Mini-Micro Systems

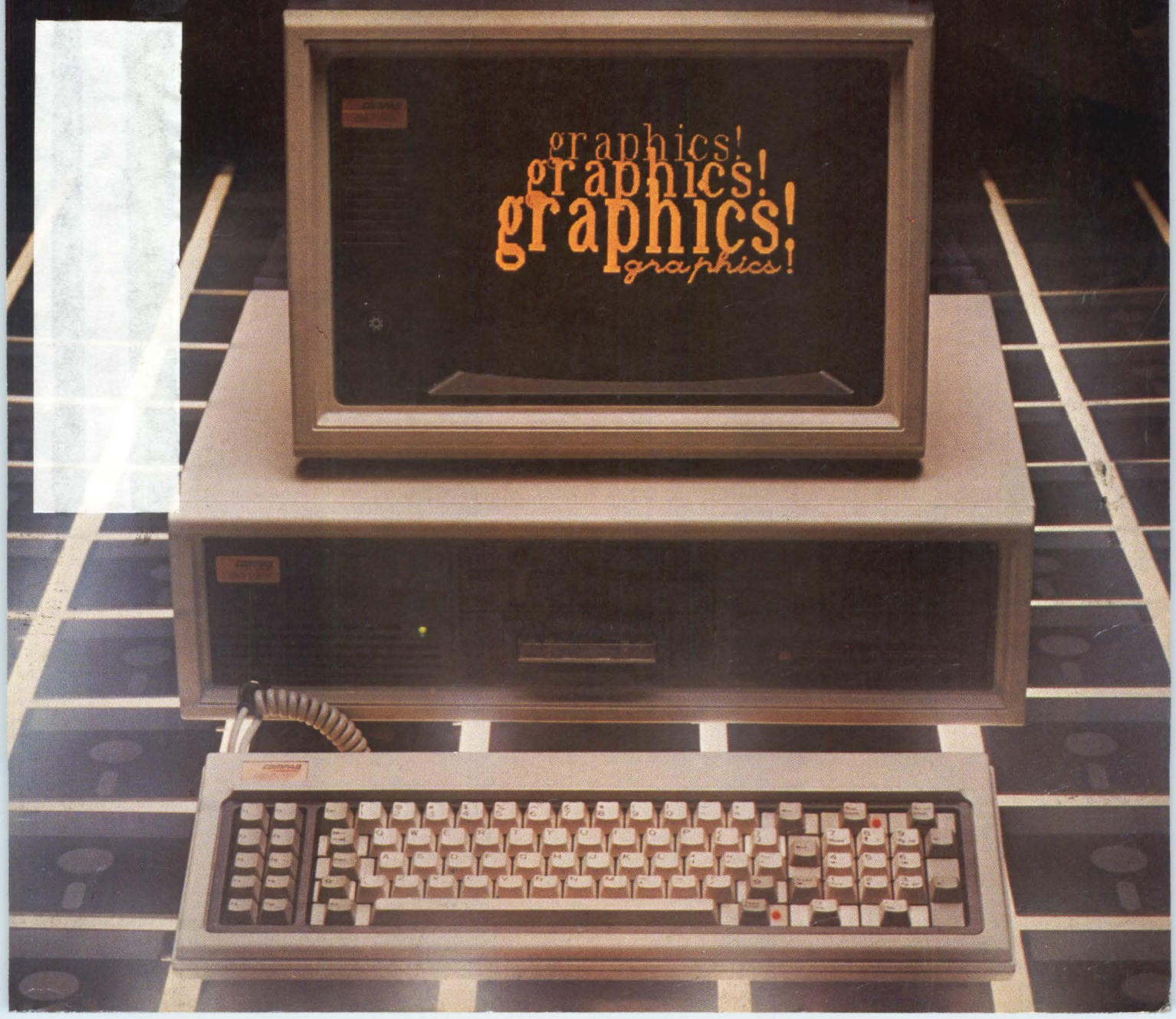
A CAHNERS PUBLICATION

JULY 1984

Better vision systems create smarter robots

Raster-based desktop plotters draw attention with speed and color

Compaq's speedy Bullet strengthens PC-compatible line



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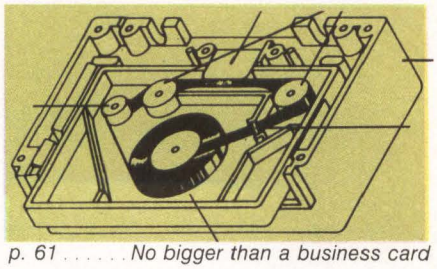

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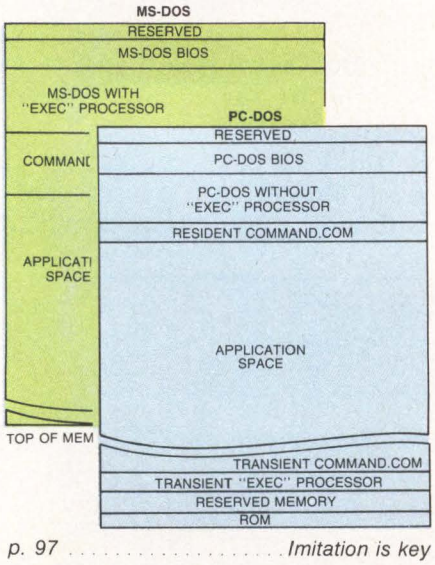
MS-DOS VS. PC-DOS: THE MEMORY ARCHITECTURES DIFFER



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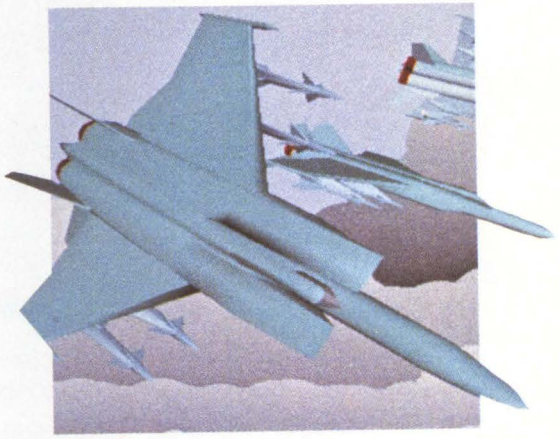

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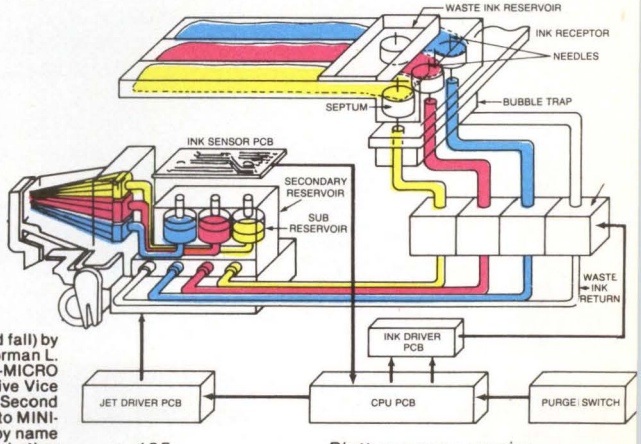

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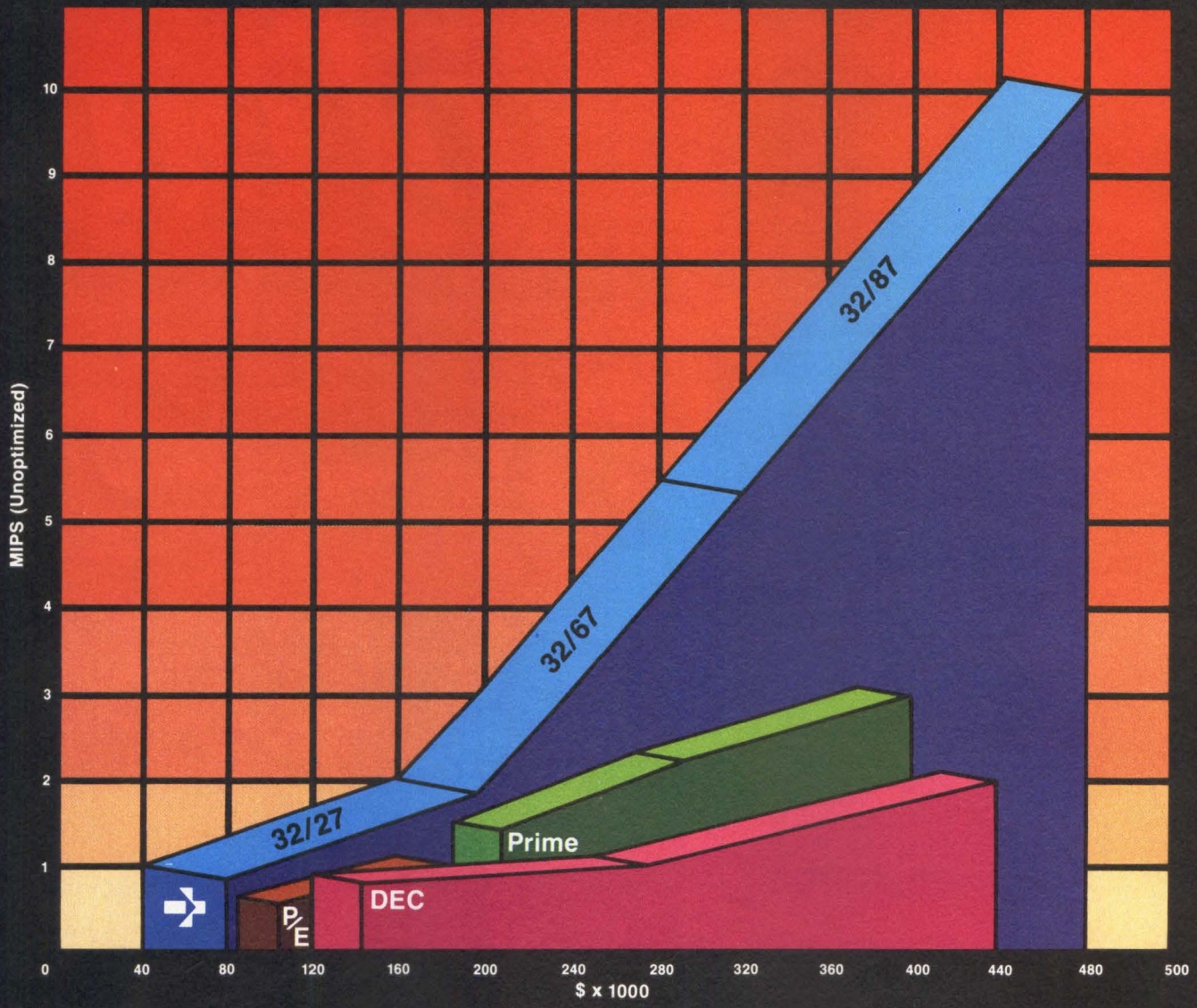

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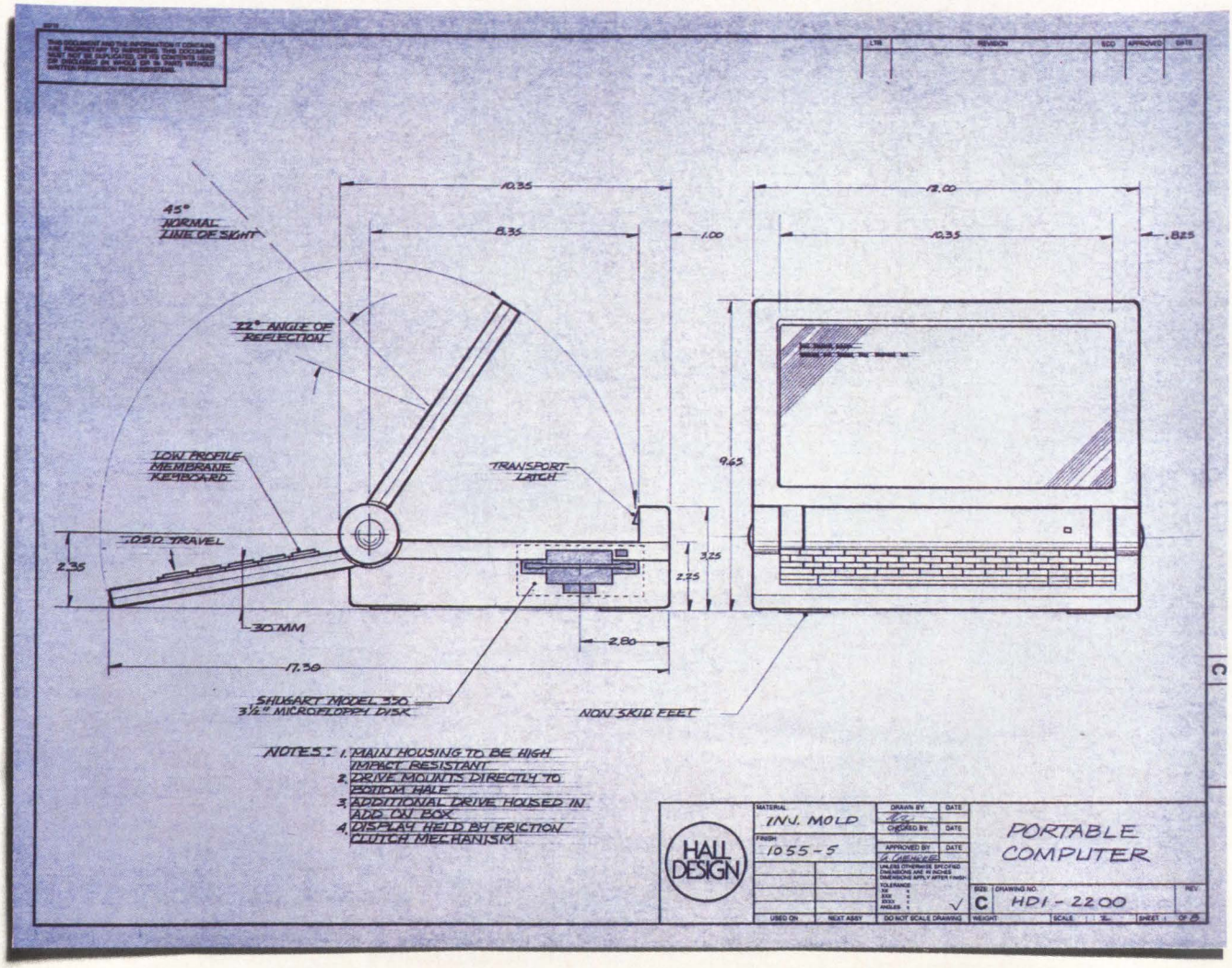

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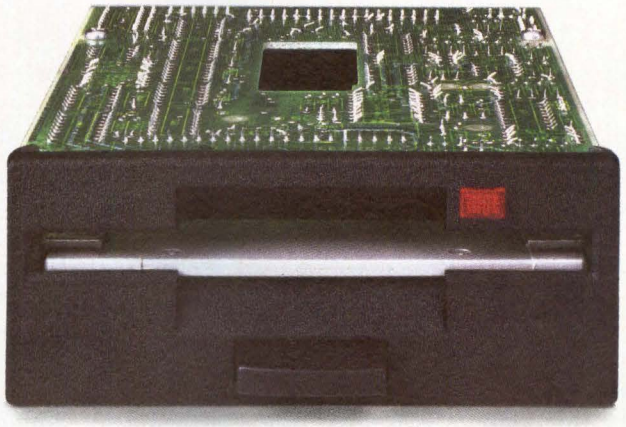

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CIRCLE NO. 8 ON INQUIRY CARD

Editorial

Rapid technology advances spawn multiple graphics standards

Because of innovative and fast-moving technology, a barrage of graphic standards have emerged to contend for widespread acceptance by the computer graphics industry. Graphics standards would permit system integrators to install graphics subsystems into computer systems with little effort, graphics vendors could add value to accepted software specifications, application programs would run on many vendors' computers and terminals, and sophisticated users could select graphics equipment from a wide variety of vendors. But, because the graphics industry is relatively young, with impressive growth and significant technology gains in a short time, numerous proposed graphics standards battle for supremacy.

For example, the International Standards Organization adopted the Graphical Kernel System (GKS), a 2-D line-drawing interface, in 1982 as a draft international standard. And the American National Standards Institute (ANSI) Technical Committee on Computer Graphics Programming Languages (X3H3) has begun the several years' process of acceptance.

In 1977, the Association for Computing Machinery's (ACM) Special Interest Group on Computer Graphics (SIGGRAPH) presented the Core system—a 2-D and 3-D line-drawing interface. Because it was the first major graphics proposal, the Core system has become a widely known but informal de facto graphics standard.

Another ANSI-adopted graphics standard is the Initial Graphics Exchange Specification (IGES). This standard, undergoing revision, provides for the representation and communication of product-definition data in computer-aided-design/computer-aided-manufacturing (CAD/CAM) equipment.

Also under development is the Virtual Device Metafile (VDM) standard for communicating and archiving graphical pictures. This standard—a draft proposal in ANSI X3H3—allows low-level routines to process data for display on any graphics device.

Closely associated with VDM is the Virtual Device Interface (VDI) standard. This method—undergoing evaluation—defines a uniform protocol for interfacing to graphics devices.

Related to VDI is the North American Presentation Level Protocol Syntax (NAPLPS). This ANSI-accepted standard deals with interfacing graphics to commercial Videotex systems.

Yet another ongoing development under ANSI X3H3 auspices is the Programmer's Hierarchical Interactive Graphics System (PHIGS). This standard extends the Core System by supporting 3-D hierarchical graphics data for computer modeling applications in CAD/CAM systems.

Lastly, the ANSI X3H3 Committee is also generating the Programmer's Minimal Interface to Graphics (PMIGS). This method represents a low-end version of the 2-D GKS system.

Because they are the most advanced, provide many applications, are easier to integrate and resist major changes, the GKS and VDI standards have found widespread acceptance. But in the volatile graphics industry, a single standard will apparently not satisfy all the application needs of this growing and changing market. However, standards that solve portability and interfacing issues should prove successful. But in the final analysis, whether standard or non-standard, graphics systems must still furnish user-acceptable cost, performance, reliability and quality. And thus, the market will establish de facto graphics standards, regardless of official sanctions.

George V. Kotelly

George V. Kotelly
Editor in Chief


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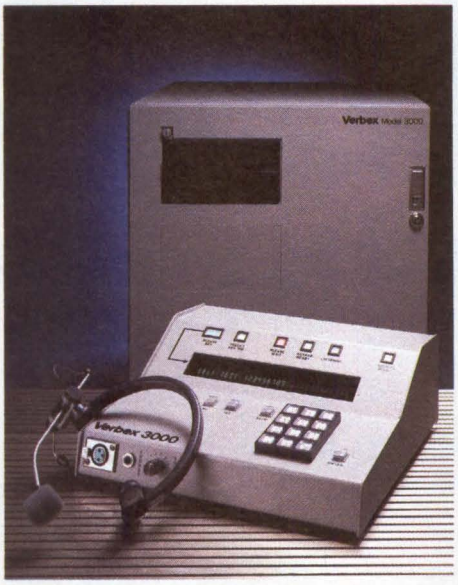
Voice Data Entry: Improving the Productivity of People and the Equipment They Use



If you're using skilled labor or trained professionals to collect, control or enter data by hand, you may be wasting time and money. Even bar code scanners and keyboard-controlled equipment may not maximize the return on your investment in your workforce and the expensive equipment they use. Such systems can constrain the speed and accuracy of your workers by demanding their complete attention or the use of both hands and eyes.

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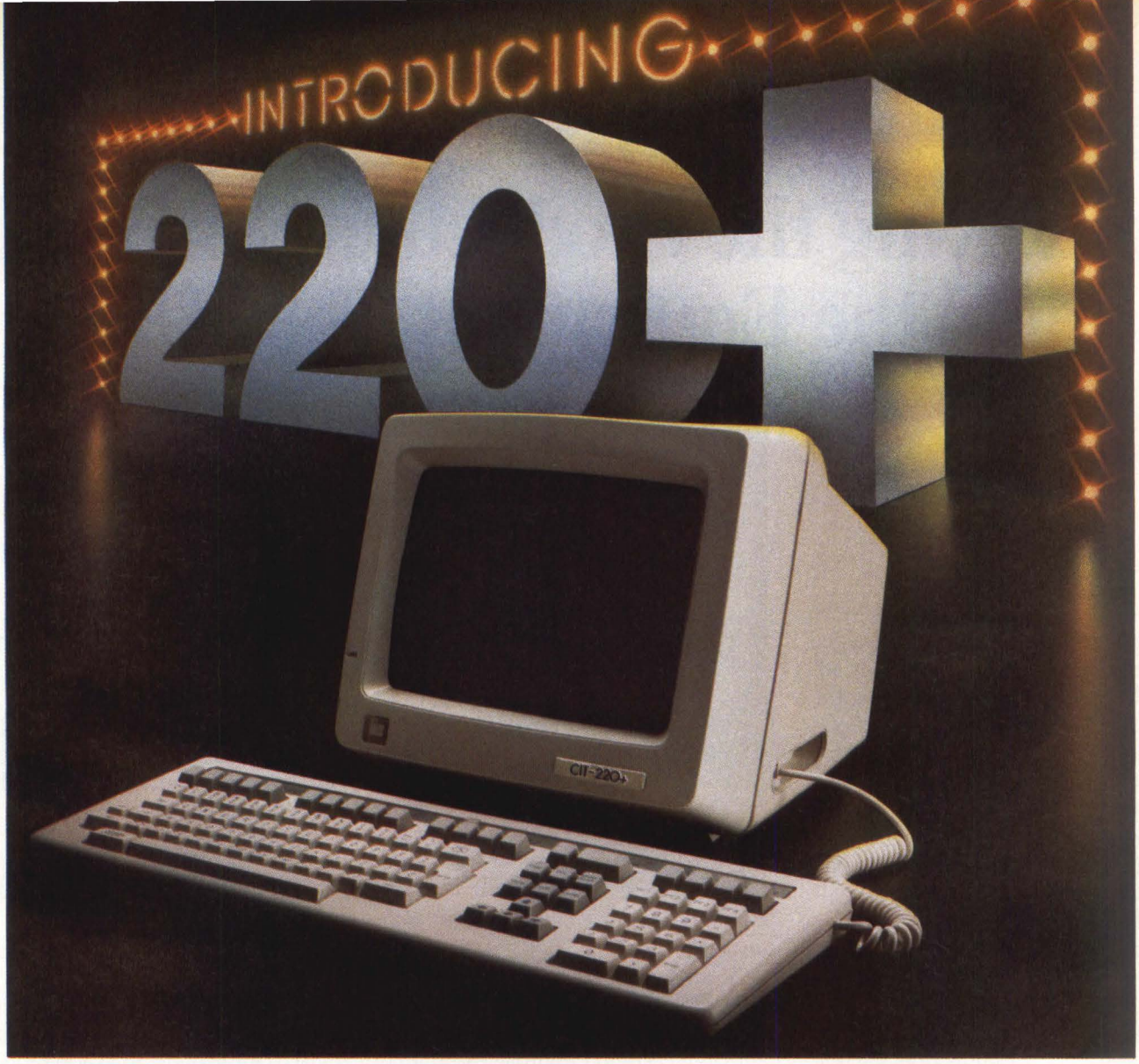

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Plus: An on/off switch on the front of our monitor (DEC's is on the back), along with an on/off light indicator at eye level for better visibility.

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Breakpoints

ACT READIES 16-BIT MICROCOMPUTER WITH INFRARED AND VOICE I/O

Applied Computer Techniques Plc., Birmingham, England, which manufactures the popular Apricot 16-bit microcomputer, is preparing the fourth wave of 16-bit microcomputer technology. Its new systems, which were planned for European introduction in late June, and U.S. introduction by September, employ the Intel 8086 microprocessor and Microsoft Corp.'s MS-DOS operating system. But that's where the similarities to the IBM PC end. The new machines start with an as-yet-unnamed $1,600 version that can drive virtually any monitor. The more powerful Executive version sports a 25-line-by-80-column liquid-crystal display, supports a 640-by-400-dot color graphics display and has voice-recognition abilities. The Executive with 500K bytes of memory should sell for less than $3,000. Both units use an infrared keyboard, an infrared roller-ball mechanism that can be used like a mouse, and a Sony Corp. of America microfloppy drive. The models can use Apricot add-in boards.—C. Warren

LIBERTY AND CIE TERMINALS AIM AT DEC-COMPATIBLE TERMINAL MARKET

Liberty Electronics USA and CIE Terminals are slated to challenge Digital Equipment Corp. with DEC-compatible terminals at this month's National Computer Conference in Las Vegas, Nev. CIE's CIT-220+ emulates DEC VT220 and VT100 functions. The two-piece, tilt-and-swivel monitor has a 12-inch diagonal screen with a non-glare P4 phosphor. Green and amber phosphors are optional. The CIT-220+ also has a DIN-standard keyboard. Liberty should unveil two DEC-compatible terminals that reportedly are software-compatible with the VT220, VT100 and VT52. The Freedom 220 and Freedom 222 will both offer the same ergonomic tilt-and-swivel montior and low-profile DIN keyboard as Liberty's Freedom 200 and Freedom 212. The Freedom 220 will list for $795. The $1,395 Freedom 222 voice/data terminal incorporates the same integral Bell 212A-compatible modem, auto-dial and -receive capability and non-volatile directory as the Freedom 212. Both terminals should be available this month, with volume shipments projected for August. CIE also plans to introduce the model 20 IBM PC-compatible serial dot-matrix printer at NCC. The $1,995 model prints at 87.5 characters per second (cps) in near-letter-quality mode and 350 cps in data-processing mode. It has a plotting capability of 240 by 140 dots per inch.—T. Moran, L. Valigra

RICOH INTRODUCES TWO PORTABLE COMPUTERS

Ricoh Co. Ltd. has introduced two portable computers, the SP50 and SP25, in Japan, but has not decided on a U.S. introduction date. The hand-held SP25 unit includes an 8-bit processor, 32K bytes of ROM and 32K to 56K bytes of RAM. It has a 16-character-by-2-line liquid-crystal display with 5-by-7-dot characters. Also included are RS232C and 300- to 9,600-baud communications. An attachable printer is optional. The lap-sized SP50 can be more fully configured with floppy disk drives, a CRT and a tiny 1½-inch screen that pops up in the SP50 box that includes cartridge storage devices. The SP50 with a keyboard sells for about $844 in Japan. Both units can run on either nickel-cadmium batteries or electricity.—L. Valigra

Breakpoints

WAVE MATE EYES IBM PC-COMPATIBLE MARKET WITH 80286-BASED MOTHERBOARD

Wave Mate Inc., Hawthorne, Calif., is preparing a late September unveiling of an IBM PC-compatible motherboard built around the 6-MHz Intel 80286 processor. Aimed at system integrators, the board can support 640K bytes of RAM. It is said to be physically and functionally compatible with the PC's motherboard. By using a pre-fetch mechanism and a microprocessor, the board handles instruction incompatibilities between the 8088 and 80286. Evaluation units are expected in late November. Single-unit price with 256K bytes of on-board RAM should be $2,450.—C. Warren

DEC RELEASES NEW VAX/VMS, COMMON LISP

Digital Equipment Corp.'s latest version of the VAX/VMS operating system includes enhanced VAXcluster support that makes the 16-node VAXcluster look more like a single distributed system. For example, under VAX/VMS 4.0, all files in a VAXcluster are viewed as a single entity, meaning that users do not have to specify a disk's location when accessing files on another VAX in the cluster. Print and batch queues are also cluster-wide. A job controller provides cluster-wide job balancing. A VAX/VMS 4.0 license sells for $10,000. Other new DEC VAX products include MicroVMS for the new MicroVAX I, which is compatible with VAX/VMS; the Common LISP artificial-intelligence language; an enhanced FORTRAN; the VAX graphical kernel standard (GKS) graphics software package conforming to ANSI and International Standards Organization GKS standards; DECnet software with extended network addressing; and a PDP-11-based terminal server that optimizes terminal connections in VAXclusters or Ethernet local-area networks. Late last month, DEC also added the UNIX-like VENIX operating system to the Professional 350. Most of the new products should be available by September. VENIX is available now.—D. Bright

MORROW PLANS SUPERMICRO FOR NCC RELEASE

Morrow Inc. plans to introduce a four- to eight-user MC68000-based supermicrocomputer at this month's National Computer Conference in Las Vegas, Nev. It will support Unisoft's UNIX System V port. Priced at less than $9,000 for retailers, it comes with 512K to 2M bytes of main memory, one to four 16M- or 34M-byte Winchester disk drives, an optional 5M-byte removable hard disk drive and one to four 400K-byte, 5¼-inch floppy drives. The price for OEMs is less than $5,500. An MC68451 memory-management unit accompanies the 10-MHz MC68000. The IEEE-696 bus system should be available in August. In mid-September, Morrow plans to add 80188-based slave processor boards running the MS-DOS operating system and housing 128K to 512K bytes of memory for local applications.

ADAPTEC RELEASES RLL CHIP, IBM PC XT CONTROLLER

Adaptec Inc., Milpitas, Calif., has enlarged its Winchester disk controller family with the AIC-270, an enhanced run-length-limited (RLL) encoder/decoder chip and the ACB2010, an improved controller board for the IBM PC XT. The AIC-270 supports 2/7 RLL encoding and decoding and supports a 10M-bit-per-second data-transfer rate. It converts high-speed 2/7 RLL encoded data from the disk drive to non-return-to-zero data for use by

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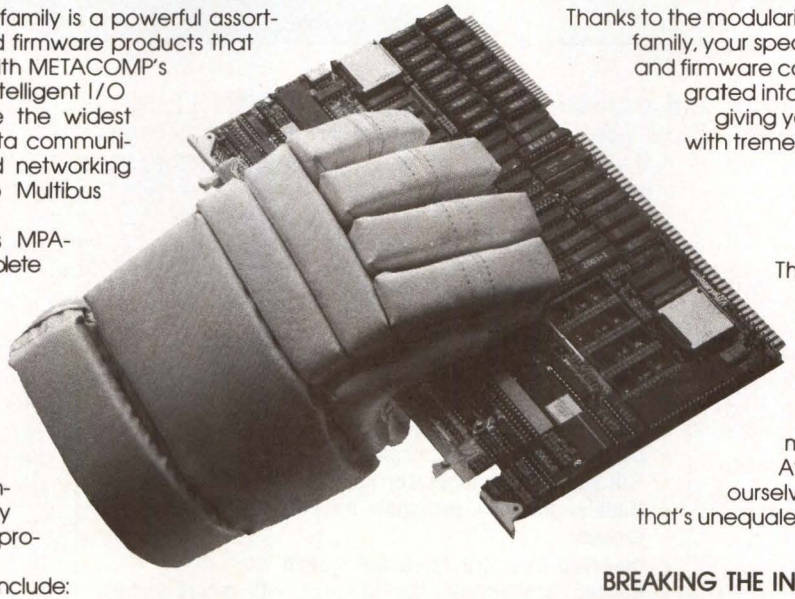

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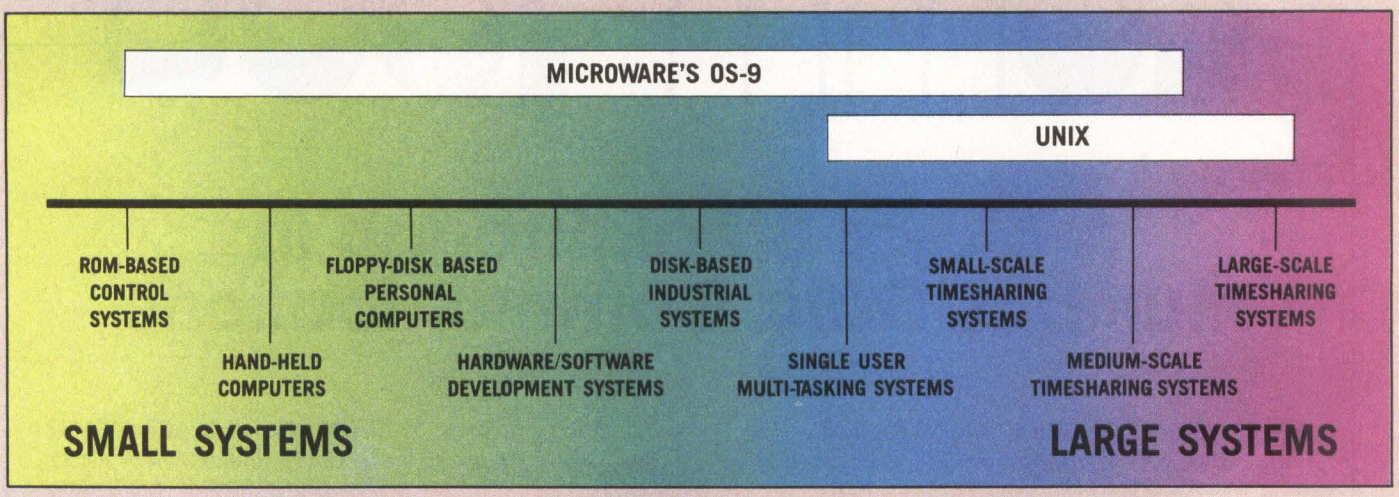

Is complicated software and expensive hardware keeping you back from Unix? Look into OS-9, the operating system from Microware that gives 68000 systems a Unix-style environment with much less overhead and complexity.

OS-9 is versatile, inexpensive, and delivers outstanding performance on any size system. The OS-9 executive is much smaller and far more efficient than Unix because it's written in fast, compact assembly language, making it ideal for critical real-time applications. OS-9 can run on a broad range of 8 to 32 bit systems based on the 68000 or 6809 family MPUs from ROM-based industrial controllers up to large multiuser systems.

OS-9'S OUTSTANDING C COMPILER IS YOUR BRIDGE TO UNIX

Microware's C compiler technology is another OS-9 advantage. The compiler produces extremely fast, compact, and ROMable code. You can easily develop and port system or application software back and forth to standard Unix systems. Cross-compiler versions for VAX and PDP-11 make coordinated Unix/OS-9 software development a pleasure.

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Comprehensive support for modular software puts OS-9 a generation ahead of other operating systems. It multiplies programmer productivity and memory efficiency. Application software can be built from individually testable software modules including standard "library" modules. The modular structure lets you customize and reconfigure OS-9 for specific hardware easily and quickly.

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Once an underground classic, OS-9 is now a solid hit. Since 1980 OS-9 has been ported to over a hundred 6809 and 68000 systems under license to some of the biggest names in the business. OS-9 has been imbedded in numerous consumer, industrial, and OEM products, and is supported by many independent software suppliers.

Key OS-9 Features At A Glance

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- Works well with floppy disk or ROM-based systems
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CIRCLE NO. 12 ON INQUIRY CARD

the controller. The encoding scheme reportedly increases disk capacity by more than 50 percent. The chip should be available in the third quarter of this year. The ACB2010 non-interleaved Winchester controller for the new IBM PC XT and compatible units supports defective-sector skipping and logical disk partitioning. It extends the 32M-byte storage limit of some systems for $255 in quantities of 1,000 or more units.—C. Bailey

CHARLES RIVER ADOPTS VMEBUS FOR ITS SUPERMICRO FAMILY

Charles River Data Systems Inc. plans to put its VERSAbus MC68000-based UNIX and UNOS supermicrocomputers on the 32-bit VMEbus. The first product to use the VMEbus will be the Universe 2203, a two-board processor housing a 12.5-MHz MC68000 processor and running the UNIX System V and UNOS UNIX-like operating systems. It is scheduled for NCC introduction and availability. Price of the system with a 35M-byte hard disk drive and an 8-inch floppy disk drive or streaming-tape drive is $15,000 to $20,000, depending on memory. Additionally, Charles River plans to offer the product in unbundled form, offering the two-board CPU set for $4,000 in single-unit quantities. This represents the company's push toward OEM and value-added market sales.—L. Valigra

SPECTRA LOGIC TO INTRODUCE SIX NEW DISK CONTROLLERS

Three new disk/tape controllers from Spectra Logic Corp., Sunnyvale, Calif., will support both removable pack or Winchester hard disks and start/stop or phase-encoded and group-coded-recording streaming-tape drives. The controllers are intended for use with Data General Corp., Digital Equipment Corp. and Texas Instruments Inc. minicomputers. The controllers support any combination of four storage module device drives and as many as eight formatted ½-inch tape drives without modification to the operating system. Data-transfer rates are 2M bytes per second for disk and 800K bytes per second for tape. Dubbed the Spectra 17 and 27 for DG systems, the Spectra 111 and 121 for DEC units and the Spectra 116 and 126 for TI computers, the products were expected to be introduced at NCC and shipped this year.—C. Bailey

SORD REMARKETS AURAGEN FAULT-TOLERANT SYSTEMS IN JAPAN

Sord Computer, which currently remarkets Charles River Data Systems Inc.'s computers under the Sord label in Japan, will also remarket fault-tolerant systems from Auragen Systems Corp., Fort Lee, N.J. The multiyear agreement is worth as much as $25 million and also involves technology exchange. Late last year, Auragen struck a similar technology-licensing agreement with European computer giant Nixdorf AG. Auragen's system 4000 incorporates clusters of MC68000s and runs UNIX. The Charles River system is also MC68000- and UNIX-based but is not being promoted as fault-tolerant.—D. Bright

MATRIX INSTRUMENTS ENHANCES MICRO GRAPHICS OUTPUT

The VideoWriter 832 from Matrix Instruments Inc., Orangeburg, N.Y., lets users interface any ASCII port to an analog device, such as film recorders, modems, microcomputers and television cameras. The $2,195 system provides

a resolution of 832 by 639 or 640 by 480 dots or two pages at 512 by 512 dots and a selection of 16 colors from a palette of 4,096. Output is to a video red-green-blue monitor. The model 832 can accept ASCII commands for fill, circle and polygon fill. The system includes hardware pan and zoom and has drivers for mice, digitizers and trackballs.—C. Warren

ARRAY PROCESSOR ADDS NEW DIMENSION TO IBM PC AND COMPATIBLES

Designed for applications that require local number-crunching power, the APB-3024PC array processor from Marinco Inc., San Diego, is designed to fit into any open slot on the IBM Corp. Personal Computer. Using an AMD29116 bit-slice processor, the board executes 8 million instructions per second and handles complex math and 24-bit floating-point and 16-bit integer arithmetic. The board is available for both IBM PC and Multibus computers for $4,250. For specialized code development the company offers a $2,500 software-development kit with an assembler, a debugger and listing utility.—C. Warren

ROBOT-LIKE ARM DIGITIZES 3-D OBJECTS

The Perceptor robot-like arm digitizing system from Micro Control Systems Inc., Vernon, Conn., senses 3-D X, Y and Z coordinate positions through precision potentiometers in each of its five joints. The device has a resolution of 0.007 inches and can be linked to any computer via an RS232C serial port. An on-board Z80A microprocessor handles the arm. The tip of the arm can be replaced with other sensors such as temperature probes or strain gauges to add a fourth dimension to the digitized object. Price is $5,500 in OEM quantities.—C. Warren

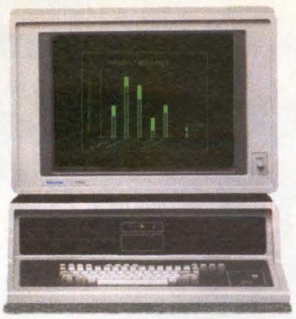
J&E COMPUTER SERVICES HAS LOW-COST FLOPPY DISK EXERCISER

The model 911 floppy disk exerciser from J&E Computer Service, Chino, Calif., is for 8-, 5¼- and sub-4-inch drives with industry-standard interfaces such as the Shugart Corp. ANSI X379. The exerciser can support single- and double-density and single- and double-sided drives. Adapters are available for Osborne Computer Corp. and Apple Computer Inc. computers. Price is $550.—C. Warren

TECH FILES: A QUICK LOOK AT INDUSTRY DEVELOPMENTS

PRINTER FILES: Centronics Data Computer Corp. recently announced the $299 Great Little Printer (GLP) for personal computer applications. The 6.6-pound GLP prints at 50 characters per second (cps) in draft mode and 12 cps in near-letter-quality mode. Both RS232 serial and Centronics parallel interfaces are available. Evaluation units will be shipped next month. Centronics also announced a 24-pin dot-matrix printer, a seven-color dot-matrix printer and a 220-cps correspondence-quality printer.—D. Bright

Delphax Systems, Mississauga, Ontario, planned a National Computer Conference introduction of an intelligent printer called the S 6000. The printer uses the company's 2460 ion-deposition print engine and a Digital Equipment Corp. LSI-11 processor to produce text and graphics at more than 60 pages per minute. Production units should be available in September. End-user prices range from $60,000 to $70,000. OEM discounts are available.—T. Moran



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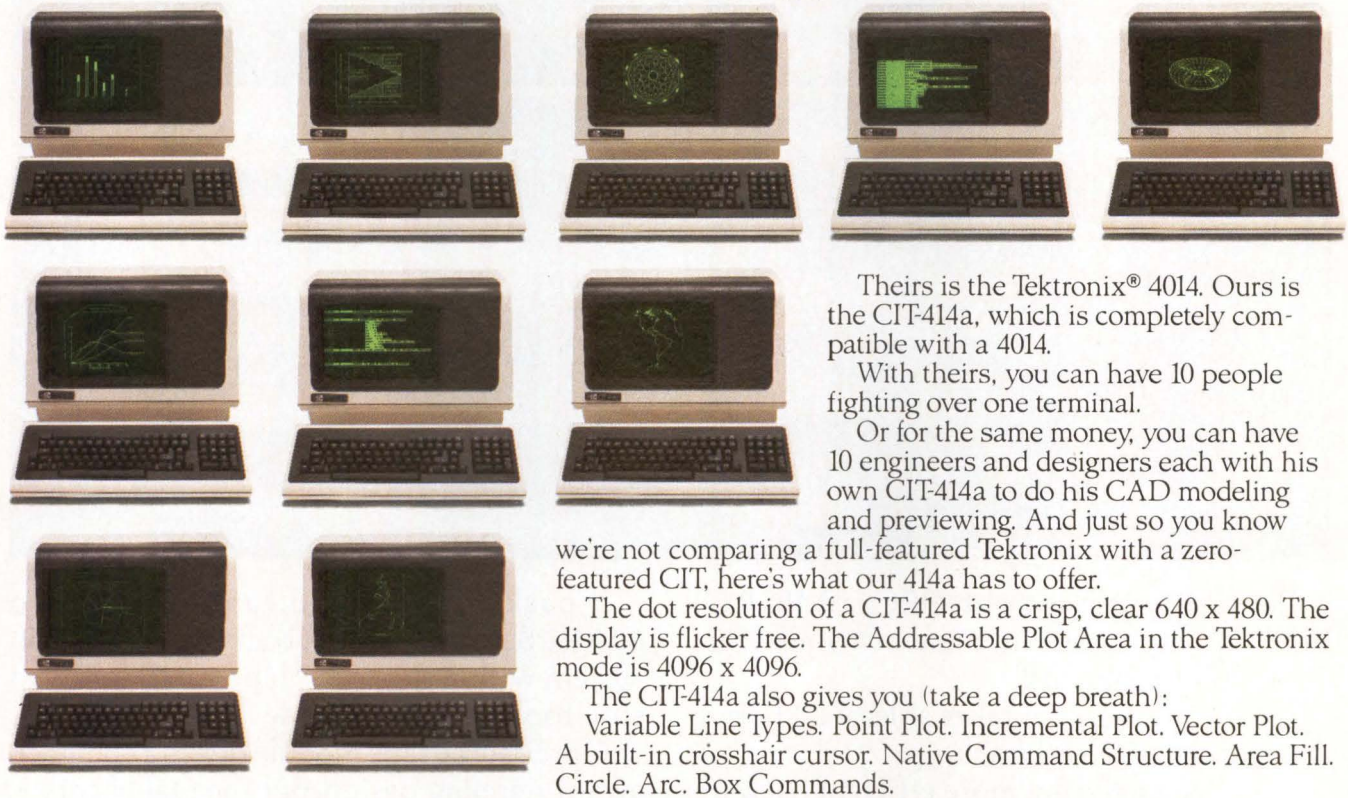

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A variable scale factor for changing image size. Relocatable origin. Special write modes. Switchable video. Compatibility with most major graphics software packages, including PLOT 10™ and DISSPLA.®

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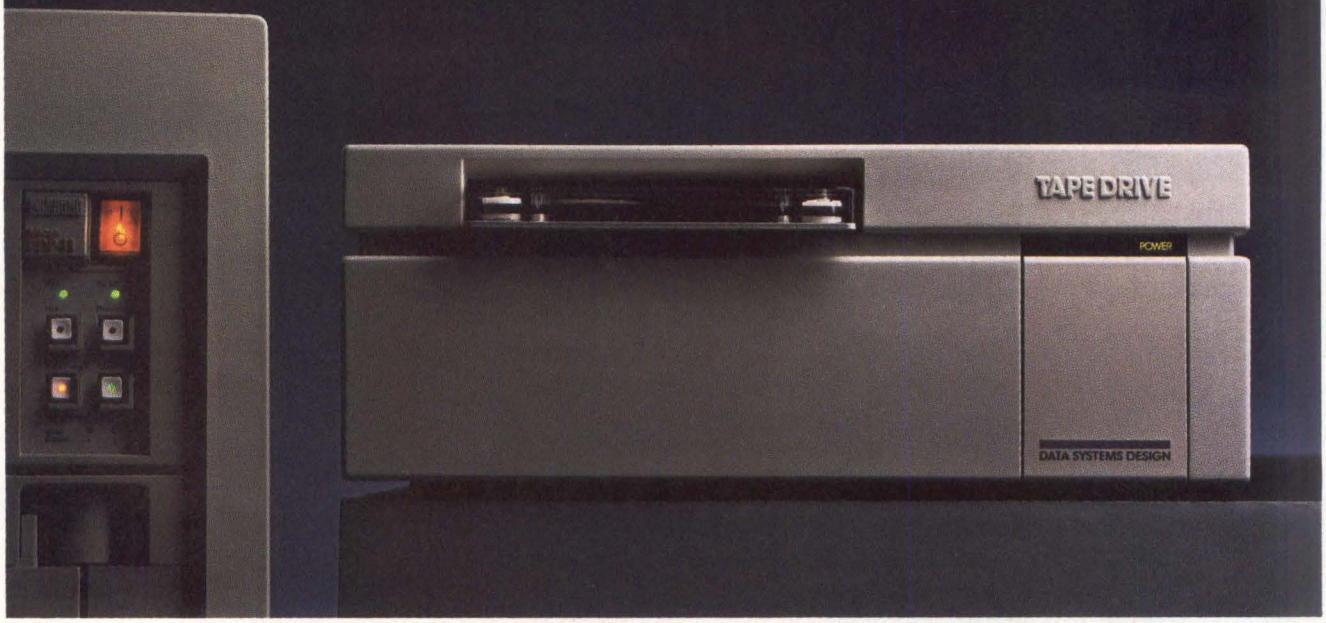

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Breakpoints

One-year-old **Ergo Systems Inc.,** Menlo Park, Calif., is introducing its HUSH 80 80-column, 80-cps thermal dot-matrix printer. The HUSH 80 will come in AC and rechargeable nickel-cadmium battery-powered versions. The battery-powered device weighs 48 ounces, including a 100-foot-long integral paper roll. The AC-powered HUSH 80 lists for $160; the battery-powered version sells for $190. HUSH 80s with a Commodore or Centronics interface should be available this month, with an RS232 version expected in the fall.—T. Moran

PLOTTER FILES: Expected late this year from marketing company **Western Graphtec Inc.,** Irvine, Calif., is the model DA6500 computer/plotter, priced at less than $1,800. The plotter has a built-in microcomputer, 16K bytes of RAM, a 4-line, 4-column liquid-crystal display and a three-pen cartridge. The plotter can accept programs from a full-sized keyboard or can download programs and work in a standalone interactive mode without the intervention of a host computer. The bed measures 8½ by 11 inches. Plotting speed is 8 inches per second, and resolution is 0.004 inches.—C. Warren

MICRO FILES: Beginning on Oct. 1, **Apple Computer Inc.** will work directly with its 1,800 dealers instead of going through manufacturers' representatives. Sales vice president William Campbell says the reason is twofold: to bring economies of scale to Apple's marketing and sales program, and to bring Apple closer to its customers.—D. Bright

Weighing a scant 20 pounds and measuring 14 square inches, the **NNC** Oasis computer series uses Phase One Systems Inc.'s 16-bit multiuser OASIS operating system. Although the compact system is primarily designed for multiuser applications, a single-user version that can be upgraded to a multiuser unit is available. The systems can accommodate a 20M-byte or 40M-byte Winchester disk drive. OEM prices are available.—C. Warren

GRAPHICS FILES: Built around the IEEE-696 (S-100) bus structure, the PC-Graphics board from **CompuCorp,** Hayward, Calif., emulates IBM Corp.'s PC color graphics functions. CompuCorp expects to unveil the board, which has been viewed by selected OEMs, this month, and plans to ship in high volumes in late August. Single-unit price is $495.—C. Warren

NOTES FROM OVERSEAS: Altos Computer Systems Inc. reportedly is negotiating a deal that would turn over worldwide marketing rights on its Pick operating system-based 586 microcomputer to start-up U.K. distributor **Unison Technology Plc.** The all-inclusive pact would mean that Altos would delegate to Unison the responsibility for marketing Altos' own system in the U.S. Unison would set up offices in Silicon Valley. Altos provided the initiative for the change-over, according to Neil Ratcliffe, president of Unison's parent company, Interactive Data Machines. Unison is contemplating subcontracting Far East sales of the 586 to a single distributor. Unison expects to generate $9.7 million in Pick business in Europe this year.—M. O'Gara

Breakpoints

Britain's **Acorn Computers Ltd.** is setting up a joint venture in Palo Alto, Calif., to develop compact laser disk drives designed as floppy disk drive replacements. The start-up, christened Optical Information Systems Inc., is an equally divided collaboration with turntable maker Better Sound Reproduction Ltd., Hong Kong. With no set media standard, the pair is comfortable borrowing from the recording industry by using a 12-cm. (roughly 4-inch) format for storing about 500M bytes of information. In 18 months, the R&D facility should have readied the first read-only production models. Acorn officials expect the compact lasers to sell at current Winchester disk prices but project a significant cost savings on a price-per-megabyte basis, especially for large accounts.—M. O'Gara

The first commercial implementation of **Intel Corp.'s** anticipated 82586 Ethernet chip set popped up last month in England at 18-month-old network house **Torus Systems Ltd.** The heralded chip appeared as an integral part of Torus' initial product, Icon, a graphics-controlled local-area network integrating communications, videotex, electronic mail and telephone dialing. The Torus gear, priced at roughly $1,300 per node for both hardware and software, runs the PC-DOS operating system and reportedly links as many as 100 256K-byte IBM PCs or look-alikes over a 1-km. (1.6-mile) network. Its concurrent software includes 450 context-specific help messages.—M. O'Gara

Concomitant with Torus Systems Ltd.'s Icon introduction, **Acorn Computers Ltd.** bought a 25 percent share of Torus, Cambridge, England. for $520,000. Torus intends to sell Icon in the U.S. by year-end. It is currently evaluating whether to sign a distributor, go through Acorn's U.S. sales network or start its own operation.—M. O'Gara

IBM Europe S.A., Paris, is abandoning its internal organization based along individual product lines in favor of one based on business areas. IBM confirmed the reorganization will give its British, German, French and Italian subsidiaries, its four largest European operations, a greater and more direct voice in the company's overall planning process. An IBM spokesman says the reorganization is a worldwide charter and would extend to IBM's Americas/Far East unit.—M. O'Gara

The fate of **Victor Technologies Inc.** appears to be in the hands of an international auction. At press time, two new bids for the U.S. microcomputer company had been planned. Diversified Swedish electronics company Datatronics offered $31 million in cash and 20 cents per $1 to Victor's secured creditors while German microcomputer supplier Beta Systems offered $27 million in cash. Both bids top the complicated proposal made by Britain's ACT, which has been valued at around $16 million. Reportedly, both new entrants would also be willing to acquire the remnants of Victor's U.S. operations, which ACT's proposal excludes. The 11th hour challenges to ACT raise questions about whether Victor will successfully emerge from its Chapter 11 status as well as ACT's chance of international success if it fails to win Victor's continental subsidiaries and distribution outlets.—M. O'Gara

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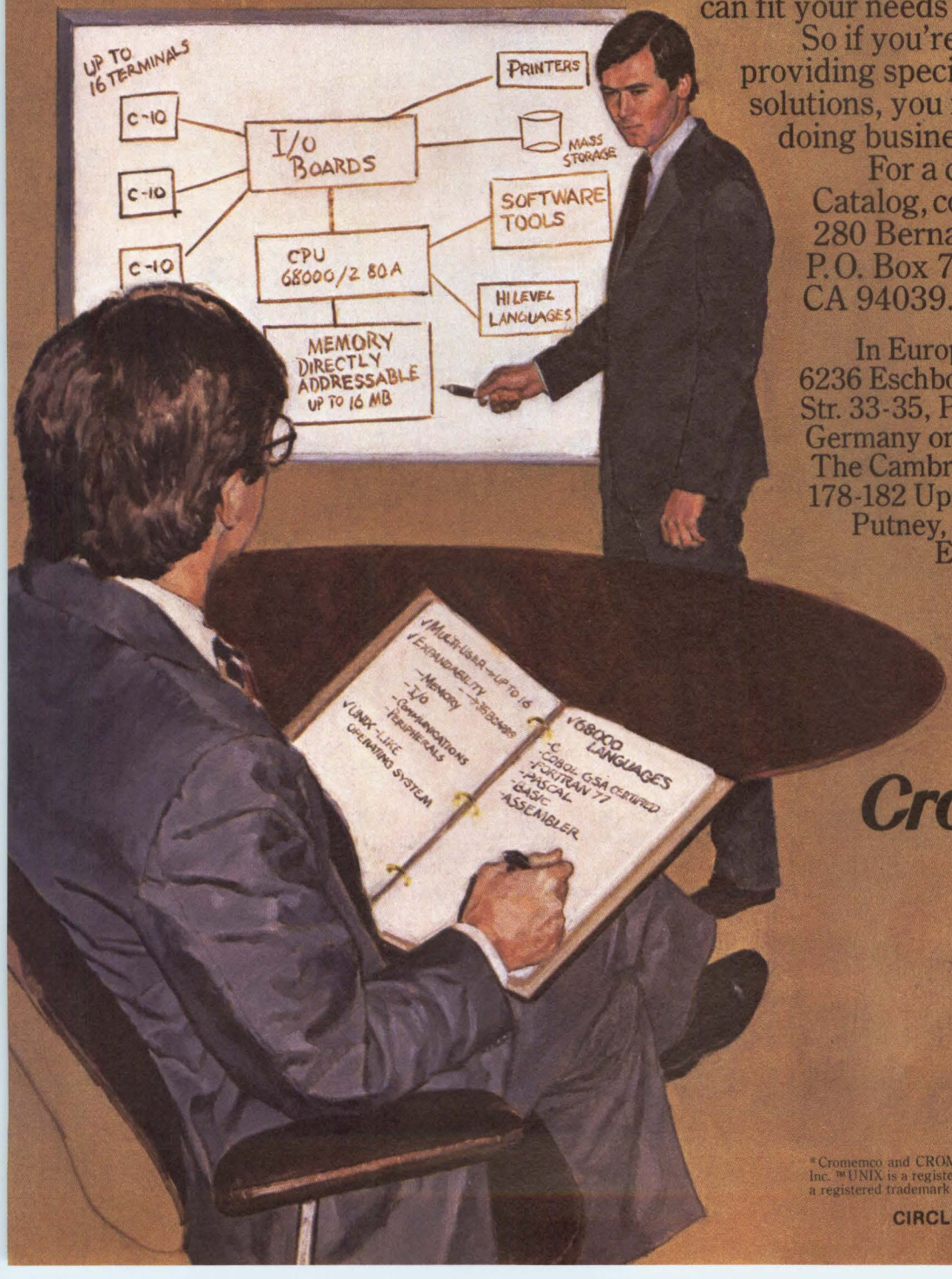

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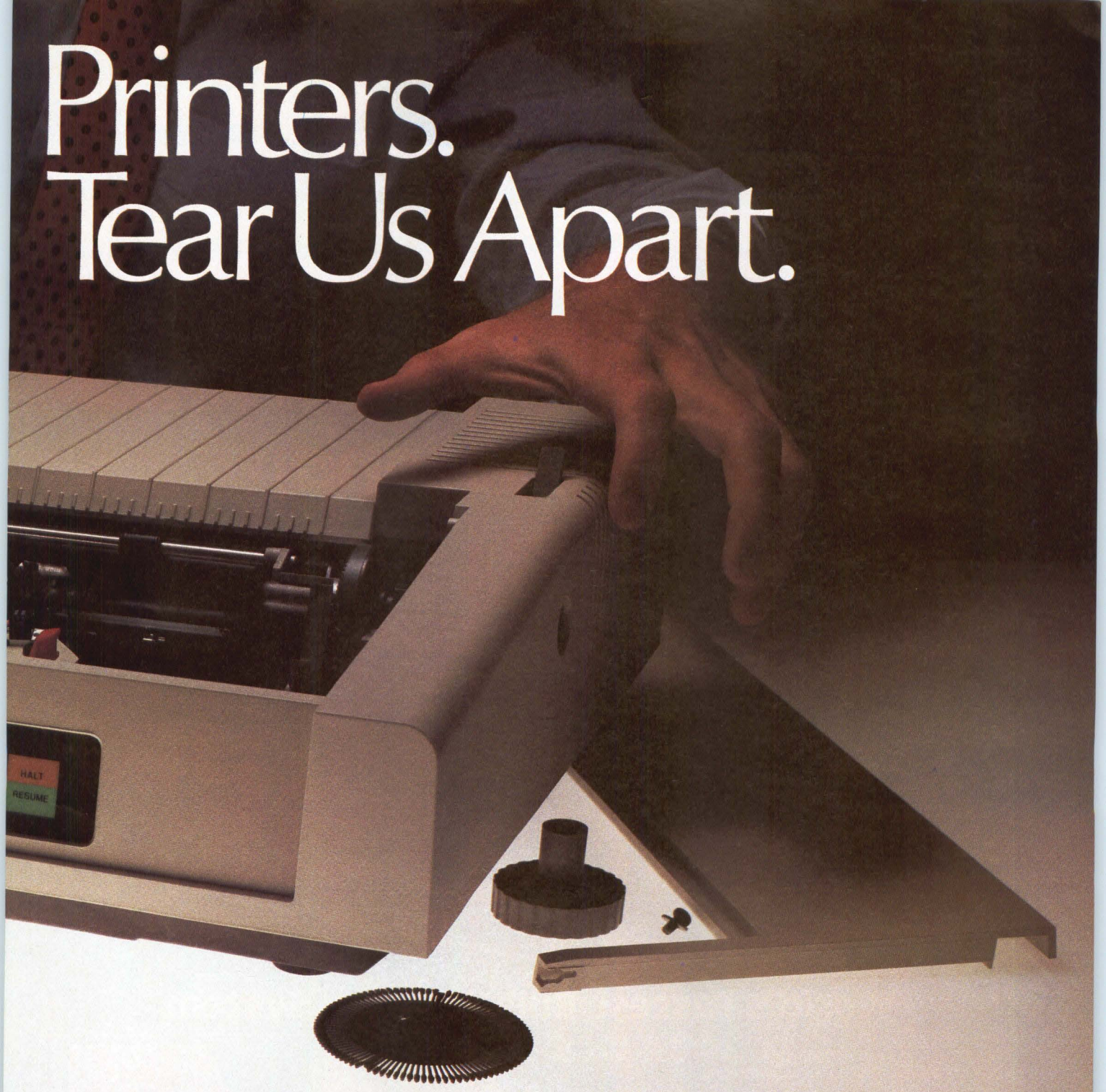

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Diablo® 630 API	40	4,000	30 min.	45 lbs.	$2295
Diablo 620 Series 35	35	4,000	15 min.	48 lbs.	$1595
NEC® 7700 Series	55	6,000	30 min.	45.5 lbs.	$2595

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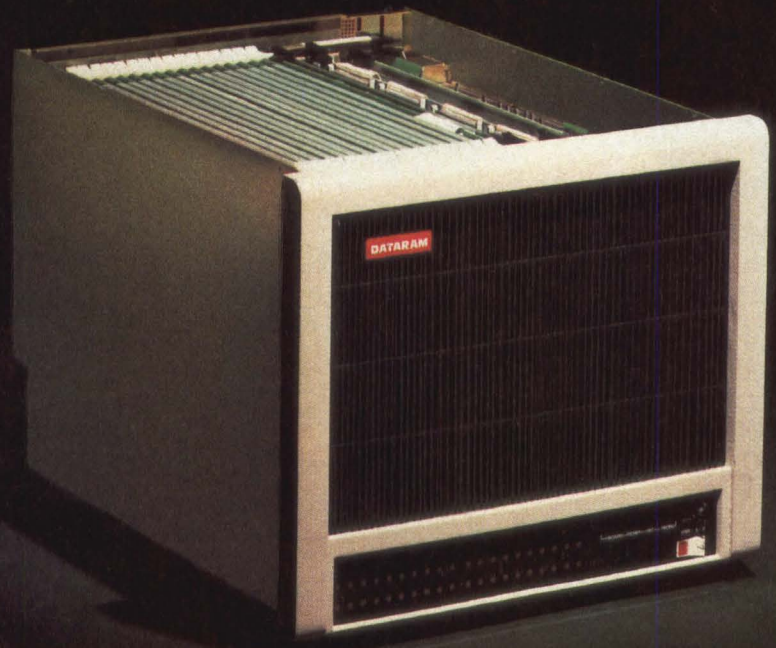

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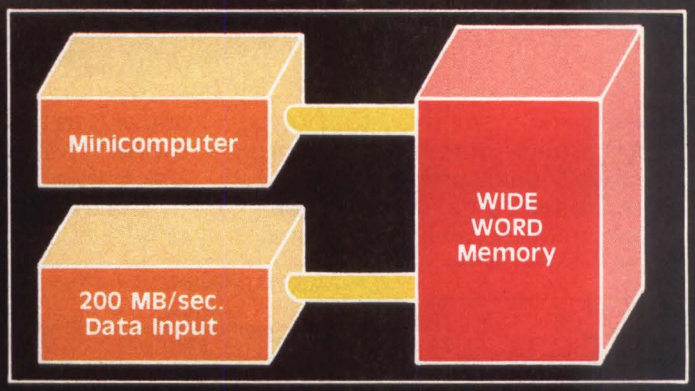

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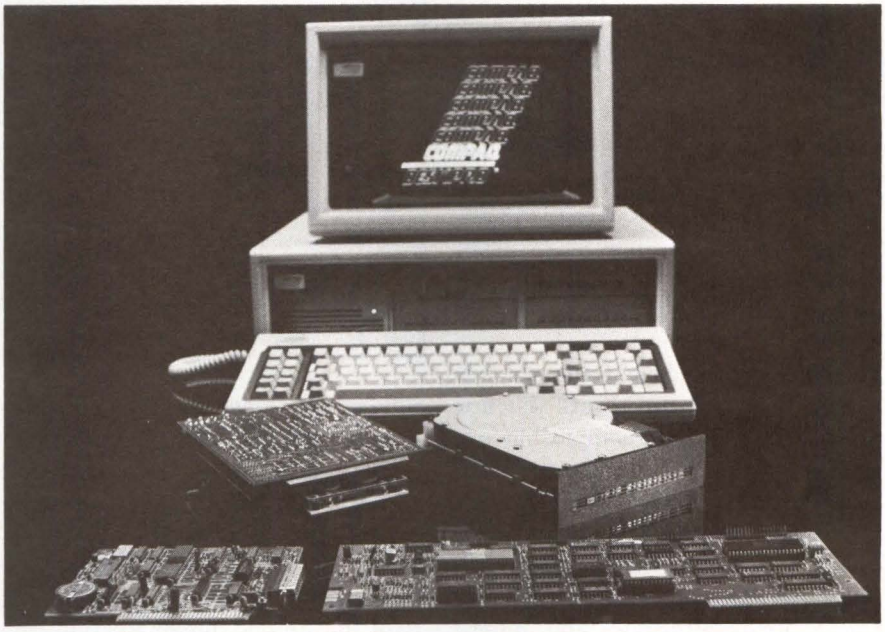
CIRCLE NO. 18 ON INQUIRY CARD

Compaq aims PC-compatible Bullet for a repeat round of success

Lori Valigra, Senior Editor



Compaq's PC-compatible Bullet desktop family *is said to perform better than IBM's PC by using an Intel 8086 processor and 256K-bit semiconductor memories. Shown is the Model 4 upgrade that includes a 10M-byte backup tape drive.*

In 1982, a handful of entrepreneurs drew a crowd of onlookers when they placed $10 million of venture-capital money in a local Houston bank. Even the bank president came out to see who could deposit such hefty funds when even large oil companies were stalled by the recession. The group came from a high-technology start-up, Compaq Computer Corp., maker of IBM-compatible portable computers. Because of its subsequent success, Compaq has stayed at the center of attention ever since.

Its strategy of introducing a portable while others mimicked IBM Corp. with desktop systems kept Compaq at arms's length from IBM. This more distant strategy paid off handsomely: the company posted a record-breaking $111.2 million in revenues during its first year, having sold just over 53,000 computers. About half that number were sold in the first quarter of this year. Though Compaq's corporate goal is to be one of the top five personal computer manufacturers, it remains to be seen whether the company can sit tight in the eye of the PC-compatible market hurricane, remain innovative and resist being swept in with the me-too clone companies.

Compaq's shot at repeating its success was expected late last month with a family of desktop systems called DESKPRO and codenamed the "Bullet." Intended to be a step ahead of IBM's machines in performance, Bullet is based on the Intel Corp. 8086 processor and employs 256K-bit semiconductor memories in the top-of-the-line model. It thus offers performance improvements over Compaq's 8088-based portable line and IBM's PCs.

Prices are comparable to new IBM PC prices, ranging from $2,495 for an entry-level system sporting the DOS 2.1 or 1.1 operating system, 128K bytes of RAM, a single diskette drive and a 25-line-by-80-character monitor to $7,195 for the top model including 640K bytes of RAM, a monitor, one diskette drive, one fixed drive and one tape drive. The integral drives mark Compaq's first use of half-height mass-storage devices. Half-height drives will eventually be available in Compaq's portables. A 20M-byte Winchester disk drive option has not yet been priced, but is scheduled for September availability. The tape drive is $1,075.

Compaq plays product improvements as its trump card against IBM and other compatible suppliers. "We innovate, but not against compatibility," explains Rod Canion, Compaq president and cofounder. He says PC compatibility is also binding to IBM's new products because of the existing volume of PC-compatible software. Adds Canion, "This market does not exist because of IBM, but the software base does, and we are compatible with this."

The Bullet includes several enhancements over IBM's PC. In addition to using the faster 8086 and 256K-bit memory chips, the systems have a switch for an 8088 clock rate mode, a board and a screen combining high-resolution text and graphics, a backup tape drive option, modular assembly of the four-product line, more unoccupied add-in card slots, and a 200W power supply to accommodate future mass-storage options. (Compaq's portables use a 120W power sup-

ply.) Additionally, Compaq claims to offer stronger dealer margins.

One example of how Compaq chose compatibility over speed is its selection of a slower 8-bit bus for the 16-bit 8086. Says Compaq director of engineering Gary Stimac, "This is the hard part of IBM compatibility." Stimac recommends exercising Compaq's memory options, because populating the motherboard with memory allows users to address 16-bit-wide words. Adding an external memory board means employing the 8-bit bus, so only 8-bit-wide words can be addressed.

COMPAQ LEADS THE IBM-COMPATIBLES MARKET

	1983		1984	
	UNIT SHIPMENTS (X 1000)	MARKET SHARE (%)	UNIT SHIPMENTS (X 1000)	MARKET SHARE (%)
IBM	550	84.0	1,100	83.0
PC	400		600	
XT	150		350	
Portable			150	
Compaq	48	7.5	78	5.9
Corona	12	1.9	25	1.9
Columbia	18	2.8	27	2.0
Eagle	12	1.9	17	1.2
Other	12	1.9	78	6.0
Total market	652	100.0	1,325	100.0

Offering lower prices and quicker availability of products is not enough in the IBM-compatible microcomputer market, explains Canion. To succeed, a company must offer product advantages. An advantage Compaq touts is its switchable processor speeds. By hitting the control, alternate and delete keys simultaneously, users can flip back and forth between the common-mode 8088 speed and the turbo-mode 8086 speed. The company expects most users to stay in 8086 mode, which runs popular programs such as Lotus Development Corp.'s 1-2-3 integrated software and Microsoft Corp.'s Flight Simulator. The turbo speeds drawing of graphics on the display two to three times over a similarly configured IBM PC. In one demonstration, the IBM PC finished 28 seconds after the Bullet.

But 8088 speed may be necessary to run some entertainment and communications packages with timing considerations. Despite Compaq officials' initial concerns, the Bullet was able to run the communications module of Lotus' Symphony integrated program.

Compaq plans to supply dealers with a list of software that runs on the Bullet and will note mode restrictions, says B. Kevin Ellington, vice president of Compaq's office computer division.

Compaq touts a two-for-one slot savings in getting high-resolution

Plugging the pieces together

Modularity is a growing concept in the computer industry. Compaq Computer Corp.'s response with the Bullet PC-compatible desktop is a line of products that can be plugged together from an entry-level unit to a top-end model. "All Bullets have the same enclosure with the same parts and pieces. We've priced the models so the sum of the parts equals the whole," explains Harold L. Sparks, former vice president of sales and service, who now is vice president of sales in the Compaq Telecommunicaitons Corp. subsidiary. IBM veteran Sparks put together Big Blue's PC distribution and dealer strategy.

Sparks maintains it is less expensive for the dealer and for Compaq to stock inventories on one model, and to build others from it. Charles G. Kinch, ComputerLand Corp. vice president of products, confirms Sparks' remark. "Modular buildup of a product is very important. The Bullet is good for price-conscious buyers, [who can then] upgrade easily."

Kinch says another advantage is that the modules come from a single source, Compaq. "One box from one vendor. I think this will open up a market opportunity that did not exist before," seconds Bill Boss, vice president of merchandising at Quest/Simtec Computers Inc., Dallas.

Mike Ampe, vice president of outside sales for another Compaq retailer, Inacomp Computer City, Garden Grove, Calif., says Compaq's faster processor, ability to run software quicker, combined text and graphics capabilities, large power supply and backup tape drive provide system growth options not found in other products. One example he cites is demand for mass-storage backup. "In the last six months, many people have wanted to back up the XT or Compaq Plus [hard disk version] with a tape drive, not 35 floppies."

The modular approach may help Compaq stay on dealer shelves, because the company essentially has fewer models. Sparks explains that dealers may have as many as six brands with multiple models. Sears Business System Center, for example, carries Compaq, IBM Corp. and Apple Computer Inc. products. This means as many as 11 products from three companies, and Compaq does not want to add four more to that tally.

Most stores want one alternative to IBM's PC, explains analyst Ralph Gilman of InfoCorp, a Cupertino, Calif., market researcher.

Dealer support is crucial

Rather than using competing sales channels, Compaq Computer Corp. sticks to a one-tier distribution scheme: dealers. The Compaq dealers add value to systems and support and service them for both end users and volume buyers in corporate accounts.

Dealers seem to like being Compaq's marketing arm. "I'd consider it a partnership," says Mike Ampe, vice president of outside sales for Compaq retailer Inacomp Computer City, Garden Grove, Calif.

Major dealers for Compaq include Businessland Inc., Entré Computer Center Inc., ComputerLand Corp. and Sears Business System Center. ComputerLand and Sears accounted for 42 percent and 13 percent, respectively, of Compaq's 1983 sales. IBM Corp. sells its PCs through IBM Product Centers, value-added remarketers, authorized dealers and its National Accounts and National Marketing divisions.

Compaq typically gives its 1,318 dealers better margins than IBM. Compaq has two pricing structures, explains Harold L. Sparks, former vice president of sales and service for Compaq, who now is vice president of sales for the Compaq Telecommunications Corp. subsidiary. Retailers selling a single disk drive system get an average 35 percent margin. Dealers that sell higher product volumes in more locations enjoy 42 percent margins. But they must order 91 days in advance. Dual-drive systems have an incentive of 3 percent above those margins, says Sparks. IBM averages about 2 percent less, he speculates.

The lower prices, higher margins and probable high cost per sale with Compaq's comprehensive support have caused some analysts concern about Compaq's ability to remain competitive with IBM. InfoCorp analyst Ralph Gilman says Compaq's cost of sales is very high compared to its margins. For the nine months ended Sept. 30, 1983, Compaq had $59 million in sales, with a cost of sales of $44.2 million.

"We want to increase [gross margins] to 40 percent," asserted Compaq president Rod Canion at a recent analysts meeting in Boston. He says the current 30 percent gross profit margins are not acceptable in the long term. To achieve that goal, Canion is implementing a two-step plan. The company will reduce product costs by using custom circuits, gate arrays and half-height disk drives, and new products will command a higher price and higher gross margins. Canion says IBM built a strong margin into its hard disk-based XT model. The corresponding margin in the hard disk Bullet may give Compaq more suitable margins.

Bolstering its strategy will be even more important as large players such as Sperry Corp., NCR Corp. and Olivetti and Co. SpA enter the picture. Olivetti recently introduced two PC-compatibles, one desktop and one portable. The 8086-based desktop with 256K bytes of memory and dual floppy disk drives retails for $2,900.

Even IBM will feel the newcomers' pinch. By 1986 its share of the combined PC, PC-compatible, and third-party add-in market is expected to drop to less than 50 percent, according to Dr. John Hemphill, vice president of Future Computing Inc.'s technology group. Worldwide factory-value revenues for that market totaled $5.6 billion in 1984. IBM captured $3.28 billion in revenues, the compatibles earned $1.53 billion, and third parties totaled $.81 billion. In 1989, Future projects IBM will enjoy $12.32 billion in revenues in a $28.81 billion market.

text and color graphics. Instead of the separate cards and monitors required for color graphics and high-resolution text on the IBM PC, Compaq offers one 640-by-200-dot display and one card.

Ellington says the monochrome monitor will be available in green or amber phosphor and will have a tilt-and-swivel option. Future plans call for a 640-by-400-dot monitor that would be Compaq's first color offering. Ellington says Compaq will build its own controller for that display. Another future offering is a mouse cursor controller.

Another slot saver is Compaq's memory option. Adding memory to reach 640K bytes would require extra memory cards on IBM's XT. The two top-line Bullet models have four empty slots, while the low-end models have six free slots. A 128K-byte RAM upgrade kit is priced at $170; a 512K-byte kit using 256K-bit RAMs is $1,295.

Bullet shipments to dealers were scheduled to begin on June 28. □

EXAMINING COMPAQ'S BULLET

		Suggested retail price	
		Without monitor	Including monitor
Model 1:	128K-byte RAM single-diskette drive	$2,240	$2,495
Model 2:	256K-byte RAM dual-diskette drives	$2,740	$2,995
Model 3:	256K-byte RAM single-diskette drive 10M-byte fixed disk serial interface/clock card	$4,740	$4,995
Model 4:	640K-byte RAM (using 256K-bit RAMs) single-diskette drive 10M-byte fixed disk 10M-byte fixed disk back-up serial interface/clock card	$6,940	$7,195

Liberty's Freedom 212 integrates terminal and telephone functions

Tom Moran, Associate Editor

The Freedom 212 integrates *a standard desk telephone, an internal auto-dial and -answer 110-/300-/1,200-baud modem and software in ROM to create a full-featured terminal with flexible telephonic features.*

Aiming at a near-$2 billion market by the end of the decade, Liberty Electronics USA, San Francisco, has launched the Freedom 212, described as the first voice/data terminal that combines the telephonic features of a display phone with the data-processing capabilities of a full-function terminal.

The Freedom 212 has an integral 110-/300-/1,200-baud modem with auto-dial and -answer capability, a detached DIN-standard 106-key keyboard, a 12-inch monochrome display and a buffered bidirectional printer port. It attaches to a user's desk telephone through a standard jack.

With a price of $1,295, the Freedom 212 can operate as a remote data terminal using its integral modem, as a voice/data display telephone or—with the modem disabled—as a Liberty Freedom 200 terminal (MMS, November 1983, Page 46). External computers can speak to the 212 as if it were a standalone device via the Bell 212A- and 103-compatible integral modem.

HOW FREEDOM 212 STACKS UP AGAINST DISPLAY PHONES

	Liberty, Freedom 212	TeleVideo, P.T.	Tymshare, Scanset	Northern Telecom, Display-phone	Zaisan, ES.1	Rolm, Cypress
Screen size (in.)	12	9	9	7	9	9
Keyboard style	detached	attached	attached chiclet	detached chiclet	detached	detached
Keys	106	75	85	55	70	68
1,200-baud modem?	Y	Y	Y	Y	Y	N
PBX required?	N	N	N	N	N	Y
Integrated handset?	N	Y	Y	Y	Y	Y
Help feature?	Y	N	N	N	N	N
Clock and calendar?	N	N	N	Y	Y	Y
Price	under $1,300	$1,144	$1,295	$2,200	$1,490	$1,960

Source: Liberty Electronics USA

Resident telephonic software

The modem automatically logs onto data services and enters passwords, has auto-redial capability and can be programmed to call a group of numbers until one answers. When the terminal is hooked to a printer, it receives and prints files while unattended. The telephonic software resides in ROM, and additional on-board non-volatile memory stores phone numbers for both voice and data calls.

A directory screen displays the last name and number called; lists names and numbers; and, in the case of data services or remote devices, stores and sets the parity, baud rate and other configuration parameters. The bottom of the screen displays dialing options that can be executed with the function keys.

Liberty president George Chao says the terminal market is changing significantly. "We are now in an application-driven environment. We see a very large vacuum in the market today that can be addressed much as the personal computer addressed [an unfulfilled need] by packaging an existing technology."

Chao predicts that all terminals will address the voice/data market by 1990. "Once you get to monolithics, [modems] will be jelly beans. I think it may happen as early as 1987, depending on the progress made in monolithics. If [monolithic modems] start hitting the streets later this year, they'll be about $30 to $50, which means, semiconductor trends being what they are, modems will be $10." Chao says that, at that price, integrating modems into terminals will be nearly universal.

Greg Carlsted, industry analyst for Dataquest Inc., San Jose, Calif., expects a high growth rate for voice/data terminals. Sales hit $41 million in 1983, Carlsted says, adding, "We believe the market will increase in 1984 to approximately $153 million, growing at a compound annual growth rate from 1984 to 1988 of about 81 percent, with sales in 1988 of $1.6 billion." Carlsted adds that the early terminal products will lead to product families. "A [company like] Rolm Corp. will have a number of these terminals that will fill a number of market needs. We believe that families of products will be necessary to remain competitive." □

HEARD ON THE HILL


Stock, Boston/Bohdan Hrynewych

AT&T sets value-added strategy

Stephen J. Shaw
Washington Editor

Less than a month after announcing its 3B computer family, American Telephone & Telegraph Co. concluded its first agreement with a value-added reseller, M/A COM Sigma Data (MSD) Inc. MSD, a Rockville, Md., system integrator, announced in April that it will integrate the 3Bs into systems for sale to the federal government. The move to outside marketers came as no surprise, but some observers criticize AT&T's apparent lack of computer marketing skill.

AT&T Technologies Inc., the deregulated arm of AT&T, was unlikely to rely solely on its extensive—but largely inexperienced—sales force in trying to move quickly into the unfamiliar commercial computer market. Agreements with third-party resellers have traditionally provided manufacturers—most notably IBM Corp.—a fast track in getting new products to end users. AT&T's deal with MSD, which sells primarily to the federal government, also complements AT&T's traditional strength in dealing with government customers, especially the U.S. Department of Defense.

AT&T is also seeking other value-added resellers (VARs). A source close to the company says AT&T has developed a strategy to market the 3B minicomputers that includes arrangements with a half-dozen VARs in six vertical market niches, including computer-aided design and computer-aided manufacturing. An AT&T spokesman says only that AT&T Technologies is looking at VARs with "technical, industrial or communications-type customers." AT&T is also trying to attract VARs by placing ads in numerous computer trade publications. The ads state: "Business partners wanted. Major U.S. firm seeks partners for new business venture with huge dollar potential. Excellent prices/terms/discount schedules for right parties."

The three-year non-exclusive pact with MSD, however, raises some significant and disturbing questions about AT&T's viability in the minicomputer and desktop computer markets. First, AT&T relies on third parties for 3B system integration and makes extensive use of consultants such as Stanford Research Inc. and McKinsey & Co., which evaluated MSD. The "hired gun" attitude seems to be a frank admission of AT&T's lack of computer marketing expertise. Although industry analysts are generally giving high marks to the Bell Laboratories' technology in the 3B computer family, AT&T's marketing skills remain unproven.

Second, AT&T is running a considerable, but unavoidable, risk in allowing VAR salespeople to call on potential customers before AT&T's internal sales organization has gelled. AT&T Technologies has two sales forces selling the 3Bs. One operates through AT&T Information Systems (ATTIS), and the other works under AT&T Technology Systems, formerly Western Electric. Under the Federal Communications Commission's Computer II separation guidelines, the two divisions cannot engage in joint marketing activities; that is, salespeople from each division cannot walk into a prospect's office together, nor can the two marketing staffs share customer information. When the sales forces of MSD and other resellers are added to the picture, potential customers could be faced with the prospect of entertaining three or more salespersons hawking the same computers.

Ideally, according to AT&T's scenario, ATTIS will concentrate on selling systems incorporating the 3Bs, private-branch exchanges and office communications products to Fortune 1,000 businesses that want to increase productivity through office automation. VARs and third-party resellers will sell to smaller accounts that desire the mix-and-match approach that tailors hardware and software from a variety of manufacturers for specific applications. AT&T Technology Systems will continue to market to ex-Bell telephone operating companies and to independent telecommunications companies. "There will be a degree of coordination among the marketing staffs for the 3B," asserts an ATTIS spokesman. "The two groups won't be competing against each other or against the value-added resellers."

MSD president Richard Litsinger disagrees with this assessment. "AT&T Technologies is not relying on ATTIS as its only outlet for the 3B. We'll be running into ATTIS in the federal marketplace," he says.

The sales forces from AT&T Technology Systems, ATTIS, and MSD "will knock each other's heads off in the federal marketplace," comments Charles Robbins, director of communications and office automation at International Data Corp., a market research and consulting organization. "The marketing distinctions in terms of who sells to which customers won't work the way AT&T anticipates [they will] on paper." The long-term success of AT&T's marketing strategy for the 3B family depends on how well the company refines the marketing guidelines for each internal division and the third-party resellers it chooses. "The key is proper coordination among all the players," says Robbins.

Until the guidelines are defined, AT&T will rely heavily on such resellers as MSD to address specific market niches. VARs will provide AT&T the time it needs to train its computer sales forces while minimizing delays in getting the 3Bs to market. □

NCC hosts test of file-transfer equipment

Marjorie Stenzler-Centonze
Associate Editor

This month, the National Bureau of Standards (NBS), General Motors Corp. and Boeing Computer Services Co. will test two types of local-area networks (LANs)—one for business and one for industry—at the National Computer Conference in Las Vegas, Nev. The tests involve 14 computer and communications companies that are backing a government/industry effort to develop networked-equipment compatibility in the business environment.

Companies involved in the business demonstration include Advanced Computer Communications, Boeing, Charles River Data Systems Inc., Digital Equipment Corp., Hewlett-Packard Co., Honeywell Information Systems Inc., Intel Corp. and NCR Corp. Companies involved on the industrial side are Allen-Bradley Co., Concord Data Systems, DEC, Gould Modicon, HP, IBM Corp. and Motorola Inc.

The demonstration at NCC follows the recent signing of an agreement by NBS, GM and Boeing to generate and promote product development implementing the international Open Systems Interconnection (OSI) standards.

Boeing president Robert L. Dryden says the standards, developed by the International Standards Organization (ISO), will enable computer users and manufacturers to develop and operate cost-effective computer networks using various manufacturers' equipment. "Without international standards, the choices facing users of these systems are either the development of ad hoc solutions to interconnect incompatible products or the utilization of a single vendor's system as a common denominator to connect other manufacturers' systems. These solutions, though effective, have been costly to develop and maintain as computer technology changes," Dryden says.

OSI functions defined

The OSI-defined architecture for distributed information-processing systems is a seven-layer division of the various data-communications functions of a network. OSI also identifies the common protocols needed for each layer to communicate with other layers. Networks developed according to the OSI concept will be vendor-independent and will support different types of equipment. The NBS, the American National Standards Institute and the Institute of Electrical and Electronics Engineers support the OSI standards.

ISO developed the OSI reference model, a framework that divides the functions of a network into seven layers. The layers of the model handle the physical connections of a computer to a communications medium and the means by which data gains access to the network.

NCC PARTICIPANTS TEST LEVEL 4 OF THE OPEN SYSTEMS INTERCONNECTION MODEL

7	APPLICATION LAYER
6	PRESENTATION LAYER
5	SESSION LAYER
4	TRANSPORT LAYER
3	NETWORK LAYER
2	DATA LINK LAYER
1	PHYSICAL LAYER

ISO's seven-layer network architecture *organizes system functions into layers. Layer 4, the transport layer, will be tested at the NCC.*

The higher layers set up connections between systems and data structures so that data can be reliably transmitted and received. The fourth layer, transport, controls information flow, including file transfers, from a sender to a receiver. The NCC demonstration will show the transport layer working with a carrier sense multiple access with collision detection (CSMA/CD) network for business use and the token bus network designed for use in factory computer systems.

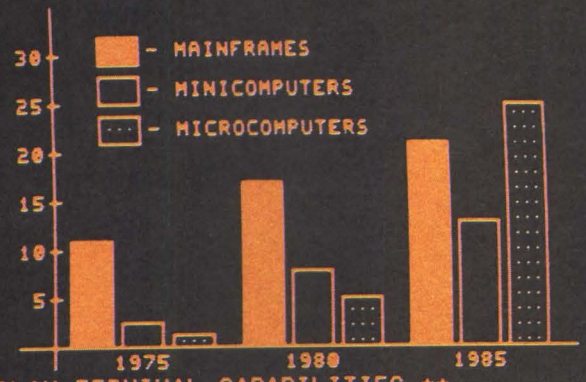
Exhibit to feature file transfer

Robert Rosenthal, manager of the LAN program at the NBS, says the demonstration will show multiple vendors using level 4 transport protocols to transport files from one machine to another. NBS plans to participate by evaluating exhibiting manufacturers' adherence to level 4. "This kind of demonstration is of major importance to the industry," Rosenthal states. "When you have major corporations using their own financial resources and asking the government to assist in testing protocols that have been internationally accepted, that in itself is greatly significant."

Not good for small companies?

Many major corporations support the effort to establish networking standards. But the idea may not be quite as appealing to small companies, says Mike MacNaughton, president of the consulting company Business Development International, Franklin Lakes, N.J. While MacNaughton agrees that establishing standards is desirable, he cites a problem for the myriad small- and

A Picture's Worth:



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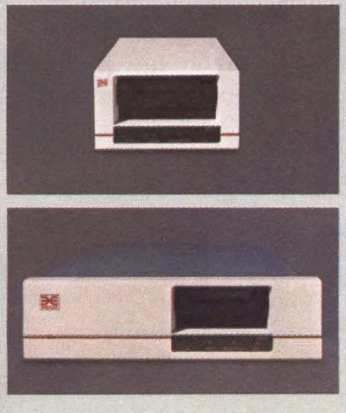

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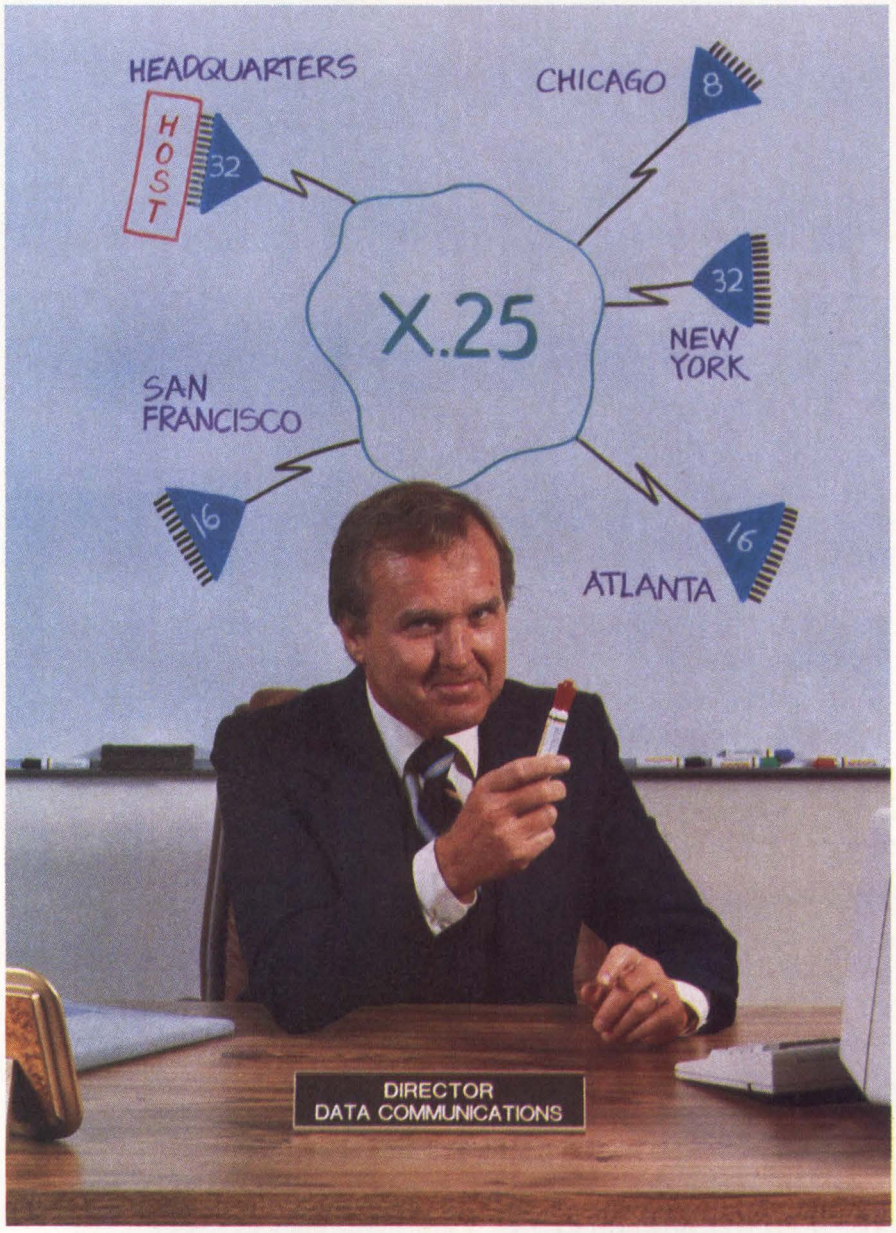

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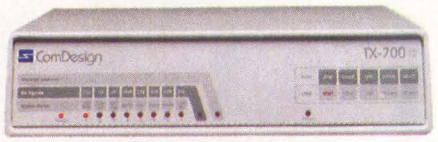

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medium-sized companies that have entered the market since "LAN" became the buzzword. "Anyone who is in the business of making micros or anything that relates to them has got themselves a LAN, and I'd be surprised if any of them will meet the standards that are coming out of NBS," he states.

MacNaughton says that, while the NBS effort is valiant, it may better suit major manufacturers and not most small ones. "Most manufacturers will not adhere to standards in this country unless there is a commercial reason for them to do so," he adds. Small companies cannot take advantage of the commercial benefits of adherence to standards, given the expense of designing products to meet those standards, MacNaughton points out.

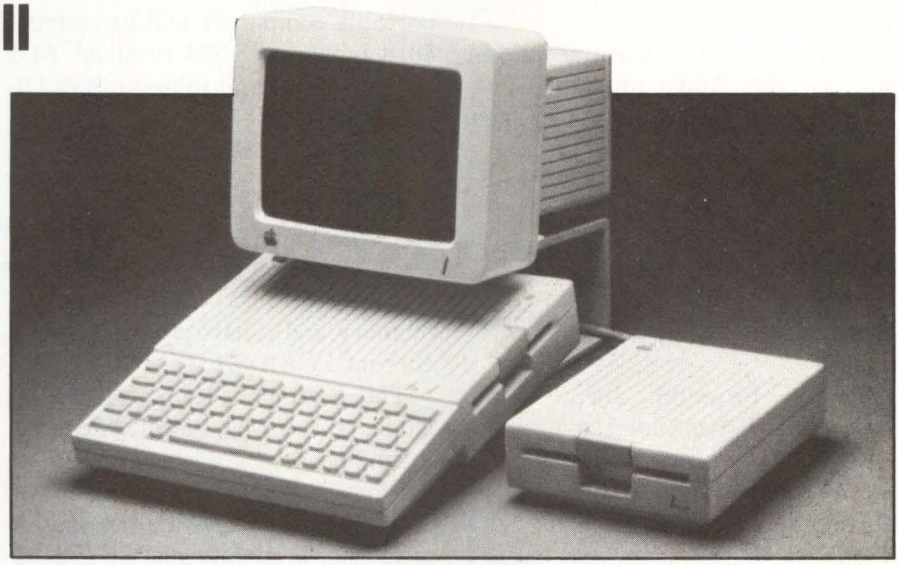
Response is strong

NBS sources say outside vendors have responded positively to the standards effort. "For a long time, people have been looking forward to a coming-out party for OSI, and it was just a matter of reaching a consensus in the international community," Rosenthal says. Many computer networking vendors are interested in developing implementations, testing them at the NBS and then developing product lines, says Rosenthal. "There are still a lot of holes, though," he explains. "We don't have an inter-net protocol in place at layer 3 yet, and we are not demonstrating session or presentation protocols. We are looking only at a LAN physical layer, a logical link-control layer and a transport layer. That still leaves layer 3, 5, 6 and 7 protocols to be tested, and that's an enormous amount of work." □

Apple introduces portable Apple II

Tom Moran, Associate Editor

Apple Computer Inc. recently unveiled the IIc, a portable member of the Apple II family, at a San Francisco exposition called "Apple II Forever." Apple developed the IIc to satisfy two long-term objectives—to prolong the life of the profitable Apple II family and to strengthen the company's presence in the portable computer market. Apple reportedly received orders for more than 50,000 IIcs on the day of its introduction.



The Apple IIc transportable computer *has an optional monochrome monitor and an optional external 5¼-inch floppy disk drive. The internal 5¼-inch drive can be seen at the right rear of the IIc.*

IIc requires monitor

Although the $1,295 IIc weighs only 7½ pounds, Apple is billing it as "transportable" rather than "knee-top" because it requires either the optional Apple Monitor IIc or another display. The $199 9-inch Monitor IIc weighs 11 pounds and displays 24 lines by 80 columns on its green phosphor screen.

The IIc includes a video expansion port that drives a red-green-blue monitor, a TV set or an optional liquid-crystal display (LCD). The 24-line-by-80-column LCD will be available in the fourth quarter of 1984. At less than 3 pounds, the LCD screen would significantly reduce the weight and volume of the IIc, making it a true knee-top machine.

Other interfaces include two high-speed serial ports, a mouse/game-paddle/joystick port, an external disk-drive port and a port for a 9V to 20V DC power unit. The serial ports support modems, printers and plotters. The IIc also has a headphone jack and a volume-control knob for its built-in speaker. Unlike previous Apple II products, the IIc has no internal expansion slots.

The IIc uses a 65C02 microprocessor, which is the complementary - metal - oxide - semiconductor

version of the 6502 CPU used in previous Apple II family machines. The low-power-consumption 65C02 runs at 1.02 MHz. Apple has expanded the RAM of the IIc to 128K bytes from the IIe's 64K bytes.

Drive retains software base

Although it measures only 2½ by 12 by 11½ inches, the IIc sports an integrated 5¼-inch 140K-byte floppy disk drive. Future knee-top portable computers will most likely have integral 3½-inch microfloppy drives, which Apple uses in its transportable Macintosh and desktop Lisa 2 systems. However, Apple opted for a 5¼-inch drive in the IIc to allow the system to access the huge Apple II software base. The IIc does not currently run CP/M programs.

To increase the potential market for the IIc, Apple introduced native-language versions for France, West Germany, Italy and the United Kingdom. A switch on the 63-key keyboard changes it from the American configuration to the native-language layout. On machines sold in the United States, the switch toggles between standard QWERTY and Dvorak layouts.

Sandra Gant, an analyst for InfoCorp, a Cupertino, Calif., research concern, expects Apple to ship 550,000 IIes and 350,000 IIcs in 1984. The 900,000-unit total represents an increase of 150,000 over InfoCorp's previous 1984 forecast. Gant expects Apple to control the actual mix of IIcs and IIes through pricing, promotion and production. Ken Lim, analyst for Dataquest, a San Jose, Calif., market research group, projects that the market for portable computers will grow from $818 million in 1983 to about $4.4 billion in 1984 and to more than $15 billion by 1988.

Apple will market the IIc through its dealer base and through selected department stores, amounting to more than 2,000 outlets in the United States. The company projects that two-thirds of the IIcs sold will be used in homes, with schools and businesses accounting for the remaining one-third.

To reduce competition between the IIc and IIe, Apple dropped the list price of a IIe with 64K bytes of RAM and one disk drive to $995. Discounters will sell the IIe for several hundred dollars below list price, which will bring the IIe into the home computer market and possibly into conflict with tough competitor Commodore Business Machines Inc. Apple will attempt to avoid such conflict by keeping the IIe out of mass-merchandising outlets and by positioning it against the PCjr. □

DRI enhances Concurrent PC-DOS

David Bright, Assistant Editor

Digital Research Inc., Pacific Grove, Calif., has added several features to its Concurrent PC-DOS for a new retail version targeted at corporate managers. Since last fall's Comdex, the company has signed about 50 OEMs for the multitasking operating system, according to operating systems marketing manager Darrell Miller.

The retail Concurrent PC-DOS runs as many as four PC-DOS or CP/M-86 applications simultaneously. Enhancements include communications, menus, windowing, a Rolodex-like database-management system and a print spooler. Digital Research recommends using an IBM Corp. PC with 512K bytes of memory and a hard disk with Concurrent PC-DOS.

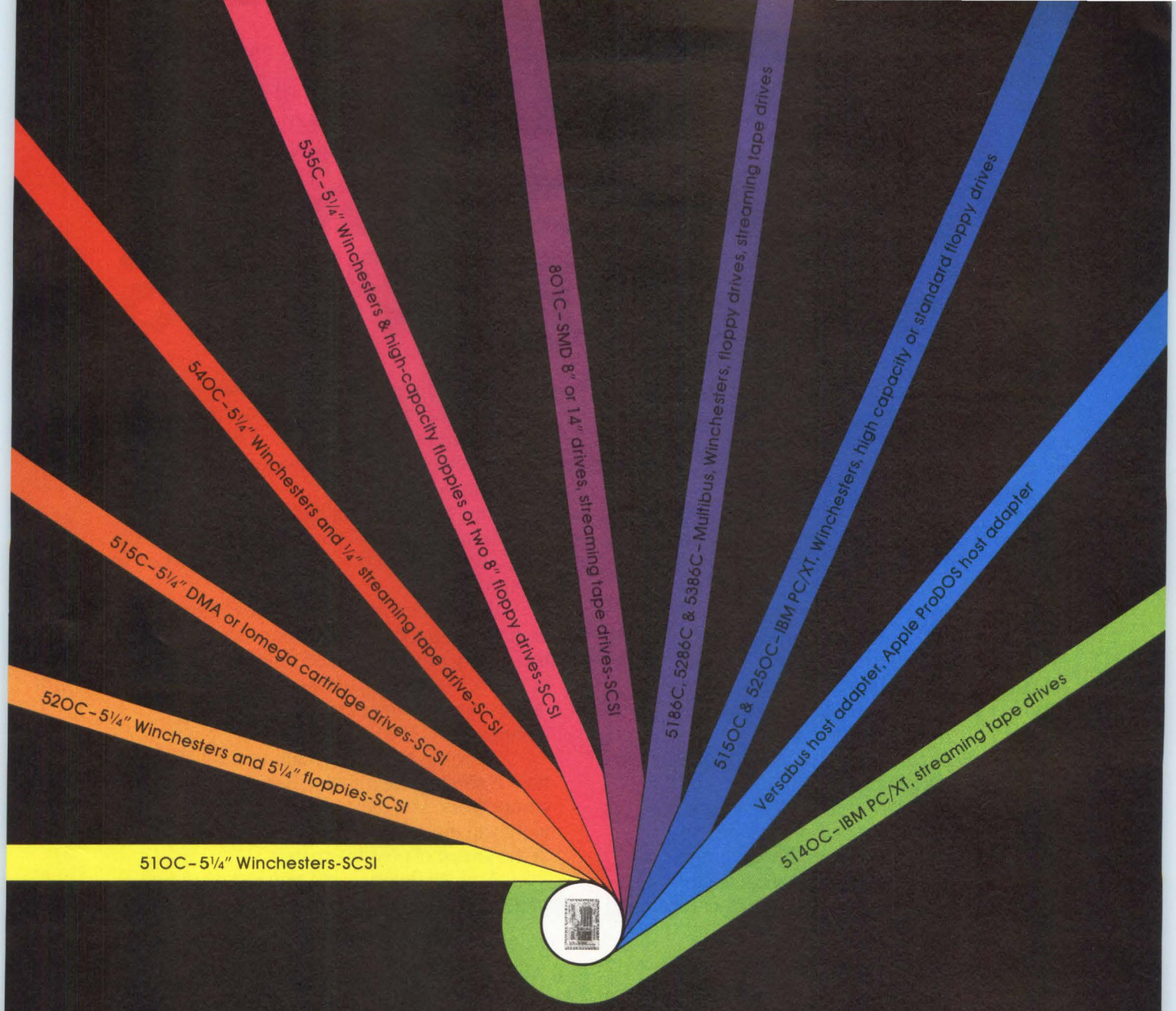
The communications feature includes a third-party software program for accessing local and remote databases such as The Source news-retrieval service. While the system is in use, a remote dial-up link allows a remote user to leave electronic messages in a mailbox. A two-user system can be created by hooking a dumb terminal to the PC's asynchronous port.

The operating system allows the display of as many as four applications in variably sized windows at one time. A cut-and-paste feature allows integration, such as the movement of spreadsheet data to a word-processing document in another window. Users can also customize or bypass the menu system, scroll through the Rolodex-like system or make automatic searches. The print spooler incorporates a queuing system similar to that on minicomputers and mainframes, with two output devices operating simultaneously, and items in the queue can be reordered.

The $295 retail Concurrent PC-DOS should be available in the third quarter. □

NEXT MONTH IN MMS

The Integrator section of Mini-Micro Systems' August issue features a story on Priam Corp.



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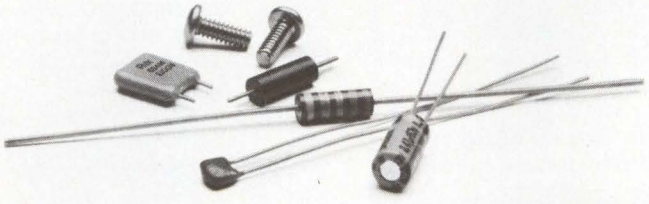

CIRCLE NO. 22 ON INQUIRY CARD

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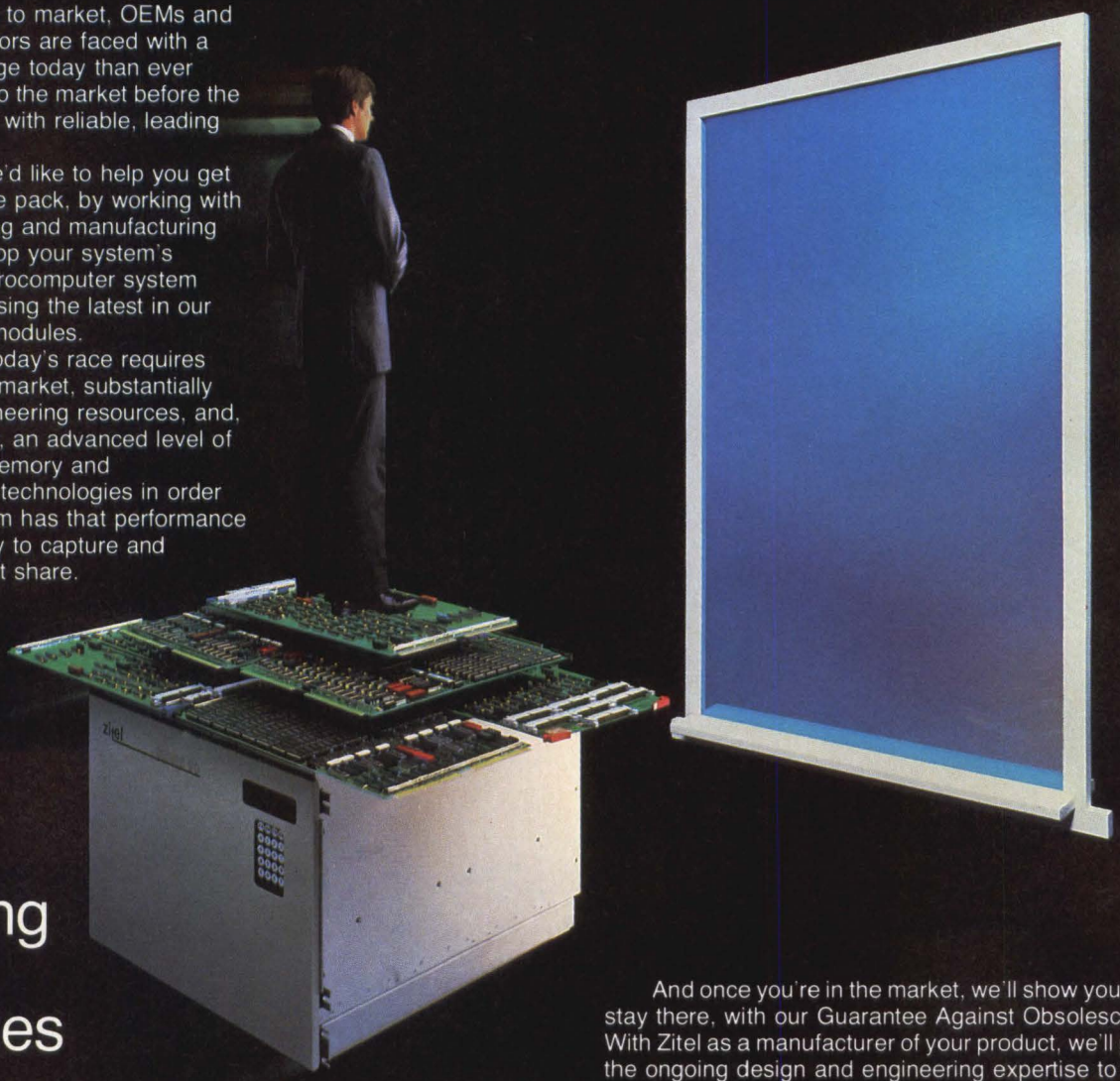

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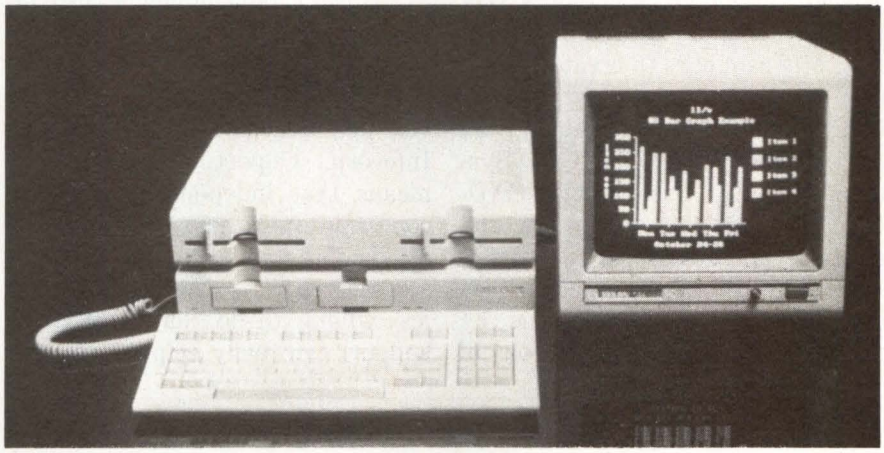
Graphics software colors Mindset computer

Marjorie Stenzler-Centonze
Associate Editor



The 20-pound Mindset personal computer *offers enhanced speed and graphics capabilities, which distinguish it from other IBM PC-compatible microcomputers.*

Plugging IBM Corp.'s perceived product gaps has made many companies rich. This could be the case with Mindset Corp., Sunnyvale, Calif., which this month expects to provide retailers with its IBM PC-compatible Mindset personal computer. Mindset is banking on what is likely to be the IBM PC's most notable weakness: graphics.

"In entering the business as a new company, we felt we needed to do something very different," says Mindset president Roger H. Badertscher, a former Atari executive. Badertscher says the Mindset microcomputer is intended not as an IBM PC substitute but as a graphics-intensive alternative. Much of the software differentiating the product from the IBM PC is just coming on-line, he says.

The Mindset, which is designed around the Intel Corp. 16-bit 80186 microprocessor, derives its graphics power from two custom graphics coprocessors made by VLSI Technology Inc., San Jose, Calif. The basic system, with 64K bytes of RAM, two ROM cartridge ports and a keyboard, sells for $1,099. A fully configured 256K-byte system with two 5¼-inch, 360K-byte floppy disk drives sells for $2,398.

A three-pronged strategy

Mindset's three-part software strategy includes IBM PC software; optimization for windows, icons and a mouse cursor controller; and graphics. "We believe there are some broad graphics application categories where graphics will be an end in itself and not just a tool to make a spreadsheet easier to use," Badertscher notes.

Initial software offerings include more than 70 packages. The machine runs most software written for the IBM PC, including Lotus Development Corp.'s 1-2-3 integrated program. Mindset is marketing a series of packages that takes advantage of the machine's graphics ability and also pushing the development of products designed for the machine by independent software vendors.

Bill Gates, president of Microsoft Corp., Kirkland, Wash., says the availability of high-quality graphics will be the next step in improving personal computers and may be a bigger leap than processor technology's move from 8 to 16 bits. Microsoft is focusing on software for the Mindset as well as Apple Computer Inc.'s Macintosh microcomputer. "Both machines share a vision of graphics," Gates says. "Apple is setting its own standards and is willing to create a software base apart from IBM; Mindset has chosen to take advantage of the existing [IBM] software base."

Fitting into retail channels

Egil Juliussen, chairman of research company Future Computing Inc., Richardson, Texas, says the Mindset fits well into the office/home personal computer market alongside the IBM PC and the Apple IIe.

Differentiating Mindset at the retail level is graphics software, says Badertscher. Mindset has private-label deals for three $99- to $399-graphics packages for professional users. The packages are Designer by Datasoft Inc., Milpitas, Calif., an entry-level program that features an undo command and a zoom for pixel-by-pixel detail drawing for business artists; Four-Point Graphics Plus by International Microcomputer Software Inc., San Rafael, Calif., a mouse- or keyboard-generated business graphics generator featuring a free-running display that generates moving-slide presentations; and Lumena by Time Arts Inc., Santa Rosa, Calif., a color package that supports a mouse and a digitizing tablet through Mindset's RS232 interface.

Mindset is making available two telecommunications packages, Telecom and Telecom+ for use with 300- and 1,200-baud modems. Both feature full-color user interfaces to

identify commands and labels. The company is also marketing an enhanced version of Microsoft's GW BASIC, designed to enable beginning programmers to create graphics-intensive programs, and CAD-DRAFT, a $495 menu-driven drafting tool by Personal CAD Systems Inc., Los Gatos, Calif. CAD-DRAFT, aimed at designers and engineers, features a user-selectable grid system that enables users to build basic designs by choosing from a combination of lines, arcs, shapes, symbols and text.

Mindset's developments also include incorporation of higher-level graphics commands into hardware. According to Ralph Gilman, senior vice president of research company Infocorp, Cupertino, Calif., this means that independent software companies will have to adhere to Mindset's standards—at least at some level. "If software companies are willing to do that, then their support can really help the product along," Gilman says. He believes market maturity will be another factor.

Gilman adds that the primary question, as far as Mindset is concerned, is whether a market for advanced graphics yet exists. "Mindset has an excellent innovation, but they don't have very much of a differentiation in the market because the market doesn't value graphics as much now as it will in a couple of years." □

Stratus fault-tolerant systems challenge Tandem

David Bright, Assistant Editor

Stratus Computer Inc., Natick, Mass., has introduced two new fault-tolerant computer systems that may pose a serious threat to Tandem Computers Inc., Cupertino, Calif., which now dominates the fault-tolerant market.

Stratus, with its FT200 (previously called the Stratus/32 continuous-processing system), was formerly a low-end player in the market. But, thanks to the new XA 400 and XA 600 systems, which use multiple Motorola 68010 virtual-memory processors, Stratus will now be able "to compete head-on with the best that Tandem has," states Omri Serlin, president of ITOM International Co., a Los Altos, Calif., market research and consulting company specializing in fault tolerance.

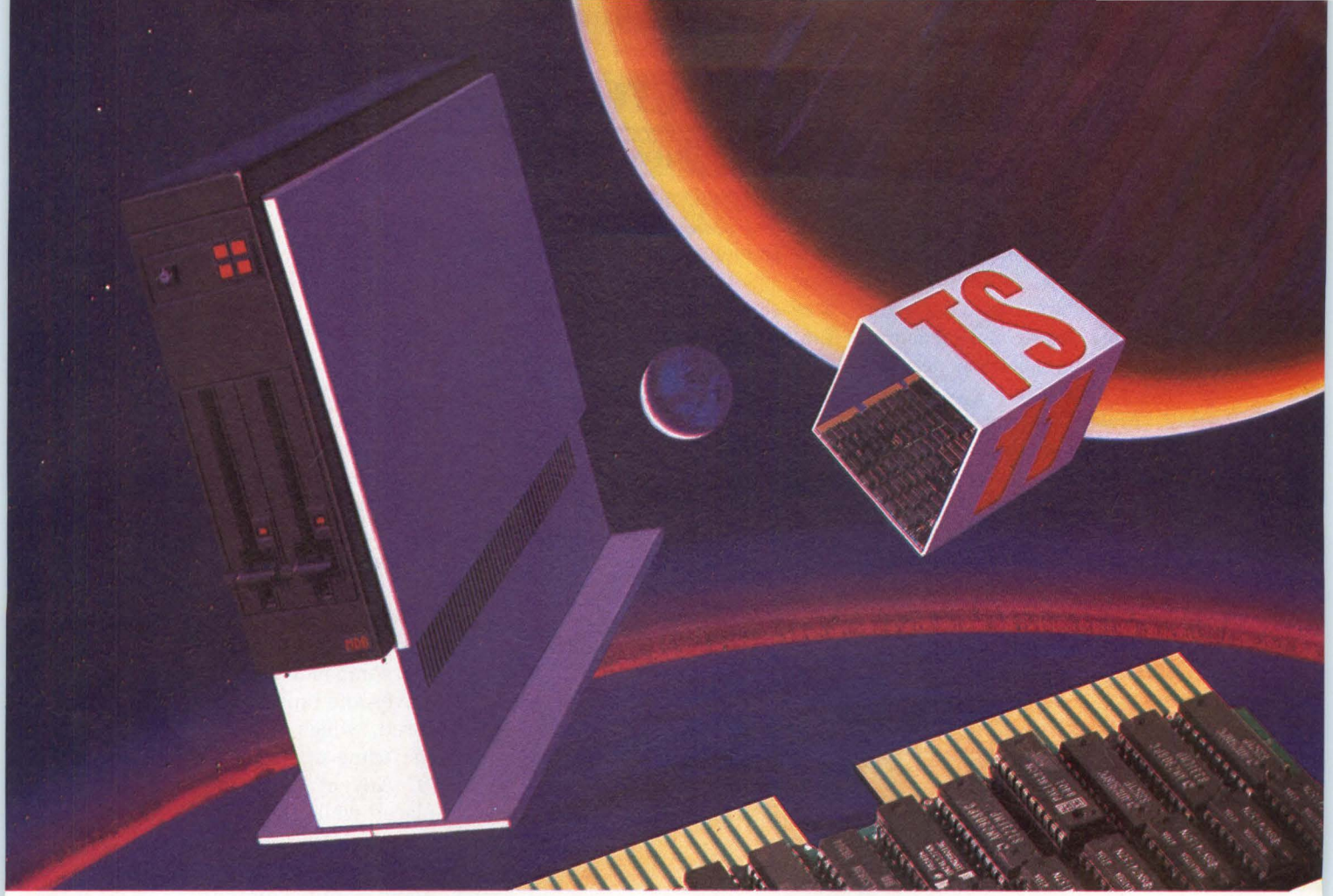
Serlin says that, although Stratus' price/performance advantage over Tandem isn't tremendous, the two companies are now in the same league. Prices for the XA 400 start at $185,000, while XA 600 prices begin at $300,000.

Stratus' fault-tolerant XA 600 *can support as many as 256 asynchronous terminals. System prices start at $300,000.*

Market is huge

With at least 175 installations so far, Stratus is one of the more established start-ups in the fault-tolerant business. Stratus, like most fault-tolerant manufacturers, targets the on-line transaction-processing market segment. Most analysts agree that this segment will enjoy tremendous growth in the next few years. Market research company InfoCorp, Cupertino, Calif., predicts the worldwide transaction-processing market will grow from $8.3 billion in 1982 to $27.8 billion in 1986. And Serlin says the market has the potential to reach $32 billion by 1986.

In typical transaction-processing environments, such as banking and airline reservation systems, most of the jobs are I/O-bound; there's not



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Designed to accommodate all kinds of change, the panels also house whatever future options the designer may require. For example, both MDB micro workstations have large disk drives and streaming tape back-up options which the packaging system can handle, as well as any number of other interfaces MDB makes including 8 or 16 channel multiplexors, synchronous serial interfaces and high speed DMA interface modules.

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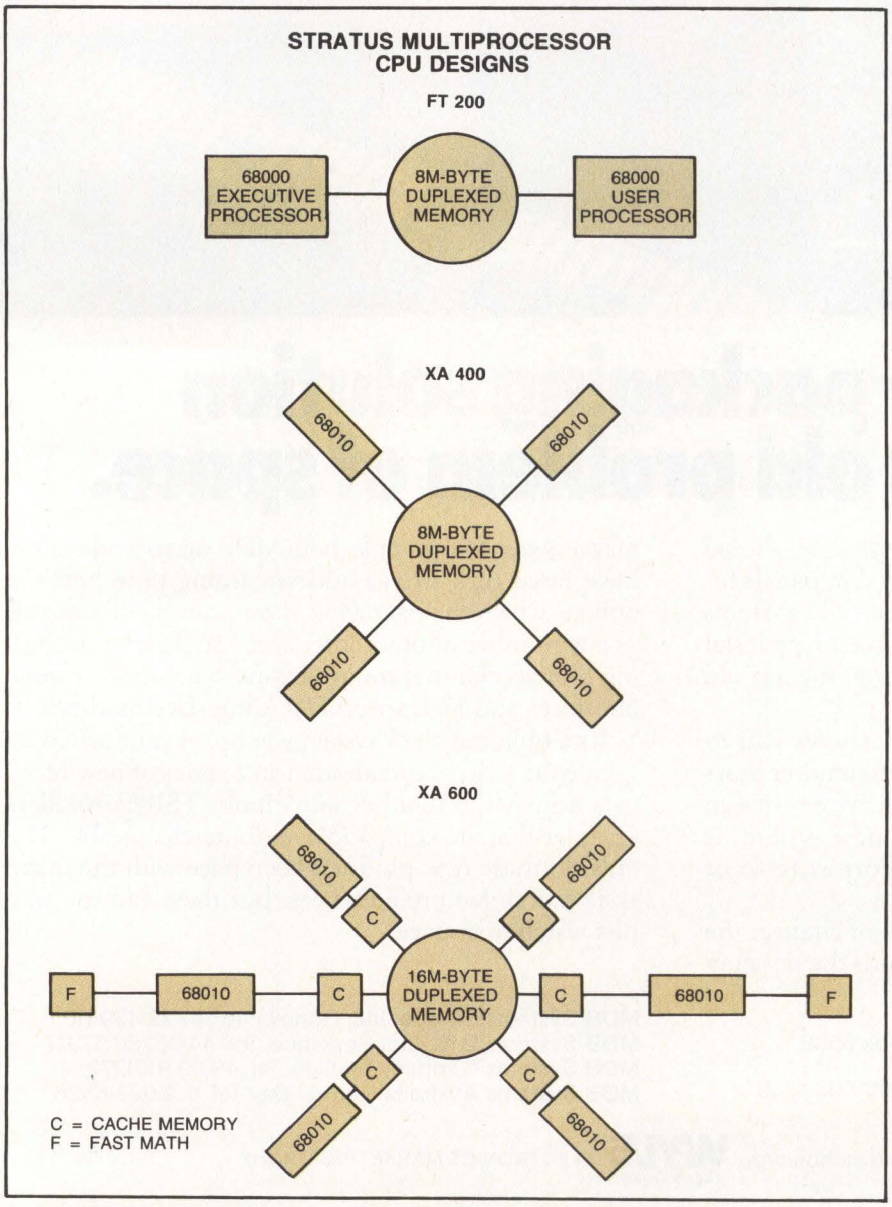
much number crunching involved. Therefore, the use of performance ratings, which are based on number-crunching power and measured in millions of instructions per second, may not be a fair way of comparing transaction-processing systems. Comparing the number of transactions per second (TPS) is much more accurate, although it's not a standard benchmarking method. Serlin says the figures Stratus and Tandem released to him from banking environments seem to offer a reasonable comparison. The Stratus XA 600 system runs at 5 to 7 TPS, and each Tandem NonStop TXP processor runs at about the same level. The Tandem system contains two to 16 processors, but when users add processors the performance doesn't increase quite linearly, he adds. A two-processor NonStop TXP processes about 10 to 12 TPS, while the Stratus XA 400 handles 4.1 TPS.



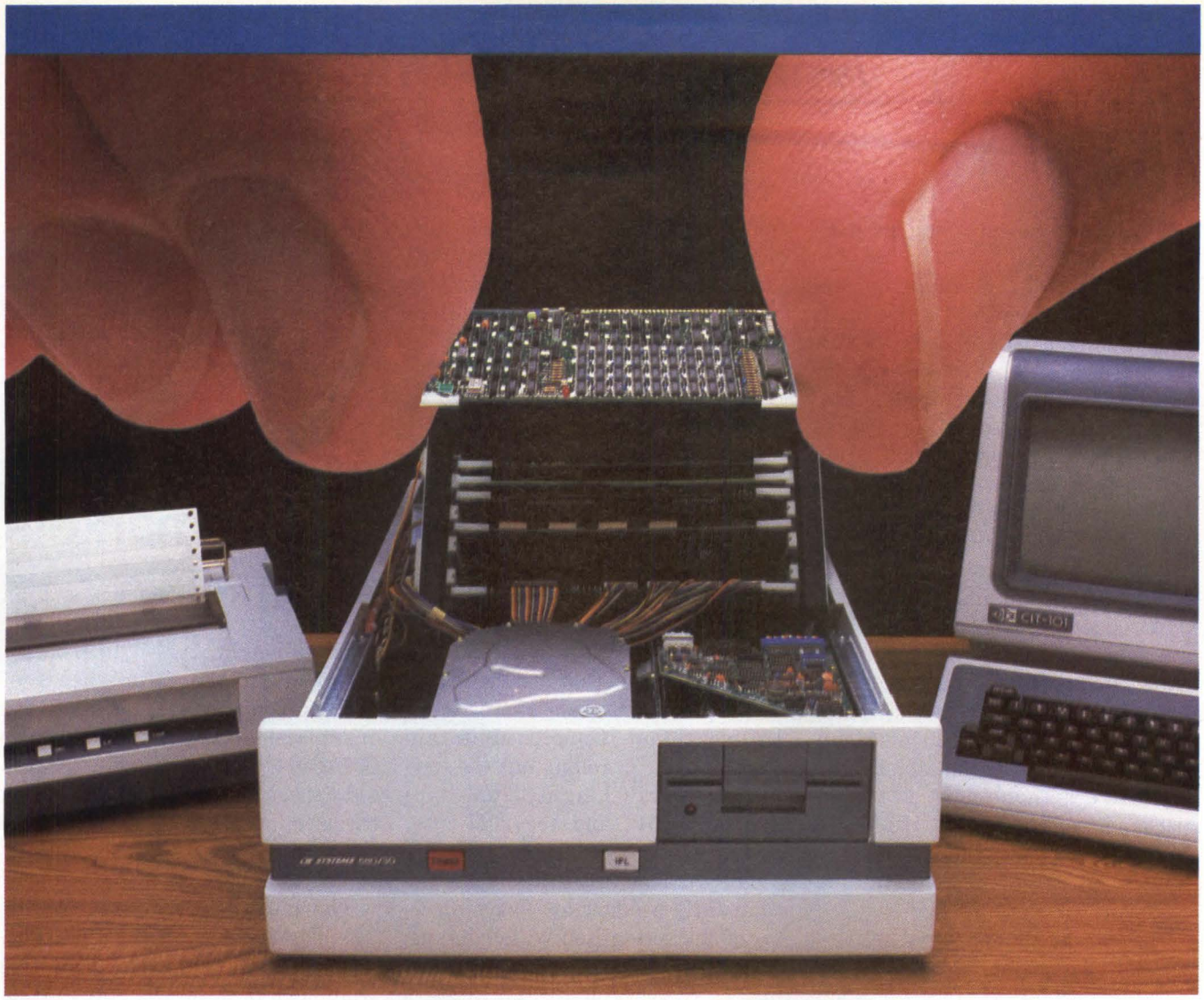
Stratus' new XA 400 *has two CPU boards, each with four 68010 processors. The XA 600's two CPUs each incorporate six 68010s with cache memory and a floating-point processor.*

Hardware is duplicated

The Stratus XA 400 has two CPUs performing identical operations. Each unit contains four 68010 processors, each of which can work separately or in parallel. Each self-checking CPU board performs as many as 8 million checks per second. If the checks on one of the boards don't match, that CPU automatically becomes disabled while the other continues operation. All basic system components, except for the tape drives and tape controllers, are mirrored, which means they perform the same operations simultaneously. Any of the boards can be replaced while the system is running.

Some other systems, like those from Tandem, also duplicate hardware, but employ software-checkpointing schemes to ensure continuous operation. In Tandem's NonStop TXP, for example, no single processor serves as a complete backup for another. Instead, built-in system utilities disperse copies of transactions occurring on each CPU to the other CPUs. If one CPU fails, the CPUs with the backup transactions pick up from the last good software checkpoint. Transaction back-out software, added by Tandem in 1981, reduces the probability of losing transactions when reverting to checkpoints, explains Serlin. Tandem added the system software that assigns backup processors in 1981.

An XA 400 with 4M bytes of redundant memory (for a total of 8M bytes), two 450M-byte Winchester disk drives, communications lines for 30 terminals, six terminals, Virtual Operating System (VOS) and COBOL lists for $300,000. An XA 600 with 16M bytes of redundant memory, two 450M-byte Winchesters, line support for 128 terminals, six terminals, VOS, COBOL and a



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In comparison, a Tandem Non-Stop TXP with two CPUs, 4M bytes of RAM for each CPU, two 540M-byte Winchesters, line support for 31 terminals, six terminals, Tandem's Guardian operating system and COBOL lists for $364,000. Additional processors, with 2M bytes of RAM, sell for $96,000 each.

Stratus says its new systems are software-compatible with the FT200. The company also announced a new version of VOS, VOS 3.0, which supports all three machines and reportedly provides a 15 percent performance improvement on the FT200. VOS 3.0 also supports SOS, a Stratus set of integrated office-management software packages that connects IBM PCs, IBM 3270 terminals and ASCII terminals to the fault-tolerant machines.

A StrataLINK local-area network (LAN) comprising as many as 32 Stratus machines performs as a single system, according to Stratus. As many as 14 Tandem systems, comprising 224 processors, can be linked in a LAN.

Stratus sales increase

Although Stratus has a long way to go before it can match Tandem's financial success, the company has been picking up steam. Its sales for the quarter ending April 1 were $7.6 million, compared with $3.3 million in the same quarter last year. Tandem had sales of $111.2 million for its first quarter ended March 31, up from $96 million for the same period in fiscal 1983.

IBM influences the market

The major obstacle facing both Stratus and Tandem in the transaction-processing market is IBM Corp.'s 4300 series mainframes, which don't incorporate fault tolerance. That difference is a major selling point for Stratus and Tandem. Stratus president William Foster says his company will do well by "complementing" IBM rather than by competing directly.

Other potential competitors in the high-end fault-tolerant market include Synapse Computer Corp., Milpitas, Calif., and Computer Consoles, Rochester, N.Y. But neither company has shipped more than a handful of systems so far. □

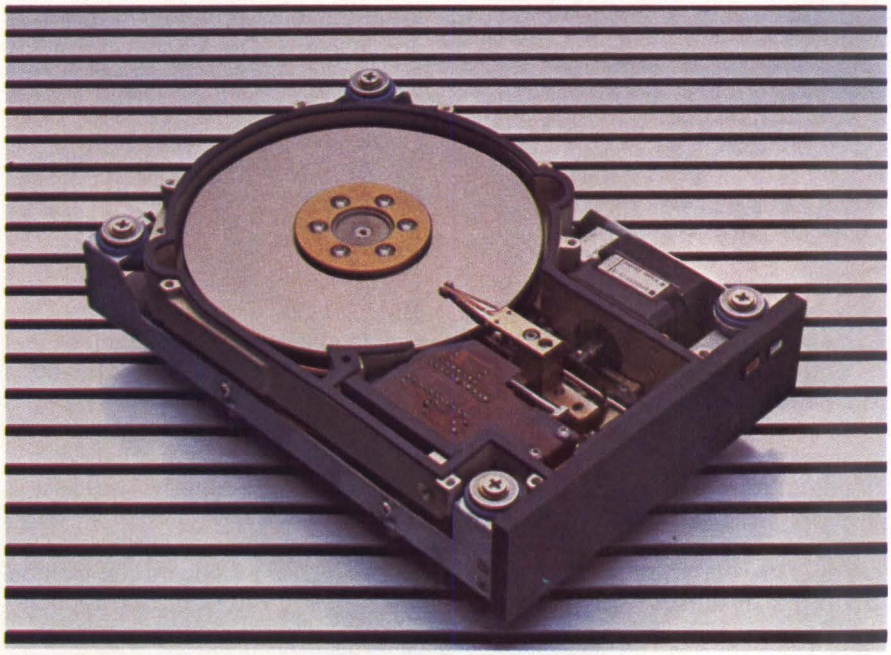
Rigid disk models extend sub-4-inch, half-height markets

Carl Warren, Western Editor

To meet the growing demand for rigid disk drives that match smaller desktop computers, Microscience International Corp., Mountain View, Calif., is rolling out the new 3½-inch, half-height, 10M-byte model HH-312 and the 20M-byte, half-height, 5¼-inch model HH-725.

The 3½-inch HH-312 fills out the company's product line, says director of marketing Ron W. Schlitzkus, with the drive featuring an unformatted capacity of 12.76M bytes, a data-transfer rate of 5M bits per second (ST-506 standard) and an average access time of 70 msec. The half-height, 20M-byte HH-725, designed for the future needs of desktop computers and for add-ins or replacements for systems such as the IBM PC, features an unformatted capacity of 25.5M bytes and an 80-msec. average access time. Like the HH-312, the HH-725 is ST-412-compatible.

The impetus for introducing the 3½-inch HH-312, says Schlitzkus, was a demand for small Winchesters from such desktop computer manufacturers as Compaq Computer



Using a thermally isolated stepper motor and a linear actuator assembly, *the 5¼-inch, half-height HH-725 has an 80-msec. average access time. An on-board microprocessor controls self-diagnostics and the closed-loop servo system, which handles precise track and sector control.*

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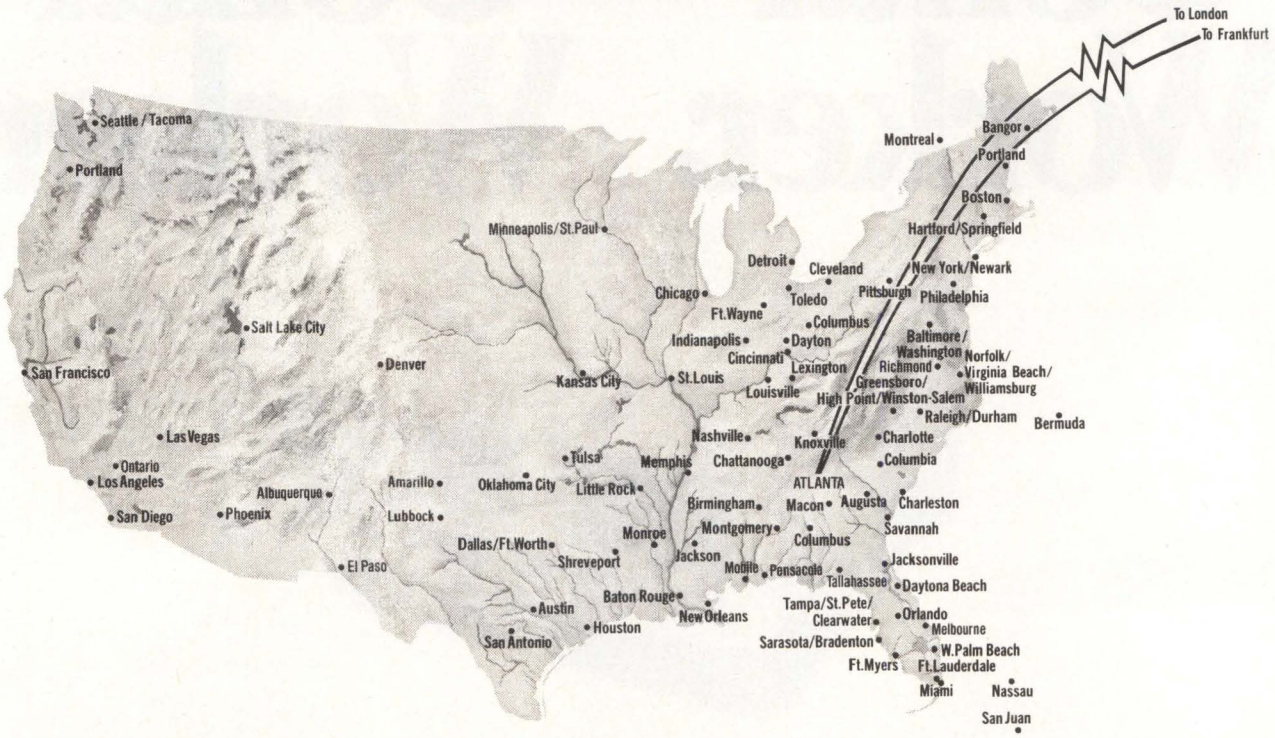

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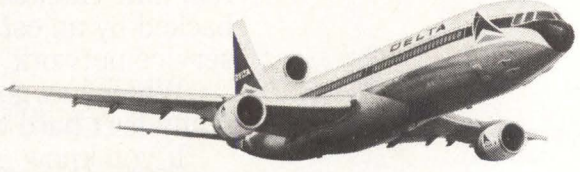

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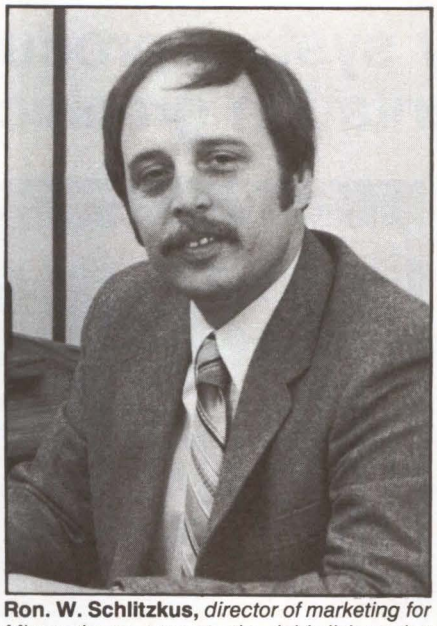
Corp. and TeleVideo Systems Inc., as well as the expected rapid growth of an add-on Winchester market for Apple Computer Inc.'s Macintosh microcomputer.

Only two manufacturers—Rodime Ltd., Glenrothes, Scotland, and Syquest Technology, Fremont, Calif.—are now supplying sub-4-inch Winchesters. Both companies' drives are slightly larger than the Microscience unit. Although Rodime and Syquest have enjoyed reasonable success with their nonstandard-size drives, Schlitzkus explains, sub-4-inch Winchesters form a new niche in the disk market. Therefore, the drives must be able to compete in price. Says Schlitzkus, "5¼-inch drives are moving up in capacity and speed. There is still a very large market for 10M-byte [drives] with lower transfer rates for single-user desktop units. And, since that market is clearly growing, it needs multiple vendors and will be totally price-driven."

Competition abounds

Microscience expects to begin shipping the new drives in large quantities before year-end, but company officials realize they are facing stiff competition. For example, other concerns planning introductions of 3½-inch drives at the National Computer Conference this month are industry leaders Seagate Technology, Scotts Valley, Calif., Tandon Corp., Chatsworth, Calif., and Miniscribe Corp., Longmont, Colo. Start-up companies Lapine Technology, Santa Clara, Calif., and Microcomputer Memories Inc., Van Nuys, Calif., are also planning similar units.

All the 3½-inch drives sport an ST-412 interface. "This is a requirement of compatibility that the system integrator expects," says Jim Porter, a Mountain View, Calif., industry consultant and president of *Disk/Trend Report*. Porter agrees



Ron. W. Schlitzkus, *director of marketing for Microscience, expects the rigid disk market to grow and to be "totally price-driven."*

with Schlitzkus that the sub-4-inch Winchester will supplant low-end 5¼-inch drives in many applications.

Virtually all the contenders plan to begin shipments of evaluation or production units of the new drives by at least the fourth quarter of this year. Porter believes that, because Miniscribe can quickly manufacture the units, it may be the first to ship.

Extending Microscience's range from the opposite end is its half-height, 20M-byte HH-725. The drive, which uses a stepper motor for positioning, has a closed-loop servo that minimizes off-track errors caused by the stepper motor.

Schlitzkus points out that the HH-712 can be combined with a half-height floppy drive. "You take out a full-sized floppy and replace it with a combination of half-height floppy and an HH-725 or with twin Winchesters. The integration is easy, since the drives are made to be plug-compatible," he says.

Microscience isn't alone in the market for half-height, 5¼-inch rigid disks. Xebec Corp. and Shugart Corp., both in Sunnyvale, Calif., are preparing similar drives. The Xebec drives have an embedded controller, but Shugart is taking a more traditional approach with its two-platter model 724, which is expected to be shown at NCC. It has a closed-loop servo and a formatted capacity of 20M bytes. The company expects to begin high-quantity deliveries in the fourth quarter.

LSI comes into play

Another factor influencing sub-4-inch and half-height Winchesters is the availability of large-scale-integration (LSI) components. Using LSI circuitry, drive manufacturers can reduce the number of boards in the drive interface and thus reduce costs. For example, both the Microscience HH-312 and HH-725 use single-board interfaces, which decrease the number of heat-producing components.

In addition, with more than 25 manufacturers offering plated media, drive makers can provide greater areal densities—measured by multiplying tracks per inch by bits per inch—than were previously possible. "We could have taken the traditional approach on both drives and used standard oxide," says Schlitzkus, "but we expect both the HH-312 and HH-725 to end up in portable or semi-portable machines. Thus, we need a rugged media, and plated is the way to go." Further, Microscience expects greater demand for higher capacities, even for desktop systems, and plated-media capacities can be increased without adding platters.

The 3½-inch HH-312 has a 10,000-bit-per-inch (bpi) bit density, a 648-track-per-inch track density, buffered seek and microprocessor-controlled self-diagnostics. Single-unit price is $999. The 5¼-inch HH-725 offers similar specs but has a recording density of 9,680 bpi and is priced at $1,100 in single-unit quantities. □

Portable display system produces high-level presentation graphics

Carl Warren, Western Editor

Displaying as many as 1,000 colors at a time, *the VideoShow 150 enhances display characteristics by using horizontal positional accuracy, which lets colors and their intensities vary in relationship to their position. This allows smooth lines and special effects, such as 3-D and shadowing.*

Aimed at providing high-level presentation graphics for office environments, the VideoShow 150, developed by General Parametrics Corp., Berkeley, Calif., provides a low-cost hardware and software solution for anyone interested in creating graphics presentations.

The goal, says company president Herbert B. Baskin, was to develop a presentation graphics system that is easy to use and doesn't require technical expertise on the part of the system integrator or end user. Thus, it was necessary to take current display methods and refine them to match perceived needs. To that end, the VideoShow 150 offers both the ability to view as many as 1,000 colors simultaneously, with fast display update, and the ease of creating graphics slide shows using General Parametrics' accompanying software package, PictureIt.

Compatible with IBM

The hardware portion of the VideoShow is a standalone unit based on an Intel 8086 microprocessor with 256K bytes of internal display RAM and a graphics display system. The unit, which can be plugged into an IBM Corp. PC or PC-compatible machine via an RS232C serial interface for slide-show development, has three outputs: National Television System Committee-compatible, red-green-blue (RGB) and digital RGB, thus supporting virtually any display monitor. The unit can also drive the display without the aid of the PC.

To display 1,000 colors at once and support six fonts in 18 styles (shadow, outline or plain), General Parametrics implemented a display method other than the standard pixel-dot technique used in most systems. "We use a look-ahead scheme to get to the next picture, so that it gives display speed," says Baskin. "But, to get the colors and definition in a display, we refined the methodology. What we do is position color in terms of the edge of a character, thus giving the impression of very high quality."

The method used in VideoShow, called horizontal positional accuracy (HPA), is a new method of putting information onto a screen. With HPA, a color is defined in terms of the horizontal element and repeating patterns that make up an object on the screen. Since intensities can be varied at each horizontal location, colors can be mixed and effects such as shadowing can be achieved. In contrast, a pixel system sets the size and attributes as functions of the pixel size, thus providing lackluster displays and poor clarity in objects such as circles, which can end up with jagged edges. HPA smooths the line much like a vector-line-drawing system, without the overhead or the need for special display tubes.

A remote device

In addition to portability, the VideoShow also features infrared remote control to move through the picture sequence much like a slide projector. Similar controls are mounted on the system.

The PictureIt software package helps keep the system as simple as possible. PictureIt allows users to create detailed graphics displays by simply filling in the blanks on fill-in formats. An accompanying manual provides detailed examples. With the VideoShow attached to a personal computer, the user can view previews during development simply by tapping a function key. Once a slide has been created, it can be saved in the desired viewing sequence.

So that developers and integrators can take advantage of the system to create other complex graphics displays such as computer-aided

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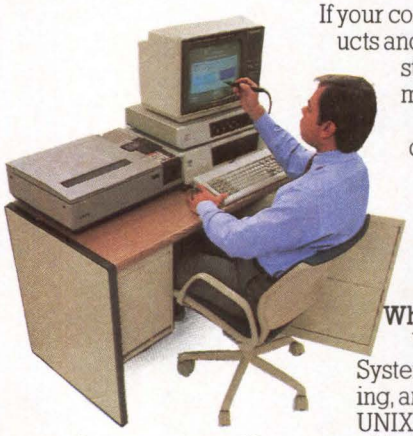

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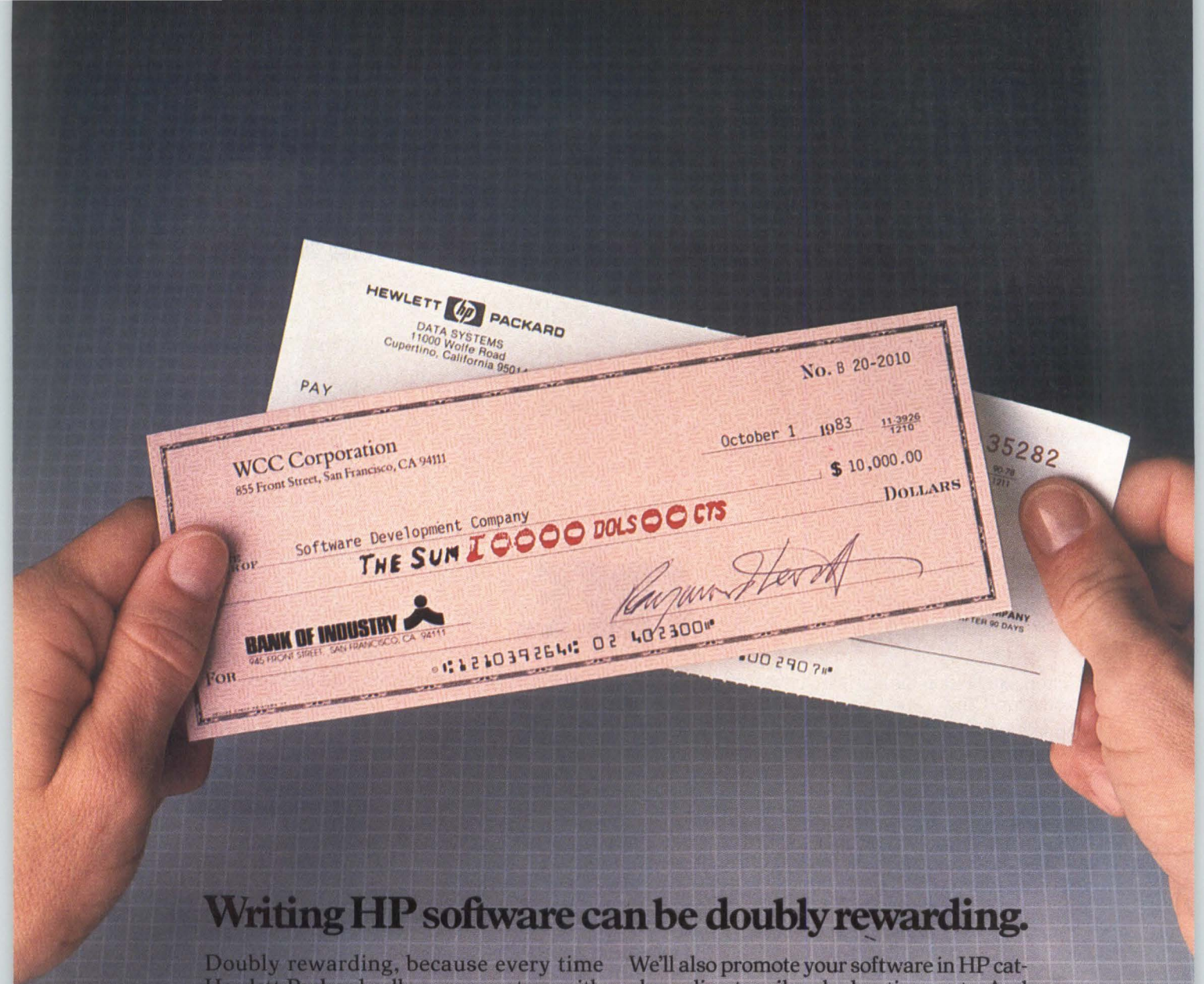

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design, General Parametrics has adopted the North American Presentation Level Protocol Syntax (NAPLPS). This syntax defines the coding, storage and transmission of graphics information. "We feel we have refined the display method and want developers to add value by creating new software. The easiest way is to give them a standard format, and NAPLPS is it," says Baskin. Besides offering a standard format for creating graphics software for the VideoShow, Baskin claims, General Parametrics provides developers with free technical assistance.

The price of the VideoShow, $3,295, includes the base unit with integrated floppy disk drive and remote control; PictureIt software sells for $595. "There are no options and nothing extra to worry about. It's a compact system that does one thing: display high-level presentation graphics," notes Baskin. □

Winchesters combine ESDI interface with high capacity

Carl Warren, Western Editor

Micropolis Corp., Chatsworth, Calif., has unveiled a family of 5¼-inch Winchester disk drives that ranges in capacity from 85M to 170M bytes and employs the proposed enhanced small disk interface (ESDI) standard to achieve a 10-MHz transfer rate.

The family, the 1350 series, has the features of the company's 1300 series, including a rotary positioner, a dedicated landing zone and servo surface and a mechanical brake.

1350 SERIES AT A GLANCE

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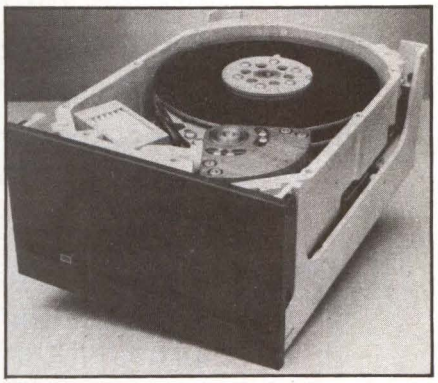
Capacity (M bytes)	85	127	170
Tracks per inch	1,120	1,120	1,120
Bits per in.	20,400	20,400	20,400
Average access (msec.)	25	25	25
No. of platters	3	4	5
No. of heads	4	6	8
Price	$1,469	$1,669	$1,837



Ranging in capacity *from 85M to 170M bytes, the 1350 series of rigid disk drives employs ESDI and has a 25-msec. average access time.*

Fast-access users

Although vice president of marketing Chet Baffa says single users can use the 1350 series, he contends, "Our real emphasis is on multiuser, networked and clustered systems that need fast access and high capacity at low dollars."

The 1350 employs a rotary voice-coil positioner system that Micropolis introduced. Baffa asserts that the mounting issue—physical orientation of the drive in the system—is as important as the drive's ability to handle data properly. "The actuator method we use is time-proven and allows virtually any mounting orientation of the drive," he says.

Use of the ESDI standard ensures that operators in a multiuser system that utilizes UNIX will get maximum performance, according to Bob Mortensen, product requirements manager. ESDI provides the device interface to support large-system transfer requirements of 10 MHz. "With a number of ESDI chip sets becoming available, ESDI is now practical both from an implementation and cost standpoint. We have all the pieces of the puzzle and can put them together," asserts Mortenson.

Despite the popularity of half-height drives, Micropolis has elected to stay with full-height designs. Baffa says none of Micropolis' customers can justify the smaller footprint. "Sure," he explains, "we'd love to make a half-height, but right now we don't see a need for it—at least for the market we address."

Industry consultant Jim Porter, president of the Mountain View, Calif., *Disk/Trend* report, concurs: "There is a place for half-height drives, and that appears to be for small desktops or portables that need only about 10M to 20M bytes. For the larger system that implies a file-server arrangement, full-height is logical. Plus the technology doesn't have to be stretched." □

NEXT MONTH IN MMS

Two hardware profiles are featured in the August issue of Mini-Micro Systems. The first examines the impact of personal computers on systems integration. The second article reviews the popular bus standards for single-board micros.

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CIRCLE NO. 28 ON INQUIRY CARD

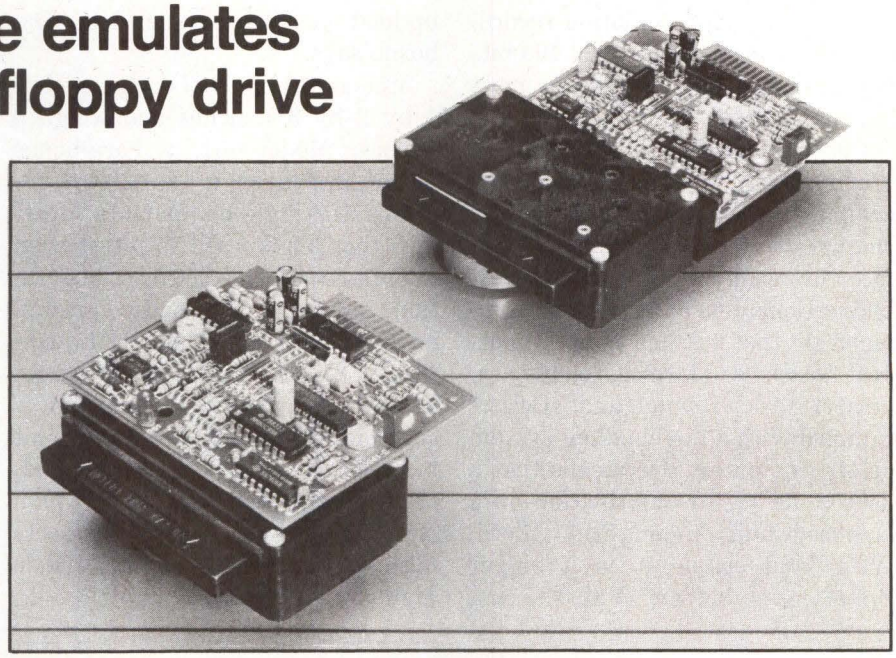
Wafer tape drive emulates single-density floppy drive

Carl Warren, Western Editor

Designed to provide low-cost functional storage for lap-sized personal computers and electronic typewriters, the MicroWafer tape storage system, developed by Entrepo Corp., Sunnyvale, Calif., sports as much as 128K bytes of formatted data, arranged in sectors ranging from 64 to 4,096 bytes, on a wafer cartridge not much bigger than a business card.

The tape storage system is an offshoot of the Exatron Stringy floppy drive, which was developed about eight years ago. It uses the same concept as that used by Texas Instruments Inc. in its 99/4 personal computer system. However, the TI system used the Stringy floppy design. "We recognized that the older design had a number of problems in reliability and interchange,"says Entrepo vice president of marketing David Osborne. "We advised TI of the difficulties, and, under our agreement with them, did and are sharing the new technology." Unlike the older design, the MicroWafer emulates a floppy disk drive by dividing the tape in sectors and by providing an interleave factor when necessary to speed data access.

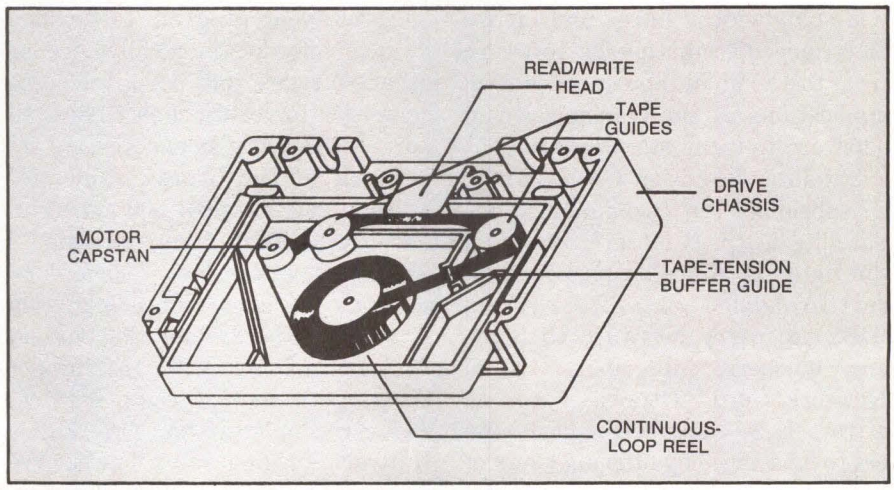
The MicroWafer series—models 101 and 107—employ a data cartridge design that is optimized to resolve interchange problems. Entrepo redesigned the wafer cartridge to offset the tape reel and to provide buffers, which ensure proper tape/head compliance. Moreover, the drives' heads are wider than the tape, thus allowing full use of the 66-mil-wide media. According to Osborne, this minimizes the chances of data dropout because the tape is fully saturated.



The Entrepo MicroWafer drives are available in two models. *Model 101 has a TTL-compatible interface, and model 107 has an LSI controller that provides an 8-bit bidirectional bus.*

The MicroWafer drives use proven technology. For example, they employ continuous-loop tape, which means that data can be formatted in much the same manner as it is on a floppy disk. A typical 69-foot-long tape can therefore accommodate 128K bytes of formatted data or 148K bytes of unformatted data with an average access time of 32 seconds to mid-tape or 1 minute from the beginning to the end of the tape.

Because the tape used in the MicroWafer is video-grade tape that is certified for data and coated to reduce tape wear, Entrepo can provide a recording density of 1,706.7 bits per inch and a flux density of 3,413.4 flux transitions per inch



About the size of a business Card, *the MicroWafer data cartridge uses a continuous-loop video-grade tape, an offset capstan, tape guides and a buffer to ensure proper tape/head compliance.*

using frequency-modulation recording. The transfer rate of 20,490 bits per second is fast enough for most applications.

Osborne envisions the Micro-Wafer being used with lap-sized computers as a low-cost media exchange. "We provide a flexible interface that easily plugs into any 8-bit bidirectional bus and a built-in command set that handles all the important functions of format, read/write, verify, seek, rewind and status." Coupled with a file-handling system on the computer, this means that a user could create information on a lap-sized unit, unplug the Micro-Wafer and couple it to a bigger system such as an IBM PC and up-load via the parallel bus, Osborne says.

Models 101 and 107 each measure 1 by 2 by 3¼ inches and weigh 8 ounces. Model 101, a bare-bones drive, features a transistor-to-transistor-logic-compatible interface that lends itself to integration in data-collection, test-instrumentation and other specialized equipment. It sells for $20 in OEM quantities. Model 107 has a large-scale-integration interface/controller that provides a single-bit bidirectional bus with three handshake lines. Price is less than $30 in large quantities. Entrepo expects both drives to become available in high volumes in July. □

Satellite software distribution looms on the horizon

Stephen J. Shaw
Washington Contributor

Two companies are developing high-flying plans for electronic distribution of computer software via satellite. Those plans will take advantage of rapid transmission over wide-bandwidth lines and move electronic distribution of software from the home into business in such applications as the transmission of software to retail store locations.

Satellite Television Corp. (STC), a subsidiary of Communications Satellite Corp. (Comsat), Washington, intends to use its proposed direct-broadcast satellite system (DBS) to carry software to home and business subscribers. Nabu Network Corp., Ottawa, hopes to attract U.S. cable television viewers to its service by offering a mix of games, educational and personal productivity software programs and a free 64K-byte home computer.

Formed to distribute software

Nabu, named after a Babylonian god who served as patron of writers, was founded in July 1981 to explore the potential of satellite and cable broadband communication media to distribute software electronically. The company embarked on a two-year program to develop its own software internally, license other software and design a home computer for cable subscribers. In July 1983, Nabu began testing its network on an Ottawa cable TV system, racking up 1,500 subscribers in the first three months.

Nabu is not the first to down-load software to cable subscribers via satellite. Others, like the Jerrold Division of General Instrument Corp. with its Playcable service, and a recent start-up, The Games Network, originated by The Source co-founder William Von Meister, have provided video game software with limited success.

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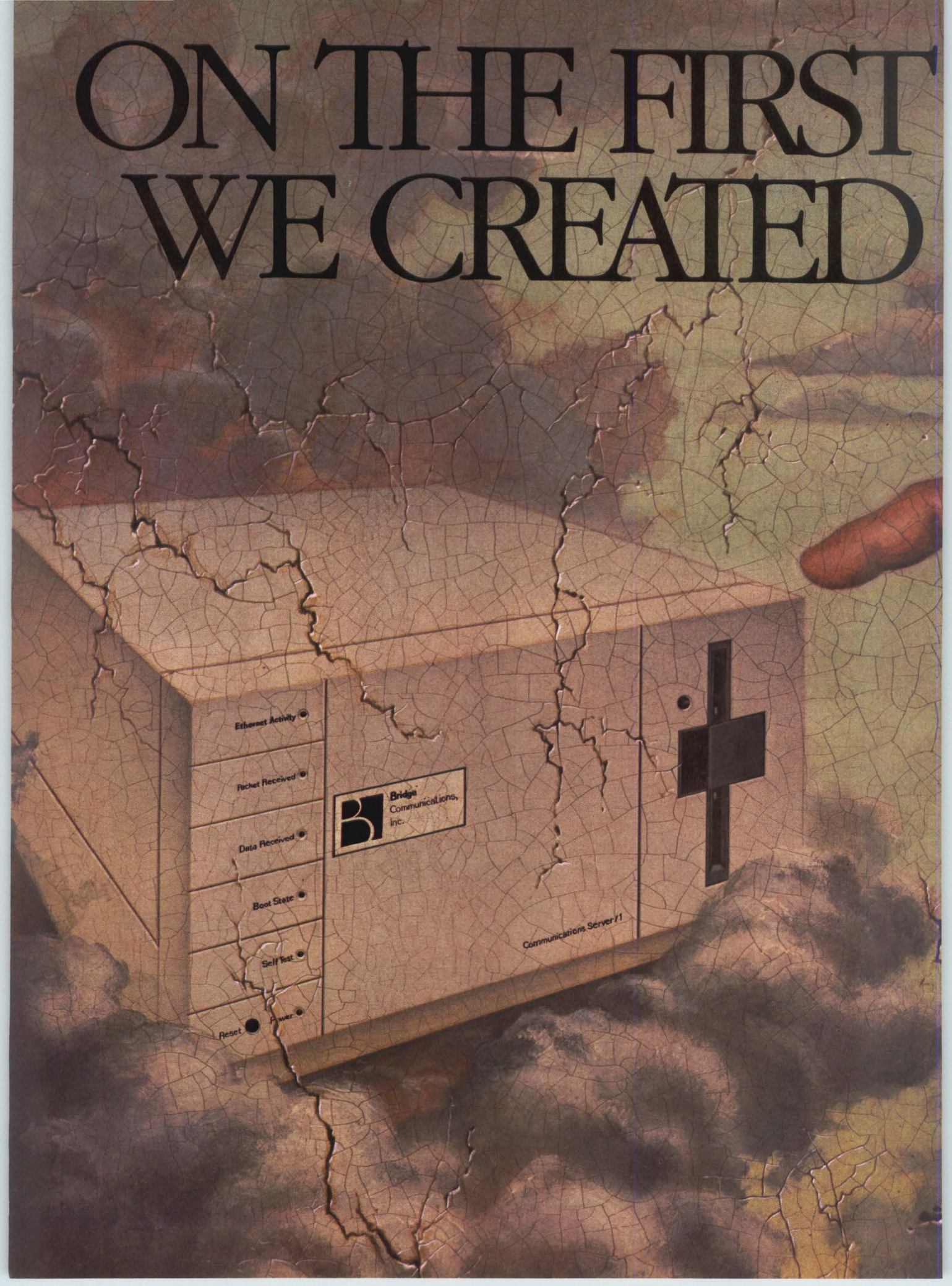
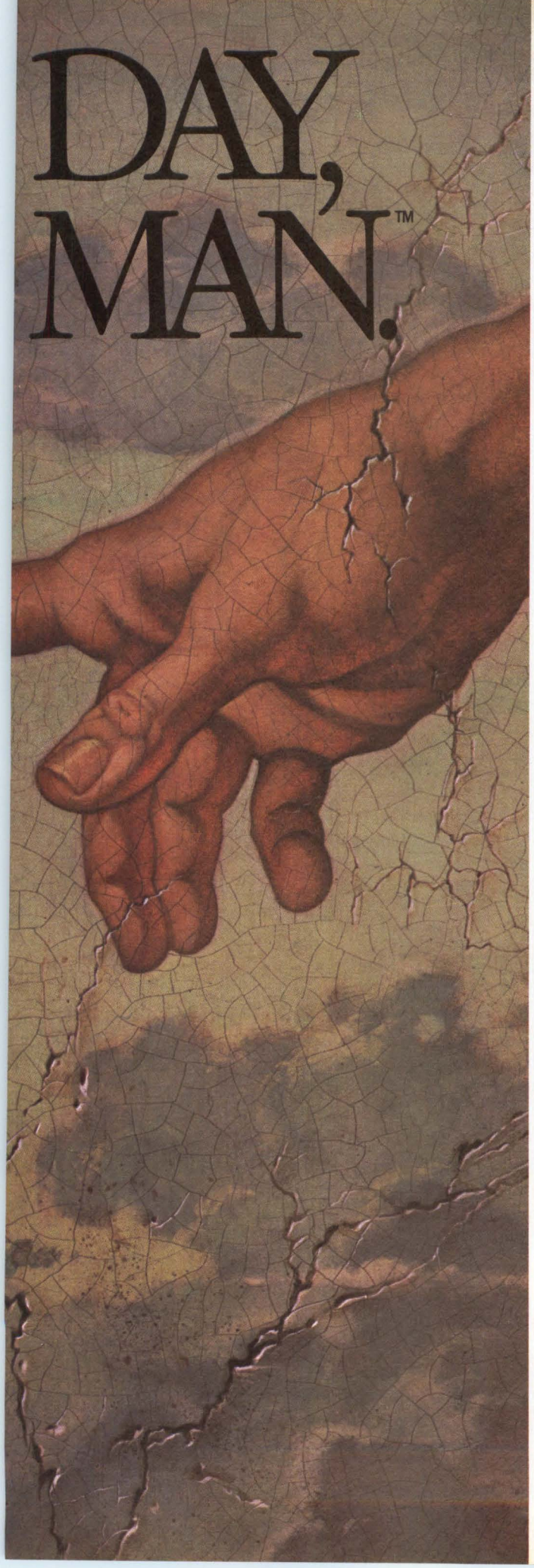

ON THE FIRST
WE CREATED
Ethernet Activity
Packet Received
Data Received
Boot State
Self Test
Reset
Power
Bridge
Communications,
Inc.
Communications Server II



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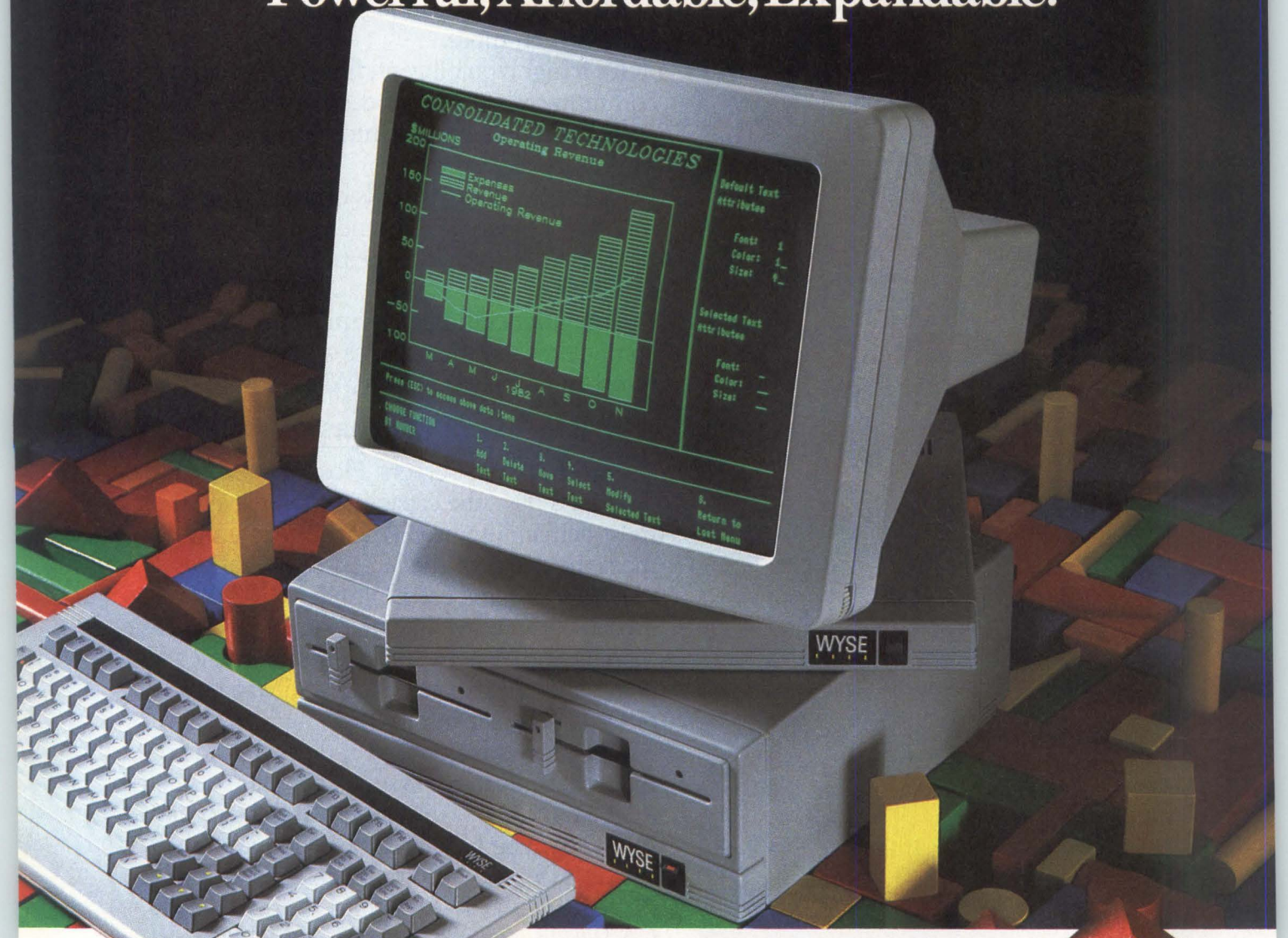

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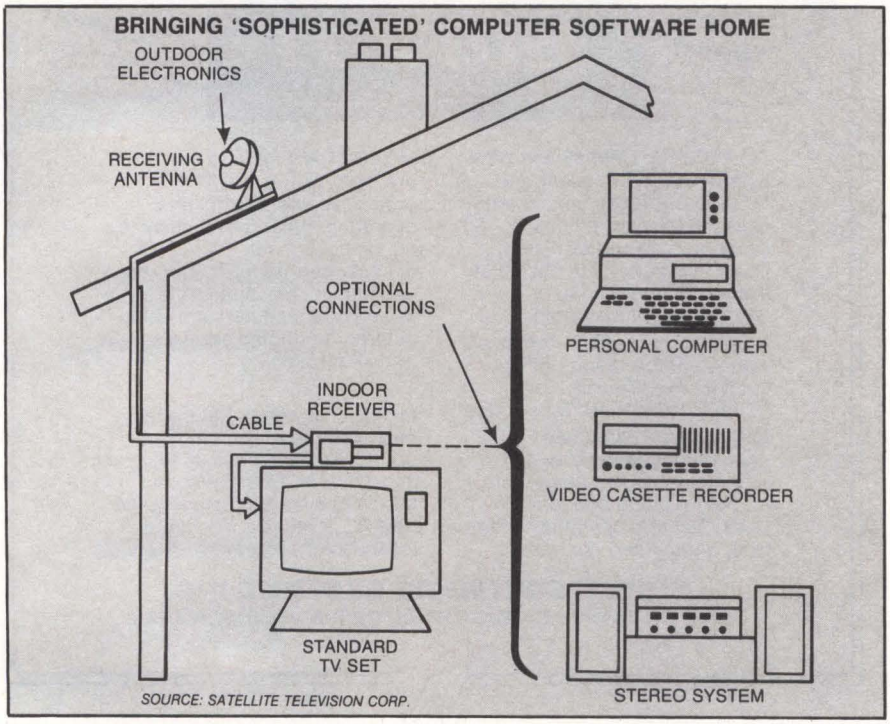
Like these other services, Nabu broadcasts a number of software programs that are continuously repeated. Subscribers select a program from a screen menu and enter their choice into the computer. The computer then "snags" the appropriate program from the data stream using codes incorporated into each program. Nabu's objective is to compete the software loading within a maximum of 20 seconds from when a subscriber enters a selection.

Plans full transponder service

The Nabu system transmits over the Canadian Anik D-1 satellite using a quarter-transponder at 9-MHz bandwidth. The company expects to switch to either a Hughes Corp. Galaxy or an RCA Corp. Satcom communications satellite for full 136-MHz bandwidth transponder service in 1985, according to Nabu operations vice president John Hughes. Using a full transponder, says Hughes, will enable Nabu to achieve a capacity of approximately 15M bits per second (bps) and carry approximately 200 64K-bit programs simultaneously. On the cable systems, the data stream can occupy an empty video channel or can be carried beneath the video signals on several channels.

Home equipment includes a demodulator manufactured by a Hong Kong electronics company and the home computer, which was built to Nabu's specifications by a large Korean terminal manufacturer, Samsung Electronics Co. The computer features a Zilog Inc. 8-bit Z80A microprocessor, 64K bytes of RAM and 8K bytes of ROM.

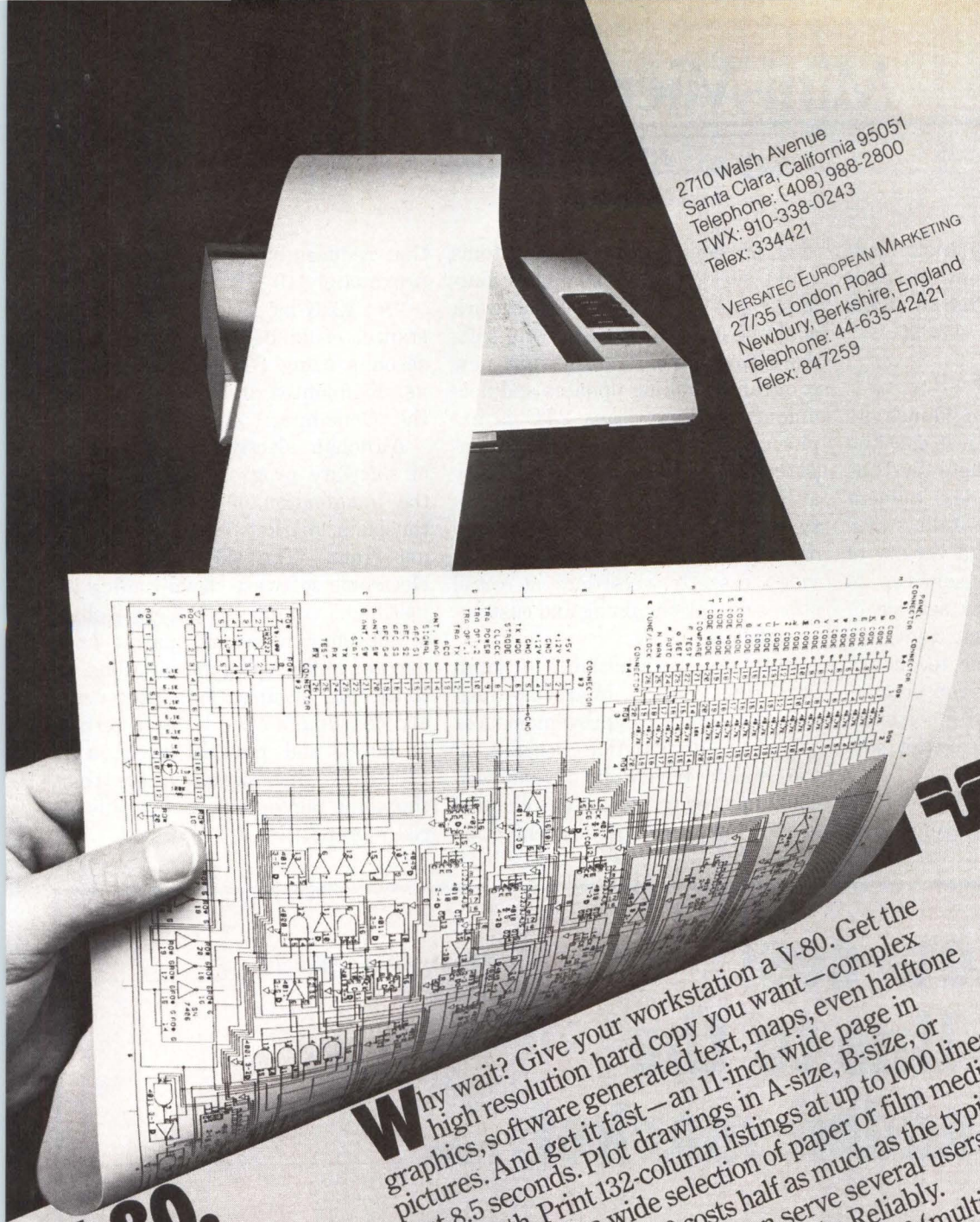
Nabu's software transmission supports the MSX operating system used in the Samsung devices. The network also carries programming for IBM Corp.'s PCjr and Commodore Business Machine Inc.'s model



64 home computers. Among the programs offered are the LOGO educational programming language developed by the Massachusetts Institute of Technology, BASIC, under license from Microsoft Corp., and a variety of arcade-like games under license from Namco of Japan.

Nabu is attempting to do with cable-delivered software what Home Box Office (HBO) did with entertainment pay-television over cable. "We're following the HBO model very closely," Hughes says. Home subscribers can receive the

STC plans an ambitious satellite-to-home broadcast network *that could include a variety of electronic information services such as remote database access, computer software down-loading and electronic publishing, as well as pay-TV programming, stereo audio and enhanced-definition video.*



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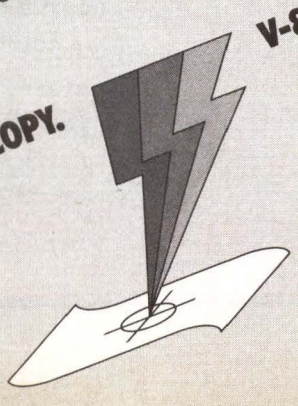

CIRCLE NO. 35 ON INQUIRY CARD

basic package of software programs, including the Samsung computer, for a one-time charge of $30 and a monthly fee of $14.95.

STC aims at business

STC is scheduled to launch its DBS service this year if it can find additional partners to help fund the estimated $600 million development costs for its planned satellite system. STC is looking at a variety of electronic information services to complement its primary service of delivering entertainment television to the home. Among the secondary service offerings STC is contemplating is delivery of computer software to homes and software retail outlets.

According to Warren Zeger, STC planning and business development vice president, the DBS systems could service retail computer outlets in two ways. First, the network could be used for transporting software inventory, transmitting new programs, making updates and documenting. Zeger says STC is exploring the establishment of a computerized archival software library at STC's program-origination facility. Second, the DBS network could down-load video programs into video cassette recorders at retail stores for sales training and customer displays.

Software distribution via satellite, says Zeger, offers approximately a 100-to-1 improvement over telephone distribution because of the higher bandwidth available—330K bps per satellite video channel—and enhanced error correction that reduces bit error rates to approximately 10−13.

"A 128K-bit program, for instance, could be down-loaded in 9 seconds using STC's DBS system vs. 15 minutes at 1,200 baud over the phone lines," Zeger estimates.

Although electronic distribution of software programs is capturing the imagination of technology enthusiasts, market prospects remain uncertain. "The skepticism about electronic software down-loading is justified," comments Robert Wells, a telecommunications analyst and partner in Wells Communications, a consulting organization. "Retailers and consumers alike think in terms of boxes and physical inventory. Electronic distribution alters this shopping perception, and that's a risky proposition." □

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	14"		10½"	8"			5¼"		
CAPACITY (M Bytes)	168/336	671	474	24/48	84	168	7/13*	7/13/20/27	31/55/86
AVERAGE POSITIONING TIME (ms)	27	27	18	70	20	20	95	83	35
TRANSFER RATE (K Bytes/s)	1012	1860	1860	1200	1229	1229	625	625	625
INTERFACE	SMD	SMD (MOD)	SMD (MOD)	SA4000	SMD	SMD	ST506/ SA4000	ST506/ SA4000	ST506/ SA4000
POSITIONING METHOD	Rotary Voice Coil	Rotary Voice Coil	Rotary Voice Coil	Buffered Stepper	Rotary Voice Coil	Rotary Voice Coil	Buffered Stepper	Buffered Stepper	Rotary Voice Coil

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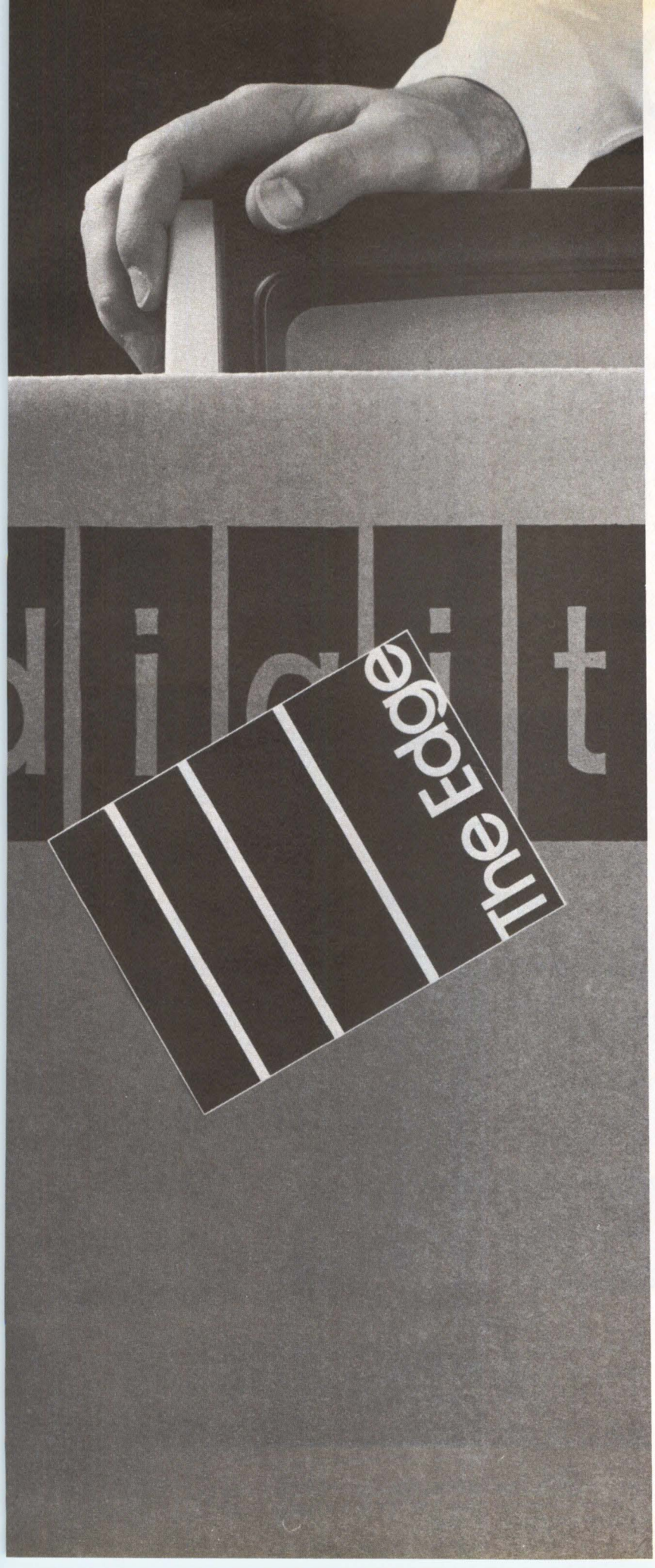

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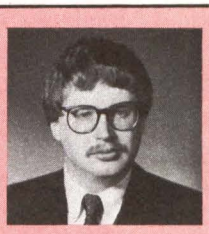
GUEST FORUM

A column for guest experts to speak out

Lawrence F. Vogel is director of editorial services for The Office Systems Consulting Group Inc., Cambridge, Mass.



Electronic databases move from computer center to professional use

Lawrence F. Vogel
The Office Systems Consulting Group Inc.

On-line database services are receiving much attention now, even though they are not new. Long used in libraries and computer centers, they are now sought by professionals and managers who want to use them as one-on-one tools.

The ability to access large amounts of information easily and directly can be beneficial to almost any business at almost any level, particularly in situations in which adequate information previously was not available.

Take, for example, the sales force of a medium-sized word-processing vendor. Salespeople have always had access to much industry information through the trade press and competitive analysis bulletins sent from headquarters each week. The bulletins can take as much as two to three hours to read. Salespeople find themselves pressed for time but still in need of timely information to support their sales efforts.

For these people, an electronic service that offers information on competing products and companies can be the answer. The result is a better-informed, more effective sales group. Much-needed information no longer remains the domain of a small group at headquarters. This can be transferred to many other areas of an organization, such as product planning, pricing or marketing programs.

The trend toward direct access to databases by end users, rather than filtering information through middlemen in information centers, dictates a new set of product requirements for those who supply state-of-the-art information services. These requirements, similar to those that successful office-automation vendors follow, are fairly simple:

- the service must present a solution to the business problems of the potential user, so information must be accurate and complete;
- it must be easily accessible and user-friendly;
- it must be time- and cost-justifiable.

All this must be accomplished by direct communication between the person and the computer on which the database resides.

Difficult as those objectives may be to achieve, the direct access issue provides the key to information services' future. Whether the database in question is a large public dial-up system or a small specialized system, its intrinsic value still lies in its ability to support the decisions of managers trying to achieve company-wide goals. Those wishing to provide such on-line services must keep those goals in mind.

Financings

Ibex Computer Corp., Chatsworth, Calif., has formed a $3 million limited partnership to complete research and development on its nine-track PCT-1000 streaming-tape drive....**Identix Inc.,** a Palo Alto, Calif., manufacturer of the IDX-10 fingerprint-verification terminal for computer-system security, recently received $2.25 million in venture-capital financing. Identix says the terminal provides a higher level of security than passwords provide. A major application area should be automatic teller machines, the company predicts. Lead investors are Citicorp Venture Capital and Genesis Capital Ltd....**Ridge Computers,** Santa Clara, Calif., recently raised $5 million to manufacture and market its Ridge 32 32-bit personal computer. Among the financiers are Hambrecht & Quist and the Bull Group, which will market the systems in France....**The Systems Center,** Dallas, has secured $3 million in venture-capital funding for new microcomputer-to-mainframe networking software. Investors include

Identix will use its recent $2.25 million in venture financing *to leverage its IDX-10 fingerprint-verification terminal into banking, financial and other markets.*

J.H. Whitney and Co. and First National Bank of Boston....**Zaisan Inc.**, a Houston manufacturer of voice/data workstations, garnered $10 million in second-round financing. Hambrecht & Quist, TA Associates and Tandon Corp. chairman Sirjang Tandon were among the participants.

Distribution/service deals

As its first national computer account, peripherals and software distributor **Micro Distributors Inc.** has chosen the Apricot portable personal computer from ACT (North America) Inc., a subsidiary of Applied Computer Techniques Plc., Birmingham, England. Applied Computer Techniques supplies the Apricot through ACT, Santa Clara, Calif....**Data General Corp.**, Westboro, Mass., has appointed Rolm Corp. as the exclusive worldwide marketer of DG's Ada work environment software systems. The systems run on DG's Eclipse MV series minicomputers. The agreement is for applications involving substantial military-specification content, such as embedded target systems for rugged environments....**Honeywell Information Systems Inc.**, Waltham, Mass., has signed a three-year contract worth as much as $10 million with Great Wall Industrial Co., the trading arm of China's Ministry of Space Industry. Great Wall, through the Peking Data Equipment Institute, is marketing Honeywell's DPS 6 small systems hardware and software.

Wet ink

Microsoft Corp. has selected Graphic Communications Inc., Waltham, Mass., to supply output device drivers for Microsoft's Windows operating environment. Graphic Communications will also provide 10 device drivers for the Windows Tool-Kit for Windows licensees. Graphic Communications plans to market Windows device drivers through retail channels....**Microscience International Corp.**, Mountain View, Calif., has signed a one-year, $4.5 million contract to deliver its 10M-byte half-height Winchester disk drives to Maynard Electronics Inc. Maynard will offer the drives for the IBM PC XT....**Stratus Computer Inc.**, Natick, Mass., has contracted with Lockheed Electronics Co. to supply a $2.5 million network of Stratus/32 continuous-processing systems over a two-year period. The fault-tolerant computers will help Lockheed modernize and automate China's air-traffic control system.

Annual report

Despite a doubling of its sales between this year and last, Centronics Data Computer Corp., Hudson, N.H., sustained a net loss of $7.7 million, or 68 cents per share, for its 1983 fiscal year, which ended on Jan. 1. A year earlier, the company's loss was $18.6 million, or $1.66 per share. Revenues were $164.1 million, compared with $82.4 million the previous year. Company president John Morrison attributed the loss to charges for obsolete inventory and corporate reorganization and to lower-than-expected revenues in domestic and foreign markets. "Substantial improvement must be made in two key areas: revenue generation and cost-of-sales reduction," states Morrison. He expects the new Horizon 80 dot-matrix printer to put Centronics back into the low end of the computer printer market.

In a related development, Centronics announced that Control Data Corp. (CDC), Minneapolis, had purchased 520,930 more shares of Centronics' stock. This brings CDC's equity investment in Centronics to 39 percent. □

SWITCHING POWER SUPPLIES TO DOMINATE MARKET

The market for switching power supplies is expanding rapidly. According to market research company Frost & Sullivan, switching power supplies, which in 1983 accounted for 35 percent of the power supply market, should have a 62 percent share by 1988. Sales during that period are expected to advance from $1.5 billion in 1983 to $5.5 billion in 1988. The proliferation of personal computers will spearhead the growth. An example of the trend is IBM Corp.'s recent call for 3 million switching power supplies for the PCjr personal computer.

CALIFORNIA TOPS LIST IN ELECTRONICS COMPANIES

California is home to more electronics and information-technology companies than any other state, according to a survey recently conducted by the American Electronics Association (AEA). Silicon Valley contains 1,600 of the approximately 2,100 electronics companies in Northern California, while the Los Angeles area boasts 979 companies. Following California's total of 4,054 resident electronics companies are New York with 948, Massachusetts with 937 and New Jersey with 555. Nationally, says AEA, there are more than 11,700 electronics companies.

NEWSBITS

JULY 1984

TI to second source WD controller chips.

Texas Instruments and Western Digital have entered into a license agreement that makes TI a second source for WD's leading edge floppy disk controllers and X.25 network controllers. Under the agreement TI plans to manufacture and market the WD177X family and WD279X family of floppy disk controllers and the WD2501/2511 X.25 packet switching network controllers. "TI is a very credible second source and this credibility is what Western Digital and our marketplace looks for in second sources of any leading edge product," according to Terry N. Holdt, WD Executive VP and Chief Operating Officer.

New portable PC sports built-in printer, Winchester.

Western Digital has announced a multi-million dollar contract to supply Matsushita Electric Industrial Company., Ltd. of Japan, with a custom Winchester controller board for their new IBM compatible portable computer. The portable, called the Sr. Partner, will be marketed under the Panasonic label. It includes a built-in monitor, printer, floppy disk drive and optional Winchester drive. The controller board was customized by WD to provide 64K to 512K bytes of RAM expansion, as well as control for up to two 5¼" Winchesters.

WD to support QIC-36 tape drive standard.

WD has announced plans to develop products in support of the QIC-36 basic streaming tape interface. With this existing standard, established by the Quarter Inch Compatibility (QIC) group, WD can now put a read/write formatter onto a tape controller, creating an opportunity to dramatically reduce overall system costs. "WD expects the basic QIC-36 streaming tape interface to become the de-facto industry standard, driven by increasing demand from manufacturers for low-cost tape controller subsystems," announced Kathy A. Braun, Marketing Director, Storage Management Products.

WD among vendors honored by HP division.

In recognition of outstanding performance this past year in both product quality and delivery, Hewlett Packard's Greeley, Colorado division has honored WD as one of their top vendors. WD was among several HP/Greeley vendors honored in May. Two week lead times, weekly deliveries, ship-to-stock quality levels and a very close working relationship between WD and the Greeley division were factors cited by HP in including WD in its annual vendor recognition program. WD supplies HP with both floppy disk and Winchester disk controller chips.

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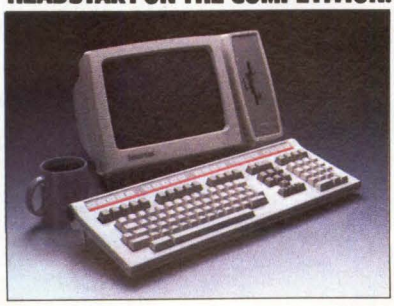

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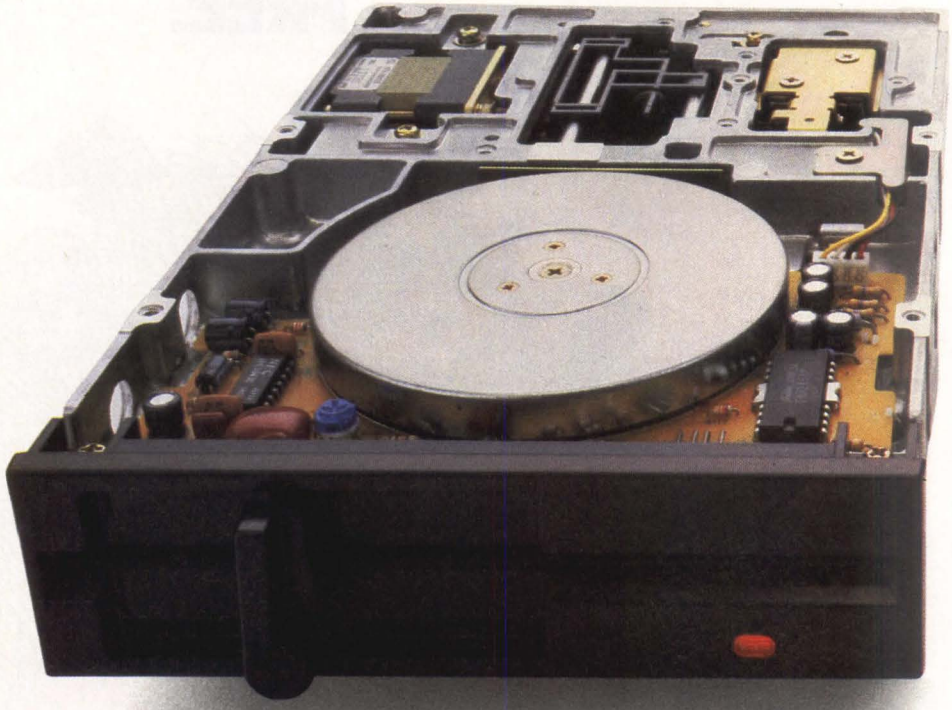

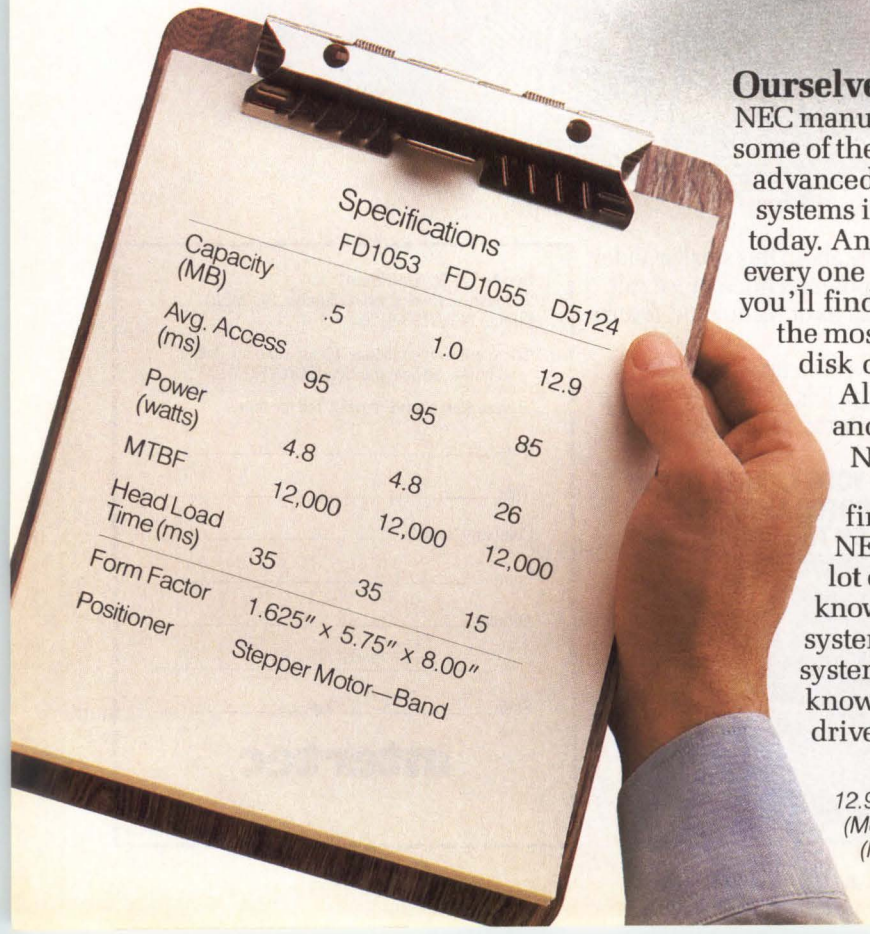

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12.9 MB of storage is available in Winchester drives (Model D5124). .5 and 1.0 MB is available in flexible drives (Model FD1053 and FD1055).

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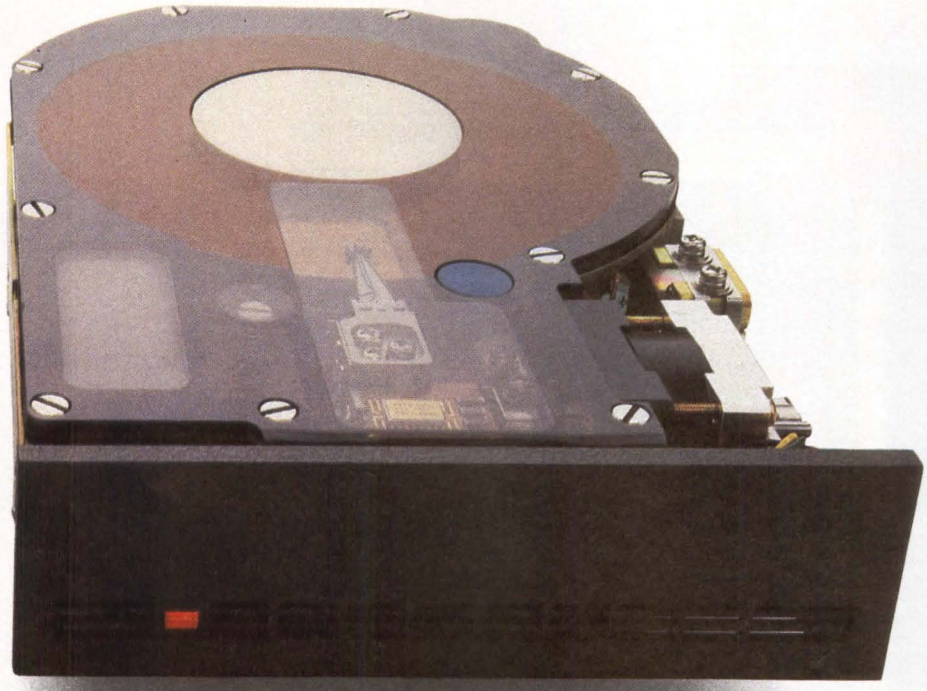

ments in electronics for almost 85 years. Today, we're a worldwide company with over $6 billion a year in sales.

NEC is one of the few who make a full range of disk drives: 8-inch and 5¼" Winchesters and flexible drives, along with a new high capacity 9" Winchester. Some drives incorporate such advanced technologies as NEC manufactured plated media and thin-film heads. Clearly NEC is at the leading edge of disk technology.

For more information on 5¼" drives or other sizes, or product literature, call 1-800-343-4418. (In Massachusetts, call 617-264-8635.) You'll discover why more and more systems builders are saying, "NEC and me."

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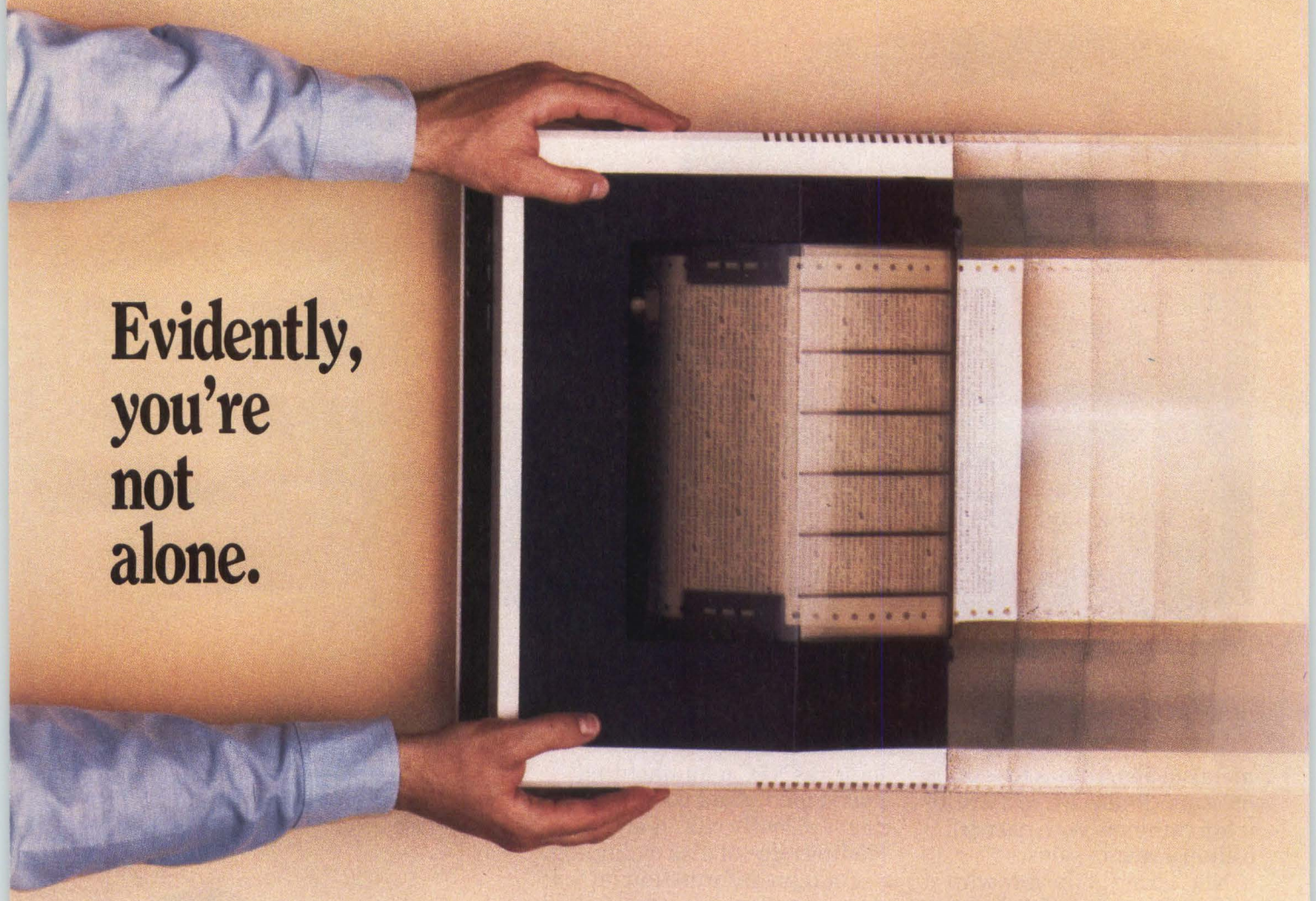

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CIRCLE NO. 44 ON INQUIRY CARD

Rair extends microcomputer line with 80286-based supermicro

Keith Jones, European Editor

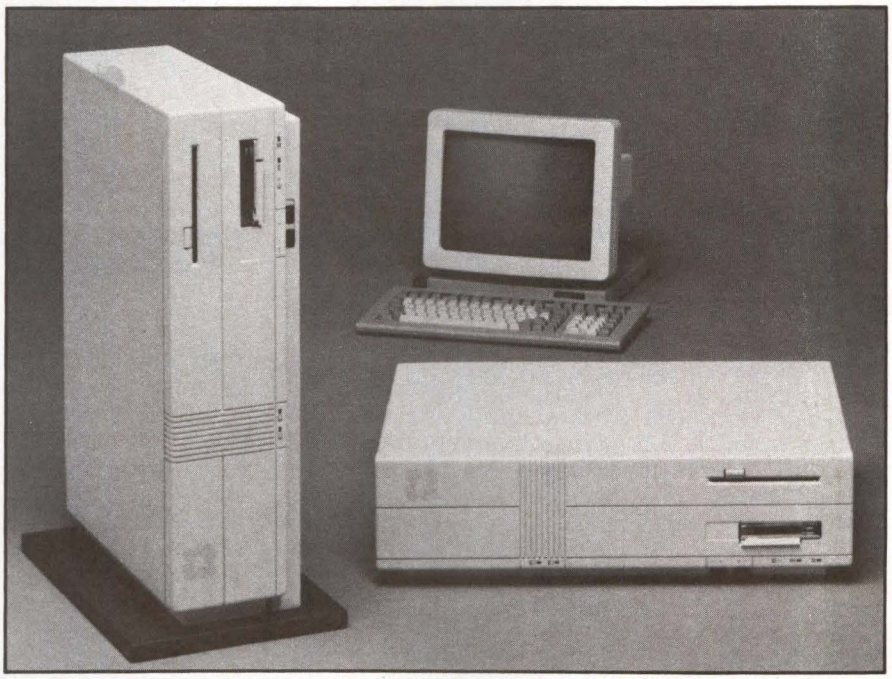
Rair Ltd., London, based its first multiuser computer, the SuperMicro, on Intel Corp.'s 80286 processor in an effort to grab part of the worldwide supermicrocomputer market, which Rair expects to reach $128 billion by 1988. Stretching market potential even further, Rair plans to support the UNIX System V implementation that Digital Research Inc., Pacific Grove, Calif., is readying for use with the 80286.

The single-quantity price of the SuperMicro starts at $15,500. Rair's U.S. subsidiary, Rair Microcomputer Corp., Santa Clara, Calif., developed and will build the product. "We expect to ship 1,000 machines this year in the United States, Britain, West Germany and France," claims Rair managing director Mark Potts. However, Potts expects Rair to be constrained for a few months, because the 80286 now is in short supply.

Potts is also waiting for the 80286 implementation of UNIX System V, which he expects Digital Research to ship during the third quarter of this year.

Available now is the SuperMicro's other operating environment, Concurrent DOS, also from Digital Research and compatible with the IBM PC's PC-DOS 1.1 operating system. But the SuperMicro does not support IBM screen graphics because Rair does not specify a particular terminal for use on the system, Potts acknowledges.

Potts denies that the SuperMicro is an attempt to leapfrog IBM Corp. to market with an 80286-based machine. Industry analysts expect IBM's anticipated multiuser computer to employ the 80286. "We chose the 80286 simply because it is the most powerful microprocessor device available. Our Santa Clara development center is very near to Intel, and our people have close relations with Intel's 80286 project engineers." Potts says a major attraction to the 80286 is its compatibility with the 8086 processor used in Rair's personal computers.



Rair's 80286-based SuperMicro computer *comes in a floor-standing (left) or desktop configuration.*

SuperMicro is more powerful

The SuperMicro is much more powerful than Rair's other products. Rair quotes a throughput of 1 million instructions per second for the machine, a performance the company attained by coupling the 80286 with the 80287 numeric coprocessor. The 80286 and 80287 reside on one board with a direct-memory-access controller. The board occupies one slot in a proprietary 16-bit-wide backplane bus that also accommodates as many as four memory boards. Each memory board houses 0.5M bytes of storage, so four-board capacity totals 2M bytes. The bus can also support as many as 16 RS232C serial communications ports and one IEEE-488 parallel interface for high-speed devices such as plotters.

A peripheral bus conforming with the small computer system interface (SCSI) standard handles all data transfers involving SCSI-compatible mass-storage devices. These include the SuperMicro's one or two integral 50M-byte, 5¼-inch Winchester disk drives. The SuperMicro also contains an integral 45M-byte ¼-inch cartridge-tape streamer drive for Winchester backup.

Comprising the $15,500 SuperMicro configuration are 0.5M bytes of main memory, a 50M-byte Winchester drive, eight serial ports and Concurrent DOS. System V will be priced separately at less than $1,500, according to Potts. □

OVERHEARD OVERSEAS

Export rules put DEC integrators in a bind

Tim Palmer, European Contributor

The Reagan administration's new export rules on U.S. manufacturers may hurt system integrators in Europe if they plan to base their systems on equipment from U.S. suppliers, especially Digital Equipment Corp. DEC made headlines recently when some of its products were caught en route to the Soviet Union.

Under the new licensing rules, DEC must obtain a certification of end use for any non-VAX computer product, including CPUs, printers, terminals and other peripherals. Purchasers of DEC equipment must inform the U.S. Commerce Department of the products' intended destination and expected use. The restrictions on VAX products are even more stringent: DEC must obtain an individual license, which DEC spokesman Dick Berube says takes four to eight weeks, for each VAX computer or peripheral destined for West Germany, Norway or Austria. The Commerce Department suspects the three countries of being stopover points for illegal export to Communist countries (Comecon). According to Berube, however, the new regulations have so far not affected the volume of DEC's overseas business: "In general, we've continued to function. The certification takes only a week or so. The government has been handling it expeditiously."

However, with anger growing in Europe over the U.S. Commerce Department's requirements, it is likely that DEC will soon feel the effects of the new rules. The company faces competition from Norsk Data A/S, Norway, which makes a line of powerful 16- and 32-bit minicomputers, GEC Computers Plc., Britain, which makes the popular Series 63 32-bit UNIX minicomputer, Bull-SEMS SA, France, producer of the 16-bit Mitra commercial minicomputer and the Solar industrial minicomputer, and Information Technology Ltd., Britain, which produces the fault-tolerant 32-bit Momentum 9000 commercial and industrial minicomputers. The companies would be more than happy to take DEC's OEM business because it would allow their customers to rest assured that the details of their applications will be safe from the prying eyes of the U.S. Commerce Department.

But if their applications are legitimate, why should users object to being recorded on Commerce Department computers? Their reasons probably stem from something that happened in the 1950s, when Britain launched the first jet-engine passenger airliner, the de Havilland Comet, which had engines built into the wings. The Comet's arrival spurred Boeing Co. to rush into production with its 707 jet, which, like the Comet, had engines built into the wings. According to legend, the U.S. government saw the Comet as a threat to the U.S. aircraft industry and tipped off Boeing that it was about to ban passenger jets with engines in the wings from U.S. airspace. As a result of the tipoff, Boeing redesigned the 707, placing the engines under the wings, and the Comet was duly barred from the United States.

Whether or not the story is true, many Europeans believe it. A European company designing a product that it hopes to sell in the United States would thus be unlikely to let the Commerce Department get details of its plans.

The new regulations imposed on DEC may be fruitless also because many Comecon countries are close to producing their own implementations of the VAX family, according to visitors at the Leipzig Spring Fair in East Germany. By now, Soviet designers have obtained enough VAX equipment to be able to produce basic prototypes. Hungary's Videoton Corp., which since 1978 has been building the Mitra 525 minicomputer under license from France's Bull-SEMS, offers a VAX version that includes the DEC PDP-11 instruction set. The Mitra 525 uses Motorola Inc.'s advanced emitter-coupled-logic 4-bit slice 10800 chip, which is also the basis of the large Sperry Corp. 1100/60 and 1100/70 mainframes. There is nothing preventing Videoton from diverting some of the French-built chips to the highly skilled computer designers in Eastern Europe.

The upshot? Any U.S. computer builder planning to offer a product in Europe should vigorously lobby Congress to persuade the Reagan administration to change its policies. There is nothing to lose, except international trade.

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Hitachi, NEC lead the way in 32-bit Japanese microprocessors

Tim Palmer
Contributing Correspondent

Having mastered high-volume, low-cost production of memory chips, Japanese semiconductor manufacturers most likely would not be content simply to second-source or reverse-engineer U.S. microprocessors. The obvious next technology for "Japan Inc." to pioneer is the upcoming generation of 32-bit microprocessors. NEC Corp. and Hitachi Ltd. have revealed plans to develop 32-bit microprocessors.

NEC was almost forced to develop an original device. The company settled a dispute with Intel Corp. in January by agreeing to stop making copies of Intel's iAPX-86 family. As a result, NEC had to lay hasty plans to develop its own parts. First up will be a real stopgap measure—a 16-bit microprocessor called the μCOM70K, which will be offered in 16- and 8-bit bus versions. The part, which should be in production by this summer, will use 2-μm.-geometry, complementary metal-oxide semiconductor (CMOS) technology. Address size will range from 64K bytes to 1M byte. The device could house as many as 200,000 transistors. The part is based on Intel's 8086 family but differs enough to avoid more trouble from Intel.

NEC plans 32-bit CMOS chip

Much more interesting is NEC's μCOM700K, which will have a 32-bit arithmetic-logic unit, come in versions with 16- or 32-bit buses and use sub-2-μm.-geometry, CMOS technology. The top member of the family will have 700,000 transistors integrated on-chip, 32 general registers and a 32-bit address, providing a maximum program size of 4.3G bytes—the same as on National Semiconductor Corp.'s planned 32132. Like National's chip, the μCOM700K will have on-chip virtual-memory management. Clock rates will be between 15 and 20 MHz, leading NEC to claim a throughput of more than 2.6 million instructions per second (MIPS). Although architecture for the device is not yet on paper, NEC plans to have the part in production by late 1986.

NEC has plenty of experience with original 16-bit microprocessors: each member of the NEAC-100 family of IBM System 34- and System 36-class machines, built and sold in the United States as the Astra line, uses one of two 16-bit microprocessors that are not offered on the market. NEC also recently agreed to second-source Zilog Inc.'s 32-bit processor.

Hitachi's plans for a 32-bit chip are less original but no less challenging than NEC's. Scheduled for introduction in 1986, Hitachi's planned chip part is of interest to anyone designing in the MC68020 32-bit version of Motorola Inc.'s MC68000 because Hitachi's offering, the HD63020, is based on the MC68020. The HD63020 is basically an MC68020 implemented in CMOS. For the part, Hitachi borrowed ideas from other chip makers but added a few original ones. The result is a chip designed to offer twice the performance of and more functionality than the MC68020 while retaining software compatibility with the Motorola part.

Although Hitachi used CMOS

Hitachi's planned 32-bit processor

- **Model:** Hitachi HD63020
- **Technology:** 1.3-μm.-geometry, N-channel metal-oxide semiconductor (NMOS) and complementary MOS (CMOS)
- **Software compatibility:** MC68020
- **Number of on-chip transistors:** 300,000
- **On-chip memory:** 256K-bit ROM, cache
- **Addressing:** separate address unit with 32-bit registers
- **Clock rate:** 40 MHz
- **Instruction set:** "MC68020" extended
- **Throughput:** 1 million instructions per second anticipated
- **Number of pins:** 100
- **Scheduled introduction:** 1986

NEC's planned 32-bit processor

- **Model:** NEC μCOM700K
- **Architecture:** 32-bit arithmetic-logic unit, 16- or 32-bit buses
- **Technology:** sub-2-μm.-geometry, complementary metal-oxide semiconductor (CMOS)
- **Number of on-chip transistors:** as many as 700,000
- **Registers:** 32 general
- **Addressing:** 32-bit
- **Program size:** 4.3G bytes maximum
- **Virtual-memory management:** on-chip
- **Clock rates:** 15 to 20 MHz
- **Throughput:** More than 2.6 million instructions per second claimed
- **Production time:** planned for late 1986

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when possible to limit power dissipation—the target is 1W for a 1-MIPS part—the company used N-channel MOS (NMOS) for features that require high performance. The most striking feature of the 300,000-transistor HD63020 will be the 256K-bit on-chip ROM. The CPU will also feature an on-chip cache memory to speed execution. The Hitachi part has a separate address unit with its own 32-bit registers. The microprocessor will have a 40-MHz clock and an extended instruction set to the basic design of the MC68020. Hitachi uses 1.3-μm. geometry in the 100-pin microprocessor.

Hitachi also plans to introduce several members of its HD63000, a CMOS version of the MC68000 family. All HD63000 family members incorporate 12-MHz clocks. Due this month is the HD63000. The 8-bit bus HD63008 should follow in the second quarter, and the virtual-memory HD63010 should follow in the fourth quarter. The 32-bit HD63020, rated in performance at just under 0.5 MIPS, is set for mid-1985 introduction. Motorola has no plans to second-source the Hitachi super-chip, but there is little doubt that U.S. UNIX system builders will want it so that they can remain competitive with Japanese manufacturers. One Japanese competitor, Sord Computer Corp., plans to use the part in its new UNIX machines. □

Microsoft, others plan expert systems

Keith Jones, European Editor

Microsoft Corp., Kirkland, Wash., is expected to offer expert-system-construction software within the next two years. The offerings are likely to be based on Expert-Ease, a package that can generate decision-making rules from information entered in a form similar to a spreadsheet. Microsoft's products acquisitions manager, Alan Boyd, says his company will collaborate on the software with Export Software International Ltd., Edinburgh, Scotland, which markets Expert-Ease in Europe.

Emerging from another European company, Nixdorf Computer A.G., Paderborn, West Germany, are expert-system "shells" that require a UNIX host with at least 1M byte of main memory. Users can easily tailor the shells for specific applications through simple if-then instructions, according to Nixdorf's expert-system specialists.

A typical host for Expert-Ease, which runs under the UCSD p-System, is IBM Corp.'s hard disk-based microcomputer, the PC XT, with 128K bytes of RAM. Microsoft's Boyd reveals that Expert-Ease is being rewritten in C to achieve portability and a significant improvement in speed. "The existing version demonstrates that expert-systems technology can be used on a microcomputer, but [the current version] is too slow at the moment."

Export Software managing director Sandy Blackie reveals that a UNIX implementation of Expert-Ease will follow the C version and that the product could also be ported to Microsoft's XENIX. Long-term plans include a version that will make "decisions" in the form of approximations rather than precise answers.

Expert-Ease originated in the Department of Machine Intelligence at Edinburgh University in Scotland, one of the world's foremost centers of artificial-intelligence (AI) research. The British government-backed Scottish Development Agency, a shareholder in Export Software, now owns Expert-Ease. It is available in the United States

Europeans ready Prolog, LISP implementations

While some European companies are developing easy-to-use expert systems, others are offering implementations of the two languages considered best-suited to constructing expert systems from the ground up: Prolog and LISP.

Originally confined to 8-bit machines, Micro Prolog from Logic Programming Associates (LPA) Ltd., London (MMS, September 1982, Page 103), is now available on 16-bit computers, including the IBM PC under PC-DOS and on machines that host CP/M-86. LPA joint managing director Frank McCabe notes that the company will this month launch a UNIX implementation written in C. Prolog Systems, Milford, Conn., offers Micro Prolog in the United States. The IBM PC version is priced at $295.

Metacomco Ltd., Bristol, England, is committed to making its product, Cambridge LISP, available under 32-bit operating systems including UNIX, says managing director Derek Budge. The company will probably select UNIX System V for its implementation. Budge identifies compactness as his product's biggest advantage over other LISP implementations. He says 400K bytes of main memory is sufficient to run the product. Metacomco maintains a subsidiary in Monterey, Calif., which sells Cambridge LISP running in its current environment, the multitasking, single-user TRIPOS operating system. Hosts for this implementation include the Sage IV system from Sage Computer Corp., Reno, Nev.

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EXPERT-EASE file: GEARBOX 28384 bytes left 1:Debristyp

	logical	integer	logical	integer	
	Debristyp	Debriswt	Vibration	Oiltaint	Remove
1	coarse	28	*	*	remove
2	fine	3	low	3	hrs58
3	fine	3	medium	3	hrs25
4	*	*	high	*	remove
5	*	*	*	38	remove
6	fine	3	medium	15	hrs5
7	coarse	1	medium	3	hrs5
8	coarse	2	medium	3	remove

```
EXPERT-EASE        file: GEARBOX      28368 bytes left    1

Vibration
      high : remove
    medium : Oiltaint
                 <23     : Debristyp
                           coarse : Debriswt
                                    <2 : hrs5
                                   >=2 : remove
                           fine : Oiltaint
                                    <9 : hrs5
                                   >=9 : hrs5
                  >=23   : remove
       low: Oiltaint
                 <17     : Debristyp
                           coarse : remove
                             fine : hrs50
                  >=17 : remove
```

This simple application from Export Software *illustrates the use of the Expert-Ease expert-system software. The application's goal is to advise on the number of hours a helicopter gearbox can operate before it must be serviced. A gearbox expert creates a spreadsheet (left) that includes two logical attributes—the type of debris in the gearbox (Debristyp) and the level of vibration. The two integer attributes are the weight of the debris (Debriswt) and the level of Oiltaint. Expert-Ease generates a decision tree that could be used by a non-expert. In this case, the user starts each decision process by entering the level of vibration into the system.*

from Perrone Associates Inc., San Francisco.

An expert in any field can construct Expert-Ease without assistance from an engineer—one of the biggest attractions of the product, says Microsoft's Boyd. Expert-Ease is "taught by example." A user can enter as many as 255 examples in spreadsheet-like rows, and each example can have as many as 31 attributes—either an integer or a logical entity—plus a result. From the examples, Expert-Ease generates a decision tree, which eliminates unnecessary attributes to reach a conclusion.

Microsoft's arch rival, Digital Research Inc., Pacific Grove, Calif., is also readying expert-system products, according to director of marketing Dr. Fred Cutler. But the company is mainly targeting the home consumer market with products aimed at applications such as family medicine. Cutler says Digital Research's commitment to high-capacity video disk storage will provide home users with the large amounts of storage expert systems require.

Nixdorf has yet to decide whether to offer its expert-system shells only to users of its own hardware or to all UNIX users, says Bernhard Mescheder, a member of the AI team at the company's headquarters. The shells are written in Ifprolog, a UNIX implementation of the Prolog AI language from Interface GmbH, Munich, West Germany. Mescheder explains that Nixdorf will aim the shells at broad application areas such as planning and fault diagnosis. Each shell will include the Ifprolog language, and the shell's other features will be written in Ifprolog. Two key shell components are a generalized rule-generating inference mechanism and a relational database for storing attributes.

Mescheder suggests that an expert who is constructing an expert system to configure a computer system, for example, would enter the statement: "IF country of installation is West Germany THEN power is 220V." The statement is translated into Ifprolog rules and stored alongside the inference mechanism. The attributes are then copied into the mechanism's variables, thus tailoring the mechanism to the application. The expert must also load the attributes into the relational database in tabular form. When a non-expert uses the completed system as an aid, a dialogue interface incorporated into the shell asks questions and interprets answers.

Mescheder reveals that Nixdorf is interested in developing systems similar in concept to Expert-Ease. The Nixdorf systems would accept examples rather than rules. The first host for Nixdorf's shells is a machine designed by Auragen Systems Corp., Fort Lee, N.J., which Nixdorf builds and sells as the 8832.

Mescheder says his company selected Prolog rather than LISP for its expert-system shells for several reasons. They include Prolog's backtracking feature, which enables a program to try alternative strategies, and its unification facility, which lets non-numeric attributes be copied into variables by pattern matching. Another big attraction of Prolog for Nixdorf is that it is widely used in European universities. □

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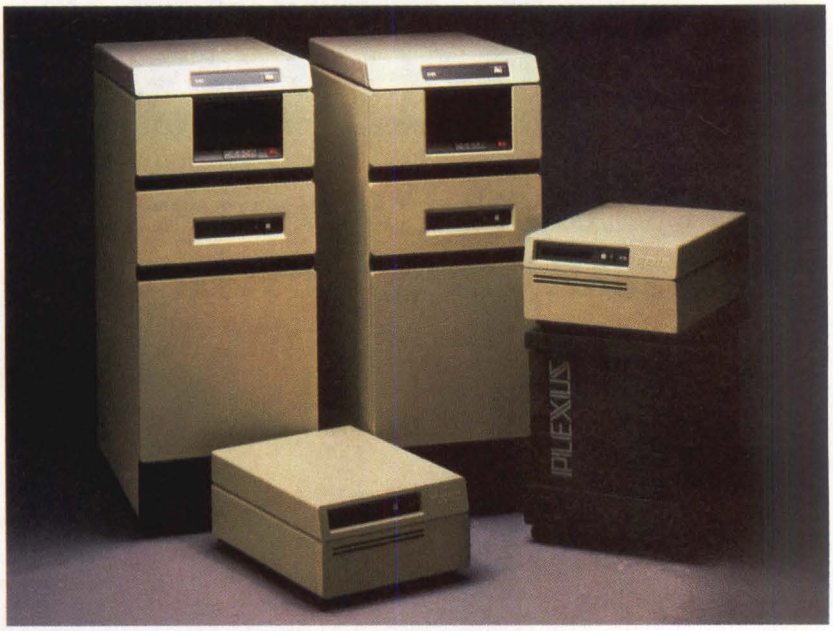

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CIRCLE NO. 50 ON INQUIRY CARD

The Interpreter

An analysis of news, issues and trends affecting the computer industry

Hardware differences can make or break the 50 IBM PC-compatible manufacturers

Degree of PC-DOS imitation is a key strategy play

Lori Valigra, Senior Editor

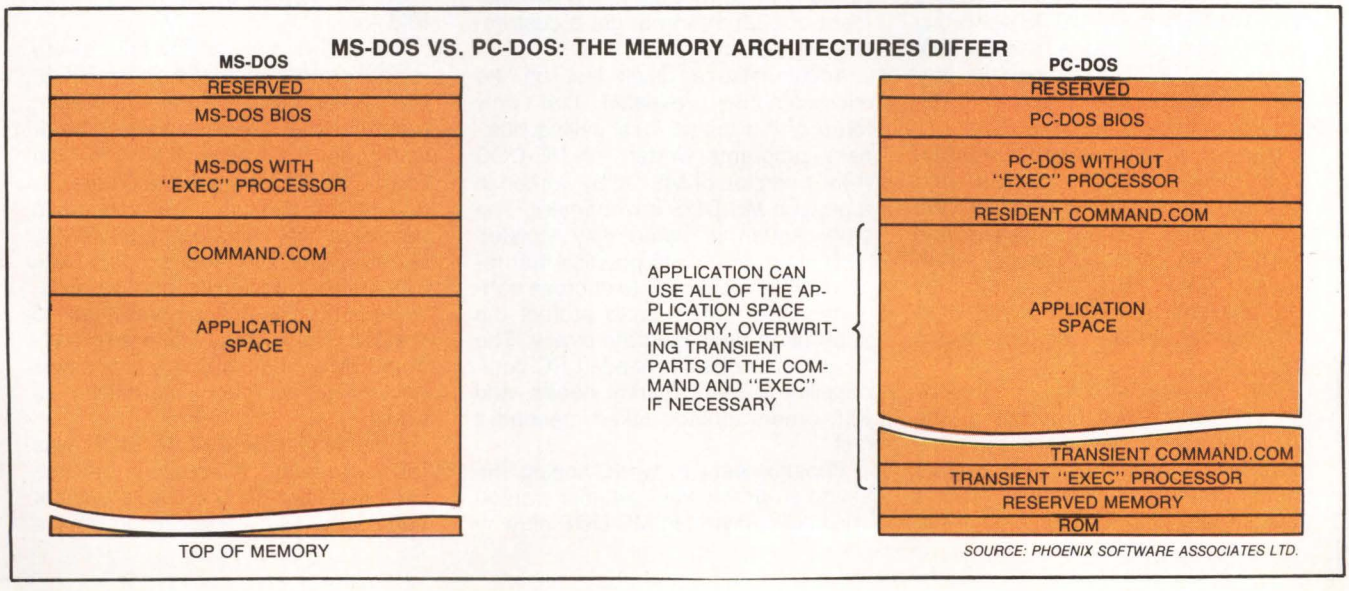
Imitating a popular item, whether it be the Mona Lisa or IBM Corp.'s popular PC microcomputer, assures a certain sales success. But imitations can become a liability. Microcomputers that too closely approximate IBM's original may invite a lawsuit, as three manufacturers have discovered. However, equipment differences that don't allow even one popular program to run without alteration could break a product or a company.

As many as 50 companies are capitalizing on IBM's product success and subsequent inability to meet demand. Rod Canion, president of competitor Compaq Computer Corp., which sells an IBM-compatible portable computer, says IBM products lead in retail store sales and are purchased most by large corporate accounts, thus making IBM the "standard" to imitate.

But PC-compatible manufacturers are damned if they mimic and damned if they don't. If they don't, they almost assure themselves a limited market because of the IBM PC's success. If they do follow IBM's lead, they must adopt the PC's good features along with its limitations. For example, some of the most popular graphics programs bypass IBM's operating system and directly address IBM hardware to speed execution, so those companies wishing to have their hardware run these programs must mimic IBM's architecture. Additionally, compatible microcomputers fall prey to price pressures from other makers of compatibles and from IBM, always able to cut prices because of its economies of scale.

Among those vendors accepting IBM compatibility as their modus operandi, debate centers on which hardware and software attributes constitute compatibility. Several companies, such as Compaq, argue that compatibility means mimicking IBM's hardware and software as closely as possible, to the point of an identical keyboard layout. Other companies, such as NEC Infor-

A noticeable difference between MS-DOS and PC-DOS is the BIOS, *which IBM chose to divide into hardware and firmware. MS-DOS buyers can write the BIOS all in software if desired, but many chose to implement part of it in firmware as IBM has.*



mation Systems Inc., choose to imitate some features and improve others. Giving their computers MS-DOS IBM-look-alike operating systems able to run some popular IBM software packages, many such companies opted to improve execution speed or display resolution, thus sacrificing a degree of compatibility.

Market researcher Future Computing Inc., Richardson, Texas, issued a report noting the levels of compatibility of look-alike machines: the highest level, operational compatibility, enables the computers to run the most popular software for the PC. Compaq offers such a system. Functionally compatible computers cannot run PC software, but manufacturers supply their own versions of the top-selling IBM programs. Texas Instruments Inc. is one such supplier. Computers with data compatibility can read or write IBM disks but cannot transfer data between disks. Wang Laboratories Inc. supplies such a personal computer. "Incompatibility" applies to computers that can't exchange data disks with the IBM PC.

Most critical to compatibility is the basic input/output system (BIOS), the part of IBM's PC-DOS operating system that performs such functions as system checks, initializing memory and setting interrupt vectors. It writes characters to the screen, reads the keyboard, and reads from and writes to the floppy disk drive.

IBM's PC-DOS is IBM's version of MS-DOS, an operating system supplied by Microsoft Corp., Kirkland, Wash. To implement MS-DOS, purchasers must write a BIOS for their target host machine. Thus, the BIOS differs on the more than 100 licensed versions of MS-DOS. IBM chose to write part of its BIOS in firmware, which it named the ROM BIOS, and to keep another part of the BIOS in software, explains Chris Larson, MS-DOS marketing manager at Microsoft. The ROM BIOS incorporates the most hardware-dependent parts of the operating system, and forces emulators to provide an equivalent ROM BIOS, so that the operating system addresses the hardware in the same manner.

Emulators cannot copy the IBM ROM BIOS because it is protected by copyright law. IBM published—and thus copyrighted—the ROM BIOS in its technical reference manual.

IBM recently settled disputes with two top-selling

A case of mistaken identity: PC-DOS and MS-DOS aren't twins

Lance Hansche
Phoenix Software Associates Ltd.

The manufacturer of a Z80-based scientific microcomputer running the CP/M operating system asked Phoenix Software Associates Ltd. to build and program an 8086 add-on board that would run the MS-DOS operating system. The goal was a machine that could run IBM PC-compatible programs even though its hardware differed dramatically from the PC's.

In seven weeks, we had five prototype printed-circuit boards and MS-DOS running in the machine. We added an 8-MHz 8086 processor and an 8087 math coprocessor, 256K bytes of RAM and a general-purpose interface bus. A version of MS-DOS 2.0 controlled all devices through the Z80.

Then disaster struck. Attracted by the portable's fast processing, the business community discovered the customer's machine, and orders began pouring in. However, before the company started shipments, it discovered that the microcomputer would not pass the ultimate test for business use: it could not run Lotus Development Corp.'s 1-2-3 integrated spreadsheet program.

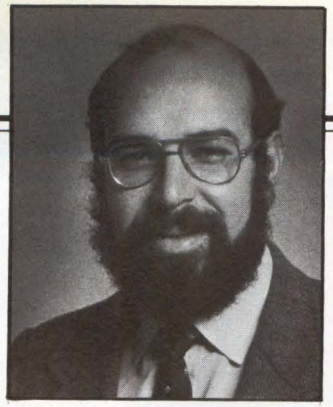
Urgent calls to Lotus deepened the gloom, because we discovered it would take 10 months and a commitment of $2.5 million to get a customized version of 1-2-3.

Additionally, a quick test on the microcomputer revealed that only three of the top 10 best-selling business programs written for PC-DOS (IBM's version of MS-DOS) worked in a generic MS-DOS environment. The other seven in some way violated normal programming practice that retains PC compatibility to improve software performance or to protect the application package from piracy. The customer decided it needed PC compatibility to meet market needs, and with orders already taken, needed it fast.

Phoenix went to work, hoping the seven programs the customer wanted to run circumvented MS-DOS only by using calls equaling those in the ROM basic input/output system (BIOS) within PC-DOS documented in IBM's technical reference manual. Five of the seven programs, however, directly manipulated hardware, making it impossible to run those programs effectively on hardware that didn't mimic IBM's.

We had to emulate the full powers —and errors—of IBM's ROM BIOS, find those parts of the application programs that directly accessed hardware and emulate them in the MS-DOS BIOS we were to create. To add to the difficulty, the customer's hardware was different from IBM's. Because the customer's board was retrofitted, it accessed hardware devices only through one parallel port to the Z80. The keyboard differed greatly from IBM's, and the floppy disk drives held twice as much information as IBM's.

Emulating IBM's ROM BIOS was relatively easy, although it became clear that third-party software authors had found many ways to abuse the



"In a PC environment, graphics programs usually call the hardware or BIOS directly," *says Jorge Noa, a founder of business graphics software developer Brag Systems.*

compatible suppliers, Corona Data Systems and Eagle Computer Inc., as well as with Handwell Corp. (with home offices in Taiwan), alleging infringement of the BIOS. Each company has agreed not to sell the offending machines. Although none paid damages or assumed guilt, the suit caused Eagle some financial hardship, according to financial statements issued by the company during its most recent quarter. In March, Eagle stopped shipping its PC-compatible Eagle 1600 and Spirit XL personal computers containing the BIOS targeted in the lawsuit and began shipping models with a new BIOS.

Many companies probably began developing an IBM-like ROM BIOS before it became clear whether ROM could be protected under U.S. copyright law. A lawsuit settled early this year between Apple Computer Inc. and Franklin Computer Corp. questioned Franklin's right to manufacture Apple II-compatible systems using ROMs containing Apple operating systems. The case was settled out of court, but the judge was expected to rule that the ROM was protected (MMS, March, Page 79). The uncertain outcome of the Franklin/Apple case apparently kept manufacturers from changing their ROM BIOS and may also have kept IBM from suing more of them earlier.

Application developers will notice no differences between PC-DOS and MS-DOS unless they develop applications circumventing DOS and addressing hardware directly, claims Larson. He says some minor differences exist, such as how a user signs on to a host microcomputer, but they do not affect the application interface. Microsoft modified MS-DOS for IBM, including such "tidbits," as Larson calls them, as extra code in the debugger to determine whether the display shows 80 or 40 columns, a hardware-dependent function. Thus far, says Larson, IBM has been receptive about adopt-

ROM. Phoenix had to ensure that routines were in the same location in both our ROM and in IBM's and that we maintained all ROM variables at the same addresses they inhabit in IBM's.

By adding to the board layout, we put direct hardware references under software control. Most are made directly to the PC's video memory to speed screen changes. This meant each memory reference within the video memory had to be trapped and transmitted to the Z80. Phoenix translated each attribute byte into proper sequence for the screen controller. The approach worked well, even with graphics, but only because the 8086's high speed compensated for screen-processing overhead.

Two problems remained. We had to compensate for the many programs directly addressing the CRT controller that change cursor attributes and control synchronization with the monitor for flicker-free changes. We also had to link the floppy disk drive controller to the hooks in copy-protected IBM-compatible packages.

After completing development of the clock and other minor devices, we decided not to emulate serial ports because programming would have been extremely expensive. Because no PC communications software announcements were pre-eminent, it was easier to convert selected packages.

Was Phoenix successful in achieving compatibility? Yes and no.

Although the VisiCalc spreadsheet does not run on the customer's microcomputer because its copy protection too cleverly uses timing characteristics of various IBM PC chips, Lotus 1-2-3 *does run* on the machine—and observably faster than on the PC.

The customer's product is a success. But the company probably won't make the mistake again of thinking that having MS-DOS assures PC-DOS compatibility.

PHOENIX LOOKS AT DEGREES OF IBM PC COMPATIBILITY

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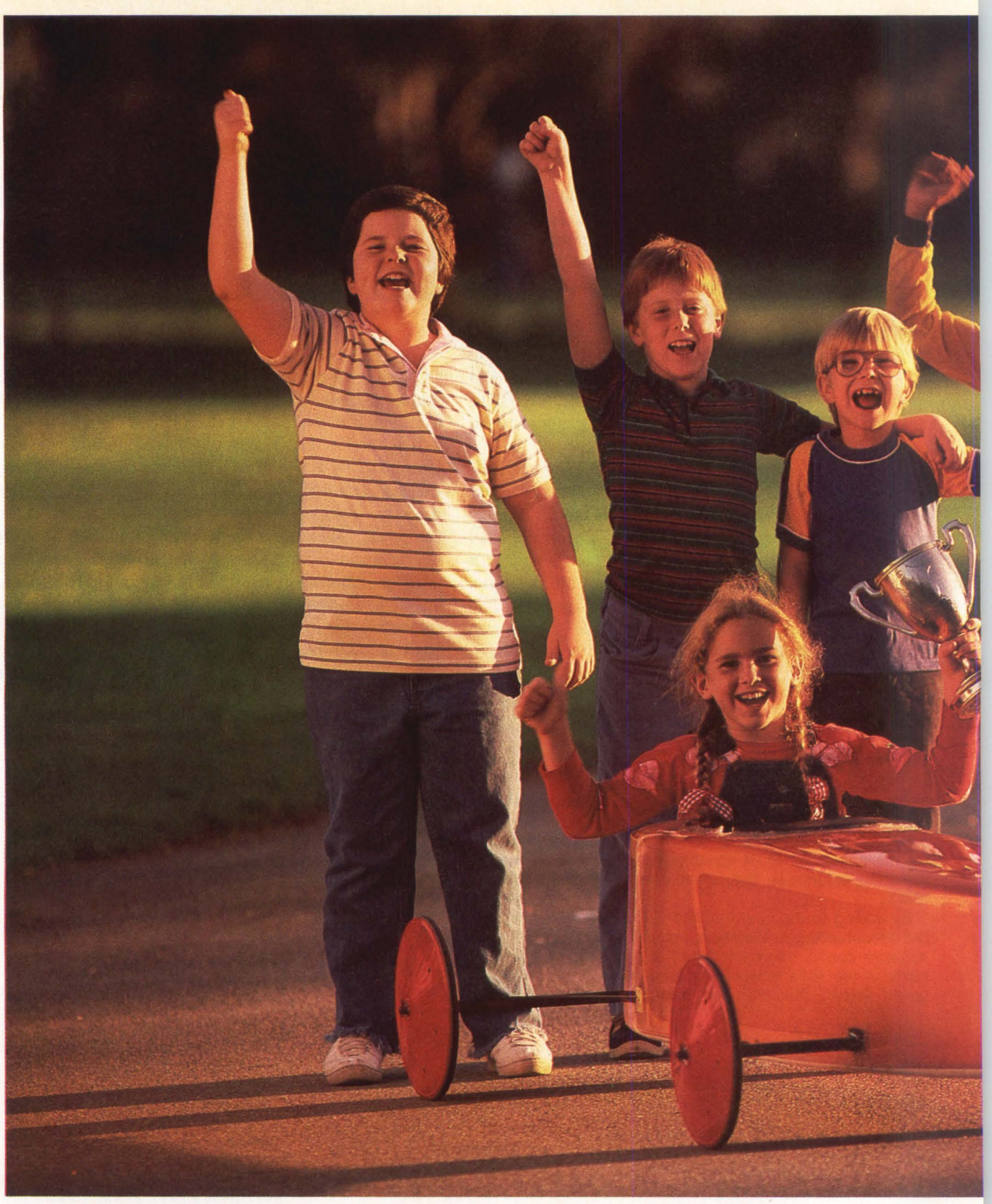

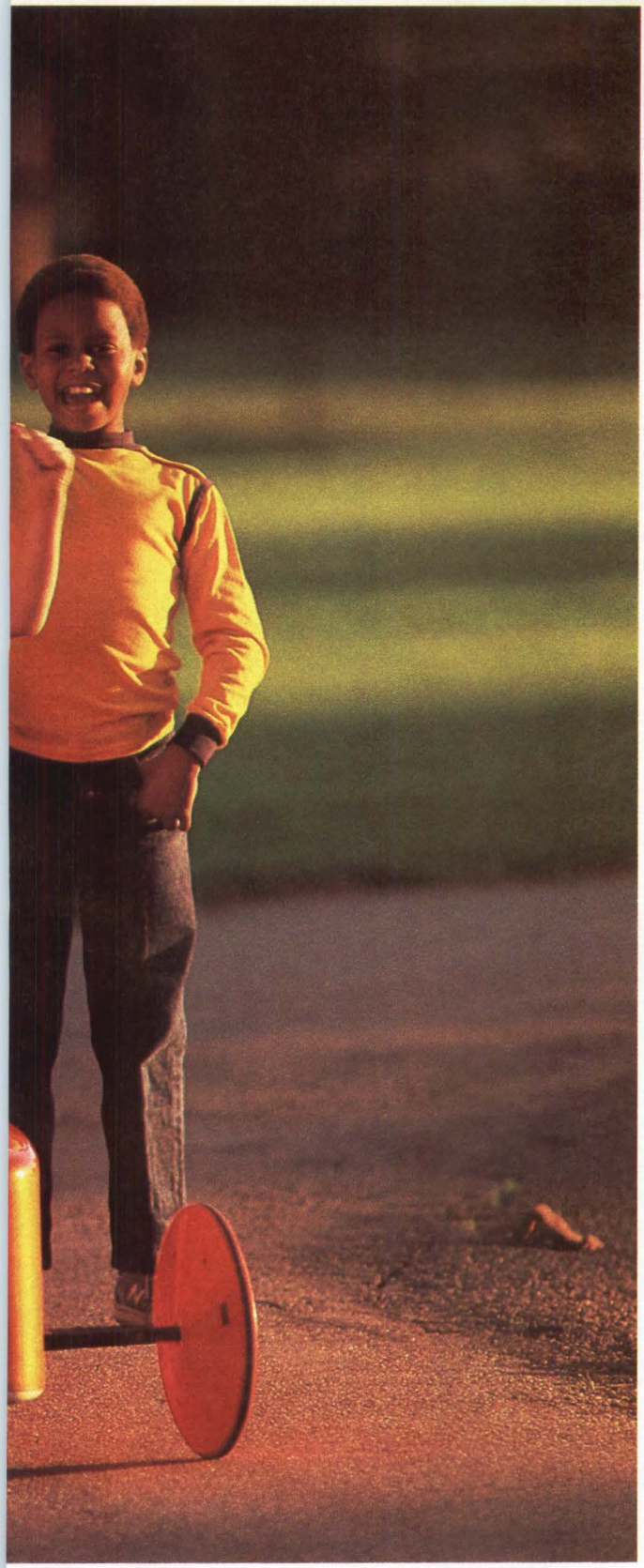

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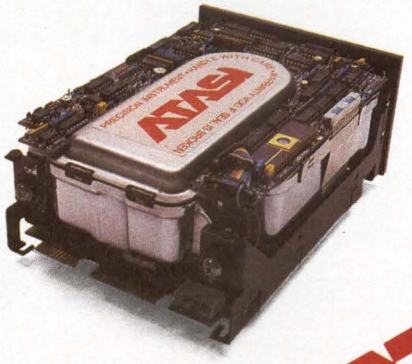

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ing any updates or changes to MS-DOS issued by Microsoft, which keeps the products on a parallel course.

Neil Colvin, president of Phoenix Software Associates Ltd., a Norwood, Mass., software house that has worked on many MS-DOS ports, notes some important differences between PC-DOS versions 1.1 and 2.0 or 2.1. All 1.1 system calls are included in 2.0 and 2.1 versions; he explains, but the software interface changed dramatically. And 2.0 and 2.1 include advanced functions similar to some available under the sophisticated UNIX operating system. Other differences in the versions include recognition of bit values.

An update notice released by Microsoft for its corresponding 2.11 version notes that to support international character sets, MS-DOS must recognize all 256 possible byte values. This means all 8 bits of a character in the MS-DOS file become important. In previous releases, MS-DOS ignored bit 7, the highest bit. Some software vendors used this unclaimed high bit, as did Ashton Tate on its popular dBASE II database manager package. To avoid problems when running under version 2.1, Ashton Tate provides a 2-byte patch to correct any problems resulting from how bit 7 is used, the Microsoft update notes.

Many application software developers write code that "talks" directly to the BIOS or to the microcomputer's hardware because the DOS is slow, explains Col-

To deal with DOS, trade features against portability

David Wittler, Samna Corp.

Samna Corp. made a fundamental decision at the outset of designing its Samna Word word-processing program. Rather than building a "portable" word processor able to run under the DOS operating system on any PC or PC-compatible microcomputer without modification, we optimized Samna Word to take full advantage of each target machine's keyboard layout, display attributes and other key features. Modifying the program for each different implementation of MS-DOS took about a day. Modifying the program for other differences in the machines took considerably longer in some cases.

So far, versions of Samna Word II and Word III run on computers from seven companies: a PC-DOS version for IBM Corp. and MS-DOS versions for Compaq Computer Corp., Columbia Data Products Inc., Corona Data Systems, Colby Computer, Digital Equipment Corp. (for the Rainbow 100 and 100+) and Texas Instruments Inc. (for the Professional).

Hardware vendors modify MS-DOS according to their product design goals. Corona and Colby, for example, have attempted to improve performance beyond that of the IBM PC. Others, such as Compaq, approximate the IBM PC blow-by-blow. Some implementations of MS-DOS require that application software developers initialize bytes or control blocks, while others do not. Other differences relate to keyboard and screen-control routines and memory consumption.

In DOS 2.0, IBM and IBM-compatible vendors provide optional American National Standards Institute standard software drivers to control the screen and the keyboard. TI is expected to do the same under MS-DOS 2.1. DEC offers both ANSI drivers and VT52 terminal compatibility under MS-DOS. Without the ANSI or VT52 drivers, it is necessary to use firmware calls or write directly to video memory to display attributes or move the cursor. Our approach was to write code directly to the screen's video memory and to write proprietary keyboard interfaces, bypassing the operating system to speed performance.

Memory consumed by the operating system varies significantly among the target machines, which affects the amount of program space available. IBM requires 12.4K bytes of memory to run PC-DOS 1.1 and 24.5K bytes to run versions 2.0 and 2.1. DEC requires 32K bytes for MS-DOS 2.05. TI requires 18.7K bytes for MS-DOS 1.25 and 35.8K bytes for MS-DOS 2.11. Samna Word III runs under PC-DOS and MS-DOS version 2.0 and higher versions and requires 320K bytes of memory on DEC and TI computers. The earlier Samna Word II package requires 256K bytes on those machines.

We encourage hardware vendors to provide software developers with as much information as possible on modifications to DOS. With that information, software developers can accommodate not just system software modifications but also hardware attributes that benefit users. This makes both hardware and software easier to sell.

One MS-DOS version of Samna Word III runs on DEC's Rainbow 100+, *demonstrated by Samna president Said Mohammadioun and executive vice president Deborah Fain. Because each hardware vendor treats MS-DOS differently, each version of the word-processing package is slightly different.*

vin. Colvin lists some of the packages, and the list reads like a "Who's Who" of software: Wordstar word processing, dBASE II, and the SuperCalc spreadsheet. VisiCalc requires complete hardware compatibility of the PC clone because it takes advantage of the PC processor's timing features.

Early manufacturers of PC-compatibles, such as Bytec-Comterm Inc. with its Hyperion portable computer, found that a display with higher resolution than the PC's 640 by 200 dots would not run the PC VisiCalc program. Colvin says the PC VisiCalc version and Microsoft's Flight Simulator are the best tests of complete hardware compatibility. Prospective PC buyers can also use Lotus Development Corp.'s 1-2-3 integrated spreadsheet package as a compatibility test because it exercises much of the PC's hardware. But the argument for compatibility diminishes if end users have what they need to operate a computer. "What if Microsoft Word does not work? Is that important?" asks Microsoft's Larson.

There are at least two new and relatively painless ways to check if a BIOS is compatible: purchasing the BIOS or using a test package.

Graphics software suppliers generally admit they are among the worst DOS abusers. "In a PC environment, graphics programs usually call the hardware or BIOS directly," says Jorge Noa, a founder of business graphics software developer Brag Systems Inc., San Mateo, Calif. He explains that the PC's 8088 processor controls the placement of dots on the display. A primary Brag application is charting, so the company manipulates the graphics hardware through the BIOS or writes three special subroutines in the PC's hardware video memory to speed horizontal and vertical line drawing, for example. Phoenix's Colvin says using the video memory is the fastest way to bring characters to the screen. Noa agrees, noting that Brag's graphics program would require 20 times the instructions and run 20 times slower if the software used only the software BIOS.

Brag's goal is to make its programs independent of both operating systems and hardware, "but we do violate this [goal] in MS-DOS and PC-DOS," Noa admits. "One example of where we suffered a lot is realizing that, because the hardware [on different microcomputers] is different, communications calls can be different." He says that, depending on the CPU used, the system may not be able to perform all BIOS functions, such as letting a user know whether a modem is connected to the system. But, "if standard MS-DOS calls are used, functionality and portability [of applications] should be guaranteed," he says.

Richard D. Rebo, vice president of R&D at database software supplier Fox Research Inc., Dayton, Ohio, underscores communications call distinctions. He explains that some look-alike machine suppliers remapped the DOS software vectors so that they are no longer in the same place as on the PC. This may mean the call to the printer, for example, may be in a different place on different machines.

Assuring the BIOS works

There are at least two new and relatively painless ways to check BIOS compatibility—to purchase the BIOS or to use a test package. Phoenix was scheduled to release an off-the-shelf, PC-compatible ROM BIOS in late April that would sell for $90,000. Purchasers would have unlimited use of the ROM. A package with the ROM BIOS, GW BASIC (configured to look like IBM's BASICA), MS-DOS 2.11 and Phoenix's PC-DOS utilities sells for $290,000. Phoenix currently offers a $30,000 off-the-shelf software BIOS.

Another option is the PC Test package from Award Software Inc., Los Gatos, Calif., which tests a BIOS for PC compatibility. It has two sections: one tests software interrupts exercising low-level drivers, such as reading a sector from a disk or placing a character on the screen. The second checks that all semiconductors are in place and that memory is used in the same way as IBM uses it, explains PC Test developer Robert Stillman, executive vice president of Award. A companion package, DOS Test, checks for PC-DOS compatibility and prints the results. For example, it probes whether the disk drives format disks in the same way as IBM's drives do. Users get printouts of the results. The programs are priced at $6,000 each; purchased together, the price is $10,000. Award has thus far sold six packages to customers including Mitsubishi Electronics Ltd. and Fujitsu Ltd. Stillman says the programs are for software developers and sophisticated OEMs implementing IBM PC look-alikes.

Microsoft's Larson offers a last word of advice to system integrators desiring PC compatibility, especially in developing the BIOS: "Do it honestly and legitimately." □

Interest Quotient (Circle One)
High 816 Medium 817 Low 818

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Those same engineers have been at it again. This time, compacting VAX architecture into the MicroVAX I™ system.

A micro by every measure, the MicroVAX I system nevertheless delivers all the versatility and speed you've come to expect from its larger namesakes. It guarantees both hardware and software compatibility with other VAX computer family members. It lays claim to the same treasure chest of development tools, utilities and languages. It provides access to the same impressive library of proven applications.

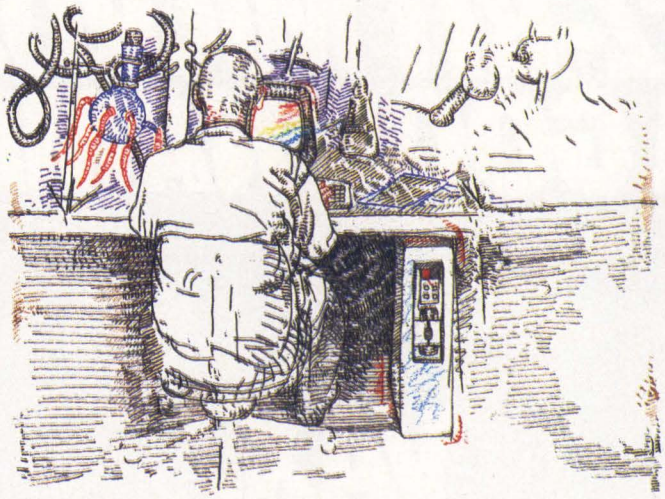
With the MicroVAX I system, the industry's premier 32-bit architecture has been miniaturized by VLSI technology. Along the way, Digital's engineers dramatically reduced something else: the cost.

Entry into the celebrated VAX computing family is now possible for as little as $10,000.

THE UNCOMMON BENEFITS OF VAX ENGINEERING HERITAGE.

A genuine VAX computer, the MicroVAX I system has been, in a sense, already proven at tens of thousands of VAX installations.

Its high bit-efficiency, for example, is achieved in true VAX architectural fashion – by accommodating data types ranging from one to 128 bits, and 21 distinct addressing modes. You can select precisely what your programs call for. The system boasts over four gigabytes of address space, made possible by full virtual memory management.



The MicroVAX I system also inherits the elegant VAX instruction set. Some three hundred separate instructions. This gives developers exquisite control over the micro, and in turn, gives the system extraordinary applications flexibility.

Bit efficiency for speed, elegant instructions for flexibility, and consequent growth potential are the heart of VAX architectural excellence. They free MicroVAX I system users from memory overlays, program segmentation and other encumbrances of competitive 16- and 32-bit micros. VAX system sophistication means compact compilers and operating systems. It means applications that execute with speed.

The MicroVAX I computer enters the marketplace prepared both to live up to the legendary status of its predecessors, and to make a name for itself.

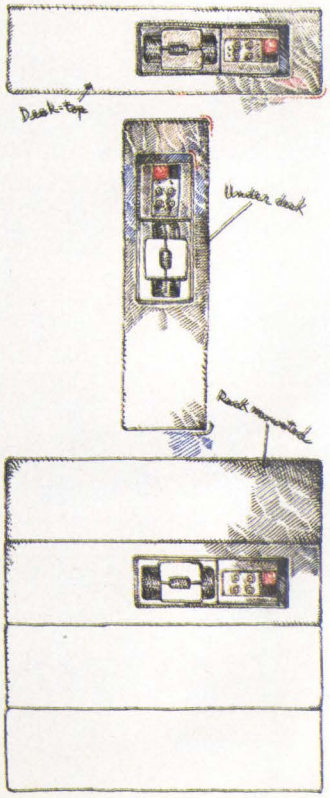
HARDWARE ENGINEERED TO GIVE YOU BIG SYSTEM PERFORMANCE.

To be sure, the MicroVAX I computer is a true micro. It fits under the desk, on the desk, or most compactly of all, taking up just 5¼" of height in a 19" rack.

The MicroVAX I system delivers over 35% of the raw power of Digital's VAX-11/780 computer. Enough to satisfy your most demanding supermicro applications. Enough to comfortably support up to five users.

There is big system capacity: one-half million bytes of physical memory is standard, and expandable to four megabytes. For highly technical applications, MicroVAX I systems also come standard with support for both single and double precision floating point arithmetic.

To enhance the already impressive execution speed, Digital's engineers even put in



an eight-thousand byte direct-mapped cache memory.

SYSTEM SOFTWARE ENGINEERED TO GIVE YOU UNMATCHED VERSATILITY.

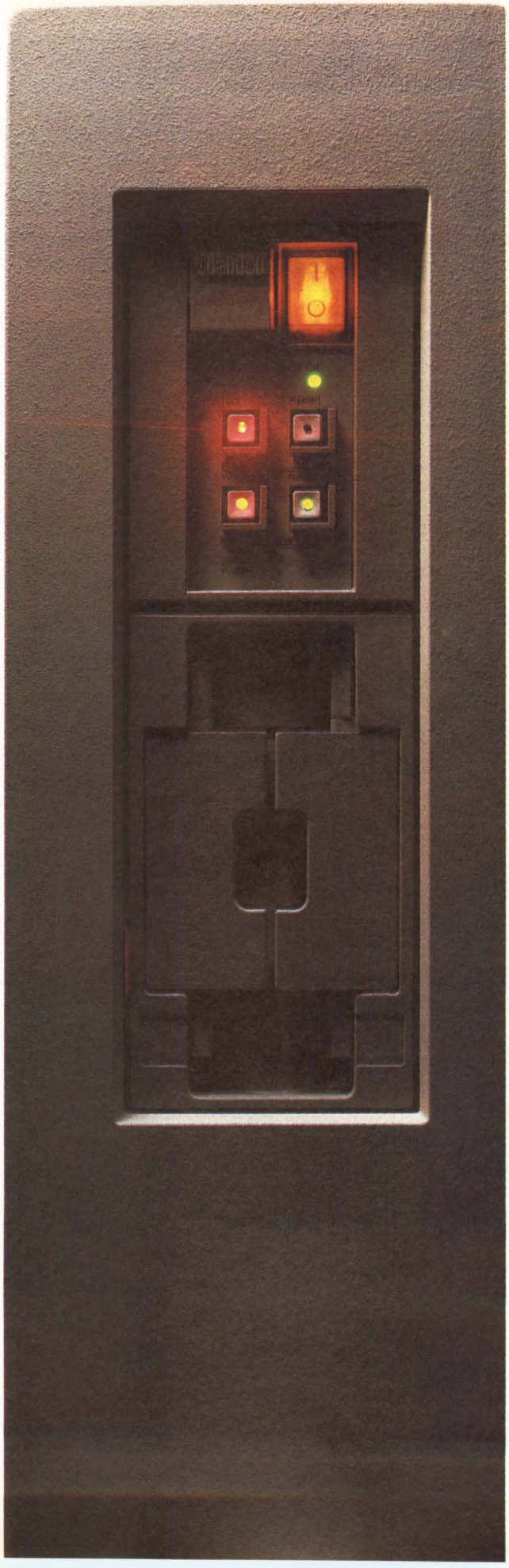
While ordinary micros give you just one, often thinly supported operating environment, the MicroVAX I system gives you a choice.

There is the MicroVMS™ operating system, Digital's famous VMS™ general-purpose system repackaged for the MicroVAX I computer. Within the storage capacity of your configuration, it will execute any user-mode VMS application. Unaltered. This opens up the complete range of unique and highly specialized Digital and third party applications and tools.

For incomparable economy, the MicroVMS operating system has been packaged by function into modules. You buy just the modules you need for your environment, then tailor the system to your application. The basic system module contains all the capabilities necessary to run applications. You can then add a program development module, a choice of networking modules, programming languages, and other optional products simply and easily. Because you never buy what you don't need, up-front investment is minimized and system overhead is reduced.

For realtime control, distributed computing and network-based multiprocessing, there is the VAXELN™ realtime programming toolkit. It gives you access to all the productivity tools of VMS. Applications developed on VMS with VAXELN software can be transported to other VAX or MicroVAX I target systems for execution. The applications do not need an underlying operating system.

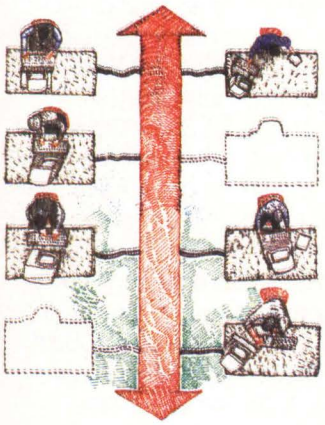
The MicroVAX I system will excel in a variety of applications settings. It is a team computer in business. A network node in process control. A technical workstation. It is a compact, high-powered computer that can be taken on location for seismic, marine and field engineering applications.



DIGITAL'S Q-BUS ENHANCED FOR HIGH PERFORMANCE I/O.

Inexpensive and high performing, the Q-bus™ data path has become a leader in the micro world and the choice of Digital's engineers for the MicroVAX I microcomputer.

The Q-bus data path now performs block mode data transfer, substantially improving its efficiency. The bus delivers transfer rates of over three



million bytes per second.

There are hundreds of devices and interfaces available for it. You may already have an investment in Digital's Q-bus structure. If so, a MicroVAX I system affords an easy and economical upgrade path to 32-bit power. For design start-ups, it gives you ready access to a complete range of supplementary products.

NETWORKING: YOUR WIDE-RANGING PRESENT, YOUR FAR-REACHING FUTURE.

The MicroVAX I system is a full-fledged member of one of the broadest ranges of compatible hardware ever sold. With it, you may employ a single, consistent computing strategy from micros to huge clustered systems.

(Continued overleaf)

You can progress along this computing path with ease, transporting programs and data among systems as your needs dictate.

As your micro applications grow, for example, it is easy and cost-effective to transport programs and files from the MicroVAX I computer to larger systems. Conversely, a MicroVAX I system becomes an ideal target for programs developed on a bigger CPU. The MicroVAX I computer can communicate with all of Digital's other computing systems via DECnet™ software. As part of a DECnet network, MicroVAX I systems can also be linked with highly efficient gateways leading to IBM's SNA™ networks and X.25 public packet switching networks.

Within smaller geographic areas, the MicroVAX I system connects to Ethernet (supported by DECnet software) by simply clamping onto the cable. In doing so, it becomes the first ready-to-implement microcomputer for building high-speed data communications and powerful processing into local area networks. Both MicroVMS and VAXELN software support the Ethernet connection.

ENGINEERED-IN RELIABILITY; INCOMPARABLE SUPPORT.

Like all of Digital's products, the MicroVAX I microcomputer is engineered for quality and produced to Digital's enviably high manufacturing standards.

The MicroVAX I computer incorporates many built-in system diagnostics. The most powerful of these is a microcode verify that performs a CPU self-test each time the computer is powered up. Many diagnostics run concurrently with normal processing, so if a failure does occur, it can be corrected quickly.

Every detail that helps assure reliability has been attended to. The system's 230-watt power supply, for instance, features thermal shutdown, overvoltage and overcurrent protection, a/c input transient suppression, and a minimum four millisecond powerdown time.

Overall, modular construction makes system service both rapid and inexpensive.

The MicroVAX I system is backed by one of the industry's most experienced small system support organizations. Digital pioneered on-site service with guaranteed up-time contracts and a selection of field services, software support programs, and user training agreements so comprehensive they suit virtually every need.

No other 32-bit microcomputer in history has ever offered its users greater potential for success.

While others promise performance, you'll be working with the industry standard 32-bit engine.

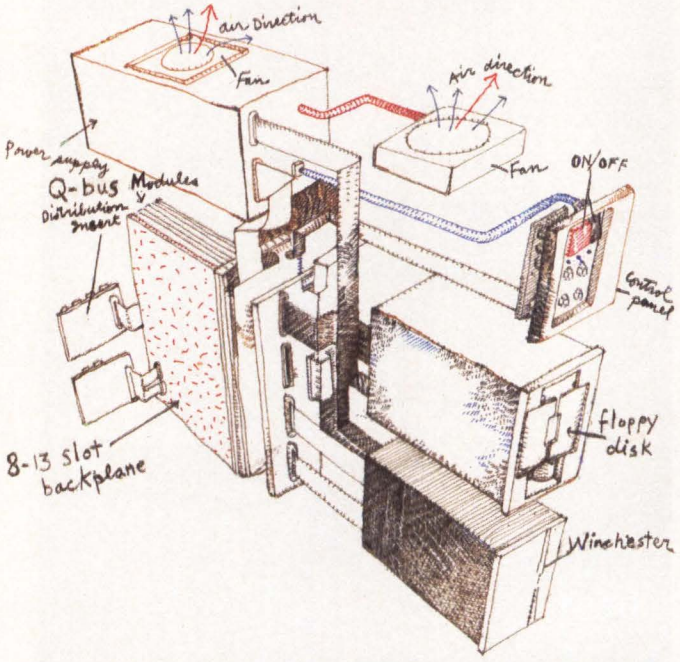
While others promise software, you'll have a choice of operating environments and programming tools.

And while others promise support, you'll be dealing with a company that has over 475 support offices in 44 countries.

DIGITAL'S MICROVAX I TECHNICAL SUMMARY

SYSTEM CONFIGURATION

Basic system for $9,995 (U.S. price, one only) includes: Two-board CPU, one-half Mbyte main memory (expandable), modular power supply, I/O port, and eight-slot Q-bus backplane. A disk-based system at $13,880 (U.S. price, one only) includes a 10 Mbyte fixed Winchester (expandable) and an 800-Kbyte floppy drive. Volume OEM discounts apply.



HARDWARE OPTIONS*	Optional	System Maximum
Memory:	256 KB, 512 KB with parity	4 MB
Floppy Disks:	2 x 400 KB	4 x 400 KB
Fixed Disks:	11 MB, 31 MB	62 MB
Communications:	1, 4, 8 lines Asynchronous Ethernet Synchronous	

*All configurations not supported by all operating systems.

SOFTWARE

Operating Environments: MicroVMS™; VAXELN.™
Supports Applications Written In: BASIC; COBOL; FORTRAN; PASCAL; PL/I; C; DSM; MACRO; LISP; OPS/5; DIBOL; RPG II.

MECHANICAL SPECIFICATIONS	Width		Height		Depth
Rack Mount:	48.3 cm 19″	x x	13.3 cm 5.25″	x x	64.8 cm 25.5″
Floor Stand:	25.4 cm 10″	x x	62.3 cm 24.5″	x x	72.4 cm 28.5″
Table Top:	54.6 cm 21.5″	x x	15.2 cm 6″	x x	68.5 cm 27″

WEIGHT (chassis only): 22.68kg (under 55 lbs.)
OPERATING TEMPERATURE: 15-32°C (59-90° F) at sea level.
OPERATING HUMIDITY: 20-80% relative humidity, noncondensing.

BEST ENGINEERED MEANS ENGINEERED TO A PLAN.

The MicroVAX I computer, like every Digital hardware and software product, is engineered to conform to an overall computing strategy. This means our systems are engineered to work together easily and expand economically. Digital provides you with a single, integrated computing strategy direct from desktop to data center, from chips to huge multiprocessing clusters.

As its name suggests, the MicroVAX I microcomputer is the beginning of a complete system and component program based on Digital-developed VLSI technology.

The MicroVAX I system is shipping now.

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Demand for enhancements, high profits add up to windfall for IBM PC add-on suppliers

The PC after-market spawned fast-growth companies, but following in Big Blue's wake is risky

Geoff Lewis, Contributing Correspondent

Through a kind of computer Darwinism, the slots left empty within IBM Corp.'s Personal Computer have been filled with scores of products and connections that adapt the basic IBM PC to new environments ranging from laboratory instrumentation to music synthesis. Along the way, a $1 billion-plus business has mushroomed around the PC and other microcomputers that can accept IBM add-on devices.

But—as in the mainframe add-on market—IBM can turn into a predator at any time, making it possible for only the fittest and most nimble to survive. As Andrew Seybold, a Torrance, Calif., consultant and analyst puts it, "The business is sustainable to an extent, but [add-on vendors] must realize that they are riding IBM's coattails. The smart money in the add-on business knows this is a windfall and are plowing their profits into other businesses that will give them long-term growth."

Nevertheless, the immediate future is profitable indeed for established add-on suppliers, according to estimates compiled by market researcher InfoCorp, Cupertino, Calif. This year, worldwide IBM PC and PC-compatible after-market sales will amount to $3.4 billion, including $920 million in software and $615 million in printers, InfoCorp reckons. Sales of add-in memory boards, "multifunction" boards, magnetic-storage subsystems and other add-ons will total $1.4 billion, InfoCorp analyst Ralph Gilman estimates. By

1988, the whole pie will expand to $113.4 billion, dominated by software and mass-storage subsystems, he predicts.

The add-on business is driven by more than omissions in IBM's product line, analysts point out. To a large degree, the higher profits retailers reap on after-market hardware fuels the industry. Computer system manufacturers typically give retailers a 30 percent discount, but the discount is based on list prices. Falling prices for IBM-compatible products have meant that dealers can seldom charge their customers full list price, causing retailers' profit margins for systems to shrink.

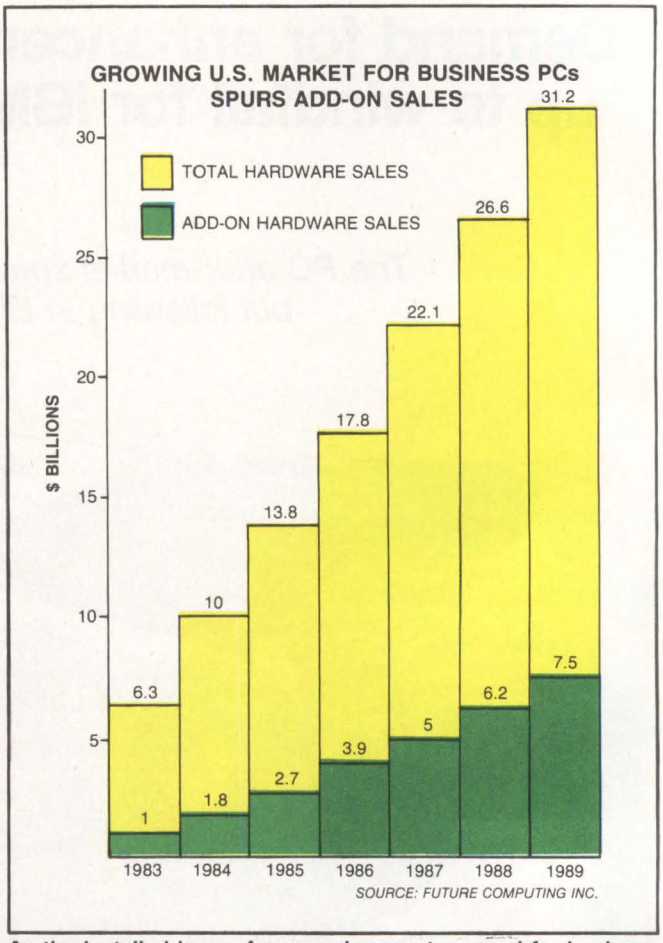
The higher profits retailers reap on after-market hardware fuels the industry.

In contrast, retailers can sell add-ons with profit margins as high as 50 percent. "The margins on machines are getting slimmer, so it is on software and add-ons that retailers will make their money," says Kenneth Orton of Future Computing Inc., a Dallas market research concern. He estimates that the U.S. office-computer market will generate $1.4 billion in retail revenues in 1984.

"The first-time buyer typically goes back where he bought the system and buys more memory and additional software within the first year," Orton points out. "As the installed base grows, these sales will become more and more significant to retailers." Future Computing's William Ablondi estimates that the U.S. hardware after-market for IBM PC-class systems, sold through retail stores and other channels, will grow from nearly $1.8 billion this year to $7.5 billion in 1989. Sales of add-ons will represent an increasing percentage of overall hardware sales, rising from 17 percent to 24 percent over the same period.

Success rests on picking the winning machines

Despite optimistic forecasts, surviving as a supplier to the after-market is far from assured, says Dr. Martin Alpert, founder of Tecmar Inc., Cleveland, a leading supplier of boards and subsystems for IBM PCs and PC-compatibles. Success in the expanding add-on business will depend on targeting machines other than the IBM PC to support. Alpert predicts that within a few years the PC market will undergo a shakeout, eliminating all but a handful of vendors that can sell enough



As the installed base of personal computers used for business grows, *sales of additional hardware to provide extra capabilities become an increasingly significant market segment, comments William Ablondi of research company Future Computing.*

systems to attract add-on business. "We think there will be three major players in the market, and we'll build products for them and for another two. If we choose the three correctly, we can be a $400 million to $500 million company in five years," Alpert says. He points out that microcomputer makers are starting to encourage add-ons; some manufacturers have approached Tecmar to line up add-on products before they publicly introduce new systems. To succeed in retail stores, manufacturers need hardware accessories, as well as an array of software, Alpert contends.

Apparently, Tecmar has identified Apple Computer Inc. as a survivor because Tecmar is preparing add-on products for Apple's Macintosh microcomputer. Alpert expects Apple products to account for almost 30 percent of an estimated total of $100 million in revenues for calendar year 1984. Sales of accessories for IBM and IBM-compatible systems should account for 50 percent, with the remaining 20 percent coming from a growing

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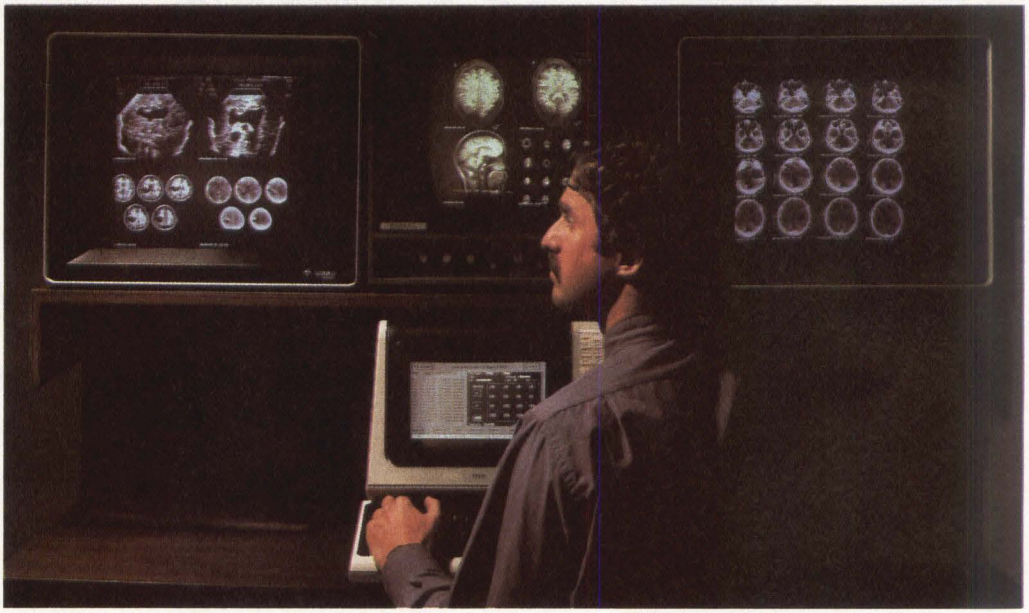

Michael Trambert, M.D., Image Processing Laboratory at U.C.L.A. Department of Radiological Sciences.

Hardware

- Up to thirty-five terminals and four image processors, with twelve 1024 monitors or forty-eight 512 monitors which can be configured into workstations.
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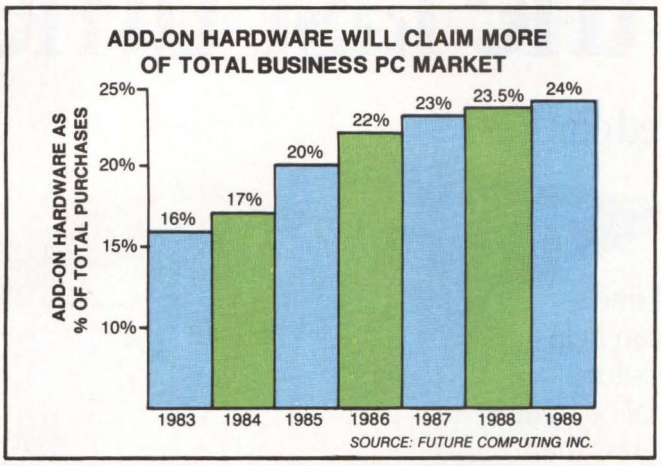
CIRCLE NO. 53 ON INQUIRY CARD



The market for add-on products will grow faster than the overall market for personal computers used in business, *many observers predict. Not only do most first-time buyers add to their systems within a year, but owners of older machines continue to want enhancements.*

contract engineering/manufacturing operation, Alpert predicts. Although he won't discuss previous years' sales, competitors estimate them at less than $10 million for the fiscal year ending June 1983.

Founded by physician Alpert to develop computerized medical equipment, 10-year-old Tecmar skyrocketed to the top of the add-on market after management latched onto the IBM PC. Only months after IBM introduced the system in 1981, Tecmar engineers tore down a retail model and began assembling add-in boards for it. From that early start, Tecmar continued its aggressive product-development schedule, producing more than 60 boards and subsystems for the PC and PC-compatible systems, including an array of technical interfaces and controllers. Although Alpert estimates that such products give the company an 85 percent share of the scientific and industrial market for add-ons, he stresses that Tecmar derives most of its revenues from high-volume products such as the now-standard multifunction board.

Putting added memory, a real-time clock and a communications interface onto a single board—when it would require separate IBM boards to offer similar capabilities—has made the multifunction card a business unto itself. No fewer than 25 suppliers have entered the market, generating annual revenues of $100 million to $200 million.

Competition drives prices down

Competition in the multifunction-board business escalated last year after Tecmar arch-rival Quadram Corp., an Atlanta subsidiary of Intelligent Systems Inc. (ISI), slashed prices by 40 percent. "The declining price has made us take a look at margins," Alpert observes, increasing Tecmar's commitment to automation. The company has invested more than $100 million over the past few years in automatic inserters, robots and automated test equipment to cut costs in its Cleveland-area factories. Despite eroding profit margins, Tecmar recently upped the ante in the multifunction-card business by throwing in what Alpert says is $1,000 worth of "free" utility software with each board.

Quadram is probably Tecmar's closest rival in providing a broad range of after-market products. Quadram founder and ISI president Leland Strange anticipates that Quadram will contribute some $50 million to ISI's anticipated $90 million in revenues this year and an even larger chunk to the $150 million the company hopes to earn next year. Quadram was one of the first manufacturers to rush to market with a multifunction card, the Quad board, which has been the company's staple product ever since. Strange says that Quadram concentrates its efforts on supplying high-volume products that computer retailers will carry in stock, rather than arcane gadgetry that only the most sophisticated technical users require. "Tecmar will carry an analog-to-digital converter, but the retailer doesn't want to stock it," he claims.

Success in the expanding add-on business will depend on targeting machines other than the IBM PC to support.

In contrast to Tecmar, Quadram has plowed fewer resources into product development—licensing or purchasing a growing percentage of designs from other suppliers—and more into marketing. Whereas Alpert boasts of Tecmar's cost savings derived from in-house production of manuals and sales-support materials, Strange talks up Quadram's expensive national television advertising campaign and heavy investment in slick graphics and packaging he hopes will appeal to retail customers.

"We pick up small markets and make them big," Strange says of the after-market. He explains that products such as the multifunction board do not offer enough incentive for IBM and its look-alike competitors to pursue. Production of the Quad board has grown to 15,000 units a month, about half Quadram's monthly volume. The other high-volume products Quadram manufactures or distributes include monitors, printer

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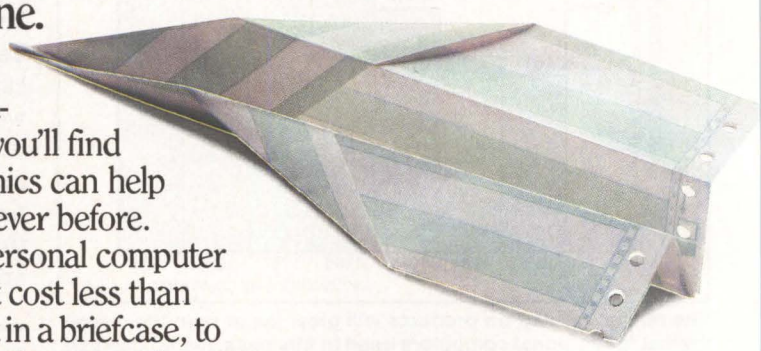

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*As ranked by "The Datamation 100," June 1983 issue. Report on the leading U.S. DP companies.

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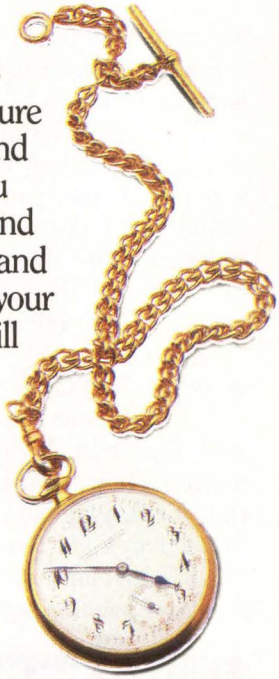

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CIRCLE NO. 54 ON INQUIRY CARD

buffers and disk drives. Like Tecmar, Quadram is counting on increasing volumes of Apple products, but Strange is banking on the anticipated IIc, not the Macintosh, to be Apple's big seller.

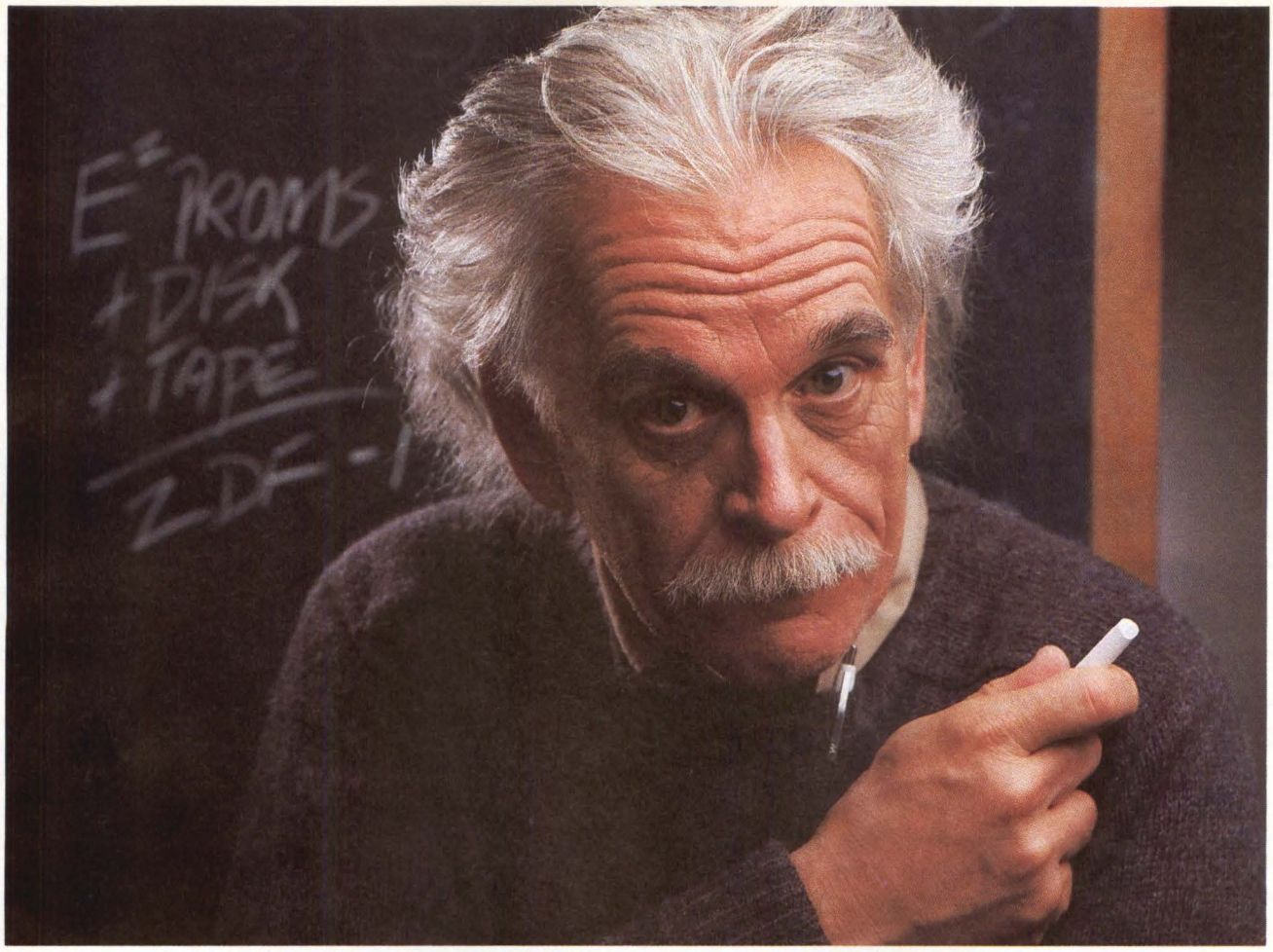
Strange, who characterizes his business as the "enhancement market," says he no longer fears that IBM or other manufacturers will redesign their computers and put him out of business. "Three years ago, when it was just Apple, you could make the argument that it would undo the business with its own boards or a redesign. But the business has changed. You really can't change everything on the motherboard when you've got 2 million units in the field," he argues. "Besides," he adds, "There is just a ton of things still to do [with the PC]."

A third major supplier of add-ons for the IBM PC, AST Research, Irvine, Calif., has concentrated on the multifunction board, communications and graphics, thus far staying out of the disk business. AST is hoping to quadruple its revenues to $50 million this year.

AST develops many of its products to fill requirements of popular software, says vice president of sales Thomas Stickel. For example, to support Lotus Development Corp.'s 1-2-3 integrated software package and other sophisticated spreadsheet products, AST manufactures a multifunction board that delivers 640K bytes of memory. The company makes an add-on RAM package that emulates a floppy disk to speed up operations of large programs such as the popular WordStar word-processing package. Stickel adds that graphics software packages will similarly generate demand for graphics hardware.

Although AST derives most of its revenues from multifunction cards, Stickel predicts that communications products will take on increasing importance as the number of desktop computers used in major corporations continues to grow. He claims that IBM has failed to provide cost-effective methods for tying PCs into mainframe networks or local-area networks. IBM's failure has created opportunities for technically adept add-on suppliers, he reasons.

AST manufactures boards that enable PCs to emulate IBM 3270 devices that are able to function in IBM's System Network Architecture, its overall communica-



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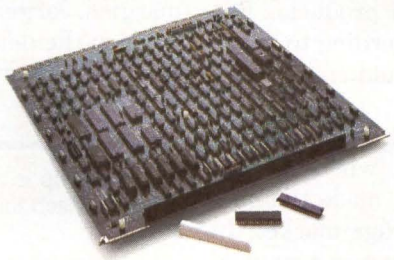

Get the full ZDF-1 story from Zetaco, 6850 Shady Oak Road, Eden Prairie, MN 55344, (612)941-9480. Telex 290975. European Headquarters: 9 High Street, Tring, Hertfordshire, HP23 5AB, England. (044282) 7011. Telex 827557. ZETACO G.

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Controller Division, Custom Systems Inc.

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tions scheme. Other AST boards allow PCs to emulate bisynchronous terminals and controllers that can work in mainframe applications. In addition, the company markets products that tie the PC to IBM's System/38 minicomputer.

Because AST's 3270 board offers more function than a similar IBM device gives, it is a popular item. It allows a PC user to download files from a host system and perform local data manipulation and printing. In contrast, the IBM version allows a PC to operate only as an interactive terminal with the host system, prompting some observers to conclude that IBM limited its function to protect terminal sales. Stickel reports that AST's product has done so well that IBM major-account salespeople occasionally recommend it.

'The first-time buyer typically goes back to where he bought the system and buys more memory and additional software within the first year.'

Looking beyond IBM

Like Tecmar's Alpert, Stickel hopes to broaden the add-on business beyond dependence on IBM and its clones: "We look at ourselves as being in the add-on business for a number of target machines that are likely to include Texas Instruments Inc., Apple and Digital Equipment Corp. models." In addition, AST has developed an OEM business that accounts for nearly 13 percent of sales. It targets those manufacturers of IBM-compatible systems and IBM value-added distributors that provide specialized software and hardware.

After building a successful PC add-on business almost by accident, Tallgrass Technologies, Overland Park, Kan., is expecting to return its attention to the OEM market. Tallgrass once planned to supply makers of Winchester disk subsystems with a combined disk/tape controller that would drastically reduce the cost of incorporating disk and tape in low-end products. But Tallgrass's approach was so radical, according to president David M. Allen, that OEMs "wouldn't touch us with a 10-foot pole."

Undaunted, Allen put together a disk and tape subsystem for the IBM PC in late 1981, when Davong Systems Inc. and Corvus Systems Inc. made the only products in the hard disk PC mass-storage market. In the past three years, 40 more disk subsystem manufacturers have entered the add-on market, building the worldwide disk/tape after-market to $685 million in sales this year, according to InfoCorp estimates. Tallgrass has maintained a unique market position by virtue of its proprietary controller—undergoing custom large-scale-integration shrinkage at American Microsystems Inc. and NCR Corp.—and a newer proprietary cartridge tape head, Allen claims.

Sales should reach $80 million in calendar year 1984 if they continue at their current rate, up from $21 million in 1983, allowing Tallgrass to plot a return to the OEM market. "Only about 5 percent of the IBM PC market is available to add-on mass-storage subsystem manufacturers, so selling to computer manufacturers represents a much larger market," Allen observes.

To address OEMs, Tallgrass is working on a product that will fit into desktop systems alongside a 5¼-inch, half-height Winchester disk. Allen is also working with tape-drive manufacturers such as Archive Corp. and Wangtec to promote ¼-inch cartridge tape as a standard for data interchange on Winchester disk-based personal computers. "If computer manufacturers decide to go a different way [opting for high-capacity floppy disks, for example], we still can do a great business in the after-market. Whether or not we get out of the after-market business, we'll be successful," Allen asserts.

Davong, one of Tallgrass' major competitors in the disk and tape business, generates about 30 percent of its revenue from OEM business, according to marketing director David Jorgensen. Davong, which shed a marginal add-in board business, is targeting the external mass-storage and networking requirements of clustered personal computer systems for systems houses, OEMs and very large companies. Jorgensen reports that his company expects revenues of $40 million this calendar year.

Because he has seen the market from both the OEM and subsystem sides, Jorgensen discounts the threat posed by disk drive manufacturers' entry into the subsystem market. Although Tandon Corp. and other drive makers have moved tentatively toward the add-on PC-disk market in a quest for higher profit margins, Jorgensen believes they will find it difficult to develop the dealer network and to provide the support needed in the retail market. □

Geoff Lewis is a senior editor of *Electronic Business* magazine, in which this article originally appeared.

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25th Status Line	Yes	Yes	No	No	No
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Graphics Characters	Yes	Yes	No	No	No
Configurable Print & Send	Yes	Yes	No	No	No
Set Up Mode	Yes	Yes	No	No	Yes
Settable Tabs	Yes	Yes	No	No	Yes
Choose Protected Attribute	Yes	Yes	No	No	No
Screen Saver	Yes	Yes	No	No	Yes
Max. Number of Displayable Characters on one screen	256**	128	128	128	128
2 Pages of Memory	Opt	No	No	No	Opt
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Warranty (Days)	365	90	90	90	90

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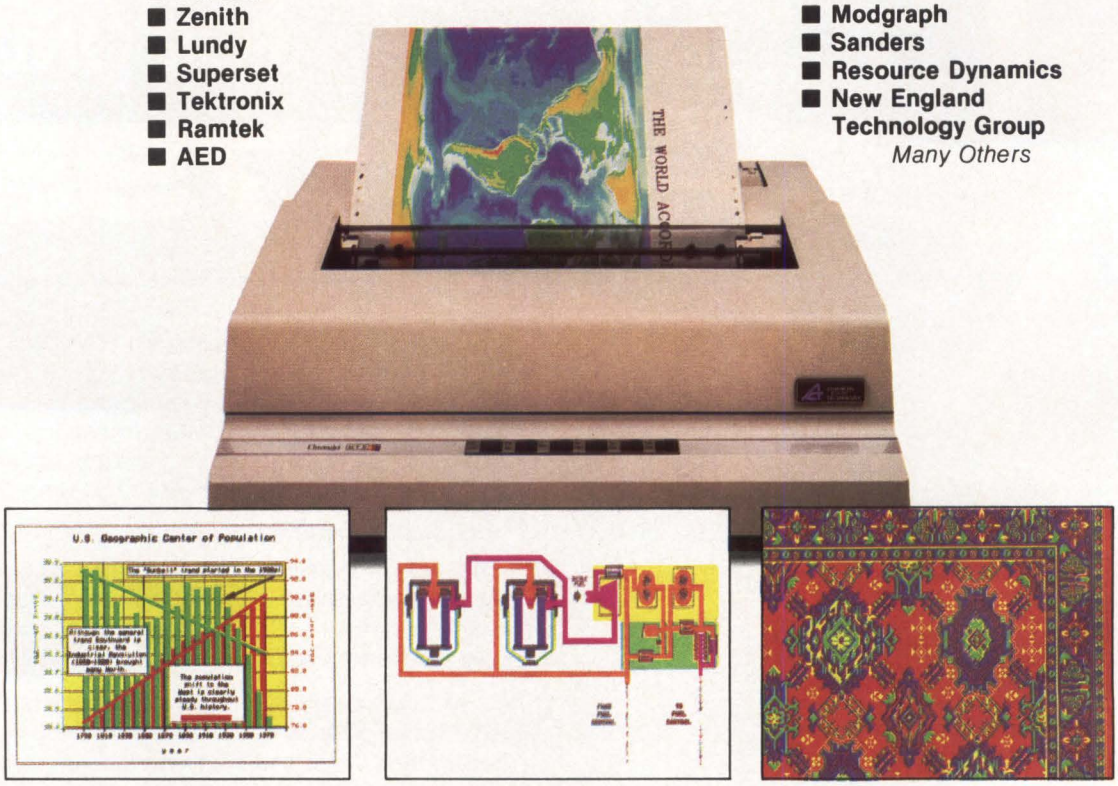
Many Others



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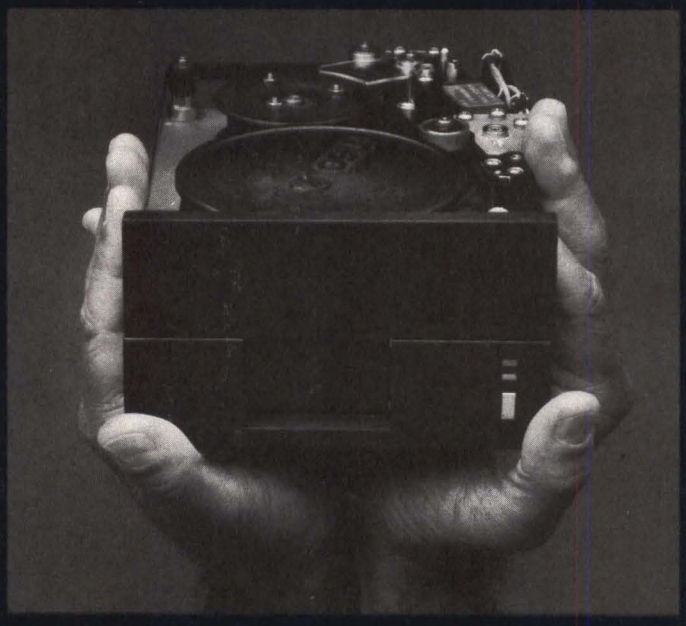

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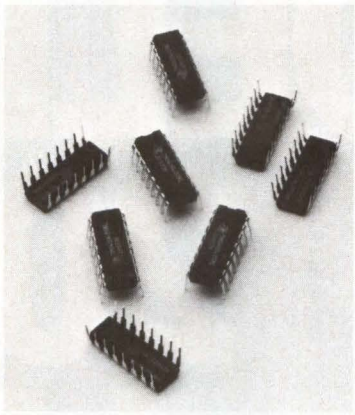

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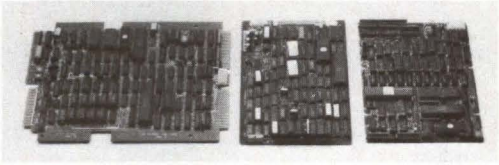

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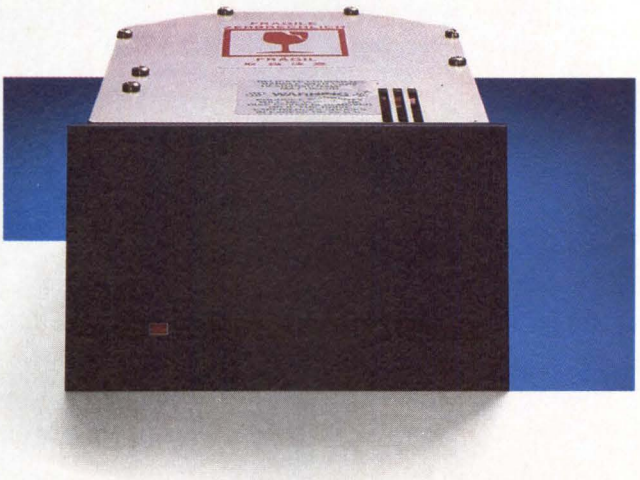

Unformatted capacity (MB)	25.52
Formatted capacity (MB)	20
Average access time (ms)	65

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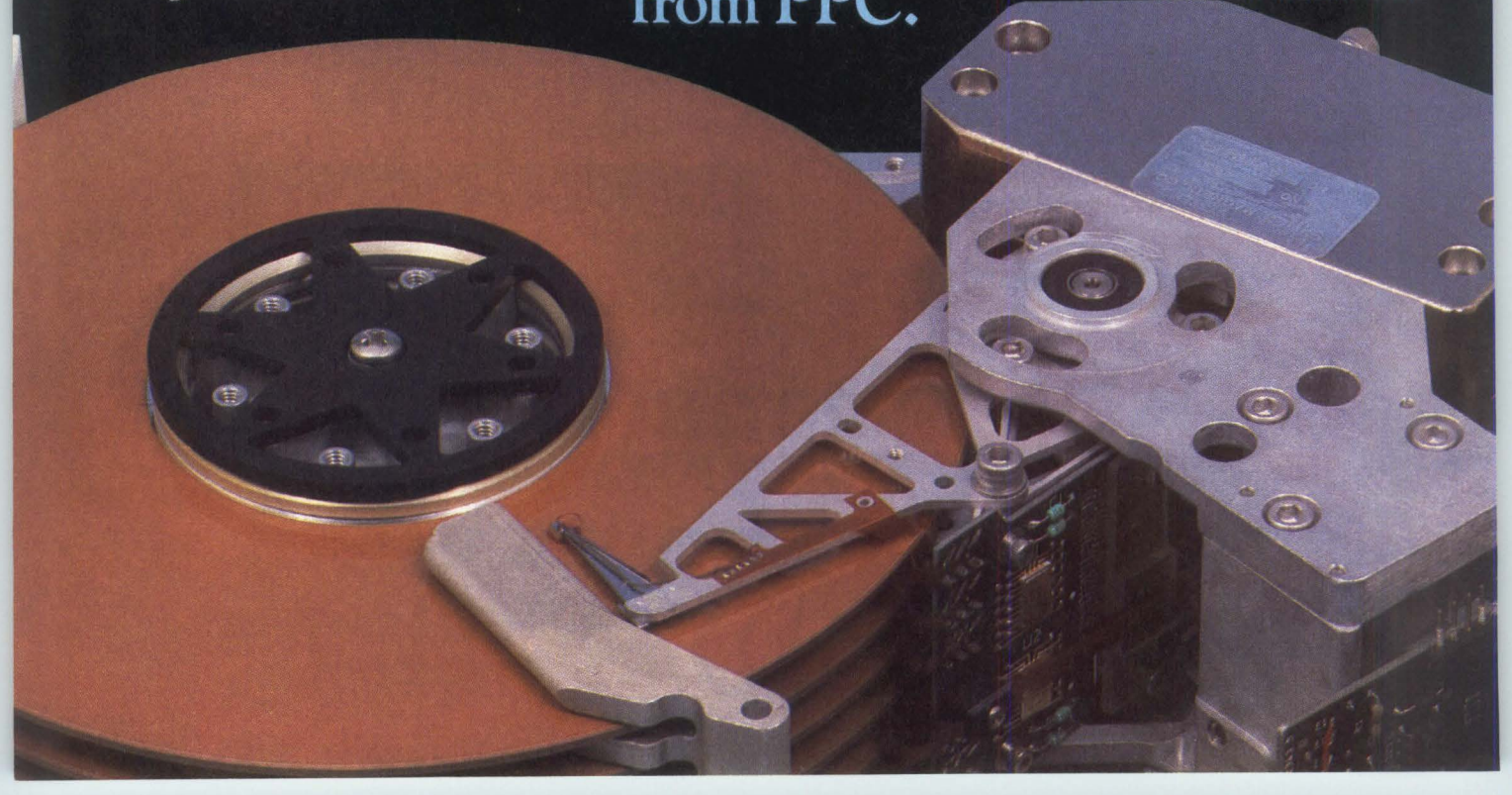


Vision systems for bin-picking robots increase manufacturing options

New vision capabilities help system integrators and software developers use robots to perform complex factory tasks

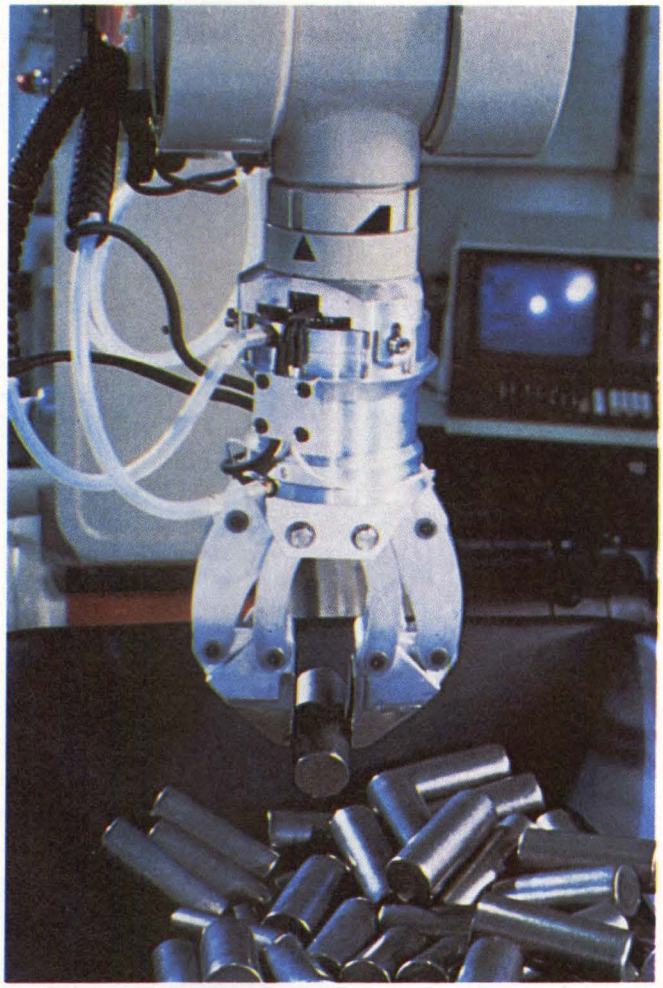
Dan Edson, Contributing Correspondent

Two recently introduced microprocessor-based, programmable-vision systems signal a major advance in machine vision and factory automation by enabling robots to remove objects from jumbled, disordered piles—an action known as bin picking. Supplied by General Electric Co., Syracuse, N.Y., and Object Recognition Systems (ORS) Inc., Princeton, N.J., the machine-vision systems control the first of a new class of intelligent, flexible, parts-handling robots. Unlike other vision-equipped robots, which can identify only those objects spread on a flat surface or viewed individually, bin-picking robots can recognize parts in bins and hoppers and in jumbled piles on conveyors and carts. This ability eliminates the time-consuming, costly processes of securing parts in rigid fixtures or spreading them on a surface.

GE sells its bin-picking vision system, BinVision, as part of a robot workstation. BinVision systems are in operation in GE plants in Bromont, Quebec, and Rutland, Vt. In both installations, a GE P50 process robot picks cylindrical metal turbine-blade slugs from bins and conveyors and presents them in a predetermined orientation to an assembly robot. This task is otherwise done by a person or by positioning equipment such as a shake table, which uses vibrations to reduce piles of parts into a single layer.

"As far as we know, these bin-picking robots are the first in the world performing full-time work in a factory environment," comments John Jensen, a GE engineer who designed the BinVision software. "Both robots work two shifts—16 hours each day."

ORS sells its new i-bot 1 vision system as a component. Undergoing beta tests in six U.S. factories, the i-bot 1 guides robots into bins and parts piles. Parts include automobile crankshafts, carburetor butterfly-valve shafts, electronic components and locomotive shock absorbers. In some installations, the parts pass on to processing robots; in others, the parts are placed in machine tools. The i-bot 1 system is "nearing the end of the test phase," reports John Artley, vice chairman of ORS. "We are continuing to refine i-bot 1 in response to our field tests and expect the vision system to be in production by the third quarter of this year."



The GE BinVision system *can remove parts from disordered piles in bins or on conveyors. Using advanced vision algorithms, the programmable, microprocessor-based system identifies the part and determines its orientation before a robot grips it.*

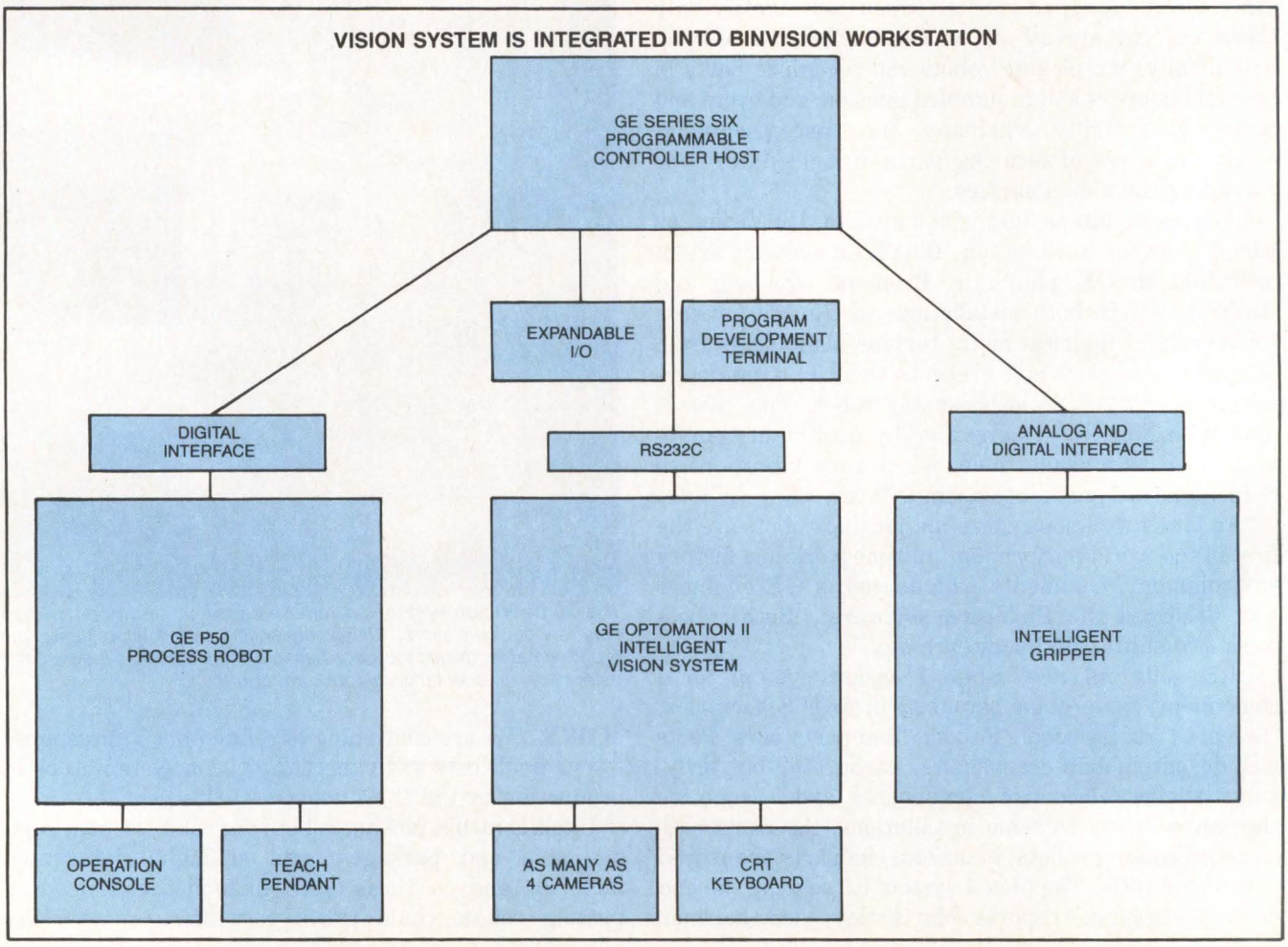
Intelligent bin-picking robots can load, unload, sort, assemble and package parts in highly integrated factories and in those with little automation. Bin-picking robots could prove cost-effective wherever

parts are stored loosely—sometimes resulting from manufacturing techniques, such as casting, extruding, forging, molding and stamping, and sometimes resulting from lack of discipline. However, the ability to operate in an undisciplined environment has sparked a heated debate. "There are other more valuable benefits of using robot vision than bin picking," states Delbert Tesar, director of the Center for Intelligent Machines and Robotics at the University of Florida, Gainesville. Tesar contends that having loose parts around encourages an inherent lack of discipline, which stands in the way of true efficiency. Other experts say a need exists for bin-picking robots and that they will be integrated into many factories.

Bin-picking methods have contrasting features

Bin-picking systems apply sophisticated vision techniques to evaluate the jumbled, 3-D scene in a disordered pile or bin. Many parts are in shadow and only edges or corners of some are visible. Generally, a video camera records the scene, and the image is analyzed until the system recognizes shapes it can identify. Many techniques exist to analyze a scene, including applying threshold values to the light intensity in each pixel; calculating perimeters, areas, axis lengths and other geometric parameters; counting such features as holes and corners; and determining the distance between various features. Vision systems compare data acquired in an analysis with data stored during a learning session, when key dimensions of a part were entered. To perform the extensive mathematical manipulations fast enough to control a moving robot requires a high-speed microprocessor and substantial computer memory.

The GE BinVison robot workstation *consists of three intelligent units controlled by a programmable controller host. In addition to the vision system, the workstation includes a robot and a gripper.*



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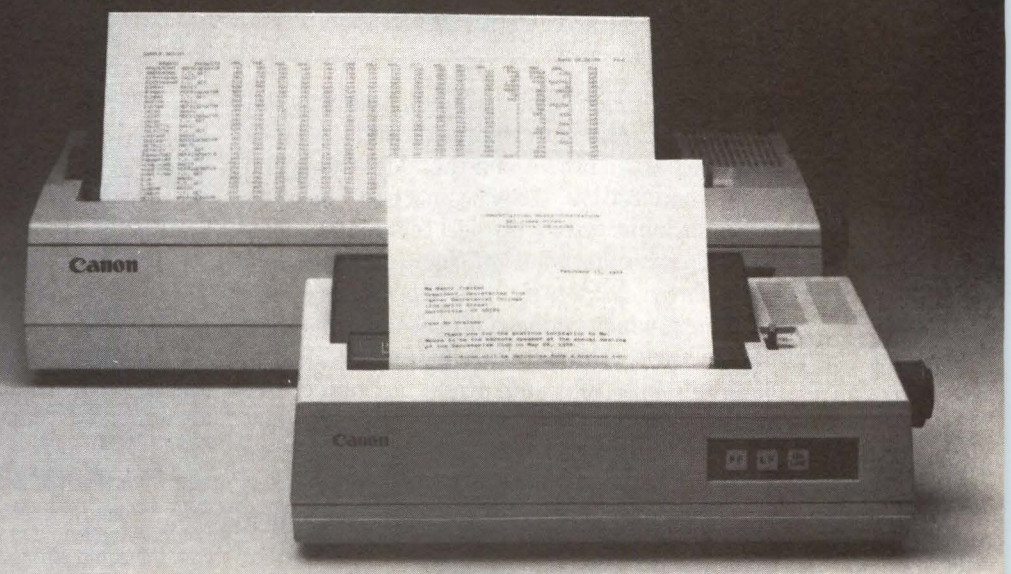

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The Integrator

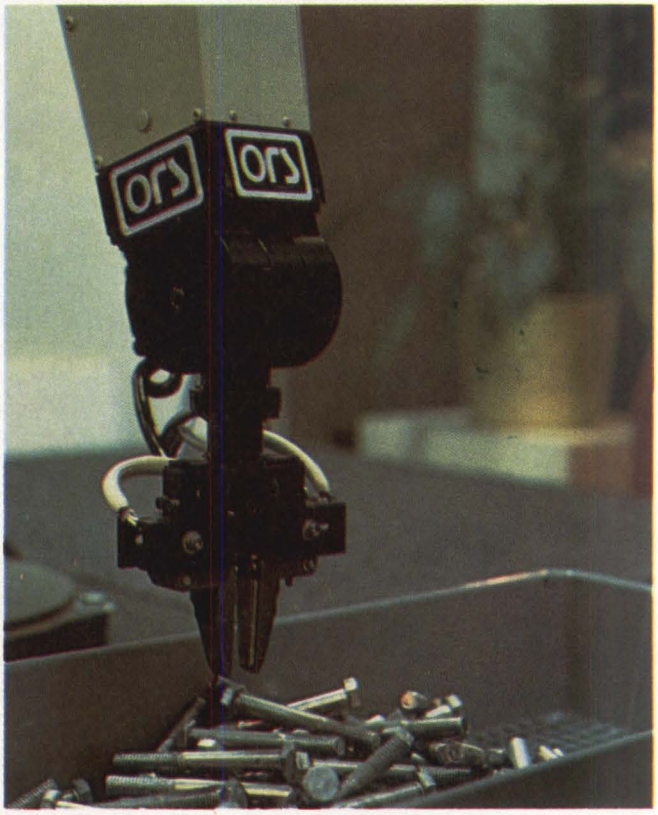
Many techniques exist to analyze a scene, including applying threshold values to the light intensity in each pixel; calculating perimeters, areas, axis lengths and other geometric parameters; counting such features as holes and corners; and determining the distance between various features.

A bin-picking robot can work in one of two ways: it can identify an object, note its orientation and then pick it up, or it can pick up an object and then identify it and determine its orientation. Each method has its strengths. In the identify-orient-pick technique, complex algorithms derive detailed information from analyzing a scene. The pick-identify-orient procedure uses simpler algorithms, which reduces processing time. But the robot may have to make an intermediate stop outside the bin to identify and orient an object. In general, robots using the identify-orient-pick method are more selective because they can detect defective parts while the parts are still in a bin. Robots using the pick-identify-orient method remove all parts, including defective parts, from a bin.

Most recent research into bin picking and development of algorithms has taken place at SRI International, Menlo Park, Calif., a non-profit research group, and at the University of Rhode Island (URI) Robotics Center, Kingston, R.I. SRI is attempting to take the identify-orient-pick philosophy to its limits, writing algorithms that will determine as much information about a scene as possible, including how removing one part affects other parts. "We would like to have better understanding of the bin and the ability to handle more complex parts with fewer operator interactions," says Bob Bolles, an SRI computer scientist.

In contrast, URI is refining the pick-identify-orient scheme, using principles the Robotics Center calls "heuristic acquisition." Bob Kelly, director of the center, explains: "Our algorithms ask a whole series of questions of increasing complexity, such as 'Can we discover a way to identify a place in the image with a high probability of picking something out?' We want to get out whatever we can; if it is defective, remove and discard it, rather than fishing around it."

BinVision employs a method similar to that researched by SRI, though GE developed its own algorithms. BinVision evaluates a scene to locate structural features, identifies viable parts and their orientations, determines which can be retrieved fastest and sends the robot to retrieve the part. In contrast, i-bot 1, based on algorithms developed at URI, searches for part geometries that the robot gripper can handle, regardless of part orientation. The vision system targets three parts; if the robot misses the first, i-bot 1 directs it to the second and then the third, if necessary. After the robot removes a part from the bin, another vision system scans the part to determine its orientation.



ORS' i-bot 1 bin-picking robot system, *here controlling a Unimation Puma 560 robot, can select parts with minor dimensional variations from the same bin. Currently being tested, i-bot 1 has handled parts such as marking pens, plier blanks, automobile crankshafts and locomotive shock absorbers.*

Robot interfaces control a variety of tasks

Because both BinVision and i-bot 1 are programmable, system integrators can use them to customize a robot for specific manufacturing operations. For instance, they could write programs that direct the vision system to perform certain tasks, such as measuring a hole diameter, after a part is retrieved. Both systems accommodate multiple cameras, so one bin might be analyzed while another is accessed.

BinVision is part of a $150,000 integrated, intelligent robot workstation, while i-bot is a $45,000 machine vision component. The BinVision robot workstation

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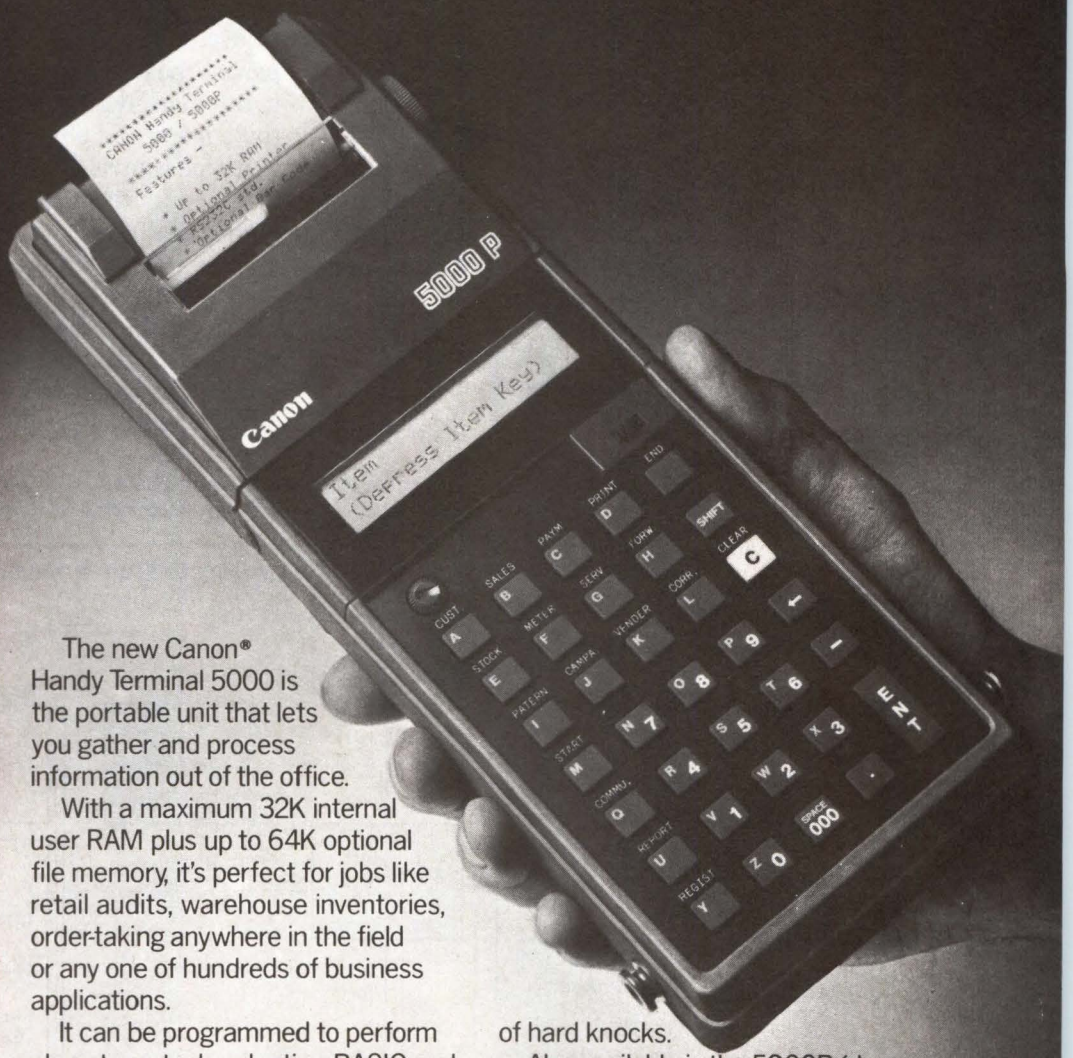

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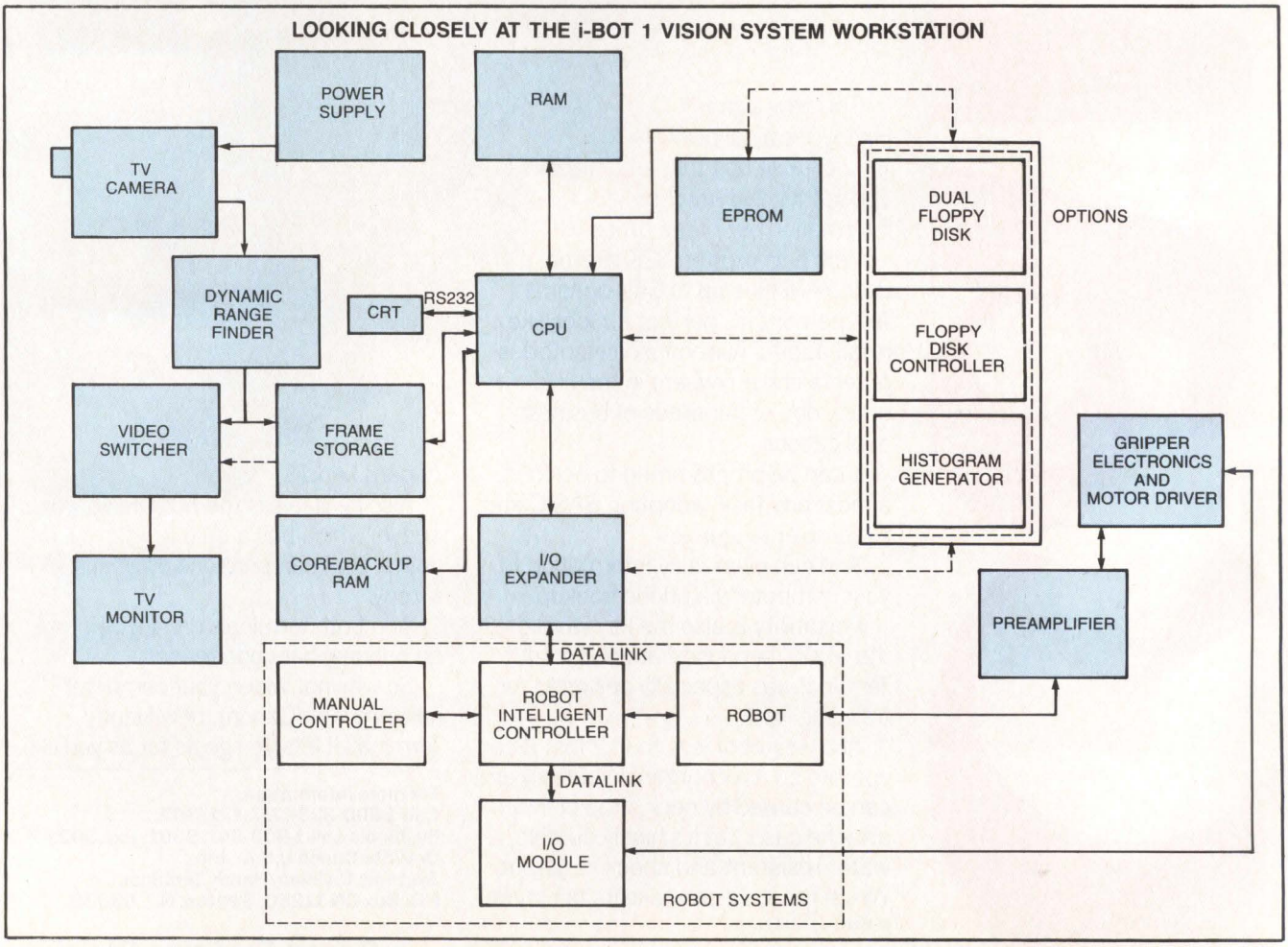
Most industry observers expect the bin-picking market to be small in comparison to overall markets for machine vision and robotics.

includes a GE P50 process robot, and BinVision is also compatible with the GE A4 and A12 process robots. The i-bot 1 works with most standard industrial robots, although all the test sites use Unimation Puma 560 robots. Both systems include a camera, vision-system software, a robot controller, a vision inspection system and an intelligent gripper.

The sophisticated, interactive grippers used with both BinVision and i-bot 1 can be either pneumatic or electronic. Each has sensor feedback. In the ORS electronic gripper, for example, an infrared-beam sensor at the tip detects an object as it comes between the jaws, and a collision sensor in the gripper body detects contact. Tactile sensors also control the programmable gripping force. ORS plans to add a sensor to detect the approach of a targeted part, which will permit the robot arm to move at high speed longer than it can now. It is currently programmed to slow at the top edge of the bin.

Robot control is an important design aspect of any bin-picking vision system. Because GE manufactures both BinVision and robots, integrating the vision system with robot controls was easier than it was for ORS. In current i-bot 1 configurations, vision-control electronics are piggybacked to robot controls. In the next generation of i-bot 1 systems, ORS will offer an integrated vision and robot control package, relieving users and robot manufacturers of designing control

A robot workstation using ORS' i-bot 1 bin-picking vision system, *with robot system inside the dotted-line box, also includes cameras, a robot and a central controller. The vision system is compatible with most advanced industrial robots.*



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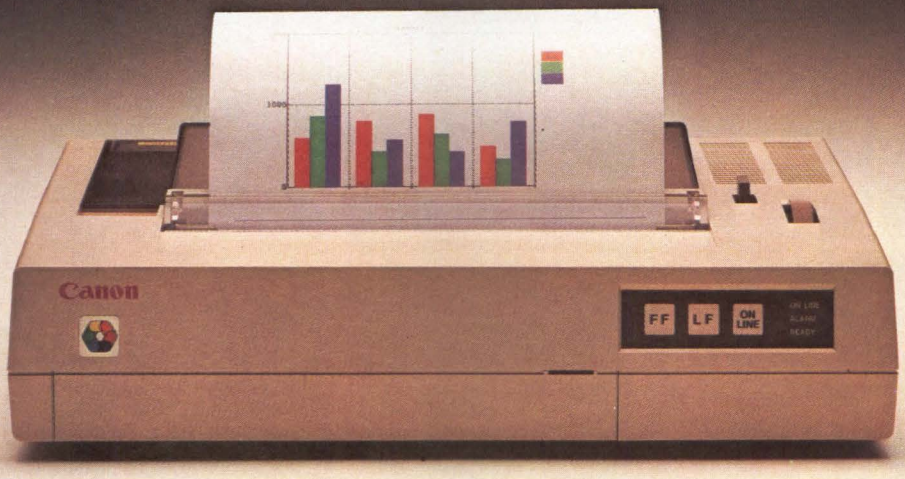

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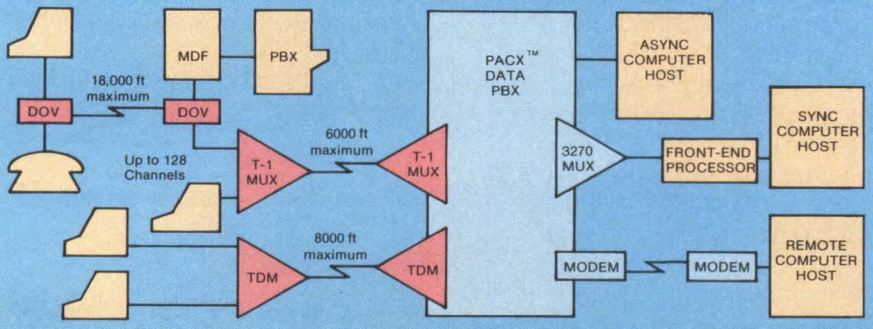

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interfaces. ORS intends eventually to integrate the inspection, or out-of-bin identification, with control electronics.

Theoretically, parts suitable for bin picking can be any size, shape, color, texture and reflectivity. To date, objects used by BinVision and i-bot have been simple, firm, relatively smooth and at least moderately reflective. According to ORS' Artley, i-bot 1 has successfully directed robots to pick up felt-tipped markers, gas filters, curved plier blanks, L-shaped shafts, ball bearings and "a mixture of semi-rusted, threaded and unthreaded bolts of various lengths."

Adequate light and an object's reflectivity are important but not critical, GE's Jenson explains: "In an application with severe lighting deficiencies, infrared lighting can be used." As more developed algorithms make vision systems capable of adapting to various levels of light, "lighting will become less and less of a concern," ORS' Artley contends.

Both BinVision and i-bot 1 can store data about several parts in memory. Without reprogramming, both systems can adjust to changing product lines and can work from an array of bins of different parts—a capability essential for assembly.

In the two GE applications, for example, both the bins and the conveyor hold two sizes of metal slugs. The BinVision system receives commands from a central controller to retrieve one part or the other and present it to an assembly robot. The part order is random, depending on the assembly robot's needs.

Although neither bin-picking system uses computer-aided design (CAD) data to recognize parts, it is a logical step in highly integrated facilities. However, even though CAD data describe parts in ways understandable to computers, vision systems can't use the data without conversion. SRI is configuring algorithms that automatically enhance CAD data with comprehensive, redundant lists of features. For example, a dihedral edge would appear—in memory—on lists of dihedral edges, lists of angles and lists of the features of each plane the dihedral edge defines.

Users must still manually "train" vision systems. To do this using BinVision or i-bot 1, an operator enters simple, basic parts information as instructed by a menu. The operator then places a part in a prearranged series of poses, which the system's camera records and stores. Control parameters, such as dimensional variability, can be assigned during training. Both GE and ORS claim the process is simple and brief.

Most industry observers expect the bin-picking market to be small in comparison to overall markets for machine vision and robotics. Companies in the market early will dominate it, believes Gerry Michaels of

Without reprogramming, both systems can adjust to changing product lines and can work from an array of bins of different parts—a capability essential for assembly.

Arthur D. Little Inc., Cambridge, Mass: "The first company with equipment that works and is accepted will have a strong position." Although GE and ORS introduced equipment first, observers don't expect those companies to hold the market exclusively. Companies with machine-vision expertise stand out as other potential participants. Robot Vision Systems Inc., Melville, N.Y., for example, has been working with Lockheed-Georgia, Marietta, Ga., on a bin-picking application, and Ford Aerospace and Commmunications Corp., Newport Beach, Calif., is researching shape-matching for 3-D objects. Automatix, Billerica, Mass., has produced 2-D vision systems that can handle touching, overlapped and partially occluded parts—which is not a very different process from bin picking.

Growth of the bin-picking market depends on improvements in cost, reliability and capacity of the system electronics. But as machine vision in general benefits from research and factory experience, so will bin picking, says John White, director of the Material Handling Research Center at Georgia Institute of Technology: "If the only application of vision were bin picking, it would not have a sufficient market to get the price down. But the totality of all vision-based applications will." Richard Miller, a Madison, Ga., factory-automation consultant, also contends that the high cost of bin-picking systems is a temporary constraint. However, the market for bin-picking robots faces an inherent contradiction: as factories become more automated, integrated and disciplined, the demand for robots that can handle unstructured parts may begin to decrease. And bin-picking robots may become obsolete. □

Dan Edson is a Cambridge, Mass., science and technology writer.

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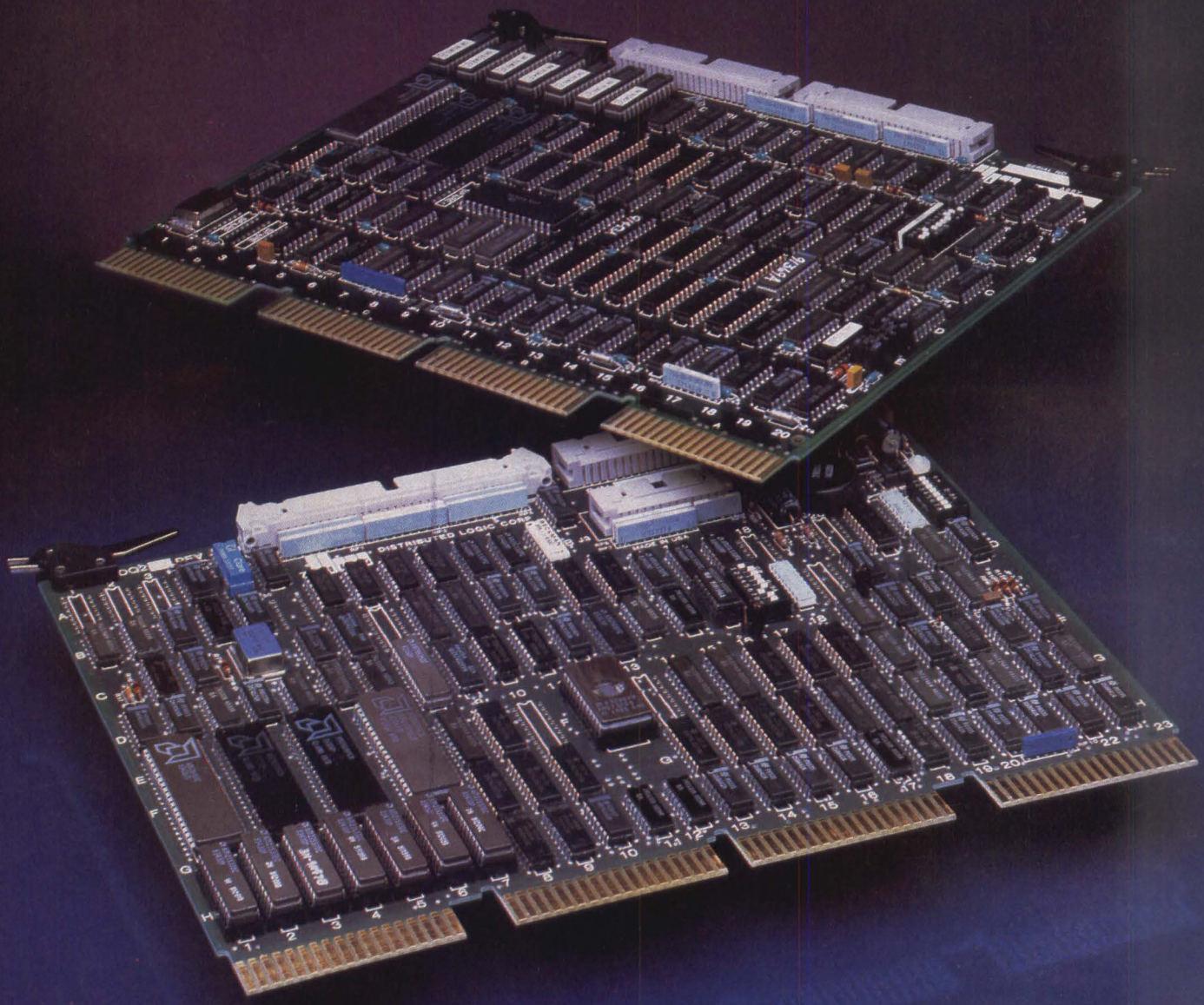

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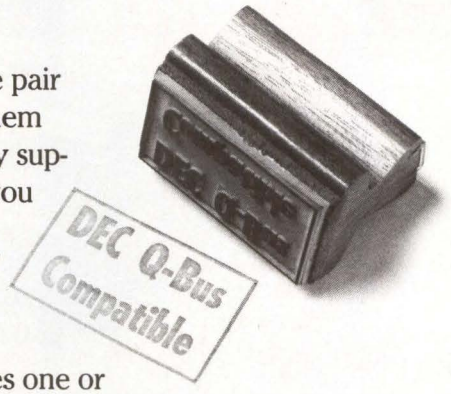

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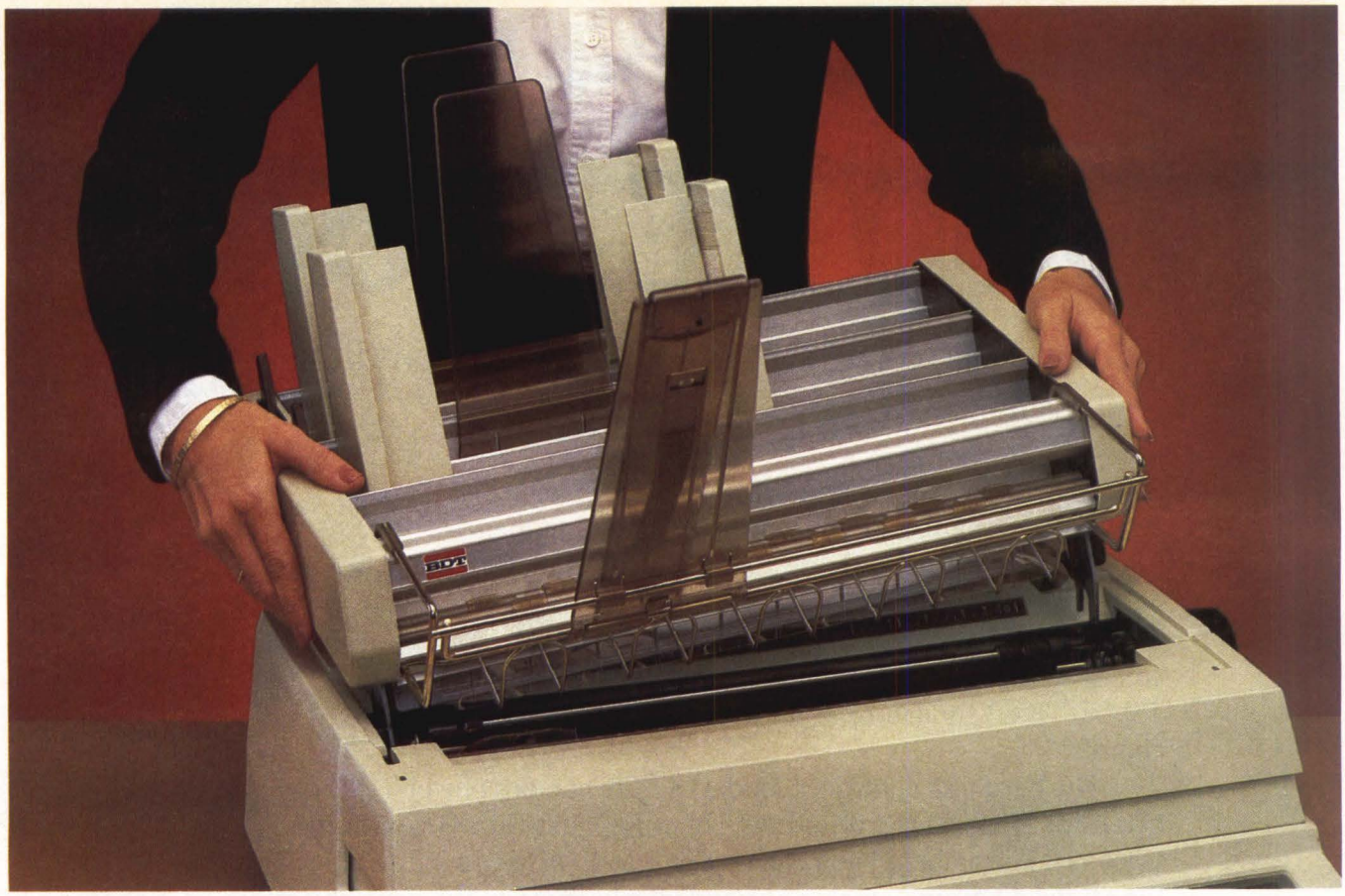

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CIRCLE NO. 68 ON INQUIRY CARD

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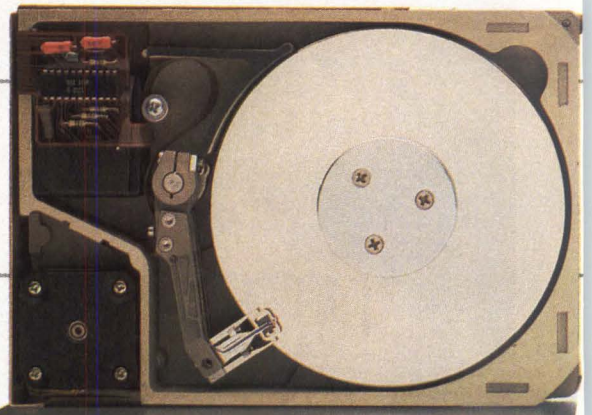

OEMs face major problems trying to decide which hard disk drives to build into their microcomputer systems. What with the wide range of drives, and so many hidden costs associated with evaluation, testing and integration, the process becomes a time-consuming and costly hassle.

But there's a way out—from the company that's helped solve OEM disk controller integration problems more often and over a longer period of time than anybody in the business. That company is Xebec.

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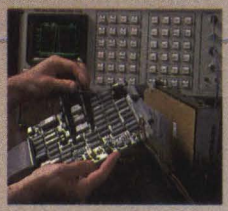
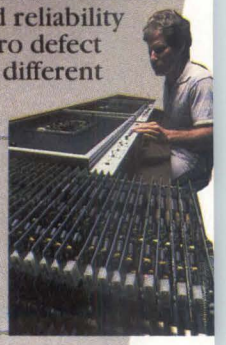


Tested Pairs. The Guaranteed Match.

With its new tested pairs program, Xebec solves a major industry problem: post-delivery drive failure when interfaced to the controller. Having to do "after the fact" drive testing for many of our OEM customers, we have decided to offer a "before the fact" program. We'll guarantee quality and reliability by assuring a match between our zero defect controllers and a choice of drives in different capacities and form factors.



It's simple. Tell us which drives you're considering and we'll test them on Xebec-designed equipment against the most rigorous standards in the industry. Standards we at Xebec have set. Then we'll tell you which of our controllers is the best match for that drive—or we'll customize a controller for you—and accelerate your time to market.

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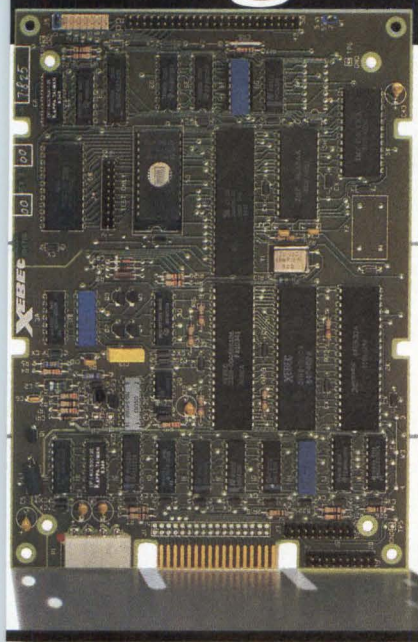

And The Pairing.

command set and other performance and reliability features.

Now these superior controllers can be paired with high-quality, Xebec-qualified drives. And you save time and money on evaluation engineering, incoming inspection, and service—while gaining a single-source, single purchase order solution to disk drive integration.

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Xebec can offer its tested pairs service to OEMs because of our commitment to quality. Zero defect quality symbolized by our "Xero D" signature and demonstrated by our superior computer-aided design, manufacturing and testing. Our talented people. Our experience. That's *how* we can provide high-quality products for prices no more than products that deliver a lot less.

Why offer our tested pairs? Why originate a new concept in quality? Enlightened self-interest. Because if we don't, someone else will. Frankly, we want to continue to enjoy the benefits of our leadership position as much as our customers do.

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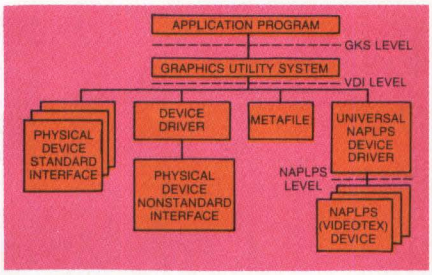
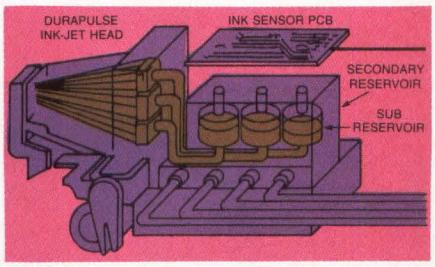
FEATURE HIGHLIGHTS

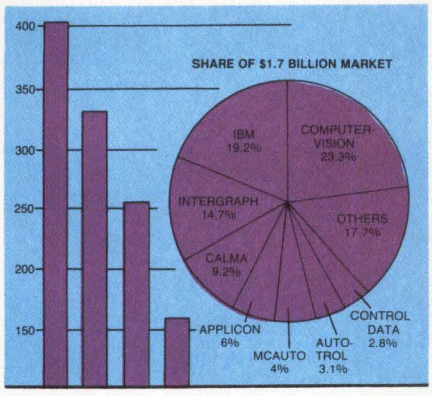
DIGITIZERS: Integrating a microprocessor-based video digitizing system that produces high-quality images need not be expensive. A slow-scan sampling digitizer residing on one printed-circuit board can work with the host system's processor to produce broadcast-quality images—for a total systems cost of about $10,000. Cromemco Inc.'s SDD sampling digitizer makes this technology cost-effective for many new applications and significantly lowers the cost of integrating digitizing systems. The story begins on **p. 144.**



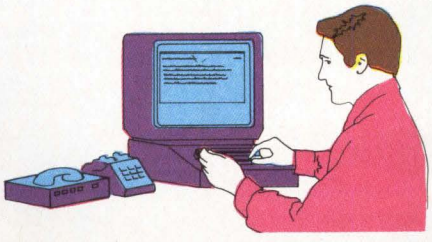
GRAPHICS SOFTWARE: The trend toward establishing libraries of prewritten device drivers is causing software writers to seek a common foundation. Under scrutiny now are the Graphical Kernal System (GKS), proposed by the ANSI committee on computer graphics (X3H3) and the North American Presentation Level Protocol Syntax (NAPLPS), also proposed by ANSI in concert with the Canadian Standard Association. Some seek standard formats, but not everyone says an established standard will be easily assimilated. For more information, see **p. 163.**



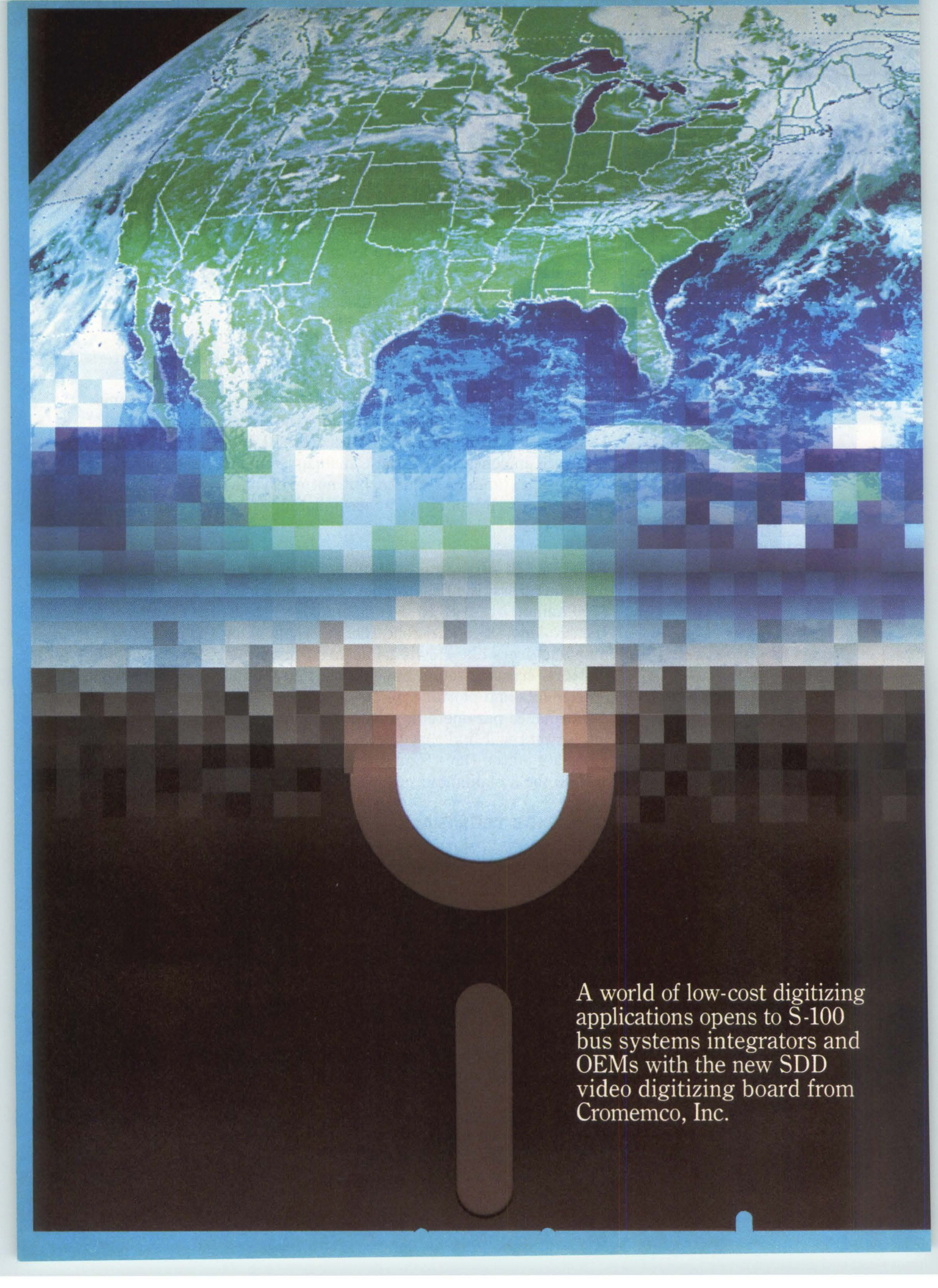
PLOTTERS: Already a $100 million industry with more than 30 manufacturers, the desktop plotter market is expected to top $500 million by 1988. New companies such as Enter Computer Inc., Roland DG and Strobe Inc. are challenging the large manufacturers like Hewlett-Packard Co. with less-than-$1,000 plotters, creating tough buying decisions. Application requirements and plotter type need to be considered, as well as performance parameters, software availability and cost. System integrators will find that task easier if they turn to **p. 185** for associate editor Dave Simpson's plotter survey, and then to **p. 199** for a manufacturers' product list.



GRAPHICS TERMINALS: MMS presents a comprehensive product survey, starting on **p. 223.** Senior editor Paul Sniger provides an overview of CAD/ CAM/CAE graphics display terminals, which now offer higher speeds, upward compatibility and increased performance at lower prices. A manufacturers' product list, beginning on **p. 235,** surveys the entire graphics terminal market, and a directory of manufacturers appears on **p. 251.**



DATA COMMUNICATIONS: Callback security systems are probably the least penetrable method of protecting a computer system's data from unauthorized access over telephone lines. The older digital systems, however, permitted an extended exchange of dialogue that enabled unauthorized callers enough time to "play" with the system. An analog secure-access-multiport (SAM) unit produced by security equipment manufacturer LeeMAH eliminates many of these limitations. See **p. 257** for details.



A world of low-cost digitizing applications opens to S-100 bus systems integrators and OEMs with the new SDD video digitizing board from Cromemco, Inc.

Sampling digitizer produces broadcast-quality messages

A low-cost video digitizing system serves varied process-control, medical- and weather-imaging and typed-text applications

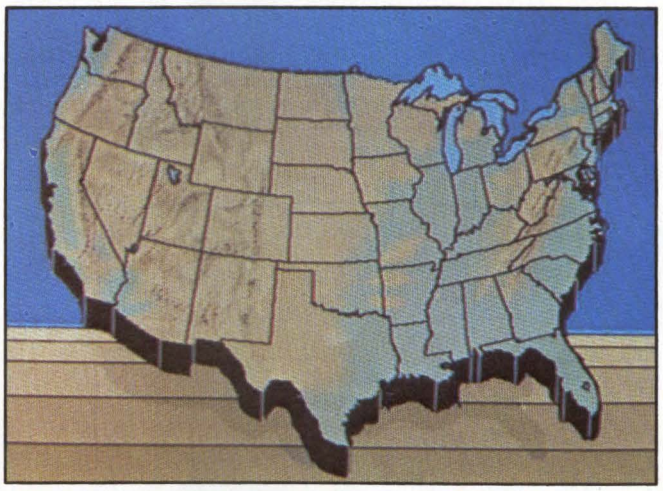
Chris Rook, Cromemco Inc.

Integrating a microprocessor-based video digitizing system that produces high-quality images need not be expensive. A slow-scan sampling digitizer residing on one printed-circuit board can work with the host system's processor to produce broadcast-quality images—for a total system cost of about $10,000. Sampling digitizers, such as Cromemco Inc.'s SDD board, make digitizing technology available for applications that formerly were not cost-effective and significantly lower the cost of integrating digitizing systems.

Before taking a look at a complete digitizing system, consider how a sampling digitizer works—in this case, the SDD board. The board accepts a standard National Television Standards Committee (NTSC) composite video input from sources such as a video camera, laser disk or videotape. The NTSC signal includes luminance (intensity), chrominance (color) and synchronization information, encoded in analog form. The digitizer must synchronize with the source's signal and take enough samples of the video's luminance and chrominance levels to build a complete image.

Synchronization is one of the most critical parts of the digitizing process. Because the NTSC input is in analog form, it isn't always easy to detect the synch pulses that designate the end of each scanned line or field (half a complete scanned image). This problem is especially serious with signals from sources such as videotapes and laser disks, where synch pulses can be degraded or even eliminated. The digitizer must therefore compensate for these low-quality signals by providing an accurate internal synch capability.

As the NTSC signal flows in, the digitizer separates the synch and luminance/chrominance information. Starting on the first video scan line, it samples that line's analog signal one or more times at evenly spaced intervals. It continues this process for all succeeding lines of the video image. When all lines have been sampled, the sampling process begins again, but this time the board samples pixels just to the right of those sampled on the first pass. It continues until all the image's pixels have been sampled and digitized by the board's analog-to-digital converter (Fig. 1). Because they don't sample and digitize all of an image's pixels on the first pass, sampling digitizers require that the source image remain constant until all the pixels have been processed.



Serving meteorological and television weather-forecasting applications *in digitizing systems, the SDD color digitizer board can combine converted satellite images with graphics overlays. (Photo courtesy of Colorgraphics Systems Inc.)*

Because they require fewer components, sampling digitizers are less costly to manufacture than flash digitizers that process an image in one pass. The trade-off is that they cannot work as fast as these units. Sampling digitizers' speed depends, to a certain extent,

on the host processor system and on the nature of the image being digitized. Working with 256 gray levels and 242-by-384-pixel resolution, the SDD can digitize an image in 1.07 seconds when tied to a 16-bit 68000 host microprocessor. That time doubles with an 8-bit Z80.

The host processor has a greater effect on digitizing speed when the image has more gray levels and/or colors. For example, to produce a full palette of 4,096 colors with 16 gray levels and 484-by-768 pixel resolution, a 68000 host requires 6.4 seconds compared to the Z80's 25.6 seconds.

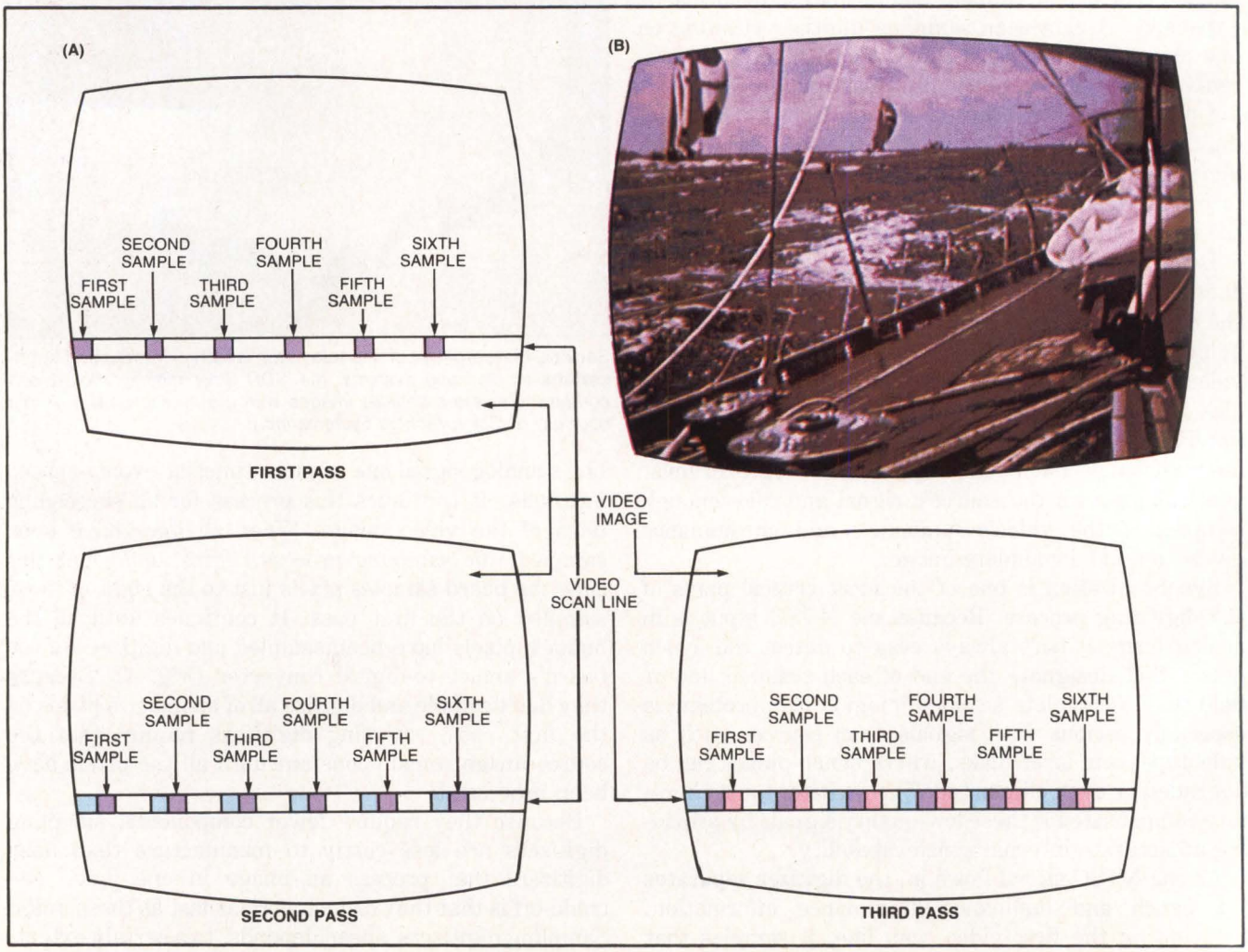
System integrators can compensate for a host processor's inability to keep up with the digitizing process by adjusting the number of samples per line made by the digitizer. A fast host such as the 68000 allows the SDD to take 12 samples per line. At this rate, the SDD must make 64 passes through a 768-pixel horizontal resolution image to digitize it fully.

Other SDD characteristics that can be software-controlled include video tint, chrominance, input gain, level control, DC restoration of black level, gamma correction and pixel color assignments. Because control of these features is necessary to ensure a good digitized image under varying conditions, it's important to consider them in detail.

Video tint, chrominance and input gain govern the appearance of the digitized image. The controls are similar to those available on color television receivers. Tint determines the hue of the pixels and can be shifted toward red or blue to adjust the color balance. Chrominance specifies the saturation of the colors set by the tint control; removing all chrominance produces a black-and-white image. The input-gain control adjusts contrasts.

Level control compensates for image intensity and has both an automatic and a manual setting. Automatic level control (ALC) works in much the same way as its audio equivalent in a tape recorder. It enables the

Fig. 1. A sampling digitizer, *such as Cromemco's SDD board, uses several passes to sample a complete video image. On each pass, it samples pixels on a video scan line to the right of those it sampled in a previous pass (A). By sampling the video image many times, it builds a complete scene (B).*



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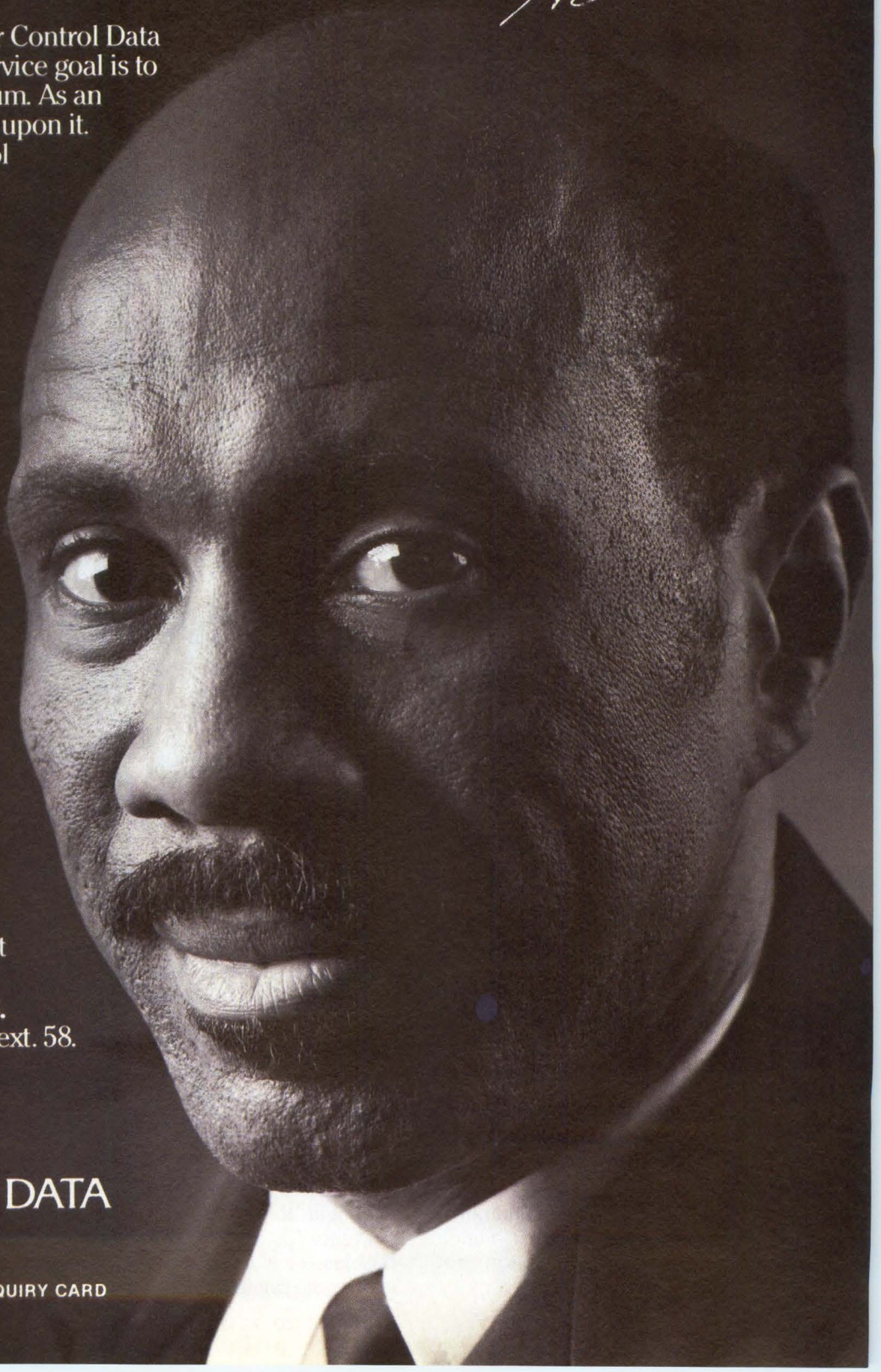

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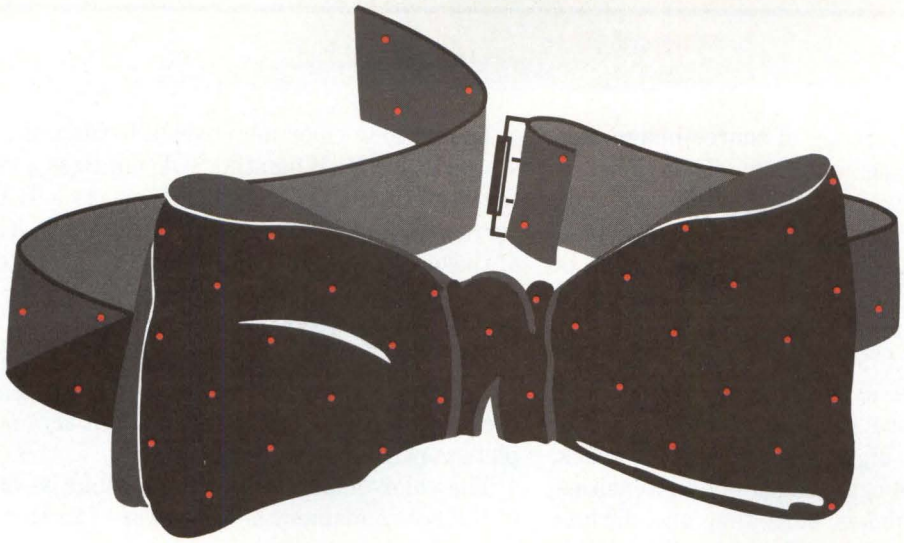

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digitizer to process a wide range of source-image light levels, regardless of lighting conditions. Thus, a bright image source or a relatively dark one emerge with approximately the same overall intensity. A manual setting overrides the ALC, so that images can be adjusted to represent more accurately the varying intensity levels within a single image or in a sequence of images.

DC restoration of black level can be turned on or off via software. This feature ensures that the darkest pixels in an image are digitized as absolute black. Because the ALC, in effect, averages pixel intensities, the restoration circuit makes sure that the darkest pixels in the range are firmly anchored in black. Without this control, the video signal could drift away from a level of true black.

Another software-controlled characteristic, gamma correction, is necessary because a CRT's electron gun does not produce an increase in image intensity exactly proportional to increases in driving voltage. The SDD's gamma circuit adjusts intensity levels to compensate for the problem so that displayed image intensity corresponds to the source image's intensity.

Color map assigns pixel values

The assignment of colors to individual pixel values is accomplished under software control through the board's inverse-color map. A red pixel in the original scene does not have to be red in that scene's digitized version. The inverse color map can specify a blue pixel, for instance, whenever it encounters a pixel code that means red in the original scene.

Being able to assign any given color to incoming pixel values has two advantages. It provides an image-processing capability that can enhance aspects of the image. And it permits a system integrator to match the digitizer's color output to the capabilities of the video display system. If the video interface can handle only 16 colors, for example, the digitizer assigns only 16 pixel color codes to the image.

The inverse-color map uses a hardware lookup table stored in RAM. When the SDD digitizes a video image, the resulting pixel code functions as a RAM address corresponding to a unique RAM location. The contents of these locations act as the digitizer's final output. The digitizer produces pixel values directly from the source image and uses those values to address the inverse-color map, whose contents determine the digitizer's color output. Because any color value can be loaded into the inverse-color map, sampling digitizers provide complete control over an image's color.

The color-mapping procedure could be implemented in the host's memory as a software function. However,

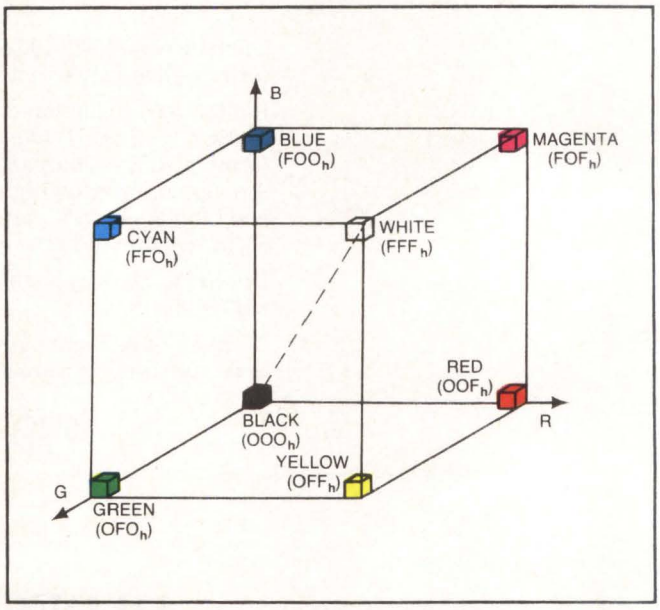

Fig. 2. An inverse-color map *allows the assignment of color values, not necessarily those in the original scene, to a video image. In this simplified representation, each of the 4,096 colors (pixel values) that the SDD digitizer produces is represented by a cell (and a hexadecimal pixel value) in a 16-by-16-by-16-cell cube. Each cell represents a unique mixture of the red, green and blue (RGB) color components used by an RGB color monitor for its display. The hexadecimal pixel value OFF, for example, addresses the pure yellow cell, a visual mixture of red and green.*

Spec summary

- **Product:** SDD color digitizer board
- **Manufacturer:** Cromemco Inc., 280 Bernardo Ave., Mountain View, Calif. 94039
- **Input signal:** RS170A composite National Television Standards Committee color video or RS330 black-and-white video
- **Maximum input image resolution:** images with as much as 754-by-482-pixel resolution can be digitized using standard TV camera and SDD interfaces
- **Maximum digitizing resolution:** 8 bits per pixel
- **Operating modes:** unprocessed composite video input, red video component, green video component, blue video component, composite color conversion with inverse-color map lookup
- **Sample rate:** One, three, six or 12 samples per horizontal image line
- **Processor output-control ports:** input gain level, chroma, tint, inverse-map data, digitizer operating mode and source control, strobes/line and delay setting
- **Bus:** S-100
- **Price, delivery:** $995, delivery from stock

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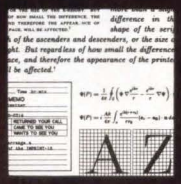
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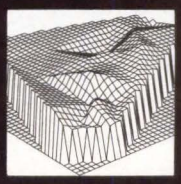
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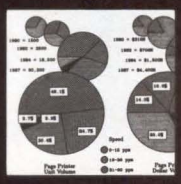
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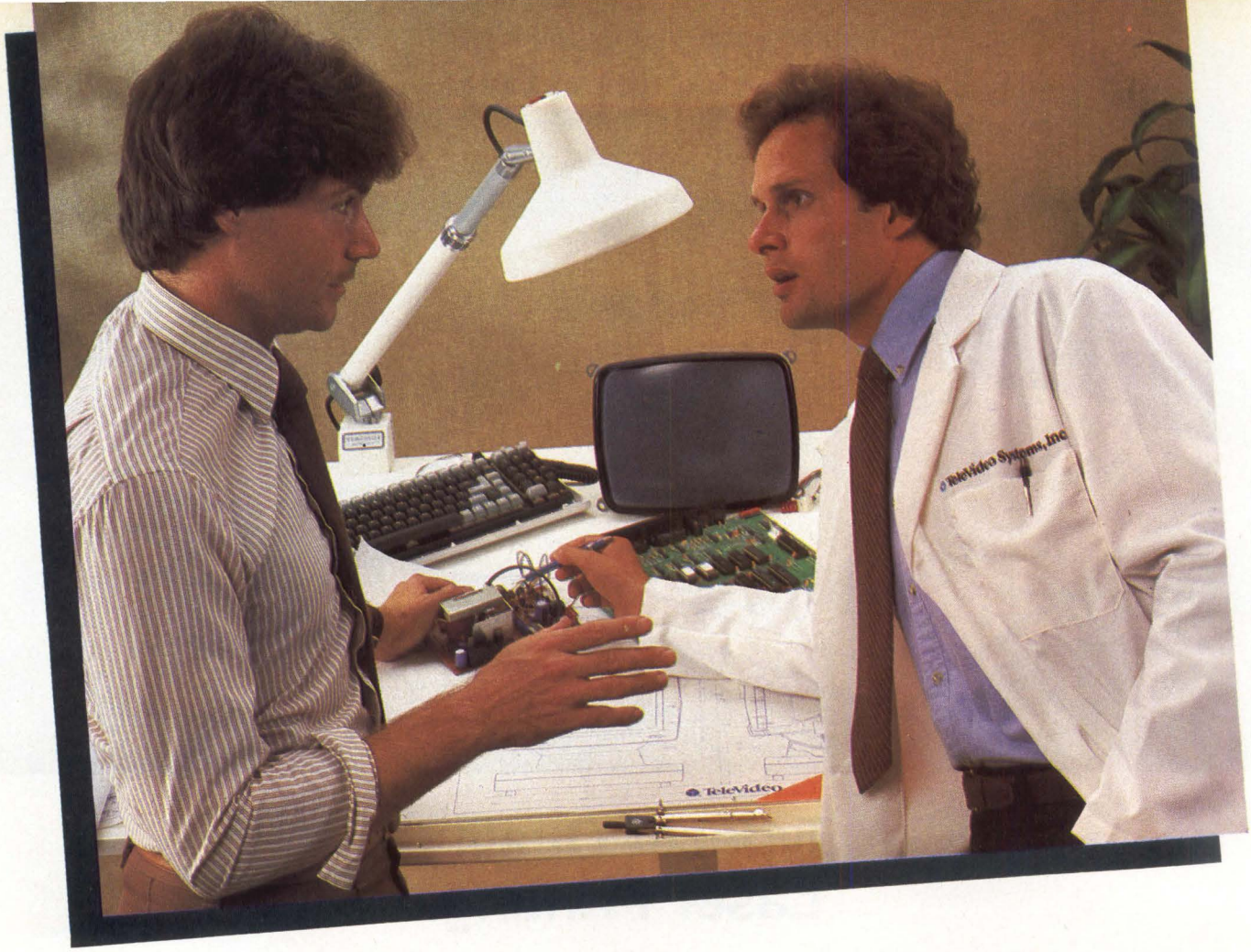

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digitizers that use a hardware map furnish the benefits of a high-speed color assignment under software control.

Considering the color map as a 16-by-16-by-16 cube rather than a 2-D array makes the assignment of color values easier to visualize. Each pixel value (color) that can be produced by the SDD corresponds to a cell in the cube (Fig. 2). For example, a hexadecimal pixel value of OFF would address the pure yellow cell. To obtain true color, that location must be filled with an 8-bit code that produces yellow in the final display.

With a display system that handles only 16 colors at a time, the parameters of the image can be tested by trying out different color values. The mapping used depends on the application. For digitizing flesh tones, blue pixel values can be ignored. Most general imaging applications need values set for white, black, two gray levels, six bright primary colors and six dim primary colors. Assigning white and black values is straightforward; most colors require some experimentation.

The SDD board functions in systems that adhere to the IEEE-696 (S-100 bus) standard, but the board is optimized to function with the video system components shown in Fig. 3. The host processor moves data from the digitizer to the two-port graphics memory at appropriate times. Software monitors the synch signals from the SDD to determine when the digitized data is ready. Because the sampling process generates pixels out of their correct order in the sampled image, the program counts the synch pulses to recognize where a pixel fits into the final image. The system's video interface retrieves the pixels in their proper order from memory and displays them on the monitor.

Other sampling digitizers might require a different system configuration. Some units lack an internal facility for assigning pixel color values, requiring that function to be performed in software. Other digitizers incorporate their own processor and memory to simplify the host-system interface and reduce host overhead. This increases their cost, however, and, unless they also provide a direct video interface from the digitizer's memory to display memory, the system must still transfer pixel data from the digitizer's memory to the display memory.

System integrators should give careful consideration to digitizer-video interface compatibility. The pixel aspect ratios (the relationship between vertical and horizontal resolution) of the two devices must match—or at least must be made to match by software modification. For example, if a digitizer generates a 484-by-768-pixel image, and the video interface is designed to display 242-by-384-pixel images, half of the pixels must be discarded. Because the aspect ratios match, this is a simple task, even though the actual pixel counts differ.

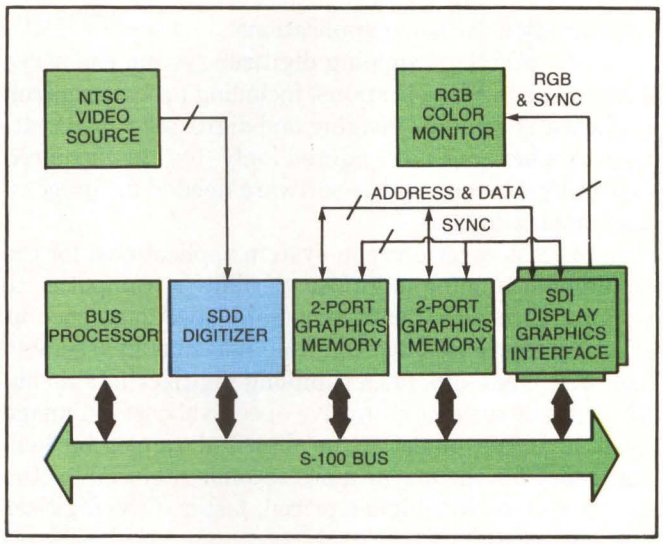

Fig. 3. A typical sampling digitizer system configuration *includes the digitizer board, the bus processor, the graphics memory, the graphics display interface, the NTSC video source and the RGB color monitor. This diagram shows the SDD board in Cromemco's CDOS S-100 bus computer. The graphics memory used with the SDD has two ports to keep the flow of data from overwhelming the bus.*

Difficulties arise if the video interface must cope with an image of 640-pixel horizontal resolution. A software procedure could map the digitizer's 768-pixel output onto the interface's 640-pixel display, but it would be a cumbersome, non-linear procedure. It is far easier to use a compatible video interface in the first place.

Graphics overlay live video images

The SDD can use the system configuration (Fig. 3) to overlay computer graphics on live video images—a capability that proves useful for a variety of special effects and applications. The process uses only the SDD board's analog circuitry; the digitizing circuits are not involved.

In producing overlays, the board converts an NTSC video source into real-time red, green, blue and synch components. A two-port RAM controlled by the video interface stores the graphics to be overlaid. Synchronized with the timing signal from the SDD, the system mixes the stored graphics pixels and the real-time video images, giving priority to the graphics.

This priority is implemented using a control line from the video interface to the SDD. The line disables the SDD's real-time output whenever the interface reads a pixel color code from graphics memory that does not begin with zero (denoting a non-background color). As a result, the graphics image appears as foreground; the real-time video image, as background. Because the SDD and other components with which it works conform to Federal Communications Commission standards, the real-time video signal with overlays can be sent directly to broadcast equipment—an important

consideration for some applications.

A cost-effective sampling digitizer system can serve a broad range of applications, including process control, medical and weather imaging and digitizing typed text. Such applications are limited only by the required digitization speed and the software needed for processing complex images.

In process-control vision-system applications, for example, a sampling digitizer permits a computer to perform automatic quality-control inspections, such as checking tolerances and counting parts on an assembly line. The trade-offs for a sampling digitizer in a manufacturing environment involve speed vs. cost vs. image quality. If the object to be digitized cannot be held stationary for the one or more seconds required for the digitizer to work, a higher-priced, faster, flash digitizer must be used.

Consider a typical inspection operation, in which fairly simple objects on an assembly line must be inspected to ensure they conform to very tight dimensional tolerances. Inspectors could measure the critical dimensions of each object by hand, but it would be a tedious task, with inherent human error. Some manufacturers achieve excellent accuracies by sighting lasers along critical dimensions. Using lasers for this type of application incurs a significant drawback, however: in addition to the objects themselves, they measure the tolerances of whatever the object is resting on. For objects on a conveyor, any variation in the conveyor's height is thus indistinguishable from variations in the object's dimensions.

A sampling digitizer can solve this problem by detecting only an object's edges, so that only the object itself is measured. The accuracy of the measurement depends on the number of scan lines covering the object. Using 400 scan lines to cover a 1-inch bolt produces a resolution of $\frac{1}{400}$-inch.

For checking only the shared outer edges of such objects, a large number of bits per pixel specifying gray scale or color probably isn't necessary. Usually, 1 bit per pixel will suffice. In complex environments, color might be necessary to differentiate an object from its background. Detecting tolerances in joined parts requires more bits per pixel. These applications demand greater time for digitizing and processing the results in software. System integrators should therefore carefully evaluate the cost/digitizing time/image-quality trade-offs involved.

Image quality proves important

In other digitizer applications, digitizing speed is less crucial than high image quality. Medical applications, including standard X-rays and computer-aided-tomography scans, which can often benefit from image processing to highlight certain features of the image, are not generally real-time activities. They do, however, call for the high resolution and the large number of bits per pixel (at least 8) that a sampling digitizer can provide.

A sampling digitizer can also prove effective for weather or topographical imaging, in which quickly changing images are not the rule. The conversion of satellite or serial-photograph images into usable form is a primary application. The SDD permits a satellite image to be overlaid with outlines of geographical features, pertinent symbols and text. The entire process can be performed and broadcast live as the satellite data is received or stored on disk for later use.

Finally, consider the conversion of typed text into a form that can be read and stored on computer. Here again, digitizing speed is not a crucial parameter. Furthermore, it's inefficient to simply store a digitized image of text without converting it to machine-readable form. Even with a good compression technique, an 8½-by-11-inch sheet of paper requires at least 20K bytes of storage, compared to about 6K bytes for storing converted text.

When considering text-digitizing applications, system integrators should also keep in mind that the NTSC video standard furnishes barely enough resolution to handle an entire 8½-by-11-inch sheet legibly. When converting an image to machine-readable form, the conversion algorithm must consider gray levels as well as solid black, which complicates the process.

Engineering paper-to-computer processing applications can also benefit from cost-effective digitization. A computer-aided-design system, for example, might convert engineering drawings done by hand to a form that could be manipulated by machine. This application requires the system to analyze vectors and convert X-Y coordinates. Because engineering drawings are usually large, the system would have to digitize a drawing a part at a time and correctly reassemble the parts.

In a more speculative and specialized application, a sampling digitizer could digitize images from a telescope and compare the results with stored images of the same section of sky. Such comparisons could detect any changes among thousands of stellar objects before a human observer could achieve the same result. □

Chris Rook is product marketing manager of Cromemco Inc., Mountain View, Calif. He holds a bachelor's degree in computer science from the University of California at San Diego and a master's in business administration from the University of Santa Clara, Santa Clara, Calif.

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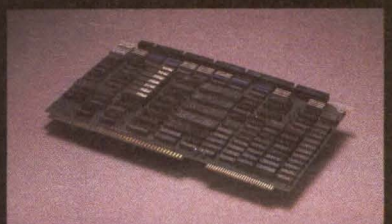

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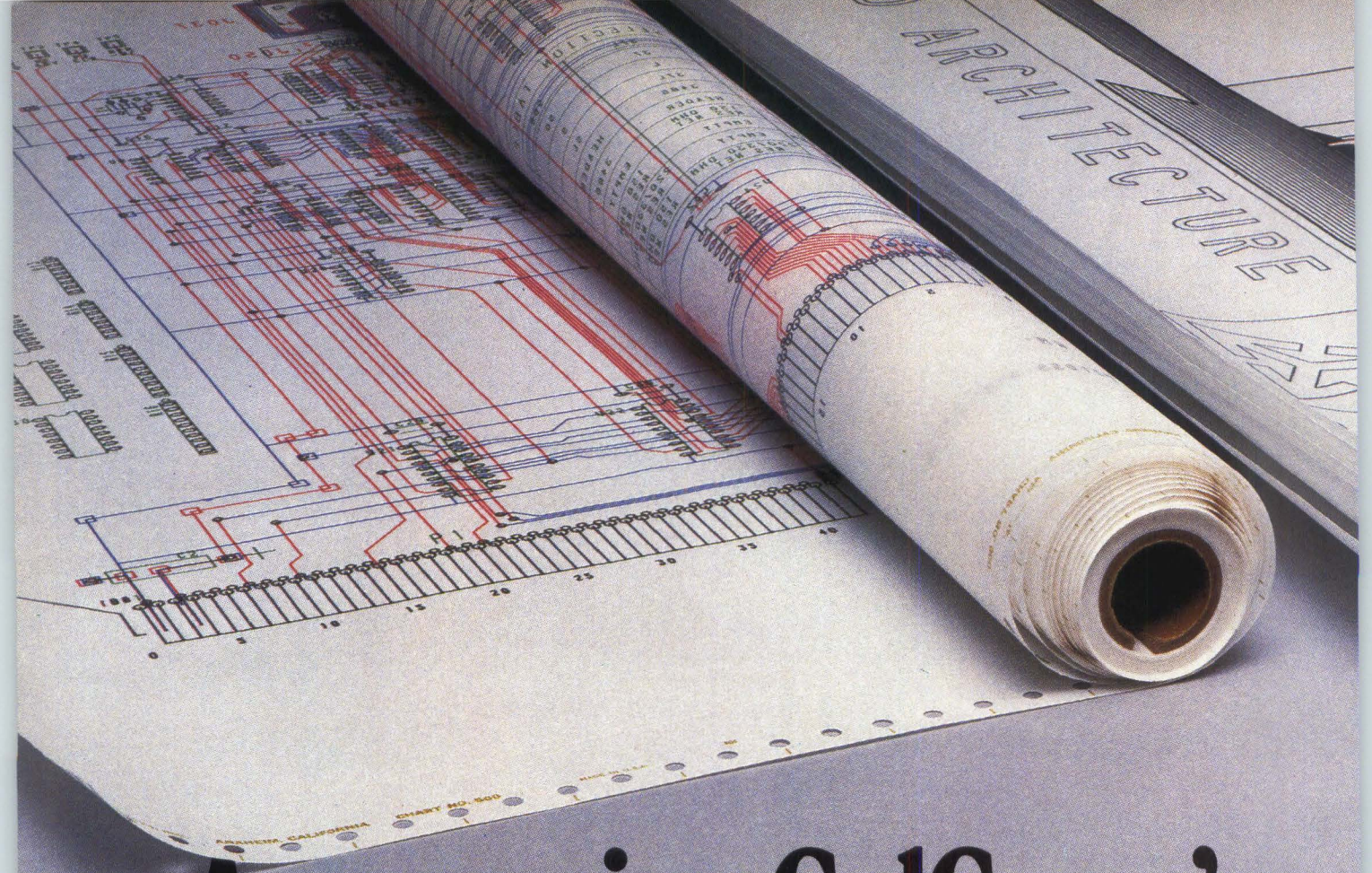

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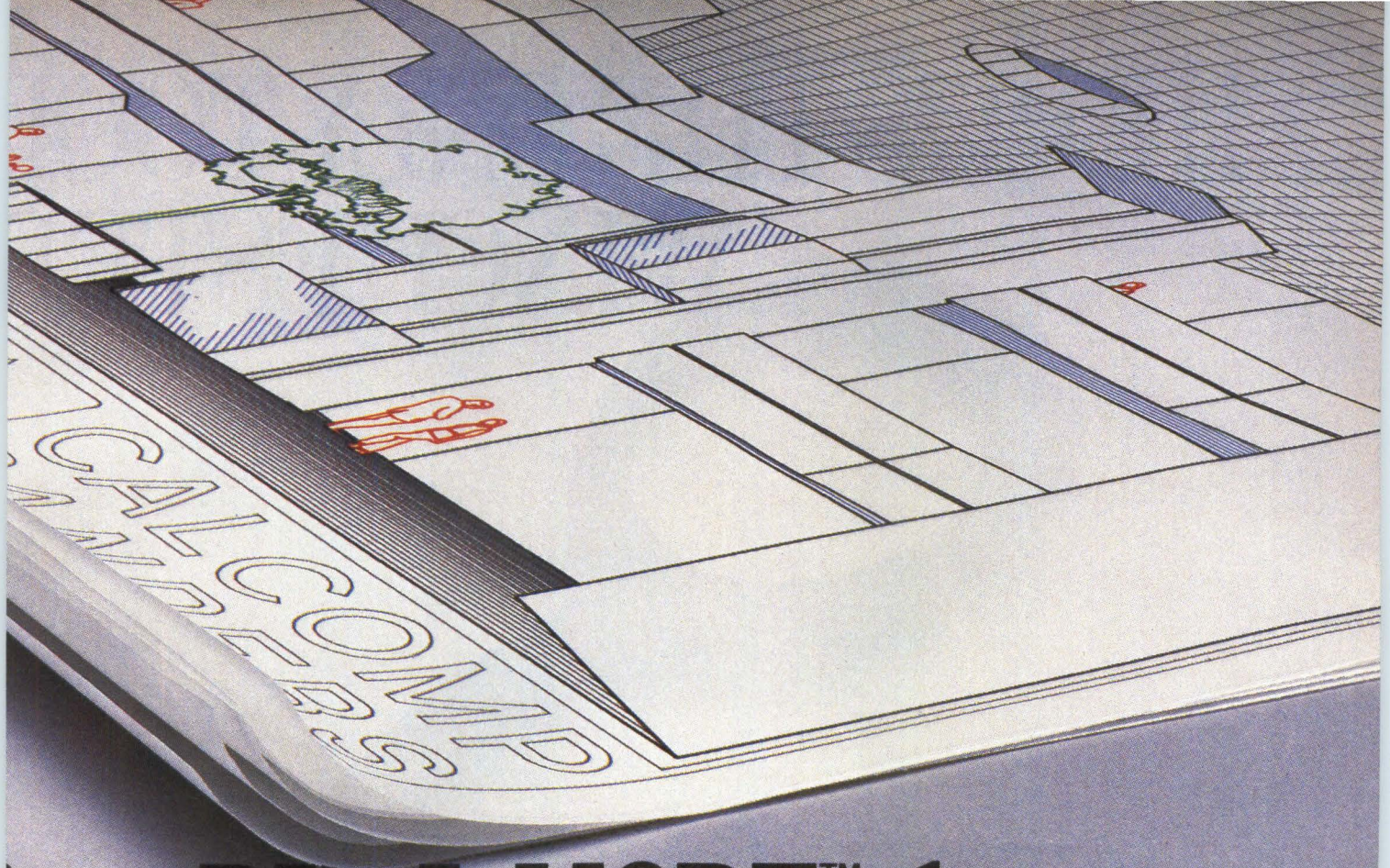

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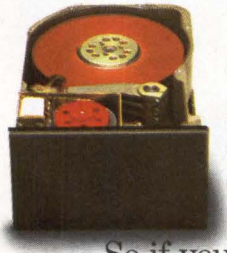

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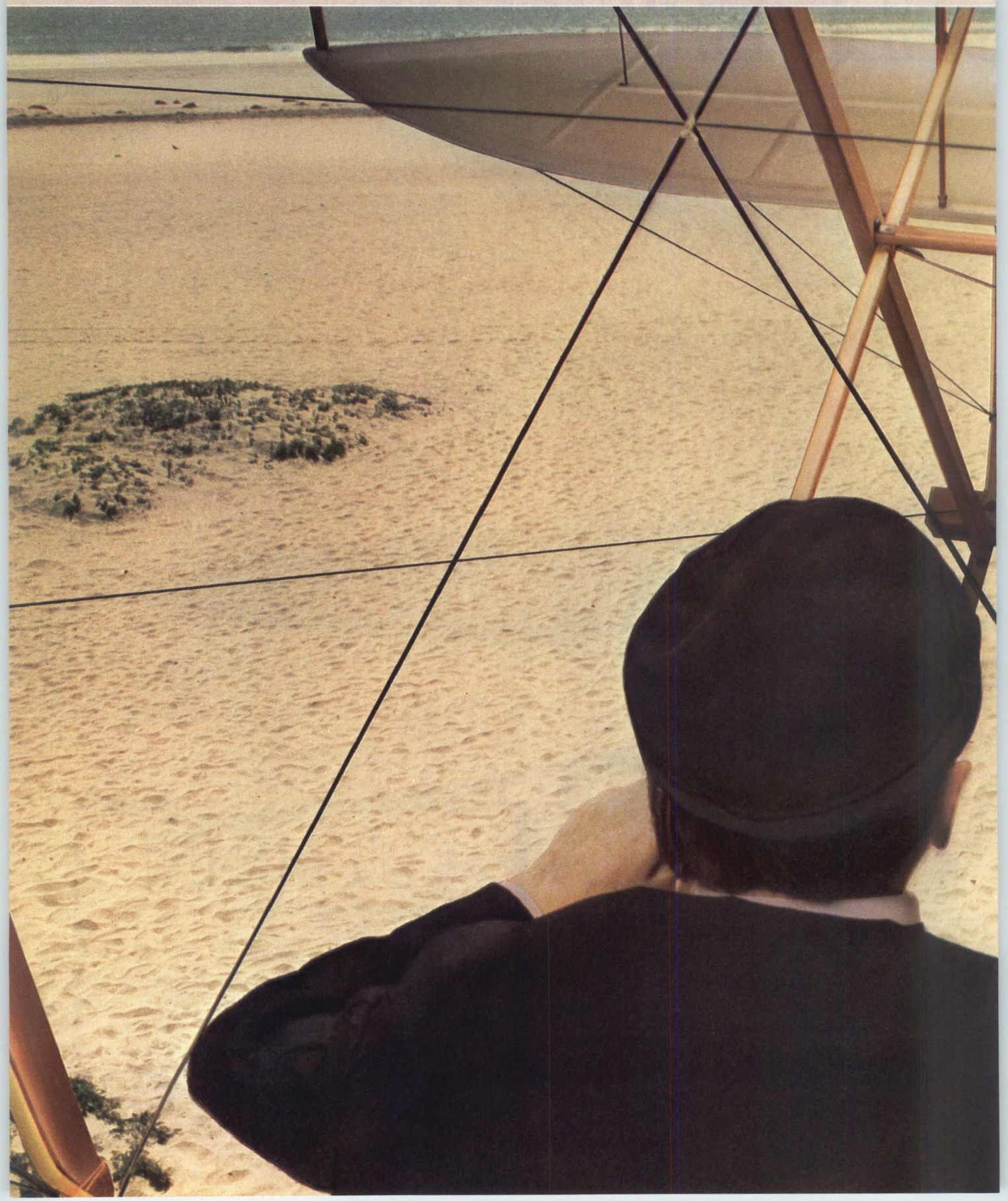

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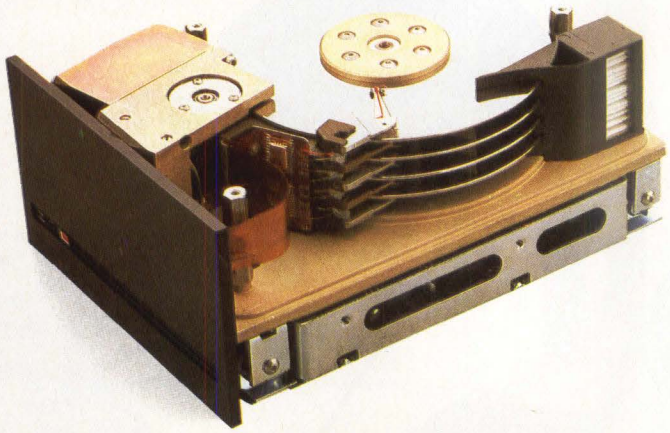

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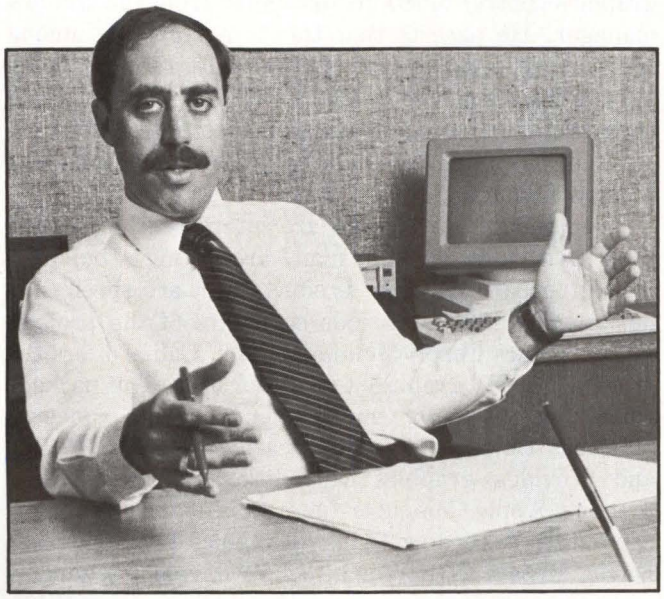
Graphics software schemes enhance peripheral interfacing

Graphics standards establish a middle ground to ease peripheral-to-system integration; pre-written device drivers optimize the task

Carl Warren, Western Editor

Software vendors and system integrators no longer have to be burdened with writing device-dependent drivers every time they add a new system peripheral. The reason? Libraries of optimized-shoe-box device drivers are now available from several vendors.

The trend toward establishing libraries of pre-written device drivers is causing software writers to seek a common foundation. These writers are examining the Graphical Kernel System (GKS), proposed by the American National Standards Institute (ANSI) committee on computer graphics (X3H3), and the North American Presentation Level Protocol Syntax (NAPLPS), also proposed by ANSI in concert with the Canadian Standards Association (CSA).



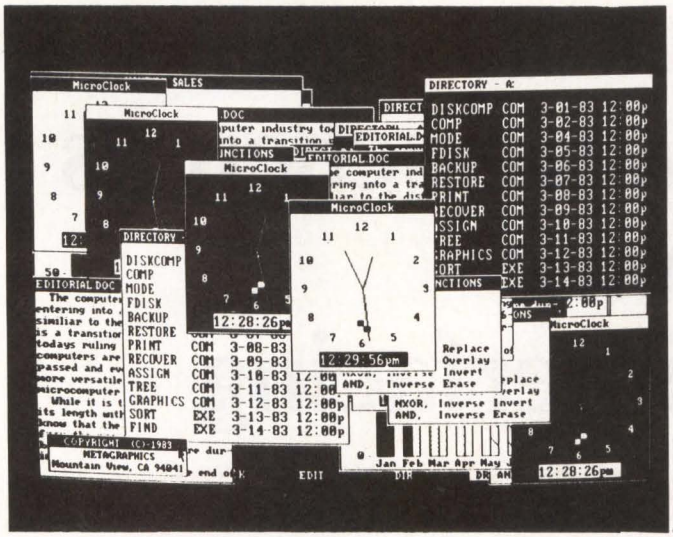
Syte president Peter J. Shaw *isn't necessarily against standards but believes they are more for technology-poor companies and can inhibit a technology-rich company from flexing its creative muscles.*

Tailoring the standard

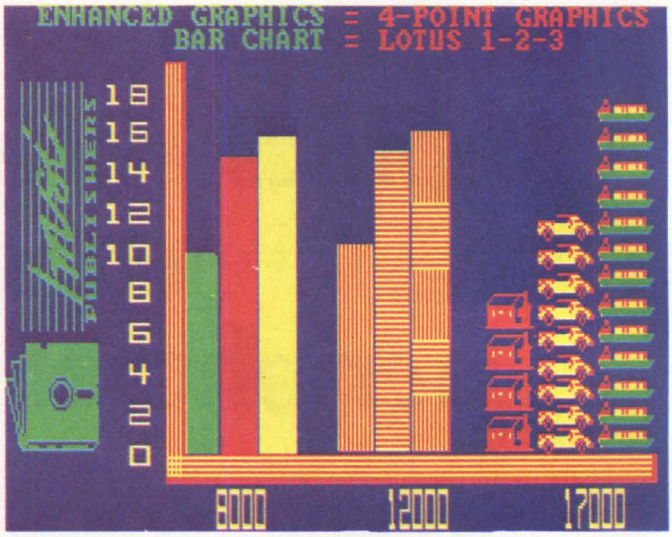
Standards may prove to be the common ground, but not everyone is willing to admit that an established standard will be easily assimilated. Most developers and system integrators contend that standards are fine as long as they are used primarily as guideposts. Most vocal on this subject is Syte Information Technology Inc. president Peter J. Shaw: "Standards are great for nuts-and-bolts and technology-poor companies. They can be a hindrance to a technology-rich company and prevent it from flexing its creative muscles. I'm not saying that standards are bad; rather, they shouldn't be restrictive. It's better to view them as a common ground for systems supported by multiple vendors."

David Wilcox, vice president of sales for Graphic Communications Inc. (GCI), Waltham, Mass., says standards "have to be tailored to match the peripheral. We don't really want to sacrifice any of the capabilities of the subordinate device, so our libraries allow for a rich command set to be implemented. But we remain true to the standard as well." The standard Wilcox refers to is the Virtual Device Interface (VDI) defined in GKS and implemented by Microsoft Corp. in MS-Windows.

Currently, GCI is working closely with Microsoft to



Metagraphics' MetaWINDOW software *is a bit-mapped tool for the IBM PC and similar computers. Fast bit-block transfers (BITBLT) are possible; a user can create icons and pull-down and pop-up menus.*



Coupling fine-line graphics *to the display device and outputting to a hard-copy device such as the Diablo Systems Inc. ink-jet printer, IMSI's four-point Graphics provides maximum flexibility for OEMs by offering a wide range of device drivers.*

develop a series of MS-Window-compatible device drivers and application software. "If windows are widely supported by the industry, it's possible to develop a large library of device drivers that software writers and system integrators can purchase. There really is a great advantage in having an operating environment that can be easily tied into; it takes the confusion out of the integration process," says Wilcox.

Dr. Bary Pollock, director of software development for General Parametrics Inc., Berkeley, Calif., and editor in chief of the computer graphics publication for SIGGRAPH, says a standard "is basically a mechanism of communication between diverse organizations; it establishes the rules or syntax. A de facto standard simply means that someone shipped a lot and other people are willing to support it." Pollock says standards have value mainly for mainframe manufacturers, not for makers of microcomputers. "It has been claimed that CP/M was a de facto operating system standard [for microcomputers], but look at the variance in implementation. The same is and will be true for implementation of graphics standards. Generalized device drivers won't come about."

To date, little direction has been given to the software writer or system integrator in developing in-house device drivers. Even attempting to follow standards has resulted in a watered-down implementation. However, the idea of shoe-box device drivers avoids this dilution.

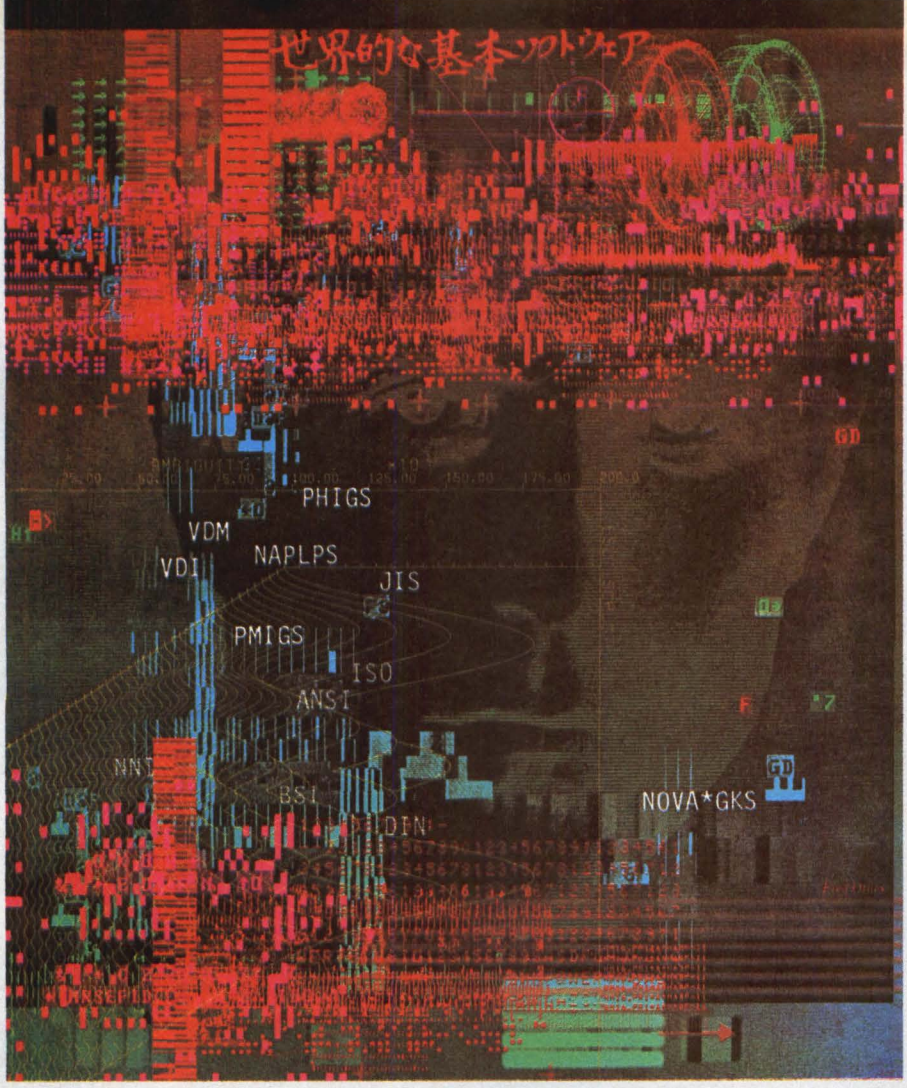
The availability of device-driver libraries, which are easily linked to a standard operating environment, encourages peripheral manufacturers to increase the capability of their products rather than to limit them. Thus, hard-copy peripheral manufacturers can implement a robust set of features without affecting the remainder of the system.

Standards prove restrictive

Software writers are not always anxious to adhere to standards. "A software writer wants to have control over the environment and not be restricted by standard rules," claims Graphic Software Systems (GSS) Inc. president Thomas B. Clarkson.

One of the trends, Clarkson contends, is to have graphics control functions decoupled from the window manager. He asserts that this is a big issue among software developers and system integrators: "Many system houses and software developers want to create their own interface to establish market differentiation. It can be as simple as a menu system or as complex as a window manager."

Even though developers are interested in creating their own environments, many are taking a building-block approach by using products that are specifically designed to handle various segments of the project. Metagraphics Corp., Mountain View, Calif., offers the MetaWINDOW graphics tool kit for $150. This package is based on the display management concepts pioneered at Xerox Corp.'s Palo Alto Research Center (PARC) and provides graphics capabilities similar to those found on Apple Computer Inc.'s Lisa or the Xerox Star computer. According to Metagraphics president Jack Davis, MetaWINDOW is a tool for developing window managers profiled for a specific system. "MetaWINDOW isn't an implementation of GKS," notes Davis. "GKS and the SIGGRAPH core proposals deal with the



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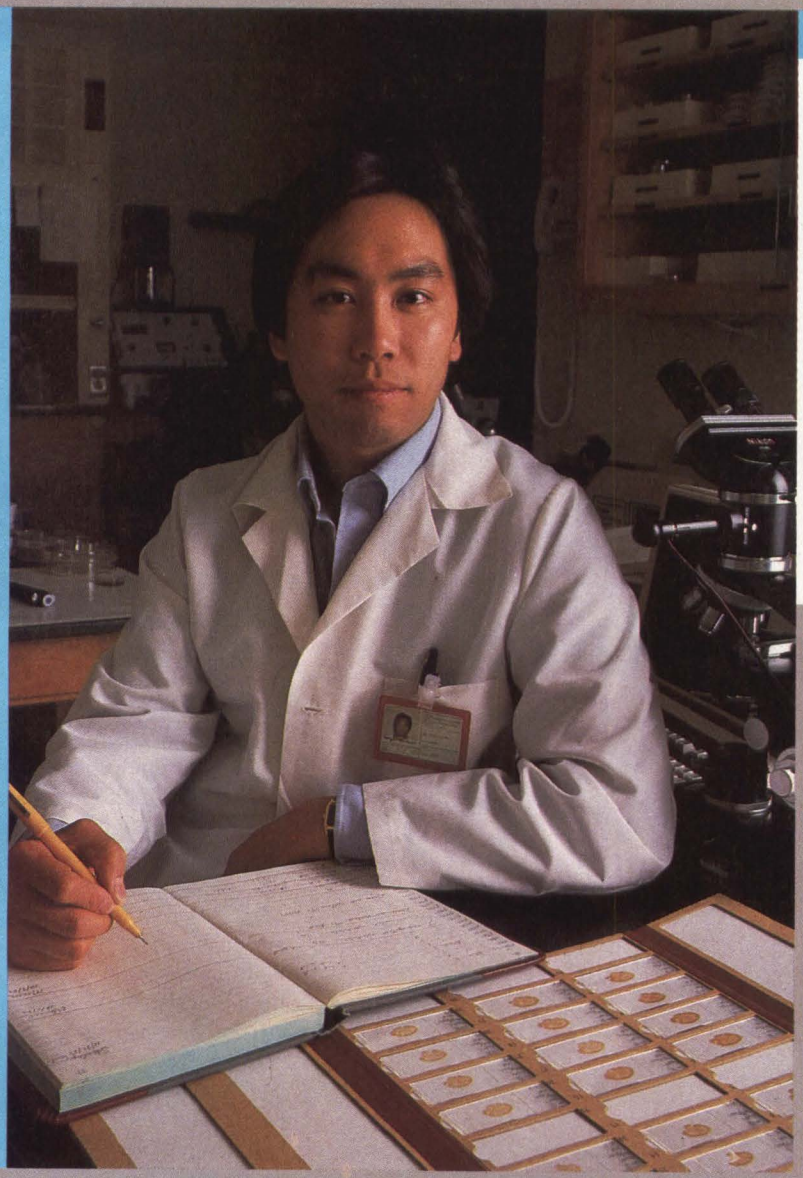

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The Pascal-2 system is available on Digital's PDP, VAX and Professional Computer systems running on the RSTS, RT-11, RSX and Unix Operating Systems.

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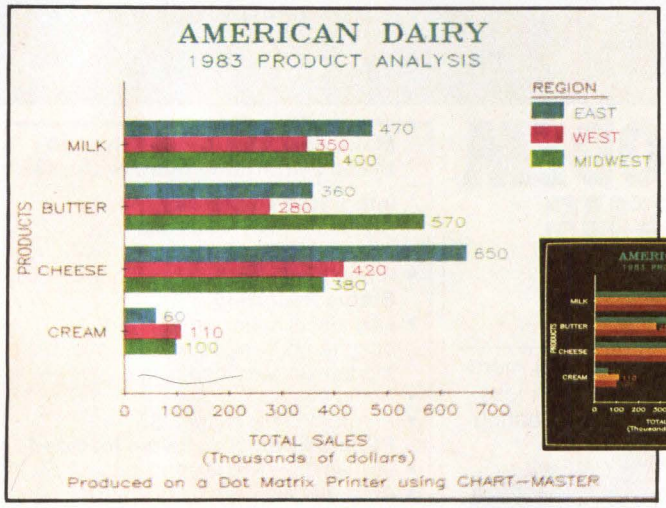
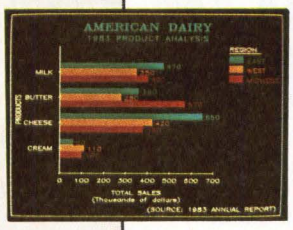
display device at a higher *device-independent* level. These standards are intended to facilitate a level of portability for applications but provide only for a limited set of bit-mapped graphics functions. Right now, MetaWINDOW is an optimized bit-mapped graphics tool for the IBM Corp. PC. But developers can put a GKS shell on top of MetaWINDOW."

Building blocks aid graphics

Media Cybernetics Inc., Takoma Park, Md., offers a similar product, Halo, for $150 and provides OEMs with a building block for display graphics. Like MetaWINDOW, Halo permits the creation of specialized windows or graphics capability on the IBM PC and PC-compatible computers. According to a company spokesman, Media Cybernetics offers libraries of routines that are easily called from FORTRAN, BASIC, C, Pascal, APL+ and Assembly languages. With Halo, users can create 3-D graphics—a function not addressed by GKS.



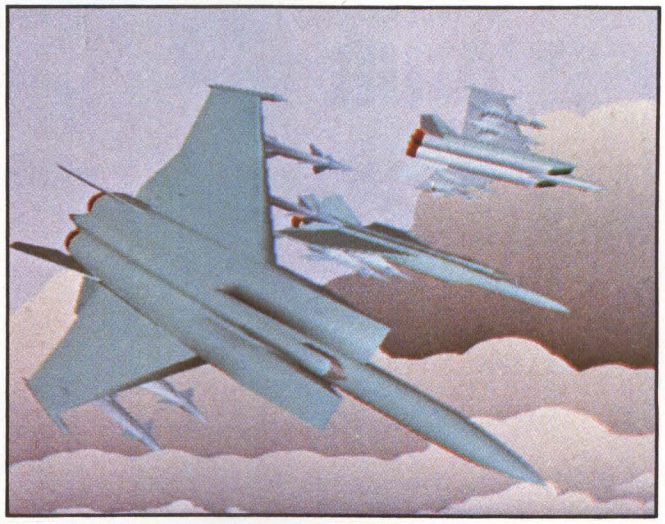


Decision Resources combines a multitude of output capabilities *by matching up with Polaroid's Pallette system for 35-mm. slides or hardcopy with a dot-matrix printer or plotter. The Chartmaster software relies on device-specific drivers to achieve the desired output effect.*

One of the companies using Halo as a development tool is Datagraphic Systems Inc., Milford, Mich. Its CADMaster package uses Halo for display functions and adds output drivers for hard-copy devices such as those manufactured by Epson America Inc. and Mannesmann Tally as well as for color prism printers from Integral Data Systems Inc. The package adds output drivers to Hewlett-Packard Co. plotters as well as to most HP-compatible plotters and to those made by Houston Instrument. In addition, CADMaster supports input devices ranging from mouse pointers to digitizing pads.

Offering similar capability based on Halo is the 3Design 3CAD package by 3Design, Seattle. This package also supports a variety of hard-copy and input devices.

Standards guide technological advancement, and



Adding 3-D solids modeling *to the IBM PC is accomplished with the Cubicomp CS-5 system. This system, which comprises a high-resolution color monitor, display-generating hardware and solids-modeling software, takes advantage of guidelines established by standards for solid- and wire-frame 3-D models.*

Graphic Software's Clarkson and others are convinced that the forerunner who establishes the standard will dominate the market. Clarkson explains that even though most software vendors have adopted VDI, implementations differ. What remains is to determine which implementation characteristics will dominate. "It's as fundamental as a cable," he says. "Once it's there, it provides the path. I see people purchasing the device driver the same as a cable—it is becoming a shoe-box technology. The one who wins is the one who supports the most devices."

Currently, Media Cybernetics, Digital Research Inc. and GSS are fighting for dominance in products shipped. Other manufacturers such as Microsoft and Metagraphics expect to capture a major share of the OEM market. Microsoft wants to establish a de facto standard with its MS-Window package.

Development times shortened

Development time can be drastically reduced using off-the-shelf device drivers. Syte Technology manager of engineering Bruce Carpenter says, "One of the

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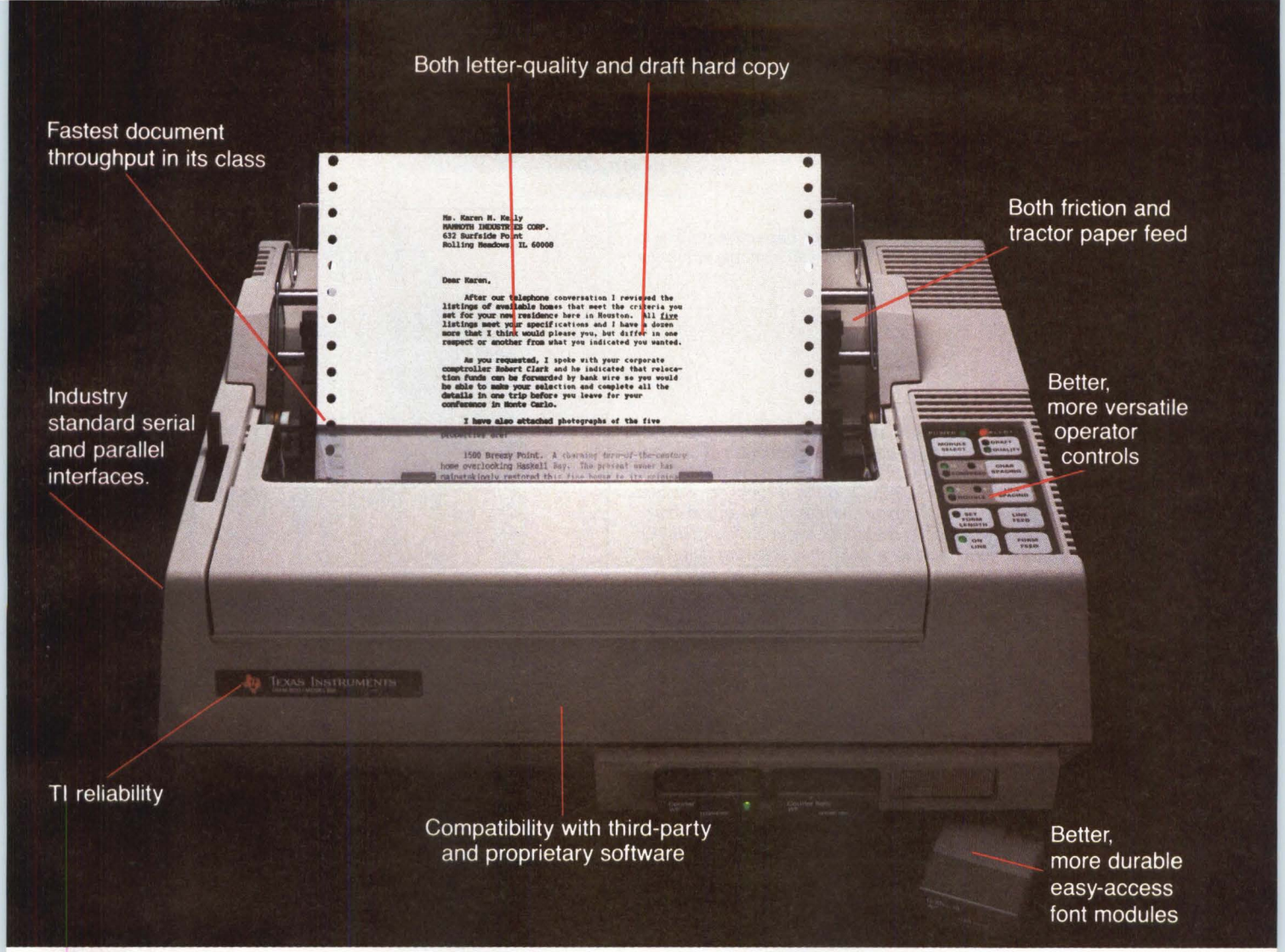

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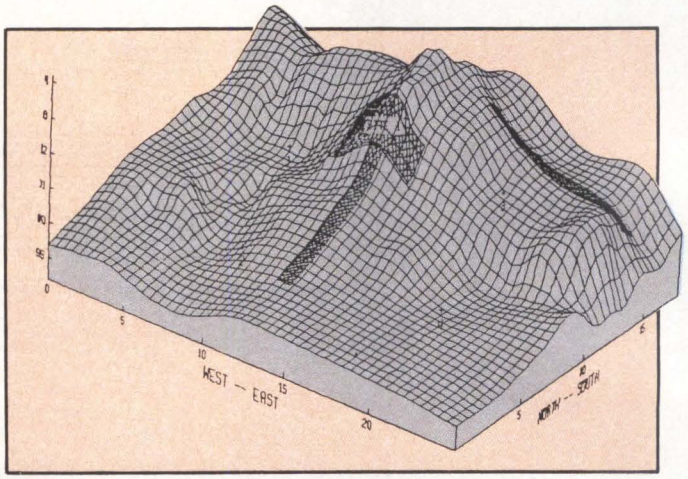
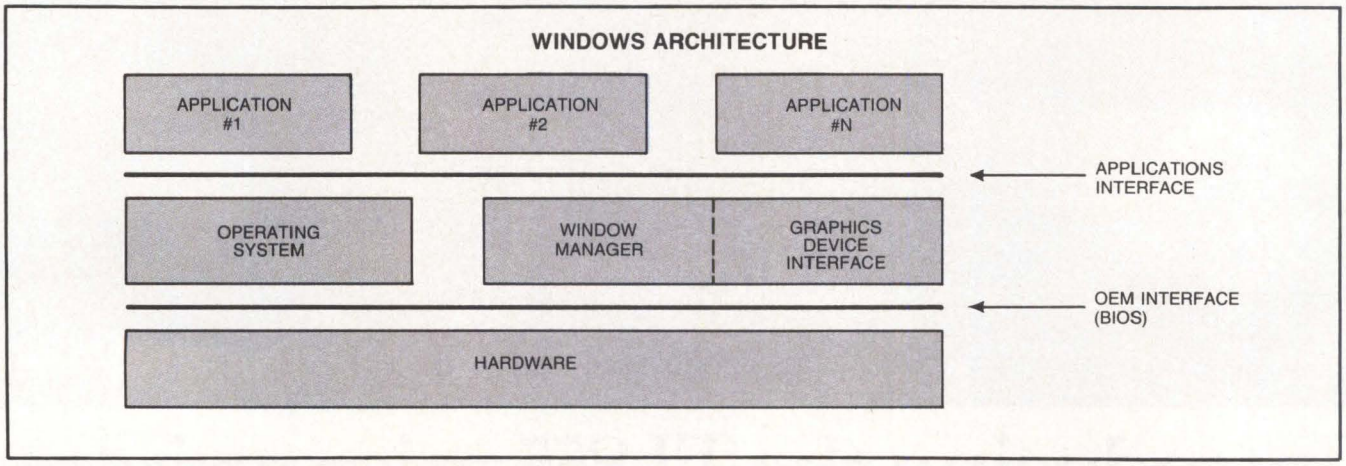


This drawing is complex in appearance *but deceptively easy to create using Digital Research's DR Access10 with a simple language file.*

Microsoft's MS-Windows system serves as a bridge between applications and hardware. *In operation, applications call the appropriate routines either in the operating system (OS), the windows or the Graphics Device Interface (GDI) to perform a function. System integrators are responsible for creating the link between the hardware and MS-Windows via the Basic Input/Output System (BIOS), and software writers need address only the software interface provided by Microsoft.*



reasons GKS is being favored is that language binding is being done. This means that a software writer can sit down and create an application in FORTRAN or C and know that he is talking the system language."

Richard Frank, chairman of Sorcim Corp., San Jose, Calif., insists that there are more important factors than providing language binding: "Essentially, when the industry moved from 8-bit machines to 16 bits, we went from a de facto software standard, CP/M, to a de facto hardware standard, the IBM PC." He adds that the architecture of the PC established a development environment that software vendors were forced to contend with. "Like everyone else, we aren't willing to be restricted by someone else's rules. We found it necessary to create our own device-independent drivers and window-management scheme."

Another package that reduces development time is Microsoft's MS-Windows tool kit, priced at $795, which combines window management, a disk operating system and a Graphics Device Interface (GDI).

The GDI capability is related directly to the GKS standard; Microsoft is working closely with GCI to provide device-specific drivers to ease implementations. According to John Butler, a Microsoft software engineer, GDI provides developers with a uniform interface to graphics and, with support of device-specific drivers, handles virtually all device technologies.

To achieve maximum ease of implementation, MS-Windows offers a modular approach: each device driver is treated as a file. Thus, drivers can be easily maintained and updated without rewriting the entire input/output system—a previous requirement in 8-bit systems.

NAPLPS may serve other segments

The GKS/VDI approach has already proven a major influence on most software vendors, but NAPLPS may spur specialized applications such as Videotex.

The NAPLPS approach is much like GKS in that it specifies device-independent data formats for encoding text and graphics and is ideal for information processing and presentation graphics. Notably, the standard is screen—thus raster—oriented and expresses coordinates as fractions of a unit screen.

Because NAPLPS is device-independent, it is expected that, with use, software vendors will be able to create single-device drivers that are compatible with any

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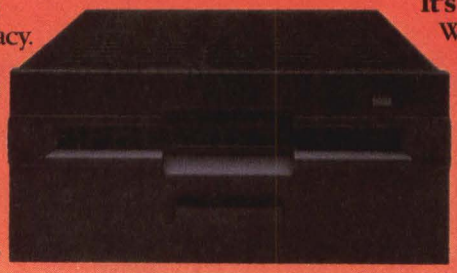

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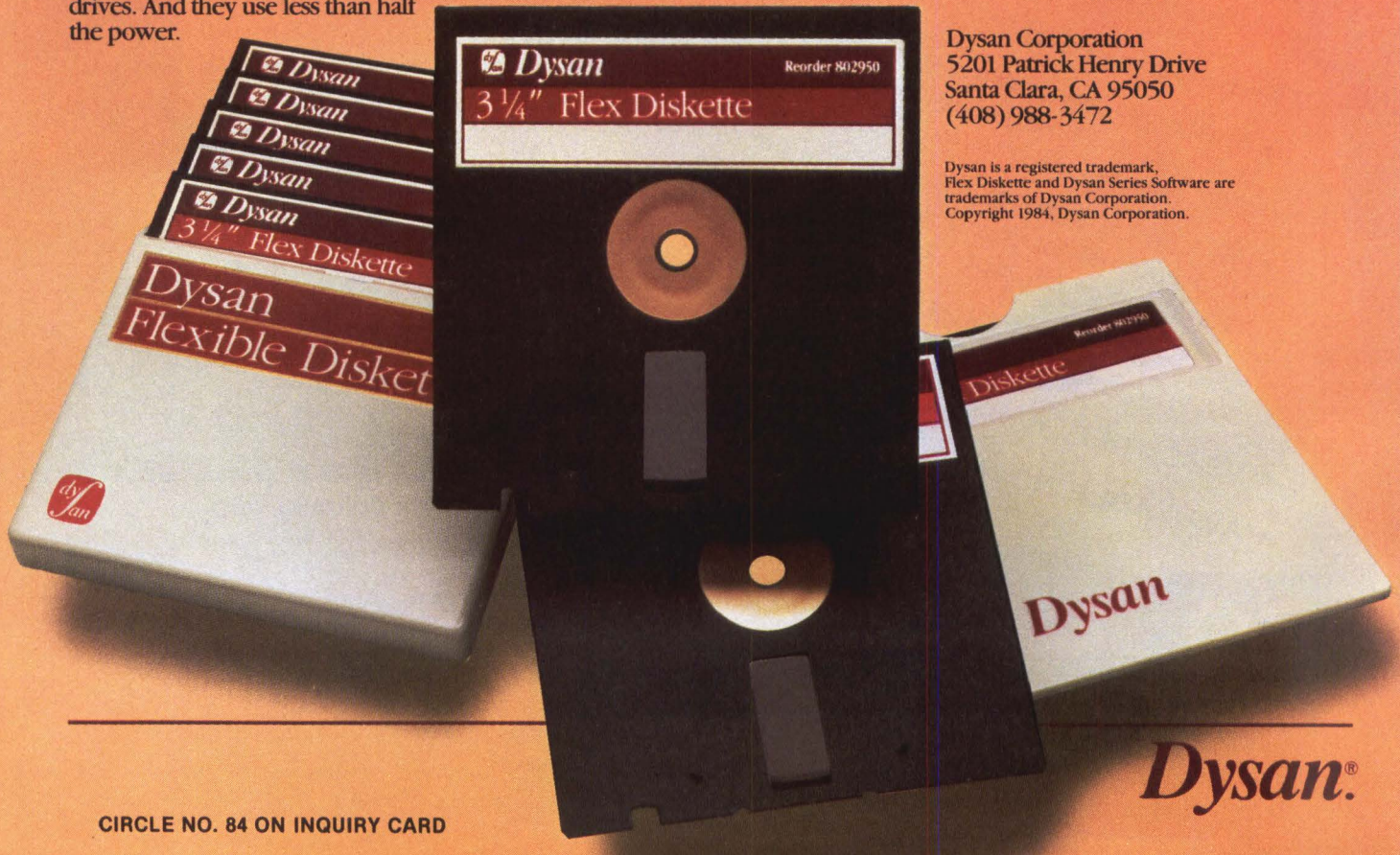

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NAPLPS-compatible system. This means that peripheral manufacturers will have to adhere to NAPLPS rules, which those favoring the GKS approach believe could be inhibiting.

General Parametrics has accepted NAPLPS for its VideoShow 150, and software development director Pollock says the NAPLPS approach was taken to ease the development of compatible software. "We have a product that is designed to create presentation-level graphics in slide-show fashion. We wanted something that would allow us to encode frames in the smallest amount of space, and NAPLPS takes only about 3K bytes. In addition, we can provide software writers with an easy environment to write within and one that isn't beset with diverse changes." Pollock, although a member of the X3H3 committee, doesn't see GKS meeting all the needs. "Right now, there are essentially two versions of GKS: ANSI's and the International Standards Organization version, and they do differ." Pollock and Syte's Carpenter think an independent standard, partly based on GKS, will emerge.

'It's better to view [standards] as a common ground for systems supported by multiple vendors.'

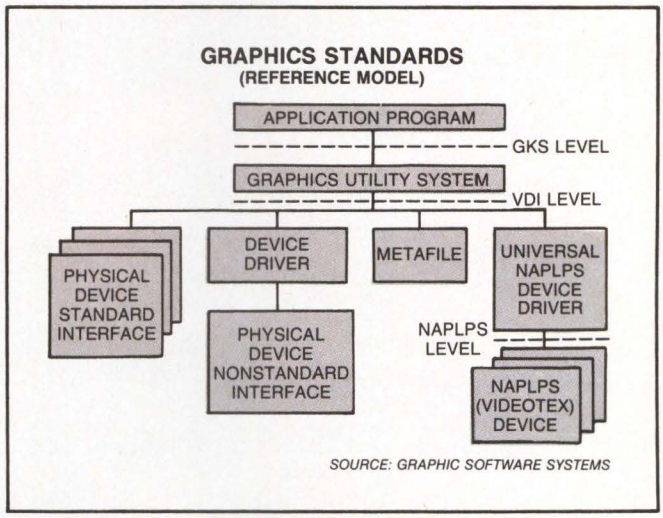
NAPLPS is resolution-independent. Consequently, developers of low-cost presentation graphics systems may consider it ideal to maximize display performance, as did General Parametrics.

Plentiful array of software

Regardless of which standard implementation approach is used, software will be available. Already on the shelves are products from Digital Research and GSS, and Microsoft and GCI expect to have a large library this year. Companies such as Sorcim and newly formed Softway, San Francisco, are working on libraries of device drivers for OEMs. Sorcim's Graphic Control System (GCS) is not an OEM product. It was developed as an in-house product. According to company chairman Richard Frank, "We were once a tool factory; now, we make spreadsheets. We may consider going back in the tool business, and we do have the ability to create that type of product." Softway is a software tool company. Its first product, Matis ($175), is a BASIC language extension that adds graphics capability for the creation of window management and device handling. Softway plans to offer a full set of library routines for OEMs.

Some peripheral companies are helping software vendors develop products for their devices. Enter Computer Inc., San Diego, offers the Sweet P plotter system, which uses the HP Graphics Language (HPGL) and the Sweet P Graphics language (SPGL) as command sets, thus easing the creation of both device drivers and application software.

Michael Manchee, product specialist, explains that, by using a rich command set, the plotter can perform complex plots with little effort on the part of the user. "Most plotters have their own command set and don't adhere to GKS. It is up to the software writer or system implementor to provide the proper driver," he says. In most cases, this is simply a serial or parallel device driver that can handle ASCII strings. For example, a simple command to pick up the pen is coded as "PU" and can be implemented even in BASIC. "We take care of processing the commands, and in many cases that is 90 percent of the burden," says Manchee.



To take into account the full-system approach, *GSS' tool kits allow a modular approach to building a graphics system. Each function, such as the physical device driver, is treated as a separate file. Conversion routines are built into the graphics utility system at the VDI level to provide the proper command set to the device driver or for NAPLPS-compatible devices.*

The model 84 plotter from California Computer Products (Calcomp) Inc., Anaheim, Calif., allows the system integrator or software writer to create easy-to-use applications. GCI has made its Graphwriter software available for use with the Calcomp plotter. This software package, when coupled with the plotter, allows the creation of complex graphics and line texturing, primarily by taking advantage of the device's rich command set.

The Pixy 3 microplotters by Mannesmann Tally, Kent, Wash., offer similar capabilities. A company spokesman explains that numerous software vendors are taking advantage of the plotter's ease of integra-

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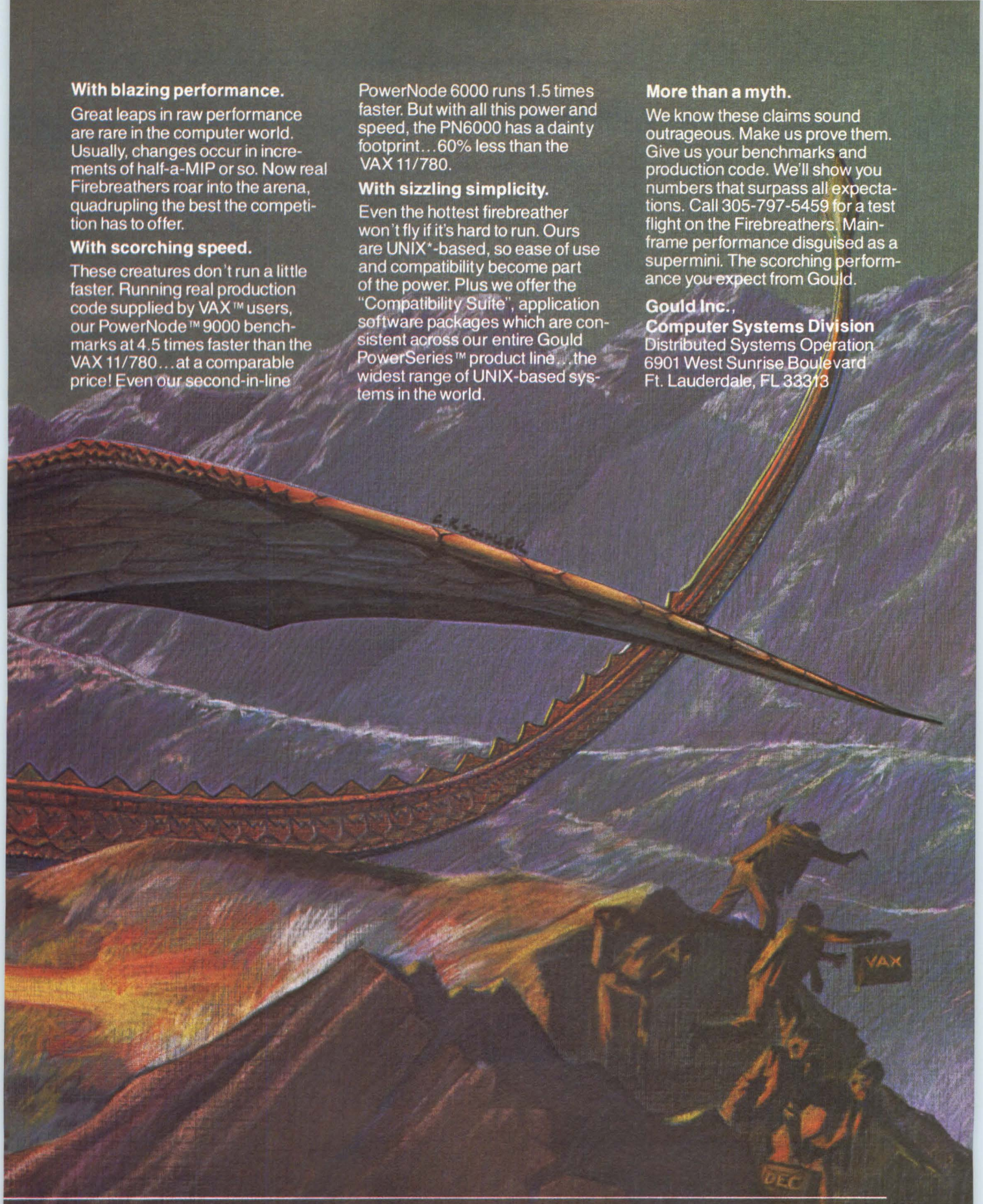

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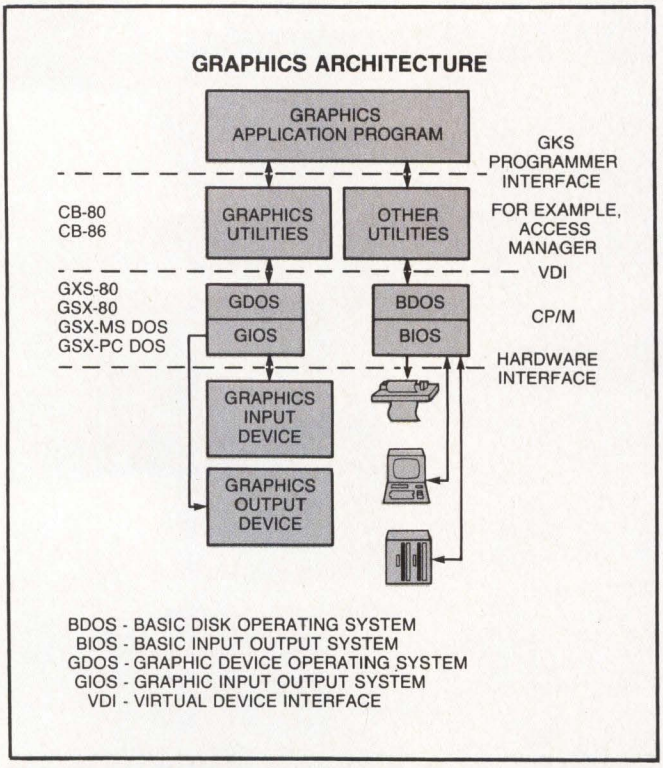
tion. For example, a range of Apple-compatible software is available, as are Chartmaster and Signmaster from Decision Resources Inc., Westport, Conn.

Houston Instrument, Austin, Texas, is touting compatibility to 79 packages, many of which are GKS-compatible. The company is anxious to provide robust command sets to improve plotter functions. Therefore, it is interested in having device drivers that support its products.



Digital Research's graphics architecture, *like those from Microsoft and GSS, is multilayered. This system couples the application to the devices via utilities and the Graphics Device Operating System (GDOS), which serves as a converter to pass information to the device-specific Graphics Input Output System (GIOS).*

Printers are hard to handle

GSS's Clarkson points out that one of the most difficult devices to handle is a printer. "Virtually every printer manufacturer has a method of handling the device and a different command set. It makes it difficult to create a generic software package, so you need to have very specific drivers," he says. As a result, GSS has developed a series of packages that are built around the GKS kernel and VDI implementation.

Among the products available from GSS are those bound either into the operating system or those that serve as modules that users can adapt. These include GSS-Solutions, which comprises GSS-Chart and GSS-Terminal. The two programs can serve as standalone products or can be bound into a full system. The terminal program permits the migration of applications from a mainframe to a minicomputer or microcomputer. Because the package is compatible with the Tektronix Inc. 4010 family, software created in this environment can be down-loaded and manipulated using Chart. This package allows for full cut-and-paste and a full array of charts and graphs.

To allow OEMs to implement full graphics capability on 8- or 16-bit systems, GSS offers the Toolkit, which includes a kernel system. According to Clarkson, this represents the first implementation of GKS in a microcomputer environment, thus providing full graphics functions as defined by the standard. The Toolkit's plotting system takes advantage of the kernel and lets users develop sophisticated charts and graphs. The modular Window Manager permits the creation of windowing systems that can be controlled by a multitude of input devices.

The key element in GSS's list may be the device drivers, however. Paying careful attention to the standards, GSS has extended the VDI proposal found in GKS. The GSS-Drivers contain a protocol converter at the device—hardware—level. The software receives the generic graphics requests, such as "draw a line," and then does the necessary conversion to make the device perform the function.

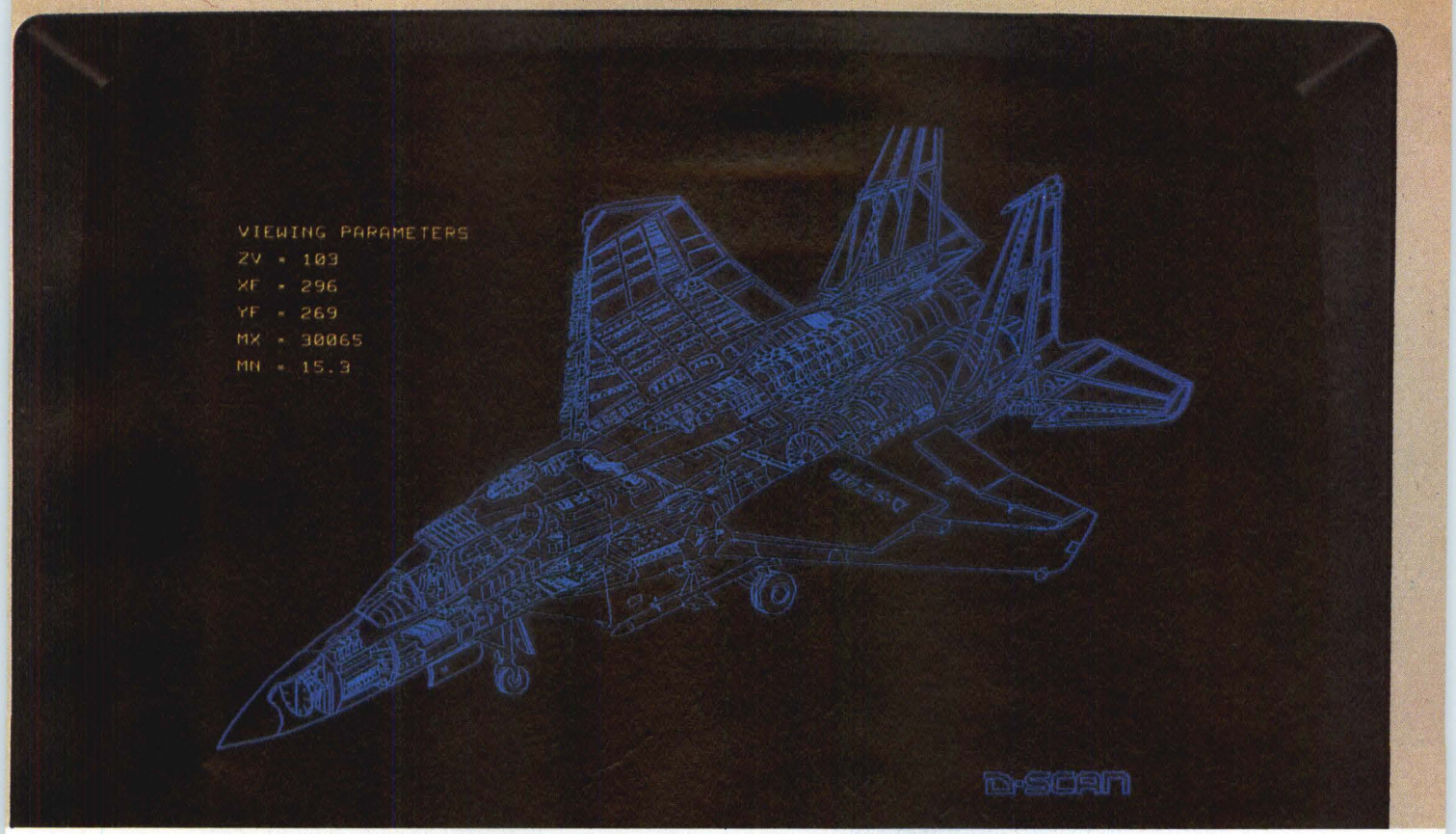
Notably, GSS hasn't limited itself to physical device drivers specified by VDI. Rather, the company offers a metafile driver for pseudo device drivers and an NAPLPS driver for videotex applications. The NAPLPS driver is important for storing information transmitted over phone lines or for NAPLPS-oriented devices. GSS provides language binding to aid the software writer.

Documentation comes on diskette

All the packages are bundled as a kit, which includes the software and documentation on diskette. The GSS-Terminal and the GSS-Chart sell for $20,000 each. GSS-Driver is priced at $10,000 for a full set. The language binding is $4,000 more. Prices of GSS-Plot and the metafile interpreter are $12,000 and $10,000, respectively. GSS adds a royalty structure based on hardware or software shipped.

Another company offering software for OEMs is International Microcomputer Software Inc. (IMSI), San Rafael, Calif. Its four-point Graphics ($195) creates smooth animation and allows easy manipulation of objects. The technique is an NAPLPS-line implementation. To support a variety of printers and plotters, IMSI offers device-specific drivers for $29.95 each.

Of the companies that are developing graphic software and specifically GKS-compatible products, Digital Research has established a significant posture. Work-



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ing originally with GSS, Digital Research integrated one of the first implementations of the SIGGRAPH core into CP/M. It has also implemented metafile for storing pictures in an encoded format for Videotex applications.

Like Microsoft and GSS, Digital Research has developed an extensive library of end-user and OEM software geared for graphics. Specifically, it offers the GSX-86 programmer's tool kit for $350. This package includes peripheral drivers and is compatible with CP/M-86, Concurrent CP/M and PC-DOS. In addition, the company provides language binding for the full family of Digital Research products.

Graphics System Extension (GSX), an implementation of GKS developed in tandem with GSS, has made it possible for Digital Research to offer such graphics packages as DR Draw ($400), DR Access10 ($500) and DR Graph ($295). According to Fred Langhorst, director of Digital Research's graphics division, the packages represent a comprehensive set of graphics tools that are easily modified to fit specific applications.

According to Langhorst, the GSX system comprises two major components: the Graphics Device Operating System (GDOS) and the Graphics Input Output System (GIOS). The GDOS is device-independent and is based on the emerging ANSI VDI standard. This portion intercepts calls from the applications and interprets them for the device-dependent GIOS. The GIOS is designed to be very device-specific, and, like Microsoft's implementation, it is designed to be hung into the system as modules. One of the companies that has adopted Digital Research's method is Digital Equipment Corp. for the Rainbow series of computers.

Although Precision Visuals Inc., Boulder, Colo., offers the DI-3000 integrated system of 200 user-callable graphics subroutines, which are developed in accordance with SIGGRAPH core and GKS, company president Jim Warner issues a warning: "Graphics standards are important, but they tend to be outpaced by new equipment. The standards are a result of give-and-take and don't always consider the marketplace." □

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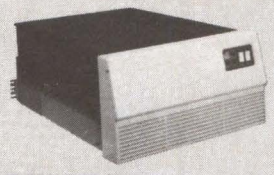

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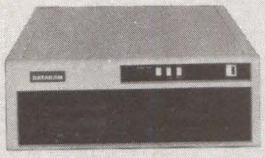

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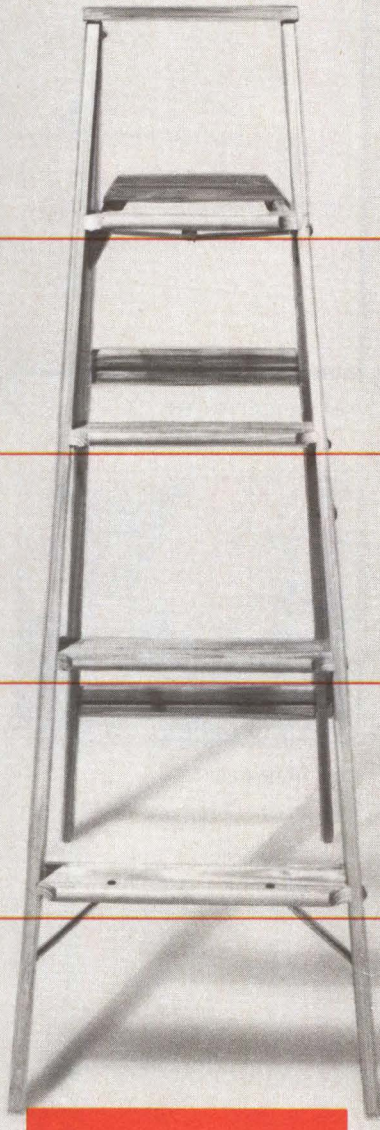

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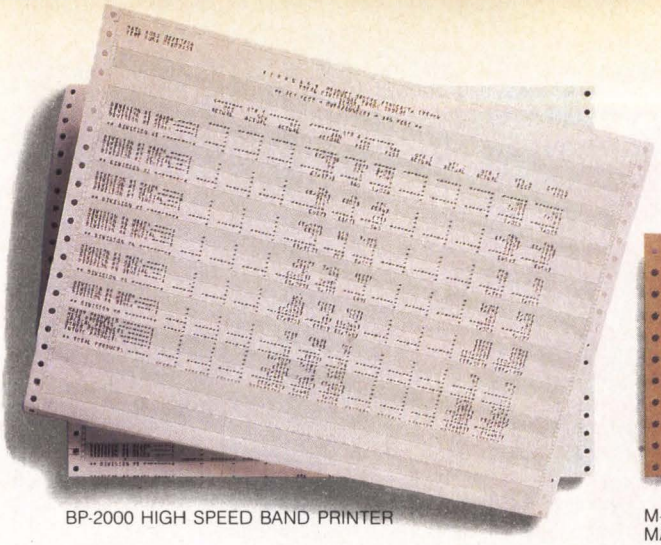
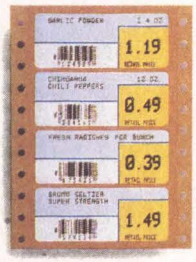
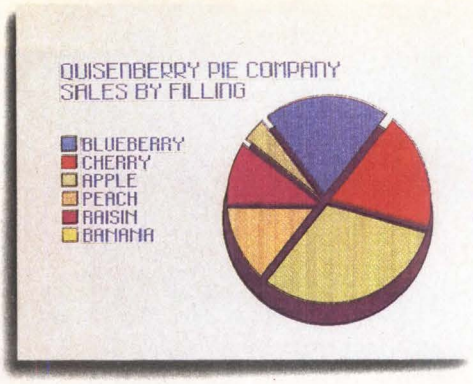


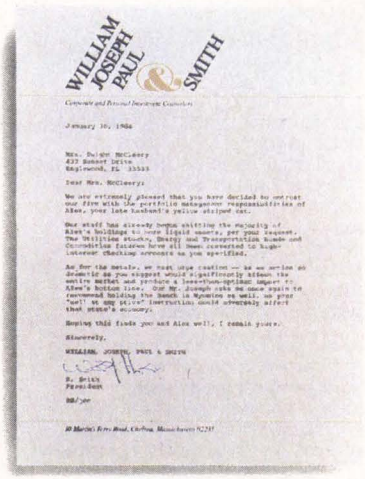
BP-2000 HIGH SPEED BAND PRINTER



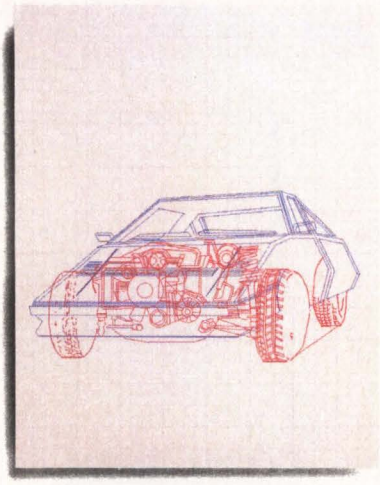
M-100L
MATRIX PRNTER



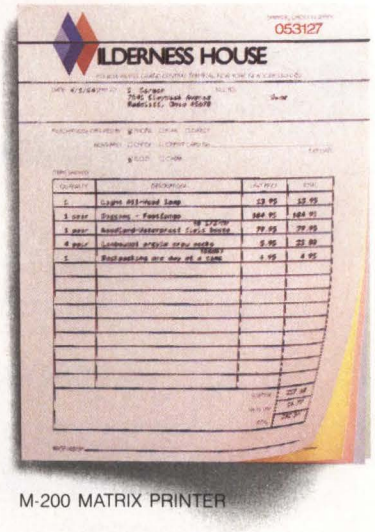
P-80 MATRIX PRINTER



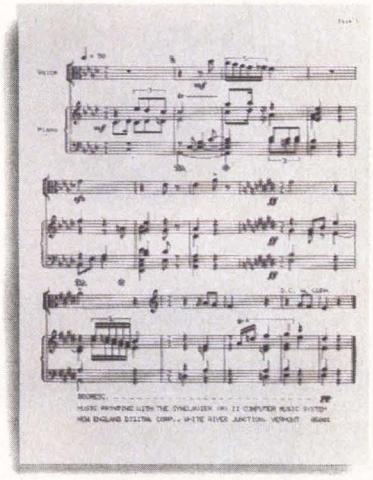
DP-35 DAISYWHEEL PRINTER



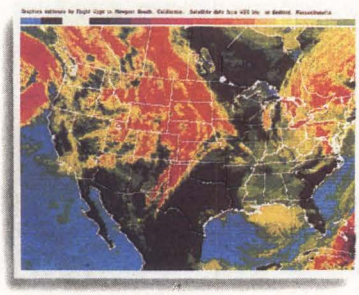
P-80 MATRIX PRINTER



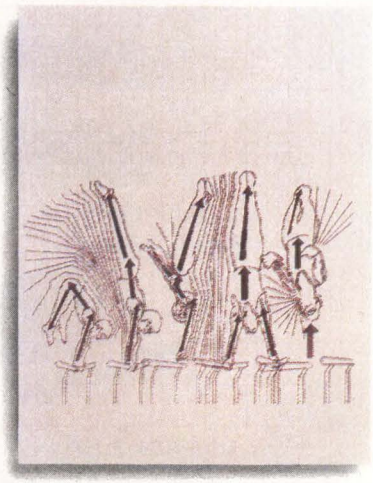
M-200 MATRIX PRINTER



P-80 MATRIX PRINTER



P-132 MATRIX PRINTER



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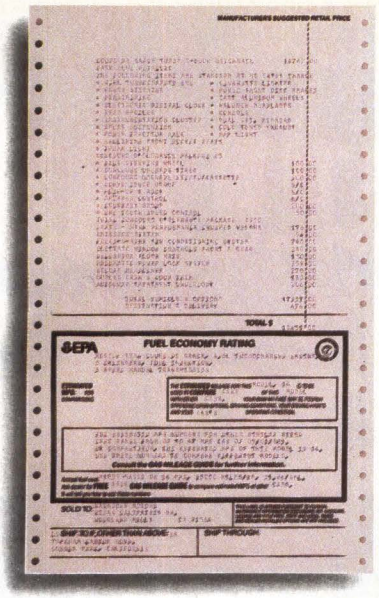
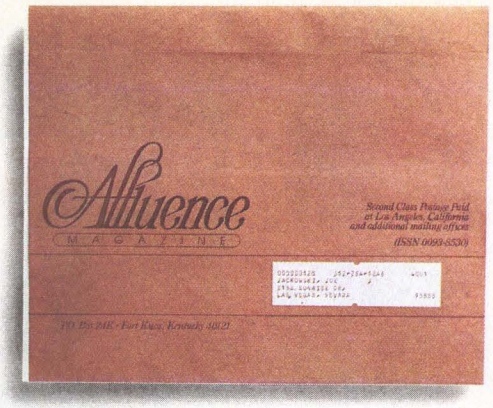
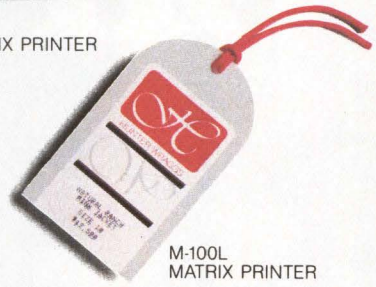


B-1000
MEDIUM SPEED BAND PRINTER

P-132
MATRIX PRINTER

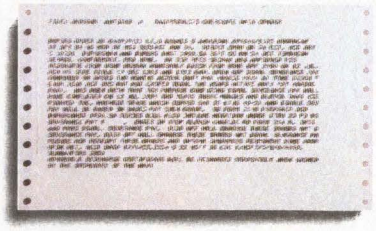


B-600 MEDIUM SPEED BAND PRINTER

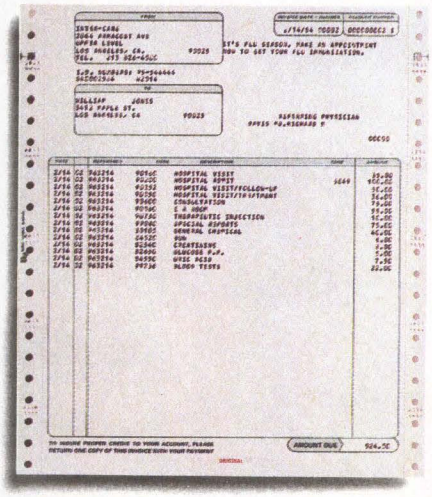


M-100L
MATRIX PRINTER

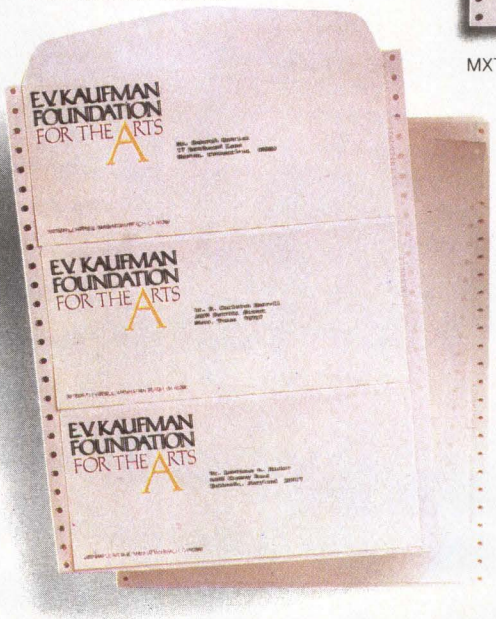
M-120 MATRIX PRINTER



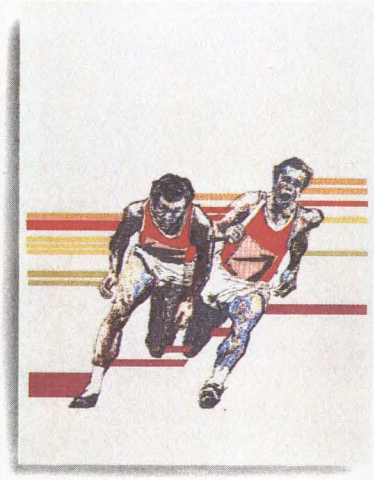
MXT-1200 MILITARY PRINTER



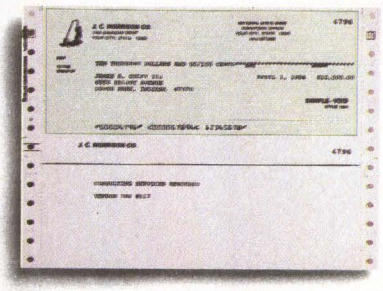
B-300 MEDIUM SPEED PRINTER



DP-55 DAISYWHEEL PRINTER



P-80 MATRIX PRINTER



DP-55 DAISYWHEEL PRINTER

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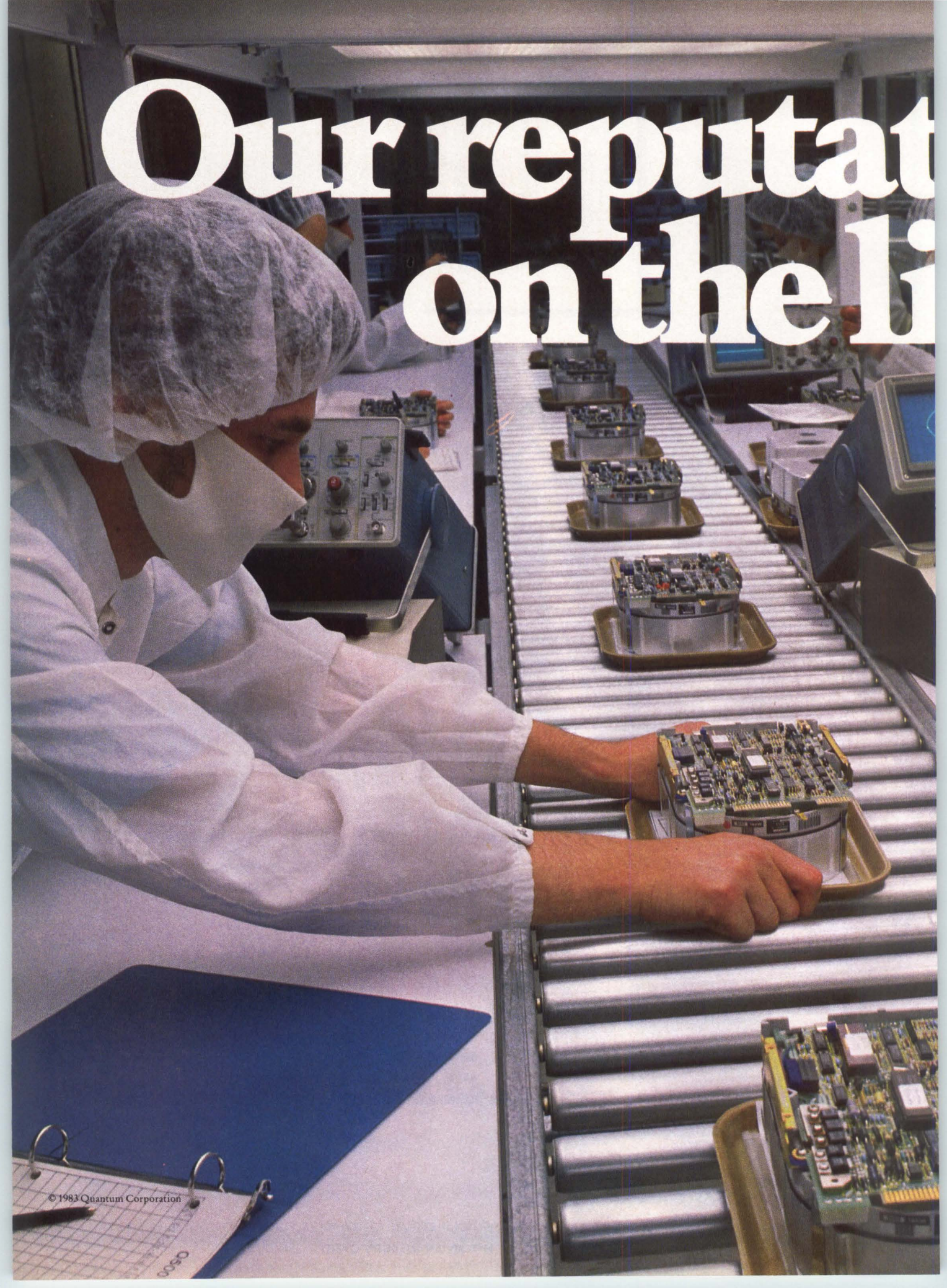
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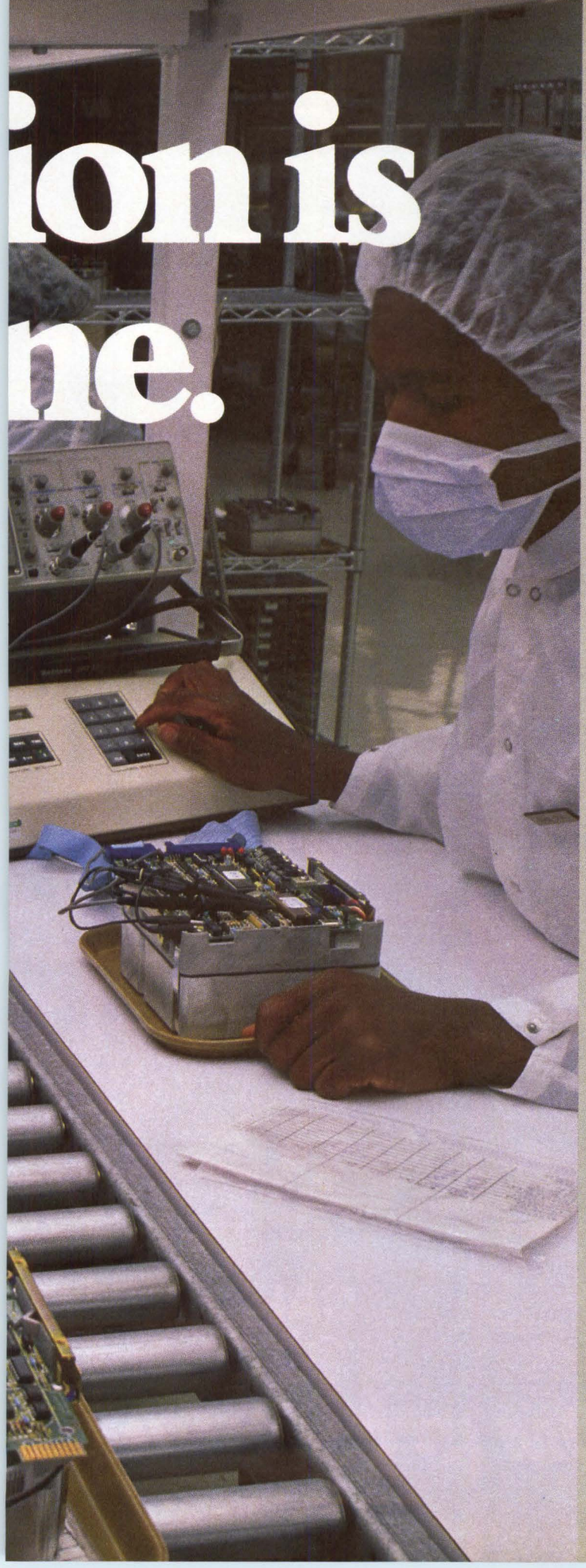

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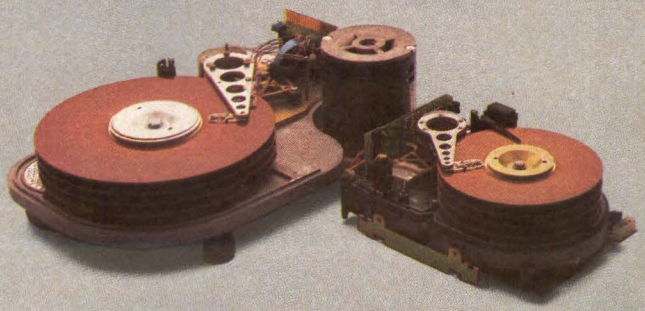

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CIRCLE NO. 91 ON INQUIRY CARD

Desktop plotters draw attention via price cuts, color

Driven by the demand for office-based graphics, the desktop plotter market is growing rapidly. Pen plotters are precise and well-proven, but raster-based devices are faster and more colorful

David Simpson, Associate Editor

The demand for small business or office-related graphics output has created a $100 million desktop plotter industry that will top $500 million by 1988, according to Future Computing Inc., a Richardson, Texas, market research company. More than 30 manufacturers currently offer desktop plotters. And, although Hewlett-Packard Co. commands over 70 percent of the market, new companies such as Enter Computer Inc., Roland DG and Strobe Inc. are challenging the large manufacturers with less-than-$1,000 plotters. System integrators have plenty of products from which to choose, but the buying decision remains tough. A variety of factors have to be matched with application requirements, including the type of plotter, technology, performance parameters, software availability and cost.

Choosing the right technology

Pen plotters are the dominant desktop graphics output devices, outselling all other technologies combined. The fastest-growing segment centers on the less-than-$2,000 category. According to Dataquest Inc., a Cupertino, Calif., market research company, U.S. shipments of less-than-$2,000 pen plotters totaled 100,000 units in 1983. This number is expected to reach 155,000 in 1984, and at a 40 percent compound annual growth rate, will exceed 300,000 in 1986. Of 1983 shipments, 65 percent were for technical applications and 35 percent were for business applications.

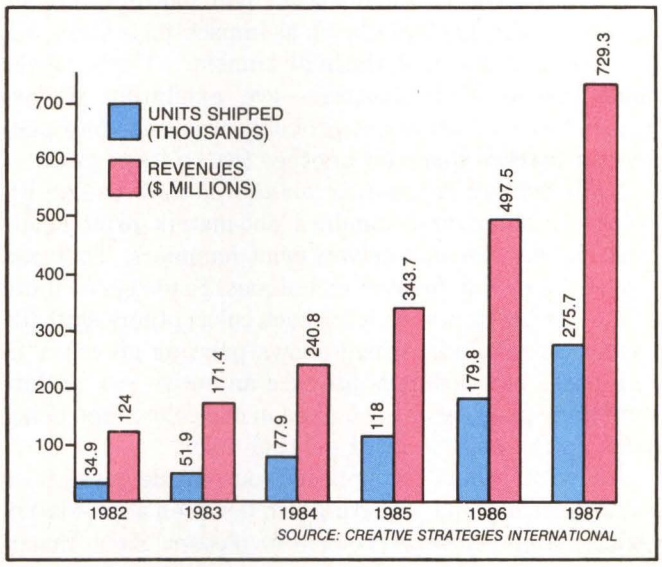

Fig. 1. Unit shipments of pen plotters for business graphics *are expected to increase at a 51.2 percent compound annual growth rate. Total U.S pen-plotter revenues are expected to increase at a 42.5 percent growth rate.*

Plotters for business applications should steadily gain market share over the next few years. Creative Strategies International, a San Jose, Calif., market research concern, projects a 51.2 percent compound annual growth rate for unit shipments of business graphics-based pen plotters, from 34,900 units in 1982 to 275,700 in 1987 (Fig. 1).

There are three types of pen plotters: flatbed, drum and hybrid (Fig. 2). Flatbed plotters generally provide high precision and allow an operator to remove and replace plots with little loss of accuracy. With flatbed plotters, the paper remains stationary while the pen plots the X and Y axes. Drum plotters are usually less expensive and can accommodate continuous-roll paper. The drum moves the paper vertically while the pens move across the paper horizontally. Hybrid plotters operate like drum plotters, plotting the X axis via pen movement and the Y axis by moving the paper vertically with pinch, or grit, wheels that hold the edges of the paper. Hybrid plotters are usually less expensive than drum plotters.

Pen plotters provide proven technology, low cost and high quality. In addition, there is an abundance of graphics software for pen plotters, most of which can be easily implemented by inexperienced users. But pen plotters are relatively slow, especially when printing text, and sometimes require user intervention. In addition, they are usually limited to producing fewer than eight colors. Consequently, a trend in the graphics output arena is aimed at raster-based dot-matrix devices, as opposed to vector-based pen plotters. Raster devices use technologies such as impact dot matrix, ink jet, electrostatic and thermal transfer. These newer units—called printer/plotters—are exhibiting performance improvements but probably won't cut into pen-plotter market share for another two to three years.

Color impact dot-matrix printer/plotters use multicolored ribbons and standard dot-matrix print heads that employ solenoid-driven print hammers. They can use serial or line-printer techniques. Some serial units make one horizontal pass for each color; others shift the ribbon as required, which allows printing all colors in one pass. Line printers produce an entire row of dots simultaneously, printing a page in one color, then going back up the page to print another color.

As with other raster-based output devices, it is sometimes difficult to distinguish between a dot-matrix printer and a dot-matrix printer/plotter. Some manufacturers point to resolution; others, to graphics software support. Lear-Siegler Inc.'s Versaprint model 520, for example, has a resolution of 150 dots per inch (dpi) horizontally by 144 dpi vertically. Although this falls short of the 240 dpi required for letter-quality output, it's sufficient for most business graphics applications.

Graphics software support is weak for many dot-matrix units, but a few printer/plotters handle most of the graphics application packages written for popular microcomputers. For example, Printronix Inc.'s MVP supports all major IBM PC-compatible graphics application packages.

Fig. 2. There are three types of pen plotters: *flatbed, such as CalComp-Sanders' M-84 (bottom left), drum, such as Nicolet Zeta's ZETA 8 (top left), and hybrid, such as Houston Instrument's DMP-40 (above).*

Most graphics application packages generate images via a list of vector commands. Pen plotters accept those commands without the need for translation. Raster-based devices, on the other hand, require vector-to-raster conversion because they create images by selectively turning dots on and off in a fixed matrix. Raster-based output devices must translate vector information into a raster or bit-mapped image, which typically requires conversion hardware, software or firmware. Although terminal manufacturers, plotter manufacturers, applications software suppliers, OEMs or system integrators can supply conversion functions, supplying such functions usually involves extra money or time.

An exception is Envision Technology Inc.'s VectorPrinter, which has a built-in vector-to-raster conversion system. The dot-matrix printer/plotter incorporates two 8088 microprocessors; one controls the print mechanism, and the other controls the host interface and command interpretation. Because the 8088s work in parallel, processing of subsequent windows—or plots—can continue while earlier plots are printed. The VectorPrinter sells for $3,495, prints on plain paper or transparencies and plots in eight colors.

The primary advantage of impact dot-matrix printer/plotters is speed. When mixing text and graphics, pen plotters are very slow, usually around 3 characters per second (cps), making them impractical in word- or data-processing applications. Impact dot-matrix units such as Printronix's $3,745 MVP and Trilog Inc.'s

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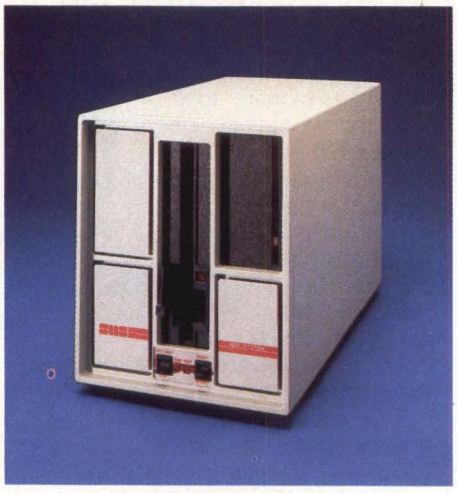

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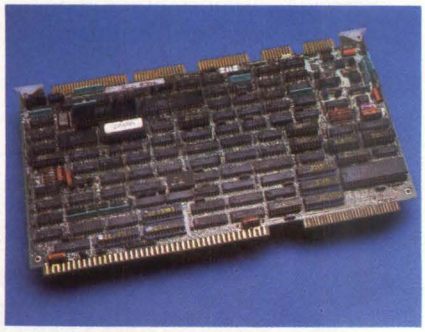

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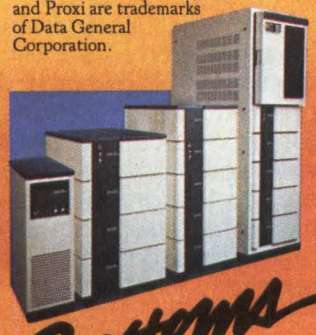

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$6,900 TIP 302, on the other hand, can print text at 150 and 300 lines per minute (lpm), respectively.

Lear Siegler's director of printer engineering, Herb Craft, claims his company is capturing pen-plotter market share because "more and more people are mixing text and graphics, such as spreadsheets, pie charts, etc." The Versaprint supports Lotus Development Corp.'s 1-2-3 and other popular application packages. "We're concentrating on developing more compatibility with the IBM PC/XT," says Craft, a strategy voiced by many dot-matrix printer/plotter manufacturers.

Ink-jet printer/plotters have print heads that spray a continuous stream of ink drops toward the paper. An electromagnetic field between the print head and the paper determines whether the dots will reach the paper or be electrically deflected. More recent ink-jet printer/plotters use drop-on-demand techniques, in which the print head controls the ink-drop flow, so that ink drops are emitted only when the print head fires (Fig. 3).

The major advantages of ink-jet plotters are speed, color capabilities and dual-mode operation. For example, Advanced Color Technology Inc.'s ACT II and Printacolor Corp.'s TC 1040 produce an 8½-by-11-inch plot in 90 seconds, regardless of the complexity of the plot. Whereas desktop pen plotters are usually limited to about eight colors, the ACT II can produce 125 shades, and the TC 1040 can produce almost 5,000 hues. Both units can print on paper or transparencies.

The disadvantages involve resolution, price and vector-to-raster conversion software, but improvements are coming quickly. Whereas 240 dpi is generally considered letter quality, most ink-jet printer/plotters currently hover around 120 dpi. However, according to Printacolor vice president of marketing Philip Frick, his company will introduce a 240-dpi desktop printer/plotter within a year.

In the cost controversy, Diablo Systems Inc. is countering with its $1,295 Series C150 ink-jet printer/plotter (MMS, January, Page 223). The unit uses continuous-stream or drop-on-demand techniques and has 120-dpi vertical and horizontal resolution. Other manufacturers are also pushing price decreases. "Our main competition is the technology itself," says Chuck Stires, marketing manager at Advanced Color Technology. "The idea is to lower prices to keep in line with the decreasing prices for systems and terminals, more than to compete quality-wise with other technologies."

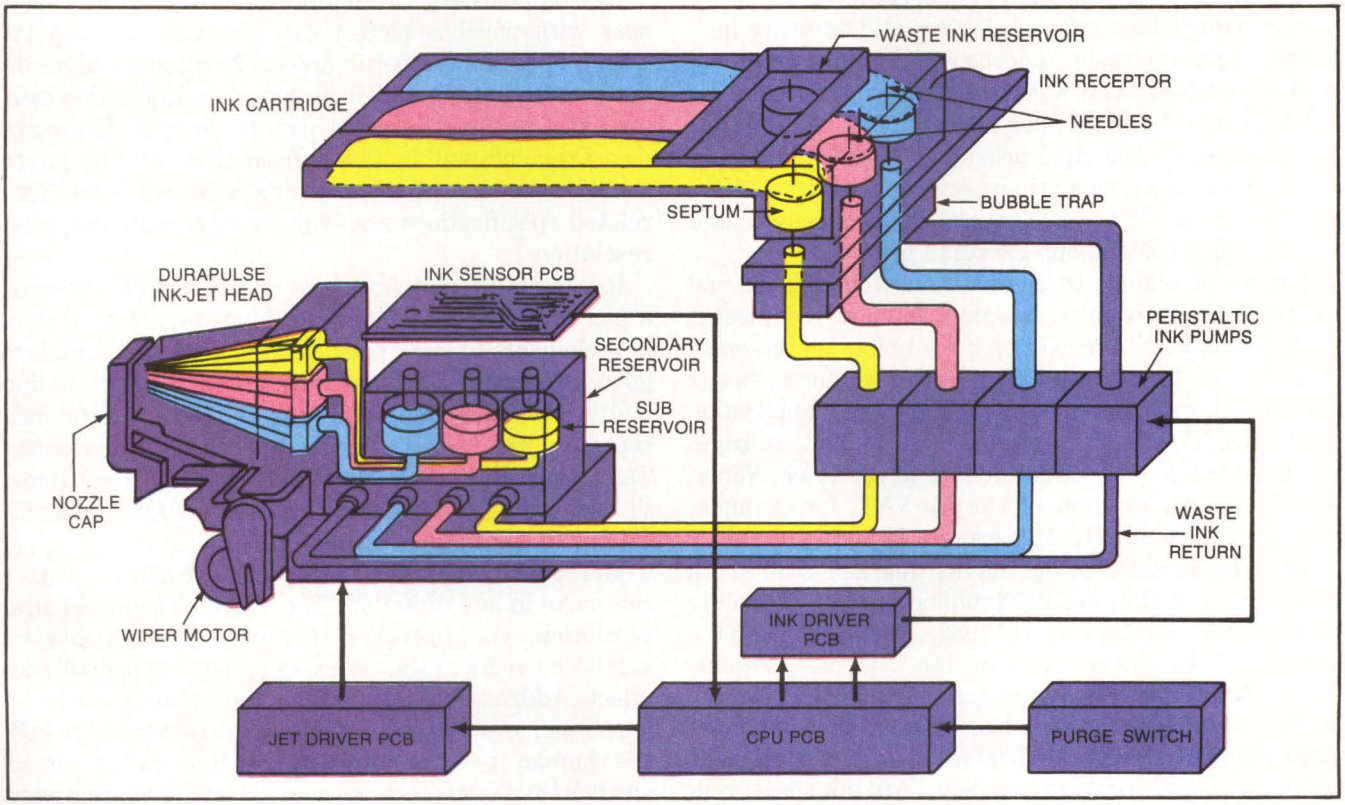


Fig. 3. Advanced Color Technology's ACT II ink-jet printer/plotter *employs drop-on-demand technology, in which electrical impulses control the flow of ink drops to the paper. The print head has 12 jets arranged in three groups of four jets each. The ACT II uses the three subtractive primary colors: yellow, magenta and cyan. As the print head moves across the page, the compression of piezoelectric crystals ejects the ink drops. The color in each pixel is produced by mixing ink drops, allowing as many as eight solid colors or 125 shades.*

Like other raster-based devices, ink-jet printer/plotters require vector-to-raster conversion software to run vector-based application programs. A software driver usually performs this translation. Most ink-jet printer/plotter manufacturers supply drivers for the popular microcomputers. Advanced Color Technology, for example, supplies drivers on floppy disk for more than 40 systems.

Electrostatic printer/plotters have only recently entered the desktop market with the introduction of Versatec Inc.'s black-and-white V-80 unit. Like other electrostatic devices, Versatec's printer/plotters produce hard copy by applying programmed voltage to an array of densely spaced nibs arranged on a stationary writing head. In response to digital commands, the nibs create electrostatic dots on the paper or film passing over the writing head. The plotter then exposes the media to liquid toner, producing an image.

Although Versatec is the only supplier of a desktop electrostatic printer/plotter, color versions are in development at other companies and may be available next year. According to Versatec's Dale Richmond, product manager for the V-80, the company is working on a small-format (desktop) color electrostatic printer/plotter, but completion date is uncertain.

The major advantages of electrostatic units are high speed, high resolution, quietness, reliability and dual-mode operation. The V-80 operates in text mode at 1,000 lpm and 1.2 inches per second in plot mode. It has a resolution of 200 dpi, providing 40,000 points per square inch, and a mean time between failures (MTBF) of 3,000 hours. The V-80 requires dielectrically coated paper, which costs about 1½ cents per page.

Richmond admits to competition from ink-jet and impact dot-matrix units, but says Versatec will meet it with faster, higher-resolution color units. On the down side, the raster-based V-80 requires vector-to-raster conversion software to run vector-based application programs. This is available in the Versaplot package, which adds a few thousand dollars to the price. Versaplot for Digital Equipment Corp.'s VAX, for example, sells for $3,500; a PDP-11 package, $2,000.

The electrostatic-output device market was worth $138 million in 1981 and $178 million in 1982, according to Creative Strategies. In 1982, Versatec had 66.3 percent of the market, Benson Inc. had 21.3 percent, and Calcomp-Sanders Associates Inc. had 12.4 percent.

Thermal-transfer technology uses a thermal print head with nibs that, when heated, melt dots of pigment onto the paper or transparency. An ink-sheet roll, positioned over a paper-transport roll, contains three bands of yellow, cyan and magenta. The medium makes one pass under the print head for each of three colors.

The major drawbacks to thermal printer/plotters are resolution and cost. Seiko Instruments U.S.A. Inc.'s CH5201B, for example, has a resolution of 150 dpi and a price tag of $11,950. Most analysts believe that thermal-transfer output devices will not have much impact in the desktop, high-quality graphics area until prices come down and resolution improves.

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

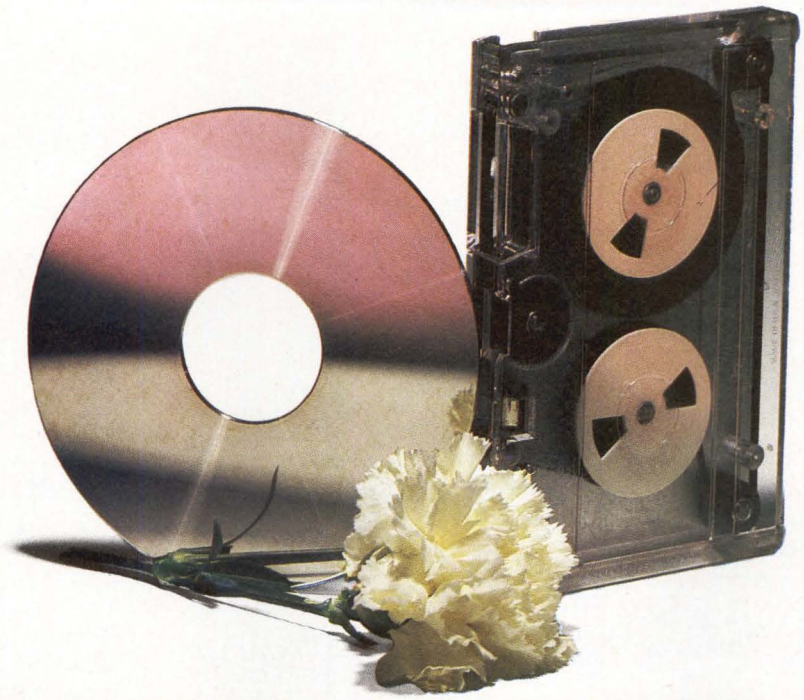
Fig. 4. Paper sizes *are often indicated according to American National Standards Institute (ANSI) or International Standards Organization (ISO) standards.*

Measuring pen-plotter accuracy

Hewlett-Packard Co. defines accuracy as the exactness with which a plotter can position one endpoint with respect to another endpoint. Most applications do not require perfect accuracy, but if an application calls for exact spacing between parallel lines or if precise measurements will be taken from the plot, the buyer should be aware of the plotter's accuracy level. Two related specifications are important: repeatability and resolution.

Repeatability measures how closely a plotter returns a pen to a plotted point, describing the ability to join new elements to those previously plotted. HP considers good repeatability to be within one-third of a line width. Most desktop plotters have 0.001- to 0.008-inch repeatability. Low-cost plotters, such as Mannesmann Tally Corp.'s Pixy 3 Microplotter ($795) and Radio Shack's FP-215 ($995), have lower repeatability specifications (0.012 inch).

Mechanical resolution is the smallest move a plotter can make in any direction. The shorter the mechanical resolution, the smoother the line. Good mechanical resolution reduces the "stair-stepping," or jagged-line, effect. Addressable resolution is the smallest pen move a user can specify programmatically. According to HP, the human eye cannot distinguish between moves smaller than 0.001 inch, so addressable resolution need not be finer than 0.001 inch. Because it would be useless to have a smaller addressable resolution than mechanical resolution, mechanical resolution is generally more important. The accompanying survey chart notes re-



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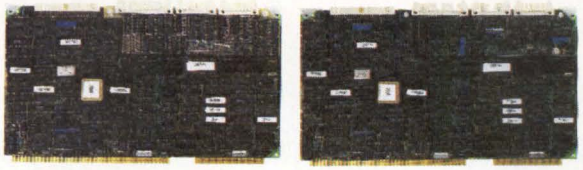

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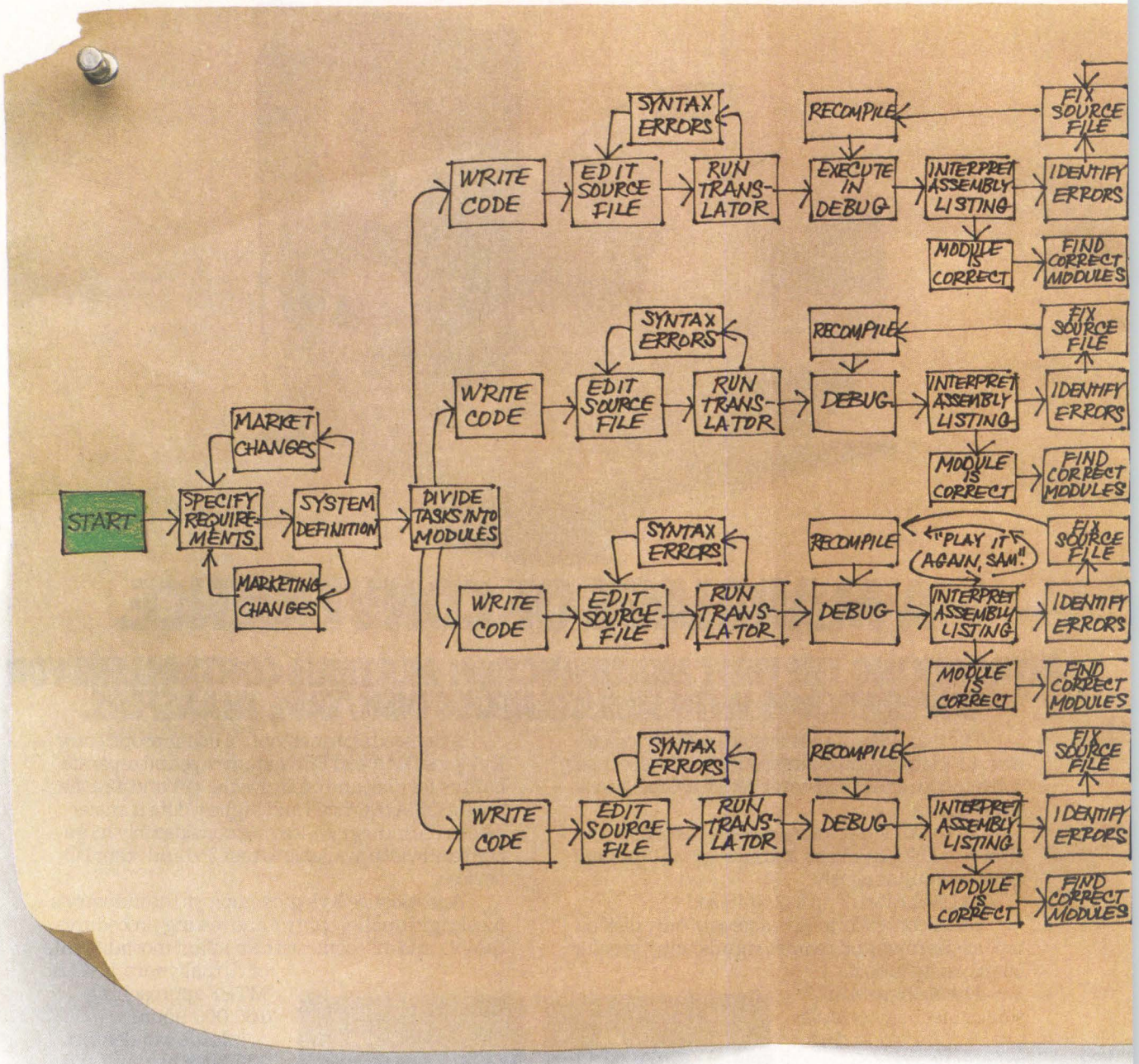

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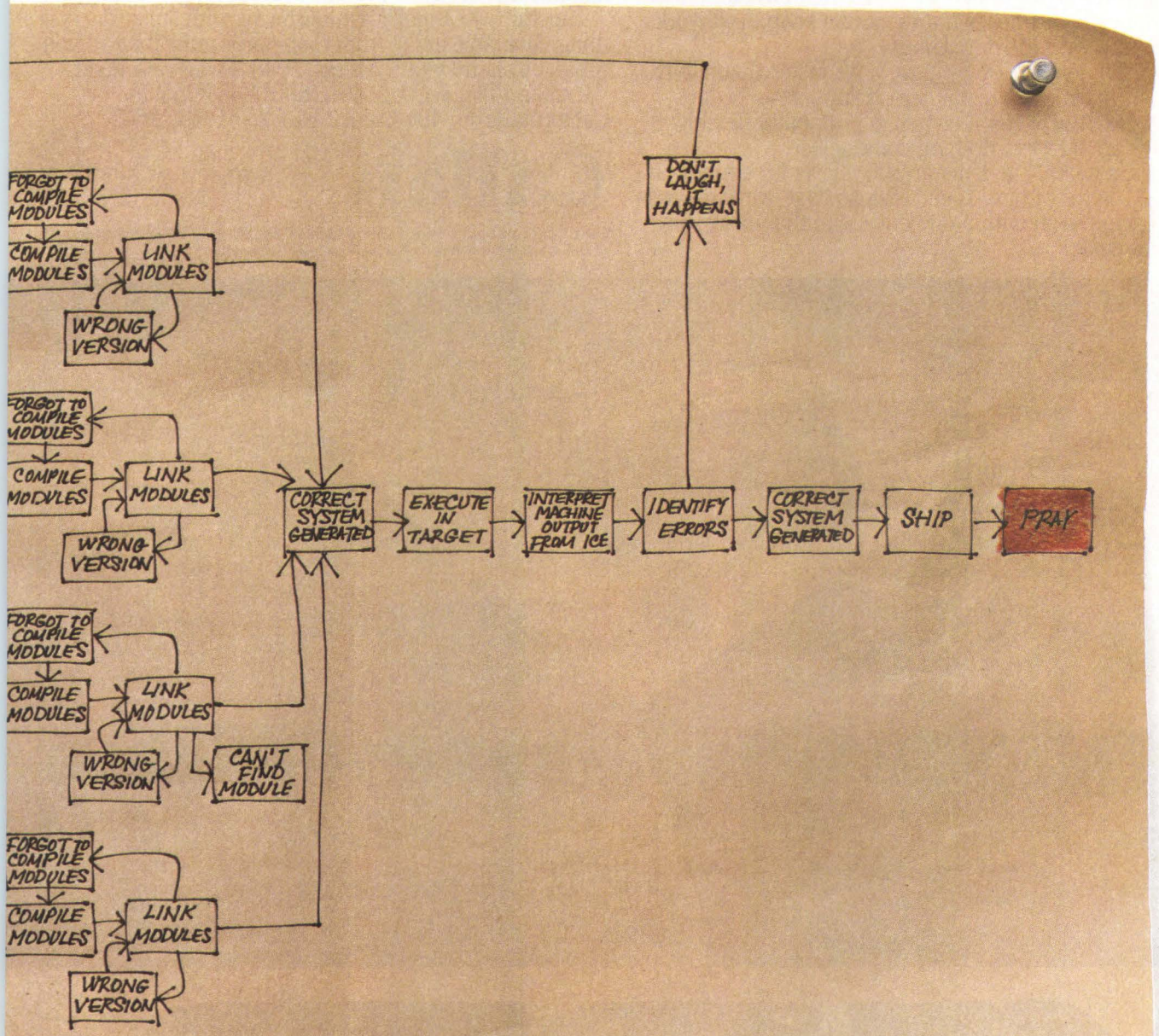

cally recompiles those modules that need it, and produces the complete, correct system. Automatically, of course.

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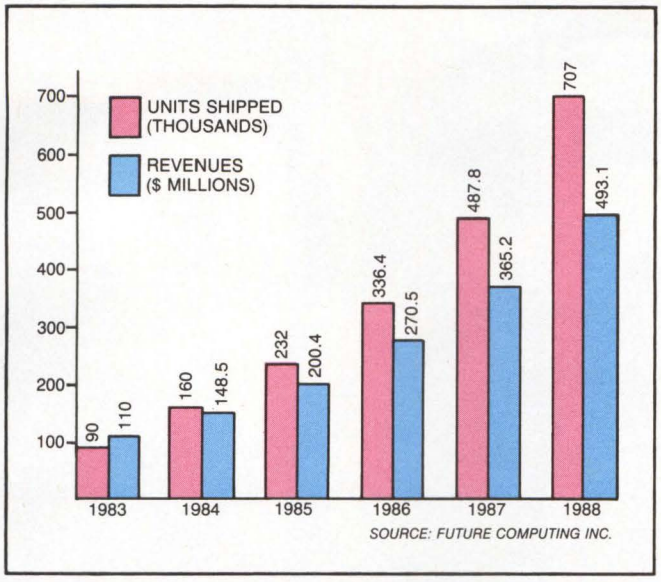

Fig. 5. The U.S. market for office-based desktop plotters *is expected to increase at a 45 percent compound annual growth rate in terms of units shipped and at a 35 percent growth rate for total revenues.*

peatability and mechanical resolution for most desktop pen plotters.

Other performance parameters important in choosing a plotter are the type and size of media that the plotter will accept (Fig. 4), plotter speed, pen actualization and acceleration and the number of available character sets and colors. Pen actualization is the time it takes the plotter to select and position a pen, and pen acceleration, measured in G's, is the time it takes for the pen to reach top speed. An increasingly important area of consideration is software (see "Graphics software schemes enhance peripheral interfacing," Page 163).

Micro boom pushes plotter market

According to Future Computing, unit shipments of office-based desktop plotters were 90,000 in 1983 and will exceed 700,000 in 1988, representing a compound annual growth rate of 40 percent. Revenues will jump from $110 million in 1983 to about $500 million in 1988 for a 35 percent compound annual growth rate (Fig. 5). Some research companies, such as Dataquest, predict that total revenues for less-than-$2,000 pen plotters will drop from 1984 to 1985 due to decreasing prices. Dataquest also predicts that pen-plotter market growth will stabilize in 1986 to 1987 because of encroachment from ink-jet, dot-matrix and thermal units.

The driving forces behind the need for desktop plotters are the office-based microcomputer boom and the graphics demands of popular application packages such as Lotus' 1-2-3 and Sorcim Corp.'s SuperCalc III. When asked what the major trends will be, many analysts respond, "Watch HP." HP has the lion's share of the installed base, its plotters are generally considered state-of-the-art, its introductions spawn me-too products, and it is able to price products competitively due in large part to economies of scale. HP's recently announced $595 ink-jet printer is a good indication of what the company can do price-wise. "In addition," says Future Computing's John Hoper, "plotters are seen as specialty items in the retail market. Retailers don't handle a lot of brands," which makes it difficult for start-ups to establish a foothold.

But the need for low-cost graphics output has created a new market niche—the less-than-$1,000 plotter. Several start-up companies have entered this arena within the last year and are now showing significant success. Examples of low-cost pen plotters are C. Itoh Electronics Inc.'s four-pen CX4800 ($695); Enter Computer's single-pen, 12-color Sweet P model 100 ($695); Mannesmann Tally's eight-pen Pixy 3 Microplotter ($795); Roland DG's eight-pen DXY-800 ($995); Strobe's eight-pen M260 ($995); and Yokogawa Corp. of America's four-pen PL-1000 ($995). Yokogawa supplies Apple Computer Inc. with the model 410 color plotter, which Apple sells for $779.

Other manufacturers have responded predictably to the influx of low-cost plotters. About a year ago, HP slashed 30 percent off the price of its two-pen 7470A to $1,095 and introduced the six-pen 7475A at $1,895. Calcomp-Sanders, traditionally a manufacturer of large-format plotters, introduced the eight-pen, $1,995 model 84. In a similar move, Houston Instrument went from a predominantly engineering-based product line to personal-computer-based plotters priced at less than $1,000.

Pricing competition from non-pen-plotter technologies is expected to drive pen-plotter prices downward over the next five years. For example, Diablo Systems' Series C150 ink-jet printer/plotter is competitively priced at $1,295, as is Lear Siegler's $2,195 model 520 impact dot-matrix printer/plotter. Although thermal and electrostatic printer/plotter prices are currently too high to compete effectively at the low end, prices will drop over the next two or three years as manufacturers smooth technology wrinkles and reach high-volume production.

Future Computing predicts that prices for low-end desktop plotters will plummet 50 percent over the next four years for units targeted at floppy disk-drive-based systems and 30 percent for units aimed at Winchester disk-drive-based systems. The market for less-than-$2,000 plotters is expected to increase tenfold by 1988. □

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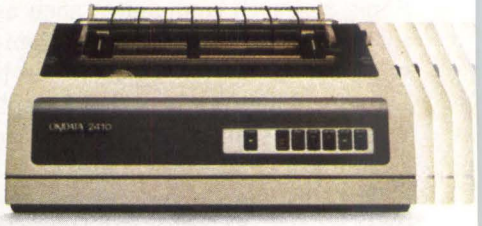

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DESKTOP PLOTTERS

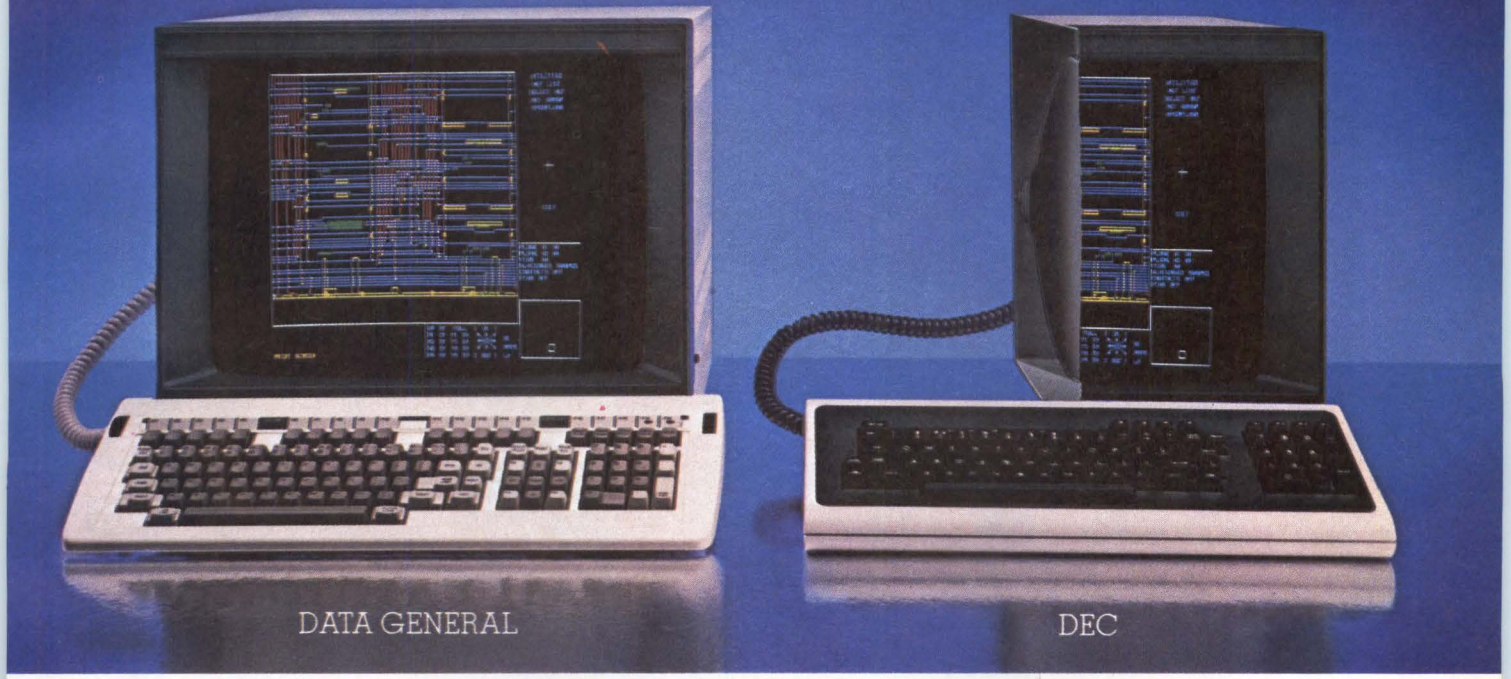
Company / Model	Plotter type	Pens: Type	Pens: No. of colors	Pens: Plotting speed (ips)	Media: Type	Media: Size (in.)	No. of character sets available	Mechanical resolution (in.)	Repeatability (in.)	Compatible software	Hardware interface	Price ($)	Circle no.
ADVANCED COLOR TECHNOLOGY 21 Alpha Rd. Chelmsford, MA 01824 (617) 256-1222													767
Act II	printer/ plotter	ink jet	8 solid colors, 125 hues	(8½ x 11 image takes 90 sec.)	paper, transparency	14⅞ roll, tractor feed		horiz: 85–140 dpi vert: 85 dpi		ACT supplies drivers for IBM PC, Apple IIe, S-100; drivers available for Chromatics, Lundy, Vetrix, Megatek, others.	serial, parallel, RS170		
ALPHA MERICS CORP. 20931 Nordhoff St. Chatsworth, CA 91311 (213) 709-1155													768
Alphaplot I	open-bed	fiber tip, wet ink	6	7	paper, film, mylar	drafting 18 x 30	2	.00125	.00125	Hewlett Packard, HPGL compatible	RS232C	4,590	
Alphaplot II	open-bed	fiber tip, wet ink	6	7	film, paper	24 x 34	2	.00125	.00125	Hewlett Packard, HPGL compatible	RS232C	5,590	
AMDEK CORP. 2201 Lively Blvd. Elk Grove, IL 60007 (312) 364-1180													769
Amplot II	flatbed	felt tip	6	8	paper, film	11 x 17	1	.002	.004	many packages available on Apple and IBM; Lotus driver supplied	RS232C, Centronics	1,099	
APPLE COMPUTER 20525 Mariani Ave. Cupertino, CA 95014 (408) 996-1010													770
Apple Color Plotter Model 410 (manufactured by Yokogawa Corp. of America)	grit wheel	special Apple Plotter pens, felt tip	4	4	paper, transparency	up to 11 x 17	software generated	.004	.008	Apple Business Graphics; PSS Graph; Graph + Calc Chartmaker, Apple writer; Apple Logo; CAD Apple, CAD 1 Micrograph	RS232C	779	
CALCOMP-SANDERS 2411 W. LaPalma Ave. Anaheim, CA 92803 (714) 821-2011													771
Model 84	flatbed	liquid ink, nylon	8	17.7	paper, film	8½ x 11	6	.004	.004	over 30 commercial software packages available	RS232C, IEEE-488, Centronics	1,995	
Model 1012	drum	liquid ballpoint, nylon	4	10	paper, film	8½ x 11, 11 x 17	1	.08			RS232C, IEEE-488, Centronics	8,400	
C. ITOH ELECTRONICS 5301 Beethoven St. Los Angeles, CA 90066 (213) 306-6700													772
CX4800	printer/ plotter; pen plotter	water-based ballpoint	4	4.8	paper	10			.008		Centronics, RS232C	695	

Chart includes pen plotters and representative printer/plotters

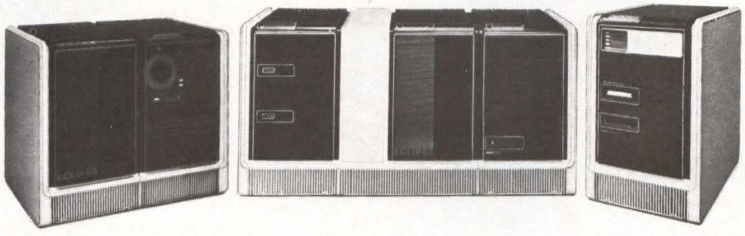
DESKTOP PLOTTERS

Company / Model	Plotter type	Pens: Type	Pens: No. of colors	Plotting speed (ips)	Media: Type	Media: Size (in.)	No. of character sets available	Mechanical resolution (in.)	Repeatability (in.)	Compatible software	Hardware interface	Price ($)	Circle no.
COMREX INTERNATIONAL 3701 Skypark Dr. Suite 120 Torrance, CA 90505 (213) 373-0280													773
ComScriber CR-1810	grit wheel	fiber tip	1	6	paper, transparency	8½ x 11		.004	.004	IBM PC, Apple, Epson, Kaypro, Osborne, Vector, Zenith	RS232C, parallel	695	
DIABLO SYSTEMS P.O. Box 5030 Fremont, CA 94537 (415) 498-7000													774
Series C150	printer/ plotter	ink jet	4 color cartridges, 100 + mixtures		paper, film	8½ x 11		120 dpi x 120 dpi		Lotus 1-2-3, 4-point graphics, INFOgraphics, Digital Research, Island Graphics Software	Centronics, RS232C	1,295	
ENTER COMPUTER INC. 6867 Nancy Ridge Dr. San Diego, CA 92129 (619) 450-0601													775
Sweet-P Model 100	grit wheel	fiber tip	1	6	paper, transparency film	8½ x 11	1	.004	.004	Many commercially available graphics programs	RS232C	695	
Sweet-P Model 600 Six-shooter	grit wheel	fiber tip	6	14	paper, transparency film	8½ x 11	19	.004	.004	Over 27 commercially available graphics programs; all HP-compatible graphics software	Centronics	1,095	
ENVISION 631 River Oaks Parkway San Jose, CA 95134 (408) 946-9755													776
430	printer/ plotter	impact dot matrix	8		paper, film	5–13	2 as a plotter; 6 as a printer	.0069 (vert) .0027 (horiz)		emulates Diablo 630, HP 7475	RS232C, Centronics	3,495	
FACIT DATA PRODUCTS 235 Main Dunstable Rd. Nashua, NH 03061 (603) 883-4157													777
4542	printer/ plotter	dot matrix	2		pinfeed only	2–17.8	11	72 dpi (vert) 140 dpi (horiz)		opt. Plot-10 graphics	parallel, RS232C, IEEE-488	3,995	
4544	printer/ plotter	dot matrix	4		pinfeed only	2–17.8	11	72 dpi (vert) 140 dpi (horiz)		opt. Plot-10 graphics includes driver	parallel, IEEE-488	4,695	
HESTAIR DATALINE LTD. Printer Div. 60 Charles St. Leicester, LE1 1FB, UK													778
B1000	drum	water-or oil-based fiber tip	4	4		10 x 15	1	.003	.01	optional graphics ROM	Centronics, RS232C		

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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Data General's ECLIPSE® MV/Family of 32-bit computers brings you the best price/performance available for engineering applications—while running some of the best electronics engineering software.

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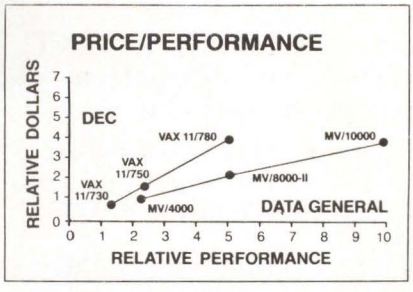
And Data General keeps you a generation ahead by bringing you comprehensive service plans and industry standard software development environments.



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a Generation ahead.

CIRCLE NO. 100 ON INQUIRY CARD

UNIX™ System V from AT&T can help you close a sale, as well as open up new markets.

It's another reason why good business decisions are based on UNIX System V from AT&T.

More and more of your customers will be demanding multi-user and multi-tasking systems. The benefits of UNIX System V—portability, reliability, flexibility—make it the ideal software system for this lucrative market.

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More choices, more opportunities

UNIX System V is virtually hardware independent. So you'll be able to configure systems using equipment from a variety of vendors.

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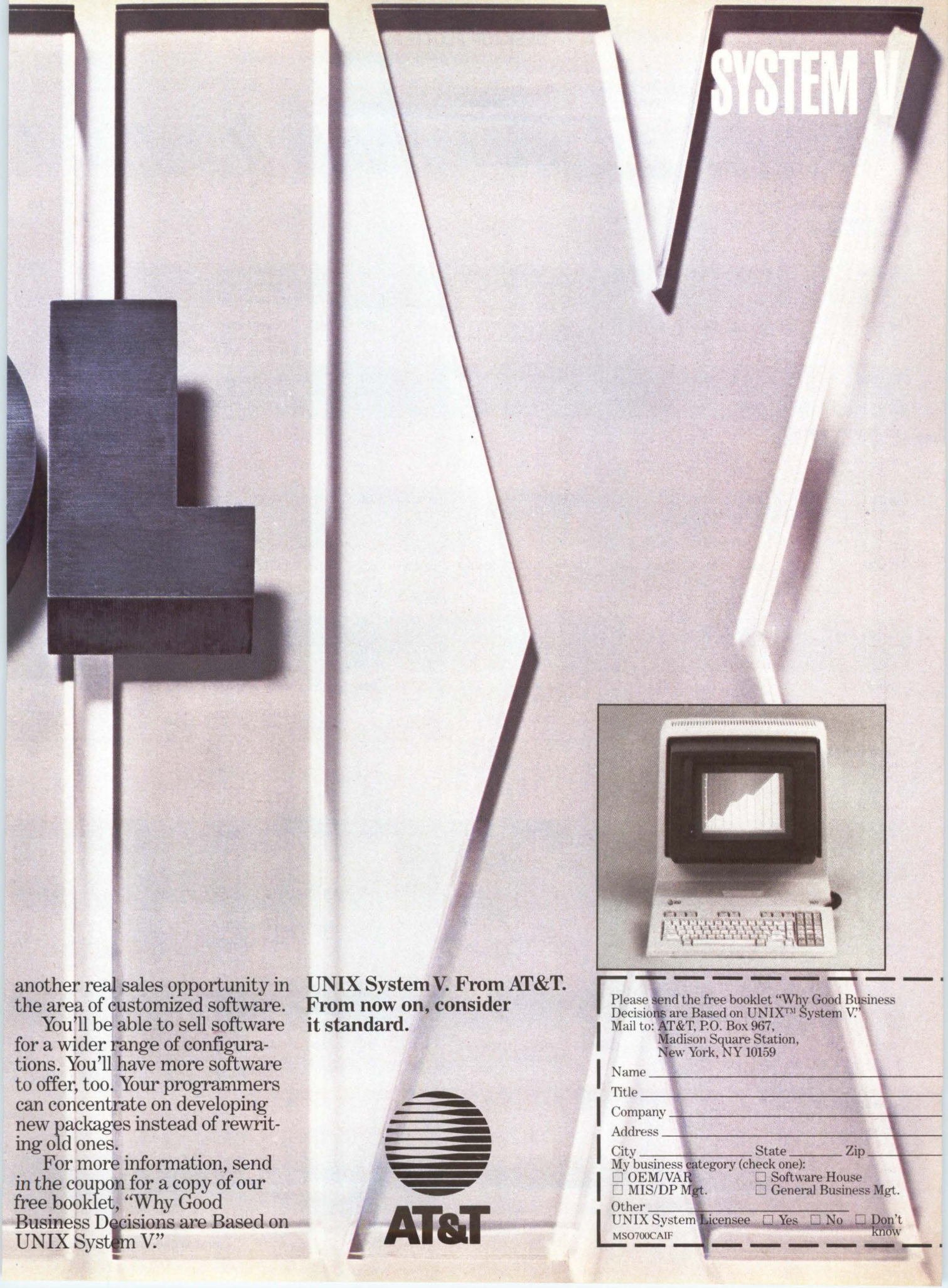
And over the long term, UNIX System V offers continuing opportunities to upgrade and expand your customers' systems. End-user flexibility translates into market opportunity for the reseller.

Software that sells

UNIX System V offers



another real sales opportunity in the area of customized software.

You'll be able to sell software for a wider range of configurations. You'll have more software to offer, too. Your programmers can concentrate on developing new packages instead of rewriting old ones.

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My business category (check one):

☐ OEM/VAR ☐ Software House

☐ MIS/DP Mgt. ☐ General Business Mgt.

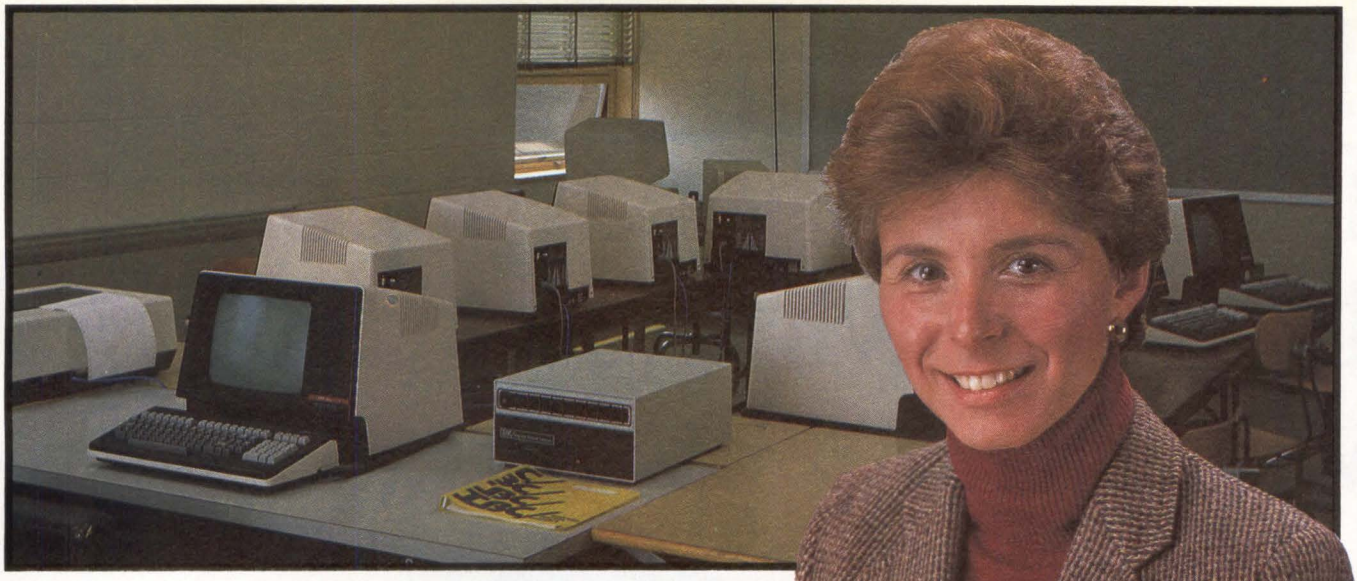
Other _____

UNIX System Licensee ☐ Yes ☐ No ☐ Don't know

MSO700CAIF

DESKTOP PLOTTERS

Company / Model	Plotter type	Pens: Type	Pens: No. of colors	Pens: Plotting speed (ips)	Media: Type	Media: Size (in.)	No. of character sets available	Mechanical resolution (in.)	Repeatability (in.)	Compatible software	Hardware interface	Price ($)	Circle no.
HEWLETT-PACKARD CO. 3000 Hanover St. Palo Alto, CA 92127 (415) 857-1501													779
HP7470A	roller grip	fiber tip	2	15	paper, overhead transparency film	8½ x 11	5	.001	.004	Hewlett Packard, Apple II, IIe, III; DEC Professional, IBM PC/XT	RS232C, HP-IG	1,095	
HP7475A	roller grip	fiber tip	6	15	paper, overhead transparency film	8½ x 11, 11x17	19	.001	.004	Hewlett Packard, Apple II, IIe, III; DEC Professional, IBM PC/XT	RS232C, HP-IG	1,895	
HP7550B	roller grip w/sheet feeder	fiber tip	6	15	paper, film	8½ x 11, 11x17	19	.001		Hewlett Packard, Apple II, IIe, III; DEC Professional, IBM PC/XT		3,900	
HOUSTON INSTRUMENTS P.O. Box 15720 Austin, TX 78753 (512) 835-0900													780
CPS-20	drum	Pentel, ballpoint, drafting, fiber tip	8	4.2	fan fold, roll chart, vellum, polyester film	11 x roll	up to 5	.005	.005	DM/PL	incremental parallel, Centronics	3,995	
CPS-30	drum	Pentel, ballpoint, drafting, fiber tip	8	4.2	fan fold, roll chart, vellum, polyester film	22 x roll	up to 5	.005	.005	DM/PL	incremental parallel, Centronics	5,995	
DMP-29, 29-3	flatbed	plastic nib	8	22	heavy bond, polyester film	11 x 17	5			most commercially available micro-computer packages	RS232C, GPIB, Centronics	2,295–2,790	
DMP-40, 40-2	drum	plastic nib, ballpoint, film ink	1, 2	4.2	bond, vellum, polyester film	11 x 17	5	.005	.005	most commercially available micro-computer packages	RS232C	995	
IBM INSTRUMENTS INC. Orchard Park P.O. Box 332 Danbury, CT 06810 (203) 796-2444													781
XY/749	flatbed	fiber tip, nylon tip, cera-micron tip, steel tip	8	13 or 18	paper, vellum, transparencies	8½ x 11	6	.04	.004	over 27 commercially available programs	RS232C, IEEE 488	1,995	
XY/750	flatbed	fiber tip, liquid ink	8	13	paper, transparencies	11 x 17	5	.04	.004	over 27 commercially available programs	RS232C, IEEE 488	4,500 5,500 (w/continuous paper feed)	
7371		felt tip	2	15	paper, transparencies	8½ x 11	5	.001	.004	IBM Industry Standard Plot Command Package, SASSGRAPH	RS232C, IEEE 488	1,100	
7372		felt tip	6	15	paper, transparencies	8½ x 11, 11 x 17	19	.001	.004	IBM Color Plotter support for GDDM; Lotus 1-2-3, BPS	RS232C, IEEE 488	1,900	
LEAR SIEGLER INC. 714 N. Brookhurst St. Anaheim, CA 92803 (714) 774-1010													782
Versaprint Model 520	printer/ plotter	dot matrix	4			16	9	150 dpi (horiz), 144 dpi (vert)	.003 dot resolution	Lotus 1-2-3; BPS, other major PC pkgs.: OEM-supplied drivers	current loop	1,395 (Q1000) 2,195 (Q1)	



"We bought an IBC Middi Cadet™ because no other system could do the job."

Sue Kardas
Director of Career Training
Burlington Area Vocational-Technical Center

"When the Burlington Area Vocational-Technical Center needed a multi-user system for student training, we considered many multi-user systems, but in demo after demo there was too much of a user delay.

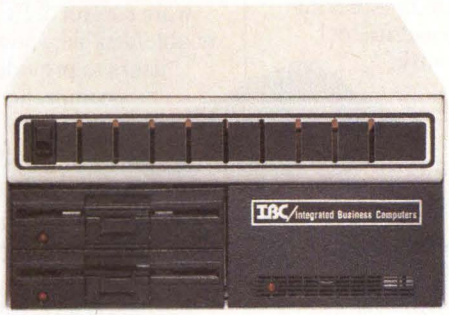
Then IBC contacted us, and offered to demonstrate the Middi Cadet's multi-user capabilities-we were skeptical, but we gave it a try.

First, the Middi Cadet ran 9 users doing word processing without any delays. As a second test, we had the Middi operating 3 terminals each on word processing, accounting and BASIC programming. Again, no user delay. This was the multi-user, multi-tasking system we had been looking for.

With the Middi Cadet, we got a higher speed Z80B processor, a very fast hard disk drive and enough memory to do the job (512K Bytes).

On top of that, we felt that we got a very good price from an excellent vendor. Our system was delivered and installed two weeks later. Since then we've been so pleased with the Middi that we're planning to buy another. With two systems providing 18 stations we will be equipped to offer training in all aspects of information processing."

The Middi Cadet is a 10 user system that includes a 6MHz, Z80B CPU; 256 to 512K Bytes of RAM memory; a 20 MB, 5¼" hard disk drive and a one megabyte 5¼" floppy disk drive.



For more information on the Middi Cadet, see your local IBC dealer.

To locate the dealer nearest you, call or write:

OUTSIDE THE USA

IBC/Integrated Business Computers

21592 Marilla Street
Chatsworth, CA 91311
(213) 882-9007 TELEX NO. 215349

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IBC/ DISTRIBUTION

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(801) 621-2294

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See us at NCC, Las Vegas Booth #D4128

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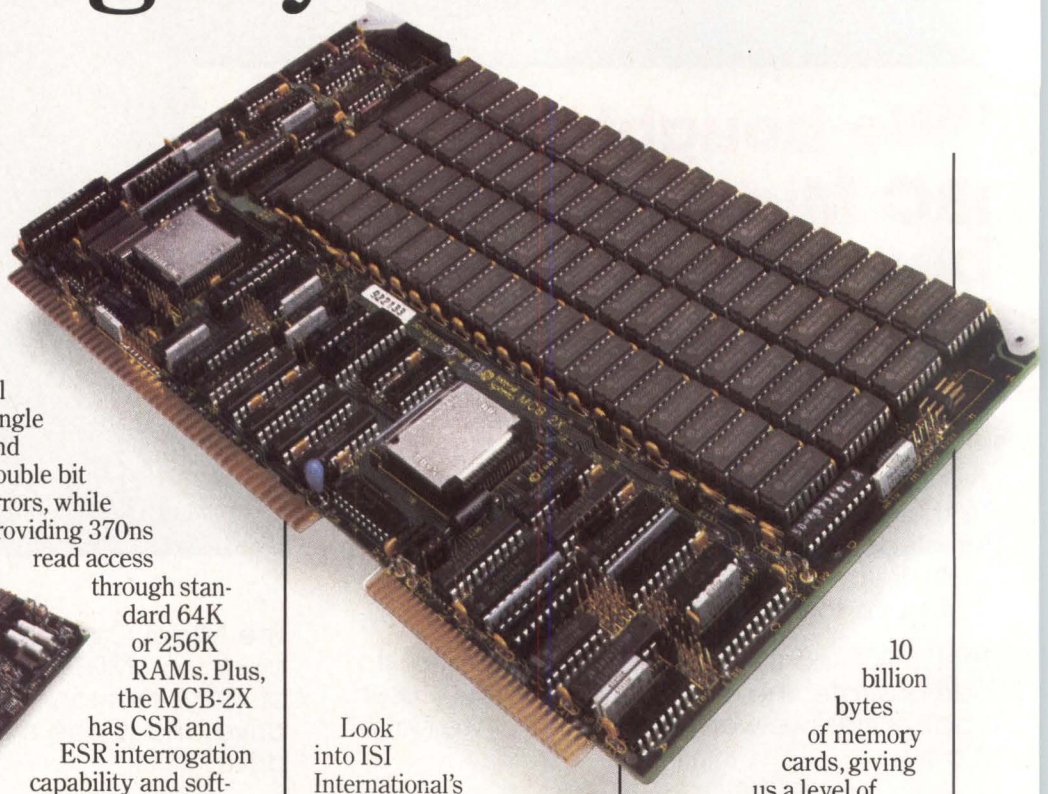
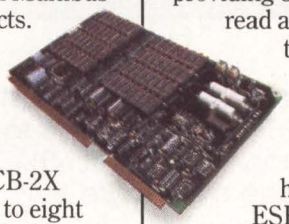
The first thing ISI International put on this new Multibus® card was 2 megabytes...

And that was just the beginning.

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

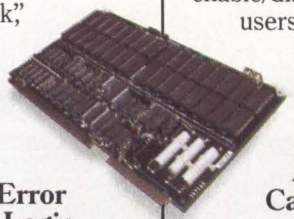




MCB-364

Superior Dynamic Memory Relocation.

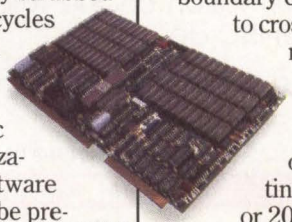
The new MCB-2X can relocate up to eight 64K or 256K blocks independently—making it a very powerful tool for "RAM disk," graphics display or multiple table look-up applications.



MCB-332

Expanded Error Correction Logic.

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



MCB-512

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

Flexible Addressing Capabilities.

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

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

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

*Multibus is a Trademark of Intel Corp.

ISI INTERNATIONAL **Formerly Intersil Systems**

ISI International Corporation
1275 Hammerwood Avenue, Sunnyvale, CA 94089 • (408) 743-4443

CIRCLE NO. 102 ON INQUIRY CARD

DESKTOP PLOTTERS

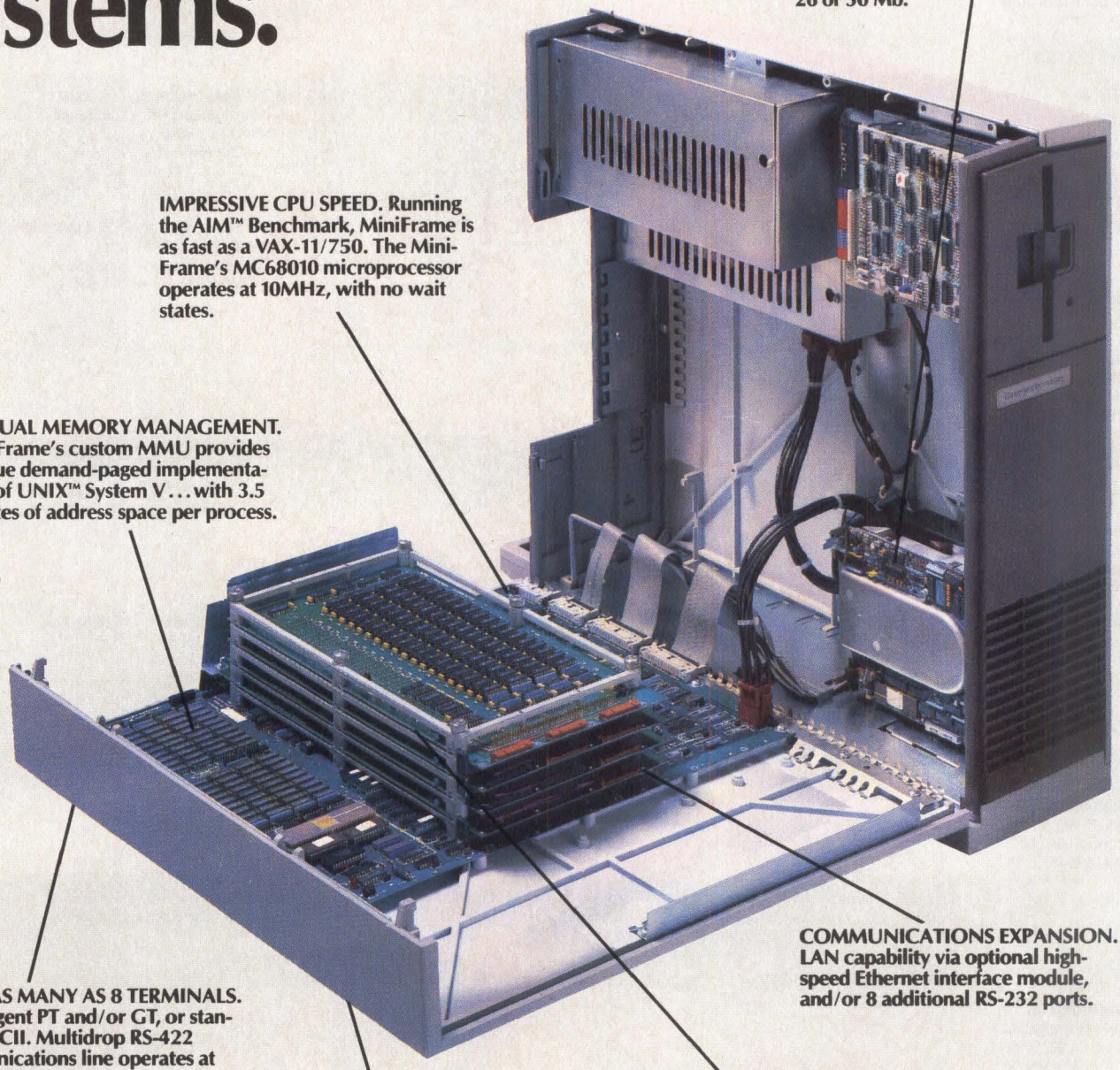
Company / Model	Plotter type	Pens: Type	Pens: No. of colors	Pens: Plotting speed (ips)	Media: Type	Media: Size (in.)	No. of character sets available	Mechanical resolution (in.)	Repeatability (in.)	Compatible software	Hardware interface	Price ($)	Circle no.
MANNESMANN TALLY CORP. 8301 S. 180th Kent, WA 98032 (206) 251-5524													783
PIXY 3 Microplotter	flatbed	water, oil-based fiber tip	8	8	paper, film	8½ x 11	9	.003	.012	PIXYGraph, Apple Business Graphics, BPS, Graphwriter, Lotus 1-2-3, Curve II, GrafTalk, others	RS232C, parallel	795	
NICOLET ZETA CORP. 2300 Stanwell Dr. Concord, CA 94520 (415) 372-7568													784
ZETA 8	drum	nylon tip liquid roller; film; liquid ink, ballpoint	8	20	translucent vellum, glossy bond, clear inking film, acetate film	11 x 50, 11 x 120	11	.001	.002	Nicolet Zeta's proprietary software including FPS, Functional, Typset, ZCHART	RS232C, IEEE 488	5,950	
ZETA 887	drum	nylon tip liquid roller; film; liquid ink, ballpoint	8	20	translucent vellum, glossy bond, clear inking film, acetate film	11 x 50, 11 x 120	11	.001	.002	Nicolet Zeta's proprietary software including FPS, Functional, Typset, ZCHART	RS232C, IEEE 488, SNA, SDLC, BSC	7,950	
NUMONICS 418 Pierce St. Landsdale, PA 19446 (215) 362-2766													785
Model 5412	grit roller	fiber tip, ballpoint, liquid ink	1	5	cut sheet film, mylar	10 x 36	2	.005	.003		RS232C, IEEE-488, Centronics	1,295	
PANASONIC INDUSTRIAL CO. 1 Panasonic Way Secaucus, NJ 07094 (201) 348-5336													786
VP-6801P	flatbed	oil-, water-based fiber tip, water-based plastic tip, water-based ballpoint	6	16	paper, transparency	7.2 x 10	1	.003	.012	Apple Business Graphics, BPS, ChartMaster, GrafTalk, Curve II and others	8-bit parallel, RS232C	1,565	
PRINTACOLOR CORP. 6040 N. Belt Dr. Norcross, GA 30071 (404) 448-2675													787
TC 1040	printer/ plotter	ink jet	4913	(8½ x 11 image takes 90 sec.)	bond, high intensity paper, transparencies	14⅞ width	8	85 dpi or 120 dpi (horiz) 85 dpi (vert)		16–20 drivers written for most popular models	RS232C, Centronics	5,495	
PRINTRONIX INC. 17500 Cartwright Rd. Irvine, CA 92713 (714) 863-1900													788
MVP	printer/ plotter	dot matrix	b&w		paper	8½ x 11				IBM-PC software	RS232C, Centronics, Dataproducts	3,745	

An open-and-shut case for making MiniFrame™ your first choice in low-cost OEM systems.

ONE TO EIGHT USERS. MiniFrame can be configured for up to 50 Megabytes of integral mass storage: 5¼" Winchester fixed disks of 13, 26 or 50 Mb.

IMPRESSIVE CPU SPEED. Running the AIM™ Benchmark, MiniFrame is as fast as a VAX-11/750. The MiniFrame's MC68010 microprocessor operates at 10MHz, with no wait states.

VIRTUAL MEMORY MANAGEMENT. MiniFrame's custom MMU provides unique demand-paged implementation of UNIX™ System V... with 3.5 Mbytes of address space per process.



COMMUNICATIONS EXPANSION. LAN capability via optional high-speed Ethernet interface module, and/or 8 additional RS-232 ports.

RUNS AS MANY AS 8 TERMINALS. Convergent PT and/or GT, or standard ASCII. Multidrop RS-422 communications line operates at 307 Kbit/sec.

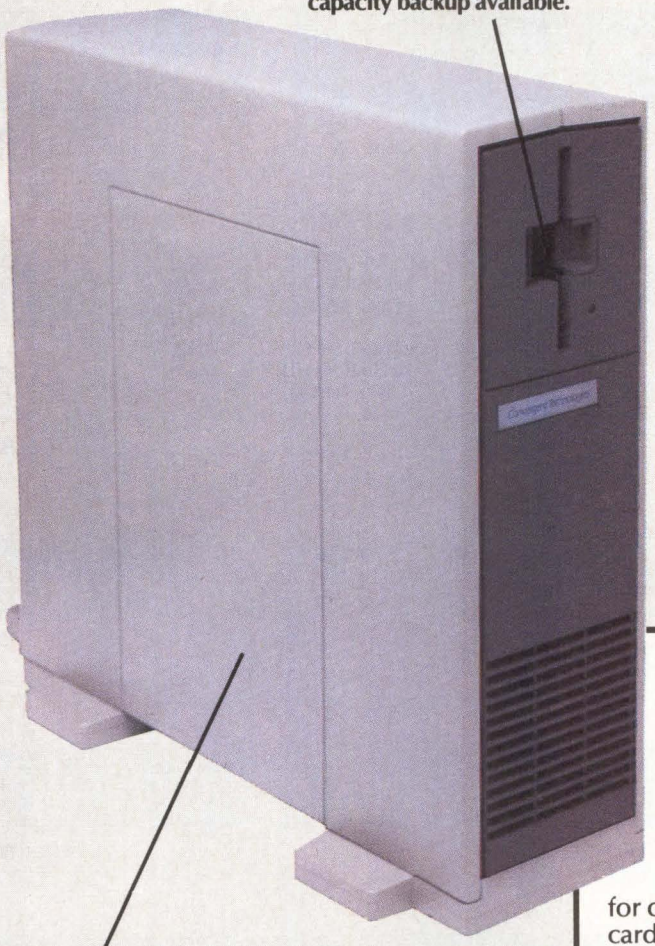
ECONOMICAL MEMORY EXPANSION. MiniFrame provides ½ Megabyte of RAM standard; up to three boards can be added for system expansion to 2 Mb.

FOR HIGH-SPEED PRINTERS, a Centronics-compatible parallel printer port is standard in the MiniFrame processor.

MiniFrame: another first from Convergent Technologies. Super-minicomputer power at PC prices.

OEMs can now meet the needs of small to medium-sized organizations for low-cost, high-performance systems capable of handling large UNIX-based applications.

The MiniFrame system—which effectively opens a whole new market for you—is unique not just for its price/performance advantages. It also provides complete flexibility in meeting requirements ranging from single-user "personal UNIX systems" to eight-terminal data-processing installations.



WE'VE CLOSED OUR CASE... now send for a complete information package. Write to Convergent Technologies, Data Systems Division, 3055 Patrick Henry Drive, Santa Clara, CA 95050. Phone: 408/980-0850. Telex: 176-825.

Convergent Technologies

Where great ideas come together

CIRCLE NO. 103 ON INQUIRY CARD

Convergent Technologies achieved this breakthrough by adapting the innovative hardware and software developed for its MegaFrame multiprocessor.

The result is a powerful, compact and expandable unit priced to give you the maximum opportunity of capitalizing on a rapidly growing UNIX market.

There are, of course, many other unique benefits of the MiniFrame system.

Convergent provides foundation software for office applications—including a powerful, Wang keystroke-compatible word processor, an advanced financial spreadsheet and complete electronic mail facility.

The Window Manager permits viewing and manipulating of up to four applications running simultaneously on Convergent's PT or GT terminal screens.

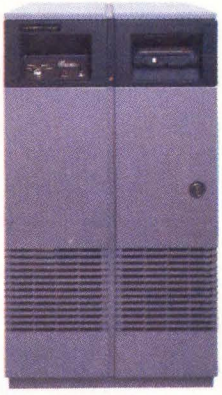
Major performance increases result from utilizing these terminals with the MiniFrame. At only slightly higher cost than standard "dumb tubes", our PT or GT terminals offer high-speed communications plus built-in processor with enough memory to execute key portions of the system code.

Programming languages include industry-standard High Level COBOL and BASIC, full FORTRAN-77, Pascal and C.

OEM prices for the MiniFrame start at less than $5,000; an eight-user MiniFrame can be configured for under $10,000. Prices like these make it an open-and-shut case for choosing the MiniFrame.

Graceful upgrade path to the MegaFrame.™

The MegaFrame, Convergent Technologies' revolutionary super-minicomputer system, utilizes multiple processors; has expansion potential to 128 users, 8 MIPS and gigabytes of disk storage. It enables OEMs to handle today's growing demand for computing services without discarding a single piece of hardware . . . or being forced into expensive CPU upgrades.



Applications software can be transported—unchanged—from the MiniFrame to the MegaFrame whenever the workload requires it. The two systems are object-code compatible, allowing OEMs to provide a complete family of systems.

MegaFrame: proof that if anyone can build a UNIX system the way it should be built—it's Convergent Technologies.

DESKTOP PLOTTERS

Company / Model	Plotter type	Pens: Type	Pens: No. of colors	Pens: Plotting speed (ips)	Media: Type	Media: Size (in.)	No. of character sets available	Mechanical resolution (in.)	Repeatability (in.)	Compatible software	Hardware interface	Price ($)	Circle no.
RADIO SHACK 1800 One Tandy Center Fort Worth, TX 76102 (817) 390-3631													789
FP-215	flatbed	fiber tip	1	4	paper	10 x 14	1	.004	.012	CGP-115		995	
CGP-115	platen	ballpoint	4	2 1/16	paper	4 inch roll	1	.004	.008	Radio Shack software		199	
RICOH OF AMERICA INC. 5 Dedrick Place West Caldwell, NJ 07006 (201) 575-9550													790
GP-1		ballpoint, felt tip	4	4.7	continuous feed, cut roll paper; overhead transparency	8 x 11		.003			Centronics, RS232C		
ROLAND DG, Division of Roland Corp US 7200 Dominion Circle Los Angeles, CA 90040 (213) 685-5141													791
DXY-800	flatbed	felt tip	8	7.5	bond, acetate	11 x 17	1	.004	.01	KEYCHART, SUPERCALC III, CHARTMASTER, BPS, AutoCad	RS232C, parallel	995	
DXY-101	flatbed	felt tip	1	7.5	bond, acetate	11 x 17	1	.004	.01	KEYCHART, SUPERCALC III, CHARTMASTER, BPS, AutoCad	RS232C, parallel		
SANYO BUSINESS SYSTEMS CORP. 51 Joseph St. Moonachie, NJ 07074 (201) 440-9300													792
PR 100 XY	modified flatbed	water-, oil-based fiber tip	4	4	paper	10 x 15	1	.003	.008	GrafTalk	serial, parallel	995 (parallel) 1,095 (serial)	
SEIKO INSTRUMENTS U.S.A. INC. 2620 Augustine Dr. Suite 140 Santa Clara, CA 95051 (408) 943-9100													793
CH5201B	thermal ink transfer	8		(8½ x 11 image takes 60 sec.)	paper, transparencies	8½ x 11		150 dpi			parallel, video	11,950	
SHARP ELECTRONICS CORP. 10 Sharp Plaza, Box C Paramus, NJ 07652 (201) 265-5600													794
CE150	printer/ plotter	ballpoint	4		roll paper	2.16	1	1/64		Sharp proprietary BASIC	cassette interface; CE158 interface module for RS232C, Centronics	230	
CE515P	printer/ plotter	ballpoint	4	2	bond, transparencies	8.5	6	.008		BASIC	RS232C, Centronics	350	
SOLTEC DISTRIBUTION P.O. Box 818 Sun Valley, CA 91353 (213) 767-0044													795
RY-1MZ	flatbed	ballpoint, fiber tip	6	15.75	paper, vellum	8½ x 11	2	.003	.003	Hewlett Packard graphics software	GP-IB, RS232C, GP-1	1,595	

ABLE's ATTACH customers enjoy their spaghetti in the dining room, not the computer room.

ABLE's ATTACH, the breakthrough multi-host terminal switching system for DEC UNIBUS computers that eliminates the spaghetti-like mess of cables in your computer room.

One ATTACH host board and a *single* cable replaces 16 DEC interfaces, and their associated "spaghetti." And it still supports up to 128 terminals on your system without the endless tangle of cables that tie-up your computer room.

One ATTACH host board does the work of many multiplexers. The immediate advantage is a dramatic reduction in mounting space and expansion cabinetry, resulting in significant cost savings. And ATTACH can be located up to a kilometer away from your computer room.

Cook up a system to meet your present data communication requirements with ATTACH. At the touch of a keyboard, terminals can be dynamically *switched* among any combination of VAX and PDP-11 UNIBUS systems. And, ATTACH is compatible with RSX, RSTS/E, VMS and UNIX operating systems.

Expanding your capabilities, or adding terminals is easy with ATTACH. As your requirements grow, simply add modular ATTACH units to your system.

Whether you have 28, or 128 or more terminals, ATTACH has the right recipe for cost-effective connectivity.

ABLE Computer's ATTACH is the most efficient terminal interconnection system on the table.

Contact the ABLE representative near you, or call ABLE toll-free at 800-332-2253.

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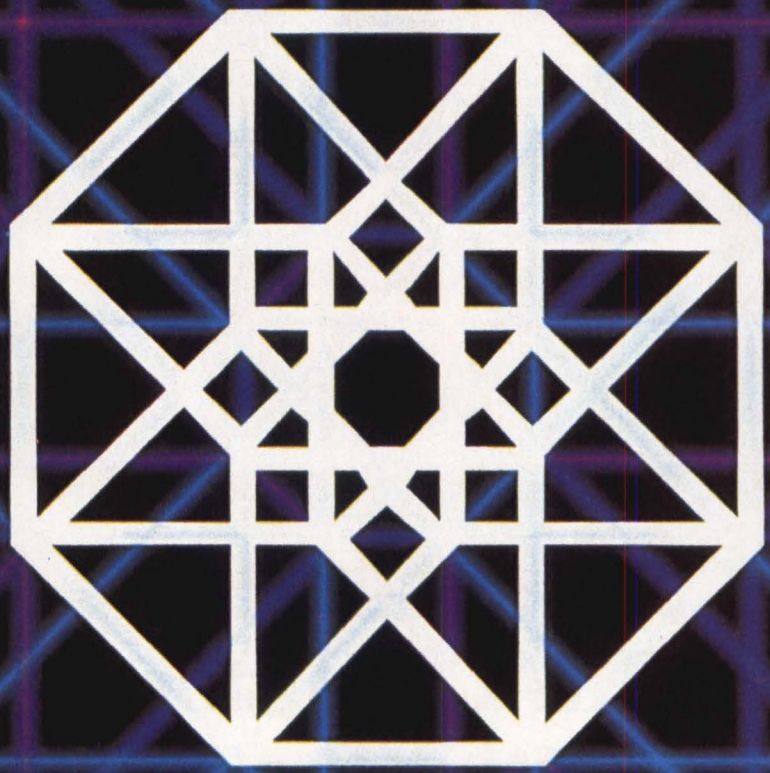
CIRCLE NO. 104 ON INQUIRY CARD

For the first time, you can get three types of computer communications systems from just one company. Quadram.



Now Quadram Makes Communications as easy as 1, 2, 3.

When it comes to enhancement products for IBM® PC's and other personal computers, no one can beat Quadram. In fact, if you use spreadsheets or large databases, you're probably using a Quadram product already.

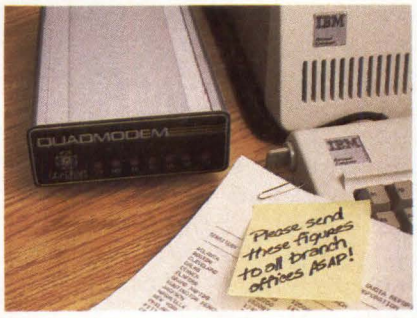
Now Quadram applies their expertise to communication devices. Not just modems, but a full range of other products, too. So that you can do anything from networking many PC's together to giving your PC full 3278 terminal emulation in an IBM mainframe environment.

Only Quadram gives you such a selection—complete with options and upgrade capability. So now it's easier for you to design the perfect system for your needs. All you need to do is remember one name—Quadram.

1. Quadmodem.™
From your home or office, reach out and touch something.

Just because your computer is all alone, that doesn't mean it has to be lonely. Not when you've got Quadmodem.

Quadmodem is a complete intelligent modem package, including an integral or standalone modem with supporting documentation. Each modem comes with QuadTalk—a powerful communications software package plus an introductory offer from The Source.℠



Just pick the model that's right for you and your computer.

The Integral Unit drops into an IBM PC, XT, PCjr or Apple IIe.

The Stand Alone is an intelligent modem that connects to your system through an RS-232 port.

Both have enhanced diagnostic capability to troubleshoot not only your system, but the system at the other end of the phone line. And both have call progress monitoring to automatically determine and compensate for different types of phone systems and transmission status (human voice, busy signal, data or dial tones). Of course, both plug directly from your computer into your phone jack.

Get the modems with the name for quality. Quadmodem.™ Fully compatible with Bell 103/212A dial-up modems and the most popular modem brands.

2. Quad3278™
Let an IBM PC communicate with an IBM mainframe.

To integrate your PC into a mainframe environment, look to Quadram first.

Because now you can have all the features of the IBM PC (mass storage and peripherals) plus the incredible power of a mainframe right at your desk. All it takes is Quadram's 3278 emulation package which includes hardware, software, even cabling.

To make your IBM PC emulate the 3278 Display Work Station, get the Quad3278.™

Once you're on-line the IBM mainframe sees you as just another 3278 terminal. Little does it know that you're actually a high-performance, intelligent work station, with all the functions of the Personal Computer. With mainframe support you can download data, process it on your PC, even store it on your own disk for later reference.

Make the connection from micro to mainframe. And back it up with Quadram quality. It's the logical step for the future.

3. Quadnet.™
Turns your IBM PC's into a Local Area Network.

Local Area Networking (LAN) is one of the most interesting and useful ideas to come down the pike. Basically, it allows you to inter-link a group of computers together so they can share information and peripherals with each other.

And now with Quadnet, you don't have to compromise your system to fit our system. Instead, you can easily link as few as two, or as many as 255 IBM PC's together in a hard-wired network. And you can configure them almost any way you want. They can work independently of each other or share resources and peripherals.

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Quadnet grows as you grow. Yet the user commands stay the same, thanks to the upward compatibility of the Quadnet operating software.

Whichever version you hook on to, you get a complete package (hardware, software, and documentation). And most importantly, you get Quadram's reputation for quality.

QUADRAM QUALITY

At Quadram, we don't make personal computers. We just make them better. So insist on the Quadram name. It's your assurance that you're buying from one of the most established and involved companies in the microcomputer field. Ask your dealer about us.

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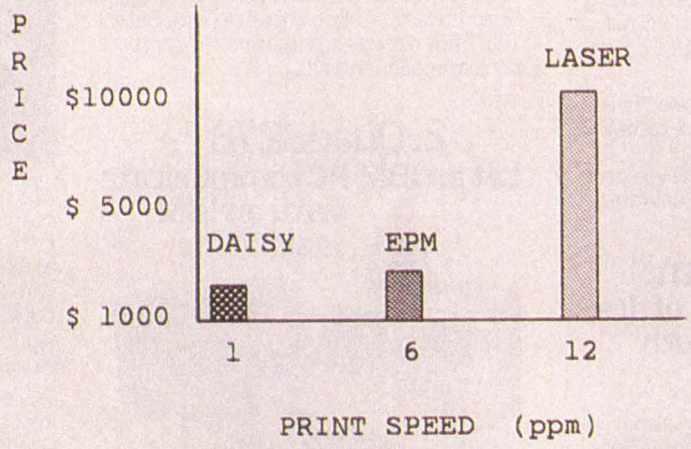
CIRCLE NO. 105 ON INQUIRY CARD

THE BEST AD FOR THE EPM IS ONE IT PRINTS ITSELF



DIABLO FROM HAMILTON/AVNET

The print quality and speed of Diablo's new Electronic Printing Machine is approaching laser. But its price certainly is not. With our quantity pricing (for more than 10 units) it doesn't cost much more than a daisywheel printer.

The resolution of the EPM is 200 x 200 dots per inch. Yet it's extremely fast (up to 6 pgs per minute depending on mix of graphics and text) because it achieves high resolution without multiple passes. As you can see, it prints graphics, and text, including large type sizes. It's office-quiet, at less than 52 dBA. and interfacing is easy, even if you want it to be used by a whole group of personal computer users.

The EPM also fits in at a factory. It is ideal for printing such things as bar codes, because it doesn't overheat the gummed backs of labels. Its high speed and reliability are also very suited to the factory enviroment.

Call our Computer Product Specialists for evaluation and applications assistance. And be sure to ask about our leasing services, as well as our other computer products.

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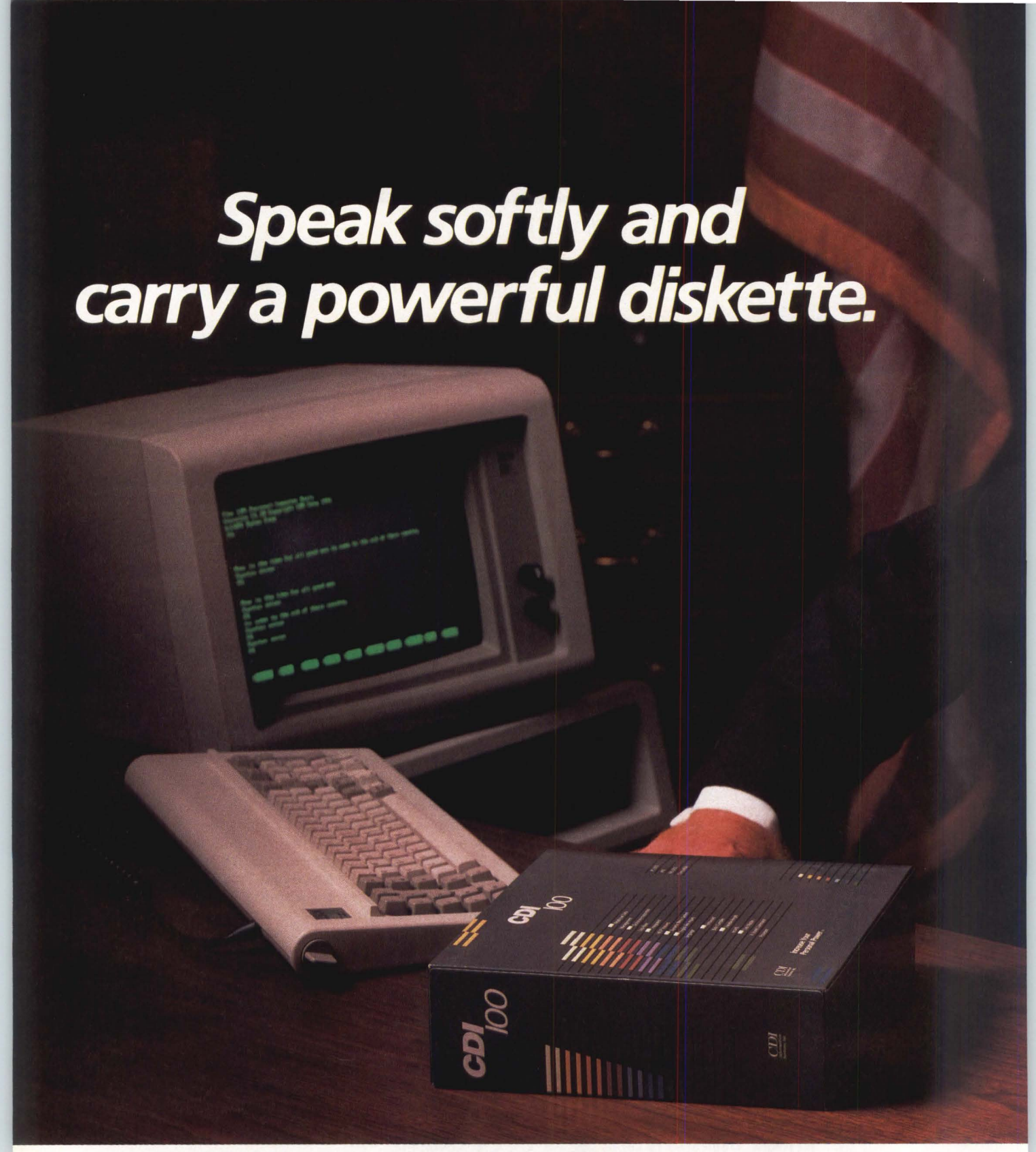
DESKTOP PLOTTERS

Company / Model	Plotter type	Pens: Type	Pens: No. of colors	Pens: Plotting speed (ips)	Media: Type	Media: Size (in.)	No. of character sets available	Mechanical resolution (in.)	Repeatability (in.)	Compatible software	Hardware interface	Price ($)	Circle no.
RY-10MZ	flatbed	ballpoint, fiber tip	10	15.75	paper, vellum	11 x 17	2	.003	.003	Hewlett Packard graphics software	RS232C, GP-1, GP-IB	1,995	
RY-1003	flatbed	ballpoint, fiber tip	4	15.75	paper, vellum	17 x 22	2	.002	.004	Hewlett Packard and CalComp graphics software	RS232C	9,750	
STROBE INC. 897-5A Independence Ave. Mountain View, CA 94043 (415) 969-5130													**796**
M200	drum	felt tip (Pilot razor point)	1	3	paper, film	8½ x 11	several	.002	.002	Enhanced Business Graphics, Strobeview	RS232C	695	
M260	drum	felt tip	8	3	paper, film	8½ x 11	several	.002	.002	Enhanced Business Graphics, Strobeview	RS232C	995	
TEKTRONIX INC. P.O. Box 500 Beaverton, OR 97077 (503) 627-7111													**797**
4662 option 31	flatbed	plastic nib, liquid ink	8	22	paper, vellum, mylar, acetate, preprinted forms	11 x 17	9	.005	.0025		RS232C, GPIB	3,995	
4663	flatbed	fiber tip, hard nib, liquid ink	2	22	paper, mylar, acetate	17 x 22	9	.001	.0025		RS232C, GPIB	10,490	
VERSATEC 2710 Walsh Ave. Santa Clara, CA 95051 (408) 988-2800													**798**
V-80	printer/ plotter	electro-static	15	1	paper, transparencies, film, vellum	11 x roll	15	.005 (200 dpi)	.01	SASGraph, Versaplot and others	RS232C, parallel	8,950	
WESTERN GRAPHTEC INC. 12 Chrysler St. Irvine, CA 92714 800-854-8385													**799**
MP1000	flatbed	water-, oil-based or ink	6	6	paper, film	A3	several	.004	.012	KEYCHART	IEEE-488, RS232C, 8-bit parallel	1,090	
WX4731	drum	ballpoint, fiber tip	4	8	paper	11.3 width roll	several	.004	less than .008		IEEE-488, RS232C, 8-bit parallel	2,490	
WX4630 Series	flatbed	ballpoint, fiber tip, ink drafting pens	1, 2 or 10	15	paper, film	A3	several	.004	.006		IEEE-488, RS232C, 8-bit parallel	3,990–6,990	
DA8400	flatbed	ballpoint, fiber tip	6	15	paper, film	A4	several	.004	.01		IEEE-488, RS232C, 8-bit parallel	1,800	
YOKOGAWA CORP. OF AMERICA 2 Dart Rd. Shenandoah, GA 30265 (404) 253-7000													**800**
PL-1000	grit wheel	plastic tip, fiber tip	4	4	paper, mylar	10 x 15	1	.004	.008	ChartMaster, GrafTalk	RS232C, Centronics	995 (RS232C), 931 (Centronics)	
PL-1000 (with Business Graphics EOM)	grit wheel	plastic tip, fiber tip	4	4	paper, mylar	10 x 15	1	.004	.008	ChartMaster, GrafTalk	RS232C, Centronics	1,183 (RS232C), 1,119 (Centronics)	

DESKTOP PLOTTERS

Company Model	Plotter type	Pens			Media		No. of character sets available	Mechanical resolution (in.)	Repeatability (in.)	Compatible software	Hardware interface	Price ($)	Circle no
		Type	No. of colors	Plotting speed (ips)	Type	Size (in.)							
PL-2000	flatbed	ceramic tip, fiber tip, drafting	4	8	paper, mylar	7 x 10	3	.002	.008	APS Graph	RS232C, Centronics	2,050 (Centronics) 2,395 (RS232C)	
PL-2000 (with Business Graph ROM)	flatbed	ceramic tip, fiber tip, drafting	4	8	paper, mylar	7 x 10	3	.002	.008	APS Graph	RS232C, Centronics	2,210 (Centronics) 2,560 (RS232C)	

Speak softly and carry a powerful diskette.



Information is power. So you can afford to speak softly when you rely on CDI/100, the powerful information management system.

CDI/100 includes a data base management system with variable length fields and an open-ended file structure. You get tailored formatting and recordkeeping that's virtually limitless.

Our dynamic menu system leads you through the steps. You can create, access and retrieve files—even generate customized reports. Suddenly you're handling vast quantities of information with ease.

Infact, CDI/100 even allows you to use a host of existing application programs, which protects your software investment while maximizing your

computer's usefulness and effectiveness.

And since all of these features are combined in just one package, CDI/100 is priced very competitively. Ask for a demonstration today, wherever you buy software.

Exceptional New Software Concept

- Everyone's Filing System
- English-like Inquiry Language
- Dynamic Menu System
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CDI 100™

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INCREASE YOUR PERSONAL POWER.™

CIRCLE NO. 110 ON INQUIRY CARD

TELEVIDEO MULTI-

TO EACH HIS OWN.

If you've had your share of sharing a personal computer, TeleVideo® Multi-User Computers mean the end of the line. From two users to 16, and even more, our systems offer the expandability and power to meet your growing needs.

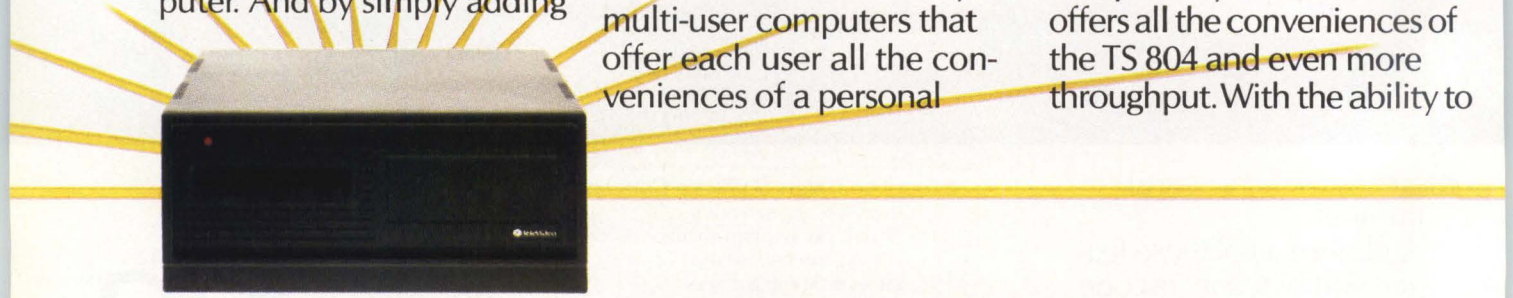
OUR SYSTEMS GROW WITH YOUR BUSINESS.
And with TeleVideo it's easy, inexpensive and controllable. You can add users to the systems with plug-in simplicity, when and where you need to. Secretaries and bosses can all share the same system without sharing the same computer. And by simply adding to your system as your business grows, your original investment is always protected.

3,000 SOFTWARE PROGRAMS AND MAINFRAME COMMUNICATION.
Our systems support industry standard software, so you'll have access to nearly 3,000 very productive programs. And by emulating IBM® 3270 and 3780 terminals with additional TeleVideo software, you can even communicate with IBM mainframes.

However large or small your business, or department, TeleVideo offers a variety of multi-user computers that offer each user all the conveniences of a personal computer. And all the power of a computer network.

THE LOWEST COST PER USER.
The all-in-one system that's the one for all, the TS 804 is completely integrated into a single desktop enclosure. The system can support up to four users and a wide selection of peripherals. And it's all available for the lowest cost-per-user on the market: under $1500.

TO EACH HIS OWN PROCESSOR.
A powerful desktop micro computer system, the TS 806 offers all the conveniences of the TS 804 and even more throughput. With the ability to



The TS 816: Up to 16 users

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USER COMPUTERS.

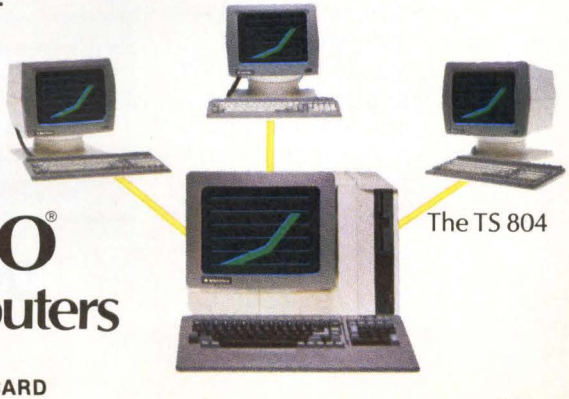
provide true multi-user capabilities for up to six stations, any combination of TeleVideo 8 and 16-bit personal computers can be supported by the TS 806.

UP TO 16 USERS AND 16-BITS.
Up to 16 workstations can be used with the TS 816, creating a flexible multi-tasking system. Any combination of 8 and 16-bit personal computers can be supported, with or without local storage.

THE WORLD'S LEADING MANUFACTURER.
TeleVideo is the leader in multi-user computers and the number one independent manufacturer of terminals. And from systems to peripherals to service and support, only TeleVideo offers you the convenience of a single-vendor solution.

For more information, call 800-538-8725 (in California, 800-345-8008).

TeleVideo Multi-User Computers. To each his own.

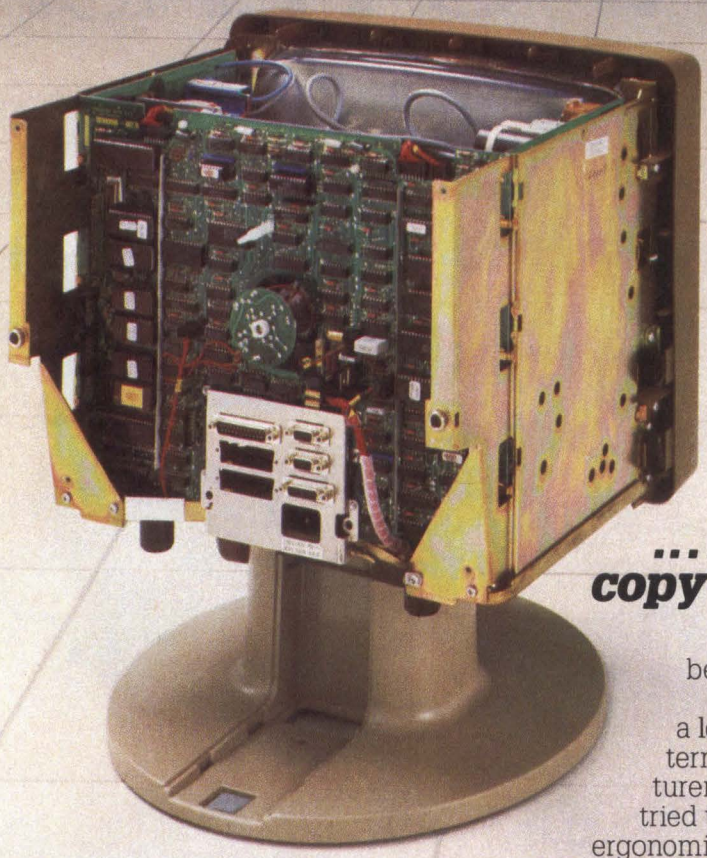


The TS 804

TeleVideo®
Multi-User Computers

TeleVideo Systems, Inc.
CIRCLE NO. 111 ON INQUIRY CARD

A lot of terminal manufacturers have tried to copy our ergonomic design



...It will be a lot tougher to copy our performance

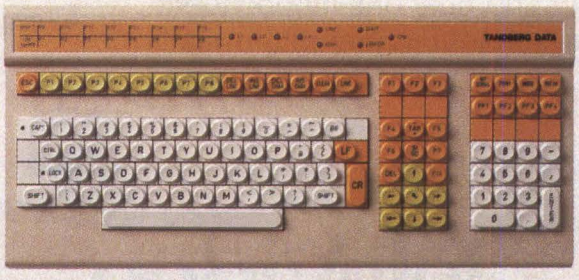
In 1980 when Tandberg Data introduced the TDV 2200 family, they were the first and only terminals in the world meeting the stringent specifications of the 1985 German Ergonomic Standard... a standard set to protect the safety, health and comfort of the operator. The TDV 2200 includes such features as tilt, swivel, height adjustment, ultra-low profile, detachable keyboard for comfort of operation, non-reflective surfaces, and anti-reflex tube for screen clarity. Since its introduction and as a testimonial to its innovative design, over 50,000 units have been installed.

Today, there are a lot of "me-too" terminal manufacturers who have tried to copy our ergonomic design and that's certainly a plus for the industry. But, with our new TDV 2200S, an even improved version, it will be a lot tougher to copy our performance.

The TDV 2200S can emulate virtually any popular terminal and protocol. It can be equipped with up to 56k bytes of memory and some models will store up to eight pages of data. It has superb communications capabilities including networking; up to 1024 different characters in a single terminal; optional high resolution business graphics; a 70Hz refresh rate for flicker-free viewing; and a 15" screen and big letters for easy readability.

Like its predecessor, the TDV 2200S also features sixteen soft switches called PUSH keys that recall previously stored words, phrases or code sequences; a simplified menu protocol that cuts set-up time in half; and character, page, block or line/field transmission. No other terminal on the market today can match all of these features. But, they are probably trying.

So, you can wait while they try to catch up with us, or you can go with the terminal that sets the pace for the industry. Tandberg Data, Inc., P.O. Box 99, Labriola Court, Armonk, N.Y. 10504. Phone: (914) 273-6400. Telex: 137357 Tanberg Arnk.



TANDBERG DATA

Tandberg Data, Inc.

CIRCLE NO. 112 ON INQUIRY CARD

Mid-range CAD/CAM/CAE systems dominate graphics display terminals

Falling prices and increased performance help trigger increased demand for mid-range CAD/CAM/CAE systems

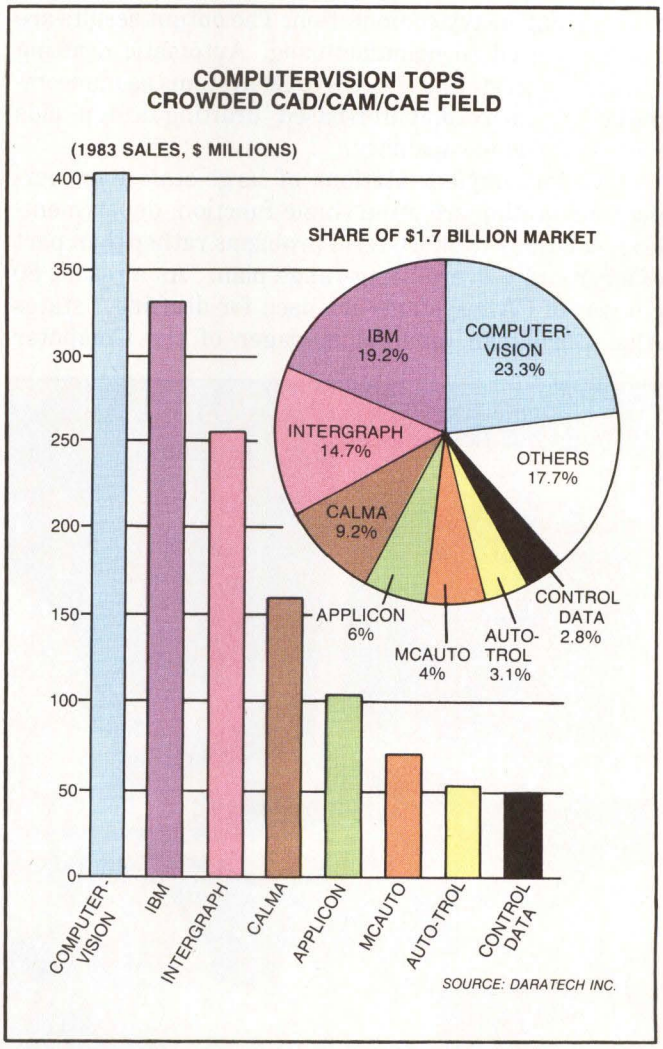
Paul Sniger, Senior Editor

Computer-aided design (CAD), computer-aided manufacturing (CAM) and computer-aided engineering (CAE) with all their ramifications—from solids-modeling to robotics—represent rapidly growing uses of graphics. New CAD/CAM/CAE systems in the high-, mid- and low-range are offering higher speed, upward compatibility and increased performance at lower prices. Industrial applications currently provide the best target for graphics terminals and particularly for color graphics terminals.

Defining the field

System integrators purchase CAD/CAM/CAE systems to aid either in system integration or to resell the systems after adding value to the hardware or software. CAD/CAM/CAE systems permit the modeling, design, drafting and manufacture of products under computer control. For example, CAD systems use computers and graphics display terminals, allowing designers to create, draft, analyze and manipulate products on a screen in 2-D or 3-D. CAE systems do more than CAD; they include computational and modeling capability. CAE systems simulate entire systems or products in the computer, whereas CAD/CAM systems address only the physical description of a product. By using a system model, CAE iteratively analyzes and tests functional characteristics such as noise, shelf life and vibration. This analysis minimizes the need for engineering and manufacturing prototypes.

According to Kenneth Bosomworth, president of research company International Resource Development (IRD) Corp., Norwalk, Conn., there are about 20 CAE workstations on the market. But more companies are rapidly entering the CAE market. "When you



By year-end, IBM will surpass Computervision in market share *by a slight margin, Daratech estimates. Revenues from CAD/CAM/CAE are expected to hit $2.4 billion this year, $3.4 billion in 1985 and $4.2 billion in 1986.*

consider that the average engineer is making $45,000 to $55,000 per year," says Bosomworth, "and that his work is increasing in complexity, the need for CAE is becoming stronger." Bosomworth points out that CAE workstations are sold in standalone configurations, and all have some communication support, although some require connection to a larger computer. The companies having extensive in-house CAE experience, says Bosomworth, are IBM Corp., Digital Equipment Corp. and Hewlett-Packard Co., "and this will give them an edge."

CAM systems oversee the work flow in manufacturing facilities and control production machinery, thus speeding the design-to-production cycle. These systems may be categorized in several ways.

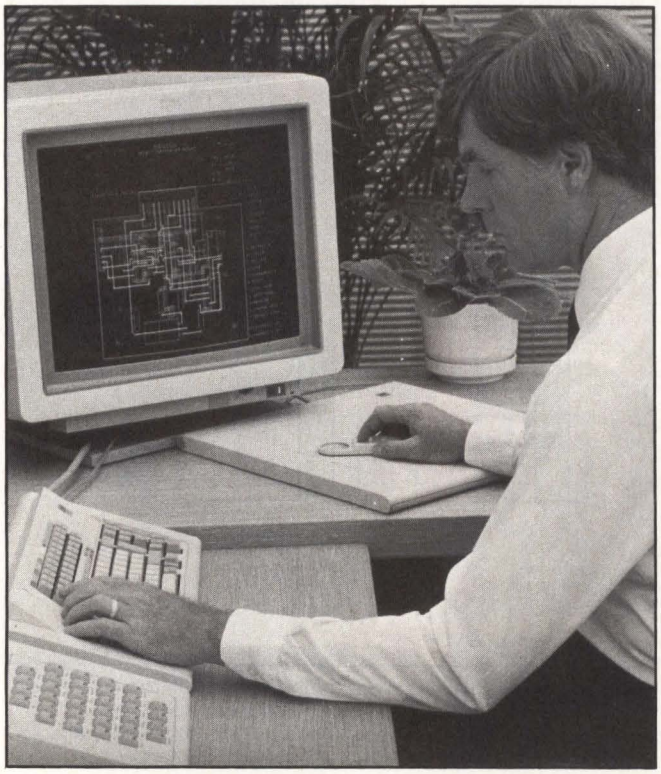
Proponents of large-scale engineering computation use terminals remote from a host mainframe. This setup provides the integrated ability to support design, drafting and heavy computation. The output results are then delivered to manufacturing. Automatic drafting system integrators use CAD/CAM systems as minicomputer- or microcomputer-based drafting/design aids with standalone capability.

However, implementations of large-scale engineering computation are often single-function, department-level solutions to short-term problems rather than part of a corporate overall long-range plan. "As a result, 80 percent of CAD systems are used for drafting," states Alan Christman, general manager of the Computer Integrated Manufacturing Division of Control Data Corp. (CDC), Minneapolis. "In fact, CAD is so often thought of as a drafting tool that the acronym CAD is often read as 'computer-aided drafting' rather than 'computer-aided design.'"

CAD/CAM **application categories** include mechanical design and manufacturing and architecture, engineering and construction (AEC). New CAD/CAM application categories are growing and include fields such as education and graphics design.

Systems are segmented into three **price categories**: the low range, which includes mostly IBM PC- and Apple Computer Inc.-based systems priced at less than $20,000; the mid-range, which includes minicomputer-based systems priced at $20,000 to $60,000; and the high range, which generally includes mainframe-based systems priced at $60,000 to more than $1 million.

The low end—personal-computer-based systems selling for less than $20,000—is experiencing the most rapid growth. Systems in this category are usually limited to 2-D capability and to drafting applications. Mid-range systems that sell for less than $60,000 are workstation-based, with the processor in the station. These systems were previously limited to drafting; however, the newer 32-bit workstations provide greater performance. The mid-range category is experiencing the most activity and is even eroding the high end. The more sophisticated high-end systems are often integrated into host-based systems traditionally found



The Editor, a software package from Applicon, *helps users learn to operate Applicon's Bravo! CAD/CAM/CAE program. The Editor provides integrated 3-D design, drafting and documentation.*

IBM's 5080 graphics system *provides as many as 256 color hues for highly detailed graphics applications.*

What's the best recommendation you can make when you're asked about business graphics?

The New Business Professional Plotter from Hewlett-Packard— The 6-Pen HP 7475A

Today, business professionals are becoming more aware of the vital importance of business graphics to their success. Tomorrow, they may be asking for your recommendation. Here's some important information that will help you. Tell them...

Make a first impression that lasts

Truly impressive graphic presentations can create a first impression of quality and professionalism that lasts and lasts. The way you present your information can be equally as important as the information you're presenting. And that's where the new HP 7475A Business Professional Plotter lets your professionalism shine through.

Standards unsurpassed in the plotter business

The technical standards of the HP 7475A have no equal for producing quality graphics. With a resolution of one-thousandth-of-an-inch, curved lines are smooth, not jagged, and straight lines are *consistently* straight. Its exceptional repeatability (the ability of a pen to return *precisely* to a given point), assures that intersecting lines and circular shapes will meet *exactly.*

Compatible with almost any personal computer in your office and supported on today's most popular graphics software packages

The HP 7475A quickly "makes friends" with most of the personal computers you may already have in your office, including IBM®, Apple™, Compaq™, Osborne®, and Commodore™—as well as a host of HP computers. You even have a choice of many off-the-shelf software packages that give you "first-day" productivity with the HP 7475A.

Your Choice: 2 media sizes

While most professional business applications will be satisfied with standard 8½ x 11" paper or transparencies, the HP 7475A adds the capability of plotting on larger 11 x 17" media, too.

The cost? Surprisingly affordable

The new HP 7475A Business Professional Plotter is an amazingly affordable $1895. When you consider the high cost of having your graphics prepared by an outside service, you'll find the return on your investment is almost immediate.

Another choice: HP's low-cost, high performance Personal Computer Plotter

For the "business on a budget," you may also want a look at our 2-pen Personal Computer Plotter, the HP 7470A. Its low-cost (only $1095) is as remarkable as the quality of its plots. With many of the same features as the new HP 7475A, the HP 7470A plots on media up to 8½ x 11." It stores and caps two-pens, and you can easily change the pens for multi-color plotting.

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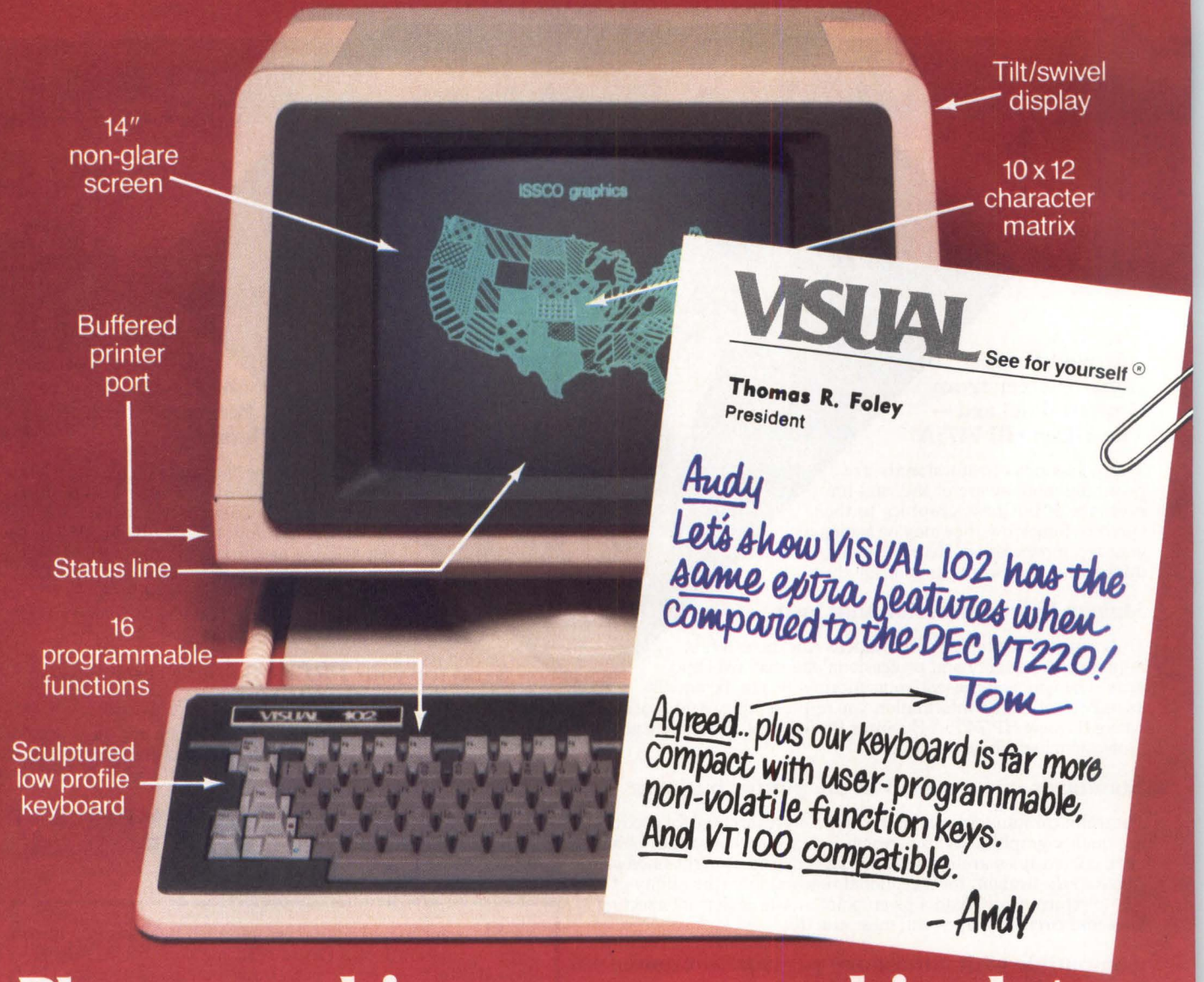

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in automotive and aerospace applications. Their prices typically include workstations, computers, plotters and software.

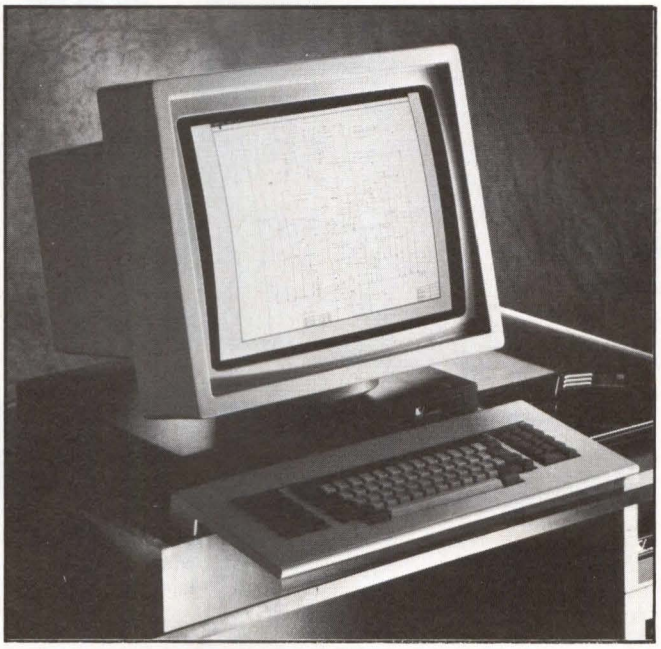
Workstations standardize

CAD/CAM workstations and graphics displays in particular entail user/system interaction. A workstation consists of a high-resolution, direct-view storage or raster-scan CRT; a keyboard; user-programmable function keys; and input units such as light pens, voice synthesis, mice, track balls, control disks, thumb wheels and digitizer pads.

The CAD/CAM industry is in the midst of change. CAD/CAM manufacturers are broadening their lines, and companies that once specialized in mid-range systems are offering high-end systems. Meanwhile, traditional high-end system makers are moving downward. One example is Applicon, Burlington, Mass., which traditionally sold only high-end systems priced in the $100,000 to $1 million range. Recognizing the growth opportunities in mid-range systems and the need to round out its line in the face of a trend toward integrated systems and compatibility, Applicon is offering new systems at around $50,000. However, the company is not neglecting the power of its line.

Applicon's recently introduced 32-bit Bravo! system includes application software that allows interactive solids, surface and finite-element modeling as well as flat-pattern and numerical-control tool-path generation. The software is offered unbundled to DEC-supplied VAX-11/780 users; Applicon's use of DEC software signals a departure from Applicon's traditional turnkey operation.

Another trend in the industry is toward **graphics software standardization.** Because value added is typically taking the form of algorithms for software modeling and shaded-color 3-D images, software is becoming more of a concern to users. System users worry that they will lose their software equity when acquiring new systems because graphics software is in a state of flux.



An intelligent, fully packaged and configured workstation for CAD/CAM/CAE, *the Computervision CDS 3000 incorporates a 32-bit 68010 and runs UNIX.*

Thus, graphics standards are needed. The 2-D Graphical Kernel System (GKS) software and the Virtual Device Interface (VDI) standards are a start. However, GKS fails to address some developments in solids modeling and shaded-color surfaces.

Typifying the trend toward graphics standard operating systems, Lundy Electronics & Systems Inc., Glen Head, N.Y., provides full GKS functionality on monochrome and color graphics terminals in its 6100 series. Megatek Corp. and Spectragraphics Corp., both in San Diego, provide partial GKS implementations.

Another trend is toward **user friendliness and simple training.** Reliable training programs are expensive. In 1982, CAD/CAM training for basic operating skills required an industry investment of $200 million in

CAD/CAM/CAE market growth accelerates

After a depressed 28 percent annual CAD/CAM/CAE market growth rate in 1982 and early 1983, '83 finished with a 32 percent rate; in fact, total 1983 revenues exceeded $1.7 billion. According to Daratech Inc., a Cambridge, Mass., research company, it is likely that the 1984 growth rate will exceed 40 percent. These statistics demonstrate that the number of vendors selling CAD/CAM/CAE systems in the United States increased dramatically—up from only 20 in 1980 to more than 100 in 1983, and companies are entering the field almost weekly.

Although projections differ slightly, other market research companies unanimously confirm this dramatic growth. International Data Corp., Framingham, Mass., for one, predicts that CAD/CAM/CAE sales will approach $2 billion in 1984 and $3.48 billion by 1986, and most of those will be color systems. Ray Barger, vice president of marketing and sales at Spectragraphics Corp., San Diego, states, "The number of color terminals in use just for solids modeling and robotics applications should grow between 35 percent and 40 percent per year."

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- *1984 Estimated Expenditures* for minicomputers, microcomputers, peripherals, and software.
- *Geographical Regions*
- *Type of Organization*
- *Minicomputers/Microcc.nputers purchased in 1983 and those installed in prior years:*
  - Vendor name and model number
  - Units acquired
  - Major applications
- *Minicomputers/Microcomputers planned 1984 purchases:*
  - Vendor name and model number
  - Units planned to be acquired
  - Major applications
  - Sites planning to change major vendor
  - Fail-safe computer operations
  - Electronic office functions

PRESELECTED LISTS AND MAILING LABELS

All selections are available as a listing or as cheshire or pressure sensitive labels. Cross tabulations of categories are also available.

Site Selection	*Site Count*
Total sites surveyed	8,511
Sites by planned 1984 expenditure levels	
$50,000-99,999	4,829
$100,000-249,999	3,582
$250,000-499,999	2,218
$500,000 or more	1,403
Sites planning to install integrated electronic office functions in 1984	1,642
HOT PROSPECTS...Sites planning to change major vendors in 1984	1,085
Value-added OEMs and third parties	3,110
Value-added user sites	4,813

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- Current Computer Vendors
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salaries. CDC expects the training cost to exceed $500 million next year.

To simplify training, the Graphics Processor from Telesis Corp., Chelmsford, Mass., replaces complicated I/O devices, computer languages and esoteric commands with simple English commands. The Graphics Processor, which was introduced late last year, sells for less than $70,000 and offers easy-to-use advanced functions such as roam, zoom, world window and user-definable color priority. Located just below the workstation is a proprietary function screen that appears as an array of squares. By touching these squares with a light pen, users can simulate a velocity joystick. Thus, users can rapidly or slowly roam about the stored picture. A zoom-control feature permits single, double or quadruple magnification, permitting detailed editing. The world-window feature permits users to switch within ½ second between a window and a world view of the picture, with the window highlighted in the world-view mode. To aid visualization in such applications as printed-circuit board design, users can assign various colors to different layers of a design.

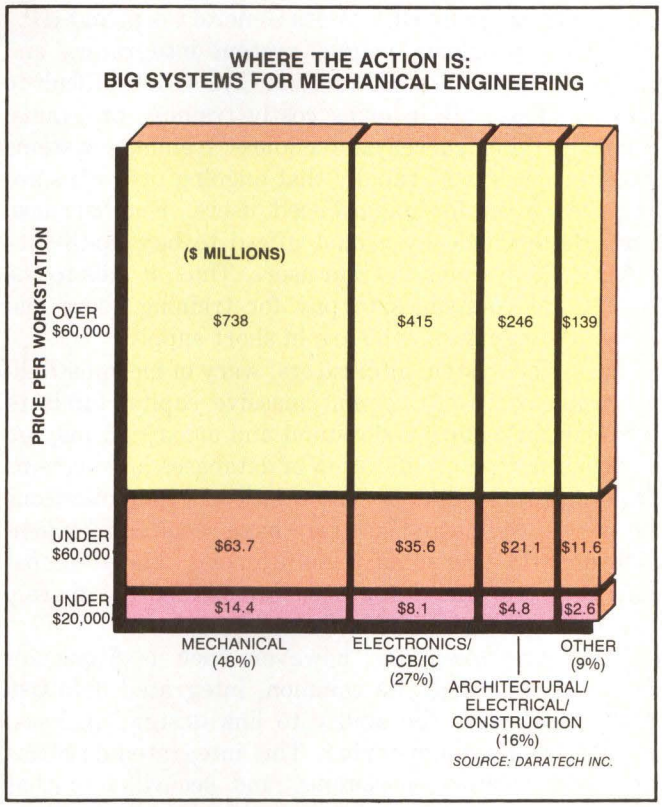
CAD systems are **typically based on second-party processors.** Two companies, Auto-Trol Technology Corp., Denver, and Calma Co., Santa Clara, Calif., base their products on Apollo Computer Inc.'s color workstations. But developing application-specific software is growing more costly, and hardware from small CAD makers is becoming more sophisticated. These two developments are sparking a trend among CAD system software developers toward designing their own hardware.

Color graphics resolution increases

A growing factor in the CAD/CAM/CAE market is IBM, a newcomer that has chalked up impressive gains. Its limitations in solids modeling and electronic design notwithstanding, IBM's model 3250 workstation captured a 19.2 percent 1983 market share, and IBM may surpass industry leader Computervision Corp. this year, according to research company Daratech Inc., Cambridge, Mass.

A major force in the emerging market for terminals with 1,024-by-1,024-pixel and higher resolution, IBM's 5080 graphics system is a high-performance raster-scan intelligent workstation that can display 256 color hues or gray shades simultaneously.

Increasing screen resolution from 512 by 512 to 1,024 by 1,024 pixels meant that IBM had to increase processing power fourfold. This increase grows as colors are added and resolution increases. Keeping large amounts of data in a host computer or a networked Winchester drive thus becomes less satisfactory because of speed limitations in transferring bulk data rapidly across



RAM or hard disk interfaces that handle serial processing.

According to Hiram French, vice president of marketing for Megatek, terminal makers will offer products that significantly increase the resolution of color graphics beyond the current maximum of 1,024 by 1,024 pixels with 16 colors out of a palette of 4,096 colors. This trend is producing more standalone capability.

In addition, terminals are becoming more powerful and self-reliant. Ray Barger, vice president of marketing and sales for Spectragraphics, agrees with French and adds, "Host-dependent terminals will eventually die out. The economics of putting the computer within the workstation will cause that to happen." Another trend, says Barger, is that individual users will increasingly want their own computing capability: "This will be another factor in the demise of the less-powerful terminals." French believes there are performance and color trade-offs in designing color terminals. Adding colors to a terminal's color palette does not provide certain high-performance features, he says, adding that "Megatek opted to increase performance via rapid refresh rates instead of by adding colors."

As for IBM, Charles Foundyller, president of Daratech, says that "IBM is moving to become a major OEM supplier of computers and workstations in the CAD/CAM/CAE industry and is moving into a market previ-

ously dominated by DEC, Data General Corp. and HP."

Serious problems plague system integrators and users, however. Newcomers find CAD/CAM difficult to learn and use. It involves costly training programs, steep learning curves and endless training: systems become obsolete so rapidly that ongoing programs are required even for experienced users. Furthermore, universities typically cannot afford to buy up-to-date CAD/CAM systems to train users. Thus, it falls to the CAD/CAM companies to pay for training users and system integrators, who are in short supply.

Users and system integrators, wary of incompatibility problems, won't commit massive capital funds to systems they don't understand and are afraid may go underused. The proliferation of databases and systems from different vendors plus a lack of communications between systems and software have resulted in expensive and time-consuming inefficiencies. Many companies claim to offer integrated capabilities but merely use sophisticated file-transfer systems.

There are exceptions, however, such as Applicon's Bravo! system with its common, integrated database that offers users the ability to link design, analysis, drafting and manufacturing. This integrated-database approach ensures consistency and security, so that created data can be used for engineering applications.

One example of the trend toward increased functionality and integration is Computervision's recently introduced CDS 3000, which offers a high degree of interaction with applications and databases residing on larger systems. CDS 3000 interacts with central CAD/CAM/CAE systems, including technical publications, facilities management and graphics and text distribution to the factory floor. "CAD/CAM/CAE workstation users require a mix of graphics applications and nongraphics functions," states Computervision president James Berrett.

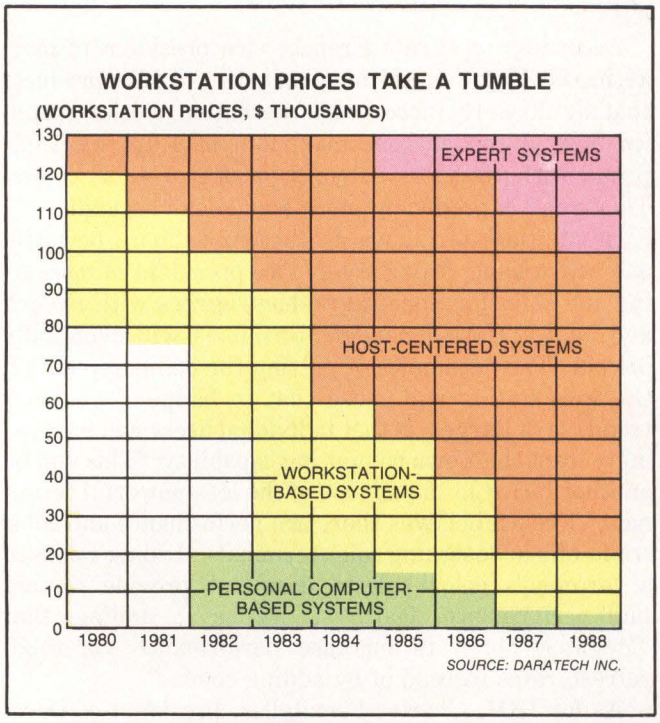
Computervision has revitalized its R&D and is looking outside the company for software, hardware and expertise to shorten development time. Prices of Computervision's IBM 4300-based CDS 4000 Version 2 high-performance multiuser system start at $250,000; the single-user CDS 3000 starts at $35,000. The CDS 4000 is another example of Computervision's new direction: it was developed jointly with Sun Microsystems Inc., Mountain View, Calif.

Another totally integrated solution is CDC's integrated computer-aided engineering and manufacturing (ICEM) approach. ICEM tailors CAD/CAM consulting, training, support, services and systems to each manufacturer's needs. Rather than simply sell systems, ICEM provides total support, offering users immediate access to sophisticated CAD/CAM at CDC application centers in major U.S. cities.

Because CDC has extensive manufacturing experience, its consultants can assist users in the design and manufacture of products. The advantages are that users lacking in-house CAD/CAM systems or capability can become immediately involved in CAD/CAM. In addition, system integrators seeking to acquire CAD/CAM capability can do so without committing themselves to massive capital expenditures. Furthermore, users with their own terminals or workstations can gain access to a full range of powerful ICEM programs through the Cybernet data services network.

As the volume, complexity and growth of CAD/CAM requirements increase, ICEM provides a natural growth path. As users progress and the shift to acquisition becomes cost-justifiable, they can begin purchasing what they need. For example, the ICEM 120-40 entry-level design/drafting system sells for less than $50,000; the system can interface with Cybernet for added capability.

The total integrated approach is proving successful with users and system integrators. According to Daratech, CDC's CAD/CAM/CAE system and service sales in 1983 grew 46.4 percent over the previous year, with 1984 expected to exceed that rate. □



In 1980, the prices of workstation-based systems *ranged from $80,000 to $100,000. This year, the price range is expected to be $20,000 to $80,000. In 1988, prices are projected to be $2,500 to $20,000.*

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FEATURE COMPARISON *	VT220 VT220 emulation mode	VISION 2200 VT220 emulation mode
VT220 Command Set	YES	YES
Function System Memory	256	1024
Programmable Functions (PF)	15	64
PF in VT100 Mode	0	64
Data Routing From Function Keys	NO	YES
Non-Volatile Function Memory	NO	YES
Four-Page Memory	NO	YES
Eight-Page Memory Option	N/A**	YES
Bi-Directional Printer Port	NO	YES
Dual Set Up Tables	NO	YES
Dual Host Support	NO	YES
Compose Key	YES	YES
Graphics Option	NO	YES
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GRAPHICS DISPLAY TERMINALS

Company Model	Display (diagonal)	Display resolution	Alpha mode screen format col. X lines (matrix character size)	Interfaces (protocols)	Emulations	Unit price ($)	Notes, features, options
ADAGE INC.							
3000	19-inch, 16M-color palette	1024x1024	program-mable	DMA interfaces to most minicomputers (PIO, DMA, NTSC)		18,200	
4100 Series	21-inch, blue	22x3000	program-mable	DMA interfaces to most minicomputers		42,920	Model 4115 is a 2D model, models 4135 and 4145 are 3D models
ADVANCED ELECTRONICS DESIGN INC. (AED)							
1024	19-inch, 256-color with 16.7M-palette	1024x768	85x69 (5x6, 7x9, 10x12, 14x18)	RS232C, DMA, RS170 (X-on/X-off)			anti-aliasing, reference grid; opt. rack-mount
512	13-inch, 256-color with 16.7M-palette	512x483	85x69 (5x7, 7x9)	RS232C, DMA, RS170 (X-on/X-off)		7,495	opt. rack-mount version with 19-inch screen
767	13-inch, 256-color with 16.7M-palette	768x575	85x69 (5x7, 7x9)	RS232C, DMA, RS170 (X-on/X-off)		9,995	anti-aliasing, reference grid; opt. rack-mount version with 19-inch screen
AMALGAMATED WIRELESS LTD.							
8602V	14-inch, monochrome, green, amber, white or 8-color	640x480	80x25 (7x9)	RS232C, RS422, current loop (X-on/X-off, bisync)	DEC VT100, Honeywell VIP7700, Univac U200, Datapoint 8227		
ASEA INDUSTRIAL SYSTEMS							
TESSEL-ATOR 8100, 8300, 8400	13-, 19-, 25-inch, 64-color	720x336	120x56 (user-defined)	RS232C, RS422, RS449, current loop (ECMA-24, X.25/2)			on board modems, Int'l. character sets; zoom, pan, bar graph, windowing, multichannel support
AYDIN CONTROLS							
AYCON 17	13-inch, 8-color	560x336	80x48 (5x5, 5x7, 7x14, 6x16)	RS232C (TTY, Bisync)	Intecolor 8001G	2,995	opt. 19-inch, rack-mount
CHROMATICS INC.							
4200	13-inch, 16-color with 4096-color palette	512x384	85x48 (5x7)	RS232C, opt. parallel, RGB (X-on/X-off)		3,995	scaled and clipped windows, display list storage and management; opt. 16 programmable function keys
4300	13-inch, 16-color with 4096-color palette	1024x768	170x96 (5x7, 10x14)	RS232C; opt. parallel, RGB (X-on/X-off)		6,995	scaled and clipped windows, display list storage and management; opt. 16 programmable function keys
CIE TERMINALS							
CIT414	12-inch, green	640x480	80x34 (7x9)	RS232C, current loop (X-on/X-off, RTS/CTS)	Tektronix 4010, 4014, 4016	1,895	simulated pan and zoom, split screen
CIT467	12-inch, 8-color	570x480	132x24 (7x9, 9x9)	RS232C, current loop (X-on/X-off, RTS/CTS)	DEC VT100; Tektronix 4010, 4014	2,995	simulated pan and zoom, split screen
CIFER							
2841	12-inch, green, orange	1024x256	128x32 (7x7, 9x9)	dual RS232C (X-on/X-off, DTR/CTS)	Tektronix 4010		screen dump, reprogrammable keyboard, non-volatile storage of keyboard, character set and communications parameters

GRAPHICS DISPLAY TERMINALS

Company Model	Display (diagonal)	Display resolution	Alpha mode screen format col. X lines (matrix character size)	Interfaces (protocols)	Emulations	Unit price ($)	Notes, features, options
COLORGRAPHIC COMMUNICATIONS							
MVI-100, model 113	13-inch, 8-color	160x240	80x48 (7x9)	RS232C (X-on/X-off)	ADDS Regent 40, IBM 3101, Hazeltine 1510, Lear Siegler ADM-3	2,750	split screen, scaling, multiple pages, rack-mount, 128 ASCII line drawing character set
MVI-100, model 119	19-inch, 8-color	160x240	80x48 (7x9)	RS232C (X-on/X-off)	ADDS Regent 40, IBM 3101, Hazeltine 1510, Lear Siegler ADM-3; DEC VT52, VT100	3,250	split screen, scaling, multiple pages, rack-mount, 128 ASCII line drawing character set
MVI-100, model 813	13-inch, 8-color	160x192	80x48 (7x7)	RS232C (X-on/X-off)	ISC 8001G; DEC VT100, VT52	3,000	process control character set, 24 programmable function keys, 4 split screens
MVI-100, model 819	19-inch, 8-color	160x192	80x48 (7x7)	RS232C (X-on/X-off)	ISC 8001G, DEC VT100, VT52	3,500	process control character set
MVI-100, model 489	19-inch, 8-color	640x480	80x48 (7x9)	RS232C (X-on/X-off)	DEC VT100, VT52; ADDS Regent 40, IBM 3101, Hazeltine 1510, Lear Siegler ADM-3	5,500	clipping, scaling, windowing, rack-mount; opt. RGB output
MVI-7	13-inch, 8-color	720x288	80x24 (7x9)	RS232C, RS422, current loop (X-on/X-off)	ADDS Regent 40, IBM 3101, Hazeltine 1510, Lear Siegler ADM-3; DEC VT52, VT100	3,500	4 split screens, clipping, scaling, windowing; opt. RGB output
MVI-7, model 719	18-inch, 8-color	720x288	80x24 (7x9)	RS232C, RS422, current loop (X-on/X-off)	ADDS Regent 40, IBM 3101, Hazeltine 1510, Lear Siegler ADM-3, DEC VT52, VT100	4,000	4 split screens, clipping, scaling, windowing; opt. RGB output
XL-13	13-inch, 8-color	640x480	80x48 (7x9)	RS232C (X-on/X-off)	DEC VT52	3,000	clipping, scaling, windowing, rack-mount; opt. RGB output
XL-19	19-inch, 8-color	640x480	80x48 (7x9)	RS232C (X-on/X-off)	DEC VT52	3,500	clipping, scaling, windowing, rack-mount; opt. RGB output
CYBERNEX LTD.							
1014	14-inch, green	1024x780	146x780 (5x7)	dual RS232C, Centronics	Tektronix 4010, 4012, 4014, 4015	2,695	supports Microsoft mouse, Summagraphics bit pad
DATAMEDIA CORP.							
Colorscan 10 graphics	12-inch, 64-color	640x240, 640x480	132x24 (7x9)	RS232C, CCITT-V.24 current loop (X-on/X-off)	DEC VT52, 100; Tektronix 4027, 4010		polygon fill, circle/pie
Colorscan 30 graphics	12-inch, 64-color	640x240, 640x480	132x24 (7x9)	RS232C, CCITT-V.24, current loop (X-on/X-off)	Lear Siegler ADM-3A, Hazeltine 1420, ADDS Regent 25, Tektronix 4027, 4010		polygon fill, arc/pie
Colorscan 60 graphics	12-inch, 64-color	640x240, 640x480	132x24 (7x9)	RS232-C, CCITT-V.24; opt. current loop (X-on/X-off)	DEC VT52, 100, 131, 132; Tektronix 4027, 4010		polygon fill, circle/pie
Colorscan 70 graphics	12-inch, 64-color	640x240, 640x480	132x24 (7x9)	RS232C, CCITT-V.24; opt. current loop (X-on/X-off)	Data General 6052, 6053, Dasher 100, 200; Tektronix 4027, 4010		polygon fill, circle/pie
DATA TYPE LTD.							
XK19	19-inch	1024x1024	132x24 (10x13)	RS232C (X-on/X-off, DTR)	DEC VT100, Tektronix 4014, TeleVideo 925		random pattern fill mode by seeding, auxiliary I/O ports
DATAVUE CORP.							
DV132C	13-inch, green	1056x240	132x24 (5x9)	RS232C (X-on/X-off, bisync)	DEC VT100	1,795	opt. rack-mount
ENVISION							
215	13-inch, 8-color with 64-color palette	640x409	132x24 (7x18)	RS232C (X-on/X-off, DTR/CTS)	DEC VT100, Tektronix 4014	3,450	opt. mouse, RGB output

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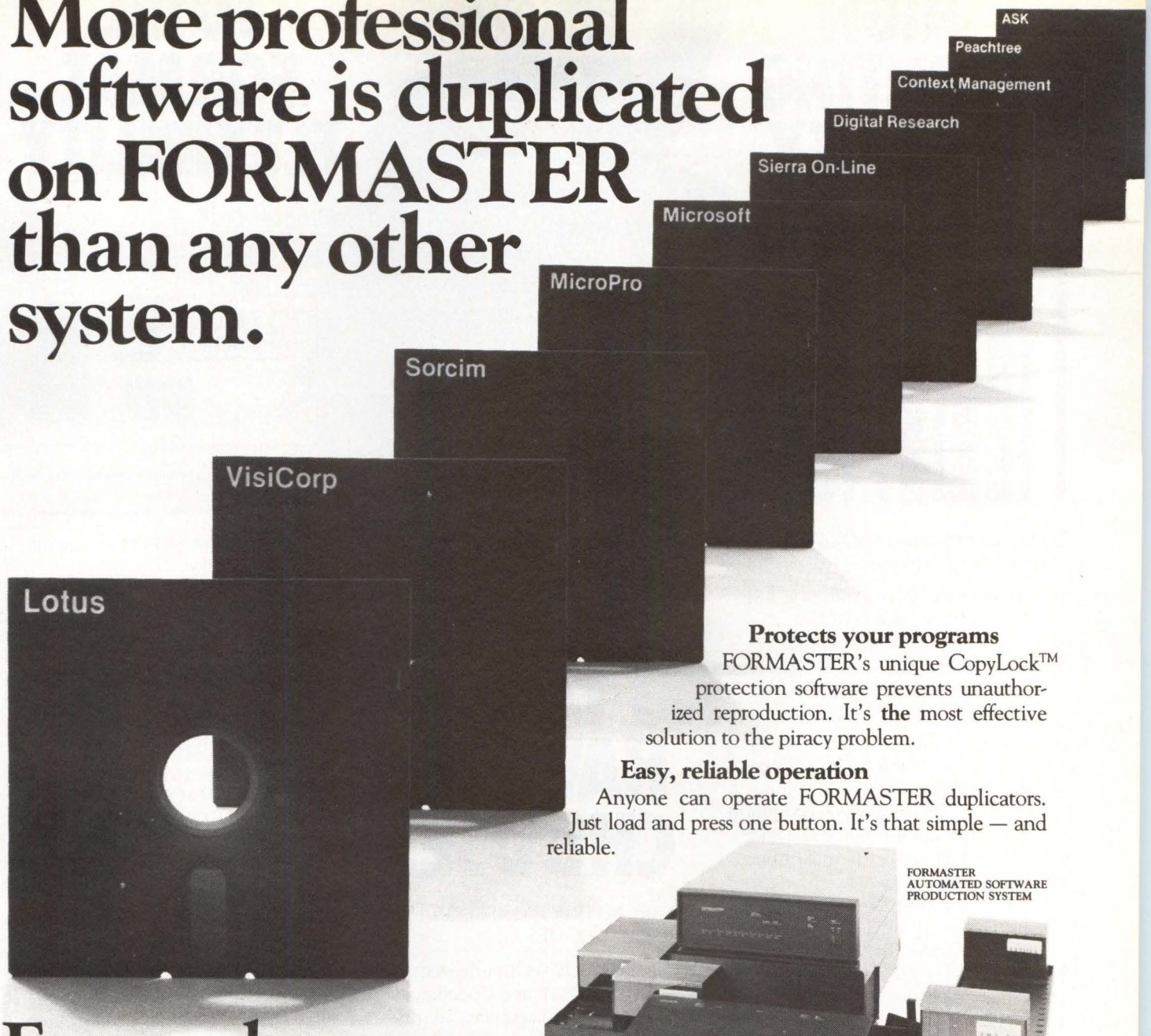

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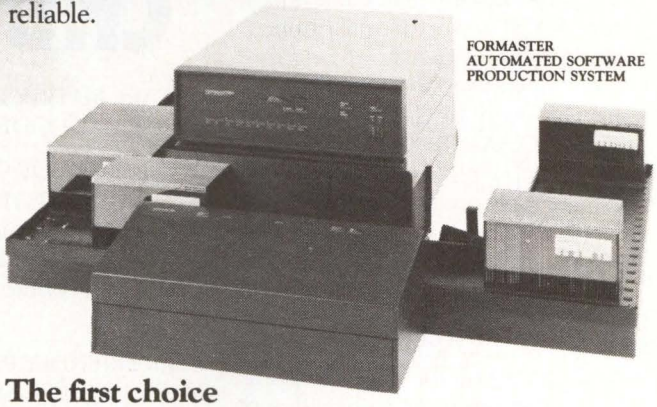

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For Literature, Circle Number 193.
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SQUARE MATRIX 8625 PRINTS THE MAJOR BAR CODES.

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GRAPHICS DISPLAY TERMINALS

Company Model	Display (diagonal)	Display resolution	Alpha mode screen format col. X lines (matrix character size)	Interfaces (protocols)	Emulations	Unit price ($)	Notes, features, options
220	13-inch, 16-color with 4096-color palette	640x480	132x24 (7x18)	RS232C (X-on/X-off, DTR/CTS)	DEC VT100, Tektronix 4014	4,950	opt. mouse, graphics tablet, RGB output
230	13-inch, 16-color with 4096-color palette	640x409	132x24 (7x18)	RS232C (X-on/X-off, DTR/CTS)	DEC VT100, Tektronix 4014	6,950	mouse, graphics tablet, opt. RGB output
239	19-inch, 16-color with 4096-color palette	640x480	132x24 (7x18)	RS232C (X-on/X-off, DTR/CTS)	DEC VT100, Tektronix 4014	9,450	mouse, graphics tablet, RGB output
FALCO DATA PRODUCTS							
FAME 100	12-inch, green, amber	640x285	132x24 (6x10)	RS232C; opt. RS422, current loop (X-on/X-off)	DEC VT100; Tektronix 4010, 4014	1,195	split screen; opt. 14-inch screen
TS100/132G	12-inch, green, amber	640x285	132x24 (6x10)	RS232C; opt. RS422, current loop (X-on/X-off)	DEC VT100; Tektronix 4010, 4014	1,095	split screen
GENISCO COMPUTERS CORP.							
G-1000	19-inch, b&w	1024x792	146x66 (7x12, 8x13, 12x20, 13x22)	RS232C (X-on/X-off)	DEC VT100, Tektronix 4014	9,950	area delete, erase, programmable keys; opt. alphanumeric overlay
G-2200	19-inch, 16-color with 4096-color palette	1024x792	146x66 (7x12, 8x13, 12x20, 13x22)	RS232C, RS422 (X-on/X-off)	Tektronix 4014, DEC VT100	12,950	area delete, erase, programmable keys, overlay
GRAPHON							
GO-140	12-inch, green	512x390	80x24 (9x12)	RS232C (X-on/X-off, DTR)	DEC VT100; Tektronix 4010, 4012, 4013	1,995	4 pages of memory
GRINNELL SYSTEMS							
2800 SERIES	19-inch, up to 16M-color palette	512x512, 480x512, 512x640, 480x640	(16x16)	RS232C, DMA interfaces to DEC LSI-11, PDP-11, VAX		30,0000–60,000	joystick, mouse, graphics tablet, 19-inch rack-mount, 24 card slots
270 SERIES	19-inch, up to 16M-color palette	480x512, 512x512	(5x7, 7x9)	DMA interfaces to DEC LSI-11, PDP-11, VAX, and most other minis		10,000–60,000	joystick, mouse, 19-inch rack-mount, 12 card slots in chassis
HMW DATA SYSTEM GMBH							
5000	14-inch, 4096-color palette	1024x1024	80x48 (9x14)	RS232C, current loop, Centronics (X-on/X-off)	DEC VT100, Tektronix 4027, IBM 3278, 3270, RJE, SNA		opt. 19-inch display
HMW ENTERPRISES INC.							
9081	19-inch, 8-color	480x384	80x48 (5x7, 5x14)	RS232C, current loop (X-on/X-off, DTR)	DEC VT100, ISC 8001G	5,000	opt. rack-mount slides
9083-S	13-inch, 8-color	480x384	80x48 (5x7, 5x14)	RS232C, current loop (X-on/X-off, DTR)	DEC VT100, ISC 8001G	4,045	opt. RS170 output, current loop port, second RS232C port
9203	13-inch, 8-color	480x384	80x48 (5x7, 5x14)	RS232C, current loop (X-on/X-off)	DEC VT100, ISC 8001G		oil, dust and watertight housing, membrane keyboard; opt. 16 programmable function keys, special graphics characters
9204	13-inch, 8-color	480x384	80x48 (5x7, 5x14)	RS232C, current loop (X-on/X-off, DTR)	DEC VT100, ISC 8001G	7,995	opt. 32K byte RAM, 32K byte ROM
HUMAN DESIGNED SYSTEMS INC.							
Concept GVT+	12-inch, amber, green, white	250x512	132x25 (5x9, 7x11)	RS232C, current loop (X-on/X-off, CTS/RTS)	Tektronix 4010, DEC VT100	1,895	46 programmable function keys, non-volatile memory
Concept GVT-APL+	12-inch, amber, green, white	250x512	132x25 (5x9, 7x11)	RS232C, current loop (X-on/X-off, CTS/RTS)	DEC VT100; Tektronix 4010, 4013	2,095	46 programmable function keys, non-volatile memory

GRAPHICS DISPLAY TERMINALS

Company Model	Display (diagonal)	Display resolution	Alpha mode screen format col. X lines (matrix character size)	Interfaces (protocols)	Emulations	Unit price ($)	Notes, features, options
ID SYSTEMS CORP.							
ID-100VB SP, ID-100VE LP	12-inch, 8-color	608x480	132x24 (8x10)	RS232C, RS170, TTL levels, current loop (X-on/X-off)	DEC VT100; Tektronix 4010, 4014	4,895; 4,995	split-screen capabilities, screen dump
ID-200	14-inch, 8-color	1280x480	132x24 (8x10, 10x10)	RS232C, RS170, TTL levels, current loop, NTSC (X-on/X-off, RTS/CTS)	DEC VT100; Tektronix 4010, 4014, 4027	3,895	eight viewports, four independent plane controls, 64K-bytes display list memory, all keys redefinable, screen dump
ID-100 MVA	12-inch, 8 shades of gray	512x256	132x24 (8x10)	RS232C, RS170, TTL levels, current loop (X-on/X-off)	DEC VT100; Tektronix 4010, 4014	2,895	split-screen capabilities, screen dump
ID-100VA	12-inch, 8-color	512x256	132x24 (8x10)	RS232C, RS170, TTL levels, current loop (X-on/X-off)	DEC VT100; Tektronix 4010, 4014	3,895	split-screen capabilities, screen dump
IMLAC							
8000	19-inch, green	2048x2048	80x50	RS232C (X-on/X-off)	Tektronix 4014	1,735	calligraphic, bit-pad; opt. light pen, multibus
INDUSTRIAL DATA TERMINALS							
2200	19-inch, 8-color	512x512	85x51 (5x7)	RS232C, parallel, current loop (X-on/X-off)		11,995	rack-mount, color printer interface
2250	19-inch, 8-color	512x512	85x51 (5x7)	RS232C, parallel, current loop (X-on/X-off)		16,595	rack-mount, color printer interface
INTECOLOR							
2427	13-inch, 8-color with 64-color palette	560x288	80x24 (5x7)	RS232C; opt. current loop (X-on/X-off)	DEC VT100, Tektronix 4010	1,995	opt. 12 function keys, RS232C printer port
VHR-19	19-inch, 8-color with 4096-color palette	1024x768	80x32 (9x12)	RS232C; opt. RS343A, current loop	DEC VT100; Tektronix 4010, 4014, 4014-1	3,995	
E8001G	19-inch, 64-color	160x192	80x48 (5x7)	RS232C; opt. current loop		2,745	
E8001 R	19-inch, 64-color	480x384	80x48 (5x7)	RS232C; opt. current loop		3,975	bit-mapped graphics
INTERGRAPH CORP.							
DSP046	19-inch, 256-color with 16M-color palette	1280x1024	160x80 (16x24)	RS232C, RS432 (X-on/X-off)	DEC VT100, Tektronix 4014	28,000	
ITHACA INTERSYSTEMS INC.							
GRAPHOS I	13-inch, 16-color with 32-, 768-color palette	640x480	80x30 (7x14)	RS232C (X-on/X-off, DTR)	DEC VT100, Tektronix 4010	6,995	16 independent display windows, reference grid
GRAPHOS II	13-inch, 16-color	640x480	80x30 (7x14)	RS232C (X-on/X-off, DTR)	DEC VT100, Tektronix 4010	3,995	16 independent display windows, reference grid; 19-, 25-inch screens
GRAPHOS III	13-inch, 16-color with 32-, 768-color palette	640x480	80x30 (7x14)	RS232C (X-on/X-off, DTR)	DEC VT100, Tektronix 4010	4,995	16 independent display windows, reference grid; opt. 19-, 25-inch screens
GRAPHOS IV	13-inch, 256-color with 32-, 768-color palette	640x480	80x30 (7x14)	RS232C (X-on/X-off, DTR)	DEC VT100, Tektronix 4010		16 independent display windows, reference grid; opt. 19-, 25-inch screens
JAPAN COMPUTER CORP.							
NJC-M1000	12-inch, green, amber	640x486	80x27 (7x9)	RS232C, Centronics (X-on/X-off)	DEC VT100; Tektronix 4010, 4014		selective erase, screen dump, mixed text and graphics

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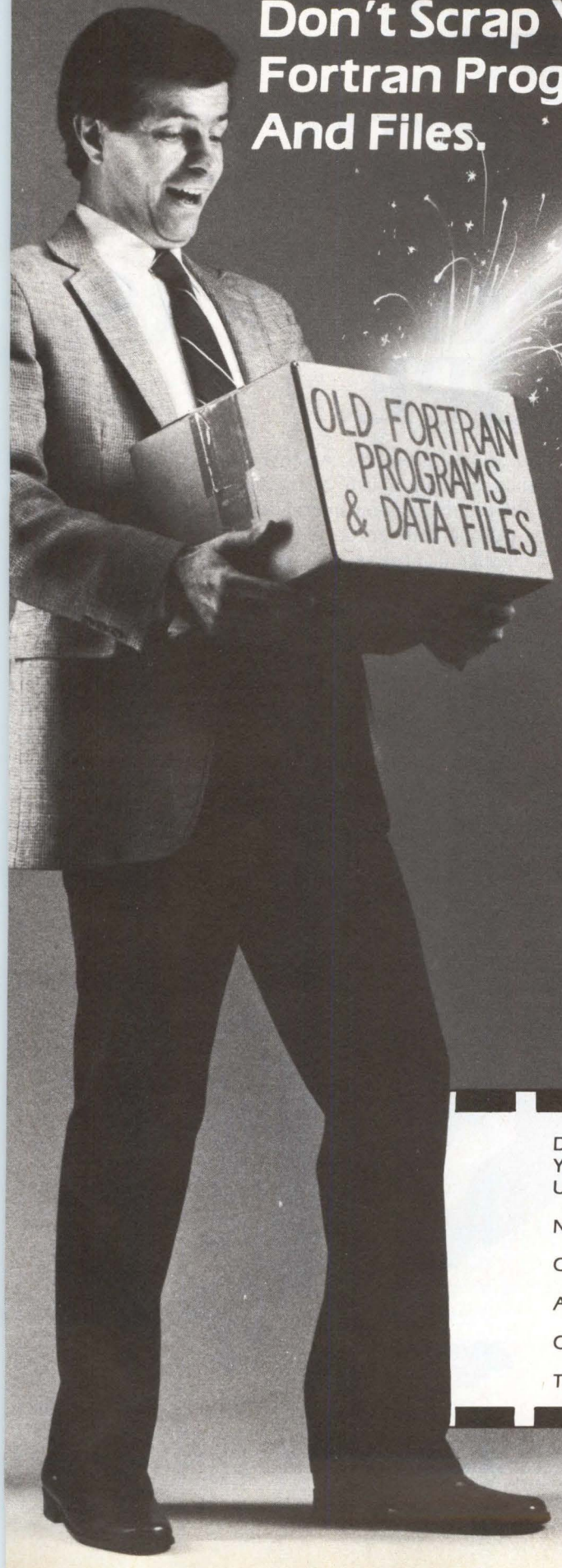

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GRAPHICS DISPLAY TERMINALS

Company Model	Display (diagonal)	Display resolution	Alpha mode screen format col. X lines (matrix character size)	Interfaces (protocols)	Emulations	Unit price ($)	Notes, features, options
NJC-M1401 II	14-inch, green, amber	1032x780	86x30 (12x26)	RS232C, Centronics, current loop (X-on/X-off)	DEC VT100; Tektronix 4010, 4014		three graphics pages, selective erase, screen dump, mixed text and graphics
NJC-C2022	19-inch, 16-color with 27-color palette	1024x780	84x30 (9x15)	RS232C, Centronics, current loop (X-on/X-off)	DEC VT100; Tektronix 4010, 4014		selective erase, screen dump, mixed text and graphics, color table manipulation
NJC-M1414	14-inch, green, amber	1032x780	86x30 (12x26)	RS232C, Centronics, current loop (X-on/X-off)	DEC VT100; Tektronix 4010, 4014		screen dump, mixed text and graphics, windows
NJC-C1441	14-inch, 8-color with 27-color palette	1024x780	84x30 (12x26)	RS232C, Centronics, current loop (X-on/X-off)	DEC VT100; Tektronix 4010, 4014		screen dump, mixed text and graphics, color table manipulation, selective erase
NJC-C1431	14-inch, 16-color with 27-color palette	1024x780	84x30 (9x15)	RS232C, Centronics, current loop (X-on/X-off)	DEC VT100; Tektronix 4010, 4014		selective erase
NJC-C1421	14-inch, 16-color with 27-color palette	1024x780	84x30 (9x15)	RS232C, Centronics, current loop (X-on/X-off)	DEC VT100; Tektronix 4010, 4014		selective erase
KEL INC.							
J1014	14-inch, green	1024x780	146x65 (5x7, 10x14)	RS232C, current loop (X-on/X-off)	DEC VT100; Tektronix 4010, 4014		selective alpha and graphics erase, supports Japanese Katakana; opt. printer
J1014C	14-inch, 8-color	1024x780	146x65 (5x7, 10x14)	RS232C, current loop (X-on/X-off)	DEC VT100; Tektronix 4010, 4014		selective alpha and graphics erase, supports Japanese Katakana; opt. printer
J1019C	19-inch, 8-color	1024x780	146x65 (5x7, 10x14)	RS232C, current loop (X-on/X-off)	DEC VT100; Tektronix 4010, 4014		selective alpha and graphics erase, supports Japanese Katakana; opt. printer
LEAR SIEGLER INC., DATA PRODUCTS DIV.							
ADM-3AG	12-inch, green, amber, b&w	512x250	80x24 (5x7)	RS232C; opt. current loop	Tektronix 4010		selective erase, write through mode, block fill
ADM-5G	12-inch, green, amber, b&w	512x250	80x24 (5x7)	RS232C; opt. current loop	Tektronix 4010, ADM-3A		selective erase, write through mode, block fill
ADM-11G	12-inch, green, amber	512x250	80x25 (7x10)	RS232C; opt. current loop, RS422 (X-on/X-off, DTR)	Tektronix 4010, 4014; Lear Siegler ADM-3A, ADM-5		4 programmable function keys, graphics printer output; opt. 14-inch monitor
ADM-12G	12-inch, green, amber	512x250	158x25 (7x10)	RS232C; opt. current loop, RS422 (X-on/X-off, DTR)	Tektronix 4010, 4014; Lear Siegler ADM-3A, ADM-5, ADM-31, ADM-32		16 programmable non-volatile function keys, graphics printer output, block mode; opt. 14-inch screen
LEXIDATA CORP.							
2400	19-inch, white	1280x1024	160x85 (7x9, 14x18, 21x27, 28x36)	RS232C	Tektronix 4014	9,900	12 programmable function keys, 4 variable-sized workspaces
2410	19-inch, 16-color with 4096-color palette	1280x1024	160x85 (7x9, 14x18, 21x27, 28x36)	RS232C	Tektronix 4014	13,600	12 programmable function keys, 4 variable-sized workspaces
LYNWOOD INTERNATIONAL							
Alpha Colour	15-inch, 4096	400x396	100x30 (7x11, 10x14)	RS232C (X-on/X-off, bisync)	DEC VT100, Tektronix 4010, IBM 3274, 3278		character sets — 544 total characters available
Alpha Graphic	15-inch, green	1000x396	100x30 (7x11, 10x14)	RS232C			character sets — 544 total characters available
MATROX ELECTRONIC SYSTEMS LTD.							
GXT-1000	19-inch, 16-color with 256-color palette	1024x1024		RS232C, RS449, parallel	Tektronix 4113	13,345	rackmount or desktop versions; supports as many as 64 independent viewports and four dialog areas

GRAPHICS DISPLAY TERMINALS

Company Model	Display (diagonal)	Display resolution	Alpha mode screen format col. X lines (matrix character size)	Interfaces (protocols)	Emulations	Unit price ($)	Notes, features, options
MEGATEK CORP.							
3355	19-inch, 16-color with 4096-color palette	1024x1024	113x75 (36x54)	RS232C, IEEE-488 (X-on/X-off)	DEC VT100, Tektronix 4014		opt. video output, hardcopy device
7250	19-inch, 16-color with 4096-color palette	512x512	85x56 (48x72)	RS232C, IEEE-488, DEC Unibus (X-on/X-off)	Tektronix 4014		opt. video output, hardcopy device
1645	19-inch	4096x4096			DEC VT100, VT52; Whizzard 6200, 7200, 7600; Tektronix 4014	8,900 (Q1)	joystick, tablet, digitizer, 3-D capability
1650	19-inch	4096x4096		Centronics, RS232C	DEC VT100, 52; Whizzard 6200, 7200, 7600; Tektronix 4014	9,900	digitizer, wand supports color
MEMOREX CORP.							
2079	15-inch, 4- and 7-color		132x27 (9x12)	bisync, SNA/ SDLC;	IBM 3279 all models	2,995	IBM graphics and software
PDS TECHNOLOGIES INC.							
2150	15-inch, green	768x585	80x24 (7x11)	RS232C, current loop (X-on/X-off, DTR)	DEC VT52, VT100; Tektronix 4010, 4014; Lear Siegler ADM-3A	2,475 (Q100)	parallel port, ruggedized and sealed for use in industrial environments
PHOENIX COMPUTER GRAPHICS INC.							
768-TM	19-inch, 256-color with 16.8M-color palette	768x1365	96x48 (8x8)	RS232C, RS422, Centronics, IEEE-488, (X-on/X-off, bisync)	Tektronix 4010		four- or eight-plane image memory, anti-aliasing; opt. zoom and pan
1024-TM	19-inch, 256-color with 16.8M-color palette	1024x1024	80x64	RS232C, RS422, Centronics, IEEE-488, (X-on/X-off, bisync)	Tektronix 4010		four- or eight-plane image memory, anti-aliasing; opt. zoom and pan
PSITECH							
319	19-inch, 8-color	512x512	85x48 (5x7)	dual RS232C (X-on/X-off)	DEC VT52, VT100; Tektronix 4010; Lear Siegler ADM-3	4,895	variable character size, 32 programmable function keys
329	19-inch, 16-color with 4096-color palette	512x512	85x48 (5x7)	dual RS232C (X-on/X-off)	DEC VT52, VT100; Tektronix 4010; Lear Siegler ADM-3	4,995	variable character size, 32 programmable function keys
214	14-inch, 8-color	512x512	85x48 (5x7)	dual RS232C (X-on/X-off)	DEC VT52, VT100; Tektronix 4010; Lear Siegler ADM-3	3,595	variable character size, 32 programmable function keys
224	14-inch, 16-color with 4096-color palette	512x512	85x48 (5x7)	dual RS232C (X-on/X-off)	DEC VT52, VT100; Tektronix 4010; Lear Siegler ADM-3	3,695	variable character size, 32 programmable function keys
314	14-inch, 8-color	512x512	85x48 (5x7)	dual RS232C (X-on/X-off)	DEC VT52, VT100; Tektronix 4010; Lear Siegler ADM-3	3,295	variable character sets, 32 programmable function keys; opt. 60K-bytes RAM
419	19-inch, 8-color	512x512	85x48 (5x7)	dual RS232C (X-on/X-off)	DEC VT52, VT100; Tektronix 4010; Lear Siegler ADM-3	8,895	buried Winchester disk storing up to 160 pages, variable character size, 32 programmable function keys
QUME CORP.							
QVT211GX	14-inch, green	644x288	80x24 (7x9)	RS232C; opt. current loop (X-on/X-off, DTR)	Tektronix 4010, 4014, 4027; DEC VT125	1,295	split-screen; opt. amber
RAMTEK							
6211	13-inch, 16-color with 64-color palette	640x480	80x24 (8x10)	RS232C, Centronics (X-on/X-off, bisync, DTR)	DEC VT52	4,995	RGB output, opt. rack-mount, 640x512 display resolution

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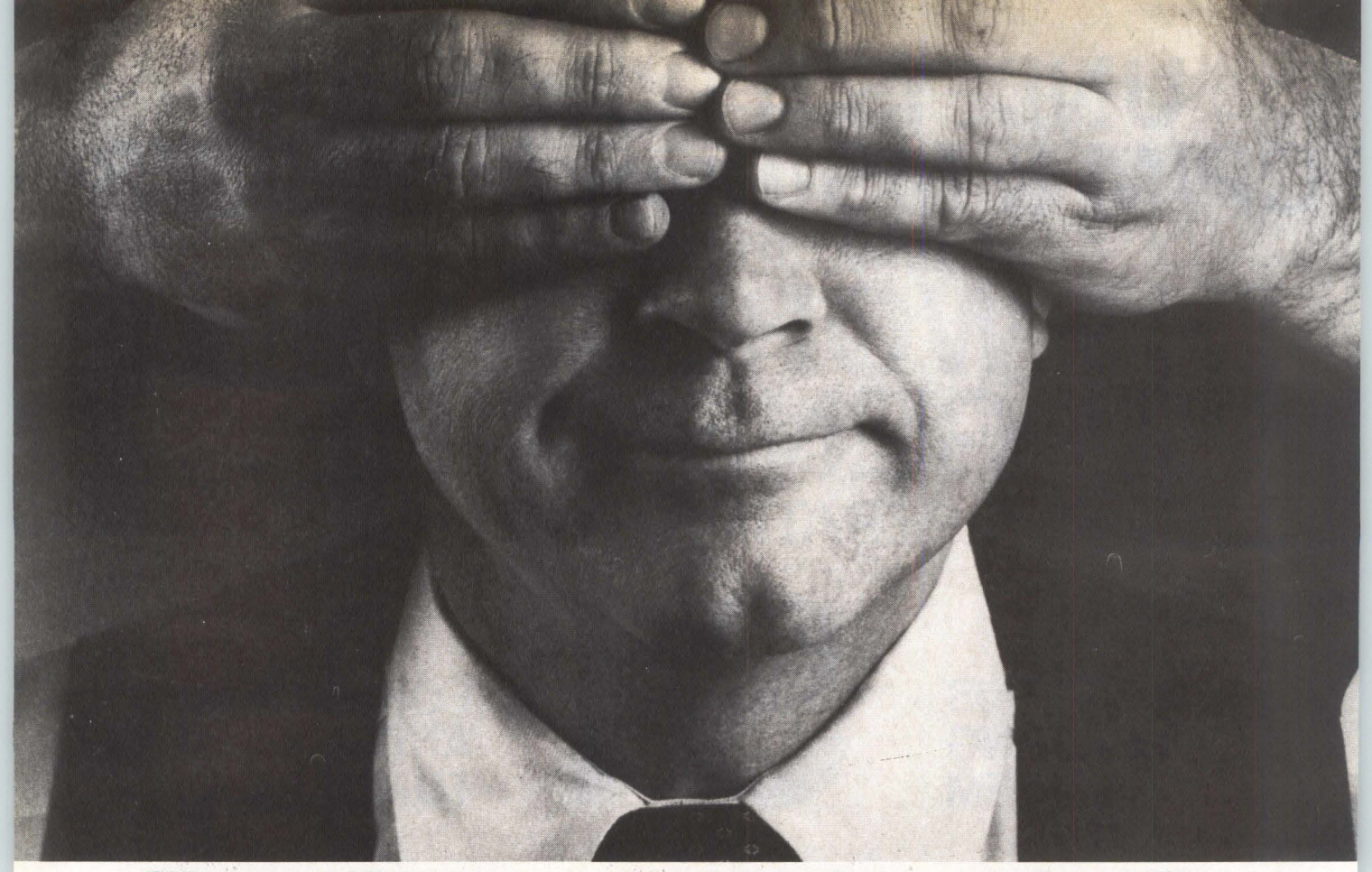
CIRCLE NO. 123 ON INQUIRY CARD



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CIRCLE NO. 124 ON INQUIRY CARD

GRAPHICS DISPLAY TERMINALS

Company Model	Display (diagonal)	Display resolution	Alpha mode screen format col. X lines (matrix character size)	Interfaces (protocols)	Emulations	Unit price ($)	Notes, features, options
6221	13-inch, 16-color with 64-color palette	640x480	132x48 (8x10)	RS232C (X-on/X-off, DTR)	DEC VT100	5,995	RGB output; opt. rack-mount
6411	19-inch, 16-color with 4096-color palette	1280x1024	80x51 (8x10)	RS232C (X-on/X-off, bisync, DTR)		14,995	opt. 256-color with 16M-color palette
RASTER TECHNOLOGIES INC.							
One/25-S	19-inch, 16.7M-color	512x512	128x66 vector character defaults to (5x7)	RS232C; IEEE-488; opt. DMA to DEC PDP-11 VAX, most hosts (X-on/X-off)	Tektronix 4014	20,000–23,000	display list, local segments, local clipping solids modeling primitives,rack-mount
One/40	19-inch, 64-color with 16.7M-color palette	1024x1024	128x66 vector character defaults to (5x7)	RS232C; IEEE-488; opt. DMA to DEC PDP-11 VAX and most hosts (X-on/X-off)	Tektronix 4014	10,000–17,000	display list, local segments, local clipping, rack-mount
One/60	19-inch, 64-color with 16.7M-color palette	768x576	128x66 vector character defaults to (5x7)	RS232C; IEEE-488; opt. DEC Unibus, VAX bus (X-on/X-off)	Tektronix 4014	10,000–17,000	local clipping, display list, rack-mount
One/80	19-inch, 256-color with 16.7M-color palette	1280x1024	128x66 vector character defaults to (5x7)	RS232C; opt. DEC Unibus, VAX bus and other DMA (X-on/X-off)		14,000–33,000	local clipping, rack-mount
One/10	14-inch, 16- or 256-color with 16.7M-color palette	640x480	128x66 vector character defaults to (5x7)	RS232C (X-on/X-off)	DEC VT100, Tektronix 4014	6,000–8,000	local clipping, display list
One/25	19-inch, 16.7M-color	512x512	128x66 vector character defaults to (5x7)	RS232C, DEC Unibus, VAX bus (X-on/X-off)	Tektronix 4010	10,000–20,000	local clipping, display list, rack-mount, RS170; opt. interfaces: Multibus, Data General, Perkin-Elmer, Gould/SEL, IBM, DACU, IEEE-488
SCION CORP.							
SuperScreen #SS1024	19-inch, white	1024x768	128x102 (6x10 up to 16x16)	four RS232C, 32-bit parallel, 16-bit parallel (X-on/X-off)			640K RAM, 80K EPROM, 5 graphics and 1 text plane, multiple-window management firmware.
SEIKO INSTRUMENTS USA INC.							
1104	14-inch, 8-color with 512-color palette	1024x780	80x48 (11x13)	RS232C, Centronics (X-on/X-off, ENQ/ACK, DTR)	Tektronix 4010	5,950	fan, mark, pixel, grid graphics primitives, 16 user-definable function keys
2412	20-inch, 7-color with 35-color palette	1024x780	132x64 (7x9, 10x13)	RS232C (X-on/X-off, ENQ/ACK, DTR)	Tektronix 401X	12,950	anti-aliasing, display list, RGB output
2414	20-inch, 1024-color with 32-, 768-color palette	1280x1024	132x64 (7x9, 10x13)	RS232C (X-on/X-off, ENQ/ACK, DTR)	Tektronix 401X	18,950	hardware anti-aliasing, console mode overlay, multiple logical surfaces
SPERRY COMPUTER SYSTEMS							
UTS 60	14-inch, 16-color	512x375	80x25 (9x15)	RS232C	Sperry Uniscope	4,533	2 logical terminals with dual page, full editing capabilities; 8 language selections, COBOL programmable
UTS 60	14.6-inch, 16-color	512x375	80x24 (9x15)	RS232C	Sperry Uniscope, UTS 400; TTY		opt. 5.25-inch diskette subsystem, disk subsystem, multi-pen plotter
SUMMIT CAD CORP.							
XT/PC 68000	19-inch, 16-color with 4096-color palette	1024x1024	160x48 (8x7)	RS422, RS232C (SNA)	IBM 3270, Tektronix 40XX	22,007	runs IBM PC, XT software, second monitor in station is 13-inch with 640x400 resolution

GRAPHICS DISPLAY TERMINALS

Company Model	Display (diagonal)	Display resolution	Alpha mode screen format col. X lines (matrix character size)	Interfaces (protocols)	Emulations	Unit price ($)	Notes, features, options
SUPERSET INC.							
CD-3	19-inch, 8-color with 263K-color palette	1024x768	120x40 (7x11)				generates NTSC, sync. on any external video signal; overlays graphics on any video signal
TAB PRODUCTS CO.							
132/15-G	15-inch, green, amber, white	512x384	132x24 (7x11)	RS232C, current loop (X-on/X-off)	Tektronix 4010	2,795	vector, point plot, incremental point plot
TEKTRONIX INC.							
4105	13-inch, 8-color with 64-color palette	480x360	80x30 (5x9)	RS232C, Centronics	Tektronix 4010, DEC VT100	3,995 (Q1)	includes German, French characters, 60 Hz refresh
4107	13-inch, 16-color with 64-color palette	640x480	80x32 (7x11)	three RS232C ports, Centronics	Tektronix 4014, DEC VT100	6,950 (Q1)	includes German, French, Japanese characters; 256K-bytes of display memory, 60 Hz refresh
4109	19-inch, 16 colors out of 4096	640x480	80x32 (7x11)	three RS232C ports, Centronics	4014 and DEC VT100 with 4113 graphics	9,950 (Q1)	includes German, French and Japanese characters, 256K-bytes of display list memory, 60 Hz refresh
4114B/ 4114B30	19-inch, direct view storage	4096x3120	(8x16, 16x30)	RS232C	Tektronix 4010	17,900	full programmability, CP/M, Fortran, 16 alphanumeric character sizes; opt. keyboard fonts, color enhanced refresh
4115B/ M4115B	19-inch, up to 256 colors from a palette of 16 million	1280x1024	(8x16, 16x30)	RS232C	Tektronix 4010, DEC VT100	19,950	32-bit addressability; standard 4 bit planes, 288K RAM, self-test, autoconverged display; opt. DMA, integrated graphics tablet, dual floppy disks, local operating system and languages
4116B/ 4116B30	25-inch, direct view storage	4096x3120		RS232C	Tektronix 4010	22,400	full programmability, CP/M Fortran, 16 alphanumeric character sizes; opt. keyboard fonts, color enhanced refresh
TELERAY							
16-GRE	15-inch, green, amber, white	240x640	80x25 (7x10)	RS232C, current loop, RS422 (X-on/X-off)	Tektronix 4010, 4014		variable character size, 4 pages of memory, 32 programmable function keys; opt. 12-, 15-inch display, 8 pages of memory, rack-mount
TELPAR INC.							
801	12-inch, 8-color	160x96	80x24 (8x10)	RS232C, current loop	Lear Siegler ADM-2A	3,200	16 function keys; opt. RS170 output, 2 pages of memory
802	19-inch, 8-color	160x192	80x48 (5x7)	RS232C	ISC 8001G	3,950	16 function keys, one page of memory; opt. rack-mount
TRANSIAC CORP.							
TR1024	15-inch, green	1024x780	145x52 (5x7)	RS232C, CAMAC, IEEE-583 (X-on/X-off)	Tektronix 4010, 4014; DEC VT100	3,500	supports as many as 4 image planes
VECTOR AUTOMATION INC.							
Graphicus-80	21-inch, green, white	4096x4096		RS232C, IEEE-488, DMA interfaces to DEC PDP-11, VAX	DEC VT100, Tektronix 4014	26,750	local 30 dynamics, local windowing, 5,000 readable characters
VERTICOM							
PLP100	13-inch, 16-color with 4096-color palette	640x480	80x48 (5x9, 7x10)	RS232C (NAPLPS, (X-on/X-off, DTR)	DEC VT100, Tektronix 4010	5,650	tilt and swivel; opt. 19-inch screen
PLP200	13-inch, 16-color with 4096-color palette	640x480	80x48 (5x9, 7x10)	dual RS232C (NAPLPS X-on/X-off, DTR)	DEC VT100, Tektronix 4010	6,450	rubber-banding, tilt and swivel; opt. Multibus compatible slots, 19-inch screen
VISUAL TECHNOLOGY							
500	14-inch, green	768x585	80x33 (10x17)	RS232, current loop (X-on/X-off, DTR)	DEC VT52, Lear Siegler ADM-3A; Hazeltine 1500, DG 200	2,495	separate alphanumeric and graphic memory, block transmission and editing capability; opt. foreign languages
550	14-inch, green	768x585	80x33 (10x17)	RS232, current loop (X-on/X-off, DTR)	DEC VT100; Tektronix 4010, 4014	2,495	opt. foreign languages

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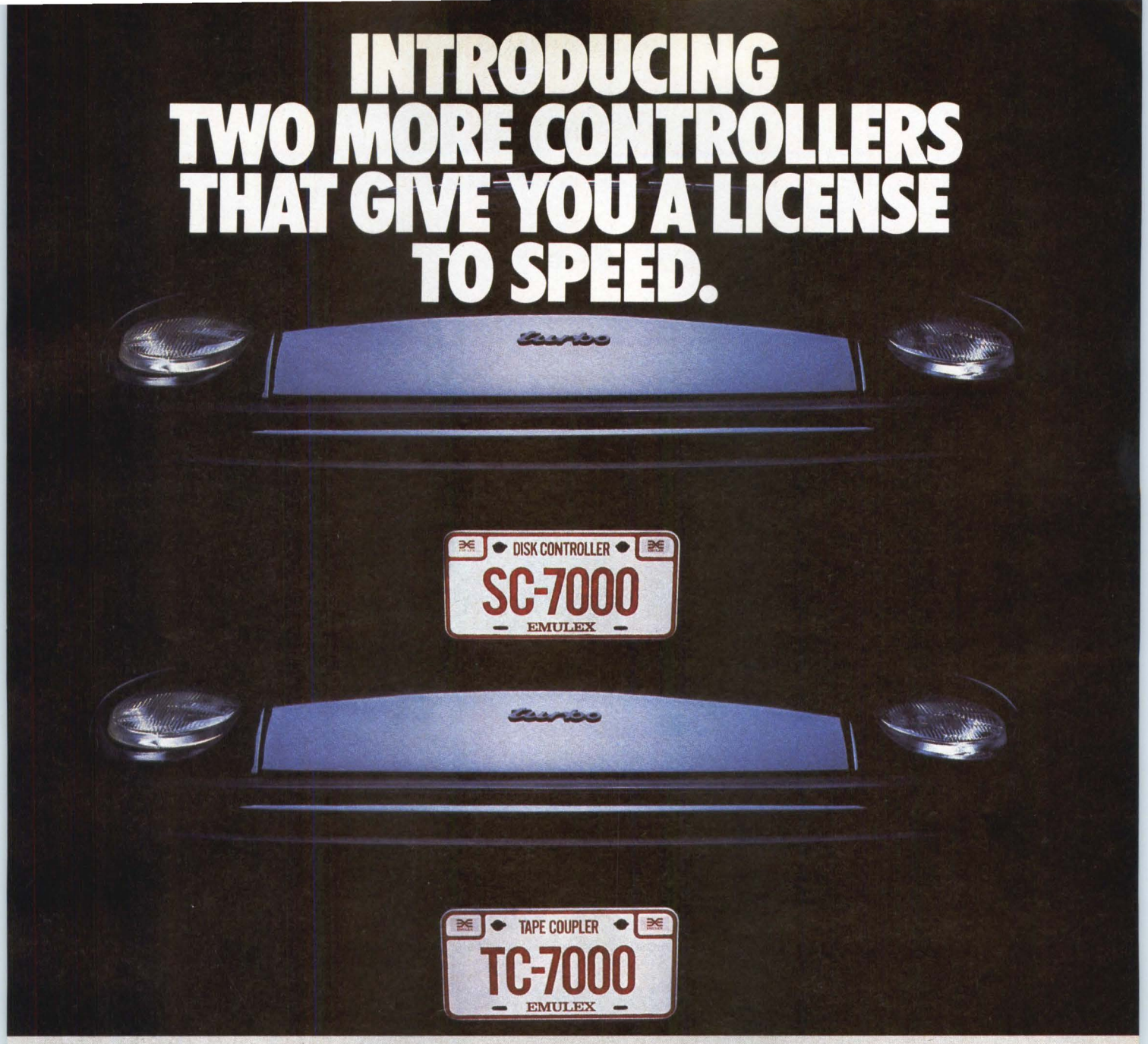

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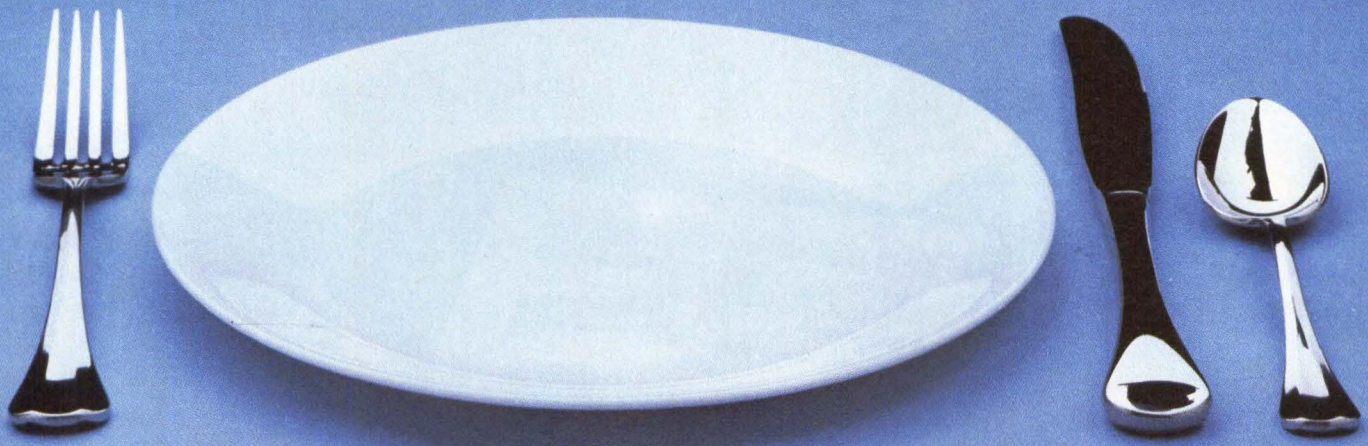
WHERE'S THE DATA?



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CIRCLE NO. 128 ON INQUIRY CARD

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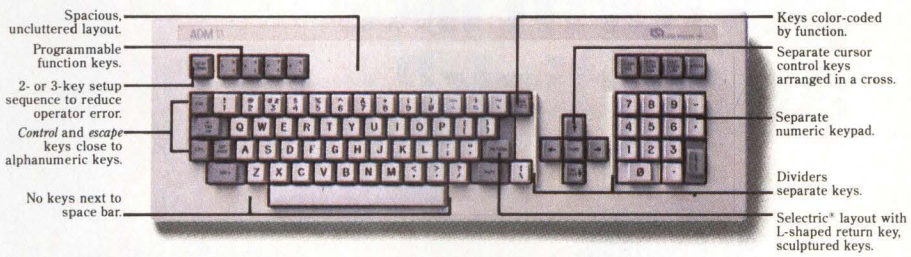
Lear Siegler's new VersaPrint™ 500 Series printers combine with Lear Siegler video display terminals for hard copy output.



Low-profile, tapered, DIN-standard keyboards with Selectric layout feature logical key groupings and adjustable tilt for comfort and efficiency. ADM 11 shown above.

	ADM 11 Conversational	**ADM 12** Editing	**ADM 24E** Host Programmable
Programmable Function Keys	4 (Shiftable to 8)	16 (Shiftable to 32)	16 (Shiftable to 32)
Non-Volatile Function Keys	Optional	Standard	Standard
Function Key Legends on 25th Line	From Host	From Host	Standard Non-Volatile
No. of Pages of Display Memory	1	2	4
Display Memory Configurations (Plus 25th Message/Status Line)	24 Lines by 80 Characters	(2) 24 x 80 or (1) 48 x 80 or (1) 24 x 158	User Definable up to 96 x 80
Scrolling	Standard Scrolling	Smooth, Jump or Horizontal Scrolling Split Screen	Smooth or Jump Scroll Split Screen
Transmission Mode	Conversation Mode	Conversation or Block Mode	Conversation or Block Mode
Editing	Limited	Full Editing & Protected Fields	Full Editing & Protected Fields
Visual Attributes: Reduced Intensity, Blink, Blank and Reverse Video. Underline also on ADM 12 and ADM 24E	3 Embedded 1 Non-Embedded	4 Embedded, 1 Non-Embedded or All Non-Embedded, plus Full Screen Reverse Video	5 Embedded, 1 Non-Embedded or All Non-Embedded, plus Full Screen Reverse Video and Highlight
OEM Flexibility	Modifiable Set-Up Characteristics	Modifiable Set-Up Characteristics & Personality	Modifiable Set-Up Characteristics. Add to Program in ROM or Down-Line Load in RAM (56K ROM or RAM. Up to 22K Display Available) Room for additional Logic Boards.
Terminal Compatibility	ADM 3A, ADM 5, ADDS Viewpoint & Regent 25, Hazeltine 1400, 1420 & 1500, DEC VT-52	ADM 3A, ADM 5, ADM 31, ADM 32	ADM 3A, ADM 5, ADM 31, ADM, 32, ADM 42

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CIRCLE NO. 129 ON INQUIRY CARD

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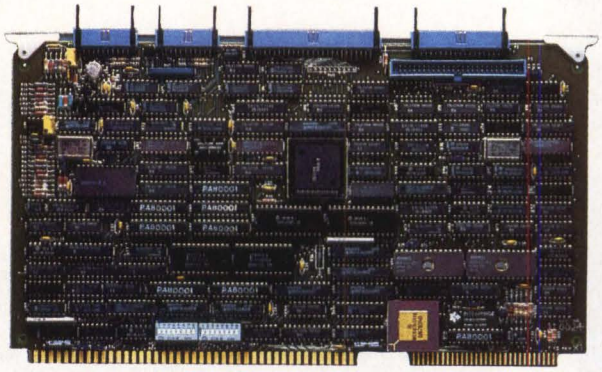
Frank Emser
Manager Hardware Development
Paradyne Corporation

The Interphase Storager Multibus™ controller can give a 5¼" Winchester disk capabilities never before possible. Storager not only gets more performance from existing ST506 drives, but also supports the new ESDI and ST412HP interfaces for more power and capacity than ever before. And since Storager can control two Winchester disks, four ¼" tapes (QIC-02), and two 3½", 5¼" or 8" floppies, the same controller can be used for every storage need.

Storager features 1:1 interleave, with concurrent disk and tape transfers and simultaneous disk and bus transfers for speed and high performance. And Storager's unique "virtual buffer" architecture with UNIX™-optimized intelligent caching can reduce or eliminate disk rotational latency and overcome data overrun/underrun problems of FIFO-based controllers. Plus, for the very first time on a controller, Storager has an *on-board* 68000 CPU.



The Storager controller is the latest product in Interphase's line of high-performance Multibus controllers. Interphase also offers Multibus controllers for SMD disks, local area networks and video monitors. Plus powerful disk controllers for the IBM® PC. They're all backed by a great customer support team that works full time with Interphase customers to assure that our products work the way they should — in the system.

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CIRCLE NO. 130 ON INQUIRY CARD

Callback security system prevents unauthorized computer access

Analog unit overcomes limitations of digital devices

Jim Smith, Omnicom Engineering

Callback security systems are probably the least penetrable method of protecting a computer system's data from unauthorized access over telephone lines. Designed to prevent an unauthorized user from gaining access to a computer's communications channels, the system will hang up and "call back" a telephone number at a pre-programmed, authorized location. Security equipment manufacturer LeeMAH's modular secure-access-multiport (SAM) unit, placed between the computer modem and the telephone lines, eliminates many of the limitations of digital security devices situated between the modem and a computer's I/O ports. It also furnishes priority call routing, can be hard-wired or remotely programmed and generates an

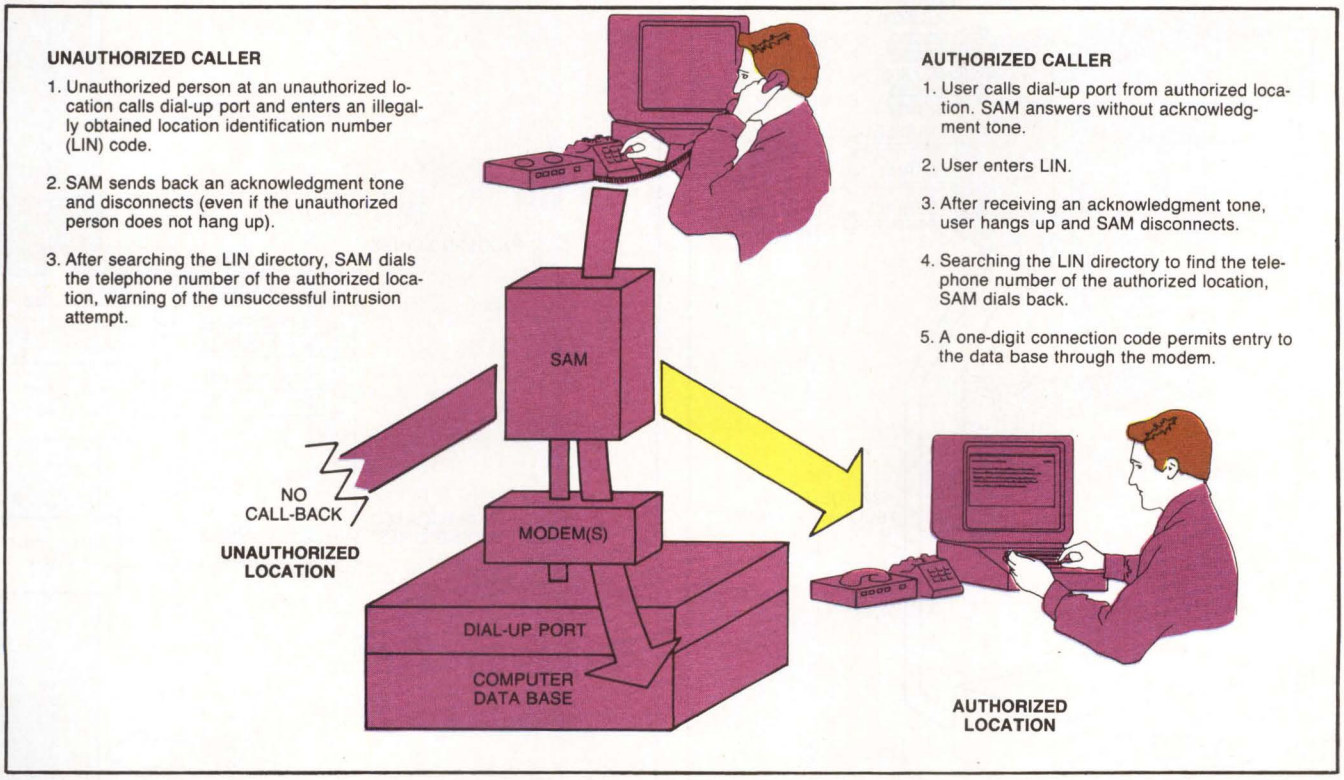


Fig. 1. Responding to authorized or unauthorized callers, *SAM calls back only telephone numbers at authorized locations, thwarting unauthorized callers who might have obtained location-identification numbers (LINs). The callback also alerts the authorized location to the unsuccessful attempt at intrusion.*

audit trail of telephone transactions.

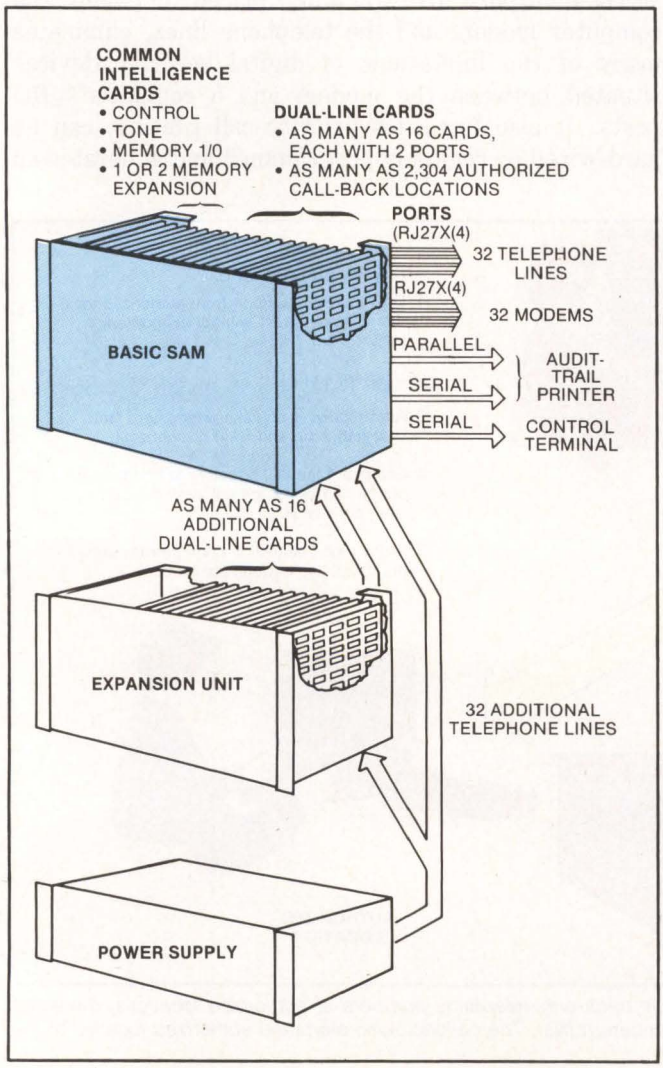
Providing better security

When first developed, callback security systems were installed between the computer's I/O ports and the modem interfacing the telephone network. Because they prompted callers for further exchange of dialogue, these early digital systems were vulnerable to the intrusions of unauthorized callers, permitting them enough time to "play" with the system.

Second-generation callback systems—including Lee-MAH's secure-access unit (SAU) and SAM device—are more secure and cost-effective and offer advantages over widely used password or encryption systems. Passwords are easily decoded or deduced. If they are complex, they are likely to be written down near a terminal so as not to be forgotten, thereby defeating their purpose. Encryption protects data only when it is transmitted. Moreover, encryption systems can be costly, requiring installation of hardware at both ends of a data-transmission connection.

Developed for use by telephone companies, the single-port SAU prevents unauthorized use of remote computer diagnostic ports. Because both the SAU and SAM reside between the modem of a computer and the telephone network and talk only in analog terms, they can reject modem-handshake requests. The units interface with originate or answer modems, including the Racal-Vadic Inc. 34XX series and the Bell Laboratories 212 series. In contrast, most digital port protectors need originate-mode auto-dial modems to function.

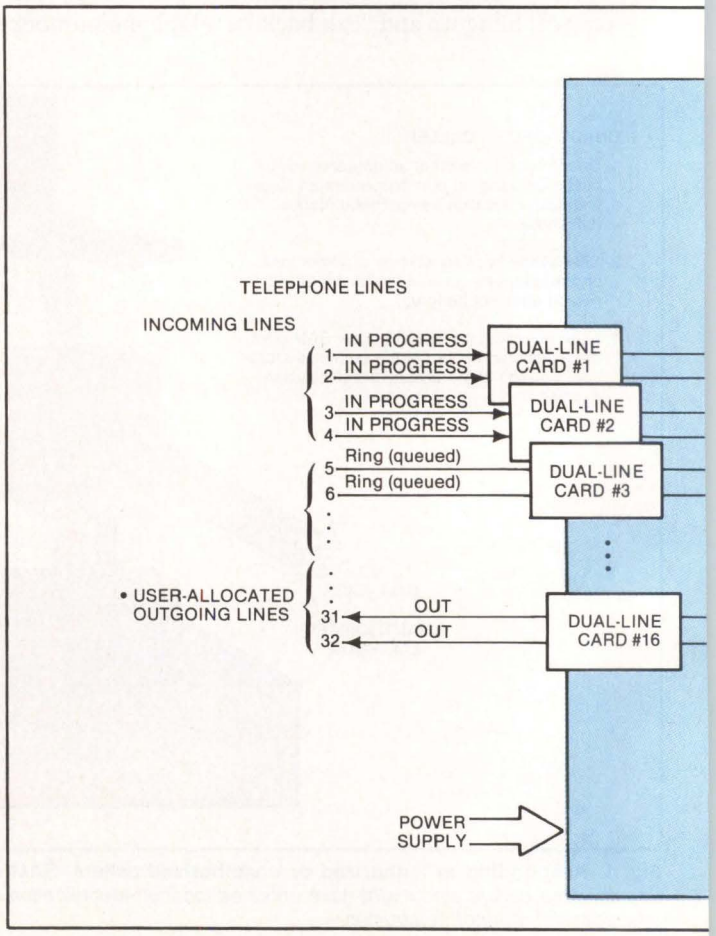
Fig. 2. The basic callback system *uses as many as 16 dual-line cards to handle 32 telephone lines and modems. An expansion unit furnishes access to as many as 32 additional phone lines. Memory-expansion cards enable the unit to store a maximum of 2,304 authorized callback locations.*

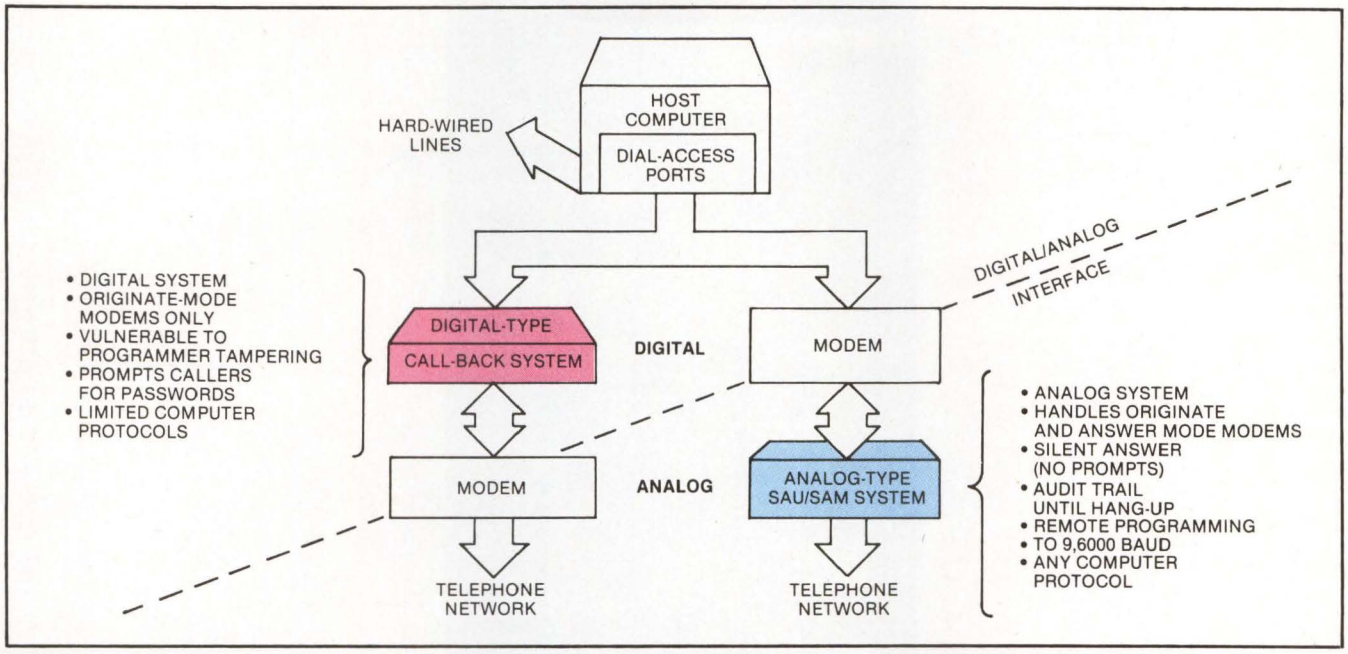


LIN code protects computer access

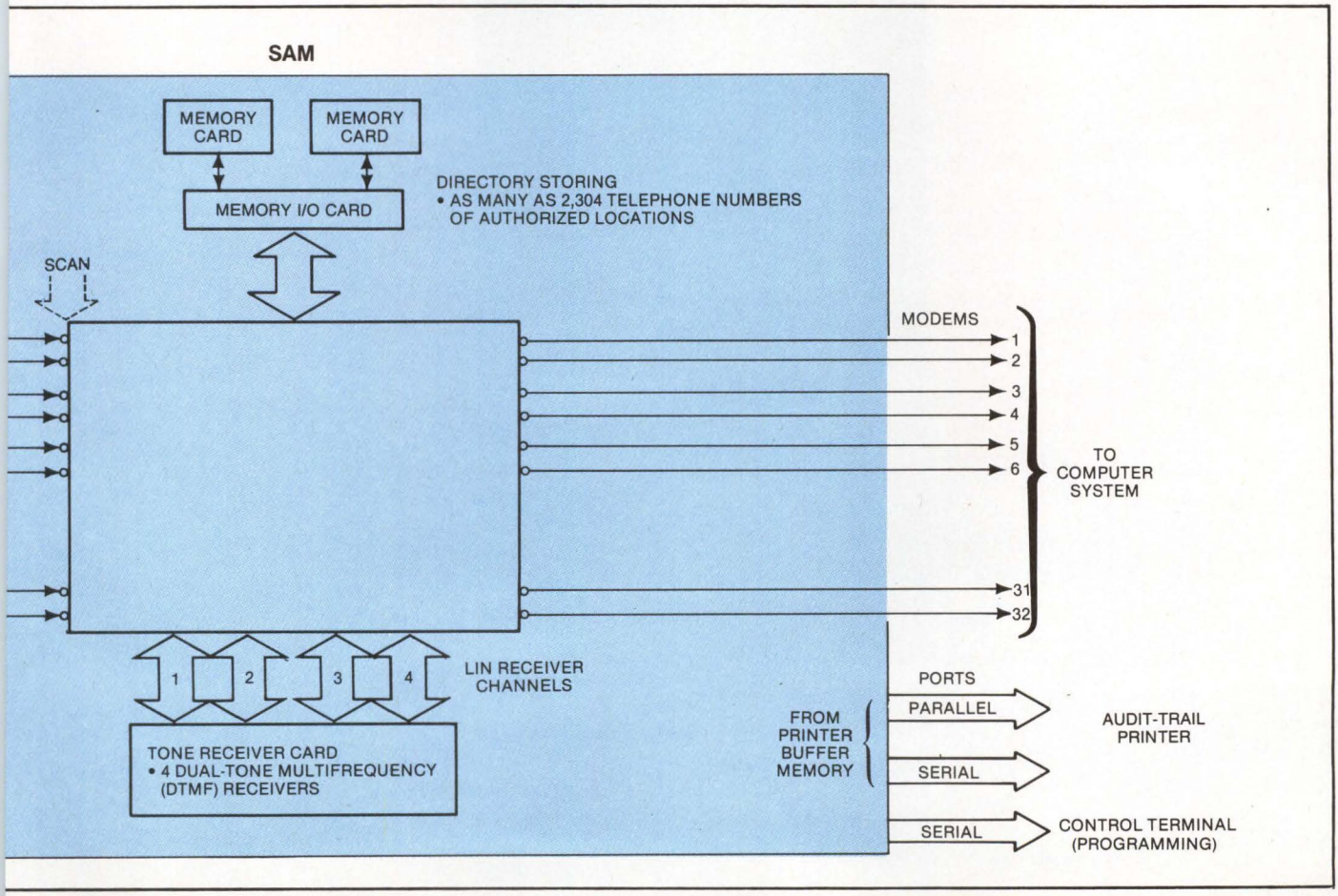
The SAU and SAM operate in a similar manner. After a call to the data center is answered, they remain

Fig. 3. Computer-access-protection unit components *indicate the scope of SAM functions from the first call to the computer center to the final connection with the computer's dial-up ports.*





Analog callback security systems, *placed between the modem and the telephone dial-up network, avoid the limitations of digital systems situated between the modem and the host computer's access ports. Operating only with originate-mode modems and prompting callers for passwords, digital systems can be vulnerable to programmer tampering.*

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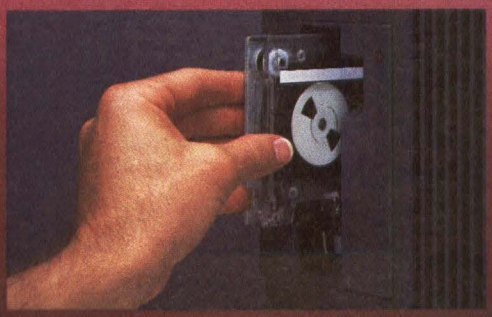

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CIRCLE NO. 131 ON INQUIRY CARD

silent and do not emit the handshake or acknowledgement tone of most handshake systems, thus masking the fact that a computer access point has been reached. Only if the correct six-digit location-identification number (LIN) code is entered by the caller does the system answer with an acknowledgement tone. It then immediately hangs up. If the LIN code matches an entry in a 256-number callback directory (as many as 2,304 telephone numbers in a 32-port system), the SAM calls back the pre-programmed telephone number at the authorized location, usually within 15 seconds. Only then are both the computer modem and the terminal modem allowed to handshake. Because the system calls back only the location identified with the entered LIN code, it thwarts callers who have the proper LIN code but are not at the authorized location (Fig. 1).

The SAM system is compatible with modem communications networks operating at speeds as high as 9,600 baud and with any computer protocol. System integrators can modularly expand the basic system from two to 32 ports using as many as 16 dual-line PC cards corresponding to the number of lines to be handled (Fig. 2). An expansion unit can provide as many as 32 additional lines for a total of 64. The non-volatile LIN directory is stored on electrically-erasable, programmable ROMs (EEPROMs).

When it detects the ring voltage of an incoming call, one of the SAM's dual-line cards passes the information on to the controller card, which sequentially scans each line card. The controller then assigns an idle, dual-tone multifrequency (DTMF) or Touch-Tone receiver (connected to the tone receiver card) to the incoming line. The tone receiver can handle as many as four simultaneous incoming calls. If more than four calls are received at the same time, the overflow is queued until the next receiver channel becomes available.

A tone receiver is usually occupied for approximately 30 seconds, but, because there are four receiver channels, maximum wait time is 15 seconds (5.5 rings), even under the heaviest traffic conditions. A call is answered within 2 seconds 95 percent of the time.

After a receiver has been assigned to the incoming call, the line card goes off-hook, remaining silent to mask the computer from unauthorized callers. If the caller enters a valid LIN code on the Touch-Tone telephone keys, SAM performs a directory search for a matching LIN entry. If a match is found, the system searches for an outgoing telephone line in the callback directory, according to a pre-configured scheme (see "Implementing programmable call routing," below).

IMPLEMENTING PROGRAMMABLE CALL ROUTING

System integrators can configure the secure-access-multiport (SAM) system for maximum effectiveness by pre-programming its operating parameters to match computer-site requirements. One of the most important of these parameters is the callback method used by the system. SAM recognizes two types of routing: same group routing (SGR) and least group routing (LGR). The first digit of a caller's location-identification number (LIN) code indicates the routing of his return call. When a LIN code is configured for SGR, the primary outgoing group of lines is selected for callback. If a LIN code is configured for LGR, the callback is prioritized and assigned a digit from 0 to 9 (lowest to highest priority). SGR directs all return calls according to the programmed priority. With LGR, however, a callback request will be directed to a group 0 line first, a group 1 line next and so on, until the line group number exceeds the first digit of the user's LIN code. Thus, a caller with a LIN that starts with the digit 0 will receive a callback only over a group 0 line; a user with a LIN that starts with 9 can be called back on any available outgoing line.

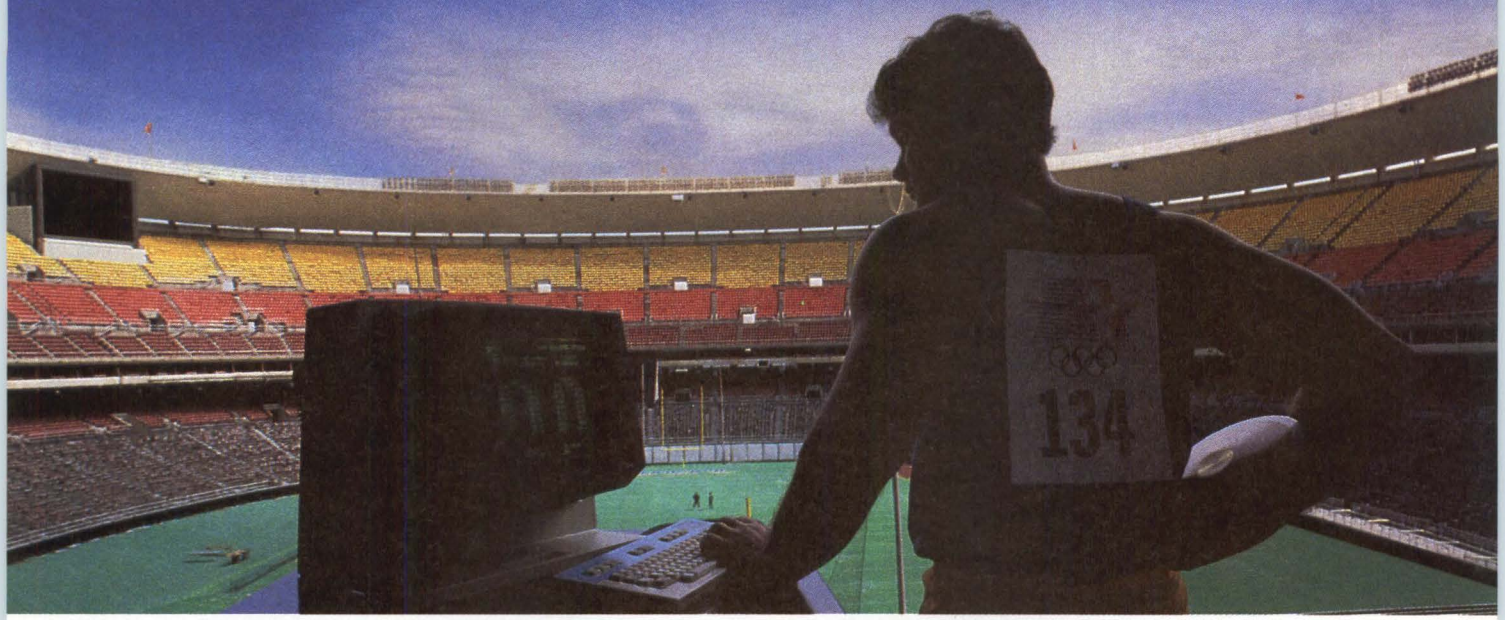
LGR allows system managers to control all computer traffic according to priority, equipment used (e.g., private branch exchange extension), communications route (local or national networks), least-cost considerations (wide-area telephone service lines or non-American Telephone & Telegraph Co. long-distance services) and other factors. Someone with a vital time-dependent task to perform would be given a higher-priority number. LGRs can also be used to permit port selection for the correct routing to a particular modem or protocol-conversion unit.

The time-control function uses the first or second digit of the LIN code to reference a table with as many as 16 entries, the current day of the week and a real-time clock to determine whether a caller can be called back. This allows eight on/off cycles per week for each of 10 groups of callers.

PROGRAMMABLE SAM PARAMETERS

- **Telephone lines.** Any of 32 (or 64) lines can be designated to receive an incoming call, originate an outgoing call or both.
- **Modem characteristics.** The type of modem (auto-answer or originate) interfacing the protected computer port can be pre-programmed.
- **Return-call routing.** The LIN code's first digit indicates the callback routing.
- **Time control.** A real-time clock and time-clock control table in non-volatile memory can be programmed to deny a return call at certain hours and days of the week.

Getting timely information to 50,000 people who need it is an event in itself.



Behind the action, pageantry and spectacle of the 1984 Olympic Games is one of the most extensive data communications systems ever built.

The Electronic Messaging System—12 computers, 1,700 terminals, 300 printers—was created for the 1984 Olympics by AT&T. And tied together with Infotron networking equipment.

The EMS is designed to replace the old system of hand-carried reports in the world's first multi-site Olympics. It does everything from displaying event results, to supplying athlete biographies for reporters, to providing schedules, qualifying information and personal messages to the participants themselves.

The system's true complexity lies in the numbers of people it serves: the 50,000 officials and reporters, coaches and athletes of the Olympic family. But the demands placed on it are very much like the demands all Infotron customers place on their networks.

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INFOTRON SYSTEMS

CIRCLE NO. 132 ON INQUIRY CARD

However, if there is no directory match for the LIN code, the incoming call is immediately disconnected without an acknowledgement tone.

Finding an available line

When it finds an idle line for the return call, the common control card directs the tone card to send a 1-second, 697-Hz acknowledge tone. If an idle line is not available, SAM checks the incoming line to determine if it can be used for the return call. If it can be used, the tone card sends a ½-second, 941-Hz tone, followed by a ½-second, 697-Hz tone, indicating to the caller that the same line will be used for the callback.

If the call cannot be returned on the same line, 15 ¼-second-on/¼-second-off, 941-Hz tone bursts signal an all-lines-busy condition, and the incoming call will be

CONTROLLING COMPUTER CRIME

Unauthorized access to computer systems—the crime that security devices such as LeeMAH's secure-access-multiport (SAM) unit are designed to prevent—can result in significant losses to the companies involved. One study estimates the annual cost of computer-related abuse at $300 million, with an average loss per incident of $45,000. A report from the federal government's General Accounting Office estimates total "computer-related crimes in federal programs" at $2.2 million, with an average loss per incident of $44,110.

In the absence of federal computer-crime laws, computer-related crimes currently fall under state criminal statutes. However, several bills relating to computer abuse have been introduced in Congress. One, H.R. 1092, the Federal Computer Systems Protection Act (see Table, below), has 108 cosponsers in the House and might have reached the floor of the House when this article appears. But, despite considerable media attention and the rush to introduce legislation in Congress, there is no consensus among legal experts or in the computer industry that current state laws are inadequate to deal with the problem or that new federal legislation is required.

"To the extent we are talking about classical criminal conduct—theft, fraud, embezzlement—where intention to do wrong is the element, whether a computer is involved or not makes no difference," asserts Dan Brooks, a Virginia attorney specializing in computer law. "There shouldn't be a great distinction between computer crime and other types of crime." Brooks advocates caution in drafting new legislation and applying criminal sanctions to conduct that is not clearly and unequivocally criminal. He thus supports clarifications of criminal statutes "to make sure they apply appropriately to traditional crimes perpetrated with computers and crimes against computers and assets related to computers."

Brooks sees problems in the borderline area of computer "hackers" who gain access to computer data banks. "I have great difficulty with the concept of taking these people and throwing them into a special category of 'crook' without some consensus that this sort of 'fooling around' is their problem and not the database operator's problem," he argues. "We can identify extremes at which we can reach a reasonably clear consensus that conduct is criminal or not. But, in the larger area between these extremes, there really isn't enough experience so that people can be held to understand that what they are doing is criminal or not."

Brooks also wants the problem to be seen in proper perspective in relation to other crimes. "We are talking about jail," he notes, not merely a slap on the wrist for offenders. And he is skeptical about further straining an overburdened criminal-justice system. "We are talking about public prosecuters who are concerned with rapes, murders, the interstate transportation of God knows what and diverting that scarce resource to the prosecution of whatever the perpetrators have done."

The members of one broad-based computer industry group, the Association of Data Processing Service Organizations (ADAPSO), have not indicated strong support for new computer-crime legislation, contends David Sturdivant, ADAPSO director of public relations. "There is not any great push in our membership for new legislation at this time. The feeling is that the laws on the books can handle anything that comes up." Members see the protection against unauthorized access afforded by security devices, encryption, passwords and other measures as the first line of defense against computer crime, Sturdivant says. "Overall, the attention to that area is very strong among our members." —*J.V.*

PROVISIONS OF FEDERAL COMPUTER SYSTEMS PROTECTION ACT

- **Applies to:** Computers "owned by, under contract to or operated for or on the behalf of" the U.S. government, federally guaranteed financial institutions and companies with interstate computer networks.
- **Penalties:** Fines of as much as $50,000 or twice the value of the property stolen, whichever is greater, and/or as much as five years imprisonment for "whoever uses or attempts to use" a computer "with intent to execute a scheme" to defraud or to obtain property by false or fraudulent means or to "embezzle or steal" such property. Fines of as much as $50,000 and/or imprisonment for five years for criminal damage to covered computers and for computer tampering with intent to deny access to authorized users.
- **Property covered:** "Anything of value," including tangible or intangible personal property; "computer processed, produced or stored data"; transmitted information; computer operating or application programs.

DATE & TIME OF CALL	STATUS	IN	OUT	ENDED	IDENTIFICATION
Sun 07/10/83 08:02:00	C	4800		08:02:15	
Sun 07/10/83 08:02:20	1 C B	4800		08:02:30	E. Edwards
Sun 07/10/83 08:01:30	1	4800	4604	09:13:46	A. Able
Sun 07/10/83 08:01:35	2	4801	4802	10:32:15	B. Brown
Sun 07/10/83 08:01:40	3	4800	4802	12:56:09	C. Cary
Sun 07/10/83 08:01:45	0	4800	4801	15:03:00	D. Douglas
Sun 07/10/83 09:30:00	2 A	4800			
Sun 07/10/83 09:30:05	3 S	4804	4604	16:33:19	F. Francis
Mon 07/11/83 10:15:00	0 A	4803		10:47:11	
Tue 07/12/83 18:39:26	1 F	4800		18:40:01	123456
Tue 07/12/83 18:40:44	2 F	4800		18:41:03	******
Wed 07/13/83 09:47:18	3 E	4800		09:47:28	A. Able
Wed 07/13/83 10:16:19	0 X	4800		10:16:56	B. Brown
Thu 07/14/83 00:23:27	1 N	4800	4804	00:24:06	C. Cary
Fri 07/15/83 01:13:24	2 I	4800	4804	01:15:02	D. Douglas
Sat 07/16/83 23:15:59	3 D	4800	4804	23:17:09	E. Edwards

Fig. 4. Audit-trail printouts *log the telephone lines used for calling the computer center (In) and the callback (Out), if different from the incoming line, tracking attempts to gain access to the computer. Status numbers indicate the receiver processing the call; the letters in the status column indicate rerouting data.*

terminated, with the understanding that the caller must try again later. The all-lines-busy signal is also given if the time-clock control function denies computer access.

Making the final connection

Under normal circumstances, the SAM returns calls within 10 to 15 seconds. After the SAM's callback, the final computer connection is established in one of three ways. Under full automatic control, the caller's data set connects directly to the line. The connection can also be made after the data set issues a valid carrier tone or after the caller enters a Touch-Tone connection code—usually the [*] key—and connects the data set to the line directly or acoustically. Both the dual-line card and common-control card continue to monitor the line until the call is terminated. After the audit trail record is printed, the idle line is freed to wait for another call (Fig. 3).

SAM is usually programmed through a hard-wired terminal. A system integrator or an end user can also employ a remote terminal for programming. For remote programming, a single-port SAU protects the terminal, and the programmer must use the same callback protocol as required by the SAM.

After properly accessing the SAM's programmable port, programmers can read and re-configure several system parameters to meet changing requirements. For example, they can change any entry in the return-call directory, including a library of the 16 most-often-used return-call numbers. They can also display system status and system and line configurations, as well as alternate group routings. Finally, programmers can alter such information as current real-time data, audit-trail records, passwords, memory locations and pre-configured menus.

Generating an audit trail

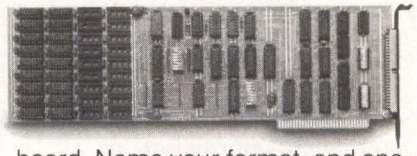
An audit trail is one of the most effective means of tracing authorized and unauthorized user activity and analyzing important system parameters. SAM begins to generate its audit trail after it first detects an incoming call, storing the information in the system's printer memory buffer. Monitored data includes the day, date and time of the call; the incoming and outgoing telephone lines used; the number of authorized locations called back and the caller's identity; and the time the call is disconnected (Fig. 4). In contrast, digital callback systems stop monitoring the caller as soon as the computer connection has been established. SAM can thus record all systematic unauthorized attempts to access the computer system as well as information on uncompleted calls, including queuing data, all-lines-busy information, invalid codes, modem and line malfunctions and return calls not answered. Additional audit-trail functions can be provided. □

Jim Smith is president of Omnicom Engineering, San Jose, Calif.

Designing a 67-Megabyte, File-Addressable, Back-up Storage System Is as Easy as...

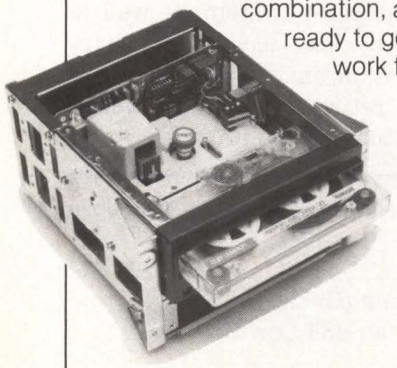
1 Choose Your Interface.

Whether you're talking SASI, RS-232, RS-422, S-100, GPIB (1EEE-488), PERTEC, Q BUS or IBM PC protocol, we've got your



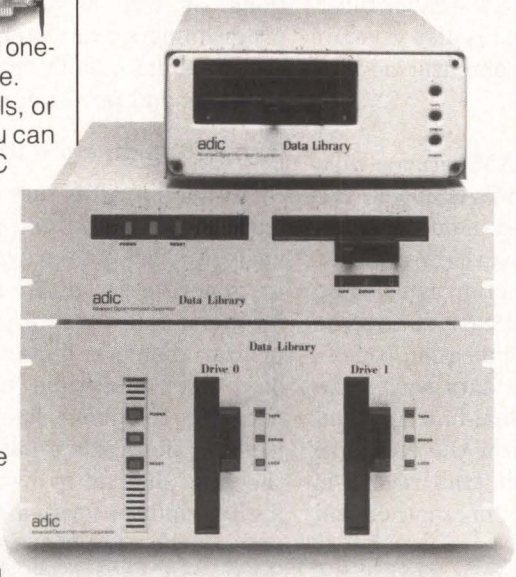
board. Name your format, and one-third of your design job is done. Instead of spinning your wheels, or taking time to reinvent one, you can take advantage of what ADIC has already accomplished. Namely, developing a high-performance, high-capacity back-up device that gives designers the choices *and* the capabilities they need.

We've built it around the compact, reliable HCD-75 ¼" cartridge back-up system from 3M. We use the 3M drive and 3M preformatted data cartridges with tape designed specifically for this application. It's a winning combination, and it's ready to go to work for you.



2 Pick Your Packaging.

Decisions, decisions, decisions. Will you be needing a desktop-style housing with UL, FCC and CSA approvals? A standard rackmount? A portable? Or would you prefer the understated elegance of bare metal, ready to drop into a package of your own? Whatever you choose,



we'll gladly deliver. And we're always willing to talk about other options.

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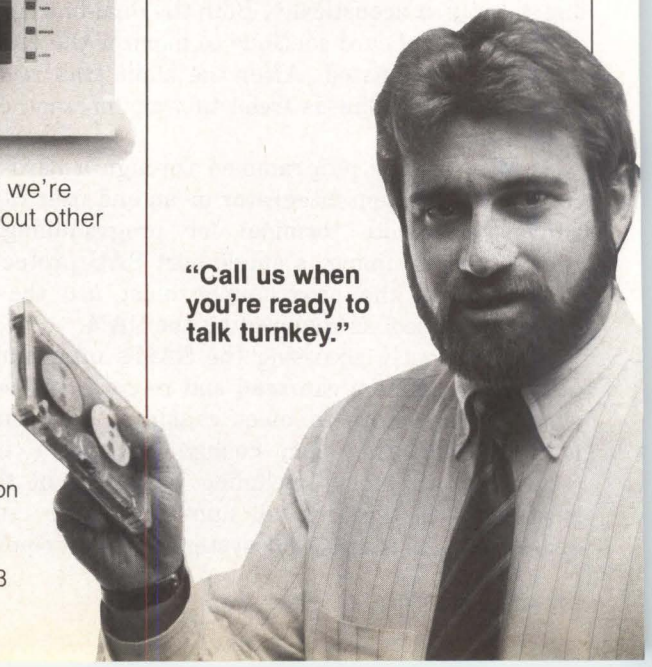

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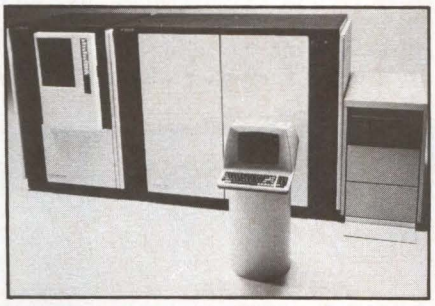
CIRCLE NO. 133 ON INQUIRY CARD

Minicomputers achieve 10-MIPS performance

The Concept 32/97 computers, the three newest members of the company's Concept/32 family of compatible 32-bit minicomputers, incorporate an emitter-coupled-logic-ECL-technology CPU with a 75-nsec. cycle time, instruction unit/execution unit CPU architecture, a four-way set associative cache memory, a hierarchical memory system, an alterable-control storage and a four-stage instruction pipeline. The computers feature a 16M-byte task-addressing capability with field upgrading via modular performance options including a multiply accelerator (MACC), cache memory, shadow memory and a dual-processor internal processing unit (IPU).

Depending on the modular performance enhancements that are included, the Concept 32/97 computers provide a performance of 4.67 million instructions per second (MIPS) to more than 10 MIPS as measured by the whetstone benchmark. In its basic configuration, which includes one CPU, 4M bytes of main memory and 32K bytes of cache memory, the Concept 32/9705 computer provides performance as high as 4.67 MIPS. The system's performance increases to 5.6 MIPS with the addition of the optional MACC. The Concept 32/9780 multiprocessor configuration, which features the IPU, provides performance as high as 8.4 MIPS. When the optional MACCs are added to the CPU and IPU, the Concept 32/9780's performance increases to 10.08 MIPS.



Gould's Concept 32/97 32-bit minicomputers *execute 4.6 million to 10 million Whetstone instructions per second.*

The Concept 32/97 product line uses the company's proprietary real-time operating system, MPX-32, and languages such as FORTRAN 77+. The computers also support UTX/32, the company's implementation of UNIX Berkeley BSD 4.2 with Bell System V enhancements.

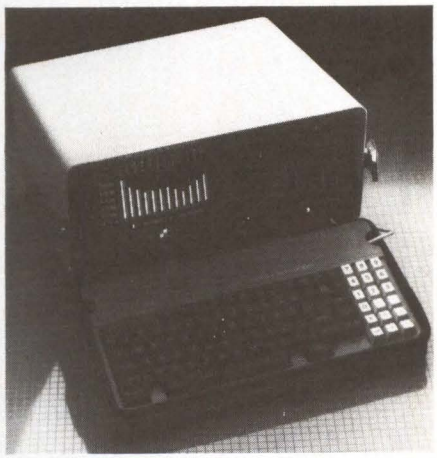
Prices for the Concept 32/97 computers range from $245,000 for a basic 32/9705 to $495,000 for a fully configured 32/9780 with two MACCs and 128K bytes of cache memory. All basic systems include 4M bytes of main memory. Delivery is 90 days after receipt of order. **Gould Inc., Computer Systems Division,** 6901 W. Sunrise Blvd., Fort Lauderdale, Fla. 33313, (305) 587-2900.

Circle No 300

Portable computer has LCD, printer, modem

The 17-pound STM PC transportable computer comes with a 16-line-by-84-character LCD with 540-by-200-pixel graphics resolution. An MS-DOS 2.0 software-compatible 80186 microprocessor drives the unit. The product features 256K bytes of RAM and has dual 1M-byte floppy disk drives. It includes a 300- to 1,200-baud, auto-dial/auto-answer direct-connect modem, a 40-column thermal printer and a detachable, low-profile, 94-key keyboard. Integrated software with word-processing, spreadsheet, database-management and graphics functions is also standard. $3,000. **STM Electronics,** 530 Middlefield Rd., Suite 250, Menlo Park, Calif. 94025, (415) 326-6226.

Circle No 301



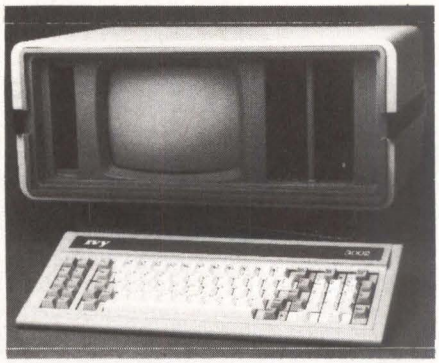
Portable offers operating system choices

The user-configurable and -expandable M3000 transportable computer is built into a water-resistant, dust-proof aluminum case. A basic configuration includes CP/M Plus running on a Z80A microprocessor with 64K bytes of RAM. Options are MS-DOS or CP/M-86 running on an optional STD-88A processor card and UNIX running on a optional STD-68000A processor card. Optional expansion card cages include the STD bus with four open slots, the VME bus with two open slots and the S-100 bus with two open slots. The basic model includes one 376K-byte, double-sided, double-density, 5¼-inch floppy disk drive. Options include dual 376K-byte, 5¼-inch floppy disk drives or a combination of a 10M-byte, 5¼-inch Winchester disk drive and a 376K-byte floppy disk drive. The computer has a detachable, 93-key, IBM-style keyboard with 14 programmable function keys and an 18-key calculator pad. The system incorporates a 9-inch green CRT that displays 80 characters by 25 lines. Prices start at $1,645. **MicroStandard Technologies Inc.,** Box 319, New Lebanon, Ohio 45345, (513) 687-1395.

Circle No 302

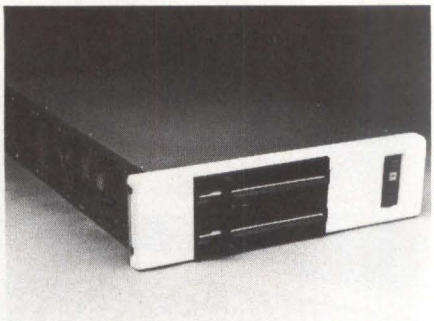
Portable micro runs IBM PC software

The Ivy 3000 series transportable computers are compatible with IBM PC software. They employ Intel's 6-MHz 80186 microprocessor and run the IBM PC-DOS-compatible IDOS operating system. The series is available in two versions, which both come with 256K bytes of RAM. Model 3001 has two half-height, 5¼-inch, 320K-byte floppy disk drives; model 3002 has one half-height, 5¼-inch 320K-byte floppy disk drive and one half-height, 5¼-inch, 10M-byte Winchester disk drive. The



computers incorporate a 9-inch amber screen that displays 25 lines by 80 columns. Two RS232C ports, one of which can be software-configured for synchronous network communications, and one Centronics-compatible port are also standard. Other features include a detachable keyboard and a battery-powered time-of-day clock. Model 3001: $2,995, model 3002: $3,995. **Ivy Microcomputers Corp.,** 220 Ballardvale St., Wilmington, Mass. 01887, (617) 657-8268.

Circle No 303



Computer runs REGULUS operating system

The MC68000-based Micro/32 computer system includes the REGULUS operating system. REGULUS features user-source compatibility with UNIX V6, 7 and System III and supports all UNIX kernel features and multikey binary-tree ISAM. The computer has 512K bytes of parity RAM, four asynchronous serial ports—two of which have modem control—and a Centronics printer port. A 10M-byte Winchester disk drive and dual, 8-inch floppy disk drives provide mass storage. $11,995. **MDB Systems Inc.,** 1995 N. Batavia St., Orange, Calif. 92665, (714) 998-6900.

Circle No 304

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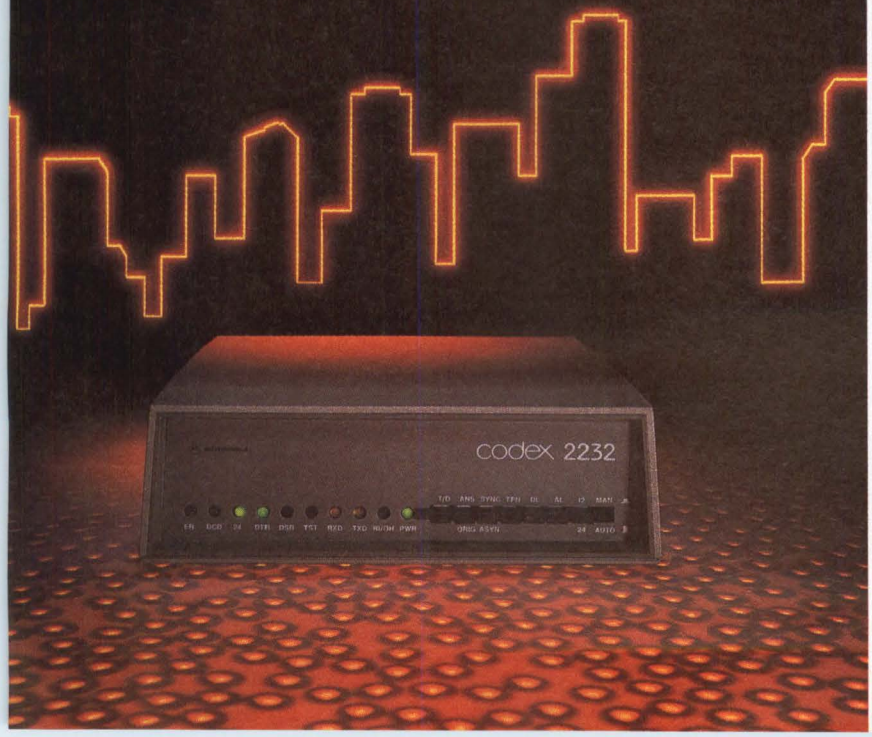

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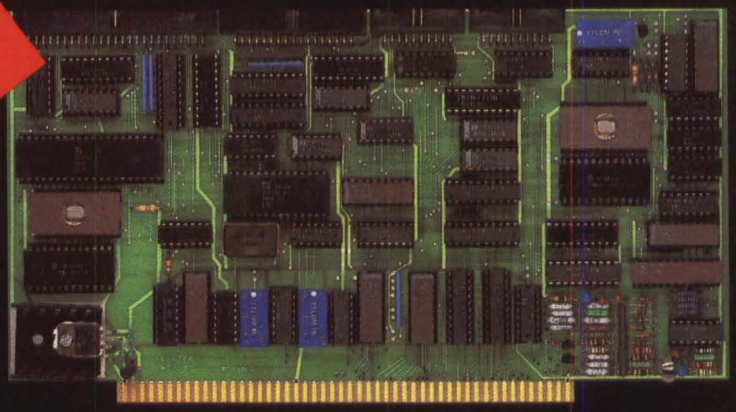

A hard disk and cartridge tape controller together on one board? Magic? Not really. It's Teletek's HD/CTC. The hard disk and cartridge tape drive controller provide the support necessary to interface both rigid-disk drives and a cartridge tape deck to the S-100 bus.

- A Z-80A CPU (optionally Z-80B) providing intelligent control of the rigid-disk and cartridge tape drives.
- Support of 5¼" rigid-disk drives with transfer rates of 5 megabits per second. Minor changes of the on-board components allow the support of other drive types/sizes and transfer rates up to 15 megabits per second. (Interface to disk drive is defined by software/firmware on-board.)
- Controller communications with the host processor via 2K FIFO at any speed desirable (limited only by RAM access time) for a data block transfer. Thus the controller does not constrain the host processor in any manner.
- Two 28-pin sockets allowing the use of up to 16K bytes of on-board EPROM and up to 8K bytes of on-board RAM.
- Individual software reset capability.
- Conforms to the proposed IEEE-696 S-100 standard.
- Controller can accommodate two rigid-disk drives and one cartridge tape drive. Expansion is made possible with an external card.

Teletek's HD/CTC Offers A Hard Disk Controller, Plus Cartridge Tape Controller, All On One Board.

TELETEK

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CIRCLE NO. 135 ON INQUIRY CARD

New Products

SYSTEMS

System executes programs concurrently

The four-user, multiprocessor CompuPro 10 microcomputer system concurrently executes 8- and 16-bit software. Based on a closely-coupled master/slave architecture, the product uses a dedicated 8088 processor with 768K bytes of RAM to handle system resources and overhead such as disk, printer and communication links, while four Z80B processors with 64K bytes of RAM each act as individual task processors. In the standard configuration, each user terminal has access to its own Z80B processor and dedicated memory for running 8-bit application programs. The central 8088 processor and its main memory are dynamically allocated to each user, the Z80B acting as a terminal handler for running 16-bit tasks. Standard features include seven serial ports, a Centronics printer port, as much as 512K bytes of solid-state disk memory and dual 5¼-inch, 1M-byte floppy disk drives. Price is approximately $1,800 per workstation. **CompuPro,** 3506 Breakwater Court, Hayward, Calif. 94545, (415) 786-0909.

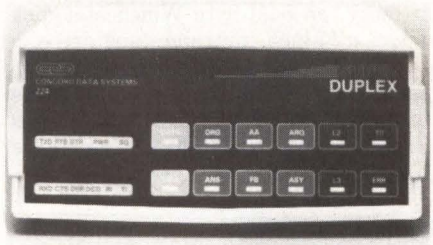
Circle No 305

Computer implements NuBus technology

The Nu Machine computer system implements 37.5M-byte-per-second, 32-bit, processor-independent NuBus technology. The product comes with a 10-MHz 68010 processor with a 4K-byte, 45-nsec. cache memory and a memory-management system implemented in hardware. The machine also features an 800-by-1,024-pixel, 15-inch, 60-Hz, non-interlaced, black-and-white display and bit-mapped graphics controller. An optional Multibus subsystem allows use of a wide variety of peripherals and controllers. A high-bandwidth translator provides the interface between the NuBus and the Multibus systems. The Nu Machine runs a UNIX-derived operating system. A windowing system provides capabilities for multiple virtual terminals on the product's display. FORTRAN and C programming languages are available. The office model, configured with a 68010 CPU, 512K bytes memory, an 84M-byte Winchester disk drive, a ¼-inch cartridge-tape drive, a display, a keyboard and a mouse, is priced at $36,240 (25 units). **Texas Instruments Inc., Data Systems Group,** P.O. Box 402430, Dallas, Texas 75240, (800) 527-3500. **Circle No 306**

New Products

DATACOMM



Modem combines auto-dialing, multiplexing

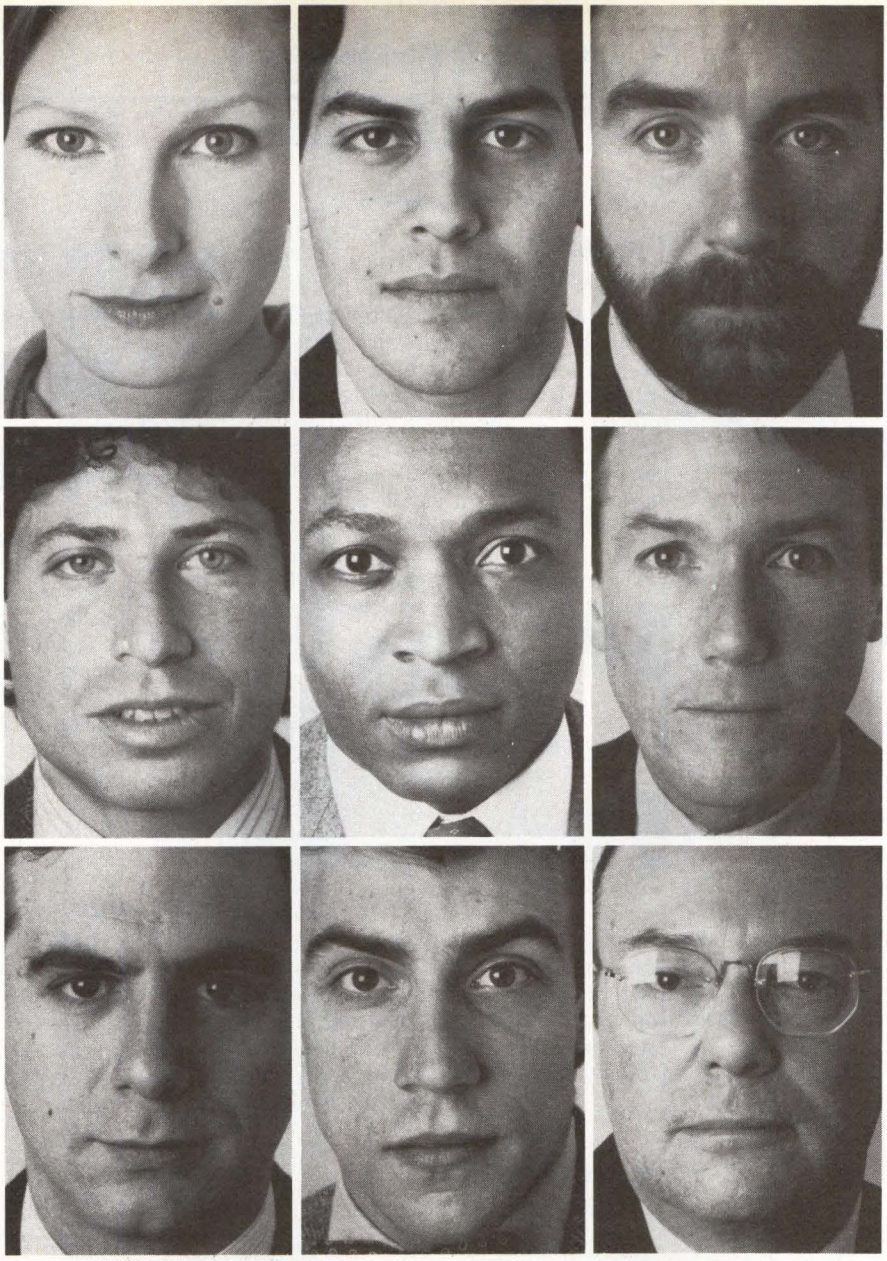
The CDS 224 Superduplex modem offers a statistical multiplexer with ARO error correction and auto-dial features. Designed for interactive and batch traffic requiring error-free data transmission, the product connects multiple asynchronous devices to a standard two-wire switched telephone for 2,400- or 1,200-bit-per-second transmission. The modem's statistical multiplexer provides three RS232C ports, which users configure via their terminal keyboards for baud rate, character format and flow control. Each port supports 14 asynchronous speeds ranging from 50 to 9,600 bps, or users can select an auto-baud feature that automatically matches port speed to the speed of the user's device. The modem features x-on/x-off and CTS flow control and an adaptive prioritizing technique. The ARO error-recovery feature uses a bit-synchronous protocol. The modem's automatic dialing feature supports touch-tone and rotary (pulse) dialing systems. $1,695. **Concord Data Systems Inc.**, 303 Bear Hill Road, Waltham, Mass. 02154, (617) 890-1394.

Circle No 307

Network incorporates twisted-pair wiring

The AST-PCnet II LAN requires no dedicated print and file servers, includes a print-spooling capability, and simplifies installation with its twisted-pair wiring and RJ11 modular connectors. The distributed-bus system runs on IBM PC XT computers. Print spooling allows queuing of print jobs on disk for as many as three shared printers on the network. The system links two to 32 personal computers on a 500-foot trunk cable without repeater circuitry. The network includes tap boxes and 15-foot drop cables and operates transparently to users. Each PC can be designated as a shared PC or as a user PC. The network uses standard PC-DOS commands to access remote disk drives and printers. It transmits data at 800K bps, uses a CSMA/CA protocol and provides file/record locking. $1,290 for the starter kit, including two controller cards, cabling and software. **AST Research Inc.**, 2121 Alton Ave., Irvine, Calif. 92714, (714) 863-1333.

Circle No 308



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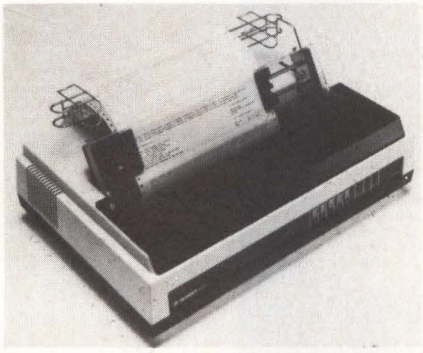
CIRCLE NO. 141 ON INQUIRY CARD

New Products

PRINTERS



Printer features movable ruby wire guide

The Hermes model 612 matrix printer operates at 400 cps in data-processing mode and at 100 cps in near-letter-quality mode. The printer uses an 18-wire matrix print head featuring a movable ruby wire guide. All printing is done in a single-pass mode—132 cpl at 10 cpi. Four character sets are resident, and eight versions are standard: U.S., U.K., French, German, Danish/Norwegian, Swedish/Finnish, Italian and Spanish. A Centronics-compatible parallel interface is also standard; an RS232C/V24-compatible serial interface is optional. The printer includes a tractor feed for continuous forms and can also handle single sheets. $2,650. **Singer Data Products Inc.,** 2351 E. Devon Ave., Elk Grove Village, Ill. 60007, (312) 860-6500.

Circle No 309

Band printer includes power stacker

The 132-column LP1200 band printer produces hard-copy output on standard single-sheet or six-part, multiple-copy, fan-fold paper and comes with an automatic power paper stacker. The printer, which plugs into any P-E Series 3200 computer, provides a typical throughput of 1,200 lpm when a 64-character set is used. A 96-character set and German and U.K. character sets are also available. A touch-sensitive control panel allows switch-selectable 80- or 132-column printing. Standard vertical spacing is switch-selectable at 6 or 8 lpi. A horizontal forms-adjustment system simplifies formatting of special forms with as many as 63 lines per page. $29,990. **Perkin-Elmer Corp., Data Systems Group,** 2 Crescent Place, Oceanport, N.J. 07757, (201) 870-4768.

Circle No 310

Printer prints in seven colors

This color graphics printer produces hard copy in seven colors directly from a CRT, a video monitor or a CPU using thermal-transfer technology. It is offered in two versions: a video interface and a digital version. The RS170-compatible model CP-80V accepts RGB signals with or without separate sync and can print a full, 640-by-480-dot page in as little as 45 seconds. The Centronics-compatible model CP-80C is

8-bit parallel and accepts commands only directly from the CPU. Print speed depends on the data-transfer rate. The data-input code consists of 192 letters with a 7-by-11 dot-matrix letter configuration. $4,950. **Gulton Industries Inc.,** Gulton Industries Park, East Greenwich, R.I. 22818, (800) 343-7929.

Circle No 311

Printer has parallel/serial interfaces

The Compumate 2100 daisy-wheel printer incorporates a Centronics-compatible parallel interface and an RS232C serial interface. The unit prints at 20 cps and outputs 115 cpl at 10 cpi, 138 cpl at 12 cpi and 172 cpl at 15 cpi. It accepts cut-sheet or continuous-feed, fan-fold paper and has a 256-character print buffer. The printer emulates the Diablo 630 command set and is WordStar-compatible. $649. **Swintec Corp.,** 23 Poplar St., P.O. Box 421, East Rutherford, N.J. 07073, (201) 935-0115 or (800) 225-0867.

Circle No 312

Matrix printer offers IBM compatibility

The model 387 table-top matrix printer features 400-cps throughput and plug compatibility with an IBM 3274/3276 or a Telex control unit. The product's standard print mechanism forms an 8-by-7 dot matrix and can print six-part forms with a total thickness of

0.027 inches. Operators can select a maximum of 136 print positions at 10 cpi and as many as 233 print positions at 17.1 cpi. Vertical spacing is operator-selectable at 3, 4, 6 or 8 lpi. An adjustable tractor pin-feeds forms from 3- to 16-inches wide. The printer offers ASCII-B, EBCDIC and international character sets are offered. Buffer sizes range from 960 to 3,564 characters. $7,200. **Telex Computer Products Inc.,** 6422 E. 41st St., Tulsa, Okla. 74135, (918) 627-1111.

Circle No 313

Full-page printer fits in less than half a briefcase

The battery-powered, full-page Thin-Print 80 thermal graphics printer weighs 4 pounds and measures 2.5 inches high by 7.5 inches deep by 11.5 inches wide. It features 40-cps bidirectional printing, a 2,048-character buffer memory, 80 or 136 cpl, an RS232C or Centronics interface and single-sheet or roll feeding from its internal paper compartment. The printer provides a dot-addressable graphics resolution of 960 by 7 dots per line. $279 including rechargeable batteries, an AC adapter and an 80-page paper roll. **Axonix Corp.,** 471 Wakara Way, Salt Lake City, Utah 84108, (800) 821-7093.

Circle No 314

Plotter provides multicolor graphics

The PL 1000 x-y plotter prints on DIN A3-sized paper and incorporates such plotting functions as circles, arcs, coordinate axes, symbols and various lines. The plotter automatically switches between four pens to provide multicolor graphics. Using oil-based, felt-tipped pens, the plotter can draw on OHP film. Resolution is 0.004 inches; maximum pen speed is 4 ips. The plotter comes with 8-bit parallel or RS232C interfaces. Prices start at $931. **Yokogawa Corp. of America,** 2 Dart Road, Shenandoah, Ga. 30265, (404) 253-7000.

Circle No 315

It Works Hard for Your Money

In considering Daisy M45 as your next printer look beyond the striking European styling. Look at its value-packed quality and performance. You'll be impressed.

Daisy M45 advanced daisywheel printers deliver true bi-directional printing at an incredible speed of 45 characters per second. You get crisp letter-quality output from printwheels interchangeable in a wide variety of type styles.

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And it's quiet. Very quiet. Daisy's designers scored a breakthrough with a minimum of moving parts — 35% fewer than other conventional daisywheels. Considerable research went into its automatically controlled "long-life", impact hammer. Plus it uses Daisy's "multistrike" cartridge to further optimize ribbon life.

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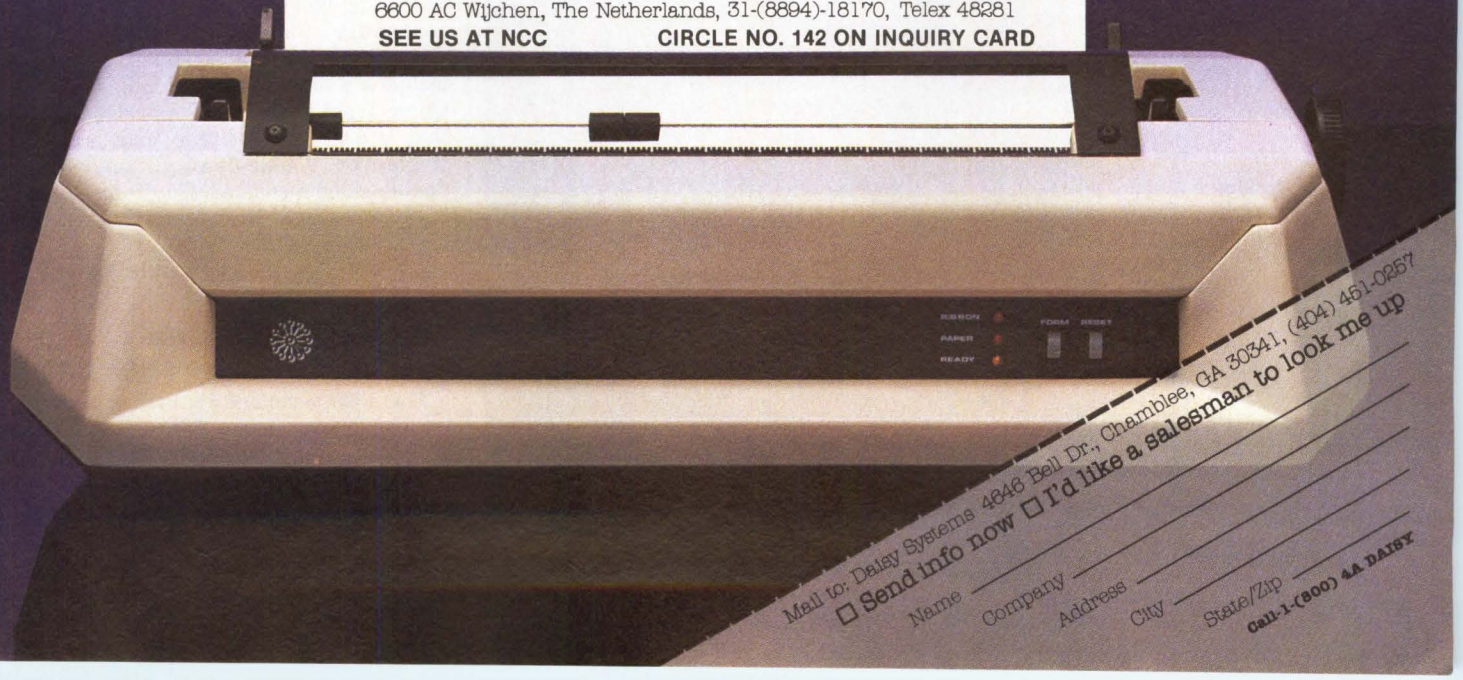

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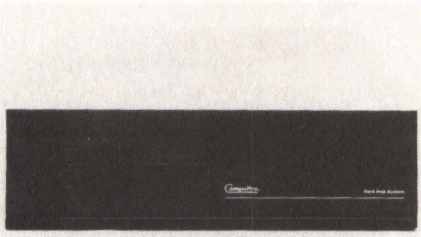
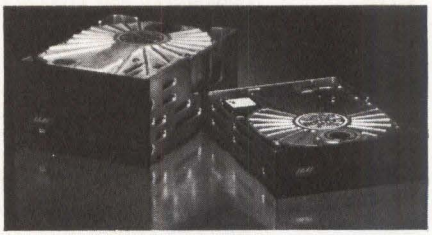
Winchesters store as much as 51M bytes

The 2306H and 2312H half-height Winchester disk drives store 6M and 12M bytes of unformatted data, respectively, on 5¼-inch plated or oxide media. The drives provide 85-msec. average access times using closed-loop stepper-motor accessing. They employ an ST506/412 interface and achieve 625K-byte-per-second data-transfer rates. The full-height, 5¼-inch Winchester disk drive models 5612H, 5624H, 5636H and 5650H store from 12M to 51M bytes (unformatted). They also use the ST506/412 interface and have 625K-byte-per-second data-transfer rates. The 5600H series employs a stepper-motor actuator design and provides 49-msec. average access times. 2300H series prices start at $535 each for 500 units; 5600H series prices start at $625 each for 500 units. **International Memories Inc.,** 10381 Bandley Drive, Cupertino, Calif. 95014, (408) 446-9779.

Circle No 316





Mass-storage subsystem packs 40M bytes

Packaged in the standard CompuPro disk enclosure (approximately 22 by 5½ by 18 inches), the H40 hard disk subsystem provides 40M bytes of mass storage for use with the company's IEEE 696/S-100 bus-compatible microcomputer systems. The subsystem features a Quantum Q540 5¼-inch hard disk, the vendor's Disk 3 DMA disk controller and the CP/M-80 and CP/M-86 operating systems. It also includes a double-sided, double-density Qume Track 842 8-inch floppy disk drive that stores 2.4M bytes and accepts single- or double-density, single- or double-sided media. $5,495. **CompuPro,** 3506 Breakwater Court, Hayward, Calif. 94545, (415) 786-0909.

Circle No 317

Winchesters feature 25-msec. average seek time

The 1320 series of 5¼-inch Winchester disk drives offers a 25-msec. average seek time, including settling. Models 1323, 1324 and 1325, which comprise the series, provide capacities of 42.6M, 63.9M and 85.2M bytes, respectively. The products support the ST506/412

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. 144 ON INQUIRY CARD

Arapahoe 7110
8-Inch Fixed/Removable Disk Drive

- 53.9 Mbytes Total Storage
- 26.9 Mbyte ANSI Standard Cartridge
- 35 msec Average Access
- Industry Standard SMD (LMD) Interface
- 8-Inch Floppy Envelope

Rigid but not fixed

It wasn't easy to design a rigid disk drive that you can remove like a floppy, but has the capacity and performance of a Winchester. In fact, Amcodyne engineers had to make removability work before they could even think about capacity and performance.

A dynamic head-loading system was developed so that heads can be retracted from the removable cartridge. Eliminating head-disk contact improves reliability so much that we are using it on our fixed-only drives as well.

A clean air system was developed to keep cartridge surface dirt out of critical areas. It works so well, our fixed/removable drives are cleaner (Class 50 or better) than most Winchesters.

An embedded servosystem was developed for adapting the drive's mechanics to minute variations in interchangeable cartridges. Not only were disk runout problems eliminated, we got the kind of fast, reliable access that you would expect of a Winchester drive.

Now that it's done, it's all very simple—simple to build, to install, to use, and to maintain. Reliability of the Arapahoe 7110 is field-proven, and we are producing them in OEM volume.

Amcodyne

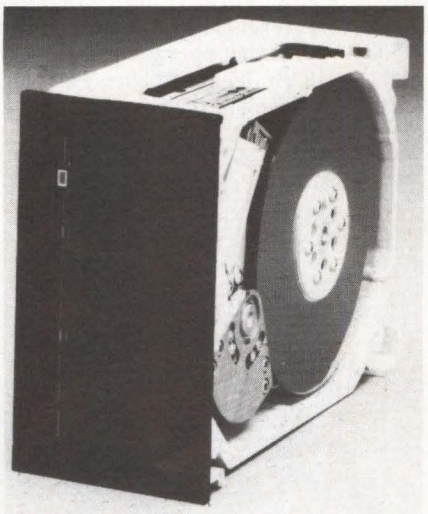
Amcodyne Inc.
1301 South Sunset Street
Longmont, Colorado 80501
(303) 772-2601

SEE US AT BOOTH # D3610 AT NCC '84

CIRCLE NO. 145 ON INQUIRY CARD

New Products

DISK/TAPE



interface. Other features include auto-positioner latching, a spindle brake and a data-free landing zone. Model 1323: $1,265, model 1324: $1,440, model 1325: $1,635. **Micropolis Corp.,** 21329 Nordhoff St., Chatsworth, Calif. 91311, (213) 709-3300.

Circle No 318

Subsystems enhance MDX development systems

The model 740 series cartridge-disk subsystems for Intel MDX development systems are available in four versions with various combinations of 10M-byte removable cartridge disk drives and single-sided, double-density floppy disk drives. The cartridge disk drives have 1.12M-byte-per-second transfer rates and 35-msec. average access times. Because the MDX systems are compatible with the CP/M-80 operating system, the cartridge disk subsystems allow a user to swap ISIS- and CP/M-formatted disks in the drive. Because the controller/interface in the model 740 series subsystems is ISIS-compatible in single density and double density simultaneously, a user can copy a file from a single-density disk to a double-density disk or vice versa. The subsystems' single-board controller/interface simultaneously emulates the Intel SBC-201, SBC-202 and SBC-206. $7,172 to $8,692. **Zendex Corp.,** 6644 Sierra Lane, Dublin, Calif. 94568, (415) 828-3000.

Circle No 319

Magnetic-tape subsystems work with SCSI bus

This trio of ½-inch tape subsystems for the SCSI bus use an intelligent controller and furnish programmable data-block sizes in read-and-write mode to a maximum of 32K bytes. All tape subsystems can use 7-, 8½- and 10-inch standard reel sizes and can store as much as 40M bytes of data on a 2,400-foot reel of 1.5-mil tape. The model TD1012/SCSI supports nine-track, 1,600-bpi recording in the start/stop mode operating at 12.5 ips and/or streaming mode at 100 ips. Data-transfer rate is 20K bytes per second in start/stop mode and 160K bytes per second in streaming mode. The model TD1050/SCSI supports seven- or nine-track, dual-density, 800-bpi (NRZI) and 1,600-bpi (PE) recording in a start/stop mode operating at 45 ips. Data-transfer rate is 72K bytes per second. The model TD1750/SCSI supports nine-track, dual-density, 800-bpi (NRZI) and 1,600-bpi (PE) recording in a start/stop mode operating at 75 ips. Data-transfer rate is 120K bytes per second. TD1012/SCSI: $4,550, TD1050/SCSI: $5,150, TD1750/SCSI: $5,950, all in 100-unit quantities. **Data Technology,** 4060 Morena Blvd., P.O. Box 178160, San Diego, Calif. 92117, (619) 270-3990.

Circle No 320

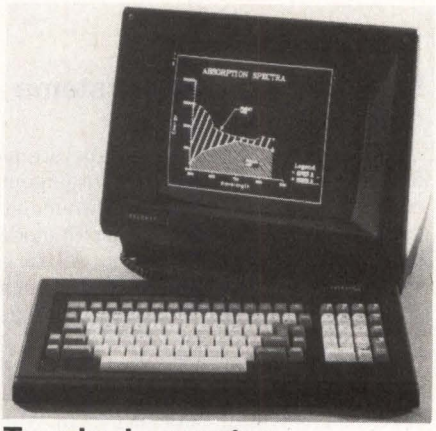
Subsystem provides 10M bytes of storage

The DataSafe-16, a 5¼-inch Winchester disk subsystem for Intel Systems, provides 10M bytes of formatted storage and three directories. Compatible with Intellec's ISIS-II operating system, the subsystem has 78,336 available blocks allocated in three directories—F0, F1 and F2. Data-transfer rate is 625K bytes per second, and average access time is 85 msec. The Z80A microprocessor-based controller includes 32-bit ECC with transparent 11-bit burst error correction. The DataSafe-16 fits on top of the Intellec and includes a Multibus adapter card that occupies one slot in the host chassis and conforms to IEEE 796 specifications. $6,500. **Winchester Systems Inc.,** 14 Laurel Hill, P.O. Box 545, Winchester, Mass. 01890, (617) 933-8500 or (800) 325-3700.

Circle No 321

New Products

TERMINALS



Terminal operates in graphics, APL modes

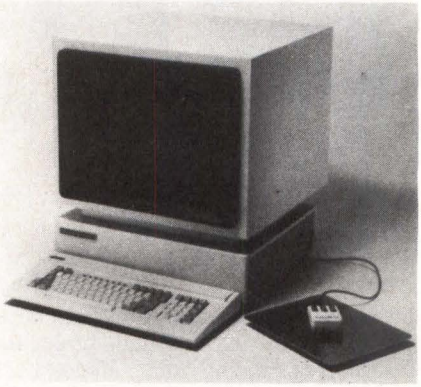
The model 16GRF/APL, an ANSI X3.64-compatible terminal, offers presentation graphics, APL capability and text editing. In graphics mode, the terminal is Tektronix 4010/4014 and Plot 10-compatible, with 240-by-640-dot bit-map display resolution. The terminal has a transparent printer port through which data are transmitted in LA120/LA34 format. In addition to APL, the terminal has four resident character sets: line drawing, mosaic, superscript/subscript and ASCII. Its 8K-byte display memory is normally configured as four 24-line-by-80-column pages. A 25th line displays setup, status and messages. The terminal's 512-character function memory can be expanded to include any unused display memory and accepts as many as 32 programmable functions. 12-inch model: $2,940; 9- and 15-inch styles with amber, green or white phosphors are also available. **Teleray Division of Research Inc.,** 6425 Flying Cloud Drive, Eden Prairie, Minn. 55344, (612) 941-3300.

Circle No 322

Graphics terminal features 512-by-480 resolution

The GTC314 color graphics terminal features a 512-by-480 bit-mapped display. Using Tektronix 4027-compatible protocol, the terminal can display arcs, circles, pies, vectors, bars and polygons. It can perform polygon fills in color or patterns. The terminal offers three character sets. The standard character set provides a display of 85 cpl with 48 lines on the terminal's 14-inch monitor. Two programmable sets permit users to define font and cell sizes as large as 256 by 128 pixels. The product's detachable keyboard uses a DEC VT100-style layout, and all keys are user-programmable. The terminal also furnishes two RS232C ports that operate at speeds as high as 19.2K baud. $2,895. **PsiTech,** 16902 Von Karman, Irvine, Calif. 92714, (714) 863-0981.

Circle No 323



Graphics terminal suits scientific applications

The ergonomically designed G-2200 terminal for CAD/CAM, CAE, scientific and business applications has a detachable keyboard and a 19-inch color monitor. The bit-mapped graphics terminal features 1,024-by-792-pixel resolution, a 60-Hz refresh rate, zoom, scroll, roam, alphanumeric and graphics overlays, selective erase and built-in support for a mouse, a tablet and a printer. The unit displays as many as 16 colors simultaneously from a palette of 4,096 hues. It is software-compatible with the Tektronix 4014 and is supported by third-party software such as ANVIL, Template, DI-3000 and BARDS. It also emulates the DEC VT100 for text editing and data entry. $12,950. **Genisco Computers Corp.,** 3545 Cadillac Ave., Costa Mesa, Calif. (714) 556-4916.

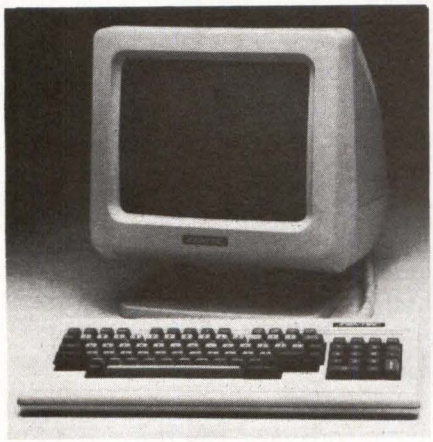
Circle No 324

Low-cost unit replaces TeleVideo 925 terminal

The Challenger 525 video terminal, an alternative for TeleVideo 925 users, features 40 reprogrammable function keys (the first 22 are factory set with codes emulating the 925); pass-through and page printing; blink, blank, reverse and underline video attributes; a screen

saver; an RS232C or current-loop interface capable of communicating at speeds as high as 38,400 baud; and keyboard setup with the Softstart non-volatile storage package. The keyboard styling combines an IBM Selectric layout with a row of 21 single-stroke function keys, an isolated numeric pad and a cursor-control key cross pattern. The terminal's 12-inch green screen furnishes an 80-column-by-25-line display. $895. **Soroc Technology Inc.,** 161 Freedom Ave., Anaheim, Calif. 92801, (714) 992-2860.

Circle No 325



Video display supports multiple emulations

The model 1021 terminal features a 12-inch green screen, ergonomic design, multiple emulations, 32 graphics characters and editing. The terminal comes in two versions, one of which emulates the Hazeltine 1500, Lear Siegler ADM 3, DEC VT52 and ADDS Viewpoint terminals. The second version, the model 1021A, supports the ANSI X3.64 standard. Both versions offer a 91-key, detachable, low-profile keyboard and a non-glare display with 24 lines by 80 characters and a 25th status line. Editing capabilities include line and character insert and delete, line and screen erase and dedicated cursor-movement and -control keys. A choice of conversation or block-mode transmission is available. RS232C and current-loop communications ports are standard. $399 (100 units). **Zentec Corp.,** 2400 Walsh Ave., Santa Clara, Calif. 95050, (408) 727-7662.

Circle No 326

ASCII terminal operates in IBM 327X environment

Designed for the IBM 327X environment, the Fame 78 ASCII terminal features an IBM 3278-style keyboard with 24 pre-set function keys and a green phosphor, 24-line-by-80-column display

with a 25th status line. It includes a 12-inch, tilt-and-swivel screen, a microprocessor-controlled logic board and a CRT control circuit for a separate sync/video CRT monitor. The product offers two bidirectional RS232C ports with user-selectable baud rates from 300 to 9,600. $995. **Falco Data Products Inc.,** 1286 Lawrence Station Road, Sunnyvale, Calif. 94089, (408) 745-7123.

Circle No 327

New Products

SOFTWARE

CAD electronic software runs on personal computers

The Electronic Design Automation software line turns an IBM PC or PC-compatible microcomputer into a specialized electronic-design workstation. The software integrates the engineering and layout portions of printed-circuit-board design. The PC-CAPS schematic-capture system uses a hierarchical design methodology and handles as many as 1,000 components and 1,000 nets at each level of hierarchy. It operates in as many as 16 colors with 50 layers. The PC-CARDS layout package creates printed-circuit boards and performs real-time checking of circuit signals for shorts and continuities. Like PC-CAPS, PC-CARDS is menu-driven and has rubber-band-line and real-time dragging capabilities. PC-CARDS can handle as many as 2,000 nets, 500 components and 10,000 component pins in as many as 15 colors and 50 layers. The PC-LOGS 12-state, event-driven logic simulator handles as many as 5,000 elements. The three packages share a common database, the Integrated Intelligent Database, that tracks electrical and logical connections and device attributes. Together the three packages sell for $9,000. **Personal CAD Systems Inc.,** 981 University Ave., Building B, Los Gatos, Calif. 95030, (408) 354-7193.

Circle No 328

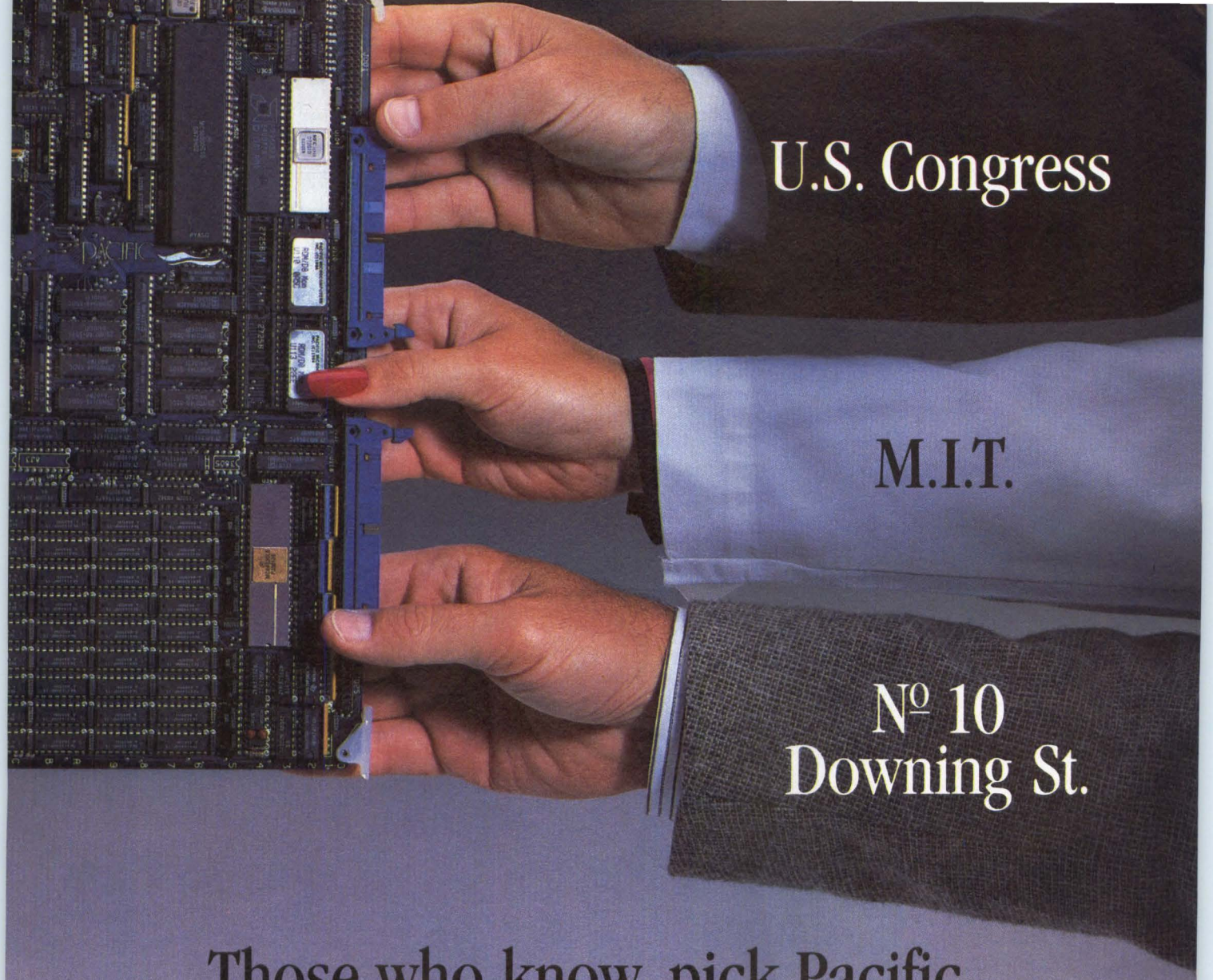
Software package includes application developer

The Aura integrated-software package features an application developer; menu operations; and integrated database, spreadsheet, word-processing and graphics modules. The package runs on IBM PC XT and PC-compatible microcomputers and requires 256K bytes of memory. Aura's database manager executes report, sort, select, edit and index functions through a menu-driven, fill-in-the-blanks user interface. Data from this module can be included in spreadsheets, graphs or word-processing documents. Aura's electronic spreadsheets can measure as large as 255 rows by 63 columns. The spreadsheet module offers more than 50 functions including statistical, financial, logical, mathematical, date and text operations. It includes a zoom feature for inspecting supporting data in related spreadsheets. Aura's word-processing documents can include database information, spreadsheets or graphs. The program can concurrently edit several files and perform text-block operations that also allow moves between documents. Aura's business graphics element offers free-draw graphics as well as the ability to alter prepared graphics dynamically and automatically. Aura also allows graphs to be included in word-processing documents. $495. **Softrend Inc.,** 2 Manor Parkway, Salem, N.H. 03079, (603) 898-1777.

Circle No 329

Cross assembler supports 8086/8088 microprocessors

The ASM186 cross assembler system implements the structured assembly language specified by Intel for the Intel 8086/8088 and 80186/80188 microprocessors. The system also includes floating-



Those who know, pick Pacific

However it's defined, quality has a way of being recognized.

For some of our customers, it might be product versatility. Two years ago we began making a 68000- based 16/32 bit CPU board that could operate with or without the popular UNIX operating system, depending on whether the customer had system- or real-time needs.

For others, performance is important. We designed a memory management unit that protects multiuser programs with no wait states. That's when we discovered that performance and versatility become interconnected.

For instance, Congress needed some method of debugging the networking system currently used by the Members' staffs. We packaged our CPU board with the necessary peripherals, and from this computer system we discovered even more applications. Our board now helps the U.S. Geological Survey analyze minor quakes from the Atlantic seafloor, while across the ocean the Prime Minister's Office uses the same product to edit correspondence.

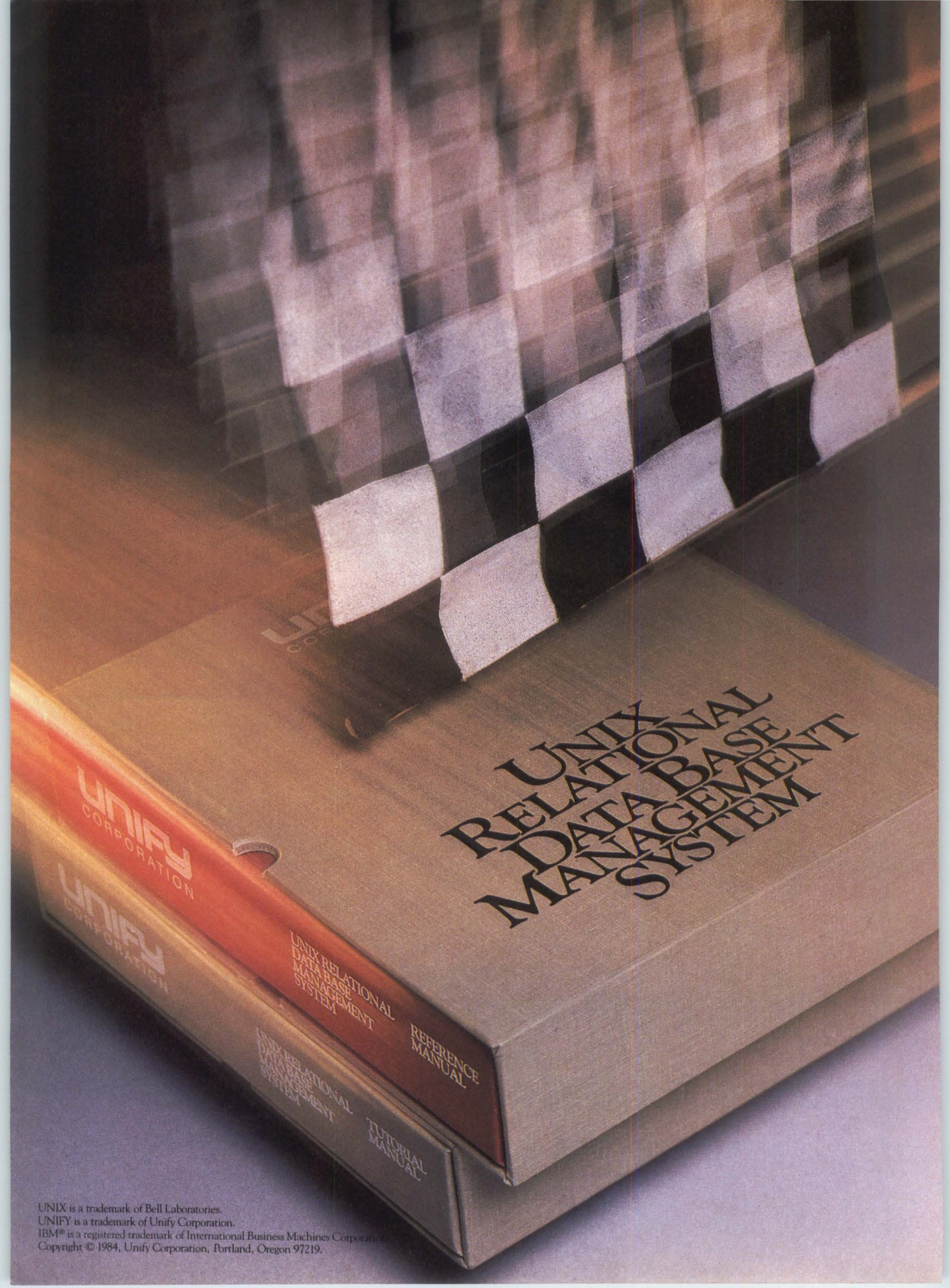
To increase performance even further we later designed a feature known as "dual porting". This allows two or more processors to work together in tandem. Like a bicycle pedaled-by-two, the speed is impressive. So too is its versatility. M.I.T. uses our new "D" board to study astronomy; General Electric uses it to control a robot for welding jet turbines.

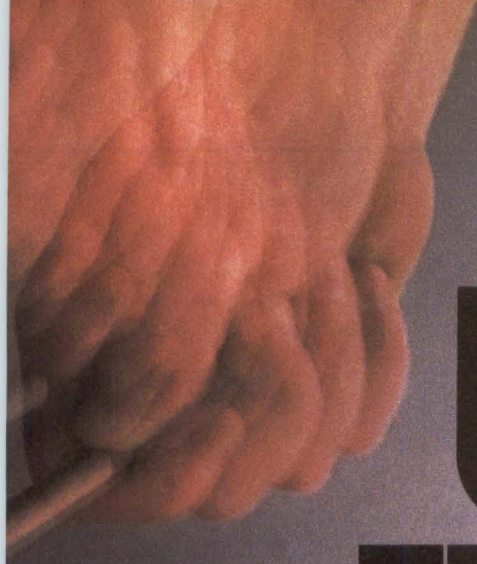
Versatility and performance aside, we like to think that our list of "Who's Who" is most attracted to us by our unique brand of personal service. Pacific sales representatives provide pre-sales consultation and we pride ourselves on our post-sales service and support . . . no matter who you are.

For additional information, contact
Sherrell Harper
Pacific Microcomputers, Inc.
160 Chesterfield Drive
Cardiff, California 92007
(619) 436-8649

PACIFIC
MICROCOMPUTERS, INC.
Quality Across the Board

CIRCLE NO. 150 ON INQUIRY CARD





UNIFY FINISHES FIRST!

In one independent competition after another, UNIFY has proved itself the fastest UNIX data base management system. No wonder it's been selected by more computer manufacturers than all other UNIX data bases combined.

UNIFY speeds you through development and expedites program execution with some of the most powerful utilities of all, including:

Fully menu-driven design.

A powerful screen handling package that helps you format screens quickly, with no coding required.

Raw I/O, that lets you bypass the UNIX file system for up to 40% faster performance in large data bases.

Built-in optimizers that select the fastest of four data access methods.

Industry standard IBM SQL query language, plus our powerful report writer, for easy access by end-users.

Ninety subroutines for advanced program development... the most complete package of its kind.

UNIFY's integrated design links program modules like screens, query language and report writer to help you quickly create complete, friendly, easily expandable applications.

Horsepower for the long run. Unlike other data bases, UNIFY won't slow down under the weight of additional data or multiple users. It's built with the power to support new features later.

Judge for yourself. Send for our 300-page tutorial and 500-page reference manual—yours for only $95—that show you how to build virtually any application. Contact UNIFY, Dept. MMS-7, 9570 S.W. Barbur Blvd., Portland, OR 97219, 503/245-6585.

UNIFY®
THE PREFERRED UNIX DBMS.

CIRCLE NO. 151 ON INQUIRY CARD

point instructions and directives required to support the 8087 numeric data processor. The system is used to assemble and link/load programs on a general-purpose host computer, then down-load those programs for execution on the 8086, 8088, 80186 or 80188 microprocessors. The package includes assembler, macro processor, linking loader, Tektronix conversion utility and down-load utility. The assembler features relocation, user-specified segment names, symbolic and relative addressing, forward references, complex-expression evaluation, a disk-paged, large-capacity symbol table and a cross-reference listing. It can generate data in several number-based systems as well as ASCII codes. $2,200. **Microtec Research Inc.,** 505 W. Olive, Suite 325, P.O. Box 60337, Sunnyvale, Calif. 94088, (408) 733-2919.

Circle No 330

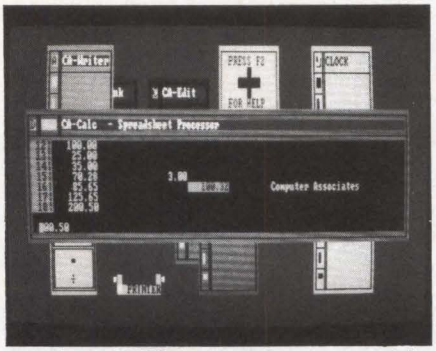
Software-development tool is language-independent

FORMIX for IBM PC and PC-compatible microcomputers is a CICS-like screen-management system composed of a run-time executive and a set of interactive screen forms-development tools. For creating screens, FORMIX provides screen-layout capability with which both the positioning and edit/validation criteria of all screen elements are defined interactively in a paint-the-screen mode. Customized, on-line help-screen, message and screen prompts are integrated with each application process. For programming, FORMIX provides language interfaces so that application programs written in standard programming languages such as BASIC, Pascal, C or COBOL load a defined screen form and call the FORMIX run-time executive. The run-time executive handles the screen I/O, message and data editing and validation. $495 for the BASIC version. **MCSI,** 9531 W. 78th St., Eden Prairie, Minn. 55344, (612) 944-5220.

Circle No 331

Workstation software has window manager

CA-Executive software consists of integrated business applications, a microcomputer-to-mainframe link and communications facility and a window manager. The software runs on IBM PC XT and compatible microcomputers and



requires 256K bytes of memory. The business applications include database-management, spreadsheet, word-processing, editing, graphics and forms-generation programs. Multiple programs can be displayed and processed concurrently through windows. Data can be retrieved, received, moved, manipulated and transmitted from one window to another or back and forth between the PC workstation and the mainframe. CA-Executive is also equipped with several utility windows including PC-DOS, directory, print-spool, clock, notepad and help windows. $695 (51 units). **Computer Associates International Inc.,** 125 Jericho Turnpike, Jericho, N.Y. 11753, (516) 333-6700 or (800) 645-3003.

Circle No 332

APL programming system runs under PC-DOS

THe APL*Plus/PC System is an extended APL language that runs under PC-DOS on the IBM PC with 196K bytes of RAM and on various IBM PC look-alikes. The latest release features a full-screen editor for modifying programs and character data, scrolling display screens, support for the DOS 2.0 operating system, graphics primitives for screen and printer, an on-line help facility and English-like keywords. $585. **STSC Inc.,** 2115 E. Jefferson St., Rockville, Md. 20852, (301) 984-5123. **Circle No 333**

Communications package sends messages over Telex

The SofGram electronic communications package allows users to create, send and receive messages over the Telex, TWX and DDD networks. The software provides a full menu- and forms-driven user interface and a filing system. Users can create messages using the screen editor supplied with SofGram or with their own editor or word processor. The package works with commercially available modems and runs on computers that use the UNIX operating system. $500. **SofTest Inc.,** 555 Goffle Road, Ridgewood, N.J. 07450, (201) 447-3901. **Circle No 334**

Modula-2 operates on VAX/VMS computers

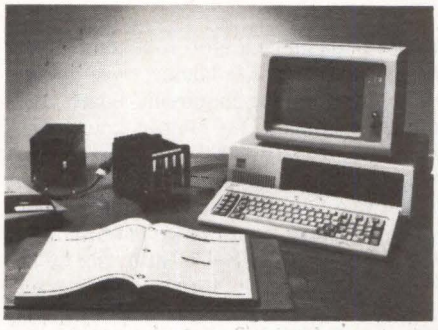
The Modula-2 VAX/VMS compiler is a full implementation of the Modula-2 language as defined in the Modula-2 Report. The compiler generates VAX native object code. The VAX/VMS linker links separately compiled Modula-2 modules. The VAX/VMS symbolic debugger can be used to debug Modula-2 programs. All debugger commands are available, including examination of variables, setting of breakpoints and stepping through the program line-by-line. The Modula-2 compiler also provides features specific to the VAX/VMS environment, such as four floating data types. Through foreign-definition modules, the compiler provides access to routines written in languages different from Modula-2, such as VMS operating-system services and run-time library procedures. $1,500 per year. **Logitech Inc.,** 165 University Ave., Palo Alto, Calif. 94301, (415) 326-3885. **Circle No 335**

Cross assemblers facilitate program development

The XMAC series of relocating cross assemblers enables any MS-DOS or PC-DOS microcomputer to serve as a development station for the Zilog Z8, the RCA 1802/4/6, the Fairchild F8/3870, the National Semiconductor 8070, the Intel 8051 or the TI TMS7000 or 9900 series microprocessors. The XMAC systems include a relocating macro assembler, a text editor, a cross-reference generator and off-loading facilities. The relocating macro assembler features macro and conditional assembly and can chain a series of source files during a single assembly. The two-pass linking loader produces an absolute Intel hex file. Members of the XMAC series share a common operational structure with uniform procedures for program entry, modification, assembly and disk-file handling. $250 each. **Allen Ashley,** 395 Sierra Madre Villa, Pasadena, Calif. 91107, (213) 793-5748. **Circle No 336**

New Products

SUBASSEMBLIES

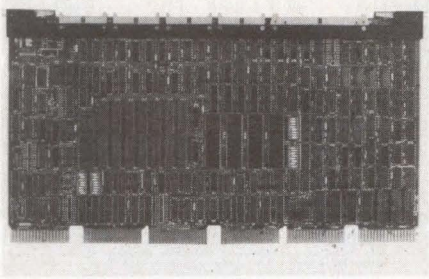


Package allows STD bus software development

With the Series 8800 Prototype Development System (PDS), IBM PC users can perform STD bus software development. The package includes software, the STD-8088 target system and documentation. The software allows users to write, compile and down-load programs to the target STD-8088 system as well as debug target-system-resident code from the operator console of the IBM PC. The debugged code can then be sent back to the PC, saved and burned into PROM. The STD-8088 target system includes an eight-slot card cage, a 10A power supply, a ZT 8812 processor board with an 8088 microprocessor, an Intel 80130-6 interrupt processor with counters and timers, two memory boards and a quad serial board for communications with the PC. PDS software consists of two packages: PC/STD 88, which provides file preparation and loading/debugging capabilities, and DBUG 88, a PROM-based monitor program. $2,800. **Ziatech Corp.,** 3433 Roberto Court, San Luis Obispo, Calif. 93401, (805) 541-0488. **Circle No 337**

Package simulates CP/M on HP minicomputers

The HP Bridge virtual CP/M microcomputer system for HP3000 series minicomputers running the MPE operating system includes a user-installable coprocessor board, software utilities for translating and transferring data and a license for CP/M. The Bridge software runs as a normal task under the MPE operating system and appears to a user to work as a standard CP/M microcomputer. The z-Board accelerator, which operates with the Bridge software, features four Z80 microprocessors, 256K bytes of RAM, eight serial I/O ports and a bit-slice machine that handles the bus and microprocessor arbitration. The z-Board allows as many as four users to access CP/M at once, each operating independently and using one Z80 cell, 64K bytes of RAM and two serial I/O ports. $5,000 for the hardware, $5,000 for the software. **Virtual Microsystems,** 2150 Shattuck Ave., Suite 720, Berkeley, Calif. 94704, (415) 841-9594. **Circle No 338**

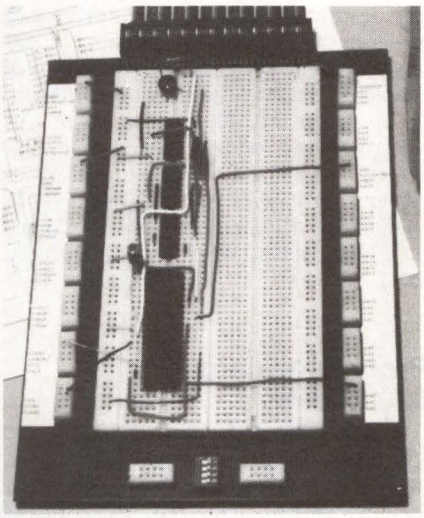


Controller emulates DEC UDA-50 Unibus adapter

The model S35/U disk controller emulates the functions and operations of the DEC UDA50 Unibus disk adapter on the PDP-11 Unibus or on the VAX Unibus. The controller can operate with as many as four SMD disks with serial data rates as high as 15M bps. Any combination of drive sizes and speeds can be mixed on the same controller, which provides several forms of redundancy and reliability enhancement. The UDA-50 performs error detection and correction on all information read from the disk as well as on-board formatting, supports dual-port capability and contains automatic self-test diagnostics. $6,800. **Dataram Corp.,** Princeton Road, Cranbury, N.J. 08512, (609) 799-0071. **Circle No 339**

Tape controllers are DEC-compatible

The TFC 825 and TFC 925 DEC TS11-compatible tape controllers come in three versions, according to the type and speed of the drive selected. The controllers work with LSI-11, PDP-11 and VAX-11 processors using 800-, 1,600-, 3,200- and 6,250-bpi tape drives with Pertec or STC interfaces. The first version works with industry-standard (Pertec) streaming and formatted start/stop drives that are front- or top-loading. The second works with low-speed, STC-compatible, GCR start/stop drives (50 ips). The third works with high-performance, STC-compatible, GCR start/stop drives (125 ips). The TFS 825, a Unibus-compatible, single-hex-sized board, which is embedded in one SPC slot, is software-transparent to DEC and UNIX operating systems. It uses a microprocessor for data-buffer management and tape-drive control and has a 16K-byte speed-matching buffer. The TFC 925, a Q-bus-compatible single-quad card controller, has the same characteristics as the TFC 825, with 22-bit addressing and block-mode DMA transfer capabilities. $1,850 to $2,950. **Aviv Corp.,** 26 Cummings Park, Woburn, Mass. 01801, (617) 933-1165. **Circle No 340**



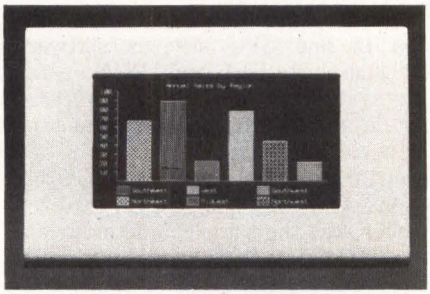
Prototyping board aids circuit development

The eZ Board experimenter system includes an epoxy printed-circuit board mounted with a set of solderless breadboarding units for building circuits. The package includes four distribution buses with 50 tie points each that can be used for power, ground, clock lines and reset commands. A four-position on-board DIP switch aids development and analysis of experimental circuits. Each switch position connects to a set of tie-point block sockets on either side, and a flat ribbon cable connects the board to a computer's bus-expansion slot. The breadboard area consists of 1,460 tie points with a capacity of 16 14-pin DIPs. Components with lead diameters as large as 0.032 plug in and can be connected with ordinary hookup wire. $174.95. **Sabadia Export Corp.,** P.O. Box 1132, Yorba Linda, Calif. 92686, (714) 630-9335.

Circle No 341

New Products

SUBASSEMBLIES



Plasma panel displays 2,000 characters

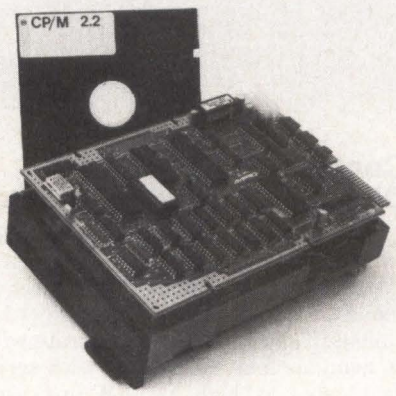
The PlasmaGraphics 120 flat-panel display uses AC and DC plasma-discharge display technology. The product provides 120,000 addressable pixels arranged in 480 columns by 250 rows. When addressed by a 5-by-7 character matrix, the panel can display 25 lines of 80 characters. All the electronics to address and time the display are housed on an integral panel driver board. Less than $1,000 in OEM quantities. **Plasma Graphics Corp.,** P.O. Box 4903, Warren, N.J. 07060, (201) 757-5000. **Circle No 342**

Processor card is 68000-based

The DVME 102 single-board microcomputer is based on a 68000 microprocessor and incorporates a 68451 memory-management unit. The board provides 256K bytes of dual-ported dynamic RAM with parity, two 28-pin boot sockets, two dual-ported RS232C channels and three programmable counter/timer channels. The memory array accommodates a 256K-by-1 RAM chip and offers memory expansion to 1M byte. The dual-channel USART supports programmable bit rates from 300 to 19,200 bps in asynchronous mode and as high as 1M bps in synchronous mode. The processor card also provides system clock, bus time-out, single-level arbiter, reset push-button and programmable-status LED indicators for system control. $3,000. **DY4 Systems Inc.,** 888 Lady Ellen Place, Ottawa, Ontario K1Z 5M1, (613) 728-3711. **Circle No 343**

Protocol converter supports color terminals

The Defender II/IIs protocol converter allows asynchronous ASCII terminals to communicate with an IBM or equivalent host computer using SNA/SDLC or BSC protocols. It features full-screen mapping, menu-driven setup capabilities and backup memory, maintains an internal image buffer, operates remote full-screen applications at low baud rates and supports terminals with color and extended highlighting features. When installed in the Defender II/IIs chassis, the product is available in an eight-port configuration. $5,500. **Digital Pathways Inc.,** 1060 E. Meadow Circle, Palo Alto, Calif. 94303, (415) 493-5544. **Circle No 344**

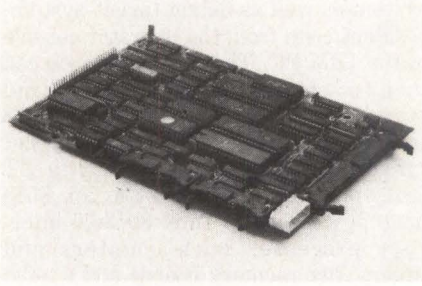


CP/M micro board mounts on minifloppy drives

The Little Board single-board CP/M computer screws directly into the mounting holes of a 5¼-inch minifloppy disk drive. The board combines a 4-MHz Z80A CPU with a printer port and floppy disk controller. The board comes with the CP/M 2.2 operating system and utility programs for formatting and copying data. It has two RS232 ports that feature software-controlled baud rates—75 to 38,400 baud for one and 75 to 9600 baud for the other. The parallel I/O port has a Centronics-compatible printer pin-out. The unit's disk I/O capability includes support for as many as four single- or double-density, single- or double-sided, 48- or 96-tpi minifloppy disk drives. $349. **Ampro Computers Inc.,** 67 E. Evelyn Ave., P.O. Box 390427, Mountain View, Calif. 94309, (415) 962-0230. **Circle No 345**

Product supports micro development

The MDS-68K package provides development support for Motorola's 68000 microprocessor in Intel's Intellec series of microprocessor-development systems. It includes a Motorola-compatible assembler, a linker/loader, a symbolic debugger, a plug-in circuit board and documentation. The plug-in board furnishes an 8-MHz 68000 CPU, a memory-management subsystem, 256K bytes of RAM and 64K bytes of ROM firmware. The firmware contains a monitor and the MDS-68K ISIS I/O interface. The board also has two serial I/O ports for use with 68000 hardware emulators. The symbolic debugger permits debugging of assembly, as well as high-level language modules, using programmer-defined symbols and statement numbers. $5,995. **Language Resources Inc.,** 4885 Riverbend Road, Boulder, Colo. 80301, (303) 449-8087.
Circle No 346



Controller, host adapters increase I/O performance

The ACB—5580 SMD hard disk controller board has SASI/ANSI SCSI support and two intelligent host adapters for S-100 and Multibus host buses. The board is aimed at improving the I/O performance of multiuser, multitasking microcomputer systems. It supports as many as seven host CPUs through the SCSI bus and as many as four SMD drives. The board drives either 8- or 14-inch, 9.6M-bps SMD disk drives. It features disconnect/reconnect, file sharing and non-interleaved operation. The AHA-1510 for the S-100 bus and the AHA-1530 for the Multibus intelligent host adapters function between the host bus and the SCSI bus as I/O processors working with the operating system's I/O supervisor. Both host adapters support DMA at 1.5M bytes per second from the SCSI bus to the host's local memory. They handle as many as eight concurrent I/O requests. ACB-5580: $980; AHA-1510: $425; AHA-1530: $460. **Adaptec Inc.,** 580 Cottonwood Drive, Milpitas, Calif. 95035, (408) 946-8600.
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CIRCLE NO. 152 ON INQUIRY CARD

New Products

LITERATURE

Handbooks list product specifications

This eight-volume set of handbooks contains product specifications of the vendor's product line. The handbooks cover software, memory components, microcontrollers, telecommunications, microsystem components, military products, development systems and OEM systems. $75, including a free, 112-page 1984 Product Guide. **Intel Corp.,** 3065 Bowers Ave., Santa Clara, Calif. 95051, (408) 496-9604.

Circle No 348

Directory lists computer graphics suppliers

The Third Edition of the *S. Klein Directory of Computer Graphics Suppliers: Hardware, Software, Systems and Services* lists more than 500 supply sources. Entries in the 224-page directory provide basic product information and business backgrounds of each company, including ownership, top management, company size, sales volume, year founded, addresses, phone numbers, telex or TWX and contact persons. The edition also contains a five-page briefing on the considerations and trade-offs encountered when buying computer graphics products. $60. **Computer Graphics Suppliers,** Directory Manager, 730 Boston Post Road, P.O. Box 89, Sudbury, Mass. 01776, (617) 443-4671.

Circle No 349

Resource profiles hardware, software firms

The second edition of *Microcomputer Marketplace* profiles companies that provide hardware, software, supplies and services to microcomputer users. The edition contains 2,300 new entries, for a total of 4,000. The companies include 2,000 software publishers; 150 distributors; 250 magazines and newsletters; 750 manufacturers of systems, peripherals and supplies; and 300 specialty companies. The first chapter identifies and describes approximately 2,000 publishers of microcomputer software and includes the companies' names, addresses, telephone numbers, products, application areas and operating and microcomputer systems. In the book's index chapters, software is grouped according to applications and compatibilities. Company profiles are arranged according to distributors and manufacturers of microcomputer systems, peripherals and supplies. The publication also furnishes directories of periodicals, associations, on-line database services and special services. 517 pages, $75. **Gale Research Co.,** Book Tower, Detroit, Mich. 48226, (313) 961-2242.

Circle No 350

Report details market for integrated software

The *Integrated Software* report focuses on integrated application-software packages that combine more than one application function in a program that moves and transfers data between functions. The report also covers "mouse-and-window" operating environments typified by Apple's Lisa and VisiCorp's Visi^{On}. The report predicts that sales of integrated application-software packages and the new operating environments will reach $6.5 billion by 1988. The report also analyzes industry economics, market forces, distribution, potential market entrants and the competitive environment, including company profiles and market shares. $1,450. **Creative Strategies International,** 4340 Stevens Creek Blvd., Suite 275, San Jose, Calif. 95129, (408) 249-7550.

Circle No 351

Book features operating systems

Volume III of *Microprocessor Operating Systems,* edited by John Zarella, describes Digital Research's Concurrent CP/M, Microsoft's MS-DOS, Hemenway's MSP, Pick Systems' Pick, Forth's polyFORTH, SofTech Microsystems' p-System, Ryan-McFarland's RM/COS, Bluebird Systems' SuperDOS and Software 2000's TurboDOS operating systems. Most chapters in the 152-page book were written by industry leaders involved in developing and implementing operating systems. $12.95. **Microcomputer Applications,** 827 Missouri St., Fairfield, Calif. 94533, (707) 422-1465.

Circle No 352

Catalog lists engineering standards

The 1984 EIA and JEDEC catalog lists more than 600 standards and publications for electronic components and equipment. It also includes interim standards and engineering bulletins; proceedings of nationwide technical conferences and workshops sponsored by the EIA engineering department committees; and the EIA's Joint Electron Device Engineering Council standards, publications and semiconductor registration lists. The catalog gives prices and ordering information. $5. **Electronic Industries Association,** 2001 Eye St., N.W., Washington, D.C. 20006, (202) 457-4981.

Circle No 353

Directory lists computer dealers

The 1984 *Directory of 22,368 Computer Dealers* lists business names, addresses, zip codes, telephone numbers and franchise information. The information is a compilation of 4,800 *Yellow Pages* telephone directories in the United States. The reference organizes information alphabetically by state and city. $369. **American Business Directories Inc.,** P.O. Box 26347, Omaha, Neb. 68127, (402) 331-7293.

Circle No 354

Multiplexer directory provides specifications

This directory provides specifications and pricing information on 140 multiplexers for general-purpose data-transmission applications. The directory also provides information on how multiplexers operate and discusses the relative merits of various multiplexing techniques. Each model description defines the multiplexer type and applications and provides information on data-channel and composite-link parameters, diagnostics capabilities and visual indicators and support. Model descriptions are arranged alphabetically by vendor. $39. **Data Decisions,** 20 Brace Road, Cherry Hill, N.J. 08034, (609) 429-7100.

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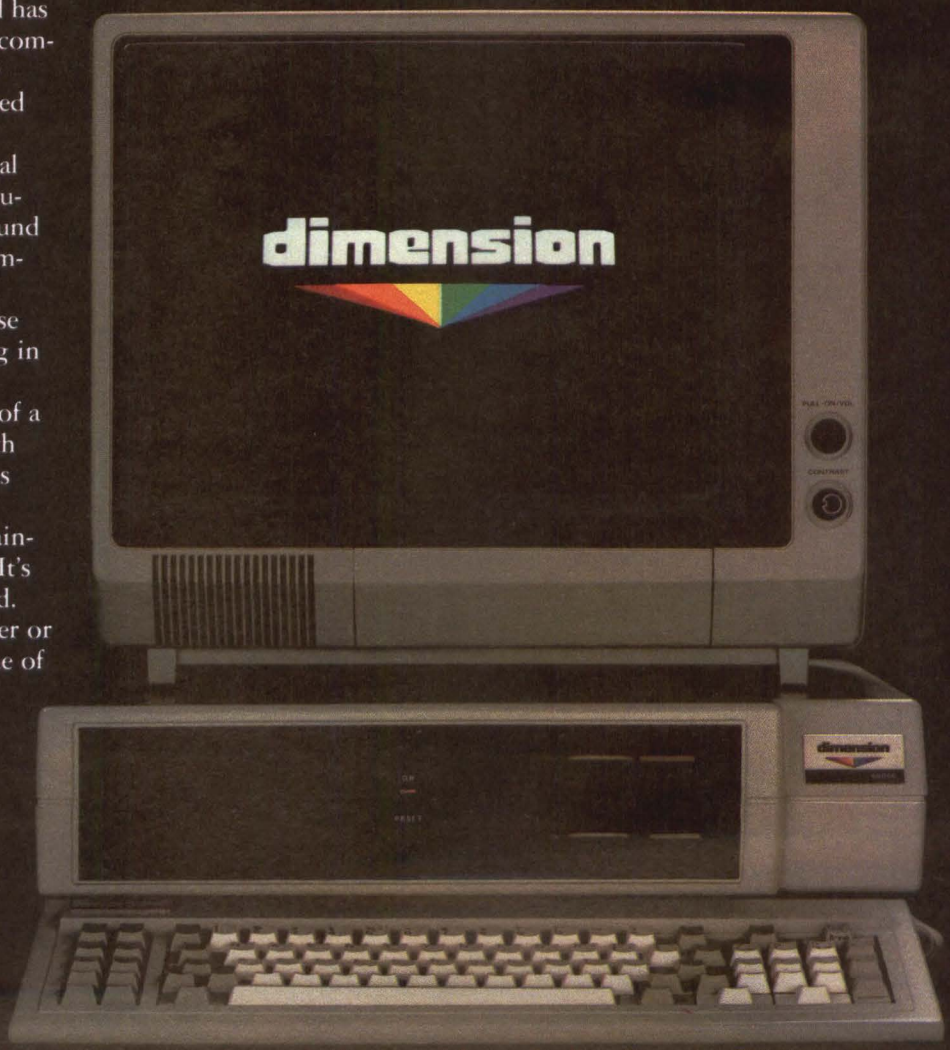

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DEALER INQUIRIES INVITED

New Products

LITERATURE

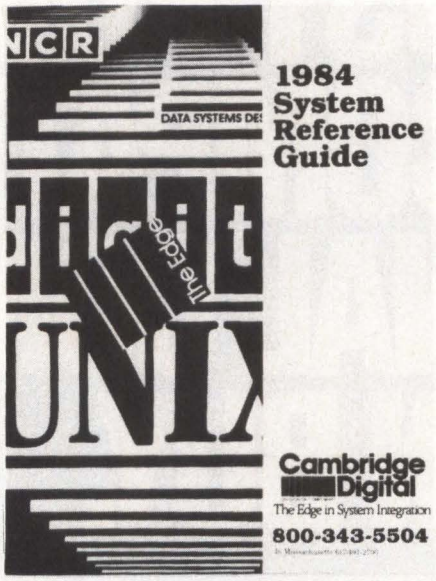
Software guide lists packages for HP plotters

This guide describes eight graphics software packages that enable Apple personal computer users to produce charts and graphs on HP 7470A and HP 7475A graphics plotters. The guide includes data sheets, sample graphics plots and hardware requirements. The guide also provides information on connecting the HP graphics plotters to the Apple IIe and Apple III, including recommended system configuration, connection instructions and communication verification. **Hewlett-Packard Co.,** 1820 Embarcadero Road, Palo Alto, Calif. 94303.

Circle No 356

Catalog describes customized systems

This 60-page product catalog describes the company's DEC-, NCR- and UNIX-compatible customized systems and software. Chapters detail the



company's offerings in DEC and UNIX operating systems and layered products; integrated Q-bus, Unibus and Multibus systems and components; mass-storage and tape drive subsystems; terminals and printers; and hardware- and software-support services. **Cambridge Digital Systems,** P.O. Box 586, 65 Bent St., Cambridge, Mass. 02139, (617) 491-2700, (800) 343-5504.

Circle No 357

Literature details CAD systems

This literature details the ICON 2000 series intergrated, computer-aided design systems based on DG's Desk Top Generation computers. ICON systems suit applications in the architectural, engineering, construction and printed-circuit board markets. The literature explains the expandable system's features, provides a system overview and details important software functions and hardware components. The literature also provides operating specifications and lists available options. **Summagraphics Corp.,** 777 State St. Extension, P.O. Box 781, Fairfield, Conn. 06430, (203) 384-1344.

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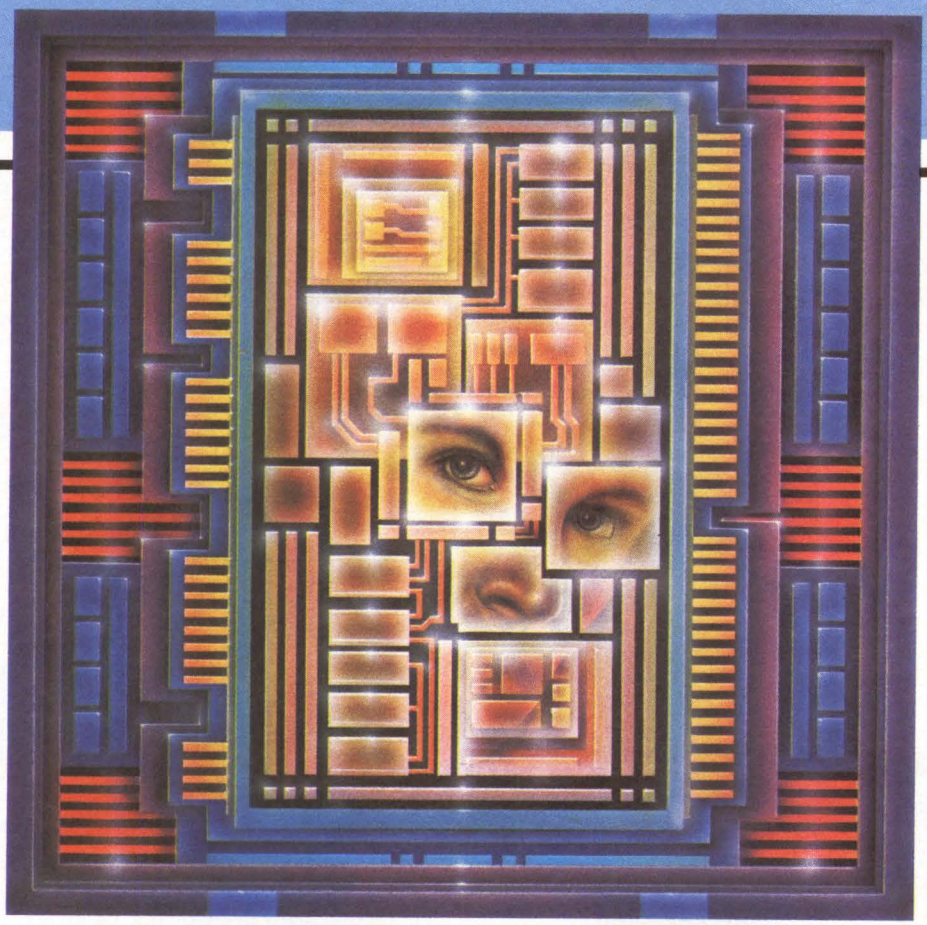

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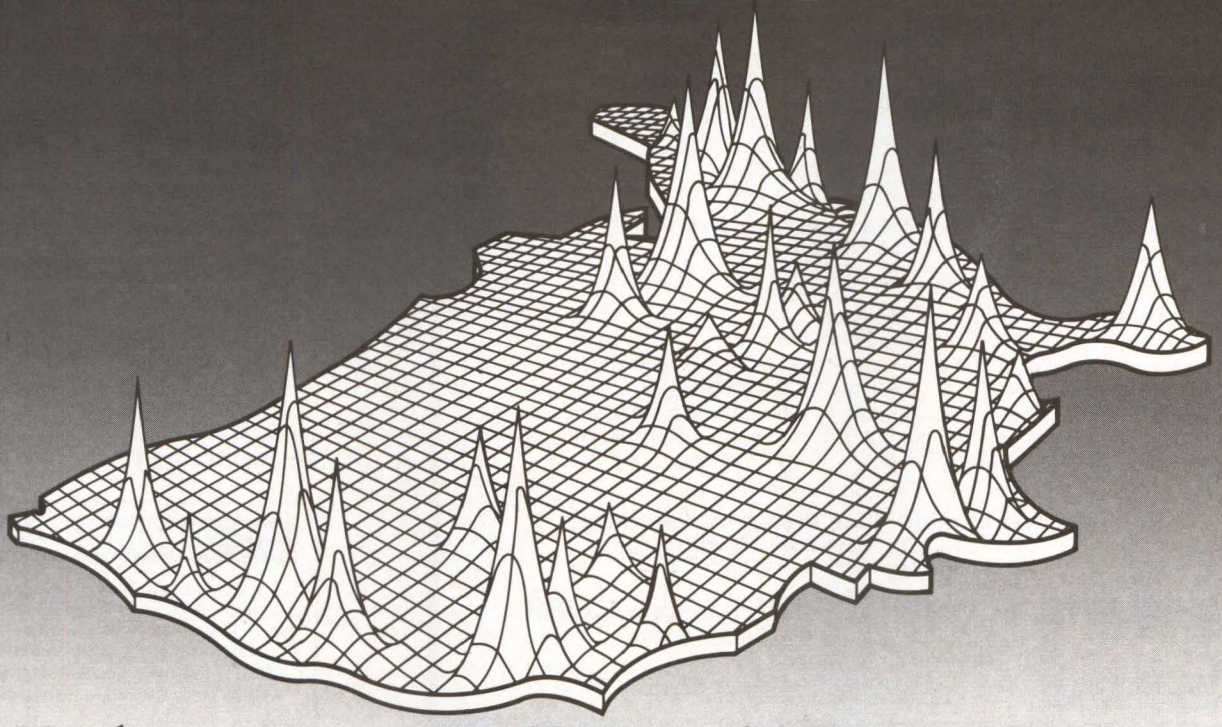
How much do computing salaries vary by geography?



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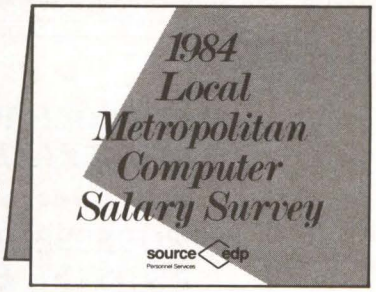

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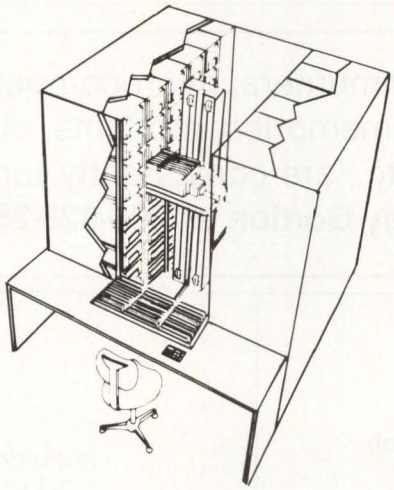

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Calendar

JULY

15-18 1984 International SPSS Software Users Exchange (ISSUE) National Conference, Drake Hotel, Chicago, sponsored by ISSUE Inc. Contact: ISSUE '84 Program Chairman, ISSUE Inc., Suite 1970, 444 N. Michigan Ave., Chicago, Ill. 60611, (312) 329-2400.

17-20 "Microprocessor Software, Hardware & Interfacing" Workshop, Los Angeles, sponsored by Integrated Computer Systems. Contact: Ruth Dordick, Integrated Computer Systems, 6305 Arizona Place, P.O. Box 45405, Los Angeles, Calif. 90045, (213) 417-8888, (800) 421-8166 (outside California) or (800) 352-8251 (in California). Also to be held on July 24-27 in Washington.

17-20 "Implementing Local-Area Networks" Course, Boston, sponsored by Integrated Computer Systems. Contact: Ruth Dordick, Integrated Computer Systems, 6305 Arizona Place, P.O. Box 45405, Los Angeles, Calif. 90045, (213) 417-8888, (800) 421-8166 (outside California) or (800) 352-8251 (in California). Also to be held on July 24-27 in Washington, Sept. 18-21 in San Diego and Sept. 25-28 in Washington.

19-21 Syntopical XII Office Automation/Information Systems Conference & Exposition, McCormick Place, Chicago, sponsored by the Association of Information Systems Professionals. Contact: Matt Smith, Case History Associates, (201) 361-0933.

23-25 Summer Computer Simulation Conference (SCSC '84), Boston, sponsored by Simulation Councils Inc. Contact: Charles Pratt, Simulation Councils Inc., P.O. Box 2228, La Jolla, Calif. 92038, (619) 459-3888.

23-27 SIGGRAPH '84 Annual Conference on Computer Graphics and Interactive Techniques, Minneapolis, sponsored by the Association for Computing Machinery's Special Interest Group on Computer Graphics, the IEEE Technical Committee on Computer Graphics, Eurographics, the Minneapolis College of Art & Design, the University of Minnesota and the Science Museum of Minnesota. Contact: SIGGRAPH '84 Conference Office, 111 E. Wacker Drive, Chicago, Ill. 60601, (312) 644-6610.

JULY 31-AUG. 3

"Database Mangement Systems -Mini, Micro & Distributed Applications" Course, Washington, sponsored by Integrated Computer Systems. Contact: Ruth Dordick, Integrated Computer Systems, 6305 Arizona Place, P.O. Box 45405, Los Angeles, Calif. 90045, (213) 417-8888, (800) 421-8166 (outside California) or (800) 352-8251 (in California). Also to be held on Sept. 18-21 in Los Angeles and Sept. 25-28 in Baltimore.

AUGUST

6-7 "Micro/Personal Computers: State of the Art" Seminar, Chicago, sponsored by Digital Consulting Associates Inc. Contact: Software Institute of America Inc., 8 Windsor St., Andover, Mass. 01810, (617) 470-3380. Also to be held on Aug. 9-10.

13-15 American Society of Mechanical Engineers (ASME) International "Computers in Engineering" Conference & Exhibit, Hilton Hotel, Las Vegas, Nev., sponsored by ASME. Contact: Mary S.H. Benedict, Exhibits Manager, or Eileen Dengler, Exhibits Administrator, ASME, United Engineering Center, 345 E. 47th St., 13M, New York, N.Y. 10017, (212) 705-7100.

13-17 "Database '84" Course, Wang Institute of Graduate Studies, Tyngsboro, Mass., sponsored by the Wang Institute of Graduate Studies. Contact: Roberta Wesley, Coordinator of Special Programs, Wang Institute of Graduate Studies, Tyng Road, Tyngsboro, Mass. 01879, (617) 649-9731.

15-16 Telecommunications 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 on Aug. 22-23 in San Francisco.

22-24 Sixth Annual Conference on Interactive Videodisc in Education and Training, J.W. Marriott, Washington, sponsored by the Society for Applied Learning Technology (SALT). Contact: Raymond G. Fox, SALT, 50 Culpeper St., Warrenton, Va. 22186, (703) 347-0055.

SEPTEMBER

5-7 National Software Show, Anaheim Convention Center, Anaheim, Calif., produced by Raging Bear Productions Inc. Contact: Philip J. Russell, National Software Show, Raging Bear Productions Inc., 21 Tamal Vista Drive, Suite 175, Corte Madera, Calif. 94925, (415) 924-1194 or (800) 732-2300.

11-13 Midcon/84 High-Technology Electronics Exhibition and Convention, Dallas, produced by Electronic Conventions Inc. Contact: Nancy Hogan or Kent Keller, Electronic Conventions Inc., 8110 Airport Blvd., Los Angeles, Calif. 90045, (213) 772-2965.

11-13 Mini/Micro Southwest '84 Computer Conference and Exhibition, Dallas, produced by Electronic Conventions Inc. Contact: Nancy Hogan or Kent Keller, Electronic Conventions Inc., 8110 Airport Blvd., Los Angeles, Calif. 90045, (213) 772-2965.

17-19 Data Storage '84, Fairmont 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.

17-24 Seventh Fiber-Optic Communications/Local-Area Networks Exhibition (FOC/LAN '84), MGM Grand Hotel, Las Vegas, Nev., organized 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.

Advertisers Index

See P. 299 for Classified Advertisers
See P. 293-298 for Career Opportunity Advertisers
See P. 303-304 for Mini-Micro Marketplace

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