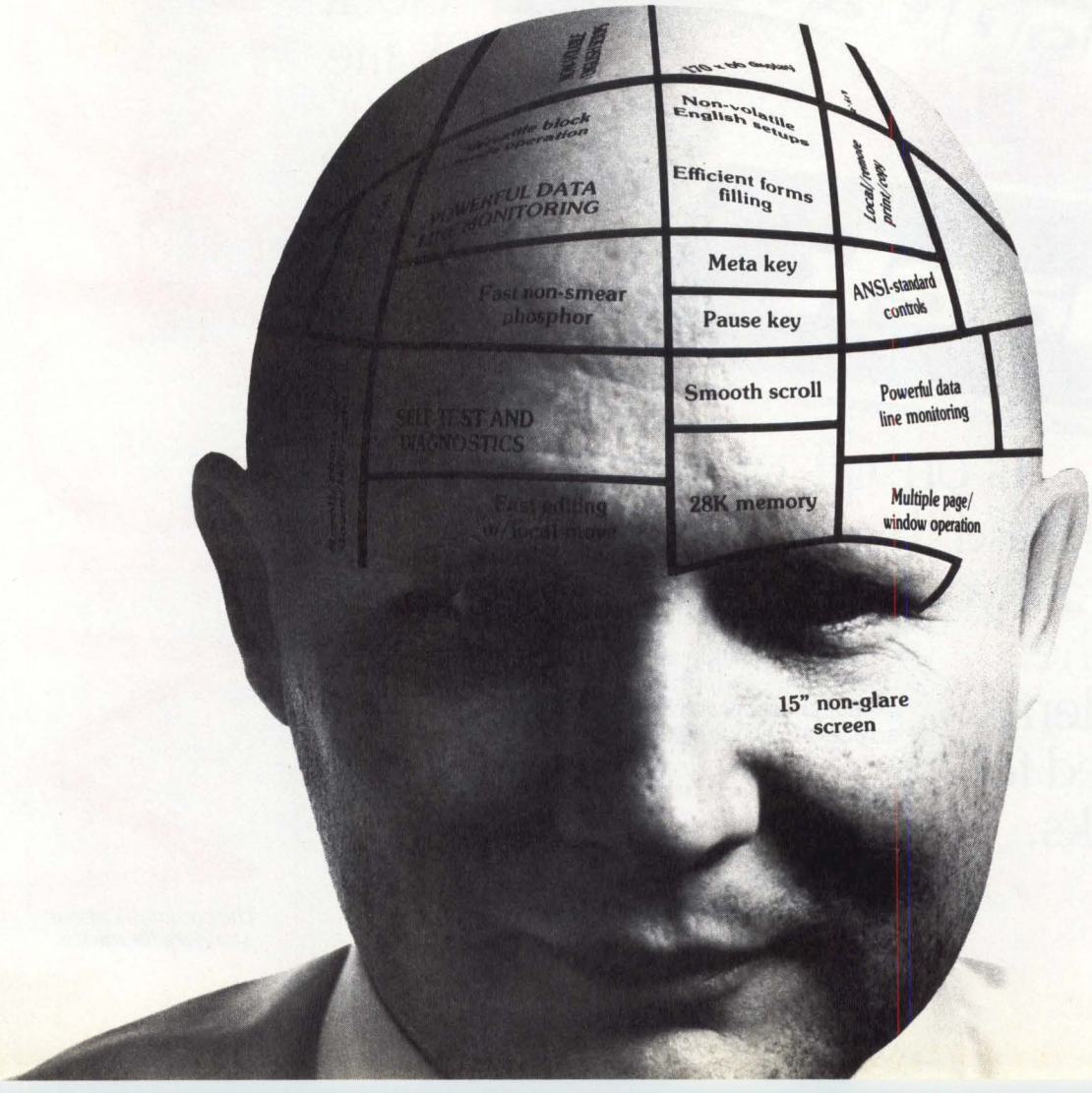


more choices and control over development costs.

More than three-quarters of the boards in the product table furnish an interface to one of the popular microcomputer buses (such as the Multibus, the STD, the VME or the S-100). The Multibus (also known as the IEEE standard 796) is the most popular among vendors of 16-bit boards. The STD bus is the favorite among 8-bit manufacturers. The VME bus, a recent entrant supported by Motorola Inc., Signetics Corp. and Mostek Corp., is gaining some adherents, while older buses such as the S-100 still attract large numbers of vendors.

One of the most striking advances in the crop of 16-bit boards is the availability of on-board controllers for floppy disk drives. This feature is available from Advanced Digital Corp., Data General Corp., Heurikon and Wintech Systems. The on-board peripheral controller makes designers' jobs easier and helps keep costs down. This benefit should become more common in the next year or two.

Significant progress has also been made in parallel-port throughput. The port on Pacific Microsystems' PM68D can run at 16M bits per sec., and three ports on the model M68K10 from SBE Inc. can each be driven at 8M bps. These line speeds are vital in working with high-speed local-area networks. At these speeds, the boards can also exchange data at the channel rates of mainframes and superminis.

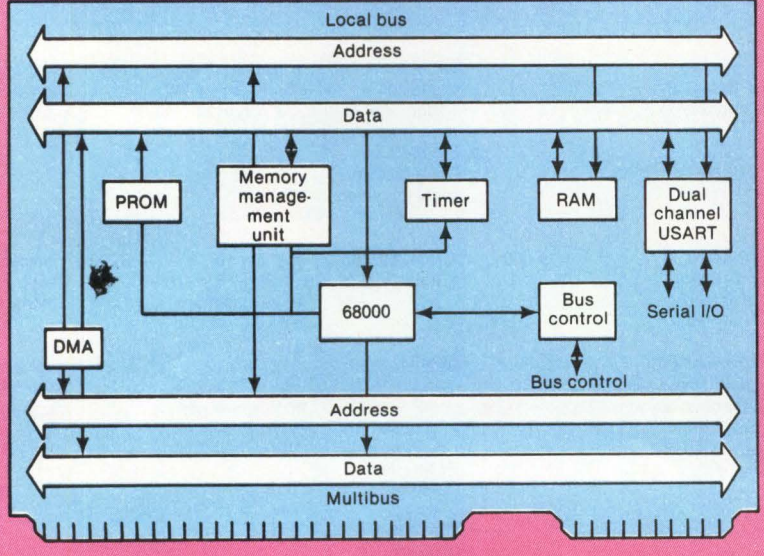
Asynchronous serial line transmission rates have been slow to advance (most still run at 50 to 19,200 baud), but designers now have the flexibility of choosing asynchronous or synchronous ports on some boards. Microbar Systems Inc.'s DBC 68K2, for example, drives its serial ports at rates as high as 19,200 baud in asychronous mode and as high as 880K baud in synchronous mode.

Most boards now come with a complete set of development tools.

Packaging, power and prices

Some vendors have managed to put keyboards and power supplies on board. Synertek Inc.'s model SYM-2 contains a 28-key keyboard, a six-digit display, eight LED lights and eight toggle switches. Most boards dissipate between 10W and 20W. Onset Computer Corp., National Semiconductor Corp. and RCA Corp., however, offer boards incorporating CMOS chips that exhibit extraordinarily low power dissipation; 100 mW for an entire board is typical. These units also incorporate on-board power supplies, an important feature in aircraft, satellites and other applications in

ARCHITECTURE OF A 16-BIT SINGLE-BOARD COMPUTER



Forward Technology Inc.'s FT-68X is a single-board computer built around a 10-MHz 68000 microprocessor. The lower address and data bus comprise the Multibus, which permits the board to exchange data with other processors or memory boards. The upper bus furnishes local communication among the FT-68X components.

The CPU does not directly address the local bus, but operates through the memory-management unit. The MMU provides address translation, sharing, memory allocation for multiple processes and a segment map for memory protection.

On-board RAM has a 256K-byte capacity, which can be expanded to 8M bytes with separate boards connected via the Multibus. The cycle-stealing direct-memory-access unit allows off-board devices to exchange data with local RAM without processor overhead.

The dual-channel universal synchronous/asynchronous receiver/transmitter supports programmable bit rates from 300 to 19,200 baud in asynchronous mode and as much as 1M bit per sec. in synchronous mode.

The timer chip incorporates five independent 16-bit counter/timers. Two are used to set the serial port baud rates; one is dedicated to memory refresh interrupts (every 2 msec.). The remaining two are available to the designer, although one of these may be allocated to reset the system when time-outs or other events occur.

which power budgets are stringent and space is at a premium.

The number of DC voltages needed to run external power supplies is important to most designers. Older boards that use Z80s and other 8-bit processors typically require +5V, +12V and −12V power. Some newer processors, such as the 68000, require only +5V, thus reducing the cost of the external power supply.

Some vendors have managed to put keyboards and power supplies on board.

Prices for single-board computers are continuously decreasing. Typical prices for 8-bit boards fall in the $200 to $300 range, although the M-80 from Miller Technology Inc., sells for as little as $69. At the other end of the 8-bit spectrum, the MSC 8011 from Monolithic Systems Corp., sells for $1364 in quantities of one to nine.

Most 16-bit boards sell for between $1000 and $2000, although Central Data Corp. offers its model B1017 for $625 in quantities of 10 to 25. On the other hand, Heurikon sells the HK-68 board for $3590, and Data General Corp.'s Eclipse S/120 model 8731 sells for $9500 for a chassis model with 128K bytes of RAM.

The prices in the product table must be examined carefully; single-unit prices are given in most instances, but generous discounts are available for OEM quantities. Discounts of 30 percent on 100 units and 50 percent on 500 units are not unusual.

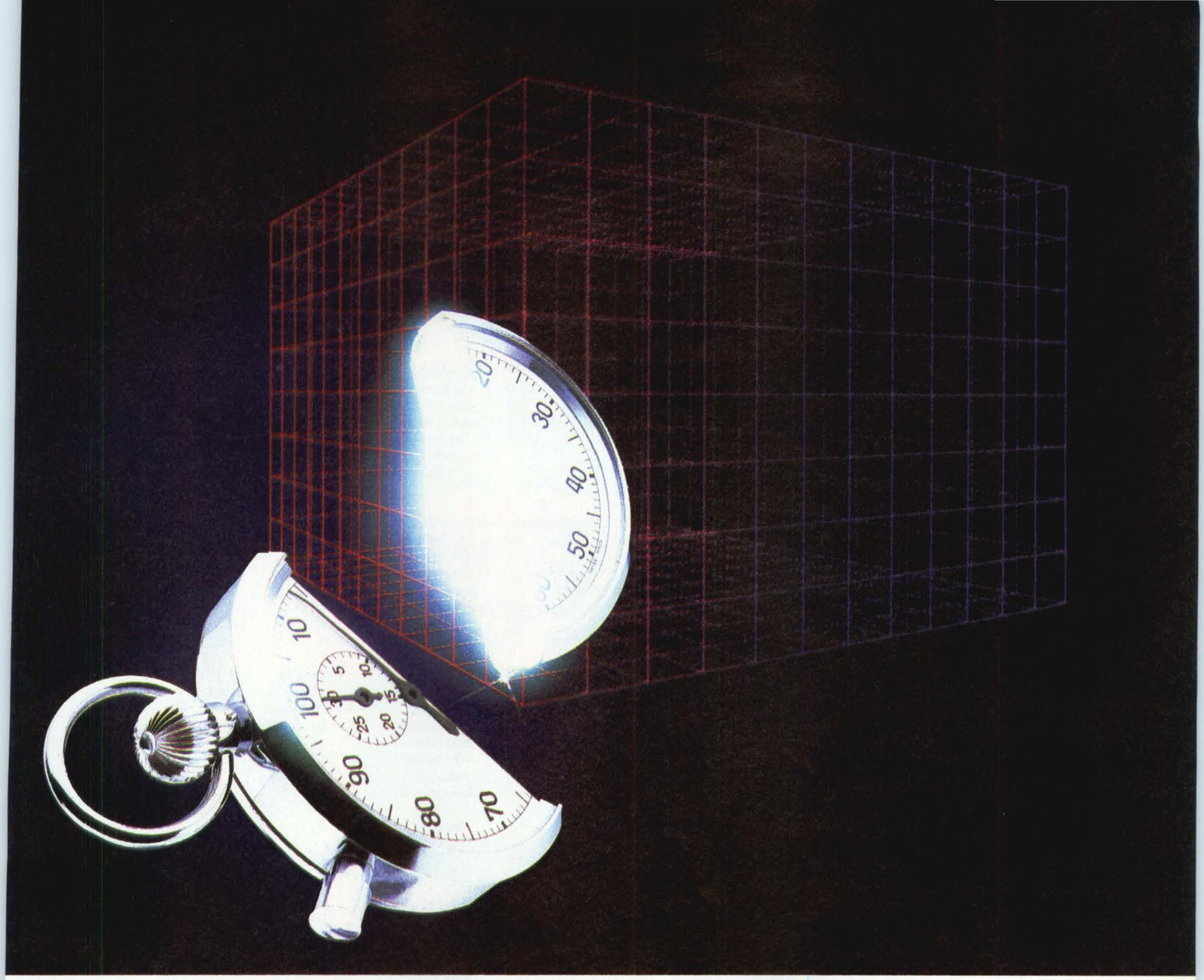
The product table

The following product table lists the most important parameters for comparing single-board microcomputers. These include the type of CPU and word size, amount of on-board memory (ROM and RAM), the number of serial and parallel I/O ports, line speeds, bus compatibility, software support (including development system), board size, power requirements and typical price (single-unit price unless otherwise noted). Vendors were asked to provide information on their two most important products or product lines. □

Malcolm L. Stiefel, now a group leader at Mitre Corp., has worked as a systems analyst, a systems engineer and a programmer on military command-and-control, hospital administration, investment securities and municipal information systems.

SINGLE-BOARD COMPUTERS

Manufacturer Model	CPU Word size (bits)	On-board memory (bytes)	I/O (ports, baud)	Bus	Software support	Size (in.) Power	Price	Notes	Circle No.
ADPS GmbH									756
ID-80	Z80A 8	2K–8K ROM 0–64K RAM	2 serial, (50 to 19200) 3 parallel		CP/M; debugger, editor, loader; character & graphics generator; DEC VT52 terminal emulator	6.5 x 9.3 +5, +12, −12 V 9 W typical	$598	includes floppy disk controller	
Advanced Digital Corp.									757
Super Quad	Z80A 8	2K–4K ROM 64K RAM	2 serial, (to 19200) 2 parallel	S-100	CP/M, MP/M, TurboDOS	5 x 10 +8, −8, +16, −16 V 40 W maximum	$700	includes floppy disk controller	
Advanced Micro Devices									758
Am 96/4126	Z8002 16	8K–16K ROM 128K RAM (dual ported)	2 serial, (4800 to 38400 baud synch 75 to 19200 baud asynch) 3 8-bit parallel	Multibus	Real-time OS; Am 96/4640 monitor; Pascal, assembler, PLMH; development facilities: PS/1000 computer, Am 8/8112/8050A	6.75 x 12 +5, +12, −12 V 20 W maximum	$2245	paging register for memory mapping to as much as 1M-byte RAM	
Am 97/8605	8086 16	8K–128K ROM 8K–16K RAM	1 or 2 serial, (4800 to 38400 baud synch 75 to 19200 baud asynch) 3 8-bit parallel	Multibus	monitor; software compatible with Intel 86/05	6.75 x 12 +5, +12, −12 V 25 W typical	$1585	5-, 8-, and 10-MHz versions; socket for 8087 coprocessor	



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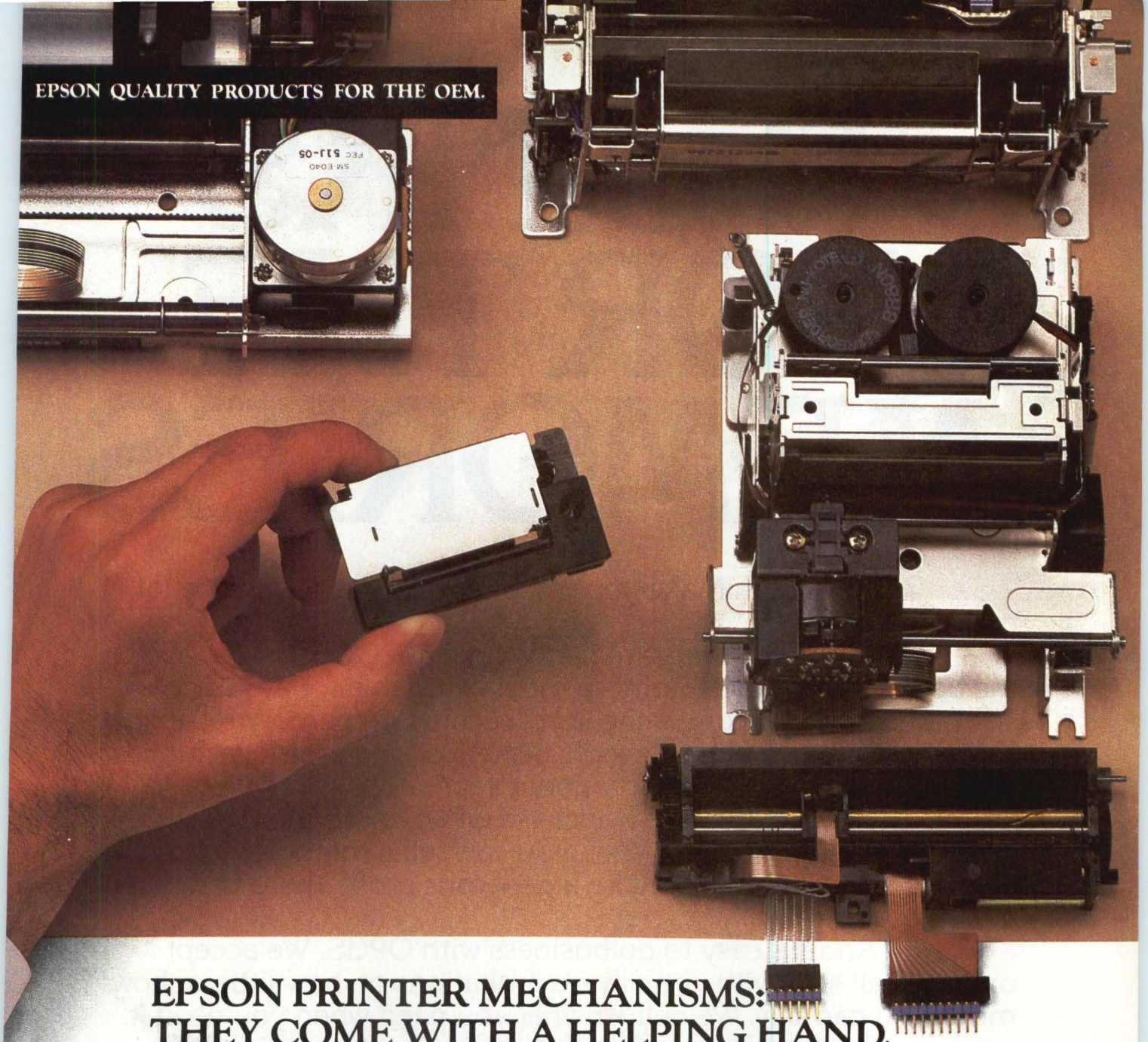
Manufacturer Model	CPU Word size (bits)	On-board memory (bytes)	I/O (ports, baud)	Bus	Software support	Size (in.) Power	Price	Notes	Circle No.
Bubbl-Tec									759
BBC-128	Z80A 8	1K–64K combined ROM, RAM 128K bubble memory	2 serial, (75 to 19200) 2 parallel, (1M)	Multibus	CP/M; FORTH	6 x 12 +5, +12, −12 V 6 W typical 13 W maximum	$1500	controls as much as 8M bytes bubble memory on separate boards	
California Computer Systems									760
CALSTAR	Z80A 8	2K ROM 64K–128K RAM	2 serial, (19.2K) 1 parallel		CP/M 2.2; ASM; editor, assembler, loader; development system: CCS 1100	8.5 x 11 90–130/180–260 VAC 60 W typical 70 W maximum	$2495–$2795	includes 2 SSDD floppy drives (DSDD optional)	
Central Data Corp.									761
B1017	Z8000 16	2K ROM		Multibus	XENIX/ZMOS; COBOL, BASIC, C, assembler; development system: Z8000 computer	+5, +12 V 20 W typical 30 W maximum	$625 10 to 25	supports as many as 32 users	
Creative Micro Systems Inc.									762
9609, 9619	6809 8	4K–32K ROM 1K–8K RAM	2 serial, (75 to 9600) 4 parallel, (340K to 680K)	EXORbus	OS9; monitor; BASIC, Pascal, C, CIS COBOL; macro text editor; interactive debugger; development facility: Exorciser	6.6 x 9.75 +5, +12, −12 V 4.84 W typical 7 W maximum	$595 to $895	parallel ports have ten lines each	
Cubit Inc.									763
6500	6502 8	4K–20K ROM 1K–4K RAM	8 parallel, (1M)	AIM-65	AIM monitor; BASIC, FORTH, Pascal, PL-65, assembler; development facility: on-board	4.5 x 6.5 +5 V 4 W typical 5 W maximum	$195	Rockwell AIM-65 computer-compatible, 9 lines per parallel port	
Data General Corp.									764
Eclipse S/120, model 8731; Eclipse S/120, model 8737	micro-ECLIPSE 16	as much as 512K RAM	1 serial, (to 19.2K)	DG Nova/ Eclipse bus, S-100	MP/AOS, RDOS, RTOS; Pascal, FORTRAN, BASIC, assembler; editor, debugger, library editor, ISAM, documentation tools; development facility: Any DG Eclipse computer	7.5 x 9.5 15 x 15 +5, −5, +12, −12 V 28 W maximum	$2800 to $9500; $1764 to $5700 qty over 200	includes floppy disk controller, on-board character, graphics generator	
Datricon Corp.									765
ACS-09	6809 8	0–40K combined ROM, RAM	1 serial, (300 to 19200)	STD	D-FORTH and OS-9; D-FORTH, BASIC, Pascal, C, COBOL, assembler; development facilities: ACS-09B computer, DV-9	4.5 x 6.5 +5, +12, −12 V 3.5 W typical 4.1 W maximum	$195	1 MHz, 2 MHz versions	



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M5XX	7 wire impact	40	3.0 LPS	59.0 oz
M12XX	Thermal	40	0.5 LPS	5.2 oz
M3XXX	9 wire impact	80	80 CPS	4.4 lb

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ACS-12	6800 8	0–40K combined ROM, RAM	1 serial, (300 to 19200) 2 8-bit bidirectional parallel ports (500K)	STD	D-FORTH OS; D-FORTH assembler; development facilities: DEC PDP-11 computer, Apple computer	4.5 x 9.6 +5, +12, −12 V 3.5 W typical 4.1 W maximum	$295		
Digital Equipment Corp.									766
FALCON SBC-11/21, Model KXT11-AA	T-11 16	0–32K ROM 4K–8K RAM	2 serial, (300 to 38400) 1 24-bit parallel, (1.6M)	LSI-11	MicroPower OS; Pascal, assembler; development facility: LSI-11/23 computer	5.2 x 8.9 +5, +12 V 12 W typical 15 W maximum	$790		
Distributed Computer Systems									767
DCS 186/16	80186 16	0–32K ROM 256K RAM	2 serial, (300 to 1M) 3 parallel, (100K)	Multibus	CP/M-86, MP/M, MS/DOS, UNIX, RMX/86; monitor; FORTRAN, C, Pascal, PL/I, BASIC, PLM-86; editor, loader; development facility: on-board	6.75 x 12 +5, +12, −12 V 20 W typical 25 W maximum	$2000		
DCS 86/16	8086 16	2K–16K ROM 0–8K RAM	3 serial, (300 to 1M) 3 parallel, (100K)	Multibus	CP/M-86, MP/M, MS/DOS, UNIX, RMX/86; monitor; FORTRAN, C, Pascal, PL/I, BASIC, PLM-86; editor, loader; development facility: on-board	6.75 x 12 +5, +12, −12 V 25 W typical 30 W maximum	$1200		
Diversified Technology Inc.									768
CBC 800/216; CBC 800/ 2400	NSC-800 8	0–64K ROM 0–32K RAM	1 serial, (110 to 9600) 6 8-bit parallel	Multibus	CP/M 2.2, IOS-4; CBC 9216 monitor; IOS-4 (based on FORTH); development facility: Intel MDS with Relms NSC-800 Spice module	6.75 x 12 +5, +12, −12 V 0.8 W typical 2 W maximum	$925 to $994	commercial version 0 to +70° C, industrial version −40 to +85° C	
Dual Systems Corp.									769
CPU/VME	68010 16	8K–32K ROM 256K–1M RAM (dual ported)	VME		UNIX System III; VMEbug monitor; BASIC, FORTRAN, Pascal, COBOL, C; development facility: VME/32 computer	6.3 x 9.2 +5 V 15 W typical 18 W maximum	$1495	hardware floating-point available; memory management unit type 16082	
CPU/68000M	68000 16	None		S-100	UNIX System III, FORTH OS; BASIC, FORTH, Pascal, COBOL, C; development facility: System 83/20 or 83/80	5.5 x 10 +8 V 10 W typical 15 W maximum	$990	industrial grade, 168-hour burn-in	

SINGLE-BOARD COMPUTERS

Manufacturer Model	CPU Word size (bits)	On-board memory (bytes)	I/O (ports, baud)	Bus	Software support	Size (in.) Power	Price	Notes	Circle No.
Forward Technology Inc.									770
FT-68X	68000 (10 MHz) 16	16K–32K ROM 256K RAM	2 serial, (600K) 1 parallel	Multibus	monitor; loader, debugger; development facility: FTI 3000 or FTI 500 computer	6.75 x 12 +5 V 17.5 W typical 20 W maximum	$2200 qty 100	includes memory management unit, supports as many as 8M bytes on separate boards	
General Micro Systems Inc.									771
GMS6506-01-01	6502 8	8K–32K ROM 1K–4K RAM	1 serial, (100 to 9600) 20 parallel lines, (to 1M)	EXORbus	OS; monitor; clock/calendar, PROM programmer; FORTH, BASIC, assembler; development facilities: on-board, GMS6500	6 x 9.75 +5, +12, −12 V 10 W typical 15 W maximum	$284 qty 100	optional IEEE-488 port, may substitute 6802 or Z-80 CPU, addresses as many as 3 64K-byte memory banks	
GMS6526-01-01	6809 8	8K–32K ROM 1K–4K RAM	1 serial, (100 to 9600) 20 parallel lines, (to 1M)	EXORbus	OS-9; monitor; clock/calendar, PROM programmer; BASIC, assembler; development facilities: on-board, GMS6800	6 x 9.75 +5, +12, −12 V 9 W typical 15 W maximum	$334 qty 100	optional IEEE 488 port; 1 MHz, 2 MHz versions; addresses as many as 3 64K-byte memory banks	
Heurikon Corp.									772
HK-68	68000 16	4K–32K ROM 128K–1M RAM	4 serial, (38400) 2 8-bit parallel	Multibus	UNIX, CAM-68; Hbug monitor; C, Pascal, FORTRAN, COBOL, BASIC; editor, loader; development facility: on-board	6.75 x 12 +5, +12, −12 V 22 W typical 44 W maximum	$3590	includes memory management unit, floppy disk controller	
MLZ-92A	Z80A 8	4K–16K ROM 16K–64K RAM	4 serial, (50 to 19200) 2 parallel	Multibus	CP/M, MP/M; Zraid monitor; C, Pascal, FORTRAN, COBOL, BASIC; editor, loader; development facility: on-board	6.75 x 12 +5, +12, −12 V 14 W typical 18 W maximum		optional floppy disk, hard disk, and streaming tape controllers; DMA controller	
Inconix Corp.									773
CINCH PAK	8031 8	4K–32K ROM 2K–8K RAM	1 serial, (28800) as many as 8 parallel		CPOS; assembler, CPAL development system: any that supports Intel MCS-51	12 x 16 115/220 V 15 W typical 26 W maximum	$7485	includes on-board power supply	
Insight Enterprises Corp.									774
EQ-4	Z80A 8	2K ROM 128K RAM	4 serial, (300/19,200) 2 parallel bus		CP/M; CRT monitor; BIOS development system: EQ-4	8 x 14 +5, +12, −12 V 8 W typical 12 W maximum	$750		

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SINGLE-BOARD COMPUTERS

Manufacturer Model	CPU Word size (bits)	On-board memory (bytes)	I/O (ports, baud)	Bus	Software support	Size (in.) Power	Price	Notes	Circle No.
Intel Corp.									775
iSBC 286/10	80286 16	0–384K ROM 0–80K RAM	2 serial 1 parallel	Multibus	XENIX 286, RMX 286R OS; SDM 286 monitor; Pascal, FORTRAN, C, BASIC, COBOL, PL/M, assembler; development facility: Series III	6.75 x 12 +5, +12, −12 V 36.2 W maximum	$3350	includes iLBX interface	
iSBC 86/30	8086 16	0–128K ROM 128K–256K RAM (dual ported)	1 serial 1 24-bit parallel	Multibus	XENIX 86, iRMX 86, CP/M-86; iSBC 957 monitor; Pascal, FORTRAN, C, BASIC, COBOL, PL/M, assembler; development facility: on-board or Series III system	6.75 x 12 +5, +12, −12 V 26.1 W maximum	$2990		
Intellimac Inc.									776
IN/MP68	68010, 68000 16	8K–128K ROM 128K–512K RAM		Multibus	UNIX V7, TeleSoft ROS; C-shell, IN/MSX monitors; Ada, FORTRAN, Pascal, COBOL, C, LISP; development facility: Intellimac IN/7000 M-series, K-series computers	6.75 x 12 +5 V 15 W typical 25 W maximum	$2495	drives separate boards with serial, parallel ports and as much as 4M-bytes memory	
Intersil Systems Inc.									777
ISB-3101, ISB-3111	8085A, Z80 8	2K–24K ROM 2K–24K RAM		STD	CP/M; monitor; BASIC, Pascal, FORTRAN, COBOL, assembler; editor; development facility: ISB-80	4.5 x 6.5 +5 V	$200	on-board counter/timer tied to I/O connector	
Ironics Inc.									778
IR-801	Z80A 8	2K–64K ROM 2K–64K RAM	2 serial, (800K) 8 parallel, (2.75M)	STD and Ibus	CP/M; IMON monitor; IRTX multitasking executive; C, Pascal, COBOL, FORTRAN; development facilities: on-board, IR-801/D	11 x 13 10 W typical 60 W maximum on-board power supply	$505 qty 25	data acquisition, control system; includes A/D converter, clock/calendar	
IV-1600	68000 (12 MHz) 16	4K–160K ROM 128K–256K RAM	4 serial, (1M) 3 parallel, (more than 8M)	VME and SASI	CP/M 68K, UNIX; IMON 68 monitor; VRTX multitasking executive; C, Pascal, COBOL, assembler; development facilities: on-board, IV-1600/D	9 x 11 +5, +12, −12 V 18 W typical 25 W maximum	$2495 qty 25		

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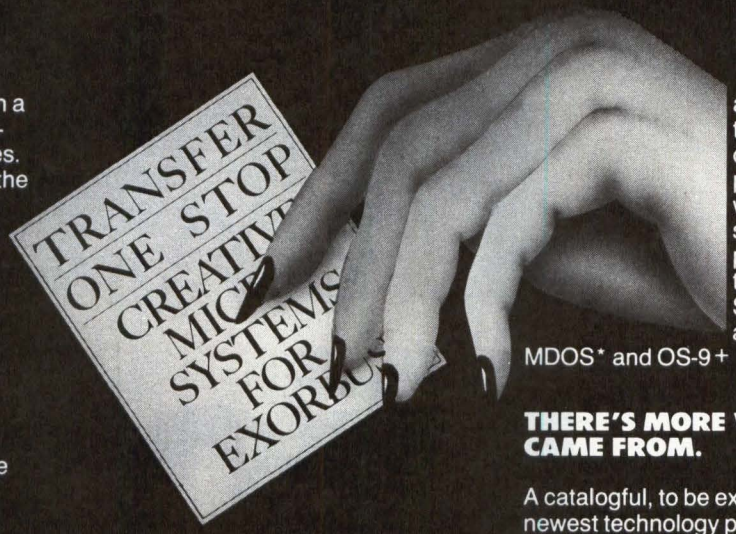

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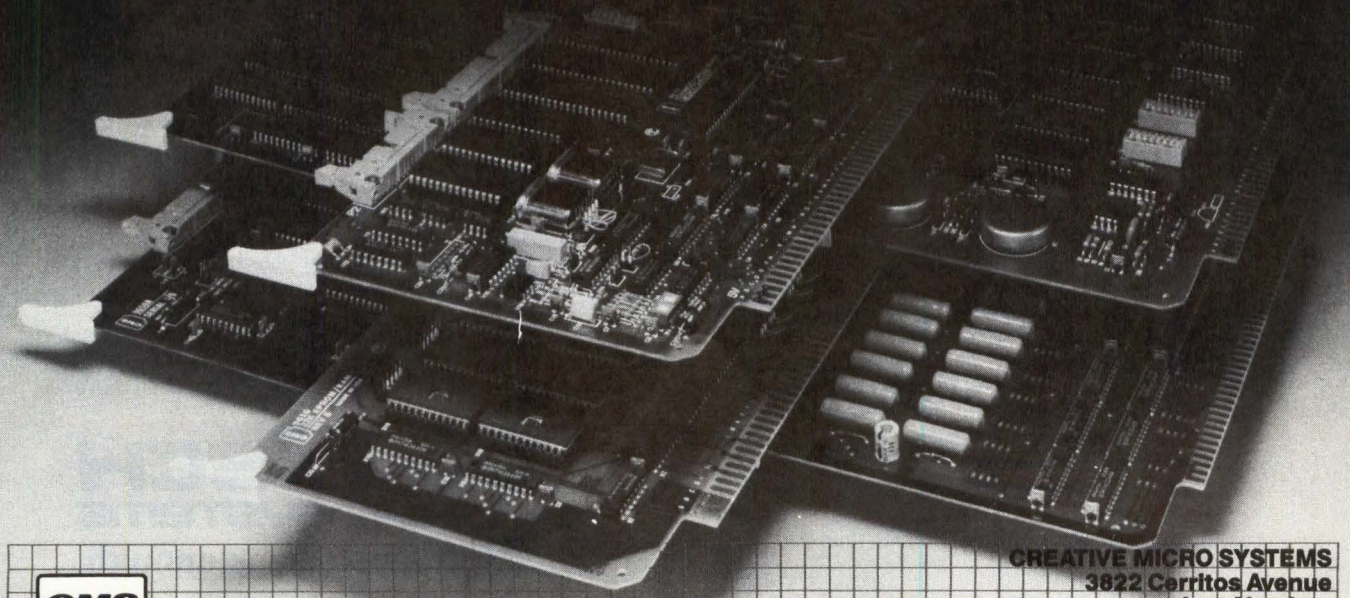

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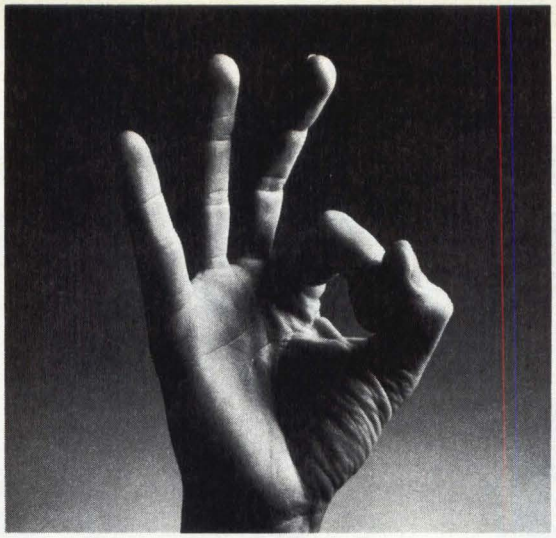
CIRCLE NO. 112 ON INQUIRY CARD



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SINGLE-BOARD COMPUTERS

Manufacturer Model	CPU Word size (bits)	On-board memory (bytes)	I/O (ports, baud)	Bus	Software support	Size (in.) Power	Price	Notes	Circle No.
Megatel									779
Quark/100	Z80B 8	512K ROM as much as 128K RAM	2 serial, (75 to 19200) 3 parallel, (250K)	S-100, STD	CP/M, MP/M; BASIC	4 x 6.5 +5, +12 V 10 W typical 10 W maximum	$995		
Microbar Systems Inc.									780
DBC 286M	80286 16	0–128K ROM 0–4K RAM	1 serial, (9600) 3 parallel, (1M)	Multibus	XENIX; Debug86 monitor; C, FORTRAN, BASIC, COBOL, assembler; editor, downloader	6.75 x 12 +5, +12, −12 V 23 W typical 35 W maximum	$1995		
DBC 68K2 Multibus	68000 16	0–128K ROM 128K–512K RAM	2 serial, (19200 baud asynch, 880K baud synch) 3 parallel, (1M)	Multibus	XENIX, Uniplus; Debug68K monitor; C, FORTRAN, BASIC, COBOL, Pascal, assembler	6.75 x 12 +5, +12, −12 V 18 W typical 23 W maximum	$1995		
Miller Technology Inc.									781
MCPU-800-03, M-80	Z80, Z80A 8	1K–32K ROM 0.1K–64K RAM	1 serial, (50 to 56000) 2 to 4 parallel (to 100K)	STD	Debug monitor; BASIC	4.5 x 7 or 4.5 x 6.5 +5, +12, −12 V 5 W typical 7.5 W maximum	$69 to $695		
Mizar Inc.									782
VME8100, VME8105	68000 16	8K–32K ROM 0–16K RAM	1 serial, (50 to 19200)	VME	CP/M 68K; monitor; C, assembler	3.94 x 6.3 +5, +12, −12 V 6 W typical 9 W maximum	$630 to $680		
Monolithic Systems Inc.									783
MSC 8014	Z80B (6 MHz) 8	0–32K ROM 64K–128K RAM	1 serial, (9600 baud asynch, 56000 baud synch) 2 parallel	Multibus	CP/M; development facility: MSC 8802	6.75 x 12 +5 V (+12 V with 2708 EPROM) 15 W typical 28 W maximum	$1364		
MSC 8186	iAPX 186 (8 MHz) 16	0–64K ROM 128K–512K RAM	1 serial, (9600 baud asynch, 56000 baud synch) 2 parallel	Multibus	CP/M 86; development facility: MSC 8802	6.75 x 12 +5 V 25.5 W typical 28.5 W maximum	$2280	math co-processor available	
Musys Corp.									784
NET/81, NET/82	Z80A 8	2K–4K ROM 64K–128K RAM	2 serial, (to 800K)	S-100	TurboDOS; COBOL, assembler; debugger, S-100 disk controller drivers	5.25 x 10 +8, +16, −16 V 10 W typical 14 W maximum	$495 to $895	S-100 slave processor for multi-user, multi-processing environment	
National Semiconductor Corp.									785
BLC-86/05	8086 16	0–128K ROM 8K–16K RAM	1 serial, (9600) 1 parallel, (24 lines)	Multibus	BLC-8957 monitor	6.75 x 12 +5, +12, −12 V		5 MHz, 8 MHz versions	
CIM-804	NSC800 8	2K–4K ROM 2K RAM	3 parallel 2 8-bit, 1 16-bit (4M)	CIMbus	BLMX-80C; CIM-660 monitor; Pascal, PL/M, assembler; editor, up/down loader; development facility: SPX-90 (Starplex)	3.9 x 6.3 +5 V 0.375 W typical 0.425 W maximum on-board power supply	$320 to $590	available temperature ranges: 0 to +70°C, −40 to +85°C	

SINGLE-BOARD COMPUTERS

Manufacturer Model	CPU Word size (bits)	On-board memory (bytes)	I/O (ports, baud)	Bus	Software support	Size (in.) Power	Price	Notes	Circle No.
Omnibyte Corp.									786
OB68K1A	68000 (10 MHz) 16	0–96K ROM 32K–128K RAM (dual ported)	2 serial 2 parallel	Multibus	Polyforth 32, Idris, MSP; Macsbug monitor; FORTH, C, Pascal; screen editor; development facility: 0B68K/SYS computer	6.75 x 12 +5, +12, −12 V 16.2 W maximum	$1495		
Onset Computer Corp.									787
CPU-6805A	146805E2 8	2K–6K ROM 1K RAM	8 parallel lines	C-44	monitor	4.5 x 5.5 +6.5 to +18 V 0.005 to 0.06 W typical 0.1 W maximum on-board power supply	$360	CMOS boards for battery applications; 8-channel, 8-bit A/D converter; real-time clock	
CPU-800A-1, CPU-8085	NSC-800 or 80C85 8	2K–4K ROM 0.1K–2K RAM	22 or 24 parallel lines	C-44	monitor	4.5 x 5.5 +6.5 to +18 V 0.02 to 0.3 W typical 0.4 W maximum on-board power supply	$250 to $370	CMOS boards for battery applications	
Pacific Microcomputers Inc.									788
PM68D, PM68K	68000 or 68010 16	8K–128K ROM 128K–256K RAM (dual ported)	2 serial, (as much as 880K) 1 parallel, (1M to 16M)	Multibus	UNIX; monitor; C, FORTRAN, Pascal, COBOL, BASIC, assembler; development facilities: DEC VAX-11 under VMS, or any computer under UNIX	6.75 x 12 +5 V 20 W typical 25 W maximum	$1990 to $2590	8 MHz, 10 MHz versions; 24-bit virtual address; RS423/422 capability	
Polymorphic Systems									789
System 8600	80186 16	4K–16K ROM 256K–1M RAM	2 serial 1 parallel	S-100	CP/M-86; editor; development facility: Poly 88	+8, +16, −16 V	$1995		
Pro-Log Corp.									790
7806	Z80 8	128K ROM 128K RAM	2 serial, (50 to 9600)	STD		+5 V	$395		
Quay Corp.									791
90 MPS, 90F/MPS	Z80A 8	7K–14K ROM 64K RAM	1 to 3 serial, (110 to 9600) 1 to 4 parallel		CP/M; monitor; COBOL, FORTRAN, BASIC; development facility: Quay 900 computer	8 x 16 +5, −5, +12, +28 V 5 W typical 20 W maximum	$800 to $900	includes on-board PROM programmer	
RCA Solid State Division									792
CDP18S600	1805 (CMOS) (5 MHz) 8	0–32K ROM 2K RAM	1 serial, (to 38,000) 20 parallel lines		Microdos; monitor; BASIC, PL/M, FORTH, Pascal, assembler; text editor, linker-loader; development facility: MS2000	4.5 x 7.5 +5 V 0.1 W typical	$329, $260 (qty over 100)	includes 8-bit counter/timer	
MBZ80N, MBZ80C	Z80 (CMOS) 8	4K ROM 2K RAM	2 8-bit parallel	CMOS Microboard bus	TPM; monitor; BASIC, Pascal, assembler; linkage editor, debugger; development facility: MS2000Z	4.5 x 7.5 +5 V 0.1 to 1 W typical	$249 to $269	2.5 MHz, 4 MHz versions	

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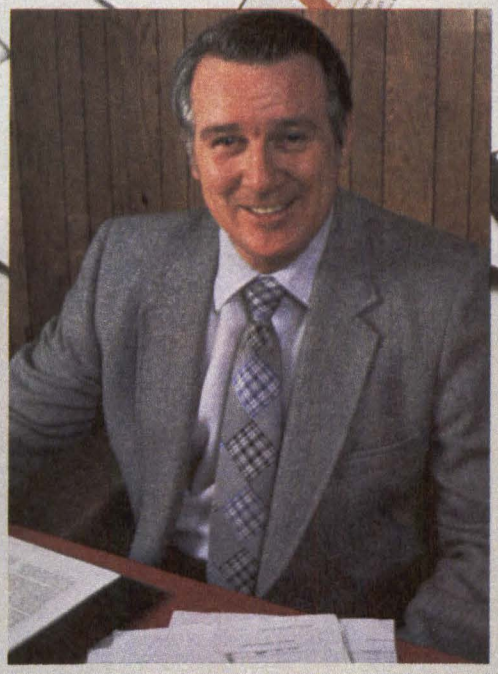

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CIRCLE NO. 114 ON INQUIRY CARD

SINGLE-BOARD COMPUTERS

Manufacturer Model	CPU Word size (bits)	On-board memory (bytes)	I/O (ports, baud)	Bus	Software support	Size (in.) Power	Price	Notes	Circle No.
SBE Inc.									793
590	6809 8	2K–16K ROM 1K–8K RAM	1 serial, (19200) 2 parallel, (3M)		AS04 OS; FORTH, BASIC; development facility: SBE model 809 computer	4.5 x 6.5 +5, +12, −12 V 7 W typical 9 W maximum	$295		
M68K10	68000/ 68010 16	4K–64K ROM 128K–1M RAM (dual ported)	2 serial, (880K) 3 parallel, (8M)	Multibus	CP/M 68K, Regulus; Probug, Hardbug, VRTX monitors; Pascal, C, FORTRAN, BASIC, assembler; development facility: DEC PDP-11, VAX-11 computer; PDS-100, PDS-200	6.75 x 12 +5, +12, −12 V 15 W typical 18 W maximum	$1395 qty 100		
Sky Computers Inc.									794
SKYFFP	Bit-sliced 32	8K ROM 8K RAM		S-100, Multibus, Versabus, VME	UNIX; FORTRAN, Pascal, BASIC, assembler; linker, loader, debugger; floating-point library routines; development facility: 68000-based computer	+5 V 20 W maximum	$2200	provides trig, transcendental, complex math, format conversion functions for M68000 micros; microprogrammable with vendor-supplied software	
SKYMNK Series	Bit-sliced 32	2K ROM 2K RAM	DMA, (2.1M)	Q-bus, Mbus, Versabus	RT-11, RSX-11, UNIX, Versados; FORTRAN, Pascal; vector library, FFT, matrix inversion; development facilities: DEC PDP-11/23, 68000-based or 8086-based computer	+5 V 35 W typical 40 W maximum	$5500, $4000 (qty 100)	provides floating-point processing for micros	
Synertek Inc.									795
SYM-1, SYM-2	6502 8	4K–28K ROM 1K–4K RAM	1 serial 2 to 5 parallel	SYM, KIM, AIM	Supermon monitor; FORTH, BASIC, assembler; editor, loader	7.88 x 8.88 8.25 x 10.72 +5 V on-board power supply (SYM-2)	$239 to $245	on-board: 28-key keyboard, 6-digit display; 8 toggle switches; 8 LEDs (SYM-2)	
Systemathica C. G. Ltd.									796
DBC-1880 Series	iAPX-188 8	0–64K ROM 0–256K RAM	1 to 4 serial 1 to 6 parallel	Multibus, IBM PC bus	DIOS OS (compatible with CP/M and ISIS)	6.75 x 12 +5, +12, −12 V 30 W typical	$795 qty 20 to 49		
MU-186000 Series	iAPX-186 16	0–64K ROM 0–256K RAM	1 to 4 serial 1 to 6 parallel	Multibus	DIOS OS (compatible with CP/M and ISIS); monitor	6.75 x 12 +5, +12, −12 V 30 W typical	$795 qty 20 to 49		

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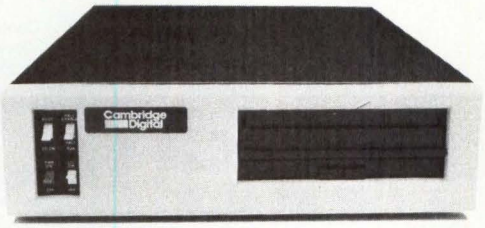

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CIRCLE NO. 115 ON INQUIRY CARD

SINGLE-BOARD COMPUTERS

Manufacturer Model	CPU Word size (bits)	On-board memory (bytes)	I/O (ports, baud)	Bus	Software support	Size (in.) Power	Price	Notes	Circle No.
United Technologies Mostek Corp.									**797**
MDX-CPU3, MDX-CPU4	Z80 8	0–64K ROM 0–64K RAM	1 serial, (to 19200) 1 parallel Centronics printer interface	STD-Z80	MOS-80; BASIC	4.5 x 6.5 +5, +12, −12 V			
MK75601 VME SBC	MK68000 16	16K–48K ROM 4K–12K RAM	1 serial, (to 19200)		monitor; assembler; development facilities: DEC VAX-11 under VMS or PDP-11 under RSX-11	6.3 x 9.2 +5, +12, −12 V	$1695		
Wintech Systems									**798**
MCM-SBC	Z80A 8	2K–8K ROM 64K RAM	Two serial, (110 to 9600)	STD	CP/M 2.2	4.5 x 7.5 +5, +12, −12 V 0.75 W typical 0.9 W maximum	$695	counter/timer, floppy disk controller included	
Wintek Corp.									**799**
6801 Micro Control System	6801 8	2K ROM 128K RAM	1 serial, (300 to 9600) 2 parallel, (32)		C-Net networking firmware; development facility: Sprint 68 computer, 6801 VICE	4.5 x 6.5 14 VAC 5 W typical 7.5 W maximum On-board power supply	$200 to $350, 50% dis- count qty 500	intended for data acquisition, control applications; includes 8- channel A/D converter, 8-bit D/A converter, 8 solid-state relays	
6809 Control Module	6809 8	0–64K ROM 2K–24K RAM	2 serial, (300 to 9600) 4 parallel, (650K) compatible with 6800 family		monitor; BASIC; loader, debugger; development facility: Sprint 68 computer	4.5 x 6.5 +5, +12, −12 V 5 W typical 7.5 W maximum	$245 50% dis- count qty 500		
Xycom Inc.									**800**
1864+	Z80B 8	2K–224K ROM 128K RAM	2 serial, (to 187.5K baud asynch, 800K baud synch) 2 parallel	Flexibus III	UCSD Pascal, CP/M; FORTRAN, Pascal, BASIC, assembler; editor, debugger, utilities; development facilities: Xycom 180+ computer, Xycom 3800B/3	8.5 x 10.5 +5, +12 V		designed for harsh environments	
Zendex Corp.									**801**
ZX 186	80186 16	0–128K ROM 128K–256K RAM	1 or 2 serial 1 24-bit parallel	Multibus	RM8-86, CP/ M-86; FORTRAN, Pascal, PL/M, assembler; linker, loader, debugger, editor; development facilities: 95/86, 95/36 computer	6.5 x 12 +5 V 12 W typical 17 W maximum	$2500		

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1-12 USERS

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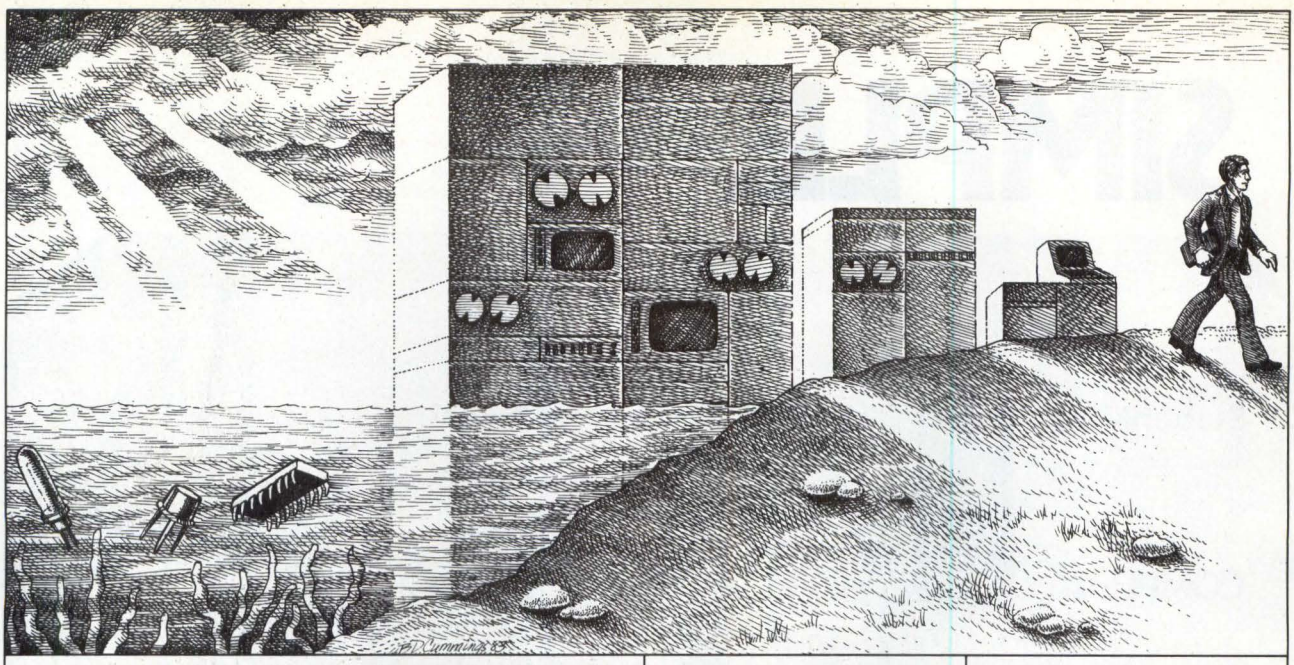
CIRCLE NO. 116 ON INQUIRY CARD

SINGLE-BOARD COMPUTERS

Manufacturer Model	CPU Word size (bits)	On-board memory (bytes)	I/O (ports, baud)	Bus	Software support	Size (in.) Power	Price	Notes	Circle No.
ZX 86	8086 16	8K–64K ROM 8K–16K RAM	1 or 2 serial, (75 to 38400) 1 24-bit parallel	Multibus	RM8-86, CP/M-86; FORTRAN, Pascal, PL/M, assembler; linker, loader, debugger, editor; development facilities: 95/86, 95/36 computer	6.5 x 12 +5, +12, −12 V 10 W typical 15 W maximum	$1467	socket for 8087 co-processor, iSBX module plug for expansion	
Ziatech Corp.									802
ZT-7805	8085 8	0–8K ROM 1K RAM	2 serial, (110 to 19200) 1 GPIB parallel, (30K)	STD	monitor; development facilities: on-board, IBM Personal Computer, Intel Series III	4.5 x 6.5 +5, +12, −12 V 4 W typical 8 W maximum	$650, $395 qty 100		
ZT-8800 Series	8088 16	0–16K ROM	as many as 1 serial, (50 to 56000)	STD	iRMX 86, CP/M 86; monitor; development facilities: on-board, IBM Personal Computer, Intel Series III	4.5 x 6.5 +5, +12, −12 V 4 W typical 12 W maximum	$195 to $449, $139 to $328 qty 100		



COMPUTERS MUST CHANGE.

The evolution from vacuum tubes to transistors to microchips has spawned a series of stunning successes for computers—from the mainframe to the mini to the micro. Not since the introduction of the telephone has a piece of equipment made such a positive impact on the workings of business.

Yet, in today's business, a substantial workforce has been largely overlooked by the computer industry: the mobile professional.

They are the executives, salespeople and field-support personnel that spend many of their workdays doing battle against the competition away from their desks—far from the comforts, conveniences and computing aids of the home office.

THE HAZARDS OF THE ROAD.

The mobile professional spends hours on planes, trains and in taxis traveling to business meetings. Only to have to return at a later date with the typed contract. Or mail in the revised report. Or call back with the final numbers.

Office automation simply hasn't moved fast enough for the mobile professional.

Between paper, pencils, pens, files, triplicate carbon copy order pads, calculators, dictation recorders, appointment diaries, phone books and a picture of the twins, the mobile professional charges off dragging half an office across thousands of miles of territory every year.

SOMETHING, INDEED, MUST CHANGE.

Clearly, what's needed is a viable alternative. A mobile computer designed specifically for the rigors of the road.

Taking the thinking professional's approach, we believe a mobile computer has to be a powerful and complete ultraportable. One that fits easily inside a briefcase. And runs on rechargeable, self-contained batteries for use en route as well as in the office or at home.

It stands to reason that it must have an adequately large display screen, a full-sized keyboard, a correspondence-quality 8½" x 11" or legal page printer and microfloppy disk drives for memory.

Necessity would also suggest an integrated modem, for two-way data communication via standard telephone lines.

All in a package that weighs in at less than 14 pounds.

THE HARDEST PART IS THE SOFTWARE.

But by far, the most important feature of a truly useful mobile computer is its software. It has to be fully confusion-proof, using familiar graphic symbols, rather than complicated computer-talk, to guide the user through each step.

It also has to offer a full complement of practical application programs, including a personal secretary, word processing and financial planning. Developed precisely for the professional demands of the mobile professional.

These are the criteria by which we've designed the Gavilan™ mobile computer. In fact, Gavilan is committed exclusively to taking the computer evolution to its next logical step.

Because, yes, computers have come a long way. But change they must.

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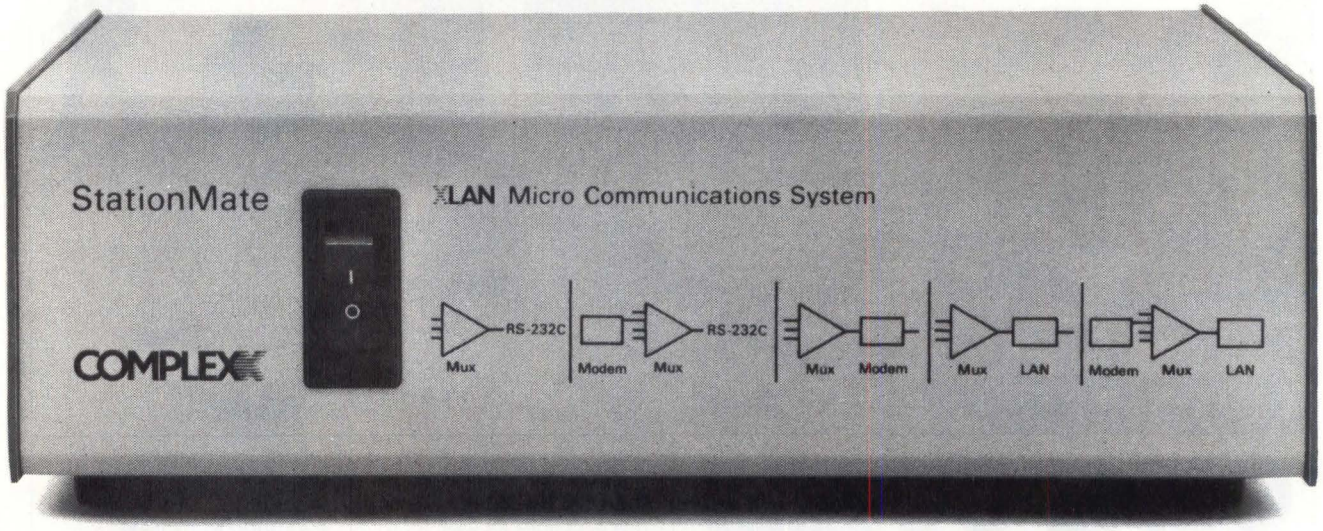
SIMPLE.



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With it you can construct a LAN with up to 64 nodes having 3 ports each. And you can create a remote workstation or provide access to the LAN on a dial-up line. All it takes is just a simple phone call.

User interface is simple, too. You can configure or establish local or remote ports, nodes and networks through menu-driven terminal commands from any port. *There are no cryptic DIP switches.*

And the biggest surprise—StationMate is priced to make networking for micro computers an economic reality: $1450.00 retail.

If you didn't see StationMate at the spring Interface and Comdex shows, call or write for application information and specifications. Complexx Systems, Inc., 4930 Research Drive, Huntsville, AL 35805, 205/830-4310.

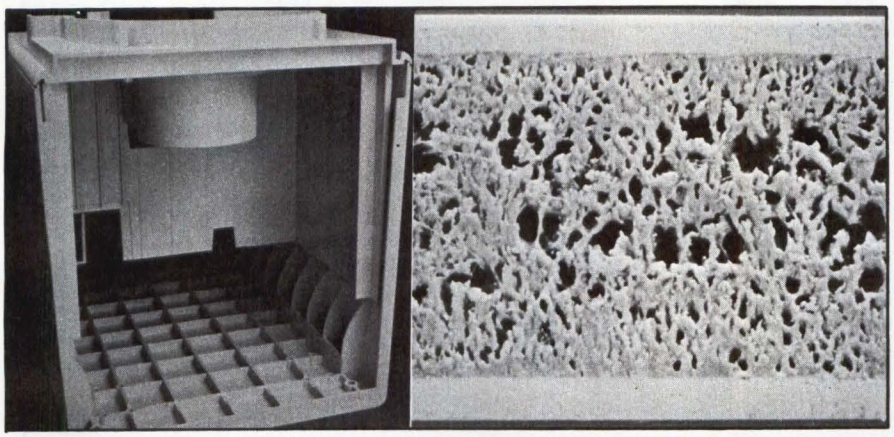
OEM, Distributor, and Dealer inquiries invited.

COMPLEXX™

CIRCLE NO. 119 ON INQUIRY CARD

Designing the right enclosure

DAVID H. FREEDMAN



Hewlett-Packard disk drive enclosure *is made of structural foam (right). Foam provides greater strength than other plastic processes, but requires extensive finishing. (Source: General Electric Co.)*

The outside of a machine can add more to its success than good looks

OEMs developing a new product often think of the enclosure—that is, the metal or plastic skin that surrounds the components—as a last-minute item thrown on to make the machine look good. While looks do count more than ever on computer equipment, the enclosure can and must do a great deal more. Choosing the materials and design that provide functions such as cooling, electromagnetic-interference shielding and impact protection requires a basic understanding of the available options.

Metal

With few exceptions, enclosures are made of metal, plastic or a combination of the two. Although special requirements sometimes indicate a material and manufacturing process, the choice is often more complex.

Among metal enclosures for computer equipment, sheet-metal fabrication is by far the most common manufacturing technique. Sheet-metal fabrication involves the deformation of a thin metal sheet through cutting, punching, bending, lancing, drilling and grinding. Separate parts can be attached through bolts, rivets or welding, and then dipped, sprayed or electroplated with a material such as zinc to inhibit rust and improve electrical connections, and finally spray-painted with two or more coats of baked enamel.

Metal enclosures are generally made of aluminum or steel. Aluminum is popular for its higher strength-to-weight ratio, but, because steel costs about two-thirds as much as aluminum (taking aluminum's greater coverage per pound into account), steel is often used for equipment for which weight savings are not important, such as large floor-standing pieces.

The major advantage of sheet-metal fabrication is its relatively low tooling cost—the cost of setting up the machinery to manufacture a part. Whereas tooling costs for a display terminal of injection-molded plastic could run to $500,000, a similar product in sheet metal might require only $30,000 in tooling costs. But sheet-metal fabrication generally uses "soft" tooling, or nondedicated machinery that requires much operator intervention, and thus carries a correspondingly high cost per piece. Plastic injection molding, in contrast, uses "hard" tooling—dedicated molds—that requires little operator intervention. When the higher material and finishing costs for sheet metal over plastic are also taken into account, the cost trade-off becomes clear: sheet-metal techniques save money up front, but lose their cost savings as production quantities grow.

In addition to low tooling costs, sheet metal has several other advantages. Because metals are electrical conductors, they provide good protection from electro-

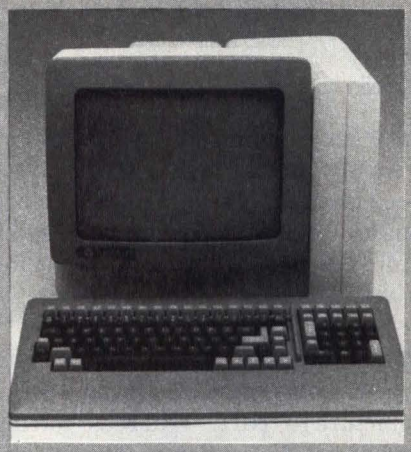
static discharge and, for a given design, relatively good shielding from electromagnetic and radio-frequency interference. Sheet metal is also strong, subject to structural failure or tearing under only the most extreme shocks, usually making it the material of

THREE NOTABLE ENCLOSURES

A total of 20 million lbs. of raw steel and aluminum go into Digital Equipment Corp.'s Westfield, Mass., plant each year, and most of it comes out again as H9640 series cabinets. Designed to contain processors and disk drives, the familiar cabinets, of which 80 percent are gray, are marketed primarily to DEC OEMs. "Cabinets come right from [DEC president] Ken Olsen," says Ron Cohen, who directs cabinet marketing. "He's really pushed for a DEC look." This DEC look is not limited to DEC equipment, however, as the cabinet is also available to non-DEC OEMs for use with other equipment.

The 40- and 60-in.-tall metal cabinets consist of reinforced panels mounted on a zinc-plated frame and can contain a load of 450 lbs. The panels are coated with iron phosphate for rust prevention, painted by an electrodeposition process and then given a final hand-applied coat of textured paint. "The texturing is more of an art than a science," boasts metals business manager George Hughes. Studs and nuts are upset-molded, or rammed, into the cabinet, and virtually all pieces and subassemblies can be stacked to save storage space and handling effort. The cabinets are shock-mounted at the feet, allowing the shipment of fully assembled systems. The emergence of computers from the computer room has called for modifications as well: DEC puts rails on its cabinets to keep spilled coffee out and adds enough rigidity to support a man's weight. "Some dingbats sit on these things," explains Cohen.

Drop-testing a DEC cabinet *simulates a typical loading-dock accident.*



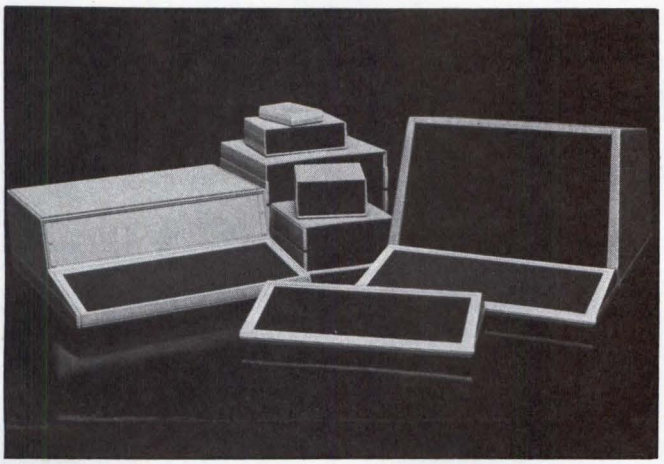
The TeleVideo 970 terminal *places most electronics in the vertical slab next to the CRT, providing efficient convection cooling and easier CRT adjustment.*

In contrast to the near-classic styling of DEC's cabinets, TeleVideo Inc.'s 970 terminal is almost unnerving in appearance. The L-shaped plastic slab cradling the suspended CRT looks as if it might have been added as an afterthought, but it is the focal point of a carefully designed enclosure. "TeleVideo had been perceived as following accepted designs," says product manager Steve Tatum. "We decided to take an innovative position." The innovation does not just run skin-deep: putting most of the components in the side slab's vertical design provides efficient, fanless cooling and frees the CRT for a wide range of adjustability. Because the CRT is balanced and lightweight, it can be adjusted from a seated position with little effort. "The amazing thing to me," says Tatum, "is that CRTs weren't designed this way in the beginning." Compared to its unique enclosure, however, the 970 is functionally mundane: it is a DEC VT100 emulator.

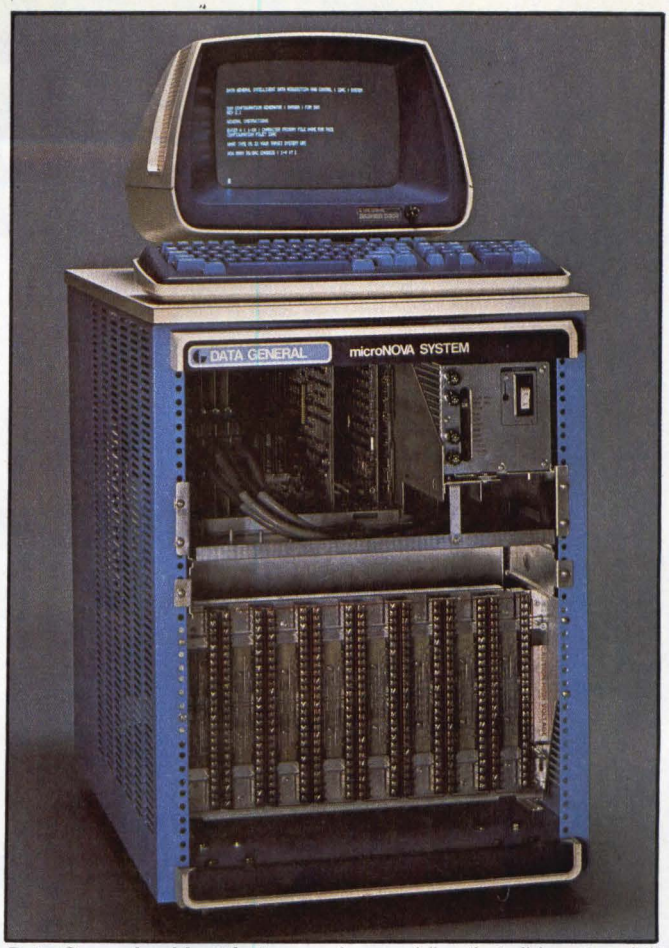
Portability seems at times to be a marketing concept rather than a feature, judging by the heft and bulk of some of the computers billed as portable. But at slightly more than 9 lbs. and smaller than many briefcases, the Compass computer from Grid Systems fits most people's travel and commuting habits. In this package sits a keyboard, a flat-panel display, bubble memory and a modem. "Fitting everything required a lot of trickiness," says Bill Moggridge, director of ID Two, the industrial design consultancy that designed the Compass enclosure. Choosing the material for the case was a problem: plastic didn't have the heat conductivity to eliminate using a fan, but aluminum was too heavy. The final choice: magnesium. As a result, the case weighs 3½ lbs. and can withstand 135G forces without damage. "The Compass can be put into a cardboard box and shipped by Federal Express," says Moggridge. To keep the lines of the plastic interior clean, the Compass has only two exposed screws. All other assembly is by interlocking pieces, but unauthorized disassembly is so difficult that the Compass had no difficulty in meeting the UL shock-hazard requirements. In terms of aesthetics, the Compass is successful: it was recently named to the New York Museum of Modern Art's permanent design collection.

Grid System's Compass computer *weighs about 9 lbs. and is smaller than a briefcase. Its magnesium case can withstand severe shocks.*

choice for larger, heavier pieces or pieces for harsh environments. Temperature variations are rarely a problem with metal because it tends to expand and contract uniformly and is not subject to thermal degradation as are many plastics. Metal's good thermal conductivity, furthermore, allows the enclosure to act as a heat sink, aiding in component cooling. It is virtually flameproof and is largely unaffected by most chemicals in an office environment, including solvents and cleaners, although paint can be damaged. Sheet-metal fabrication also has a short lead time compared to other processes. An enclosure can go from drawing board to production in three to 12 weeks, compared to as much as a year for some plastic processes.



PacTec's off-the-shelf plastic enclosures *include housings for keyboards, terminals and desk-top consoles, and are available with custom front panel and colors and with EMI/RFI shielding. Prices range from $17.50 to $77 in quantities of 1000.*



Data General cabinet *features subassemblies that slide out and tilt up to provide service access.*

Problems with sheet metal, besides its high post-tooling manufacturing costs, include its malleability, making it vulnerable to dents and scratches, and its sensitivity to moisture in exposed areas, potentially leading to corrosion. In addition, metal-fabrication manufacturing does not lend itself to complex, small or extensively curved parts.

Sheet-metal fabrication is not the only manufacturing process used to make metal enclosures. Die casting, which involves pouring molten steel or aluminum into molds, is occasionally used for pieces requiring a great deal of extra weight or strength, such as bases for tall cabinets. Metal extrusions are made by squeezing softened metal through a shaped hole, like squeezing toothpaste from a tube, and can be used as side panels in a box-like enclosure. Drawn metal processes use a powerful hydraulic press to pull a metal sheet over a simple protruding mold, forming a tub shape that can be used as the basic frame of an enclosure. All these techniques involve high tooling costs, but usually save several manufacturing steps and can often be bought off-the-shelf from manufacturers specializing in the process. Zero Corp., Burbank, Calif., for example, stocks 40,000 sizes of untrimmed, tub-shaped aluminum containers.

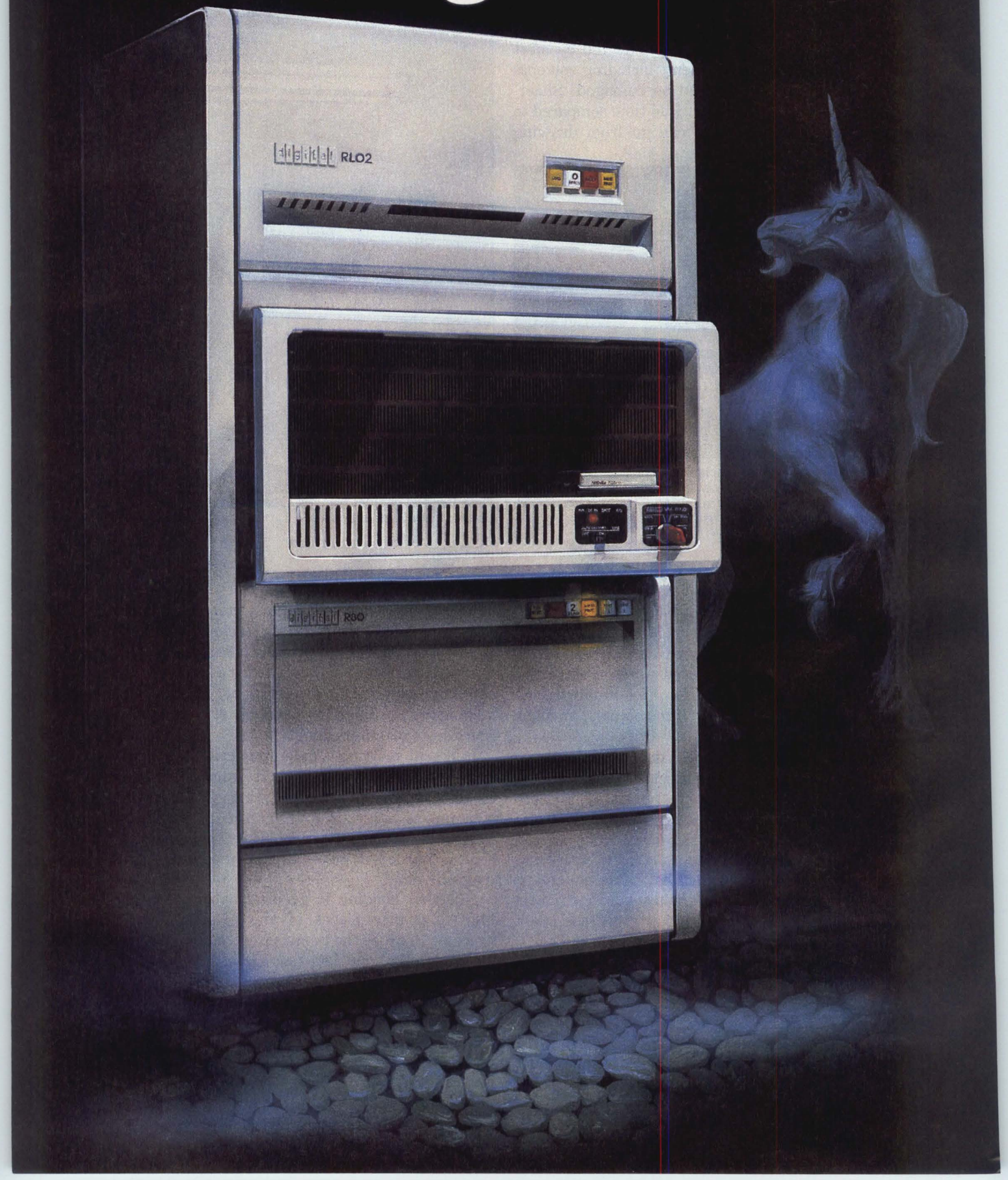
Plastic

Plastics provide more options than metal in terms of materials and manufacturing techniques. There are almost a dozen ways to manufacture a plastic enclosure for computer equipment, and each of these encompasses a number of possible variations. The most popular techniques are injection molding, structural foam and reaction-injection molding.

Injection molding (sometimes called straight injection molding to distinguish it from injection-molded structural foam) uses a rotating screw in a heated cylinder to force heated, softened plastic at high pressure into a water-cooled, clamped mold. The cooled, hardened piece is then mechanically ejected from the mold.

Injection molding is generally able to produce the highest quality pieces of any plastic-manufacturing process. Because the resin is injected into the mold at a pressure of 20,000 lbs. per sq. in., there is an even distribution of plastic throughout complexly curved and detailed molds. Vents, logos and threaded inserts can all be molded in. The surface of the ejected piece is usually free of the defects that plague other processes, and dyes can be mixed with the resin before molding, resulting in "through-color" that makes scratches less noticeable. Like most plastics, injection-molded plastics

The Magic of VAX



VAX-11/730

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The key to VAX performance and versatility is the VAX common architecture, which of course is an integral part of the 11/730. This one design feature ensures that all VAX systems, including the 730, support identical instruction sets, extendable data types, process structure, protection modes and 32-bit addressing.

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The VAX/VMS industry-standard priority-based operating system is included in the low price of the VAX-11/730. This single operating system runs on every VAX system, regardless of performance level. So you can select the 11/730 with confidence—if you require an upward migration in the future, you never have to reprogram, recompile, or relink. Software is always compatible. Programmers never have to relearn. You never outgrow the magic of VAX and VAX/VMS.

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CIRCLE NO. 120 ON INQUIRY CARD

are lightweight, durable and rustproof.

Because injection-molded pieces require little or no finishing, the piece costs are low, often a third or less of metal or other plastic piece costs. In addition, injection molding allows parts consolidation. Enclosures that might normally comprise 20 or more separately fabricated aluminum pieces could be produced in a few injection molds, creating significant savings in fabrication and assembly costs. But tooling costs for injection molding are tremendous. The high pressures and temperatures involved require heat-treated, machined-steel molds that can cost $500,000 for a CRT-sized enclosure (less expensive aluminum and epoxy molds can be used for prototype runs). The low piece costs for injection molding generally don't start to overcome the tooling costs until production quantities approach 20,000, although some vendors report using injection molding with quantities as low as 5000. The tooling process for injection molding is as slow as it is expensive, requiring lead times of 30 weeks to a year.

Despite its overall high quality, injection-molded plastic shares some of the disadvantages that characterize plastics in general. Plastic is not as strong as metal and can crack or even shatter from an impact that would only slightly mar a metal enclosure. This brittleness is an especially significant factor in larger and heavier equipment, such as free-standing disk drives, printers and minicomputers, although enclosures for such equipment have been successfully manufactured from plastic. The problem can also be exacerbated in design and manufacturing: tight radii (curved surfaces) create molded-in stress, as does overly rapid or uneven mold cooling.

Most plastics also are subject to thermal degradation problems, some at temperatures as low as 140°F—temperatures often reached inside enclosures and trucks parked in the sun. Plastics become more brittle at lower temperatures; some become exceedingly fragile at temperatures encountered in northern shipping routes. Plastics have lower thermal conductivities than metal, furthermore, and thus do not provide enough heat-sink effect to help cool components. They are also nonconductors of electricity, offering virtually no protection against EMI/RFI and ESD. Some plastics are sensitive to cleaning fluids common in offices and appear streaked or smeared when exposed. Plastics also must be treated to meet Underwriters Laboratories flame-retardancy standards, and even then cannot match metal in this regard.

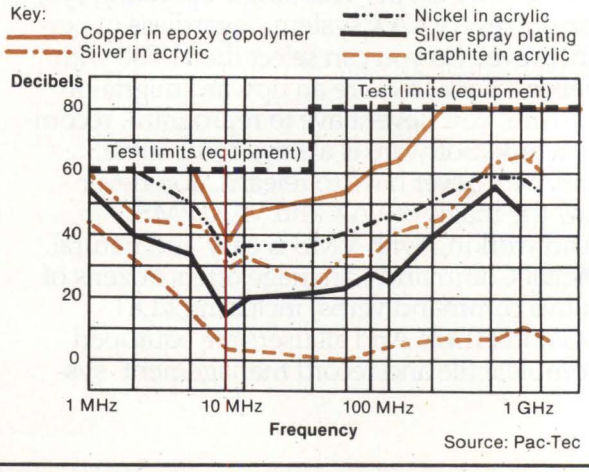
Finally, injection molding is a sensitive process. Anything less than expert design and manufacturing techniques can lead to the surface defects from which injected-molded materials are usually free. Such defects include wrinkles, pockmarks, flash (a film protruding around the edge) and sinking (a slightly concave area). Rejection rates of 10 percent are not uncommon and can easily get higher. Tolerances (the degree to which a dimensional specification can be reliably achieved) and dimensional stability (the degree to which the material retains these specifications over time and different conditions) are better for injection molding than for most other plastic processes, but are still not equal to those for metal. They are, however, within the requirements for most enclosures.

Structured foam parts are manufactured in a technique similar to that of injection molding, and structured-foam molders often use equipment designed for straight injection molding. The process differs from straight injection molding in two major ways: gas (usually nitrogen) is forced into the softened resin while it is in the heated cylinder, eventually causing it to foam, and the mixture is injected into the mold at considerably lower pressures than those used for straight injection molding.

The chief advantages of structured foam are lower

Shielding effectiveness—selected materials

Coating materials	Coating thickness (mils)	Sheet resistance Ω/square @ 1mil
Plastic	125	∞
Aluminum panel (for reference)	62.5	0
Silver paint	1	0.01
Silver/graphite (2 coat)	0.2/1.0	0.01/100
Copper	2	2
Copper/graphite (2 coat)	2/2	8/100
Graphite	2	20
Nickel	2	1



EMI/RFI shielding effectiveness *is given for different materials (left) and as a function of frequency (right). Effectiveness decreases with resistance and increases with decibels.*

tooling costs and a greater strength-to-weight ratio than straight injection molding. The lower costs result from the lower injection pressure requirements of the easily spread foam. Aluminum molds, which are less expensive and more quickly available than steel molds, can often withstand the demands of structured foam production runs, although steel inserts may be required in higher quantity runs. Production quantities not much higher than a few thousand can sometimes be produced in epoxy molds.

Forced convection generally benefits from the same design techniques as natural convection.

Charles River Data Systems' Universe *(rear view, top removed) shows fan placement for horizontal cooling path. Vertical cooling, which is generally more efficient, is not practical for stacking components.*

Molded structured foam resembles a hardened sponge coated with a thin layer of solid plastic that forms during cooling. The lightweight foam core provides thickness, an important contribution to a piece's strength because of the rigidity of a wall is proportional to the cube of the wall's thickness. Thus, a given quantity of resin might produce a piece in structured foam that is twice as thick as would be produced by injection molding and, therefore, theoretically eight times as strong (other considerations make the actual strength difference less dramatic, but still significant). Thus, structured foam is often used for enclosures with heavier load-bearing duties and those exposed to impacts, for which the foam's cushioning properties are helpful. Structured foam also offers slightly greater sound absorbency, helpful in reducing printer and disk drive noise.

The most serious drawback to structured foam is the poor quality of its surface appearance when removed from the mold. Unlike injection-molded pieces, structured foam often has swirling, pockmarks and wrinkles. Finishing requirements include sanding and several coats of paint. Although the finished product can look as good as an injection-molded piece, the finishing can double the total piece costs. Thus, despite its lower tooling costs, structured foam quickly becomes less cost-effective as production quantities hit the tens of thousands.

Reaction-injection molding of urethanes is similar to structural foam, but uses even lower mold pressures. The lower pressures allow the use of medium- to low-quality aluminum and even epoxy molds for runs as high as 5000 or more, with correspondingly lower tooling costs and lead times. Reaction-injection molding pieces require even higher finishing costs than do structured foam pieces, however, and the strength-to-weight ratio is considerably lower, so the process is best suited for low-quantity runs of relatively small enclosures. Thermoforming, in which a plastic sheet is softened and forced onto a mold, also requires low tooling costs and is usually suitable only for runs that are not likely to top a few thousand in quantity.

Cooling and shielding

The basic technique of cooling electronic equipment relies primarily on airflow. The more cool air brought into an enclosure, across the components and out again, the cooler the equipment stays. There are two ways to set up such an airflow: natural convection and forced (fan) convection. Designers can roughly calculate airflow requirements by considering the power dissipation of the components and the heat capacity of air. If natural convection can't meet these requirements, then a fan must be installed. In either case, the two techniques are not mutually exclusive: forced convection generally benefits from the same design techniques as natural convection.

To aid natural convection, vents should be placed near the top and bottom of an enclosure. The larger the vents, the better the cooling, but vents that are too large cause problems with acoustic and electromagnetic noise and with UL shock-protection requirements. In addition, vents in plastic enclosures should be placed parallel to the flow of resin into the mold to avoid uneven distribution.

If possible, the most temperature-sensitive components should be placed near the bottom of an enclosure

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where the air remains cooler, but not if it means putting heavy components near the top where they could make the enclosure unstable. Disk positioning in stacked peripheral configurations presents an uncomfortable choice: near the bottom for cooler operation or near the top for less exposure to dust. Open vertical paths through internal components, by mounting boards vertically, for example, aid natural convection. Curved plates can act as baffles to direct air onto components that would otherwise be missed by the airflow.

Even after designing for the best possible natural convection, many machines still require the forced convection provided by fans. If a device is targeted for factories, a designer can simply add a set of massive fans. Machines used in an office must be quiet, however, and that means airflow should be the minimum needed for sufficiently cool operation. To get the most out of a forced airflow, fans should be placed either at the bottom blowing in or at the top blowing out: the former creates more turbulence for greater air coverage, while the latter pulls air along natural convection paths for greater efficiency. The airflow from a fan decreases toward the edge of the blades, so baffles may be required to distribute the air evenly, particularly if the airflow is directed at board edges. Mechanical devices with irregular work loads, such as printers, floppy disk drives and tape drives, can employ thermostat-controlled fans to supplement convection cooling when active.

In addition to guiding airflow, a metal enclosure can act as a heat sink if the hottest components are placed close to the inside of the enclosure. Heat is then transferred through the enclosure to the air—or to anything else contacting the enclosure's exterior, including a hand.

Computer equipment is more often a perpetrator than a victim of electromagnetic and radio-frequency interference, but Federal Communications Commission regulations that went into effect last year are designed to make computer equipment vendors shoulder the burden (see "Who's afraid of the FCC?" below). To comply with the regulations, vendors must have their machines tested to ensure low EMI/RFI emissions. Meeting the standards can require special shielding techniques, especially for plastic enclosures. Plastic itself is virtually transparent to radiation, but shielding can be provided through the addition of internal metal cages; metal flakes or fibers mixed into the plastic resin; and metallic tapes, paints and plating. Such modifications can be expensive, adding as much as 20 percent to the cost of an enclosure, and do not always provide the degree of shielding required to meet the FCC standards.

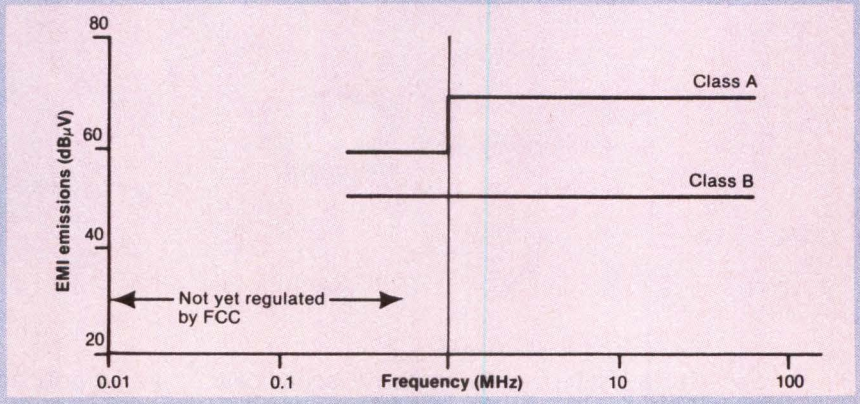
WHO'S AFRAID OF THE FCC?

The FCC regulations for computer equipment are clearly laid out in Part 15 of the FCC rules, and are further explained in bulletins OST 52 and 54. These documents differentiate equipment designed for residential use (home video games, for example) from equipment for commercial use and give the precise limits on radiated noise for each at different frequencies. The only thing that is unclear about the rules is whether many vendors will bother to comply with them.

It's not that the computer industry is rife with scofflaws, but that vendors balk at the time and expense often required for compliance. The regulations are fairly tough. Pac-Tec, an enclosure manufacturer proud of its EMI shielding, admits that its products do not meet the FCC requirements. "They meet down-to-earth requirements," says product development vice president Peter Peroni. Some vendors worry that the cost of compliance could mean the failure of marginally profitable products. "If the FCC is tough on enforcement," says Charles River Data Systems product manager Jim Isaak, "people could go out of business."

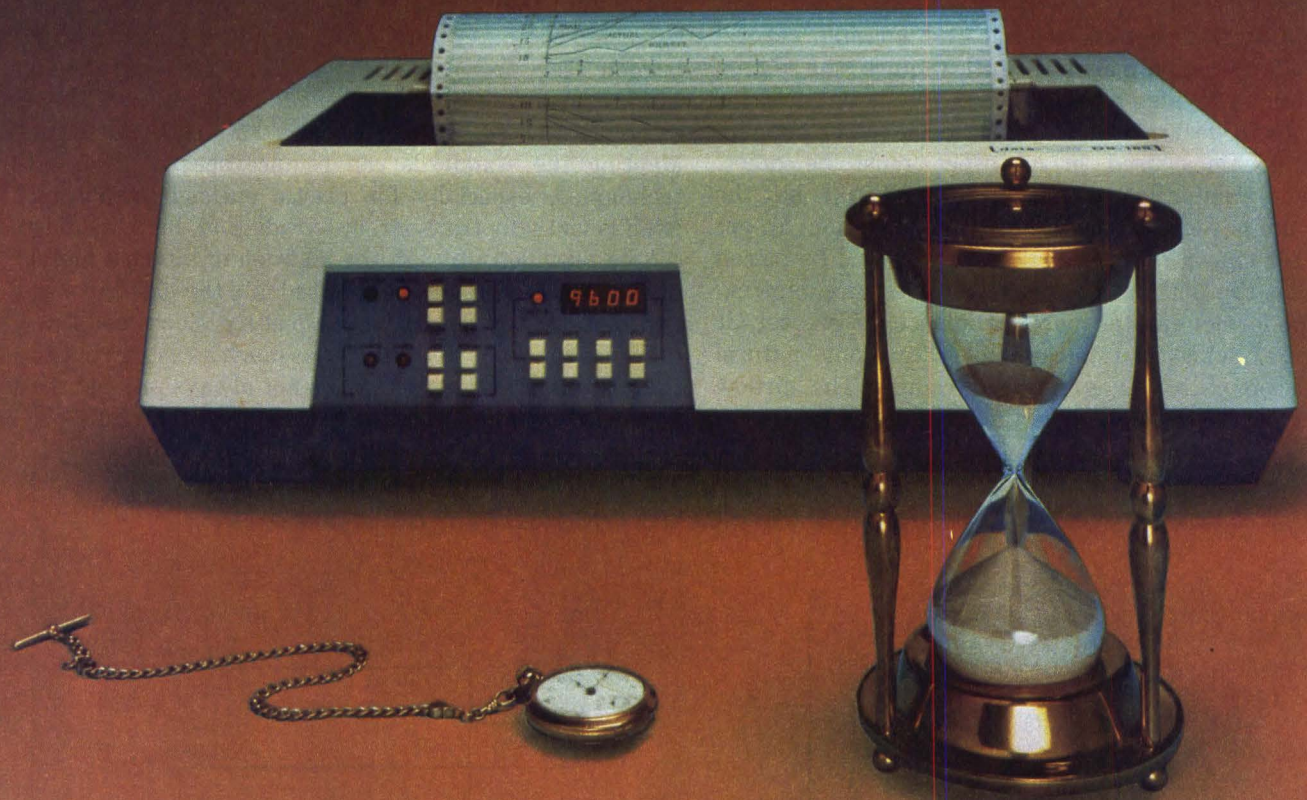
If vendors' fears rest on the FCC's ability to enforce the regulations, they may have little to worry about. "To be perfectly honest, we don't have the manpower to check all manufacturers," says FCC branch chief Art Wall. Wall, one of the authors of the regulations, claims that the FCC hopes vendors will police themselves. "A few cases of interference are reported," says Wall, adding, "There is the possibility of fines."

Vendors that do get caught with their shields down can take some consolation in knowing that they will not be the first. The FCC nabbed Coleco Industries Inc. last October for "marketing its Colecovision model 2400 prior to Commission authorization." The fine: $2000.



The FCC's EMI regulations *limit emissions of both commercial (class A) and residential (class B) computer equipment. The regulations do not apply to devices manufactured before 1981.*

TIME-PROVEN PERFORMANCE



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But Joe Knight, structural foams marketing manager at General Electric Co., Pittsfield, Mass., claims that properly treated plastic enclosures can meet military-specification standards, which are considerably tougher than FCC requirements (see "Designing enclosures for the military," below).

Choosing an effective shielding material does not ensure elimination of emissions; even a solid metal enclosure can radiate heavily through vents and other holes. "If there's an opening you can get a business card into, you'll have emissions," says David Cahill, metals engineering manager at Digital Equipment Corp. Leakage can be minimized by using several small, narrow holes rather than one circular one, or by covering holes with wire mesh or baffles. Experimentation generally leads to the most effective vent configuration. External and internal cables can also be a source of EMI/RFI. Charles River Data Systems reduced emissions from its Universe system by using a shielded, grounded RS232C cable, while Stanford Applied Engineering Inc., San Diego, Calif., offers EMI filters for power lines. Such filters attach to the inside of the enclosure at the outside power connector to prevent the power cord from acting as a noise antenna.

Other considerations

A well-designed enclosure can contribute to a device's reliability and usability in several ways. These include providing easy service access, impact protection, electrical grounding and compliance with any of a myriad standards and regulations.

One way of allowing service access is to use a metal chassis or sub-chassis within the enclosure, an approach that also facilitates production testing. Data General Corp.'s sliding and tilting sub-chassis fully exposes and raises low-mounted components. "Can you imagine a guy trying to peer into a disk drive 4 in. off the ground?" asks DG engineering support manager Dick Jaeger. Components mounted to the enclosure itself should use studs and nuts that are welded or molded to the frame so they cannot be dropped.

Machines can be protected from shipping-dock accidents by shock mounting sensitive components, often involving no more than rubber or spring inserts at mounting points. Although there are standardized impact tests for electronic equipment, results can be wildly inconsistent, and many designers recommend simply repeatedly dropping and kicking the machine to see what breaks. Vendors that ship completely assembled equipment must take more precautions to protect against impacts than those whose equipment is assembled on-site.

Adequate enclosure grounding ensures against excess electrostatic discharge and reduces shock hazards. Metal enclosures provide good grounding if paint is scraped from fasteners and rust protection such as zinc plating is applied before assembly. The increasing popularity of conductive paints, however, may make both steps unnecessary. Plastic enclosures can depend on an internal metal frame or on metal paint or plating. Unfortunately, the high-conductivity metal coatings that provide optimum EMI/RFI shielding do not provide optimum electrostatic protection, so a compromise is usually required.

Most computer equipment does not require special acoustic shielding to operate innocuously in a typical office. According to the Occupational Safety and Health Association, a busy office produces about 80 dB of noise, while printers, the noisiest of peripherals, rarely go much beyond 70 dB. Printer noise can be slightly reduced by insulating enclosures with foam padding,

DESIGNING ENCLOSURES FOR THE MILITARY

Equipment designed for use on a bomber or a nuclear submarine must meet different standards for reliability than those required for a receptionist's desk. "The functions of airborne and office equipment are identical," says Sanders Associates' Frank Slater, who works with graphics displays used on B1 bombers, "but there's a fierce difference in design." This difference involves everything from screws to transistors, but enclosures bear much of the responsibility for protecting sensitive electronics from conditions as severe as a nuclear attack.

Because weight is at a premium on a bomber, Sanders's military-specification display uses 40/1000-in.-thick aluminum, with no internal frame, requiring special riveting and welding techniques. This thin structure must provide secure mounting for 40 lbs. of components in the face of 20G impact and must not provide an operator hazard at shocks as high as 40G. Slater claims Sanders's equipment will survive impacts as high as 120G, comparable to what would be experienced by a crashing jet. The FCC's EMI/RFI requirements are child's play next to the standards set by the military for the B1's equipment, expected to withstand the effects of the massive electromagnetic pulse generated by a nuclear explosion. Shielding is particularly difficult for a CRT, points out Slater: "A CRT is a box with a great, big hole in it." Sanders tackled the problem by using an internal shield that conforms to the shape of the tube itself.

Enclosure cooling on the B1, oddly enough, is a simpler matter than with commercial equipment, as the box is fed cool air from the jet's air-conditioning system. The components themselves, however, must operate in temperatures from −55 to 71°C. Why build equipment able to withstand conditions that no human being could survive? "The military's point of view," explains Slater, "is that if the hardware survives, they can always get a new crew."

and a number of companies offer special sound-dampening enclosures for bringing printer noise below 60 dB. For other devices, enclosures that eliminate excessive forced-air noise are probably doing their share of noise abatement. In rare cases, power-supply hum can be amplified by a sympathetic resonance in an enclosure, requiring structural modification or a different type of power supply. Vendors interested in reliably measuring acoustic noise should follow the procedure outlined in the American National Standards Institute's standard S1.29-1979.

The FCC is not the only organization setting standards for computer equipment. Indeed, some vendors find its regulations among the most easily ignored. Mil-spec standards are generally considered the toughest, but only those vendors vying for military contracts need be concerned with them. In the U.S., the UL standards are widely complied with, although compliance is voluntary and often costs months of waiting and tens of thousands of dollars. UL tests for flame-retardancy and electric shock and breakage hazards, and many users would not consider purchasing equipment that did not meet these standards. The UL's requirements for electronic equipment are described in document UL 478, which is available from UL in Northbrook, Ill. Agencies setting standards for electronic equipment outside the U.S. include the Canadian Standards Authority and Germany's Verband Deutsche Electrotechniker. Most European countries have their own agencies, but many of these pass equipment that satisifies the demanding VDE requirements. Vendors marketing equipment outside the U.S. should examine applicable standards before designing an enclosure.

An OEM that is too small to support in-house enclosure design and manufacturing facilities has a number of outside resources to which it can turn. Many industrial design consultants specialize in electronic equipment enclosures. Such services range from producing sketches of proposed designs to handling the entire process through post-production inspection. Costs vary as widely and can be determined on an hourly or contract basis. Industrial designer George Horton of Mann-Horton and Associates, Englewood, N.J., recommends that vendors request detailed proposals from consultants specifying all aspects of the process before committing to a consultant: "The proposal should be phrased the way the OEM phrases its product development." A list of industrial designers by location and specialty can be obtained from the Industrial Designer Society of America, McLean, Va. The actual manufacturing can be handled by any nationwide tooler, molder or metal fabricator.

Independent testing organizations can facilitate certification with both U.S. and other agencies. Such services can add significantly to certification costs, but often pay for themselves in time and effort saved. Lee Pulver of Pulver Laboratories, Boise, Idaho, claims his company can cut UL's four- to six-month testing process to two days, and a 14-month VDE wait to six months. The company offers consulting on test compliance, after which it guarantees that the equipment will pass the relevant test on the first try.

Off-the-shelf enclosures offer an option to OEMs producing prototypes or very low-quantity runs. Such enclosures lack the visual appeal and product differentiation of custom enclosures, but they can reduce or eliminate exorbitant tooling costs and long lead times. Most such enclosure vendors offer expertise in selecting, adapting and even customizing standard enclosures, sometimes at little or no extra cost. "We'll eat some of the tooling dollars," says Larry Tracewell of Tracewell Enclosures, Columbus, Ohio, "because it will bring the customer back."

Whether going with an off-the-shelf or a custom product, OEMs should ascertain that their enclosures source could gear up for larger quantities should an unexpected demand develop for their product. Some vendors might argue, however, that this is a problem they would love to have. □

David Freedman is a former associate editor for *Mini-Micro Systems*.

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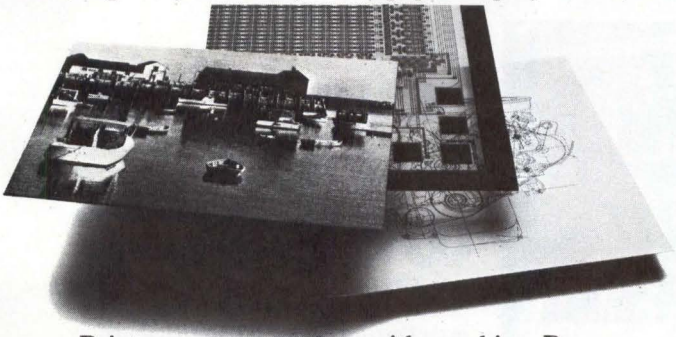

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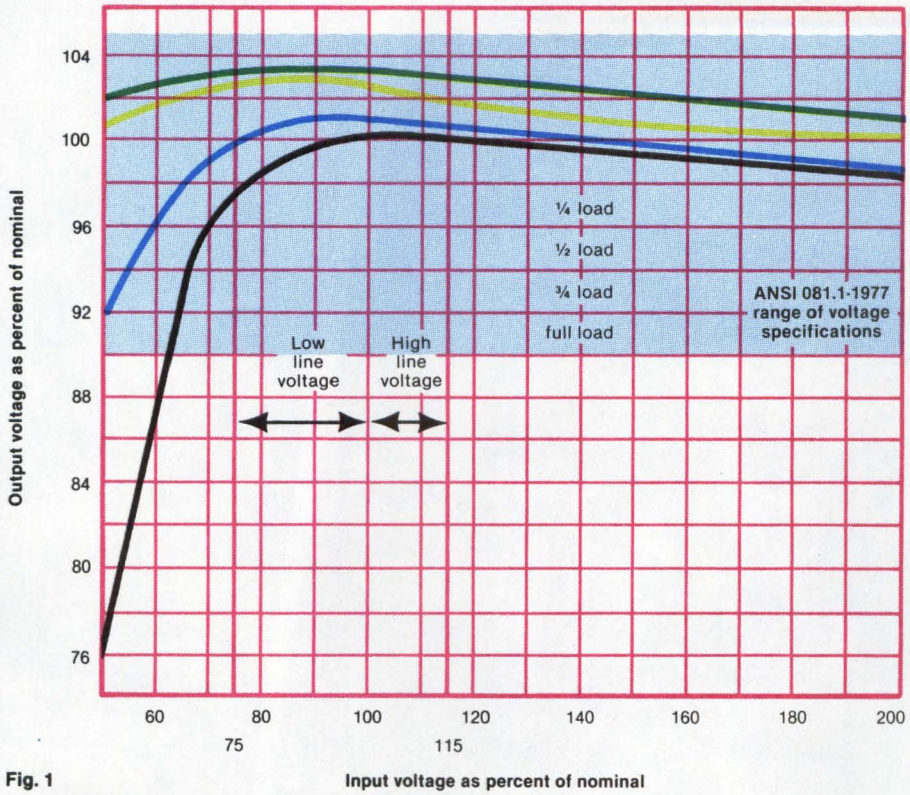


Fig. 1

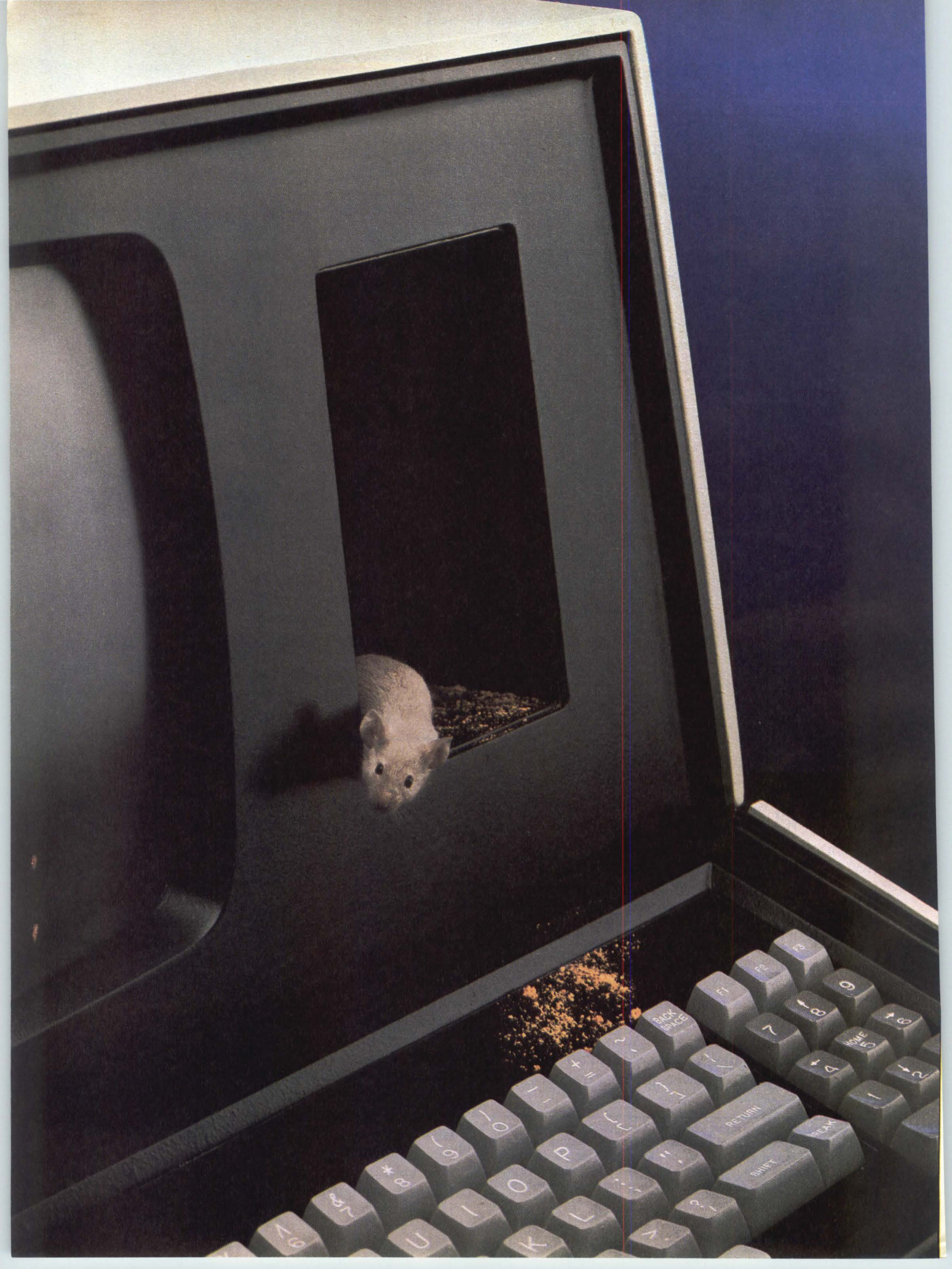
Power-protection equipment guards against utility line problems that can interfere with or even damage computers

Many users see their computer systems as office equipment that need only be plugged into a wall socket. Such users depend on system integrators to provide complete systems that meet their needs, and, whether they know it or not, power protection may be one of these needs. To select the most cost-effective protection for its customers, a system integrator should understand the type of power problems that can be encountered and the protection options that are available.

Power problems can come from utility-supplied power or internal power-demand fluctuations. There are seven basic kinds of disturbance inherent in utility-supplied power: voltage spikes, electrical "noise," sags, surges, power glitches, frequency drifts and blackouts. All can have costly and damaging effects on computer equipment and can be prevented or minimized only by installing additional equipment.

- **Voltage spikes** are sudden, brief disturbances that, when displayed on an oscilloscope, appear as sharp spikes in the power-wave curve. Reaching magnitudes of many hundreds of volts, spikes can oscillate with kilohertz or megahertz frequencies. Through capacitive coupling within computer equipment, spikes can erase stored data and alter active data. These errors can be difficult to detect. In extreme cases, sensitive circuit elements can be destroyed.
- **Electrical noise** is a succession of spikes, generally of both polarities and of a magnitude much lower than that of an isolated spike. Noise often originates with motor control devices, electric motors, relays and remote atmospheric discharges. Although less destructive than a sharp powerful spike, electrical noise can cause intermittent computer malfunctions.
- **Voltage sags,** or brownouts, are common worldwide. Lasting from several cycles to several hours,

Fig. 1. Input versus output voltages *for a typical voltage regulator show that such equipment can be effective in keeping output fairly constant against a wide range of input voltages. Output voltage normally varies with the load as well; lightly loaded regulators provide better regulation at low input voltages than do heavily loaded regulators.*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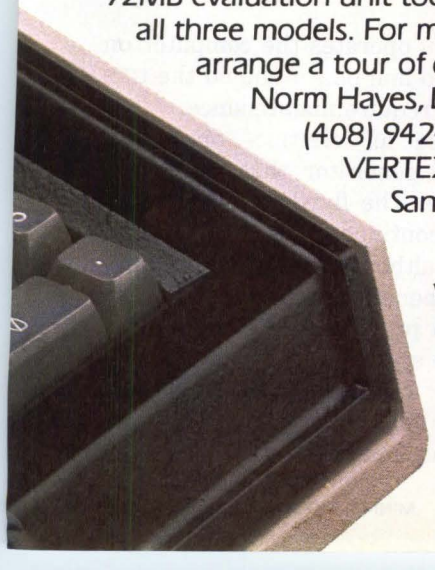

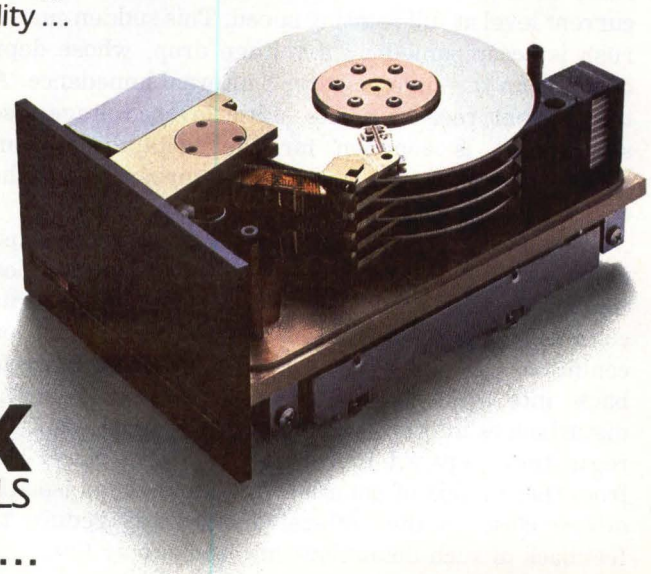

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they involve line voltages dropping to 80 percent or less normal levels. Computer equipment can malfunction, overheat and incur lasting damage, or simply shut off in the middle of a run. Brownouts can extend to a region, a city or just one building.

- **Voltage surges** are increases in voltage levels that last many cycles, seconds or even minutes, but do not reach the magnitude of a sharp spike. Voltage surges can seriously damage computer input circuits and can often cause extensive data alterations.
- **Glitches** are brief outages or near-outages lasting less than a cycle and often occur when utility networks switch from one feeder line to another. The completion of the switchover causes a voltage overshoot on the heels of the near-outage, a combination of disturbance that can inject errors into a computer run.
- **Frequency drifts** are not common on U.S. utility networks, but equipment powered by mobile generators is often subject to drift of more than a cycle, potentially causing timing malfunctions.
- **Blackouts** are not very common, but when they occur, they lead to the ultimate disturbance—an unplanned shutoff of a computer. Depending on the computer's function, this can result in anything from an annoyance to a disaster.

Watch the computer itself

Fluctuating internal power demand also can cause extensive computer malfunctions. Computer equipment is sensitive to even minor drops in voltage caused when equipment on the same line is actuated, including lights. Equally significant are disturbances caused by the computer system itself. For example, for several seconds after start-up, disk drives draw current at rates as much as five times higher than their static current level at full rotating speed. This sudden current rush is accompanied by a voltage drop, whose depth depends on the supply source's internal impedance. As the current recedes to its static level, voltage rises sharply. It is common for the voltage drop and subsequent sharp rise to cause disturbances in other computer equipment on the same circuit.

Certain types of switching power supplies can cause, in effect, an endless succession of full-load/no-load conditions, with each load period causing high inrush currents. Depending on source impedance, such load conditions can cause waveform distortions that are fed back into the power line only to cause further disturbances in other equipment. In several countries, regulatory steps are under way to protect power lines from these kinds of pollution. A well-shielded isolation device close to the "offensive" load can reduce the feedback of such distortions into the supply line.

A dedicated power line connecting the computer system directly to the building's main power panel provides limited protection against internal-demand-produced fluctuations. But such a line can cost several thousand dollars and offers no protection against externally caused problems.

Power-protection options

A wide range of power-protection equipment is available, each type offering a different level of protection at different cost. The basic choice is among four major types of equipment: uninterruptible power supplies, isolators, regulators and isolator/regulators.

Uninterruptible power supplies assure a steady, controlled flow of power to a computer system, regardless of disturbances, including blackouts. A UPS offers the widest protection available, but the initial and operating costs of such equipment make it justifiable only for installations in which uninterrupted computer operation is truly essential. There are four major types of UPS:

Equipment	Major benefit	Approximate cost per 5 kVA capacity
Isolation devices	Filter out voltage spikes to varying degrees	$500 - 900
Voltage regulators	Regulate supply voltages	$1500 - 2200
Isolator/ regulators	Filter out voltage spikes, regulate supply voltages	$1600 - 2200
Uninterruptible power supplies (UPS)	Filter out voltage spikes, regulate voltages, supply power during blackout	$12,000 - 15,000

Four major types of power protection *vary in cost as well as effectiveness against different types of problems.*

- A continuous-service UPS converts utility power to direct current to charge a set of batteries. Direct current from the batteries is changed to AC to energize the computer.
- A forward-transfer UPS enables the computer to operate on line power, but switches to battery power in case of main power interruption. The battery is kept charged by the UPS.
- A reverse-transfer UPS operates the computer on battery power, switching to line power should the UPS fail, become overloaded or require maintenance.
- Motor generators use an electric- or diesel-powered motor to turn a generator that supplies a carefully regulated voltage. The flywheel effect of an electric-motor generator continues power generation after loss of prime power, although frequency stability quickly suffers. An added benefit of a motor generator is the line-to-load isolation provided and the resulting protection from power-line spikes.

A diesel-powered motor can be used as a backup power supply switched on only when needed, and can run continuously throughout an extended blackout. But

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a diesel adds the concerns of engine noise, exhaust gasses and fuel storage. A diesel-motor generator must be used in tandem with a static UPS. When utility power goes out, the static UPS keeps the computer energized and switches on the diesel generator. Once the latter has reached full speed, its power is used to keep the UPS batteries replenished, ensuring full, uninterrupted computer operation.

Isolation devices electrically isolate the computer equipment from the power source, filtering out voltage spikes. The least costly protection devices, isolators are usually not effective against a range of problems. Some filter out high-frequency spikes but are much less effective with low-frequency spikes; some reduce common-mode (line-to-ground) spikes well, but not transverse (line-to-line) spikes.

Voltage regulators keep supply voltages within a specified range (Fig. 1). Some cause their output voltage to oscillate between permissible low and high values. Others have only a narrow regulation window that provides no protection against relatively wide voltage swings. Voltage regulators provide no protection against voltage spikes.

Isolator/regulators combine the characteristics of isolation devices and voltage regulators, providing protection against voltage spikes, noise and fluctuations. The cost is not much higher than that of an individual isolator or voltage regulator. Some do not protect against transverse voltage spikes or low-frequency (less than 1-Hz) spikes; others cannot protect against voltage swings greater than +/- 15 percent.

Which to choose?

A UPS is the choice when uninterrupted computer operation is essential and cost is no object. But less costly equipment can protect against most power problems.

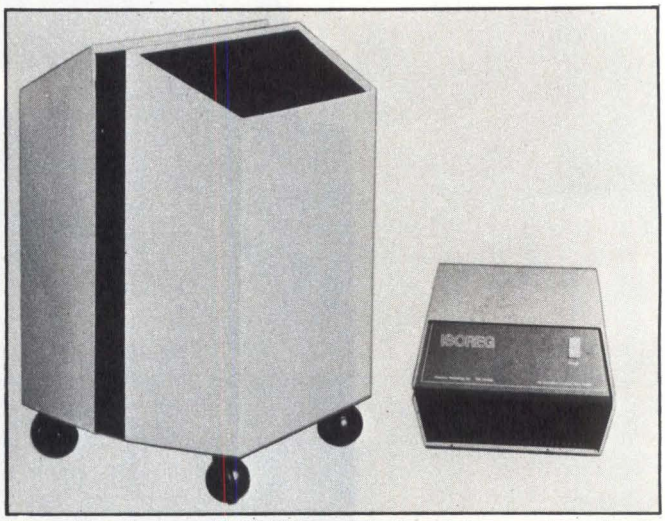
Regulators are essential wherever utility voltages can fluctuate more than 5 percent. By itself, a 5-percent deviation from nominal is hardly cause for trouble. But when added to the voltage drop normally experienced within a building, a 5-percent reduction in utility power can translate to a 10-percent reduction at the computer. This deviation is beyond the tolerance of most computers and leaves no margin for the brief voltage sags that occur when other electrical equipment is turned on.

When considering a voltage regulator, the integrator must examine voltage windows and response time.

- **Input voltage window.** How wide a voltage deviation can the regulator accept while still supplying a well-controlled output voltage? An input voltage window of +/- 10 percent offers protection against only minor voltage deviations; +/- 25 percent is decidely more useful. Such extra protection is particularly valuable in a brownout when application voltages may hover for hours around 90V to 100V, often dropping below that level in response to sudden additional power demands.

Voltage regulation on the high side can be as important as on the down side. In some areas, especially those close to generating stations, supply-line voltages are often higher than the norm. This can markedly shorten the life of electronic circuits. Even in power grids on which voltages are generally correct, there are instances when voltages can rise 10 or 15 percent above normal for seconds or minutes. A computer should be protected against such surges just as it should be shielded from voltage sags.

- **Output voltage window.** A variation of 1V to 2V from, say, 120V, is not terribly critical, so a +/- 0.25-percent output voltage offers little advantage over a 0.50-percent output voltage window. In some regulators, output voltage oscillates within a band bounded by the permissible positive and negative deviation values. Although such a regulator may operate entirely within its own specifications, as well as within the computer's tolerance band, the resulting continuous rise and fall in the supply voltage causes difficulties in some computer equipment.



Isoreg Corp.'s 5- and 1.25-KVA isolator/regulators *are intended for power protection in data-processing and process-control applications. The company offers models ranging in power from 125 VA to 25 KVA.*

- **Response time.** How quickly a voltage deviation can be corrected is critical for determining a voltage regulator's usefulness.

Tap-switching regulators incorporate a transformer whose output voltage is continuously monitored. A voltage deviation is corrected by switching taps on the transformer's primary winding. This process can be completed in a half-cycle if the input voltage stays at its new level. If the input voltage continues its slide or rise, correction may require several successive tap changes, each consuming as much as a half-cycle. This

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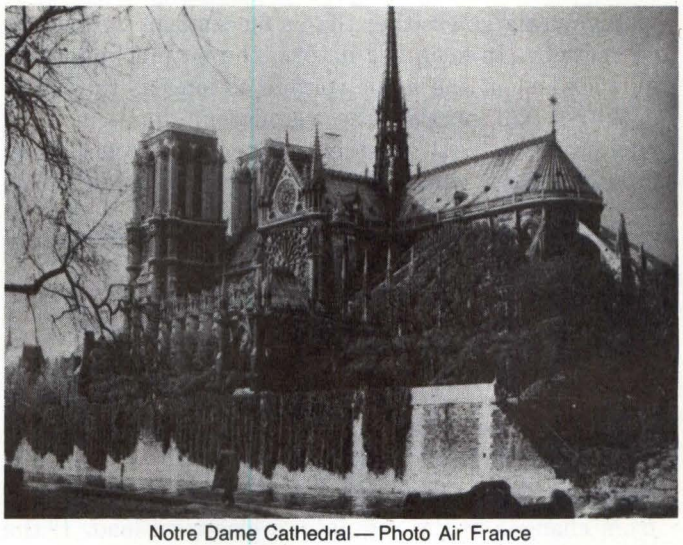

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half-cycle lapse stems from the need to switch only when the voltage changes from positive to negative or vice versa.

Certain types of ferroresonant regulators, by contrast, provide a high degree of immunity from input voltage variations rather than a mechanism for making corrections. In such regulators, the output voltage is independent of the input voltage as long as the latter does not fall outside the regulator's input voltage window. The result is essentially zero response time; input voltage variations are simply ignored. This

Some isolation devices filter out high-frequency spikes but are less effective with low-frequency spikes.

capability does not apply to voltage variations arising from changes in the regulator's electrical load. If the load is reduced, say, 50 to 75 percent, the output voltage will rise 1V or more but will stabilize at the new level in, at most, three cycles. Conversely, a major increase in load results in a slightly reduced but well-stabilized output voltage.

If protection against voltage spikes is required, an isolation device provides an effective solution. More often, however, a combination of both isolation and voltage regulation is more desirable. Some voltage regulators are based on auto-transformer principles that provide no isolation at all; others use shielded isolation transformer structures to keep out voltage spikes. Among the types of isolator/regulators available are versions that incorporate electrostatic shielding and transformer geometrics that separate the primary coil from the secondary coil and a magnetically saturated iron core structure. These three elements—shielding, coil separation and saturated core—ensure trapping of both high- and low-frequency spikes of either the line-to-ground or line-to-line types.

Shielded "high" or "super" isolation transformers are superior to unshielded isolation transformers in blocking certain types of spikes. However, the decibel noise-rejection values of super isolation transformers do not necessarily indicate how well spikes are reduced in an installation (Fig. 2). The noise-rejection decibel value is measured with a 0.01-microfarad capacitor to simulate the stray capacitance in the computer equipment and in the power line between the transformer and the computer. When actual stray capacitances are lower than 0.01 microfarads, the resulting noise-

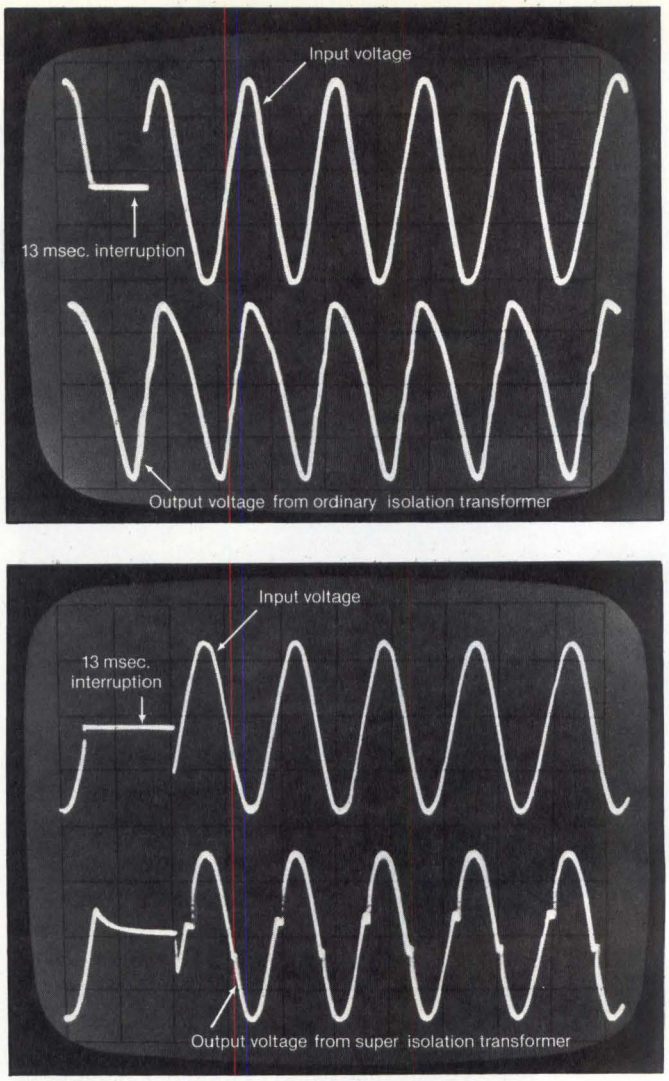

Fig. 2. Power protection response to a voltage interruption, *displayed here on a dual-trace oscilloscope, can be better from an ordinary isolation transformer (top) than a super isolation transformer. Super isolation transformers are most effective against high-frequency voltage spikes.*

rejection level is commensurately lower than that implied by the high decibel ratings.

Worse, the high decibel values apply to measurements of transverse-mode spikes of relatively high frequencies (more than 100 KHz), attenuated best by the shielded isolation transformers. For spike frequencies of 10 KHz or less, the shielded isolation transformers offer much less protection. Such spikes raise the magnetic flux in the transformer's steel core, causing the transfer of these spikes from the primary to the secondary winding and onto the computer without much attenuation at all.

Power-protection equipment protects against down time and damage resulting in unknown costs, at a known, up-front cost. And, like other types of insurance, it is well worth considering. □

Emil B. Rechsteiner is president of Isoreg Corp., Littleton, Mass.

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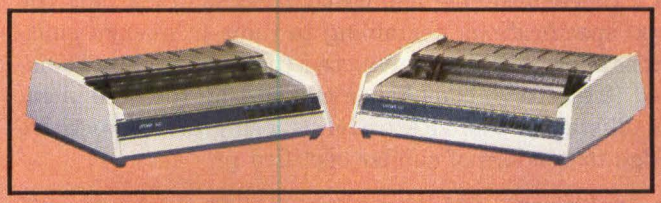

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REGULATION

Engineering for EMI compliance

E.J. SNYDER, Summagraphics Corp.

New products must comply, and certain older products are undergoing redesign to meet FCC limits on electromagnetic interference

The invasion of digital computing equipment in the general consumer market has brought with it regulations governing the amount of electromagnetic interference to other consumer equipment. OEMs are familiar with the Federal Communications Commission's regulation, issued in 1980, that specifies emission limits and requires that all computing devices carry a label indicating compliance or noncompliance and identifying their equipment class.

But, as some companies have discovered, compliance with the regulation isn't merely a labeling requirement; it can often mean a major engineering overhaul of the product. For product design engineers, EMI compliance is a time-consuming and costly process of learning the FCC specifications pertaining to radio-frequency emissions, designing for conducted (power-line) and radiated (free-space) compliance and testing the equipment at all stages. The alternative is losing the competitive edge to vendors of similar certified products.

Understanding the regulations

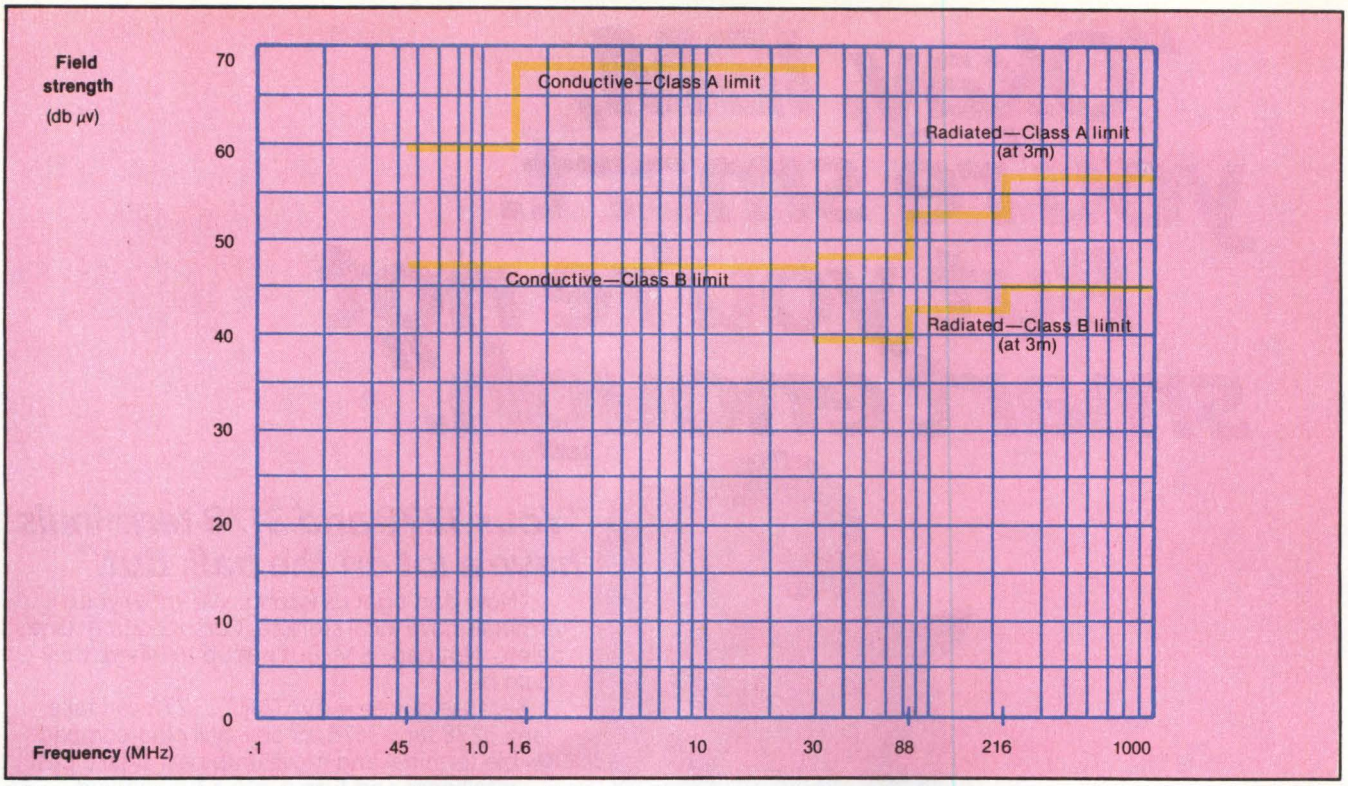
The FCC puts any electronic equipment that generates and uses more than 10,000 pulses (cycles) per sec. into one of two categories, each of which carries a different set of limits. Class A industrial computing devices are those sold for use in commercial, industrial or business environments and not to the general public. Class B consumer computing devices can also be used in commercial, business and industrial applications and include personal computers and associated peripherals such as data tablets/digitizers, and electronic games.

Regulations set conducted and radiated limits for both classes. The conducted frequency range is between 450 KHz and 30 MHz. Class A limits range from 60 to 70 dB above 1 μV. Conducted limits for Class B devices, at 48 dB above 1 μV, are tighter than those of Class A. The frequency range for radiated emissions is from 30 to 1000 MHz. As with the conducted limits, compliance for Class B radiation emissions is more stringent than for Class A. The maximum Class B radiated limit is 46 dB versus 57.5 dB for Class A (measured at 3m.).

The compliance deadline for products already in production or being sold before Oct. 1, 1981, is October, 1983. Compliance for products designed after the ruling went into effect in 1980 was Jan. 1, 1981, for Class B and Oct. 1, 1981, for Class A.

Engineering for compliance

Most engineers have no trouble understanding specification terms such as EMI, electromagnetic compatibility, conducted interference, radiated interference, susceptibility and EMI limits, but other terms are less obvious: VDE, CICPR, AND and IEC (regulatory bodies that must be dealt with), as well as compliance procedures, EMI measurements, radiated measurements, EMI instrumentation (use of spectrum analyzers versus EMI meters) and many other complex requirements and procedures. Consequently, a company is wise to engage the services of a consulting and testing organization to obtain a degree of expertise with a minimal financial commitment. The support of a good laboratory can be invaluable, especially in a first compliance effort.



FCC-specified interference limits *for conducted and radiated emissions are more stringent for Class B consumer computing equipment than for devices in Class A, which are not sold to the general public. Conducted power emissions are measured on AC power lines, and radiated emissions are measured in the atmosphere surrounding the device.*

After the engineering staff is familiar with the regulation and has selected a consulting laboratory, it should establish baseline measurements of the device's emissions by performing quick scan tests of its conducted and radiated levels. Periodic scans help engineers monitor their progress in reducing these emissions to specified levels.

Actually reducing emissions can be done by a company's engineers with the help of a testing facility that can provide a technical staff to assist in solving out-of-spec conditions. This stage is usually time-consuming because of the iteration of product testing, problem isolation, parts ordering and retesting.

The first engineering problem is the control of conducted emissions, and the quickest "fix" is the use of EMI line filters. Many power-supply manufacturers are selling units that meet FCC and VDE requirements for computing devices. In other cases, line-to-ground capacitors can reduce conducted emissions to compliance levels.

Correcting noncompliant radiated levels is more difficult. A shielded cabinet (RFI coatings when plastics are used) with minimal openings around connections and a good RF ground reference can help. All cables exterior to the device, excluding the AC power cord, are sources of high-level radiated emissions and should be shielded, with shields terminated to the chassis at both ends when possible.

Testing for compliance

When design changes are complete and an in-house scan shows the device to be within specifications, the unit is ready to be submitted to an independent, FCC-approved laboratory for a controlled analysis. This formal testing phase is usually conducted in rural, open locations that offer a low ambient-electromagnetic environment. The facility must also have equipment calibrated periodically in accordance with the National Bureau of Standards.

These test facilities perform both conducted and radiated emission measurements. Conducted, line-to-ground noise measurements are made using a 50-ohm, 50-microhenry line impedance stabilization network. Radiated measurements are performed using both vertically and horizontally polarized antennas, usually at a distance between 3m. and 30 m. A final FCC test report is prepared by the test facility.

FCC certification

Verification of Class A units is a self-certification procedure: the manufacturer performs the required FCC measurement tests. This procedure satisfies the letter of the law, and a sample unit is not required for FCC review unless specifically requested.

Certification of a Class B consumer product, however, requires FCC evaluation. The company must submit the final test report and sample unit and wait for both a letter of certification and an FCC ID code. □

E.J. Snyder is vice president of Summagraphics Corp., Fairfield, Conn.

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STEPHEN A. HALPERIN, ACL, Inc.

Topical antistat combats electrostatic discharge in electronic data-processing environments

Everyone has experienced the jolt of touching a door handle or another person after walking across a rug in a relatively dry environment. The resulting electrostatic discharge (ESD) ranges from 2000V to 30,000V. People generally survive such a charge with no side effects, but some machinery is not so hardy. ESD has inactivated terminals, frozen cursors on CRT terminals, jammed paper in printers and damaged CPU components and devices. Static also causes other sporadic problems to equipment, such as memory loss, pre-triggering and function changes.

Large data-processing installations contend with ESD by keeping equipment in a special room where temperature and humidity can be controlled. Although this precaution reduces static charges, it does not eliminate them. To do so, better static-control measures are necessary. One of the most effective and least expensive is to treat the work area with a topical anti-static spray.

Materials and environment affect ESD

Static results from the interaction of materials or people, combined with movement. Wherever movement occurs, static can be generated by rubbing or separating two materials (Table 1). A data-processing environment contains many potential sources of static generation, including furniture, tape-storage canisters, disk covers and plastic sleeves. An acrylic dress over a

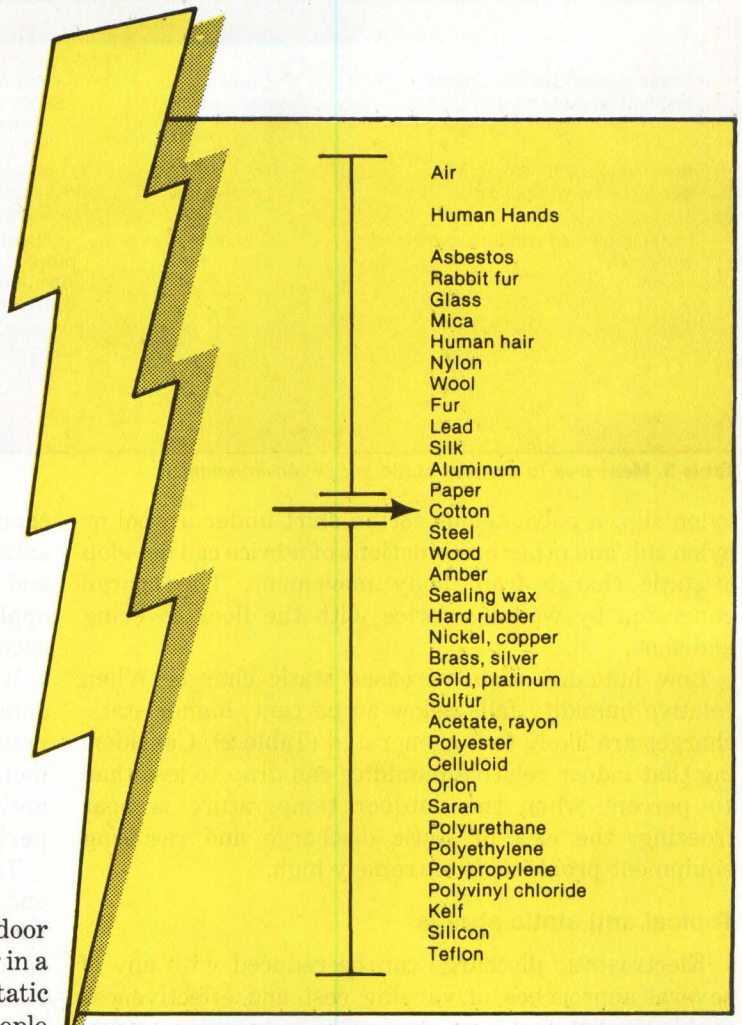


Table 1. Interaction of any two materials can produce a charge. *In this triboelectric series, cotton is identified as a reference material. Cotton tends to absorb moisture, thereby rendering it somewhat conductive; however, it can still produce a static charge. Materials listed above cotton tend to surrender electrons when friction is produced, thus becoming positively charged. Materials listed below cotton tend to become negatively charged. For example, if nylon and polyethylene are rubbed together, the nylon will become positively charged, and the polyethylene will become negatively charged. The farther apart two materials are, the greater amount of static electricity they will generate together. For instance, nylon and polyethylene produce a greater charge than nylon and steel. A hand rubbing Teflon produces an even greater charge. (Source: Robert Taylor, "Physics of Electrostatic Charge Generation in Industrial Processes," Litton Systems, Inc.)*

Common static-producing situations in the EDP environment	Electrostatic voltages	
	65% to 90% relative humidity	10% to 20% relative humidity
Walking across carpet	1500	35,000
Walking across vinyl floor	250	12,000
Touching work-bench materials	100	6000
Removing papers from vinyl envelopes	600	7000
Picking up common plastic bag from work bench	1200	20,000
Touching chair padded with polyurethane foam	1500	18,000

Table 2. Electrostatic voltages vary with materials *and increase as relative humidity drops.*

	Cost	Effectiveness	Shortcomings
Install humidifiers or increase humidification of central system	Hundreds to thousands of dollars	Does not eliminate static; only reduces magnitude	Humidifiers take up space and increase energy costs; excessive humidity may damage metal parts and walls and cause respiratory problems
Install antistatic carpeting or conductive vinyl flooring	More than $20 per sq. yd.	Usually effective only in holding a charge to 2200V at 20% humidity	Only effective when static generation is related to the floor
Install grounded conductive mats in work area	$30 to more than $100 per mat	Useful only for preventing charges on operator's body while operator is on the mat	Minimal protection from transient traffic or from charges generated on the equipment itself; mats must be clean to be effective
Apply a topical antistat	$10 per qt. or less	Eliminates static charges even to 15% humidity	Treatment is not permanent and visual checking is impossible; efficacy known only by experimentation; may leave odor; some care required during application

Table 3. Measures to combat static *in EDP environments.*

nylon slip, a polyester or cotton shirt under a wool or nylon suit and other combinations of fabrics can develop a static charge from body movement. The charge generated by walking varies with the floor covering and shoe.

Low humidity also increases static charge. When relative humidity falls below 50 percent, higher static charges are likely to be generated (Table 2). Considering that indoor relative humidity can drop to less than 10 percent when the outdoor temperature is near freezing, the risk of static discharge and resulting equipment problems is extremely high.

Topical anti-static sprays

Electrostatic discharge can be reduced with any of several approaches of varying cost and effectiveness (Table 3), but the least expensive is to use a topical antistat. Several are on the market. When evaluating them, buyers should ask:

- Does it meet the static decay criteria of military and medical specification?
- Is it effective on all materials?
- Does it function at relative humidities lower than 15 percent?
- Is it non-odor-producing, nonstaining and completely biodegradable?
- Does it leave a residue?
- How long does it last?
- How large an area does it cover?

Topical antistats also vary considerably. While 1 gal. of antistat typically covers 900 to 1500 sq. ft. and lasts as long as 30 days, ACL, Inc.'s Staticide covers 2000 sq. ft. and lasts several months. In addition, while many antistats leave a residue, Staticide facilitates normal vacuuming.

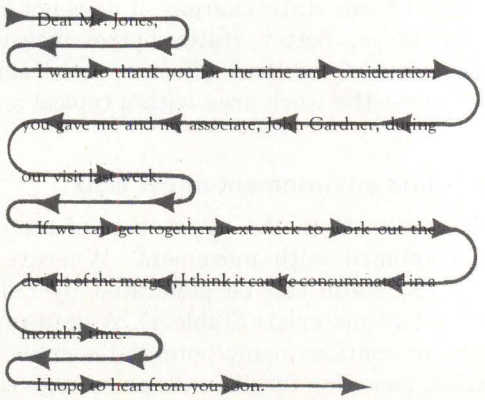
A water-based topical antistat can be used on all materials and surfaces except fabrics subject to water stains. It can be applied directly to carpets and textiles from its spray container; for large areas, the use of a mechanical sprayer speeds application. Some equipment is sensitive to 200V. To prevent 600V to 1800V charges generated by a person's rising from a chair, an antistat should be applied to seat cushions, chair frames and casters and anything else a person touches. One application is usually adequate for a season, but heavily used paths should be treated every 60 days.

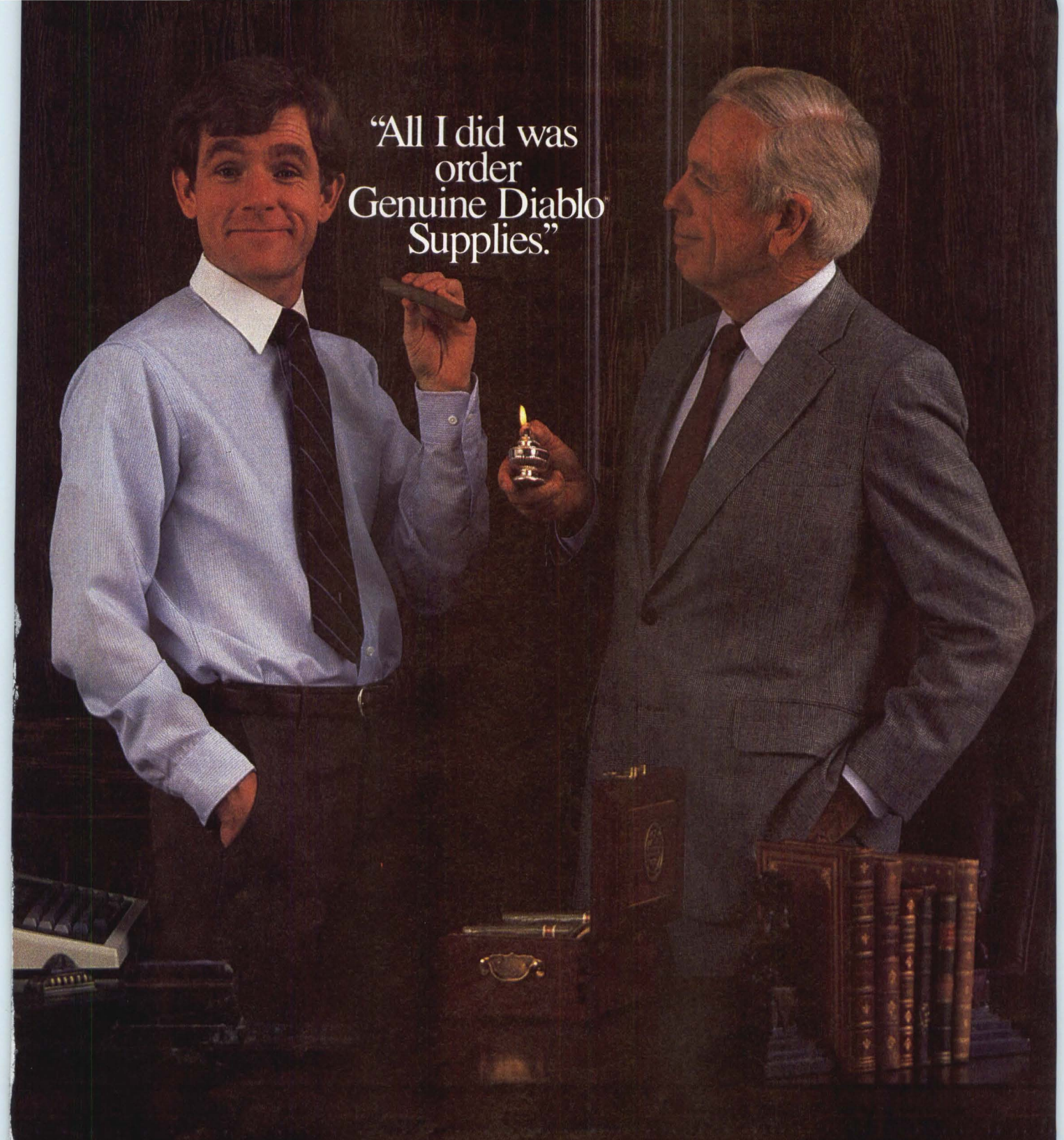
It is also important to treat the approaches to a data-processing area. If an area is large and uncarpeted, the antistat can be applied with a mop. This method generally deposits a greater amount of topical antistat, resulting in greater protection for a longer period of time.

The effectiveness of a good topical antistat was endorsed by Honeywell Information Systems, Inc., which, after an extensive field-service test of Staticide, concluded that one application at the beginning of the static season can avert more than 5000 service calls per year. □

Stephen A. Halperin is executive vice president of ACL, Inc., Elk Grove Village, Ill., and senior consultant and operations manager of that firm's industrial division.

A figure featured on p. 21 of the Mini-Micro Systems Peripherals Digest (Spring 1983) is incorrect. The bottom section, "Bidirectional printing with logic seeking" diagram is illustrated as follows:





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All these people agreed to do something about communication chaos.

ANSI was the answer. In the computer industry, compatibility between terminals, computers, and printers is so vital, fifty well-known computer firms, major customers, user groups, and trade associations decided to put an end to the communications chaos. They met under the auspices of the American National Standards Institute (ANSI) and developed ANSI X3.64—the most comprehensive standard for information interchange yet devised.

ANSI X3.64 insures code compatibility between diverse peripheral devices. It prevents users from being locked into single vendors. It reduces the cost of programming, and makes software portable from machine to machine. At TeleVideo, we believe ANSI X3.64 will be the dominant communications standard—now and in the future. If everyone will abide by the standard, the chaos in peripheral communications will come to an end. For more information about how the ANSI Standard can help you, call TeleVideo at 800-538-8725 (in California call (408) 745-7760).

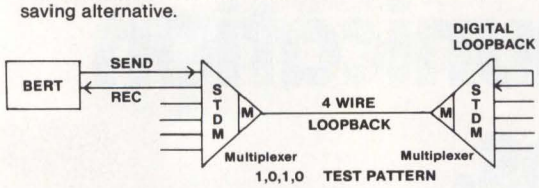
TeleVideo Systems, Inc.

CIRCLE NO. 135 ON INQUIRY CARD

THE DATA DETECTIVE #4

The Case of the Prejudiced BERT

The bit error rate tester (BERT) is one of the basic pieces of test equipment that should be in everyone's data detective kit. One of our customers was an experienced user of a small battery powered BERT, and he used his tester frequently to check the error rate of his private line and async modems running at 1200 baud. His BERT transmitted an alternating pattern of marks and spaces (which are continuous U's in ASCII) and counted any bit that did not alternate as an error. As more lines were added to the system, the day came when a statistical time division multiplexer was a necessary cost saving alternative.



The STDM's were duly installed on a spare phone line and the BERT was called upon to certify that the new arrangement worked. With the remote end in loopback the BERT immediately began to show errors, and in a few minutes its counter had overflowed. Replacing the STDM with the 202 modems showed no errors and proved the line was good. A different brand of STDM was tried, but the BERT nixed that one also. At this point, the question was, how could a statistical multiplexer, which presumably corrects errors, deliver faulty data and not indicate such errors on its diagnostic lamps? Clearly the errors were imaginary and the BERT was simply prejudiced against multiplexers or was it? Switching the test pattern to constant spaces or marks showed no errors. Why then should an alternating test pattern result in a counterfeit error count? The answer was that the BERT was just slightly underspeed and most multiplexers (and FDX modems) output data slightly overspeed so that overspeed terminals will not needlessly fill the buffer.

In normal operation, an extra rest bit is inserted by the STDM's every so often to take up the slack, and the BERT counted this non-alternating bit as an error. Proof that the BERT was indeed biased came when the terminals were finally attached and worked without error. —R.G.

NEXT MONTH: The Phantom Sign-off

Calendar

AUGUST

26-28 "Computers for Farm and Family" Seminar and Trade Show, St. Paul, Minn., organized by the Minnesota Agricultural Extension Service and *The Farmer/Dakota Farmer* magazine. Contact: Sandra J. Becker, OSP-XY, 405 Coffey Hall, 1420 Eckles Ave., St. Paul, Minn. 55108, (612) 373-0725.

AUGUST 31 - SEPTEMBER 2

Eurographics '83 Conference, Zagreb, Yugoslavia, sponsored by the European Association for Computer Graphics. Contact: ATLAS, Congress Department, P.O. Box 17, YU-41001, Zagreb, Yugoslavia, Telex: 22413 yu altcon.

SEPTEMBER

12-14 The International Data Base Management Systems Symposium, Santa Monica, Calif., sponsored by Continuing Education Institute. Contact: Continuing Education Institute, 10889 Wilshire Blvd., Suite 1000, Los Angeles, Calif. 90024, (213) 824-9545. Also to be held Oct. 10-12, Arlington, Va.

12-14 "Discovery '83: Computers for the Disabled" Conference, Minneapolis, sponsored by the University of Wisconsin-Stout's Office of Continuing Education, the Stout Vocational Rehabilitation Institute and Closing the Gap. Contact: John K. Enger, Office of Continuing Education, University of Wisconsin-Stout, Menomonie, Wis. 54751, (715) 232-1167.

12-15 Tenth Australian Computer Conference, Melbourne, Australia. Contact: Susan Coleman, Publicity Chairperson, P.O. Box 4063, Mail Exchange, Melbourne, 3001, (03) 41 6220.

13-15 "Automating Technical Information from Design to Support" Symposium, San Diego, Calif., sponsored by Aerospace Industries Association. Contact: John W. Stahl Jr., 1725 De Sales St. N.W., Washington, D.C. 20036, (202) 429-4635.

13-15 1983 Federal Computer Conference, Washington, D.C., sponsored by Federal Education Programs. Contact: Federal Computer Conference, P.O. Box 368, Wayland, Mass. 01778, (800) 225-5926 or (617) 358-5181.

16-18 COMPUFAIR Seattle, Seattle, sponsored by Compufair Inc. Contact: Tom Ikeda, Compufair Inc., 909 N.E. 43rd St., Suite 302, P.O. Box 45218, Seattle, Wash. 98105, (206) 633-3247.

16-18 Great Southern Computer & Electronics Show, Jacksonville, Fla., presented by the Great Southern Computer & Electronics Shows. Contact: Great Southern Computer & Electronics Shows, P.O. Box 655, Jacksonville, Fla. 32201, (904) 384-6440 or 353-0418. Also to be held Oct. 7-9, Orlando, Fla.

19 DEXCOMP Fall '83 Seminar and Expo, Pittsburgh, sponsored by the Digital Equipment Corp. Competitive/Compatible Group. Contact: Diane Tener, Conference Manager, DEXCOMP, 2021-113 Business Center Drive, Irvine, Calif. 92715, (714) 851-0623. Also to be held Sept. 22 in Rochester, N.Y., Oct. 13 in Washington, D.C., Nov. 15 in St. Louis, Mo., and Nov. 17 in Minneapolis.

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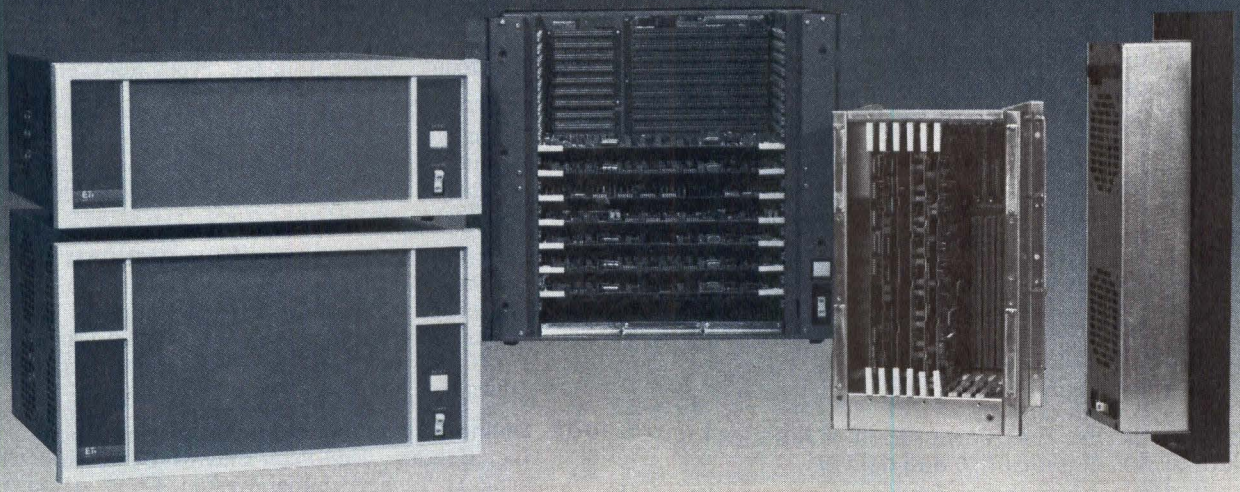
8250	9-slot NEMA Enclosure mounting	$1180.
8263	23-slot NEMA Enclosure mounting	$2105.



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Calendar

23-24 **First Annual Dakota Computer Fair,** Bismarck, N.D. Contact: Stephen Cobb, Dakota Computer Fair '83, P.O. Box 7036, Bismarck, N.D. 58502, (701) 224-0166.

26-28 **Maecon/83 Electronic Show and Convention,** Kansas City, Mo., sponsored by Kansas City and St. Louis Sections of the IEEE and the Heart of America and Spirit of St. Louis Chapters of the ERA. Contact: Maecon/83 Professional Program Committee, c/o Dale Litherland, Director of Education, 8110 Airport Blvd., Los Angeles, Calif. 90045.

26-28 **Sixth European Conference on Electrotechnics,** Brighton, England, organized by the Institution of Electrical Engineers, sponsored by the Convention of National Societies of Electrical Engineers of Western Europe and Region 8 of the IEEE. Contact: The Manager, Conference Services, Institution of Electrical Engineers, Savoy Place, London WC2R OBL, U.K. (01) 240-1871, ext. 222.

28-29 **Ottawa Computer & Office Automation Show,** Ottawa, Canada, presented by Industrial Trade Shows of Canada. Contact: Industrial Trade Shows of Canada, 20 Butterick Rd., Toronto, Ontario M8W 3Z8, (416) 252-7791.

OCTOBER

4-6 **PC '83 International Conference and Exposition,** Boston, produced by Northeast Expositions. Contact: Northeast Expositions, 826 Boylston St., Chestnut Hill, Mass. 02167, (617) 739-2000 or (800) 343-2222.

4-7 **The European Computer Trade Forum,** Birmingham, England, organized by Clapp & Poliak International. Contact: Roswell S. Wolff, Manager, International Marketing, Clapp & Poliak International P.O. Box 70007, Washington, D.C. 20088, (301) 657-3090.

5-6 **COMPUSOURCE '83,** San Jose, Calif., sponsored by Norm De Nardi Enterprises. Contact: Carol L. Reimer, Show Manager, Norm De Nardi Enterprises, 289 S. San Antonio Rd., Suite 204, Los Altos, Calif. 94022, (415) 941-8440.

5-6 **"Getting the Most from Your CAD/CAM System" Seminar,** Milwaukee, presented by the University of Wisconsin-Extension. Contact: John M. Leaman, Department of Engineering & Applied Science, University of Wisconsin-Extension, 929 N. Sixth St., Milwaukee, Wis. 53203, (414) 224-4189.

10-12 **Online '83 Conference,** Chicago, sponsored by Online Inc. Contact: Jean-Paul Emard, Conference Chairman, 11 Tannery Lane, Weston, Conn. 06883, (203) 227-8466.

10-14 **Seventh International Fiber Optics & Communications Exposition,** Atlantic City, N.J., sponsored by Information Gatekeepers Inc. Contact: Paul W. Fitzgerald, Exposition Marketing Manager, Information Gatekeepers Inc., 167 Corey Rd., Suite 111, Brookline, Mass. 02146, (617) 739-2022.

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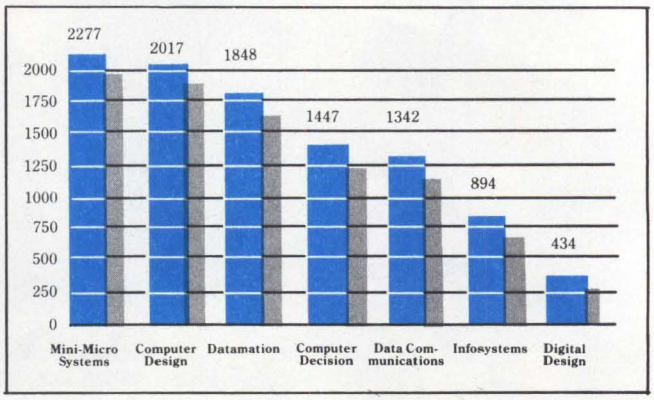

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SYSTEMS

High-performance color graphics workstations are priced at less than $20,000 each

Hewlett-Packard Co. and Tektronix Inc. have introduced high-performance color graphics workstations that are priced at less than $20,000 each. Designed as a personal CAD workstation, the HP Series 200 model 36C is priced at $17,660 with a system configuration that includes 640K bytes of RAM, two 5¼-in. floppy disk drives and the BASIC and Pascal programming languages. Tektronix's model 4115 computer display terminal is priced at $19,950.

The HP Series 200 model 36C features four graphics-memory planes, a gray scale and a color map that are accessible through HP's enhanced BASIC or Pascal graphics-language extensions. The model 36C offers two ways of producing colors. It allows selection of 16 true colors from a palette of 4096 colors for lines or filled images by controlling the intensity of the CRT guns. The model 36C can also generate 4913 dithered area shades for color compatibility with other HP products. Its 12-in. display screen features an 80-character × 25-line display and a resolution of 512 × 390.

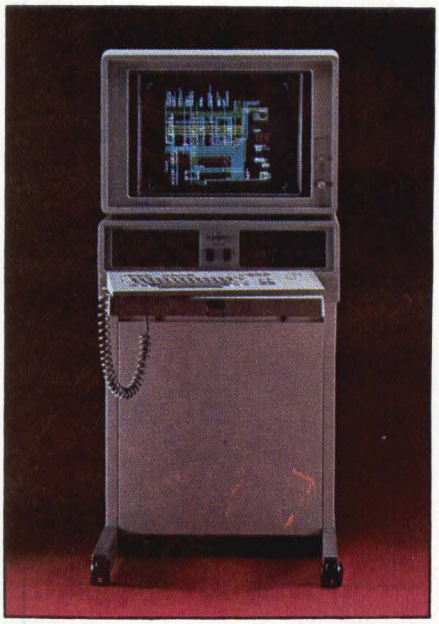
Graphics images stored in the Tektronix model 4115 terminal's 32-bit coordinate space are displayed at a resolution of 1280 × 1024 pixels. Color control is provided in the standard configuration by four bit planes, which can be expanded optionally to eight bit planes. The bit planes can be used to specify as many as 256 colors simultaneously from a palette of 16 million colors. The terminal's pan and zoom features provide fast access to any part of the locally stored graphics data.

The Tektronix model 4115 also features a scrollable dialog area, local picture segments, a local programmability package, a local version of the Tektronix PLOT 10 Interactive Graphics Library and ANSI X3.64 standard text manipulation. The model 4115's dialog area offers two character sizes for alphanumeric text that provide as many as 34 lines of 80 characters or 64 lines of 160 characters.

The HP model 36C offers a broad range of interfaces including standard HP-IB and optional RS232C, 16-bit parallel, DMA, datacomm, RGB, BCD and a high-speed hard disk interface. It supports a range of peripherals from low-priced printers, plotters and microfloppy disk drives to high-performance Winchester disk drives, E-sized plotters and high-speed printers. Through terminal-emulation software, the model 36C can act as a character- or line-mode terminal to communicate and transfer data with other HP host computers. It allows bidirectional file transfers. Custom BASIC or Pascal, datacomm routines and customized datacomm interfacing are possible through optional interface cards.

The model 4115 features sustained PLOT 10 graphic and alphanumeric communications at 19.2K baud through a standard RS232C interface. An available DMA interface provides 10M-baud communications over distances as great as 1000 ft. Color copies are available through an optional interface to the Tektronix model 4691 color graphics copier. The model 4115's local memory is expandable from the standard of 288K bytes to 800K bytes. Mass-storage options include one or two 500K-byte floppy disk drives. Optional input devices include keyboards and graphics tablets. **Hewlett-Packard Co.,** 1820 Embarcadero Rd., Palo Alto, Calif. 94303.

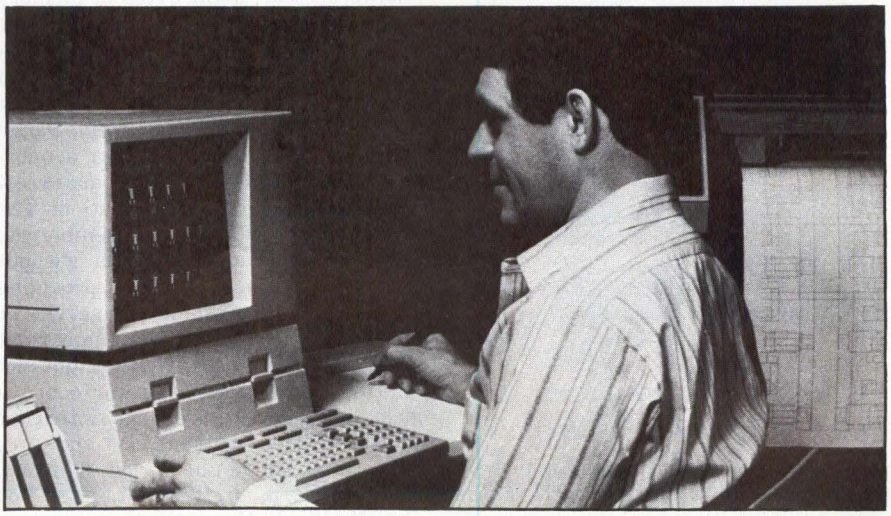
Circle No 300



The Tektronix model 4115 computer display terminal *features a color raster-scan display that displays 1280 × 1024 pixels at a 60-Hz refresh rate. It can be used for applications such as IC design, finite-element modeling and cartography.*

Tektronix Inc., Marketing Communications Department, Mailing Station 63-635, P.O. Box 500, Beaverton, Ore. 97077.

Circle No 301



Hewlett-Packard Co.'s Series 200 model 36C personal CAD workstation *features the MC68000 microprocessor, integrated mass storage and a range of supported peripherals.*

New Products

SYSTEMS

Small-business computer includes software

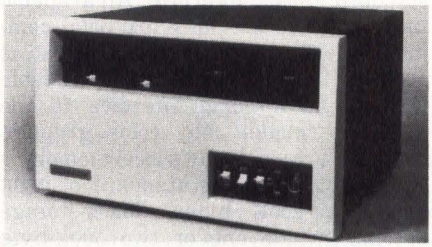
The Freeport multi-user small-business computer includes menu-driven application programs that provide financial control of small-business and retail operations. The Freeport's integrated accounting software package features stand-alone modules for payroll-processing, spread-sheet, budget-calculation, point-of-sale, word-processing, mailing-list and electronic-mail functions. Also included is the MICROCOBOL programming language. Hardware features include Digital Equipment Corp.'s LSI-11/23 microprocessor, a Freeport terminal, a low-profile keyboard with numeric keypad and four function keys, a 5¼-in. Winchester and floppy disk controller, a 10.4M-byte hard disk drive and a 500K-byte floppy disk drive. The Freeport contains 256K bytes of RAM and provides six additional ports for as many as six more terminals. Each terminal can accommodate its own printer. Price is $14,995 including the computer, a monitor keyboard, one terminal and all software. **Advanced Electronics Design Inc.,** 440 Potrero Ave., Sunnyvale, Calif. 94086.

Circle No 302

Data-acquisition systems have 128K-byte RAM

Designed for scientific and industrial data-acquisition applications, the Focus 5010 and 5020 large-capacity, FORTRAN-programmable, real-time data-acquisition and -control systems feature high-speed operation (as many as 100,000 measurements per sec.), 16-bit accuracy and more than 1000 channels of field-expandable analog and digital I/O. Packaged in a mobile RETMA enclosure, the Focus series can be configured from more than 85 analog and digital I/O boards varying from FET multiplexers to isolated low-level input units. The system provides direct connection to I/O transducers and receivers, real-time synchronization and event scheduling and response to external interrupting events. Both models provide 128K bytes of RAM and 20M bytes of Winchester disk storage. The Focus 5010 runs the RT-11 operating system, while the Focus 5020 runs the RSX-11M operating system. A library of FORTRAN-callable subroutines is included. Prices vary with configuration. **Analogic Corp.,** 14 Electronics Ave., Danvers, Mass. 01923.

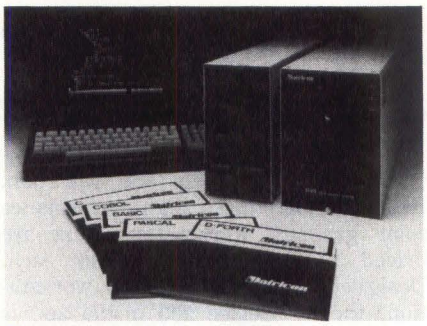
Circle No 303



Microcomputer features unique packaging design

The Diskstor M-2 microcomputer system includes a 10-MHz, 16-bit 8086 microprocessor, 128K bytes of memory with parity, serial and parallel interface ports and dual, double-sided floppy disk drives with a total storage capacity of 2M bytes. It runs the MS-DOS operating system and is suitable for a wide range of applications including data acquisition, factory automation, automatic test equipment and office automation. The computer's entire chassis assembly can be removed from the front without unmounting the shell, thus providing access to all subassemblies for service or maintenance. The cast-aluminum front bezel pops off for access to the eight-slot Multibus card cage. Operator controls include key-lock power and interrupt switches, boot switches, DC and RUN indicators. Single-unit price is $8590. **Comark Corp.,** 93 West St., P.O. Box 474, Medfield, Mass. 02052.

Circle No 304



System supports STD-bus micros

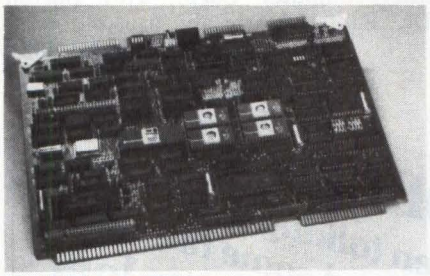
The model DV-9 software-development system supports a wide range of STD-bus hardware and offers five high-level languages—Pascal, COBOL, BASIC, C and D-FORTH—as well as assembly-language programming. The package includes two independent STD-bus systems: a development computer for generation and maintenance of application source code and development of OS-9-based applications and a target backplane for configuring application hardware and software. The development computer features a 2-MHz 6809 CPU, 62K bytes of memory, three serial I/O ports, 32 bits of parallel I/O, a floppy disk controller, two double-sided floppy disk drives with a total storage capacity of 2.2M bytes and an EPROM programmer. Standard software includes the OS-9 modular, multitasking operating system, the BASIC09 interpreter/compiler, Macro Text Editor, a 6809 assembler and an interactive debugger. Price is $7500 in single-unit quantities. **Datricon Corp.,** Datricon Plaza, 155 B Ave., Lake Oswego, Ore. 97034.

Circle No 305

Multi-user systems have three processors

The Tiger ATS family of multi-user supermicrocomputer systems features a tri-level computer architecture with a transaction processor, an intra-network processor and a control bi-processor. Each processor has its own RAM, but each also shares a global memory ranging from 256K bytes to 1M byte of addressable RAM. Each transaction processor incorporates a 16-bit Intel 8086-2 microprocessor and processes short transactions for as many as eight terminal devices, each operating at speeds as high as 19.2K bps. The

intra-network processor also incorporates an Intel 8086-2 microprocessor and serves as a system resource manager and resource scheduler. Supplied with 32K bytes of dedicated RAM and as much as 16K bytes of dedicated PROM, it performs long tasks assigned to it by any transaction processor. The control bi-processor incorporates a 16-bit Intel 8089 dual-channel processor that interfaces to the Winchester disk drives and streaming-tape drives. Two models of the Tiger ATS are available: the ATS 32 and ATS 64 provide as many as 32 and 64 ports, respectively. The systems support the CADOL and COBOL programming languages and a wide range of application packages. Prices depend on configuration, but range from less than $30,000 to more than $250,000. **Cado Systems Corp.,** 2771 Toledo St., Torrance, Calif. 90503. **Circle No 306**



CPU board features I/O expandability

The TM990/103 microcomputer module includes the 16-bit model TMS99110 microprocessor with macrostore memory. Macrostore is a memory space for frequently used functions or algorithms that can be accessed at full processor speed—167 nsec. at 6 MHz. The 1K-byte macrostore ROM located on the TMS99110 chip is programmed with single-precision floating-point instructions that make the TMM990/103 well-suited for high-precision, computation-intensive applications. Primarily intended for use as a high-speed process controller, the TM990/103 has 17 interrupts, 15 of which are maskable. It also has two programmable RS232C ports with baud ranges of 110 to 37.4K baud. On-board communications register units provide serial and parallel interfacing. The module features on-board expansion of I/O via two IEEE P959 bus-compatible sockets. The module's memory can be expanded via memory-expansion platforms that plug directly into existing RAM, ROM and EPROM sockets. Memory-expansion platforms provide as much as 64K bytes of RAM, 64K bytes of EPROM or macrostore ROM or various combinations of memory on a single platform. The TM990/103 has an 87-member instruction set that includes instructions such as signed multiply and divide. Available software includes the PDOS disk-operating system, the UCSD p-System and TI Microprocessor Pascal. Prices of the TM990/103 start at $1660 in single-unit quantities. **Texas Instruments Inc., Semiconductor Group.,** P.O. Box 401560, Dallas, Texas 75240. **Circle No 307**

New Products

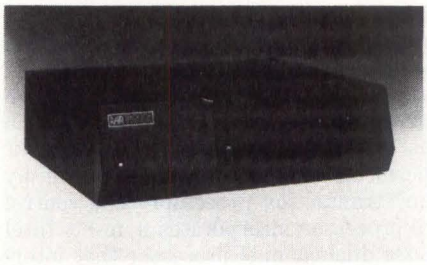
SYSTEMS

CP/M-based micro aimed at small-business market

Centered around T-BASIC and the CP/M operating system, the model T100 personal/professional computer is aimed at operators of small businesses. The T100 features a Z80A microprocessor, an 89-key detached keyboard and three I/O video screen options including a 12-in. monochrome screen, a 14-in. eight-color screen and a flat-panel LCD showing eight lines of 40 characters. Also included are 64K bytes of RAM, a 32K-byte ROM for the T-BASIC language and a 16K-byte RAM for video. Mass storage for data and programs is available in the form of two double-sided, double-density, 5¼-in. floppy disk drives with a total storage capacity of 560K bytes. An entry-level configuration, including a keyboard and a CPU, is priced at $795. An expanded version, including a green display and two floppy disk drives, is priced at $2385. **Toshiba America Inc., Information Systems Division,** 2441 Michelle Dr., Tustin, Calif. 92680. **Circle No 308**

Multi-user micro is targeted at system integrators

Designed for OEM and technical users, the Black Box 3/60S microcomputer system features a 16-bit 8088 microprocessor and 256K bytes of RAM, expandable to 1024K bytes. The computer interfaces with as many as 16 terminal, peripheral and data-communications devices via RS232 ports operating at speeds as high as 19.2K baud and



an IEEE-488 parallel bus operating at 800K bytes per sec. Data storage is provided by an integral 5¼-in., 19M-byte Winchester disk drive and a 5¼-in., 1M-byte floppy disk drive. Running under the 16-bit MP/M-86 multi-user operating system, the Black Box 3/60S supports a wide variety of 16-bit software including the BASIC, COBOL and Pascal programming languages and word-processing, spreadsheet and database applications. Price is $9500 in single-unit quantities. **Rair Microcomputer Corp.,** 4101 Burton Dr., Santa Clara, Calif. 95050.

Circle No 309

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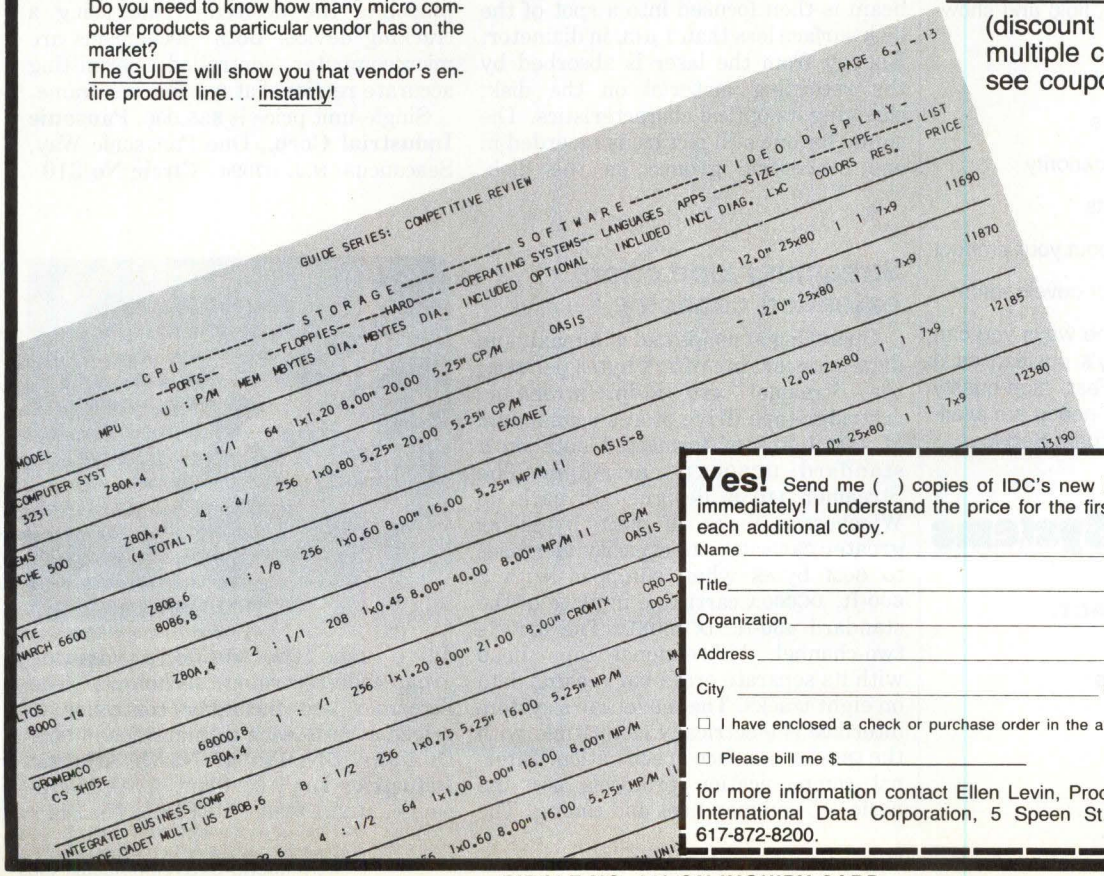

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CIRCLE NO. 143 ON INQUIRY CARD

New Products

DISK/TAPE

Disk still video recorders use semiconductor laser technology

The Panasonic Industrial Co. has introduced three direct-read-after-write disk still video recorder/playback systems for information storage-and-retrieval applications. The three versions are the model TQ-2020F, which can record 300-line NTSC video, the model TQ-2022F, which features motion playback of NTSC color video frames at a 30-frame-per-sec. rate, and the model TQ-2021FB, which is capable of 450-line resolution monochrome recording. Each can be controlled and polled through its RS232C interface.

Panasonic's system employs a single semiconductor laser as an optical source for reading and writing information on an 8-in.-diameter disk with 15,000 concentric grooves coated by a thin film of sensitive recording material.

Unlike conventional optical-disk recording systems, the new systems do not make any holes on the disk. The video signals are modulated by varying the laser beam's intensity. The laser beam is then focused into a spot of the disk surface less than 1 μm. in diameter. Energy from the laser is absorbed by the recording material on the disk, changing its optical characteristics. The signal for one still picture is recorded in one concentric groove on the disk.

Panasonic Industrial Corp.'s erasable optical-memory disk recorder system *can place as many as 10,000 video images on an 8-in. disk.*

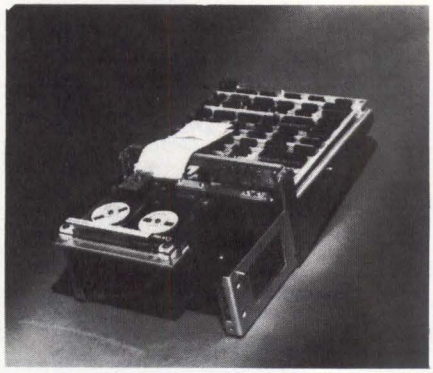
During playback, the laser beam, using less power than in the recording process, is reflected onto the disk and reconverted into the original video signal.

To retrieve a frame of a stored picture, a linear motor drives an optical head for a rough search, and the head pinpoints the desired frame using a tracking device. Both mechanisms are microcomputer controlled, permitting accurate retrieval at 0.5 sec. per frame.

Single-unit price is $35,000. **Pansonic Industrial Corp.,** One Panasonic Way, Seacaucus, N.J. 07094. **Circle No** 310

Streaming tape offers extended capacity

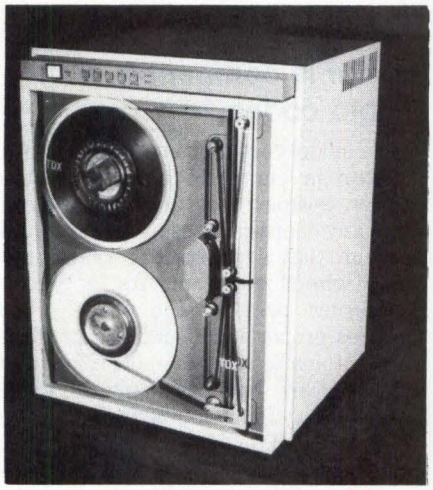
Operating at 90 ips and at a maximum data-transfer rate of 72K bytes per sec., the Streamer 410 ¼-in. streaming cartridge-tape drive stores a minimum of 45M bytes of formatted data on a standard DC300XL cartridge. The Streamer 410 is designed to back up Winchester disks of 30M bytes or greater capacity. Its capacity increases to 60M bytes when equipped with a 600-ft. DC600A cartridge in place of the standard 450-ft. DC300XL. The drive's two-channel, bidirectional tape head with its separate erase bar records data on eight tracks. The model 410's system interface is electrically compatible with the QIC-02 interface specification. Internal communication protocols use the basic QIC command set and timing. The



drive uses the vendor's variable group-code-recording technique. The Streamer 410 including controller is priced at $975 each in quantities of 500. **Quantex Division of North Atlantic Industries Inc.,** 60 Plant Ave., Hauppauge, N.Y. 11788. **Circle No** 311

Cartridge-disk subsystem stores 10M bytes

The model BC-10 disk storage subsystem for the IBM Personal Computer, the Victor 9000 and S-100-based microcomputer systems includes a dual-drive cabinet, an 8-in., 10M-byte cartridge-disk drive, a host interface card, a 10M-byte cartridge and an operating-system software patch. The subsystem can be used with the CP/M-80, CP/M-86, concurrent CP/M-86, MP/M-11, MP/M-86 and MS-DOS operating systems. The drive features a 1.13M-byte-per-sec. data-transfer rate and a 35-msec. average access time. Single-unit price is $3750. **BC Systems Inc.,** 1016 E. 31st St., LaGrange Park, Ill. 60525. **Circle No 312**



Magnetic-tape system features many interfaces

The TDX ½-in. reel-to-reel magnetic-tape drive operates at 75 ips. Rewind speed is 300 ips. The drive features a dual-gap read-after-write head; NRZI, PE or dual-density recording formats; and a microprocessor-controlled embedded formatter. Standard interfaces include RS232, IEEE-488 and parallel buffers. Optional interfaces are offered for Data General Nova/Eclipse computers, Digital Equipment Corp. PDP-11/VAX Unibus computers and DEC LSI-11 Q-bus computers. The complete tape system is available in a stand-alone cabinet or a rack-mount configuration. Prices start at $4700. **TDX Peripherals Division of GAW Control Corp.,** 148 New York Ave., Halesite, N.Y. 11743. **Circle No 313**

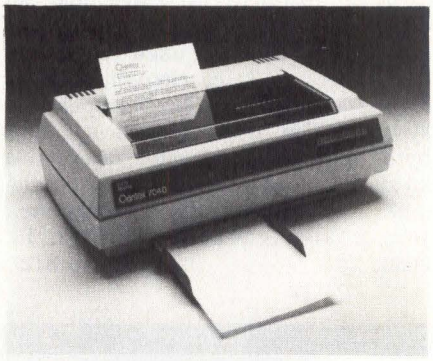
New Products

PRINTERS

Dot-matrix printers feature high-resolution printing

The JDL P700 and JDL P200 serial dot-matrix impact printers feature high-speed, high-resolution letter-quality printing. Both printers feature single-pass, 58-cps printing of 18 × 24 resolution pica characters and single-pass, 70-cps printing of 15 × 24 resolution elite characters. The JDL P700 also offers a 145-cps data-processing mode. Both printers offer 180- × 180-dpi graphics. The JDL P700 prints as many as 162 characters per line, and the JDL P200 prints as many as 108 cpl. Paper feed is by friction and pin for the JDL P700 and by automatic sheet feed for the JDL P200. Both models have a bidirectional print head and are outfitted with an Intel 8085 chip for Centronics and RS232C interfaces. Prices are $2099 for model JDL P700 and $2149 for model JDL P200. **Pacific Technology Services Inc.,** 332 Pine St., San Francisco, Calif. 94104.

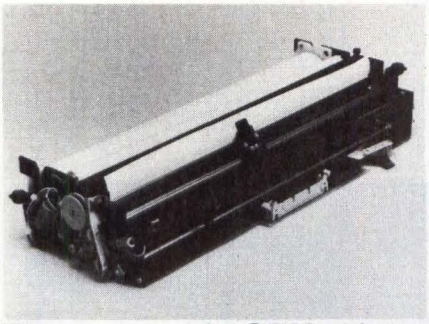
Circle No 314



Printer is compatible with Diablo codes

The model 7040 multimode dot-matrix printer is compatible with Diablo printer escape codes and can be used with any word-processing or graphics package that supports the Diablo 630 daisy-wheel printer. As a word-processing printer, the model 7040 features proportional spacing, justification, automatic underline, overprint and bold. It can store as many as three letter-quality fonts on line from a choice of Courier, Trend, Emphasis, Cubic, Italics and Script. In the near-letter-quality and letter-quality modes, the printer operates in multiple passes at 75 and 37.5 cps, respectively, and features character matrixes of 24 × 9 and 48 × 18, respectively. As a data-processing printer, the model 7040 prints bidirectionally at 180 or 150 cps using the character sets of USA, UK, Germany, France, Norway/Denmark, Sweden, Finland and Spain. The printer also features dot-addressable graphics at a density of 144 × 144 dpi. The model 7040 also offers a single-sheet feed capability. The manual single-sheet feeder incorporates a combination roller/tractor that allows the use of continuous-form or cut-sheet documents without an external device attachment. Single-unit price is $2195. **Qantex Division of North Atlantic Industries Inc.,** 60 Plant Ave., Hauppauge, N.Y. 11788.

Circle No 315



Thermal-matrix OEM printer prints at 120 cps

The Execuport P200 thermal-matrix OEM printer has a 16-element columnar print head that produces high-resolution characters in a variety of sizes and styles at 120 cps. Two standard character fonts—9 × 11 and 5 × 7—are included in an on-board ROM. On 8¾-in.-wide paper, the 9 × 11 font prints 80 characters per line, and the 5 × 7 font prints 136 characters per line. On 14⅞-in.-wide paper, the 9 × 11 font prints 136 characters per line, and the 5 × 7 font prints 233 characters per line. By using software control from a host computer, two 24 × 80 format pages can be printed side by side on 14⅞-in.-wide paper. Other features include several tabbing modes, internal and remote diagnostics and as much as 11K bytes of internal buffer storage. A Centronics-compatible interface is standard, and an RS232C interface is optional. Price is $650 each in quantities of 1000. **Computer Transceiver Systems Inc.,** P.O. Box 15, E. 66 Midland Ave., Paramus, N.J. 07652. **Circle No 316**

Non-impact matrix printer prints at 50 lpm

The model PR2300 printer uses a single-jet print head to direct carbon particles onto regular paper in a 7 × 7 dot matrix. The paper is sensitized with electrical impulses in a pattern corresponding to the desired character or graphic pattern and attracts the carbon particles where they are permanently affixed. The PR2300 prints a 96-character ASCII set and offers seven other foreign-language sets and software-selectable character sets. This 80-column printer prints as fast as 50 lpm. Pitches of 10, 12 and 15 cpi are available with variable line spacing. The PR2300 offers normal, compressed, double-height, double-width and boldface printing with single or double underlining. The printer features a 1K-byte buffer and offers a choice of Centronics or RS232C interfaces. Single-unit price is $560. **Docutel/Olivetti,** 155 White Plains Rd., Tarrytown, N.Y. 10591. **Circle No 317**

New Products

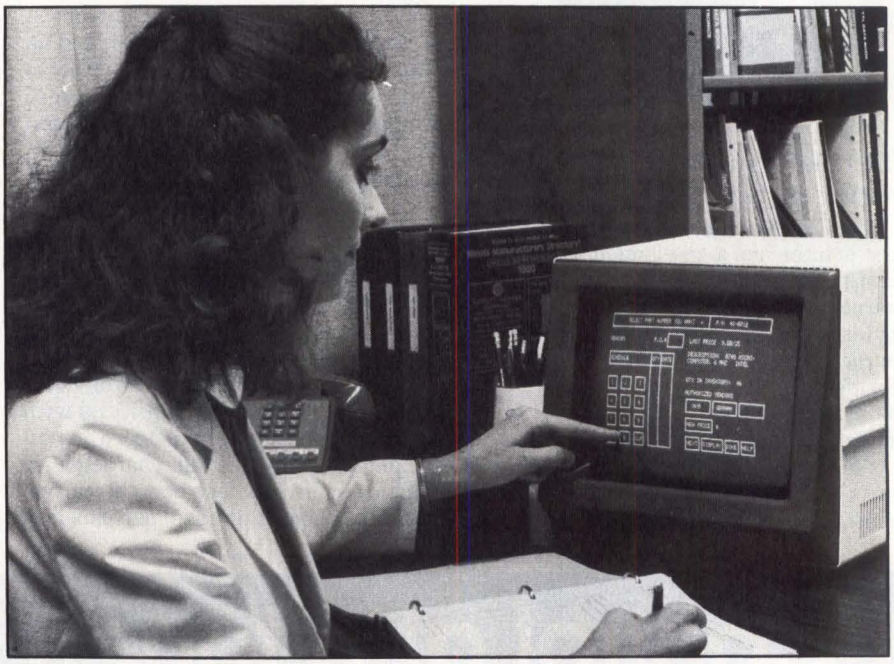
TERMINALS

Touch-activated terminal features low cost

Envisioning a market for low-cost, touch-activated terminals in applications such as computer-aided instruction and public-access devices used in libraries, shopping malls and trade shows, Electro Mechanical Systems Inc. has introduced the Touch Information Display terminal for a single-unit price of $1400.

The TID's low price is a result of its design from the ground up as an integrated touch-sensitive terminal. Compared with its competitors, which typically consist of a touch panel mounted on the front of a standard terminal, the TID saves money by eliminating panel-mounting costs and by better electronics integration. An Intel 8085 microprocessor and its associated memory handle both terminal and touch-panel functions in the TID, whereas rival systems require a separate processor and memory for the touch panel.

For its touch capability, the unit relies on LEDs and phototransistor detectors around the screen's periphery. Output results when crisscrossing beams of infrared light are interrupted. Output resulting from a touch can be the average xy coordinates or an ASCII character associated by software with a touch area. Touch areas can be any size or shape and can be set up using a menu-driven routine stored in ROM. As many as 648 active touch areas can be defined. Terminal parameters are stored in the nonvolatile array of a shadow RAM device.

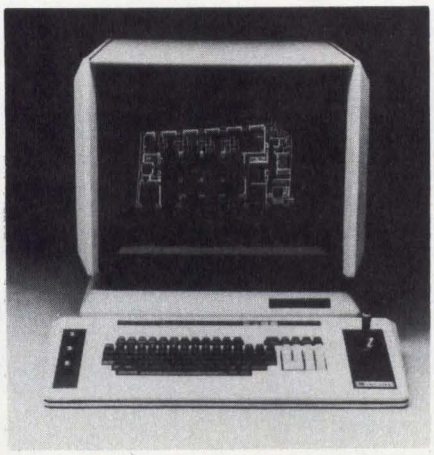


Electro Mechanical Systems Inc.'s Touch Information Display terminal *uses opto technology. Because no screen overlay or mechanical switches are involved, the optical approach is more reliable than techniques that rely upon capacitive or membrane screens.*

The TID's 12-in. amber CRT displays 24 lines × 80 characters. The terminal's character set includes 96 ASCII characters and 32 graphics symbols. Characters are displayed on a 5- × 7-dot matrix in a 6- × 10-dot field. The TID emulates all Lear Siegler ADM-3A cursor addressing functions. It communicates with a host processor via an RS232C interface at data rates as fast as 19.2K baud. A standard keyboard port is included. **Electro Mechanical Systems Inc.,** 801 W. Bradley Ave., Champaign, Ill. 61820. **Circle No** 318

Graphics terminal fits on a desk top

The Whizzard 1645 desk-top engineering terminal offers selectable pixel resolution of 1024 × 960 or 1280 × 960. It provides 2D interactive graphics concurrent with alphanumeric capability. VT-100/52 compatibility allows users to perform graphic design functions as well as software development, documentation and report generation. Optional Tektronix 4014 emulation will be available soon. The 1645 uses an 8-MHz 8086 microprocessor as the graphics processor and employs display-list processing techniques. The display-list architecture provides capabilities for local manipulation of screen graphics—such as zoom, scale, translate, clip, rotate, pick and polygon fill—with minimal host intervention. The 1645 also uses a digital vector generator that processes display-list vectors at speeds as much as 10 times higher than a general-purpose microprocessor. Other 1645 features include a tilt-and-swivel display screen, a detachable keyboard with a 10-key data-entry keypad, 16 programmable function keys and optional joystick and valuator dials. Single-unit price is $13,900, with quantity discounts available. **Megatek Corp.,** 3985 Sorrento Valley Blvd., San Diego, Calif. 92121. **Circle No** 319



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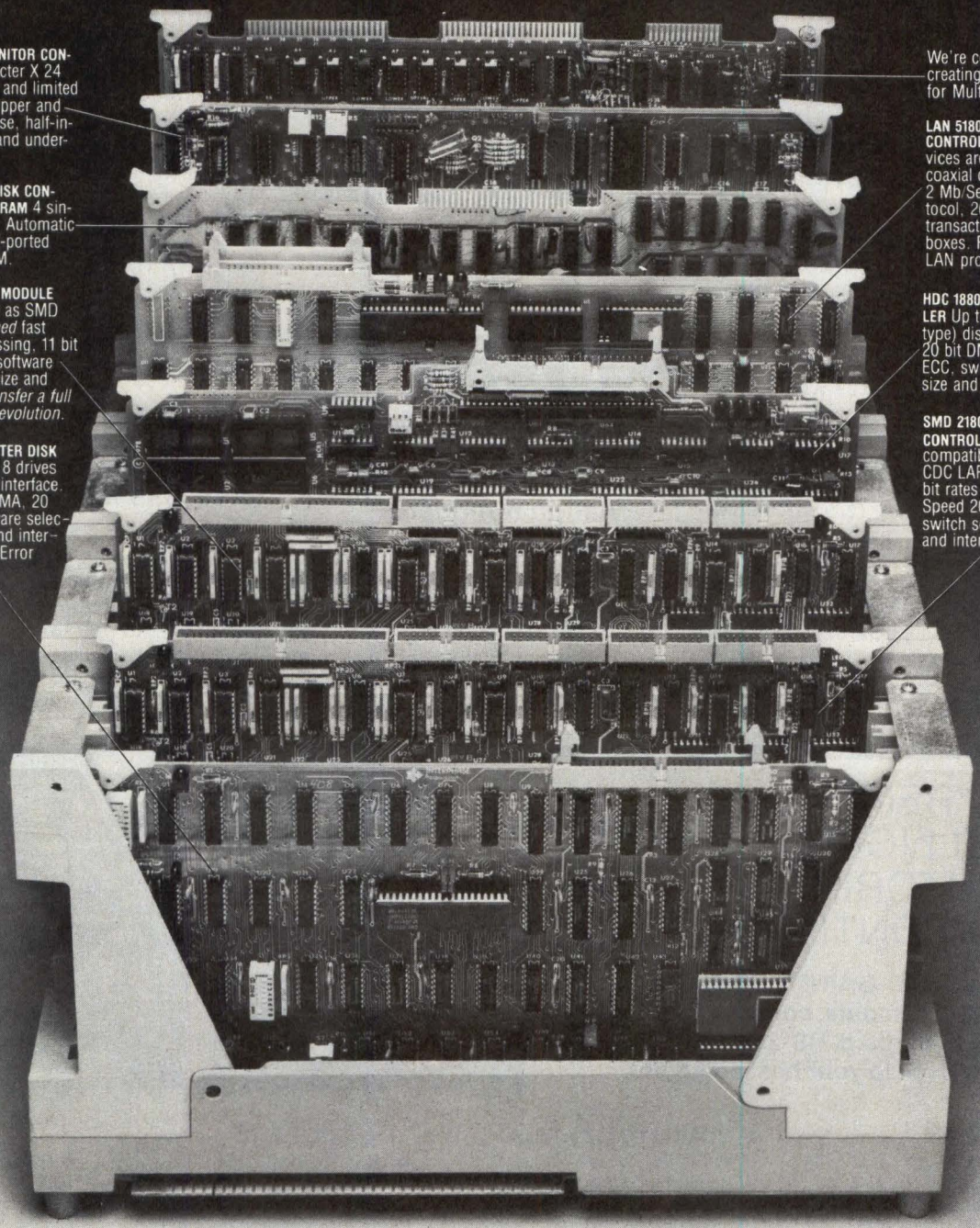

VMC 186 VIDEO MONITOR CONTROLLER 80 Character X 24 line alphanumeric and limited graphic display. Upper and lower case. Reverse, half-intensity, flashing, and underline attributes.

FDC 1680 FLOPPY DISK CONTROLLER WITH 16K RAM 4 single density drives. Automatic DMA into the dual-ported on-Board 16K RAM.

SMD 2181 STORAGE MODULE CONTROLLER Same as SMD 2180 except *damned* fast DMA 24 bit addressing, 11 bit Error Correction, software selectable sector size and interleave. *Can transfer a full track in one disk revolution.*

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LAN 5180 LOCAL AREA NETWORK CONTROLLER Up to 255 devices are supported on a coaxial cable. Data rates up to 2 Mb/Sec. SDLC/HDLC protocol, 20 bit DMA, automatic transaction completion, mailboxes. First in a family of LAN products.

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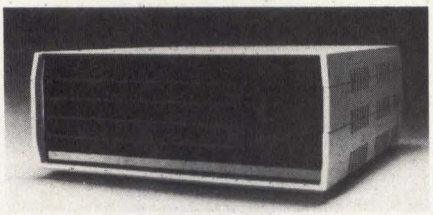
CIRCLE NO. 147 ON INQUIRY CARD

New Products

DATACOMM

Auto-dial modem stores 10 numbers

The model AJ 1259-AD is an auto-dial/auto-answer triple modem that is compatible with the Bell 212A and VA 3400 series modems at 1200 bps and with Bell 103/113 modems at 300 bps. Th model AJ 1259-AD allows terminal users to enter, store and selectively change as many as 10 telephone numbers. The modem is FCC-approved for direct connection to the switched telephone network via RJ-11C modular jacks or RJ-41S and RJ-45S data jacks. The unit is microprocessor controlled and offers continuous self-test and diagnostic features. When answering a call, it automatically selects the appropriate communication protocol and data rate. Price is $875 in single-unit quantities. **Anderson Jacobson Inc.,** 521 Charot Ave., San Jose, Calif. 95131. **Circle No 320**



International modem operates at 4800 bps

A CCITT V.27 bis-compatible network-control and -management modem, the model NCM4800V operates at 4800 bps on four-wire unconditioned M1040 or 3002 leased lines. This microprocessor-based modem also features 22.4-msec. fast-train compatibility, data-train equalization, self-testing, V.27-compatible scrambling and 2400-bps auto-selectable fall-back operation. Its modular stand-alone enclosure accommodates a variety of built-in options including network control, dial backup, secondary channel, an internal spare modem and multiplexing. The model NCM4800V is priced independently by international distributors. **Intertel,** 6 Shattuck Rd., Andover, Mass. 01810. **Circle No 321**

Package allows IBM PCs to access mainframes

Blue Lynx, a hardware/software system for the IBM Personal Computer, permits integration of the Personal Computer into SNA/SDLC systems and networks. An IBM PC equipped with Blue Lynx emulates many of the features of the IBM 3276 terminal/

controller. Blue Lynx includes a plug-in communications card with associated software supplied on a floppy disk and is priced at $690 in single-unit quantities. Blue Lynx is also available with bisynchronous hardware and software for $650 or combined bisynchronous and SDLC support for $1080. **Techland Systems Inc.,** 39 Carwall Ave., Mount Vernon, N.Y. 10552. **Circle No 322**

Statistical multiplexer offers line consolidation

The Datamux, a two-port statistical multiplexer for point-to-point data communications, supports port and composite link data rates as high as 9600 bits per sec. The link protocol (SDLC) provides CRC 16 error detection and correction. Other features include automatic speed detection, diagnostics and system statistics. The unit's operating parameters can be selected from the terminal/computer equipment or via an internal option switch. The Datamux is designed to operate with the vendor's 212 modem and automatic calling unit. An ASCII-transparent mode allows users to communicate with the automatic calling unit through the Datamux. Price is $835 in single-unit quantities. **Datec Inc.** 200 Eastowne Dr., Suite 116, Chapel Hill, N.C. 27514.
Circle No 323

PBX modem provides voice, data comm capabilities

The ComNet 48 PBX modem allows personal computers, word processors and intelligent terminals to communicate with each other or with central processors using the switching and contention ability of a PBX system. By combining PBX and modem technology, ComNet 48 provides a local-area network for switched voice and data services. ComNet 48 uses twisted-pair wire within a building and does not require a central switch, additional cabling or any changes to the main distribution jack. Both a telephone and a terminal can be plugged into the ComNet 48. The unit operates on regular line power. ComNet 48 provides full-duplex, two-wire synchronous or asynchronous data-communications capability at 4800 bps and operates isochronously at 300 to 1200 bps. It is available in stand-alone or rack-mount versions and is priced at $975 in single-unit quantities, with quantity discounts available. **Avanti Communications Corp.,** Aquidneck Industrial Park, Newport, R.I. 02840.
Circle No 324

New Products

SOFTWARE

Communications package runs on IBM PCs

The Relay menu-driven communications software package for the IBM PC enables a user to send and receive messages or files simultaneously between IBM PCs while printing and editing locally. It also offers communications with mainframe hosts, up- and down-loading of data and transformation of the IBM PC into an APL terminal. When used with a VM/370 system running the vendor's PC3270 package, Relay simulates a local IBM terminal on the IBM PC including all function keys. Relay also features a full-screen text editor that can be used to create or modify files while on Relay or alone as a dynamic off-line tool, an on-screen help facility, a directory to store telephone numbers and characteristics of frequently accessed computers, support for popular auto-dial/auto-answer modems and split-screen message communication between PCs. Single-unit price is $89. **VM Personal Computing Inc.,** 60 E. 42nd St., New York, N.Y. 10165. **Circle No 325**

Database program is easy to use

Information Please is a text-oriented program designed to make database operations easy for first-time computer users. It runs with the Select word-processing program and is compatible with VisiCalc and MultiPlan. The program prompts a user with simple English commands and includes Select's on-line Teach tutorial to reduce start-up time. The Information Please diskette has numerous sample charts such as mailing lists, customer lists, personnel records and calendars to help the user organize information. The program performs column math and sorts, alphabetizes, stores, organizes and retrieves data and text. Information Please is available for the IBM Personal Computer, for Digital Equipment Corp.'s line of personal computers and for other 16-bit microcomputers with the CP/M and MS/DOS operating systems. Price is approximately $295. **MicroRIM Inc.,** 1750 112th Ave. N.E., Bellevue, Wash. 98004. **Circle No 326**

Development tool cuts programming time, costs

PRO-IV software, a business application-development tool, is now available as an independent software package for the IBM Personal Computer and 8086-based microcomputers. PRO-IV acts

as a multi-user, multitasking database-management system integrated with an application-development facility. The system saves time because applications are created without assemblers, compilers or a high-level language. Instead, users define applications by completing system-design worksheets with a fill-in-the-blanks format that uses a PRO-IV vocabulary but no coding. PRO-IV software is available for the CP/M-86, PC-DOS and MP/M-86 operating systems. Price is $400 in single-unit quantities. **Capro Inc.,** 12781 Pala Dr., Garden Grove, Calif. 92641. **Circle No** 327

Word-processing for Basic Four S/10 computers

The S/10 word-processing system runs under the Business Basic/Micro operating system on the vendor's Basic Four S/10 small-business computer. This software package features an electronic filing interface; mathematical functions; keystroke storage/recall of frequently used phrases; random page and line access; function keys such as page, merge, search and center; and automatic headers and footers. Price is $695. **MAI/Basic Four Business Products Corp.,** 601 San Pedro N.E., Albuquerque, N.M. 87108. **Circle No** 328

Quality-assurance software runs on HP 1000 series

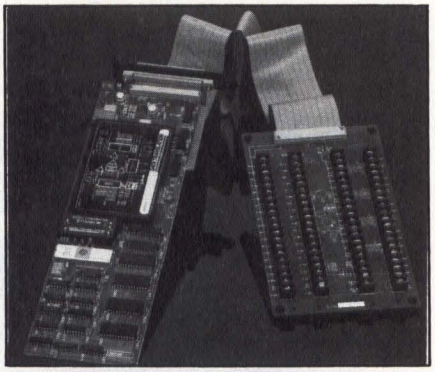
Eight quality-assurance software packages for the Hewlett-Packard 1000 series computers can be used independently or together to form an integrated quality-assurance data-management system. Calibration is a calibration-scheduling system for gauges and test instruments. Instruction Management provides on-line data storage and retrieval of instructions for receiving, sampling, inspection, assembly, calibration and other manufacturing functions. Incoming Quality Management is a receiving-inspection, material-status and control system. Vendor Rating adds rating-system capabilities to the Incoming Quality Management package. Process Analysis provides numeric and graphic analytical tools for many statistical quality-control areas. Production Quality Management allows on-line storage and data-management capabilities for variable data and interfaces with the Process Analysis analytical package. Coordinate Measuring Machine Quality Management provides on-line data-collection, -storage and -management capabilities for part-measurement data collection from coordinate measuring machines. This package can also interface with the Process Analysis package. Acceptance Sampling can design and anaylze lot-by-lot single-sampling plans for attributes. Prices range from $3000 to $10,000 for each package. **Hewlett-Packard Co.,** 1820 Embarcadero Rd., Palo Alto, Calif. 94303. **Circle No** 329

SUB-ASSEMBLIES

Board, software package turn IBM PC into data-acquisition-and-control system

Data Translation, a manufacturer of microcomputer-compatible analog I/O products, has expanded its line of plug-in data-acquisition boards for the IBM PC with the DT2805. The DT2805, a low-level, wide-range, single-board analog and digital I/O system, joins the DT2801, introduced in December. Priced at $1295, the DT2805 features an eight-channel, 12-bit A/D converter system with software-selectable gains of 1, 10, 100 or 500 as opposed to the DT2801's high-level gains of 1, 2, 4 or 8. These new gain ranges allow the IBM Personal Computer to be interfaced to a variety of low- and high-level signal sources including thermocouples, strain gauges and pressure transducers. The DT2805 also includes two D/A converters with 12-bit resolution, 16 lines of digital I/O and an on-board programmable clock.

The DT2805 contains an on-board microprocessor that, with microcode, acts as the interface between the DT2805 and the IBM PC, controls all on-board analog and digital I/O operations and performs board self-test functions. The DT2805 can be programmed from the IBM's interpreted and compiled BASIC languages as well as Assembly language. The entire single-board system operates from the host computer's +5V power supply via an on-board DC/DC converter.



Data Translation's DT2805 plug-in data-acquisition board *(left) for the IBM Personal Computer combines A/D, D/A and digital I/O functions with hardware- and software-control features and several operating modes including DMA and PIO data transfers. The DT2805 plugs into the optional DT707 screw terminal panel (right) via an integral 1m.-long, flat-ribbon cable.*

The PCTHERM real-time software package, a library of routines designed to be called from BASIC programs operating under PC-DOS, complements the DT2805. Priced at $695, this optional package supports all analog I/O, digital I/O and clock functions available on the DT2805 board. PCTHERM also includes utilities and linearization tables for handling thermocouple inputs.

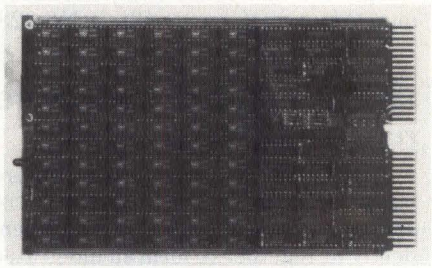
The DT707 screw terminal panel, available as an option for use with the DT2805, provides for easy connection of all a user's analog and digital signals to the computer system. Priced at $149, the DT707 can be configured with an optional thermocouple cold-junction compensation circuit. **Data Translation,** 100 Locke Dr., Marlboro, Mass., 01752. **Circle No** 330

Interactive graphics tablet expands capabilities

The HP 17623A interactive graphics tablet allows users to create original computer graphics or digitized sketches, strip charts or maps on the HP 2627A color graphics terminal. The HP 17623A has an enter point key in addition to a switch within its pen. The enter point key can be used to improve digitizing accuracy by entering the point without the need for applying pen pressure. An invert axes button on the tablet rotates the HP 17623A's coordinate system for use by left-handed persons. An on-line button is also available to enable or disable the tablet. The graphics tablet has as many as 2048 × 1560 points of resolution within an 8- × 10.6-in. active digitizing area. Its repeatability is within one resolution unit. The HP 17623A measures 1.5 × 18.4 × 14.4 in. and weighs 6.3 lbs. so its user can operate the tablet while holding it on his lap. The HP 17623A plugs into the keyboard interface of the HP 2627A. Single-unit price is $1920. **Hewlett-Packard Co.,** 1820 Embarcadero Rd., Palo Alto, Calif. 94303. **Circle No** 331

LSI memory module features 512K bytes of RAM

The model 18MP LSI-11 memory module offers 256K or 512K bytes of high-speed RAM on one dual-height, half-quad board. Featuring 22-bit addressing, the model 18MP includes on-board parity generation and checking as well as all timing and control logic for the memory. Refresh circuitry operates transparently to the user, and



the starting address is plug-selectable to any 16K-byte boundary. Selection of 18- or 22-bit addressing is also plug-programmable. The model 18MP-256 is priced at $995, and the model 18MP-512 is priced at $1795 in single-unit quantities. **ADAC Corp.,** 70 Tower Office Park, Woburn, Mass. 01801. **Circle No** 332

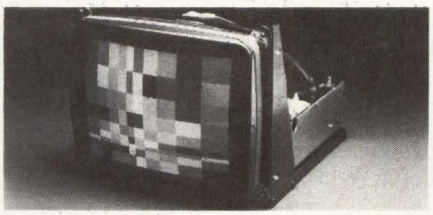
Add-in memory cards contain 1M byte of RAM

The models EMC VX-1MB and EMC VX-1/2MB are add-in memory cards for Digital Equipment Corp.'s VAX-11/730 and VAX-11/750 computers. The EMC

VX-1MB contains 1M byte of main memory mounted on a standard plug-compatible HEX card, while the EMC VX-1/2MB contains 512K bytes of main memory. Both cards use 64K-byte RAM components and are hardware and software compatible with the host computer. Each memory card contains a rear-mounted off-line switch. A miniature LED status light is also mounted to the rear of each card. Single-quantity price for an EMC VX-1MB is $2450. **EMC Corp.**, 385 Elliot St., Newton, Mass. 02164. **Circle No 333**

Color display monitor features shadow-mask CRT

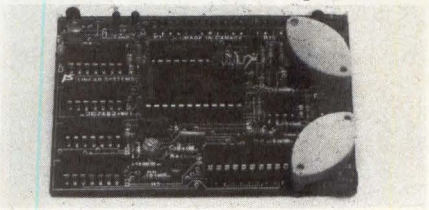
The model ICM-14 high-resolution color graphics display monitor features a 0.31-mm.-dot pitch shadow-mask CRT and 25-KHz horizontal frequency or optional 19.2-KHz frequency. The 14-in. diagonal monitor displays 34 lines of 80 characters. Characters are in a 7 × 9



matrix with 2-dot, 2-line spacing. As many as 27 colors can be displayed from three R, G and B video inputs and the optional halftone DR, DG and DB signal inputs. A built-in 115V/230V AC power supply is standard. OEM pricing is available. **C. Itoh Electronics Inc.**, 5301 Beethoven St., Los Angeles, Calif. 90066. **Circle No 334**

Calendar/clock controller performs timekeeping

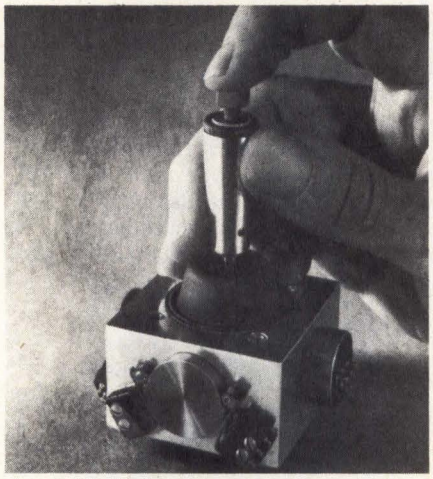
The model LS 7482 calendar/clock module is a general-purpose timekeeping source for Multibus-compatible systems. On-board power-down circuitry protects data without CPU overhead. Outputs include thousandths of seconds, hundredths of seconds, tenths of seconds, seconds, minutes, hours, days of the week, days of the month and months counters with corresponding latches for alarm-type functions. An interrupt to a host can also be generated at pre-set times. This board has uses in industrial-control microcomputers and



in time-sharing data-processing systems. Software driver listings are supplied in Intel 80/85 code with each unit. The model LS 7482 is priced at $325 in OEM quantities. **Industrial Modules Inc.**, 1400 Coleman Ave., Suite 24G, Santa Clara, Calif. 95050.
Circle No 335

New Products

SUB-ASSEMBLIES

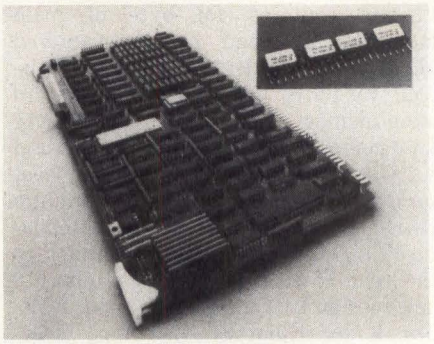


Joystick has push-button handle

The model 531 two-axis potentiometer-type joystick features all-metal construction, an environmental boot seal and high-reliability conductive-plastic center-tapped potentiometers. Options include direction or limit switches and a finger-operated switch on the joystick handle. Prices range from $300 to $800, depending on quantity and options. **Measurement Systems Inc.,** 121 Water St., Norwalk, Conn. 06854. **Circle No 336**

Advanced packaging puts controller on one board

The model HRG2 is a high-resolution (1024 × 1024 × 4), 16-color raster graphics controller on a single Multibus board. The vendor shrank the board's 512K-byte video memory array by a factor of four by using 256K-byte memory devices that pack four 64K-byte chips on a 22-pin single-in-line package. By repackaging three digital-to-analog converters in a single custom hybrid IC, the vendor reduced D/A converter space by two-thirds and conversion time from 4 to 2 nsec. per conversion. Additional HRG2 hardware capabilities include



high-speed (80-MHz) video output, an NEC 7220 graphics processor with hardware vector/raster conversion, multiple viewing windows, pan and scroll, a 24-bit DMA interface that operates at 350K bytes per sec. and an optional 512 × 512 × 4 organization. Price is $1980 each in 100-unit quantities. Price for the 512 × 512 × 4 format is $1260 each in 100-unit quantities. **Ikier Technology Inc.,** 7 Oak Park, Bedford, Mass. 01730.

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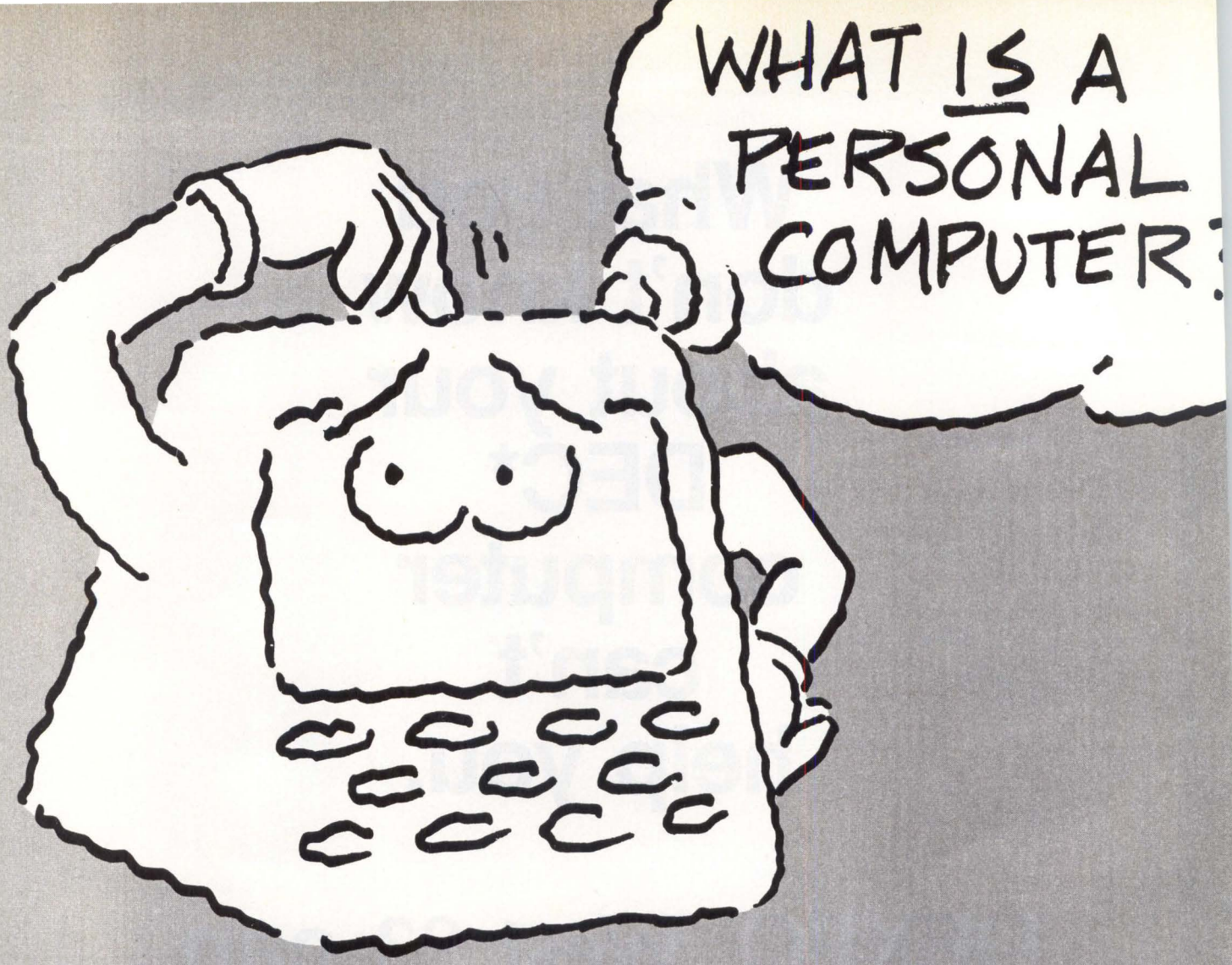

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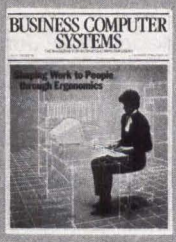

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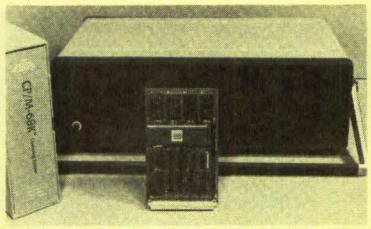

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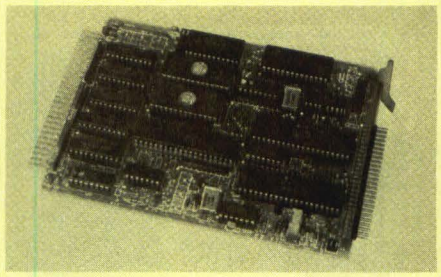

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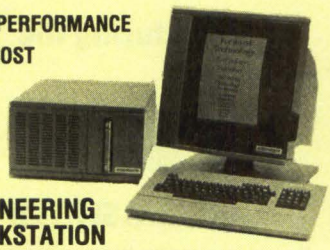

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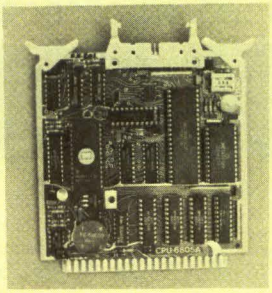

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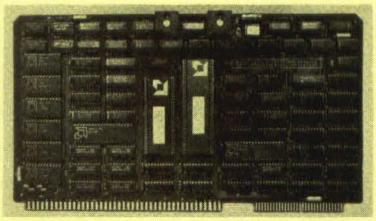

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New Products

LITERATURE

Brochure details robotic assembler

The Mikronipulator, a robotic assembler for surface-mounted electronic components and other small electrical and mechanical assemblies, is described in a six-page brochure. The brochure details the capabilities and specifications of the Mikronipulator in three stages, namely the basic robot, the hybrid circuit assembly station and as a major module in a fully integrated hybrid assembly system. The brochure covers all aspects of the Mikronipulator's performance including mounting position, programmability, internal computer and memory capacity, degrees of freedom of motion in x, y, z and theta axes, throughput, repeatability, resolution and EIA standard interfaces. **Affiliated Manufacturers Inc.,** U.S. Highway 22, P.O. Box 5049, North Branch, N.J. 08876. **Circle No** 338

Catalog lists software for Data General computers

The 600-page *Catalog of Application Solutions* lists more than 600 software packages for nearly 100 industries available from OEMs and independent software vendors for use on Data General computers. The catalog lists packages for general accounting, financial management, general banking accounting, life insurance and other insurance applications, physician and dental-office practice management, inventory control, MRP, architectural design, civil and mechanical design and text editing. **Data General Corp., Information Systems Division,** 4400 Computer Dr., Westboro, Mass., 01581. **Circle No** 339

Line printer care guide covers 13 topics

Written for sophisticated and unsophisticated users, *The Care and Feeding of Line Printers* helps users maximize printer performance and longevity. This eight-page tutorial booklet covers 13 major aspects of line-printer operation and offers hints and facts about duty cycles, site environments, temperature, static, dust, power supplies, ribbons, paper, printer services and maintenance and printer selection. **Digital Associates Corp.,** 1039 E. Main St., Stamford, Conn. 06902. **Circle No** 340

Coding standard guides software planning

Written for software designers, managers and quality-assurance departments, this do-it-yourself set of software standards can be tailored to establish a company's programming practices. The 62-page guide covers documentation and coding practices for COBOL, FORTRAN and BASIC. Examples show how early versions of these languages can be made to meet modern programming rules. Price of the guide is $25. **Associated Technology,** Route 2, Box 448, Estill Springs, Tenn. 37330. **Circle No** 341

Data sheet details large-screen, system

The model MDS 1100/1024 tactical plasmascope display system is described in a two-page, two-color data sheet. The data sheet emphasizes the model MDS 1100/1024's ability to be used as a laboratory tool that is well-suited for system and software development. The terminal's computational capabilities are also highlighted. The reverse side of the sheet lists functional, environmental and physical specifications of the product. **SAI Technology Co.,** 4060 Sorrento Valley Blvd., San Diego, Calif. 92121. **Circle No** 342

LITERATURE THAT COSTS

Book clarifies information technology

Written for nonspecialists, the 140-page *Information Technology: An Introduction* introduces the concepts, applications and tools of information technology. In part 1, author Peter Zorkoczy examines what information technology can do and has done. In part 2, he gives a technical explanation of the most important information technologies including computers and telecommunications and data networks. The text is cross-referenced and supplemented by more than 50 tables, figures and illustrations. Price is $29.95. **Knowledge Industry Publications Inc.,** 701 Westchester Ave., White Plains, N.Y. 10604. **Circle No** 343

Guide reviews Zenith/Heath software

The 144-page *How to Use Zenith/Heath Computers* by Hal Glatzer is an easy-to-read guide filled with many tips for current and prospective system owners. Chapters one and two examine the history of Heath computers and provide a simplified view of how a microcomputer works. Chapters three and four detail the basic hardware of Zenith/Heath computers and further explore elementary computer operating principles. Chapters five and six present an overview of operating systems and application software and include reviews of many popular programs for word processing, business accounting, database management, games and programming languages. Chapter seven considers hardware expansion and upgrades. Chapter eight includes tips on troubleshooting and maintenance. Chapter nine illustrates some of the applications for Zenith/Heath computers. The book concludes with a chapter that instructs readers how to assemble the H-89 computer. Single-copy price is $19.95. **S-A Design Books,** 515 W. Lambert, Building E, Brea, Calif. 92621. **Circle No** 344

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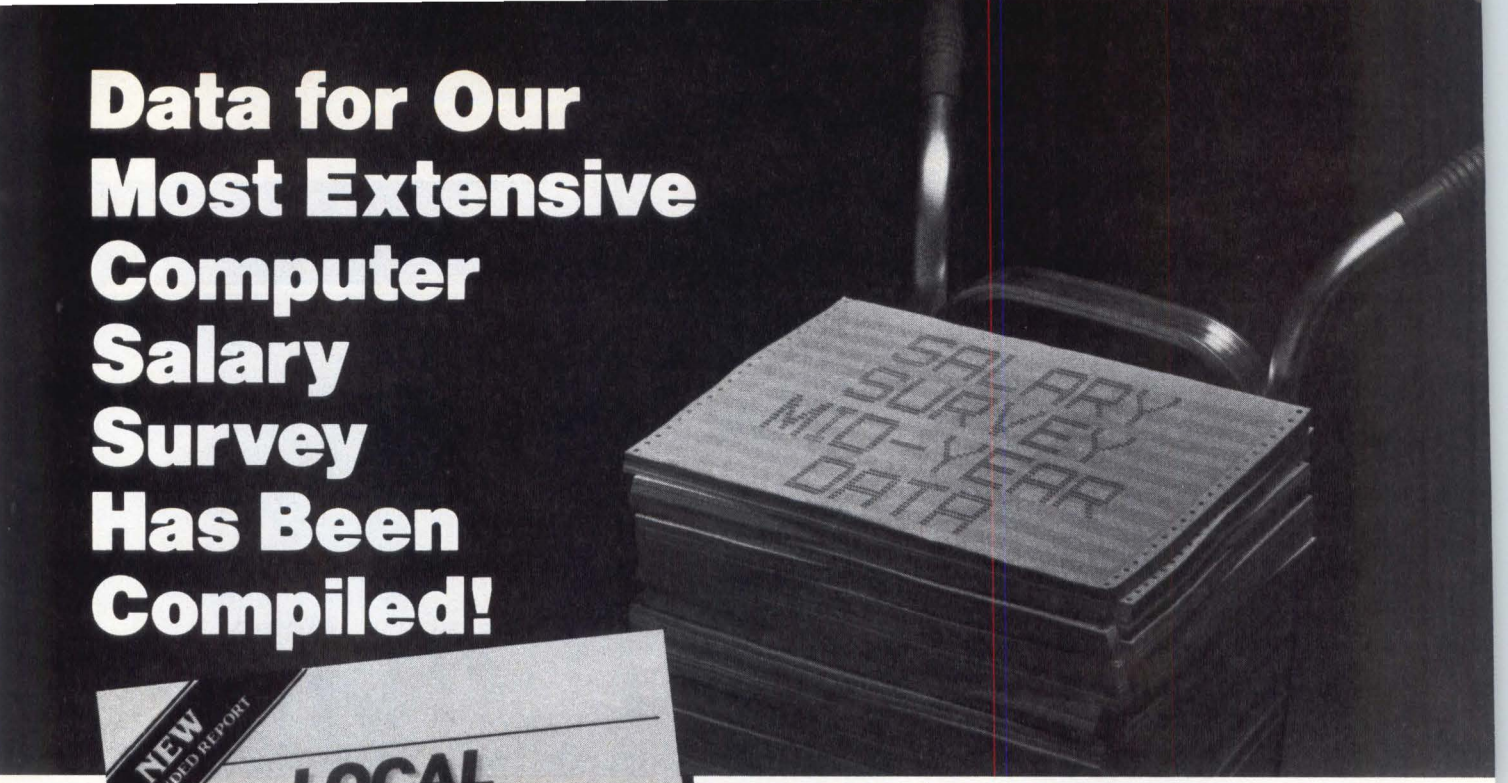

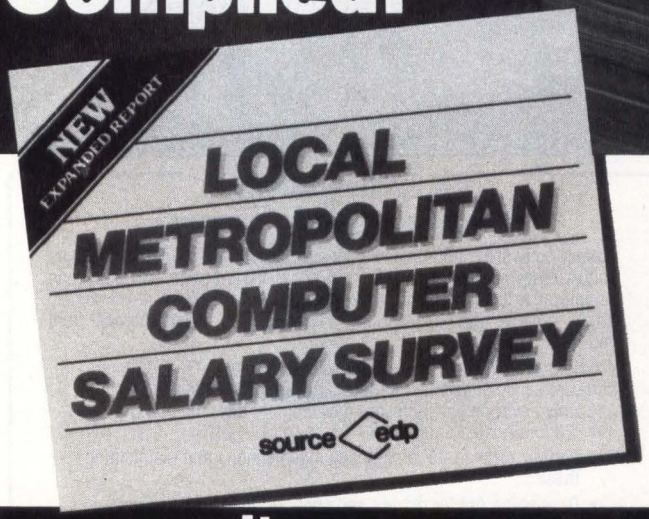

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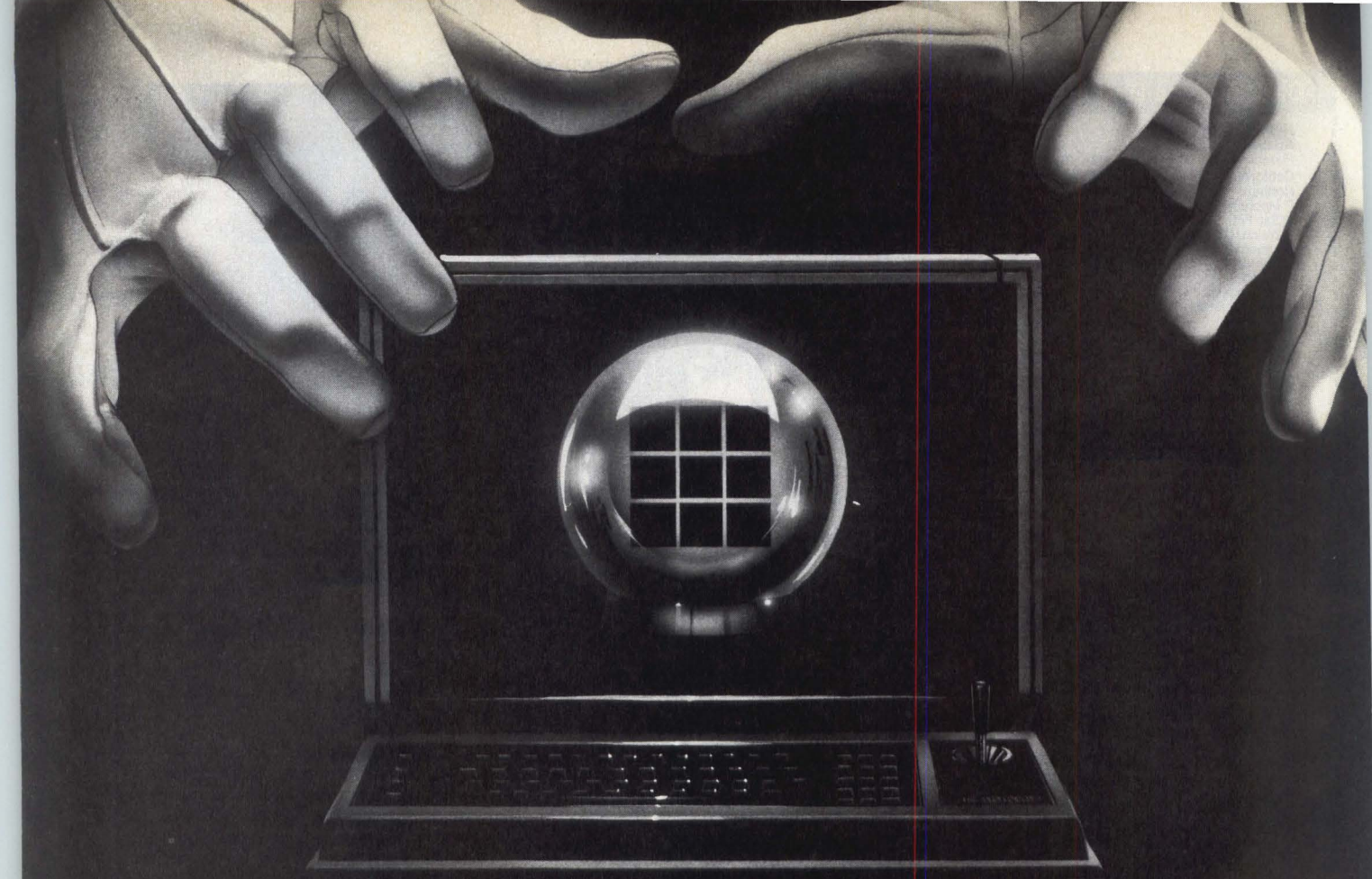

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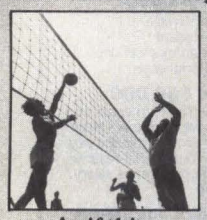

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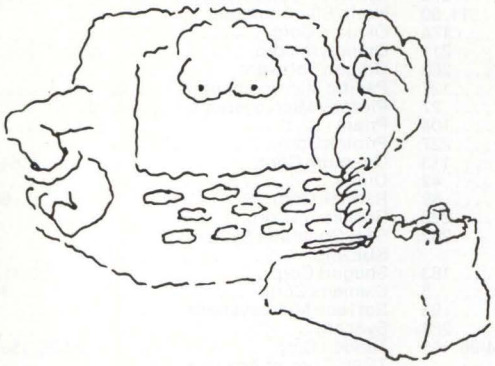

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See page 297 for Computer Consultants Corner
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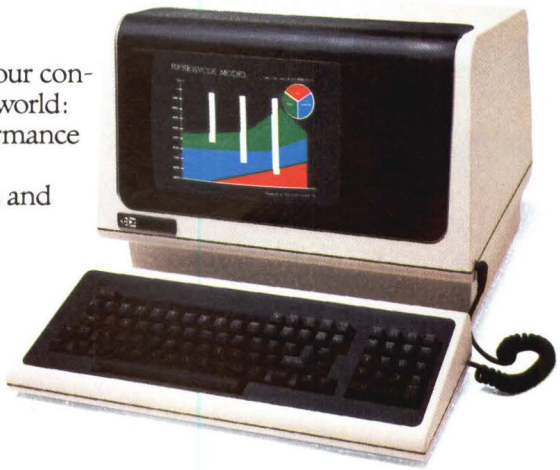

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