Mini-Micro Systems

A CAHNERS PUBLICATION

SEPTEMBER 1984

Line printers: The impact of higher quality, lower costs

Will software standards be possible?

Disk controller boosts system performance

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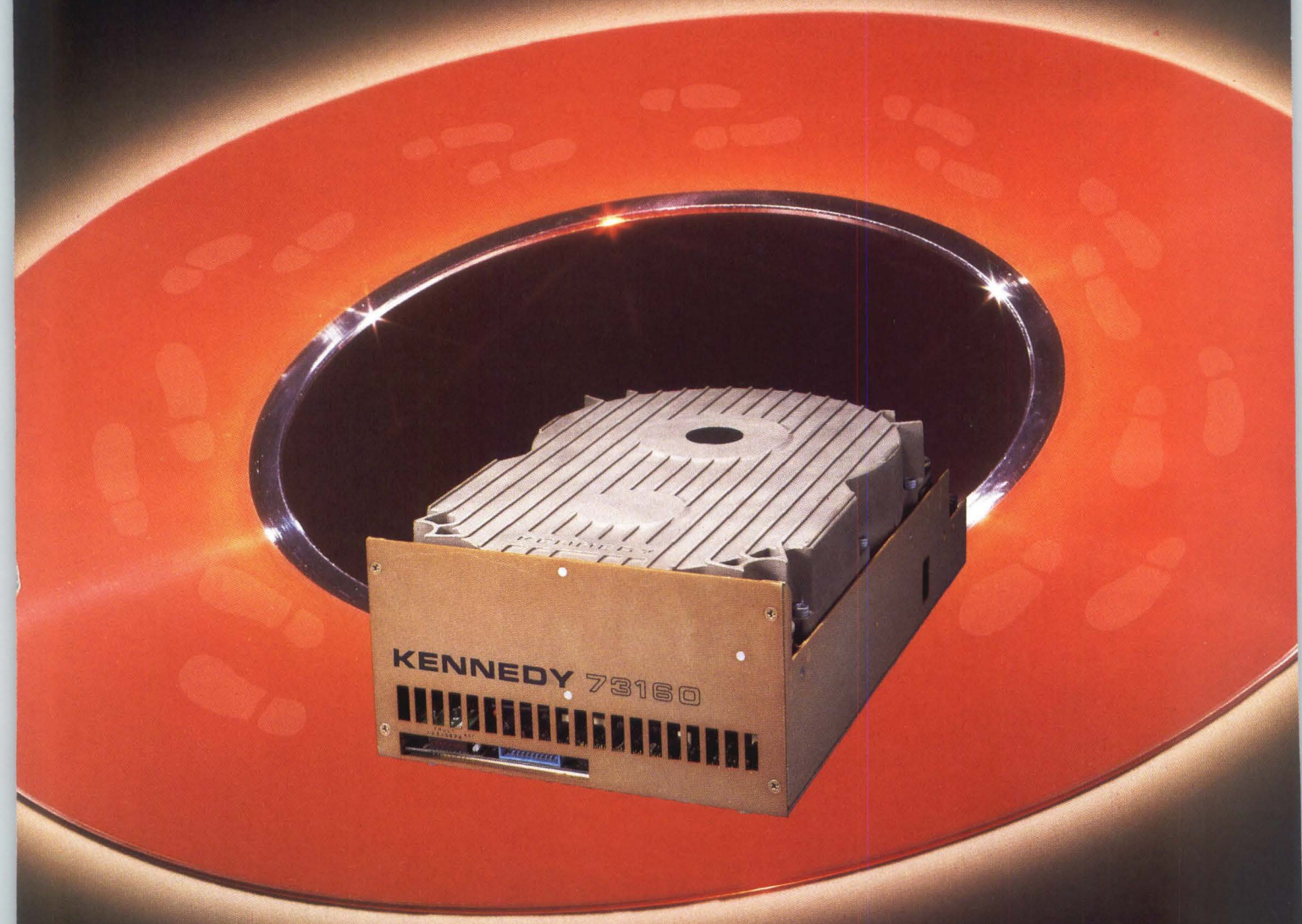

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CIRCLE NO. 1 ON INQUIRY CARD

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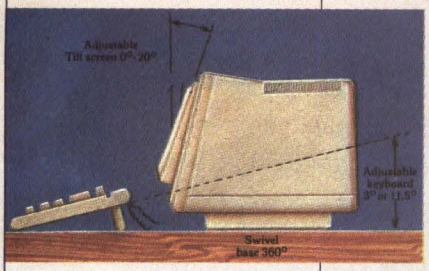
When you get this new HP display terminal, suddenly you'll be running applications with less effort. In less space. For less money. And with more confidence, having HP's reliability and quality to count on.



Less effort.

The first thing that will impress you is how easily everything fits into place. Integral tilt and swivel make screen and keyboard adjustments easier. Power and brightness controls are right up front, at your fingertips.

Working becomes more pleasant, thanks to the non-glare, high-resolution screen and well defined, smooth scrolling characters. Up to four pages can be stored in display memory, with up to four more pages available as an option.

And all that happens on a 12-inch display that only takes up about one square foot of your desk.

More helpful.

With eight non-volatile, programmable function keys, it will take you less time to enter complex or repetitive commands. A handy terminal status line tells you what mode you're working in. And 17 national language keyboards are available to make work easier for everybody, just about everywhere.

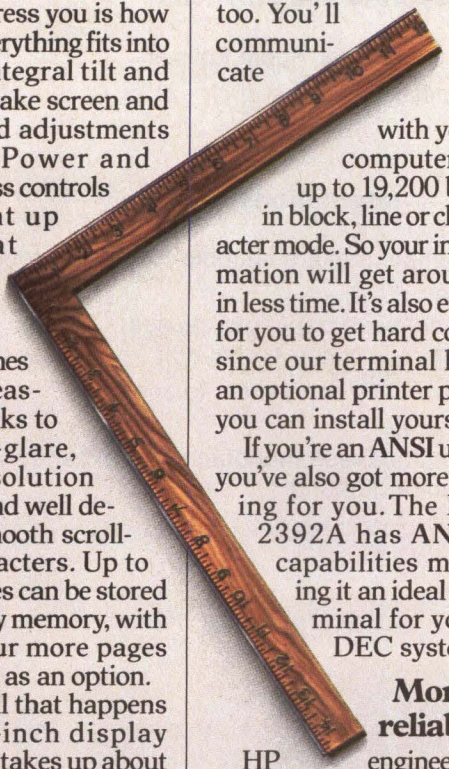
You get more speed, too. You'll communicate with your computer at up to 19,200 bps in block, line or character mode. So your information will get around in less time. It's also easy for you to get hard copy, since our terminal has an optional printer port you can install yourself.

If you're an ANSI user, you've also got more going for you. The HP 2392A has ANSI capabilities making it an ideal terminal for your DEC system.

More reliable.

HP engineered the HP 2392A using state-of-the-art VLSI technology to minimize component count and increase reliability.

But, if you do need support services, just pick up the phone. A worldwide network of HP sales and service offices is staffed by qualified engineers ready to help you.



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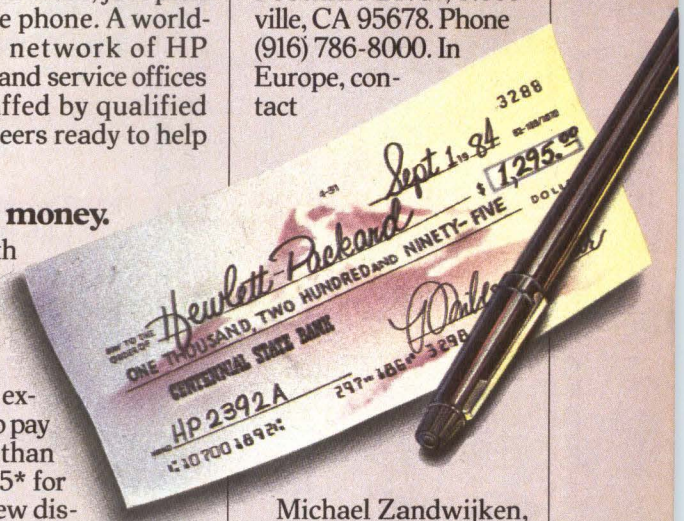

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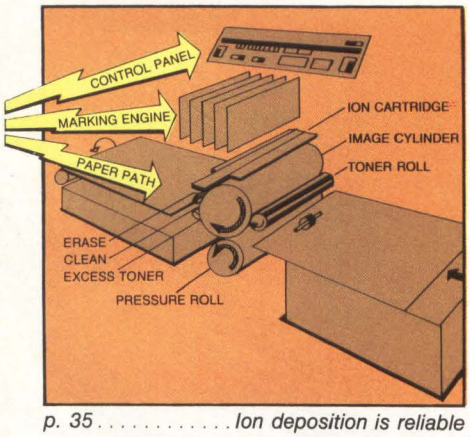
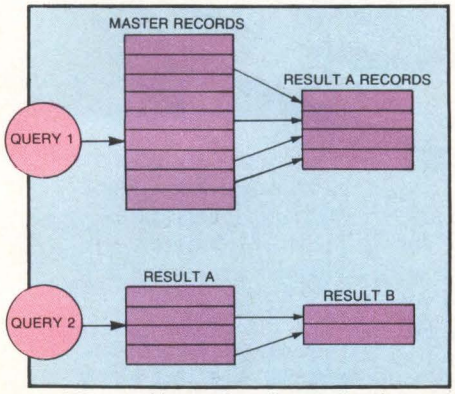
Mini-Micro Systems

p. 163 . . . . . Interphase Corp. presents the Storager disk controller. Art direction by Ron Carl, photography by Ellen Schuster. Graphics workstation courtesy of Silicon Graphics. Winchester drive courtesy of Maxtor Corp.



p. 35 . . . . . Ion deposition is reliable



p. 127 . . . . AI speeds software development

MINI-MICRO WORLD
News

31 Wyse unveils 64-color alphanumeric terminal

32 AT&T grabs at MS-DOS market share

34 Software vendor taps riches of 1-2-3

35 High-speed Delphax S6000 impels ion printing into new channels

38 Gould UNIX supermini reaches 10 MIPS

43 Heard on the Hill: Anatomy of a computer sting

45 Congress questions price of DOD hospital computer network

46 Half-height 25M-byte Winchester suits mid-range system architectures

50 Active-matrix technology improves liquid crystal displays

54 Ungermann-Bass stretches network connection options

58 Plain-vanilla data-interchange standard proposed for UNIX applications

62 Teletype adds 200-cps dot-matrix printer

70 Database manager eases OEM application-development tasks

72 Grid links products to IBM, expands portable line, cuts prices

Corporate and Financial

77 Franklin's success sours after Apple lawsuit

78 Corporate and financial briefs

International

81 Taiwan's PC-compatible makers stumble following problems with IBM copyrights

87 Japan's stance on software copyright causes international rebuke

89 Price pressures drive U.S. companies to seek Far East manufacturing

96 Pacific Perspective: Japanese manufacturers expand, diversify to meet semiconductor demand

INTERPRETER

99 Relational DBMS vendors girded for ascent of multiuser microcomputer market

111 Will 1984 be the year of the LAN?

INTEGRATOR

127 Artificial intelligence techniques speed software development

143 Diagnostic diskettes suit system integrators but can leave users confused

151 Graphics system rejects keyboard in favor of simple controls

FEATURES

161 **Feature Highlights**

163 **UNIX-optimized controller supports intermixed tape, floppy, Winchester drives** . . . device reduces rotational latency and increases peripheral performance

175 **Line printer leaders lower prices, improve reliability** . . . the impact vs. non-impact battle rages on

187 **Impact line printer table**

202 **Market considerations hinder search for software standards** . . . proponents and opponents face off

215 **Large software package ports from a 32-bit to a 16-bit machine** . . . memory management proves the most difficult problem

225 **Intelligent I/O board extends S-100 systems to 16 terminals** . . . Macrotech's ADIT provides intelligent processing for S-100 based systems

235 **Simplicity is key goal in applications development** . . . mature development methods help develop complex applications

249 **Law column:** Can copyrights protect all forms of software?

DEPARTMENTS

4 Editorial Staff

11 Editorial

15 Breakpoints

255 Guest Viewpoint

257 New Products

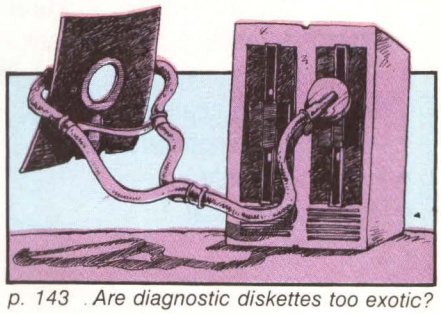
280 Calendar

283 Classified Advertising

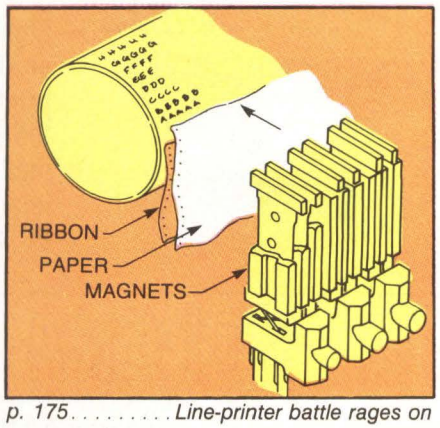
284 Career Opportunities

288 Index to Advertisers

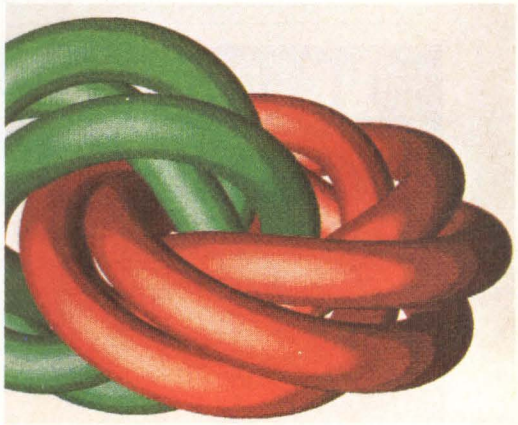
289 Mini-Micro Marketplace



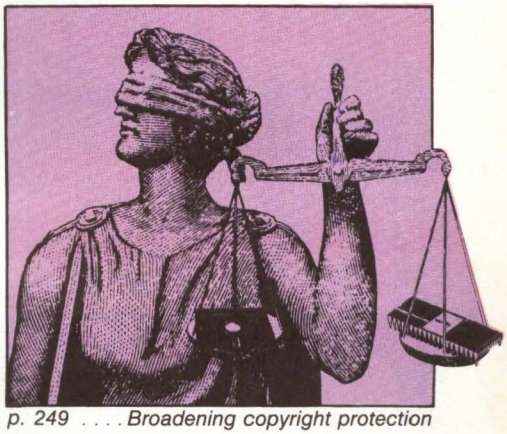
p. 143 . Are diagnostic diskettes too exotic?



p. 175 . . . . . Line-printer battle rages on



p. 202 . Moving towards software standards



p. 249 . . . . Broadening copyright protection

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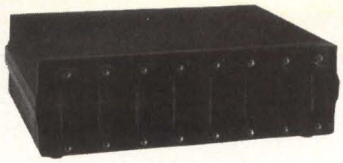

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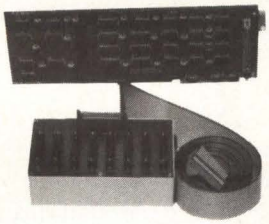

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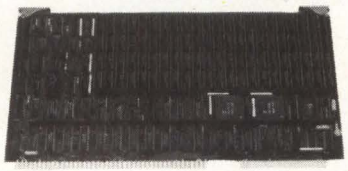

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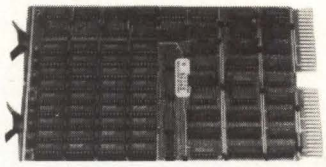

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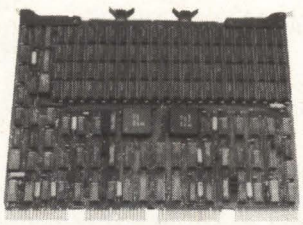

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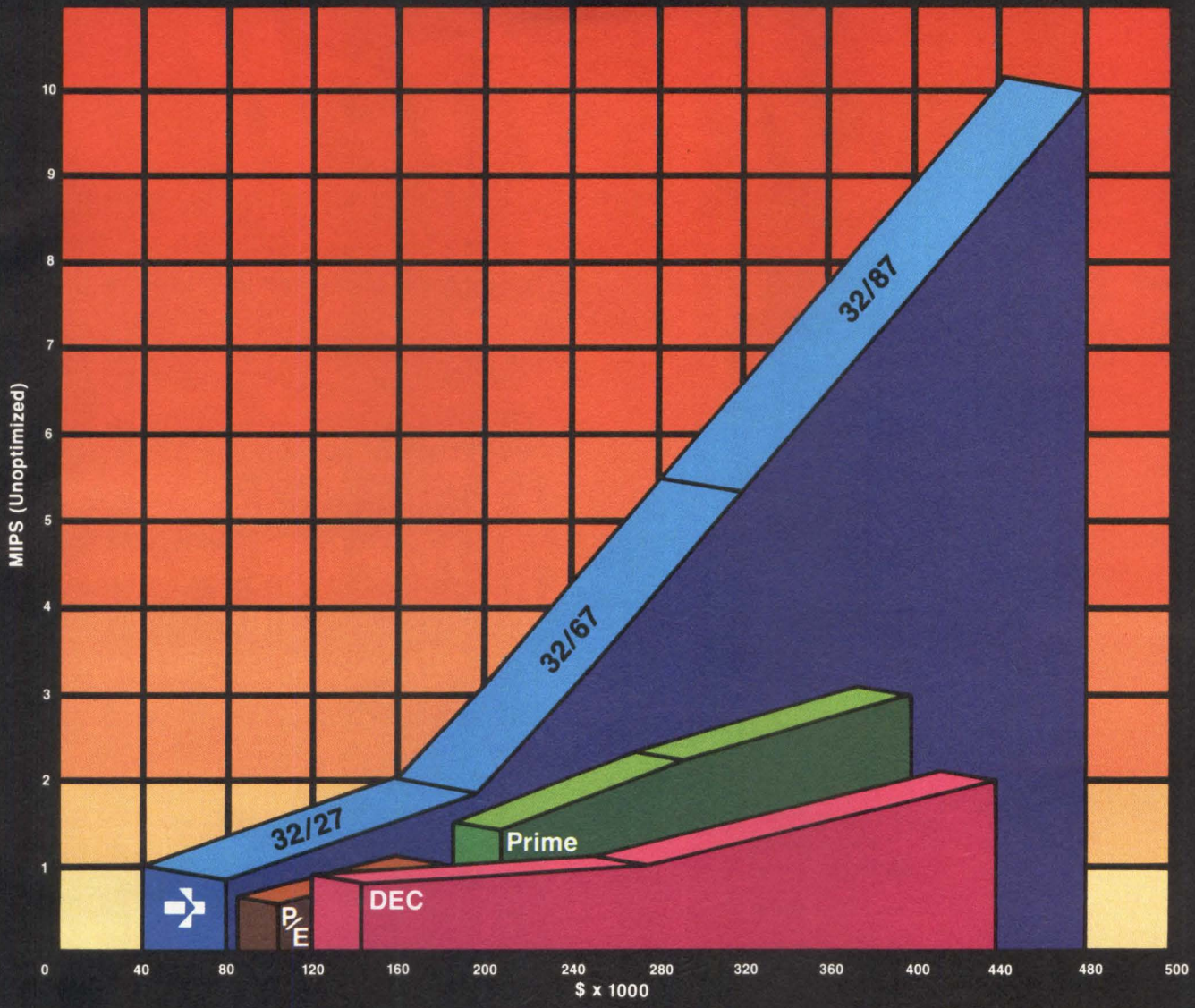

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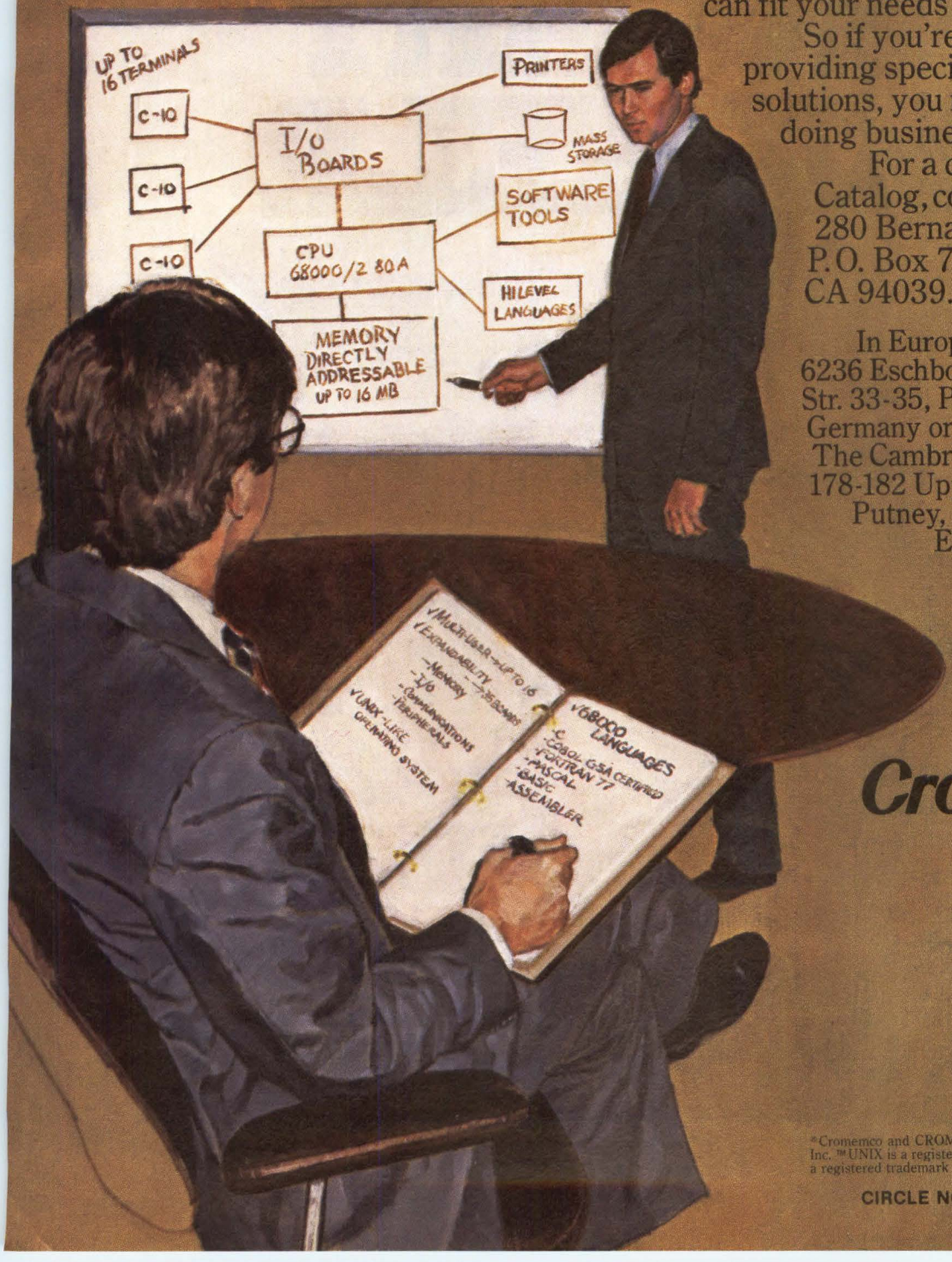

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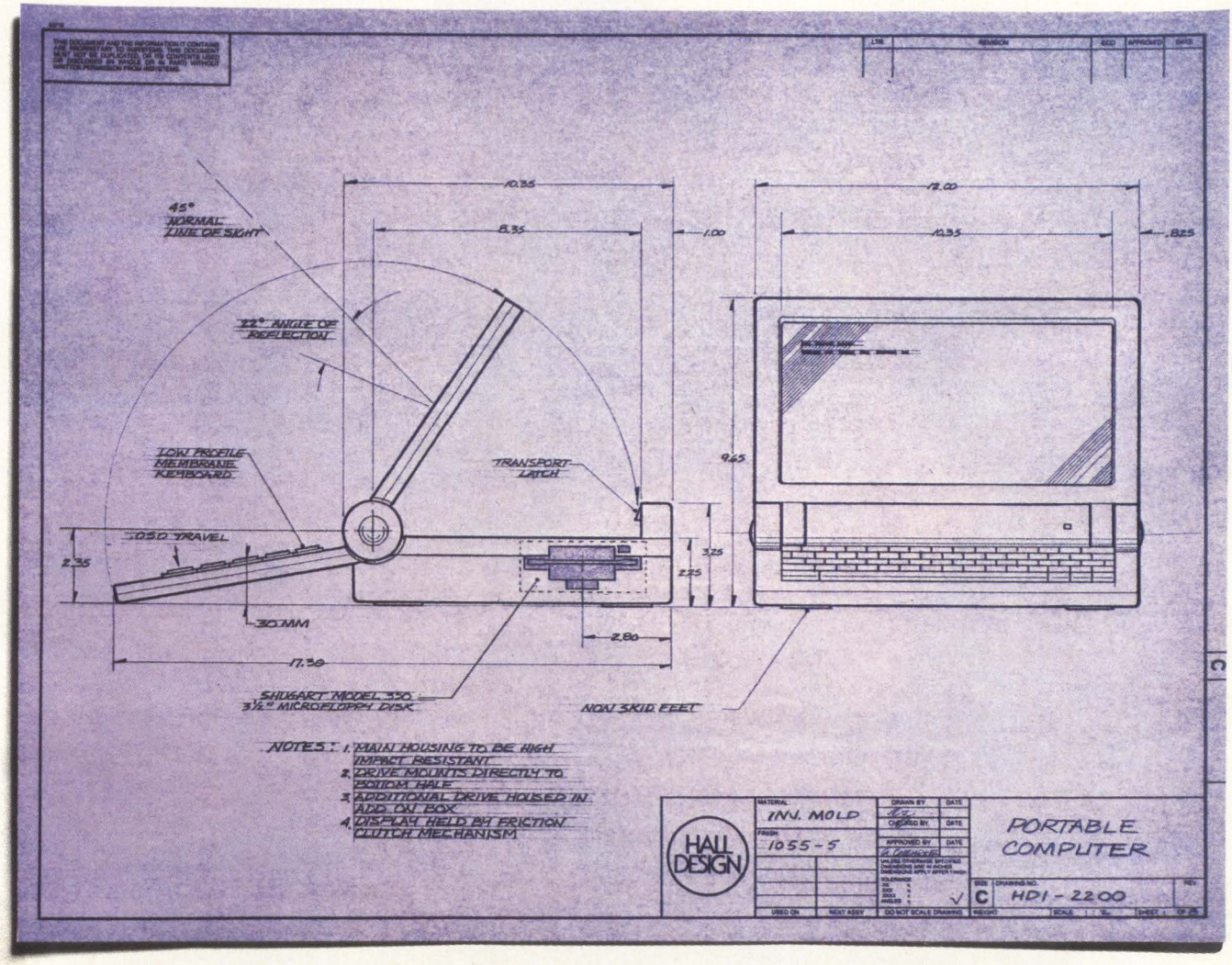

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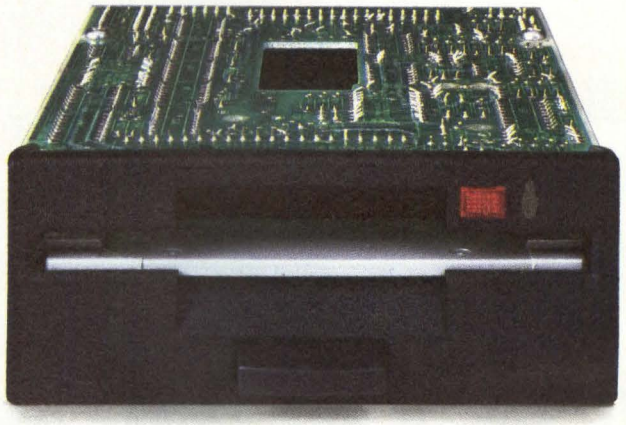

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The proven compact drive and proven quantity supplier

With thousands of its 3½" Winchester drives in operation today Rodime has further demonstrated its reputation for reliability, a major design consideration for its 3½" drive, and quality. It has a rugged design with high resistance to shock, an important consideration for portability and for vibration prone environments. Using advanced large-scale integration, the entire electronics for the drive are on a single compact board and there are no adjustments or select-on-test components.

New design horizons

The compact size of Rodime's drive suddenly puts large-scale storage into areas never considered before. The 350 series is one-fourth the volume of a 5¼" Winchester drive. And the 250 series, which includes

mounting brackets and a face plate, fits into the same space as a half-height 5¼" Winchester offering even further shock and vibration isolation. Now, system designers have a new level of flexibility. One area that has received attention is use with portable computers. Several major portable computer manufacturers have already incorporated Rodime 3½" Winchester disk drives into their products. There are other equally exciting areas such as desk top computer systems, intelligent terminals, point-of-sale terminals, industrial controllers, telecommunications systems, navigation and guidance systems, and portable instrumentation. In fact, the list of potential uses is only limited by the imagination of the system designer.

A tradition of excellence

In a few short years, Rodime has established itself as a major force within the Winchester disk drive industry. Rodime is one of the few manufacturers that are delivering 5¼" Winchester drives with a broad range of capabilities up to 54 megabytes. And is the only manufacturer delivering high-performance 3½" Winchester drives in production quantities.

For the compact 3½" Winchester disk or other 5¼" Winchester requirements, look to Rodime. Rodime delivers.

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CIRCLE NO. 10 ON INQUIRY CARD

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EDITORIAL

UNIX falls short of standard status

Despite zealous press, public relation and advertising efforts, UNIX will not become the de facto industry-standard operating system, technically speaking, for 16- and 32-bit microcomputer-based multi-user operating systems. It does not possess all the key features that an operating system requires to handle today's advanced computer architectures and technologies. However, on the plus side, UNIX is a powerful operating system, has achieved success in the computer marketplace and has the backing of AT&T. On the debit side, though, its shortcomings have hampered widespread implementations because UNIX doesn't solve all of the computer industry's software problems.

And what are these UNIX deficiencies? International Data Corp., a Framingham, Mass.-based market research company, documents them all in their recent research memorandum entitled "Whither UNIX?" First, UNIX is simply not user-friendly. Its command structure and system administration functions are terse and complex, especially to unsophisticated users, and, therefore, hard to learn. Several software companies have built packages with a more user-friendly shell around UNIX, but this patchwork approach restricts functions and reduces overall efficiency.

Another deficiency: UNIX runs slowly and inefficiently on small single- and multiuser computer systems. In addition, it has no record files, no index files and no file-locking. Moreover, it has no security capability and is subject to system crashes. Even more negative, though, no single UNIX standard exists. In fact, more than a dozen AT&T and University of California at Berkeley UNIX versions are available, and few are identical to, or compatible with, one another. For instance, take your pick from Version III, Version V, the University of California at Berkeley 4.1 and 4.2 BSD versions, and the commercial Idris, VENIX and XENIX adaptations. And further clouding the scene is the fact that even within the same version, variants coexist, such as for I/O handling, system commands and functional supersets. Indeed, these variants also diminish software portability and compatibility.

Still another deficiency centers on the lack of available applications software for UNIX-based systems. In fact, the limited supply of UNIX-based software has hindered universal acceptance. Other factors have also impeded approval. For example, UNIX software is minicomputer-derived and drastically outmoded. Developed years ago in an academic environment and targeted at software development, UNIX doesn't contain the important microcomputer-software features needed today. These features include multiple-application program and database management, network communications, machine independence, real-time support, multitasking, memory protection, security, virtual storage, windowing and bit-mapped graphics. Such features can be fixed, modified, patched and enhanced into UNIX, but they would not result in an optimized, fully integrated operating system.

If not UNIX, then what? System integrators still want the desirable features of UNIX, such as C language, directory structure, pipes and programmer's workbench. Fortunately, forward-thinking software companies have anticipated present and future operating requirements. They have produced integrated operating systems that provide multiple coordinated software services. And such systems are application-adaptable and modifiable to avoid obsolescence. For example, Digital Research Inc., Pacific Grove, Calif., offers Concurrent DOS; Multi Solution Inc., Lawrenceville, N.J., provides S1; Microsoft Corp., Bellevue, Wash., supplies XENIX; and other companies have comparable offerings.

UNIX brought the importance of operating-system software into prominence. It has served its purpose. Let's now benefit from the experience and move on to the newer, more capable and fully integrated operating-system solutions—the same way industry moved from the 8-bit CP/M world to the 16-bit MS/DOS arena. The marketplace has accepted UNIX, but not as the single standard. Indeed, the marketplace will accept many other operating systems as well. Sensible integrators will employ the one that meets application requirements and not the one rated as the de facto standard.

George V. Kotelly

George V. Kotelly
Editor in Chief

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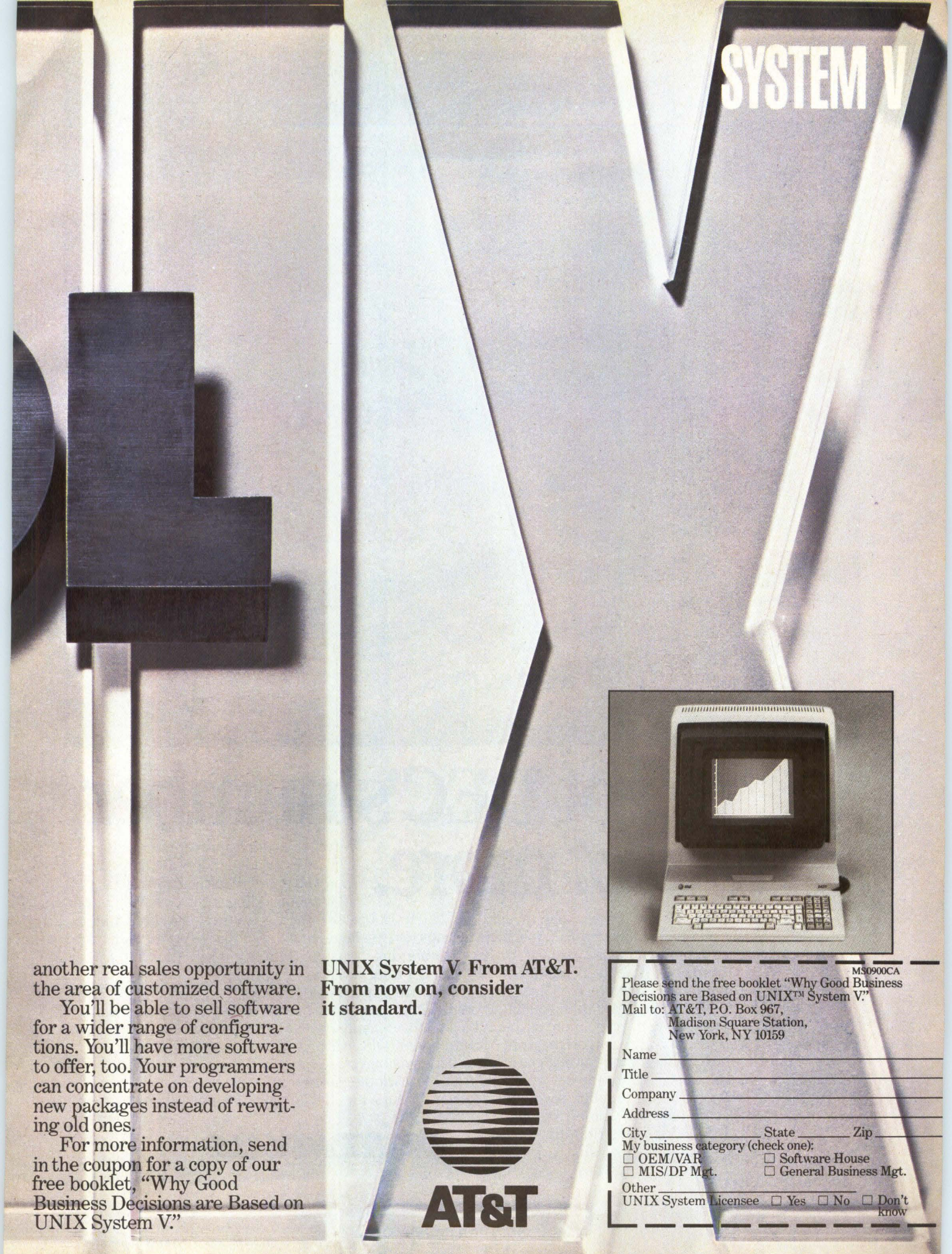
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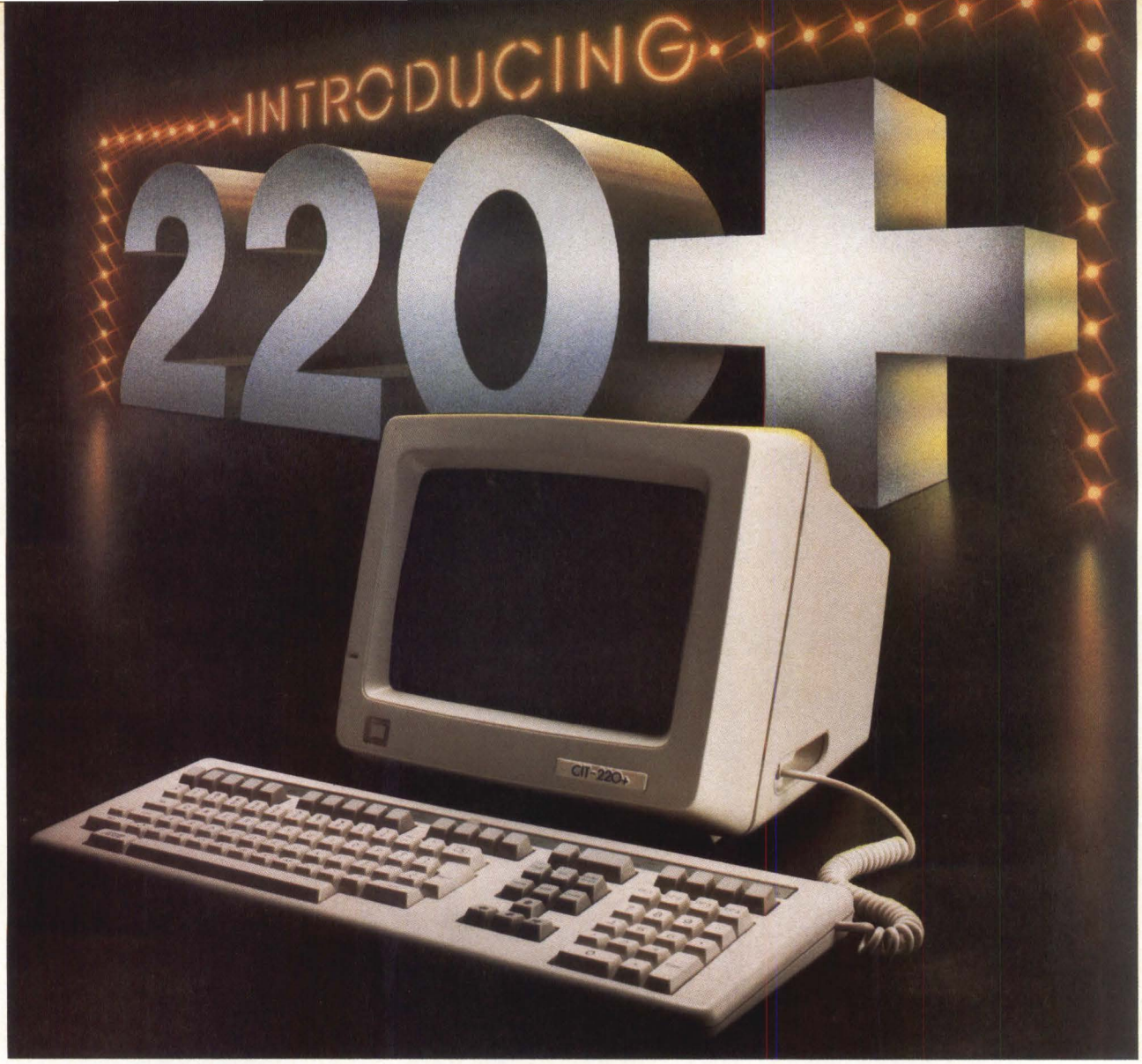

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CIRCLE NO. 11 ON INQUIRY CARD

Breakpoints

IEEE FORMS WORKING GROUPS FOR NUBUS and MULTIBUS II STANDARDS

IEEE will have four committees working on 32-bit bus standards. In addition to IEEE P896 Futurebus and IEEE P1014 VMEbus groups, the Microprocessor Standards Committee of the IEEE is requesting two new "P" numbers in order to establish working groups that will derive 32-bit bus standard specifications from the NuBus and MultiBus II. Both new working groups are scheduled to hold organizational meetings during this month's Midcon trade show in Dallas, Texas. Paul Borrill, chairman of the P896 committee, will serve as interim chairman of the Multibus II working group. George White, Texas Instruments Inc.'s NuBus development manager, will serve as interim chairman of the NuBus standard working group.—R. Dalrymple

NETWORK SYSTEMS CORP. READIES FIBER OPTIC NETWORK

Networking pioneer Network Systems Corp., Brooklyn Park, Minn., plans to complete its prototype Datapipe fiber-optic network by the end of the year. Datapipe is said to operate at 275M bits per second and is designed to join other networks with fiber optic cable. It will interface with the company's primary network product, Hyperchannel, as well as with other vendors' products, including Ethernet LANs.—M. Stenzler-Centonze

JMI DEVELOPS NSC 32000 CROSS COMPILERS

By the first quarter of 1985, JMI Software Consultants Inc., Spring House, Pa., plans to have C, Pascal and BASIC cross compilers available to move source code from applications developed on several hosts to National Semiconductor Corp.'s NSC 32000 systems. The hosts are Digital Equipment Corp.'s VAX superminicomputers running VMS, IBM Corp.'s Personal Computers running PC-DOS, and IBM's 370 and 4300 mainframes running VM. The C cross compiler comprises both a native code generator for the host system and a code generator for the NSC 32000. The C cross compiler is based on Whitesmiths Ltd. program. Also in the works are native compilers for NSC 32000-based systems.—D. Bright

NEW HP 3000 MINICOMPUTER IS PRICED UNDER $20,000

Early this month Hewlett-Packard Co. planned to introduce the smallest, lowest-priced member of its HP 3000 minicomputer family. The Series 37 Office Computer, which is priced less than $20,000, is said to be software-compatible with all other HP 3000s. The user-installable Series 37 is desktop-high and supports seven terminals; with an I/O extension board it can support 28 terminals. The minimum configuration includes 512K bytes of memory, a 55M-byte Winchester disk drive, a 67M-cartridge tape drive, seven terminal ports, a console, the MPE V/E operating system and a database-management system. Availability is scheduled for next month.—D. Bright

DATABASE MANAGEMENT SOFTWARE CAN BE ACTIVATED BY VOICE ON IBM'S PC

A voice-activated database-management system for IBM Corp.'s Personal Computer is being readied by Supersoft Inc., Champaign, Ill. Marketing director Stephen Hagler cannot quote an availability date or price, but he notes that one piece of the system, the voice recognition board from Tecmar Inc., Cleveland, is already available with Supersoft Scratchpad spreadsheet

software for $995. The Dax Plus database-management software is already available for the IBM PC without the Tecmar board. Dax Plus was developed by Derwent Data Systems Ltd., Sunderland, England. Hagler says Texas Instruments Inc., Austin, Texas, will offer Dax Plus for use with its Professional computer and with TI's Speech Command voice recognition system.—K. Jones

BRIDGE PREPARES ETHERNET COMMUNICATIONS SERVER

Bridge Communications, Mountain View, Calif., is expected to introduce this month the CS/1-SNA Ethernet communications server. The server will combine protocol conversion to the IBM SNA environment with local network connections and services, enabling ASCII terminals to function as IBM 3278 terminals. Each CS/1-SNA server will handle as many as 24 terminals. The CS/1-SNA is expected to be priced at $13,000 per unit plus a $1,000 annual software fee for updates and maintenance.—M. Stenzler-Centonze

PRIMAGES TO INTRODUCE 100 CPS DAISY WHEEL PRINTER

Primages Inc., Bohemia, N.Y., is developing a daisy wheel printer that could run as fast as 100 characters per second (cps). (The top speed of most daisy wheel printers is currently 90 cps.) The new printer, which is slated for introduction at Comdex in November in Las Vegas, will have a very competitive price, according to president Anthony Mauro. The company presently makes the $1,695 Primage I, which prints 45 cps, and the new printer will use the same open-loop stepper motor that the earlier model uses. Mauro says the special damping method added to the stepper enables quality printing at high speed.—D. Bright

ZAISAN UNVEILS INTEGRATED VOICE/DATA PC-COMPATIBLE WORKSTATION

Zaisan Inc., Houston, Texas, is expected to ship an IBM PC-compatible personal computer with an integrated autodial/answer telephone this month. The ES.3 system has voice and data capability, a 360K-byte floppy disk drive and 128K bytes of RAM. Price is $2,595. A $3,295 version has two disk drives and 256K bytes of RAM.—T. Moran

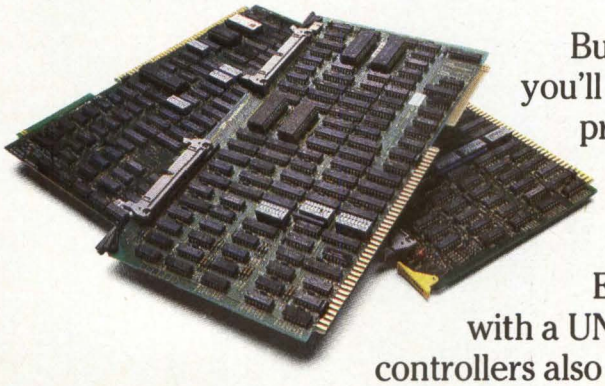
SAGE INTRODUCES MC68000-BASED SUPERMICROCOMPUTER FAMILY

Sage Computer, Reno, Nev., which is changing its name to Stride Micro, is unveiling a family of MC68000-based multiuser supermicrocomputers. The Stride 420, 440 and 460 all contain a Centronics-compatible printer port and a Corvus Omninet LAN interface. The 420 has four serial ports and a 640K-byte floppy disk drive. The 440 has 16 serial ports, one floppy drive and a 10M-byte Winchester drive with 15M-byte and 33M-byte options. The 460 supports as many as 22 serial ports and four Winchester drives. Its total available disk capacity is 448M bytes. Scheduled for availability this month, the basic systems without terminals will be priced at $2,900 for a 420, $5,900 for a 440 with a 10M-byte Winchester drive, and $8,900 for a 460 with a 15M-byte Winchester drive.—T. Moran

TAIWAN COMPANIES ARE DEVELOPING IBM PC LOCAL AREA NETWORKS

One of the first Taiwanese-designed local area networks (LANs) for the IBM PC was recently introduced by R.P.T. Intergroups International Ltd., which

OUR MULTIBUS CONTROLLERS ALREADY SPEAK YOUR LANGUAGE.



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Every Systech multibus controller comes with a UNIX Device Driver.** And because our controllers also contain a self-test program, you can install and check them out without CPU support or software development.

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Advanced Digital boards are IEEE 696 compatible, run under a variety of operating systems such as CP/M 2.2,* CP/M 3.0, Concurrent CP/M, MP/M,* OASIS,* and TurboDOS* and are available with CPU speeds of 4, 6, or 8MHz. On-board memory capacities range from 64KBytes to 1 MByte.

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(Top row L to R: Super Slave 128, HDC-1001, Super Slave 64, Bottom row L to R: Super Quad, Super 186, Super Six)

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also represents National Advanced Systems and Wang Laboratories Inc. in Taiwan. Known as Trans-Net, the LAN supports 64 IBM PC or compatible systems when in operation, says Ken Kao, the managing director of R.P.T.'s computer department. Other specifications include hard-disk sharing, CSMA/CD protocol, printer-spooling files, distributed bus topology and a data rate of one megabit per second. Trans-Net can operate under PC-DOS and MS-DOS, and requires a minimum of 128K bytes of RAM per connected system. The LAN uses RS422 twisted-pair wires. R.P.T. is negotiating with prospective distributors in the United States and Europe, Kao says. The suggested retail price for Trans-Net is $495 per node. IBM PC LANs from seven other Taiwanese firms are expected to be available by early next year. The seven firms, which include AOC International, Mitac Inc., Multitech Industrial Corp., Shinlee Corp. and Tatung Co., are now jointly developing the LAN in cooperation with Taiwan's government-supported Electronics Research and Service Organization.—C. Hintermeister

IBM SHOWS ARTIFICIAL INTELLIGENCE PRODUCTS

Signalling its determination to be as major a player in artificial intelligence (AI) as in all other areas of computer technology, IBM Corp. recently unveiled several AI research projects and a new product at the National Conference on Artificial Intelligence, Austin, Texas. The product, LISP/VM, a version of the widely-used AI language, is designed for time-sharing users of System/370 computers. IBM also exhibited Paris Scientific Center (PSC) Prolog for the same machines. An experimental shell system, PRISM, incorporates a set of procedures that can be used to construct a variety of expert systems that mirror the way experts solve problems. An experimental PC-based program, HANDY, permits the design of highly interactive AI user interfaces that include windows, color animation, graphics and speech synthesis.—J. Victor

SORCIM ORCHESTRATES MOVE AGAINST SYMPHONY

Sorcim/IUS Corp., San Jose, Calif., is expected to introduce this month an integrated software product positioned against Lotus Development Corp.'s Symphony. The Symphony software package combines word-processing, communications, database-management, spreadsheet and graphics functions with a window management system.—M. Stenzler-Centonze

STARTUP SELLS CUSTOM IBM PC CONFIGURATIONS TO OEMS

OEMTEK Inc., San Jose, Calif., hopes to grab a share of the IBM PC-compatible market by selling only to OEMs. The new company, which provides custom configurations, manufactures a range of modular PC products from keyboards and monitors to XT workstations and distributed database file servers supporting as many as 100 users. The workstations use the Intel Corp. 8088 chip; the file servers use the 8086 and 80826 chips. The offerings include low-profile modules, standard-sized modules, and both IBM-identical keyboards and enhanced keyboards.—D. Bright

Breakpoints

TECH FILES: A QUICK LOOK AT INDUSTRY DEVELOPMENTS

PRINTER FILES: Concept Technologies Inc., Portland, Ore., is preparing to unveil this month a $7,995 laser printer based on Canon U.S.A. Inc.'s print engine. The new printer is designed to work with the company's Concept 100 publishing system that integrates word processing with graphics capability. The printer runs at 8 pages per minute and has 300-dot-by-300-dot-per-inch resolution. It uses plain paper or transparencies, has bit-mapped memory and is compatible with Tektronix Inc. 4014 and Diablo Systems Inc. 630 products. A manual switch allows up to four users.—C. Warren

Dataproducts Corp., Woodland Hills, Calif., plans to introduce its first non-impact printer next month—a table-top, 24 page-per-minute laser printer with 300-dot-by-300-dot-per-inch resolution. The printer is based on a Toshiba Corp. print engine, to which Dataproducts has exclusive rights. Dataproducts-built controllers are optional. The printer's OEM price ranges from $7,000 to $12,000.—D. Bright

Taking a different approach to multi-color dot-matrix printing is **CAL-ABCO,** Woodland Hills, Calif., with an as-yet-unnamed 180 character-per-second, 132-column dot-matrix printer. The price is expected to be less than $1,200. To be introduced as early as December, the printer uses a proprietary ink-pad system with eight color pads. The printer can thus print multiple colors without either multiple passes or shifting ribbon zones. Moreover, the printer, which is being shown to selected OEMs, is able to print IBM PC color graphics without reducing speed.—C. Warren

MICRO FILES: Digital Equipment Corp., Maynard, Mass., is expected to introduce this month the PRO 380, an upgrade of the company's PRO 350 microcomputer. The PRO 380 will use a faster, higher performance PDP-11-type microprocessor.—T. Moran

SOFTWARE FILES: Lantech Inc., Dallas, Tex., is offering its uNETix UNIX-like operating system for the IBM PC and compatibles as a $399 developers' tool kit. The kit includes a choice of either the VI full-screen Berkeley editor, or the Rand Institute editor, which is an enhanced version of the VI. In addition, the package comes with the standard ED line editor, the VTTY terminal emulator and a window manager. The kit's integration facility allows movement of source code segments from larger machines to the IBM PC and back again. Lattice C, available for $200, produces either PC-DOS- or uNETix-compatible code.—C. Warren

Microsoft Corp., Bellevue, Wash., which has made a major commitment to support Apple Computer Inc.'s Macintosh microcomputer, is readying Microsoft Word for the Macintosh. November availability is planned. The word processing program joins MultiPlan, MultiBasic and Microsoft Chart, which are already available.—M. Stenzler-Centonze

LINE PRINTER COMPARISON CHART

STANDARD FEATURES	CIE TERMINALS CI-300	CIE TERMINALS CI-600	DATAPRODUCTS B-300/600	PRINTRONIX P-300/600
LOWEST PRICE	X	X		
L Q PRINTING	X	X	X	
COMPRESSED PRINT	X	X		
GRAPHICS RESOLUTION				
60 x 72	X	X		X
120 x 72	X	X		X
200 x 144	X	X		
200 x 288		X		
BOLDFACE PRINTING	X	X		
SLANTED PRINTING	X	X		
CHAR. ENLARGEMENT	X	X		
INT'L CHARACTERS	X	X		

This printout proves we out-print the competition.

The chart above tells a telling story about our CI-300 and CI-600 Matrix Line Printers. Feature for feature, they out-print Dataproducts® and Printronix®—and at a lower cost. Our printers can accommodate many types of applications and computer systems. They provide both multimode printing and graphics plotting. Graphics resolution on the CI-300 and CI-600 printers is the highest available on a line printer in their speed class, with excellent graphics quality for business, scientific and barcode applications. Barcode applications are easily developed with optional graphics card.

Interfacing is not a problem either. RS232-C Serial, Centronics® and Dataproducts Parallel, and IBM-compatible interfaces accommodate most types of computer systems.

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Roger Scaggs
President, APS Systems, Inc.
Dallas, Texas

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Most of our customers require more than a single-user desk top system. They need a good, fast multi-user computer without a minicomputer price tag.

We looked at many of the so-called low-cost "Supermicros" running UNIX™ but decided to continue selling **IBC**-OASIS™ computers. UNIX requires a lot of horsepower to run well, and the low cost UNIX systems did not have the performance to do our customers job to our satisfaction.

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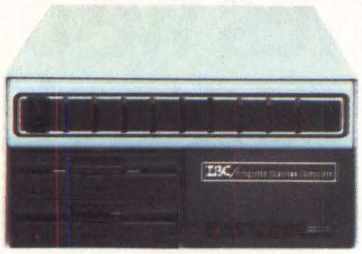

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Breakpoints

Oracle Corp., Menlo Park, Calif., scheduled a late August introduction of its Oracle relational database management system for the IBM Corp. PC-XT, Texas Instruments Inc. Professional, and Digital Equipment Corp. Rainbow computers. The first microcomputer version of Oracle, including Oracle Link software for transferring data files between microcomputers and mainframes, will be priced at about $1,000 (minimum six orders) for each computer's version.—T. Moran

On-Line Software International Inc. and **ITT Corp.** have announced a licensing agreement under which ITT's European affiliates now have exclusive rights to market On-Line's IBM-compatible micro-and-mainframe software in Europe.—M. Stenzler-Centonze

The $149.95 Grafix Partner from **Brightbill Roberts & Co. Ltd.,** Syracuse, N.Y., for the IBM PC and compatibles, is designed to work with such popular software packages as Lotus Development Corp.'s 1-2-3 and Ashton-Tate's Framework without requiring extra memory. Grafix Partner allows any graphics function to be enhanced with color and special fonts. It also works with any input device such as joysticks, bit pads or light pens. The package can also drive any dot-matrix printer, according to the company. The Grafix Partner function is called by simultaneously depressing three keys. Deliveries are expected this month.—C. Warren

COMMUNICATIONS FILES: Linkware Corp., Waltham, Mass., this month plans to add VAX/VMS and IBM/MVS support to its Linkware: Information Server software. The "virtual server" currently connects IBM PCs and other personal computers to the VM operating system on IBM mainframes. It features selective file access, security, auditing and DIF transformations. The company, which is backed by Ungermann-Bass Inc., a local area network leader, is readying an Apple Macintosh version for first-quarter availability. Price for microcomputer modules is $350 and less, depending on quantity. For host machines the price is $15,000.—D. Bright

RANDOM DISK FILES: Using both the Enhanced Small Disk Interface (ESDI) capability for tape drives and the Small Computer System Interface (SCSI) to provide host computer independence, the newest family of controllers from **Electronic Processors Inc.,** Englewood, Colo., gives system integrators a range of tape and disk subsystems. The EPI-3, expected to be about $650 in volume quantities, is a ½-inch tape-only controller that supports streaming with a 128K-byte buffer. For mid-range applications, the 1450 EPI-2 is a combination controller that can support four 5¼-inch Winchester drives, four ½-inch tape drives, four ¼-inch tape drives, or any combination thereof. The EPI-1 low-end tape controller for personal computers is in the $250 range. Prototypes of EPI-2 and EPI-3 are available now. Production is scheduled for November.—C. Warren

NOTES FROM OVERSEAS: Britain's largest computer maker, **ICL Plc.,** reportedly became the target of a serious takeover bid early last month by fellow British giant, Standard Telephone and Cable (STC). STC's initial offer was a stock exchange deal worth about $450 million, and that may be increased. The surprise

merger move immediately received the apparent blessing of ITT Corp., STC's one-time sole owner, and now 35-percent shareholder. ITT already is said to be interested in taking a 29.9 percent share of the merged companies, should the deal come to fruition.—M. O'Gara

The export value of floppy disk drives shipped from Taiwan this year is running at least six times ahead of the 1983 pace. Floppy disk drives have become a favored peripheral product for medium- and small-scale companies, who want to establish a good reputation with OEM suppliers as a step toward later offering one-board computers and other products. Mitac Inc. and other companies are expanding their production capacity, as are some of the bigger manufacturers, like the Tatung Co. and the Teco Electric and Machinery Co.—I. Kakehashi

Not to be outdone by the lustrous IBM-CES-Merrill Lynch videotext alliance, **AT&T** has lined up British videotext pioneer Aregon International to co-develop and co-market its videotext product. The new 10-year pact calls for AT&T to supply its Sceptre terminals and Aregon to supply an Americanized version of its IVS-3 software. AT&T International gets the exclusive rights to sell it abroad under a royalty arrangement with Aregon worth about $3 million. The new software, called IVS-5, supports eight to 500 users and incorporates messaging facilities. The videotext system will use Digital Equipment Corp. VAX-11/750, /780, /785, or MicroVAX minicomputers as front-end processors.—M. O'Gara

IBM U.K. has finally nailed down a long-rumored alliance with Britain's public telephone authority, British Telecom, that is considered by rivals as dangerous. Competitors also view the coupling as crucial to Big Blue's strategy for dominance of Britain's telecommunications market. The pair plan to establish a joint venture, run by an IBM-appointed chief executive, to provide a national data network management service based on IBM's Systems Network Architecture (SNA). A particular sore point among competitors is the possibility of IBM's proprietary SNA becoming a standard. The British government already has pledged to promote a network standard from the International Standards Organization.—M. O'Gara

Signs are the 8-inch floppy is on its way to becoming passé. The **Japan Electronic Industry Development Association** (JEIDA) has found that a half-million 8-inch drives were shipped by Japanese makers in the fiscal year that ended in March, while 1 million 5¼-inch drives and 50,000 of the newer 3-inch, 3¼-inch and 3½-inch drives were shipped in the same period. Demand for 8-inch drives probably will reach a peak of 600,000 in the fiscal year 1985, being surpassed then by 5¼-inch models, which will then settle into a steady 20 percent annual growth by fiscal year 1988. That means that 2 million 5¼-inch drives would be shipped in the next fiscal year, and 2.5 million in the fiscal year 1988. At the same time, 3-inch and 3½-inch drives will grow to 1.1 million units in fiscal year 1985 and 3 million by 1988.—I. Kakehashi

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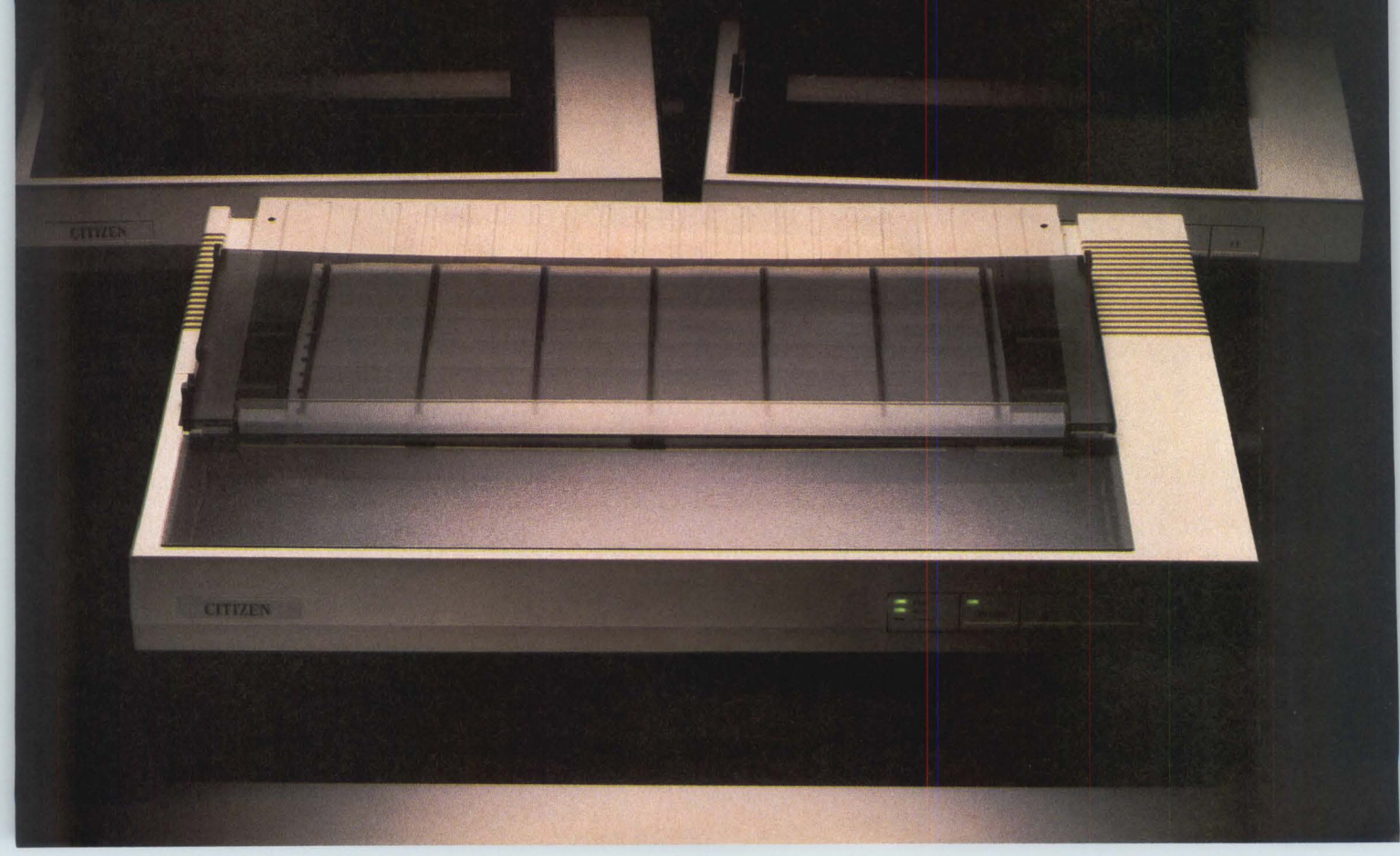

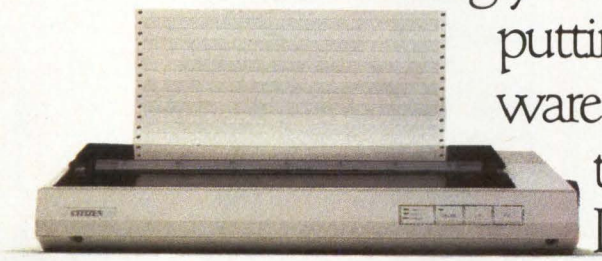

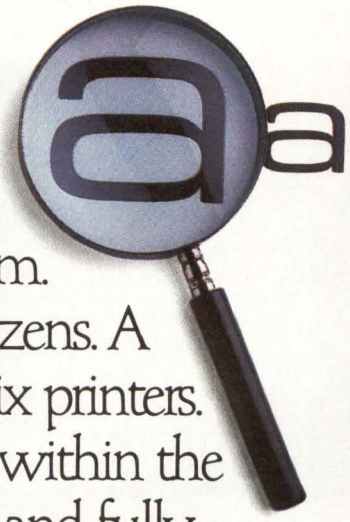

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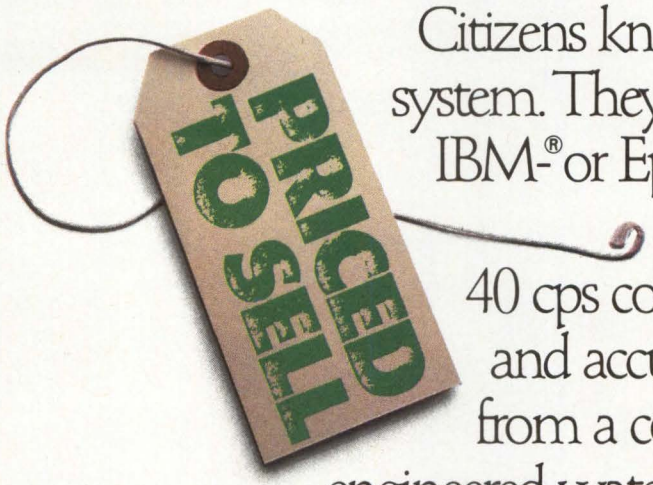

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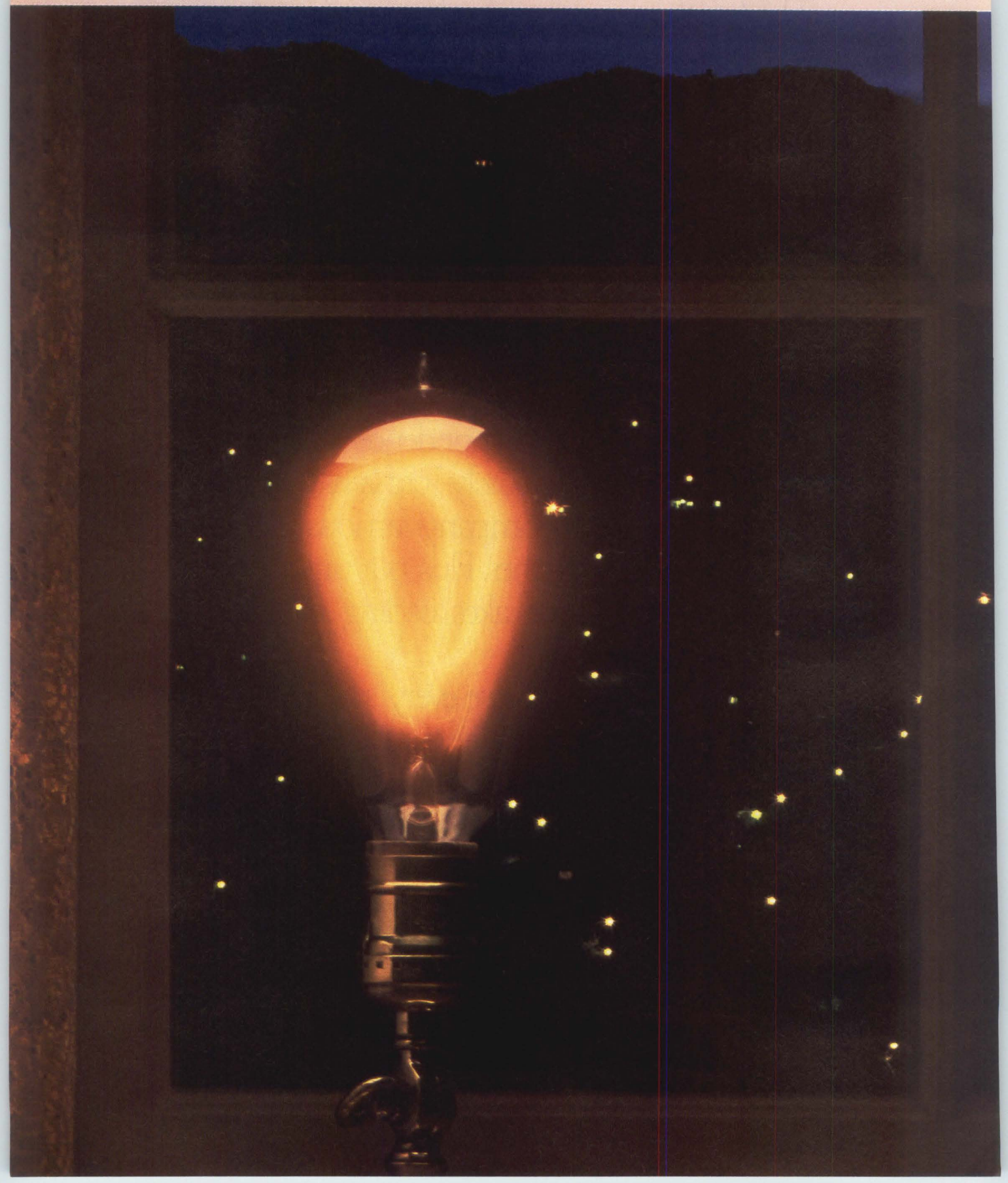

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CONTROL DATA

Wyse unveils 64-color alphanumeric terminal

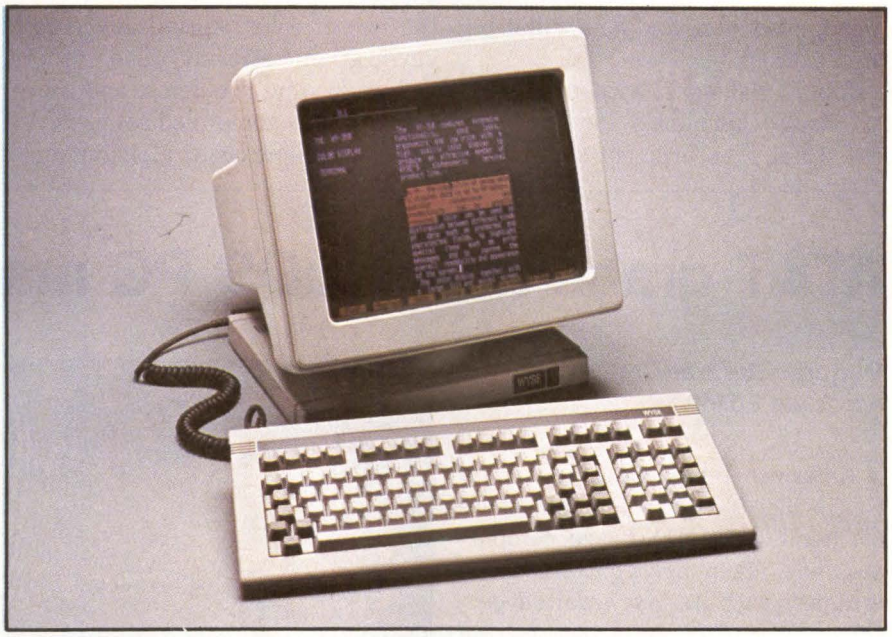
Tom Moran, Associate Editor

Wyse Technology, San Jose, Calif., is unveiling the WY-350, a 64-color, 80- or 132-column alphanumeric terminal with a retail price of $1,295. Its price equals that of the eight-color WY-300, which the WY-350 is expected to supersede.

The WY-350 has a 15-inch, tilt-and-swivel screen that displays either 80 or 132 columns by 24 lines plus a status line and function-key labeling line. The 128 ASCII characters are displayed in a 7- by 13-dot matrix in a 10- by 13-dot cell. Although 64 colors are available, black must be either the foreground or background color for each individual character. The 16 pre-defined, color-scheme palettes can be interchanged by the user at any time except during setup. All terminal parameters are configured using soft-screen setup. The user can also create additional color schemes while in setup mode.

The detached keyboard of the WY-350 can be tilted either at the DIN-standard angle or at the same angle as an IBM Selectric typewriter. The keyboard includes 101 keys, including a numeric keypad and 16 function keys that can be shifted to provide 32 functions.

Two asynchronous RS232C serial ports, a modem port capable of up to 38.4K bits-per-second (bps) transmission speeds, and a 19.2K bps printer port are included. The WY-350 offers block and conversational modes in either half- or full-duplex, and is compatible with the WY-50, Lear Siegler ADM-31, ADDS Viewpoint, Hazeltine 1500, and TVI 910, 920, and 925. The terminal weighs 25 pounds and the display console measures 13½ inches high by 14 inches wide by 15 inches deep. Wyse predicts the WY-350 will be available in production volumes in November or December.



Wyse Technology's WY-350 64-color alphanumeric terminal *has a 15-inch screen that displays 80 or 132 columns of text. The $1,295 terminal will initially be aimed at applications in which highlighting of information is critical.*

Some industry observers predict that color alphanumeric terminals will become standard. Others doubt there is great demand for color outside of graphics applications. "Some people will [demand] a color terminal, and others will think that it is not worth [the price]," says Lionel Martin, Wyse's director of marketing for terminals. "We feel, provided that the price premium is not outrageous, that people would rather have [displays] in color."

Sufficient software is lacking

Alphanumeric terminals currently lack enough application software to really exploit their capabilities. According to Martin, "It is a chicken-and-egg situation. As [the industry] produces fairly inexpensive color alphanumeric displays, more and more people will write their applications taking color into account. Once that happens, a lot of possibilities [will] open." Martin adds that Wyse already is talking to software developers about packages that might use a color display.

Other manufacturers currently making color alphanumeric terminals include Applied Digital Data Systems Inc. (ADDS), Hauppauge, N.Y.; Esprit Systems Inc.'s Hazeltine Terminals Division, Melville, N.Y.; Intecolor Corp., Norcross, Ga.; and IBM Corp.

George Chao, president of Liberty Electronics, USA, San Francisco, Calif., agrees with Martin that software support is essential to color alphanumerics, and adds that the cost premium over monochrome will also play a part. "For ASCII color terminals over $900 there could be a problem. The cost-premium issue also applies to hard copy." Chao points out that present color,

alphanumeric software is limited to mapping different video attributes to default to different colors. "Eventually, color will be a standard. The question is when, and how will it be implemented."

Robert Sanekoff, vice president for display terminals for the San Jose, Calif., research concern Dataquest Inc., is not as convinced of the ultimate success of color alphanumeric terminals. "There are certain applications that lend themselves to the use of color, specifically credit verification, aircraft, and other, weight-loading problems, and there are probably some medical uses. In the general-purpose, alphanumeric world, color will have a limited market because there is limited applications software and limited total systems support in the way of low-cost, color printers and plotters." Sanekoff does not expect color terminals to exceed 20 percent penetration of the alphanumeric terminal market in the next five years. □

AT&T grabs at MS-DOS PC market share

Marjorie Stenzler-Centonze
Associate Editor

American Telephone & Telegraph Co., which recently announced its 3B family of UNIX-based computers, has taken a step toward the ordinary with its long-awaited personal computer introduction: an IBM PC-compatible model.

AT&T is making available through major computer retail chains its Personal Computer 6300, an IBM look-alike based on the MS-DOS operating system. At $2,750 without the MS-DOS and $2,810 with it, PC 6300 runs about 5 percent below the cost of the IBM PC. In addition, the company announced a local area network, (LAN) called Information Systems Network, designed to link AT&T PCs to more powerful computers. It is scheduled to be available in January, which would beat IBM to market with a similar network by about two years.

A typical configuration of the PC 6300 features, along with the MS-DOS, an Intel 8086 processor (faster than the IBM PC's 8088), 128K bytes of RAM, dual 5¼-inch floppy disk drives, a monochrome monitor, parallel and serial I/O ports, color graphics interface, higher-resolution graphics, and seven expansion slots. A 10M-byte hard disk drive version with 256K bytes of RAM sells for $4,985.

Charles Marshall, *chairman of AT&T Information Systems, says AT&T wants to be the broadest and best supplier of personal computers in the market.*

The PC 6300 is being manufactured for AT&T by Olivetti SpA, in which AT&T has a 25 percent interest. Olivetti is handling European sales.

Not 'just another clone'

But most industry analysts say there's not much difference between the products. "The AT&T PC is just another dreary clone of the IBM PC," Kenneth G. Bosomworth, president of the consulting company International Resource Development Inc. (IRD), Norwalk, Conn., says. "As far as the user, IBM or even Apple Computer Inc. [are concerned], there [will be] little impact

AT&T goes after independent software vendors . . .

In an effort to stimulate software development for its UNIX System V-based 3B computer family, AT&T is initiating an independent software vendor support program.

The program features separate but similar efforts by AT&T Technologies Inc. and AT&T Information Systems to support software development through formal training sessions and a 25-percent discount on computer systems. AT&T is offering a variety of software publishing options and reference catalog publishing.

Jack Scanlon, vice president of AT&T Technologies' Computer Systems Division, says UNIX represents an opportunity for independent software vendors to become hardware-independent. "UNIX allows [them] to write to an operating system rather than to a specific box," Scanlon remarks.

Scanlon claims vendor interest in AT&T's programs is strong, and expects the number of UNIX System V

felt from the AT&T announcement. The real impact will be felt by other clone makers like Compaq Computer Corp. and Columbia Data Systems Inc.," because AT&T is such a large company.

Some industry observers speculated during the last few months that AT&T's PC would be based on the UNIX operating system. Frank Vigilante, division president for product management and development at AT&T, explains his company's choice. "We decided on an MS-DOS box because of the enormous software available that is just not available on UNIX," he says.

Users of the PC 6300 can take advantage of a vast assortment of available software running on MS-DOS. And, by using AT&T's PC Interface for the 3B computers, users can gain access to the UNIX operating system as well, Vigilante points out. The PC Interface links AT&T's 3B2 microcomputers to personal computers, enabling users to move files between UNIX-based machines and MS-DOS-based machines. The only connection supported now is in an Ethernet LAN. In the Ethernet, the PC Interface requires AT&T's 3BNET network interface in a 3B2 computer and 3Com Corp.'s Ethernet interface board in the PC 6300. RS232 connections should be available late next year.

The Personal Computer 6300 *operates with AT&T's 3B UNIX-based computer family through the company's PC Interface.*

MS-DOS: The smart choice

Jean Yates, president of Yates Ventures, a Los Altos, Calif. market research company, says AT&T made a wise decision to go with MS-DOS. "If AT&T had announced a UNIX-based system they would have very little applications software for the single-user PC market," Yates says. There will be MS-DOS systems wherever AT&T goes to sell into large accounts, she adds. "They [the accounts] may as well have the machines be AT&T, MS-DOS-based systems with links, interfaces and networks...rather than have all of them be IBM systems," hooking into IBM mainframes, she says.

Yates says a UNIX-based, single-user, single-tasking system doesn't make sense when MS-DOS is the standard. What makes better sense, she says, is a UNIX-based Western Electric WE32000-based or Motorola MC68000-based workstation that operates in either a single-user or network configuration with multitasking and multiple windows, and has a telephone. "That's what I expect [will be] the system that's under development for AT&T by Convergent Technologies," Yates says, adding that it would cost more than the PC.

AT&T signed an OEM agreement earlier this year with Convergent, Santa Clara, Calif., under which Convergent will design and manufacture a proprietary line of products for AT&T.

. . . but is it slowing things down?

packages to triple by the end of this year from the 300 packages available in 1983. Conferences are being held throughout the country to accelerate interest in the software development program, he says.

While the industry awaits System V software, some people question the practicality of AT&T's separate efforts. AT&T Information Systems, which sells to end users, and AT&T Technologies, which sells to value-added resellers and OEMs, are required to maintain separate marketing programs under terms of the AT&T divestiture.

Jean Yates, president of Yates Ventures, a Los Altos,Calif. research company, says these requirements are slowing things down. "Vendors are dealing with two parts of AT&T, contracting with them for two sets of requirements, two pricing schedules and two distribution schedules and the efforts are not necessarily meshing."

Meanwhile, the AT&T network is drawing a good deal of attention from potential users and competitive vendors. "The network is interesting because it is so similar to IBM's concept," IRD's Bosomworth states. IBM recently announced a LAN to be based on token ring architecture. The network, however, is planned for two to three years from now. "For once, AT&T has been able to implement something faster than IBM can."

While the network differs on the architectural level from the one proposed by IBM, users will notice many similarities, Bosomworth explains. The AT&T network and the proposed IBM version are similar in physical configuration and both require twisted pair cables, making them simpler and less expensive to install in existing buildings. "What the user ends up seeing in both AT&T and IBM networks is a backplane configuration in which all of the printed circuit card interfaces are in a central equipment cabinet," Bosomworth says.

The way data is handled internally within those two printed circuit card interfaces is different, he points out. "In IBM's case, a chip is used to implement the token-passing network. In the case of AT&T, there's an existing printed circuit card that is a discrete component device that is used to implement the network. It is not a token-passing network."

One of the major problems, according to Bosomworth, is still insufficient support for the creation of a network. "Users still see a lack of large-scale filing systems they can hook into and a lack of mainframe software to respond to a local network situation," he says. "You can tie a mainframe into a local network with no trouble at all, but to actually make it do something useful is a whole different story." □

Software vendor taps riches of 1-2-3

Carl Warren, Western Editor

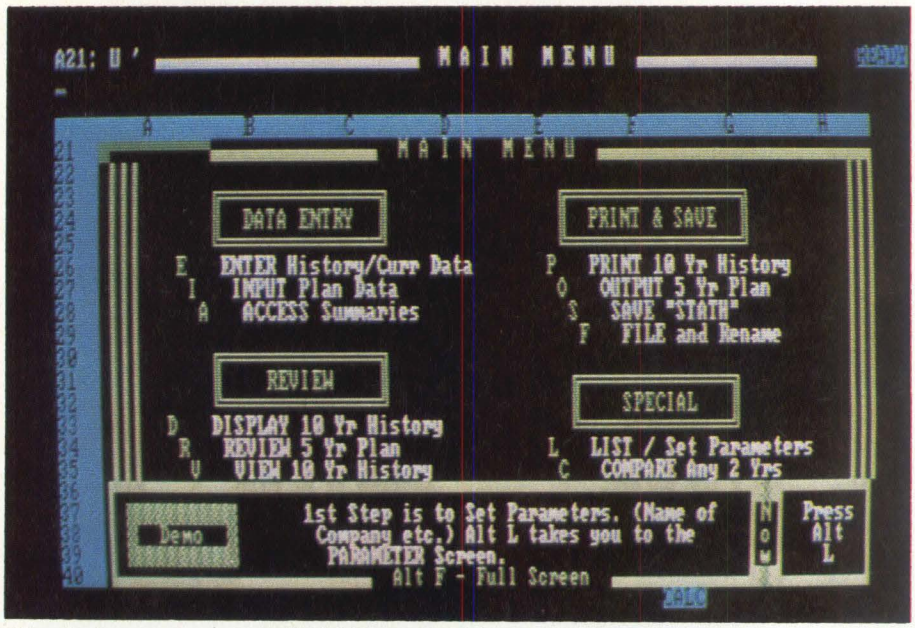
Because some application programs are rich in features, they have become ideal environments for development of other applications. DSS Development Inc., Bloomfield, Conn., took advantage of Lotus Development Corp.'s popular 1-2-3 integrated package and created 52 OptionWare business applications based on it.

"We have done more than make templates. We have defined sets of macro [commands] within the constraints of 1-2-3 that allow us to manipulate data and set user boundaries," says DSS President Ian A.R. Boyd. "Templates are simply guidelines to perform a task. We provide a full interactive environment for the user."

DSS may be the only application provider taking such a thorough tack. Most others are building sets of pre-defined templates without extending the focus or using the full power of the 1-2-3 environment. Louis Barnett, president of consulting company Metalogic Corp., Rancho Palos Verdes, Calif., likens the DSS approach to building applications in a high-level language. "In reality it doesn't make much difference what the language or environment is. It is more important to maximize [a product's] use, whether it's BASIC, a data base manager, or the C language."

Language defines 1-2-3 basics

DSS' goal, according to Boyd, was to remove users from the basic 1-2-3 environment and put them into another application environment. This meant all functions in the new application had to be defined. DSS created a language to define the basic 1-2-3 functions with a set of macro commands combined with instruc-



Employing a macro-command language *made up of the basic functions found in Lotus 1-2-3, DSS created 52 specialized application programs that extend 1-2-3's functions.*

tions. Each macro command defines specific actions to be taken by an application task. For example, in an asset-management application, the instructions define program actions such as inventory control and fixed asset. Included in DSS' macro-command language are entry forms with graphics for each application.

The OptionWare business programs are priced at $130 each. DSS may develop a similar base for Ashton-Tate's recently-introduced Framework integrated software. "We don't really see a need to try to create competitive integrated packages. We feel that [those packages] are providing a more useful user environment, and are making it easy for software writers to create applications within that context," explains Boyd.

Toward this end, Lotus and Ashton-Tate made provisions for software writers to take advantage of the internal functions of their products. Some observers contend that integrated software packages are establishing new operating system philosophies and may eventually supplant operating systems for most single-user microcomputers. Metalogic's Barnett speculates this may foreshadow an entirely new approach to creating application software. □

High-speed Delphax S6000 impels ion printing into new channels

Tom Moran, Associate Editor

Printer engine supplier Delphax Systems of Westwood, Mass., has introduced its first complete product, the S6000 60-page-per-minute (ppm) intelligent printer. Designed for high-volume applications calling for 100,000 to more than 1.5 million printed copies per month, the S6000 incorporates Delphax's model 2460 ion-deposition print engine and sells for between $60,000 and $80,000, depending on configuration.

The most striking advantage of ion-deposition over laser-xerography technology is reliability, claims Gary Sharpe, president and chief executive officer of Delphax. He says the soft photoconductive drums used in laser- xerographic printers tend to retain toner, resulting in a low toner-transfer rate. In the Delphax process, however, toner is attracted to charged particles projected onto the surface of a hard dielectric drum. The drum presses directly against the paper, fusing the toner to the paper. This avoids any need for the heated fusing roller or the radiant heat source used in laser xerography, while increasing the amount of toner transferred from the drum to the paper. Laser printers are more complicated than ion-deposition products, and require more energy.

According to Edward Webster, president of Datek Information Services Inc., a Waltham, Mass., printer information company, the print quality and pressure fusing of ion deposition have both been improved with the new product. "It [the printed characters] had a shiny image that a lot of users didn't like, but now Delphax has textured rollers and new toners that improve the appearance quite a bit. The print quality is not as good as a lot of laser printers, but it does have an edge on price and speed, and it may have an edge in reliability."

The Delphax S6000 uses a Digital Equipment Corp. LSI-11 processor and is fitted with four available card slots for options. It prints standard line-printer formats on cut-sheet letter-size paper with a resolution of 240 by 240 dots per inch. The S6000 offers portrait and landscape printing, can change print size or type within a page, and is compatible with both IBM 3211 and Dataproducts Corp. interfaces. OEMs can add additional buffers, a disk drive, or a job-request control unit if desired. Other options include up to four electronic forms overlays, job separation capabilities and additional type fonts and sizes. Delphax estimates the mean time between failures to be 300,000 pages.

Complete printer to help sales

Sharpe says Delphax decided to offer a complete system because integrators of the print engine, although important, are not the major potential market for its products. "The prime marketplace is among the mainframe and minicomputer companies because [printers] are sold as parts of their systems. [Their] main interest is to get to market quickly with a complete product that's ready to plug and play. We have not found that there is a widespread interest in buying just the mechanism [in that market]."

Peter Steiner, vice president and director of the Electronic Printer Industry Service with the market research company, Dataquest Inc., San Jose, Calif., echoes Sharpe's statement that Delphax will strengthen its position by introducing a complete product. "[The

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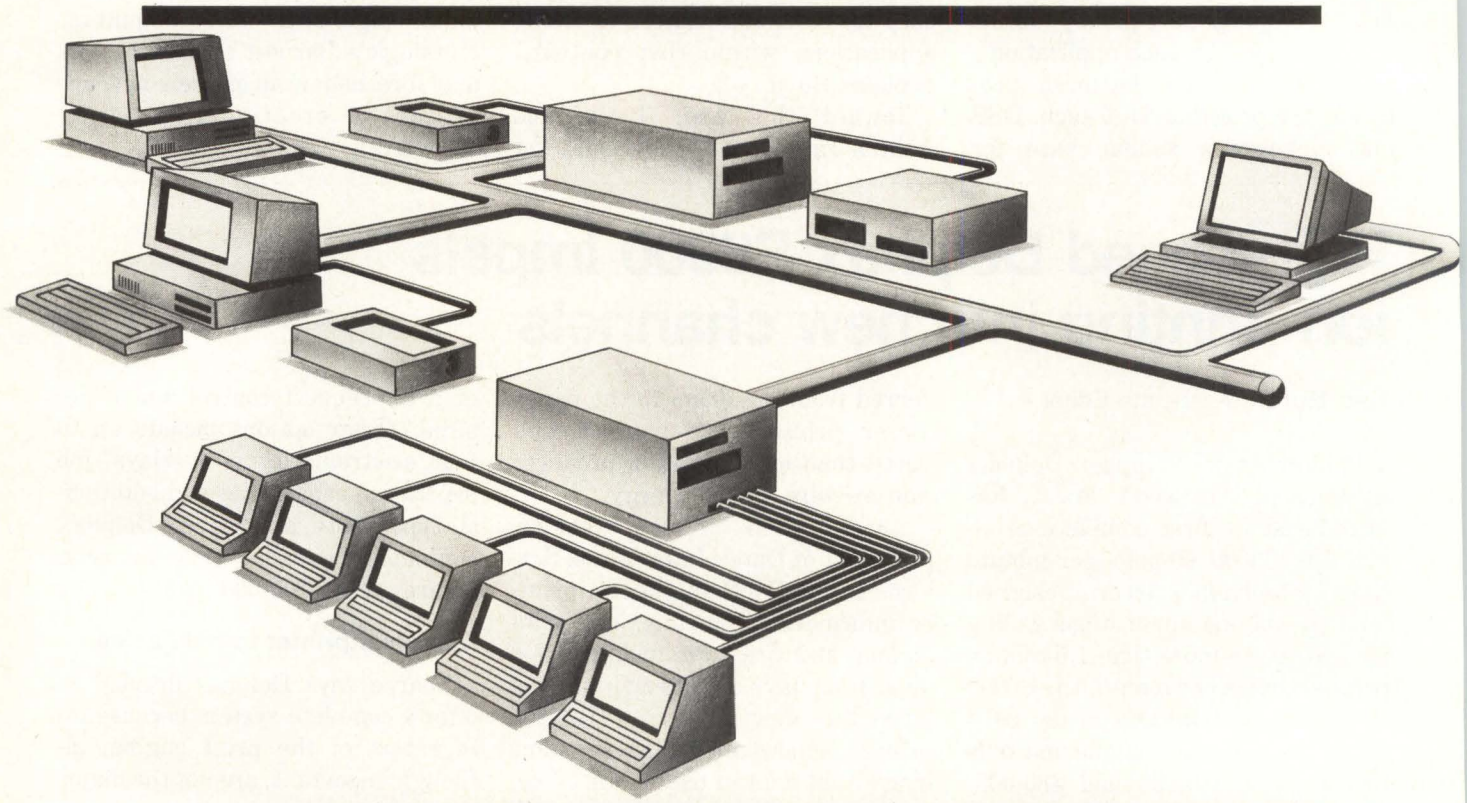

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S6000] does broaden their product line and should open up some new markets to them. It should be especially interesting to smaller OEMs and to turnkey operations. It is considerably cheaper and there aren't many machines in that [speed and price] range. That could be an advantage."

Meanwhile, Delphax's OEM business has received several boosts. Delphax recently signed a two-year, $3 million agreement for Royal Business Machines Inc., Windsor, Conn. to distribute the S6000 to mainframe and large minicomputer installations as the Royal 8800. A three-year, $6 million contract calls for I.E.R., Paris, to distribute the S6000 and the 2460 print engine in France. A third contract permits C. Itoh Electronics to build a low-cost desktop office printer designed by Delphax. The 30-page-per-minute device is expected to be priced less than $10,000 and to be available in the third quarter of 1985. □

Laser, ion technologies both improving

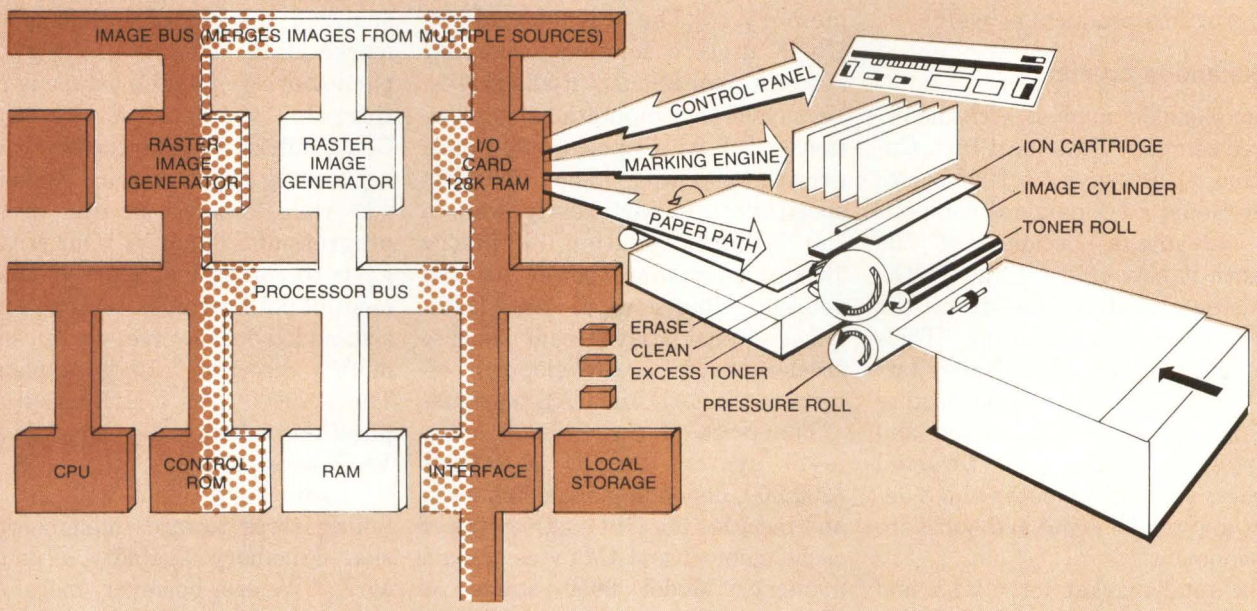
The main competition for laser xerographic technology comes from ion-deposition and magnetic printing technology. At the National Computer Conference in Las Vegas, Nev., in July, Cynthia Peripheral Corp. announced its MP 6050 perpendicular magnetic printer. Cynthia said evaluation units of the 50 page per minute (ppm) printer would be available in the fourth quarter for $15,000.

President Edward Webster of Datek Information Services Inc., of Waltham, Mass., estimates that domestic shipments of non-impact page printers rated from 44 ppm to 100 ppm will grow from 325 units in 1983 to 2,800 units in 1986. He says Delphax Systems' new 56000 printer and the Siemens Corp.'s ND3 laser printer are the main competitors in this class.

Webster says that next year will be very important to the success of non-laser page printers. "They will either make it or fade away. Ion deposition appears to be making it." He says that funding from Canada Development Corp., Vancouver, B.C., a joint-venture partner in Delphax along with Dennison Manufacturing Co., Framingham, Mass., which provided technology, should help give Delphax the staying power necessary to develop a different technology, if necessary.

But Dataquest's Steiner points out that the cost of laser printers is coming down and improvements in their liability are being made. "The introduction of the amorphous silicon drum by Canon [U.S.A. Inc.] will take away some of the advantages that the [ion deposition] technology may have had before. [The silicon drum] is a very hard drum that's supposed to last the life of the machine."

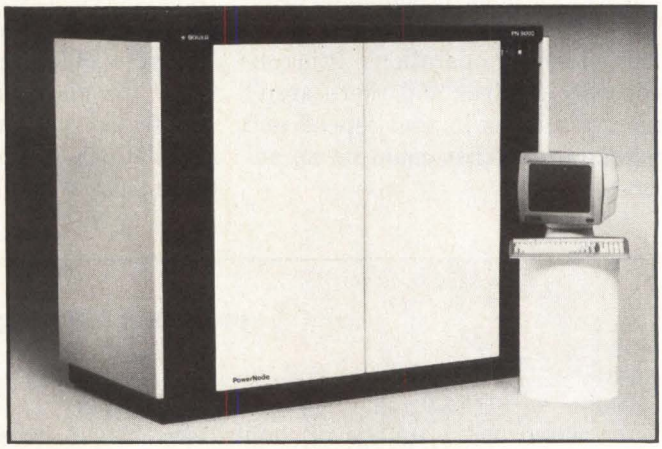
DELPHAX'S S6000 PRINTS 60 PPM



The Delphax ion-deposition print process *eliminates heat-fusing and toner-recycling, making the system simpler than laser printers. Toner is fixed onto the paper between the pressure roll and the hard dielectric image cylinder.*

Gould UNIX supermini reaches 10 MIPS

Marjorie Stenzler-Centonze
Associate Editor



Gould officials *say the new PN9000 supermini competes more on mainframe turf than with minicomputers because of its speed, which can reach 10 MIPS.*

Gould Inc.'s Computer Systems Division, Fort Lauderdale, Fla., recently unveiled the PowerNode 9000 super-minicomputer, completing the company's evolution from an industrial to a totally electronics orientation. Concurrent with the PowerNode 9000 introduction, Gould sold its battery division, its last non-electronic business unit.

The PN9000 comes in three models which offer several times the speed of Digital Equipment Corp.'s VAX 11/780, according to G.E. Rodts, vice president of marketing and sales for the division. The PN9000 completes Gould's UNIX-based PowerSeries family of computers at the high end. "Our strategy is to complement our strong position in the real-time, scientific, 32-bit marketplace," Rodts says. Gould will continue to address that business and will pursue the UNIX-based systems market with distributed systems products as well.

Applications crucial

Jim Renalds, analyst with the research company Dataquest Inc., Cupertino, Calif., says the 9000 series gives Gould a tremendous competitive advantage because of the breadth it now offers in its UNIX-consistent product line from the PS1000 desktop unit on up. "Their strategic planning is really on target," he states. "The crucial factors will be applications software and their sales approach to targeted markets such as computer-aided design, and engineering and software development."

The total market for UNIX and UNIX-like systems was $1.1 billion in 1982, according to the research company Frost & Sullivan of New York, and is expected to climb to $5.1 billion by 1985.

Rodts says the PN9000 32-bit virtual memory processor opens new market opportunities for Gould because of its speed, which ranges from 4.5 million instructions per second (MIPS) to 10 MIPS, and its 16M-bytes of virtual memory. (Although DEC's top-end VAX systems' raw speed is much slower, just under 2 MIPS, all VAX machines support 4G bytes of virtual memory.) "The PN9000 offers UNIX users a solution to current systems' limitations," Rodts states. He says high computational applications, such as graphics, offer good growth potential. The PN9000's speed suits it particularly well to the film-automation industry "where computer power is devoured," Rodts says. But Dataquest's Renalds says Gould needs to accelerate software development efforts in the CAD and CAE markets.

The price of the PN9000 entry level system begins at about $200,000, depending on peripherals, and includes the CPU, 32K bytes of cache memory and 4M bytes of main memory. Model 9050 starts at $230,000. The most powerful system, the PN9080, begins at $310,000 and includes a second processor called the Internal Processing Unit. The IPU operates in parallel with the CPU and boosts performance by close to 80 percent without a proportional increase in price, Rodts says. The 9080, when fully configured, can have a total of 128K bytes of cache memory.

The PN9000 series utilizes Gould's UTX/32 operating system, which is based on the Berkeley 4.2 UNIX extension, with additional features from System V. "After we analyzed the use of UNIX in the marketplace, with VAX users in particular, we found most using the Berkeley version," Rodts says. Gould officials believe the best market strategy is to support Berkeley 4.2 while keeping an eye on the progress of System V. "Our strategy is to continue supportive treatment of both versions, so that when a standard does evolve, we can shift in that direction," Rodts explains. The PN9000 runs UNIX-based applications software developed on the VAX, he says.

Rodts says Gould will also be taking steps toward implementing shared memory capability, as on the VAX. "We are, however, more of a competitor to some mainframes than to VAX because our speed is so great," he adds. □

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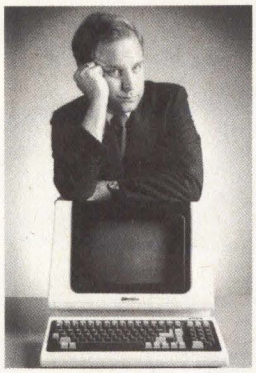

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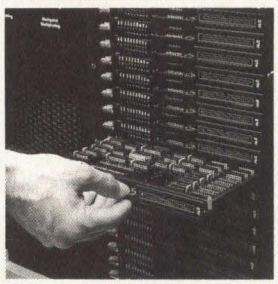

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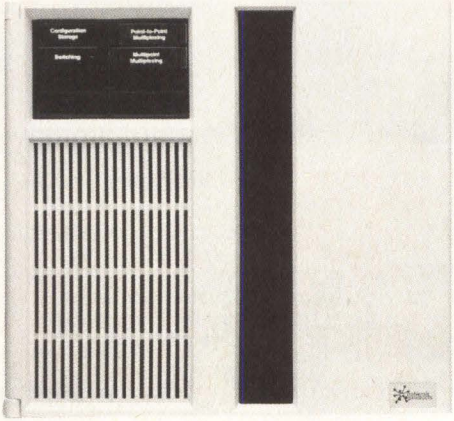

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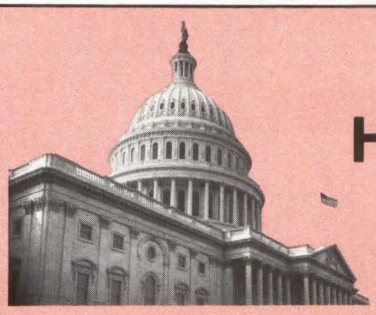

HEARD ON THE HILL

Anatomy of a computer sting

Stephen J. Shaw
Washington Editor

Life in the computer business doesn't often resemble an episode of "The FBI", but for a time earlier this year a Boston software executive found himself playing a role that could have been lifted from a script of that old television series.

David Rozewski is the marketing manager for Intersystems Corp., a system-integration company that incorporates the MUMPS operating system into minicomputers and peripheral hardware, for medical applications. Intersystems is a contractor for the Veterans Administration's Decentralized Hospital Computer Program (DHCP). It most recently integrated a variety of MUMPS-based applications packages to run on a PDP-11/24 minicomputer for the DHCP system.

Last October, Rozewski attended a conference in Baltimore sponsored by a medical-records society. While taking a look at the exhibits he noticed that the Department of Defense had a booth promoting its Tri-Services Medical Information System (TRIMIS), an ambitious project to provide 169 military hospitals with computer support for clinical laboratory functions, pharmacy activities, patient-scheduling and admission/transfer/discharge processing.

Rozewski knew that a request-for-proposals (RFP) was being prepared by the TRIMIS program staff for procurement of hardware and software that could total upwards of $250 million, and Intersystems was very interested in bidding on at least a portion of the project. A key question was whether the RFP would specify MUMPS as the operating system. Rozewski reasoned that because of Intersystems' experience with the DHCP, it would have a possibly decisive edge in competing for the DOD contract, if MUMPS were required.

Rosewski went to the TRIMIS booth, where he met Edward Thomas, a TRIMIS procurement officer. After explaining his interest in TRIMIS, Rozewski arranged to meet Thomas for lunch in Washington, D.C. to talk over how DOD planned to handle the procurement.

Thomas brought along another person, Arthur Hill, whom he introduced as a friend. Rozewski says he later learned that Hill was a middle-level executive with the Mobil Oil Corp. When the introductions were completed, the Intersystems marketing manager quickly got down to the business at hand.

Was TRIMIS going to a MUMPS-based system, Rozewski asked. He said Thomas did not reply directly, but told him that, if he wanted the information, the TRIMIS official expected a "favor" in return. Rozewski later said he was too surprised to say anything.

Thomas, he said, pressed the point. "What's this contract worth to you?" he asked, according to Rozewski's reconstruction of the conversation. Rozewski stalled, saying that he needed to check with his company.

Upon his return to Boston, Rozewski discussed the situation with his boss. He related that Thomas' companion, Hill, had told Rozewski that Thomas was "the main man" in formulating the upcoming RFP. A TRIMIS spokesman confirmed that, indeed, Thomas was involved in writing the RFP, but the spokesman said Thomas was only one of several procurement officers working on the project and that Thomas' role involved "messaging" the system's functional requirements that were being developed by the staffs of the DOD hospitals. Regardless of Thomas' role, Rozewski and his superiors at Intersystems decided the situation was too serious to ignore.

The company contacted the U.S. attorney in Baltimore, where the inital contact between Thomas and Rozewski had taken place. The Federal Bureau of Investigation was quickly brought in, and a computer "sting" was devised.

Rozewski was asked by the FBI to meet again with Thomas and Hill, this time wearing a tape recorder to document any bribe attempts. Rozewski refused, saying he was not comfortable playing such an undercover role. The FBI and Intersystems then agreed to have an FBI agent pose as an Intersystems employee and meet with the two men.

According to Rozewski, Thomas and Hill fell easily into the FBI trap. "They didn't even question whether the agent was really who he said he was," commented Rozewski. "Not too bright."

Subsequent meetings between the phony Intersystems representative and the two men were videotaped and recorded. In exchange for advance information on the TRIMIS RFP, and a promise to slant the RFP specifications in favor of Intersystems, Thomas and Hill asked for $60,000 in cash and 1 percent of the contract award, if Intersystems should be the successful bidder. Rozewski estimated the total payoff would have been approximately $670,000.

The FBI reported it arrested both men at a Bethesda, Md. hotel after an initial payoff was made. Thomas pleaded guilty to bribery and conspiracy charges. Hill was convicted on a charge of conspiring to commit bribery. Both men are currently awaiting sentencing.

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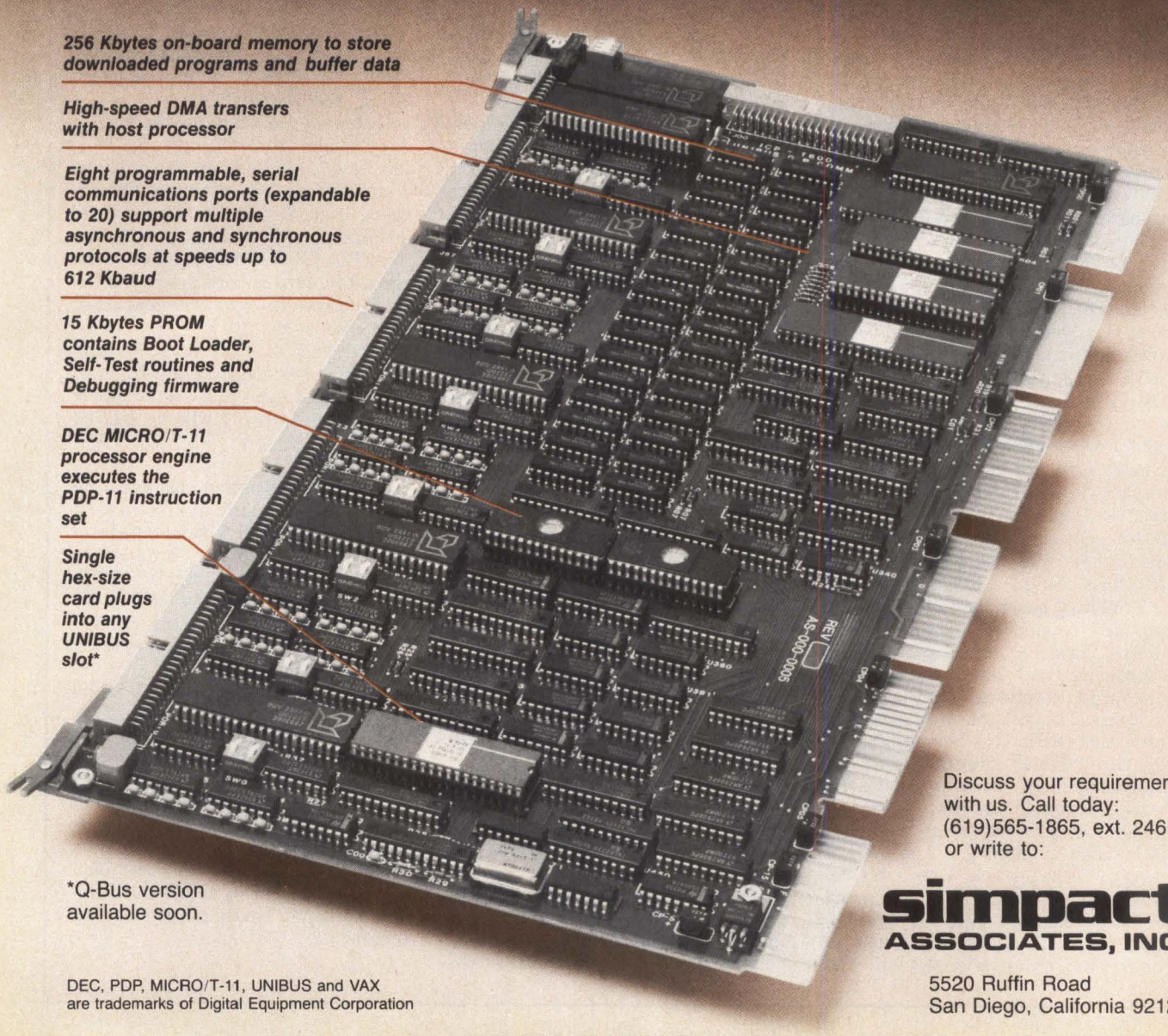

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CIRCLE NO. 22 ON INQUIRY CARD

Congress questions cost of DOD hospital computer network

Stephen J. Shaw
Washington Editor

Congress is raising its eyebrows at the expensive $397 million price tag for the Department of Defense's Tri-Services Medical Information System (TRIMIS). TRIMIS will link 120 military hospitals in a sophisticated computer network.

Critics of the system say that the DOD could learn from the Veterans Administration, which is completing a two-year, $62 million project to implement a similar medical information network providing computer support to 169 VA hospitals. A $250 million request for proposals (RFP) had been expected to be authorized for TRIMIS by the DOD early this summer. But two requests for review of the program, coupled with the criminal conviction of TRIMIS program executive Edward Thomas for attempted bribery in relation to the RFP, have placed a hold on the funding.

In a letter to Secretary of Defense Caspar W. Weinberger, Rep. G.V. "Sonny" Montgomery (D.-Miss.), chairman of the House Committee on Veterans Affairs and a member of the powerful House Armed Services Committee, asked why the DOD has not taken advantage of the VA's experience in developing its Decentralized Hospital Computer Program (DHCP). Montgomery asked for a review of the TRIMIS costs and urged Weinberger to keep in mind a 1982 law, which Montgomery sponsored, mandating that VA and DOD medical resources be shared whenever feasible.

Montgomery specifically questioned why the DOD has not included in its plans the use of 75 software applications packages that the VA developed internally for the DHCP system and that would be available for free.

"I have been a strong supporter of DOD initiatives brought before the House Armed Services Committee and the Congress, as they are the results of effective planning and good judgement," Montgomery wrote. "It does not appear that this TRIMIS decision reflects those same good qualities."

The House Appropriations Committee also has asked the DOD to review and provide justification of the costs of the hospital program, according to a TRIMIS official who asked not to be identified.

The same official, however, defended the program against charges that it is too expensive compared to its VA counterpart. TRIMIS, he explained, will support more applications than the DHCP and has more functional requirements incorporated into its design, including one specifying that TRIMIS interface with several non-DOD medical information networks.

Responding to Montgomery's criticism about ignoring the 75 VA-developed software packages, the TRIMIS spokesman said that no decision has been made yet regarding their use by the DOD. He notes that the DHCP system employs the MUMPS medical operating-system language which was specified in the VA RFP. MUMPS will not be specified in the TRIMIS RFP and the decision on which computers and operating system to employ will be left up to the bidding companies, he said.

Roger Cooper, VA director of medical information resources notes, "The base-level functions of the two systems are the same." Both medical information systems are intended to provide data-processing support for various operational functions through centralized databases. Operational functions of both TRIMIS and DHCP include: patient registration, admission, discharge and transfer, clinic scheduling, pharmacy record-keeping, and clinical laboratory results-reporting.

However, in addition to those applications, TRIMIS is expected to also support other medical-records databases, programs for radiology support, nursing and other health-care scheduling, and clinical dietetics. The network is also being designed with interface requirements not found in the VA system. These include communications with a DOD health-care-eligibility system for military retirees and dependents, and a uniform charting-of-accounts system that allocates hospital personnel work loads and resources.

Comparative costs disputed

The TRIMIS official disputes the cost estimates used by Montgomery in comparing the two hospital systems. The $62 million figure, he says, includes initial equipment purchase but not the significantly higher life-cycle costs. In addition, he charges, it provides for only a single year of equipment maintenance, and does not reflect software development costs that were absorbed internally by the VA.

On the other hand, TRIMIS' $397 million price tag represents its total life-cycle cost, including maintenance; its greater, more expensive

functionality; and the development of software application packages commercially instead of through internal DOD resources.

According to a VA document that details the automatic data-processing plan for fiscal years 1984-89 for the Department of Medicine and Surgery, which is responsible for implementing DHCP, the total life-cycle cost of the DHCP system including the quoted $62 million is projected to reach $204 million. This includes maintenance, equipment, software, operating supplies and training. Comparison of the two systems' life-cycle costs reveals a gap of $193 million, significantly less than the $335 million difference as outlined in Montgomery's letter to Weinberger.

When asked if Montgomery's criticism of the TRIMIS network and its costs were valid, the VA's Cooper responded, "It's a tough call. The VA software, in particular, does not contain enough functionality for DOD."

Cooper says DOD hospitals handle more dependents and outpatients, with accompanying requirements for more extensive record-keeping and file transfer. VA hospitals provide care for less mobile and generally less healthy patients. He doubts, however, that the DOD is trying to incorporate too many applications into the TRIMIS system. "When do you stop adding requirements to your wish list?" he asks. □

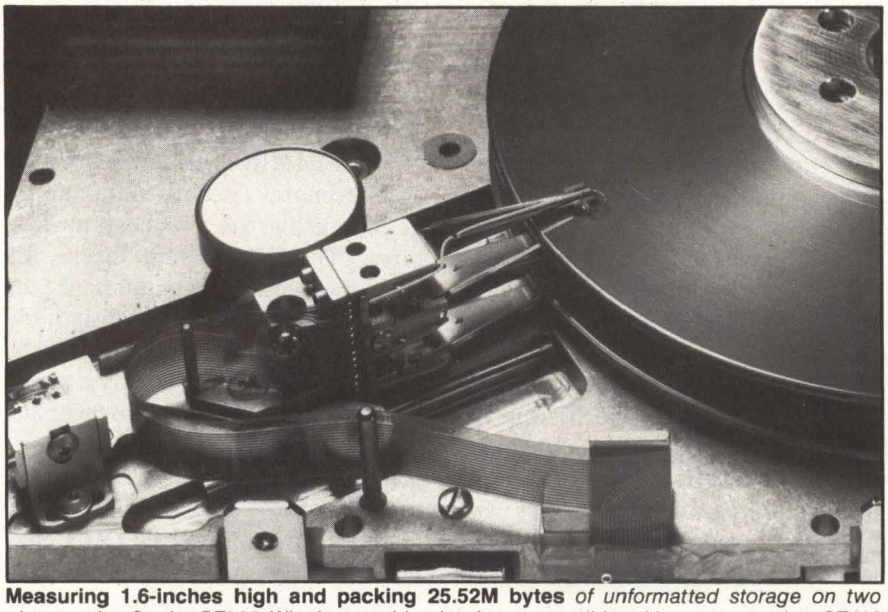
Half-height 25M-byte Winchester suits mid-range system architectures

Carl Warren, Western Editor

The market for more storage on mid-range microcomputer system architectures is prompting disk-drive manufacturers such as Cogito Systems, San Jose, Calif., to boost capacities beyond 10M bytes on new models.

Cogito has introduced the model PT925, half-height 25.52M-byte (unformatted) drive, into its existing series of 6.38M-byte to 12.76M-byte, half-height drives.

The PT925 drive has two platters, 527 tracks-per-inch (2,448 tracks) and 11,150 bits-per-inch. It is plug-compatible with systems using the ST412 controller, and is priced at $625 in quantities of 10,000. Evaluation units are planned this month with production quantities scheduled for November.



Measuring 1.6-inches high and packing 25.52M bytes *of unformatted storage on two platters, the Cogito PT925 Winchester drive is plug-compatible with systems using ST412 controllers.*

According to Cogito's vice president of marketing, Andrew Roman, there is a trend in mid-range architectures toward higher capacities in smaller packages. "Operating system software [e.g., UNIX] is pushing the storage requirement. For example, at least 6M bytes to 7M bytes of disk storage is required for UNIX. This leaves very little [room] for applications and data."

Drive can take a punch

Since Cogito and other manufacturers of similar drives, such as Microscience International Corp., Mountain View, Calif., are aiming at the transportable, desktop system market (MMS July, Page 52), the drives have to be rugged enough to withstand handling without damage to the data surface.

To ensure data integrity, the PT925's head/disk assembly has a three-axis shock mount. In addition,

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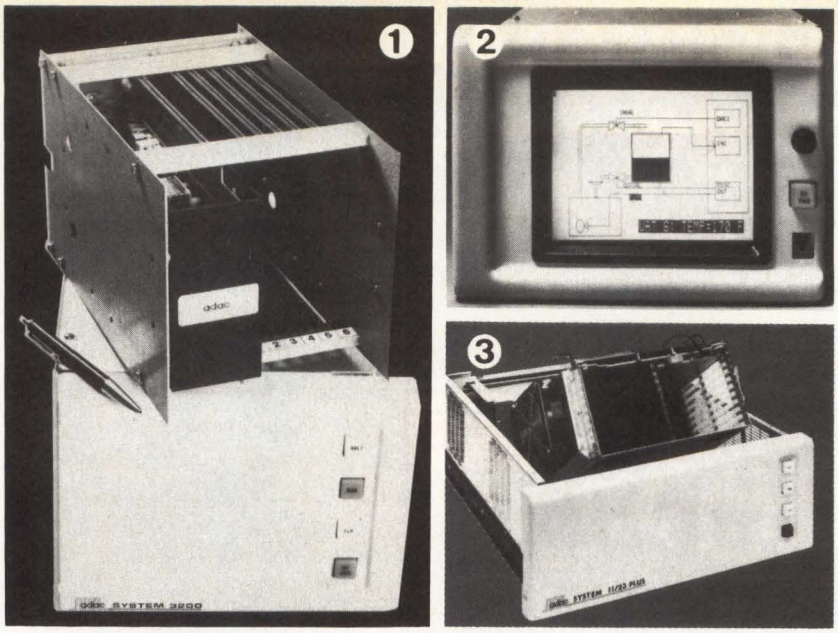

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CIRCLE NO. 24 ON INQUIRY CARD

a mechanical brake stops the spindle rotation in six seconds so the read/write head can be moved into a safe zone should a disk problem occur. Moreover, the drives use thin-film media, which is typically less prone to damage.

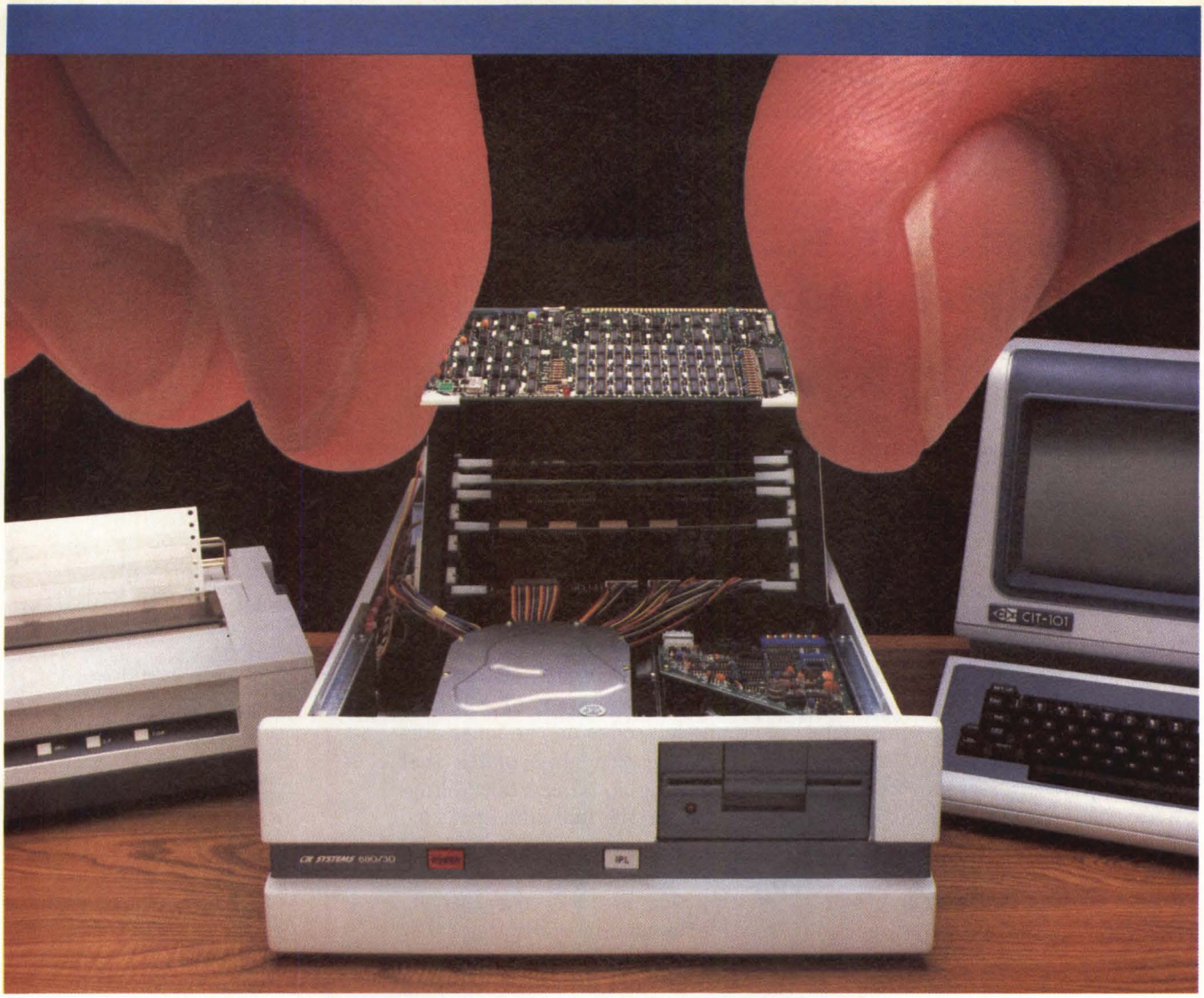
Access speed is not an issue

The PT925 employs a rack and pinion, open loop actuator and has an average access time of 75 msec. Although the drive can't stack up against faster closed-loop servo designs, Roman insists that isn't an issue. "The important issue [in this market] is, can the drive ensure data integrity and remain cost-productive?"

Roman contends that speed is more important in multi-user systems than single-user systems. Moreover, he says the system integrator is the one who affects the overall operation of the drive. "What the system integrator needs to do is employ a controller and operating system that will allow caching—full- or multiple-track buffering—to achieve the greatest throughput. If speed and super-high capacity is what they need, then another type of drive is needed, and they can expect to pay a high price for it," says Roman.

Market to expand

Jim Parker's 1983 Disk/Trend report, published in Mountain View, Calif., indicates that the market for half-height 5¼-inch Winchesters will explode from 72,000 units shipped in 1983 to more than 2 million by 1986. What could eat at some of this growth, however, is 3½-inch 20M-byte Winchester drives encroaching on the same market. Currently, only one manufacturer, Microcomputer Memories Inc., Van Nuys, Calif., has a 25M-byte 3½-inch Winchester that it is preparing to ship late this year. □



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CIRCLE NO. 25 ON INQUIRY CARD

Active-matrix technology improves liquid crystal displays

Tom Moran, Associate Editor

One of the first commercial devices to use active-matrix technology —touted as the solution to the size and performance limitations of liquid crystal and other flat-panel displays—is being introduced by Panelvision Corp., Pittsburgh, Pa. The company is using the technology in a roughly 4- by 5-inch liquid crystal display (LCD) unit called the MiniGraphic.

Active-matrix addressing integrates a semiconductor, thin-film transistor and storage capacitor with each picture element (pixel). The pixels each act as their own memory cell for the duration of the frame period. Panelvision predicts that active-matrix addressing will solve the traditional problem of individually wiring thousands of pixels and will produce flat-panel displays with the size and resolution of CRTs.

The company says it can apply active-matrix addressing to any of the many electro-optical flat-panel display technologies. Active-matrix circuitry functions as a dynamic random access memory (DRAM), but because it only surrounds the pixels, it is much less dense than a DRAM. Traditional multiplexed LCDs have a matrix of row and column electrodes on the inner surfaces of the two glass plates that surround the liquid crystal. Voltages applied to the individual row and column electrodes activate the appropriate pixels. This time-division multiplexing is done consecutively row-by-row and is therefore slower than the DRAM-type function inherent in active-matrix technol-

The MiniGraphic display system from Panelvision *uses active-matrix semiconductor circuits to address its 24,576 picture elements. The high-contrast, large-viewing-angle device is said to offer greater flexibility than previous liquid crystal displays.*

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ogy. A problem with the technology may lie in the product's manufacturing yield. A small defect in a semiconductor wafer can make the wafer partly or completely useless. Since semiconductor fabrication techniques will be used to make large active-matrix devices, they may be prone to production problems. An early version of the MiniGraphic system had a number of dead pixels because of the fabrication technique, which gave the effect of a scrolling stadium scoreboard with a few bulbs burned out. However, Panelvision sources expect such yield problems to be soluble.

Display has high contrast

Two problems with LCDs have been their small viewing angle and low contrast, especially in poor lighting conditions. The MiniGraphic's 90 degree viewing angle and 8:1 contrast ratio are twice those of traditional LCDs. The device's 24,576 pixels form up to 512 characters in a 5- by 7-dot character matrix. The MiniGraphic measures 5¼ inches wide by 4 inches high by ½ inch deep and weighs 8 ounces. The active display area is 3.84 inches by 2.56 inches with 16 rows of 32 characters. The display supports full graphics and has a refresh rate of 60 Hz.

Because of the MiniGraphic's small size, Panelvision expects OEMs and system integrators to use the MiniGraphic in applications such as automated teller machines, aircraft instrumentation, and electronic cash registers. The graphics ability of the MiniGraphic display could also be applied to oscilloscopes, medical instruments, and process-control panels.

A second, transflective version of the MiniGraphic will be available with an optional electroluminescent lamp for outlining the display in darkness. In transflective mode the contrast ratio of the LCD is reduced to 6:1.

The MiniGraphic display alone is priced at $750 for a single unit, and the MiniGraphic system with a controller is priced at $1,475. Panelvision will offer discounts for volume purchases. When attached to the back of the MiniGraphic, the printed circuit board controller adds ½ an inch to its depth. The controller can be located away from the LCD screen, if thinness of the display is critical.

The controller includes an RS232 serial port, a Centronics-compatible parallel port and inputs for direct memory access. It supports seven data communications rates from 150 baud to 9600 baud. Panelvision planned to ship the MiniGraphic and the MiniGraphic system with controller beginning in August.

Enhancements to follow

A second Panelvision product will be the PV 2000, which will display 25 lines by 80 columns on an active area 8 inches by 5 inches. Prototypes are scheduled for the fourth quarter of 1984, with production quantities expected in late 1985. The larger PV 2000 is intended for small systems and portable computers, and is expected to have over 250,000 pixels and 400-line resolution. Future possibilities for active-matrix technology include gray scaling, color devices, and the integration of controllers directly into the semiconductor circuitry of the display.

According to T. Peter Brody, vice chairman and director of technology at Panelvision, "Active-matrix addressing solves the critical interconnection problem. It enhances the performance of liquid crystals and other display materials to a point where they can rival a CRT."

Brody, who founded Panelvision in 1980, formerly headed active-matrix development at the Westinghouse R&D laboratories. Panelvision has obtained exclusive licenses to patented Westinghouse technology and has raised $11 million from venture-capital sources.

Sandy Gant, analyst for research concern InfoCorp, Cupertino, Calif. says that Panelvision's active-matrix addressing is an approach with potential. "The clarity of the display was better than [previous LCDs]. It will be interesting to see the larger display. They were announcing an addressing capability that happened to be linked with LCD technology. I'm sure they have a bright future. [The MiniGraphic] is an improvement on LCDs and it will help LCDs as a technology." Arthur D. Little, Cambridge, Mass., estimates that the market for flat-panel displays could reach $2 billion within a few years. □

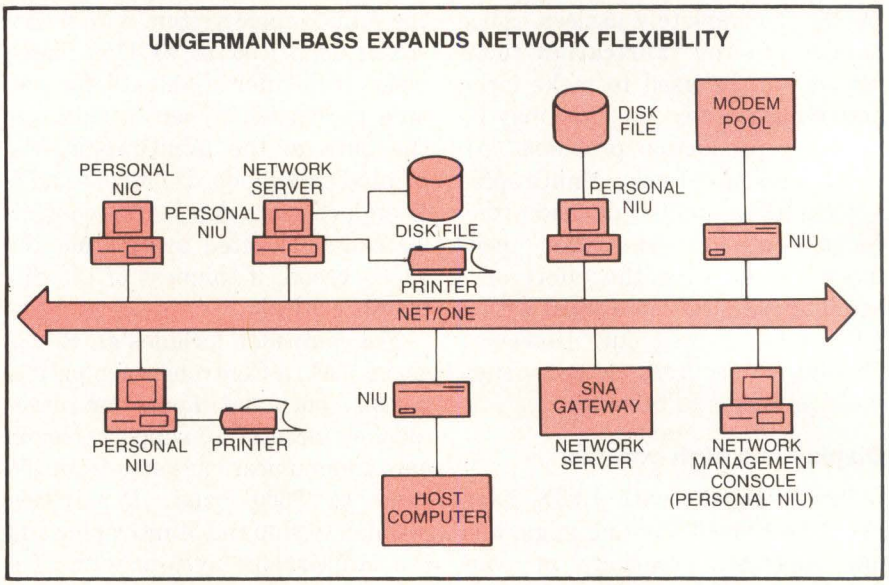
INTEL DEVELOPS 256K-BIT CHMOS DYNAMIC RAMS

Intel Corp. has introduced its first 256K-bit dynamic RAMs that use the company's high-performance metal-oxide semiconductor (CHMOS) technology. The 51C256H is optimized for high-bandwidth applications such as graphics displays and has a 120-nanosecond access time and a Ripplemode cycle time of 65 nanoseconds. (Ripplemode allows the single access of up to 512 bits within a single row.) The 51C256L targets low-power applications such as portable computers. It requires a total data retention current of 230 microamperes. The 51C256HL provides a combination of both low power and high performance. All three products are pin-compatible with Intel's recently introduced 64K-bit CHMOS dynamic RAMs.

Ungermann-Bass stretches network connection options

The Personal Network Interface Controller (NIC) and the Personal Network Interface Unit (NIU) *from Ungermann-Bass enable IBM PCs and PC-compatible micro-computers to attach to the company's Net/One local-area network.*

Marjorie Stenzler-Centonze
Associate Editor



Ungermann-Bass, Inc., Santa Clara Calif., has expanded its options on the Net/One local area network (LAN) with a modestly priced interface controller designed to offer system integrators added flexibility in connecting personal computers.

The Personal Computer Network Interface Controller (NIC), a $595 plug-in board, links the Net/One LAN to IBM PCs and PC-compatible microcomputers. The NIC is intended for use in PC workstations as is Ungermann-Bass's own Personal Network Interface Unit (NIU), introduced earlier this year for $1,095.

The NIU is a processor-based interface that executes network communications protocols under control of an Intel 80186 microprocessor. The NIU has 128K bytes of memory and a high-speed interface across the PC bus. All networking protocols run in that memory.

Choosing connection options

From an operator's standpoint, the differences in using a personal computer with the NIC rather than the NIU would not be apparent, says James F. Jordan, vice president and general manager at Ungermann-Bass. He notes that the networking protocols and software that run on the board in the NIU, run in the PC with the network controller. "However, the NIC puts more processing burden on the PC itself, so it's not going to deliver as high [a] performance as the NIU," Jordan says.

Typically, he says, NIUs would be used in personal computers functioning as disk or print server stations, while the Personal NICs would be used in those computers employed as workstations. With this combination, the system integrator has the option of using smart boards or unintelligent boards at different prices, Jordan points out. "System integrators can mix, match and build systems as traffic and performance require," he states. "Systems can be built around the application rather than trying to fit the application to 'non-smart' boards, for instance, and working around that."

Jordan expects the market for network interface options to expand as the installed base of LANs continues to grow. The installed base of LANs currently is 15,900 worldwide, according to the research company International Data Corp., Framingham, Mass. The number of LANs installed is expected to reach 100,000 by 1988, the company predicts.

Choosing cable and software

Both the NIU and the NIC support all Net/One media, including standard Ethernet, 10M-bps thin-coated baseband, 5M-bps broadband or 10M-bps fiber optic cable, and can be used with Net/One Personal Connection software such as

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Add-on value	30	62	120	187	266	358	497	673	41.2%
Service and support	50	102	189	321	496	765	1,132	1,642	54.1%
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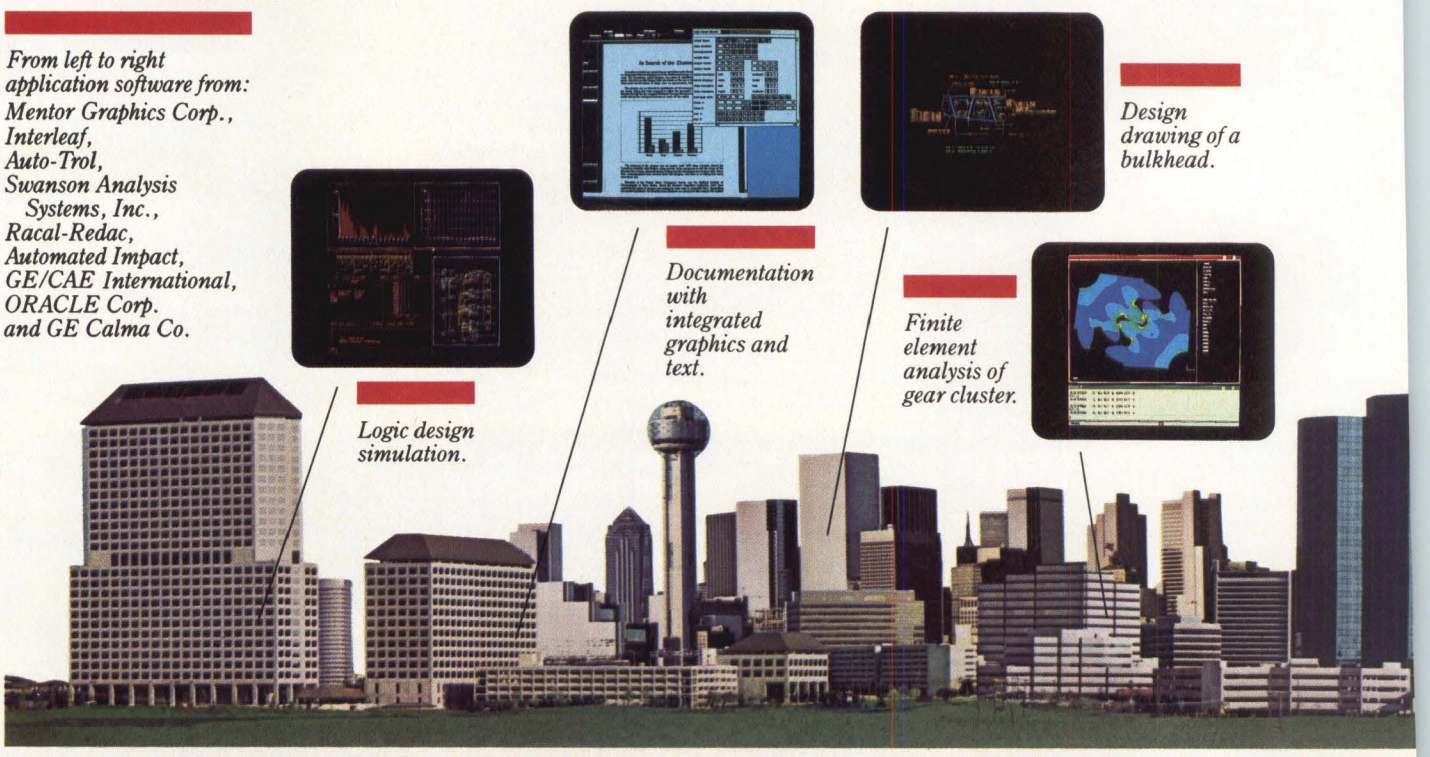

From left to right application software from: Mentor Graphics Corp., Interleaf, Auto-Trol, Swanson Analysis Systems, Inc., Racal-Redac, Automated Impact, GE/CAE International, ORACLE Corp. and GE Calma Co.

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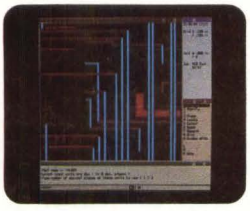
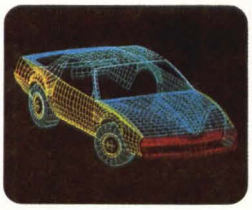


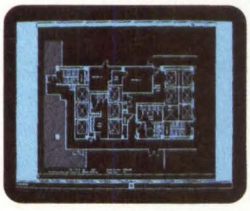
Printed circuit board layout.



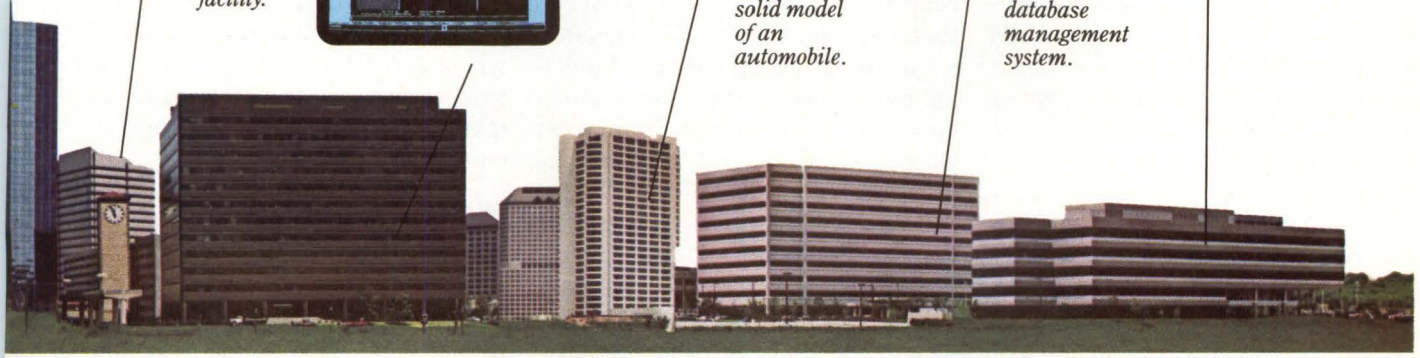
3D surface model.

Exploded solid model of an automobile.

Relational database management system.



Space plan of a facility.



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Diskshare, Printshare and Mailshare.

Personal computers configured with either the Personal NIC or NIU can use Diskshare to access files and application programs from shared hard disks on the network. Mailshare software enables network users to send letters, messages and files over the network and Printshare permits shared access to printers.

The NIC will be sold by the Ungermann-Bass direct-sales force to major financial institutions and Fortune 500-type companies. The majority of sales will be to OEMs and system integrators who need to put together multiple microcomputer systems, Jordan says. □

Plain-vanilla data-interchange standard proposed for UNIX applications

Stephen J. Shaw
Washington Editor

Four software-development companies have banded together to push for a standard data-interchange format for UNIX-based application packages. The group, known as Independent Software Information Standards (ISIS), released a draft of the proposed standard, also known as ISIS, for industry review at the spring Comdex computer conference in Atlanta.

The proposed ISIS standard seeks to achieve an industry consensus on "read" and "write" files, definitions of command languages and access programs. The goal is to incorporate common headers into all application packages and allow data to be passed between separate programs and users. Although ISIS would provide less file-interchange capability than found in integrated packages, such as Lotus Development Corp.'s 1-2-3, its advantage lies in its ability to exchange data between software programs from different developers by adding common headers.

"ISIS is essentially an intermediate file that allows the user to get data in or out of a program," says Steve Thomas, marketing communications director at Software Express Inc., one of the four founding members of the ISIS group. "For instance," Thomas says, "if you're working on a general ledger file and need to get data out of a spreadsheet program, you can do it."

According to Thomas, the proposed ISIS standard would be simple for software companies to incorporate into their UNIX application software. Only the three pages of C language programming need to be written into a program, he says.

ISIS ideal for UNIX

The ISIS format is well-suited to the UNIX operating system environment, say industry analysts. UNIX-based computer systems are designed for multiple users who share software files and databases that are added as needed. "ISIS reflects the basic idea of UNIX, [in] that a system need not be monolithic but composed of a series of building blocks," says Brian Boyce, managing analyst for software at Gnostic Concepts Inc., a consulting organization in Menlo Park, Calif.

Boyce sees ISIS as evolving from the data-interchange format (DIF) that allows a degree of data interchange on CP/M operating systems. Under the DIF format, one program, such as a spreadsheet, could write the information and another package, such as a database manager, could read it. Because of the differences in the nature of database files, relational databases in a UNIX environment usually use a relational database model, while CP/M-based systems most commonly use a hierarchical database model. For this reason, ISIS is more complex than DIF, "but not much more," comments Boyce.

Besides Software Express, the other three ISIS consortium founders include Access Technology Inc., South Natick, Mass., Quadratron Corp., Encino, Calif., and Unify Corp., Sacramento, Calif. The four are integrating ISIS compatibility into their own software packages and expect other developers to quickly follow suit. The ISIS standard is currently under review by the UNIX/Usr/group—an association of UNIX users, software developers and equipment suppliers—whose favorable endorsement would greatly increase the chances of the standard's gaining widespread acceptance.

M/A-Com chooses ISIS programs

The efforts of the ISIS founders to create a uniform data exchange format for UNIX software received a boost in May when M/A-Com Sigma Data (MSD) Inc. selected ISIS-compatible programs from all four companies to be packaged by

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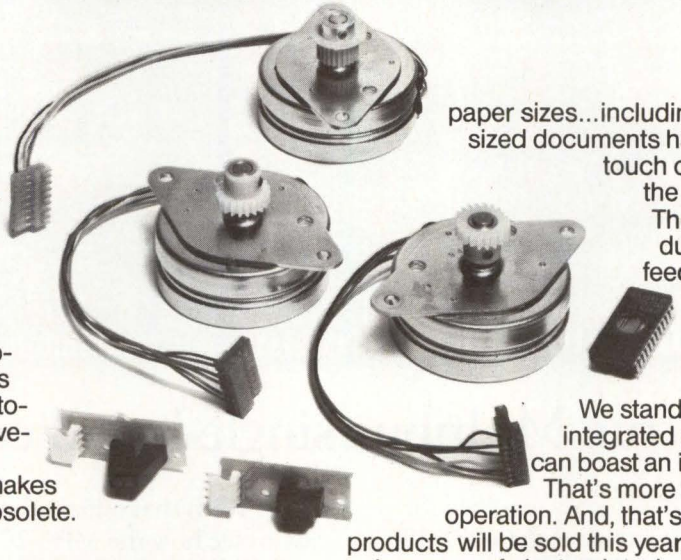

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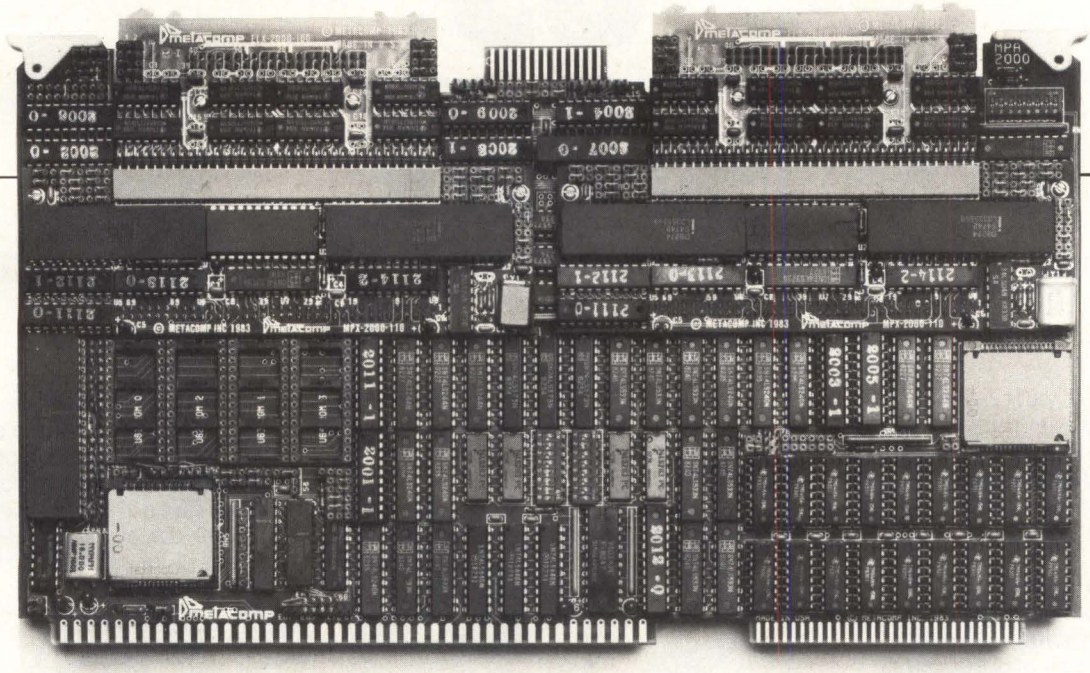

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THE MULTIBUS BREAKTHROUGH PEOPLE

MSD into the AT&T 3B computer series. AT&T signed an OEM agreement with MSD to market computer systems based on 3B hardware to the federal government. It marks one of the first such accords AT&T has reached with a value-added reseller for its new computer family.

Software application packages that MSD has made available for distribution with the 3B line include Quadratron's complete office automation series, Unify's relational database system, Access Technology's Supercomp 20 and 20/20, and the APGEN series of application generators and accounting applications from Software Express.

MSD, however, is careful to point out that the packages were not chosen because of their data-exchange capabilities under the ISIS approach, but rather because they are good programs, suitable to the type of federal customers MSD is pursuing. During negotiations with AT&T, neither party raised the subject of ISIS, recounts Michael Abramowitz, MSD vice president for systems marketing. He notes that other UNIX-based applications packages that MSD is making available on the 3B computers include programs that do not conform to the ISIS format, including The Santa Cruz Operation Inc.'s adaptation of Microsoft Corp.'s Multiplan and the MIMIX and PC WORKS communications packages from Touchstone Inc.

Nevertheless, Abramowitz says there is a "definite need" for a data exchange standard for UNIX systems, and that the ISIS proposal could be beneficial to an end user in an office environment by consolidating databases for multiple applications. "The ISIS group has approached this area properly," the MSD executive says. "There will be some standard established."

ISIS still not widely accepted

The ISIS draft has not met with immediate widespread acceptance. One software developer says it will take a year or more and require the strong endorsement of a major hardware manufacturer for ISIS to come under serious consideration by the 100-odd companies estimated to be working on UNIX applications. Another says that ISIS could suffer from the "not-invented-here" syndrome that will delay acceptance of

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CIRCLE NO. 32 ON INQUIRY CARD

the ISIS standard by most software companies.

Other software developers, however, are keeping their eyes on what happens with the proposed standard and are preparing versions of their packages with the ISIS headers in case ISIS finds acceptance as a de facto industry standard. These companies include Data Resources Inc. and The Santa Cruz Operation.

Gnostic's Boyce predicts that ISIS will gain enough momentum by 1985 to change the "not-invented-here" syndrome to the "me-too" syndrome.

ISIS is an inclusive standard, not an exclusive one," Boyce says. "It's generic enough, sensibly drawn, and so beautifully vanilla that it will run on any UNIX variation." □

Teletype adds 200-cps dot-matrix printers

David Bright, Assistant Editor

AT&T has followed up the spring announcement of its 3B computer line with several related products, including dot-matrix printers. The company's Teletype Corp. subsidiary, a longtime supplier of terminals and printers, recently announced the 5300 family, intended to compete with Digital Equipment Corp.'s LA120.

The popular LA120 is noted for its reliability. But Teletype marketing vice president Daniel Printz stresses the new units' own reliability, plus their speed, flexibility and features. He expects half of the new products' sales will be to AT&T for integration with the 3B series. The rest will go to other OEMs and distributors.

Each of the two models in the 5300 line operates bidirectionally, producing draft-quality copy at speeds up to 200 characters per second (cps). DEC's LA120 produces draft quality at 180 cps.

The compact model 5310 uses a 9-inch platen, and the model 5320 uses a 15-inch platen. All other components of the two printers are interchangeable, including the ribbon cartridges. Teletype's nine-wire

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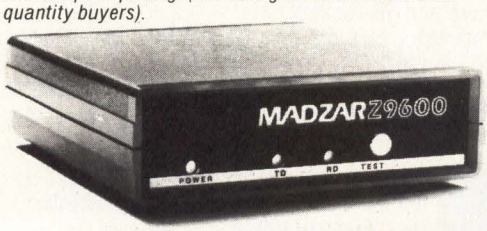

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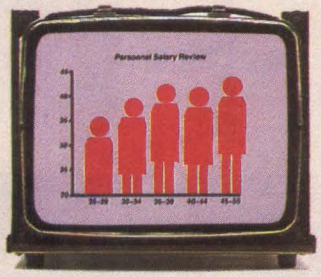
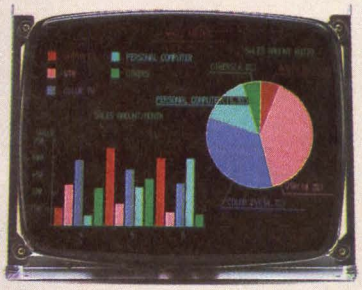
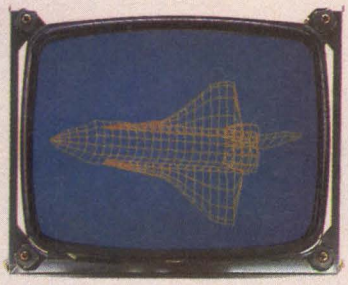


Administration

Order Entry



Marketing and Sales



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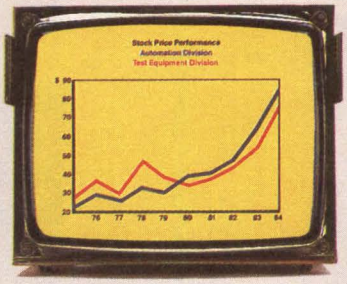

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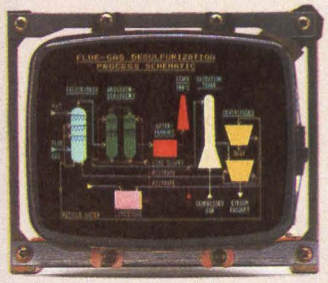

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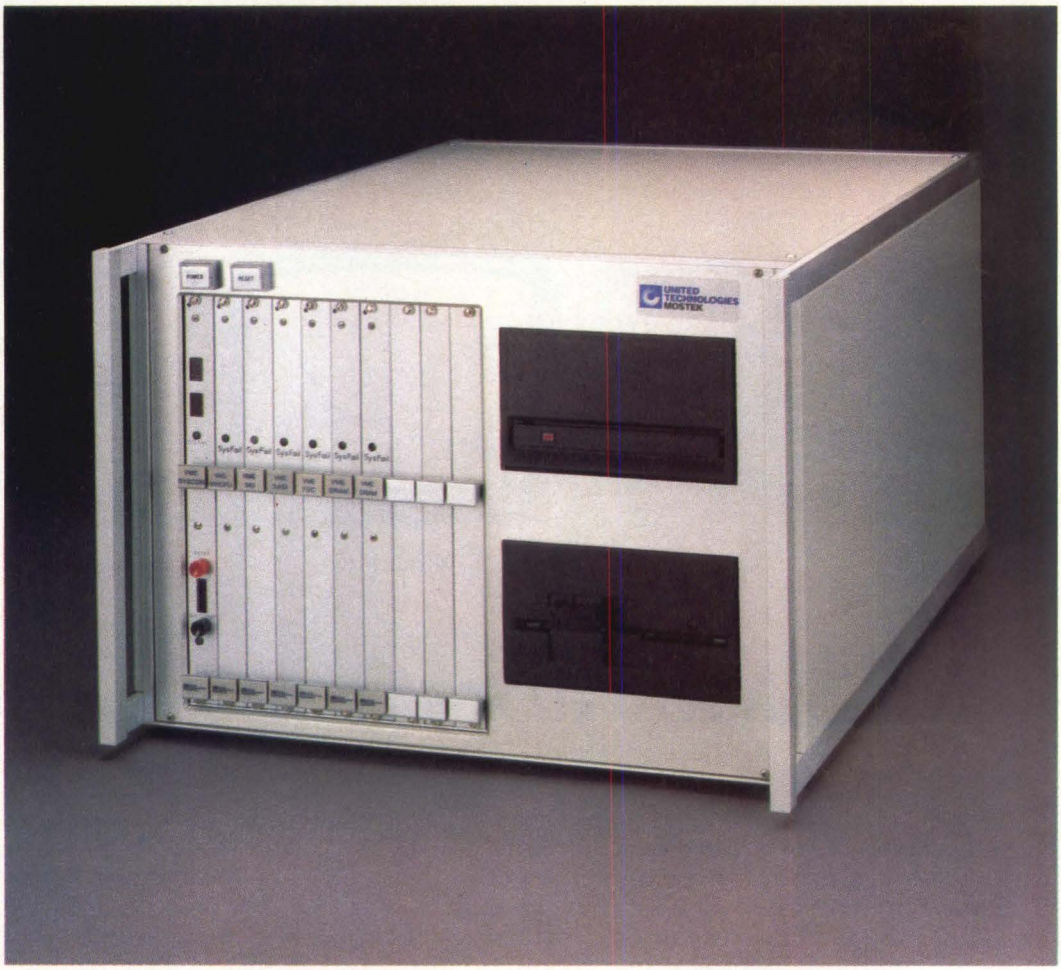

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CIRCLE NO. 36 ON INQUIRY CARD

AT&T announces UNIX network interfaces

AT&T has announced the first three UNIX System V network interfaces in its new COMMKIT network and communications software. The packages support the company's 3B computer line and other minicomputers running UNIX System V.

The synchronous terminal interface enables ASCII and EBCDIC terminals to communicate with UNIX System V minicomputers, while the Ethernet interface supports Digital Equipment Corp. VAX minicomputers in an Ethernet local-area network (LAN). The Ethernet interface provides batch file transfer, remote command execution, communications with other Ethernet-compatible machines and user-level compatibility with 3BNET, which is supported on the 3B line. The price for either interface is $5,000.

The HYPERchannel interface provides the software connection between 3B20 computers or other UNIX System V minicomputers and the HYPERchannel LAN from Network Systems Corp. The price is $10,000. All three products should be available in the fall.

print head has a life of 100 million characters, says Printz. The 5310 weighs 15 pounds; the 5320 weighs 21 pounds. Teletype's 5310 and 5320 and DEC's LA120 all handle communications speeds up to 9,600 baud. An integral modem is optional on the Teletype printers but not on the LA120.

The 5310 and 5320 become printing terminals with the addition of the optional, low-profile, detached keyboards. The 5320's keyboard has a built-in keypad. Setup is performed via eight pressure-sensitive buttons and a 4-character liquid-crystal display (LCD) on the front of the printers. The 300- to 1,200-bit-per-second modem performs auto-dial, auto-log-on and auto-answer, displaying the status on the LCD. Users can select line-buffer sizes of 256 bytes, 1K byte or 2K bytes.

Friction-feed platens are standard on both printers, with a pin-feed platen optional on the 5310. The 5310 has a "last-form-tear-off" feature that saves paper; it is unnecessary to feed an empty form through the printer between documents.

The printers contain three Intel 8051-based circuit boards: a controller, a print card and a board for the LCD. Users can replace the boards themselves by tipping the printers forward and removing four screws.

Printz says the maximum noise level on the printers is 74 decibels when producing high-resolution graphics. Fifteen character sets, including APL, Securities Industry, Finnish and Italian, are standard. The printers have three graphics modes: bit-mapped, business and Videotex with the mosaic element set. List prices range from $1,300 to $1,987 for the 5310 and from $1,775 to $2,463 for the 5320. □

TELETYPE CORP. 5300 FAMILY TAKES ON DEC LA120

	5310	5320	LA120
Print speed cps	200, bidirectional	200, bidirectional	180, bidirectional
Characters per inch	8 settings: 5-16.7	8 settings: 5-16.7	8 settings: 5-16.5
Character matrix size	7 x 9	7 x 9	7 x 7
Form width (in.)	3-9.5	3-15	3-14.9
Paper type	single sheet, roll, fanfold	single sheet, roll, fanfold	fanfold
No. of forms printed	6	6	6
Interfaces	RS232C	RS232C	RS232C, RS423
Integral modem?	$500 option	$500 option	no
Line buffer (bytes)	2K	2K	1K (optional 4K)
Weight (with keyboard) (lbs.)	15	21	102
Price ($)	1,300	1,775	2,420
Price with keyboard ($)	1,492	1,984	2,800

AT&T subsidiary Teletype *plans to sell its new 5310 (right) and 5320 dot-matrix printers to AT&T and other OEMs and distributors.*

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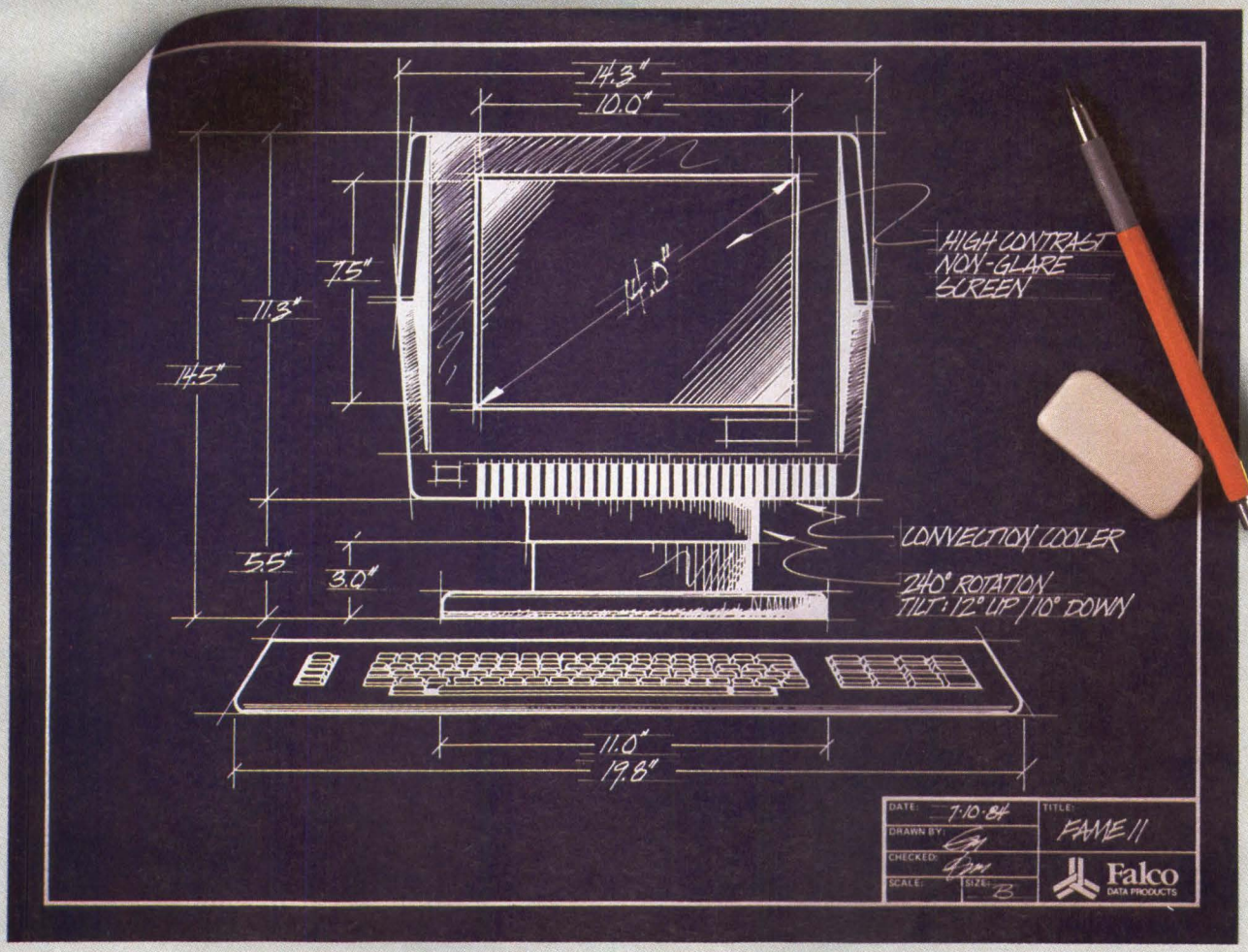

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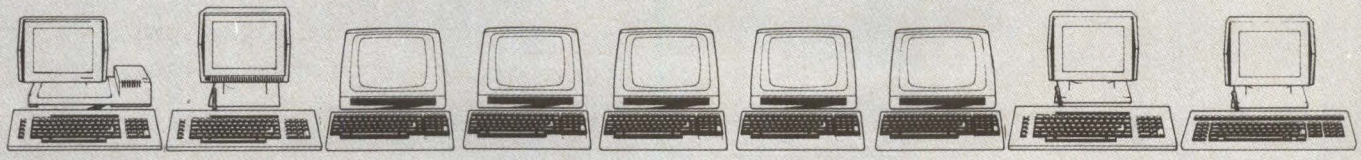

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CIRCLE NO. 38 ON INQUIRY CARD

Database manager eases OEM application-development tasks

Carl Warren, Western Editor

Aimed at OEMs and system integrators, the Probase database-management system (DBMS), developed by Probase Group, Redondo Beach, Calif., is a full-feature relational database manager for both 8- and 16-bit computer environments.

Even with microprocessor constraints, relational database systems provide users with a number of functions. Probase—available for systems using Digital Research Inc.'s CP/M-80 or CP/M-86, IBM Corp.'s PC-DOS or Microsoft Corp.'s MS-DOS operating systems—can support up to 16 million bytes per file on 16-bit systems and 1 million bytes on 8-bit systems. Although these files are larger than most microcomputer systems can accommodate, Probase supports large files across multiple diskettes.

Generators are the key

Probase's application generators are key product elements, says Probase president Curt Luce. Luce points to three optional aids for program developers: QUICK GEN, REPORT GEN and MENU GEN.

The screen-oriented QUICK GEN generates data-entry and display programs. Formats are laid out as if they were on a piece of paper. Field sizes and the proper entry format are selected by developers. Unlike other products, such as generators for Ashton-Tate's dBASE II and III database managers, QUICK GEN permits setting the order for entering each field. To maximize flexibility of the generated screens and data dictionary definitions, dynamically created tables can be edited to fine-tune the application. "Once the application is generated, the user can then further enhance the system by using the supporting development language," says Steve Bostwick, president of Query Computing Systems Inc., Torrance, Calif. "In addition, a master creation file can be kept for use when the database-entry system has to be changed. The operator needs only the final results."

Probase Group's president, Curt Luce, *is waiting to see what AT&T's impact on the software industry will be. He's taken a conservative approach in making the Probase database-management software more portable by using the C language.*

REPORT GEN and MENU GEN are used in the same manner as QUICK GEN but serve special purposes. One of the major problems with database-management systems, according to both Luce and Bostwick, is their inflexibility in creating reports. Therefore, REPORT GEN lets users design a report by moving the fields around on the screen as in creating the database. "Virtually any form design desired can be created," claims Luce.

The MENU GEN links many defined databases and functions. For example, many menus can be nested—one calls the other, and each defines a different set of functions.

Networking available but . . .

Due to the increasing emphasis on multiuser capability in networks, the Probase Group offers Probase Net, which is compatible with 3Com Corp.'s Ethernet local-area network. The Probase software allows as many as 100 users on the network and—like Ashton-Tate's—provides record-locking to ensure proper updating and security of files.

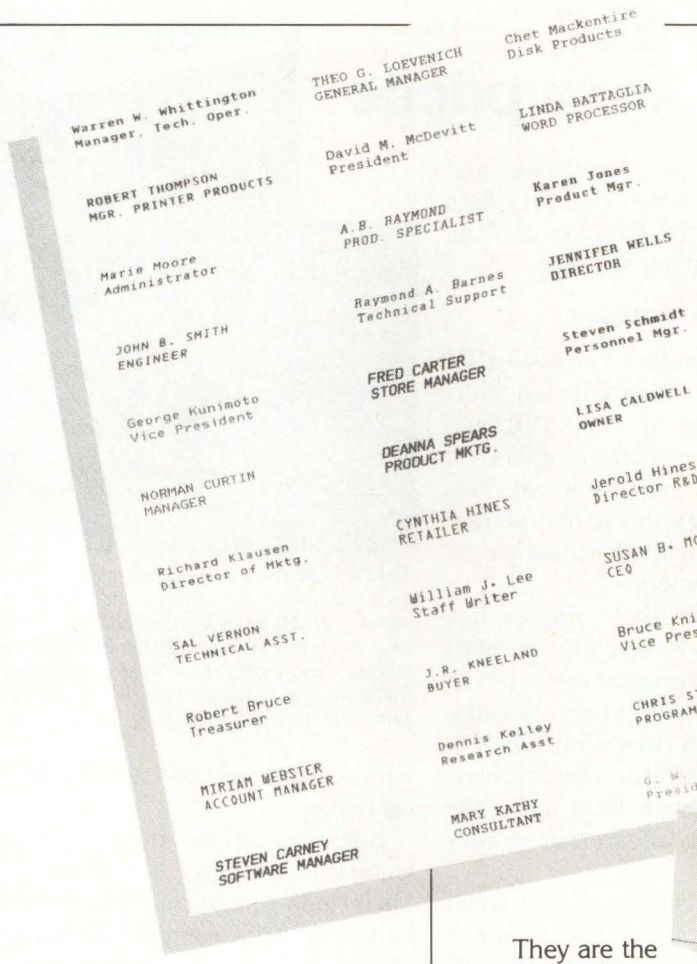
A back door to portability

Software portability is a major industry issue, and Luce is taking a back-door approach. "Right now, we have Probase written in machine-dependent code. However, the application definitions and databases are portable. Plus, due to the flexible command language, users can quickly create a utility to port foreign files to operate under Probase or back to [operate under] another product such as MicroPro International Corp.'s Wordstar. We consider this to be solving one of the major problems in portability." In addition, Probase comes with utilities that handle file translation, thus saving the integrator's time.

But Luce isn't forsaking the portability of the product either. Probase is exploring the optimum method of providing processor-independent code so that Probase can be ported to any processor. "We will soon have a version of Probase written in C. The question is, however: Is it the optimum language for the long haul? We think there may be other options. A great deal depends on AT&T's influence on the overall market.

The Probase system including the three generators sells for $390; Probase P without the generators sells for $180; the program generators alone sell for $210; and Probase Net lists for $540. Probase R, a run-time-only version, sells for $90. □

Printers as versatile as the people who use them.



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They are the first true multi-speed, multifunction integrated letter-quality and graphics printers available.

The GP300 product line features Philips' proprietary and field-proven 18-needle print head. It produces single-pass dot resolutions up to 18×50 in text and up to 144×144 dots/inch for graphics. All at speeds up to 300 cps.

You can use the printer interface to load any of the 95 character sets including OCR-A and -B, bar codes, dot addressable graphics, forms, and logos. You can even extend your print horizontally or vertically to produce super-high or super-wide characters as well as non-alphanumeric symbols.

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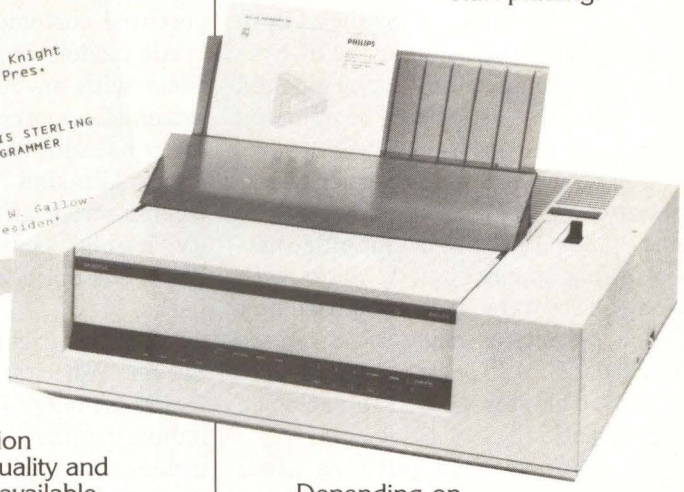

Depending on your application, you can choose from a complete line of paper handling devices including platen, tractor, or front feed as well as automatic single sheet handlers.

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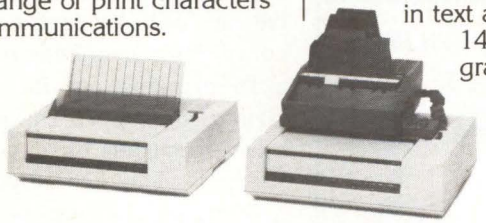

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CIRCLE NO. 39 ON INQUIRY CARD

Grid links products to IBM, expands portable line, cuts prices

Tom Moran, Associate Editor

Grid Systems Corp., Mountain View, Calif., has expanded its family of Compass portable computers. It also has linked its products to the IBM Corp. environment via networking, MS-DOS compatibility and software for terminal emulation and data-file conversion.

Grid introduced its new version, Compass II, in two models: the 256K-byte 1121 at $6,795 and the 512K-byte 1129 at $7,995. Both have four sockets for 128K-byte ROM cartridges that can be plugged in by users. Grid should be shipping the 10-pound portables.

A new $3,450 GridServer workstation is a bare-bones version of the Compass designed for office networking applications. It works with the GridServer, a desktop base unit that permits as many as 58 remote or local IBM PCs and Compasses to share disk storage and to exchange information.

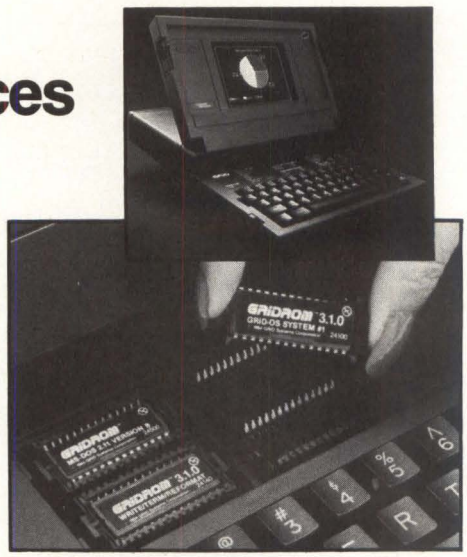
Three new Grid software products are GridAccess, a telephone-management program for Compasses; GridRecord/GridPlayback, which replicates long command sequences with one keystroke; and GridTransfer, which converts data files between the Grid-OS and the MS-DOS operating systems.

Grid plays the IBM card

MS-DOS support, Grid-to-IBM PC data-file translation and software emulation of IBM 3101 and 3270 terminals combine to give Grid users access to the IBM world. This product strategy should help attract those whom Grid identifies as its potential customers.

All models in the Compass line come with an 8086 CPU, an 8087 arithmetic coprocessor and a 6-inch diagonal electroluminescent display. Although the 25-line-by-80-column screen affords excellent clarity, its high power drain limits the life of the optional external battery packs.

With the exception of the GridServer Workstation, the Compass family members sport 384K bytes of bubble memory. The Compass IIs include the four ROM sockets and one 128K-byte ROM pack with system utilities. ROM cartridges will start at $225. MS-DOS, the Grid word processor, and the Grid terminal emulator are available on ROM cartridge.



Grid's Compass II *offers as much as 1.4M bytes of solid-state memory, including 512K bytes of RAM, 384K bytes of bubble memory and as many as four 128K-byte ROM cartridges. Grid is offering a ROM cartridge with software that emulates IBM 3101 and 3270 terminals, among others.*

Like two of the three previous Compass systems, both Compass IIs include an integral 300- to 1,200-baud Bell 212A-compatible modem.

Portable stores 1.4M bytes

Starting with 512K bytes of RAM and 384K bytes of bubble memory, the Compass II 1129's on-board memory can be expanded to 1.4M bytes using four 128K-byte ROM packs. Grid claims the Compass II has at least twice the memory of competing briefcase portables.

In bringing out its new family, Grid also dropped the prices on its existing models by 23 percent to 30 percent. The 256K-byte Compass 1100 was $5,995 and is now $4,250. The Compass 1101 with 256K bytes of RAM and 384K bytes of bubble memory, was $6,795 and now sells for $4,995. The 512K-byte Compass 1109, which topped the line at $7,995, now sells for $6,195. It also has 384K bytes of bubble memory. □

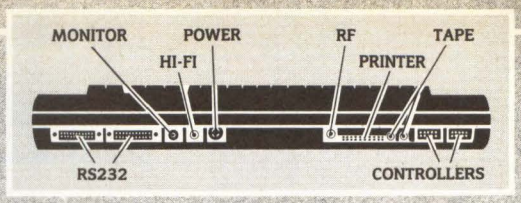
GRID EXPANDS PRODUCT FAMILY, ADDS ROM SLOTS TO HIGH END

Model	EL display 8086 8087	RAM memory (K bytes)	384K-byte bubble memory	512K-byte ROM slots	1200/300 baud modem	Price ($)
GRiDServer Workstation 1705	•	256				3,450
Compass 1100	•	256	•			4,250
Compass 1101	•	256	•		•	4,995
Compass 1109	•	512	•		•	6,195
Compass II 1121*	•	256	•	•	•	6,795
Compass II 1129*	•	512	•	•	•	7,995
Tempest 1107	•	512	•	•		12,495

*includes one 128K-byte ROM pack with system utilities

Source: Grid Systems Corp.

The MTX512 opens up to endless OEM possibilities.



Until now, micros meant limitations. In hardware. In performance. And in OEM applications. But the new Z-80A based MTX512 micro computer opens up a whole new world of applications for OEMs. Because it gives you power and flexibility no micro has ever given you before. Especially when you consider the base price—under $600 retail.

A designer's dream

The MTX512 will surprise you with its standard features. 16 color high resolution graphics. 8 simultaneous windows. Cartridge ports for up to 4MB ROM, pageable in 32KB increments. An uncommitted parallel port. Centronics parallel printer port. Monitor, RF, hi-fi and cassette ports. Plus 104KB of memory—including 64KB user RAM—expandable to 512KB through user-transparent memory segmentation. But don't stop there. The MTX512's open architecture lets you customize to your own needs. Internal expansion slots let you add twin RS232C ports, plus your own custom boards. Optional floppy, hard disk or silicon disk drives provide storage up to 160 MB. You can even connect up to 256 units together in our Oxford Ring–Local Area Network (LAN).

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Add disk drives, and the MTX512 runs CP/M,* allowing you to choose from the world's largest library of software.

Quality components for added reliability.

When you use computers in your applications, assurance in quality and performance is essential. The MTX512 is designed around proven components, like the Zilog Z80A (running at 4 MHz) and the TI 9928 video processor. All housed in an anodized aluminum case, which not only provides extraordinary durability, but heat dissipation and RF protection as well.

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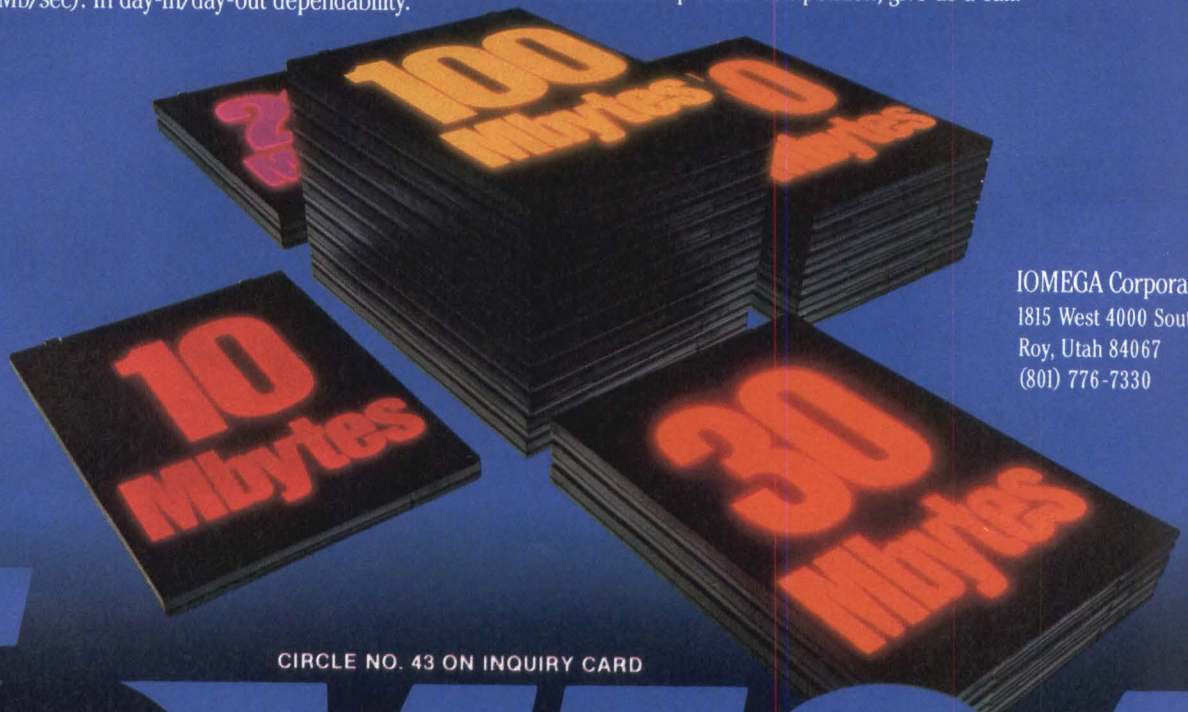

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CIRCLE NO. 43 ON INQUIRY CARD

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Franklin's success sours after Apple lawsuit

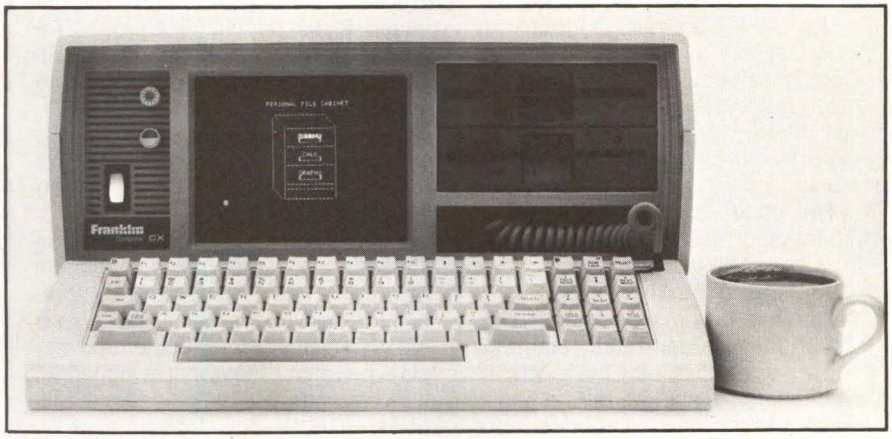
David Bright, Assistant Editor

Franklin Computer Corp., once a highly prosperous Apple-compatible vendor, is now faced with the possibility of closing. Following a wave of top management resignations, massive layoffs and production delays on its new portable microcomputer, the 3-year-old Pennsauken, N.J., company filed in late June for federal bankruptcy protection under Chapter 11.

Until very recently, the company appeared to be growing at a healthy pace. In its fiscal year ended in March, Franklin said it sold 70,000 Ace computer systems, causing revenues to jump to $71 million, from $28 million the previous year. At one time the company boasted more than 1,500 dealers. And former president Avram Miller, previously manager of Digital Equipment Corp.'s Professional computer program, had bigger plans for the company. Miller had recruited several top engineers from IBM Corp., DEC and other industry leaders to build the CX portable computer, which runs Apple II software as well as MS-DOS and CP/M. After Franklin had settled out of court an 18-month-long legal battle with Apple Computer Inc. last January, its future seemed assured.

Apple had claimed that Franklin illegally copied the Apple operating system, which resides in ROM. Franklin agreed to develop its own operating system, which is split between ROM and disk memory. In return, Apple gave Franklin a grace period of three months to make the changeover.

At that time, Franklin co-founder and chairman Barry Borden called the settlement (for $2.5 million) "wonderful." "This will work out fine for both companies," he said. Borden has since left the company.



Franklin Computer Corp.'s 27-lb. CX computer *is the first portable to run Apple II software, MS-DOS and CP/M. However, Franklin is strapped for funds and may not be able to produce the CX in quantity.*

Apple lawsuit drained Franklin

But Franklin's recent troubles may stem from that long fight with Apple. "They just didn't bounce back from the Apple lawsuit," sums up a source close to the company. For one thing, Franklin's investment in the new operating system called for in the settlement was "substantial," as Borden put it. To make matters worse, Franklin was late shipping computers with the new system.

Meanwhile, Franklin was also readying the CX portable for a May introduction. Then, in early April, Miller resigned, saying his long-range professional goals could not be fulfilled at Franklin. "My real interest was in developing a large, broadly-based company engaged in microcomputer applications beyond the personal computer industry," he said. About the same time, the company laid off 70 of its approximately 500 employees.

Most of Miller's management team has since resigned, including William Sydnes, operations vice president; Varam Erdekian, manufacturing vice president; and Eugene Sherman, marketing vice president. After further resignations and layoffs, the company finally let go 160 of 275 employees remaining at the time of the Chapter 11 filing. Co-founder Joel Shusterman, who had resigned in February, returned three months later as acting president.

Still hoping to recover

Shusterman and new chairman Morton David still hope to save Franklin. The company's "loyal" dealers and the fact that Franklin makes the only legal Apple-compatible portable are stressed by Shusterman as strong points. In a statement announcing the bankruptcy filing, David said the company was negotiating to be acquired.

But analyst Alan Hirsch of Datapro Research Corp. says Franklin's efforts are not going to be good enough. In his opinion, "only Apple can introduce an Apple II portable and get away with it." Apple can easily quash any Apple-compatible competition by decreasing its prices, he explained. Furthermore,

...and Osborne is reborn

Tom Moran, Associate Editor

As Franklin was filing for bankruptcy protection, the Osborne Computer Corp. received court approval for its own reorganization plan. After an official, 60-day waiting period, Osborne expected to be healthy by early this month.

The once successful innovator of the transportable computer is moving from its 112,000-square-foot Hayward, Calif., facility to a 24,000-square-foot building in Fremont, Calif. Under the reorganization plan, Osborne becomes a new company. It's creditors receive $15.5 million and 20 percent of the new company's stock. Controller Mike Anthofer says Osborne's $15.5 million debt already has been reduced to less than $9 million, and will be paid off within 15 months. At one point, the company even auctioned off furniture and equipment, netting $1.1 million for its creditors.

Osborne will contract its manufacturing to third parties who will provide it with systems packaged for vertical markets. The company plans to sell half of its products overseas, says vice president of operations Chodi McReynolds.

Even as the bankruptcy protection proceeded, Osborne's products continued to be popular in Europe. Towards the end of reorganization, 80 percent of the company's sales were in overseas markets. Osborne currently has approximately 60 domestic dealers and will continue looking for major account sales in vertical markets, says McReynolds.

Osborne president Ronald J. Brown stresses the company's commitment to portable and transportable computers. But its IBM-compatible portable is not a significant factor in the recovery plan, he adds. Osborne has signed an OEM arrangement with Vadem of Milpitas, Calif., for Vadem's 9-lb. MS-DOS portable with built-in modem, 5¼-inch disk drive and LCD screen. Brown says Osborne will sell the Vadem machine overseas after adding value in the form of communications products.

Former chairman Adam Osborne and former president Robert Jaunich remain on the board of directors, but neither is involved in the company's day-to-day operations. Adam Osborne has begun a software publishing concern and Jaunich is working as a consultant to venture capitalists.

Hirsch says, the Apple II base is eroding. Franklin is trying to "scrape the crumbs off the market, but those crumbs are dwindling." He added that he also feels Franklin suffers from poor management.

Egil Juliussen of the market researcher, Future Computing Inc., Richardson, Texas, claims "the market is there" for another Apple-compatible portable. The problem with Franklin is that it grew too fast and lacks a "top-notch management team," he says. He further suggests that the management shuffle was the result of a power struggle.

Another problem at Franklin is one that plagues many other small computer companies: money. Miller's vision was apparently bigger than his company's bankroll. Franklin might have been able to absorb the $2.5 million payment to Apple, but there were other, related costs, such as legal fees for the long litigation process, development costs for the new portable and for the new operating system, and losses resulting from the late shipment of the operating system. The expense of bringing Miller and his associates to the company, and construction of a new building, added to Franklin's monetary troubles.

The company had accumulated $6 million in venture capital and had planned a stock offering to get more cash. But it delayed the initial offering, Miller said last fall, because of the impending introductions of the IBM PCjr and the Apple Macintosh.

Upon rejoining Franklin, Shusterman conceded that the financial bind caused by witholding the stock offering, combined with the pressure of developing new products, had "produced a very anxious environment" at Franklin.

Product manager Gwen Lurie remains optimistic about the CX portable. She claims Franklin's "high assets" put it in better stead than most Chapter 11 companies. But those assets may not be high enough. Reportedly, Franklin even had trouble getting the bankruptcy protection press release out to the media. The company's public relations outfit refused to send it out because Franklin was behind in payments, according to an agency employee.

Franklin's initial CX shipments were delayed from June to late August due to "parts shortages," but Lurie says that may actually be "a blessing" because it allows more time to fully test the machine. However, continued delays will give Apple more operating time to staurate the market with its IIc portable.

If Franklin finds a way to produce the CX in quantity, it must also hang onto its dealer network, which has fluctuated between 900 and 1500 outlets. William Peer, president of one such dealership, Lane Business Systems, Morris Plains, N.J., says he plans to stay with Franklin, if it can produce. But he admits the situation is "up in the air," noting the company had not even notified him about late shipments. □

Wet Ink

Archive Corp., Costa Mesa, Calif., recently signed several companies to contracts for its ¼-inch, streaming cartridge tape drives. Altos Computer Systems Inc. will buy $6 million worth of Archive's 60M-byte drives over two years, while Media Distributing Inc. is committed to purchasing $5.5 million worth of drives. Point 4 Data

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Corp. and Maynard Electronics Inc. will buy $3.3 million and $3 million worth, respectively....**Language Processors Inc.**, Waltham, Mass., landed two contracts for its LPI-COBOL compiler. In a $4.5 million, five-year deal, NCR Corp. will offer the compiler with its Tower MC68000-based computer. Plexus Computers signed to purchase $3 million worth of the compilers over five years....In a $4 million, 18-month agreement, Data Phase Corp. agreed to purchase approximately 60 Parallel 300 fault-tolerant computer systems from **Parallel Computers Inc.**, Santa Cruz, Calif. Data Phase will add its library information software and resell the systems to libraries....MDS Quantel Inc. and **Printek Inc.**, Benton Harbor, Mich., signed a multi-year agreement for MDS Quantel to purchase at least $3 million worth of Printek 930 printers. MDS Quantel also acquired manufacturing rights to the 930. The printers will be used with MDS Quantel's office workstations....**Shugart Corp.**, Sunnyvale, Calif., recently picked up two contracts for its half-height 5¼-inch minifloppy disk drives. Mindset Corp. will use the 500K-byte drives in its new IBM PC-compatible computer, optimized for graphics. And Zenith Data Systems will incorporate the drives in its new Z-100 PC series of IBM-compatible desktop and portable computers. The Mindset agreement is for $8 million; the Zenith, for $3 million....**Western Digital Corp.**, Irvine, Calif., will supply TeleVideo Systems Inc. with $5 million worth of Winchester and floppy disk drive controllers. The controllers will be used in TeleVideo's multi-user and personal computers. Western Digital has been supplying TeleVideo with controllers since 1981.

Quarterly report

For the 12 weeks ended June 2, **Data General Corp.** reported that revenues surged to $277.1 million from $188.7 million for the same period a year earlier. Earnings increased to $19.6 million, or 74 cents per share, from $4.3 million, or 18 cents per share a year previously. For the 36 weeks ended June 2, revenues reached $745.1 million, compared to $557.1 million for the same period a year ago. Net income for the 36 weeks rose to $41.2 million from $12.5 million. □

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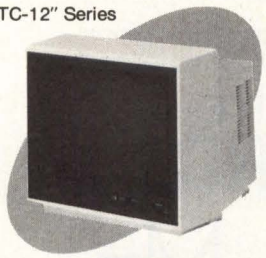
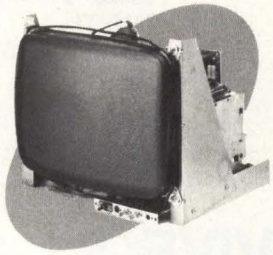
	FTC-1203-R* (0.38mm Dot trio)	FTC-1201-N (0.47mm Stripe)	FTC-1201-P (0.47mm Dot trio)			FTC-1208-I (0.28mm Dot trio)
	FTC-1208-R* (0.28mm Dot trio)					
14" (CRT Pitch)	FTC-1423H-R (0.42mm Stripe)	FTC-1410H-N (0.52mm Stripe)	FTC-1410H-P (0.52mm Stripe)	FTC-1410H-NR (0.52mm Stripe)	FTC-1410H-PR (0.52mm Stripe)	FTC-1435-I (0.39mm Dot trio)
	FTC-1435H-R (0.39mm Dot trio)	FTC-1416-N (0.64mm Stripe)	FTC-1416-P (0.64mm Stripe)			FTC-1455H-I (0.31mm Dot trio)
	FTC-1455H-R (0.31mm Dot trio)					

FTC-12" Series



Application/NTSC・PAL (Commodore・Apple II, IIe), RGM (IBM PC・Apple II, IIe, III・RGB TTL & Analog)
*FTC-1201-R, 1208-R: Applying for FCC Standard (Class B). *through Interface-Module
*FTC-1203-R: Acquired FCC Standard (Class B). FTC-1203-R, 1203-I : Non-Glare

CDM-14" Series



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CDM-1203	12"	0.38mm Dot trio
CDM-1201	12"	0.47mm Stripe
CDM-1455H-R	14"	0.31mm Dot trio
CDM-1435H-R	14"	0.39mm Dot trio
CDM-1423H-R	14"	0.42mm Stripe
CDM-1410H-R	14"	0.52mm Stripe

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Taiwan's PC-compatible makers stumble following problems with IBM copyrights

Charles Hintermeister
Taiwan Correspondent

The enthusiasm and optimism with which Taiwanese computer makers entered the IBM PC-compatible market last year appears to be dwindling. Victims of strong local and international competition, Taiwanese companies are also being forced to contend with their own underveloped distribution channels, a recent IBM PC price cut and an underlying fear of continuing legal difficulties with their products.

Taiwanese computer companies had once set their sights on a PC-compatible market that promised a bonanza for all—one which would lift the island's young computer industry out of the legal morass and economic dead end of Apple II counterfeiting. Now, they have largely abandoned the idea of entering the U.S. market using their own brand names, and are increasingly counting themselves lucky to land OEM deals. Taiwanese makers who displayed PC-compatible systems at the July National Computer Conference in Las Vegas, Nev., say they were there looking primarily for OEM buyers in the United States.

Stan Shih, chairman of Multitech Industrial Corp, *says IBM's price cuts will benefit Taiwan's computer industry, because more U.S. manufacturers will seek offshore manufacturing sites.*

IBM challenges Taiwan's BIOS

The manufacture of 16-bit PC-compatibles in Taiwan began last year with a development project sponsored by the Electronics Research Service Organization (ERSO), an arm of the government-run Industrial Technology Research Institute. Nine companies each paid as much as $150,000 for rights to manufacture and distribute their own versions of the PC-compatible machine that ERSO designed. A number of other Taiwanese companies came up with their own designs.

The ERSO prototype was independently designed, ERSO assured the nine firms, and would not likely lead to a legal conflict with IBM. But, although it appeared that ERSO went to considerable lengths to design a basic input/output system (BIOS) that did not violate IBM's copyrights, IBM reportedly wrote to Taiwanese manufacturers and government officials in April that it had not succeeded. Several shipments of Taiwanese-made 16-bit PC clones were detained at U.S. Customs, and Taiwan's Ministry of Economic Affairs threatened to impose a ban on the export of such

When compatibility becomes counterfeiting

When IBM accuses PC clone makers of copyright infringement, the charge generally involves copying the basic input/output system (BIOS), which plays a crucial role in determining the degree of compatibility with software written for the IBM PC. It was with this in mind that Taiwan's Electronics Research and Service Organization (ERSO) designed the BIOS for its IBM PC-compatible system, says Chia-Chi Chin, manager of ERSO's System Design Technology Group.

"The ERSO BIOS was independently developed," declares Chin, "and does not violate IBM copyrights." Chin, who played a leading role in ERSO's IBM PC-compatible development project, says the project took about one year to complete and involved 11 ERSO engineers. "If we had wanted to simply copy the IBM PC," he said, "we could have done it in a few weeks at considerably less expense. Instead, we developed our own independently."

IBM appears to disagree. Chin admits that ERSO used published IBM material relating to the PC, a step which IBM Taiwan Corp. general manager Barry B. Lennon deplored. Not only should ERSO not have used IBM PC documents, says Lennon, they should not have had anyone on their development team who had more than a passing familiarity with the IBM PC. Only in this way, he says, could ERSO have assured itself of coming up with a truly independently developed product.

When ERSO officials met with IBM attorneys in April, says Chin, they discussed only the principles of what constitutes copyright infringement, and did not enter into technical details. The changes that ERSO subsequently made in the BIOS, he says, were carried out entirely by ERSO engineers without IBM's involvement. Consulting firm Arthur D. Little Inc., Cambridge, Mass., acted as a bridge in discussions between ERSO and IBM, Chin says.

systems until the problem was resolved. Though the threat was never carried out, many companies complied with a request from both IBM and the Ministry to temporarily slow, or halt, exports.

IBM attorneys visited ERSO headquarters in Taiwan's Hsinchu Science-based Industrial Park in April. Although what passed between the attorneys and ERSO was largely kept secret, local news reports indicated that a review of records and documents pertinent to the development process convinced IBM that ERSO's prototype did indeed violate IBM copyrights on the PC's BIOS. The attorneys reportedly agreed, however, that the similarities between the two BIOSs were "minor and unintentional." ERSO carried out some necessary changes, apparently with the help of foreign legal and technical advisors, and IBM is said to have written ERSO in May that it no longer considered ERSO's BIOS to be in violation of its copyrights.

Worries persist

The incident threw a serious scare into Taiwanese PC-compatible makers, many of whom used to make Apple II look-alikes until legal problems led them to stop. Shipments have since resumed and, for the most part, are passing U.S. Customs. But delays in getting products into the United States, coupled with IBM's recent price cuts for the PC of 18 percent to 23 percent, have made U.S. marketing efforts even tougher for the Taiwanese concerns.

The price advantage held by Taiwanese computer makers has been seriously reduced by IBM's price cuts. As lower price had been Taiwan's major—perhaps only—advantage, many Taiwanese 16-bit system makers are considering getting out of the market. Selling to OEMs is not enough, they say. "Even though we have our own office in the United States," explained Michael Conley of Multitech Industrial Corp., "we realized some time ago that we don't have the ability to effectively market our MPF-PC there." Multitech, a large Taiwanese computer manufacturer, recently signed an OEM agreement with Applied Digital Data Systems (ADDS), Hauppauge, N.Y., under which Multitech's MPF-PC will be exclusively marketed in the Unites States under the ADDS' PC-1 model name.

OEM sales are difficult, too

Tim Juan, a marketing specialist at Mitac Inc., Taupei, Taiwan, takes Conley's pessimism one step further, saying that not only are Taiwanese makers unable to penetrate the 16-bit PC market in the United States, but that prospects for OEM sales look dim as well. The reason, he says, is that since the IBM PC price cut, U.S. OEM buyers have been offering to buy systems for around $800 free on board (FOB), meaning OEMs would then own the systems. That would enable the Taiwanese to send the product to the United States for about $1,000. Taiwanese manufacturers, however, says Juan, are generally unable to deliver 16-bit systems for so little.

As evidence of the local industry's dim view of the future of the IBM PC clones, Juan said that negotiations between Intel Corp. and the Taiwanese government for rights to manufacture the 8088 microprocessor in Taiwan have been abandoned. Other industry observers have suggested that the negotiations were dropped simply because the persistent, serious shortage of 8088 chips in Taiwan has largely eased.

Juan and others at Mitac believe that the product life of 16-bit IBM PC-compatible systems is limited, and that far-sighted Taiwanese firms are now preparing to act as OEM manufacturers for the coming wave of 32-bit systems. Mitac shocked the industry last year by declining to participate in the ERSO development project, choosing instead to make its own PC-compatible system.

Multitech's chairman, Stan Shih, still anticipates opportunities for Taiwanese companies in the PC-compatible business. While agreeing that most Taiwanese computer firms—his own included—had been overly optimistic about their ability to distribute their own products in the United States, he believes the IBM price cut will, in the long run, benefit Taiwan's computer industry. "The price cut," he says, "will cause a serious shake-out among U.S. manufacturers of IBM PC-compatible systems, and will force increasing numbers of them to seek offshore manufacturing sites. A number of those sites will undoubtedly be in Taiwan." U.S. manufacturers have always held a strong lead in technology and product design, he says, but have lost their edge in production, thus obliging them to increasingly seek out overseas manufacturers. □

POSTAL SERVICE'S ECOM MAIL SYSTEM ORDERED SOLD

The Postal Service Board of Governors has ordered the U.S. Postal Service to sell its ECOM computerized mail system. The decision came after months of criticism from government agencies and private companies that ECOM was stifling the development of the commercial electronic mail market by charging prices that were far below service costs, and illegally subsidizing the difference with revenues from first-class mail service. All ECOM equipment must be sold or leased to private companies, according to the board ruling. The board's decision came after it rejected a proposal that called for a price hike of ECOM letters from $.26 to $.39.

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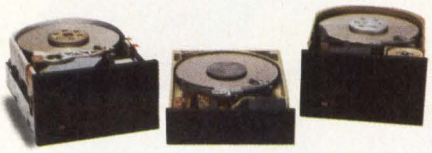

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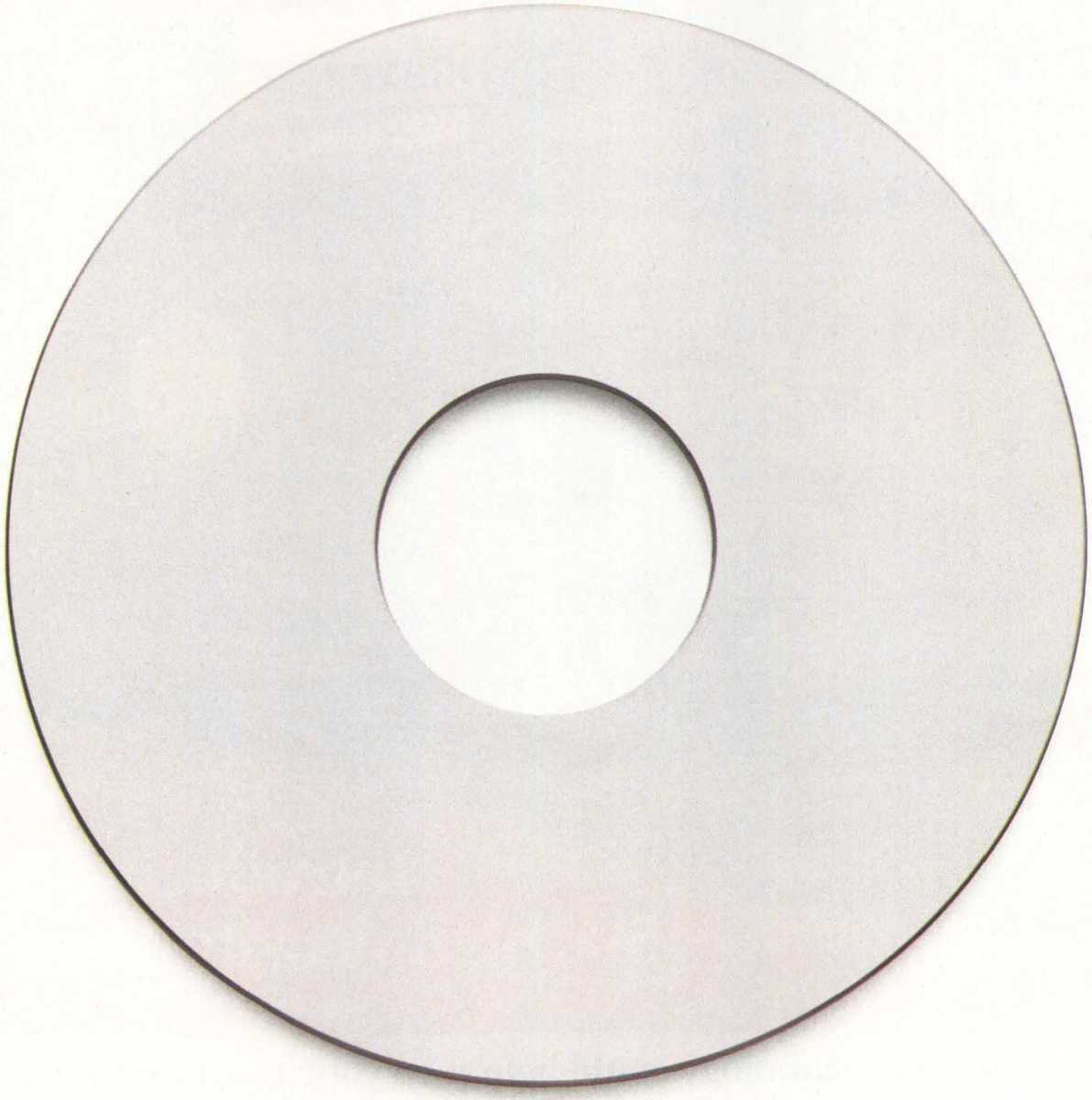

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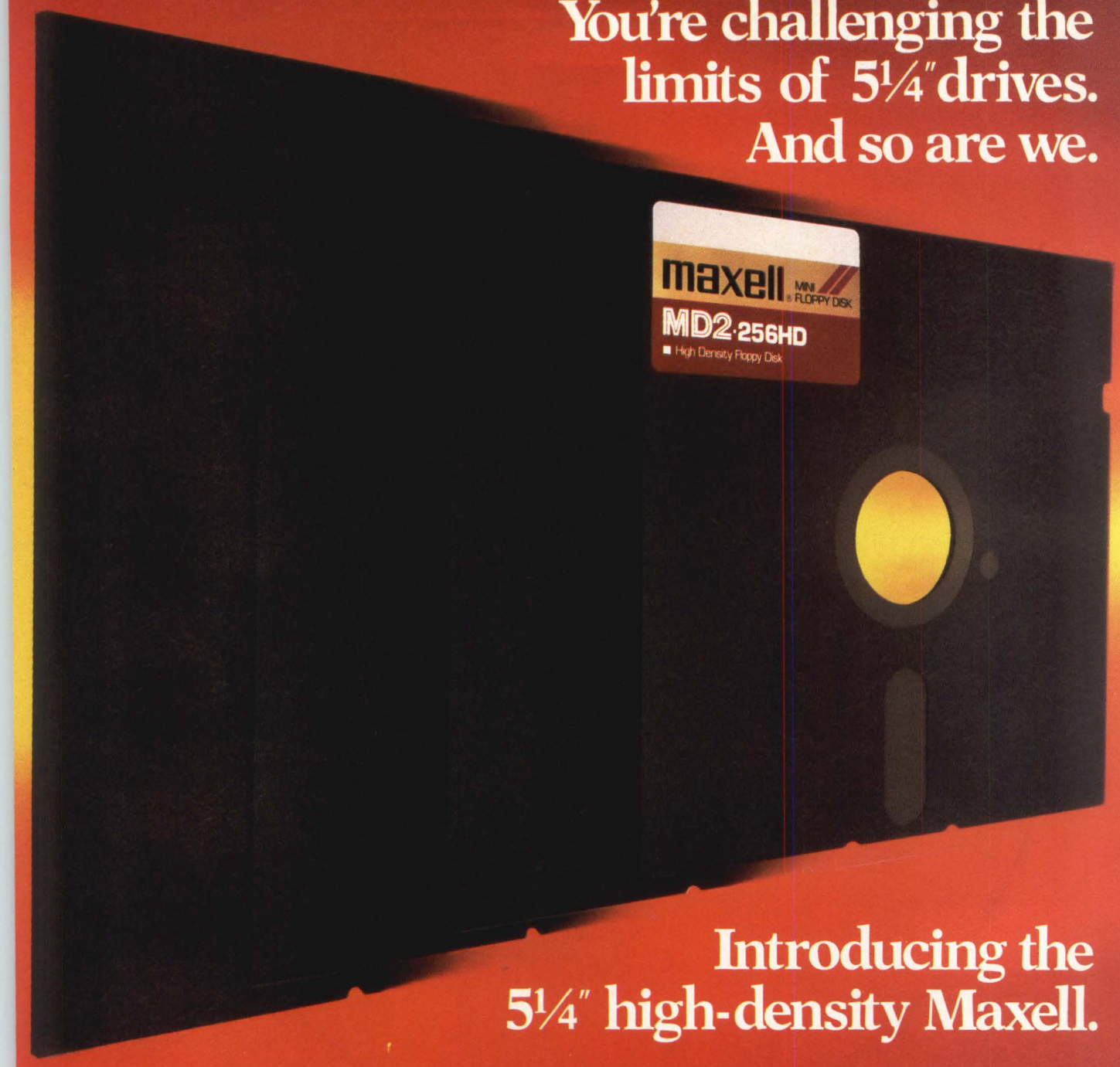

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CIRCLE NO. 48 ON INQUIRY CARD

Japan's stance on software copyright causes international rebuke

George Black
Contributing Correspondent

Any hopes for an early solution to the international dilemma over software copyright protection seem to have dwindled. Japan is at odds with the rest of the world on the issue.

The Japanese maintain that current copyright law is unlikely to provide adequate protection. Japan's Ministry of International Trade and Industry (MITI) early this year had proposed a bill to improve protection by requiring Western software vendors to deal by license through Japanese hardware manufacturers. But the bill included provisions to cut the period covered by a copyright from 50 years to 15 years. One of the bill's many Western critics, Dr. Douglas Eyeions, spokesman for the European Computing Services Association (ECSA), London, notes that obligating software vendors to sell through Japanese hardware manufacturers would be particularly intimidating to IBM. The U.S. view, which is broadly backed by most other nations, is that copyright law has worked well in the past and does not need changing.

The Agency for Cultural Works blocked the bill when it was debated in the Diet, the Japanese Parliament. The Agency controls such legislation, but a battle with MITI over the rights to introduce similar legislation continues.

The U.S. argument has been summed up by Sen. Frank R. Lautenberg, D-N.J., who was a cofounder of the computing service company Automatic Data Processing, Roseland, N.J. He says, "The MITI proposals would weaken consensus, encourage other nations to follow Japan's example and invite international retaliation." Terry R. Lautenbach, a vice president in IBM Corp's Information Systems Group, says that any nation that does not enact a suitable copyright law will be taking a divergent course from the rest of the world. The MITI legislative proposals on software, including systems software, would be disastrous for IBM, says Lautenbach, who argues that IBM is entitled to all the profits of its own research and risk-taking.

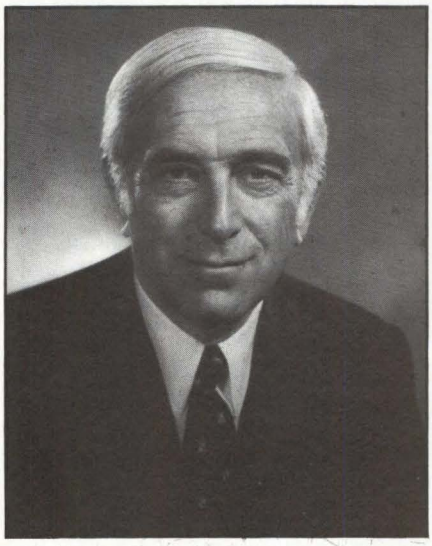
The 15 nations composing ECSA stand firmly behind the United States and IBM. According to ECSA's Eyeions, this is not only a Japan/United States issue, it is a Japan/rest-of-the-world issue.

Some Europeans fear that Japan is inviting piracy by claiming its existing law is inadequate to prevent it, says Eyeions.

The Japanese are particularly worried about the state of copyright laws in neighboring Far East countries. China, for instance, does not recognize copyrights, and China is Japan's biggest potential market. However, Yang Chao Shu, director of the Chinese government software center at Beijing, says China is reviewing the need to come into line with the rest of the world on copyright matters.

The president of the Japan Software Industry Association, Kazuro Fujimoto, asserts that no international consensus exists about software protection. Faced with angry protests by the Americans, the Japanese have tried to appear flexible. Zentaro Kitagawa, law professor at Kyoto University, emphasizes that Japan thinks the matter needs further study before any conclusion is reached.

The software protection issue came to a head at the World Computing Services Industry Congress



Sen. Frank R. Lautenberg *says dissenting software protection schemes proposed by Japan would weaken consensus, encourage other nations to follow Japan's example and invite international retaliation.*

Dr. Douglas Eyeions, *spokesman for the European Computing Services Association, notes that making Western software vendors sell products through Japanese hardware manufacturers would particularly intimidate IBM.*

held in Tokyo in June. Especially vehement during the session was John Maguire, president of the American software house, Software AG. He asked why a 1982 recommendation by the Japan Software Industry Association (JSIA) to MITI to adhere to the copyright formula has been ignored. Kitagawa responded that a difference of opinion had since arisen between JSIA and MITI.

The copyright issue could take years to sort out. The United States, strongly influenced by IBM's situation, is unlikely to yield. According to IBM sources, the company takes the matter very seriously. Contracts offered to IBM employees who write programs for the Personal Computer stipulate a 70-year copyright.

Eyeions' statement of unity in Europe reflects policy, rather than actuality. In his own country, Britain, no case has been brought to court to test the law. So far, cases have been settled out of court, which is less expensive. And, Lautenberg warns, Japan's neighbors may follow its example. Korea has yet to accede to either the Berne Copyright Convention of 1886 or the Universal Copyright Convention of 1952, and Korea's small software business has begun to grow at a phenomenal pace. □

George Black is the software editor of *Computer Weekly*, based in London.

Shrink wrap licensing binds software pirates

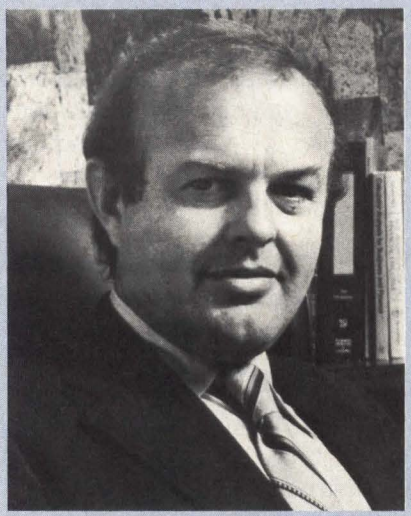
Keith Jones, European Editor

A novel way of preventing unauthorized duplication of software, called shrink wrap licensing, is being pioneered in California and Louisiana. Shrink wrap licensing establishes a software license as soon as a user breaks open the package in which a piece of software is contained. The license would theoretically be a contract prohibiting copying, modifying, selling or renting—and possibly, reverse engineering—of the software.

W. Krag Brotby, chairman and founder of Vault Corp., a Westlake Village, Calif., vendor of software portection products, says his company has worked closely with legislators in California and Louisiana on shrink wrap bills. Brotby says that shrink wrap licensing, added to existing state contract laws, will be more easy to enforce than federal copyright legislation. A problem with copyright, Brotby adds, is that software often can be rewritten to avoid copyright infringement, while providing the same functionality. He notes that a shrink wrap contract between maker and user can include the prohibition of such reverse engineering.

Brotby traveled to Europe, Australia and the Far East earlier this year to promote both the shrink wrap concept and his own company's products, which he describes as "not impregnable" and needing backup by legislation.

With a shrink wrap license, the user becomes a licensee of the software publisher the moment he or she opens the package, provided there is contract legislation affirming the legality of the agreement inside the package. Brotby cites the preliminary draft of a Software License Enforcement bill introduced to the California legislature by Assemblyman Gray Davis, D-Los Angeles. The bill says a license will be enforceable "provided that a written legend is affixed to, or packaged with, a copy of computer software in such a manner that the legend is clearly and conspicuously visible upon a cursory examination of the copy...and provided that the legend states clearly that (1) any use of the copy of the computer software will constitute acceptance of the terms of the accompanying license agreement and/or states that (2) any opening of the package, envelope or container in which the copy of the computer software is contained will constitute acceptance of the terms of an accompanying license agreement." It goes on to state that any user who does not agree with the license can return the unused, unopened copy of the software program to the party from whom it was acquired, within a reasonable period, for a full refund.



W. Krag Brotby, *chairman of the software protection company Vault Corp., is promoting shrink wrap protection in the United States, Europe, Australia, and the Far East.*

Brotby describes the software protection situation in Europe as "a shambles" because of the lack of legislation. A new pressure group in Britain called the Federation Against Software Theft has been set up to extend the criminal penalties of the Copyright Act to computer software. FAST members include the British operations of IBM Corp., Digital Equipment Corp., Digital Research Inc., and Microsoft Corp.

On behalf of FAST, a member of Parliament is promoting a bill that would provide a fine of up to $3,000 for each illegal copy made, and up to two years in prison. These penalties already apply to records, films and video recordings. One member of FAST's management group, Roger Tuckett, a senior commercial lawyer with DEC Ltd., Reading, England, estimates that DEC in Britain loses $15 million each year in licensing fees through unauthorized copying and usage. FAST estimates that overall software theft in Britain totals up to $250 million a year in lost revenue.

Price pressures drive U.S. companies to seek Far East manufacturing

Lori Valigra, Senior Editor

The falling prices of products such as terminals and personal computers in America have forced some competitors out of the market, and others out of the country.

The thought of Far East manufacturing may conjure up images of tiny sweat shops filled with hand laborers. But producers in the Orient are coming into their own, offering automated facilities and test capabilities. They can successfully backstop U.S. companies buckling under price pressures by offering relief from stateside labor rates, and by having product assembly and production situated close to major component sources.

So far, U.S. companies have approached Far East manufacturing in three main ways: they set up plants for their own products, they subcontract work for their own designs, or they purchase products designed and made by Far East companies. Digital Equipment Corp. (DEC) set up Far East plants as long ago as 1972. Others, such as ITT Corp., moved to the Far East more recently. ITT's Qume Corp. subsidiary makes printers and disk drives in Taiwan, while the ITT Information Systems unit signed Far East subcontractors to make its Xtra, an IBM PC-compatible microcomputer. Applied Digital Data Systems Inc. (ADDS) early this year became the exclusive U.S. distributor for a Taiwanese company's PC-compatible. The approach each company takes is based largely on a company's resources and time-to-market issues.

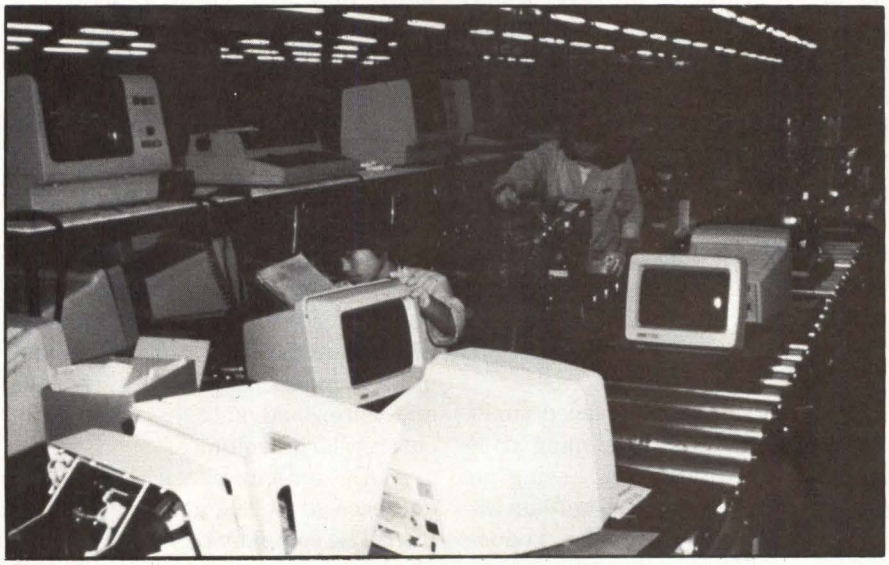
DEC has vast resources

In Taiwan, Hong Kong and Singapore, DEC owns about 500,000 square feet of space—to be almost doubled by 1986—and employs 4,000 people. The Taiwanese plant produces terminals in high volumes, and the Hong Kong and Singapore plants meet all of DEC's needs worldwide for semiconductor memories.

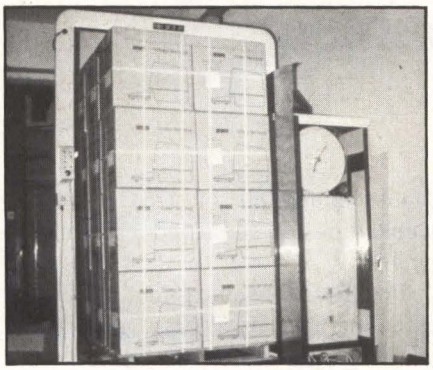
The 100,000-square-foot DEC facility in Taoyuan, Taiwan, is 45 minutes by car south of Taipei, the capital city. It is an equal distance from the Hsinchu Science-based Industrial Park, the site of many U.S. manufacturing plants such as those of Wang Laboratories Inc. and Qume. Taoyuan's rural location is far from competitors, which keeps job-hopping to a minimum, says Richard H. Yen, vice president and director of DEC's Far East engineering and manufacturing locations. Yen explains that DEC initially chose Taoyuan to be near an RCA Corp. plant. When RCA withdrew from the computer industry in the early 1970's, DEC purchased RCA's core-memory-building equipment, hired its personnel, and started making its own core memory.

DEC began manufacturing terminals five years ago in Taiwan. The Taoyuan facility is devoted to high-volume products such as the VT220 terminal and personal computer displays. VT100 production has been shifted to the United States, and the successor VT220 product has taken its place on the line in Taiwan. Yen proudly points out that the VT220 was the first product designed for DEC in Taiwan. "In the United States, manufacturing plants seldom have design capabilities," Yen explains. Manufacturing capacity for the VT220 product is 200,000 terminals annually, but the line is just now being ramped up. Yen says DEC is the 14th largest exporter in terms of dollar volume in Taiwan. RCA is the largest.

Low labor rates and tax relief



DEC's Taiwan plant has 100,000 square feet of manufacturing space. *The company is now ramping up production of its VT220 terminal there.*



DEC ships its terminals and personal computer monitors from Taiwan to the United States in containers. *About 1,000 cartonned terminals fit in each container (above). The containers are then shipped to Long Beach, Calif., on vessels such as the one shown (right), a 20-day process, and then moved on trucks to DEC's New Mexico facility.*

programs enable low-cost manufacture in the Far East. Of DEC's 1,000 Taoyuan employees, 700 are direct laborers working on production lines. Yen says those employees typically earn less than $1 per hour, compared with about $3.50-per-hour rates in the United States.

Tax relief also is a point in favor for Far East manufacturing. DEC has bonded factories, allowing it to import raw materials and re-export them as finished goods within one year, paying duty only on scrap parts. Additionally, Taiwan's government allows a five-year tax deferment for each product line produced by a company.

Special considerations

Yen explains that DEC is careful to observe local work practices such as the 48-hour-work-week. But where many Taiwanese companies are open six days a week, DEC employees work 48 hours in six days one week, and 48 hours in five days the alternating week. DEC organizes outings for its employees each year, a common Taiwanese practice. And, the company hires local managers, as well as workers. Yen notes he is the only employee at Taoyuan from the United States.

The most obvious consideration at DEC's Hong Kong plant, called DEC House, is real estate, or lack of it. Hong Kong is strikingly vertical, with barely enough room to stretch your arms between the numerous high-rises. The company's Hong Kong facility is located in the colony's mainland New Territories, where property is slightly less expensive.

DEC House has 13 floors, divided by a large bank of elevators. Manufacturing is confined to boards, memory systems, power supplies, and other products not requiring heavy factory automation. Different work is performed on each floor in about 14,000 square feet of space. Employees move large carts of assemblies from floor to floor in the huge elevators, so catching an elevator is a prized art at DEC House.

Time-to-market issues

Both ITT and ADDS faced time-to-market issues in developing IBM PC-compatible products. Facing an already crowded market and anticipating IBM's recent price reductions on its PC, the companies chose Asian manufacturing sites for their products.

ITT took its PC-compatible design to Taiwan's Multitech Industrial Corp. and Mitac Inc. to be built. Though Multitech also builds its own PC-compatible product, for which it has signed an exclusive North American distributor agreement with ADDS, ITT is not worried about its design being copied. Counterfeit computers have been notorious in Taiwan, particularly Apple II-type computers. "You must pick the right partner [in order] to protect the design," says Thomas N. Payne, president of ITT Information Systems, Tempe, Ariz. "It [copying] is no more a danger in Taiwan than anywhere else."

Payne says ITT's product has little labor content in it, so labor rates are not ITT's real savings. "The real factor is materials costs," he says, explaining that Taiwan is close to many sources of semiconductors and other components, which gives cost and access advantages when purchasing large volumes.

ADDS' anticipation of IBM's price decrease drew the company to Taiwan. The company based its product plans on its ability to undercut IBM's lower prices, says ADDS

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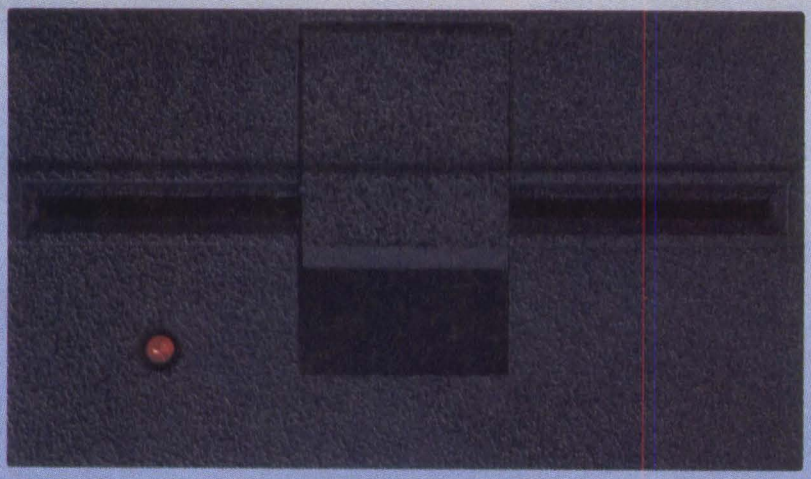
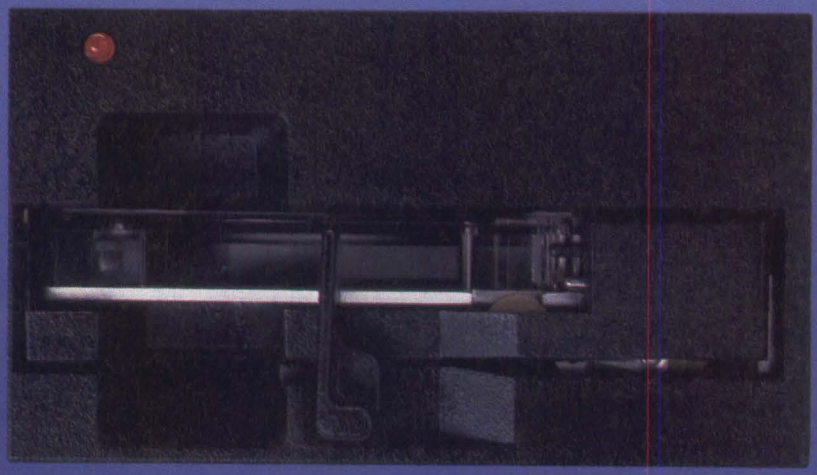


THE END OF THE SECONDARY STORAGE SPECTRUM EVERYONE FORGOT ABOUT WAS THE MIDDLE.



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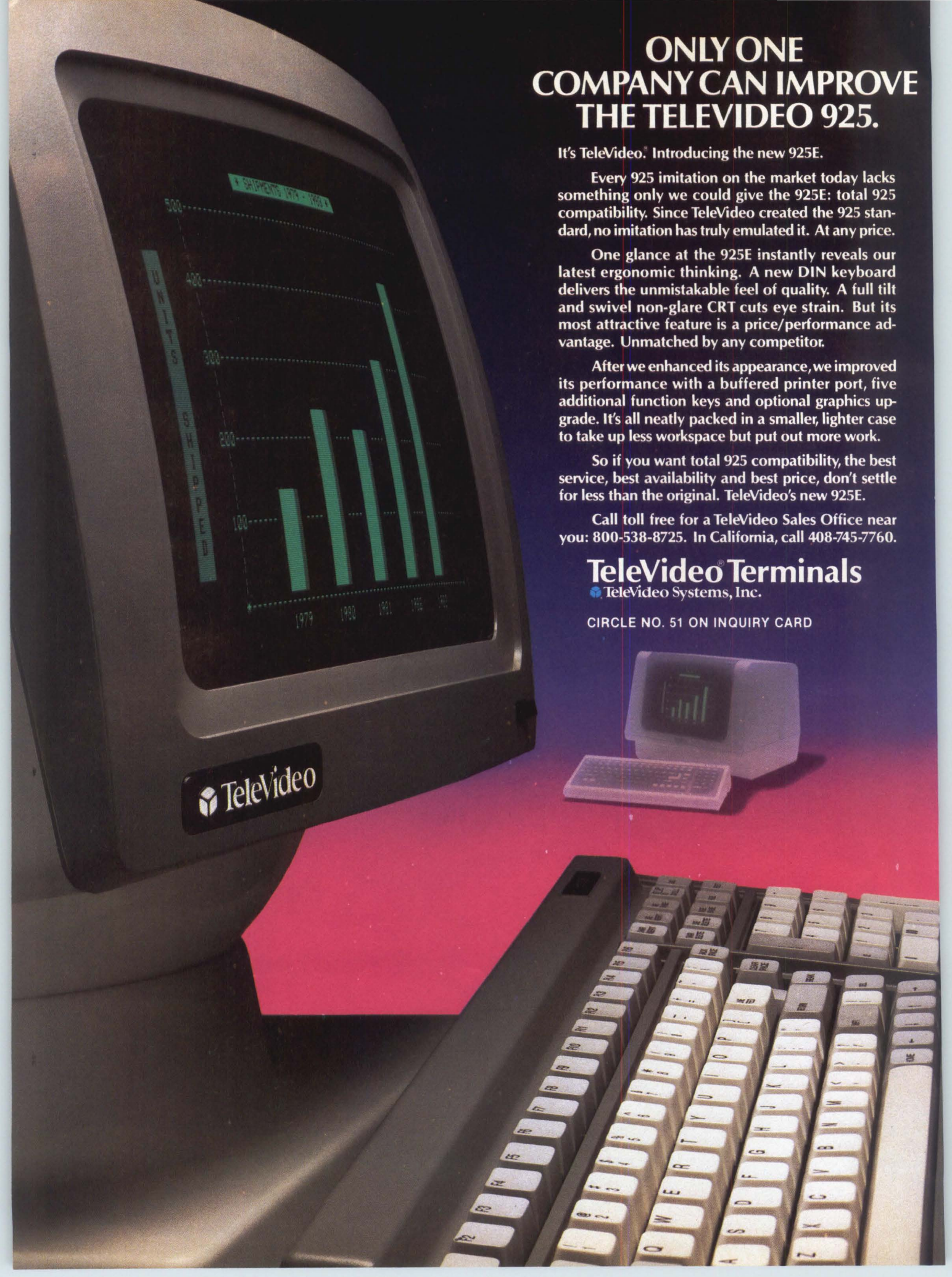

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president David G. Laws. He won't disclose what type of cost savings ADDS has gleaned from its link with Multitech, because that would reveal ADDS' ability to reduce prices even further in competitive situations. Laws says Multitech was chosen as a vendor because of its product quality. "We went only to Multitech. We were impressed with them as a vendor, with their technical capability, and with the financial arrangements," he says.

An idea of the cost savings to be had was given by James R. Hung, director of Shinlee Corp.'s foreign trade department. Shinlee manufactures a PC-compatible that is distributed through Articulate Computers Inc., Costa Mesa, Calif., an agent for Shinlee's Synco marketing group in Taiwan. Shinlee charges Articulate about $1,000 for the machine, which Articulate in turn sells for two to two-and-one-half times that price.

Unexpected snags met

ADDS had to delay its product introduction about one month, until the end of July, because of unforeseen problems. About 700 Multitech machines were seized and held by U.S. customs officials in Seattle, Wash., in April on grounds of copyright infringement. The alleged infringement was of the basic input/output system (BIOS), with which U.S. mimic makers also had problems. Laws says ADDS would not have purchased the machines had it suspected the problem. But Multitech has since been able to ship 10 units incorporating a new BIOS to the United States, and ADDS showed the product at the National Computer Conference.

Multitech expects a significant growth in its PC-compatible product activities. The company increased its production capacity from 3,600 square feet to 45,000 square feet over the past three years. It has separate lines for the ADDS and ITT products.

The ADDS contract is worth as much as $15 million to Multitech, says Michael J. Conley, marketing specialist in Multitech's international marketing division. He says the ITT contract will pull in substantial revenues as well, because Multitech expects to deliver 30,000 units to ITT this year. □

LASER DISKS TO PROLIFERATE

Last year, the emerging optical storage market was only $1 million. But that market will grow to $40 million this year and to $90 million next year, according to an International Data Corp. study. The growth curve is then expected to head almost straight up, with the market reaching $8.7 billion by 1990. In contrast, the bubble-memory market will peak at $450 million in 1987, predicts IDC. For archiving, optical disks have a longer shelf life than magnetic disks, while also providing faster access time. IDC says that it is very unlikely that optical storage devices will replace floppy disk drives or Winchester disk drives.

COMMERCE DEPT. PROBES HONG KONG MARKET LOSS

The U.S. Department of Commerce has concluded that delays in obtaining export licenses for digital telephone switching and other equipment did not cause a boycott of U.S. companies by a Hong Kong telecommunications company. Cable and Wireless Systems (CWS) of Hong Kong decided in May to end what it called its "traditional reliance" on American electronic equipment in favor of products from European and Japanese companies. The Department of Commerce examined export license requests from Harris Corp., Emerson Electric Co., and Racal Export Corp. and concluded that, despite delays of up to eight months for export license approval, this was not a factor in CSW's decision. The Commerce Department analysis did not offer an alternate explanation for the loss of U.S. sales.

U.S. HIGH-TECH TRADE SURPLUS FALLS

The traditional U.S. trade surplus for electronic and information-technology products fell precipitously in 1983 and threatens to disappear this year, according to Department of Commerce statistics. Exports of these products totaled $26.8 billion in 1983, while imports were valued at $26.7 billion, producing a positive trade balance of $100 million. For 1982 and 1981, the export trade balances stood at $3.5 billion and $4.8 billion, respectively. Exports in 1982 totalled $24.9 billion and imports $21.4 billion. In 1981, $24 billion worth of goods were exported and $19.2 billion imported.

INFORMATION AGE INSTITUTE SHUTTERED

The Information Age Institute, founded in February to sponsor a variety of research projects in computer and information technology, has been shut down after failing to enroll any companies as members. The Institute had been started by the Computer and Business Equipment Manufacturers Association and the National Electrical Manufacturers Association to study and provide industry guidance in such areas as health aspects of extended video display terminal use, computer security and privacy, productivity of workers in information industries and job displacement due to office automation.

PACIFIC PERSPECTIVE

Japanese manufacturers expand, diversify to meet semiconductor demand

Ichiro Kakehashi
Tokyo Correspondent

Japan's semiconductor makers do not expect the shortages for key devices that have prevailed since mid-1983 to abate before the year-end. As a result, they have accelerated their capital investments in this fiscal year to expand capacity.

The continuing supply-demand imbalance has brought into the picture several companies that are better-known for other things. Makers of audio and video equipment, cameras and watches—even automobiles—are making semiconductors or getting ready to.

Osamu Ohtake, research manager at the Tokyo office of Dataquest Inc., the Cupertino, Calif., computer industry market research company, said that the capacity is being raised fastest to meet the accelerated demand for memory devices. This is an area in which Japanese manufacturers have the biggest sales advantage —70 percent to 80 percent of world demand.

The growth, Ohtake said, is coming at the expense of American and European competitors. This is because the market for semiconductors and integrated circuits (IC) estimated at $18.8 billion worldwide last year, goes beyond memory parts. Japanese manufacturers are steadily raising their share across the product range, producing 37 percent of all ICs made last year, up from 34 percent in 1982.

In the fiscal year that ended in March 1983, Japan's nine largest semiconductor makers invested about $1.02 billion in capital expansion. In the fiscal year that ended last March, the investment in new plant and equipment jumped to nearly $1.75 billion for the top nine companies. In the current fiscal year, according to spokesmen for each of the companies, the anticipated investment is more than $2.55 billion. Some analysts in Japan say that estimate is conservative. That figure represents only the semiconductor-related spending plans of NEC Corp., Hitachi Ltd., Toshiba Corp., Fujitsu Ltd., Matsushita Electronics Corp., Mitsubishi Electric Corp., Tokyo Sanyo Electric Co., Oki Electric Industry Co. and Sharp Corp.

If the investments of other manufacturers—among them Ricoh Co., Sony Corp., Seiko Electronics Industry Co., Nippon Gakki, Nippon Denso, and newcomers like Fuji-Xerox—are added to the spending plans of foreign-owned and joint-venture companies like Nippon Motorola Seizo, Texas Instruments Japan and the new Fairchild Japan operations, the total investment this year in Japan is nearer to $3 billion.

Pioneer Electronics and Clarion Co. are among the audio-oriented companies that are adding a new factor to the complex semiconductor equation. Clarion's semiconductor facility in Tohoku is to raise capacity to about 40,000 to 50,000 devices a month by fall.

That is the kind of capability that analysts who watch Japan's semiconductor industry say makes the supply-and-demand ratio tricky. There are other factors.

Olympus Optical, which established its first semiconductor research facility in 1981, is now making some of its own custom ICs, as is Canon, with 440 employees in its Component Development Center. But competitors see the Olympus capability as the tip of an iceberg. The companies that have been concentrating on a narrow product range have found in the past recession that diversification is wise from the standpoints of both profit and technological development for future growth.

Among the biggest semiconductor makers, NEC, which is second only to Motorola in production, is expected to spend nearly $510.6 million in this fiscal year on new plant and equipment. The company would not give details of its semiconductor spending plans, but most of the investment is expected to be directed to the Kyushu NEC diffusion facility—its seventh—now under construction, and to establishing two new affiliates and expanding its Yamagata subsidiary's production capacity.

NEC's semiconductor output grew an estimated 26 percent in the last fiscal year, to $1.574 billion, and it expects an output of around $2.04 billion in the current fiscal year that ends next March. Its production of 64K dynamic RAMs is now 7.4 million chips a month, which is expected to be raised to 10 million a month by the year-end.

Microprocessor production is also growing fast; already at 12 million devices a month, NEC's Micro Processor unit (MPU) output is to be raised to 17 million units a month by early next year.

Hitachi Ltd., now Japan's largest consolidated electronics company and one of the four largest companies in Japan, surpassed Texas Instruments Inc. last year as the largest producer of memories.

That represented about one-third of all Hitachi-built ICs last year, but the total was far above the forecast of $1.29 billion projected at the beginning of the last fiscal year. At $1.44 billion, the total value represented an increase of about 35 percent from the previous fiscal year, with output this year expected to be worth at least $1.83 billion. To do that, Hitachi will invest $468 million in new plants and equipment this year, with about $374 million to parent-company capacity and the rest to affiliates.

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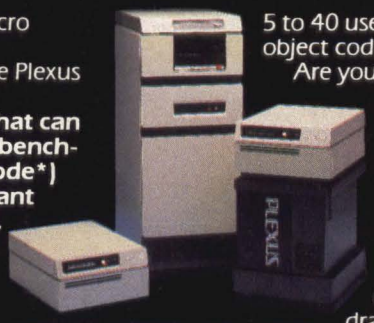

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Relational DBMS vendors prepare for ascent of multiuser microcomputer market

To fit a growing market, vendors compress minicomputer database-management systems, add muscle to personal-computer packages

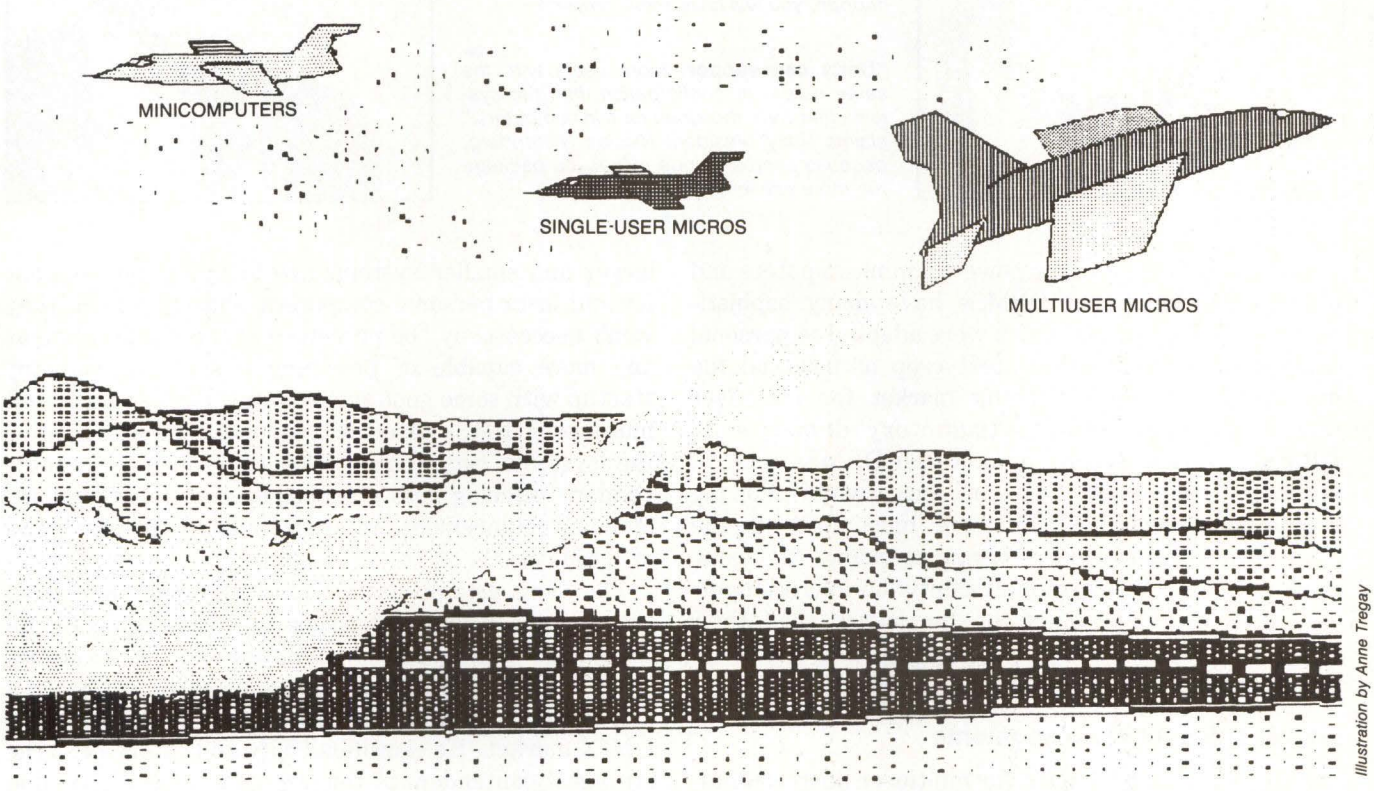


Illustration by Anne Tregay

"This [DBMSs for multiuser microcomputer] *market is certainly going to be taking off next year," predicts analyst Ann Morley of International Data Corp.*

Sarah Glazer, Senior Editor

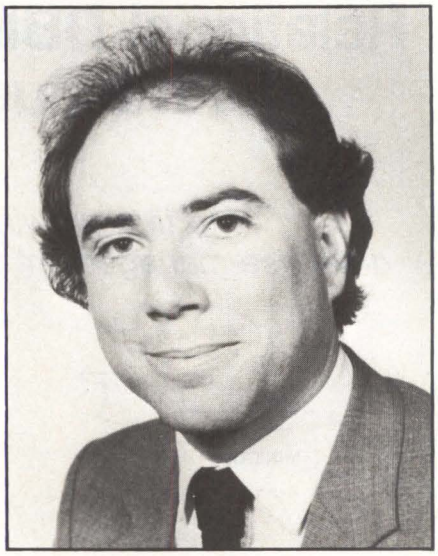
One of the computer's earliest appeals was the promise of instant access to huge bodies of information. Pioneers predicted that computers would answer—in mere seconds—the questions that routinely sent clerks pawing through file cabinets and trudging through libraries. Sadly enough, the first methods of organizing computer databases were cumbersome and difficult to use. But now the dream of instant answers has come closer than ever to reality with the development of relational database-management systems (DBMSs).

In contrast to earlier database managers, relational DBMSs don't require that users know how the database is organized before they can extract information. From the user's point of view, finding information is somewhat like using a library card catalog that contains several cross-referenced listings for every book. A relational DBMS indexes key portions, or fields, within each record, allowing the system to answer questions about data in those fields without having to manipulate entire records. And, rather than having to search the whole database for an answer, the software need examine only the relevant index.

The Interpreter

◄ **"In the microcomputer environment,** *you are forced to make compromises," says Harvey Jeane, vice president of product development for Ashton-Tate. "As operating systems take partnership in making things happen, you will have more power."*

► **"Unify can support** *more users with the same hardware configuration than the systems that were designed for minicomputers," claims Unify president Nicolas Nierenberg, because compact code makes the package run more efficiently.*



Originally developed for powerful minicomputers and mainframes, relational DBMSs have many sophisticated features, some of which were adapted to personal computers to create the latest crop of personal file managers. But the emerging market for multiuser microcomputers puts contradictory demands on DBMSs. Certain features of multiuser DBMSs must, of necessity, be complex. For instance, while allowing simultaneous searches, software must prevent the chaos caused by two users trying to change the same record at once. Yet, to run efficiently on microcomputers, these packages must be far leaner than their powerful—but memory-hogging—counterparts designed for faster-processing minis and mainframes.

Market splits into two segments

Only a handful of DBMSs for multiuser microcomputers have existed for more than a year. Most of these, such as Informix from Relational Database Systems Inc. and Unify from Unify Corp., were written for the UNIX operating system. DBMSs developed for multiuser personal computers running MS-DOS and other personal-computer operating systems are virtually all newcomers. "It's a wide-open marketplace," says Ann Morley, senior software consultant for research company International Data Corp., Framingham, Mass.

Morley predicts that the DBMS market for multiuser personal computers, typically supporting two to eight users, will "certainly be taking off next year." She estimates that the market will zoom in either 1985 or 1986, depending on how soon hardware advances take place. But Morley declines to forecast market leaders. Although companies with popular packages for both larger and smaller systems are bringing out versions for multiuser personal computers, she argues that they won't neccessarily "be perceived in the marketplace as any more capable of providing a solution than any startup with some good technology." Prices for current multiuser DBMSs based on personal computer operating systems range from $400 to $1,200, with some vendors offering less expensive, run-time versions. Memory requirements range from 256K to 384K bytes of RAM.

The more established UNIX-dominated segment of the market consists of packages aimed at more powerful computers that typically support eight to 32 users, according to analyst Deck Hazen of Yates Ventures, a Los Angeles research company that specializes in the UNIX market. He classifies Unify and Informix as the strongest contenders in this category. Gaining ground are Oracle from Oracle Corp., Sequitur from Pacific Software Manufacturing Co. and Ingres from Relational Technology Inc., he says.

Price and memory requirements in the UNIX-dominated segment vary more widely than for personal computers. Prices, which start at more than $1,000, vary according to developers' options. Memory requirements depend on hardware configurations, but can be as little as 256K bytes of RAM. Most vendors report that 0.5M byte of RAM is usually required.

Ensuring data integrity

A key feature that differentiates multiuser DBMSs from single-user packages is record-locking—software that keeps two or more users from changing the same record simultaneously. Ideally, a DBMS should lock as

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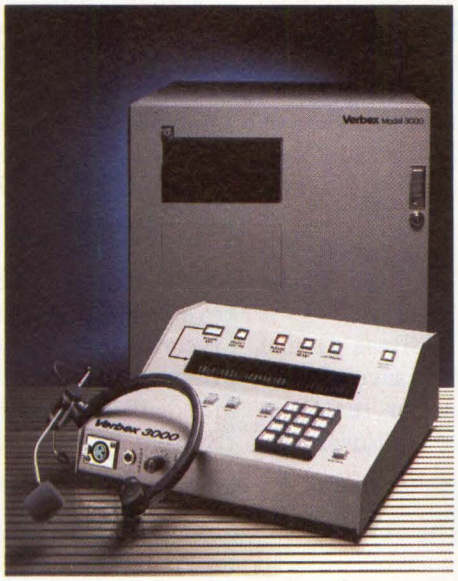

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little of the database as possible while an update takes place, to keep from inconveniencing other users. But such deftness depends on software complexity, which, in turn, can slow a system down.

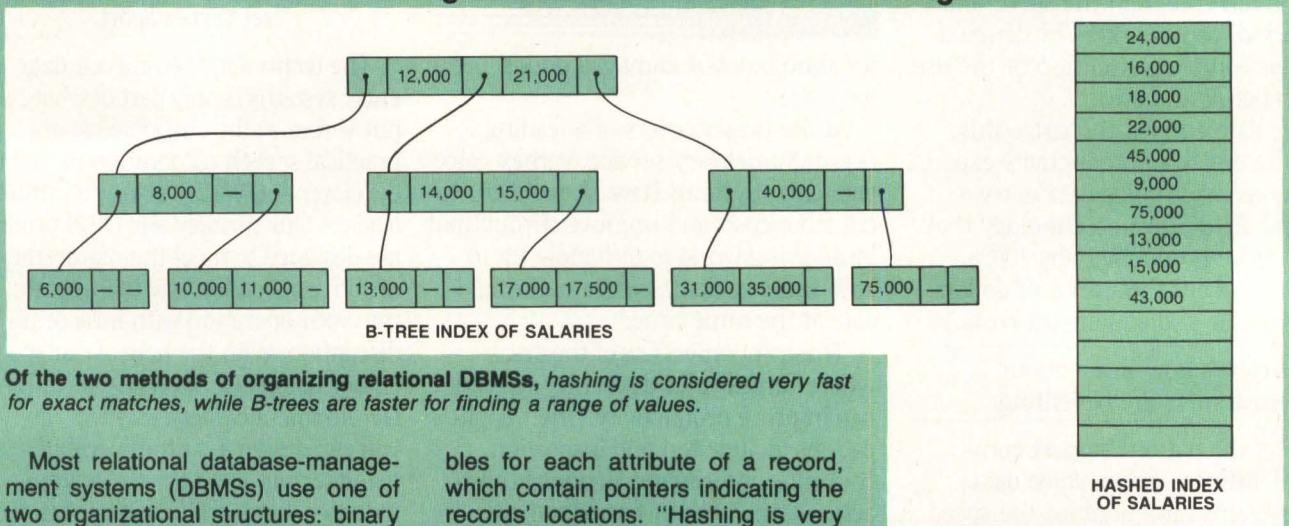
Many DBMSs designed for only a few users lock an entire file of records during every update. One such example is R:base 6000 from Microrim Inc., Bellevue, Wash., a package designed for clustered terminals and local area networks (LANs). It runs under MS-DOS or Convergent Technologies Inc.'s CTOS operating system. R:base 6000 automatically locks a relation-level file while any record within it is updated. Other users won't mind, "if it doesn't take too long," argues Microrim chairman and chief executive officer Wayne Erickson, R:base's developer.

Multiuser versions of Ashton-Tate's dBase II and dBase III also lock at the file level, says Harvey Jeane, vice president of product development for the Glendale, Calif., software publisher. For the multiuser version of MS-DOS-based dBase III, which Jeane expects to be on the market this fall, "we're working mainly with LAN [vendors]," he reports. "We provide file-locking, and they provide the hardware."

Slightly more sophisticated is Mag/base from Mag Software Inc., Canoga Park, Calif., a DBMS that runs under the MP/M-86 and Concurrent CP/M-86 operating systems. According to Greg Scott, company president, Mag/base automatically implements record-level locks that leave all of a file—except the record being changed—available for other users to update. This feature facilitates operation of the package by as many as 16 users.

All the UNIX-based DBMSs lock at the record level, even though UNIX System V itself doesn't yet include record-locking. Roger Sippl, president and founder of Relational Database Systems Inc., Palo Alto, Calif., predicts that AT&T won't release record-locking for System V before the year-end at the earliest.

Looking at structures: B-trees vs. hashing



Of the two methods of organizing relational DBMSs, *hashing is considered very fast for exact matches, while B-trees are faster for finding a range of values.*

Most relational database-management systems (DBMSs) use one of two organizational structures: binary trees—called B-trees—or hashing. "Both are shortcuts" to locating certain kinds of data within stored records, explains analyst Deck Hazen of research company Yates Ventures, Los Angeles. He points out, however, that all DBMS organizing structures add overhead to the packages as well.

Both methods have staunch adherents. Although many experts claim that hashing can be a faster method of finding data, others note that it slows down drastically, should maintenance become slack.

For hashing, developers build tables for each attribute of a record, which contain pointers indicating the records' locations. "Hashing is very fast when you're looking for one exact match," says Ish Rosenblit, a database specialist for the Coca-Cola Co., Atlanta.

B-trees are structures like inverted trees that organize attributes sequentially, Rosenblit explains. A piece of data having a value between two others at the "branch level" can be found by following a pointer to the "leaf level."

"With B-trees, a search key is always a sort key," says Robert Sippl, president of Relational Database Systems Inc., Palo Alto, Calif. When looking for a range of values, B-tree organization prevents a separate search for each piece of data, because each piece in a sequence is beside or points to its successor.

Sippl claims that B-trees are easier to maintain because they can grow dynamically. If additions of data make a tree unbalanced, software can rebalance it, allowing it to occupy memory space efficiently. For hashing, space for an entire index must be allocated in advance, he says, forcing the programmer to anticipate future needs for space. If space runs out, search efficiency is greatly impaired.

```
                    Current Query Context
 list the salespeople with salary greater than average
 which of those are in california
 are there any poor performers

Did not understand: poor performers
Please enter a synonym or change spelling.
R>salespeople with sales less than plan

Do you want to make this a permanent definition? (Y/N).....
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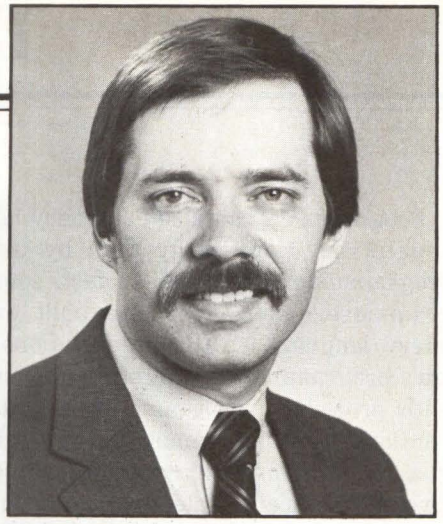
Microrim's Clout natural-language processor *lets a novice user query a database without regard to formal structure of the requests.*



"**Menu-based systems** *are easy to use but inflexible, while command-based systems are flexible but hard to use," comments Microrim chairman and chief executive officer Wayne Erickson about differences between DBMSs oriented toward end users as opposed to program developers.*

Keeping failures from contaminating data

But for powerful database packages, record-locking is not enough; it should be only the tip of the data-integrity iceberg, contends Joseph Alsop, president of Data Language Corp., Billerica, Mass., developer of Progress, a UNIX-based DBMS. "Many users have large databases that contain vital information, and a system must be able to preserve data integrity through all types of failures," he explains. "An organization can't afford to lose records like inventory." Progress' recovery capability, says Alsop, includes "before-imaging and rollback," that prevent losing data despite power outages and other such system failures.

Some other DBMSs use different recovery methods. For example, Informix allows users to provide some or all files with transaction audit trails that—in case of failure—can work with recovery routines to reconstruct data. Oracle has an automatic rollback feature that reacts to system failure by returning the database to an earlier, uncontaminated state. Users would then have to re-enter only the most recent transactions. Ingres also provides full recovery in case of failure, with features that include rollback and roll-forward capabilities.

However, a few databases in the high-end segment lack recovery capability. Unify Corp., Sacramento, Calif., is still developing such features for Unify, according to president Nicolas Nierenberg. "Now we have only rebuild capabilities," he admits. Although Unify is waiting for the anticipated enhancements of UNIX System V, Nierenberg expects recovery features to be available by mid-1985.

Recovery features may overburden the lean programs of the less powerful, personal-computer-oriented DBMSs. "To support rollback, the overhead would be too much for an 8086 to handle," reasons Microrim's Erickson. "It would slow the system down too much." Therefore, R:base 6000's recovery features consist simply of a "reload" command. "You salvage what you can," Erickson says.

Ashton-Tate's Jeane agrees that recovery adds unacceptable overhead to an 8086-based computer. "But," he counters, "with new processors like the 68010 and the 80286, all the overhead required for recovery still doesn't make operation too slow." Jeane reveals that future dBase versions will include recovery capability.

Should a package suit users or developers?

Higher-end DBMSs are designed to be used by programmers, Jeane contends, while low-end packages are more often geared toward end users. "We go after the doctor or the lawyer," he says, even though he acknowledges that "dBase II is perceived as difficult to learn," earning a reputation for requiring a skilled programmer to set up many applications. Jeane claims that developers of dBase III took this criticism to heart and made the new package far easier to use.

While high-end products are often chock-full of sophisticated application-development tools aimed at programmers, many also have features that make them accessible to end users. These include query languages (simple, English-like programming languages that allow non-programmers to make "ad hoc queries" of a database) and report-writers (prepared screen formats that users can easily customize to generate reports from the answers to their queries).

Unify's query language, SEQUEL, is forms-based and integrated with its report-writer, says Nierenberg. This lets a user's questions appear on a screen in the same format as the eventual report. Most other DBMS report-writers are not integrated, he claims, forcing a user to format reports separately.

Programmers can also use query languages to build applications more easily than by using conventional programming languages. In fact, some packages' program-development tools are built entirely around a query language. Although Relational Technology allows programmers to augment applications for Ingres with procedural programming languages, these conventional languages must go through the query language. "We don't let a programmer call the database directly," explains sales manager Chris Dozier. "The query language automates the calls."

"A relational, nonprocedural language is not powerful enough to build full-blown applications," argues Data Language's Alsop. Progress uses a "fourth-generation language to build applications and retrieve data," he says, describing it as very different from query languages. He claims it can take the place of using both procedural languages and query languages to develop programs.

Even some of the low-end DBMSs have easy-to-use database languages. Microrim has Clout, which it describes as "a natural-language processor" that employs artificial-intelligence techniques to allow end users with no programming experience to use the database. "A mainframe database has an administrator to help end users," comments Microrim's Erickson. Clout lets a user ask questions of the database without having to worry about correct syntax, for example. He says that untrained programmers could use Clout to build applications but admits that it would be cumbersome. The language processor is intended, instead, for ad hoc queries.

Reconciling the very different needs of end users and program developers is an avowed goal of most DBMS vendors. But most of them acknowledge that making their packages useful to both kinds of users will require two sets of features. As technology advances, the contradictions increase, Ashton-Tate's Jeane notes. "Users will have access to awesome power, but the user who can afford these products is less sophisticated than ever." □

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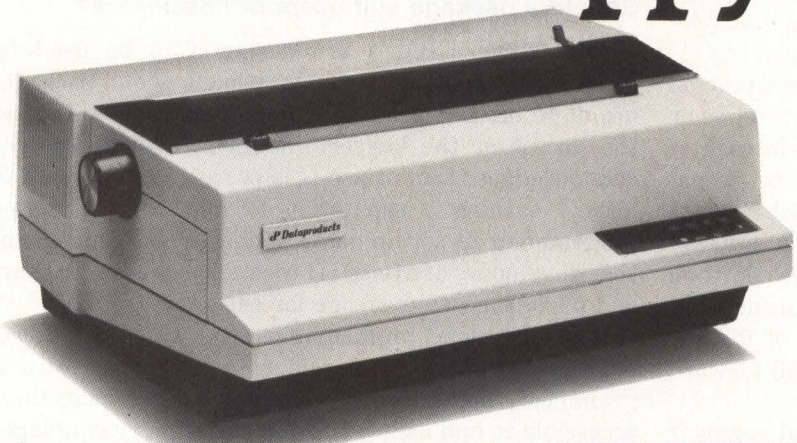

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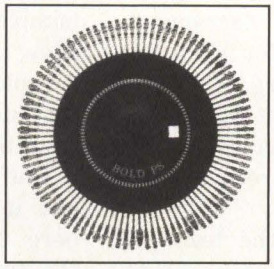

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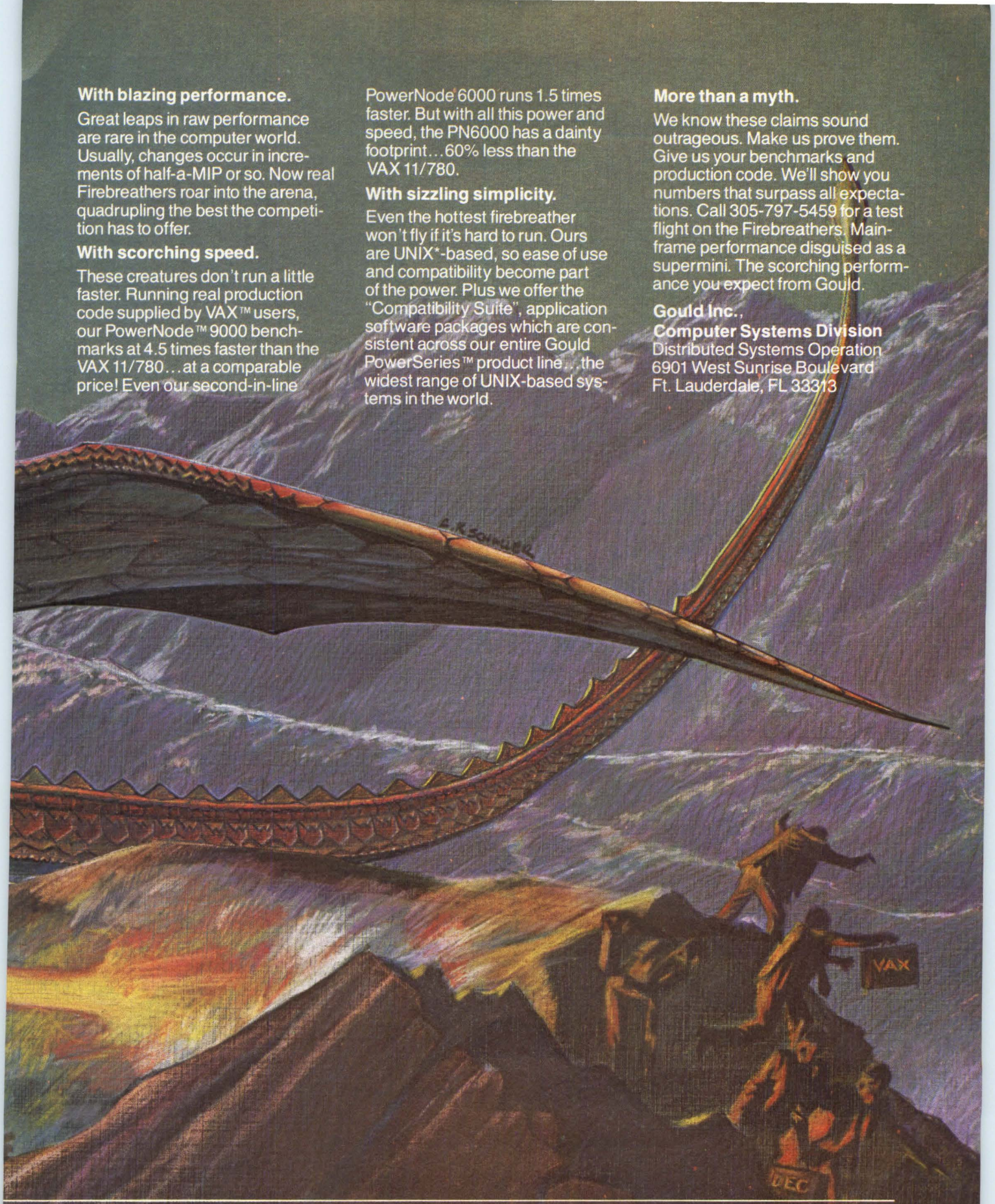

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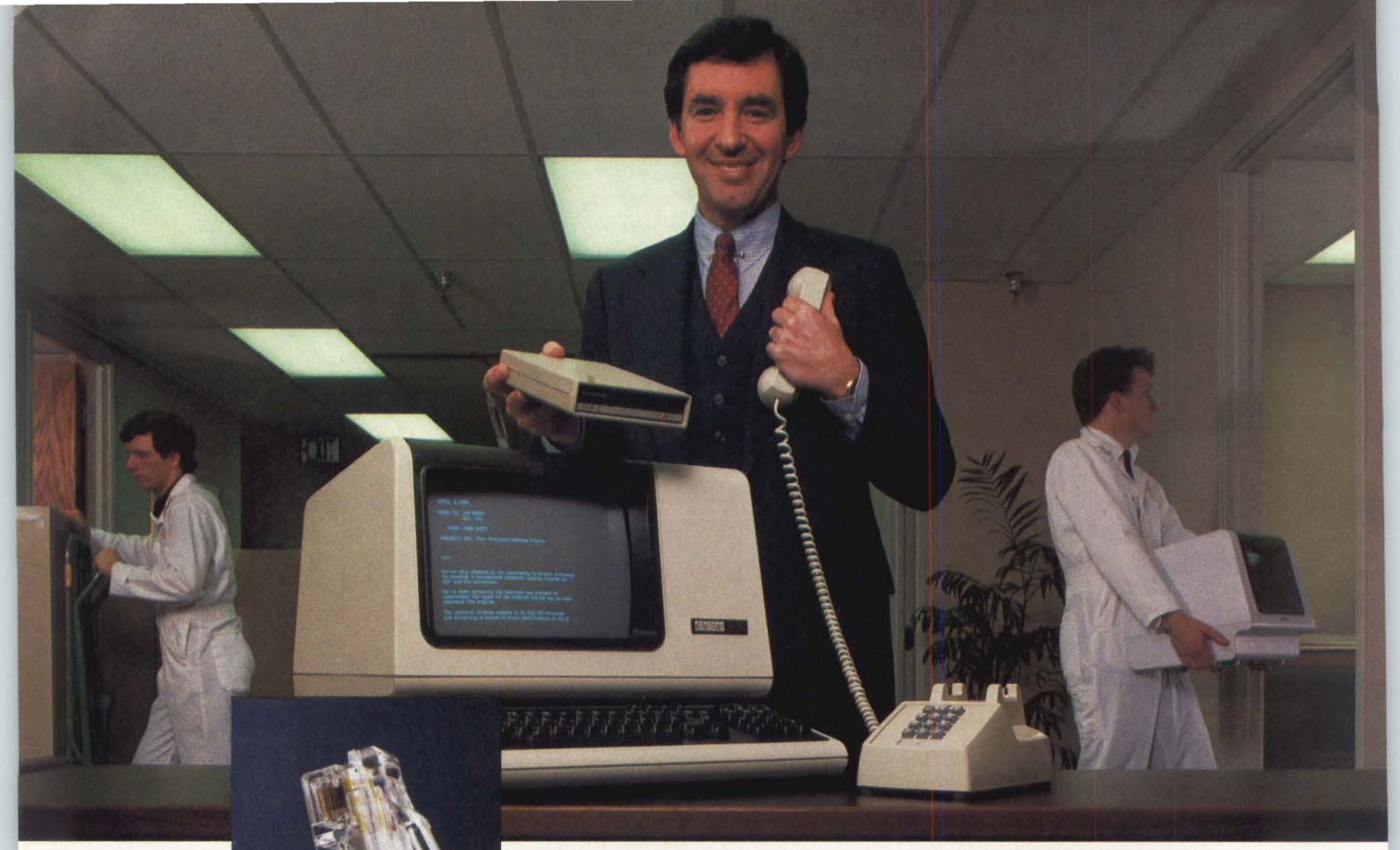

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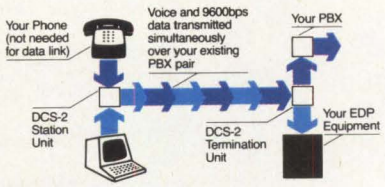

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Will 1984 be the year of the LAN?

Not unless network vendors find the right marketing strategy will they get a chance to sell a local-area network with every PC

Mary Jo Foley, Contributing Correspondent

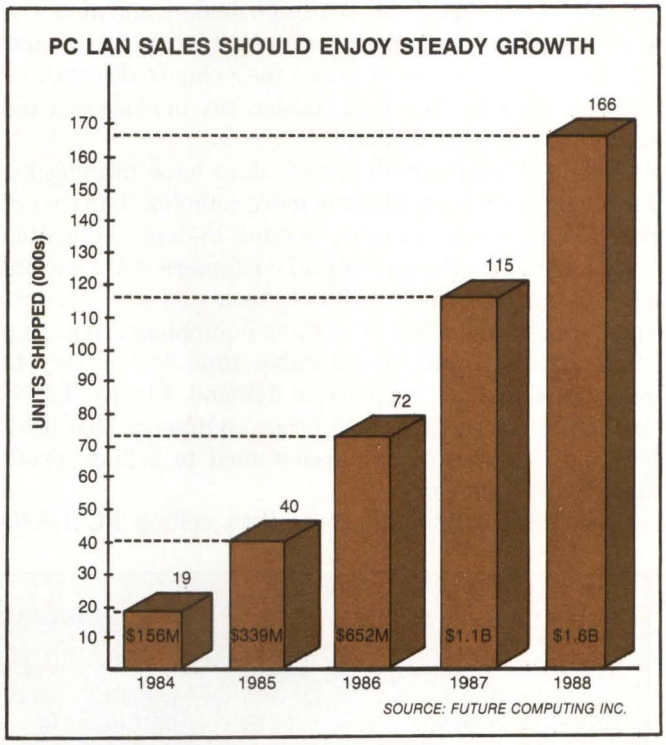
The market for personal-computer local-area networks (PC LANs), potentially the largest and most lucrative segment of the LAN market, has yet to materialize. Although the PC has become an indispensable tool in thousands of offices, networks linking them are few in number. The LAN market foundered for a host of reasons—chiefly the unresolved debate about standards, IBM Corp.'s failure to take the networking plunge and a scarcity of networking software. Market players and watchers first predicted that 1982 would be the year of the PC LAN. At the end of that year, they updated their forecasts to 1983. Now they claim that the market will take off this year.

But, this year, evidence exists to back up the predictions. Although most OEMs have so far remained casual observers of LANs, many are now signing contracts with network suppliers involving products that will support the OEMs' computers and peripherals. Customers are also finally leaving the sidelines to purchase PC networks, both singly and in high volumes.

Unless LAN vendors begin to exploit all available marketing channels, however, shipments will again fall short of market predictions. Most suppliers sell PC LANs directly to end users or through a few OEMs—channels that may be too limited to accommodate the anticipated rush. This year, according to research concern Future Computing Inc., Richardson, Texas, LAN suppliers in the United States will ship 19,000 networks worth $156 million for interconnecting PCs and related peripherals. By 1988, vendors will ship 166,000 PC LANs worth $1.58 billion, Future Computing predicts. At these rates, shipments each year will increase 72 percent, while their dollar volume will grow 78 percent annually.

Selling through OEMs has proved an effective way to distribute general-purpose LANs that link all types of computers—not just PCs—and their related peripherals. Vendors such as 3Com Corp. and Sytek Inc., both of Mountain View, Calif., have successfully sold their general-purpose LANs through OEMs, but most PC LAN vendors are only now building their OEM sales forces. But it takes capital and time, however, to build manufacturing capacity to meet OEM contracts. It's also possible that an OEM might decide to manufacture its own LANs or to sign a contract with another LAN supplier.

Direct sales, another proven market channel for PC LANs, also has limitations. With direct sales forces that rarely exceed 30 people, most network vendors will be unable to meet an expanding demand. "How can



Sales of PC LANs will finally take off this year, *increasing steadily through 1988, predicts research company Future Computing. The figures do not include LANs used to connect intelligent terminals and their peripherals. They include only the hardware and software necessary to connect personal computers and their peripherals.*

a little, 50-person company make a sales call on AT&T?" asks one vendor. "We wouldn't know where to begin."

Some vendors try retail sales

To address their marketing problems, an increasing number of PC LAN vendors are adopting a new distribution strategy—retail sales. They reason that customers will prefer to use retail outlets as one-stop shopping centers for all PC equipment, including LANs. Backing up this thinking is the experience of at least one company: Corvus Systems Inc., San Jose, Calif. Corvus sold all its Omninet LANs through dealers and distributors until last year. Most vendors, testifying to their faith in the new channel, claim they plan to discontinue direct sales once their retail outlets are in place to avoid undercutting their dealers.

Selling through retail outlets does have drawbacks, however. LAN technology is more complex than that of most PCs and peripherals, making in-depth education necessary for both dealers and customers. Networking devices are also more difficult to install and support than almost any other PC add-on equipment, requiring that dealers invest considerable time and money to carry products not yet in great demand. Finally, LANs are lower-priced than most other equipment that dealers and distributors are accustomed to selling; profit margins are smaller.

Despite the difficulties, retailers selling PC LANs generally report positive results. For example, Micro D, a Fountain Valley, Calif., distributor, has sold Corvus' Omninet for two years and is "looking at a few other PC LANs," according to company president Lorraine Mecca. The PC LAN "is not a product every chain store can carry," she contends. "Most LANs don't have on-board file-locking systems," the software that ensures data integrity by allowing only one user at a time to operate on a file. This shortcoming of most LANs "prevents distributors from being able to recommend [PC LANs] right off the shelf," she says. Micro D also distributes Corvus Winchester-disk systems, PCs and other products. "Corvus as a whole is among our top 20 vendors," Mecca says. Although specialized retailers were the first to carry PC LANs, national retail chains such as the Businessland, ComputerLand and Entré Computer stores have started to handle them.

Until recently, "there has been insufficient focus on the benefits PC LANs can provide, and too much on the technology," comments Anthony Morris, president of New York computer dealer Morris Decision Systems. Morris has carried Nestar Systems Inc.'s PLAN series since 1981 and 3Com's Etherseries since early 1983. The company also carried Corvus' Omninet and Orchid Technology's PCnet, but has "migrated away" from what he describes as less powerful, low-end LANs. Overall, Morris reports "increased momentum" in the

IBM: competitor or customer?

IBM Corp. has traditionally made its presence known in the network market by its absence. Its lack of networking announcements until late last year kept industry watchers guessing and potential customers from making any moves, for fear of risking incompatibility with IBM.

By mid-1984, IBM had made three announcements concerning local-area networks (LANs). Last December, it announced a token-passing, general-purpose ring network. In mid-February, it announced Clusternet, a low-end baseband network for connecting PCs, PC XTs, PCjrs and portable PCs. And in early May, in what was considered its biggest "non-announcement," IBM conceded that its general-purpose office LAN would not be unveiled for two to three years and that those wishing to prepare for it should install twisted-pair copper wiring in their buildings.

But none of these products is expected to become the network standard that the computer industry expected IBM to unleash into the LAN market. Increasingly, industry insiders are toying with the idea that IBM may wind up adopting a multinetworking strategy. With such a strategy, IBM might both manufacture its own networks and sell those from several other suppliers, predicts Kim Myhre, an analyst with International Data Corp., Framingham, Mass.

So far, IBM has given no clues concerning its direction in the PC-networking area, outside of Clusternet, which "is almost not a LAN at all," according to one analyst. But whether it becomes a manufacturer, a reseller or both, IBM will have a huge impact on the PC-network market. The company has by far the largest installed base of personal computers, so its endorsement—or lack thereof—could make or break any of the independents.

Myhre predicts that "something like Corvus [Systems Inc.'s] Omninet could be IBM's solution for the PC LAN environment." Indeed, IBM and Corvus last year negotiated a three-year, $70 million contract with the West Virginia public school system for IBM PCs networked with Omninet and Corvus drives. But IBM also could introduce a low-end broadband product, Myhre says, as the company reportedly is negotiating a deal for Localnet hardware and/or software with Sytek Inc.

Perhaps Corvus' manager of OEM sales, John Houghton, puts it best, confiding: "Trying to understand IBM's networking strategy is like trying to nail Jell-O to a wall. The eventual goal is distributed processing on micros, but it is getting there via a curved path."

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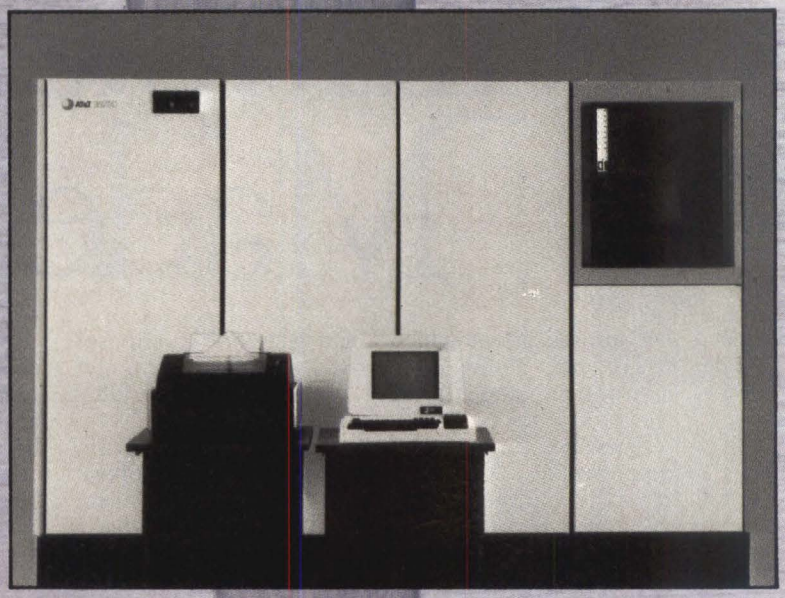

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Power. Performance. Profits.

In every way, the 3B20D from AT&T is in a class by itself. We designed this 32-bit super minicomputer to give new meaning to the concept of ultra-high reliability.

To set new standards for uptime.

To break new ground with our enhanced UNIX™ Operating System –UNIX RTR–that offers your customers maximum real time and time-sharing advantages.

And to give you the technically advanced machine you need to realize the full business potential of the lucrative multi-tasking and multi-user market.

A NEW BEST SELLER

The 3B20D will prove essential for industries whose business depends on the absolute reliability of their computer systems. Companies with reservation systems, such as airlines or hotels. Or those with command and control systems, on-line banking or financial systems.

To deliver on its promise of unfailing performance, the 3B20D from AT&T continues computation during diagnosis, hardware faults, and hardware and software updates. The result is downtime that can be measured in minutes-per-year.

Other benefits include a crash-proof file system, and a host of features that prevent memory failure and reduce programmer error.

YOU CAN COUNT ON THE 3B2 AND 3B5, TOO

For complete systems solutions, your customers will welcome the other members of the 3B family of computers. Especially because they're based on UNIX System V.

Our 3B2/300 is a powerful 32-bit supermicro that's perfect for situations where a number of people require desk-top computers. It can support up to 18 users at individual workstations–all sharing peripherals and data.

Our 3B5/100 and 3B5/200 can accommodate up to sixty users, without sacrificing response time. You'll find these super minicomputers powerful tools for a variety of applications–software development, office systems and CAD/CAM.

For all the members of the 3B family of computers, AT&T pledges a full program of service and support, including a comprehensive and flexible program for OEMs and VARs.

That and the unsurpassed research and development capability of our own AT&T Bell Laboratories make an unbeatable combination. Machines that won't let your customers down, coupled with support that won't let you down.

Only from AT&T.

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TELEX®

Telex Shamrock 9250 has everything you want in a GCR tape subsystem. Right down to your favorite color.

It's the color of the money you stand to save with the new Telex Shamrock 9250. The most affordable GCR subsystem in its class.

Telex engineers have been making advancements in GCR technology for over a decade. The Shamrock 9250 is the biggest breakthrough yet. It gives you the faster access and throughput, greater storage efficiency and higher data reliability you look for in a full performance GCR subsystem. And it does so with the kind of cost efficiency other tape drives just cannot match.

The savings start right up front. The unit price of the Telex Shamrock 9250 is half that of previous GCR subsystems. Its compact design frees up valuable space. And with the assistance of Telex Engineering experts, your interface development will be fast and efficient.

Down the road, the savings continue to add up. Cost of ownership of the Telex Shamrock is truly attractive. There are no planned service calls because the 9250 requires no preventive maintenance. Self-calibrating capability eliminates the need for scheduled adjustments. When service is required, the resident diagnostics hold costs to a minimum. Lower power consumption (typically 100 milliwatt) of the 9250 gate arrays increases reliability and keeps energy costs in line.

There are more reasons why the Shamrock 9250 is today's best value in full GCR performance. For the rest of the story, call your nearest Telex OEM Sales Office or our OEM Marketing Department at 918-627-1111. And let us show you how good you'll look in Telex Shamrock green.

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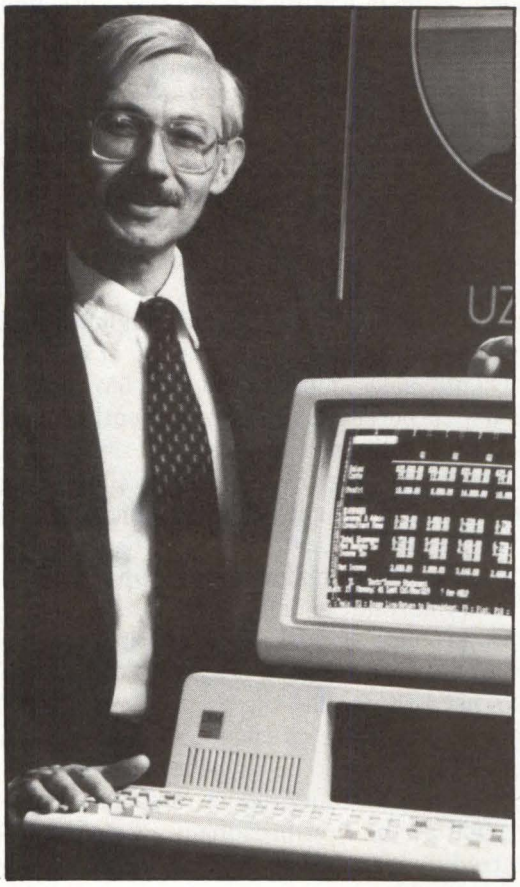

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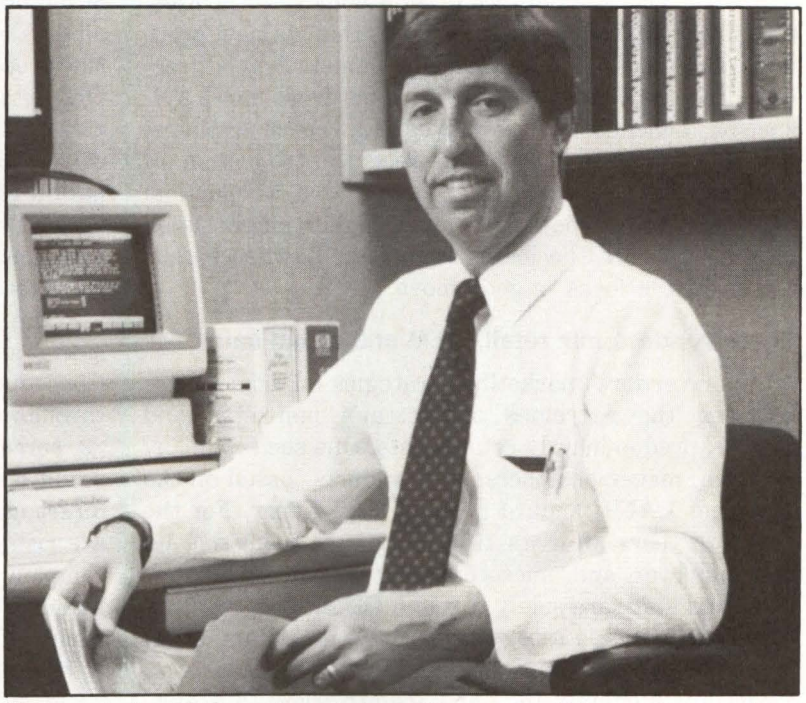

"Our products will be purchased where PCs are bought," *says 3Com president William Krause of the company's decision to add retail sales to its successful OEM marketing strategy.*

Nestar's marketing plan skirts the dealer/distributor channel, *relying instead on selling through OEMs, value-added resellers and its own direct sales force, says vice president of marketing Peter Hertan.*

dealership's LAN sales, even though he characterizes the typical PC LAN installation as small.

No single strategy dominates

At least one supplier—Nestar Systems Inc., Palo Alto, Calif.—has ruled out the dealer/distributor channel altogether. "We're not catering to low-cost items that go through dealers," says vice president of marketing Peter Hertan. Instead, Nestar sells its PLAN 3000 and 4000 networks through a 12-person direct-sales force and a few value-added resellers. Its series 2000, introduced last December, is sold through OEMs. Computer manufacturers may opt to sell PLAN 2000 either "as our brand or theirs," Hertan reports. Eagle Computer Inc., Nestar's first OEM, sells PLAN 2000 as Eaglenet Link.

Hertan says that Nestar will announce five other IBM-compatible OEMs this year and that the company expects OEM sales to represent 20 percent of this year's anticipated $20 million in revenues. Almost 85 percent of Nestar's stock belongs to London's Rank Organization, which also jointly markets Xerox Corp. products sold outside of the United States.

Corvus is pursuing a different course. Until last year, the Corvus national sales division handled LANs, selling half to retail dealers and half to distributors. This year, 15 percent of the company's business will come from OEM sales, says John Houghton, manager of the two-person OEM sales division. By late February, Corvus had signed on 32 OEMs, including Canon USA Inc., Fujitsu America Inc., IBM, NEC Inc. and Olivetti & Co. Moving into a new marketing channel isn't easy, notes Robert Clark, head of the Corvus national sales division: "It's costly in marketing terms to bring an OEM on-board—it could take from a year to 18 months." Retail sales are easier, he says, especially since a third-party maintenance organization handles 30 percent of Corvus' service responsibility.

Corvus sells its storage systems and PCs through the same dealer/distributor/OEM channels. Although sales for the nine months ending Feb. 21 were $39.9 million, up from $33.1 million for the same period last year, net income declined drastically, from a profit of $3.1 million for the nine months ending in 1983 to a loss of $1.3 million for the nine months ending this year. A Corvus spokesperson insists the poor showing did not result from distribution changes but instead stemmed from problems in getting new products out the door.

Analyst David Lawrence of Montgomery Securities, San Francisco, agrees with Corvus that its new products caused company income to plummet. A good fraction of Corvus business used to come from non-LAN-specific Winchester disk drives, Lawrence explains. But he points out that the recent introduction of Omninet LAN drives has changed that proportion: "The company is putting a much higher emphasis on LANs." Despite the losses it caused, Lawrence calls the change in focus "a good move."

Some vendors mix retail, OEM and direct sales

Other vendors' marketing strategies fall somewhere between the extremes of Nestar's non-retail and Corvus' predominantly retail slants. One such company is 3Com, maker of Etherseries products, based on the Ethernet LAN standard pioneered by Xerox. For the first two years after its 1979 founding, 3Com sold its minicomputer and microcomputer networking hardware and software solely through OEMs.

Through this strategy, it acquired a number of impressive customers, including Hewlett-Packard Co., Texas Instruments Inc. and Zenith Data Systems. 3Com president William Krause reports that "although all the details still aren't worked out," the company is in the process of adding AT&T Technologies Inc. to its OEM stable. 3Com will provide AT&T with the transceiver—the device that connects a computer to a LAN cable—for AT&T's recently announced Ethernet-compatible 3B Net. Although 3B Net was designed primarily for large computers, AT&T's PC Interface, a plug-in card announced in conjunction with the network, allows PCs to access the network.

3Com, which went public in March, is adding retail stores and value-added resellers to its list of outlets. Consequently, its sales mix is roughly 55 percent through OEMs, 25 percent through retail outlets, and 20 percent through direct sales, Krause says. As a result of its retail addition, the company is eliminating direct sales, he notes. Despite this prohibition, sales are rising; for the three quarters ending Feb. 29, the company announced $10.8 million in sales, up from $4.8 million for the full year ending May 31, 1983. The company's new premise, Krause says, is for its products to be "purchased where PCs are bought."

"PC LANs need to parallel the way PCs are sold," agrees Kenneth Biba, vice president of Sytek Inc.'s six-month-old PC division. The division will manufacture and sell LocalNet/PC, a product that, if available by year-end, will be the first broadband PC LAN. PC LANs have traditionally transmitted data using baseband technology, which has low-cost, low-performance characteristics that are ideally suited to PC interconnection.

Sytek sells its general-purpose LAN, LocalNet, directly to Fortune 1,000 companies and on a limited basis through OEMs and retail outlets, Biba says. Sales for Sytek, 51 percent of which is owned by General Instrument Corp., reached more than $30 million last year, he reports.

For its PC network, Biba explains, the company will stress high-end retail outlets. "For some time, our OEM business will dominate [within the PC division], but this will shrink," he predicts. "There are many types of PCs, and Sytek wants to be a diversified supplier." However, Sytek is reportedly in the throes of negotiating a deal for LocalNet/PC hardware and/or software with the biggest OEM of all—IBM. □

Mary Jo Foley is an associate editor of *Electronic Business* magazine, in which this article originally appeared.

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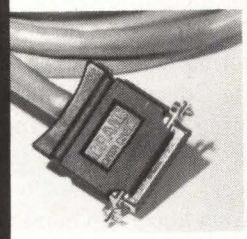
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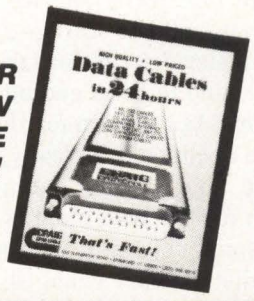

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It's finally happened... your opportunity to be in the right place at the right time.

Consider: Over the next five years the market for business computers is estimated to be more than $300 billion. That's *billion* with a "b." And that's not counting add-ons and aftermarket sales.

And that means hundreds of thousands of businesses are looking for computers *right now*... but that's not all. They're also looking for consulting, applications, training, supplies and ongoing support. They're looking for a reliable computer company—but they're also looking for someone who knows their business.

And, that means if you're a Digital Commercial OEM, they'll be looking for you.

Why Digital?

Because Digital is one of the world's leaders in the computer reseller market. *More OEMs work with Digital than with any other computer company.* In fact, Digital is the second largest computer company in the world, with over $4 billion in revenue in 1983 alone.

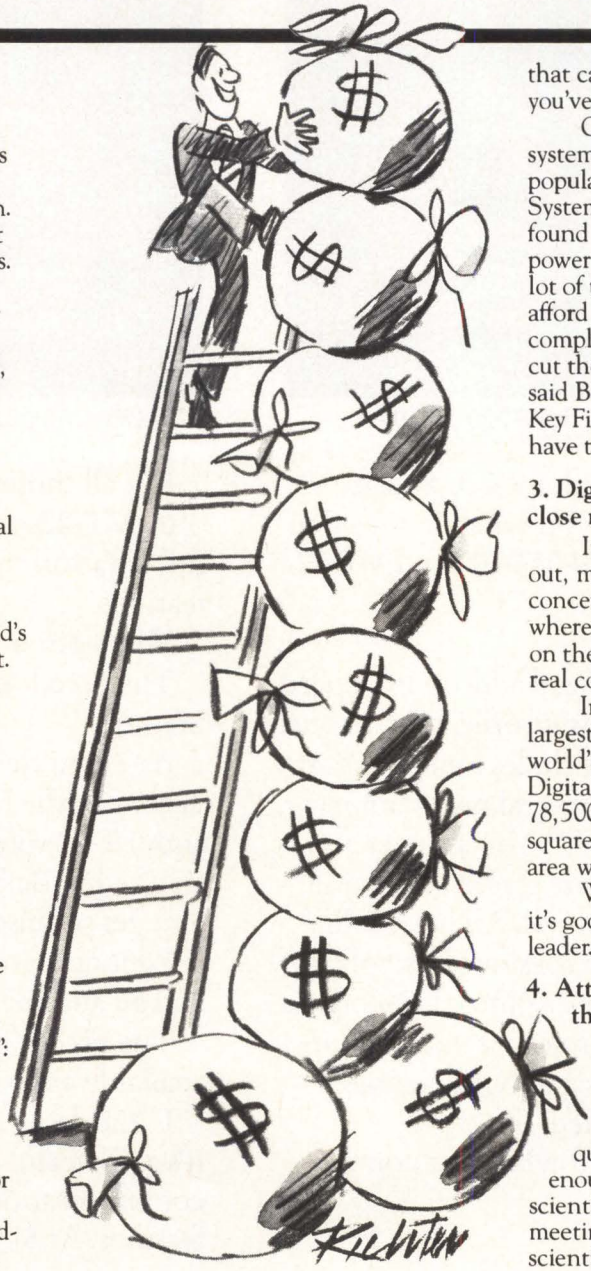
And no one does more than Digital to help Commercial OEMs get their slice of the pie. Here are just some of the ways we can help you be more successful:

1. Sell the widest range of compatible computers in the world.

Here is proof that Digital is the computer company that "thinks OEM": We have created the broadest range of compatible computer systems in the industry. Computers that have proven themselves in the Commercial OEM channel—and in the marketplace—for over 20 years.

Our range extends from our award-winning PCs (we have three families), through our family of PDP-11 systems, which has been a mainstay of the Digital OEM marketplace for more than a decade, on through our complete VAX family, famous for setting the standard in 32-bit computing.

Our commitment to compatibility means you'll get more mileage out of your software applications. You'll spend less time rewriting programs, more time selling the ones you've got. And you'll be able to sell the same application to a wide variety of businesses, both small and large. In short, you get maximum protection of your investment in software applications.



2. Open up whole new markets practically overnight.

How would you like to discover a whole new market for your application almost overnight? Digital makes this possible—with a broad range of computers that can enable you to reach customers you've never been able to reach before.

One example is the MicroPDP-11 system, the latest in a whole history of popular PDP-11 computers. Key Financial Systems, a Digital OEM in New Jersey, found that the MicroPDP-11 put high-power data processing within reach of a lot of trust companies who couldn't afford it before. This opened up a completely new market for them. "It cut the cost of hardware in half for us," said Bill Brinsfield, Vice President of Key Financial Systems, "and we didn't have to touch our software."

3. Digital's reputation can help you close more sales.

In today's computer market shake-out, more and more end users are concerned about reliability. That's where Digital's credentials as a company on the Fortune 100 list can give you a real competitive edge.

In addition to being the second largest computer company and the world's leader in minicomputers, Digital can also boast of more than 78,500 employees and 8 million square feet of manufacturing area worldwide.

When the competition gets fierce, it's good to know you're running with a leader.

4. Attract more customers—and keep them happier—with Digital's high-quality computers.

At Digital we know that the opposite of quality is customer frustration, so we impose our own quality standards—standards tough enough to satisfy the most demanding scientific and technical applications. By meeting the rigorous requirements of scientific environments, Digital has earned an industry-wide reputation for outstanding quality.

And that hasn't happened by accident. We test all our computers for thousands of hours, in a variety of demanding, real life situations. And we are the only major company to give a limited, 1-year on-site warranty on our personal computers.

So you can look forward to more sales—and fewer "unpleasant surprises" after the sale.

YOU CAN MAKE A DIGITAL OEM.

5. Digital's service and support programs can help customers feel more comfortable buying from you.

Digital has a service network of more than 18,000 personnel in 43 countries on 5 continents, as well as carry-in centers, and a fleet of fully equipped mobile units in major cities throughout the U.S., Canada, and Western Europe.

We even offer remote diagnosis of computer problems by telephone, plus a Telephone Support Service which puts you in touch, instantly, with someone who understands your computer.

It's a complete blanket of service that can make any customer feel a lot more comfortable about buying from you.

6. Our outstanding educational system and training programs can help you increase your effectiveness—and your sales!

At even the most basic level Digital's educational services mean increased revenue for you.

Our Profit Express program, for example, makes it possible for you to buy Digital's training courses and products at a substantial discount. (You can resell these courses to customers at a profit, or use them to train your own people.)

We have 27 training centers offering more than 300 courses, including lab courses, audiovisual courses, computer-based instruction, and even our own library of textbooks.

These courses are for you and for your customers. But we also have special programs just for Commercial OEMs, such as the Commercial Business Orientation Seminar (CBOS). CBOS gives you everything you need to know about planning and running your business.

Because the more you know, the more you'll sell.

"Our Commercial OEMs have specialized experience and knowledge in various markets that we do not have. Their expertise and entrepreneurial spirit have contributed greatly to our success."

Ward MacKenzie, Vice President, OEM Group
Digital Equipment Corporation

7. Get the inside track on your competition with Digital's information programs.

To help you know more, and know just the right things, Digital will keep you supplied with our product information, marketing information, technological news, and more.

We've even set up an On-Line Communications Program designed to provide you with critical business information. This information will include lists of applications that Commercial OEMs have made available for resale, as well as up-to-date product and marketing information.

Priceless information—for the price of a phone call!

8. Seminars, trade shows, and symposiums help you sell more effectively.

At Digital we'll never just drop our computers on your doorstep and wait for you to sell them. Quite the contrary. We support you all the way... and we do a lot of this support in person, face to face.

For example, there's the Executive Seminar, a forum for the exchange of ideas with Digital management and other OEMs. And Digital symposiums give you first-hand information on products and product services.

9. Find hidden customers with Digital's Market Mapping, Lead Matching, and Business Review Programs.

Many of Digital's programs are designed to ensure that when you jump into Digital's Commercial OEM program you'll have a soft landing. Here are some examples:

Through the Market Mapping and Business Review Programs, Digital will thoroughly analyze your market and help locate new opportunities for you.

The Lead Matching program matches prospective customers (anywhere in the U.S.) with the Commercial OEM who has just the right package.

And all this is just the beginning. Because Digital has many other ways to help boost your profits. Like special incentive programs. The Authorized Distributor Program. Advertising and lead generation programs. And more.

There's really nothing else like it in the industry... and there never has been. That's because only Digital has pioneered the OEM business for the past 20 years. Only Digital has the largest share of the OEM market. Only Digital.

Wouldn't you like to make more money, and command a larger piece of the action as a Digital OEM? Isn't this the time and the place for you?

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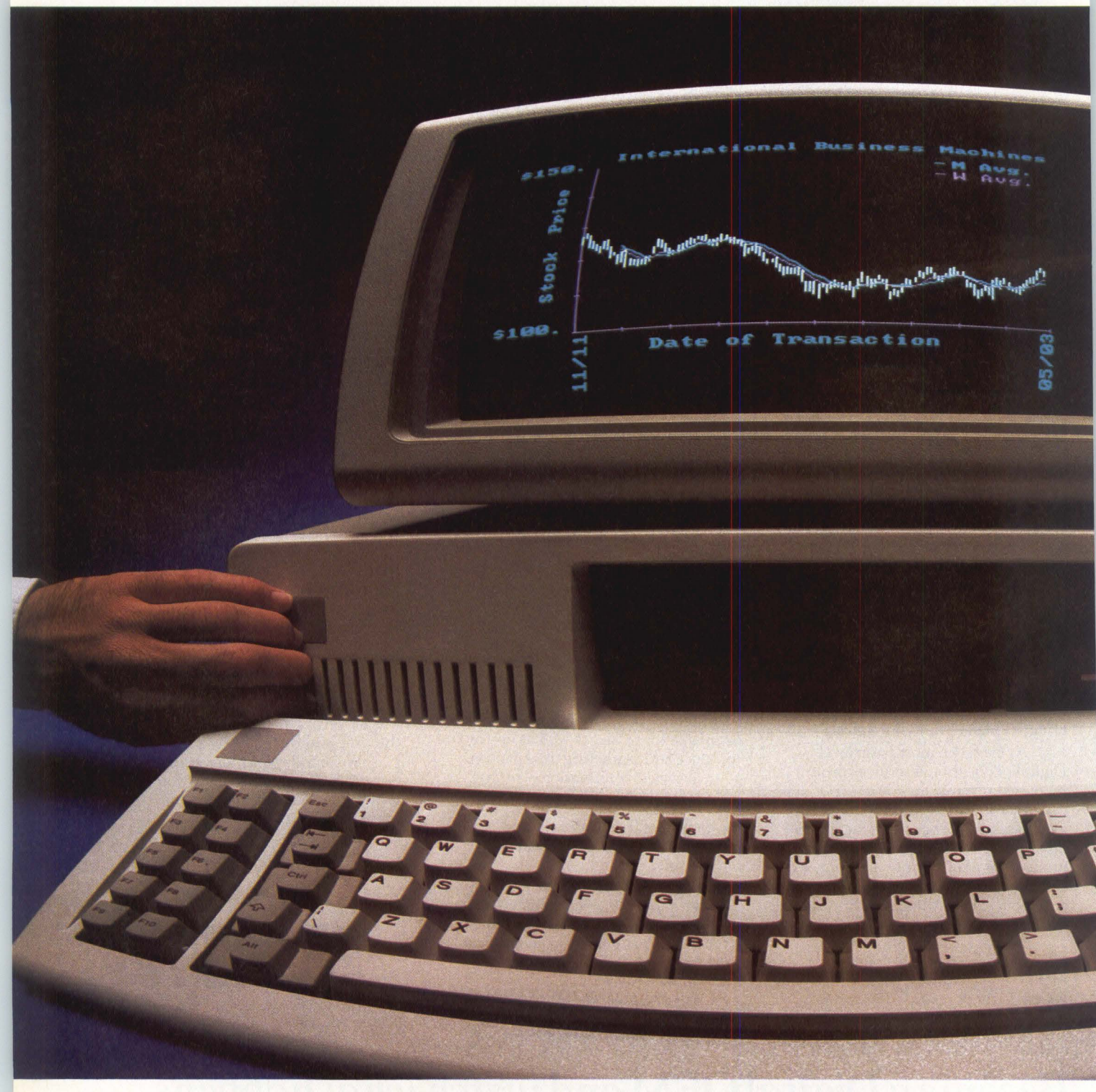
CIRCLE NO. 62 ON INQUIRY CARD

HOW TO STRETCH A PC TO CREATE NEW MARKETS.



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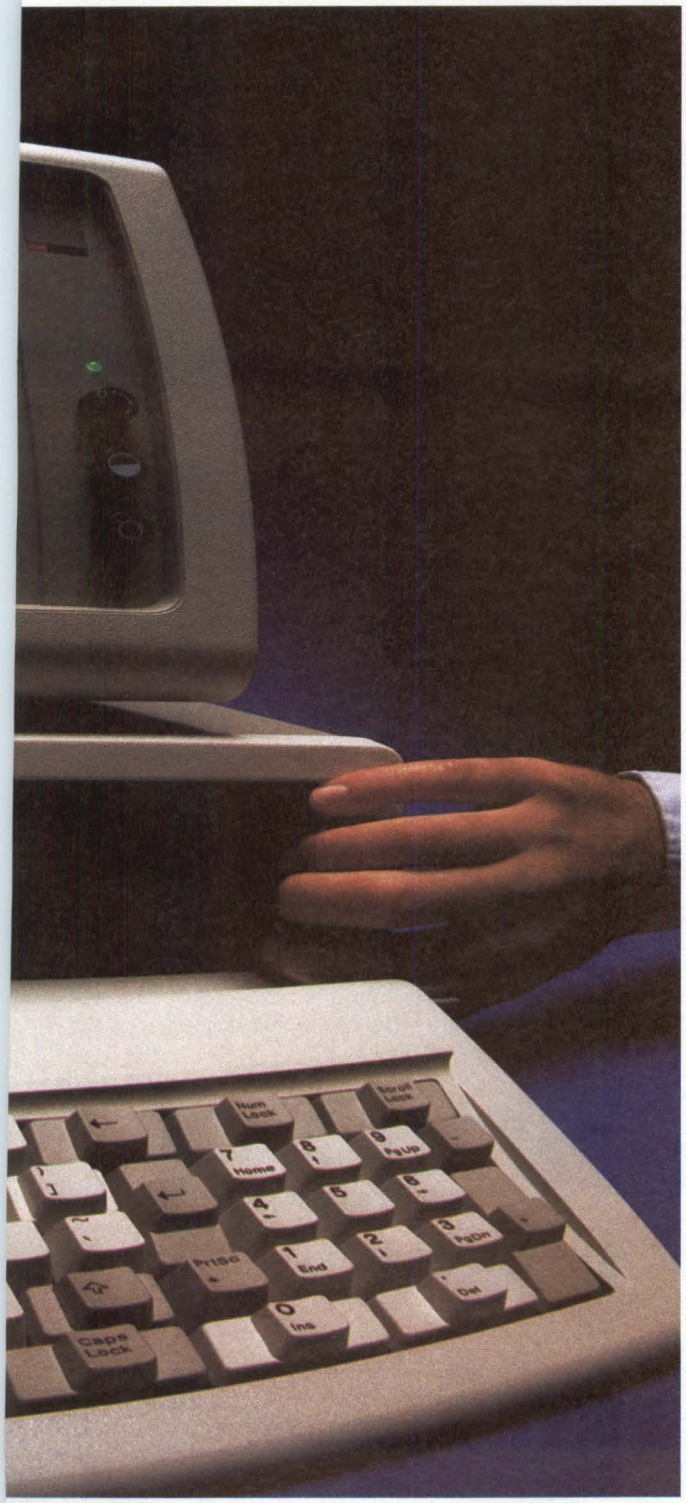

When is a PC not a PC? When you turn it into a personal data base cruncher. Or a personal graphics workstation. A personal image processor. Even a personal signal processor.

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We've put array processor technology to work to supercharge the PC. Suddenly a spectrum of applications that were beyond that PC's capabilities are wide-open possibilities.

If your strength is software, the Marinco array processor gives you incredible performance improvements. Even the most complex spreadsheets can ripple faster than you can say 1-2-3. Enormous data bases can search, sort and report in the blink of a cursor. And high speed arithmetic calculations which slow a standard PC down to a crawl are performed in split seconds.

If you're a systems integrator, VAR or OEM looking for a competitive advantage, a PC with a Marinco array processor is a natural line extension, enabling you to offer a cost-effective "personal" version of your best-selling product.

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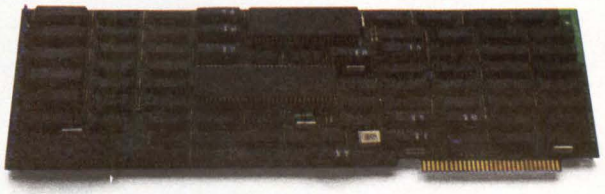
The Marinco array processor is especially flexible and easy to program. So you can get to market quickly. Which, after all, is the name of the game.

We could fill pages with pertinent performance specs on our PC-compatible array processor. So we did. We've put together an 8-page brochure that will stretch your imagination. And just might open a world of opportunity. Write for a copy. Marinco Computer Products, 3878 Ruffin Rd., San Diego, CA 92123. Or call 1-800-421-4807, in CA (619) 268-4814.

Marinco array processors include a 24-bit floating point board with optional IEEE-754 compatibility and a 16-bit integer-only board for maximum price/performance.



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CIRCLE NO. 64 ON INQUIRY CARD

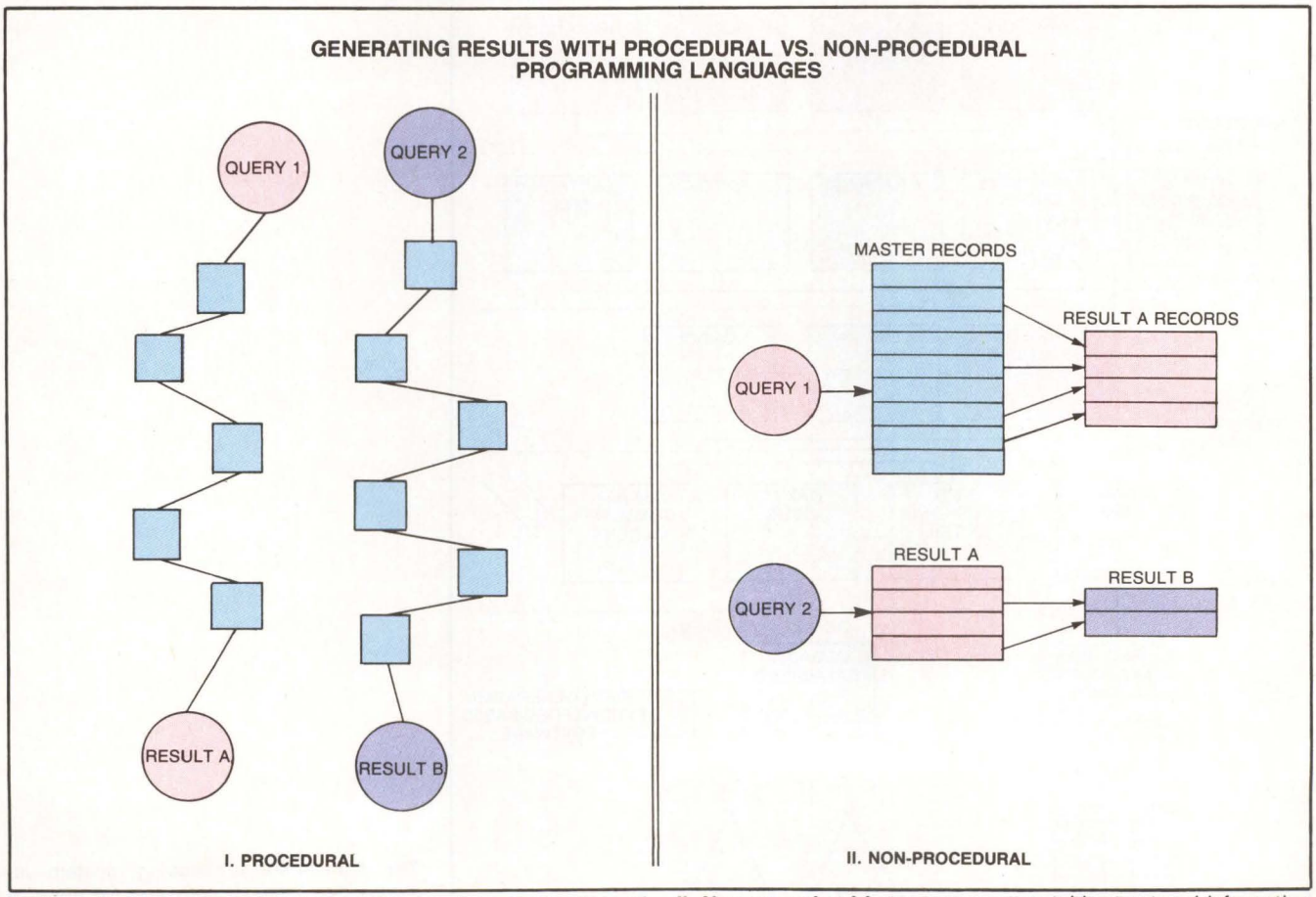
Artificial intelligence techniques speed software development

Using expert systems tools to customize commercial COBOL package saves time, will make future modification easier

Bernard P. Wess Jr., Information Architects Inc.

Expert systems, which use principles of artificial intelligence (AI) to structure bodies of information, now exist primarily for sophisticated applications in science and engineering. But those AI concepts can also help system integrators develop and maintain commercial data-processing systems. These tools can reduce the time needed to customize and later modify a software package and also improve software's usefulness by making it more closely reflect the human decision-making process.

Information Architects Inc., Needham Heights, Mass., recently used expert systems technology to develop a customized, transaction-processing package for a distribution company. The foundation was a



I. Procedural programming languages *produce a structure of step-by-step instructions to generate results. Even if result B is included in result A, a common situation in database accessing, the two queries initiate independent instruction paths to their results.*

II. Non-procedural languages *access table-structured information. Here, software derives result B from records already retrieved to generate result A.*

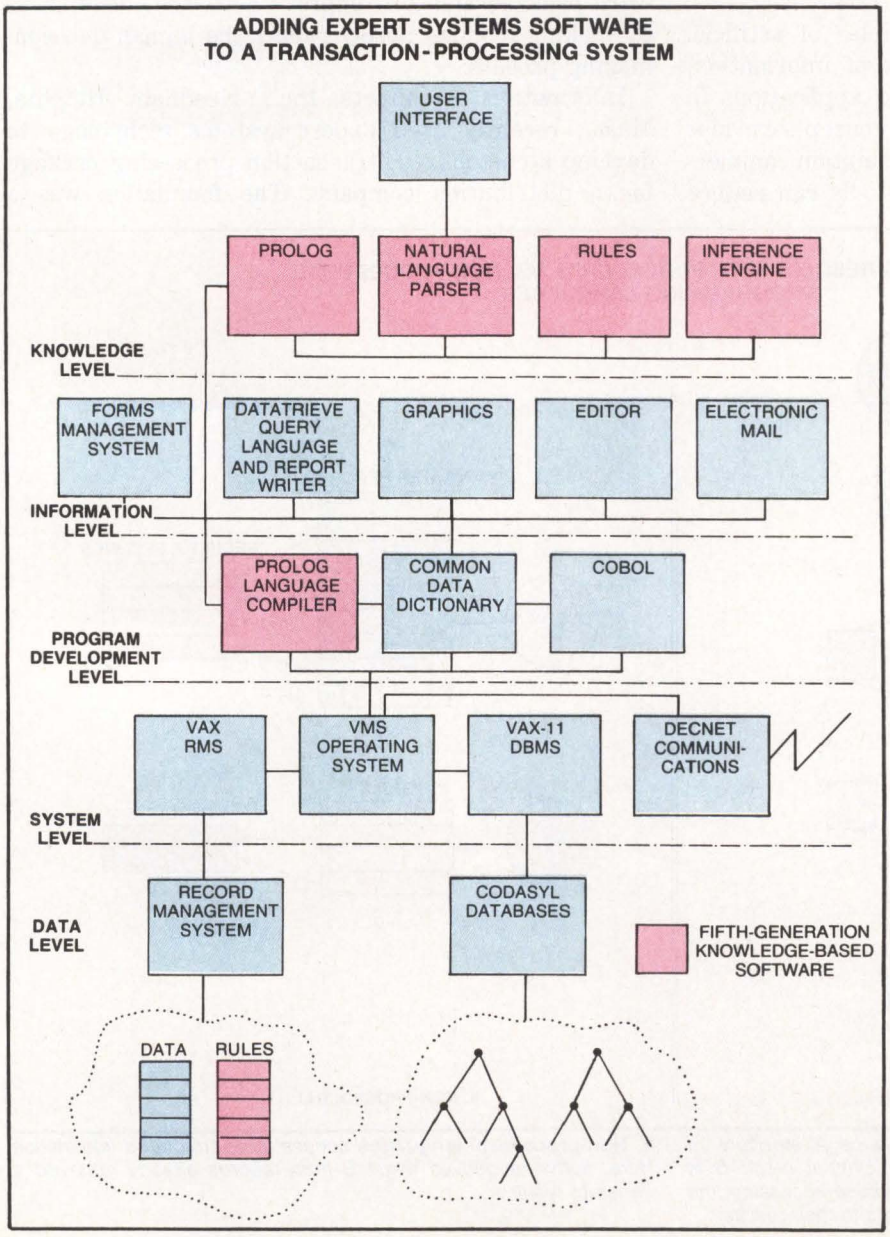
standard, commercial package written in COBOL, a programming language well-suited to business applications. Rather than writing all the custom software in COBOL, however, Information Architects wrote portions in the AI programming language Prolog.

The software designers had found they could program some of the customer's business procedures—especially evolving ones—far more easily by using Prolog and AI concepts than by using COBOL and conventional development approaches. They wound up using a combination of languages and development approaches, matching each with a compatible business procedure.

Software spans five generations

The past 35 years has seen the emergence of five generations of software development methods—all still used. The first two generations concern processing data. First-generation software, written in machine language, deals with individual units of data, while second-generation software, written in high-level programming languages such as COBOL, handles data organized into records. The programming languages used are *procedural*, consisting of step-by-step instructions, such as "if/then/else," "do while" and "perform."

Third-generation software, also written in high-level, procedural languages, is oriented toward databases.



The transaction-processing system *includes five levels of software. On top of a four-level COBOL-based foundation package, Information Architects added a fifth level containing knowledge-based expert sytems software.*

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*Source: U.S. Dept. of Commerce

In these programs, the structure of the database itself imparts information in addition to that contained within individual records.

Fourth-generation software uses *non-procedural* languages and is oriented toward information contained in a database-management system (DBMS). Non-procedural languages, such as Nomad and Query By Example, allow users who are not trained programmers to access table-structured data simply by stating requests. A transaction-processing system created by using fourth-generation methodology has four levels: data in a database, system software (including the operating system and the DBMS), program-development software (including high-level languages) and information software (including tools such as forms managers, graphics interfaces and query languages to present information easily).

Fifth-generation software, which encompasses many branches of AI, adds the knowledge level to the four-level model above. This level includes logical rules, entered by the application developer, about the facts stored at the data level. Using an inference engine, the system can generate answers to queries by inferring relationships between the rules and relevant facts. To express such rules, new programming languages were developed, including LISP, Themis and Prolog. The knowledge level might also include a natural language parser and rules about syntax and semantics, to make querying the system easy.

AI features make programs more flexible

In planning payroll budgets in a commercial transaction-processing system, for example, the data, information and knowledge levels all come into play. Employees' hourly pay rates, stored at the data level, are facts. Software at the information level can create 18-month payroll projections for each department by retrieving facts from the data level and processing them into a display or report.

Software at the knowledge level can generate one or more logical results in response to a query such as, "Do our payroll projections exceed 110 percent of our previous year, and, if so, what department budgets should be cut and by how much?" Knowledge-level software produces one or more alternative results through inferences from relevant facts (pay rates and department sizes) and rules (company policy and managers' experience).

Of course, in all companies, such facts and rules change. But while procedural languages like COBOL can effectively access large, simply organized data structures, they can't easily manage the rules of human decision-making. When programmers use conventional languages—even non-procedural ones—to program decision-making processes, the code is usually complex and difficult to change.

An AI language gives programmers a convenient tool for expressing rules in machine-readable form. Information Architects used a version of the expert systems language Prolog, developed by the University of Sussex, Brighton, England, which has a built-in inference engine, editors, a symbolic (source language) debugger and interfaces to other programming languages.

The software designers found that they could program some of the customer's business procedures—especially evolving ones—far more easily by using Prolog and AI concepts than by using COBOL and conventional development approaches.

The inference engine is a formal mathematical proofing algorithm that permits a system to understand a knowledge-level query and then generate logical results from facts in the database and from rules written in Prolog. To do this, the inference engine must be able to recognize patterns, compare statements and create complex data structures such as syllogisms and B-trees.

An inference engine can detect conflicts between a new rule and existing rules as soon as the new rule is written—an ability beyond the scope of conventional programming approaches and languages. If available facts and rules don't provide enough information to answer a query, the system asks the user qualifying questions in an attempt to clarify alternatives.

Expert systems methods simplify changes

Information Architects' client company needed generic business applications, such as general ledger; applications specific to the distribution field, such as order entry; and unique applications, such as managing a customer-service application. Furthermore, the company wanted to implement the system over a nationwide network.

To save time, the developers decided to buy a foundation package and customize or add software as needed. They estimated they could use 70 percent to 80 percent of most commercially available packages without

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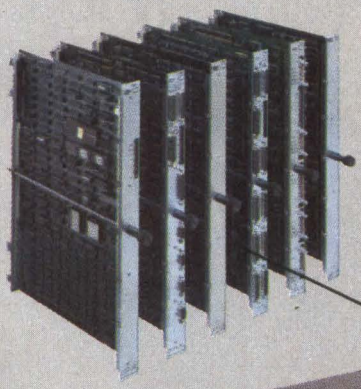
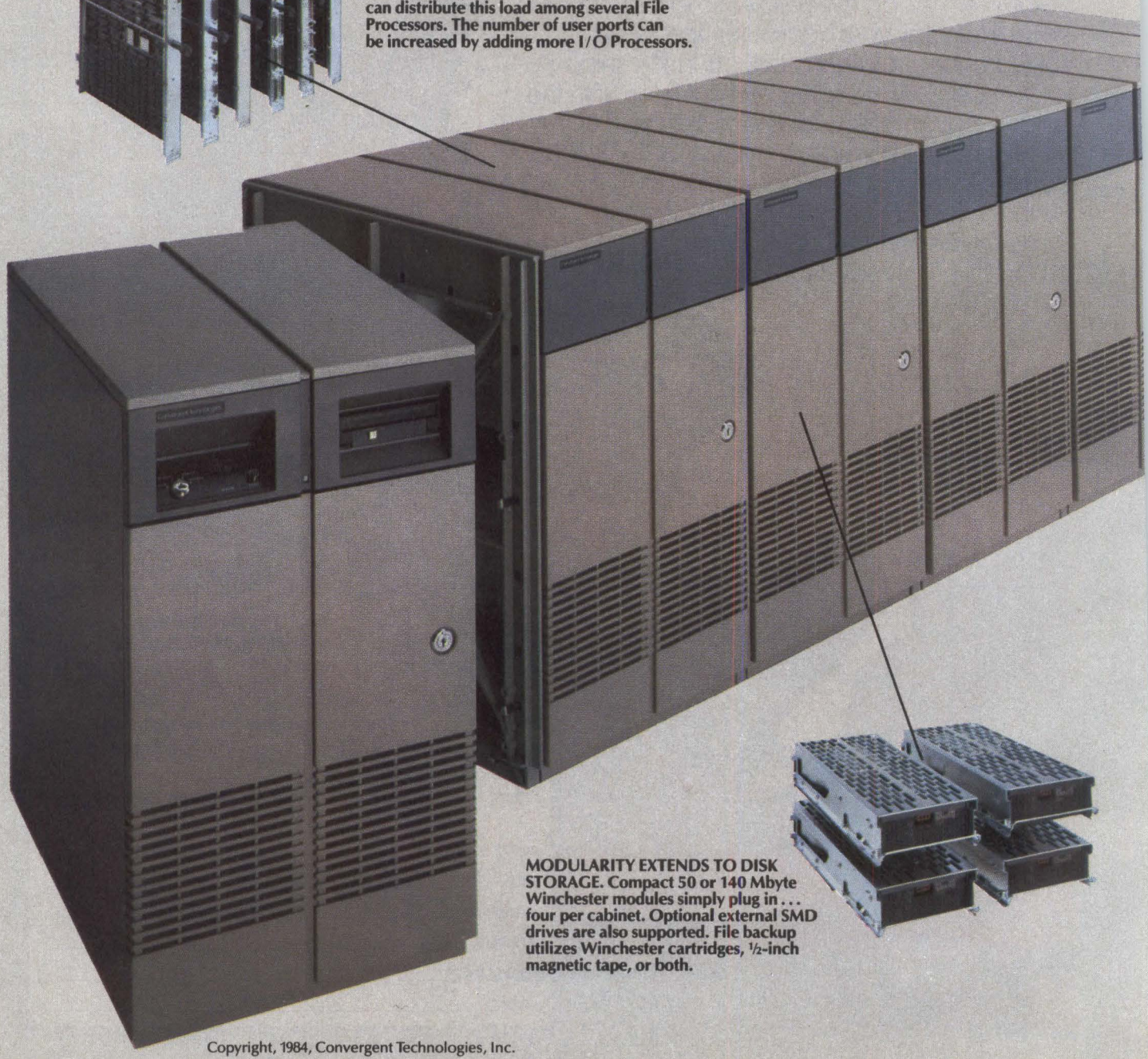


CONFIGURABLE ACCORDING TO USER NEEDS. As many as six processors can be installed in each enclosure. CPU-intensive jobs utilize multiple Applications Processors. Systems with heavy disk usage can distribute this load among several File Processors. The number of user ports can be increased by adding more I/O Processors.



MODULARITY EXTENDS TO DISK STORAGE. Compact 50 or 140 Mbyte Winchester modules simply plug in . . . four per cabinet. Optional external SMD drives are also supported. File backup utilizes Winchester cartridges, ½-inch magnetic tape, or both.

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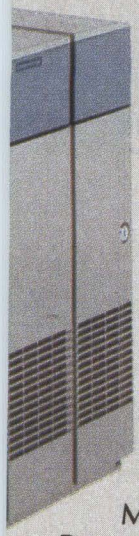

No other system can match the MegaFrame's potential for field expansion. It enables manufacturers and systems builders to keep pace with today's requirements for more and more computing services . . . but *not* at the cost of discarding hardware or performing expensive CPU upgrades.

MegaFrame's architectural breakthrough. Dependence on traditional single-CPU shared-logic architecture is the root of systems bottlenecks.

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MegaFrame's virtual memory Applications Processors each have a 32-bit CPU, up to 4 Mbytes of RAM and run a demand-paged version of UNIX System V. Up to 16 of them can operate in parallel.

The File Processors effectively function as back-end machines providing DBMS, ISAM and other disk-related services. Up to six File Processors each with four disks can operate in parallel.

Terminal and Cluster Processors can also be added—the latter serving front-end communications needs. They off-load communications from the other processors by running protocols such as SNA and X25 networks.

MegaFrame's daisy-chained cabinets offer total expansion potential of up to 36 slots. OEMs configure the system needed for specific applications simply by adding the correct number/combination of processors.

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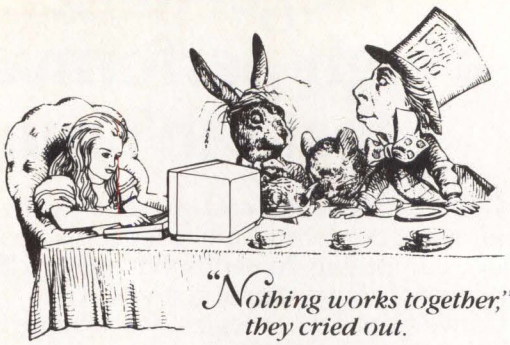

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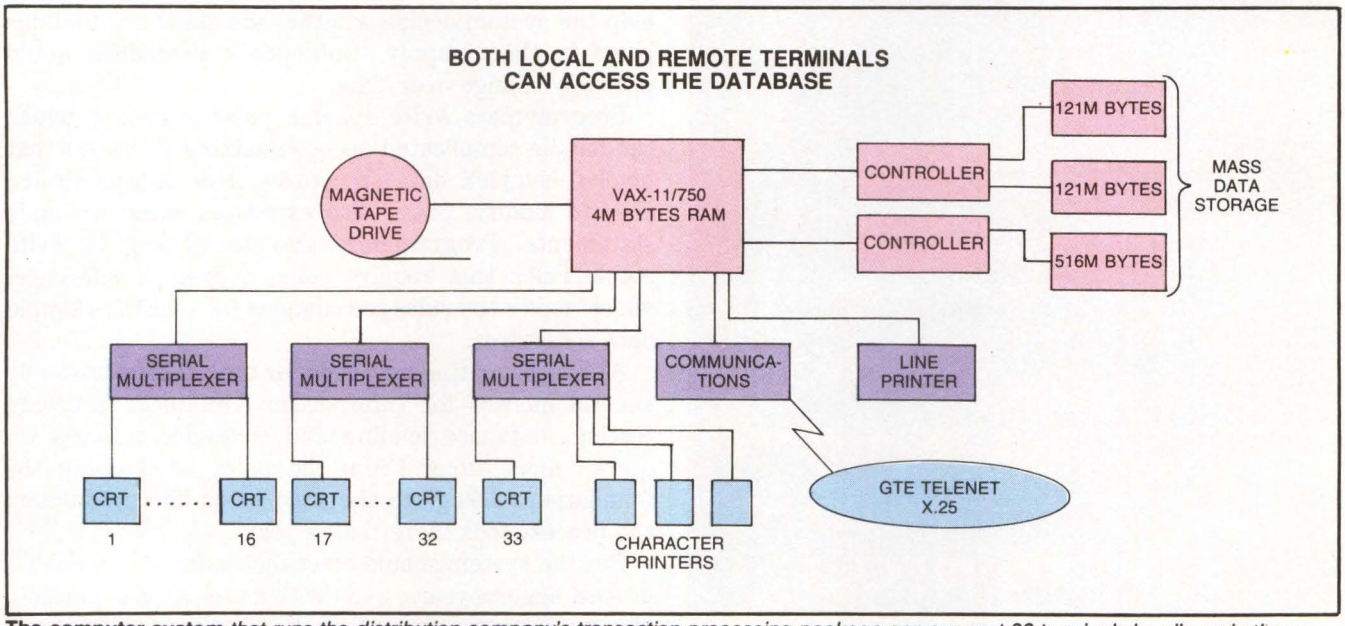

The computer system *that runs the distribution company's transaction-processing package can support 33 terminals locally and others scattered nationwide, linked via a public network.*

changes. The developers looked for certain features: general business modules written in COBOL for real-time transaction processing; thorough documentation; and built-in application development tools such as audit trails, journal files and a screen generator. They also wanted a package that could interface with accounting files and had a query language/report writer. Finally, they wanted the software house that supported the package to provide source code.

After reviewing 15 possible choices, Information Architects selected Xerox Computer Services' PRAXA package, which has 100,000 lines of COBOL code and occupies 10M bytes of mass memory. The package runs on Digital Equipment Corp.'s VAX computers, letting developers use the X.25 packet-switching protocols contained in DECnet communication software to build networking around GTE Telenet's public packet-switched network.

Programmers used three programming languages to develop the custom software: COBOL, Datatrieve (DEC's database query language and report generator) and Prolog. They decided which language to use after determining whether a particular business procedure was governed by stable, unstable or dynamic rules. This represents a technique developed to build expert systems.

Stable rules include government regulations, and cast-in-concrete policies like, "Don't accept a shipment unless it is labeled with the number of an outstanding purchase order." Stable rules with simple data structures, including those the distribution company might add in the future, are written in COBOL.

Unstable rules often arise from temporary or uncertain solutions to problems. For example, an occasional shipment may be received without a purchase order, logged into the system and then returned. The materials manager may even decide to violate a stable rule on purpose, as when an unlabeled shipment is immediately needed in production. Establishing an unstable rule to cover such emergencies, the manager could require the receiving clerk to enter an unlabeled shipment's bill of lading in the computer system, verify its quantity and then decide—on an individual basis—how to proceed. Unstable rules will eventually be converted to either stable or dynamic rules.

Programmers write unstable rules in Datatrieve, an easy-to-use query language that can simulate human decision-making in procedures that have simple data structures. Producing the same results as COBOL code, Datatrieve is far easier to modify. Therefore, Information Architects specified that the customer's maintenance programmers should write, if possible, all new stable rules in Datatrieve first. After fine-tuning the software, they can convert the stable rules from Datatrieve to COBOL code, which runs more efficiently.

Dynamic rules are firm, but expected to change as company needs and policies change. For example, a dynamic rule for unlabeled shipments might require the clerk to check an inventory database of part numbers to

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help the system decide whether the shipment contains parts in short supply. But such a procedure would probably change over time.

Programmers write dynamic rules in Prolog, which can handle complicated decision-making processes that involve complex data structures. Not only is Prolog easy to modify, but it also expresses rules in simple statements. Programmers also use Prolog to write stable rules that require some degree of inference, which makes the rules too complex for COBOL's simple data structures.

Although writing new code for the package took only several months for Information Architects, software testing, database loading and customer training required more time. From the point of choosing the foundation package to the start of on-line production, the process took more than a year.

But the system should meet the customer's needs for at least several years, even with anticipated expansion. The company can upgrade its host processor to a larger VAX machine or can increase capacity through networking several VAXs. And modifying software will be simpler than for most conventional packages because of the flexibility of Prolog and expert systems methodology. □

Bernard P. Wess Jr. is president of Information Architects Inc., Needham Heights, Mass.

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High 807 Medium 808 Low 809

NEXT MONTH IN MMS

Mini-Micro Systems' October issue focuses on software utilities and mass storage memories for small systems.

Other topics will include:
- stretched-surface recording
- a flexible PC/XT DBMS
- microcomputer graphics

LOOKING AHEAD IN MMS

The Fall issue of Mini-Micro Systems' Peripherals Digest is due in mid November. This comprehensive reference guide will cover the following topics:
- disk drives (up to 5 ¼-inch)
- disk subsystems
- cartridge tape drives (up to ¼-inch)
- alphanumeric terminals
- serial printers

A directory of manufacturers will also be included.

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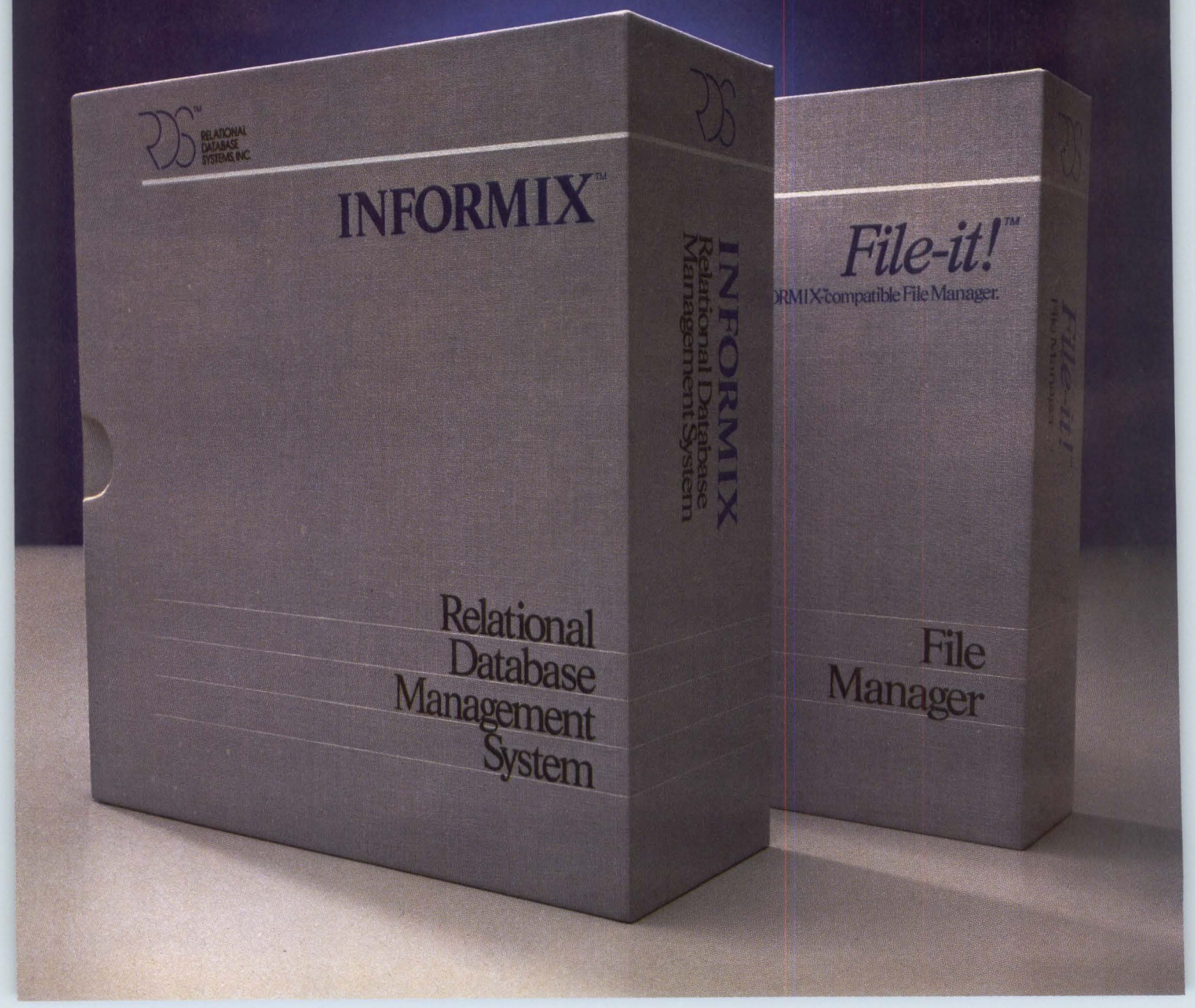

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- Charles River Data Systems Universe 68
- Convergent Technologies Miniframe and Megaframe
- Corvus Systems Uniplex
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- DEC 11/23, 11/34, 11/44, 11/60, 11/70, VAX 11/730, 11/750, 11/780
- Dual Systems System 83
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- General Automation Zebra (all models)
- Hewlett-Packard 9000 Series 200, 9000 Series 500
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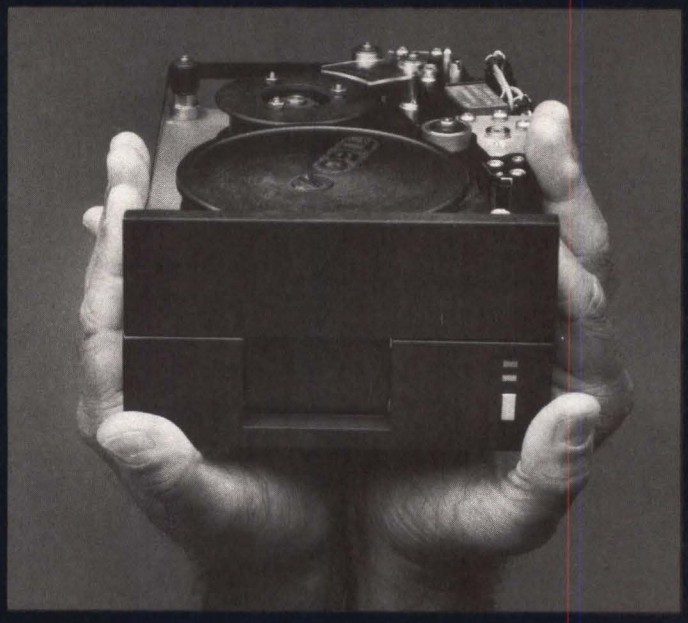

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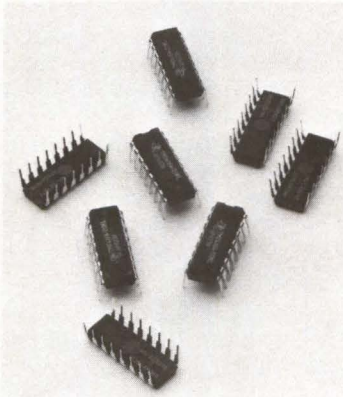

64 KB cache memory in its interface makes it look like a start/stop drive.

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Plus more efficient use of your tape, covering a full 95% of it.

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Now, if the Double Drive sounds like it might be just what you need, here's more good news. It will fit your system.

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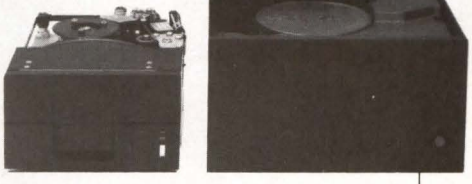
Series 80 to right. Series 50 below.



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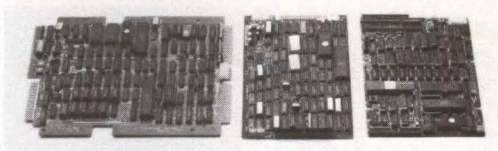

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Diagnostic diskettes suit system integrators but can leave users confused

Exotic tool may prove too sophisticated for most end users

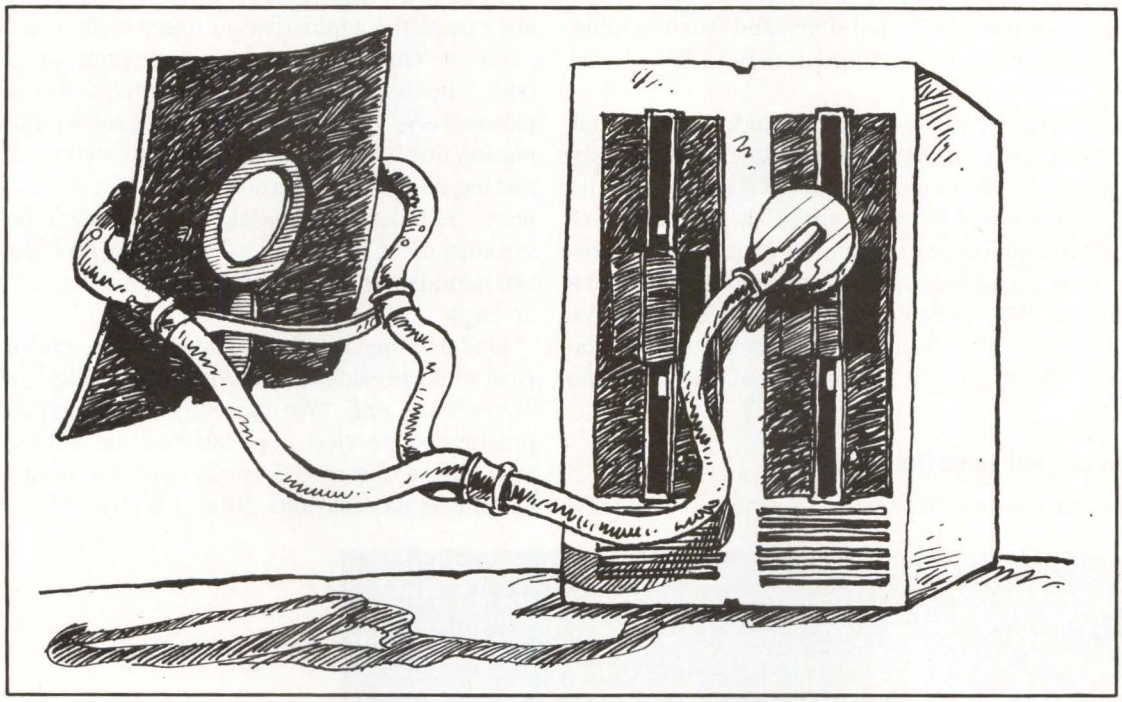


Illustration by Jon McIntosh

Diagnostic diskettes *can detect problems in a flexible disk drive by reporting detailed information about its internal operation.*

Carl Warren, Western Editor

Diagnostic diskettes—designed to report detailed information about the internal operation of flexible disk drives—are becoming recognized troubleshooting tools. By pinpointing problems, they allow for timely corrective action. But while the exotic diskettes promise important benefits for equipment manufacturers and system integrators, they may be too sophisticated to help the average end user.

Currently, three California-based companies—Dymek Corp. in San Jose, Dysan Corp. in Santa Clara, and Verbatim Corp. in Sunnyvale—make the diskettes for a variety of systems, most often those using 5¼-inch disk drives. The devices provide information about characteristics of a drive's alignment that can affect interchange. If the alignments of two drives are too dissimilar, neither will be able to read data written by the other. Diagnostic diskettes simulate typical operation of a drive and measure rotational speed, clamping, noise tolerance, read/write functions, track alignment, erase-crosstalk, and positioner accuracy.

Dymek's Recording Interchange Diagnostic Diskette (RID) identifies problems that can prevent the interchange of diskettes from one system to another. According to Duane Meulners, company president and chief executive officer, the RID's purpose is to provide the user with insurance. "We consider the RID to be an extension of users' application libraries. By periodically using the RID, they can be assured of being able to

recover data," he says.

Verbatim's Disk Drive Analyzer offers similar capabilities. Like the Dymek product, Verbatim's diskette picks up inaccuracies in the alignment and overall operation of the flexible disk drive and warns a user that a drive needs corrective action.

For a typical end user, corrective action consists of seeking out a qualified service technician. However, getting the drive properly aligned may cause new problems for the user, insists Mycroft Labs Inc.'s Vice President of Operations, Bruce Justham. "More than likely, end users will use the diagnostic diskette at the wrong time," he says. "They will have already been writing data using a misaligned drive and won't be able to read the data with an aligned drive. It's a real Catch-22."

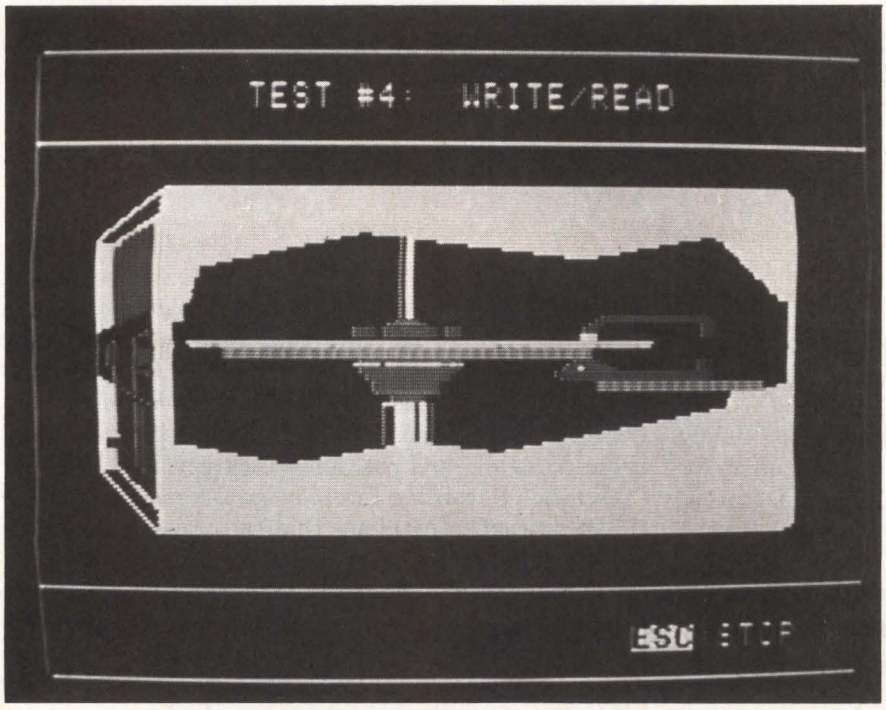
Dymek's Meulners, however, doesn't expect that problem. "The use of a diagnostic diskette will quickly become part of the standard use of the drive," he predicts. "A user will know to check the drive before using it, thus avoiding misalignment problems." Moreover, Meulners argues that post-alignment problems will be minor. The purpose of the devices is to give users confidence that recorded information will be recoverable 80 percent to 90 percent of the time, he notes.

Diskettes deliver benefits to OEMs

Despite diagnostic diskettes' promises, Andrew Czernek, director of marketing for Zenith Data Systems Corp., Glenview, Ill., doesn't think they will fare well in the consumer market. "End users aren't really attuned to understanding the technical ramifications of a device," he says. "More than likely, if they use the diagnostic diskettes, they will tend to misinterpret the information or use the diskette at the wrong time." System integrators and resellers will benefit most from using the diskettes, Czernek contends. "They can make sure that the drives are operating properly before they put them in the end user's hands."

Brad Baker, general manager of Dysan's C.E. division, agrees. Baker asserts that diagnostic diskettes are meant for sophisticated users such as system integrators. "Our diskette gives more than just a 'go/no-go' test," he explains. "We can dynamically adjust the parameters, thus giving the integrator detailed information on the characteristics of the drive, allowing the setting of operating parameters." But Baker is quick to warn that diagnostic diskettes shouldn't be mistaken for alignment diskettes. "This type of tool lets you find the boundaries, and alignment diskettes set the focus," he says.

Underlining benefits for system integrators is Steve Bostwick, president of Query Computing Systems Inc., Torrance, Calif. "We typically create systems for sophisticated vertical applications," he notes. "The system has to operate correctly, and the diagnostic diskette gives us assurance [that it is] by letting us quickly



Using graphics *to display a diagnostic test in operation, Verbatim's disk drive analyzer diskette checks the accuracy of a flexible disk drive.*

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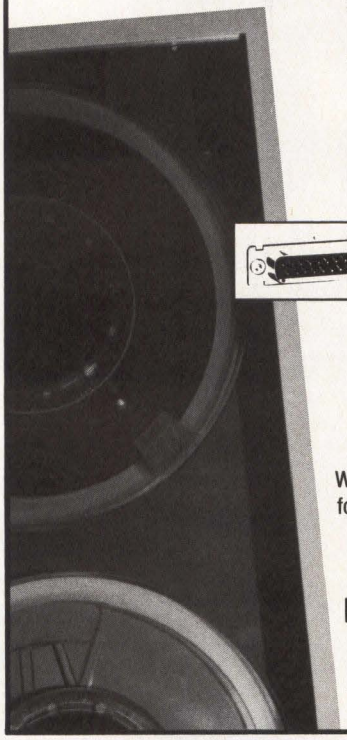

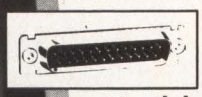

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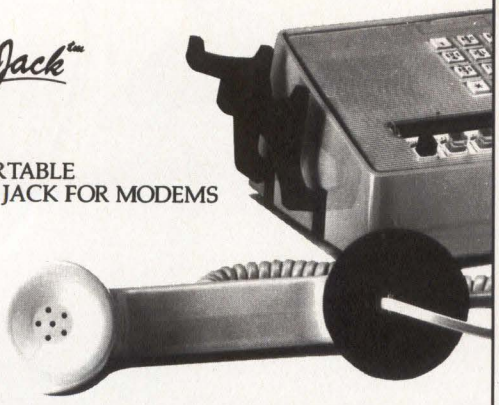

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The Integrator

find faults before we ship."

Reporting methods differ

Although the three manufacturers' diagnostic diskettes work in a similar manner, their reporting methods differ. For example, Dymek's device uses a menu-driven system to guide the user, reporting a "go" or "no-go" after each test. Verbatim's diskette uses a similar technique but, in addition, has graphics that show the test in operation.

The Dysan diskette also incorporates graphics during tests that display the drive's operating margins. This information is extremely helpful, comments James Swanner, president of Wordmovers Inc., Lawndale, Calif., a systems house specializing in desktop systems. He emphasizes that misaligned disk drives cause major problems because "they go out of alignment over a period of time and newly aligned drives can't read the old data diskettes." Displaying margins help determine a system's operating boundaries, so old data can be recovered before realignment, Swanner explains.

'I think a typical end user would end up being more confused than assisted.'

Not a large consumer market

David Pava, president of Byte Industries Inc., Hayward, Calif., is one of those who feel that, although the devices are useful for computer sellers, they are inappropriate for most end users. "I don't see them being used early enough to be of benefit. I don't see retailers clamoring to have them on their shelves," he says. Query Computing Systems' Bostwick agrees: "I think a typical end user would end up being more confused than assisted."

Wordmovers' Swanner agrees that resellers will find the diskettes most useful. "Right now," he says, "we have them in the store for our use." He also reports that he has convinced members of a Kaypro user's group to buy a diagnostic diskette. "The members bring their systems in and we check them out. If necessary, we can perform the alignment," he says. But utilizing the devices is beyond most end users' capabilities, Swanner maintains. He warns that "the diagnostic diskettes are only good if you know what they are telling you." □

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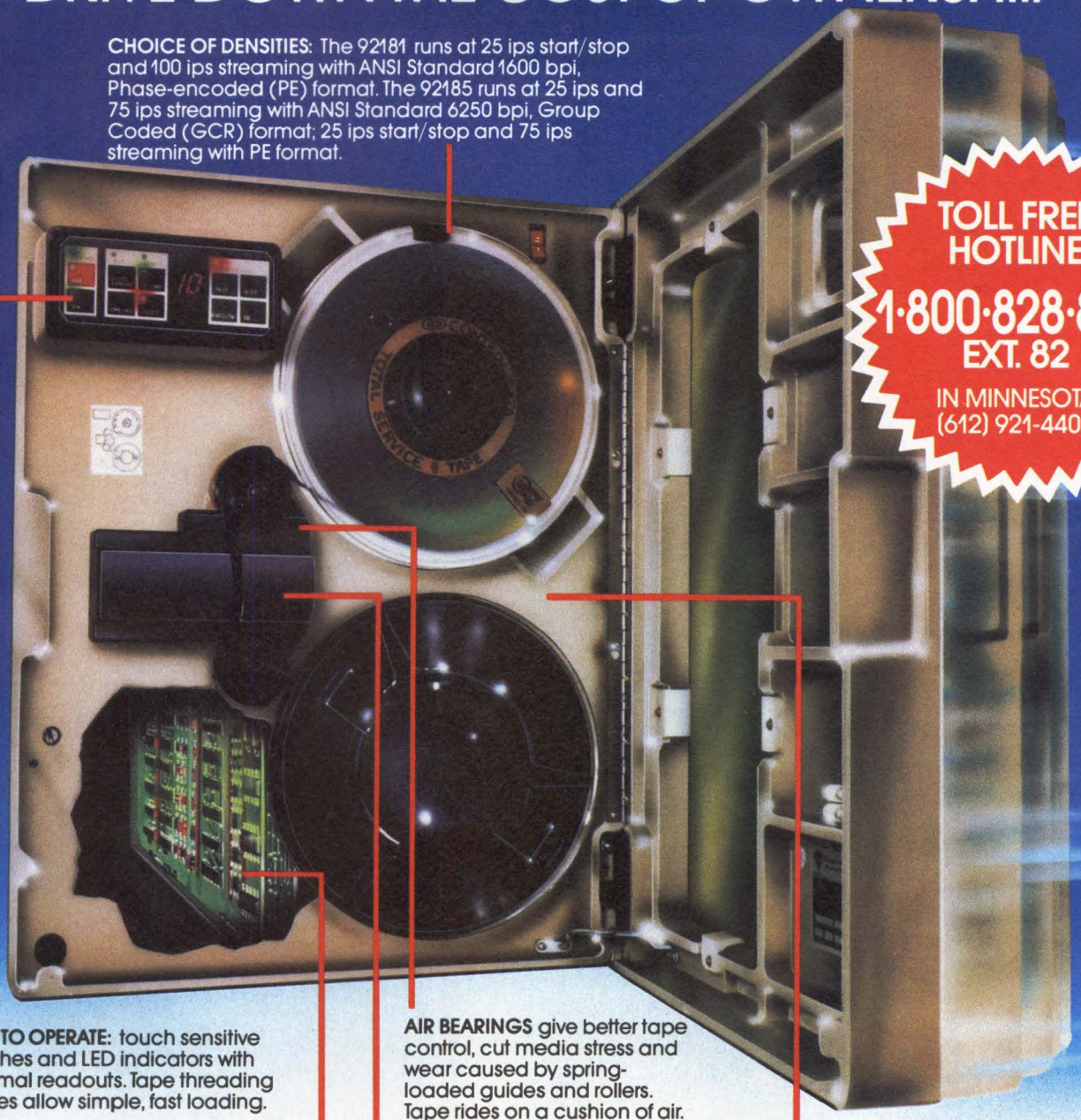

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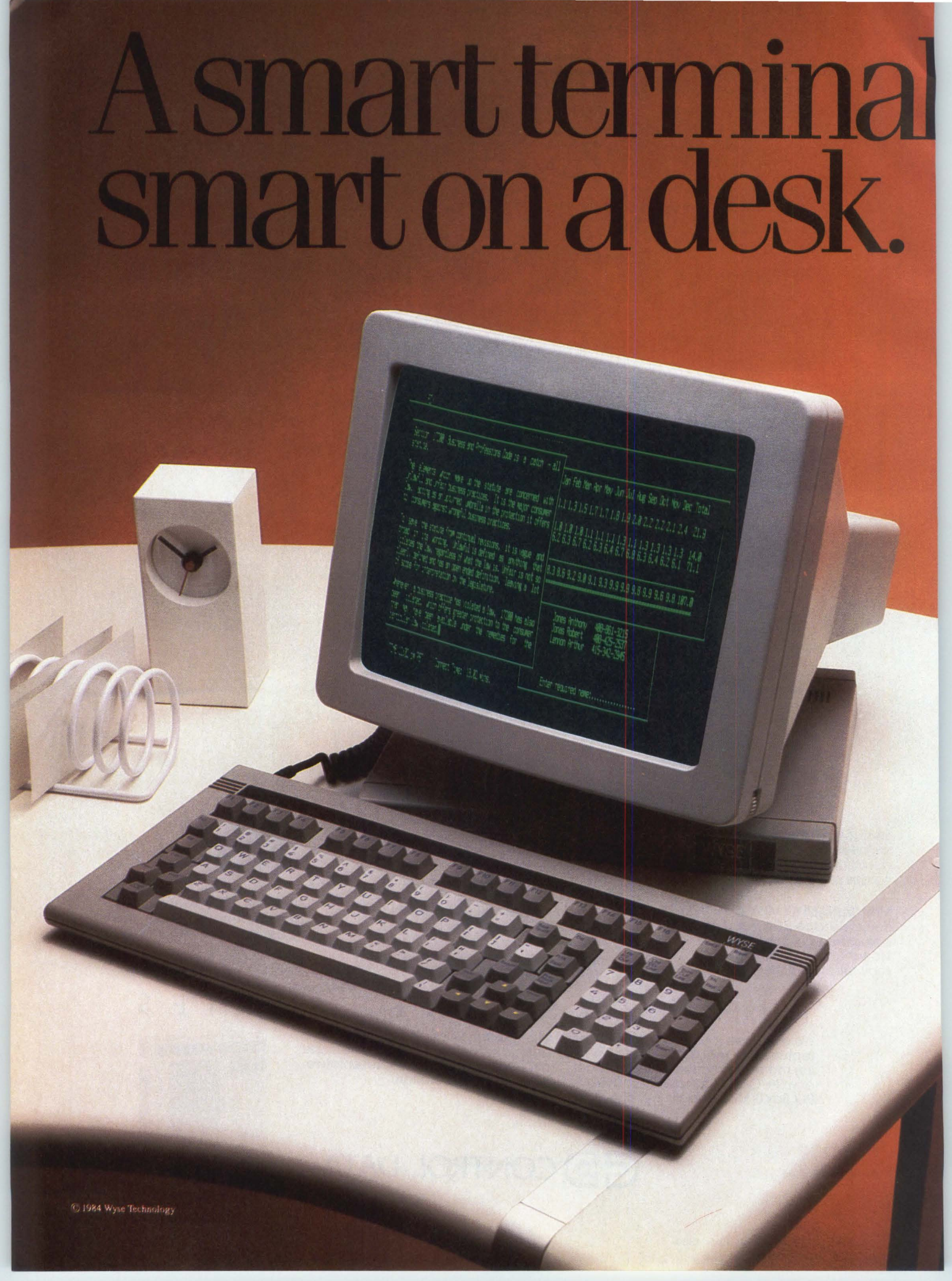

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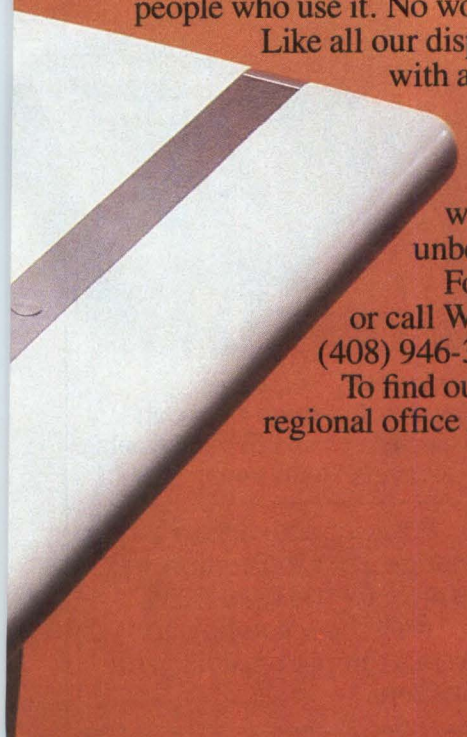

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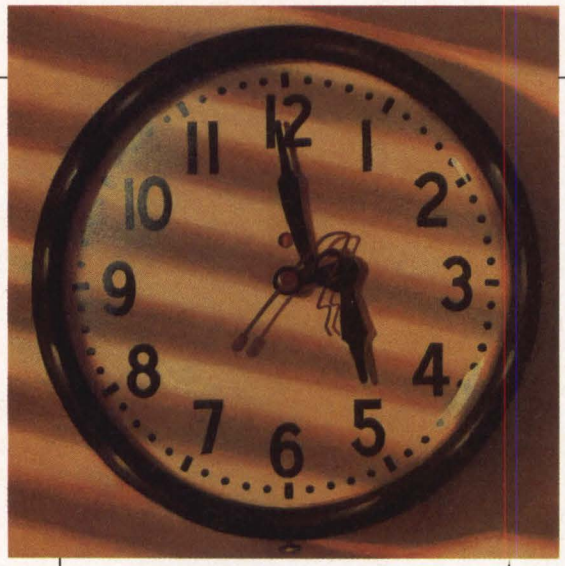

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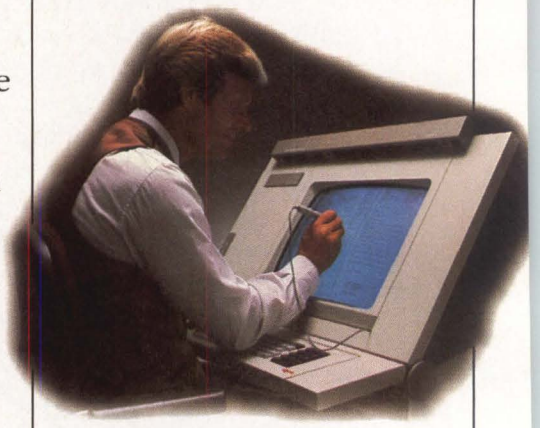

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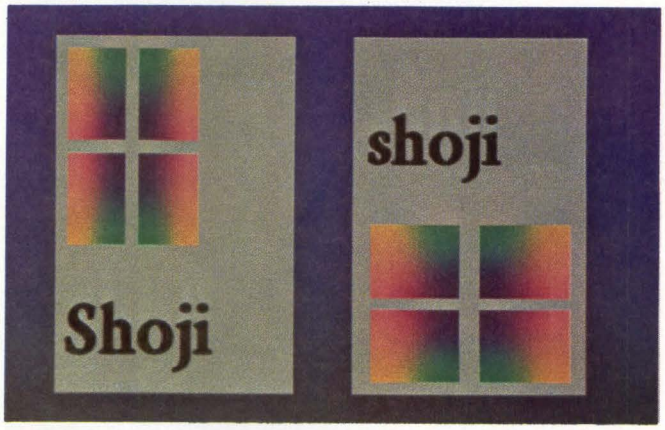
Graphics system rejects keyboard in favor of simple controls

Developed for artists, graphics software directs easy-to-use input devices to manipulate images precisely without typing

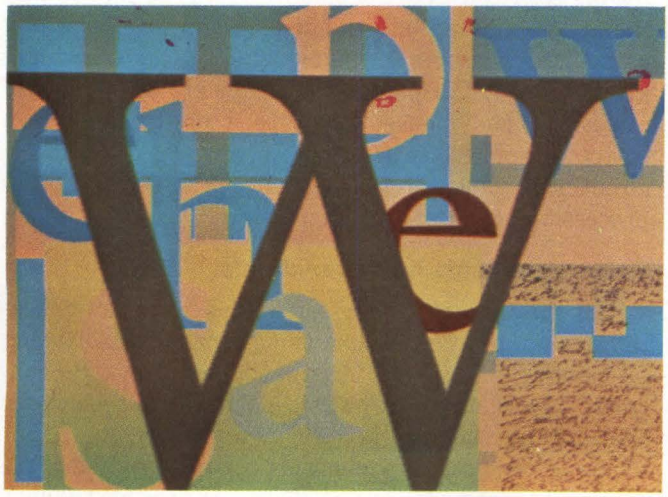
Sarah Glazer, Senior Editor

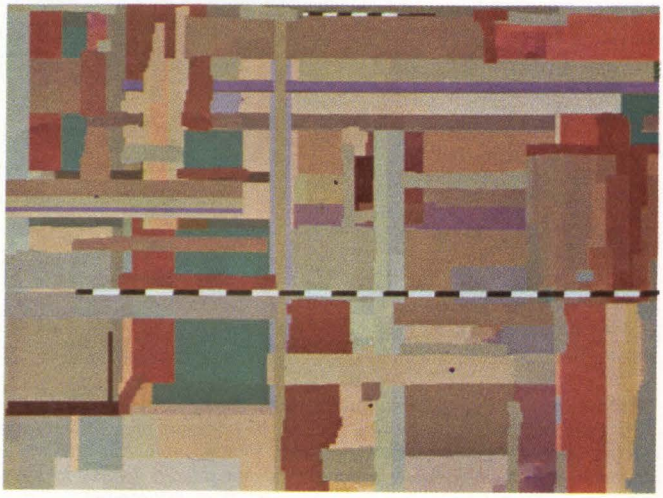
Paradoxically, the more advanced computers become, the less training users need to operate them. Directing machines that have powerful capabilities is now within the grasp of users who can't program at all and, in some cases, may even have trouble finding their way around a keyboard. But giving such users access to a computer isn't easy. A designer or system integrator must analyze how people work with traditional tools and then devise a way for the computer to harness human skills and help unleash creativity.

Designing a powerful graphics system that could be used by people who may have no previous computer experience but extremely exacting requirements—artists—was the goal of Lightspeed Computers Inc., Boston. Trained to plan and work visually, most artists find a keyboard an intolerable intrusion between their



The range of colors that can be created on the screen is almost infinite, *as these works by Nathan Felde illustrate. The artist chooses color completely through controls shown on the screen. No keyboarding is needed.*





The Integrator

Francis Olschafskie

After feeding photographic images into the system with a digitizing camera, *the artist can manipulate the contents of a CRT screen with a variety of techniques. It's so easy to alter an image drastically that the system includes a mechanism that makes it easy to save screen contents frequently, either for printing or reference.*

hands and the graphics display, making alternative input devices a must. Yet, while needing input devices that are easy to use, artists also require a highly sensitive system with sophisticated capabilities.

Lightspeed's four founders, who met while studying in the Massachusetts Institute of Technology's graphics department, are attuned to artists' special needs and familiar with conventional computer graphics equipment. They pool training in engineering, computer programming and fine arts and have all been involved in creating their own artwork using computers. This led them to design a system to enhance visual decision making. "Artists think visually," says Francis Olschafskie, one of Lightspeed's founders. They need to define colors and shapes without having to use words or other codes.

To strengthen visual control and minimize reliance on verbal commands, a digitizing tablet and a mouse, rather than a keyboard, control the display. The keyboard is unnecessary even to activate the system's main menu, which consists of one-word program titles on colored areas, or "buttons," on the screen. Using the stylus on a digitizing tablet, the artist guides a cursor to one of the buttons and presses the tablet to activate that program's sub-menu.

Pressing one corner of the mouse (Lightspeed calls it a flipper box) switches the display to a second window, where the artist can create a work or can view a montage of small versions of previously recorded screens, much like a contact sheet of photographic images. The box also activates a straight-edge feature; pressing one corner makes the cursor move vertically, while pressing another makes it move horizontally.

The artist can also introduce images into the display by using a video camera connected to a high-resolution digitizer. After scanning photographs or 3-D objects, the digitizer converts the image into digital signals that the artist can feed into the display and manipulate by using other features of the system. To make the high-resolution CRT display respond quickly to motions of the stylus and mouse, Lightspeed produces its own custom graphics boards. The company also chose to use an MC68000 microprocessor as its CPU because of its processing speed, notes Olschafskie.

Software reflects human methods

"All the options in our software deal with applications in an artist's life, like using an airbrush or using oil-painting techniques," Olschafskie explains. He contends that relating graphics capabilities to techniques the artist already uses is the system's key strength. For example, the process of choosing colors, a portion of the "paint" program, follows as closely as possible the way

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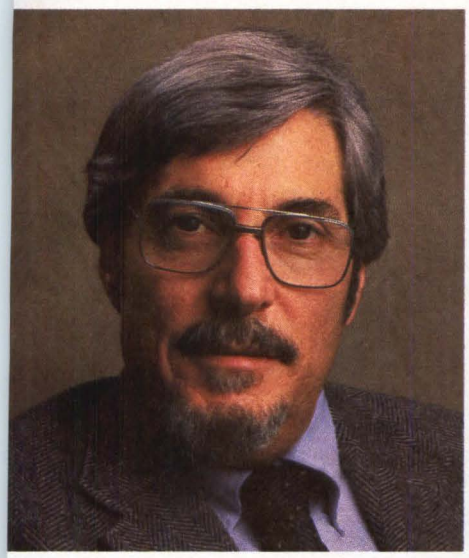

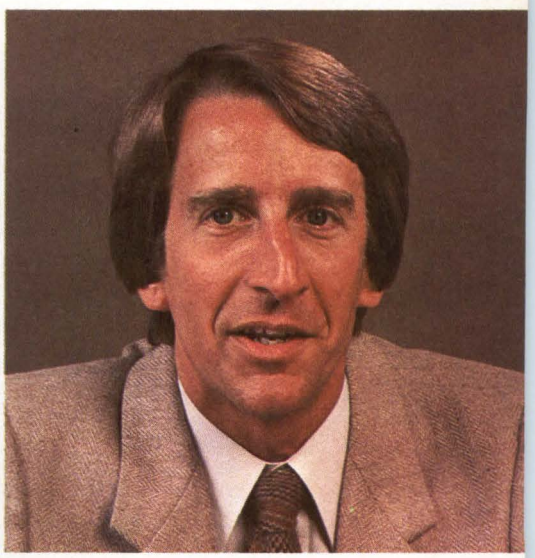

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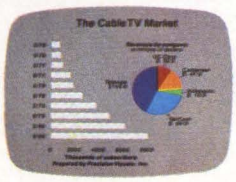

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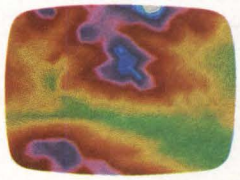

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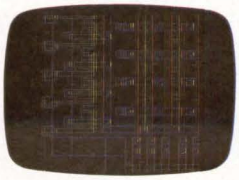

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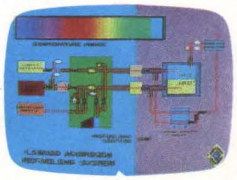

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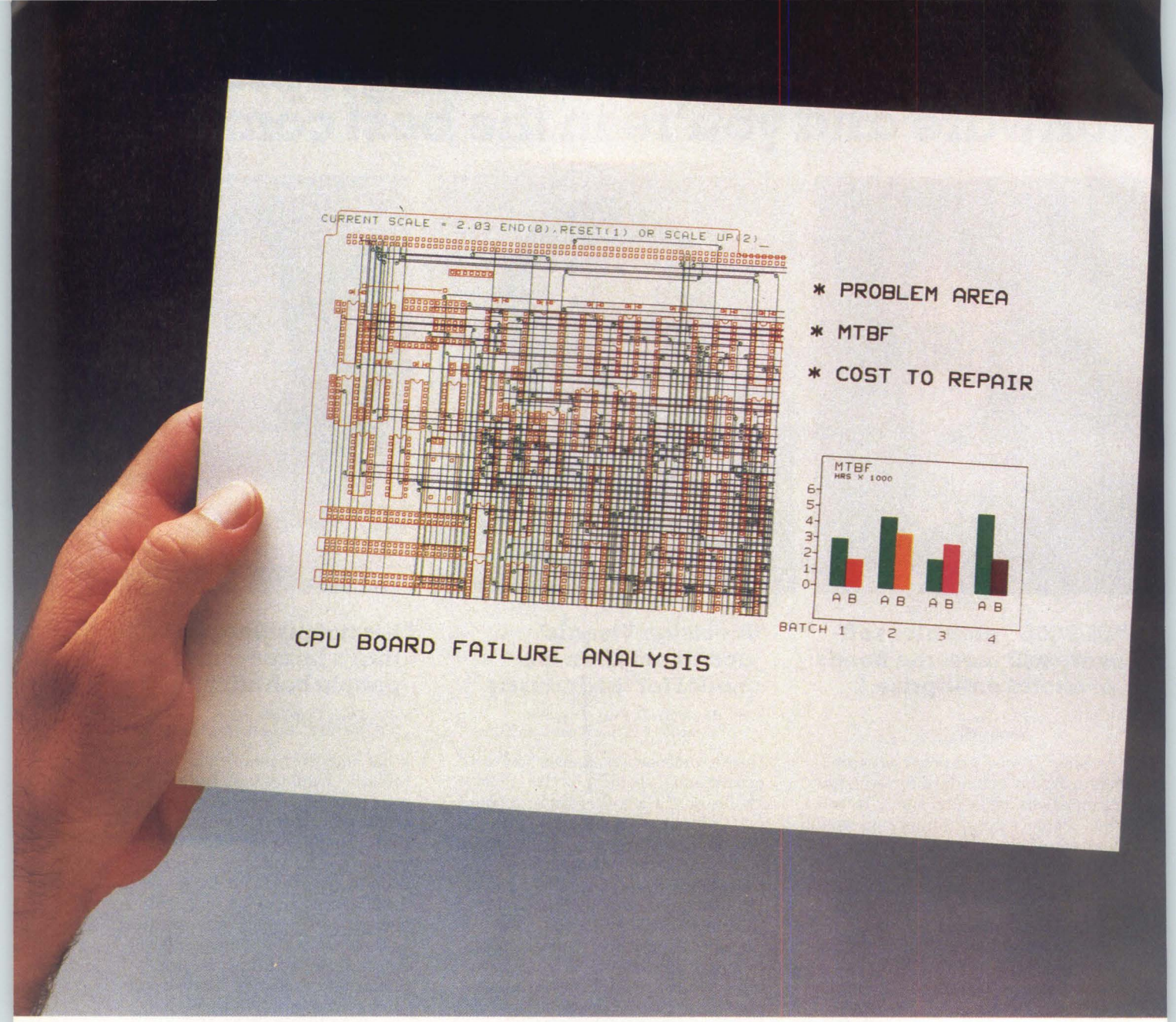

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SEIKO INSTRUMENTS

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CIRCLE NO. 78 ON INQUIRY CARD

an artist would mix colors using oil paints. At one side of the screen, a palette appears that has a spectrum of high-intensity colors and a "gray scale," a stripe that shows intensities of gray from white to black.

Using the cursor like the tip of a brush, the artist touches colors or shades of gray and brings them to a section of the palette reserved for color mixing. Here, the artist can mix as many as four colors and shades of gray as one would on a palette and can create as subtle a range of color as is possible with paint. Again, as with oil paint, the artist can also mix colors or grays directly on the image on the screen. Olschafskie claims that this mixing technique gives artists the infinite range of color they are accustomed to using. In contrast, most computer graphics systems, even those that offer over 100 colors, emphasize high-intensity hues, leaving the artist who wants to use pastels or subtle shading at a loss, he says.

The other main component of the paint program is choosing "brushes," which define the size and shape of an area of color (a group of pixels) an artist activates by moving a stylus across a digitizing tablet. Choices consist of rectangle, circle and smear brushes.

The rectangle brush produces a series of overlapping rectangles (a familiar computer graphics technique) that follow the path an artist traces on the tablet. The circle brush similarly produces overlapping circles, which gives the path of color a soft edge. The smear brush differs from the other two in that the artist can't use it to apply color. Instead, it defines a path in which already displayed colors are averaged or, in artist's terms, "smeared." Made up of overlapping circles, the smear brush has soft rather than jagged edges.

The artist chooses the width of a path of pixels, or the brush's size, from a size scale displayed at one edge of the screen. The artist can pick any width ranging from a mere point to about 1 inch and chooses visually, simply by moving the cursor to any position on the scale. In addition to size, each brush, except a smear brush, has a transparency level. The artist can apply opaque color or can lighten a color's density to an almost-transparent film. Once again, the artist chooses visually, from a continuous transparency scale on an edge of the screen.

The circle and smear brushes relate closely to traditional fine-art techniques, Olschafskie asserts. The circle brush produces an effect like that of an airbrush, a conventional piece of artist's equipment that produces a very controlled paint spray. Using the smear brush resembles a number of conventional techniques: smearing wet oil paints on a canvas to blend colors and soften edges, rubbing pastels together on paper to blend them and rubbing a charcoal drawing to produce shading.

Other features of the system produce results similar to effects a photographer can create in a darkroom. The artist can "flip" an image to make its mirror image, create "negative" images—not unlike photographic negatives—and superimpose grids or other patterns over an image. However, some features have no counterparts in the fine-arts world. For example, the system can define an area on a screen and repeat it. By creating a path of repeated images, the artist can effectively use a part of the screen as a brush.

Unleashing creativity

Another goal of the designers was to make it easy to save images. "Because you can alter an image so dramatically and so quickly, it's important that people can get back to where they were," Olschafskie explains. The artist can dump screens in 35 seconds, storing them on a floppy disk or in a temporary buffer that can hold several screens and display them in a contact-sheet-like format.

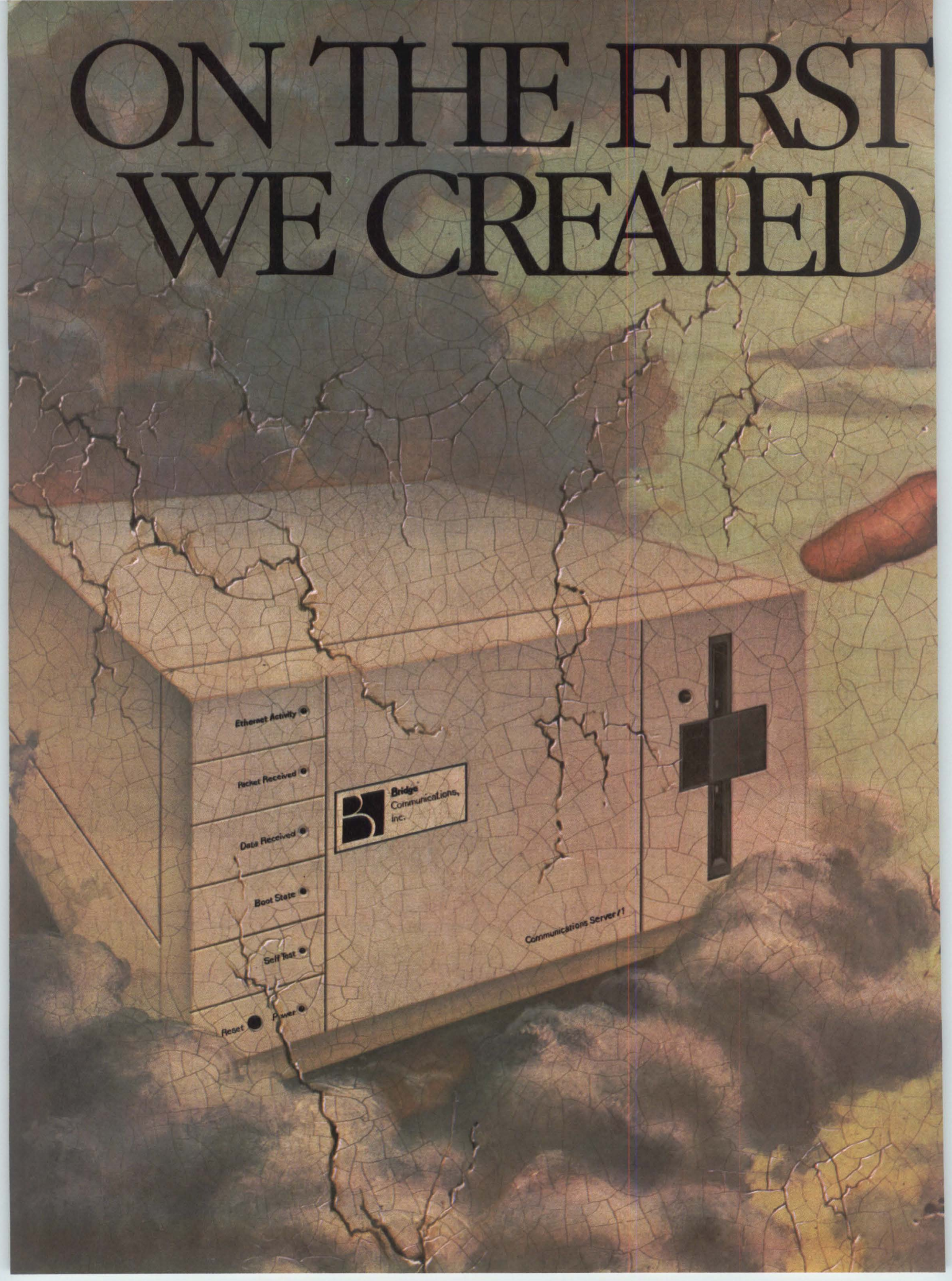
For hard copy, Lightspeed chose a photographic film recorder, operated by a foot pedal, that can produce 35mm slides or transparencies and negatives in others sizes. In Olschafskie's view, photographic hard-copy devices give a wider range of color than plotters and electrostatic copiers produce.

Although some artists use the system to create final products, others use it merely as a study tool. "With the computer, you can change your image so quickly, it makes you use your creativity," Olschafskie reasons. "You can't just settle for something that's not quite right." He argues that the computer can be an especially powerful tool for letting artists study their work and learn what's possible more easily than by producing traditional studies.

To make computer graphics more available to artists —few of whom could afford to buy a system— Lightspeed rents its equipment and studios on an hourly basis. Before renting equipment, an artist must go through a training session that takes at least 4 hours. But, even for those with no previous contact with computers, Olschafskie insists, training takes no more than 10 hours.

Because the company developed its software to enable users to control all functions without a keyboard, artists can quickly learn to use sophisticated features with a minimum of effort. And the founders of Lightspeed believe that making a system easy to operate is one of the most important steps in making computers available to many potential users. □

Interest Quotient (Circle One)
High 813 Medium 814 Low 815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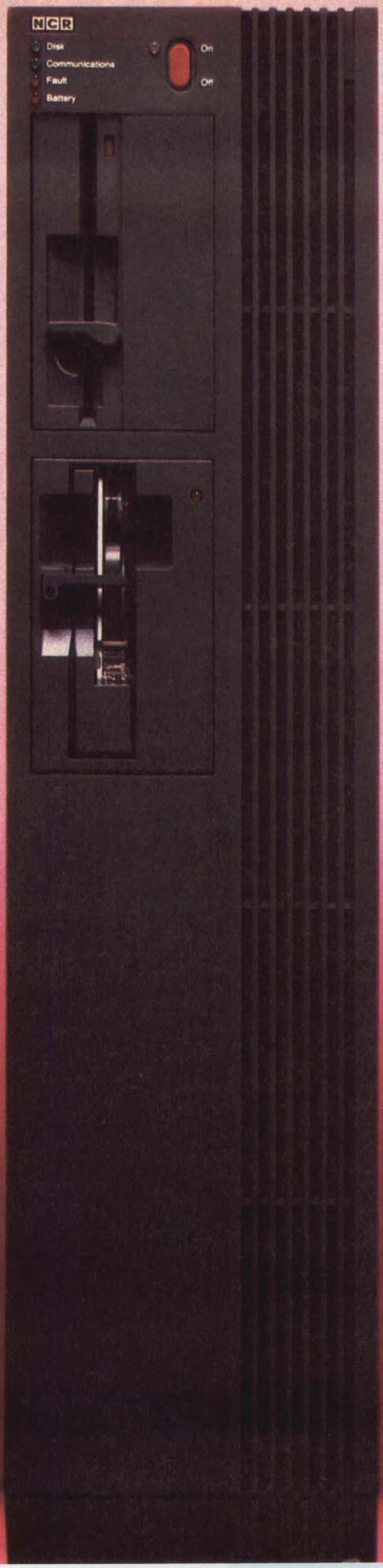
CIRCLE NO. 79 ON INQUIRY CARD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Disk
Communications
Fault
Battery
On
Off

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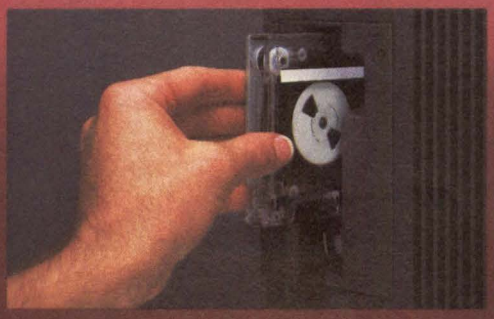

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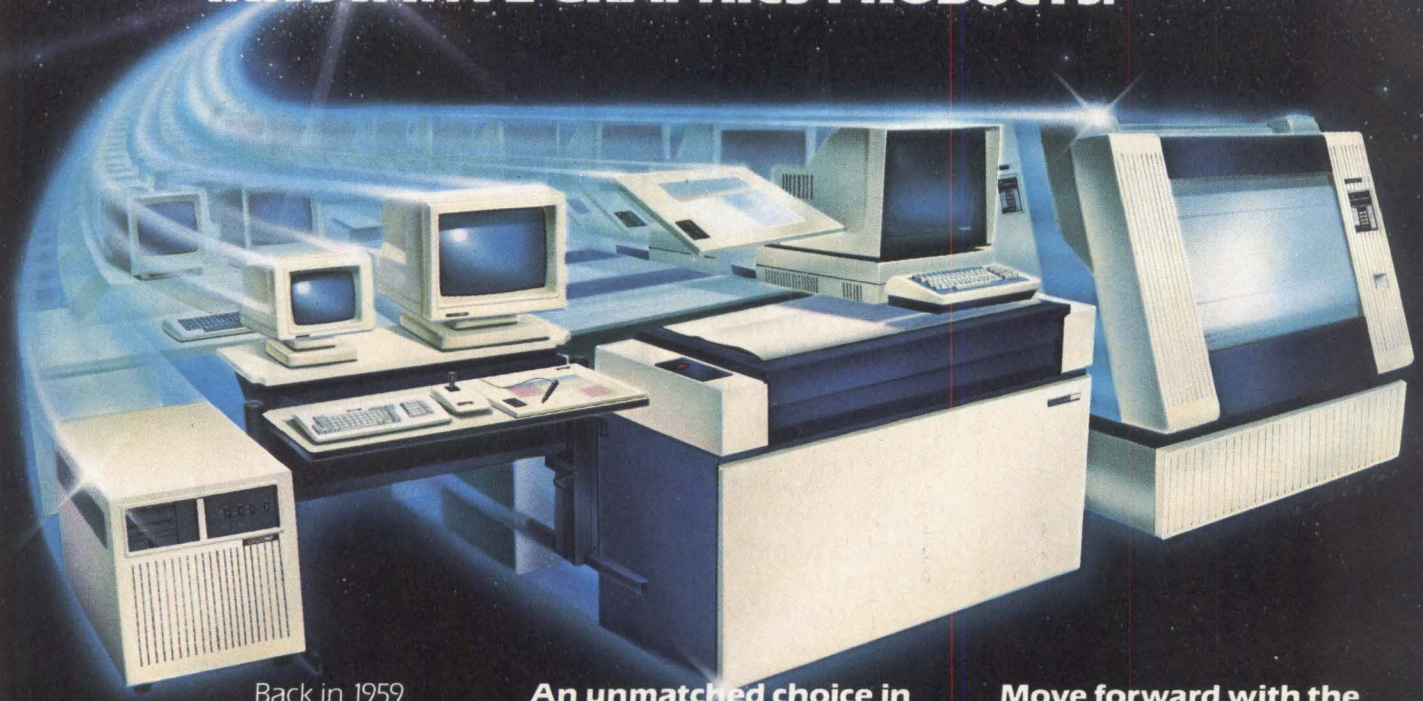
CIRCLE NO. 80 ON INQUIRY CARD

TWENTY-FIVE YEARS AGO CALCOMP PIONEERED THE MOVEMENT TOWARDS INNOVATIVE GRAPHICS PRODUCTS.



Back in 1959 when computer graphics was barely a concept, CalComp pioneered the first computer-driven plotter. Since then we've had one successful product after another, and the momentum has never been greater than it is now.

Versatile DUAL-MODE™ pen plotters fill out the line.

To offer you the broadest line of plotters in the industry, we've introduced a new generation of intelligent, microprocessor-based DUAL-MODE™ pen plotters. They give you the versatility to run unattended, continuous roll batch jobs, as well as drawings on cut-sheet or pre-printed forms.

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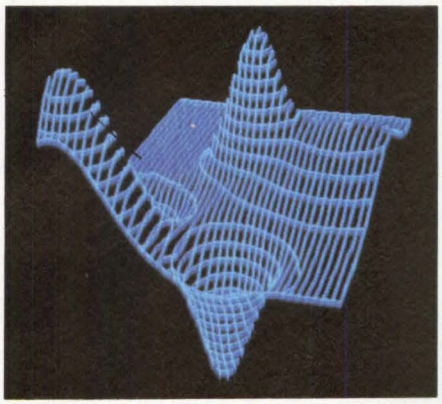
THE MOMENTUM IS GROWING

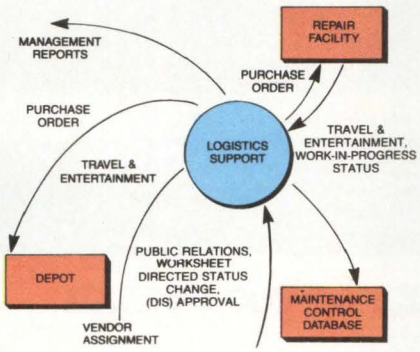
CIRCLE NO. 81 ON INQUIRY CARD

FEATURE HIGHLIGHTS

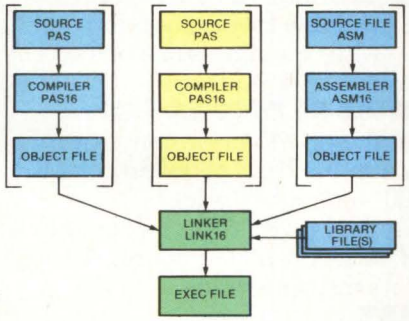


SOFTWARE: While most of the industry advocates **software standards,** proponents and opponents stand nose-to-nose in a battle of conflicting objectives. Some manufacturers cite the need to be different to ensure their market share. Others will accept standards only if those standards guarantee that hardware will be available to support their offerings. See **p. 202** for more information.

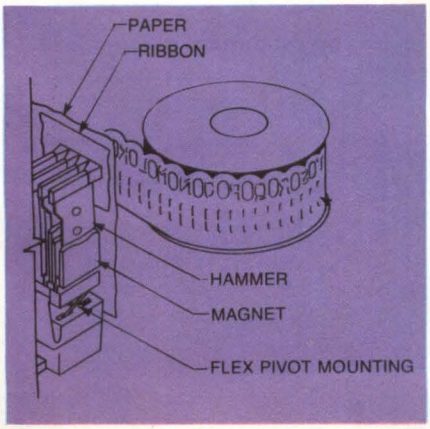
Hardware manufacturers, software resellers and end users are demanding more functionality from application and operating software. To meet this challenge, software developers are employing structured specification designs using **software tools** such as programmed logic trees, automatic application code generators, optimized compilers and linkers for code generation and software/hardware debuggers. Turn to **p. 235** for the whole story.



System integrators attempting to **transport large software packages** from one hardware environment to another can benefit from companies such as Digital Innovations Pvt. Ltd., which has ported National Semiconductor Corp.'s NSX16 development tools from a 32-bit DEC VAX supermini running VMS to a 16-bit PDP-11 mini running RSX-11. To find out how they did it, consult **p. 215.**



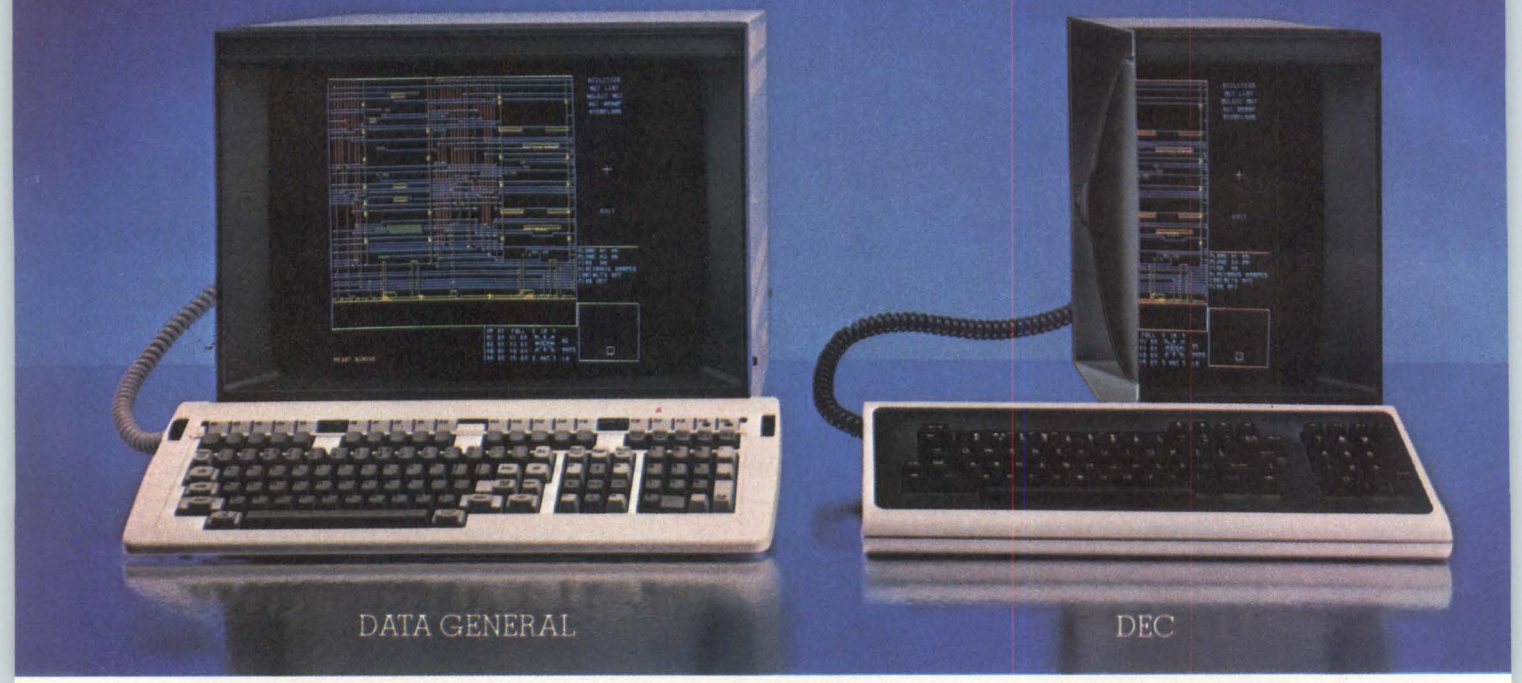
CONTROLLERS: Microcomputer peripherals have proved to be a major bottleneck in system performance, especially in disk-intensive UNIX environments. The need for higher performance devices has produced a new generation of disk drives, which in turn has required higher performance disk controllers. Interphase Corp. has developed the Storager, which increases performance through reduced rotational latency, virtual buffering and disk caching. More details appear on **p. 163.**



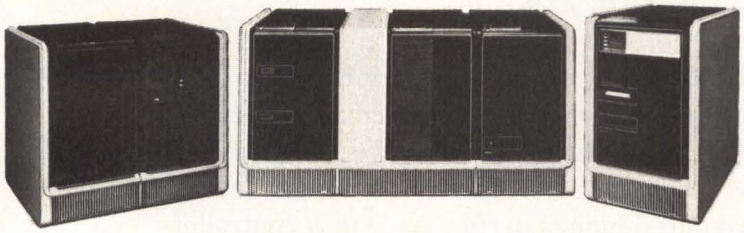
LINE PRINTERS: Impact or non-impact? Impact printers continue to dominate the line-printer industry despite a promised market revolution in non-impact machines. For more information, see **p. 175** and peruse the **impact line printer table** on **p. 187.**

COMMUNICATIONS: An intelligent I/O board permits more users to run programs simultaneously from a single host without decreasing throughput. Macrotech International Corp.'s ADIT I/O board, detailed on **p. 225,** provides intelligent processing for S-100 based systems and supports up to 16 terminals, printers, modems or other serial devices.

DATA GENERAL'S MV/10000. LESS MONEY THAN DEC'S VAX 11/780 AT TWICE THE SPEED.



DATA GENERAL'S MV/FAMILY–TOP PERFORMANCE, NOT TOP DOLLAR



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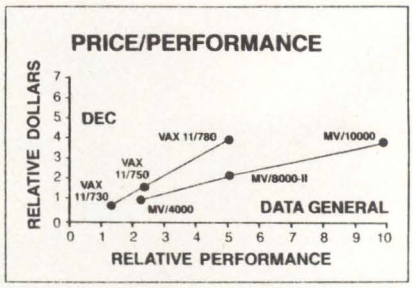

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CIRCLE NO. 82 ON INQUIRY CARD

UNIX-optimized controller supports intermixed tape, floppy, Winchester drives

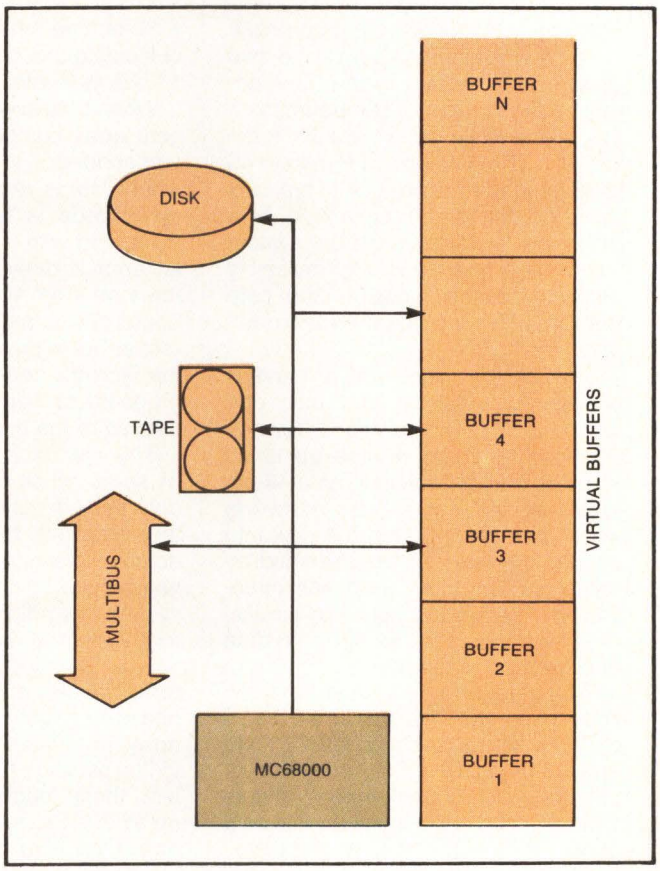
Working with Multibus systems and major disk interfaces—including ESDI, ST506 and ST412—controller uses multitasking architecture with virtual buffering and disk caching to reduce rotational latency and increase peripheral performance in disk-intensive applications

A. Edward Turner, Interphase Corp.

While CPU power is increasing rapidly, microcomputer peripherals are becoming the bottlenecks that system integrators must confront in seeking greater overall system performance. This situation is particularly true in disk-intensive UNIX environments. The need for higher- performance, higher-capacity storage devices has led to a new generation of 5¼-inch Winchester disk drives that have faster interfaces and storage capacities in excess of 300M bytes. This, in turn, has led to the need for higher-performance disk controllers that take advantage of the new drive and interface capabilities.

Interphase Corp.'s answer is the Storager disk controller, which works with Multibus-based systems and supports all major 5¼-inch disk interfaces. A multitasking architecture increases performance by reducing rotational latency. Other architectural features—such as "virtual buffering" and disk caching—boost the performance level of 5¼-inch disks to that of 8-inch storage module device (SMD)-type disks. The controller board supports two 5¼-inch Winchester drives, four ¼-inch tape drives using either quarter-inch cartridge (QIC)-02, or Archive Corp. interfaces and two floppy disks intermixed in any two of three formats—3½-, 5¼- or 8-inch.

The Storager employs a multitasking, virtual buffering architecture. This scheme reduces data-transfer delays resulting from disk rotational latency and pro-



MC68000 microprocessor manages the pool of virtual buffers *and regulates activity on the controller. It allocates and de-allocates buffers as they are accessed or released by the disk, tape or Multibus.*

vides simultaneous disk and bus transfers as well as concurrent disk and tape operations.

Two bipolar-state machines manage the data streams. The direct memory access (DMA)-control state machine manages data movement between the controller and the Multibus; the buffer control state machine manages data movement between the controller and its peripheral devices. The two state machines operate independently to allow simultaneous data movement between the controller and the bus and between the controller and its peripherals.

A Motorola MC68000 microprocessor regulates activity on the Storager controller. It breaks up commands, sets up data transfer operations and manages the pool of virtual buffers that support a variety of activities on the controller. The Storager has 16K bytes of on-board memory that can be treated as a series of sector buffers. Any of three devices—disk, tape or Multibus—can access the individual buffers. The 68000 dynamically allocates and de-allocates buffers as they are requested or released by the various devices. Because each device has a seemingly endless supply of buffers, this design eliminates data overrun and underrun problems inherent in first-in-first-out (FIFO)-based systems. The multitasking architecture and the pool of buffers assist in reducing rotational latency.

A traditional controller, upon receiving a multi-sector request from the operating system, waits to read and transfer data until it encounters the first of the requested sectors. This delay accounts for an average rotational latency of half a track, or eight milliseconds of additional access time. For example, if the request is for a full track of data, a traditional controller takes an average of a revolution-and-a-half to accomplish the transfer. In comparison, the Storager begins reading as

Two bipolar state machines manage the data streams.

Custom gate arrays decrease component count

Jointly developed by Interphase Corp. and Signetics Corp., the two custom gate arrays in the Storager reduce the number of components on the board while increasing its functionality. The gate arrays eliminate 45 to 50 integrated circuits (ICs) typically found on this kind of controller. As a result, the Storager offers the system integrator a board with high reliability and low cost. In addition, the gate arrays perform on-board error correction.

One of the gate arrays handles serializer/deserializer and error-correcting code (ECC) functions. Typically, these functions require up to 20 ICs. The chip is packaged on a 48-pin leadless chip carrier, and converts serial data coming from the disk into parallel data that can be handled by the controller. In the opposite direction, the gate array converts parallel data from the controller to serial data to be written to the disk.

The gate array includes a cyclic code generator that produces 16-bit cyclic redundancy check (CRC) code and 32-bit ECC. CRC code detects but does not correct errors, and is typically used on floppy disks and as a check on header fields on hard disks. In contrast, ECC, which is generally used on data fields, detects errors and allows for correction. ECC generates a 32-bit checksum, which is capable of locating and correcting errors up to 11 bits in length.

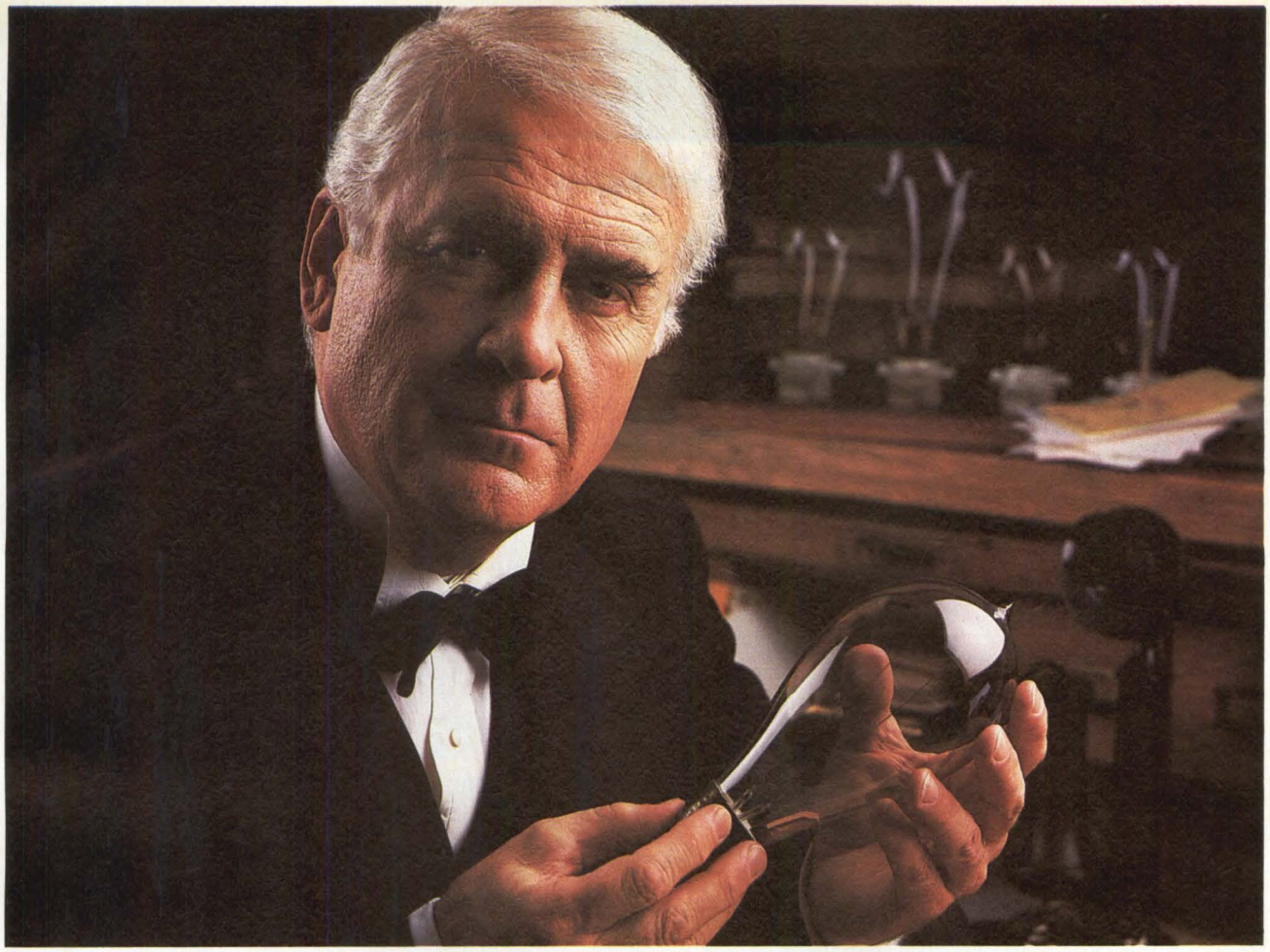
When data is written to the disk, the gate array computes the cyclic code and appends it to the data. In reverse, when data is read from the disk, the cyclic code is read, computed and compared with what was just read. If an error is detected, the ECC generates an error syndrome that the on-board 68000 processor uses to correct errors in the data. In other words, the Storager performs error correction on-board so that only correct data is passed to the host.

This approach is in contrast to that of some other controllers that pass only the error syndrome to the host, thus requiring the host to make the actual correction. Not only does this necessitate host intervention, but the system integrator must write software for the host to handle the correction.

The Storager's other custom gate array handles encoding/decoding and phase-lock-loop functions. The gate array is arranged in a 24-pin dual in-line package (DIP). In other controllers, these functions typically require up to 30 ICs. As with the other gate array, this chip frees more space on the board for other ICs.

The Storager's encoding/decoding chip handles a variety of functions, including:

- Conversion of non-return-to-zero (NRZ) data to frequency modulation (FM) or modified frequency modulation (MFM) encoded data. This function converts digital data into a form that can be written on the magnetic media of the disk. Single-density floppies typically use the FM data format, and double-density floppies and hard disks typically use the MFM data format.
- Conversion of FM or MFM encoded data to NRZ data. This involves converting the analog data read from the disk to digital data.
- Address mark detection and generation for soft-sectored disks.
- Write precompensation with external delay line. Because precompensation varies with different drive manufacturers, the Storager allows the precompensation cylinder number to be programmed on a per-drive basis.
- Receive clock regeneration, commonly known as "data separation," which separates the clock and data signals.
- Phase comparator portion of the phase-lock-loop circuitry. This function assists in isolating clock and data signals.



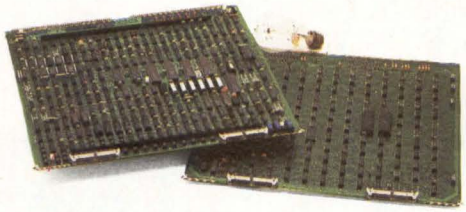
Zetaco's latest inventions make 86 disk and tape drives Data General BMC compatible.

Zetaco's BMX-1 disk drive controller and BMX-2 mag tape coupler give the user of Data General's high-speed BMC (Burst Multiplexor Channel) full compatibility with the newest high-speed, high-capacity, non-DG drives.

These two bright ideas let you choose virtually any high performance SMD-type disk drive or ½" tape drive to run on the BMC or Data Channel on DG's newest Eclipse or MV Series mini.

Each BMX-1 supports up to 4 SMD-interfaced hard disk drives. Each BMX-2 supports up to 8 streaming or start/stop tape drives.

Zetaco's full emulation of DG's 60XX and 61XX series disk and 6026 and 4307 tape subsystems means no software patching is required. E^2 PROMs eliminate switches, making drive configurations and functions selectable via downline loaded software. And Zetaco's exclusive backplane cable design is plug-and-go compatible with DG's FCC and non-FCC compliant chassis.



Discover the BMX Series from Zetaco, 6850 Shady Oak Road, Eden Prairie, MN 55344, (612) 941-9480. Telex 290975. European Headquarters: 9 High Street, Tring, Hertfordshire, HP23 5AB, England. (044282) 7011. Telex 827557. ZETACO G.

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CIRCLE NO. 83 ON INQUIRY CARD

Lear Siegler's New ADM 220

DEC VT 220™ Compatibility. More performance with High Touch™ Style.

DEC compatibility. Ergonomic styling. Standard features that include advanced editing, 15 programmable function keys, DEC VT220 keyboard layout, and user-friendly set-up. All these–and more–are combined in Lear Siegler's ADM 220 video display terminal.

The ADM 220 is engineered for use with Digital Equipment Corporation and ANSI X3.64 compatible systems. It is compatible with the DEC VT220, as well as the VT100™ and VT52.™ Add Lear Siegler's superior styling and ergonomics and you have a VDT that offers maximum operator comfort and efficiency.

Lear Siegler's High Touch style includes a full tilt and swivel monitor that stops positively in any position. The low-profile, DIN standard keyboard includes a built-in tilt adjustment. Set-up is easy with parameter menus displayed in English, French or German.

The ADM 220 provides four non-embedded visual attributes (blink, bold, underline and reverse video), 80 or 132 column x 24 line display (plus 25th status line), split screen, double high/double wide line attributes, and vertical or horizontal scrolling.

The ADM 220's unique 3-level function keys give you 15 fixed functions and 15 programmable functions. An added feature (not available on DEC's VT220) is the addition of 15 programmable, non-volatile functions.

A 12-inch green or amber screen is standard and 14-inch displays are optionally available.

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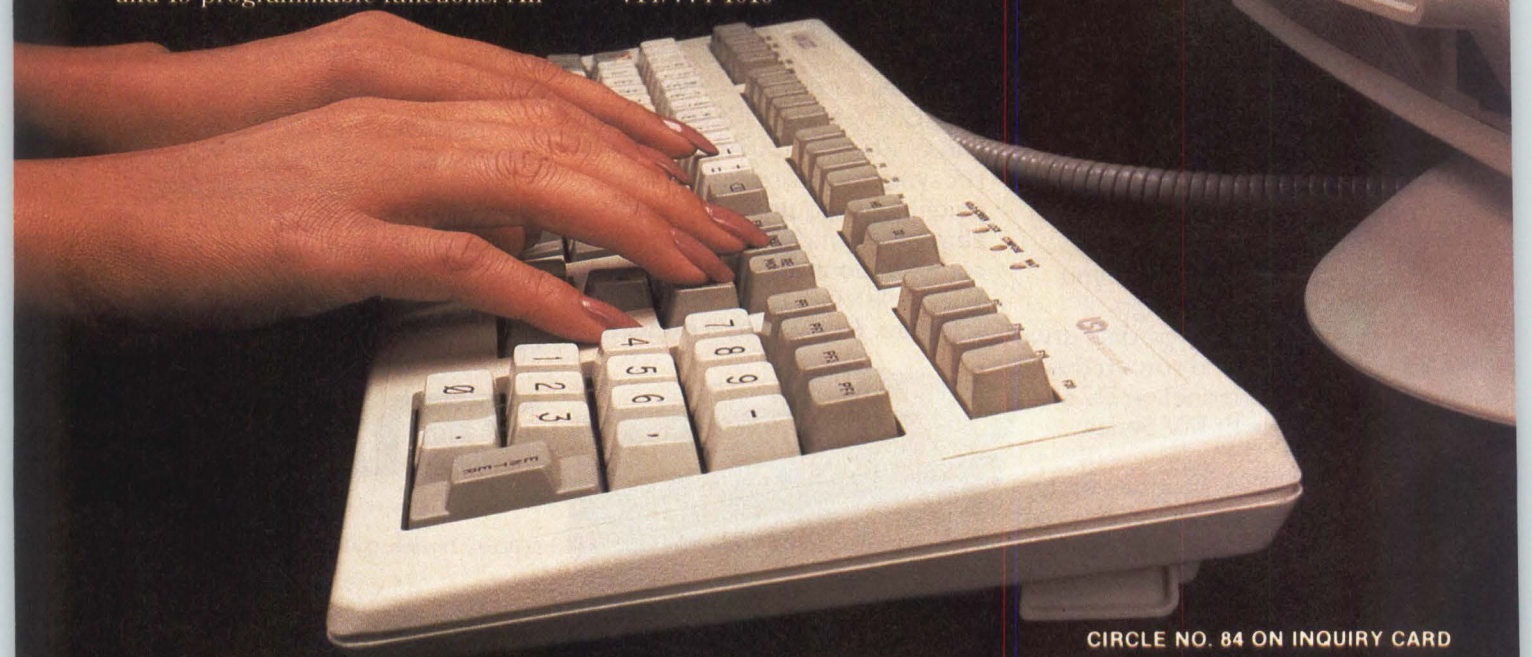

CIRCLE NO. 84 ON INQUIRY CARD

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soon as the head lands on the track and begins transferring data as soon as it encounters any of the requested sectors.

Because it does not have to wait for the disk to rotate to the beginning of the requested string, the Storager never takes more than a single revolution to transfer an entire track of data. For example, if the operating system requests sectors 0-7 and the head lands at sector 4, the Storager immediately begins reading and transferring data. The controller first places sectors 4-7 in the correct location in the system memory and then reads and transfers sectors 0-3. This technique reduces rotational latency in direct proportion to the size of the request and eliminates latency for reads of one track or more.

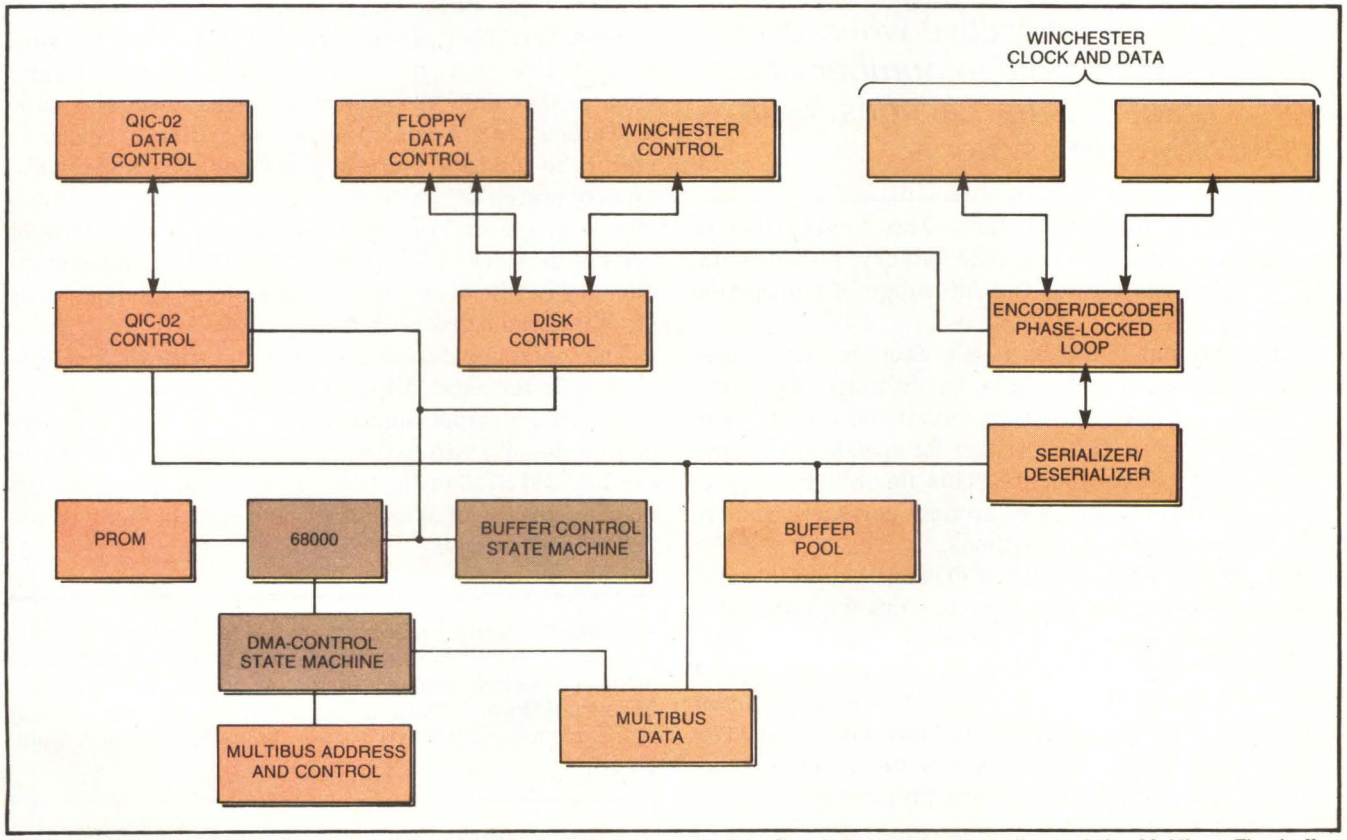
Caching optimizes controller for UNIX applications

Intelligent caching can greatly improve overall system throughput in disk-intensive applications. Tests have shown throughput improvements averaging greater than 40 percent compared to a traditional 1:1 interleaving scheme without caching.

The controller accesses requested information from the disk and, while awaiting further instructions, continues to fill the cache with subsequent data from the disk. When the controller has completed a read operation and transferred the requested data, if there are no other requests in its queue, it will continue to read the next sequential data until it has filled all available buffers. Thus, if sequential data requests from the operating system are for logically contiguous sectors, as is frequently the case in file-oriented transactions, these requests can be satisfied directly from the cache

Spec summary

- **Company:** Interphase Corp.
- **Model:** Storager
- **Interfaces:** enhanced small disk interface(ESDI), ST506 or ST412HP hard-disk interfaces; floppy interface; QIC-02 or Archive tape interfaces
- **CPU:** Motorola 68000
- **Unit initialization block concept:** software control of disk, parameters, gap sizes, stepping rates, etc.
- **DMA rate:** 3M bytes per second
- **Component count:** 115 integrated circuits
- **Sector size:** 128 to 2,048 bytes
- **Hard disk support:** two
- **Tape support:** four
- **Floppy disk support:** two (single-sided/single-density, double-sided/double-density; 3½-, 5¼-, 8-inch)
- **Data buffer:** virtual buffer (buffer pool for all units allows sector first-in-first-out operation, caching, zero latency read and write and streaming-tape operation.)



The architecture of the Storager *disk controller includes an MC68000 microprocessor that regulates activity on the controller and two bipolar state machines. The DMA-control state machine manages data flow between the controller and the Multibus. The buffer-control state machine manages data flow between the controller and peripherals.*

ESDI interface extends ST506 capabilities

In November 1983, a committee of disk and controller manufacturers completed specifications for the enhanced small-device interface (ESDI). The specifications provided for the connection of disk and tape drives to a single controller. The new interface was targeted at high-performance 5¼-inch Winchesters.

The ESDI interface differs from the industry-standard ST506 interface primarily in speed and flexibility. ESDI supports transfer rates of 10M bytes per second and faster, whereas the ST506 is limited to 5M bytes per second. It places the data separator on the drive rather than on the controller. This method improves performance because the data separator, which is an analog device, can be optimized for the characteristics of the specific disk drive.

Data gets transmitted between the drive and the controller in the non-return-to-zero (NRZ) format. Because NRZ data require a separate clocking signal, the interface specification is not limited to a single-disk transfer rate, and can accommodate higher transfer rates as the need arises. Data transmission between the disk and controller is more reliable and less subject to error using the NRZ format.

An ESDI connection comprises two cables: a control cable that is daisy-chained from drive to drive, and a series of radial data cables that connect the controller with each disk drive. The ESDI also supports two methods of head positioning. In step mode, step and direction lines are used with no facility for reporting configuration or status information, as in the ST506 interface. The preferred method of operation is serial mode, in which the interface communicates command data, configuration and status information on the control cable.

without accessing the disk.

Caching proves most effective when disk activity involves a large number of short, contiguous transactions, as is the case with most UNIX-based systems. As transaction size increases, caching becomes less important and reduced rotational latency becomes more important. For transactions of a track or more, rotational latency will go to zero. The combination of caching and reduced rotational latency provides improved disk response for the full range of transaction sizes.

Caching is most effective when disk activity involves a large number of short, contiguous transactions, as in most UNIX-based systems.

Many optional features of the Storager are under software control. For example, the Storager has a unit initialization block (UIB) that allows the system integrator to configure the controller for specific disk types and operating environments. This flexibility lets system integrators configure around software choices rather than hardware limitations.

To support a wide variety of drives, system integrators can program the controller to work with all methods of sector addressing, including hard sectoring, address mark and byte clock. The controller also supports all methods of head positioning — serial cylinder selection and stepper pulses — and has software control of step rates to take advantage of drives supporting buffered steps. Sector sizes are programmable from 128 to 2048 bytes.

The major interfaces for 5¼-inch drives are the industry-standard ST506, the enhanced small-device interface (ESDI) and the ST412HP, which is a 10-MHz version of the ST506. Using an on-board data separator, system integrators can mix ST506 and ESDI drives or ST412HP and ESDI drives with the same controller. This capability provides easy migration from existing ST506 drives to new, high-performance drives.

The controller board uses two custom large-scale integration (LSI) circuits: the data separator (encoder, decoder, and phase-locked loop) and the serializer/deserializer. The LSI circuits are implemented in gate arrays. The Storager supports streaming and start/stop modes and allows simultaneous disk and tape operations. In streaming mode, the controller allocates buffers to the tape drive in a manner that ensures the tape operates at maximum speed. It can do off-line mirror-image backups and restores without the use of system memory. File-oriented transfers using system memory can be done concurrent with, and independent of, Winchester disk activity.

The controller can handle two floppy disks in 3½-, 5¼- or 8-inch formats. Most controllers cannot intermix sizes. Single sided/single density and double sided/double density are software selectable. Disk formats can be IBM 3740 or System 34. All caching and performance features of Winchester disk control apply to the floppy disk as well. □

A. Edward Turner is vice president of Interphase Corp., Dallas. Turner joined Interphase in 1983 after several years as technical marketing manager for the Information Networks Division of Hewlett-Packard Co. Before that, he was manager of the telecommunications support group for Procter & Gamble Co.

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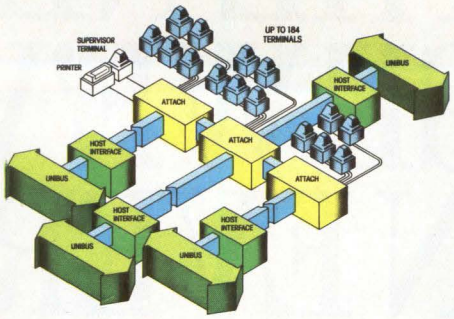

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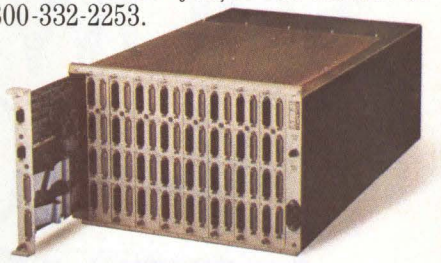

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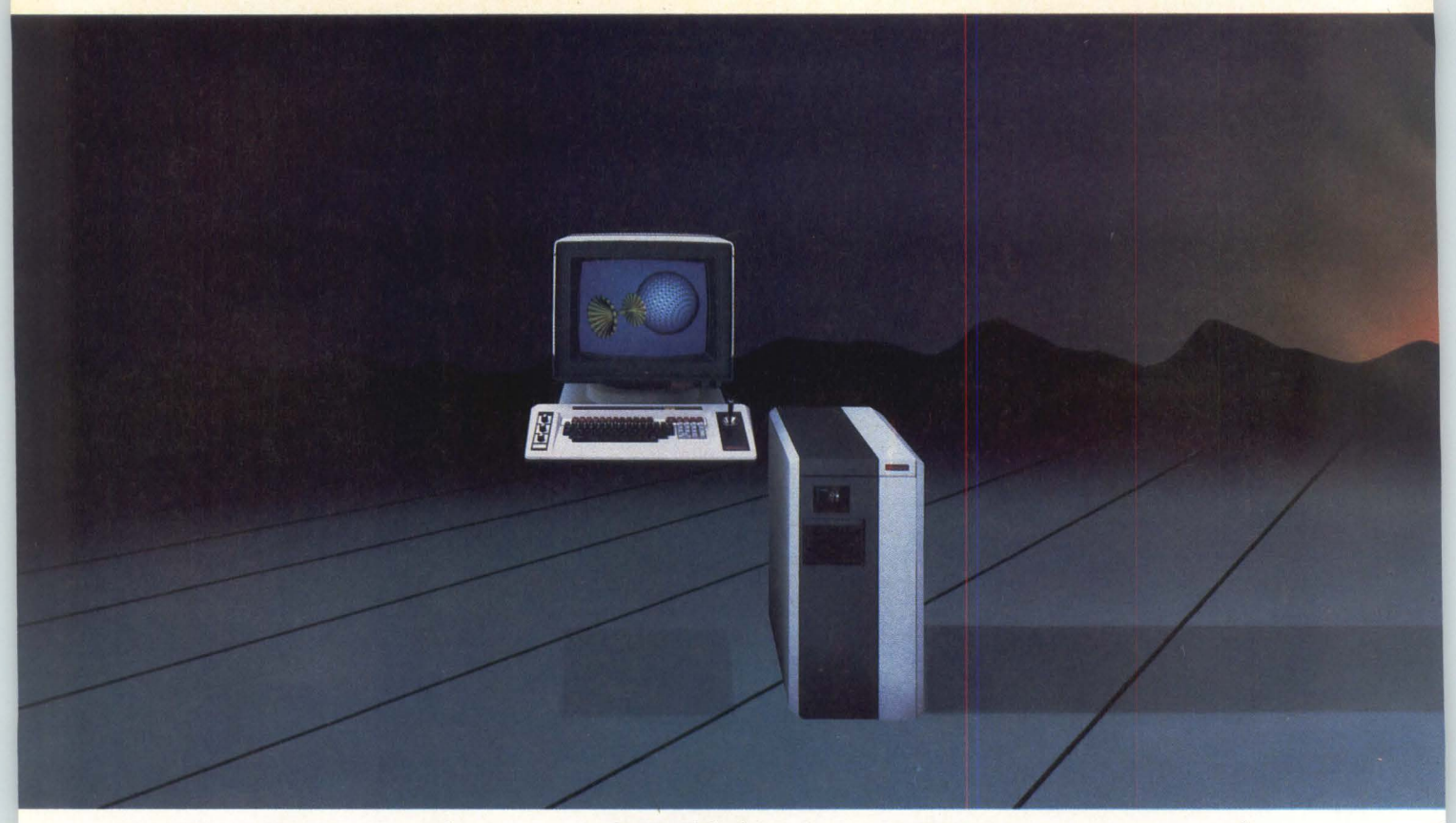

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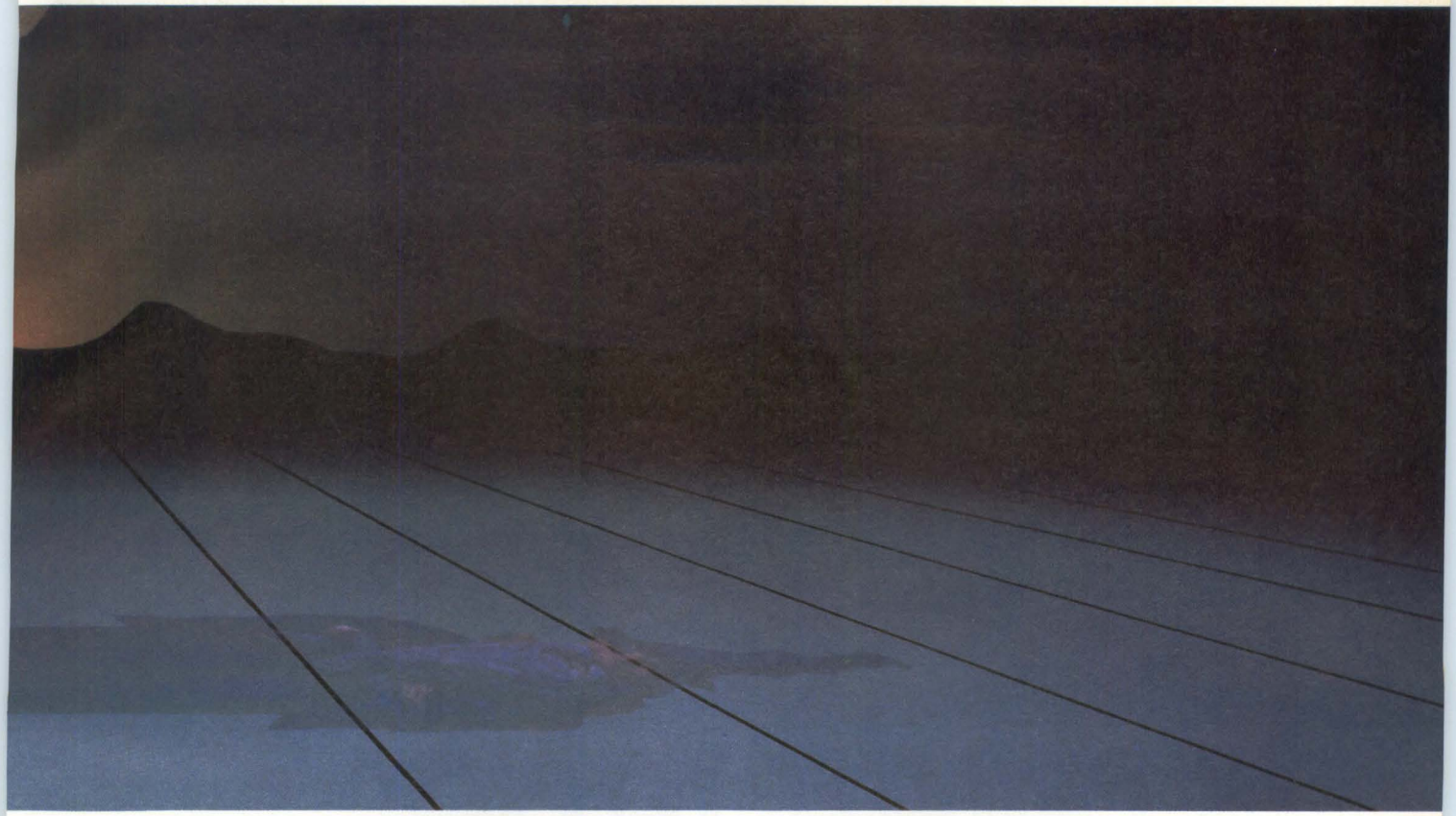

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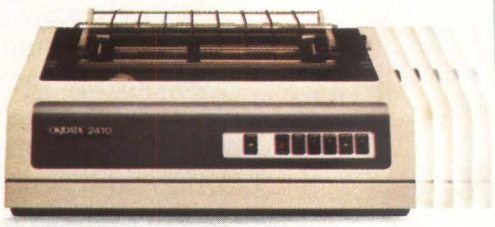

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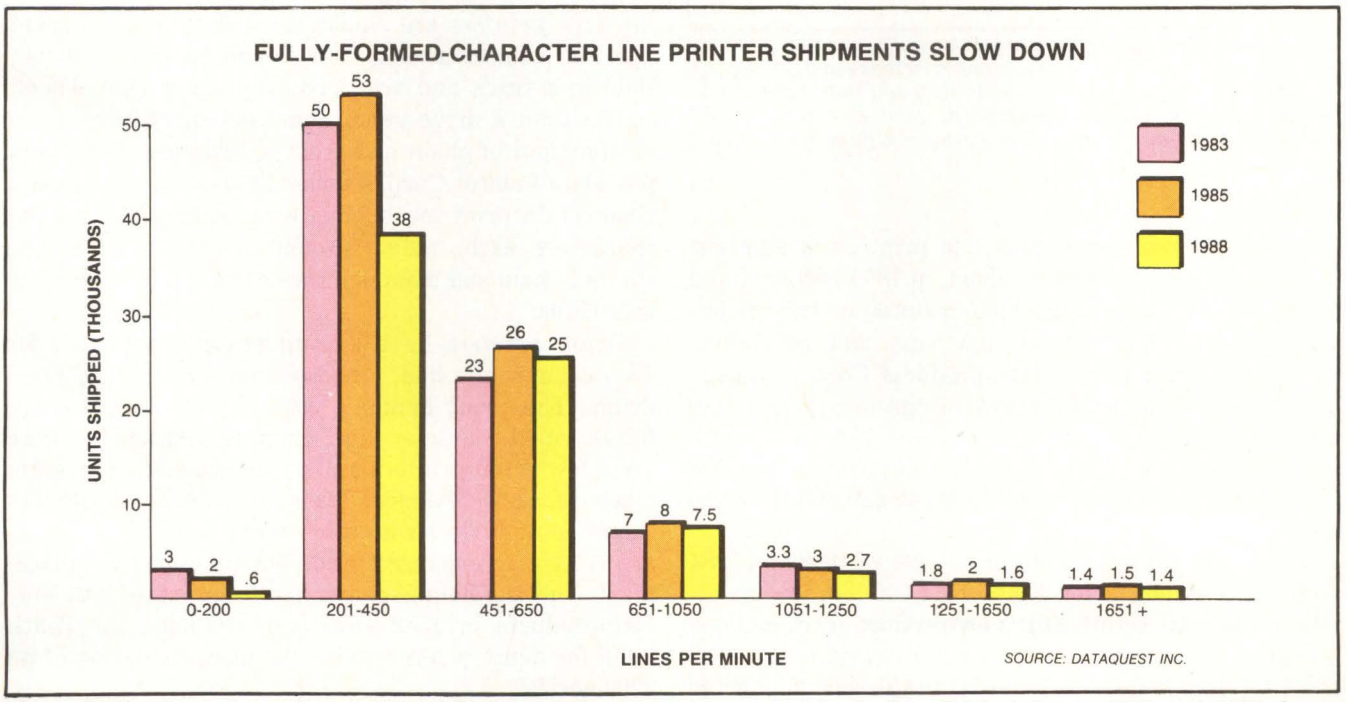
Line printer leaders lower prices, improve reliability

Although non-impact printers threaten the low and high ends, the 300- to 2000-lpm market remains the domain of impact line printers, particularly band printers and emerging dot-matrix units

David Simpson, Associate Editor

As it has for the past few years, controversy in the line-printer industry continues to center on the impact vs. non-impact debate. Impact line printing is a mature industry, leading some analysts and manufacturers to believe that the time is ripe for non-impact technologies. Nevertheless, the much-touted non-impact line-printer revolution is still in its early stages.

Non-impact printing, however, is beginning to capture low-end market share with high-speed thermal and ink-jet printers and is threatening the high-end market with non-impact page printers using laser-xerographic and ion-deposition techniques. Currently, the

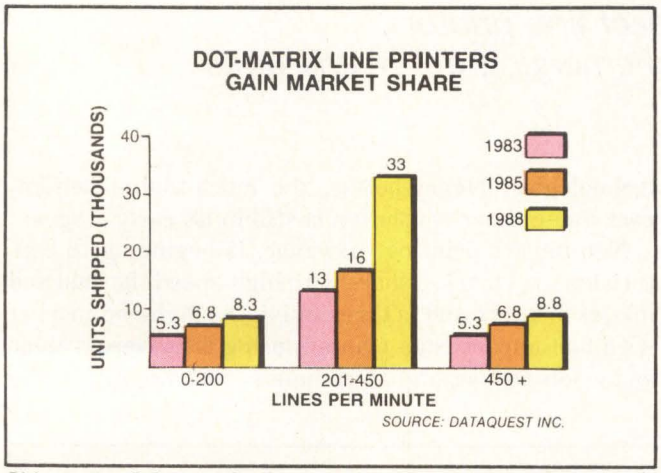


The market for line printers that produce fully-formed characters *is expected to decline slightly between 1983 and 1987 due to competition from other technologies, particularly impact dot-matrix.*

300- to 2000- line-per-minute (lpm) market is dominated by impact printers. Band printers rule this market, but impact dot-matrix units are gaining popularity. OEMs have more than 80 products from which to choose. To facilitate buying decisions, some impact line-printer manufacturers are eschewing technological innovations in favor of improved reliability, added features and lower prices.

Band technology dominates impact printers

Band printers incorporate a horizontally rotating steel or plastic band with embossed characters. A bank of print hammers strikes the paper and ribbon against the characters as they rotate into position. The print mechanism usually contains a full line of print hammers.



Shipments of dot-matrix, line printers *operating between 201 and 450 lines per minute (lpm) are expected to increase at a 27-percent, compound annual growth rate between 1983 and 1988. Units operating at under 200 lpm are expected to grow at 7 percent, and over-450-lpm, dot-matrix printers are expected to grow at a 9-percent rate.*

Over 60 percent of impact line printers in a recent MMS survey (see product chart, p.187) employ band technology. Band printers have maintained their popularity due to high speed, low cost and reliability. Centronics Data Corp., Dataproducts Corp., Storage Technology Corp. and Synergy Printer Systems Inc. are among companies offering over-1500-lmp units. Average prices are $8000 for a 300-lpm printer, $11,000 for 600 lpm, $17,000 for 1,000 lpm and $20,000 for 1,500 lpm.

The rise in superminicomputer sales in 1983 and 1984 spurred the market for 1,000- to 2,000-lpm line printers, leading to significant, new-product introductions from market leaders. Centronics, for example, unveiled the 1,800-lpm E-Series Model III in the second quarter of this year, and Dataproducts began shipments of its 2,000-lpm BP-2000 late last year. Centronics and Dataproducts are the front-runners in the impact-line-printer market.

Other significant new printers include Cynthia Peripheral Corp.'s 1,200-lpm PR1200 and 1,500-lpm PR1500, Centronics' 400-lpm Linewriter 400 and 800-lpm Linewriter 800, IBM Co.'s 2,000-lpm 4245 and 3,600-lpm 4248 (the fastest impact printer on the market) and Teletype Corp.'s 300-lpm T-300. Teletype's T-300 uses belt technology, the other printers employ band technology. Belt printers are similer to band printers except that they use a belt with character slugs, instead of a band with embossed characters.

Japanese manufacturers made a strong showing in 1984 with Fujitsu Ltd.'s Jupiter M3000 series, ranging from 390 lpm to 1,300 lpm, and Hitachi Ltd.s UP series, which goes from 470 lpm to 2,000 lpm. The printers will be marketed in the United States by Fujitsu America Inc. and Hitachi America Ltd., respectively. Fujitsu's introductions are indicative of the move away from technological innovation and toward improved reliability and lower cost. Mean-time-between-failure (MTBF) specifications for the M3040 and M3041 are 4,000 hours; the faster M3042 and M3043 claim a 6,000-hour MTBF.

Train printers push unconnected character slugs along a looped horizontal track. As with belt and band printers, hammers strike the ribbon and paper against the character slugs. Train printers have multiple sets of characters so that a full revolution of the track is never required to set a character in place.

Chain printers are similar to train printers except that the character slugs are linked together, do not slide in a track and are driven by a sprocket wheel, rather than a drive gear. Some manufacturers use a combination of chain and train techniques. For example, Data Printer Corp.'s series 1200 line printers use a ChainTrain print mechanism with eight links of eight characters each, pulled around a rail. Most of the current chain and train printers were introduced in the late 1970s.

Drum printers have a complete character set for each column in a line, embossed on a cylindrical steel drum. The print hammer action is similar to other fully-formed-character line printers. Although there are a few drum printers still on the market, they seem headed for obsolescence. Their precision is usually less than that of devices with other technologies, the drums are relatively expensive and sometimes need replacement, and the hammers require frequent adjustment. Dataproducts in 1982 effectively sounded the death knell for drum printers with the discontinuation of its 2200 series.

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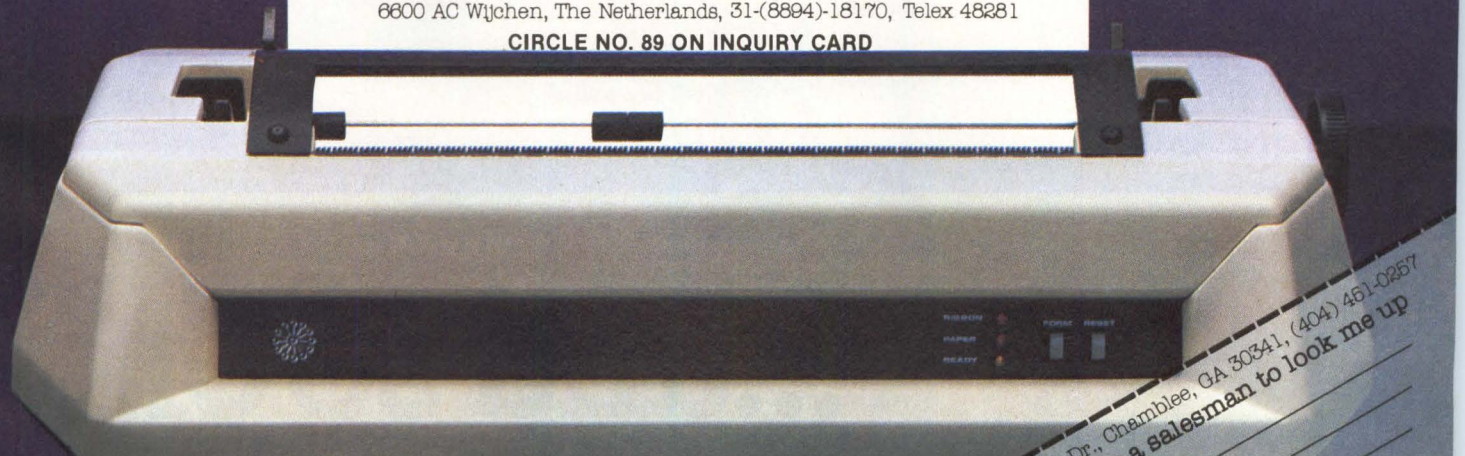

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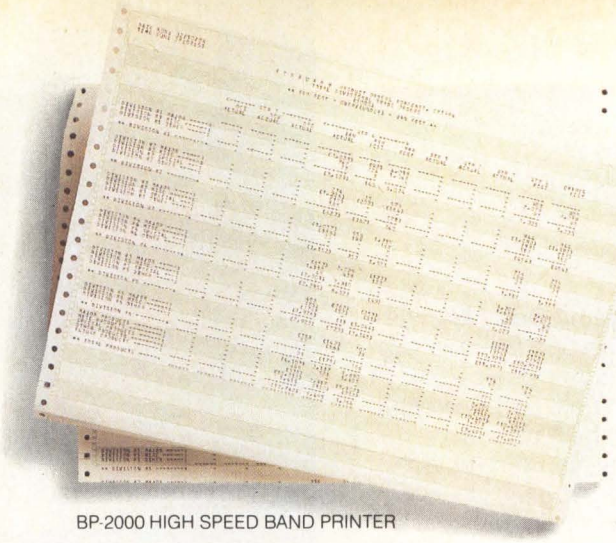
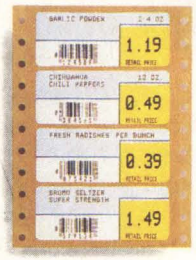
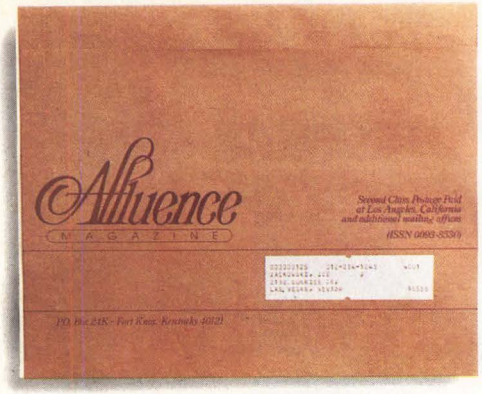


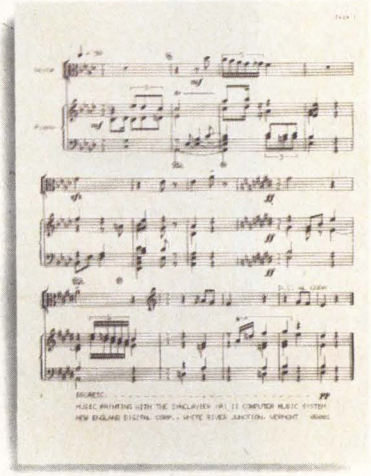
BP-2000 HIGH SPEED BAND PRINTER



M-100L
MATRIX PRINTER



B-600 MEDIUM SPEED BAND PRINTER



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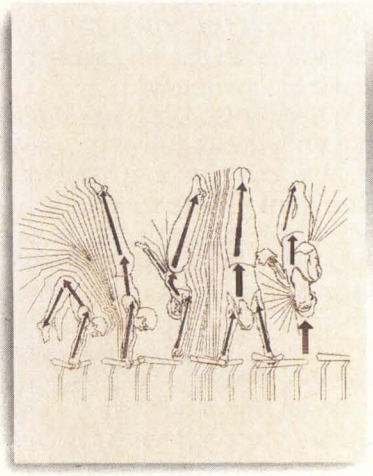
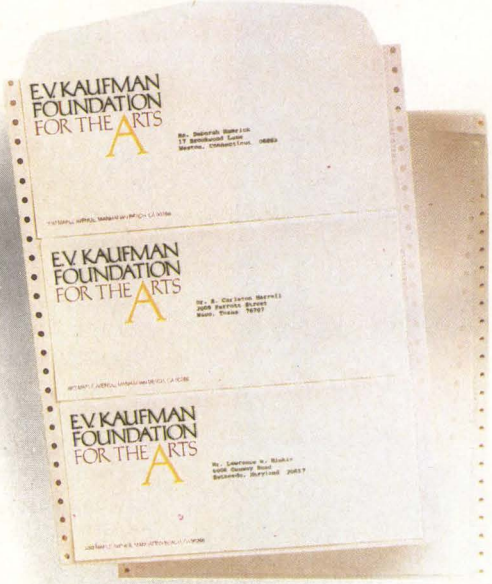
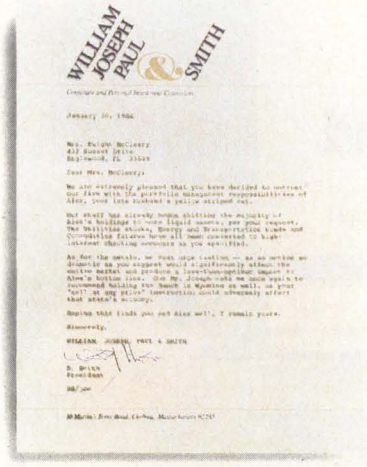


8020 MATRIX PRINTER

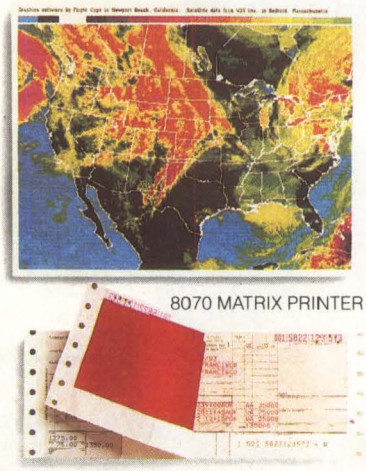


DP-55 DAISYWHEEL PRINTER



DP-35 DAISYWHEEL PRINTER

8050 MATRIX PRINTER



8070 MATRIX PRINTER

M-120 MATRIX PRINTER

...and so on.

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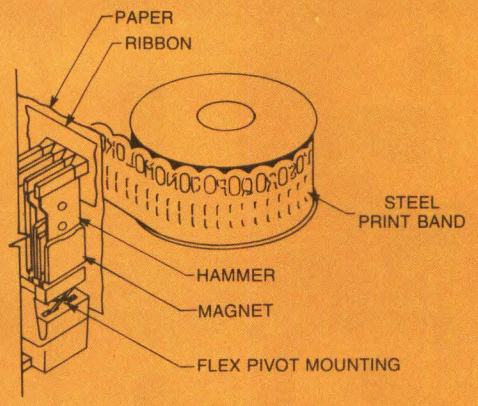
CIRCLE NO. 90 ON INQUIRY CARD

innovation in fully-formed-character line printers came from the market leader, Centronics. The 400-lpm Linewriter 400, introduced in mid-1983, and the recently introduced 800-lpm Linewriter 800, both employ a linear, free-flight hammer technology. The use of a linear hammer—as opposed to an arcing, or pivoting, mechanism—virtually eliminates character clipping (the absence of part or all of a character). According to director of marketing Bob Barbary, linear hammers improve print quality by providing a true sandwiching between paper, ribbon and character.

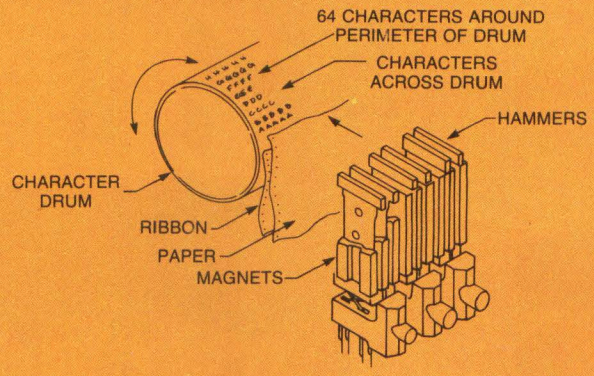
Centronics is also concentrating on reliability. MTBF specs for the Linewriter 400 and 800 are 2,860 and 2,200 hours, respectively. Barbary adds that the printers require no preventive maintenance. One way that manufacturers are improving reliability is via the increased use of LSI chips, which reduces the number of mechanical parts.

In lieu of technological innovations, some manufacturers of fully-formed-character line printers are concentrating on lowering prices. One example is Dataproducts' recently introduced BP-2000, a 2,000-lpm band printer. "The BP-2000," says product manager Gary Berthelson, "is priced in accordance with the throughput increase over the BP-1500, as opposed to pricing in accordance with market niche." IBM's 2,000-lpm printer, he adds, is priced around $65,000; the BP-2000 costs $30,000. Dataproducts is also working on

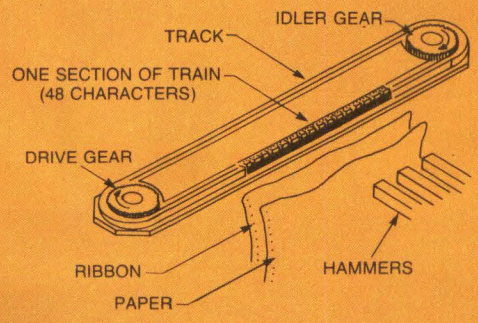
REVIEWING LINE PRINTER TECHNOLOGIES



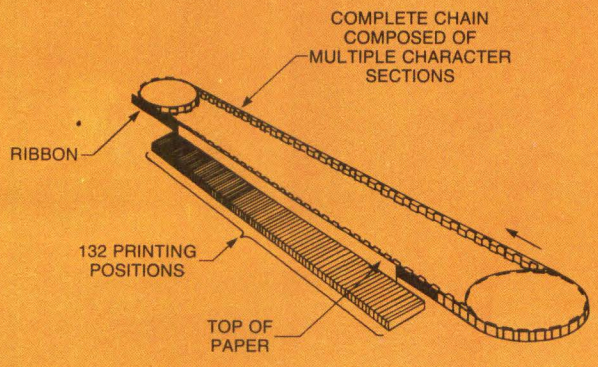
Band and belt printers *employ either of two horizontally rotating devices: a steel or plastic band with embossed characters, or a belt with character slugs. As a character moves into position, a print hammer is actuated, impacting the paper against the ribbon and the character.*



Drum printers *have a complete character set for each column in a line, embossed on a cylindrical steel drum. Images are transferred to the paper when hammers strike the paper and the inked ribbon, which are sandwiched between the drum and a bank of hammers—one for each column.*



Train printers *have embossed character slugs that are pushed along a horizontal track by a pair of gear drivers, past hammers that strike the paper and inked ribbon. Typically, multiple sets of characters are in the track; therefore, only a fraction of a revolution is required to set a character in front of a column.*



Chain printers *operate on a principle similar to that of train printers, with the following differences: Slugs on a chain printer are linked together, do not slide in a track, and are driven by a sprocket wheel, rather than a drive gear.*

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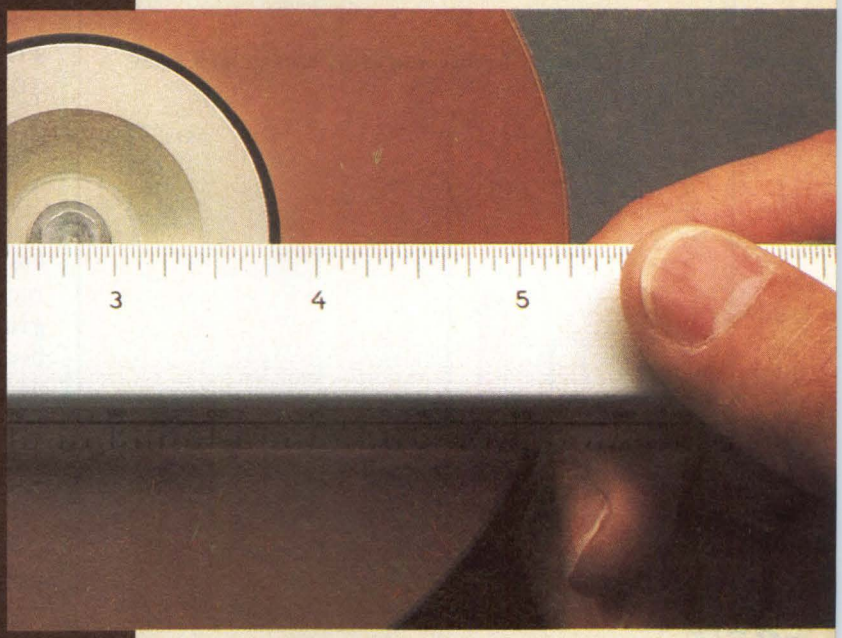

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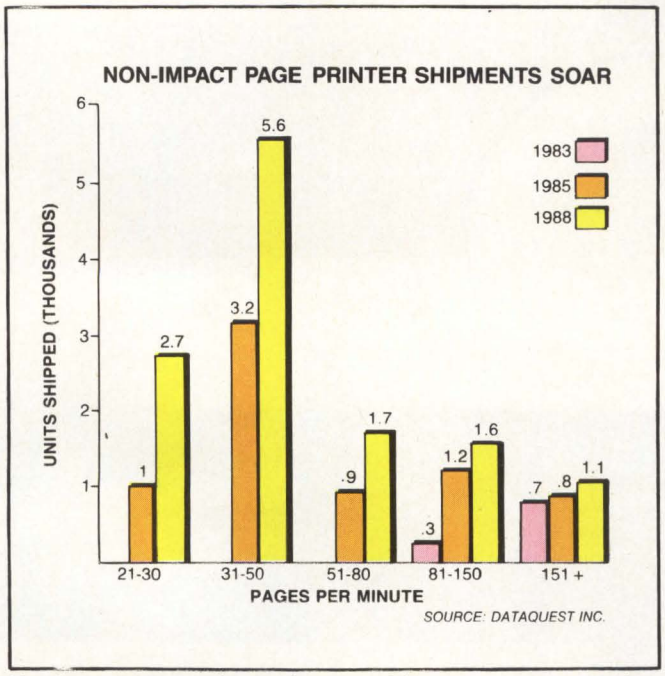
new print-hammer technologies to increase speed and reliability.

The line printer market is experiencing slow going at the low end because of competition from high-speed, impact and non-impact, serial-matrix units and at the high end because of competition from page printers. Yet some analysts expect the market to undergo steady —if somewhat modest—growth over the next few years. For example, Datek Information Services Inc., a Newton, Mass., consulting and publishing company specializing in printer market research, expects shipments of fully-formed-character line printers to go from 86,800 units in 1983 to 104,000 in 1986. Revenues are expected to rise from $1.15 billion in 1983 to $1.4 billion in 1986. Analysts agree that the greatest growth in the impact line printer market will come from impact dot-matrix units.



Non-impact page printers *that use plain paper are expected to exhibit dramatic growth in the 21-150 pages-per-minute range between 1983 and 1988. Faster page printers are expected to exhibit modest growth.*

Impact-matrix printers enter low end

Serial, dot-matrix printer speeds have been increasing rapidly in the past few years, enabling them to compete at the low end of the line printer market. This shift has given rise to dot-matrix line-printers, a classification that is often based more on speed than on line-printing technology. These new printers are entering the 300-lpm range, and some are pushing 600 and 900 lpm.

Matrix printers offer a variety of advantages over fully-formed-character line printers, including graphics and color capabilities. Line printer applications have had little need for color in the past, but graphics are becoming an increasingly desired feature. Graphics are important in applications such as forms generation, bar coding and computer aided design/computer-aided manufacturing (CAD/CAM). Expanding the need for graphics, system integrators are adding decision-support software to minicomputer-based systems.

Another advantage of impact, dot-matrix line printers is low cost. Genicom Corp., Hewlett-Packard Co., Printronix Inc., Trilog Inc. and Synergy offer 300-lpm printers for around $5,000. Genicom, Mannesmann-Tally Inc., Printronix and Synergy offer 600-lpm units for less than $8,000. Hewlett-Packard also boasts the fastest matrix line printer: the 900-lpm 2566A, due out this fall.

The rise in superminicomputer sales in 1983/84 spurred the market for 1,000 to 2,000-lpm line printers.

There are also drawbacks: Impact-matrix line printers do not produce fully-formed characters, and they require sophisticated software, especially for color and graphics. Also, price-to-speed ratios may be misleading because these printers can operate at various speeds, depending on the application requirements. For example, Genicom's 4410 operates at 75 lpm in correspondence-quality mode, 240 lpm in near-letter-quality mode and 300 lpm in draft mode.

Datek expects an annual growth rate of 25 percent in the dot-matrix line-printer market over the next few years, compared to about 10 percent annual growth for the total line-printer market. Sixty percent of these units will be aimed at the low-end market: around 300 lpm. Datek expects unit shipments to increase from 31,000 in 1983 to 55,000 in 1986 and revenues to grow from $318 million in 1983 to $515 million in 1986.

Printronix leads independent manufacturers of impact-matrix line printers, and last year strengthened its market position by acquiring Data Printer, a leading manufacturer of band and chain printers. Mannesmann-Tally, another leader in the dot-matrix field, recently announced the 660-lpm MT-660, a markedly high-speed dot-matrix unit that should challenge other manufacturers to keep pace.

The primary competition for fully-formed-character printers at the low end of the line market is the impact dot-matrix printer, but non-impact serial printers show

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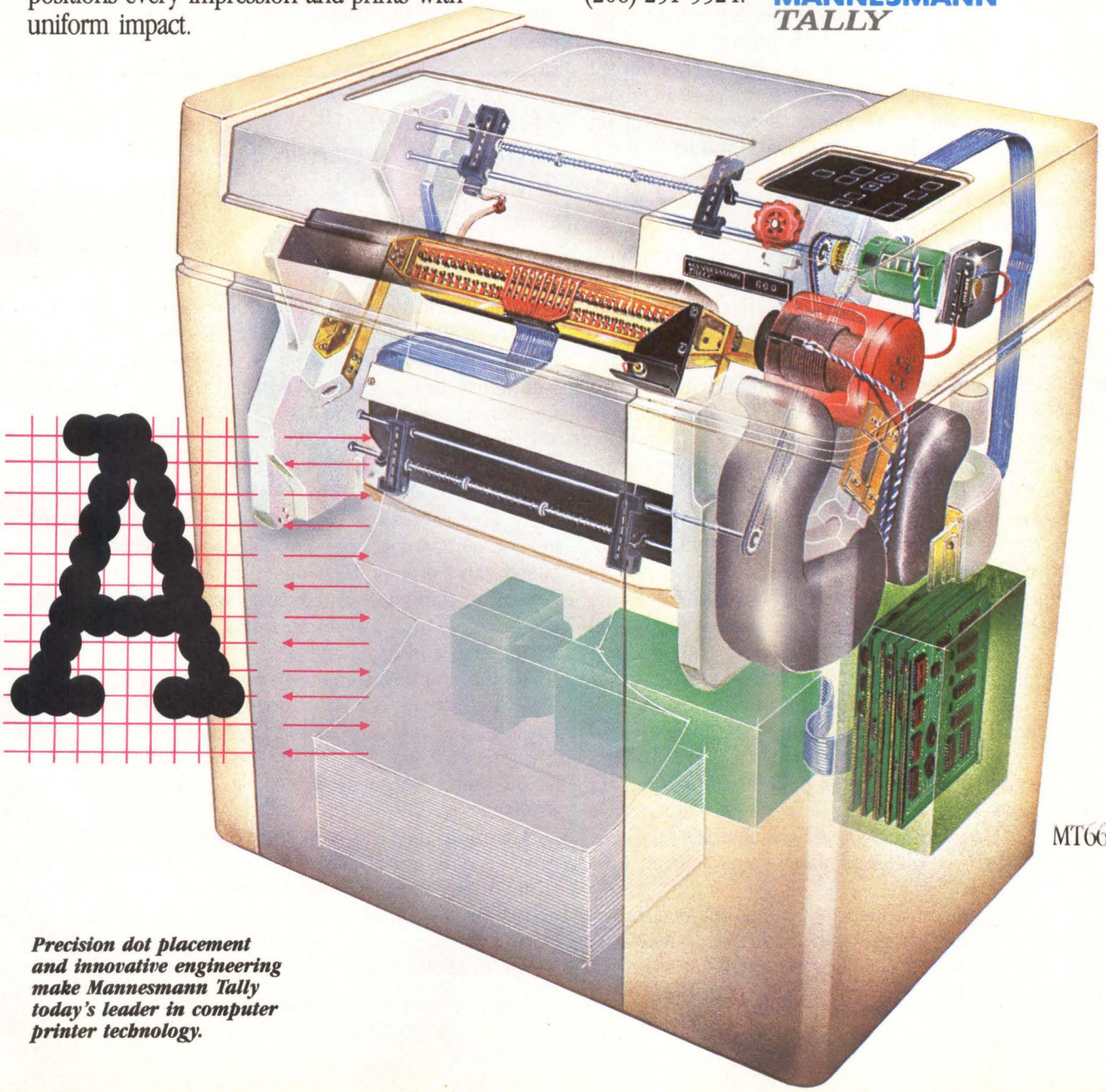

MT660

Precision dot placement and innovative engineering make Mannesmann Tally today's leader in computer printer technology.

CIRCLE NO. 92 ON INQUIRY CARD

promise of getting to 300 lpm within the next few years. Most analysts, including Dataquest's Dean Scott, agree that at present there are no non-impact serial technologies that compete in the line-printer arena.

Thermal or thermal transfer, electrostatic and ink-jet technologies are most often predicted to affect the line-printer market at the low end. Over-100-characters per second (cps) thermal printers are available from Alphacom Inc., B-G Instruments Inc., Computer Devices Inc. and Computer Transceiver Systems Inc. And Hewlett-Packard and Siemens Communications Systems Inc. offer over-150-cps ink-jet printers, but these speeds are far below those of line printers. Non-impact technologies are also experiencing slow acceptance because of high costs, interface problems, lack of software and relatively low reliability. In addition, they cannot simultaneously print multiple copies. "Non-impact printers will start digging into our market in about three to five years in applications where multipart forms are not required," says Dataproducts' Berthelson.

Non-impact printers have had more success at the high end of the line-printer market. These units—called page printers—use technologies such as laser xerographic and ion deposition. Page printers typically operate from 6 to 150 pages per minute (ppm).

When IBM introduced the 20,000-lpm model 3800 laser printer in 1975, many industry observers thought that this signaled the end of impact line printers. But IBM soon introduced advanced impact line printers (such as the 4245 and 4248) putting those expectations to rest. Other manufacturers have developed laser-based, line or page printers.

At the low end, Canon U.S.A. Inc.'s 8-ppm LBP-CX was one of the first to compete directly with impact printers, both serial—and to a lesser extent—low-end line printers. Introduced in 1983, the LBP-CX uses the disposable cartridge technology incorporated by Canon in the PC-10 and PC-20 copiers. Relative to line printers, one problem with the LBP-CX—as with other non-impact printers—is its low duty-cycle. Datek's director of research Jonathan Gower says, "The controversy is over application, not technology. There is not a duty-cycle equivalence between impact and non-impact printers. Low-end non-impacts have low duty-cycle capabilities." Canon officials maintain that the LBP-CX is targeted more at high-end daisywheel than at low-end line printers.

A more recent introduction in the low-end laser-printing market is Fujitsu America's desktop M3071A. The printer is targeted at OEMs and prints at either 16 or 20 ppm. A barebones unit costs $5,620; those with options, $8,380.

Lending credence to low-end non-impact page printing—and representing a major move by an established impact line printer manufacturer—Dataproducts is working on a 24-ppm printer based on a laser diode and a selenium photoreceptor drum. The printer is to be a joint effort of Dataproducts and Toshiba Ltd. in which Toshiba will contribute its non-impact print-engine technology and manufacturing capabilities and Dataproducts will add interfaces, applications software and marketing expertise. This new product, scheduled for release at the Comdex Fall show, (Nov. 12-16, Las Vegas, Nev.) places Dataproducts in competition with non-impact laser printers from Canon and Xerox, Corp. particularly the Xerox 2700. Analysts see the move as a shortcut into the non-impact technology that is destined to cut into Dataproducts' impact line-printer business.

Matrix printers offer a variety of advantages over fully-formed-character line printers, including graphics and color capabilities.

High-end laser printers include General Optronics Corp.'s 2,600-lpm Holloscan 28, Siemens' 21,000-lpm ND3 and Xerox's 18,000-lpm 9700. These printers are well above line-printer speeds and costs. (IBM's 3800, for example, costs more than $300,000.)

Other page-printer technologies include magnetographic (Cynthia Peripheral), thermal (Diablo Systems Inc.), electrostatic (Honeywell Information Systems Inc.), electroerosion (IBM) and ion deposition. A number of companies offer ion-deposition page printers based on Delphax Systems' print engine, including American Computer Hardware Corp., Anser Technology, Imagen Inc., Paradyne Corp., Rennaissance Marketing Inc. and Symbolics Inc.

At this year's National Computer Conference (NCC), Delphax introduced its own ion-deposition printer based on the company's 2460 print engine and a Digital Equipment Corp. LSI-II processor. The S6000 prints at 60 ppm. End-user prices range from $60,000 to $70,000.

Affecting only the very high end of the line printer market, non-impact page printers are expected to jump from 5,200 units shipped in 1983 to 72,500 in 1986, according to Datek's projections. Revenues are expected to climb from $298 million in 1983 to about $1 billion in 1986. □

Interest Quotient (Circle One)
High 819 Medium 820 Low 821

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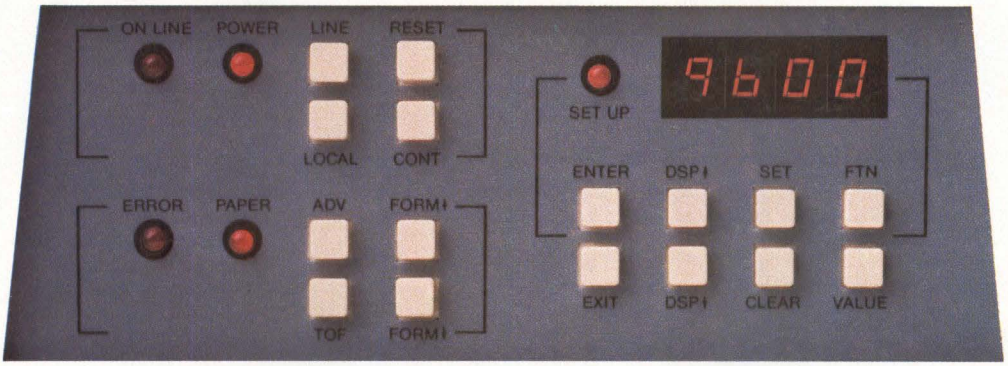

It's easy to drive a Datasouth high performance printer. Just look at the dashboard. Everything you need to know or do is right there, ready to go.

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With a few simple keystrokes, you can program up to 50 different features in just seconds. Settings are retained in a non-volatile memory that keeps them safe on power-down. No other printer is more willing, in more ways, to perform the commands of its computer or its user.

WATCH THE ROAD

Every Datasouth printer has a 4-digit LED readout that displays all the features and settings that other printers leave to your imagination. So you can make changes and check settings with little more than the push of a key and the glance of an eye. With a Datasouth, it's easy to see what's going on, any time you want.

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Front panel controls eliminate the need for dipswitches, jumpers and other primitive devices. You manipulate all your parameters quickly, right on the front of the printer. So you can make the most of a most capable printer. You can program forms control, make fine adjustments down to 1/48" increments, select handshaking protocols and activate a variety of capabilities. Then you can watch your Datasouth perform with the kind of high-speed precision that leaves some pretty hot competitors in the dust.

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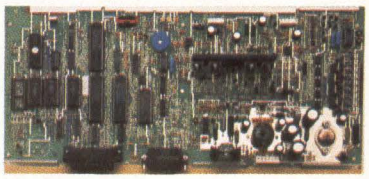

Just about any computer can drive a Datasouth printer and put its foot to the floor. A Datasouth will communicate at up to 9600 baud through standard serial and parallel interfaces, with a 2K buffer.

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Datasouth reliability comes in two high performance models. The DS180 is a legendary workhorse that delivers crisp data quality printing at 180 CPS. The new multimode DS220 cruises at 220 CPS for high speed data printing and at 40 CPS for letter quality word processing. Both models print precision dot-addressable graphics.

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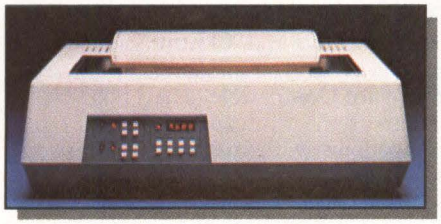

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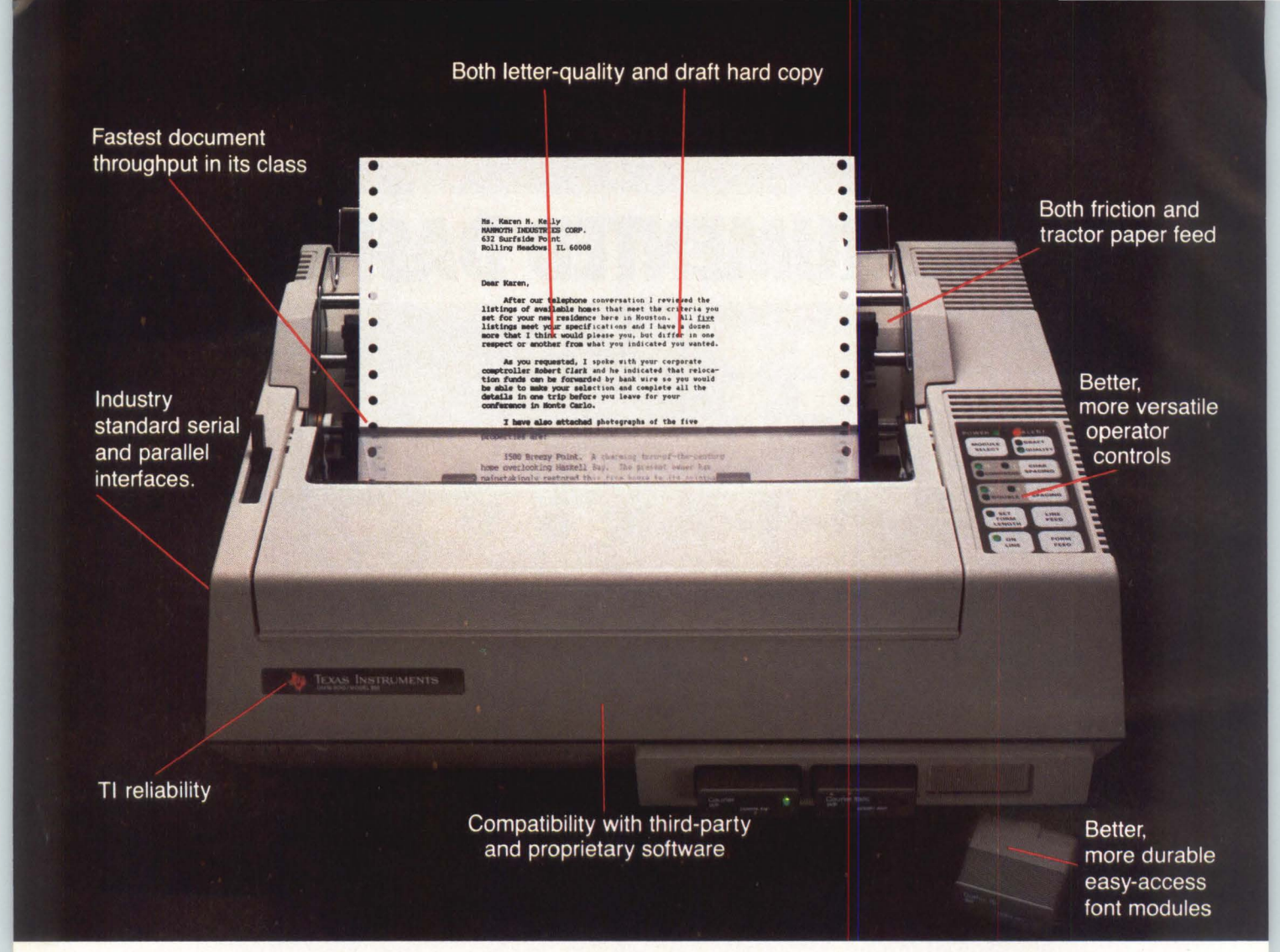

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Tough Font Modules For Quick Character Change. Three font modules can be inserted into the front of the printer at one time, and are accessed individually. Each contains both draft- and letter-quality character sets. They're easier to use, more reliable and more durable than traditional metal or plastic daisy wheels.

More Productivity Than Any Other Microprinter. The 855 offers both friction and tractor paper feed, to handle all types of word and data processing applications. A quick-change snap-in cartridge ribbon. Raster and mosaic graphics. And intelligent printing which maximizes document throughput — regardless of format.

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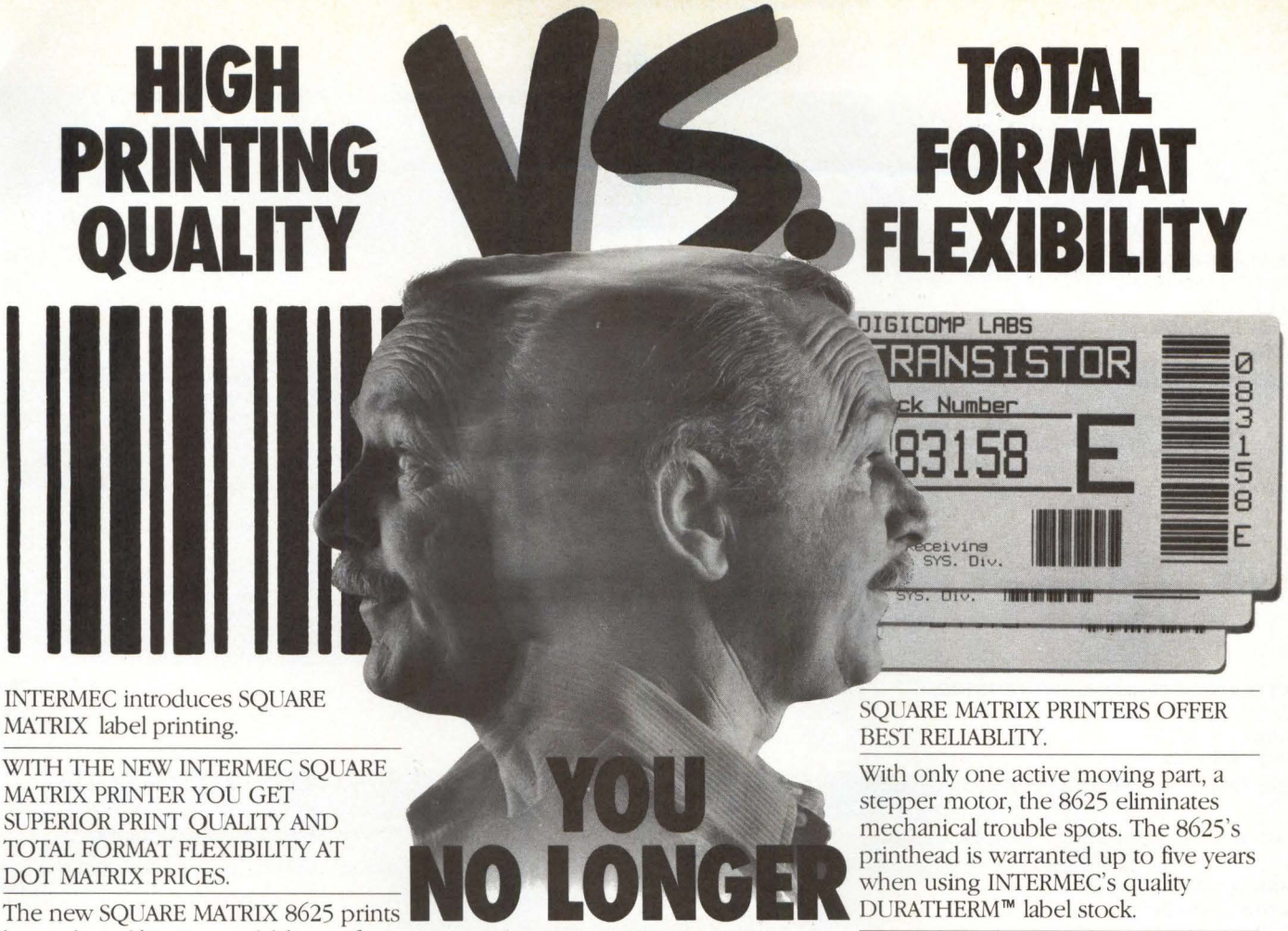
IMPACT LINE PRINTERS

Company / Model	Print method	Print speed	Characters/line	Forms width (inches)	Interfaces (protocols)	Price ($)	Notes, features, options	Circle no.
BURROUGHS CORP. Burroughs Pl. Detroit, MI 48232 (313) 972-7000								775
B9246-6, 12/13, 20	band, train	650, 1250, 2000	132			14,700; 42,500; 69,300		
B9249-375	chain	375/500	132			14,700		
CENTRONICS DATA COMPUTER CORP. 1 Wall St. Hudson, NH 03051 (603) 883-0111								776
E-Series Model I, II, III	band	1130, 1440, 1800	48-128	4–16	Dataproducts		towel ribbon; opt. acoustic cabinet, noise level less than 60 dBa	
Linewriter 400, 800	band	400, 800	48–128	4–18	RS232C, RS422, RS423, Dataproducts, Centronics (19.2K bps, X-on/X-off, DTR, ETX/ACK)	4,885; 6,595 (in small OEM quantities)	block graphics; opt. 62 or 55 dBa acoustic cabinets	
CYNTHIA PERIPHERALS CORP. (A BULL PERIPHERIQUE COMPANY) 766 San Aleso Ave. Sunnyvale, CA 94086 (408) 745-0855								777
PR1200, 1500	band	1200, 1500	136	4–19	Dataproducts	16,000; 18,000	self-test, re-inking ribbon, static eliminator; opt. paper stacker, acoustical cabinet	
DATA PRINTER CORP. (Subsidiary of Printronix) 99 Middlesex St. Malden, MA 02148 (617) 321-2400								778
1200, 1210, 1260	chain	1200, 1000, 600	132	3.5–17.5	Dataprinter, Dataproducts, Centronics, RS232C, CDC	19,390; 16,673; 11,210	8- or 12-channel VFU, self-test diagnostics, four forms tractors, "quietized" cabinet	
DP600, 750, 1000, 1200	band	600, 750, 1000, 1200	132	3.5–17.5	Dataprinter, Dataproducts, Centronics, RS232C, CDC	9,385; 7,855; 10,875; 13,350	8- or 12-channel VFU, self-test diagnostics, universal power supply, EVFU, DAVFU, "quietized" cabinet; 1000 and 1200 include paper pullers	
3101, 3121	band	1000, 1200	132			10,875; 13,350		
3601, 3751	band	600, 750	132			7,855; 9,385		
BT1500	band	1500	132			19,500		
DATAPOINT CORP. 9725 Datapoint Dr. San Antonio, TX 78284 (512) 699-7000								779
9257, 9258	band	300, 600	132	4–16	serial, parallel	8,500(Q1), 7,225(Q100); 11,950(Q1), 10,150(Q100)	pedestal cabinet; opt. acoustic cabinet	
DATAPRODUCTS CORP. 6200 Canoga Ave. Woodland Hills, CA 91365 (818) 887-3924								780
B-300, 600, 1000	band	300, 600, 1000	132, 136	3–16	Dataproducts, RS232C, Centronics (19.2K bps, X-on/X-off, ETX/ACK, ACK/NAK, DTR)	6,800; 8,600; 12,800	self-test, diagnostic status display, static eliminator; opt. 60 dBa acoustic cabinet, universal power supply, Dataproducts parallel interface	
BP-1500, 2000	band	1500, 2000	132, 136	3.5–18.75	Dataproducts, RS232C, current loop (19.2K bps)	23,000; 30,000	universal power supply, four forms tractors, vertical format unit, self-test, diagnostic status display	
DECISION DATA COMPUTER CORP. 100 Witmer Rd. Horsham, PA 19044 (215) 674-3300								781
6610, 6665, 6680	drum	1000, 650, 800	132			17,600; 13,600; 15,200	power paper puller, sound-proof cabinet	

IMPACT LINE PRINTERS

Company / Model	Print method	Print speed	Characters/line	Forms width (inches)	Interfaces (protocols)	Price ($)	Notes, features, options	Circle no.
6703-25	impact matrix	300	132			6,188	coarse/fine, vertical/horizontal adjustment	
6807, 6811, 6814	band	700, 1100, 1400	132			12,100; 17,000; 23,000	vertical/horizontal adjustment, forms motion sensor, front/rear operation panel	
DIGITAL EQUIPMENT CORP. 146 Main St. Maynard, MA 01654 (617) 897-5111								782
LP 25, 26, 27	band	215–1200	132, 196	3–16				
FUJITSU AMERICA INC. 3055 Orchard Dr. San Jose, CA 95134 (408) 946-8777								783
M304X Series	band	300, 600, 900, 1200	132, 136	3–17	RS232C, Centronics, Dataproducts (150-9.6K bps)		built-in acoustic cabinet; opt. power stacker, custom interface	
GENERAL BUSINESS TECHNOLOGY INC. 1891 McGaw Ave. Irvine, CA 92714 (714) 261-1891								784
3220LP, 3230LP, 3240LP	band	720, 1130, 1440	132, 198	4–16.75	IBM S/34, S/36, S/38	11,500; 16,995; 19,995	self-test, acoustic cabinet; opt. line counter, power paper stacker	
GENICOM CORP. One General Electric Drive Waynesboro, VA 22980 (703) 949-1170								785
310, 340, 510	belt	240, 340, 425	132	3–15	Centronics; opt. RS232C, current loop (9.6K bps, X-on/X-off)	4,170(Q1), 3,336(Q100); 4,835(Q1), 3,868(Q100); 6,080(Q1), 4,864(Q100)	opt. dual sheet feeder	
4410	impact matrix	75, 240, 300	132, 158, 175	3–16.54	RS232C, RS449, Centronics, Dataproducts, current loop (19.2K bps, X-on/X-off)	5,500(Q1); 4,400(Q100)	bit-mapped mosaic graphics, 12-channel VFU, 20-ips paper slew, dual tractors	
4440	impact matrix	150, 465, 600	132, 158, 175, programmable	3–16.54	RS232C, RS449, Centronics, Dataproducts, current loop (19.2K bps, X-on/X-off)	7,500(Q1); 6,000(Q100)	bit-mapped mosaic graphics, 12-channel VFU, 20-ips paper slew, dual tractors	
HARRIS CORP. COMPUTER SYSTEMS DIV. 2101 W. Cypress Creek Rd. Ft. Lauderdale, FL 33309-1892 (305) 974-1700								786
4240	chain	1000	132, 136	3.5–19.5		29,900	controller, EVFU, electronic paper width adjustment	
4250, 4260	chain	730, 1200	132, 136	3.5–19.5		30, 900; 39,900	controller, EVFU, electronic paper width adjustment	
4270	chain	900	132, 136	3.5–19.5		40,900	controller, EVFU, electronic paper width adjustment	
4326, 4336, 4356	band	300, 600, 1200	132	3–16		11,900; 16,900; 28,900	controller, EVFU, dual bands, dual speed	
HONEYWELL INFORMATION SYSTEMS INC. 200 Smith St. Waltham, MA 02154 (617) 895-6000								787
9619/9620	belt	900, 1200	136	4–19	RS232C, Honeywell OAS, DPS6	26,000; 33,000		
9626/9627	band	300, 600	132, 136	3–15	RS232C, Honeywell OAS, DPS6	11,500; 14,450		

HIGH PRINTING QUALITY VS. TOTAL FORMAT FLEXIBILITY



YOU NO LONGER HAVE TO CHOOSE.

INTERMEC introduces SQUARE MATRIX label printing.

WITH THE NEW INTERMEC SQUARE MATRIX PRINTER YOU GET SUPERIOR PRINT QUALITY AND TOTAL FORMAT FLEXIBILITY AT DOT MATRIX PRICES.

The new SQUARE MATRIX 8625 prints bar code and human readable text from a series of tight fitting squares. These squares virtually eliminate the gaps, ragged edges and grayness so common to dot matrix printing. Since the 8625 SQUARE MATRIX is a thermal printer, variations in image density are eliminated giving you superior printing quality with every label. The result: The SQUARE MATRIX 8625 gives you bar code labels with optimum scanning performance plus maximum print format flexibility.

ONE UNLIMITED FORMAT, SQUARE MATRIX 8625 DOES THE WORK OF 10 PRINTERS.

The 8625 gives you the ability to print multiple bar codes in up to 10 different formats: two are pre-programmed and eight are user programmable.

SQUARE MATRIX 8625 PRINTS ANYTHING, ANYWHERE, ANY SIZE.

Print any height label up to 3¼" high. Bar code height can vary up to the full height of the label. Three different text fonts, special graphics, lines, boxes and logos can be printed in any direction or magnification any place on the label.

For Literature, Circle Number 193.
For Demonstration, Circle Number 194.

SQUARE MATRIX 8625 PRINTS THE MAJOR BAR CODES.

CODE 39, CODE 93, Interleaved 2 of 5, 2 of 5, CODE 11, and Codabar, all with high density capability, are pre-programmed within the 8625. Even UPC/EAN is printed in most popular densities.

USER FRIENDLY PROMPTING MAKES SQUARE MATRIX LABEL FORMATS EASY TO DEVELOP.

Anybody can do it. Just plug it in and the user friendly prompting menu allows even untrained personnel to design custom formats quickly. Using standard interfaces, the 8625 operates with most mini computers and CRT terminals.

THE SQUARE MATRIX 8625 PRINTS LABELS ON DEMAND.

The 8625 delivers single labels as needed or in batches in straight through or spooled form with no paper waste.

SQUARE MATRIX PRINTERS OFFER BEST RELIABLITY.

With only one active moving part, a stepper motor, the 8625 eliminates mechanical trouble spots. The 8625's printhead is warranted up to five years when using INTERMEC's quality DURATHERM™ label stock.

SMALL SIZE, SMALL PRICE, UNLIMITED FLEXIBILITY AND QUALITY MAKE SQUARE MATRIX THE LOGICAL CHOICE.

The compact 8625 takes very little space at a work station and even less from your budget. To find out more, contact INTERMEC Corporation, 4405 Russell Road, P.O. Box 360602, Lynnwood, WA 98036-9702. Call 206/743-7036. TELEX: U.S. 152447, Int'l (ITT) 4740080.

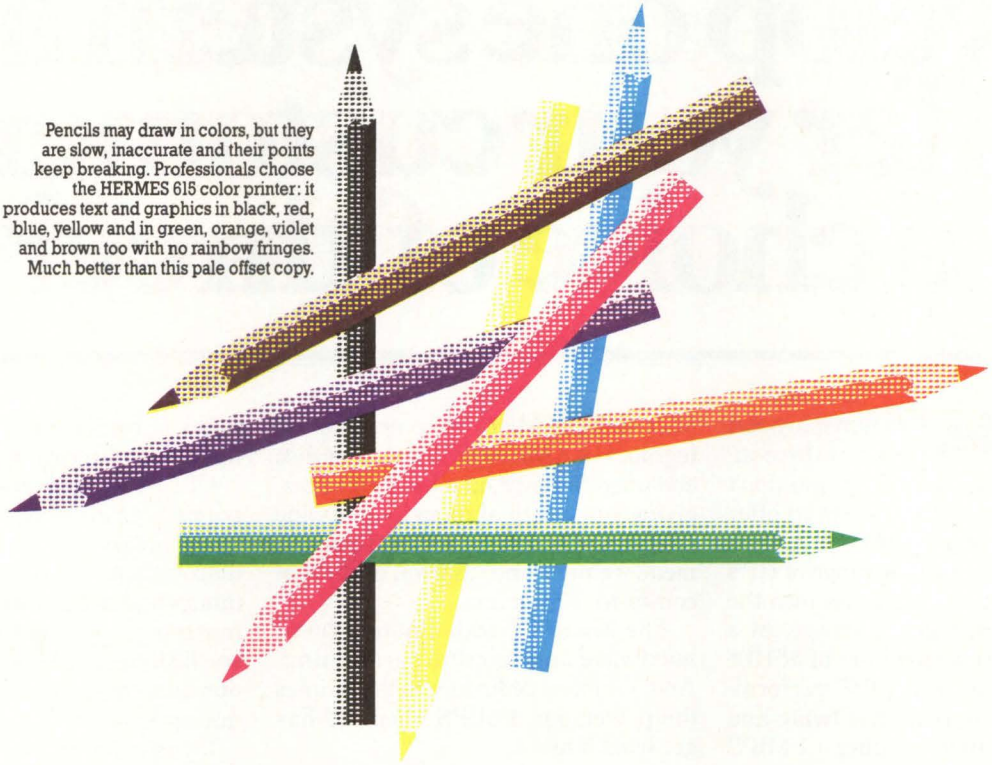
INTERMEC®

The industrial bar code experts.

IMPACT LINE PRINTERS

Company / Model	Print method	Print speed	Characters/line	Forms width (inches)	Interfaces (protocols)	Price ($)	Notes, features, options	Circle no.
HEWLETT-PACKARD CO. (BOISE DIV.) 11311 Chinden Blvd. P.O. Box 15 Boise, ID 83707 (208) 323-6000								788
HP2563A	impact matrix	300	66, 132, 220	3–16.7	RS232C, RS422, HP-IB, HP Multipoint, Centronics, Dataproducts (300-19.2K bps, X-on/X-off, ETX/ACK, ENQ/ACK)	5,700(Q1); 3,876(Q100)	raster graphics, programmable 16-channel VFC, self-test; opt. cabinet, stand, sound cover, passive stacker	
HP2565A	impact matrix	600	66, 132, 220	3–18	RS232C, RS422A, HP-IB, Centronics, parallel (300-19.2K bps, X-on/X-off, ETX/ACK, ENQ/ACK)	18,500(Q1); 12,025(Q100)	raster graphics, programmable 16-channel VFC, self-test; opt. bar codes, passive paper stacker	
HP2566A	impact matrix	900	66, 132, 220	3–18	RS232C, RS422A, HP-IB, Centronics, parallel (300-19.2K bps, X-on/X-off, ETX/ACK, ENT/ACK)	21,500(Q1); 13,975(Q100)	raster graphics, programmable 16-channel VFC, self-test; opt. bar codes, passive paper stacker	
ITT COURIER TERMINAL SYSTEMS INC. 1515 W. 14th St. Tempe, AZ 82581 (602) 894-7000								789
6260, 6230	band	600, 300	132	15.5–22	Centronics parallel (up to 1.5M bps)	13,550; 11,350	self-test diagnostics, LED indicator	
9341, 9342	band	300, 600	132	15.5–22	Centronics parallel (up to 1.5M bps)	11,350; 13,550	self-test diagnostics, LED indicator	
MANNESMAN TALLY INC. 8301 S. 180th St. Kent, WA 98032 (206) 251-5500								790
MT-660	impact matrix	660	66, 132, 198	4–16	Dataproducts, Centronics; opt. RS232C, RS422, current loop (4.8-150K bps)	7,995	plot mode graphics, self-test, 60 dBa noise level; opt. block characters, static eliminator, universal power supply	
MILTOPE CORP. 1770 Walt Whitman Rd. Melville, NY 11747 (516) 420-0200								791
HSP 3609-212A	impact matrix	600	80, 132	9.325	RS232C, parallel, MIL-STD-188C, Rolm, Norden, Honeywell, IBM, NTDS (9600 bps)	20,000	meets military specs; line addressable graphics	
LP 3036	impact matrix	300	36, 60	4.25	RS232C, parallel, MIL-STD-188C, Rolm, Norden, Honeywell, IBM, NTDS (9600 bps)	7,500	meets military specs	
PRINTER SYSTEMS CORP. 9055 Comprint Ct. Suite 200 Gaithersburg, MD 20877 (301) 258-5060								792
B-300, B-600	band	300, 600	132	3–16	RS232C, Centronics, Dataproducts (50-19.2K bps)		int'l character sets available; opt. pedestal and paper shelf	
B-1000, B-1500	band	1025, 1500	80, 132	3–16	RS232C, Centronics, Dataproducts (50-19.2K bps)		opt. tape controller and/or direct access 12-channel VFU	
PRINTRONIX INC. 17500 Cartwright Rd. P.O. Box 19559 Irvine, CA 92713 (714) 863-1900								793
DataPrinter 1200 Series	drum	600–1200	132	3.5–19.5	parallel, serial, TTL, DPC S-1003 Universal (X-on/X-off, ETX/ACK)	11,210–19,390	12-channel VFU, forms-length selector, static eliminator, parity check, acoustic cabinet, I/O interface, paper puller	
DataPrinter 3000 Series	band	600–1200	132	3.5–17.5	RS232C, DataPrinter, Dataproducts, Centronics, Control Data (X-on/X-off, ETX/ACK)	7,855–13,350	EVFU, acoustic cabinet, forms-length selector, parity check	

Although our HERMES 615 multi-mode printer comes in a plain black and white casing **it prints text and graphics beautifully in 8 colors.**



Pencils may draw in colors, but they are slow, inaccurate and their points keep breaking. Professionals choose the HERMES 615 color printer: it produces text and graphics in black, red, blue, yellow and in green, orange, violet and brown too with no rainbow fringes. Much better than this pale offset copy.

Printing and graphics in 8 colors are just two of the numerous outstanding features of the HERMES 615. Professionals who only pick the best will also appreciate:

Its speed. Bi-directional, shortest path printing. 400/480 cps Data, 100/120 cps Near Letter Quality (single pass).

Its resolution. Finest print quality available on a matrix printer. So good you can even print signatures. Bit mapped graphics in single and double density modes, 6 dot densities in each mode. A circle on the screen means a circle on the paper too!

Its quality. Swiss high quality construction. Quality that lasts – thanks to its exclusive «moving-ruby» head.

Its versatility. Wide range of attractive characters sets in 16 national versions, as well as math symbols, bar codes and Teletex. Dual ports, parallel (Centronics™/Epson™ compatible) and serial (RS-232C/RS-422) interfaces. DIABLO™ 630 emulation optional.

HERMES®
The impressive printers

Made by HERMES PRECISA INTERNATIONAL, CH-1401 Yverdon

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TX, AR, OK, LA:	US DATA Associates, Inc.,	(214) 680 9700
MD, DE, VA, DC, PA, S.NJ:	MESA TECHNOLOGY Corp.,	(301) 948 4350
NY State, NY City, N.NJ:	TMA LOGON,	(201) 646 9222
Upstate NY:	NACO ELECTRONICS Corp.,	(315) 699 2651
MI, OH, KY, WV, W.PA:	LOWRY and Associates, Inc.,	(313) 229 7200
FL, GA, TN, AL, MS, NC, SC:	GENTRY ASSOCIATES, Inc.,	(305) 859 7450
CO, UT, ID, MT, NM, AZ:	PAR Associates,	(303) 371 4140

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Printer Division
1900 Lower Road, LINDEN, NJ 07036, (201) 574 0300

CIRCLE NO. 94 ON INQUIRY CARD

How can you develop one system and offer your customers a choice of three?

Simple. Develop it around HP's new three-in-one microsystem. That way, you don't have to redesign your system to offer your customers a range of performance. Because the entire power range of HP's new A-Series computers fits into the same small, convenient package. At a slimmed-down starting price of $6110*

So you can offer 1 MIPS performance. Or floating point hardware and microprogramming in either a 1 MIPS or 3 MIPS computer. Whichever one your customer chooses, you can fit it easily into the same space in your system.

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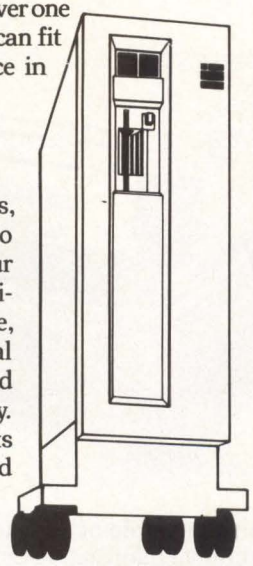
Our A-Series family consists of the Micro 26, Micro 27 and Micro 29. The Micro 26 comes with integrated 14.6 Mb mini-Winchester disc and microfloppy. And it has 8 I/O slots, giving you plenty of room for our wide selection of I/O cards for instruments, measurement and control, and datacomm, to name a few.

The Micro 27 adds floating point hardware and microprogramming. And, for jobs needing up to three times the power, our 3 MIPS Micro 29 has got what it takes.



Our new microsystems also come in this floor-mount or bench-top models.

Our brand new operating system really performs.

That's one secret of our success. The new, full-function RTE-A real-time operating system provides the performance you need for your real-time automation applications. Ranging from dedicated machine control to monitoring instruments to supervising a network of computers.

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Of course, these compact new computers are part of our newly expanded OEM program. This includes higher discounts and credits, extended warranties and free training. So you'll make more when you get to market. And you'll also get there faster with our new operating system and newly packaged microsystems.

If you'd like micro, mini or maxi performance in one micro package, call your local HP sales office listed in the white pages of your phone book. Ask for a technical computer representative. Or write for more information to: Hewlett-Packard, Attn. Greg Gillen, Dept. 08171, 11000 Wolfe Road, Cupertino, CA 95014. In Europe, write to Henk van Lammeren, Hewlett-Packard, Dept. 08171, P.O. Box 529, 1180 AM Amstelveen, The Netherlands.

*A600+ microsystem component, 128Kb memory, box, Winchester disc.

Prices are U.S.A. list in OEM quantities of 100 and include integrated peripherals, one interface card, RTE-A and 512Kb of memory for Micro 26 and Micro 27. Micro 29 includes 768Kb of memory.

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1 MIPS for
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3 MIPS, plus floating point hardware and microprogramming, for $16,650

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There is a Facit Printer to satisfy virtually all printout requirements. From putting your Personal Computer on low cost printing terms, to the most professional heavy duty application with printers that put four-colour dots anywhere on paper.

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FACIT

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USA: 235 Main Dunstable Road. P.O. Box 828, Nashua, N.H. 03061. Phone: (603) 883-4157.

CIRCLE NO. 96 ON INQUIRY CARD

IMPACT LINE PRINTERS

Company / Model	Print method	Print speed	Characters/ line	Forms width (inches)	Interfaces (protocols)	Price ($)	Notes, features, options	Circle no.
P300, P300XQ	impact matrix	300, 400	132	3–16	Centronics, Dataproducts, RS232C, current loop (X-on/X-off, ETX/ACK, DTR)	5,400; 6,450	bar codes, business graphics, double-high chars.; opt. multi-mode capability, intelligent graphics	
P600, P600XQ	impact matrix	600, 800	132	3–16	Centronics, Dataproducts, RS232C, current loop (X-on/X-off, ETX/ACK, DTR)	7,500; 8,550	bar codes, business graphics, double-high chars.; opt. multi-mode capability, intelligent graphics	
RACAL-MILGO INC. COMPUTER PRODUCTS DIV. 6250 N.W. 27th Way Ft. Lauderdale, FL 33309 (305) 979-4000								**794**
4295	impact matrix	300	132	4–15.8	Centronics (IBM, Bell 8AI, Univac)	3,599	self-test, 2 buffers, bidirectional printing	
SOUTHERN SYSTEMS INC. 2841 Cypress Creek Rd. Ft. Lauderdale, FL 33309 (305) 979-1000								**795**
BP1500, BP2000	band	1500, 2000	132	3.5–18.75	serial, parallel,DEC, DG, Perkin-Elmer, TI, HP, Prime, Gould, IBM, Burroughs (up to 19.2K bps, X-on/X-off, ENQ/ACK)	18,000 (BP2000)		
QT 300, 600, 1000, 1200	band	300, 600, 1000, 1200	132	4–16.75	serial, parallel (up to 19.2K bps, IBM 2780/3780, Univac MTR, Honeywell VIP 7700)	7,000; 10,000; 15,000; 17,000	IBM compatible, bar codes, bit-mapped graphics, quiet cabinet	
STORAGE TECHNOLOGY CORP. (DOCUMATION) 2270 S. 88th St. Louisville, CO 80028 (303) 673-4066								**796**
impact 3000	band	3000	132	18.75			automated elevator stacker, line counter, VFU, DAVFU	
Univ. 1000	band	1600	132	18.75	Dataproducts	13,775	automated elevator stacker, line counter, VFU, DAVFU	
SYNERGY PRINTER SYSTEMS INC. 4020 Fabian Way Palo Alto, CA 94303 (415) 493-8181								**797**
CB1200, 1800	band	1200, 1800	132, 136	4–16.75	Dataproducts, Centronics, RS232C, HP-IB (19.2K bps, X-on/X-off, ETX/ACK, ENQ/ACK, IBM 2780/3780, Burroughs)	16,950(Q1), 12,950(Q100); 21,950(Q1), 16,950(Q100)	12-channel DVFU, acoustic cabinet; DEC, Wang, IBM, DG, HP compatible	
LW400, 800	band	400, 800	132, 136, 198, 204	4–15	Dataproducts, Centronics, RS232C, HP-IB (19.2K bps, X-on/X-off, ETX/ACK, ENQ/ACK, IBM 2780/3780, Burroughs)	5,950(Q1), 4,495(Q100); 7,950(Q1), 5,995(Q100)	12-channel DVFU, acoustic cabinet; DEC, Wang, IBM, DG, HP compatible	
C1300, 1600	impact matrix	300, 600	136, 160, 182, 227	3.5–16	RS232C, Centronics, DPC (19.2K bps, X-on/X-off, ETX/ACK, ENQ/ACK, IBM 2780/3780, Burroughs)	4,495(Q1), 3,495(Q100); 5,995(Q1), 4,695(Q100)	12-channel DFVU, bit-mapped graphics, bar codes; DEC, Wang, IBM, DG, HP compatible	
TELETYPE CORP. 5555 Touhy Ave. Skokie, IL 60077 (312) 982-2000								**798**
40	belt	300	80, 132			3,262	input buffer	
4540	belt	300	80, 132			5,595	input buffer	
T-300	belt	300	132		serial, parallel	4,400	self diagnostics	

IMPACT LINE PRINTERS

Company / Model	Print method	Print speed	Characters/line	Forms width (inches)	Interfaces (protocols)	Price ($)	Notes, features, options	Circle no.
TRILOG INC. 17391 Murphy Ave. Irvine, CA 92714 (714) 863-3033								799
C60 Colorplot	impact matrix	300	132, 220	4–16	Centronics, Dataproducts; opt. RS232C (110-9600 bps, X-on/X-off)	11,500	256-color printing, bit-mapped graphics	
TIP 150, 300, 301	impact matrix	38–150; 78–300	132, 178, 200	4–16	RS232C, Centronics; opt. Dataproducts (110-19.2K bps, X-on/X-off, DTR)	3,900; 4,900; 5,900	static eliminator, compressed printing; opt. bar codes and bit-mapped graphics	
TIP 302 Colorplot II	impact matrix	78–300	132, 178, 220	4–16	RS232C, Centronics; opt. Dataproducts (110-19.2K bps, X-on/X-off)	6,900	256-color printing, bit-mapped graphics, nonstop printing	
WANG LABORATORIES INC. 1 Industrial Ave. Lowell, MA 01851 (617) 459-5000								800
5573, 5574, 5575	band	300, 600, 1100	132	16	proprietary	9,500; 13,250; 29,500	tractor feed, interchangeable bands, remote model available	

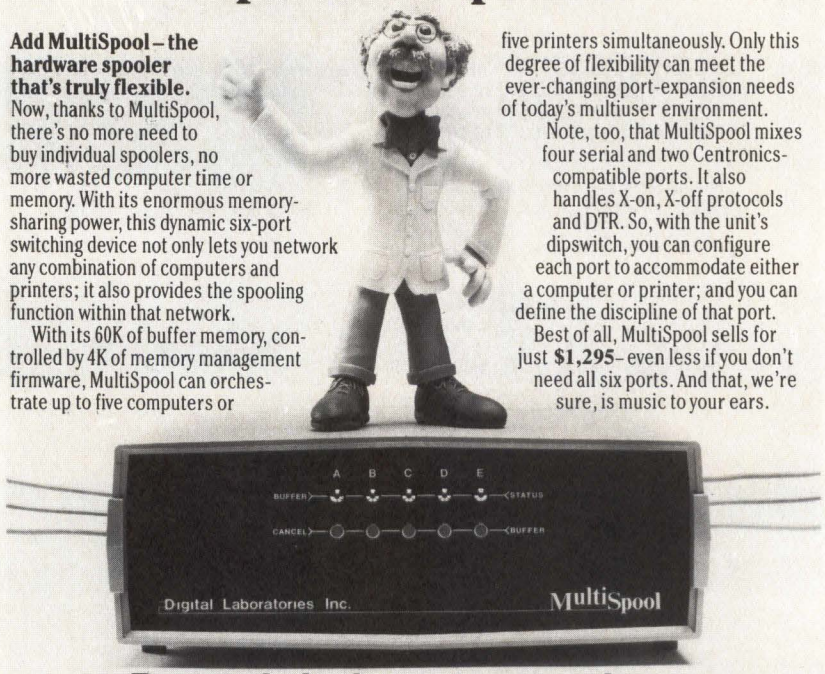
Printer sharing systems for multiple computers and printers.

Add MultiSpool – the hardware spooler that's truly flexible. Now, thanks to MultiSpool, there's no more need to buy individual spoolers, no more wasted computer time or memory. With its enormous memory-sharing power, this dynamic six-port switching device not only lets you network any combination of computers and printers; it also provides the spooling function within that network.

With its 60K of buffer memory, controlled by 4K of memory management firmware, MultiSpool can orchestrate up to five computers or five printers simultaneously. Only this degree of flexibility can meet the ever-changing port-expansion needs of today's multiuser environment.

Note, too, that MultiSpool mixes four serial and two Centronics-compatible ports. It also handles X-on, X-off protocols and DTR. So, with the unit's dipswitch, you can configure each port to accommodate either a computer or printer; and you can define the discipline of that port.

Best of all, MultiSpool sells for just **$1,295** – even less if you don't need all six ports. And that, we're sure, is music to your ears.



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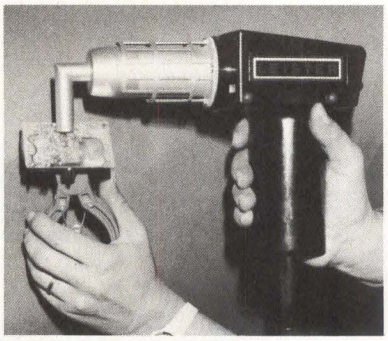
De-soldering of a CB.



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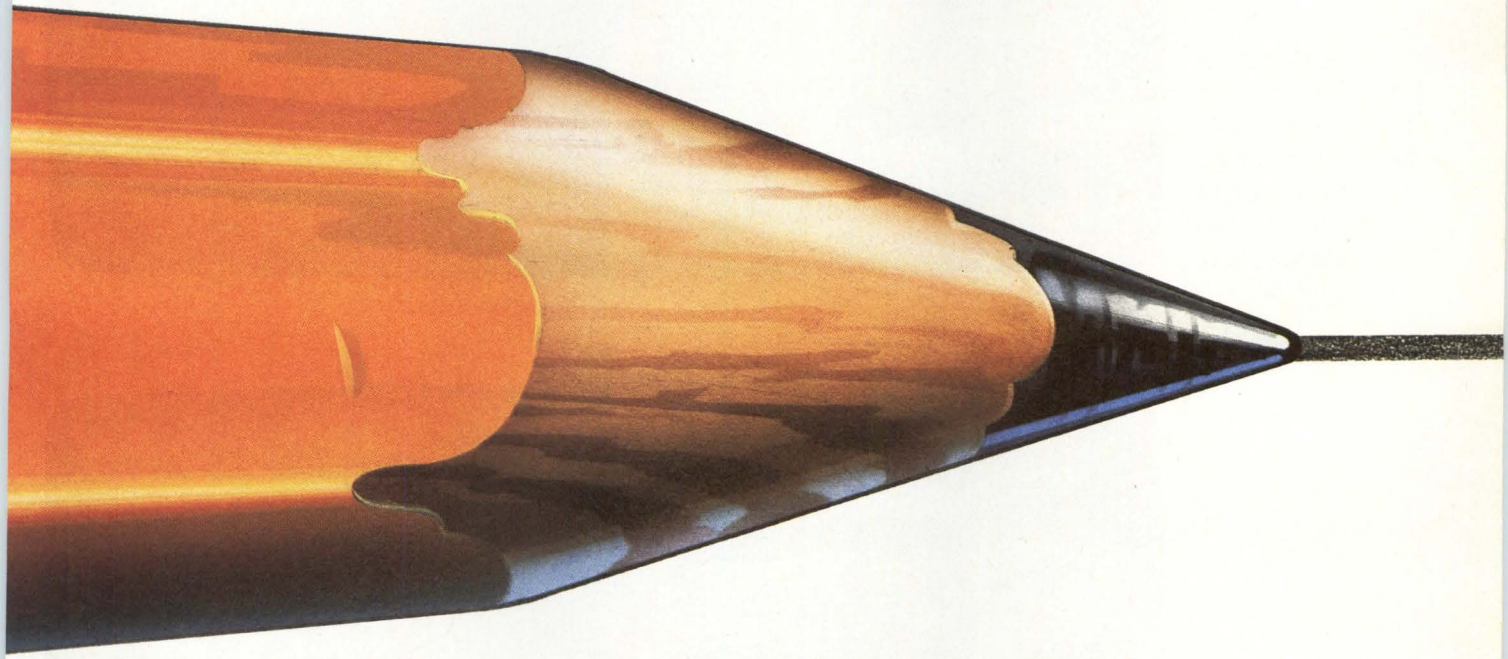
East Coast Office, 1 Industrial Way West Bldg. E, Eatontown NJ 07724, Tel. (201) 544-1212, TWX 888307

CIRCLE NO. 98 ON INQUIRY CARD

The only line printer easier to maintain than ours.



At Centronics, we combine the most advanced technology available with 20 years of experience to build the world's most reliable line printers. So that you don't have to worry about maintenance.

Take our Linewriters at 400 and 800 lpm. They deliver print quality better than any line printer on the market, at noise levels below 55 dB(A). Yet they're so reliable that with no preventive maintenance whatsoever, they run for 18 months without service. Something no other line printer can do.

For heavy duty applications, our E-Series line printers can print three times faster. Up to 2400 lpm. And they too require less maintenance than any printer in their category. So they're perfect for your most demanding needs.

Pick up a pencil and write us. We'll show you that if you're looking for line printers, you have to look at Centronics.

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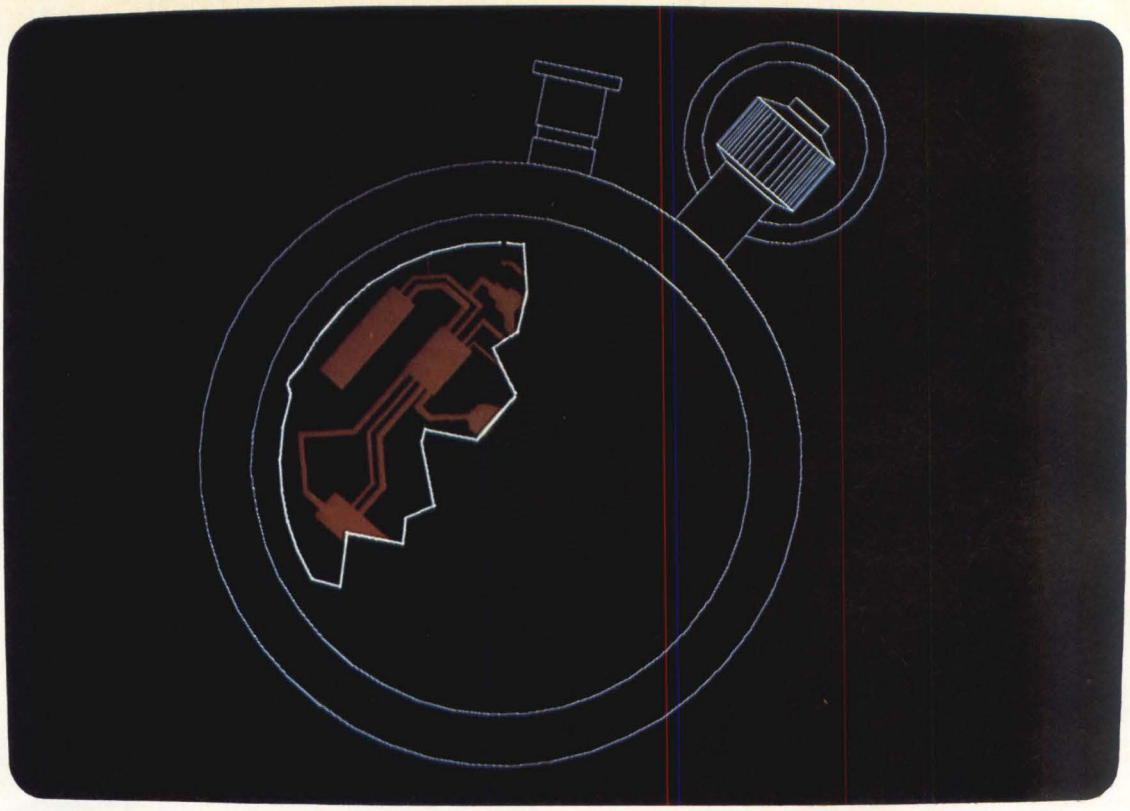
An affiliate of Control Data Corporation

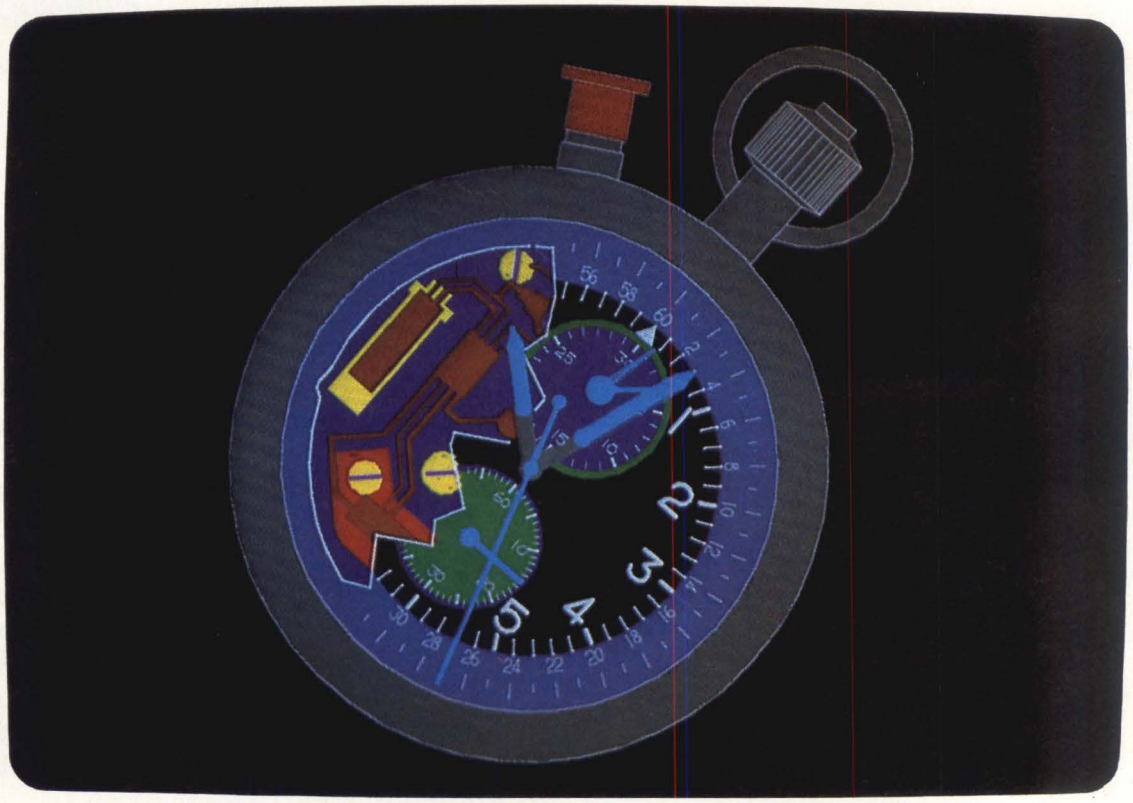
When was the last time you looked at us.

Centronics Data Computer Corp., Dept. A, One Wall Street, Hudson, NH 03051. Tel. (603) 883-0111.

CIRCLE NO. 99 ON INQUIRY CARD



An average terminal gets this far in 1.4 seconds. You'll twiddle your thumbs for 14 seconds before it's finished.



New HiSCAN terminals complete the entire drawing in just over one second.

Graphics terminals with ten times the drawing speed. $2,195 Monochrome, $2,995 Color.

Stop watch courtesy of Heuer Electronic Corp.

"One, one thousand... done!"

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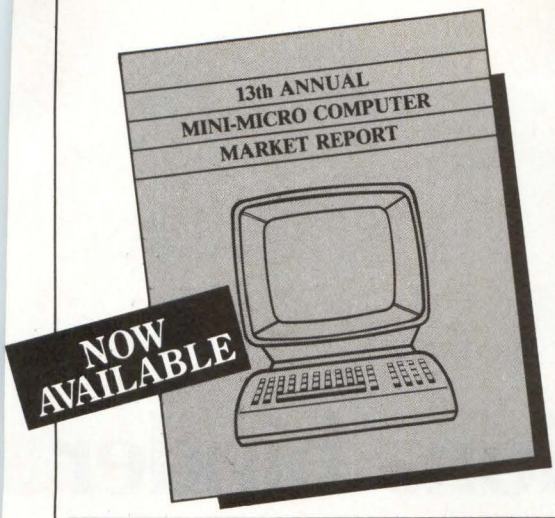

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$250,000-499,999	2,218
$500,000 or more	1,403
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Market considerations hinder search for software standards

Acceptable sets of standards promise to end interchange problems through portability, longer software life

Carl Warren, Western Editor

Software standards are stumbling forward even as conformity and flexibility issues throw up roadblocks. But, while most of the industry says it wants standards, proponents and system and software manufacturers stand nose-to-nose in a battle of conflicting objectives.

Though standards promise to eliminate confusion of interchange, display methods and integration of foreign devices into systems, software manufacturers often advocate particular standards only out of self-interest. They want standards that will guarantee that more hardware will be available to support their offerings. By the same token, hardware manufacturers want to ensure that support will be available from a variety of sources—the goal of all, of course, being to grab more of the market share.

Regardless of supporters' motives, it seems clear that standards benefit the end user by making it possible to better match software and hardware to meet a given objective.

Three ways to set standards

Basically, there are three ways of setting standards:

- Market force, which leads to a de facto standard. A dominant manufacturer establishes a methodology and forces others to follow suit in order to enjoy market share.
- Simple evolution. Typical examples are UNIX for operating systems—just now becoming prominent for multiuser system—and Smalltalk, LISP and Prolog for artificial intelligence. This type of standard evolves as a product first, carves a niche in a small market and later expands as manufacturers perceive its value.
- Established by committee, such as those of the American National Standards Institute (ANSI), or the Institute of Electrical and Electronics Engineers (IEEE). Some standards committees aren't formal but are coalitions of manufacturers banded together to establish a working relationship and to develop a market. One example of this is the Independent Software Information Standard (ISIS) group, formed to provide a standard method of interchanging information between different software environments.

Regardless of the method used to establish a standard, the expected result is order from chaos.

A critical look at standards

Even with a great deal of emphasis on standards, there are pockets of resistance to across-the-board standardization, with many software manufacturers citing the need to be different to ensure a healthy market share. Peter Shaw, president and chief execu-

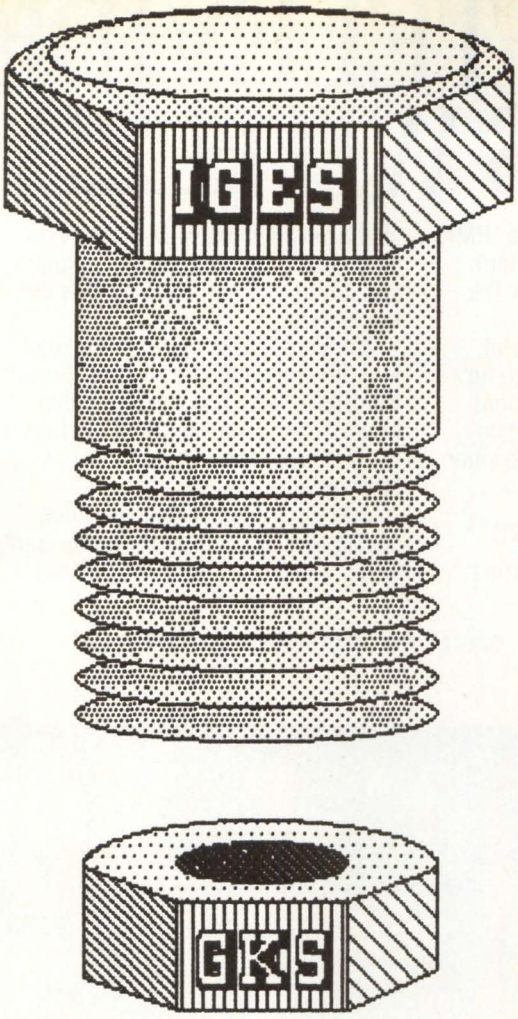


Illustration by Anne Tregay

A mix of software standards *solves compatability issues for specific tasks, but inconsistencies exist from standard to standard, creating system interchange problems.*

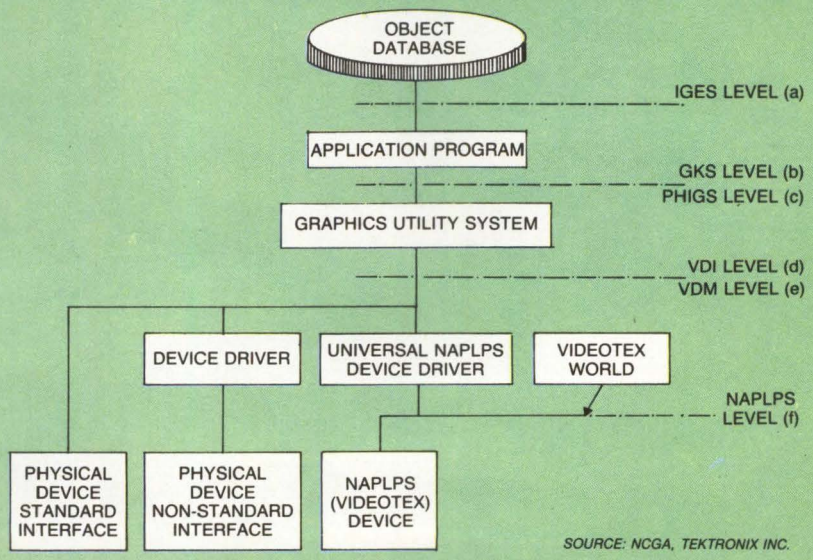
Tools for designers serve specific needs

An alphabet soup of graphic standards purport to provide designers with an array of tools with which to work:

(a)**The Initial Graphics Exchange Standard (IGES)** is an American National Standard Institute (ANSI) standard for transporting Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM) data within and between systems; (b)**The Graphical Kernel System (GKS)** is an ANSI standard that defines two-dimensional objects; (c)**The Programmers Hierarchical Interface to Graphics (PHIGS)** is a developing standard, similar in concept to GKS, for dynamic systems; (d)**The Virtual Device Interface (VDI)** is a two-way protocol which takes place at the lowest level of device independence; (e)**The Virtual Device Metafile (VDM)** represents a standard file format for 2-D graphics data; (f)**The North American Presentation Level Protocol Syntax (NAPLPS)** defines the methods of presentation and storage for Videotex graphics.

Notice that IGES is highest and in between the applications and the object databases. The other standards serve special functions, like device handling, as they progress down the structure.

Thus, each standard is designed to serve a specific need in the system.



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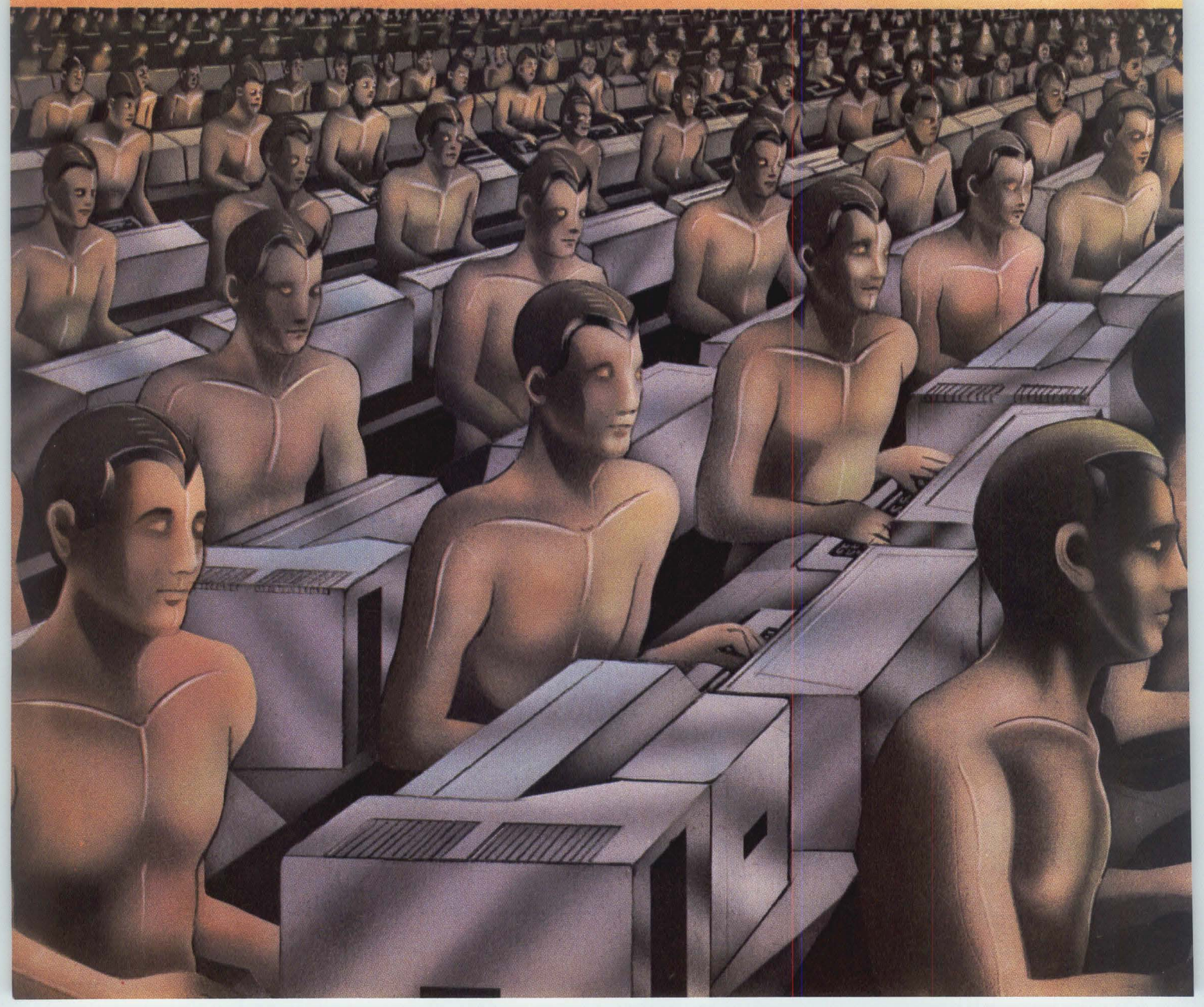

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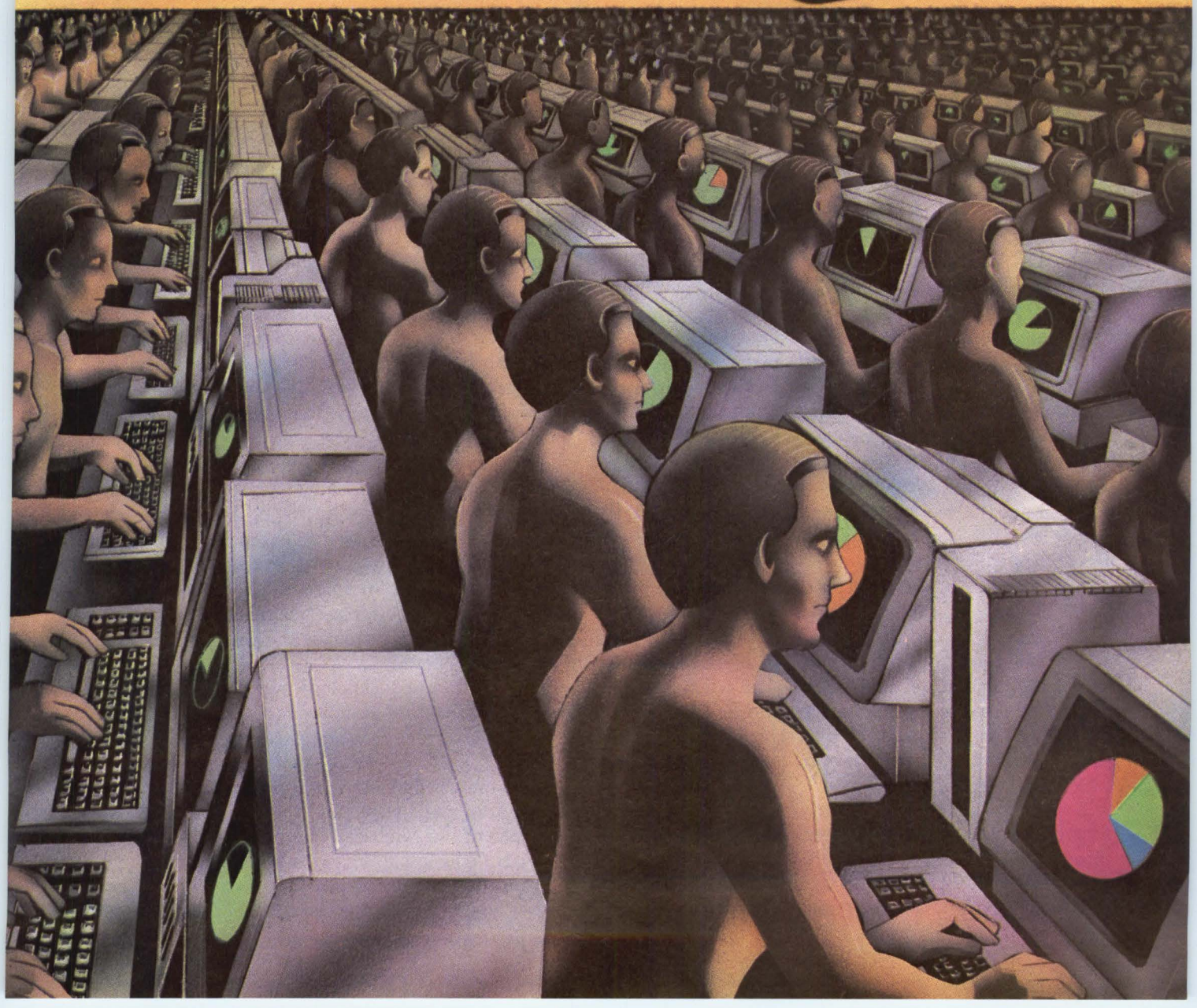
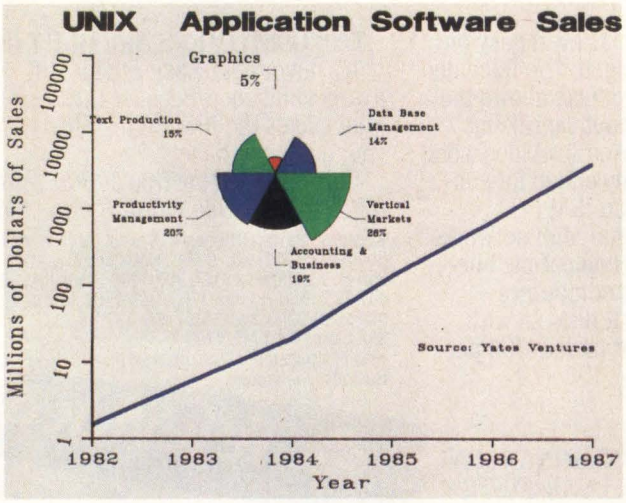
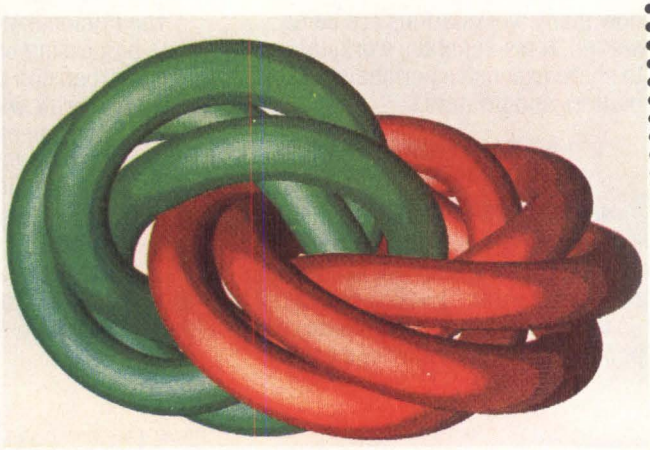




The Graphical Kernel System *(GKS) provides a standard interface for high-level business graphics. (Courtesy of Visual Engineering Inc., Palo Alto, Calif.)*



By coordinating the basics *of a standard while exploiting the features of the graphics-output device, sophisticated results are possible—including 3-D perspective from 2-D devices. (Courtesy of Uniras Inc., Burlington, Mass.)*

tive officer of Syte Technology Inc., San Diego, stresses that adherence to standards often hinders design, and adds that, while they can't be ignored, standards do not work to the advantage of "fast-paced, technology-mature" companies.

Though Shaw's candor may appear to indicate that Syte intends to avoid standardization, such is not the case. Syte, like many companies competing in an increasingly difficult market, does adhere to standards, but only when it suits a company purpose. President Edwin P. Berlin Jr. of Cubicomp Corp., Berkeley, Calif., says that he, too, will adhere to standards, given certain conditions. "If someone had data files written on a machine using the Graphical Kernel System (GKS) file structure, we'll provide a utility to translate that information. But we aren't going to make files compatible to run on a competitor's machine—there is no percentage in it for us."

The hesitancy of manufacturers to leap on the standards bandwagon gives rise to important questions. Will efforts to standardize be foiled because manufacturers won't cooperate? Will there be an ultimate tribunal, consisting of end users, that will force the issue? There are really no clear-cut answers, but differing opinions abound, centering on which standards are under discussion and what market segments are being addressed.

End users, whether they are independent integrators or Fortune 5000 companies integrating a system into their infrastructure, often have the wrong idea about standards. Typically, they believe that adherence to a standard implies they must be followed to the letter. With communications this seems to be the case, but generalized systems—either for business, or graphics—require a more flexible approach.

One software company built on standards is Precision Visuals Inc., Boulder, Colo. "We've hung our hat on standards since 1979," explains James R. Warner, company president. "But that doesn't mean we ignore the performance issues and burden the system with a by-the-book-standards implementation."

Warner believes that standards are necessary and, if nothing else, teach a specific way of handling graphics. Moreover, he maintains that people get steeped in extensions. "Typically, you find that only 10 percent of the implementation follows the standard. The other 90 percent is made-up extensions to perform functions the way the end user expects them. We continually get customers coming to us for extensions, and often it starts directly with the hardware manufacturer six to 12 months before they introduce the hardware. What they want is something that represents a standard approach but still maximizes the performance capabilities of the system."

With hardware technology rapidly leap-frogging, it becomes difficult for standards to keep up. And virtually everyone agrees that standards aren't meant to be a panacea.

One staunch defender of standards is Dr. Peter R. Bono of Ship Analytics Inc., North Stonington, Conn., chairman of the American National Standards Committee X3H3 on computer graphics. "Standards represent a codification of current practice. As such, they lag and always will. What standards have done for the graphics

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industry is give us a common vocabulary—we all now talk the same language and can understand each other."

Bono contends that, besides providing a common vocabulary, standards open up wider markets for companies and benefit end users who are nervous about getting locked into one company, rather than being able to find solutions from multiple vendors. He points to Graphic Software Systems Inc., (GSS) Wilsonville, Ore., which has developed a software approach around the GKS and Virtual Device Interface. "They see it as a market opportunity, not a hindrance," Bono says. "However, manufacturers of turnkey systems who are offering unique solutions to their customer base may be worried—standards would tend to erode their market."

Thomas B. Clarkson III, president of GSS, says, "Standards provide us with a set of rules to follow. They don't inhibit our creativity, however. We go to great lengths to maximize the performance of the devices by using device-dependent drivers."

Bono and Clarkson point out that the decision to be device-dependent requires a tradeoff between portability and the full use of the machine environment. "Device independence gives you portability; device dependence lets you exploit the device," says Bono.

Although it's a give-and-take situation, no one is forcing anyone in the industry to use standards. They exist as a tool and can be used, modified or ignored. In some cases, standards are used to a point, and device dependence takes over to exploit the device.

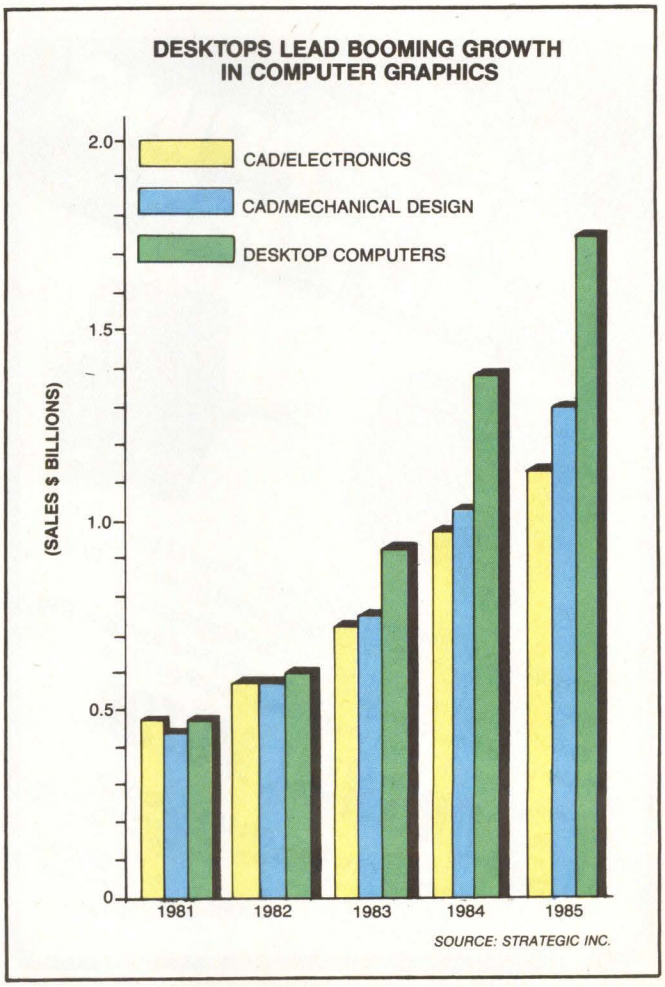
Precision Visual's Warner cautions that hardware manufacturers should consider the impact of the total system, not simply try to shove standards in ROM for the sake of having done it. "The software people are in the business of solving the matching problems and maximizing the system," asserts Warner. He says that what is done often entails picking the appropriate standard—if one exists—to handle the task at hand. "Sometimes a standard isn't appropriate," he says.

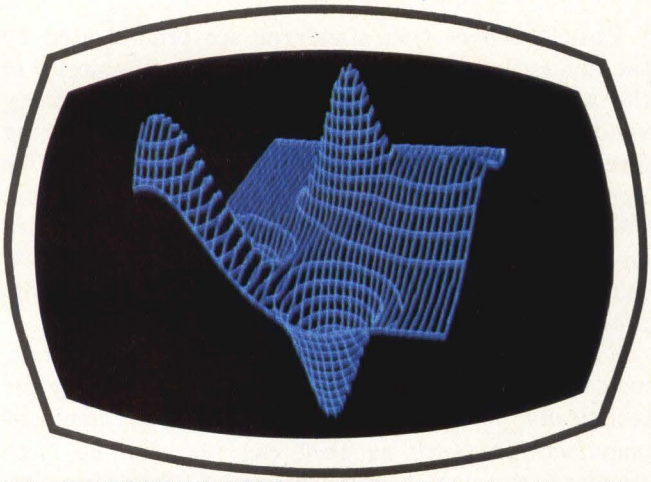
No easy answers

Clearly, there are no clear answers to the chaos surrounding graphics standards. It appears that, on the one hand, there are solid reasons to base the entire implementation on standards; on the other hand, modification is a must. Brian Rosen, vice president of engineering for PERQ Systems Corp., Pittsburgh, Penn., emphasizes that standards provide a comfort level for users. "The first contact we have with a customer is to satisfy a check list. On that list is what standards we support. Once we get past that, we can concentrate on solving the problem with the proper solution—and that solution has a foundation in standards."

Rosen believes that standards are promulgated by the diversity in software vendors. "A vast majority of the software being written today is by third-party vendors, and because of this, standards are being forced." Rick Stuckey, partner in technical services for Arthur Anderson & Co., Chicago, agrees with Rosen. "We have a policy that dictates that some things require creativity and mundane functions don't. We don't encourage the reinventing of the wheel. So standards prevent that."

Even though standards may offer a lot, Syte's Shaw may be right on target in claiming they are only for technically poor companies. For example, dominant manufacturers such as IBM can establish de facto standards through sheer market force. "Take for example the IBM-PC," says Stuckey. "It has a method of using the screen for graphics, and they have essentially locked it up so everyone has to do it differently. It is a standard and one that has to be dealt with. Therefore, software writers can decide to support the IBM approach and everyone else. Should Microsoft MS-





Using the SIGGRAPH CORE standard *as the basis, with machine-independent subroutines and device-dependent device drivers, sophisticated graphics can be achieved. (Courtesy of Precision Visuals.)*

Windows concept catch on, it means only two versions of the same software will need to exist for all practical purposes—that's basically what standards are all about: increasing markets and portability."

CIRCLE NO. 105 ON INQUIRY CARD

Applications set the standard

No matter what anyone says, the applications—solutions to real-world problems—set the standards. In many cases, such as those built around software tools from companies like GSS, Microsoft Corp. and Precision Visual, the basis is a standard. But, with a growing emphasis on graphics, many non-standard approaches will also be used. "Good standards promote creativity, rather than inhibit it. They prevent individuals from wasting time on mundane tasks,"concludes Arthur Anderson's Stuckey.

Bono agrees and says there is no question that standards use more machine resources and do affect performance. "However," he says, "they also provide developers with a quick method of prototyping and creating a working base for the software. Once the basic design is done and is working, the performance-sensitive parts can be rewritten to optimally use the device."

Is certification a problem?

Currently, there is no process of certification of products that claims compatibility to a standard. The reason? "Our legal system isn't set up to handle it,"says Bono. "Who's going to stand up and say someone's product violates any given standard? I'm not, and I don't think anyone else will." Bono explains that the self-certification process is used in the United States. For government contracts, however, there are guidelines that have to be met. "Right now the National Bureau of Standards is establishing certification methodology for GKS implementations when dealing with the government—but that's the only time it may be important," explains Bono.

No one loses

Despite the widespread disorder in graphic software standards, it appears that no one really loses. Manufacturers who follow standards are benefitting from a common vocabulary but are still free to optimize designs to meet specific goals, and end users aren't forced to throw out a software investment with an upgrade in hardware—they merely rewrite the device-dependent portions. Confusion exists in the definitions and choosing what standard to use for what application. Charles J. Simon, president of Vectron Graphic Systems Inc., Santa Clara, Calif., sums it up, "We create systems to solve our problems and we take the best approach that promises the widest market." □

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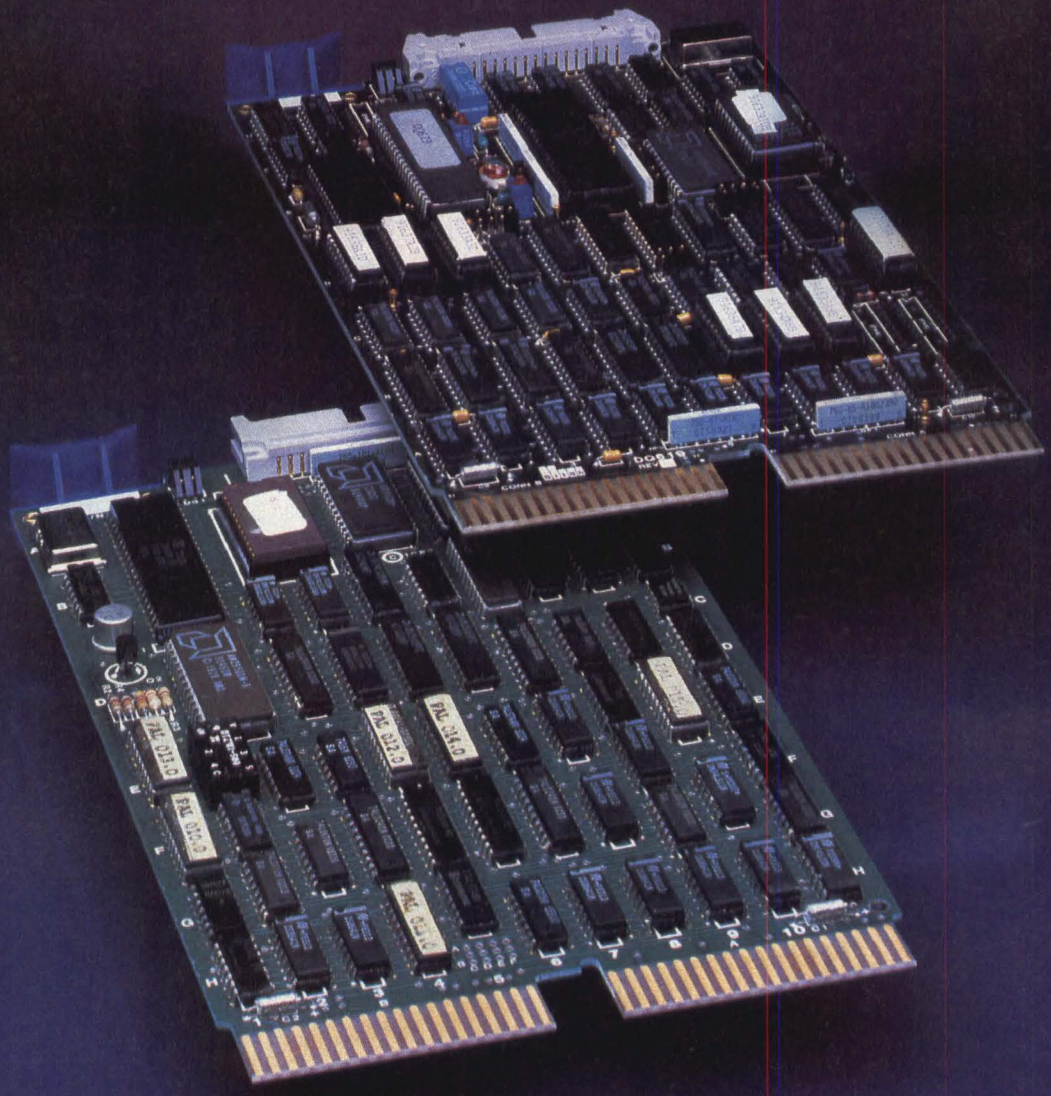

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CIRCLE NO. 108 ON INQUIRY CARD

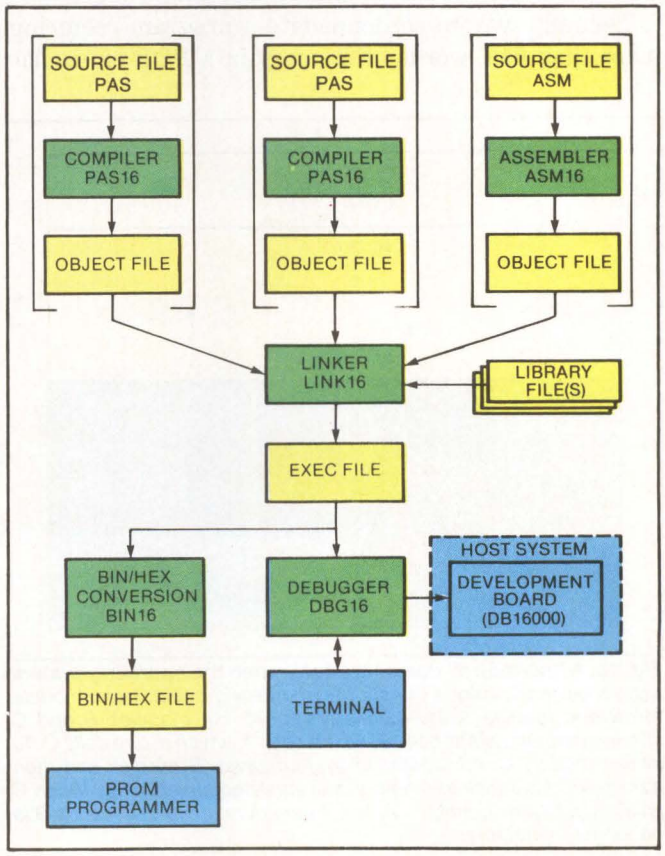
Transport software packages from 32-bit to 16-bit machines

A VAX-to PDP-11 case study shows system integrators how to accomodate differences in operating systems, compilers, machine-word sizes and memory management

Madhu Mehta, Digital Innovations Pvt. Ltd.

System integrators attempting to transport large software packages from one hardware environment to another can benefit from the experience of companies that have completed such a task. One such company is Digital Innovations Pvt. Ltd., Vadodara, India, which has ported National Semiconductor Corp.'s NSX16 development tools from a 32-bit Digital Equipment Corp. VAX supermini running VMS to a 16-bit PDP-11 minicomputer running RSX-11. Digital Innovations completed the port, including quality-assurance testing, in approximately 8,000 man hours. Memory overlays allowed the company to reduce the memory requirement of the NSX16 package from more than 400K bytes on the VAX to 145K bytes on the PDP-11.

The purpose of Digital Innovations' port was to make the NSX16 software tools available to PDP-11 users



The NSX16 cross-software package *includes the PAS16 Pascal cross compiler and the ASM16 cross assembler to generate code for NS16000-based systems. LINK16 links object files and library routines into an executable file. Users can then employ the BIN16 utility, which prepares the file for programmable read-only memory (PROM) generation. Users can debug the code using the DBG16 utility and then can down-load it to target systems such as National's DB16000 development board. The NSX16 package operates with the VMS, RSX-11 or Starplex II operating system and is available from Softrade International, Pleasantville, N.Y.*

who wish to create application programs for NS16000-based target systems such as National's DB16000 development board. Project managers for the porting effort established guidelines to ensure that programmers could revise the PDP-11 code to coincide with future enhancements to the VAX version. Three of the most important guidelines are:

- To preserve the original program structure, making necessary changes on a statement-to-statement rather than a module level. This preservation reduces the amount of converted code and facilitates its identification.
- To preserve the original program algorithms, thus reducing the likelihood of subtle bugs caused by inconsistent logic.
- To design the target package as a whole. For example, the package might include an assembler and a linker. If the assembler recognizes only 350 external symbols per program, there is no point in having the linker support more than 350 symbols per object file.

Null procedures facilitate overlay swapping

Memory management is perhaps the most difficult problem in porting a large program. To move code from the VAX to the PDP-11, Digital Innovations had to adapt software written for the VAX's demand-paged virtual memory to the PDP-11's segmented memory, which is limited to a 64K-word addressing range.

The only way to accommodate a program requiring more than 64K words of memory in a PDP or similar computer environment is to overlay some program modules. To overlay a module, the operating system temporarily replaces that module with a module of the same size or smaller. When the program subsequently requires the original module, the operating system transfers the module from the disk to memory.

In primitive implementations of overlaying, the operating system does not save a module on disk before overlaying it. In such an environment, the system can restore a module's *original* state, which resides on disk, but not a module's latest state. Although a module's code generally does not change during program execution, its local data *does* change, so a program must be carefully designed to avoid losing data during overlaying.

The RSX-11 operating system used by Digital Innovations supports a sophisticated overlaying method called swapping. In swapping, the operating system saves on disk the current state of an overlaid module, so local data have the correct values when the operating system restores the module in memory. RSX-11 automatically handles the transfer of overlays between memory and disk using the system's auto-loading mechanism.

Swapping does not solve all problems associated with overlays, however. In chains of subroutine calls, a procedure might be unable to return to its caller because the caller has been "swapped out" (Fig. 1a). Digital Innovations solved this problem by using "null procedures," which do not perform any operations.

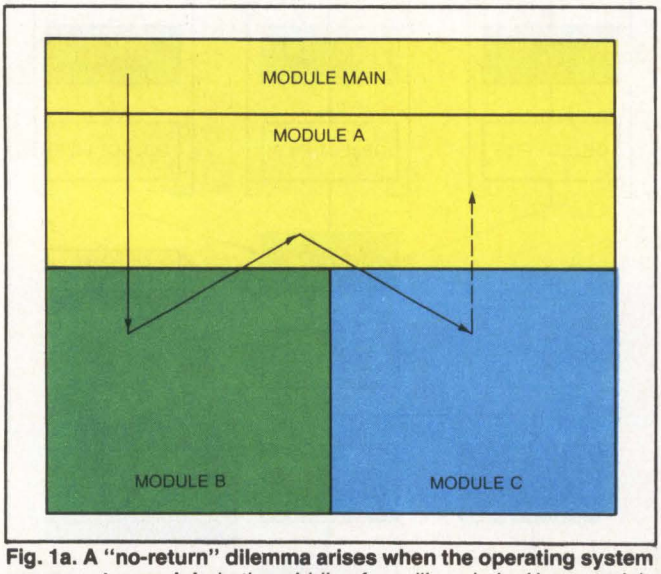


Fig. 1a. A "no-return" dilemma arises when the operating system swaps out a module *in the middle of a calling chain. Here, module MAIN and module A are memory-resident, but modules B and C share an overlay. MAIN calls B, which calls A, which in turn calls C. To invoke module C, the operating system saves B on disk and then transfers C from disk to memory previously occupied by B. When C finishes, it returns control to A, but A cannot return to B because B is no longer in memory.*

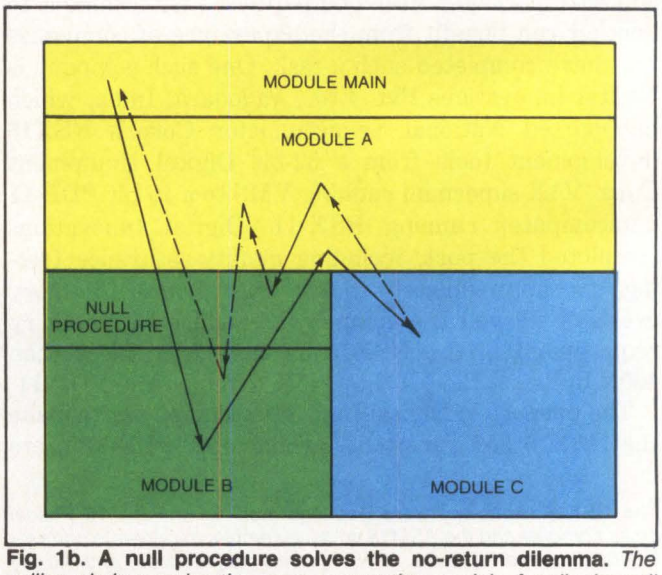


Fig. 1b. A null procedure solves the no-return dilemma. *The calling chain remains the same except that module A calls the null procedure after completing all of its operations. Because the null procedure resides in the same overlay as module B, the call to the null procedure causes the operating system to reinstate B in memory. The null procedure itself performs no operations, so it immediately returns to its caller, module A. Now, module A can return to its caller, B, which completes the chain by returning to MAIN.*

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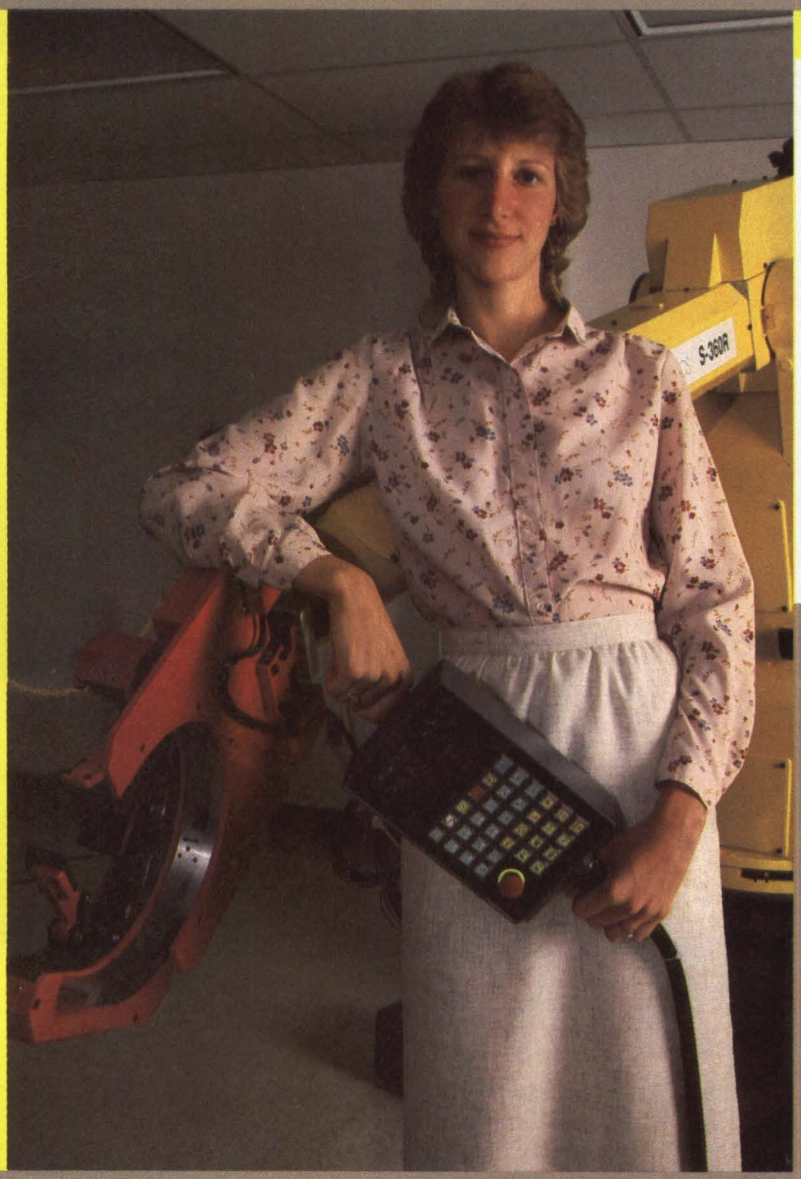

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CIRCLE NO. 110 ON INQUIRY CARD

NSX16 element	No. of lines	No. of procedures	Memory occupied without overlay (bytes)	No. of segments overlaid	Overlay size (bytes)
LINK16	9,188	97	53,344	6	20,432
PAS16	41,787	415	140,540	34	21,256
DGB16	18,130	202	109,676	26	26,156
ASM16	7,463	132	47,260	7	27,748
BIN16	3,538	11	30,708	1	30,708
LIB16	5,580	100	51,120	7	17,644

Heavy use of memory overlays *reduces the total memory requirement of the six NSX16 components from 433K to 145K bytes.*

Instead, they cause the operating system to reload the desired overlay so that program execution can continue (Fig. 1b).

In RSX-11, programmers can improve software performance by using memory-resident, rather than disk-resident, overlays. If more than 64K words of physical memory are available, RSX-11 permits overlays to reside in memory even when they are swapped out. The system loads these overlays by simply changing a software pointer to the address of the desired overlay.

In chains of subroutine calls, a procedure might be unable to return to its caller because the caller has been 'swapped out.'

Managing the overlays in the target NSX16 package was particularly difficult because the code is written in Pascal. The Pascal run-time library occupies an average of 22K bytes, even when overlaid. Pascal programs also rely heavily on stack operations, requiring large stack spaces averaging 15K to 20K bytes that cannot be overlaid. Global data also is difficult to split in overlays. Because of these constraints, the PDP-11 version of the NSX 16 package is heavily overlaid (above). For example, the PAS16 component requires 140,540 bytes of program space without overlays, but Digital Innovations squeezed it into only 21,256 bytes.

Variant records accommodate new word size

The VAX performs arithmetic on 32-bit quantities, whereas the PDP-11 performs arithmetic on 16-bit quantities. Digital Innovations accommodated this architectual difference by constructing a library of double-word (32-bit) arithmetic functions for the PDP-11 to implement the NSX16 package. Digital Innovations created 14 such functions to perform all necessary arithmetic operations. One function, for example, converts a 16-bit integer to an equivalent 32-bit integer. These functions declare a 32-bit Pascal variant record that can be viewed as a Boolean variable; a floating-point variable; or an array of bits, bytes or words.

Unfortunately, the double-word functions to implement 32-bit arithmetic require changes to the program's source code. Moreover, what was once a simple arithmetic expression can become complex as function calls substitute for arithmetic operators.

When porting a program from one machine to another, the porting team often has to rewrite the source code in a different programming language or in a different version of the same language.

The NSX16 porting team accommodated differences between two dialects of Pascal. The original NSX16 package is written in Digital Equipment Corp.'s VAX Pascal, but the team wrote the target package in Oregon Software Inc.'s Pascal-2. The two versions of Pascal differ in several ways:

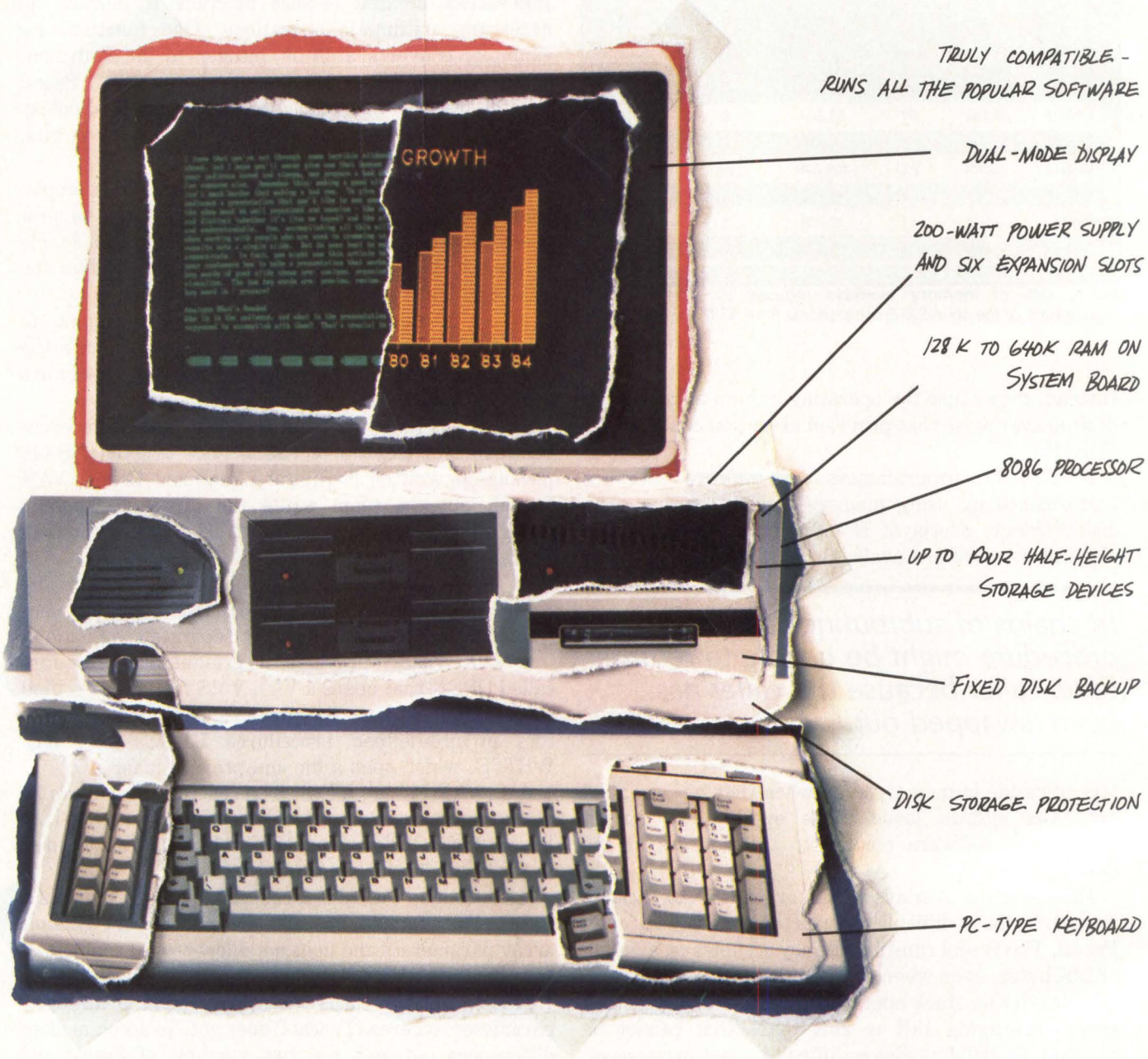
- VAX Pascal compiles procedures separately by recognizing a keyword called MODULES. Pascal-2 uses a compilation switch to perform separate compilation.
- VAX Pascal provides a pre-defined procedure called OPEN that opens a VAX/VMS file with specified characteristics. Pascal-2 provides additional parameters in pre-defined procedures RESET and REWRITE, which open a file and prepare it for I/O.
- In VAX Pascal, a FOR loop control variable can be declared at an outer level and used in an inner level. In Pascal-2, a FOR loop control variable must be declared in the level at which it is used.

In addition, Pascal-2 lacks some features of VAX Pascal. For example, Pascal-2 does not support dynamic array parameters and does not allow nested comments. Consequently, VAX Pascal has the pre-defined function UPPER, which returns the upper bound of an array parameter, whereas Pascal-2 does not. To accommodate differences between the two versions of Pascal and between VMS and RSX-11, Digital Innovations developed 23 Pascal-2 functions and three Pascal-2/Macro interfaces to replace VMS system and library utilities. □

Madhu Mehta is co-founder and managing director of Digital Innovations Pvt. Ltd., Vadodara, India. He received M.S. and Ph.D. degrees in electrical engineering and previously worked for eight years at GTE Corp., Chicago.

Interest Quotient (Circle One)
High 825 Medium 826 Low 827

Computer dreams.



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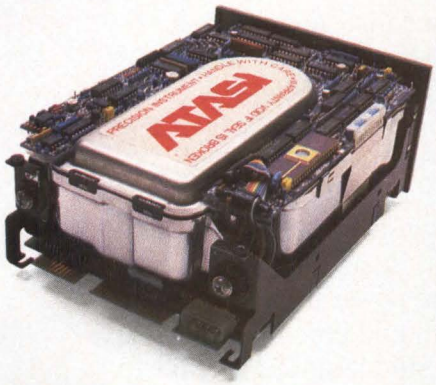
Shock and vibration: twin problems

Shock, and the closely related problem of vibration, have come under intense study at ATASI Corporation, and for good reason: both can cause loss of data. A severe pulse shock can cause a

AN ENVIRONMENTAL IMPACT REPORT.

drive's head to "slap" against the disk, removing a "divot" of oxide material, along with the data written there. Severe vibration can cause the head to overshoot or undershoot a track, so that the head can't find the data it's seeking. In addition, vibration can fatigue components over time, and perhaps lead to premature failure.

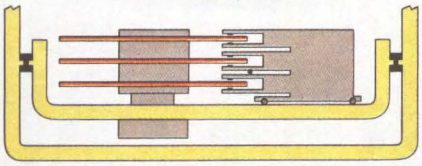


ATASI's 46 Mbyte, 5¼-inch Winchester disk drives are available in production quantities immediately.

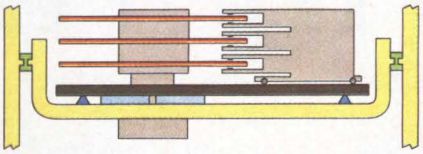
Double shock isolation

In order to sustain high shock loads, the ATASI design incorporates a unique dual system for shock and vibration isolation. Like most disk drives, ATASI drives have isolators between the frame and the head/disk assembly bowl. In addition, ATASI's proprietary design includes elastomere isolators inside the bowl, between the bowl and baseplate on which the head/disk assembly is mounted. A foam pad with high damping properties, also located between the baseplate and the bowl, further protects the head/disk assembly from vibration.

The grommets ATASI uses for isolators are far from ordinary. To handle both pulse shocks and vibration effectively—to avoid a declining spring rate with displacement while maintaining adequate damping properties—ATASI tested 330 different options before making a choice. These tests involved the use of a laboratory shaker as well as computer models.



Most disk drives only have shock and vibration grommets (black) between the frame and the bowl.



ATASI's proprietary design also includes isolators (blue) between the bowl and baseplate.

ATASI's double isolation system more than protects its drives—and the data they store—from the shocks of the office environment.

Beyond the shock/vibration problem

Shock and vibration engineering is only one of a number of ways ATASI achieves such a high level of data integrity. ATASI drives also feature dedicated "landing zones." Upon powerdown—intentional or emergency—the back e.m.f. of the motor is used to position the carriage over data-free landing zones. A carriage lock then mechanically holds the carriage in place, protecting the data field from any head contact.

The ATASI White Paper

At ATASI, we are proud of the quality we build into every drive we make, and we encourage clients to test our products rigorously. To help, we have prepared a White Paper on shock and vibration for systems integrators. It discusses test methods and the interpretation of test data in detail.

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```
BLU FROM DTE   TIME 00:00:06:86   LENGTH=47

LINK HEADER = C1 00

ADDR = C1 CONTROL = INFORMATION N(S) = 0 N(R) = 0 P/F BIT = 0

TRANSMISSION HEADER = 2D 00 02 01 04 89
FID TYPE 2  ONLY SEGMENT EXPEDITED FLOW
DAF = 02  OAF = 01  SNF = 0489

REQUEST HEADER = 6B 80 00
SC FI ONLY RU
DR1I = 1  DR2I = 0  ERI = 0  DEFINITE RESPONSE REQUESTED
RESPONSE BYPASSES TC QUEUES
CODE 0

RU LENGTH = 36

0000  31 01 03 03 B1 90 30 80 00 00 88 F8 00 00 02 00
0010  00 00 00 00 00 00 00 00 02 00 00 07 E3 E2 D6 F0
0020  F0 F4 F0 00
BIND—NONNEGOTIABLE
FM USAGE—PRIMARY LU PROTOCOLS FOR FM DATA
FM PROFILE = 03   TS PROFILE = 03
FM DATA USAGE (PLU) = B1   FM DATA USAGE (SLU) = 90
FM USAGE COMMON LU PROFILES = 3080
PACING SLU TO PLU = 00   PACING NCP TO SLU = 00
MAX RU FROM SLU = 88   MAX RU FROM PLU = F8
PACING PLU SEND COUNT = 00   PACING PLU RECEIVE COUNT = 00   LU TYPE = 02
PS VALUE CHARACTERISTICS = 00 00 00 00 00 00 00 00 02 00
CRYPTO OPTIONS = 00   CRYPTO ENCIPH. MODE07
CRYPTO KEY:—

0000  E3 E2 D6 F0 F0 F4 F0 00
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CIRCLE NO. 111 ON INQUIRY CARD

Intelligent I/O board extends S-100 systems to 16 terminals

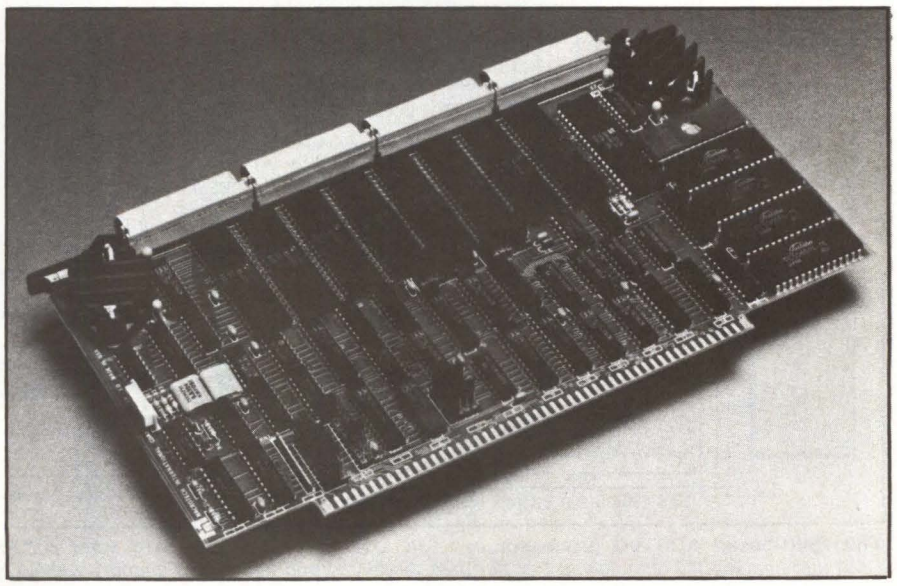
Z80B-based board combines eight dual-channel serial communications controllers and resident operating system to bring 'front-end processing' to S-100-based microcomputers

Mike Pelkey, Macrotech International Corp.

Non-intelligent I/O boards must continually communicate on a character-by-character basis with a host to access files and application software. In small systems with, say, four users, a non-intelligent board does not noticeably restrict the host's operating speed. The greater the number of users, however, the greater the need for on-board intelligence and functions such as message-level communications, direct memory access (DMA) and dynamic allocation of on-board memory. An intelligent I/O board permits more users to run programs simultaneously from a single host without decreasing throughput. Macrotech International Corp.'s ADIT I/O board provides intelligent processing for S-100 based systems and supports up to 16 terminals, printers, modems or other serial devices.

DMA and on-board OS offload host processing

Because host operating systems usually perform I/O communications on a character-by-character basis, the host spends much time converting message levels to character levels. While the ADIT board has commands that allow operating systems to continue this approach,



The ADIT intelligent I/O board *extends S-100 systems to as many as 16 terminals, modems or printers. While the ADIT board can enhance any multiuser operating-system environment, its on-board software specifically supports protocols for UNIX, AMOS or Digital Research Inc. (DRI) -based operating systems.*

it also includes message-level commands. Because the ADIT can communicate with the host at the character or message level, it reduces the host's message-to-character conversion times.

Consider an output operation in which the host wants to send 32K bytes of data to a printer. The host operating system would normally check status throughout the transaction by pointing to each character in its memory, reading it, and sending it to the printer. In an ADIT-equipped system, the I/O board accepts the output command and address of the data and directly copies into its memory the information from the host while the host performs its regular application processing. This process is transparent to the host. After copying the information, the board performs the full output and informs the host when the command has been completed.

A number of firmware-implemented functions aid in offloading host processing. For example, on-board jumpers furnish a default channel configuration that can be dynamically reconfigured by commands from the host. Because of the jumpers, the board can initialize all lines without assistance from the host if all lines have the same setup. That would usually be the case if all lines are connected to terminals operating at the same baud rate. If the line setups are not the same, the host would have to reset, or reconfigure, the lines. The ADIT board accomplishes this dynamic reconfiguration via host commands.

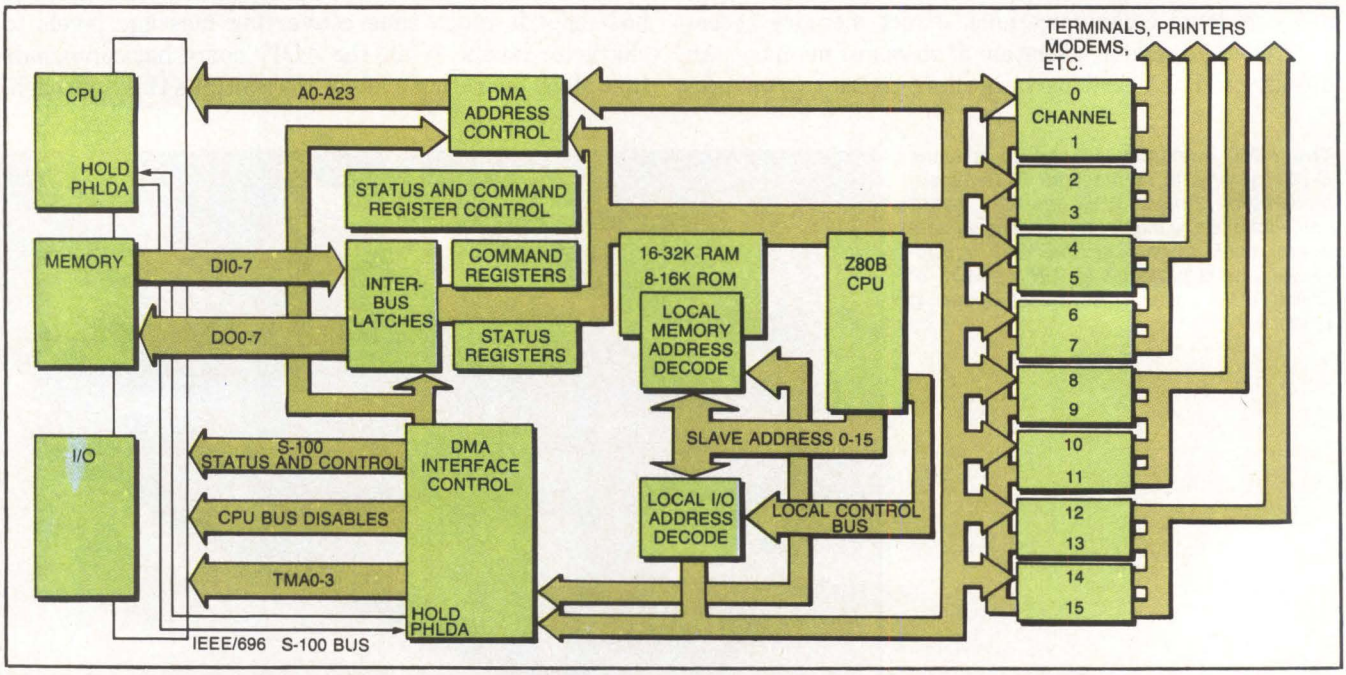
Input commands can use one of three input-editing protocols—Digital Research Inc.'s MP/M-86 or Concurrent CP/M, Alpha Micro Systems' AMOS or American Telephone & Telegraph Co.'s UNIX. Alternatively, the input commands can use one of four user-downloaded protocols. When input commands are in effect, the ADIT operating system (AOS) holds the incoming characters and responds to the terminal-editing control codes until an end-of-line character is received. A user can edit the input before the host is aware of any input from the terminal. The host receives the entire line through a DMA transfer to host memory.

The ADIT board implements DMA in accordance with IEEE-696 standards, using 24-bit addressing. The I/O channels can transfer data directly to and from host memory without tying up the host CPU. When the ADIT board uses DMA, it controls the transaction by issuing strobes, control signals and data to read or write in host memory.

Controlling the bus

In a DMA transfer, the ADIT first requests the host CPU to relinquish control of the bus. When the host acknowledges the request, the I/O board places the desired address on the bus. When writing into host memory, it also places the data byte on the bus. The board returns control of the bus to the host after the transfer is completed.

The AOS multitasking, real-time operating system resides in 8K bytes of ROM. All 16 channels have access to 16K or 32K bytes of RAM, which are divided into



The Z80B-based ADIT I/O processor *has 16K to 32K bytes of on-board RAM and 8K to 16K bytes of ROM. The board uses 24-bit DMA that enables I/O channels to transfer data directly to and from host memory without tying up the host CPU.*

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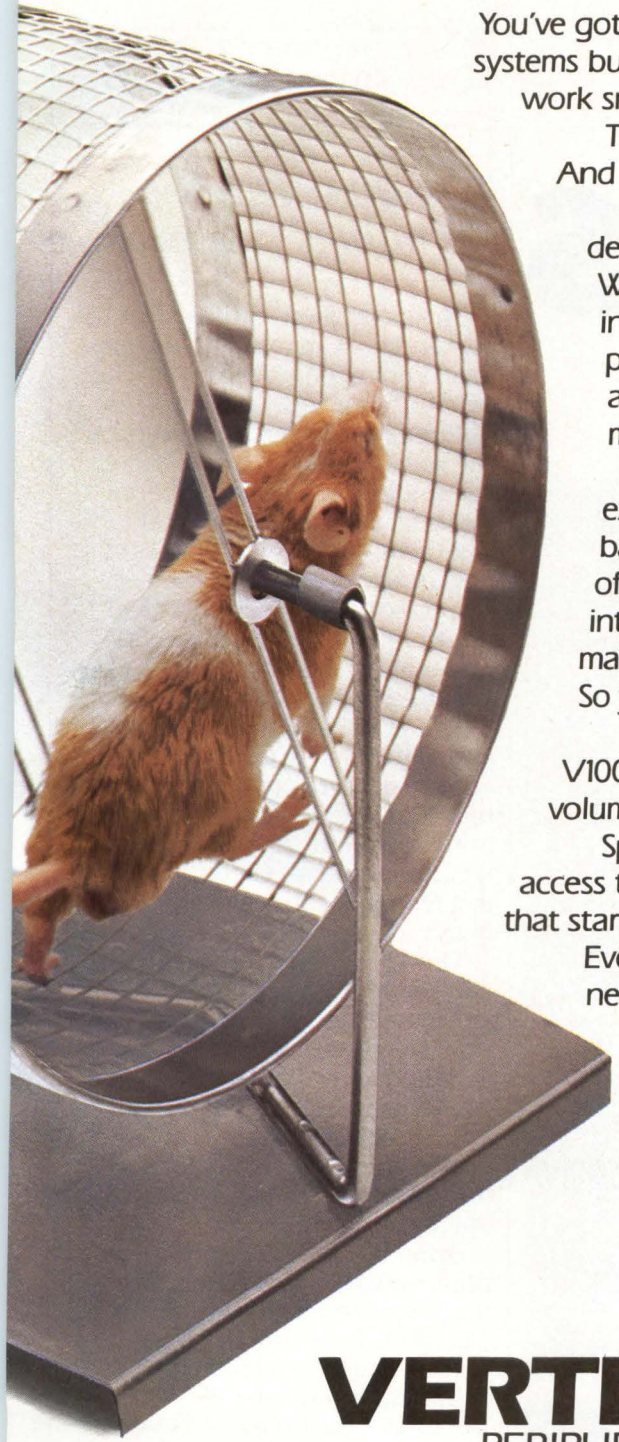

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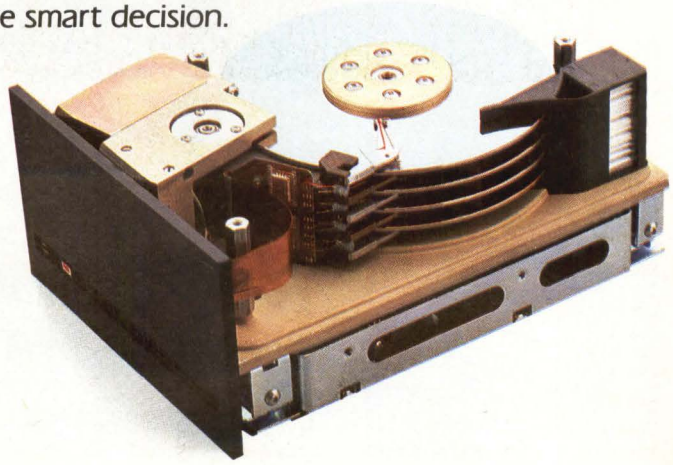

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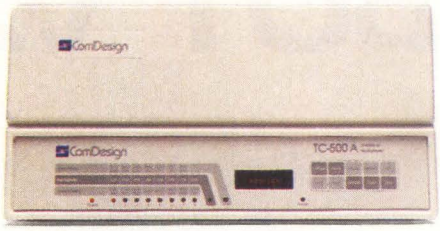

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discrete 32-byte packets. Each packet contains 4 bytes of chain-pointer information and 28 bytes of data-storage space. If a message is longer than 28 characters, the AOS links additional packets.

Spec summary

- **Company:** Macrotech International Corp.
- **Model:** ADIT board
- **Command ports:** number of ports: five, address width: 8 bits, address selection: any 8-byte boundary, data width: 8 bits
- **Direct-memory-access channel:** address width: 24 bits, data width: 8 bits
- **On-board processor:** CPU: 6-MHz Z80B, no wait states; ROM: 200 nsec., 8K or 16K bytes; RAM: 150 nsec., 16K or 32K bytes
- **Serial communications controllers:** speed: 6-MHz, master clock: 4.9152 MHz, number of channels: four, eight, 12 or 16
- **Transmission speeds:** synchronous: 1.23M bits per second (bps), asynchronous: 38.4K bps
- **Power consumption (+8V only):** four channels: 2.8A, eight channels: 3.2A, 12 channels: 3.6A, 16 channels: 3.9A
- **Price:** Four models from $1,075 to $2,125 in single-unit quantities, OEM and quantity pricing available

After the board transfers a group of 28 characters over a channel, it returns the empty packet to a pool of available packets. Each channel needing memory space obtains these packets from a pool. At any given instant, one of the 16 channels might not need memory or might need thousands of bytes of memory. The AOS dynamically allocates memory to the channels. This process is transparent to the host and to the user.

Balancing the load

The ADIT board uses closed-loop feedback techniques and dynamic allocation of on-board memory to maintain control during heavy usage. When the board is handling communications on multiple channels, some channels will be doing output from the host while others will be active on input. If the capacity is nearing saturation, the AOS slows down output-character handling by allocating less of the available memory to the output channels, while preventing data loss. However, the system must process input data as it occurs to prevent data loss or overrun conditions. The AOS maintains sufficient memory packets for input use so that input is not slowed and data is not lost. The AOS dynamically adjusts memory allocation as needed in the real-time environment to prevent data loss.

The host initiates I/O processing by issuing an immediate command through the port interface. Four transfer commands institute the lowest level of interface transfer. These commands are single-character commands, as opposed to commands associated with extended processing. Using only the single-character commands, the host can communicate with the ADIT board with minimal change to the host operating-system I/O drivers. Most of the board's commands, however, are associated with extended processing that uses DMA. To use the extended commands fully, a programmer must make sophisticated modifications to the host operating system I/O drivers.

The host initiates extended commands by issuing an immediate command that includes a 24-bit address of the extended-command control block. The AOS interleaves commands that might not be processed immediately with commands on the other channels. The host determines completion of extended commands by polling for current status or by use of the interrupt system.

PALs and six-layer architecture concentrate logic

The ADIT is a six-layer, 5-by-10-inch printed-circuit board. Programmed-array-logic (PAL) integrated circuits contribute to logic concentration. All decoding and creation of output terms and subterms can be implemented on PALs, eliminating the need for separate chips. PALs communicate with the bus via tri-state and open-collector output structures in addition to normal totem-pole-type output structures. Further reducing the size of the board, the use of static RAM eliminates the need for additional refresh circuitry.

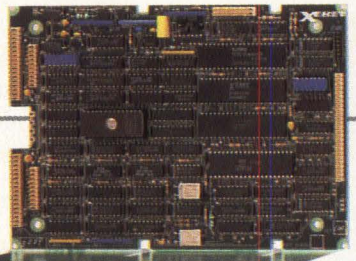
The Z80B-based ADIT board contains eight 8530 serial communications controllers with two channels on each controller. Each pair of 8530s connects to a single 34-pin ribbon connector that has four panel cards, each providing the cable connection for a single channel. In a fully implemented, 16-channel ADIT board, there are four ribbons with four channels each. Cards are available for RS232C, RS422 and RS423 line protocols. □

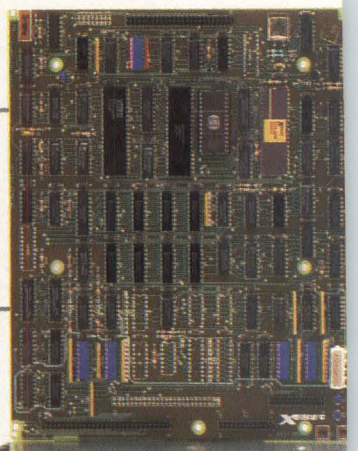
Mike Pelkey is executive vice president of Macrotech International Corp., Chatsworth, Calif. A founder of Macrotech, where he oversees all engineering functions, Pelkey has had extensive experience in designing S-100 systems. Before launching Macrotech, he was with International Micro Machines (IMM) Inc., a research and development company that he founded in 1975. At IMM, Pelkey was instrumental in the development of a multiprocessor-based cash-accounting network marketed by Unilever Ltd., a British subsidiary of Lever Brothers Inc. Pelkey developed S-100 products manufactured by Base 2 Inc.

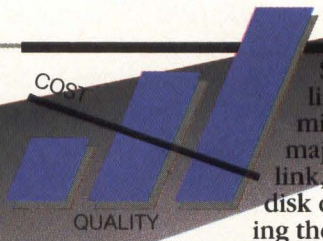
Interest Quotient (Circle One)
High 828 Medium 829 Low 830

Between Your System Micro Are Two Lines

Our Controller Line.







Smoothly and efficiently linking today's diversity of micros and disk drives is a major headache for OEMs. That link, of course, is made by a disk drive controller, and choosing the right one means walking a fine line between getting the performance and reliability you want and the amount of money you want to spend to get it.

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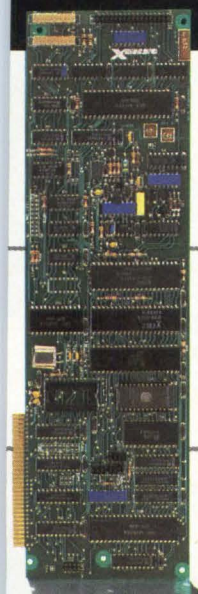
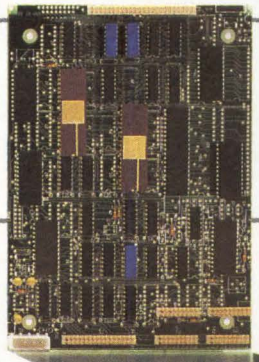
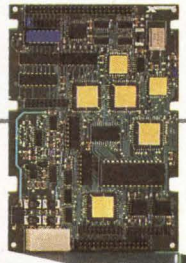
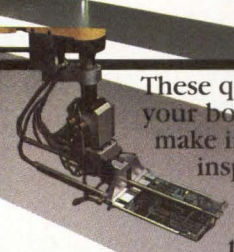


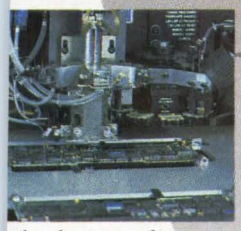
Your Bottom Line.







Solution: Xebec's tested pairs program that tests and matches drives and Xebec controllers, guaranteeing that they'll work in tandem, using Xebec-designed test equipment and Xebec-defined tough test standards. Available now in a range of capacities and configurations, tested pairs will help you cut down on evaluation and incoming inspection with a single-source, single purchase order solution you can trust.



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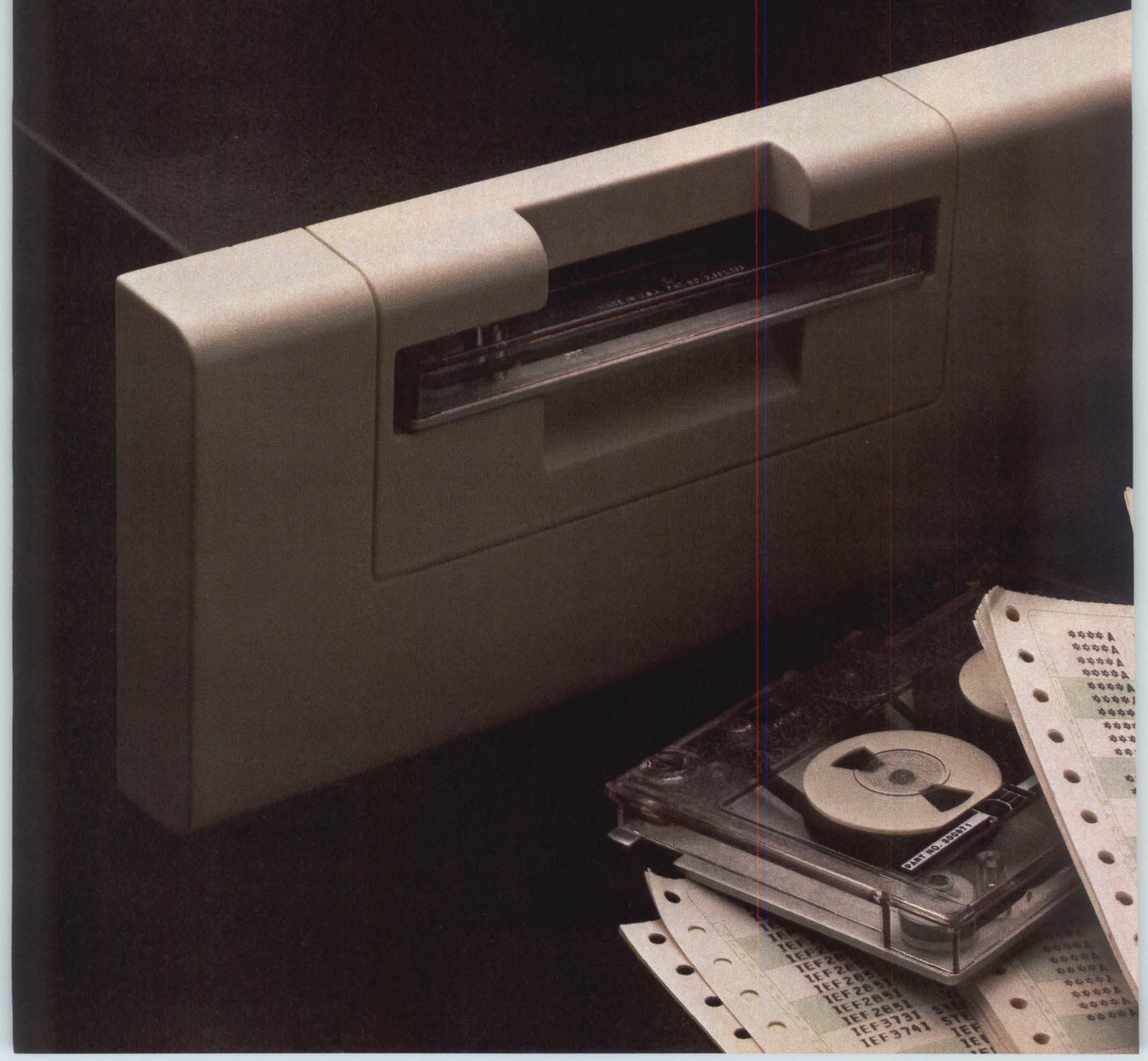

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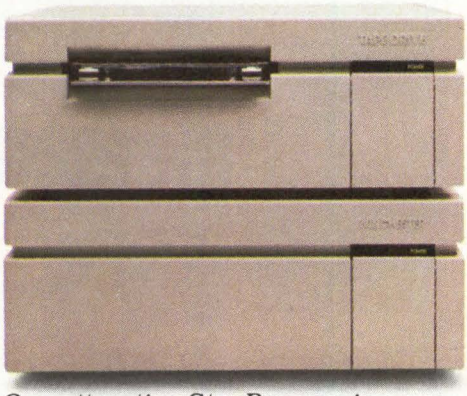

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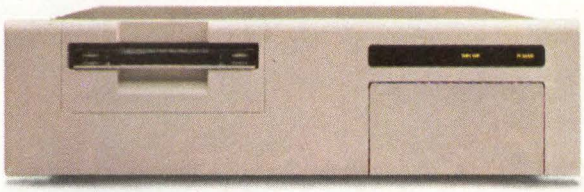

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Simplicity is key goal in applications development

Structured analysis, processing logic trees, compilers, debuggers, operating-system extensions, kits from vendors—software development tools get more sophisticated. But the goal is to make them easier to use.

Carl Warren, Western Editor

Software developers face increased demand for more functionality from applications and operating software. In response, they are employing structured specification designs using variations on programmed logic trees, automatic application code generators, optimized compilers and linkers for code generation and software/hardware debuggers.

In addition, many developers rely on multitiered testing, such as evaluating the application concept, developing the user interface, and alpha and beta product testing.

Because the newest generation of applications is extremely complex, software developers are using mature methods to create the foundation specifications that define program operations. Metalogic Corp., Rancho Palos Verdes, Calif., favors the structured-analysis method to create foundation specifications. According to Metalogic president Lewis Barnett, systems are so complex that they must be broken down into component parts to ensure that all elements are addressed. "However," says Barnett, "care must be taken not to lose sight of the big picture—a major feature of structured analysis."

The structured-analysis method (Fig. 1) is a primary development tool used to create functional specifications. It can be used to define the elements of a complex system such as a maintenance-control system. In the structured-analysis method, the scope of the project is defined as a series of functions without losing the overall purpose. Furthermore, each function is defined with in and out information paths.

Structured analysis defines tasks as functions of other tasks. For example, data elements can be defined as functions of bigger elements (Fig. 2). This method allows the examination of a problem from two or three different angles, thus determining the overall flow between each process, as well as what should be in the data store or files.

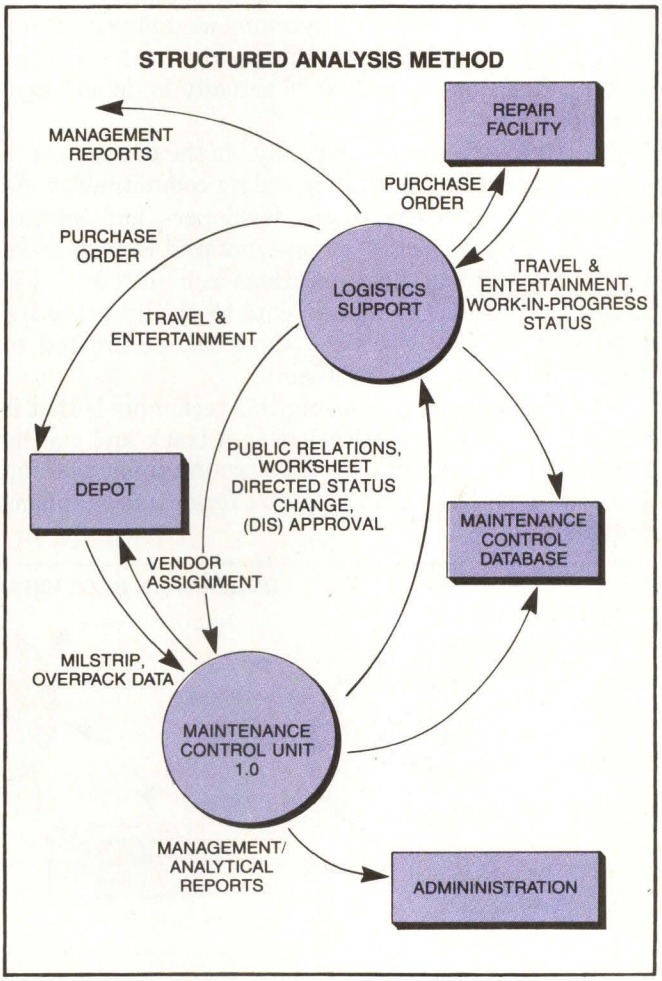

Fig. 1. A context diagram establishes a project's working environment and working boundaries. *Each input donates an output to the next major element. The diagram shows all the major elements for a maintenance-control system.*

Further structured analysis is important because it deals with outside entities to an internal process. For example, system integrators can identify where inputs originate and where outputs terminate (Fig. 3). Metalogic's Barnett explains that it establishes the context of the operation.

Barnett points out that by using structured analysis, system integrators aren't burdened with the actual data structure until it's absolutely necessary. "You break each part down into its constituent parts, then refine it to the primitive process. This is a process of hierarchical decomposition—you decompose the problem to the smallest element."

There are rules to follow, however. Specifically, structured analysis requires the conservation of data flow(s). Therefore, any set of flows (inputs and outputs) must be accounted for at the lowest levels. When using this method, the context diagram is the highest level, and it sets the system's environment definitions and boundaries. "You define graphically the function of the system. You don't care how it actually is done," says Barnett.

The purpose is to remain flexible in the design and to make decisions before making coding commitments. As the concept is decomposed, developers and system integrators can resort to using structured English as an add-on tool. Thus, flow diagrams can include "IF," "FOR" and "WHILE" statements to clarify primitive actions. Moreover, decision tables can be created to further decompose the problem.

"A major advantage of using this technique is that it is auditable. Each function leaves a track and can be traced—inputs and outputs are accounted for; nothing gets lost, and the overall goal isn't forgotten," explains Barnett.

To speed the creation of supporting data dictionaries and to keep track of decision tables and flows, Barnett employs the Informix relational database-management system from Relational Database Systems Inc., Palo Alto, Calif. By automating the bookkeeping functions, Barnett speeds documentation and uses data dictionaries in coding. "Basically, I use a full range of development tools. On the one hand, I have structured analysis as a thought-guide tool, and on the other, a database manager to keep the books in order, maximizing my skills. This is a system approach to creating systems."

Coding requires structure

Another important thought tool, used by application and system software developers, is the processing logic tree (PLT), developed by Dr. Randall Jensen of Hughes Aircraft Co., for handling complex software projects. The PLT technique employs standard flowcharting symbols, thus eliminating the requirement for users to learn new symbols. PLTs resemble structured analysis in that the big picture concept is never lost. The PLTs represent "step-wise refinements"—starting with a gross concept and refining and expanding it. The PLTs lend themselves to final refinement into code. Moreover, PLTs are inherently structured, thus eliminating "GO TO" statements.

Another important aspect of using PLTs is that they avoid the "double-think" problem, which until now has been rampant in the software industry. This problem arises when software developers put the lowest-level portions of the program first, then refer back to them. Employing a structured step-wise methodology bypasses this pitfall. What's more, programs written

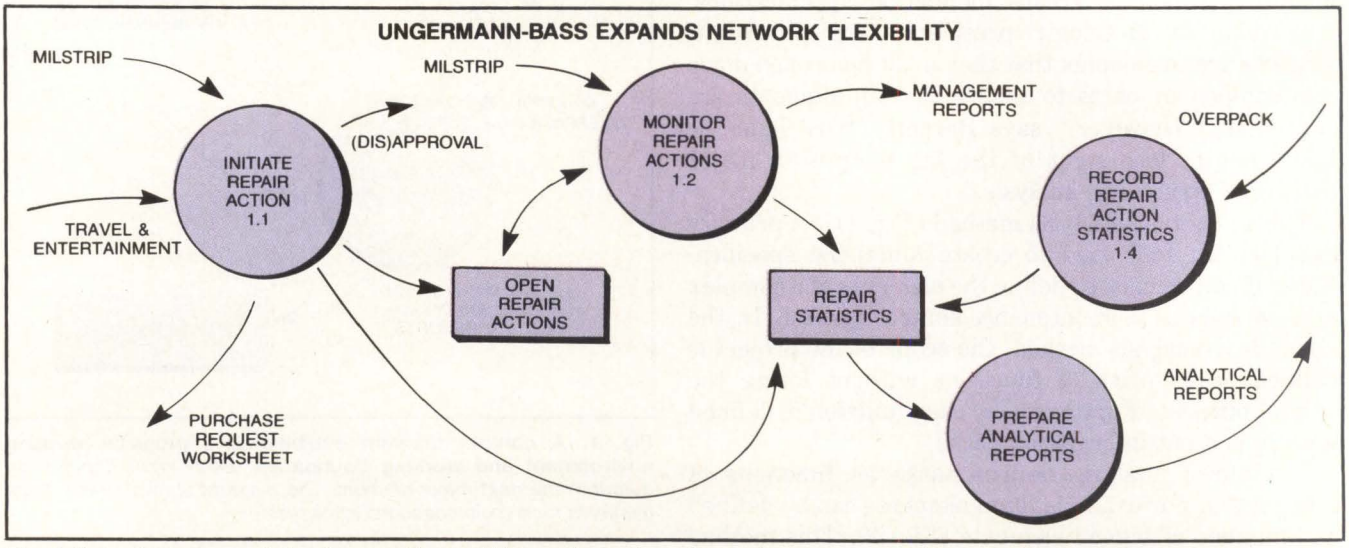

Fig. 2. Data elements are defined as functions of bigger elements. *The maintenance-control unit comprises multiple functions with numerous inputs.*

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from the top down make maintenance easy.

One company that is using this method for development is Query Computing Systems Inc., Torrance, Calif. "Our users typically require a complete set of documentation to provide proper maintenance of the code," says Query president Steve Bostwick.

According to Bostwick, the goal of the structured step-wise method is to bring mainframe techniques to microcomputers. "Microcomputer programs are harder to create. The tools aren't there. You have to build them and be aware of the limitations imposed by the microprocessor and the system architecture."

Query and other developers use "conceptual tools." Included in that category are PLTs and reference manuals to coordinate the work and to set programmer standards. The documentation required includes the design specification, which is created using structured analysis, the as-coded maintenance specification with flow diagrams in the form of PLTs and a users manual.

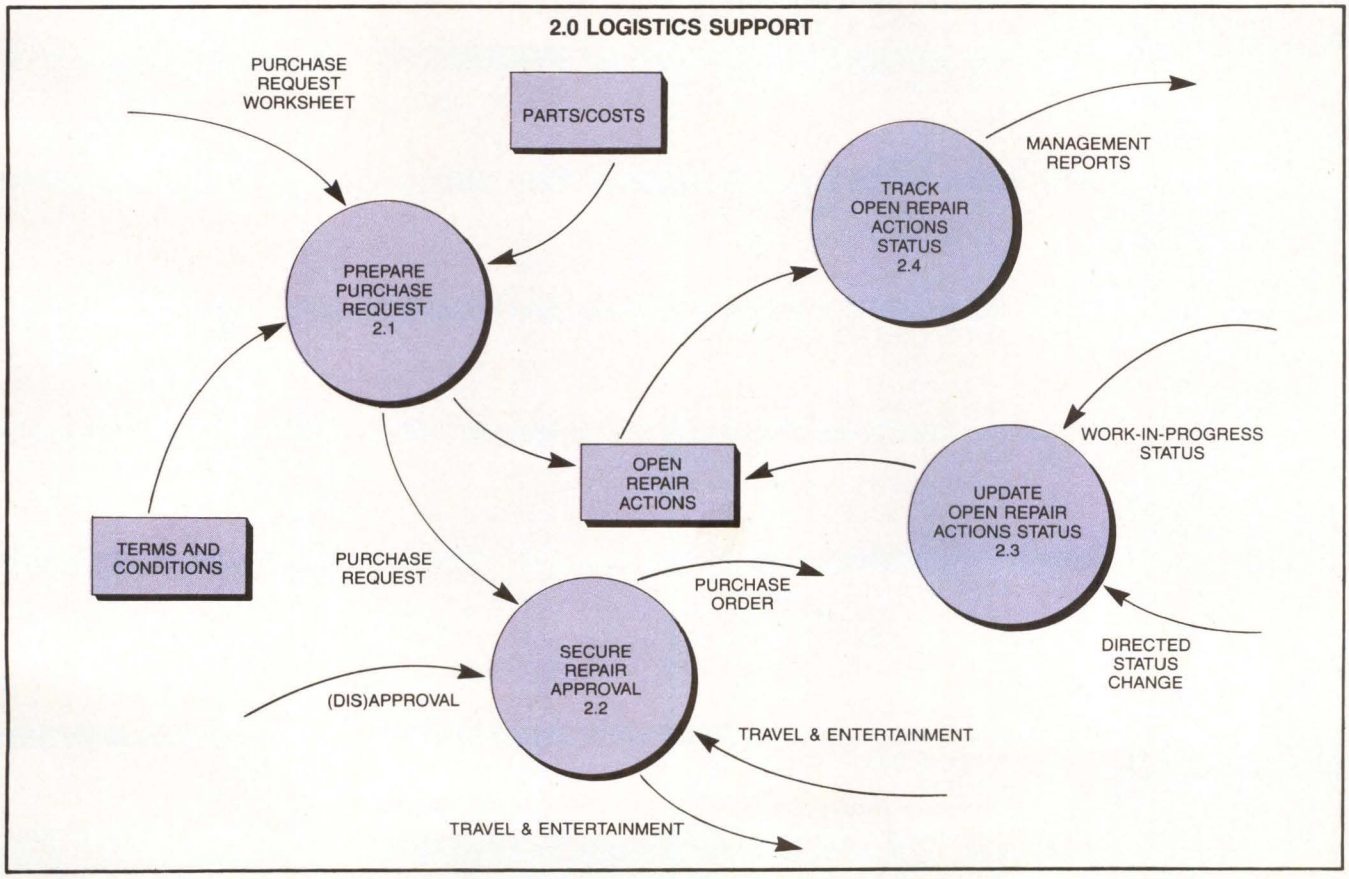
For large projects, many developers first create the users manual and then code to it. The PLTs, developed in concert with the users manual, serve as a map. For example, to create a search function (Fig. 4), the operation is defined as a series of step-wise operations, or elements. Each element is defined in terms of operation with cause-and-effect relationships defined, giving the programmer directives on how to and what to code.

These created functions become part of a utility library that Query's Bostwick explains is the same as capital equipment is to a programming shop.

Because Query relies heavily on PLTs in its development work, the company has automated the process in much the same manner as Metalogic has for structured analysis. However, Query has added an extra benefit. "The creation of PLTs can be time-consuming and often cumbersome. Therefore, we use a database of the functions and employ a plotter to perform the actual drafting," notes Query's chief engineer Steve Cook. Besides automating the drafting, Query gains additional benefits because the company need only update the database; the computer redraws the PLT. In addition, the plotter output is used in the specification documentation.

Although it would seem that it takes a master programmer to use the tools, Query's Bostwick insists that isn't the case. "If the personnel who are going to do the programming are capable of writing a decent essay

Fig. 3. A system's inputs and outputs, *when defined by structured analysis, become auditable and have clearly structured links to every system level.*



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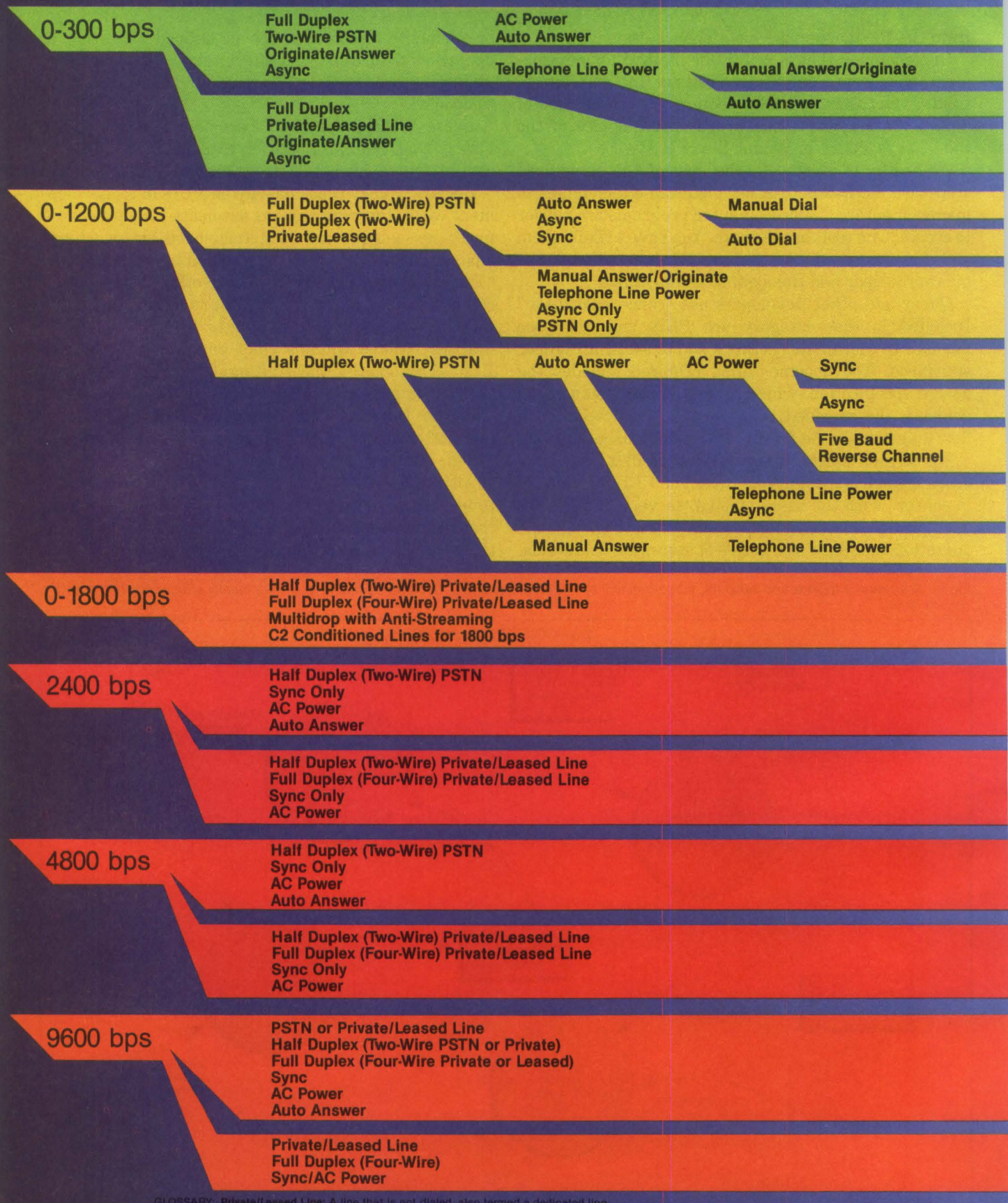

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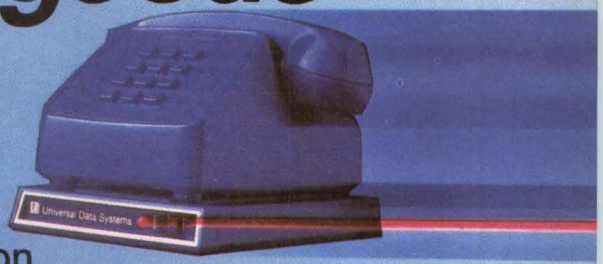

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103 LP 0/A
103J LP
108
212A
212A/D
212 LP
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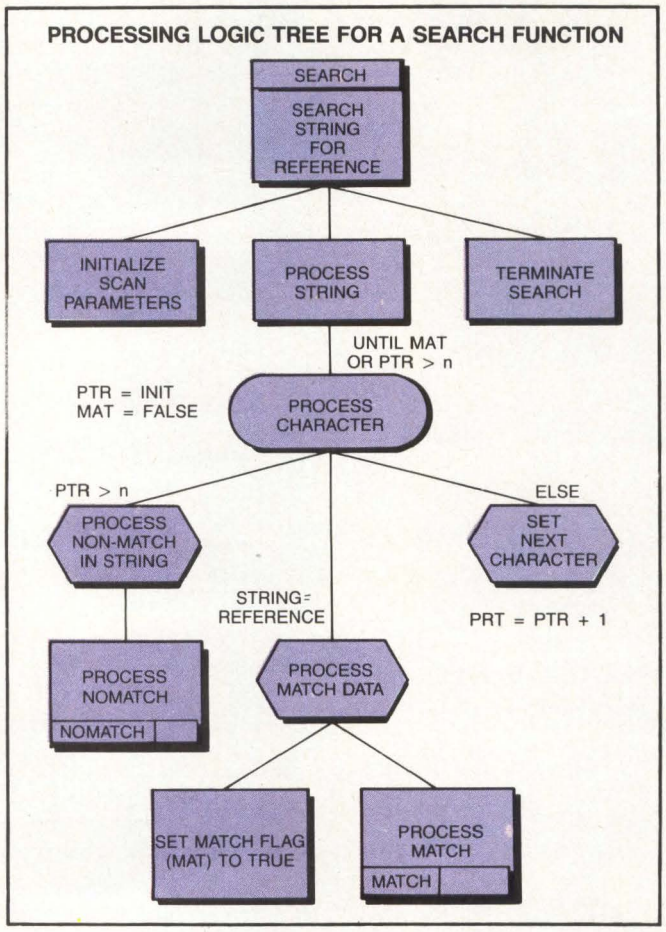

Fig. 4. Using standard flowcharting symbols and step-wise refinements, *PLT's permit the decomposing of complex processes into straightforward "byte-sized" parcels. PLT notation permits the indication of subroutines, indexing and counters.*

and are provided with the proper tools to do so, they can create a decent program. The trick is to give them the proper tools, guidelines and motivation—the fallout is the program."

Once the specification for a software product is created, developers and integrators turn to sophisticated software and hardware tools to create the application.

Some developers shy away from commercial tools, insisting they are too restrictive. Typically, tracers and automated documentation products don't take into account all the parameters the developer is concerned with, thus giving rise to in-house-created tools such as those used by Metalogic and Query.

But even though some developers are wary, all agree that a number of commercial tools, including compilers, linkers and debuggers, are important to ease development tasks. According to Jeff Harbers, associate manager, productivity software group for Microsoft Corp., Bellevue, Wash., optimized compilers, linkers and debuggers are musts for developers. "We are primarily a C house and as such have created special versions to develop our products. In concert with this, we employ software-tool experts to maintain the tools."

Although Microsoft has developed specialized in-house tools, it also offers developers a range of products, including Windows, which the company terms an "operating-system extension." To assist developers in the use of Windows, Microsoft is providing a tool kit that comprises Windows and a C and Pascal compiler for $795. The company plans to ship the tool kit this month to qualified developers.

Other tools exist too

Microsoft isn't the only software vendor offering tools. For example, system integrators can develop applications for dBase II from a wide range of available application generators. These programs, serving as front ends, permit the generation of screen formats and ultimately the database structure without requiring an in-depth understanding of how the dBase II application-development language works.

Another popular package is Quickcode from Fox & Geller Inc., Teaneck, N.J. Priced at $295, Quickcode lets integrators create an application and command files and provides hooks to export data to Micropro International Corp.'s WordStar word-processing package. Another similar product is the $195 Autocode developed by Stemmos Ltd., San Francisco. This application generator works much like Quickcode and furnishes field numbering on the screen layout. In addition, the dProgrammer product from Sensible Designs Corp., San Diego, looks like Autocode and has the same price. It, too, speeds the generation of dBase applications.

Although speedy compilers and code generators are important aspects of application development, tools that locate problems are equally important. Typically, most developers and integrators employ a variety of debugging aides to locate problems and make patches. Probably the leader in software debugging aids is Digital Research Inc., Pacific Grove, Calif., which recently introduced the DR Assembler Plus tools. The tools include an assembler, a linker, a debugger, a librarian and a cross-reference utility. The $200 package operates with the CP/M family, PC-DOS or MS-DOS.

Offering a similar approach to debugging is the Mylstar Symbolic Debugging Program created by Mylstar Electronics Inc., Northlake, Ill. This $120 package provides full macro command functions and trace, breakpoint and debugging facilities. Like many other software tools, it operates in the MS-DOS and PC-DOS environments.

Because both systems and software are becoming more complex, software tool manufacturers require innovative approaches. For example, the $2,495 PC

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Probe debugging system developed by Atron Corp., Saratoga, Calif., contains a microprocessor-based board that plugs into an IBM PC expansion slot and an outboard control for resetting or stopping the system. Included with the package is a sophisticated debugging program that permits memory examination and system operation monitoring in an interactive mode. Atron has extended the system and offers an add-on $100 logic probe, allowing the monitoring of signals external to the PC Probe and the system. A $395 software module provides performance and timing analysis of user programs. According to Gary Carleton, Atron's director of software, "It's important that developers recognize the necessity of employing sophisticated tools to create complex programs. Before, the technology really wasn't available to allow the creation of these tools. We can provide dynamic tools, rather than static ones, that allow the programmer to take real-time snapshots of a program's operation."

Taking an integrated approach

Taking an almost integrated approach to development tools is Phoenix Software Associates Ltd., Norwood, Mass. Designed for use with 8088/86-based systems running PC/MS-DOS and CP/M-86, the company's four programming tools include a full-screen text editor, a dynamic debugger, an object-module linkage editor and a library manager. The $225 P-MATE86 full-screen, single-keystroke editor supports as many as 10 auxiliary disk buffers that speed editing functions and encompasses an extensive macro-language for developing macroinstructions that handle frequently used operations. The $245 P-FIX86 symbolic debugger has a windowed full-screen display and in-line assembler and permits breakpoint insertion. This package also works in tandem with the $345 P-LINK86, which includes the $125 P-LIB86. Phoenix's tools can use the outputs from Microsoft and Digital Research products.

Software-development tools are getting more sophisticated but easier to use. To meet future needs of software developers and system integrators, however, software manufacturers such as Digital Research and Microsoft are simplifying the development task even more by taking an open-system approach. At an independent software vendors seminar held by Microsoft last February, Microsoft president Jon Shirley emphasized that an open-system approach is required so that developers and system integrators can take maximum advantage of the hardware and operating-system environments. The trend is toward divorcing applications from hardware and operating-system dependency, thus clearing the path for the creation of easily transportable applications. □

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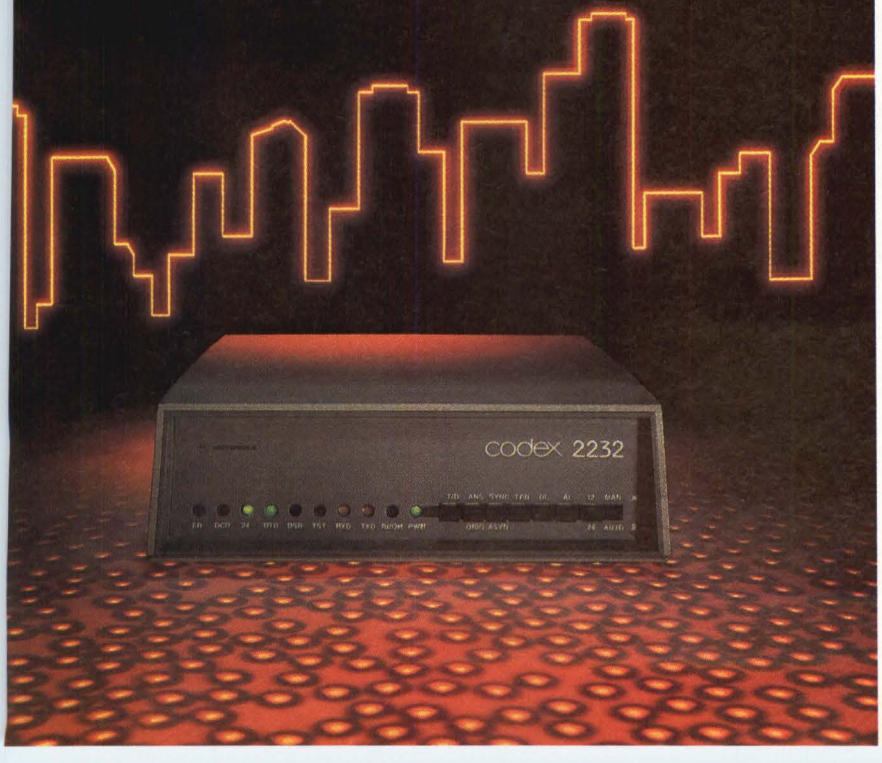

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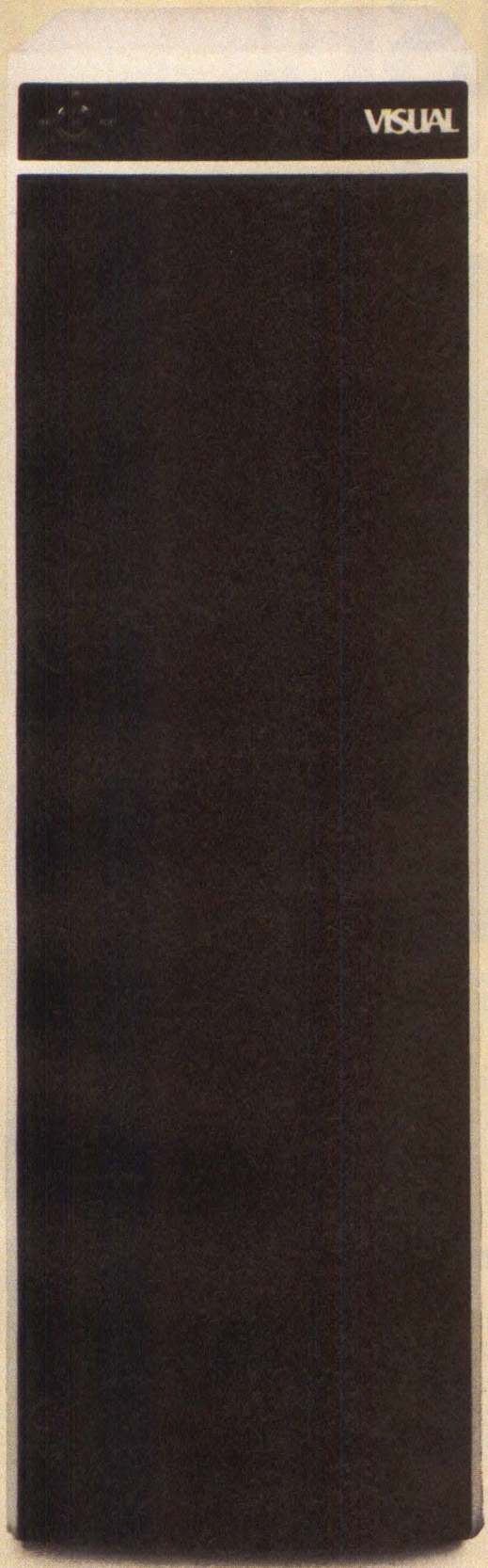

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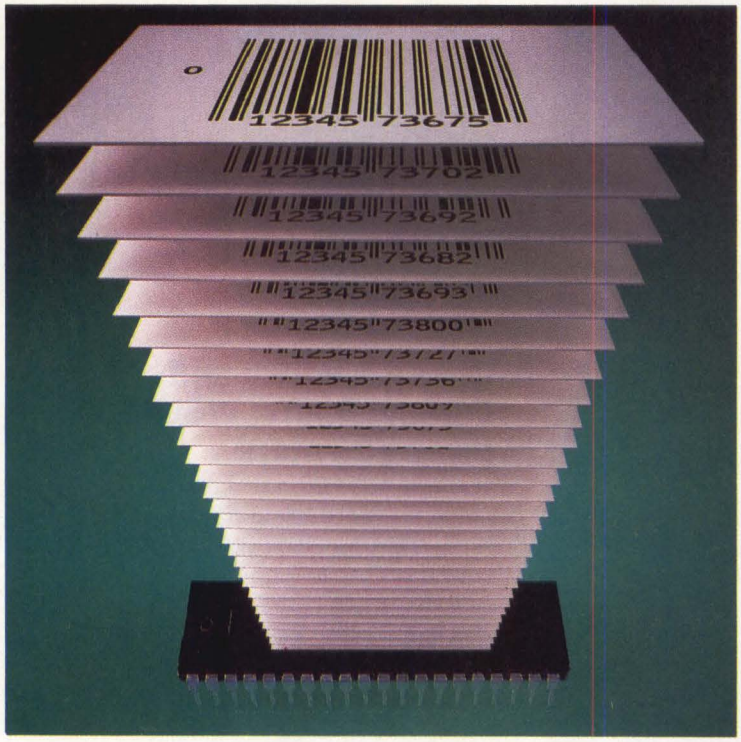

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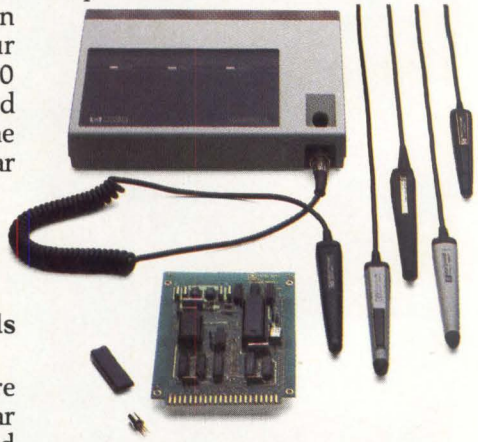

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Can copyrights protect all forms of software?

Apple vs. Franklin decision broadens copyright protection for computer programs

Collage by Anne Tregay

L.J. Kutten, Attorney at Law

The U.S. legal system has not protected computer software as well as computer hardware and other high-technology products. Although patent law and trade-secret statutes adequately protect computers and peripherals against misappropriation and unauthorized use, most software cannot be patented. Until recently, copyright protection for all forms of software other than source code, including object code in ROM (or on floppy disk) and computer operating systems, was ambiguous at best. But last fall's decision of the 3rd U.S. Circuit Court of Appeals in *Apple Computer Inc. vs. Franklin Computer Corp.* goes a long way toward providing computer software the protection it needs. Barring a review by the U.S. Supreme Court, it definitively extends copyright protection to all forms of software.

Protecting player-piano rolls

The controversy over copyright protection for computer software has its origins in the 1909 Copyright Act. In enacting the statute, the U.S. Congress wrote into law the Supreme Court's decision in *White-Smith Music Publishing vs. Apollo Co.* In the case, White-Smith sued for copyright violation because Apollo had produced player-piano rolls for its machines of two popular musical compositions owned by White-Smith. The Supreme Court ruled that Apollo had not violated the copyright because the piano rolls were not in a form that could be read or interpreted by themselves and hence were not a copy of the underlying musical composition. For a work or document to be protected by copyright under the 1909 Act, a person had to be able to read or understand it. Expressed in terms of today's technology, a flowchart or source code could be copyrighted under the 1909 law, but a program stored in ROM or expressed as object code could not.

With the proliferation of computer technology, Congress passed the 1976 Copyright Act. A significant

advance over the 1909 law, it furnishes copyright protection to original works "fixed in any tangible medium of expression [e.g., a floppy disk] from which they can be perceived, reproduced or otherwise communicated either directly or with the aid of a machine." This statute covers works physically embodied in any stable form that a person or a machine can read, including punched cards and magnetic tape. In 1980, Congress amended the 1976 Act by adding computer programs to the category of material that can be copyrighted.

Under the 1909 or 1976 Copyright Act, copyright protection extends to computer programs written on paper or recorded by some other visibly perceivable method. But the two acts leave other important legal questions unanswered, including:

- Can a software developer copyright a computer program if the program is not visibly perceivable?
- Can the developer copyright object code in addition to source code?
- Can an operating system be copyrighted?
- Can a program embodied in a ROM chip be copyrighted? At what point does a program embodied in ROM become part of the machine? If a program in ROM is a machine part, is it a "utilitarian object" and thus not eligible for copyright protection?

Apple vs. Franklin defines the issues

With these legal issues unclarified, Franklin Computer Corp., Cherry Hill, N.J., aimed to capture a substantial niche in the microcomputer market by selling its "Apple-compatible" Ace 1000 microcomputer for a lower price than Apple Computer Inc., Cupertino, Calif., sold its Apple II. To be compatible, the Ace 1000 had to run nearly all 15,000 Apple II application programs. Instead of developing its own operating system, Franklin copied all 14 Apple II operating-system programs embodied in ROM or floppy disk, including the Autostart ROM, Applesoft, DOS 3.3 and Apple 13-sector boot ROM.

Franklin had considered writing its own operating-system programs. But according to vice president of engineering David McWherter, this course was unfeasible because there were "just too many entry points in relationship to the number of instructions in the program." Without 100 percent compatibility in the entry points, Franklin could not ensure 100 percent compatibility between its computer and Apple application programs.

Apple sued Franklin in the federal District Court of Eastern Pennsylvania, alleging copyright infringement, patent infringement, unfair competition and misappropriation. Apple based its claim for copyright protection on four major points:

- A computer's operating system is a form of expression and not an idea or process, which cannot be copyrighted.
- Object code is a form of expression and a work of authorship, whether stored in ROM or on a floppy disk.
- A ROM is a tangible medium of expression.
- In enacting copyright legislation, Congress intended to protect all computer programs as literary works, no matter what their form.

Apple requested a temporary injunction prohibiting Franklin from "using, copying, selling or infringing" Apple's copyrights. Franklin admitted to the court that it had copied Apple's programs. But it denied Apple's claims, arguing that the company's copyright registrations were invalid and unenforceable because the programs were ineligible for copyright protection.

The District Court denied Apple's request for an injunction, asserting that the programs' eligibility for copyright protection was in question and that Apple had failed to show it had a reasonable probability of winning the case on its merits. Apple appealed the decision, and after six months of deliberation, the Court of Appeals overruled the lower court.

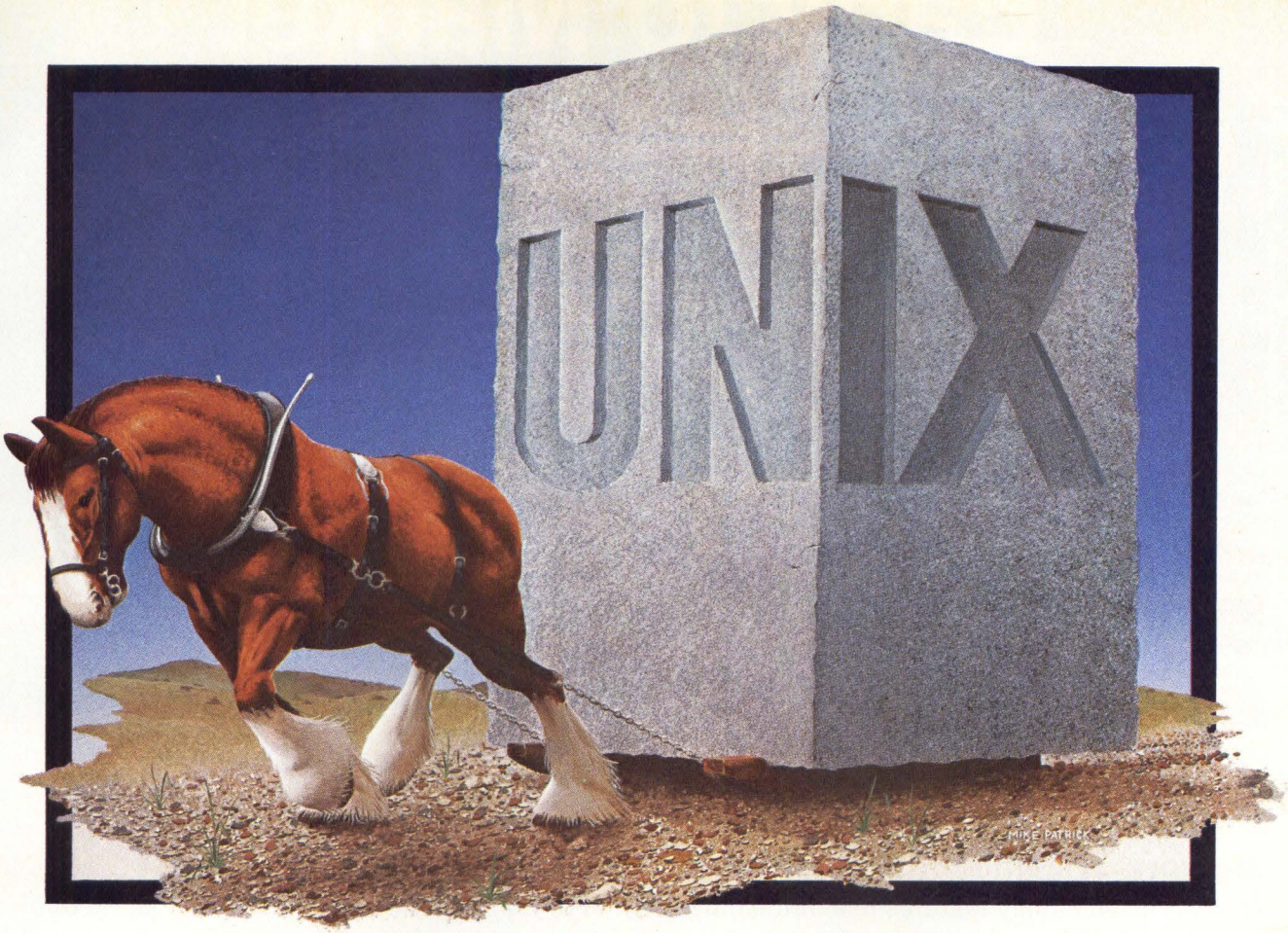
In 1980, Congress amended the 1976 Copyright Act by specifically adding computer programs to the category of copyrightable materials.

In overruling the District Court, the Court of Appeals specifically stated that:

- object code can be copyrighted,
- a computer program embedded in ROM can be copyrighted, and
- an operating system is subject to copyright.

The Court of Appeals rejected the argument that object code, unlike source code, cannot be copyrighted. In an earlier case, *Williams Electronics Inc. vs. Artic International Inc.*, the court had ruled that "the copyrightability of computer programs is firmly established after the 1980 amendments to the Copyright Act." Under the 1976 Copyright Act, a work must be an original work of authorship fixed in a tangible medium of expression. Although the law, the court said, "does not expressly list computer programs as works of authorship, the legislative history suggests that programs were considered copyrightable as literary works."

For example, with the 1980 amendments to the Copyright Act, Congress defined a computer program as "sets of statements or instructions to be used directly or indirectly in a computer in order to bring about a certain result." Because object code is the only instruction a computer can run directly, Congress must



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CIRCLE NO. 122 ON INQUIRY CARD

have meant to protect object code, the court said. Furthermore, the court noted, under copyright law, "the category of 'literary works'...is not confined to literature in the nature of Hemingway's *For Whom the Bell Tolls*." It also encompasses expression in numbers or other symbols. "Thus, a computer program, whether in object code or source code is a 'literary work' and is protected from unauthorized copying."

Finally, the court considered the question of whether object code must be perceivable or intelligible to people to be eligible for copyright—the distinction first raised in the *White-Smith* case. In this respect, the fact that people cannot read a program directly has no bearing on the case, the court ruled. The distinction raised by *White-Smith*, the court said, was specifically rejected by the 1976 Copyright Act, which protects works in *any* tangible means of expression "from which they can be perceived, reproduced or otherwise communicated" either directly or *with the aid of a machine*.

Can a program embodied in a ROM chip be copyrighted? At what point does the program become part of the machine?

The court spent little time on discussing copyright protection for computer programs embedded in ROM. The media on which a work is stored, the court stated, does not affect whether the work is eligible for copyright protection: "The medium is not the message." A program meets the 1976 Copyright Act's requirement that a work be fixed in a tangible means of expression "through the embodiment of the expression in the ROM." That a program is etched on a ROM, the court asserted, does not make it a machine or part of a machine and thus ineligible for copyright protection.

Franklin had argued that an operating system is not subject to copyright because it is merely a "process," "system" or "method of operation" and because it is a purely "utilitarian work." In regard to the first argument, an earlier Supreme Court case (*Baker vs. Selden)* held that a "process," "system" or "method of operation" cannot be copyrighted. A book's copyright did not give its author the exclusive right to use a system described in the book. The appeals court, however, rejected Franklin's argument. "A process is no more involved [in this case]," it said, "because the instructions in an operating system program may be used to activate the operation of the computer than it would be if instructions were written in ordinary English in a manual which described the necessary steps to activate an intricate complicated machine."

The decision of the Court of Appeals, in effect, denies that an operating system is an idea—an important distinction in copyright law. A form of expression can be copyrighted; the idea behind it cannot. Thus copyright does not protect the "process," "system" or "method of operation" in the operating system. It protects only Apple's *expression* of the "system" involved. Franklin could have developed its own expression or version of the Apple operating system without violating copyright law.

The court dealt with another interesting point of law. If there exists only *one* possible expression of a "process," "system" or "method of operation," the expression is a purely "utilitarian work" and cannot be protected by copyright. Therefore, if it were impossible to write a compatible operating system that could run most Apple II application programs, Franklin could legally copy part or all of the Apple operating system. The court rejected this argument by noting that the district court had "made no findings" deciding whether some or all of Apple's operating system represented the only way to express the underlying ideas. In effect, copyright protects Apple's expression of its operating system unless Franklin can prove there is no other way to express the ideas behind it.

The court also noted that Congress had made no distinction between application programs and operating systems when it added computer programs to the Copyright Act. In addition, the Court cited several lower court cases that upheld copyrights involving operating systems. Ultimately, the court asserted, "both types of programs instruct the computer to do something. Therefore, it would make no difference for purposes of section 102(b) [of the Copyright Act] whether these instructions tell the computer to help prepare an income tax return (the task of an application program) or to translate a high-level language program from source code into its binary-language object-code form (the task of an operating system program such as Applesoft)...There is, therefore, no reason to afford any less copyright protection to the instructions in an operating system program than to the instructions in an application program." □

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L.J. Kutten received the Juris Doctor degree from Washington University, St. Louis, Mo. A member of the Missouri and Illinois Bar Associations, he is in private practice, specializing in all aspects of computer and high-technology law. Kutten is the author of *Computer Buyer's Protection Guide*.

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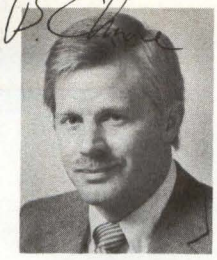


William B. Elmore, is president of Visual Engineering, San Jose, Calif. He holds an M.B.A. degree from Stanford University and B.S.E.E. and M.S.E.E. degrees from Purdue University.

UNIX and GKS standards create opportunities for graphics

William Elmore, Visual Engineeering

Two important computer industry standards — UNIX for operating systems and the Graphical Kernel System (GKS) for graphics — are making it possible to run the same programs on different computer systems. This will create large markets for both hardware and software graphics products. There's already a huge demand for computer graphics software in business, scientific and technical fields, and 1984 will see just the beginning of explosive growth in this broadly-based market.

According to a report by Strategic Inc., San Jose, Calif., of the 31 million people who could make good use of computer graphics, fewer than 1.5 million will actually start putting them to work in 1984. Why the delay?

Until recently, software developers concentrated on programs for word processing, spreadsheets and databases, relegating graphics to the back burner. Graphics programs were difficult to write — and expensive to produce. Most had limited portability and were aimed at a narrow market. Moreover, many vendors viewed graphics merely as an additional application, not a feature. But, today, our perception has changed. Graphics capabilities are recognized as features. And features sell products. Ironically, in their scramble to include graphics as a value-added feature, vendors could find themselves caught in a strange contradiction: Although creating graphics software from scratch can help a company set itself apart from its competitors, this approach can be costly and self-defeating. By adhering to standards, software developers are still able to create a unique product line and their packages can run on a larger number of machines.

Standardization clearly affects the software developer's bottom line. For example, established standards increase the pool of applications programmers. Standards avoid the need for constantly re-inventing the wheel in an attempt to train people in esoteric operating systems and languages. In addition, standards simplify programming and reduce development time. This reduced development time translates into lower costs in adapting existing software to new generations of processors. What's more, standards can also release the creativity of applications programmers by letting them focus on the applications. More important, vendors can rapidly bring to market a variety of programs that stimulate sales of computer systems to graphics-hungry end users.

Standards offer a strong package of benefits to end users, too, by increasing the availability of reasonably priced, presentation quality graphics. Because sophisticated users don't want to be locked into a particular system, portability is a big issue — and this is one area where UNIX excels. Its flexibility facilitates the use of a wide range of peripherals from many manufacturers.

In addition, UNIX is easy to use on computers of all sizes from mainframes to personal computers and suits networked single- and multi-user systems — the wave of the future.

UNIX also facilitates the portability of graphics applications through its ability to network with other UNIX machines. Another major strength of UNIX is its ability to access data quickly from other sources, including database, word-processing and spreadsheet packages.

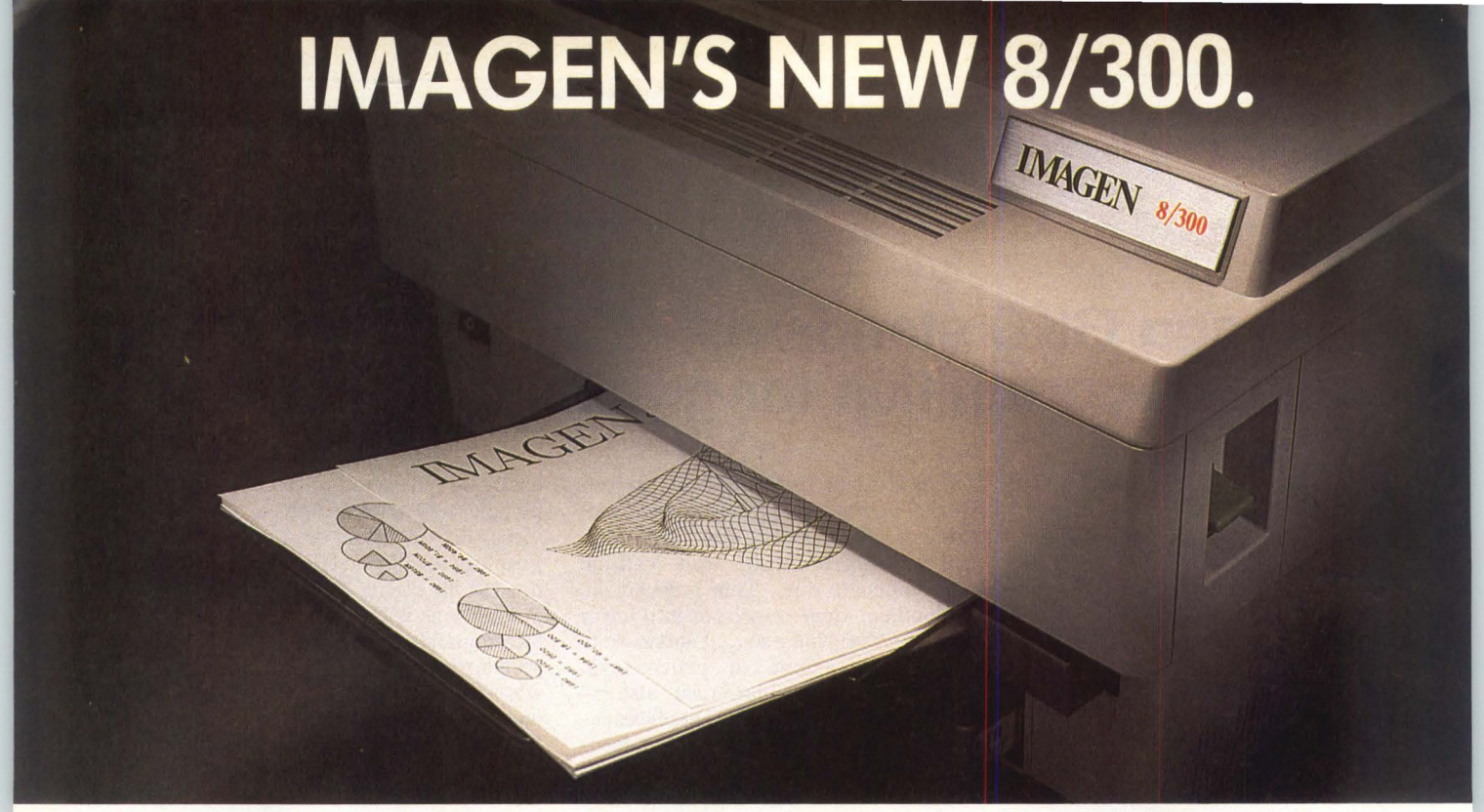
The acceptance of UNIX as a standard operating system by major computer manufacturers, and of GKS as the standard graphics language, will bring mainframe-like graphics capabilities to small computers. It will also open up new opportunities for OEMs and system integrators.

GKS, a software standard for two-dimensional computer graphics, allows graphics software to operate independently of the computer type and of the graphics output and input device types. Graphics output can easily be redirected to laser printers, pen plotters, photographic output devices or to color or monochrome graphics terminals. GKS provides the needed functions for a majority of applications with a minimum number of commands. And GKS is the official standard in Europe and has been adopted by the International Standards Organization (ISO). In the United States, the American National Standards Institute (ANSI) has endorsed a proposal for adopting GKS as the American national standard. American computer software companies now use GKS for two reasons: to sell graphics software in Europe — and to support a workable solution for standards.

The lack of good software previously served as a deterrent to the use of graphics. Today, new graphics programs provide tools for programmers and end users. By increasing user productivity, these new programs make the creation of graphics more cost-effective on all levels of expertise.

UNIX has been the operating system of choice for many engineers and there is a huge marketplace for graphics in technical applications. In addition, UNIX is rapidly becoming used for business applications. Thus, we'll see an increasing demand for graphics in both areas.

The graphics explosion is bringing new programs to the market but OEMs and system integrators must be selective in their choice. Any discussion of graphics software must focus on the levels and complexity of graphics software and on the sophistication of users. Graphics functions for systems and applications programmers differ significantly from those for business end users who need to create graphics easily and quickly. Programs utilizing the GKS standard, written in C for the UNIX environment satisfy the most important needs of today's users in creating presentation-quality graphics — ease of use, portability and cost-effectiveness.



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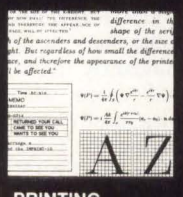
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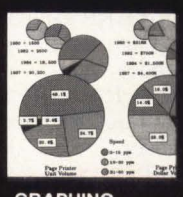
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SYSTEMS

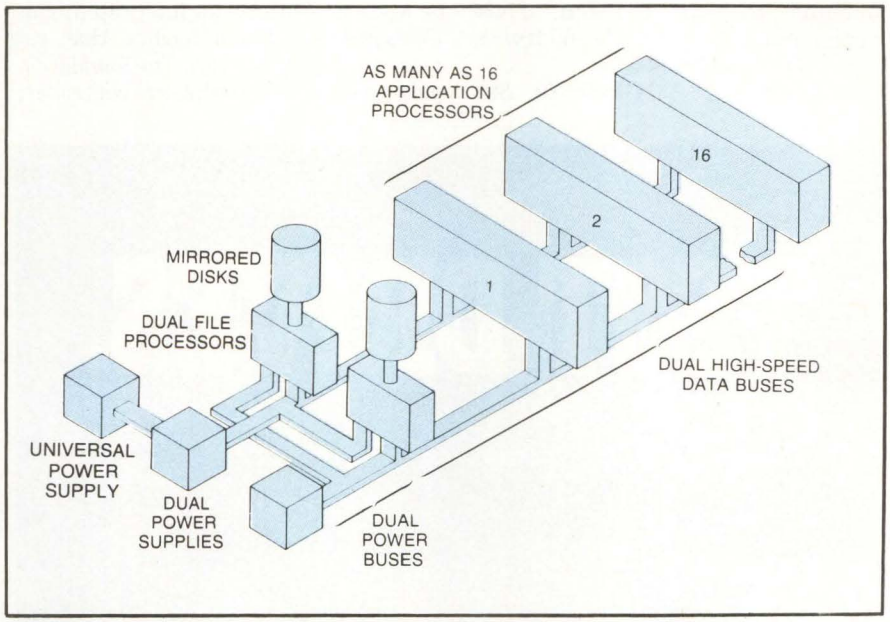
Fault-tolerant computer aids on-line transaction applications

The Reliant Computer, a distributed multiprocessing system, offers a fault-tolerant architecture. The architecture consists of multiple application processors, dual data buses, dual file processors, dual disk controllers, mirrored disks, and dual power supplies contained in a cabinet the size of a standard two-drawer office file. The application processors handle all communications between users and the system; the file processors govern internal data transfers and the system printers. The twin data buses, file processors and disk subsystems operate in parallel, performing real-time mirror images of each system operation.

The product's distributed design dedicates independent 8- or 16-bit microprocessor-based boards to running specific application programs. Each Intel 8086-based board has a much as 512K bytes of on-board RAM, a tri-ported "mailbox" for communications with both data buses and four RS232 ports that connect to displays, printers and other I/O devices.

The Systems Activity Monitor (SAM) checks all modules in the system for actual or impending failures. When SAM senses a problem, the diagnostic program shuts down the defective component while the system continues to run; if an application processor goes down, that processor board and its attached devices are temporarily disabled.

The computer, including the SAM diagnostic program, operates under control of the company's proprietary NH DOS operating system, which supports file locking for concurrent file sharing, error correction and file security levels. Other NH DOS functions include spooling, despooling and automatic program loading. A multitask dispatcher allocates processing power among the competing processes.



NoHalt Computers' fault-tolerant Reliant *computer system has an internal architecture that replicates crucial system components. If a power supply fails, the other power supply keeps the system running. If a disk drive, disk controller or file processor fails, the system runs on the mirrored information copied in the alternate file subsystem. Should a data bus fail, communications between application processors and the disk subsystem continue unaffected on the other data bus.*

A basic configuration, including one 16-bit application processor, mirrored system components with twin 20M-byte Winchester disk drives, NH DOS and utilities, sells for $25,570. **NoHalt Computers,** 1750 New Highway, Farmingdale, N.Y. 11735, (516) 225-2121.

Circle No 300

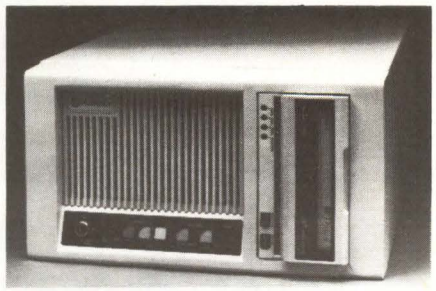
Portable computer includes modem

The RoadRunner portable computer measures 3 by 11 by 8 inches and weighs 5 pounds. Powered by an 8-hour-rated removable, rechargeable battery, the unit uses an NSC800 microprocessor and removable 8K- and 16K-byte cartridges for data storage. It includes a parallel printer and RS232C communications interfaces as well as a built-in 300-baud, auto-dial, auto-answer modem. The computer runs CP/M-compatible software and provides a built-in text editor, a phone directory, a name/address list, a daily schedule and remote communications programs. The 73-key keyboard includes 18 function keys. The display provides 8 lines of 80 characters and 480-by-64-dot resolution graphics. $2,015. **Micro Office Systems Technology Inc.,** 35 Kings Highway East, Fairfield, Conn. 06430, (203) 367-2525.

Circle No 301

Computer system uses DEC LSI-11/73 processor

Based on the DEC KDJ11-AA LSI-11/73 processor, the model 8650 computer system features a 41.6M-byte fixed/



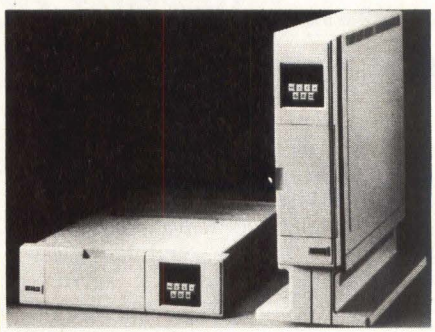
removable Whitney-technology hard disk drive (20.8M bytes fixed, 20.8M bytes removable, formatted) and 256K bytes of RAM, expandable to 4M bytes. It also includes six RS232C ports. The

system runs most DEC LSI-11 and PDP-11 operating systems and software with little or no modification. $17,950. **Plessey Peripheral Systems Inc., Computer Systems Division,** 17466 Daimler Ave., P.O. Box 19616, Irvine, Calif. 92714, (714) 540-9945.

Circle No 302

Microcomputer system is DEC-compatible

The SMS 1000 model 40, a DEC LSI-11 Q-bus-compatible microcomputer system, features an integrated, single-board foundation module that requires no backplane slot. The foundation module includes a peripheral controller,



two serial ports, backplane circuitry and a support monitor subsystem that contains system analysis, system utilities and diagnostics software. Model 40 uses LSI-11/23 or LSI-11/73 CPUs with as much as 2.5M bytes of main memory. Single or dual 5¼-inch Winchester disk drives with capacities ranging from 12M to 70M bytes each, one 8-inch, 1.2M-byte floppy disk drive or single or dual 5¼-inch, 800K-byte floppy disk drives and a 21M-byte cartridge-tape drive are available. Model 40 supports RT-11, RSX-11M, RSX-11M-Plus, RSTS/E, UNIX and TSX-Plus operating systems. The product comes in floor- or rack-mount versions. Prices start at $5,800 (50 units). **Scientific Micro Systems Inc.,** 777 E. Middlefield Road, Mountain View, Calif. 94043, (415) 964-5700.

Circle No 303

Multiprocessor computer runs Concurrent CP/M-86

The single-user, dual-processor Poly 8/16 computer features a two-board set that includes an 8-bit Z80 processor with 64K bytes of RAM running CP/M-80 on the system master card plus a 16-bit 80186 processor with 256K bytes of RAM running Concurrent CP/M-86 on the slave board. The computer can support as many as four users by adding 80186 slave boards. The version of Concurrent CP/M-86 supplied offers multitasking built-in windows and PC-DOS compatibility. The basic system includes the master and slave boards, a five-slot S-100 motherboard, one 5¼-inch, 800K-byte floppy disk drive, four RS232C/RS422 ports, two parallel ports, a monochrome display terminal and operating system and GSX graphics extension software. Prices start at $4,495. **PolyMorphic Systems,** 5330 Debbie Lane, Santa Barbara, Calif. 93111, (805) 967-0468.

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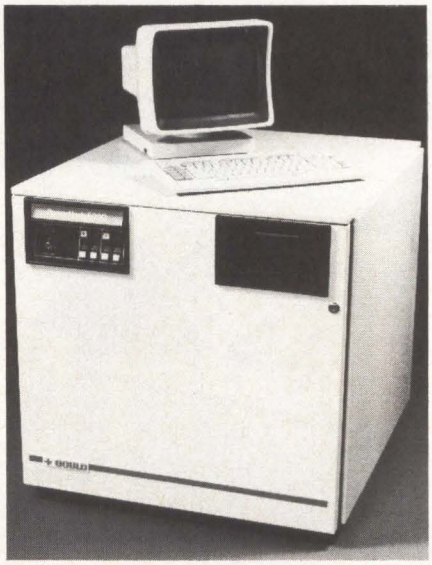
New Products

SYSTEMS



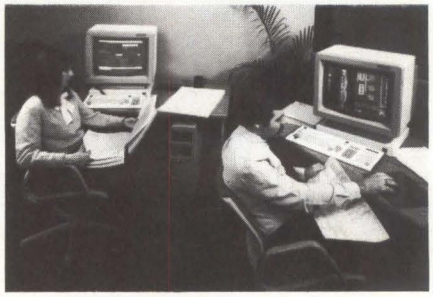
Computers provide network support

The 32-bit, UNIX-based PowerNode 6000 virtual-memory computer system serves as a computational node in a LAN or as a standalone processor with multiple terminals. The computer comes in three configurations—models PN6030, PN6050 and PN6080—that differ in packaging and expansion capabilities. Each model includes a 32-bit virtual-memory processor. A 32-bit internal-processing unit is optional on model PN6050 and standard on model PN6080. All models include 2M bytes of main memory and 32K bytes of dual cache memory per processor. Memory can be expanded to 6M bytes for model PN6030 and 16M bytes for model PN6080. The computers are built around the company's SELbus synchronous bus with a 26.7M-byte-per-second transfer rate. Model PN6030 is packaged in a 30-inch-high cabinet and includes an 80M-byte Winchester subsystem and a removable 60M-byte cartridge-tape subsystem. Models PN6050 and PN6080 are packaged in 71-inch-high cabinets. The PowerNode 6000 series runs the UTX/32 operating system, which is based on the Berkeley 4.2 version of UNIX with selected Bell System V features. The computers support C, FORTRAN 77, ISC Pascal and RM COBOL programming languages. Prices start at $80,000 for the PN6030 and $150,000 for the PN6080. **Gould Inc., Computer Systems Division,** 6901 W. Sunrise Blvd., Fort Lauderdale, Fla. 33313, (305) 587-2900.

Circle No 305

Workstation supports two users

The dual-user Workstation 500 system accommodates two 19-inch raster graphics displays—either two 1,024-by-1,024-dot resolution monochrome units, twin 832-by-600-dot resolution color units or a color/monochrome pair. Each display has a dedicated 68000 graphics processor with a 128K-byte program store. Each graphics processor contains a software library of graphics primitives for plotting 2-D graphs; drawing polygons, circles and arcs; and scrolling, zooming and panning images. The workstation incorporates dual 10-MHz microprocessors (68010 and 68000), a 4K-byte cache, a 1,024-element translation buffer and a 1,024-entry I/O map. A 50M-byte Winchester disk drive with a 5¼-



inch floppy disk drive or a ¼-inch cartridge-tape drive provides mass-storage capabilities. The workstation uses a real-time, virtual-memory, UNIX-based operating system that provides multitasking, memory-locked processes, guaranteed process priorities, contiguous files and high-speed pipes. A system with a CPU, 1M byte of ECC memory, real-time UNIX with C and FORTRAN and dual monochrome displays sells for $11,370 (100 units). **Masscomp,** 1 Technology Park, Westford, Mass. 01886, (617) 692-6200.

Circle No 306

Graphics workstations boast mini capabilities

The GW/8000 and GW/10000 graphics workstations are packaged engineering graphics systems based on the mid-range and high-end Eclipse MV/8000 II and MV/10000 minicomputers. The systems integrate two monitors—a 19-inch color graphics display featuring 1,280-by-1,024-dot resolution and a Dasher D460 alphanumeric monitor—in one workstation. Each system includes a CPU, dual monitors in an integrated

housing, the GDC/1000 graphics controller, the GKS Level 2B programmer's graphics interface and the AOS/VS operating system. The workstations suit solids modeling, seismic analysis and geophysical image-processing applications. Prices start at $160,500 for the single-user GW/8000 system with 354M-byte non-removable disk and tape drives. A fully configured, four-user GW/10000 system, including the 354M-byte disk drive and a cartridge-tape drive, sells for $345,000. **Data General Corp.,** 4400 Computer Drive, Westboro, Mass. 01580, (617) 366-8911. **Circle No 307**

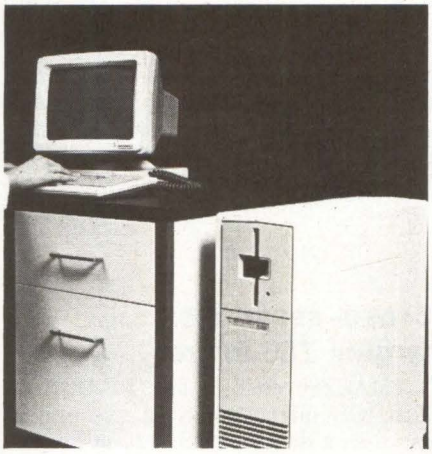
Office minicomputer supports 64 users

Packaged in two desk-height cabinets, the Prime 2550 minicomputer contains a two-board CPU with custom gate arrays and supports 64 interactive users. The machine features quad floating-point capability and hardware decimal arithmetic. It runs on the PRIMOS operating system. Priced at $99,500, the standard system package includes a 32-bit CPU, 2M-byte main memory, 16K-byte cache memory, 315M bytes of rigid disk storage, a 1,600-/3,200-bpi streaming-tape drive, a PST100 console and a diagnostic processor. **Prime Computer Inc.,** Prime Park, Natick, Mass. 01760, (617) 655-8000. **Circle No 308**

Pick-based micros are expandable

The Sunshine series of microcomputers features a 10-slot S-100 bus chassis and a Motorola 68000 CPU. The computers use the Pick or XENIX operating systems. Offerings in the series begin with an entry-level, four-user system having 256K bytes of memory and 5M bytes fixed/5M bytes removable Winchester disk storage. The top-of-the-range product features 4M bytes of internal memory, 280M bytes of disk drive capacity, the ability to handle 32 users, a ½-inch tape drive controller and a parallel printer port. Prices start at $9,995. **Climax Computer Corp.,** 3605 W. MacArthur Blvd., Suite 702, Santa Ana, Calif. 92704, (714) 545-8357.

Circle No 309



UNIX-based computer features windows

Based on the Motorola 68010 microprocessor, the 6000 series computer systems run under a UNIX-derived operating system with the Uniview common user interface. Uniview provides menus and help screens and allows windowing of eight tasks simultaneously, copying and moving information between windows and direct access to UNIX commands. For application development, COBOL, BASIC, Pascal, SIBOL and C programming languages are available. Communications software for the 6000 series includes 2780/3780 bisynchronous (BSC) remote job entry, 3770 SNA remote-job entry, 3270 BSC interactive communications and 3270 SNA interactive communications. Model 6300, with two workstations, 20M bytes of disk storage, 1M byte of memory, the UNIX operating system, a 68010 CPU and a character printer sells for $15,181. Model 6600, with eight workstations, 74M bytes of disk storage, 1.5M bytes of memory, a character printer and a line printer, the UNIX operating system and a 68010 CPU sells for $70,650. **Four-Phase Systems,** 10700 N. DeAnza Blvd., Cupertino, Calif. 95014, (408) 255-0900.

Circle No 310

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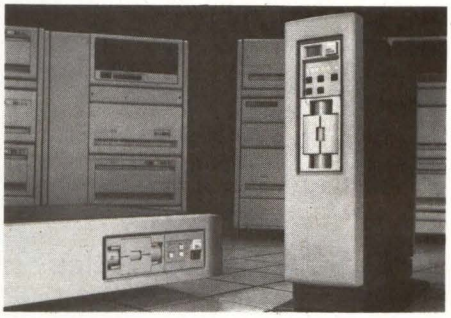
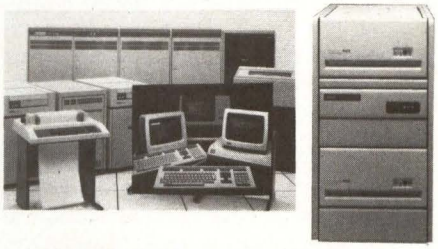
- VAX 11/750
- VAX 11/782





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New Products

SOFTWARE

C library contains 200 functions

The Greenleaf Functions C library, a programmer-productivity tool for the IBM PC and IBM PC-compatible microcomputers, holds more than 200 functions and routines and supports Computer Innovations C86, Microsoft C or Lattice C compilers. It includes more than 32 DOS functions for DOS 2.0 and 1.1, 23 video- and screen-control functions, more than 60 string functions, five color-graphics functions, 44 graphics-printer functions, six keyboard functions, nine time and date functions, RS232 asynchronous communications functions and four software-diagnostics functions. The package also contains a 200-page manual with examples of each function, demonstration programs with source code and a reference card. $175 with assembler and complete source code in C. **Greenleaf Software Inc.,** 2101 Hickory Drive, Carrollton, Texas 75006, (214) 446-8641.

Circle No 311

Package provides data-analysis capabilities

The Statpro statistics and graphics database workstation is a series of integrated statistics, graphics and data-management programs. Statpro turns Apple's Lisa 2 computer into a professional research and management workstation. The database component allows users to enter, edit, manipulate, transform, store, copy and print data. The statistics component contains statistical procedures grouped into descriptive, regression, analysis of variance, time series and multivariate modules. The graphics component provides standard graphing functions, including scatter, triangle, regression and box plots as well as pie charts and histograms. $1,995. **Wadsworth Professional Software Inc.,** Statler Office Building, 20 Park Plaza, Boston, Mass. 02116, (617) 423-0420, (800) 322-2208.

Circle No 312

Compiler family runs on 68000-based UNIX systems

This six-member family of high-level language compilers allows users to mix subprograms written in different languages into one program. The compilers, for COBOL, RPG-II, Pascal, C, PL/I and BASIC, run on computers that use the Motorola MC68000 microprocessor and the UNIX operating system. They use the company's Component Architecture, a modular software architecture that combines front-end, optimizer, code-generator, run-time-library and high-level-debugger processors into a compiler. The compilers use ISAM to handle data files; programs written in one language can address and use files written in another language. The compilers sell for $50,000 each to hardware OEMs, plus royalties based on system size. Single copies with run-time license distribution rights are available. **Language Processors Inc.,** 400-1 Totten Pond Road, Waltham, Mass. 02154, (617) 890-1155.

Circle No 313

Cross-assembler targets Z80 micro

XMACZ80 enables any PC-DOS or MS-DOS microcomputer system to serve as a development station for the Zilog Z80 microprocessor. This software system includes a relocating macroassembler, a linking loader, an absolute macroassembler, a text editor, a cross-reference generator, a hex file converter and offloading facilities. The relocating macroassembler features full macro and conditional assembly and can chain a series of source files during one assembly. The two-pass linking loader produces an absolute Intel hex file. The absolute macroassembler handles projects that do not require the relocation feature. A user-configurable down-loader offloads programs developed under XMACZ80 to the target processor for test. $250. **Alley Ashley,** 395 Sierra Madre Villa, Pasadena, Calif. 91107, (818) 793-5748.

Circle No 314

Floating-point library runs on 68000 micros

The 68000 FPAC/DPAC floating-point library is a set of subroutines that processes floating-point numbers in the proposed KCS IEEE single- and double-precision formats. In addition to standard arithmetic operations and integer-to-floating-point conversion routines, the library includes functions to compute sine, cosine, tangent, arctangent, square root, common logarithm, natural logarithm, exponentiation and floating-point-number-to-integer power. It also contains ASCII-to-floating-point and floating-point-to-ASCII conversion routines. The reentrant package performs basic single-precision operations at approximately 12,000 FLOPS on an 8-MHz 68000 microprocessor. Double-precision basic operations run at approximately 5,000 FLOPS. Single-precision 68000 FPAC: $750; double-precision 68000 DPAC: $1,250. **U.S. Software,** 5470 N.W. Innisbrook Place, Portland, Ore. 97229, (503) 645-5043.

Circle No 315

Utility transfers files between computers

The IBM PC's file-transfer system (FTS) utility program provides bidirectional file transfers between PCs and mainframes running OS/VS2 TSO. FTS runs under version 1.1 or later of PC-DOS and requires the IRMA decision-support interface printed-circuit board. The board furnishes the communication link to the host mainframe via a 3270 control unit. FTS supports files containing character data only. It supports PC files consisting of ASCII graphics characters and the following ASCII control characters: horizontal tab, line feed, form feed, carriage return and control Z. $295. **Mackensen Distributed Systems,** 3323 Pearl St., Santa Monica, Calif. 90405, (213) 452-5520.

Circle No 316

Tool transports programs from RSTS/E to VAX/VMS

The BIO series of external callable routines emulates the RSTS/E disk file I/O environment on the VAX/VMS operating system and aids transportation of application programs for the RSTS/E operating system to the VAX/VMS operating system without converting to RMS files and without major programming logic conversion. It also allows RSTS/E software to continue to perform multiblock I/O transfers with full file sharing and block locking. $500 to $3,000. **Park Software Inc.,** P.O. Box 202 Northgate Station, Seattle, Wash. 98125, (206) 284-4025.

Circle No 317

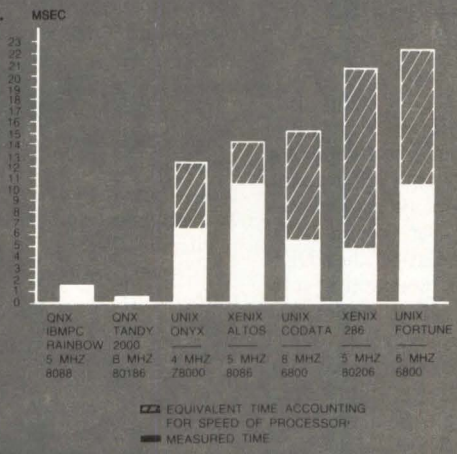
Technical Bulletin
No.1 in a series.

Subject : Engineering for maximum performance.

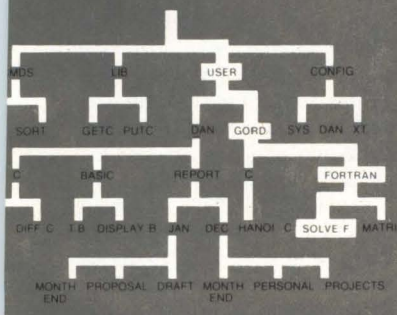
Quantum Software Systems Ltd. bring you QNX — The Ultimate Operating System. The design of QNX allows you to take advantage of an IBM-PC or similar micro-computers in ways that are only possible on large mini and mainframe computers.

Unlike other UNIX™ type systems QNX was engineered for the 8086/8088 architecture. All of QNX's features were designed into the operating system right from the beginning. As a Real-Time Multi-Tasking O/S, QNX will support up to 48 tasks executing simultaneously. It is also a Multi-User O/S with a Time-Sharing environment supporting up to 17 users, with a security conscious Message-Passing Protocol ideally suited for Local Area Networks. We will shortly be announcing a true (not just a file server) distributed Local Area Network version of QNX.

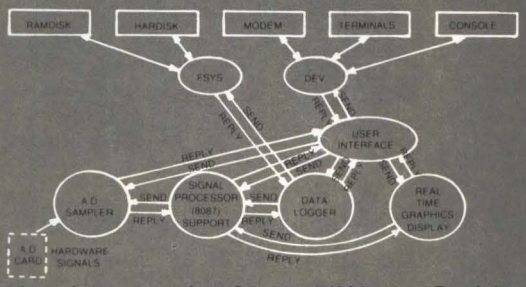
To minimize memory requirements we allow Shared Code and Shared Libraries. Disk access is accelerated by Disk Caching. To improve productivity we give you Multiple Windows. For those of you who wish to add new devices, you simply mount a Device Driver. Our operating system is compact (64K). Of course QNX is fast; benchmarked to be 20 times faster than other popular UNIX™ systems. On a 8 Mhz 8088, task switching is done within 1.3 msec. Interrupt latency is under 1 msec and kernal call overhead is under 50 usec.



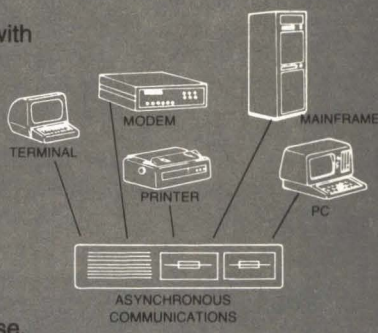
The QNX file system is highly optimized with minimum floppy disk access and is tolerant of power failure. It is a Hierarchical Directory System with 16 character file/directory names. There are NO limits to number of files, or number of directories. The file system has a minimum File Allocation Unit of 512 bytes regardless of disk size with a directory overhead of less than 2%. Up to 40 files can be opened simultaneously. The QNX Multi-User file security includes read/write/append/execute/modify file permissions, and read/create/block/modify directory permissions. 256 Groups of up to 256 users in each group are possible. QNX files can grow automatically and need not be contiguous.



The Intertask communications include message passing, non-blocking signals, and asynchronous exceptions. Messages are passed at the rate of 3 usec/byte on a 5 Mhz 8088 and may consist of up to 64K bytes. Partial I/O of messages is permitted and message forwarding is supported. Priority task scheduling will allow up to 16 priorities and 48 simultaneous tasks. Messages may be sent between tasks on different nodes in the local area network version of QNX.



Asynchronous Communications are completely interrupt driven with up to 16 serial (RS232) devices supported. Input/output Flow Control is supported for XON/XOFF and DTR/CTS hardware. Loss of carrier can generate a High Level Exception. Line Editing is a programmable option on any terminal and terminal independence is made simple with a "TERMCAP" type database.



Other Quantum Software product development tools include a "C" Compiler, a Full Screen Editor, an 8086 Assembler, a Fortran Compiler, a Basic Compiler, a Qbol (Dibol) Compiler, and Graphics and Math libraries with complete 8087 support.

Minimum hardware required is an IBM-PC or compatible with 128K RAM, single 320K floppy drive, and display/keyboard (or terminal). Maximum requirements are 880K RAM, 8087 math co-processor, 8 disk drives (floppy, hard or ramdisk), 2 parallel printers and 16 RS232 devices (terminals, modems, printers).

QUANTUM SOFTWARE SYSTEMS LTD.
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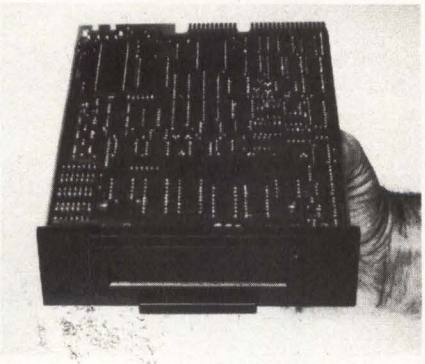
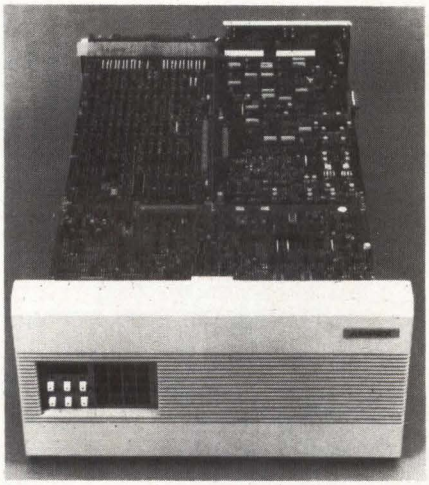
New Products

DISK/TAPE



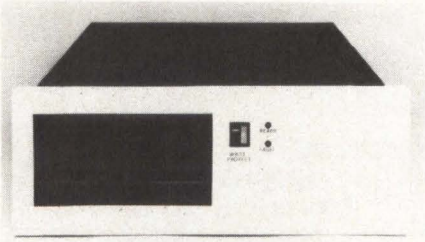
Micro cartridge-tape drives store 10M bytes

The model 110 and 210 tape drives pack 10M bytes of formatted data on DC-100A-sized cartridges to meet Winchester disk backup needs. The 110 comes in a half-height, 5¼-inch form factor; the 210, a 3½-inch form factor. They incorporate a host interface that is hardware-compatible with SA450 minifloppy controllers. Both products read and write data at 39 ips and transfer data at 250,000 bps. Recording density is 6,400 bpi on eight tracks. $300 (500 units). **Irwin Magnetics,** 2311 Green Road, Ann Arbor, Mich. 48105, (313) 996-3300. **Circle No 318**



Winchester stores at $10 per megabyte

The Centaurus family of 14-inch Winchester disk drives provides 330M, 660M or 825M bytes of unformatted rack-mountable storage capacity. All three models offer average access times of less than 25 msec. using a linear voice-coil actuator in a closed-loop, dedicated-servo system. Incorporating an SMD interface with dual-port capabilities, the drives support 1.859M-byte-per-second data transfers. The products use RLL 2,7 encoding and have track capacities of 40,320 bytes per track. The units support densities of 960 tpi and 12,500 bpi. Model 825: $8,250 (OEM quantities). **Ampex Computer Products Division,** 401 Broadway, Redwood City, Calif. 94063, (408) 725-2017. **Circle No 319**

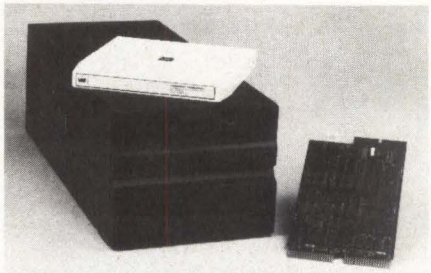


Winchester subsystems store 140M bytes

The CI-1340-WF Winchester subsystems for DEC LSI-11 microcomputer-based systems store 42M, 70M or 140M bytes, using a 22-bit DMA controller for the Winchester disk drive. The rigid disk drive has a 20-msec. average access time and a 1.2M-byte-per-second data-transfer rate. It emulates the DEC RK06 and RK07 drives, permitting software-transparent operation under the RSTS-E, RSX11M, RSX11M+, RT11 and UNIX operating systems. All subsystems contain a 2M-byte, dual floppy disk drive or streaming-tape drive backup. Prices are $6,995, $7,195 and $8,195 for the 42M-, 70M- and 140M-byte models, respectively. **Chrislin Industries Inc.,** 31352 Via Colinas, Westlake Village, Calif. 91362, (818) 991-2254. **Circle No 320**

Memory subsystem is Q-bus-compatible

The model 81QB-4 mass-storage subsystem provides 41.6M bytes of formatted storage capacity for DEC LSI-11 Q-bus systems. The subsystem includes two of the vendor's model 8520 fixed/removable, 8-inch disk drives, an SASI controller, a Q-bus host adapter and a shielded interface cable. The package emulates as many as four RL02 14-inch disk drives and is software-compatible with operating systems and diagnostics for the RL01/02, including RSX11M, RSTS and UNIX. Model 81QB-2 contains one fixed/removable disk drive and stores 20.8M bytes. Model 81QB-4: $11,020 (100 units); model 81QB-2: $6,420 (100 units). **Vermont Research Corp.,** Precision Park, North Springfield, Vt. 05150, (802) 886-2256. **Circle No 321**



Half-height minifloppy packs 1.6M bytes

The double-sided model 475 half-height, 5¼-inch floppy disk drive features an unformatted capacity of 1.6M bytes, a 500K-bit-per-second data-transfer rate and a 91-msec. average access time. The 96-tpi unit can read data written on 48-tpi, 5¼-inch diskettes. Recording density is 9,646 bpi. A brushless, direct-drive DC spindle motor revolves the spindle at 360 rpm. A stepper-motor/band-actuator system positions the read/write head. Other key specifications include power requirements of 12.5W, operating, and 3.6W, standby, and an MTBF rating of 10,000 power-on hours. Less than $200 in OEM quantities. **Shugart Corp.,** 475 Oakmead Parkway, Sunnyvale, Calif. 94086, (408) 737-4355. **Circle No 322**

Subsystems add 40M bytes to LSI-11s

The CI-820 Winchester subsystems for DEC LSI-11 microcomputer-based systems are available with formatted capacities of 10M, 20M and 40M bytes. All subsystems contain a 2M-byte dual-diskette-drive or streaming-tape backup. One 22-bit dual-DMA controller handles floppy and Winchester disks. The drives access data in 40 msec. (average) and transfer data at 625K bytes per second. They emulate RL01, RL02, RX02 and RX03 drives, permitting software-transparent operation under RSTS-E, RSX-11M, RSX-11M+, RT11 and UNIX operating systems. $4,495, $4,995 and $5,995 for the 10M-, 20M- and 40M-byte versions, respectively. **Chrislin Industries Inc.,** 31352 Via Colinas, Westlake Village, Calif. 91362, (818) 991-2254. **Circle No 323**

More than A Memory
A Commitment To Quality

Every department, every person in our organization is dedicated to one goal—to deliver the finest in disk memories.

At Century Data Systems, we see quality as a pervasive, company-wide attitude. And our customers share this perspective.

Leading OEMs continue to rely on Century Data Systems disk memories for superb reliability, year after year. That's the real payoff from our total approach to quality.

At Century Data Systems, quality is much more than a memory. It's a living company commitment. And it can work to your advantage. Write or call for specifics.

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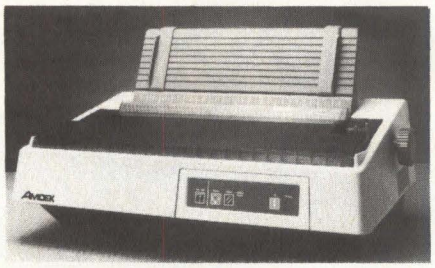
CIRCLE NO. 130 ON INQUIRY CARD

Printers employ 125-character daisy wheels

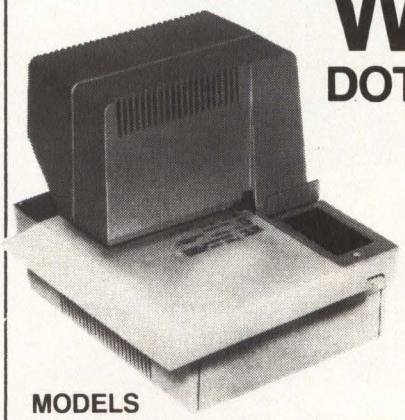
The 500 series daisy-wheel printers operate at a 50-dBa noise level and have Centronics and RS232 interfaces. The transportable model 5025 prints at 25 cps; the 5040 and 5055 desktop models print at 40 and 55 cps, respectively. The printers can print 132-column forms for spreadsheet applications using 125-character daisy wheels. The print wheels for the models 5040 and 5055 are interchangeable. External software controls allow the printing of as many as



309 Teletex characters. Model 5025: $799; model 5040: $1,675; model 5055: $1,990. **Amdek Corp.,** 2201 Lively Blvd. Elk Grove, Ill. 60007, (312) 364-1180. **Circle No 324**

WESTREX

DOT MATRIX PRINTERS



NEW! STAND-ALONE, 150 CPS SLIP/DOCUMENT PRINTERS

8000 SERIES

MODELS 8400/8410

Model 8400 and Model 8410 are new, packaged, stand-alone, alphanumeric, bi-directional, flat bed, Slip/Document dot matrix printers. They print up to 40 columns at 12 characters per inch at 3 lines per second. Both models provide side or front form insertion; top and bottom-of-form sensors and adjustable Slip Document Stop. The print head employs a 7-needle vertical array that permits selection of fonts and characters (5 × 7, double width, etc). The character set is fully alphanumeric under software control. The 100% duty cycle print head life is rated at 100 million characters.

Model 8400 and Model 8410 are complete with control and drive electronics. Serial RS-232C or TTY and parallel interfaces are available. Both units can provide multiple print lines and carbon or pressure sensitive copy.

Model 8410 additionally features a stepping motor paper drive system which permits variable and programmable forward reverse line spacing for applications requiring line selection and or unique form indexing.

QUANTITY DISCOUNTS AVAILABLE.

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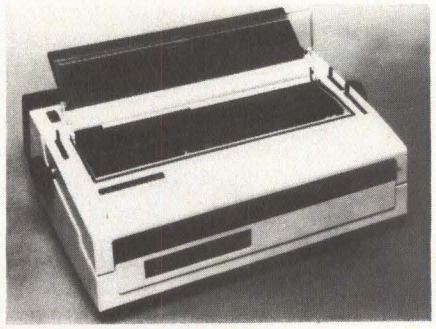
CIRCLE NO. 131 ON INQUIRY CARD

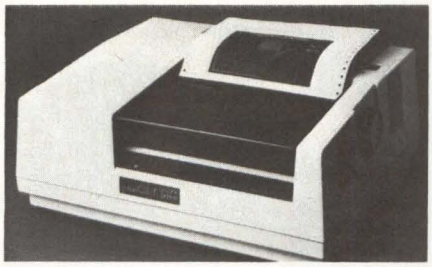


Daisy-wheel printer operates at 36 cps

The model EXP 770 daisy-wheel printer provides bidirectional, 36-cps printing on paper as wide as 17 inches. The standard model contains a 2K-byte buffer, expandable to 48K bytes. The product supports word-processing functions including subscript, superscript and boldface. It features carrier feed in units of 0.0083 inch and forward/reverse paper feed in units of 0.0208 inch. The printer also emulates the Diablo 630. A Centronics interface or an RS232C interface is standard. $1,295. **Silver-Reed America Inc.,** 19600 S. Vermont Ave., Torrance, Calif. 90502, (213) 516-7008. **Circle No 325**

Printer suits color applications

The Gulton color printer produces hard copy in seven colors from a CRT, CPU or video monitor. Using a triple-pass thermal-transfer process, the printer can reproduce video images on non-thermal Z-fold paper or acetate film. Model CP-80V is RS170 compatible and accepts RGB signals with or without separate sync. It prints a full page (640 by 480 dots) in 45 seconds. Model



CP-80C is 8-bit parallel and Centronics-compatible. It accepts text and graphics directly from a CPU. The data-input code consists of 192 characters; the character configuration is a 7-by-11-dot matrix. $4,950. **Gulton Industries Inc., Graphic Instruments Division,** Gulton Industrial Park, East Greenwich, R.I. 02818, (800) 343-7929. **Circle No 326**

Dot-matrix printer uses 24-pin technology

Featuring a 24-pin print head, the P1340 dot-matrix printer provides letter-quality output, high-speed drafts and graphics in one pass. In letter-quality mode, the 80-column unit prints at 54 cps. It produces draft-quality documents at 144 cps and graphics with 180-by-180-dpi density. Additional features include software-selectable multiple fonts, pitches, line spacing, condensed print and proportional spacing. Qume Sprint 5 emulation is standard. The unit handles letter sheets or continuous forms from 4½ to 10 inches wide. In compressed print mode, the printer furnishes a 132-column format on letterhead-sized sheets. Friction-roller paper feed and a built-in forms tractor are also standard. The printer connects to microcomputers and word processors via a Centronics-compatible interface. $995. **Toshiba America Inc., Information Systems Division,** 2441 Michelle Drive, Tustin, Calif. 92680, (714) 730-5000.

Circle No 327

INTRODUCING THE CTS 212AH MODEM

Discover in nine minutes what it's taken ninety years to develop;

Reliability.

CTS Technological Reliability

The high speed, digital signal processor in our 212AH modem was originally engineered for very complex, custom modem systems. We now have applied this advanced technology to a standard Bell 212A compatible product. You get clear, error free transmission despite varying phone line conditions. Other features include auto dial/answer, remote digital loopback, full duplex 300 bps and 1200 bps asynchronous operation and 1200 bps synchronous operation. In a few minutes you'll discover our modem has all the bells and whistles you could ask for. Yet, at a surprisingly low price.

CTS Field Reliability

We warranty our 212AH modem for two years, and we demand our distributors service and support your needs immediately. Once in the field, our modems operate with all data terminals, more than 100 types of computers and are Hayes compatible.

CTS Brand Reliability

In 1896 CTS began manufacturing hand cranked, wooden, wall mounted telephones. Today, we offer the sophisticated 212AH modem. It's taken us almost ninety years of hard work, intensive research and innovative products to develop a reputation for reliability. Take nine minutes, examine our 212AH modem, and find out for yourself.

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New to the industry since 1896.

CIRCLE NO. 132 ON INQUIRY CARD

Matrix line printer runs at 400 lpm

The Dasher GPS dot-matrix line printer operates at 400 lpm. The printer feeds paper as fast as 10 ips and features high-speed space skip when more than five spaces appear between characters.

The unit's programmable functions include character set and pitch, form setting, horizontal and vertical tab settings, underscore, memo-quality print and alternate character sizes. The product prints as many as 136 cpl when printing at 10 cpi. The printer has 11 resident character sets including U.S., U.K., French, German, Swedish/Finnish, Danish/Norwegian, Spanish, Swiss, kana/ASCII, kana/Japanese and DG multilingual. Serial interface version: $2,995, parallel interface version: $2,950. **Data General Corp.,** 4400 Computer Dr., Westboro, Mass. 01581, (617) 366-8911.

Circle No 328

WHILE EVERYONE WAS TALKING ABOUT OPTICAL DISK TECHNOLOGY, ALCATEL THOMSON GIGADISC WAS DELIVERING.

Gigadisc, the new laser memory system developed for low-cost storage of large quantities of data, has proven itself in field applications worldwide already.

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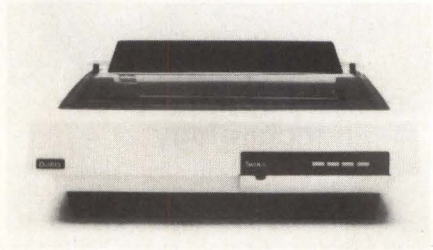


Daisy-wheel printer offers universal interface

The Series 36 daisy-wheel printer prints Shannon text at 28 cps. The device uses drop-in, 98-character plastic print wheels that are available in 18 languages and 19 fonts. The printer features automatic print-wheel recognition and can print as many as 132 columns in 10 pitch. The unit handles one- to five-part forms as wide as 15.2 inches. It offers a variety of interfaces through an all-purpose interface, including RS232C, IEEE-488 and Centronics. The interface is selected by using the appropriate host/printer cable. A 12-bit parallel interface is also available. A 1,280-character buffer is standard. $1,595. **Diablo Systems Inc.,** 901 Page Ave., P.O. Box 5030, Fremont, Calif. 94537, (415) 498-7000. **Circle No 329**

HP terminal has ergonomic features

Featuring a green screen and an ergonomically improved design, the HP 2392A display terminal performs many of the functions of the HP 2622A block-mode data-entry terminal which it supersedes. The new terminal suits data-entry, program-development and data-inquiry applications on HP host systems. ANSI-standard compatibility is available at no extra cost. Furnishing a 12-inch diagonal display, the product occupies approximately one cubic foot of desk space. It incorporates an integrated tilt-and-swivel mechanism. Characters are formed with a 9- by 14-dot cell. Smooth scrolling enables users to read through as many as four pages of text without pause. The unit offers 17 different keyboard language options for international use. Other features include local-editing keys and a 64-character line-drawing set. Communication with host systems occurs via a combined RS232/HP 422 port. $1,295. Delivery is approximately six weeks ARO. **Hewlett-Packard Co.,** 1820 Embarcadero Road, Palo Alto, Calif. 94303.

Circle No 330

Dual-personality terminal combines Tek, DEC traits

The CIT-414a monochrome graphics terminal combines Tektronix 4010/4014 terminal emulation and terminal DEC traits. Priced at $1,495, this 4010/4014 alternative provides a flicker-free 640- by 480-dot resolution display with a 4,096-by-4,096 addressable plot area. Its Tektronix personality offers variable line types, vector/point/incremental plotting, and, using standard 4014 commands, four character sizes. A keyboard-controlled, eight-direction crosshair cursor enhances compatibility with the Tektronix GIN mode. The product's native graphics mode provides line, circle, arc and box generation capabilities. In ANSI mode, features include DEC editors EDT, KED and TICO, tutorial setup mode and reverse video. Other standards include a printer port for LA100, C. Itoh 8510 and Epson MX-80 compatibility, a detachable keyboard and a non-reflecting screen. **CIE Terminals Inc.,** 2505 McCabe Way, Irvine, Calif. 92714, (714) 660-1421.

Circle No 331

GCR YOUR BACKUP REMEDY

Take a minute . . . let's talk about the benefits of GCR (group-coded recording) tape subsystems.

Today's disk drives offer faster transfer rates and larger storage capacities than ever before, placing stringent demands on the tape subsystems used to back them up.

A high density GCR tape subsystem is your logical choice for high performance backup.

Let's Talk Benefits

GCR packs data at 6250 bits per inch—a standard tape reel holds up to 180 megabytes of data! That translates into fewer tape mounts and rewinds, reducing operator involvement . . . and that's a saver. GCR also provides an outstanding improvement in read/write reliability. Time that was previously spent in retries and error recovery can now be used for computing. That's another saver!

Let's Talk Affordability

Until now, many thought GCR technology was out of their budget. Not anymore! At CCG - California Computer Group, our GCR subsystems start as low as $ **10,500**

Let's Talk Choice

You can't make the right choice unless you have a choice. And CCG helps you choose the right GCR subsystem for your DEC, DG, HP, PE and TI systems. Whether it's a Kennedy 9400, a CDC 92185 "Keystone" or a STC 2920 "Avalanche"

Let's Talk Expertise

At CCG, we're not just selling hardware . . . we're sharing knowledge. Our configuration specialists examine your needs, then help you determine the right GCR subsystem for your application.

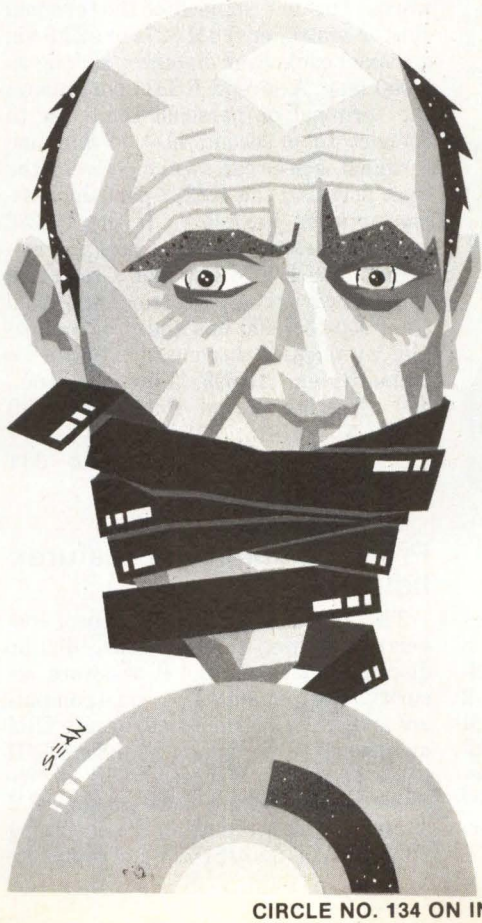
And CCG's been around—our clients include Lockheed, USC, TRW, Citibank, Mobil Oil, University of Chicago . . . even Notre Dame.

Let's Talk Teamwork

CCG works with you every step of the way . . . from your first call until your systems are up and running. And whenever you need us, we're only a phone call away.

Let's Talk . . . . .

There's so much more to talk about. Call us—we'll show you how CCG can put GCR to work for you!



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CIRCLE NO. 134 ON INQUIRY CARD

New Products

DATACOMM

Product combines modem with telephone

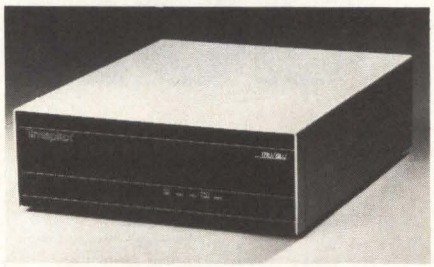
The Tel-A-Modem integrates an intelligent modem device into a two-line desk-type telephone. The product is compatible with all RS232C terminals and computers. Telephone features include audiovisual phone status, hold function for both lines, last-number automatic re-dial, nine-number memory automatic dialer and individual volume controls for ring signals and line monitor. Modem features include 300- and 1,200-baud data-transmission rates, full-duplex operating mode, automatic answer, automatic selection of baud rate and answer/originate tone, tone or pulse dialing and programmable signal interchange. Five LEDs provide modem status information. $695.95. **Code-A-Phone Corp.,** 16261 S.E. 130th Ave., Clackamas, Ore. 97015, (503) 655-8940.

Circle No 332

Device performs as async ASCII host

The MC-80/602 communications processor converts a general KSR device or an asynchronous ASCII host into a full-function IBM 3277-1, 3277-2 or 3278-2 terminal communicating with the IBM host using the EBCDIC binary synchronous communications protocol. The device supports IBM 3277/3278 virtual screen sizes of 480, 960 and 1,920 characters. It also supports all IBM 3277/3278 screen-formatting capabilities including auto-tabbing and protected or unprotected alphanumeric, numeric and non-display fields. The unit provides as much as 16K bytes of ROM, 16K bytes of RAM and one serial communications port. $1,650. **Innovative Electronics Inc.,** 4714 N.W. 165th St., Miami, Fla. 33014, (305) 624-1644 or (800) 327-3955.

Circle No 333



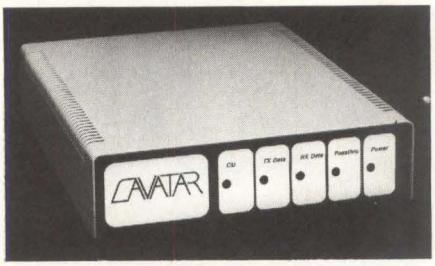
Protocol converter allows IBM 3278 emulation

The TRU/BLU 78 protocol converter permits an ASCII terminal or personal computer to substitute for IBM 3278 synchronous terminals in SNA networks. The unit connects to the terminal cluster controller (IBM 3274 or 3276) via a coaxial cable over distances as long as 5,000 feet. A second RS232 port allows the terminal or personal computer to connect to a second host. From one terminal, a user can switch between the coax port and the RS232 port, increasing network flexibility. If the RS232 port connects to a second host via modems, TRU/BLU 78 supports such features as password protection, autobaud from 300 to 9,600 bps and programmable automatic disconnect. Setup is menu-driven. $1,695. **Timeplex Inc.,** 400 Chestnut Ridge Road, Woodcliff Lake, N.J. 07675, (201) 930-4600.

Circle No 334

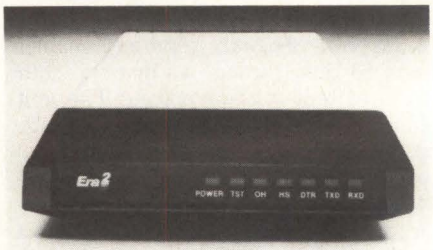
Protocol converter features help screens

The PA1000E universal protocol converter features help screens, dial-up disconnect and multilevel password security. The unit allows personal computers and ASCII terminals to access IBM mainframe environments and ASCII hosts locally or remotely. The device connects via coaxial cable to an IBM 3274/76 cluster controller supporting IBM BSC or SNA/SDLC environments



and through an auxiliary RS232C port to ASCII devices, including a printer or modem for connection to an asynchronous host, public information or time-sharing service. ROM-based help screens are available for personal computers such as the IBM PC running 3101 emulation software, the DEC Rainbow running VT100 emulation software and Apple's Macintosh running MacTerm and terminals such as the DEC VT100 and IBM 3101. An optional terminal-emulation software package, Compass, provides IBM 3278-2 and DEC VT100 emulation for MS-DOS-based microcomputers. $1,095 for the PA1000E, $100 for Compass. **Avatar Technologies Inc.,** 99 South St., Hopkinton, Mass. 01748, (617) 435-6872.

Circle No 335

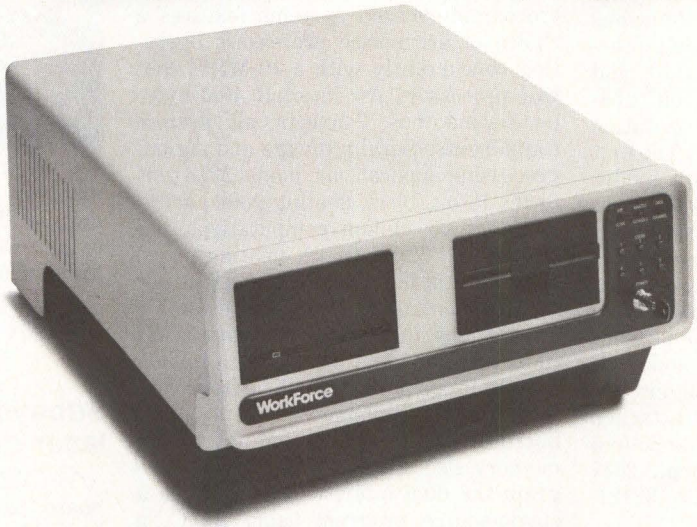


Modem provides error-free datacomm

The Era 2 SX/1200 standalone 1,200-baud modem implements the MNP machine-independent, error-correcting protocol. MNP detects transmission errors between Era 2 modems caused by line interference or low-quality telephone connections and retransmits lost or incorrectly received data. The product is Bell 212A-compatible, supports RS232 devices and can be rack-mounted. It can store as many as nine telephone numbers of 36 digits each, with battery backup. Prices start at $599. **Microcom Inc.,** 1400A Providence Highway, Norwood, Mass. 02062, (617) 762-9310.

Circle No 336

White Collar Worker. Blue Collar Worker.



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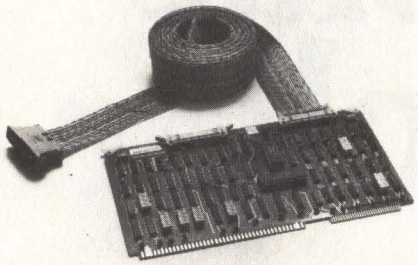
CIRCLE NO. 135 ON INQUIRY CARD

New Products

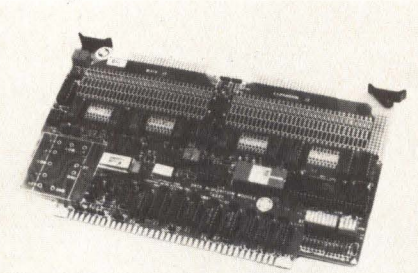
SUBASSEMBLIES



Versatec plotters connect to Multibus computers

The model 10071-5 interface connects Versatec printer/plotters to Multibus computer systems. The product's interface registers provide 8-, 16-, 20- and 24-bit address decode with inhibit capability, I/O or memory-mapped operation and 8- or 16-bit register access. The unit supports all Multibus interrupt modes and furnishes 8- and 16-bit DMA transfers with switch-selectable byte ordering in 16-bit mode at rates as high as 400K bytes per second. Other switch-selectable options include CBRQ/drive capability, parallel or serial bus priority and single-transfer or block-mode bus arbitration. The interface delivers on-board diagnostics without an attached printer/plotter. $2,000, including 25-foot cable and manual. **IKON Corp.,** 2617 Western Ave., Seattle, Wash. 98121, (206) 624-3410.

Circle No 337



Module performs 12-bit A/D conversions

The model GMS6520 EXORbus data-acquistion module provides 12-bit A/D conversions of 64 input channels and software programmability. It furnishes two banks each of 16 differential or 32 single-ended inputs. A programmed differential gain amplifier has gains of 1, 2, 5 and 10 and multipliers of 1, 4 and 10. Each channel can be software-programmed for single-ended or differential operation to full-scale voltage for unipolar or bipolar inputs. Full-scale inputs are 0V to 5V, 0V to 10V, ±5V, ±10V, ±2.5V, ±10.24V or ±5.12V. $680. **General Micro Systems Inc.,** 1320 Chaffey Court, Ontario, Calif. 91762, (714) 621-7532.

Circle No 338

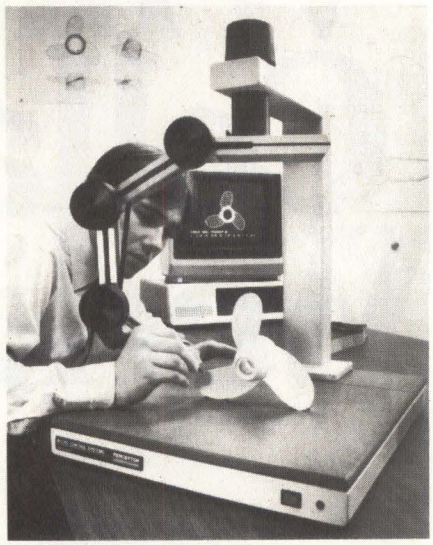
Array processors feature dual processors

The Zip 3200 series of software-programmable array processors for microcomputer-based systems features a choice of arithmetic processors operating concurrently with a 10-MIPS control processor. An internal 40M-byte-per-second bus connects all system components. Serving image and signal-processing applications, model 3216 performs 16-bit (block floating-point) arithmetic at 20 million computations per second and 32-bit (block floating-point) arithmetic at 5 million computations per second. Serving graphics and scientific applications, model 3232 performs 32-bit (floating-point) arithmetic at 10 million computations per second. The basic configuration is implemented on a three-board Multibus card set and has a main memory size of 128K bytes. Users program the dual internal processors in a single-source program using Zip/C, a programmable language that employs a C-like syntax. $8,000 and $10,000 for the Zip 3216 and Zip 3232, respectively. **Mercury Computer Systems Inc.,** Wannalancit Technology Center, 600 Suffolk St., Lowell, Mass. 01854, (617) 458-3100.

Circle No 339

3-D digitizer has on-board intelligence

The Perceptor electromechanical digitizer can acquire 3-D points at the rate of seven x, y and z coordinates per second and send them over an RS232 interface to computers that accept serial inputs. The product consists of a precision-machined digitizing arm attached to a frame that is mounted on a ground aluminum reference plate. A Z80A-based circuit board enclosed in a metal housing beneath the reference place performs the electrical data-acquisition functions. Applications include interactive 3-D CAD, contour analysis of objects that fit within the unit's work volume, medical applications and field mapping of various information by fixing specific sensors to the device's pointer tip. Contact the company for price. **Micro Control Systems Inc.,** 27 Hartford Turnpike, Vernon, Conn. 06066, (203) 647-0220.



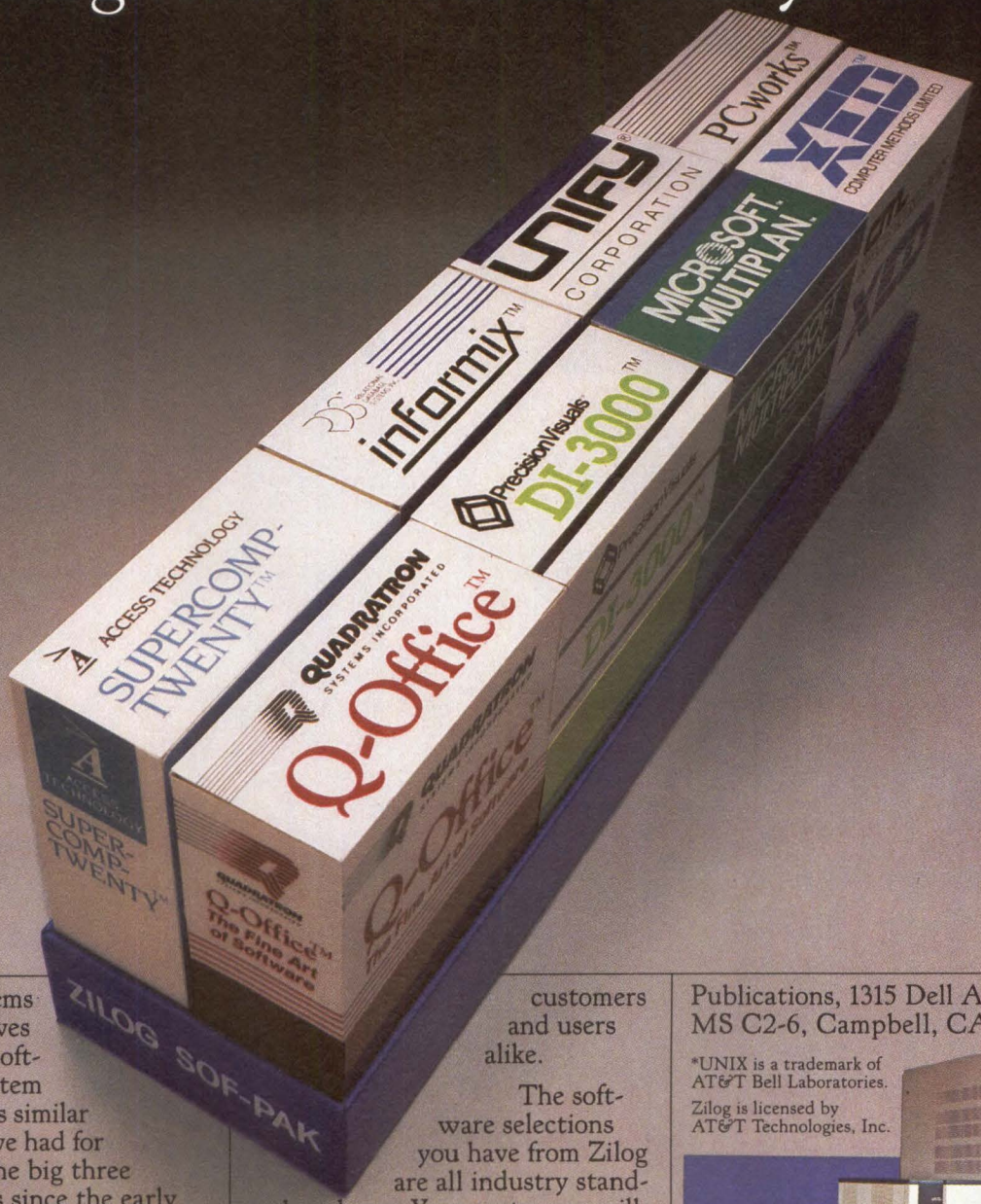
Circle No 340

Subsystem combines laser-disk video, graphics

The V:Link 1000 video-disk controller board package for the IBM PC and look-alikes consists of a plug-in board and associated software. The package generates computer graphics, passes control commands to video-disk players and reads digitally encoded data, such as frame numbers, from the video disk. Users can generate graphics that cover a screen or overlay graphics on video. Users can also move animated images around the screen in real-time with a standard input device such as a tablet. Mapped into eight contiguous 8088 I/O addresses, the board contains a graphics processor, a disk player communications processor and a data-decoding processor. The graphics processor provides 256-by-192-pixel resolution, 16 colors, including transparent, and 33 graphics planes. Software includes a library of control subroutines callable from BASIC, Pascal and C; a graphics-definition package that provides facilities for interactively defining graphics, animation and text; and a BASIC language-development system. $1,150. **Visage Inc.,** 12 Michigan Drive, Natick, Mass. 01760, (617) 655-1503.

Circle No 341

Zilog now gives users of the System 8000 the kind of choice the big three cereal companies have given breakfast eaters for years.



Zilog Systems Division now gives you a choice in software for the System 8000 supermicros similar to the kind you've had for breakfast from the big three cereal companies since the early 1960's. You get to select the software you need when you need it. It's an easy and practical way to satisfy individual tastes.

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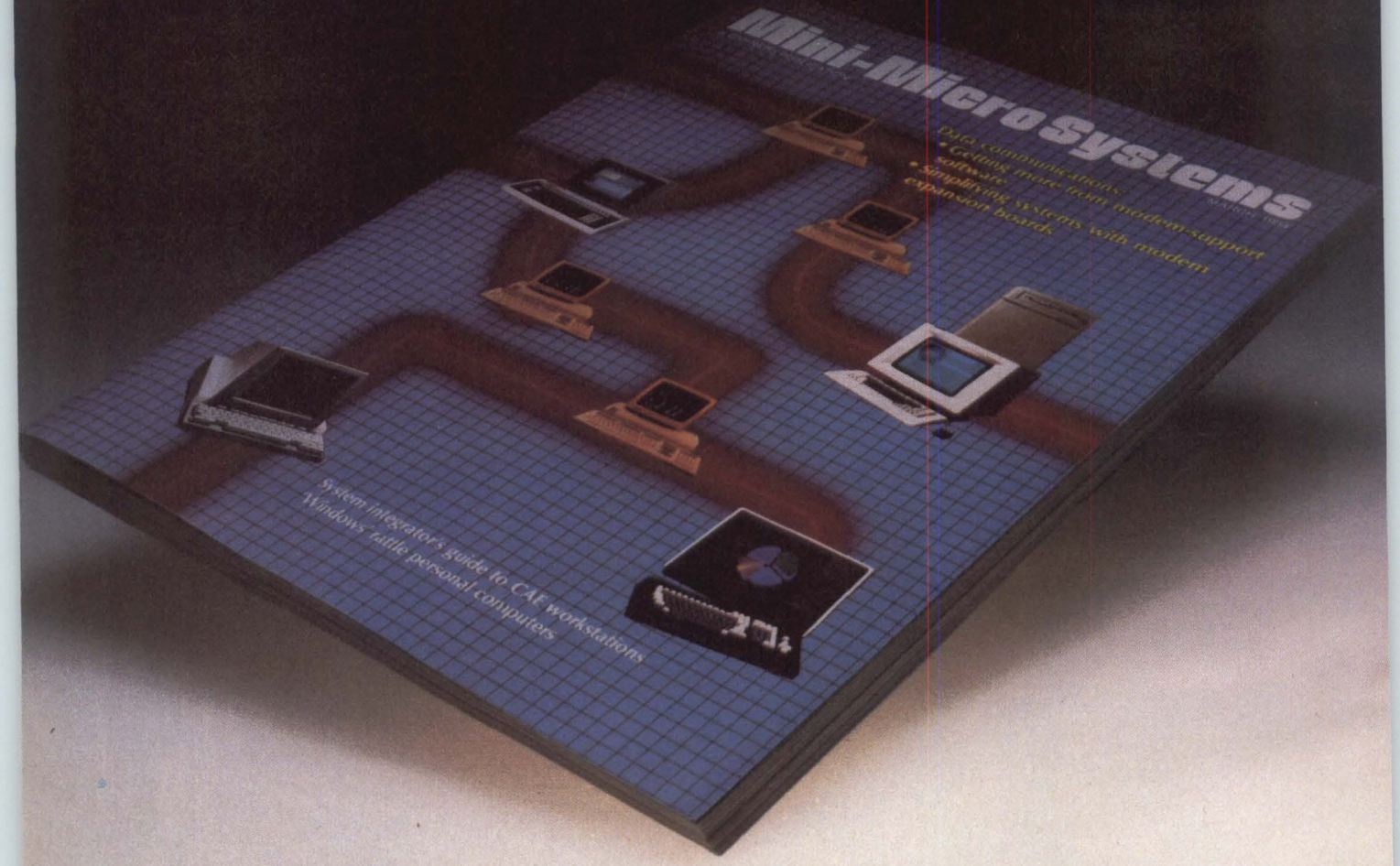
CIRCLE NO. 136 ON INQUIRY CARD

This year Mini-Micro Systems readers will spend almost $50 billion on Minicomputers and Microcomputers*



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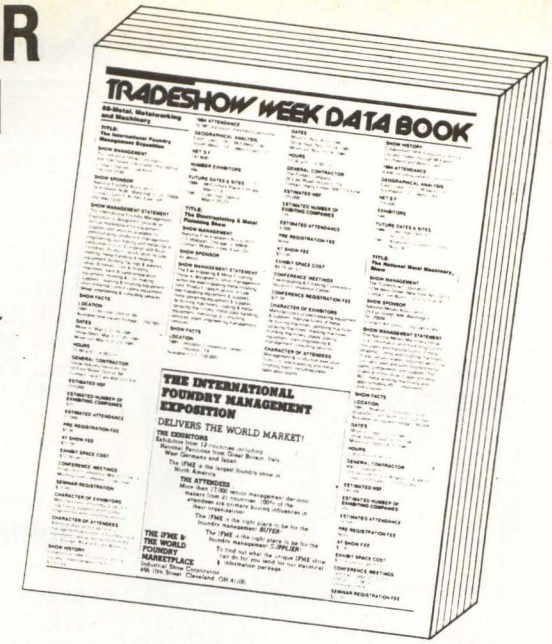

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CIRCLE NO. 138 ON INQUIRY CARD

New Products

LITERATURE

Brochure describes MM series of digitizers

This four-page brochure describes the company's MM series of digitizers. It features technical data, interface options, physical data, accessories and photographs of the products in use. **Summagraphics Corp.,** 777 State St. Extension, P.O. Box 781, Fairfield, Conn. 06430, (203) 384-1344.

Circle No 342

Guide covers video data acquisition

Written for engineers who want to configure a video data-acquisition system, this four-page product-selection/designer's guide introduces the company's PC-Eye Capture System. The guide covers text capture, pseudo-color, camera considerations, lenses, speed, hard copy, accessories, system configuration and specifications. **Chorus Data Systems Inc.,** P.O. Box 810, Hollis, N.H. 03049, (603) 465-7100.

Circle No 343

Catalog lists datacomm products

This data-communications products catalog describes the company's line of switches for data terminals, printers, computer ports, modems, multiplexers, concentrators and front-end processors. The catalog also details null modems, data cables and modem/terminal interface testers. The publication includes a wall chart that describes the pin/signal relationship at the industry-standard EIA RS232 data-communications interface. **Electro Standards Laboratory Inc.,** P.O. Box 9144, Providence, R.I. 02940, (401) 943-1164.

Circle No 344

Catalog covers Multibus products

This 248-page catalog details the company's Multibus product line of more than 70 products, including single-board computers, memory modules, I/O extenders and analog and peripheral controllers. The catalog includes brief descriptions of the IEEE 796 bus (Multibus) and the IEEE P959 bus (iSBX) specifications. **Symbicon Associates Inc.,** 89 Route 101A, Amherst, N.H. 03031, (603) 673-8898.

Circle No 345

Guide aids LAN planning

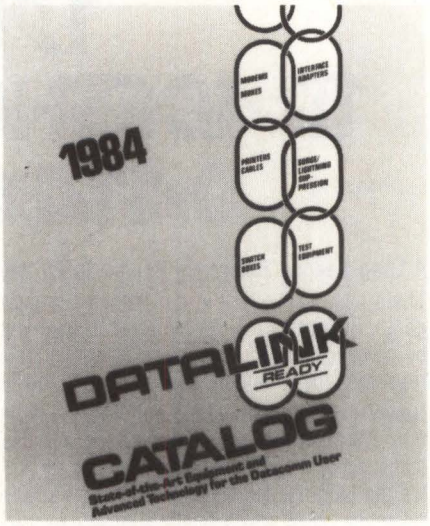
"How to Stay Calm When Your Company's Getting Wired," an easy-to-read guide to LAN planning, defines the three primary LAN technologies: baseband, broadband and PBX. The guide identifies and discusses 13 basic planning criteria covering topics such as areas served, interconnections, topology (star, bus or tree), adaptability (ease of changing service), resource sharing, security, adherence to network standards and mixed services (voice, video and data). **Sytek Marketing,** 1225 Charleston Road, Mountain View, Calif. 94043, (415) 966-7330.

Circle No 346

Technical manual specifies STD-bus products

The STD-bus technical manual and product catalog contain specifications and data sheets on the company's STD bus product line. The product catalog covers memory and I/O cards, motherboards, card racks, utility cards, prototyping aids and power supplies. Each data sheet covers features; operational, electrical, environmental and mechanical specifications; functional capabilities; options; and ordering information. **Pro-Log Corp.,** 2411 Garden Road, Monterey, Calif. 93940, (408) 372-4593.

Circle No 347



Communications catalog lists 1,000 products

This 160-page catalog lists more than 1,000 data-communications products including modems, multiplexers, interface adapters, loop converters, surge suppressors, cables and accessories. The publication includes a section on telecommunications references and standards. **Datalink Ready Inc.,** P.O. Box 2169, Melbourne, Fla. 32902, (305) 676-0500.

Circle No 348

Literature outlines VMEbus modules

This six-page color brochure describes the company's VMEbus-compatible product line, including a UNIX-based development system, single-board microcomputers, I/O cards, memory cards and disk and graphics controllers. **DY-4 Systems Inc.,** 1475 S. Bascom Ave., Suite 200, Campbell, Calif. 95008, (408) 377-9822.

Circle No 349

Brochure details Pick-based computers

This six-page color brochure describes the Sabre family of multiuser, multitasking computers that support the Pick operating system. The brochure highlights the Pick operating system, the company's System Builder application generator and hardware specifications. **Pertec Computer Corp.,** Mail Station 71-81, 17112 Armstrong Ave., Irvine, Calif. 92714, (714) 660-0488.

Circle No 350

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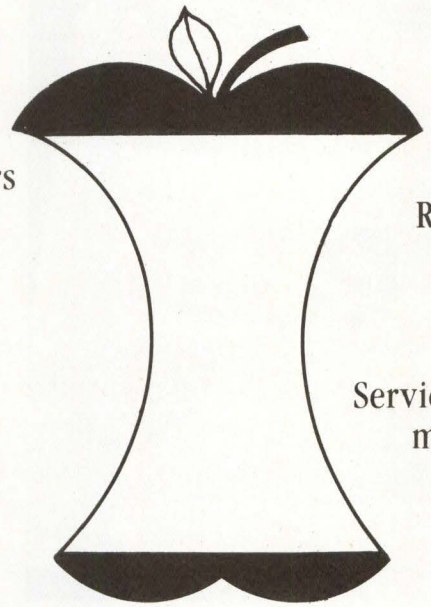

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CIRCLE NO. 139 ON INQUIRY CARD

New Products

LITERATURE

Handbook covers software design, use

Edited by Charles R. Vick and C.V. Ramamoorthy, the *Handbook of Software Engineering* shows how to apply software engineering tools and techniques at each stage of software development. The 720-page handbook, which contains 285 illustrations, explains simulation modeling, data design, operating systems, management of software development, software testing technology, database management and system evaluation. It discusses strategies for hardware/software trade-offs, performance measurements, fault-tolerance techniques and formal verification procedures. $62.50. **Van Nostrand Reinhold,** 135 W. 50th St., New York, N.Y. 10020, (212) 265-8700.

Circle No 351

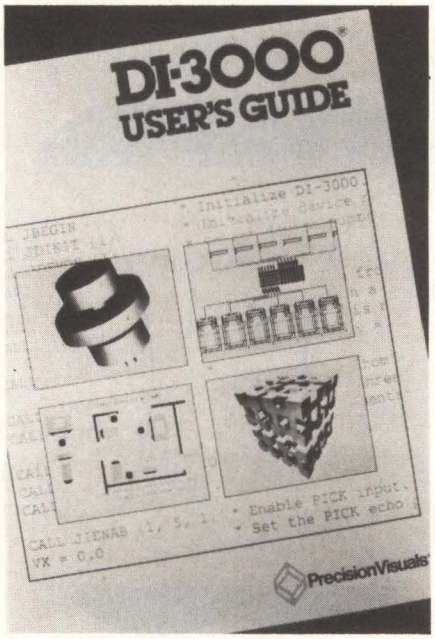
Volumes cover microcomputer interfacing

The Micro-Match two-product service covers planning, installing and interfacing of microcomputers. The first product, Blueprints, includes ready-to-use interface diagrams and step-by-step interface instructions for implementing a working interface between microcomputers, CRTs, modems, printers, plotters and special input/output devices. Blueprints contains pin-to-pin cable designs, switch-setting diagrams, jumper configurations, device specifications and interface notes for hundreds of device pairs. The second product, Access Forum, assists data-processing professionals in integrating microcomputer technology into computer environments. The products are updated quarterly. $690 per year. **Command Computer Corp.,** P.O. Box 5096, Philadelphia, Pa. 19111, (215) 745-5555.

Circle No 352

Graphics software user's guide provides tutorials

The revised and expanded, 500-page users' guide for the DI-3000 graphics software tools package contains a detailed, step-by-step tutorial that presents the basic concepts of device-independent graphics; more than 200 illustrations, including color plates depicting DI-3000's hue/saturation/lightness color capabilities; a reference section; more than 100 partial programs that illustrate commonly used graphics functions; and nine annotated programs that can be used as prototypes for basic business graphs, slide generation and 3-D modeling applications. $35. **Precision Visuals,** 6250 Lookout Road, Boulder, Colo. 80301, (303) 530-9000.



Circle No 353

Directory details 400 UNIX packages

The second edition of the *UNIX Applications Software Directory* lists almost 400 software packages in 27 categories. Each listing provides the package's price and hardware requirements and its supplier's name, address and telephone number. The directory also includes a cross-reference matrix, in which software is listed by major function and application. $50. **Onager Publishing,** 6451 Standridge Court, San Jose, Calif. 95123, (408) 225-3541.

Circle No 354

Report outlines software distribution

The 180-page "Microcomputer Software Distribution" report focuses on evolving distribution patterns and strategies for microcomputer software from 1983 through 1990. According to the report, retail outlets and direct responses accounted for 78 percent of all microcomputer software distributed in 1983. The study predicts that, as these two channels decline in importance, computer and software franchises will become the primary channel for the rest of the decade. The report also forecasts software sales by type of outlet through 1990. $985. **Find/SVP, Information Products Division,** 500 Fifth Ave., New York, N.Y. 10110, (212) 354-2424.

Circle No 355

EIA directory lists member organizations

The 60th anniversary edition of the *EIA Trade Directory and Membership List* lists the Electronic Industries Association's members, associates, affiliates, corporate locations, division locations, telephone numbers, top-level management personnel, products manufactured and corporate trade names. It also records the EIA's board of governors, association committee organizations and the officers and staff of EIA's groups, divisions, departments, councils and panels. $25 for EIA members, $50 for non-members. **Electronic Industries Association,** 2001 Eye St., N.W., Washington, D.C. 20006, (202) 457-4980.

Circle No 356

Study examines artificial intelligence

The two-volume "Artificial Intelligence—A New Tool for Industry and Business" shows how AI will affect product manufacturing, research, teaching and training workers, computer programming, business management and decision making. Volume 1 discusses AI technology and its applications and includes a market analysis and forecast for each application. Volume 2 presents the AI programs of U.S. universities. This volume summarizes ongoing projects, lists available research reports and presents contacts for more information. $485. **Technical Insights Inc.,** P.O. Box 1304, Fort Lee, N.J. 07024, (201) 944-6204.

Circle No 357

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Calendar

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17-19 **"Industrial Robots" Course,** Center for Robotics Research of the University of Cincinnati, Cincinnati, sponsored by the University of Cincinnati. Contact: Susan Lyons, Mechanical and Industrial Engineering Department Mail Location 72, University of Cincinnati, Cincinnati, Ohio 45221, (513) 475-4387 or (513) 475-2738.

17-19 **Data Storage '84,** Fairmount Hotel, Denver, sponsored by Disk/Trend Inc. and Freeman Associates. Contact: Cartlidge & Associates Inc., 4030 Moorpark Ave., Suite 205, San Jose, Calif. 95117, (408) 554-6644.

17-21 **C Programming Workshop,** San Diego, sponsored by Plum Hall Inc. Contact: Joan Hall, Plum Hall Inc., 1 Spruce Ave., Cardiff, N.J. 08232, (609) 927-3770.

17-24 **FOC/LAN '84,** Las Vegas, Nev., sponsored by Information Gatekeepers Inc. Contact: Michael O'Bryant, General Manager, Information Gatekeepers Inc., 138 Brighton Ave., Boston, Mass. 01234, (617) 787-1776.

18-20 **SEMICON/East '84,** Boston, sponsored by Semiconductor Equipment and Materials Institute Inc. Contact: Mary Beth Kern, Semiconductor Equipment and Materials Institute, 625 Ellis St., Suite 212, Mountain View, Calif. 94043, (415) 964-5111.

18-20 **Federal Computer Conference,** Washington Convention Center, Washington, sponsored by National Council for Education on Information Strategies. Contact: (617) 358-5301.

18-21 **"Implementing Local-Area Networks" Course,** San Diego, sponsored by Integrated Computer Systems, 6305 Arizona Place, P.O. Box 45405, Los Angeles, Calif. 90045, (213) 417-8888, (800) 352-8251 or (800) 421-8166.

19-20 **Factory Systems Seminar,** New York, sponsored by The Yankee Group. Contact: Lisa Caruso, Seminar Director, The Yankee Group, 89 Broad St., Boston, Mass. 02110, (617) 542-0100. Also to be held Sept. 26-27 in San Francisco.

19-28 **35th International Exhibition of Data Processing, Teleprocessing, Communication, Office Procedures and Office Systems (SICOB),** CNIT, La Defense, Paris, sponsored by International Trade Exhibitions in France Inc. Contact: Pierre Wagner or Claire Bring, International Trade Exhibitions in France, 8 West 40th St., New York, N.Y. 10018, (212) 869-1720.

20-21 **"Intelligent Robots" Course,** Center for Robotics Research of the University of Cincinnati, Cincinnati, sponsored by the University of Cincinnati. Contact: Susan Lyons, Mechanical and Industrial Engineering Department, Mail Location 72, University of Cincinnati, Cincinnati, Ohio 45221, (513) 475-4387 or (513) 475-2738.

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IMAGE CAPTIONS

Top:

- *Left back corner: 2-D FFT processed in 2 minutes with LIPS Plus.*
- *Four 1024^2 medical images: multimodality, split screen display.*
- *Face: CT scans in 3-D modeling, plastic surgery at Mallinckrodt.*
- *Mountains: LIPS assists fast graphics hardware and large memory matrices with GKS-based Auxiliary Graphics Processor. Courtesy S.A.I.*
- *Pseudo-colored flowers: shows LUT manipulations. Note graphic load display plus intensity reference scale.*
- *Same 1024^2 flowers: shows color cut and paste in 1 frame time.*
- *Jars and pens: Synthetic image like #4, courtesy Pacific Data Images. Photo by Jim Weil.*

Bottom:

- *Two corners: LIPS driver supports 1024^2 LANDSAT imagery, courtesy NASA-Ames Research.*
- *Top bas relief: Matrix filter, the basis of classification and recognition. LIPS allows kernels of any shape and size and executes at video rates.*
- *Histogram: line or pixel analysis under LIPS.*
- *Spheres: fast Z-buffer merge, courtesy Rensselear.*
- *Cake and strawberries: 1024^2 looks good enough to eat.*
- *Bottom: mesh algorithm, courtesy Lunar & Planetary.*
- *Weather satellite: shows graphics overlay, courtesy MacDonald Dettwiler.*

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Calendar

24-25 **World Conference on Ergonomics in Computer Systems,** Los Angeles, produced by World Conference on Ergonomics in Computer Systems. Contact: Robert W. Bailey, Ph.D., Computer Psychology Inc., 54 E. Main St., P.O. Box 16, Mendham, N.J. 07945, (201) 543-9009. Also to be held on Sept. 25-26 in Dallas, Sept. 26-27 in Chicago, Sept. 27-28 in New York, Oct. 1-2 in London, Oct. 3-4 in Dusseldorf, West Germany, and Oct. 4-5 in Helsinki, Finland.

24-26 **PCExpo,** Anaheim Convention Center, Anaheim, Calif., sponsored by PCExpo Shows. Contact: Steven Gross, PCExpo Shows, 333 Sylvan Ave., Englewood Cliffs, N.J. 07632, (201) 569-8542.

25 **Invitational Computer Conference,** Southfield/Detroit. Also Oct. 10 in Cherry Hill, N.J. and Oct. 23 in Englewood/Denver, Colo. Contact: Susan Fitzgerald, conference manager C-2, 3151 Airway Ave. Costa Mesa, Calif. 92626, (714) 957-0171.

25-27 **International Industrial Controls Conference & Exposition (IIC '84),** Philadelphia Civic Center, Philadelphia, organized by Tower Conference Management Co. Contact: Lowell B. Koppel, General Program Chairman, Tower Conference Management Co., 331 Wesley St., Wheaton, Ill 60187, (312) 668-8100.

26-27 **Ottawa Computer & Office Automation Show,** Lansdowne Park, Ottawa, organized by Industrial Trade Shows. Contact: Robert Grainger or Peter McLean, Show Managers, or James K. Mahon, Group Show Manager, Industrial Trade Shows, 20 Butterick Road, Toronto, Ontario M8W 3Z8, (416) 252-7791.

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1-4 **INFO: Information Management Exposition and Conference,** New York Coliseum, New York, sponsored by Clapp & Poliak, a Cahners Exposition Group. Contact: INFO, Cahners Exposition Group, 999 Summer St., P.O. Box 3833, Stamford, Conn. 06905, (203) 964-0000.

1-4 **"Make the Right Connections," NATA's 1984 Convention and Exhibition Showcase,** Sheraton Washington Hotel, Washington D.C., sponsored by North American Telecommunications Association. Contact: Karen Palermo, NATA, Suite 550, 2000 M St., N.W., Washington, D.C. 20036, (202) 296-9800.

2-4 **Northcon '84 High-Technology Electronics Exhibition and Convention,** Seattle, produced by Electronic Conventions Inc. Contact: Nancy Hogan or Kent Keller, Electronic Conventions Inc., 8110 Airport Blvd., Los Angeles, Calif. 90045, (213) 772-2965.

2-4 **Mini/Micro Northwest '84 Computer Conference and Exhibition,** Seattle, produced by Electronic Conventions Inc. Contact: Nancy Hogan or Kent Keller, Electronic Conventions Inc., 8110 Airport Blvd., Los Angeles, Calif. 90045, (213) 772-2965.

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The Printronix commitment to produce quality printers engineered for reliability, durability and performance has contributed to the phenomenal growth of our company over the past several years, AND we're still growing! Because 1984 promises to be yet another year of growth and success, we need to expand the depth of our Engineering Department. The following opportunities are currently available:

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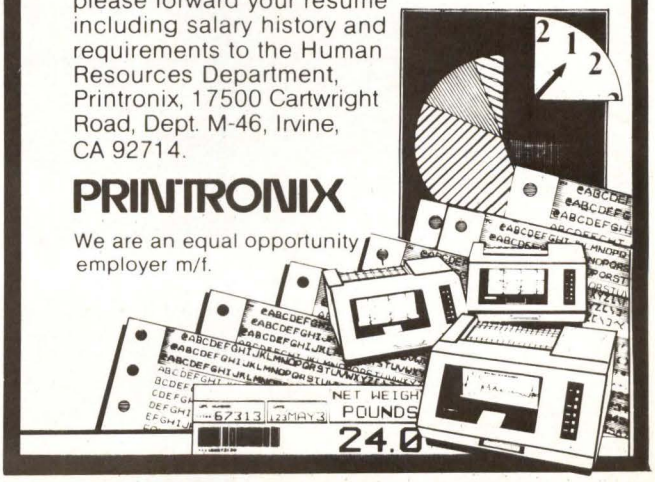

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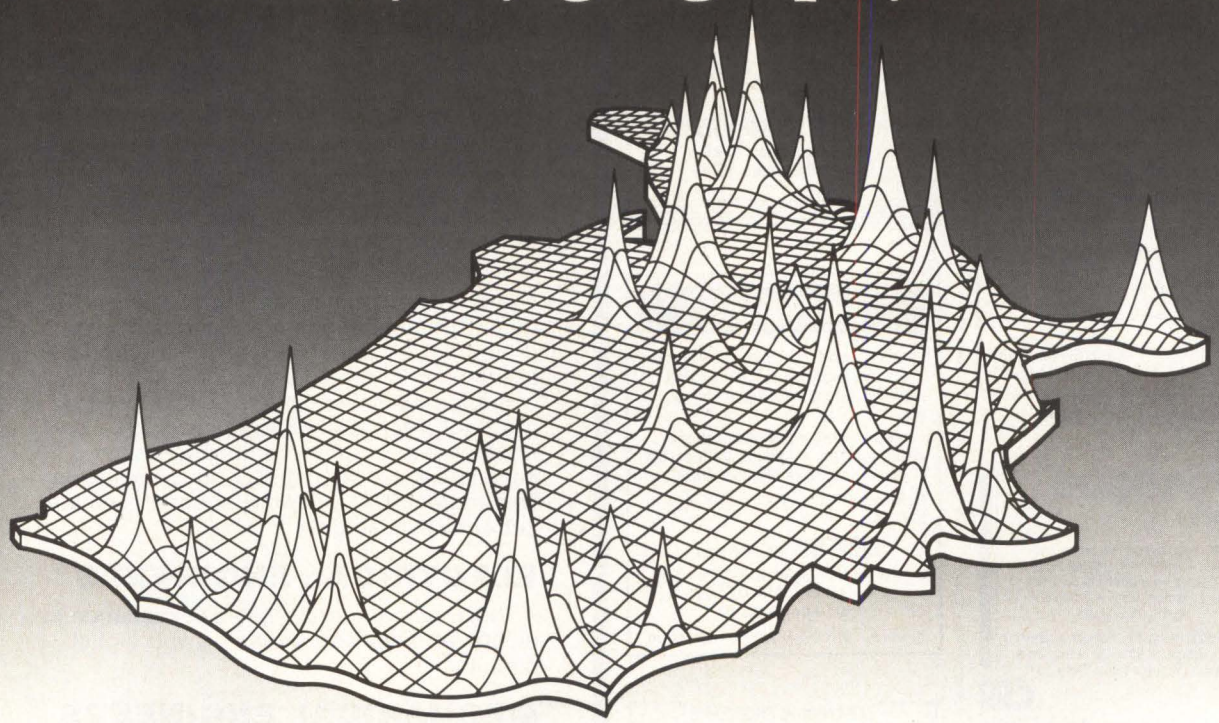

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Advertisers Index

Able Computer 169
ADAC Corp. 48
Advanced Digital Corp. 18
Advanced Electronic Design (AED) 254
Alcatel/Thomson Gigadisc 268
American Federation of Information Processing Societies, Inc. (AFIPS) 129, 131
Ampex Corp., Computer Products Div. 170-171
Anadex Inc. 55
Apollo Computers 56-57
Applied Data Communications 258
Applix Inc. 134
Atasi Corp. 222-223
Atron 280
AT&T Technologies, Inc. 12-13, 114-115
Bridge Communications 156-157
C. Itoh Electronics E3
Cahners Exposition Group 277
CalComp 160
California Computer Group 269
California Data Link 62
Cambridge Digital Systems (Div. of Compumart) 91
Centronics Data Computer Corp. . . 197
Century Data Systems (a Xerox Co.) 265
Chrislin Industries, Inc. 4
CIE Systems 49
CIE Terminals 14, 21
Cipher Data Products, Inc. 92-93
Citizen America 26-27
Codex Corp. 245
ComDesign 228
Compaq Computer Corp. 220-221
CompuPro 25
Control Data Corp.—Business Prod. Group 20
Control Data Corp.—Eng. Services 200
Control Data Corp.—OEM 147
Convergent Technologies 132-133
Craig Data Cable 118
Cromemco Inc. 6-7
CTS Corp.-Datacomm Products . . . 267
Daisy Systems 177
Danish Data Electronics E8-E9
Data General Corp. 162
Dataproducts 75, 106, 178
Datasouth Computer Corp. 185
Data Technology Corp. (DTC) 47
Delta Airlines 208
Digi-Data Corp. 61
Digilog Business Systems (DBS) . . 214
Digital Datacom Inc. 271
Digital Engineering 198-199
Digital Equipment Corp. 120-123
Digital Laboratories, Inc. 196
Dilog (Distributed Logic Corp.) 212-213
Dual Systems 52
Dysan Corp. 211
Electronic Conventions 74
Elsevier Science Publishing Co. . . 106
Emulex Corp. 40-41
Epson America, Inc. C3
Facit Inc. 194
Falco Data Products 67
Gould Inc., Computer Systems Div. 5, 108-109
Gould Inc., Imaging Div. 281
Gould Inc., Software Div. 237
Hayes Microcomputer Products . 68-69
Hermes Precisa Intl. 191
Hewlett-Packard 1, 192-193, 248
Houston Instrument Div. of Bausch & Lomb 259
Human Designed Systems Inc. (HDS) 39
IBC/Integrated Business Computers 22, 251
Ibex Computer 146
IBM Corp. 97
Imagen Corp. 256
Infotron Systems Corp. 238
Intercontinental Micro 36
Intermec Inc. 189
Invitational Computer Conferences 279
Iomega Corp. 76
Karl Leister 196
Kennedy Co. C2
Lear Siegler Inc. 166
Liberty Electronics USA 119
Logical Microcomputer 136
Madzar Corp. 62
Mannesmann Tally 183
Marinco Computer Products . . 124-125
Maxell Computer Products Div. . . . 86
Maxtor Corp. 145
MCG Electronics 260
Megatek Corp. 172-173
Memotech 73
Metacomp 60
Micom Systems Inc. C4
Micro Peripherals Corp. 146
Micro-Term 126
Mini-Micro Systems E10, 201, 274
Mitsubishi Electronic America 63
Mostek Corp. 64-65
Multi Solutions 79
NCR Corp. 158-159
Network Products 42
Novell Data Systems 113
Okidata Corp. 174, 217
Olivetti E7
Oregon Software 218
Oriental Motor USA 210
Pacific Microcomputers 101
Philips Peripherals 71
Plexus Computers 98
Precision Visual 153
Priam 28-92
Pyramid Technology 243
Qualogy Inc. 232-233
Quantum Corp. 180-181
Quantum Software 263
Qubix 150
Racal-Vadic Inc. 234
RDS-Relational Database Systems 137-139
Rodime 10
Rosscomp Corp. 140-141
Scientific Micro Systems 142
Seiko Instruments USA 154
SGS Systems Div. 83
Shugart Corp. 8-9
Simpact Assoc. Inc. 44
Solana Electronics 4
Symbol Technology 50-51
Systech 17
Tandon Corp. 84-85
Tekelec 224
TeleVideo Systems Inc. . . 94, 204-205
Telex Computer Products Inc. 116
Teltone Corp. 110
Texas Instruments Inc. 186
Toei Electronics 80
Tradeshow Week Inc. 275
Unify Corp. 107
Unisoft Systems 207
Unitronix 261
Universal Data Systems Inc. . . 240-241
Verbex 102-103
Vertex Peripherals 227
Visual Technology Inc. 246-247
West Computer E4
Westrex OEM Products 266
Wyse Technology 148-149
Xebec 230-231
Zetaco Div. of Custom Systems . . . 165
Zilog Inc. 273
Zitel 252
Ziyad 59

See P. 283 for Classified Advertisers
See P. 284-287 for Career Opportunity Advertisers
See P. 289-290 for Mini-Micro Marketplace

*Please note any page number with an E proceeding it will appear in the Foreign edition only.

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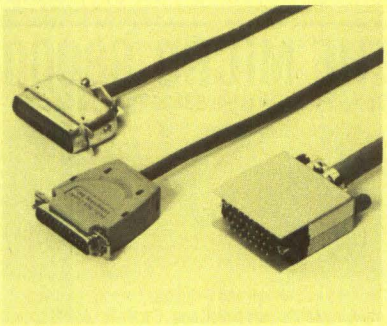

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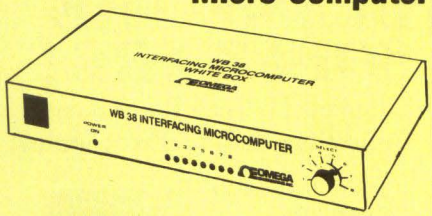

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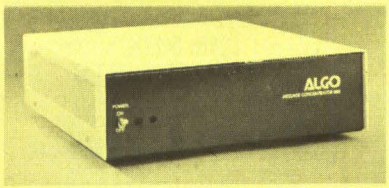

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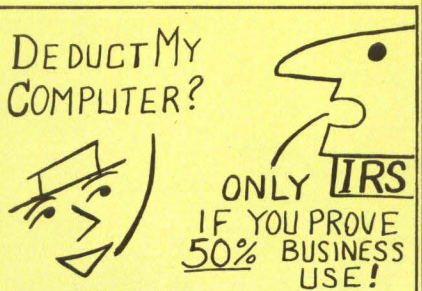

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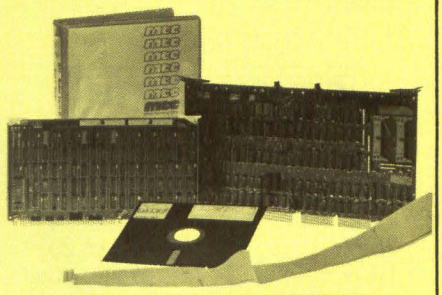

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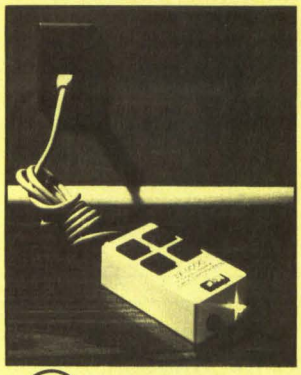

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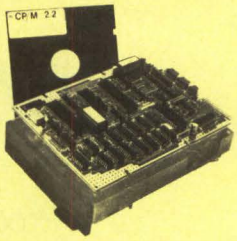

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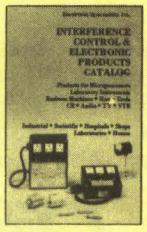

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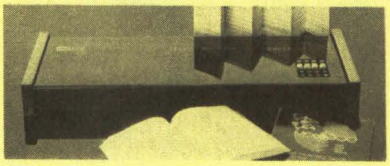

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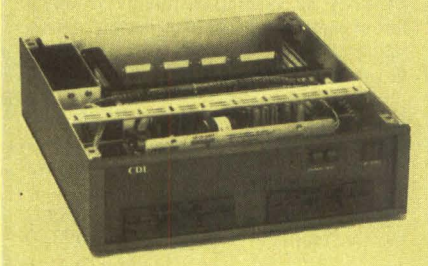

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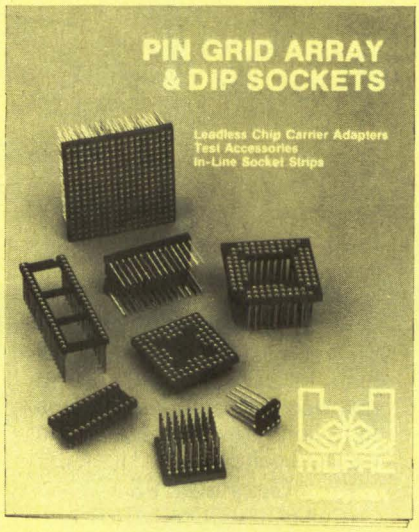

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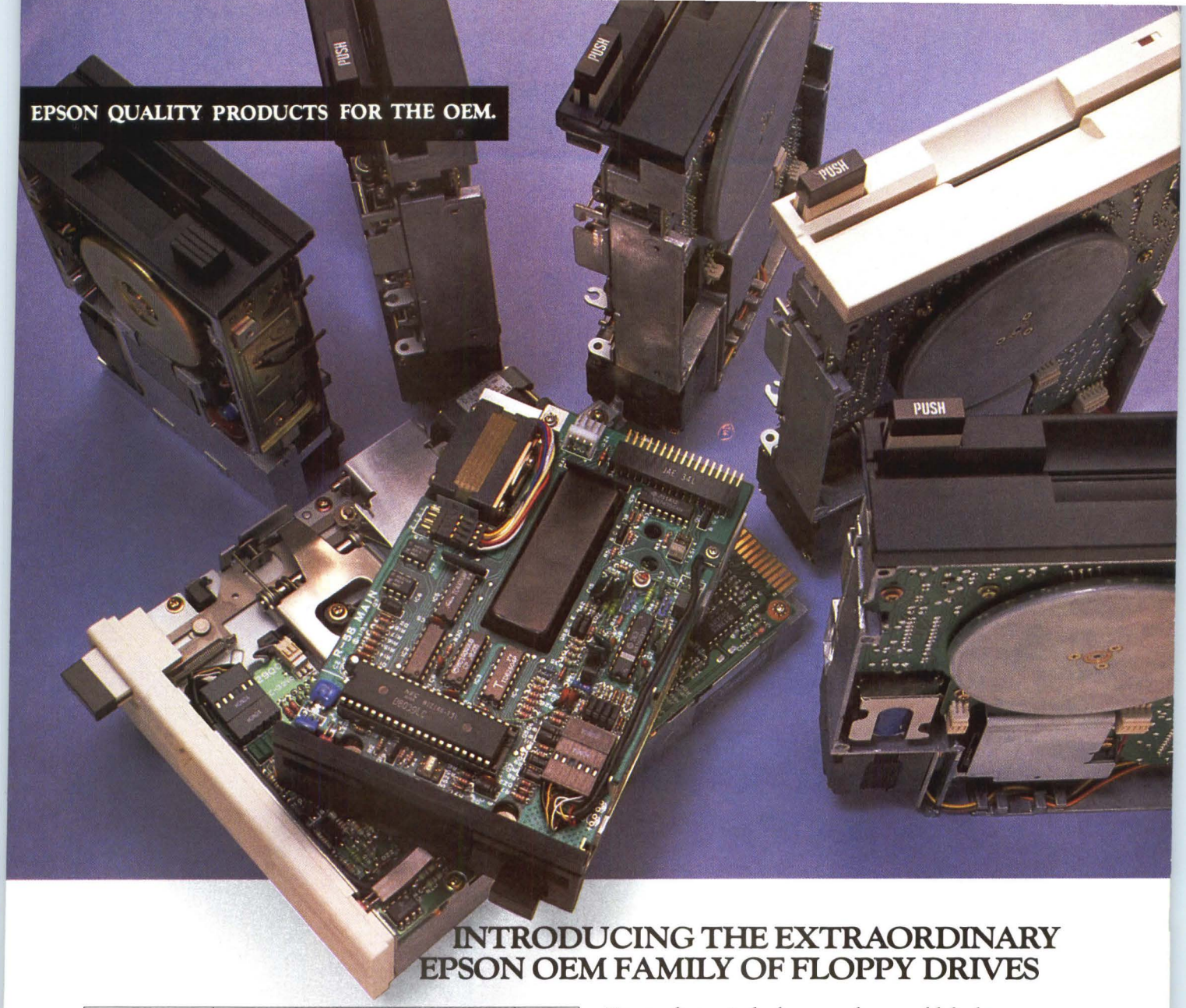

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