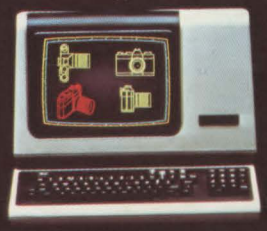
Mini-Micro Systems

A CAHNERS PUBLICATION

JULY 1982



SPECIAL REPORT: COMPUTER GRAPHICS

- 3-D imagery
- Device-independent software
- Business graphics packages

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Kennedy was the first to utilize the ¼″ 3M cartridge for disk backup; Kennedy was the pioneer in Winchester disk technology, and was a leader in developing a low cost streaming tape drive.

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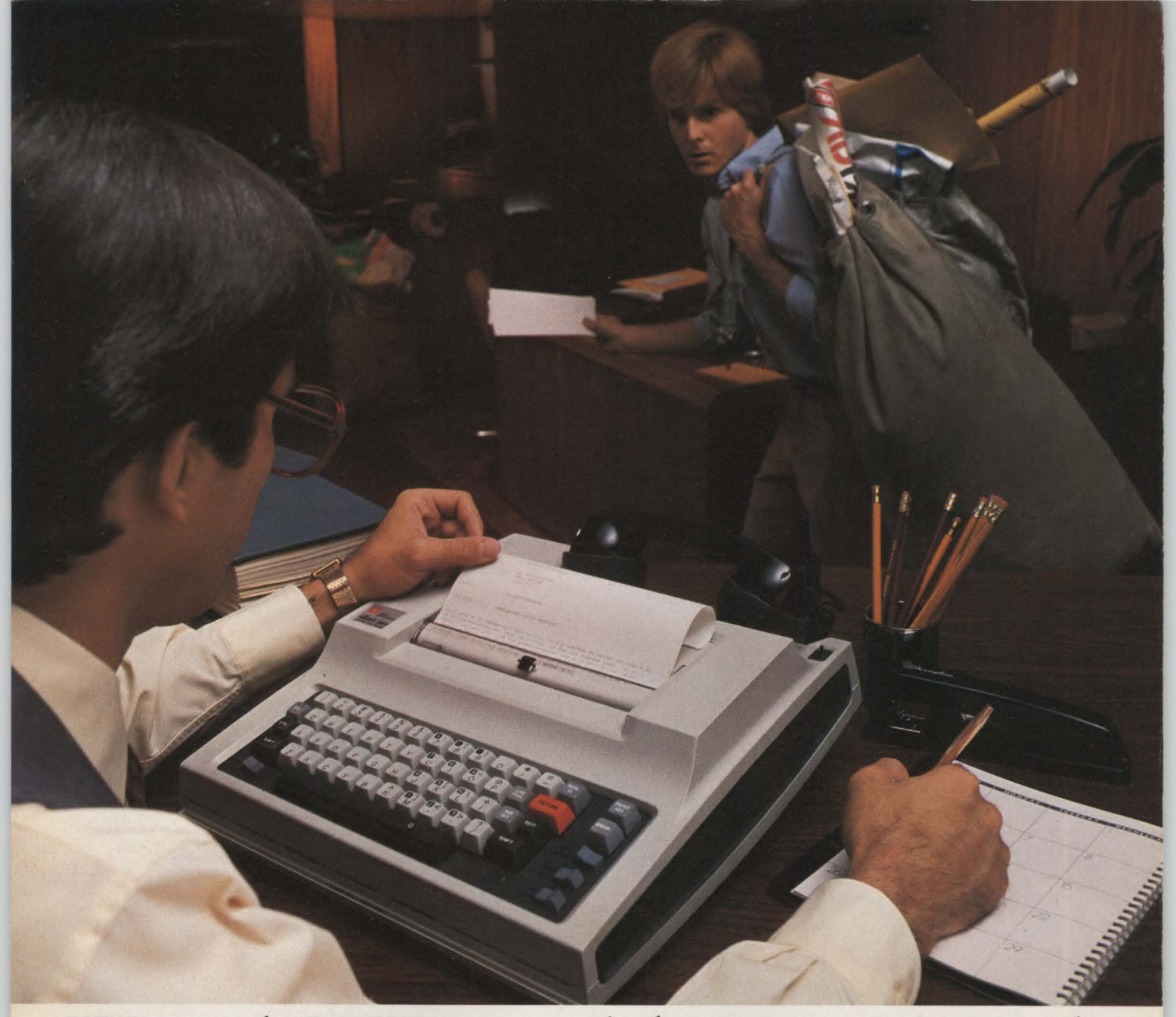

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Electronic mail is fast becoming a communications vehicle of the future. And now, Texas Instruments and GTE Telenet offer a practical solution that lets you take better advantage of this growing information medium. By using TI's *Silent 700** Portable Data Terminal, the subscribers of GTE Telenet's computerized Telemail† service get their information in minutes, not days.

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Ramtek lends color to your decisions.

There are dozens of ways to effectively use the color-graphics created by a Ramtek 6211. Computer aided design; process monitoring & control; business information systems; mapping research & science—to name a few of them.

The 6211 is a complete terminal with a high resolution color monitor and display electronics. A full range of off-the-shelf graphics software packages are available. You can display 16 colors at once from a palette of 64. And Tektronix 4014 emulation allows you to work with 16 colors instead of just one.

For hard copy, couple the 6211 with a Ramtek 4100 colorgraphic printer for quick inexpensive quality plain paper copies. Its exclusive four-head design produces full color in a single pass. With separate, easy-to-change re-inking ribbons, there are no messy toners or chemicals to replace.

The 6211 is just one of a complete line of 6000 series terminals offering a broad range of screen resolutions including the model 6412 with resolution to 1024 x 1280 picture elements. The 6000 series terminals are available in desk-top or rack-mount configurations with light pen or graphics tablet options.

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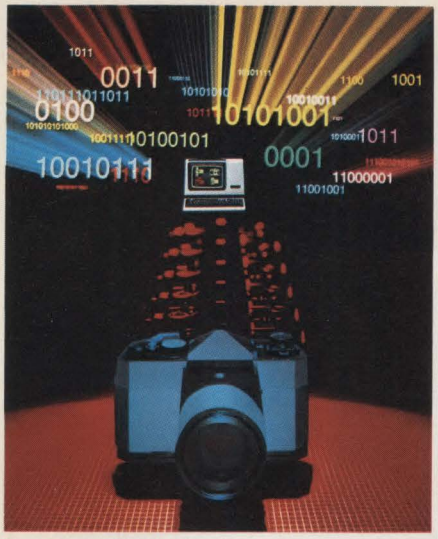
Finite element model displayed created by PATRAN, a product of PDA Engineering.



Mini-Micro Systems's annual report on computer graphics details the four main components of modern graphics systems: processor hardware, graphics software, input peripherals and output peripherals (see p. 162). Cover photo by Stills Studio— Jim Conaty, Boston; art direction by Vicki Blake.

Page 85 . . . . . Trade bills disputed

Page 256 . . . . Software simplifies graphics

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Mini-Micro Systems

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FEATURES

INTERPRETER

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MINI-MICRO WORLD

DEPARTMENTS

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ADDS PLANS SYSTEMS LINE EXPANSION

Terminal supplier Applied Digital Data Systems, which now claims to be deriving 25 percent of its sales from microcomputer systems, is planning to bracket its line of Mentor computers. The original Zilog, Inc., Z8000-based Mentor 4000 will be joined by a low-end, desk-top system that is expected to retail for less than $10,000. Like the earlier Mentor, it runs the Pick operating system and is based on a "Z family" microprocessing unit. The system is due in October—in time for the arrival of two Pick competitors, which are expected to hit the market with systems that will undersell the Mentor. The challengers are Datamedia Corp., which introduced a Motorola 68000-based system in May, and Altos, which expects to field an Intel 8086-based system in the fourth quarter of this year. ADDS is also planning high-end models with four to six times current Mentor performance. Those systems are due out in the fourth quarter of 1983.

NATIONAL PLANS SPEECH MODULES, DEC BUYS SPEECH BOARDS

National Semiconductor Corp., Santa Clara, Calif., planned to deliver a speech-development/word-editing system built around a proprietary Z80-based microcomputer called the MSC-6605 (MMS, June, p. 219). But the company has moved from the full-system approach and plans instead to offer speech modules that can be linked to any CP/M-based microcomputer via an RS232 interface. National's Digitalker time-domain speech-synthesis device will allow words to be extracted from diskette and down-loaded to the CPU for compilation into a custom vocabulary. The tabletop module should be ready early next year and will sell for less than $4000.

Digital Equipment Corp. reportedly has purchased 25 speech-recognition boards that give a VT-100 terminal a 100-word vocabulary. The terminals are reportedly being evaluated for data-collection in industrial systems. The outside vendor may be Interstate Electronics Corp., Anaheim, Calif., which markets the model VRT3000 single-board voice-recognition module for VT-100 terminals.

INTEL, ZILOG 16-BIT CHIPS ARE IMMINENT

Intel Corp. will deliver a high-performance, single-chip 16-bit microcontroller by year-end. Called the 8096, the device will top off the Santa Clara, Calif., company's microcontroller family that includes the 8048 and 8051. Zilog expects to begin delivering its Z800 next year. The chip is Z80-compatible through an 8-bit data bus, but has a 16-bit internal architecture.

DIGITAL RELEASES LOW-END PDP-11/23 PLUS-BASED SYSTEM

In late June, Digital Equipment Corp. was expected to announce a low-end PDP-11/23 Plus-based microcomputer called the Micro-11. Targeted at OEMs, the system includes the CPU with 22-bit addressing, 256K bytes of parity memory, a seven-slot LSI-11 bus backplane that supports optional peripherals, an RD-51 10M-byte 5 ¼-in. Winchester disk drive, an RX-50 5 ¼-in. floppy-disk drive with 800K bytes of storage, a universal power supply and controllers. Single-user price is $9200 for either a desk-top or rack-mountable system. A desk-top system with a general operating-system license and a four-line asynchronous multiplexer will sell to commercial OEMs for $10,255. The Micro-11 supports the RSX-11 Plus, RT-11, CTS-300 and RSTS operating systems. DIBOL and COBOL programs, Datatrieve II for data access and RMS-11 file-management software can be run under CTS-300 and RSTS. Communications for the Micro-11 include DECNet and will eventually include Ethernet. DEC's technical OEM and commercial OEM groups will sell the product.

JOINT VENTURE PUTS C, UNIX ON MULTIBUS BOARDS

Multibus-compatible board builder Zendex Corp., Dublin, Calif., has become a licensee for Houston software distributor C Ware's CC86 C compiler and for Coherent, its UNIX-compatible operating system. The software will be available for Zendex's ZX-86 8086-based single-board CPU and for systems built around the board. In return, Zendex will provide C Ware with current and future hardware for the development of software for other 16-bit processors and additional real-time, multitasking operating systems, officials at the companies say. CC86 compiler object code sells for $1750. Coherent is priced at $2000. Zendex's ZX 86 is available with 5-, 8- or 10-MHz 8086s, and prices start at $1695.

NCC Breakpoints

INDUSTRIAL OCR SYSTEM READS INCOMPLETE TEXT

Based on research begun in the early '70s, a former Massachusetts Institute of Technology professor has formed a company to sell an optical-character-recognition system for industrial applications. Boston-based Cognex Corp. sells its Dataman system for $30,000. The company contends the system can read blurred, skewed or incompletely formed characters that would baffle other OCR readers. Dataman operates at about 15 cps, reads 0.020- to 20-in.-high characters and is built around a DEC LSI 11/23 and RCA video components. IBM Corp. has purchased the first Dataman system for reading serial numbers on silicon wafers.

JUNE'S NCC WAS THE MOST ACTIVE IN RECENT HISTORY

The most exciting National Computer Conference in recent memory attracted 96,000 attendees to Houston last month. To take in the plethora of new products and announcements, many of which change their industry niches, attendees would have had to rush from booth to booth for four days. Particularly noteworthy were the faceoffs among potential suppliers of sub-4-in. floppy-disk drives for an emerging media standard and the battle for shelf space for small computers. The DEC booth typified the popularity of such computers—attendees forcefully elbowed their way through a crowd to view the new personal computers. In the following pages, MMS editors review the show's highlights and some forthcoming events.

MICROFLOPPY STANDARDS DEBATED

A battle over media standards has hit the nascent market for sub-4-in. floppy-disk drives, even though pilot production of this hardware is only beginning. On one side of the issue are Sunnyvale, Calif., Xerox subsidiary **Shugart Associates** and three diskette vendors that used the show to announce formation of a committee to propose a small-diskette standard to ANSI in September. On the other side is Shugart arch-rival **Tandon Corp.**, Chatsworth, Calif., whose upcoming introduction of a 3 ½-in. drive using the diskettes developed by **Sony Corp.** for its microfloppy drive (MMS, April, 1981, p. 17) may set a de facto standard before ANSI can act.

One source close to Shugart says the standard that the committee will propose could be modeled on the media used by Sony on its 500M-byte microfloppy drive coupled to the protective 3-in. hard-cartridge packaging concept developed late last year by a Japanese consortium that includes longtime Shugart partner **Matsushita Electric Industrial Co., Ltd.** Shugart demonstrated a 3 ½-in. floppy-disk drive using a modified Sony cartridge, and this fall plans to announce the hardware priced at less than $100 in large quantities. Shugart sees itself as a mediator between Sony and Matsushita, both of which have long been at odds over the issue of video-tape cassette standards.

The standardization efforts of Shugart and the three media companies involved—**Verbatim Corp.**, Sunnyvale, Calif.; **Dysan Corp.**, Santa Clara, Calif.; and Dysan-funded Massachusetts start-up **Tabor Corp.**—are not attempts to stifle competition from all Japanese vendors and are not in violation of U.S. antitrust statutes, a committee spokesman says. "This is not a closed group, and the Japanese will be involved in our activities by the time we're done," says Shugart marketing vice president George Sollman, acting as spokesman for the committee. This apparently was news to Sony, however. "We absolutely wish to become involved in this," says Myles Tintle Jr., national sales manager at Sony's Data Products Division in Paramus, N.J., "but this is the first we've heard about it."

But by the time any standard is formalized, Tandon may already be well entrenched in the market with a double-sided 125K- and 250K-byte 3 ½-in. drive called the TM-35. Tandon's drive is a smaller version of its TM-50 series half-high 5 ¼-in. floppy-disk drives—also unveiled at NCC—and will be available for $50 to $60 (mechanics only) in high-volume orders. Complete TM-35 and TM-50 drives will both be priced in the $110 to $120 range in 100,000-lot orders, and may be in high-volume production during the first quarter of next year. The TM-35 will not be compatible with the 20-month-old Sony device, however. Rather, in a move to adopt existing de facto standards, the Tandon drive is designed with the same transfer rate and track capacity as existing hardware, permitting users to map data off 5 ¼-in. diskettes and onto the newer 3 ½-in. media.

De facto standards favoring Sony's 3 ½-in. diskette may also get a boost from Sony. The company has lowered the 1000-lot price of its hardware to $240, and may reduce it to less than $100 in large quantities. Sony's new pricing schedule may spur a second look by **Apple Computer, Inc.**, which reportedly has expressed interest in the Sony drive but was turned off by its high price. It remains to be seen, however, how interested Apple is and how responsive Sony might be. One Apple source says the microcomputer vendor wants high-volume pricing in the $40 range.

In addition to Sony, almost every major Japanese disk-drive maker showed floppy-disk drives based on the 3-in. standard announced last December. **Hitachi's** HFD 305S, the only small drive running on the show floor (ominously in an IBM personal computer next to a Tandon 5 ¼-in. standard-height floppy) is scheduled for shipment to the U.S. market during the third quarter of this year. That move could further pressure the committee and ANSI to move on sub-4-in. media standards. Hitachi's drive will be priced at $150 in 5000-lot orders. Single-unit media price is $4. **Panasonic** (Matsushita) will uncork its 3-in. floppy-

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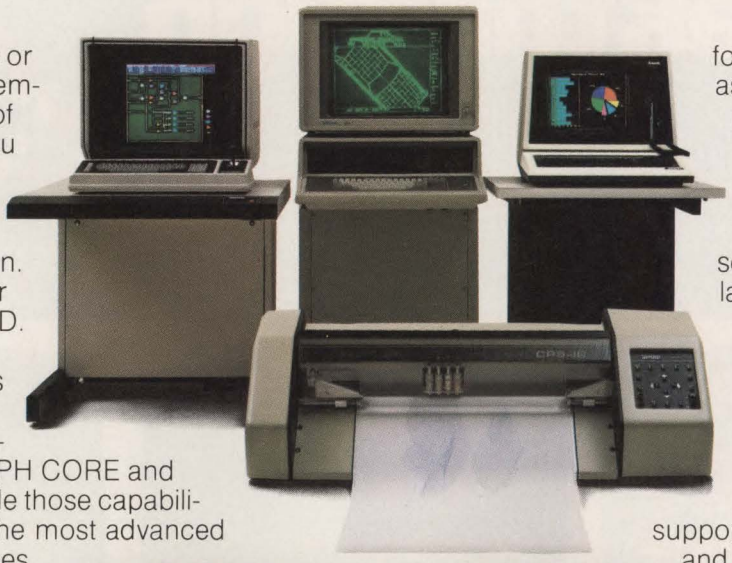

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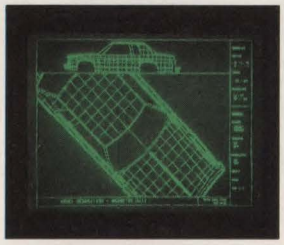

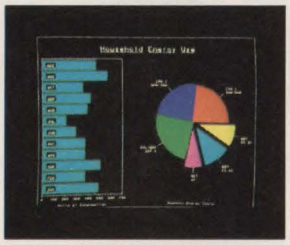

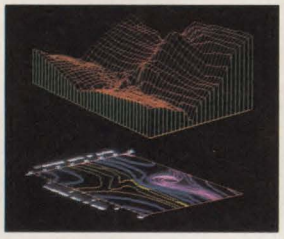

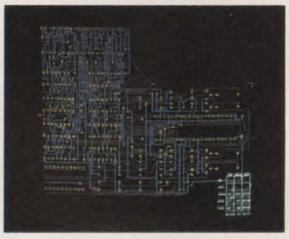

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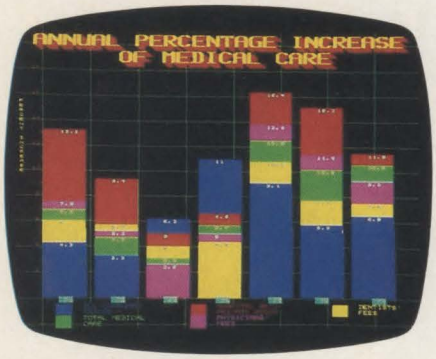
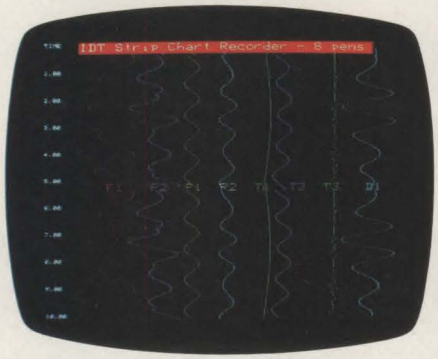
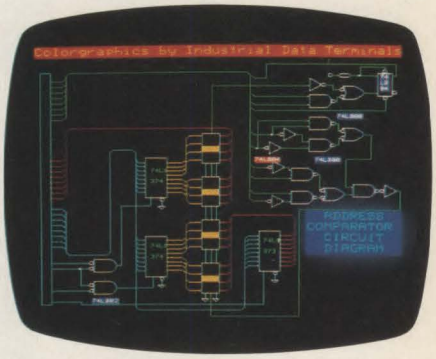
Bubble Breakthrough







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PLOT 10* software compatibility is now available. A new hardware vector generator draws vectors 10 times faster. New front access design permits easy maintenance, plus room for three full-color display memory planes.

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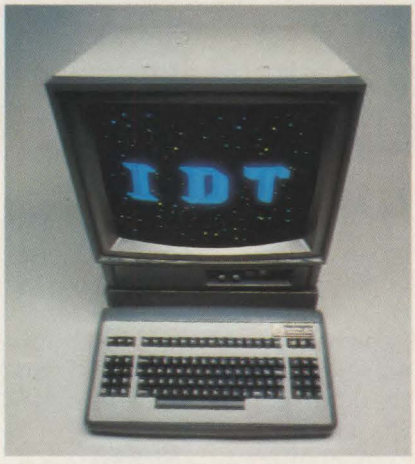

- **Highly reliable. Ruggedly designed for long life and low maintenance in industrial environments.**
- **Non-volatile memory provides megabit capacity within the terminal for a library of pictures and subpictures.**
- **Rapid display of graphics with bubble and subpicture architecture stored within the terminal. High-speed, high-resolution presentation. 512 x 512 individually addressable pixels.**
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disk drive early next year (MMS, June, p. 101).

Also set for first quarter 1983 production is a 1M-byte, 96-tpi, 3-in. drive from **Nissei Sangyo America**. Evaluation versions of the unnamed drive will be available in the U.S. late this year at $250 in 5000-lot orders. Nissei appears anxious to cover its bets in the sub-4-in. market. A drive using Sony's 3 ½-in. media is planned.

SLIMLINE FLOPPY DELUGE CONTINUES

Based on the number of slimline 5 ¼-in. floppy-disk drives unveiled at NCC, it may be some time before drives smaller than 4 in. dominate the market. In addition to its TM-50 series, **Tandon** previewed its TM-55 drives—two 48-tpi, half-high devices with 250K- and 500K-byte capacities, and a 500K-byte and a 1M-byte 96-tpi device. The four drives offer faster access times than the TM-50 and are priced approximately the same as standard-height floppies. Production quantities will be available in the second quarter of 1983.

Shugart is expected to announce two half-high floppy-disk drives in September. Those drives are the double-sided, 48-tpi, 500K-byte SA455 and the 1M-byte, double-sided, 96-tpi SA465. Prices are not firm, but one source says they will be less than $100 per drive in large volumes. Production volumes are set for the fourth quarter of this year.

Meanwhile, Japanese vendors are making a major effort to carve out a piece of the half-high, 5 ¼-in. floppy-disk market. **Hitachi** showed its 1M-byte FDD-413B, and its super-thin (41-mm. or 1.6-in.) 500K- and 1M-byte HFD-510 drives. Pricing and delivery are not set. **Toshiba** also jumped into the slimline floppy market with its 500K- and 1M-byte ND-06D series and a 1.6M-byte, 8-in., half-high drive. Also at the Toshiba display was the firm's first Winchester, a 15M-byte removable-only disk-cartridge drive, the MK80R. The drive uses the Dysan cartridge and operates at 478 bpi/6700 frpi. Price and delivery dates are not set.

TEAC Corp. showed a line of four slimline floppy drives: the single-sided, 250K-byte, 48-tpi FD-55A; the 500K-byte, 96-tpi FD-55E; the double-sided, 500K-byte, 48-tpi FD-55B; and the 1M-byte, 96-tpi FD-55F. The single-sided drives are priced at $165 and $198, respectively in 1000-lot orders, and are available now; the double-sided FD-55B is priced at $230 and is available now; the 1M-byte FD-55F is priced at $285 and will be shipped late in the third quarter of this year. TEAC also plans a drive using the 3-in. **Matsushita** media standard.

Tandon provided a sneak look at its first tape-cartridge drive—a 30M-byte, ½-in., 20-track streaming device for 5 ¼-in. backup. The unnamed drive has the same form factor as a 5 ¼-in. Winchester, and uses two floppy-disk drive heads. Pricing is unavailable. A 60M-byte version and a 90M-byte version are in the works. A half-high, 5 ¼-in. Winchester and a half-high Winchester disk-cartridge drive are "under study" at Tandon. Further information is unavailable. A 3 ½-in. Winchester is scheduled to appear around mid-1983. Shugart is planning a 6M-byte, single-platter, half-high, 5 ¼-in. Winchester.

5 ¼-IN. WINCHESTERS AIRED

As anticipated, several vendors including **Atasi, Evotek, Priam Corp.** and **Tandon** took advantage of NCC to announce second-generation, high-capacity, 5 ¼-in. Winchester disk drives (MMS, May, p. 19). **Rotating Memory Systems** used the show to preview a half-high Winchester incorporating a rotary voice-coil actuator and storing 50M to 60M bytes on four platters. Evaluation quantities will appear in the first quarter of next year. Reports are circulating that RMS is up for sale. One source says that both Intel Corp. and Commodore International have looked at the firm. The most interested party appears to be Santa Barbara, Calif.-based InfoMag parent, **Computer and Communications Technology**. Two **Control Data Corp.** 5 ¼-in. Wren Winchesters appeared at NCC: 19M- and 32M-byte devices priced at $1415 and $1720, respectively. Production quantities are set for the second quarter of next year.

SyQuest Technology, Inc., Fremont, Calif., the first company to unveil a less-than-4-in. rigid-disk drive (MMS, June, p. 239), will announce a licensed second source for its 3.9-in., ST-506-compatible SQ-306 hardware and the drive's 6M-byte disk-cartridge media during the fourth quarter of this year. Price is $450 in 1000-lot orders. Reports indiciate that **Hitachi** and **Y-E Data** also may announce 3.9-in. drives this year. **Evkin Corp.**, Tustin, Calif., plans to ship prototypes of an unnamed 3 ½-in., ST-506-compatible Winchester this month.

Quantum Corp. may throw its hat into the 5 ¼-in. ring late this year with a 40M-byte product that reportedly will use the company's torque-motor actuators.

Sources in Houston report that **Data Peripherals**, Sunnyvale, Calif., will announce the Manx 6M-byte, 5 ¼-in. disk-cartridge Winchester at the fall Comdex show. Prices will be around $500 in 100-lot orders.

Micro Peripherals, Inc., Chatsworth, Calif., is following **Seagate Technology's** lead to cash in on the market for high-capacity 5 ¼-in. Winchester disk drives (MMS, January, p. 17). Both MPI's new Griffin I and Seagate's ST-412 are two-platter drives that hold 12M bytes of unformatted information. The Griffin I has an average access time of 35 msec., and a maximum access time of 55 msec. It is MPI's first Winchester product, and will be followed by 20M- and 40M-byte, four-platter family members. Single-quantity price for the Griffin I is $1675, and 1000-quantity price is $1000. MPI chairman and CEO Ralph Gabai explains that to get total efficiency on all drive surfaces, MPI has used a technique to microstep from track to track and store information in memory after each track.

Micropolis Corp. released a 5 ¼-in. Winchester series with 38-msec. average access time. The Micropolis 1300 series is positioned in the high-performance micro-Winchester spectrum, with unformatted capacities ranging from 17.3M to 51.9M bytes (MMS, March, p. 10). Quantity 1000 prices will be $900 to $1400, depending on capacity, and evaluation units will be ready in the fourth quarter. The 1300 series incorporates the industry standard ST-506 interface, dimensions, bezel, mounting and data rate.

NCC Breakpoints

IBM Corp. will announce a three-year contract for more than 300,000 5 ¼-in. Winchester disk drives this year. IBM reportedly is looking at two or three vendors and, says one source, has narrowed the field to **International Memories, Inc.**, Seagate and Tandon. An IBM spokesman neither confirms nor denies the report.

TERMINAL SUPPLIERS ENTER WIH μCs

Beehive International's entry into the personal-computer/work-station market is Topper, a Z80A-based system with 64K bytes of main memory, integral dual 5 ¼-in. floppies storing 800K bytes and the CP/M operating system. Beehive hopes Topper's emulation of an IBM 3278 terminal in an IBM 3270 network will distinguish the $2995 entry from the crowd. To ease the merger of CP/M and IBM's Systems Network Architecture, Topper includes Work Station Language software to simplify down-loading of IBM host files to CP/M-based programs and to help use Topper as a remote data-entry station. The Salt Lake City-based terminal manufacturer plans to follow Topper with a line of work stations based on the Motorola MC68000 chip family. Due at Comdex in October is an MC68008-based intelligent terminal code-named T1, which will be followed in mid-1983 by the T2 and T4 UNIX-based work stations. The T4 reportedly will offer an auxiliary storage subsystem holding as much as 100M bytes in the form of three 5 ¼-in. Winchesters.

Commodore Business Machines, Inc.'s Computer Systems Division, Wayne, Pa., released a series of microcomputers ranging from the P128 microcomputer that plugs into a TV set to the BX256, Commodore's first 16-bit professional computer. The BX256 is based on an 8-/16-bit 8088 microprocessor and can use an optional Z80 processor board. The $2995 computer will be available this fall from Commodore dealers. The product has 256K bytes of user RAM, an 80-column screen and built-in dual disk drives. The BX256 is an enhanced version of the company's B series microcomputers. Another B series computer is the B128, a second-generation CBM professional microcomputer that has 128K bytes of user RAM, an 80-column screen and built-in dual drives. The Commodore 64, another new product for home and business microcomputing, is priced at $595. The model 64 uses VIC 20 peripherals and programs and files created for the PET and CBM machines. It has a 64K RAM memory, a 40-column × 25-line screen, graphics in as many as 16 colors, and sound.

Topping other portable personal computers unveiled at NCC in combined screen size, capacity and expansion capability is a first effort from **Jonos Ltd.**, Anaheim, Calif. The system includes a 9-in, 25 × 80 CRT screen, an eight-slot card cage (of which only three slots are initially occupied) and as much as 10.3M bytes of disk storage. The luggage-like enclosure houses Z80A and 8085 microprocessors, an STD-bus and a CP/M-based system that normally contains two Sony 3 ½-in. microfloppy-disk drives, each with 322K bytes of formatted capacity. Space to add one SyQuest 3.9-in. 5M-byte Winchester is available, and a second Winchester can replace one of the two microfloppies. A strap-on, weather-sealed serial printer is optional.

Hitachi released two microcomputers, one targeted for OEMs and called the Data Pal, and one called the 16-bit Personal Computer that will be formally introduced in the consumer market next February. The 8086-based Data Pal is aimed at business users and will sell for about $4000 with a monochromatic display or $4500 with a color display. Prices do not include a printer. The 12-in. CRT displays graphics in 640- × 400-dot resolutions. The processor includes 12K bytes of ROM and a maximum of 384K bytes of RAM. As many as three 0.8M-byte, 5 ¼-in. floppy-disk drives can be attached. Optional storage includes as many as two 1M-byte, 8-in. floppy-disk drives or one 10M-byte microWinchester disk drive. The product has RS232C and parallel interfaces and an optional GP-IB interface. The operating system is MSDOS, and languages include BASIC, COBOL, FORTRAN and Pascal. The OEM-only product will be sold this fall. The 16-bit Personal Computer is based on an 8088 microprocessor with as much as 256K bytes of address space. A $1000 RGB color monitor can display as many as 15 colors. The computer with one floppy-disk drive, a keyboard and 128K-byte memory is priced at about $3500. A black-and-white monitor is priced at $300.

While small computers were everywhere on the show floor, three boxes containing **Panasonic's** JB-3000 8088-based microcomputer sat somewhere in Houston. A Panasonic source says the three computers were scheduled to be shown but were stopped at the last minute. The source says one reason is a possible large OEM contract negotiation—maybe from **Xerox's Office Products Division** in Dallas. A Xerox OPD spokesperson says there is no basis for that speculation, particularly because the product is not compatible with the current Z80A-based Xerox 820. A more probable explanation stems from Japanese reports that speculate **IBM** is negotiating with Panasonic parent **Matsushita** to market the JB-3000 in the U.S. as a low-end personal computer and to supply software for it. An IBM spokesman confirms that the two giants are in discussion, but he would not speculate on the outcome. Another IBM spokesperson declines comment about a rumored high-end, MC68000-based microcomputer under development in Boca Raton, Fla. The Panasonic JB-3000 was shown at the Hanover Fair (MMS, June, p. 101), and is targeted to sell for about $4500.

TERMINALS ADD GRAPHICS, FEATURES

The trend toward ergonomic features moved into the lower priced spread of VDTs at NCC, with several vendors going to complete outside-U.S. manufacture to cut costs. **Lear Siegler Inc.'s** 8085-based ADM22 is built by Teco Electric & Machinery Co., Ltd., Taiwan. The $695 terminal includes a detachable keyboard, seven function keys, a status line, five video attributes, line and word editing, block-mode transmission and graphics mode operation.

Visual Technology unveiled the Visual 50, a $695 terminal with smooth scrolling and a low-profile keyboard. Visual Technology claims the price has been kept low by use of the Signetics video-display chip set

Continued on p. 266

8510A Pro/Writer

1550 Pro/Writer II

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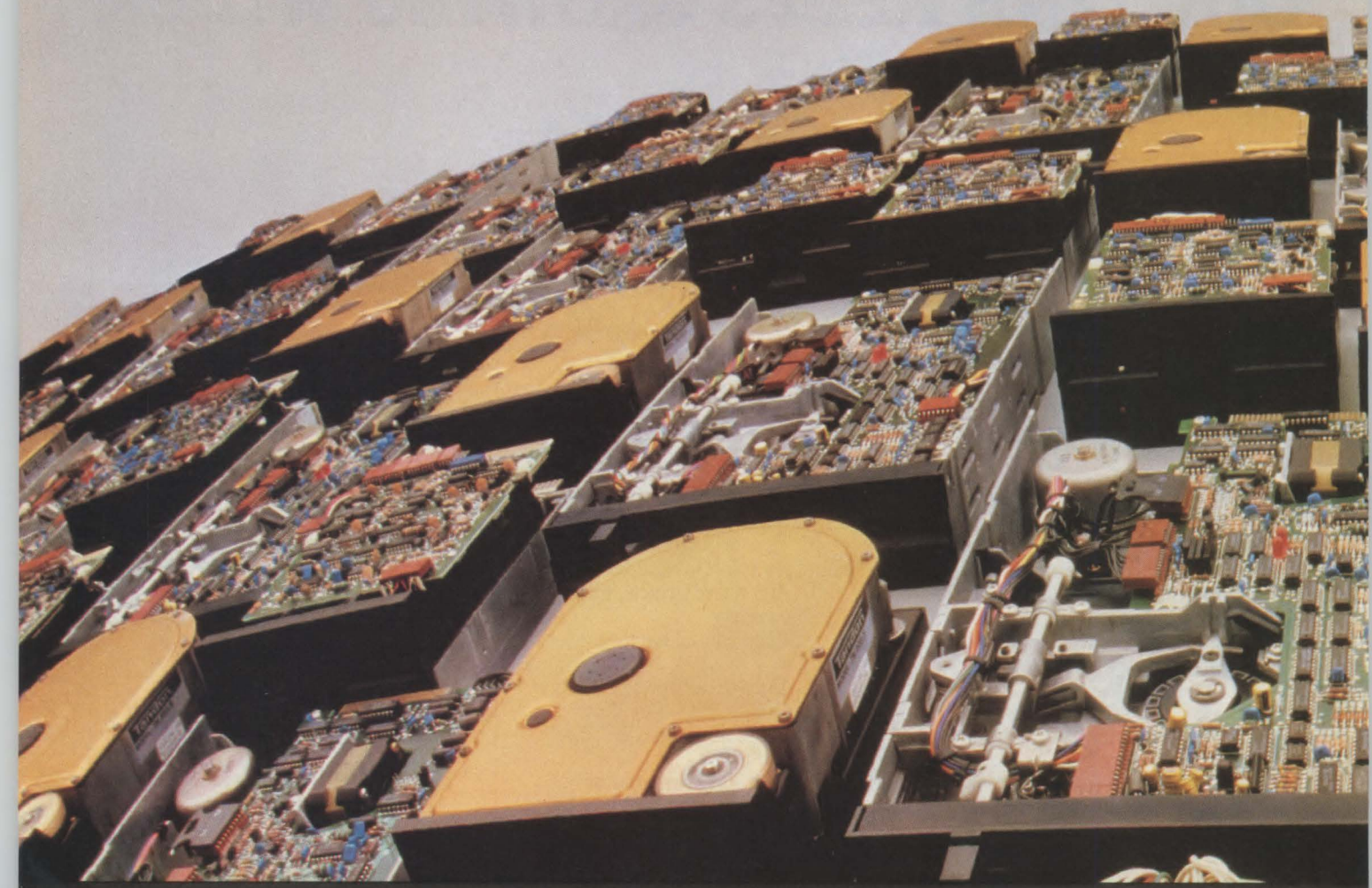

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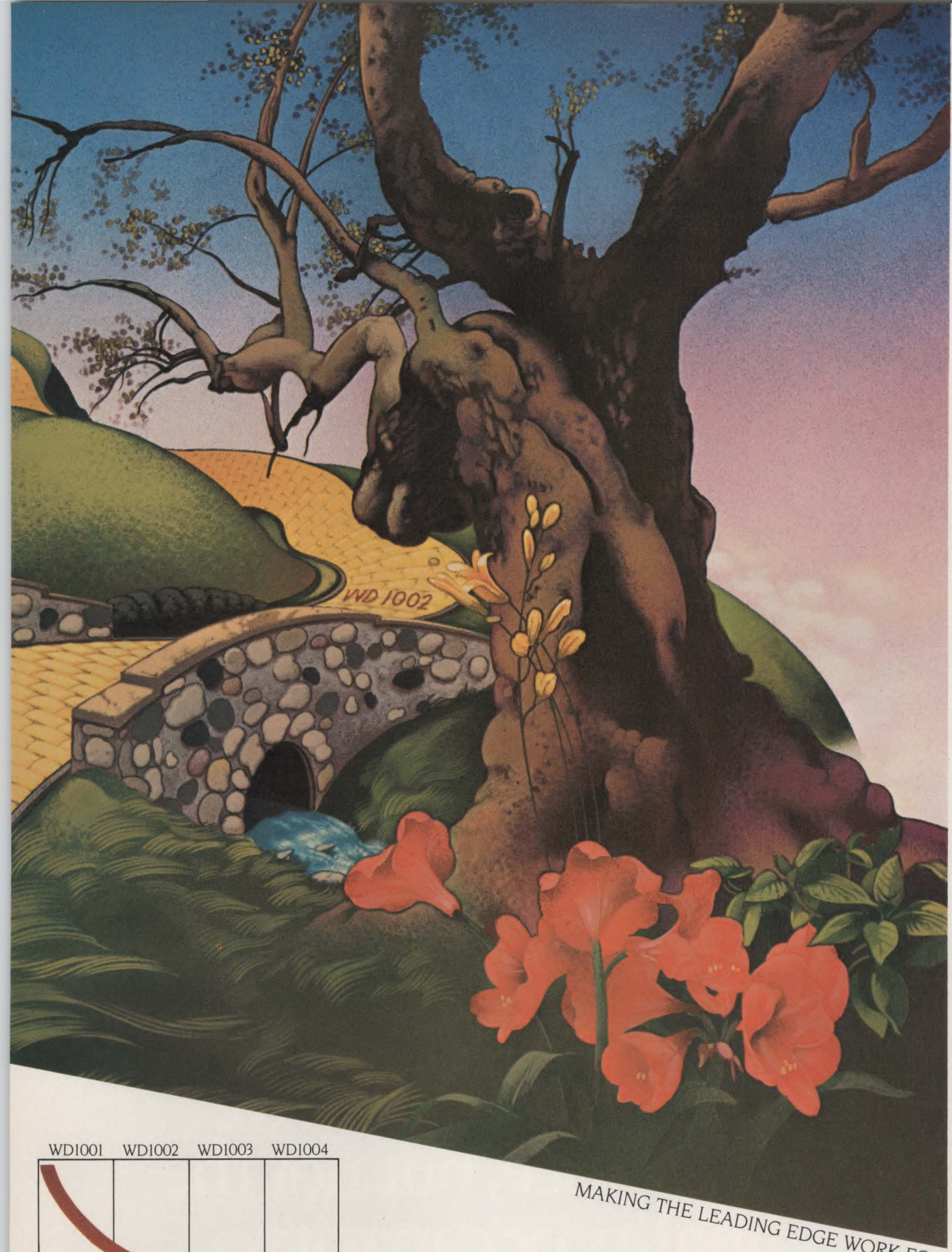

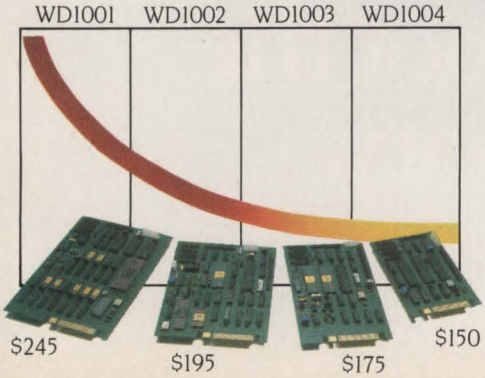

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CIRCLE NO. 101 ON INQUIRY CARD

New personal-computer entires take aim at IBM's moving target

A spate of recent introductions by potentially major players in the personal-computer market is illustrating that IBM Corp.—not Apple Computer, Inc.—is the competitor whose product was in the minds of marketing and development teams when new systems were on the drawing board.

Starting with Digital Equipment Corp.'s entry into the personal-computing fray in May, (MMS, June, p. 15), the field has been expanding with systems from large organizations hoping to compete in an IBM-defined market. Some additions include two Japanese electronic giants: Nippon Electric Co. and Sony Corp. A third entry—with a new edition of a line that has been tailored to the IBM niche—is Hewlett-Packard Co., DEC's minicomputer rival (see "H-P adds $1795 personal system, boosts memory of HP87," p. 18).

NEC Information Systems Advanced Personal Computer *is based on Intel Corp.'s 8086 16-bit microprocessor. In a basic 128K-byte version with a monochromatic screen and a 1M-byte, 8-in. NEC floppy-disk drive, it carries a list price of $3298.*

NEC Information Systems, the $100-million Lexington, Mass., subsidiary of the $5-billion Nippon Electric, is offering the Advanced Personal Computer (APC) aimed at business applications. NECIS entered the personal-computing market last year with the PC 8000 low-end system whose U.S. marketing is shared with NECIS's sister subsidiary, NEC Home Electronics. This time, however, NECIS has an exclusive on the APC and will add the product to a line that already includes the Astra small-business system and a range of hard-copy and magnetic-storage peripherals.

The APC is based on Intel Corp.'s 8086 16-bit microprocessor. In a basic 128K-byte version with a monochromatic screen and a 1M-byte, 8-in. NEC floppy-disk drive, it carries a list price of $3298. An eight-color version with two floppy-disk drives is priced at $4998. The NEC systems are expandable to 256K bytes of RAM and include a separate 4K-byte battery-powered memory and a standard asynchronous/synchronous port. Available NEC printers are a 100-cps dot-matrix model for $695 and spinwriter character printers. A second floppy-disk drive is priced at $700. Memory is expandable to 256K.

Software for the APC includes CP/M-86, Ryan-McFarland CP/M-86 COBOL and a group of standard applications such as general accounting, word processing, MicroPlan business planning, and dBase II database management from Ashton-Tate. For scientific applications, NEC offers a 32-bit floating-point arithmetic processor for $250.

Line-drawing graphics, an as-yet-unpriced option, is supported under both operating systems, which will be priced at less than $250 each when the product is shipped in July.

NEC is formulating a strategy for moving into the major accounts market with the APC and has named former Astra midwest regional manager David A. Gipe national accounts manager. However, NEC stresses that its existing dealer network will handle the sales.

In addition, NEC says it is planning to offer the APC through OEMs and value-added third-party channels. For the retail market, NEC has approached Sears, which carries the PC 8000, as well as IBM's model.

In pitching the APC as a business product rather than a consumer product, NEC stresses communications from the start. Communications emulators include asynchronous ($495) for links to NEC's own Astra small systems as well as to

other systems. In addition, NEC offers synchronous 2780/3780 or 3270 for $900 each (with HASP capability at $450 extra).

Another untried but possibly formidable Japanese competitor in the low-end microcomputer market is Sony, which recently established a Microcomputer Products division in Paramus, N.J., to launch the SMC-70 personal computer. Although Sony has traditionally been a world leader in the consumer electronics business, the company is stressing business applications for its micro.

The system is based on the 8-bit Z80A microprocessor, but is available with an 8086 upgrade card for about $1000. Division general manager Donald Marro says there are no plans to offer a straight 8086 version in the near future.

The basic Z80A version, scheduled for shipment in September, is priced as low as $1475 with 64K bytes of program/data RAM, 38K bytes of graphics memory and a separate 32K-byte system memory. A color monitor is $895, and a monochromatic monitor is $375. Dual 3½-in. Sony floppy-disk drives (storing 560K bytes of data) are priced at $1100. With the bundled Sony interpretive BASIC (including graphics extensions), a viable 16-bit personal business computer can be configured for about $3600.

Four levels of graphics are included in the basic product, supporting 16-color graphics and 640 × 400 monochrome resolution. Four pages of color graphics can be stored in graphics memory for animation or comparisons, Sony says.

In addition to Sony BASIC, the SMC-70 will include CP/M. At the product's introduction, the company was considering both CP/M-86 and MSDOS for the optional 16-bit processor.

Applications software will include the ubiquitous VisiCalc, a family of word-processing packages, a six-module accounting package and vertical-market packages to be developed by outside vendors. In addition, Marro says, the company will offer asynchronous and bisynchronous communications emulators. Sony will provide software houses with versions of the SMC-70 for writing packages onto its 3½-in. media.

While the basic specifications for the SMC-70 place it in the increasingly crowded IBM niche among business users, Sony offers more

H-P ADDS $1795 PERSONAL SYSTEM, BOOSTS MEMORY OF HP87

Hewlett-Packard Co.'s personal computer division is on a roll. Just four months after introducing the 500K-byte HP87A, the Corvallis, Ore., group has unveiled its lowest priced personal system yet, the HP86. At the same time, the company has extended the memory in the HP87A to 640K bytes.

The HP86 with keyboard and 128K bytes of RAM is priced at $1795. A complete system, including floppy-disk drives, display and printer, is priced as low as $3900, depending on peripherals, say H-P officials. The company expects the HP86 to compete with the IBM Corp. personal computer and Apple Computer, Inc.'s Apple III.

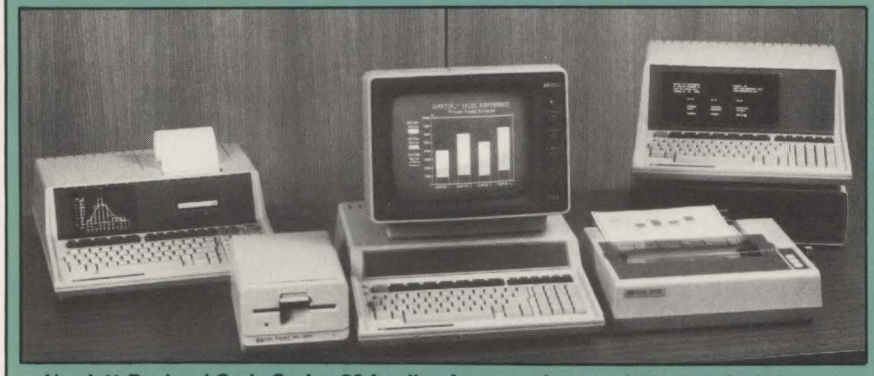
Because the HP86 uses H-P's proprietary 8-bit processor, the same microprocessor used in the HP85 and 87, it is compatible with existing Series 80 software. It also runs software written for Digital Research, Inc.'s CP/M by plugging in H-P's 82900 CP/M modules, a separate Z80-based board priced at $495.

H-P provides a 9- or 12-in. video display for the HP86. Mass storage is provided by a 270K-byte floppy-disk drive. Several printers, including a dot-matrix device, are also available from the company. Dedicated interfaces connect the processor to these peripherals, say H-P officials.

Memory can be expanded to 500K bytes of RAM from the HP86's basic 128K bytes using plug-in memory modules. Four ports in the system's chassis permit addition of RAM and ROM, the CP/M module or modems.

H-P has also extended the software available for its Series 80 systems with the introduction of the HP86. For instance, the firm has added accounting, payroll and inventory packages running under CP/M from Peachtree Software, Inc. These packages are priced at $750 each. Database management is provided by dBASE II from Ashton-Tate, Los Angeles. It is priced at $650. Both can be purchased from H-P.

In the non-CP/M mode, the HP86 runs all software written for H-P's other Series 80 personal computers, including VisiCalc and H-P's graphics software. The HP86 communicates with various information services such as the Source, Dow Jones and Compuserve with two data-communi-



Hewlett-Packard Co.'s Series 80 family of personal computers *now includes (from left) the portable HP85, the HP86 and the HP87XM, with 128K bytes of built-in user memory.*

upgrade potential than most others in the field. The system's architecture includes 13 I/O connectors: seven are occupied by standard interfaces for RS232 communications, a Centronics-type printer port, a numeric keypad interface, an RGB/ composite video interface, a light-pen interface and a tape-cassette interface; the six remaining include two within the desk-top enclosure for the floppy-disk controller and the 192K-byte memory-expansion option, while three of the remaining slots are housed in a separate slide-out tray positioned behind the power supply. These slots are not committed for any existing options.

The 13th I/O connector enables users to connect the 8086 board (which can be ordered with 128K or 256K bytes of RAM) or attach a

Sony's SMC-70 personal computer *is based on the 8-bit Z80A microprocessor, but is available with an 8086 upgrade card for about $1000. The basic version is priced as low as $1475 with 64K bytes of program/data RAM, 38K bytes of graphics memory and a separate 32K-byte system memory.*

cations packages. Other software packages are available through the HP PLUS third-party software program.

A basic HP86 consists of a keyboard and processor in one chassis with 128K bytes of RAM and is priced at $1795. Prices for the 9- and 12-in. video displays are $295 and $325, respectively. The 270K-byte floppy-disk subsystem sells for $850. Dot-matrix printer prices start at $795.

The company's large memory machine, the HP87A, introduced in March, has been given a boost in capacity from a maximum of 500K bytes to 640K bytes. An HP-IB (IEEE-488) interface has also been added. The new model is called the HP87XM.

Like the HP86 and 87A, the HP87XM is compatible with all H-P personal-computer software, including those packages that run under CP/M. The XM with 128K bytes of RAM and built-in HP-IB interface sells for $2995. Prices for memory modules for all three systems range from $295 for a 32K-byte board to $495 for 64K bytes and $795 for 128K bytes.

—Larry Lettieri

NORTH STAR UPGRADES ADVANTAGE, ANNOUNCES LAN

North Star Computers, Inc., San Leandro, Calif., recently added a 16-bit version to its Advantage 8-bit microcomputer line. The Advantage 8/16 includes Intel Corp. 8088 8/16-bit and 8-bit Zilog, Inc., Z80 microprocessors. Upgrades to the more than 10,000 installed 8-bit Advantage systems can be made through a $499 upgrade board, which plugs directly into the bus in the system chassis.

The new system supports five operating systems, including MSDOS (IBM's PCDOS for its personal computer). CP/M-86 will be added.

The $4099 system, which has two integrated floppy-disk drives, a 148K-byte RAM and two processors, can read IBM personal-computer diskettes, but cannot write them. With a 5M-byte hard-disk and one floppy-disk drive, the Advantage 8/16 retails for $5499. First deliveries are targeted for the fourth quarter. The operating systems are priced separately at $149 each. When the new system was announced, North Star also cut prices on the 8-bit system. An 8-bit Advantage with dual floppy-disk drives dropped from $3999 to $3599.

Additionally, the company announced a baseband local-area network called NorthNet, which is designed to link the 8- and 16-bit Advantage systems on a 1M-bit-per-sec. branching network system that uses unshielded twisted-pair cabling with repeaters every 1000 ft. Included with the network is a server work station, a typical work station that includes a board to control network functions. Price for the server board is $499, and the network hookup is $399. As many as 64 nodes can be used on the network. The network does not support North Star's ASP operating system, although it will do so in the future.

One novel feature, the company claims, is Fastack, which keeps the line open between the sender and receiver work stations long enough for an acknowledgement to be transmitted to the sender. The company claims this reduces tension and increases effective bandwidth and throughput 50 to 60 percent. The network initially will support the IBM 2780 and 3780 protocols.

—L. Valigra

COMPARING THE FOUR NEW PERSONAL-COMPUTER ENTRIES

	Model	Price	MPU	Disk	Operating system
IBM Corp.	Personal Computer (64K)	$3495	8088	160K minifloppies (320K, add $200)	Personal Computer OS, CP/M-86, USCD p-System
NEC	APC (128K)	$3298	8086	1M-byte, 8-in. floppy disk	CP/M-86, MS DOS
Hewlett-Packard	HP-86 (64K)	$2940	8-bit (proprietary HP)	270K minifloppy	HP Series 80 BASIC, CP/M (board)
Sony	SMG-70 (64K)	$2950	Z80A (8086 co-processor optional)	560K dual 3½-in. floppies	Sony BASIC, CP/M

Compiled from data supplied by each vendor

separate expansion box with its own power supply and five additional I/O connections. Sony plans to fill some of the available real estate with an 8-in. floppy drive, Winchester-disk options and a 256K cache memory, Marro says.

Although Sony is quiet about many of its expansion plans, Marro says the system will be open to OEMs. "We will allow and encourage third-party boards by supplying technical information and specifications for the (Sony proprietary) board design," he says.

Sony will also pursue third-party resellers for the systems, but Marro does not anticipate getting down to the "no-skins" level.

Sony's major marketing thrust, however, will be through a dealer organization and retail stores. Among the target dealers are existing Sony Office Products dealers and video products dealers. Retail stores may include computer store chains.

When Sony ships in its new products September, it will collide in the market with some tough—and better established—competition in the personal-business-computing niche. In addition to an IBM offering that many industry observers expect to be further enriched by fall, Sony will face the initial shipments of DEC's products.

The stampede to 16-bit personal-business computers in the $3000 to $3500 range reflects an analysis of the IBM personal computer. Marilee Laurence, analyst with Dataquest, a Cupertino, Calif., market-resarch firm, reports that studies indicate the average selling price of the IBM product is approximately $3500 without applications software.

However, she cautions that no matter how carefully new products are aimed, the market (and, in particular IBM) is a "moving target." She expects IBM to add rigid-disk storage, improved graphics, data-base-management tools and networking capabilities at an aggressive rate.

The ink had hardly dried on the comparison sheets NEC used to show its merits versus IBM when those data were outdated by IBM enhancements. In late May, IBM introduced a 320K-byte minifloppy disk, added an enhanced version of its personal computer DOS operating system (updated by Microsoft, the original vendor), cut the price of the standard 160K-byte floppy and reduced the basic dot-matrix printer by more than 26 percent to $555.

The new disk, which operates under the new 1.1 release of the PCDOS operating system, as well as under CP/M-86 and UCSD p-System Version IV, will be available this month for $650. The 160K-byte drive was cut from $570 to $450. Two drives can be attached to a single system.

The new version of the operating system, priced at $40 (the same price as the original), provides improved response time as well as asynchronous communications to a parallel or serial printer or through the optional asynchronous communications adapter to a remote printer. The company also added a $300 BASIC compiler package and BPI Systems accounts-receivable and inventory-control packages, priced at $425 each.

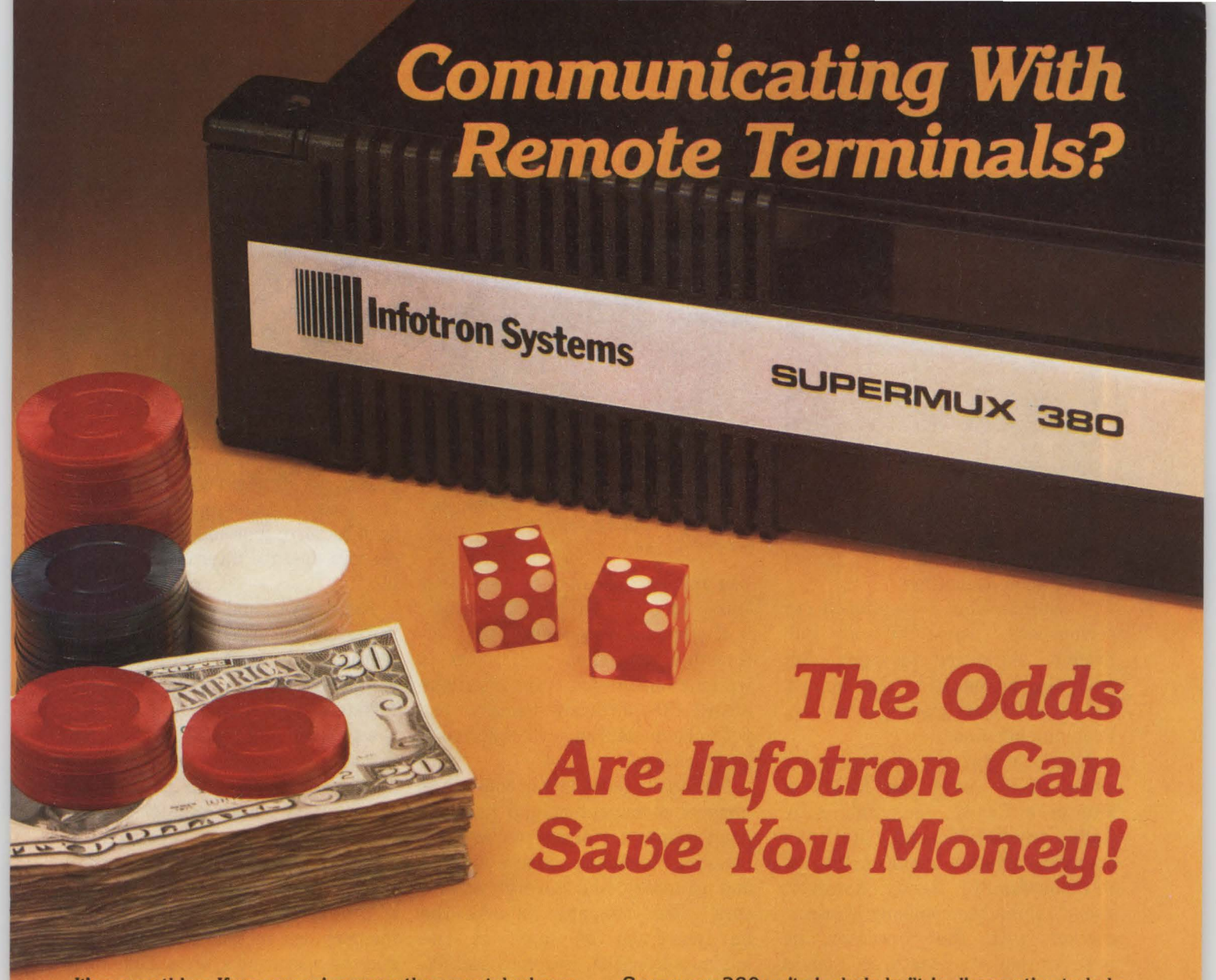
—Geoff Lewis

National plans to deliver 16032 CPU this month

National Semiconductor Corp. begins delivering its NS16000 microprocessor family this month after what some observers have called too many false starts since announcing the device nearly two years ago. However, officials at the Santa Clara, Calif., company think the 16000's hardware (16-bit data bus, 32-bit internal architecture) and broad software support are coming at the right time to pose a real threat to industry leaders Intel Corp. and Motorola, Inc.

National's vice president of marketing Joseph Van Poppellen believes the company is at the beginning of a market that will not peak until 1990. Van Poppellen thinks that leaves National plenty of opportunity to garner at least 20 percent, and possibly more than one-third, of the potential $2-billion market for 16- and 32-bit processor and peripheral hardware. Nonetheless, National must overcome what it admits is a somewhat tarnished image as a microprocessor house, an impression left by what could be

Communicating With Remote Terminals?



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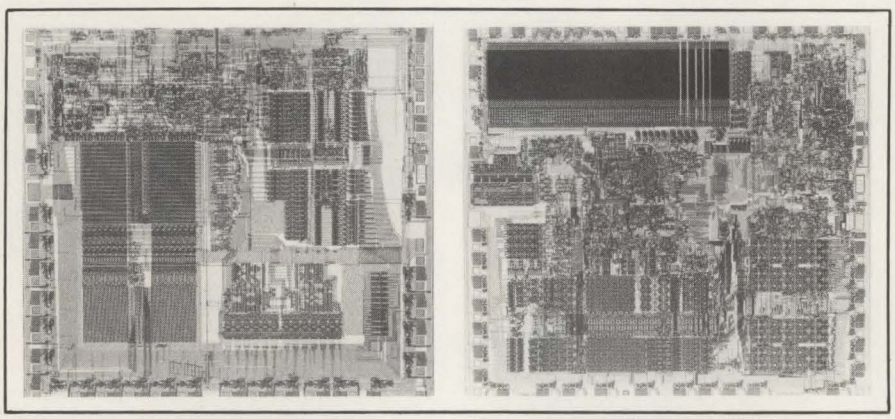

National's demand-page virtual memory *hinges on getting the 16082 memory-management chip (left) to market soon after the 16032 CPU (right) is delivered.*

looked upon as caution.

"Customers have questioned our seriousness," says Subhash Bal, product marketing manager. But with the introduction this month, Bal says, "We are making it happen. People believe us."

"National has an education job ahead of it," says Jim Ready of Hunter & Ready, Inc., Palo Alto, Calif., which will supply its VRTX operating system-in-silicon for the NS16000 family. Ready, however, doesn't think the company is late to market with the processor; he believes that some features, such as the 16000's ability to handle software components such as VRTX, put it in front of the competition. "Technically, there are no problems" with the 16000, he adds. National's toughest task, Ready feels, will be to win design-ins from Motorola's 68000, which, he says, has about a three-to-one edge over Intel's and Zilog, Inc.'s entries.

That's not happening yet, although Bal claims the 16000 is winning design-ins. "In situations where the hardware decision has yet to be made," he says, "the 16000 is the choice."

National's 16000 lineup consists of memory-management and floating-point chips; peripheral devices for handling terminals, mass storage and graphics; and several processors. The company expects the hardware to be used in the business-systems, graphics and data-communications markets and in applications requiring large amounts of memory.

Leading off will be a chip set priced at less than $200, consisting of the NS16032 CPU and NS16201 clock chip.

The NS16032 is said to be the first microprocessor with a full 32-bit internal architecture. With its 16-bit data bus and 24-bit address bus, the 16032 can handle high-level language addressing modes and instructions. Further, it supports instruction abort and retry, a capability required for virtual memory. (Motorola's 68010 will have a similar feature when it is shipped this year.) The 6-MHz processor can address as much as 16M bytes of memory. Additionally, the 16032 is built upon a pipelined architecture; four independent processors operate internally in parallel.

Key to National's NS16000 family is its demand-paged virtual-memory feature, borrowed from mainframe computers. When used with the NS16082 memory-management chip, the 16032 allows a programmer, for instance, to access the complete addressing range of the microprocessor. This means that a programmer does not need to know where in memory (or disk storage) program data are located. Anytime a program accesses data not in memory, the instruction is aborted, and the operating system exchanges the blocks needed with the least recently used data in physical memory. The instruction is then re-executed. Data are moved in 512-byte increments and are compressed or replaced according to the operating-system setup.

Demand-page virtual memory depends on National's delivering the NS16082 MMU on schedule, says Bal. Both the MMU and the NS16081 floating-point processor are due during the third quarter. "The MMU has to happen," says Bal, "to make the strategy work. It gives the processor power the others don't have."

There are 19 chips in the NS16000 product line. National and its second-sources, Fairchild Camera and Instrument Corp., Sunnyvale, Calif., Synertek, Inc., Santa Clara, Calif., and Eurotechnique (of which

NATIONAL'S 16032 AND THE COMPETITION

	National 16032	Motorola 68000	Intel 286	Zilog Z8003
Speed	6 MHz at introduction (10 MHz shortly thereafter)	10 MHz (samples in two years)	8 MHz (HMOS-III will be 10 MHz)	10 MHz
Virtual memory	yes	no (on 68010)	yes	yes
Architecture	full 32-bit	partial 32-bit	16-bit	16-bit
Address range (bytes)	uniform 16M	uniform 16M	16M	8M
Pipelining	highly pipelined	some pipelining	highly pipelined	pipelined
Data bus	multiplexed address/data bus	unmultiplexed, yet slower	unmultiplexed	multiplexed
Packaging	48-pin	64-pin	68-pin chip carrier	48-pin

Sources: National Semiconductor (for 16032, 68000, 286), Zilog (for Z8003)

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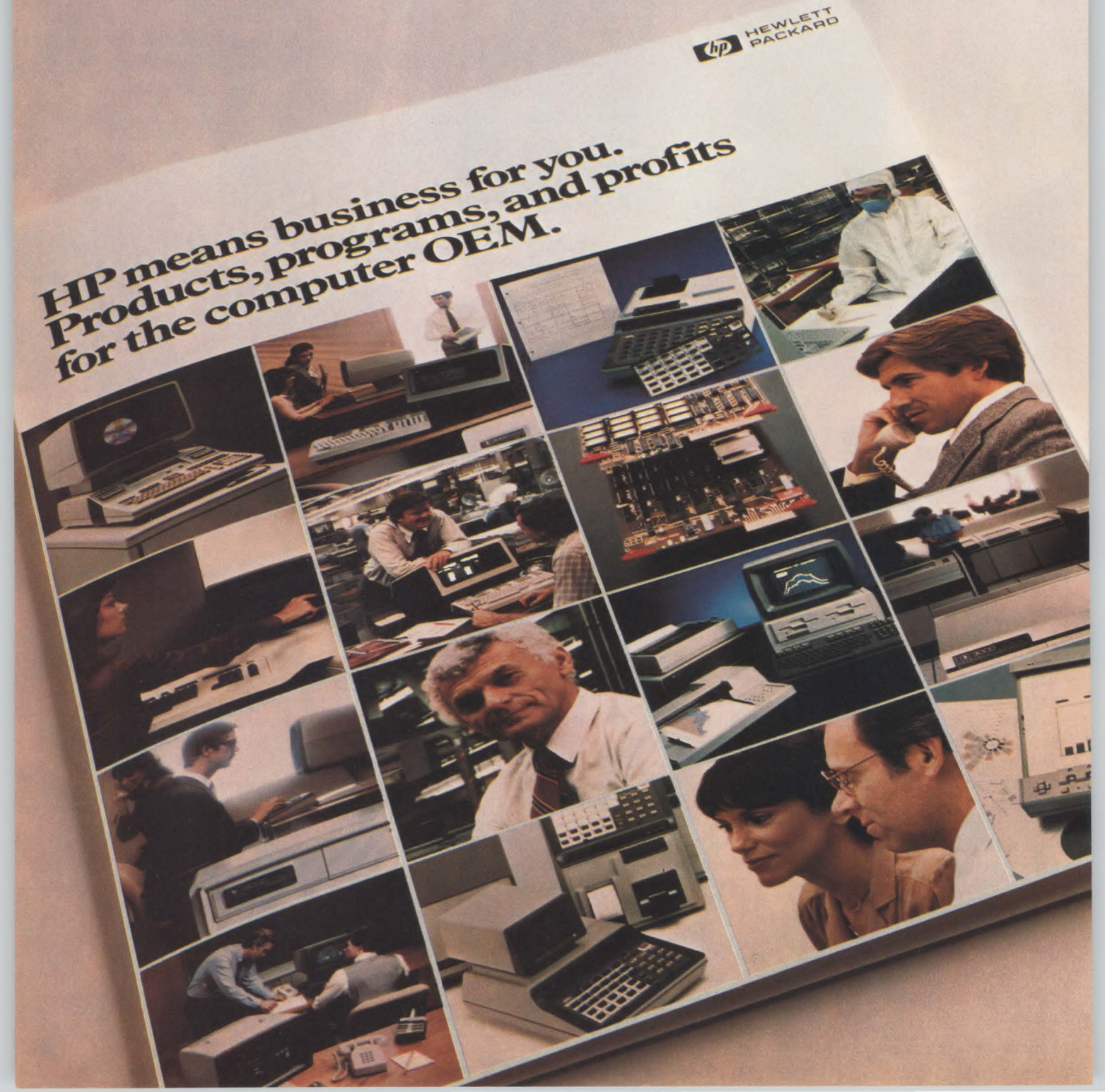

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National owns 49 percent), France, are working closely on developing the family. All three partners will build the processors, says Bal, but the peripheral devices will be done independently, though the partners will discuss product plans. "We don't want to duplicate our efforts," he says.

National is using its XMOS proprietary scaled N-channel silicon-gate MOS process to build the processors and some of the peripheral devices. Fairchild and Eurotechnique will use their own processes, but all will be compatible, Bal says.

Future NS16000 parts, however, will be manufactured using CMOS, the process generally regarded as the technology of choice for future VLSI-circuit design. National, which is said to have considerable experience in CMOS (its NSC800 8-bit CMOS microprocessor has been in production for more than a year), will begin producing CMOS NS16000 parts by 1984, Bal says.

Extensive software support for the product line is coming from National and an impressive list of third-party sources. For its part, National will provide several languages for cross-software and resident-software development. Among these languages are Pascal, an assembler, C and FORTRAN. The company will also offer UNIX (version 7) and a proprietary operating system called BLMX/16. A System III UNIX is also planned, Bal says.

Besides Hunter & Ready, third-party vendors designing software for the NS16000 include Translation Systems, Inc., Allston, Mass., which will introduce C, Pascal, FORTRAN, RPG-II, BASIC, PL/1 and PL/M-86 by year-end. COBOL is planned for mid-1983. Whitesmith's, Ltd., New York, plans to supply a C compiler and Pascal, both of which are expected by early next year.

Digital Research, Inc., says it will write a version of its recently introduced concurrent CP/M for the 16016, a version of the 16032 that is compatible with the 8080 instruction set yet retains the 16032's full 32-bit architecture. Officials at the Pacific Grove, Calif., firm indicate it may develop an operating system specifically for the NS16000 family.

—Larry Lettieri

NS16000 product family and availability

CPUs		Available
16032	16-bit data bus, 32-bit architecture	now
16016	8080-code-compatible, 32-bit architecture	2Q83
16008	8-bit data bus, 32-bit architecture	4Q82
32032	32-bit data bus, architecture	2Q83
16010	Single-chip 16032	1Q84
16C032	CMOS 16032	1Q84
32132	32-bit CMOS	1985
Slave Processors		
16082	MMU	3Q82
16081	FPU	4Q82
System peripherals		
16201	Clock	now
8400	ECC	now
8409	RAM controller	now
16202	Interrupt	4Q82
16203	DMA	2Q83
Advanced peripheral controllers		
	Terminal management processor	2Q83
164xx	Local-area network	3Q83
164yy	Hard-disk controller	3Q83
16456	Protocol communications	1Q83
16425	X.25 communications	4Q83
16413	CRT	4Q83
16488	GPIB	4Q83
16105	I/O	3Q84
16802	Local-area network	3Q84
16204	Bus arbiter	3Q84
	Graphics	1985
	User-definable peripherals	1985

Source: National Semiconductor

Wang launches personal computer, pins hopes on VS

Wang Laboratories, Inc., acted in late May to bolster what it considers its leadership position in office computing, adding a pair of low-end models to its VS line of minicomputers and making its expected plunge into the personal-computing market.

Strategically, the three systems can be regarded as both offensive and defensive maneuvers, says senior vice president of R&D operations Frederick A. Wang. The personal computer, which Wang officials characterize as "complementary" to the company's existing word-processing and computing products, tends to fall into the defensive category. With prices ranging from $3395 to $8945, the

Wang's Professional Computer *is available in a range of packaged configurations ranging in price from $3395 to $8945.*

Wang Professional Computer is aimed at professional and managerial workers in major accounts—especially Wang's—and is a response in part to competing products from IBM Corp., Digital Equipment Corp. and Xerox Corp.

On the offensive, the company has lowered the price of admission to its VS minicomputer line with two systems, the smaller of which can be configured for as little as $33,000. While the personal computer might attract more public attention, it is the expanded VS line that the company is counting on to produce real revenue growth, Wang explains.

The new systems, the VS 25 and 45, are based on a proprietary Wang VLSI 16-bit processor design, but are compatible with the 32-bit VS operating system and with existing VS applications.

More significantly, they are the precursors of Wang's plan to migrate users of its aging 2200 line of small-business computers to the VS line. Charlie Johnson, VS product manager, says the VS 25 (which sells for about $33,000 in a small configuration) will "skim" the high end of the current 2200 line, the multi-user MVP. He expects the system to appeal to MVP users running COBOL and expects the migration to begin once the appropriate bridging software and utilities are available. Those items, along with a VS model that can be configured in a $12,000 to $15,000 system, are scheduled for release within a year, he says.

Wang expects the low-end VS products to strengthen the company's sales in the small-business systems/office data-processing markets in which the 2200's annual growth rate recently has slipped to 10 percent—a lackluster performance in a company growing at close to 40 percent annually. In addition, the company is hoping the 25 and 45 will prove attractive to IBM System 3, 32, 34 and 38 users. It may also be marketed against the IBM 8100 distributed-processing system, Wang says.

Johnson says some of Wang's optimism for the low-end VS line has already proved justifiable: as of the official introduction, there were orders for 1000 units on the books. This compares with a total VS series installed base of 5000 CPUs since the line was introduced in 1977.

The 25 and 45 share a CPU, but the 25 is limited to a maximum of 10 work stations, while the 45 supports as many as 20. The 25 has one or two 34M-byte Quantum fixed-disk drives within its 36-in.-high cabinet, while the 45 supports as many as four external disk drives, each with capacities of 30M to 640M bytes. The 25 is available with 256K to 512K bytes of 64K RAM, and the 45 has as much as 1M byte. The 25 can be field upgraded to a 45 for $3000. Add-in memory is $2000 per megabyte.

Although the processor accommodates only 16-bit words, 32-bit words can be split, Johnson says, adding that all instructions and data paths are 32 bit. To bring the throughput up to a speed he describes as 20 percent faster than a VS 890, the 25/45 CPU has a separate Intel 8086-based bus processor, which has its own 64K bytes of RAM and a special operating system to manage disk access and all other I/O functions. The bus processor memory includes 2K bytes of battery-powered RAM for diagnostics, error logging and other critical functions.

The basic VS 25 includes the CPU, 256K bytes of main memory, the bus processor, a 1.2M-byte floppy, a 16-port serial device controller, a disk controller and a 34M-byte drive. It is priced at $25,000, including the VS operating system and one compiler. The 45's basic model is a 256K-byte system with the floppy-disk drives and a 32-port serial device controller. It is priced at $21,000 without an internal disk drive and $28,000 with the 34M-byte drive and the VS operating system with one compiler.

Both systems have nine slots in their chassis, five of which have standard features on the base 25 and four of which come filled on the 45 (in which the disk controller is not included). The 25 is scheduled to be shipped in July, and the 45 will follow in September.

For the 2200 line, the company has added Option-W, which is priced at $1000 and enables the stand-alone SVP 2200 to support a second work

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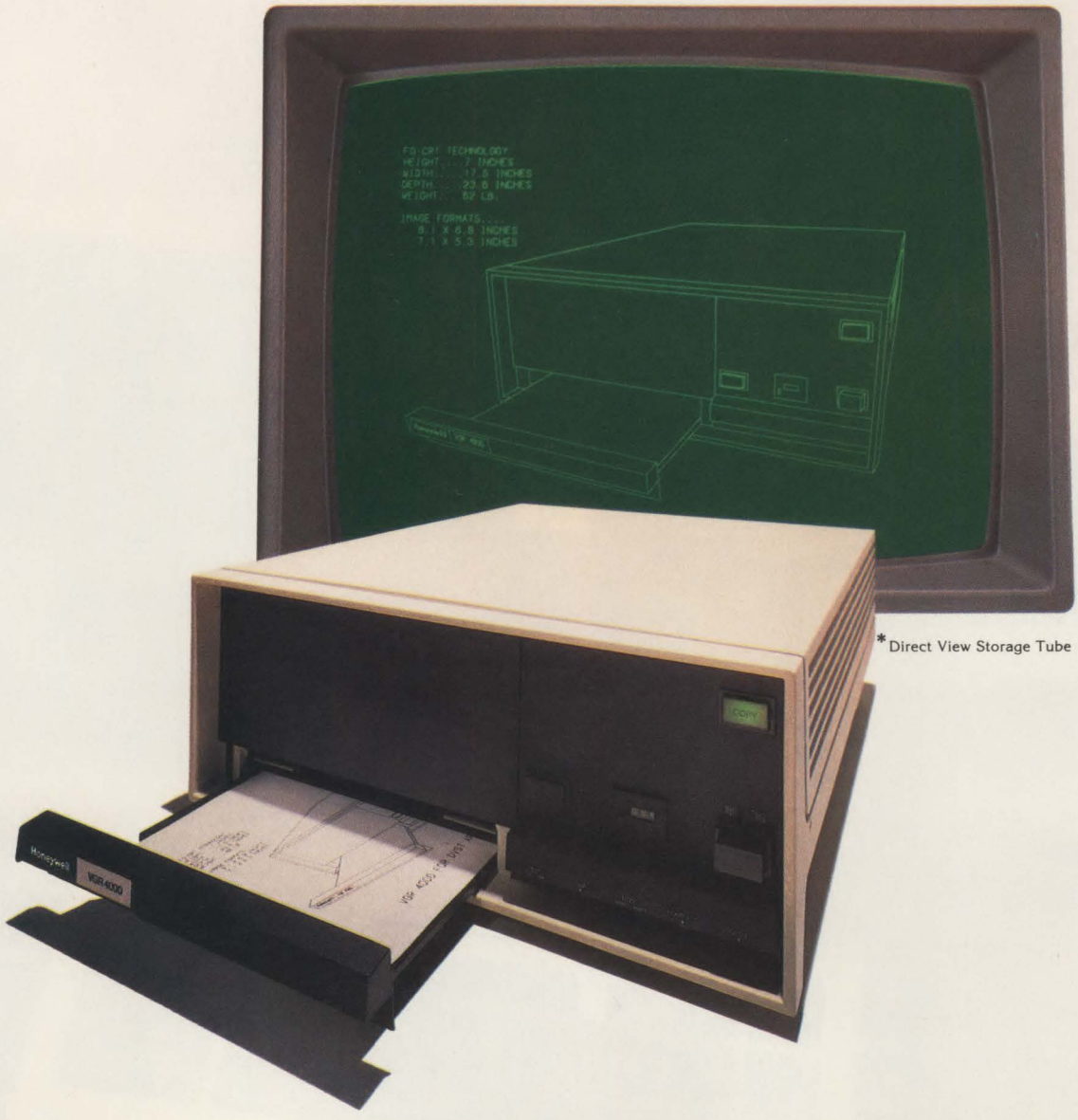

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station. In addition, the company added a new display terminal to the series priced at $2200.

Another option has been added for LVPs (low-end multi-user system) and MVPs and supports four additional local or remote terminals, a time-of-day clock, an asynchronous communications controller with software-selectable baud rates and software-driven port selection. That option, 2236MXE, will be available this month for $1400.

The Wang Professional Computer, as the company's personal-computer offering is dubbed, is available in various packaged configurations ranging in price from $3395 to $8945, but it can also be custom-configured by users. The systems are packaged in a 6.5- × 14.5- × 22.6-in. cabinet with a separate keyboard and display and—much as DEC did with its personal computer—the system unit can be removed from the work surface and clamped onto the edge of the desk. However, Wang also provides an option that resembles a draftsman's lamp in the way it suspends the 12-in. display over the desk. Bundled into the price of the system unit is the Microsoft MS-DOS operating system and BASIC-86. Wang also offers a CP/M-80 soft card option and two software packages: Multiplan and a version of Wang word processing.

The system is available with 128K to 640K bytes of RAM, one or two 320K minifloppy drives, a 5¼-in. Winchester drive storing 5M bytes and an interface for emulating Wang VS, OIS, 2200 or Alliance terminals. Printer options include a 20-cps Wang daisy-wheel printer priced at $2695 or an 80-cps Epson printer, pricing for which is not set.

The system unit with 128K of memory, a single floppy keyboard and no display lists for $2695, and an interface for a black-and-white or a color television attachment is optional. The basic packaged configuration, the PC 002, includes a character display adapter and the Wang display for $3395. The PC 003 adds a second disk to the 002 as well as PC-Multiplan, a spread-sheet analysis program. PC 004 adds a character and graphics display adapter to the 003 and includes PC word processing, a version of Wang's word-processing software geared to professional users. The 005 version lists for $5095. The high-end model has 256K bytes of memory, the Winchester drive and both of the 004 packages. It lists for $8945.

Wang's VS 45 minicomputer *is targeted for small- or medium-sized companies, department-level processing and remote facilities.*

Wang officials say third-party distribution plans are not in place, but that dealer, retail and OEM agreements will be concluded by this fall when shipments are expected to begin. John F. Cunningham, executive vice president of field operations, expects only about one-third of all Wang personal-computer sales to go through such channels, although the year-old program to develop third-party outlets is "being beefed up." That program was launched for the Wangwriter entry-level word processor, which is now sold through dealers and retailers such as Sears and ComputerLand. He says volumes for the personal computer should exceed those of Wangwriter, which was delayed in initial shipments. For fiscal year 1982 (ended June 30, 1982) Wangwriter sales were expected to hit only 7000 units—30 percent less than Cunningham's earlier projections.

Wang's thrust in entering the personal-computer market is to address its own customer base and larger customers seeking personal computers that will tie into corporate data-processing and telecommunications networks. "We would like to sell to existing accounts and to customers who are going to grow. We don't care about onesy-twosies," explains president An Wang.

—Geoff Lewis

Sytek ties IBM CPUs to minis, micros via broadband

In a move that could make multi-channel 300-MHz broadband technology more appealing to designers of local-area networks, Sytek, Inc., Sunnyvale, Calif., has developed an interface option for its line of 2M-bit-per-sec.-per-channel high-speed packet communications processors. Called the U02 option, the interface permits remote minicomputers and microcomputers and peripherals from other vendors to be tied via 75-ohm modulated broadband coaxial-cable television (CATV) links to the byte-multiplexer, block mux or selector channels on mainframe processors operating under IBM Corp.'s Systems Network Architecture.

The new hardware operates with Sytek's line of LocalNet System 40 packet communications processors announced last September. It incorporates its own CPU and

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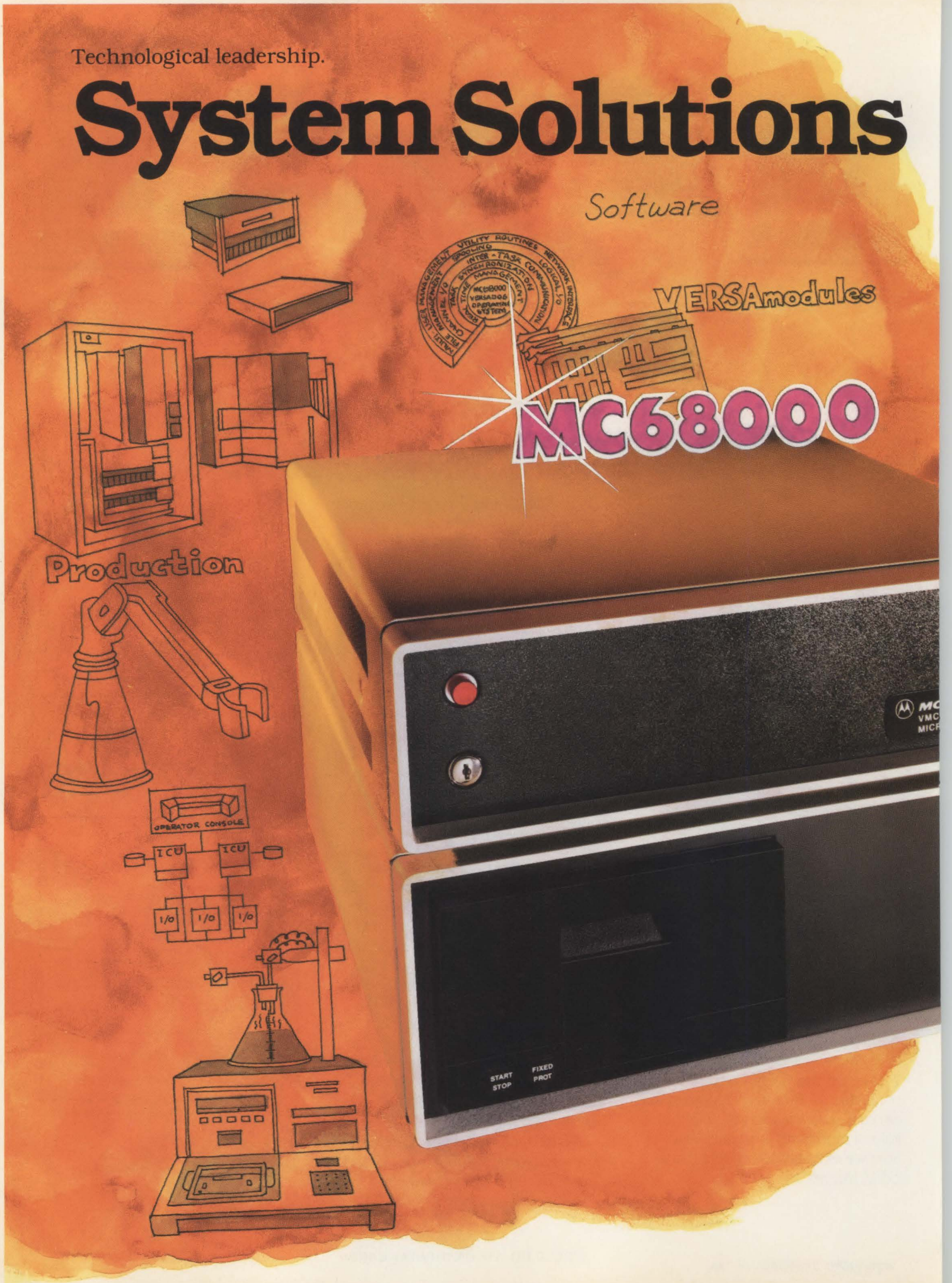

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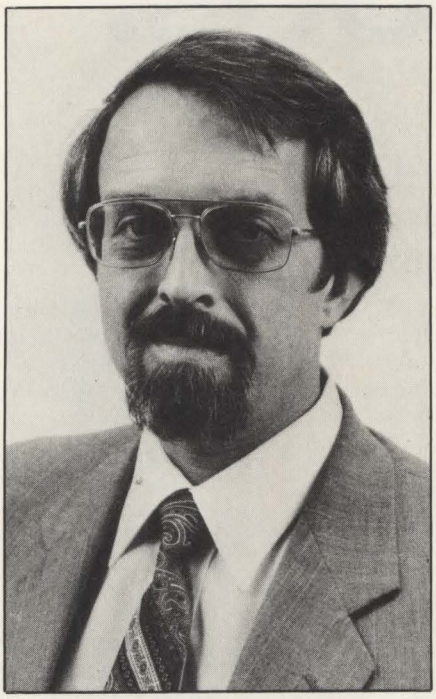
memory, as well as the bus control and status circuits needed to map all IBM I/O channel commands onto the broadband network. The option emulates an IBM 3274—the local control unit for the mainframe vendor's 3270 information display system.

System 40 processors with the U01 option are designed for broadband LANs based on Digital Equipment Corp. 32-bit VAX superminis running under the VMS operating system. They have already been installed at 12 sites, and 100 more units are on order. Three System 40 processors with the U02 option will be installed at beta test sites—a bank, a university and an aerospace firm—this year.

It was inevitable that someone would offer hardware allowing IBM mainframes to be interfaced to broadband LANs, says Sytek marketing director Jim Hunter. The reason: "Sixty percent of the dollars spent in this country for commercial data-processing equipment is spent on IBM hardware," he explains, "But on the factory floor, in graphics systems, in office automation and in computer-aided design and manufacturing applications, other companies do things better." Until now, however, the link between systems driven by IBM mainframes and application-oriented LANs based on processors from other vendors has been the 9600-bps telephone circuit, he says, "and that's neither a very fast nor a very cost-effective way to make large-scale data transfers."

Sytek's decision to tie broadband cable networks to IBM processors may also cast a new perspective on much of the recent controversy that has surfaced between broadband proponents and those favoring lower capacity, lower speed baseband links, especially as it relates to office-automation applications, Hunter adds.

As Hunter sees it, because of the geographic span and low interconnection cost, broadband will serve as a network backbone, with baseband links connected to the central trunk via gateway circuits and functioning as localized branch networks supporting office automation and other applications.



Sytek's Jim Hunter: *"Sixty percent of the dollars spent in this country for commercial data-processing equipment is spent on IBM hardware. But on the factory floor, in graphics systems, in office automation and in CAD/CAM applications, other companies do things better."*

Ken Bosomworth, a Norwalk, Conn., industry analyst and president of International Resource Development, Inc., agrees with Hunter's assessment of the relationship between broadband and baseband, especially as it relates to the office of the future. "There is no market for LANs per se," he says, "so what we're really talking about is the hardware that is attached to them." As a result, he goes on, the whole question of LANs for office-automation applications revolves around the question of whether or not work stations, file servers and associated hardware will become commonplace.

At the same time, however, he questions the need to interconnect office-automation and EDP systems. "There is a very serious question in my mind as to whether or not you need to communicate from a central IBM host to an LAN designed for these applications," he says. "In many cases, it may be convenient to do so, but for the most part, there will be little requirement to transfer large blocks of data from a central data bank to a work station." If the requirement does demand this, CATV may be overkill, and a telephone circuit may be more than adequate, he maintains.

Steve Randesi, president of Communications Solutions, Inc., Cupertino, Calif., and publisher of the *SNA Perspective* newsletter, concedes there are some performance limitations to baseband circuits, but, like Bosomworth, feels that, "For many applications, it [baseband] will be more than sufficient."

Randesi notes that the first packet-switched LAN to be supported by IBM will probably operate at baseband frequencies. This network has not been announced but IBM presented four technical papers describing a baseband networking concept at a February meeting of the IEEE 802 local-area networking committee.

If such an announcement is made by IBM, even more fuel could be added to the LAN controversy. According to a number of reports, access to IBM's LAN will be via a token method that uses an algorithm to insure that every terminal on the network gets access to the line within a guaranteed wait time. Xerox, on the other hand, has cast its lot with the contention method, under which access to the line is essentially on a first-come, first-served basis.

Sytek's Hunter does not feel that the possibility of an IBM baseband entry will lessen the impact of either broadband technology or his company's plans to offer hardware that will interface broadband LANs

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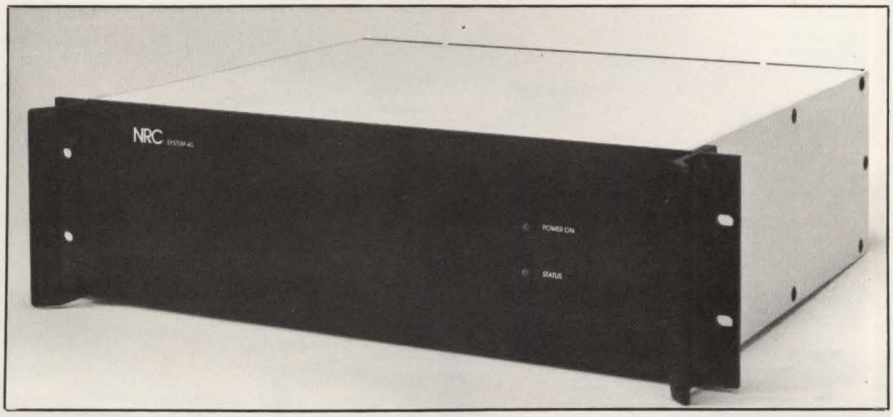
to IBM mainframes, however. "With a network based on a broadband spine and baseband branches, the systems designer can handle whatever type of baseband access he wants simply by separating the channel frequencies in the broadband line," he explains. As a result, he says, one channel could be used to move data from baseband networks using contention, while another channel on the same broadband cable could be used for baseband transmission using the token method.

The key issue of the coming years will not be which technology will predominate, but rather the interconnection of networks, Hunter says. "The main highway in the form of a broadband link has been available for some time," he says. "The big issue up to now has been the cloverleafs, and we think we've solved that problem."

At the same time, Sytek announced an IBM Binary Synchronous Communications (bisynch) protocol option for its line of LocalNet 20/100 packet communications units. Designated option P02, it allows users to transfer data from an IBM 3705 front-end processor directly to a broadband cable, replacing point-to-point modems in the process. The option will support IBM's 2770, 2780 and 3780 remote batch terminals, and its 3270 information display system.



Announced last September, Sytek's LocalNet System 40 packet communications processor *is now available with the bus control and status circuits needed to tie IBM mainframe I/O channels to 75-ohm broadband cable TV networks. The device emulates the 3274 control unit used with IBM's 3270 series intelligent display system.*

Price for the LocalNet 40 system is $8500 in single-unit quantities. Price for the U02 option is $32,000, and price for the U01 option for VAX superminis is $1500 in single-unit quantities. The LocalNet 20/100 with bisynchronous option is priced at $1400. —*John Trifari*

Intel adds UNIX-like machines to systems family

Intel Corp.'s growth as a systems supplier has continued strongly since announcing its first system-level product, the 86/330, last November (MMS, November, 1981, p. 42). Within months, database and transaction-processing systems from the company's Phoenix-Ariz.-based Commercial Microsystems Operation followed. Now Intel's Hillsboro, Ore., OEM microcomputer systems division is adding four new products to the 86/330 family, including two machines that run XENIX, Microsoft, Inc.'s implementation of UNIX.

Called the 86/330X and 86/380X, the XENIX systems are Intel's first entries into the interactive, multiuser UNIX market, say company officials. Competition for the OEM hardware is expected to come from Plexus Computers, Inc., and Zilog, Inc., both of which introduced UNIX-based 16-bit machines during the past year.

Both XENIX machines are built around Intel's iAPX 86/30 8-MHz 8086 single-board computer, which provides speed higher than that of the entry-level 86/330, which is powered by a 5-MHz processor. The 86/380X provides system expansion via a dual-chassis configuration, while the 86/330X is available as a desk-top system or in a single 19-in. chassis.

Memory management and protection, required in all UNIX-based systems, are provided by Intel's iSBX 309 board, also just announced. The company says the board handles as many as seven users through an on-board process map cache memory. The cache, plus an algorithm built into XENIX, are said to help reduce swapping in the memory. The operating system also loads user programs into noncontiguous 2K-byte memory areas.

Five RS232C ports are standard on the 300X series machines. Four channels can be added via the iSXM 100 system-extension kit, which includes a 309 board, a four-channel communications board and cabling.

Intel offers C and Assembler-86 for the 86/330X and 86/380X. The firm plans to offer a BASIC interpreter and compiler, FORTRAN, COBOL and Pascal this year. Intel expects support from its independent software sources, officials add.

Two systems that run the company's iRMX 86 real-time operating system have also been introduced. One is an upgrade for the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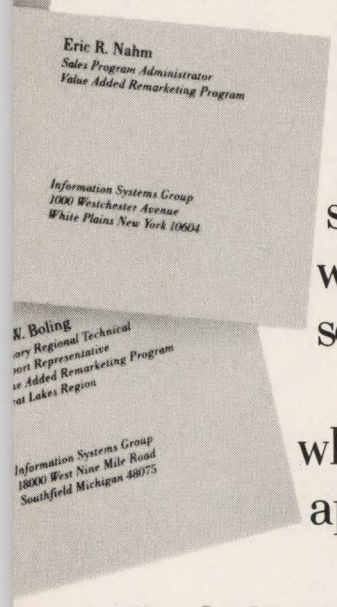

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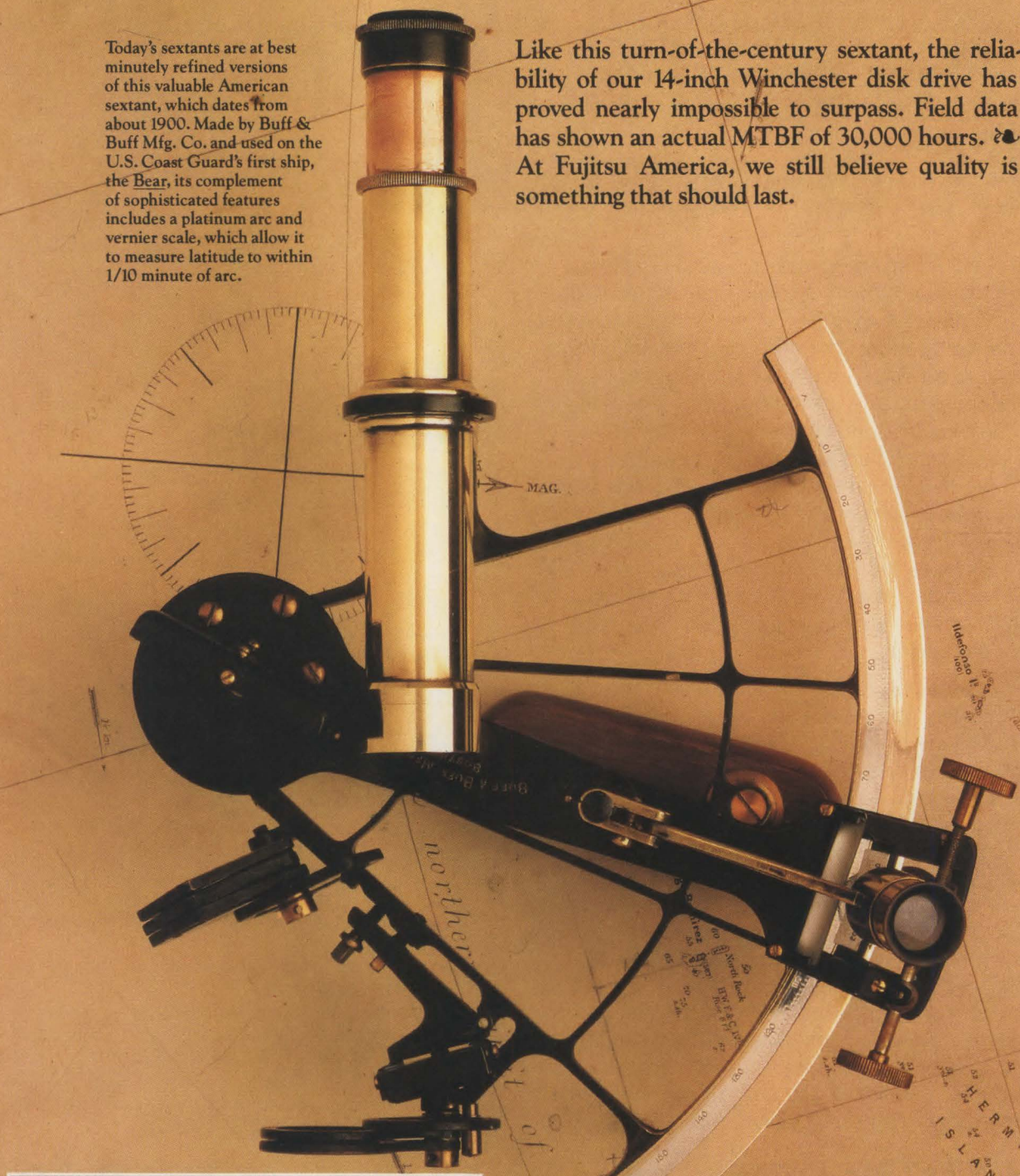

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CIRCLE NO. 54 ON INQUIRY CARD

86/330, called the 86/330A. As in the XENIX machines, the 86/330 uses an 86/30 CPU board. Memory in the 330A has been increased by 64K bytes to 384K bytes. Additionally, the new processor has two slots for system expansion, so the 86/330A can be augmented with Intel's iSBX expansion boards for applications such as graphics or data communications, the company says.

Like the XENIX-based 86/380X, the iRMX 86-based 86/380 is a two-chassis machine aimed at OEMs who need room for system growth. However, the 86/380 uses Intel's 86/20 numerical-processor board as well as the 86/30 central-processor board. Intel says the combination provides processing power greater than that of low-end minicomputers. The 11 remaining slots in the chassis are available for system expansion.

The second chassis is designed to house the system's peripherals, an 8-in. Winchester-disk drive and an 8-in. floppy-disk drive. Space is provided for one additional mass-storage device in the second 380 and 380X chassis, Intel says.

Peripheral hardware is the same in all four systems. Mass storage is provided by 35M-byte, 8-in. Winchester and 1M-byte floppy-disk drives. User memory is 384K bytes of RAM. Each system handles five users in its basic configuration.

Price in quantities of 10 for an 86/330X is $20,300, and includes the basic five-user system, XENIX and the iSXM 100 extension module to allow expansion to nine users. An iSMX board sells for $1440 in quantities of 10. The 86/330A iRMX 86 system is priced at $19,000, also in quantities of 10.

The 86/380 system is available with either iRMX 86, priced at $24,500 each for 10, or with XENIX, selling for $25,900 each for 10. Both models are equipped with two chassis. The XENIX system, however, also includes the iSBC 309 memory-management and protection board. An iSBC 309 sells for $750.

Intel plans to start deliveries of all four systems next month.

Intel also has introduced multitasking and multiprogramming capabilities into its single-user iRMX 86 operating system for 8086- and 8088-based systems. When used with either an iSBC 534 communication expansion board or an iSBC 544 intelligent communications controller, iRMX can access as many as four terminals. The multiterminal support also makes it possible to run Intel's Universal Development Interface for multiple applications.

Release 5 of iRMX 86 will be available by year-end. OEM license fees are $6000. —*Larry Lettieri*

INTEL SLASHES 8087 NUMERIC PROCESSOR PRICE

Citing tens of thousands of shipments of its 8087 numeric processor as the reason, Intel Corp., Santa Clara, Calif., cut prices more than 50 percent for the iAPX-86 and iAPX-88 systems device. Previously selling for $320 each in 1000-unit quantities, the numeric processor is now priced at $150 each for the same-sized order. Volume pricing is projected to further drop by half by 1983. "We anticipated most 8087 demand to center around low-volume, high-computational-ability areas such as robotics, navigation and industrial control," explains Jeffrey Miller, microprocessor operation marketing manager. "The 8087's popularity in high-volume applications, such as personal computers, small-business machines and graphic displays, has created a volume demand for 8087s that has significantly reduced per-unit production costs." Among the low-end system vendors that have a spot open for the 8087 are Mitsubishi, Seiko, Sirius, Altos, TAB, Systime, IBM Corp. and Compupro. The 5-MHz part has been in volume shipment since December.

Mid-range graphics CRT terminal market gets rolling

When the dust swirled by the galloping activity in low-end, limited graphics terminals and high-end, high-resolution CAD/CAM application-driven terminals settles, a mid-range graphics CRT market geared to system integrators and large end users will emerge. Three companies recently joined that segment with products priced between $10,000 and $20,000.

The trio—newcomer Florida Computer Graphics, Lexidata Corp., and Tokyo-based Nippon Computer Co., Ltd. (no relation to Nippon Electric Co.)—may address a $2-billion market by 1986 for that class of product, according to figures from FCG.

FCG, which formally opened its doors for business a little more than a year ago in Lake Mary, Fla., on paper has assembled a solid company, product and business approach. Over the past 10 months, it has built a modular graphics product called Beacon; structured its sales, marketing, administration, distribution and support groups; and put in place a relatively automated assembly operation, all in 44,000 sq. ft., says FCG president Michael R. Coffman.

Beacon is the first in a family of raster-scan, bit-mapped color graphics terminals to be released by FCG. Targeted at OEMs, system integrators and large end users, the basic system is priced at $12,950 in single units, including graphic command primitives. A configuration with a keyboard, a 128K-byte

memory, a 160K-byte graphics memory, interfaces, operating system, languages, display and disks is priced at about $17,000 to $20,000. Discounts for 100-unit quantities will exceed 31 percent.

The product includes a multiprocessor architecture. The 16-bit graphics processor is made of Advanced Micro Devices, Inc.'s 2901 bit slices with 48-bit microcode and a 200-nsec. cycle time. A Z80 used as an administrative processor commands the 2901 to perform graphics or mathematical functions. The bit-slice processor does not run general-purpose software programs. Intelligent disk controllers, DMA-channel access and other distributed processors help the Z80 to obtain high throughput. Other microprocessors are dedicated to the keyboard (the 8048-type processor) and bezel function keys.

The processors control multiple high-speed buses, so that system designers can find the most efficient way to perform a task with maximum throughput. For example, in a graphics application, the Z80 administrator passes graphics commands to the graphics processor and does general-purpose tasks. While executing CP/M application programs, the Z80 accesses its own processing memory, which can be expanded to 256K bytes of RAM and 32K bytes of ROM, and can borrow memory normally allocated to graphics. When the Z80 uses the memory-mapping functions of the terminal's FCGOS operating system, 896K bytes of RAM is available.

The 16K-byte graphics RAM is organized as 640- × 480- × 5-bit pixels, expandable to 1280 × 960 × 5, so that four 16-color images can be held in memory simultaneously. Additional graphics memory organization can be done by the Z80 when graphics are not displayed. The administrator then structures the graphics memory as 160K bytes of RAM, expandable to 640K bytes. Mixed graphics and processing memory is programmable.

The graphics terminal contains Z80A-based intelligent disk controllers. The controllers are used for look-ahead buffering, which reads additional disk sectors into the controller's memory, and for aiding the Z80 administrator by handling low-level I/O tasks. Four controllers can be daisy-chained to one RS422 port, so that 16 drives can be attached. Mass storage can include 5M-byte 5¼-in. Winchester- and 5¼-in. floppy-disk drives. An optional board for color output is available.

The terminal has seven interfaces including one parallel, one RS422 and two RS232 (one with full bit/byte protocol and one asynchronous).

The basic model screen is a 13-in. raster color display; 19-in. color and 15- or 19-in. monochromatic versions are also available. The total screen image is refreshed at 60 Hz, but that rate is augmented so that it appears to be higher than the 80- to 85-Hz threshold at which flicker is detectable, says John B. Cottrill, vice president of R&D.

The display can be divided into four variable-sized windows, which can be controlled by keyboard commands to view different parts of documents, for example.

Applications software for Beacon includes QWIKdraw and QWIKchart. The menu-driven packages do not require that a user write, test or edit a graphics program. The company supplies other software and relies on third-party software suppliers. The FCGOS operating system is compatible with CP/M 2.2, but is modified to accept interrupts and memory-management functions, explains Cottrill.

To lure OEMs, FCG includes systems engineering designs that allow for easy expansion. Graphics memory arrays on processor boards, for example, accept 16K, 64K and 256K RAM chips. When 256K chips are available in quantity, Beacon will store 16 16-color images. Another example is the DMA channel, which is extended onto each board so that fast read/write operations are available on enhanced systems.

Joel Orr, Orr Assoc., Danbury, Conn. sees the unit more in a business than a CAD/CAM graphics market. "This is not so much because of the quality of the terminal, but because leading CAD/CAM companies are looking for a less structured computer product. Most

DEC, INTEL, TEKTRONIX JOIN ON GRAPHICS STANDARDS

Digital Equipment Corp., Intel Corp. and Tektronix, Inc., together have adopted two emerging graphics standards, which they plan to incorporate into future products. The companies claim no standardized methods exist for the creation and transmission of computer graphics images, which results in inefficiencies, particularly in the portability of graphics application software. The companies will encourage other corporations and organizations to use these graphics standards. The first of the two proposed standards is the North American Presentation Level Protocol Syntax (NAPLPS), developed by the Canadian Department of Communication. NAPLPS is a communications protocol for graphics information transmission. This prosposal is considered for adoption by the ANSI Committee X3L2, Character Sets and Coding. The Virtual Device Interface (VDI), the second proposed standard, is developed by the ANSI Technical Committee X3H3, Computer Graphics Programming Languages. The VDI aims to provide standardized access to graphics functions to improve portability of software among computer systems and graphics devices. The VDI can be implemented in software or hardware and provides a device-independent way for system implementors to access a wide range of graphics devices.

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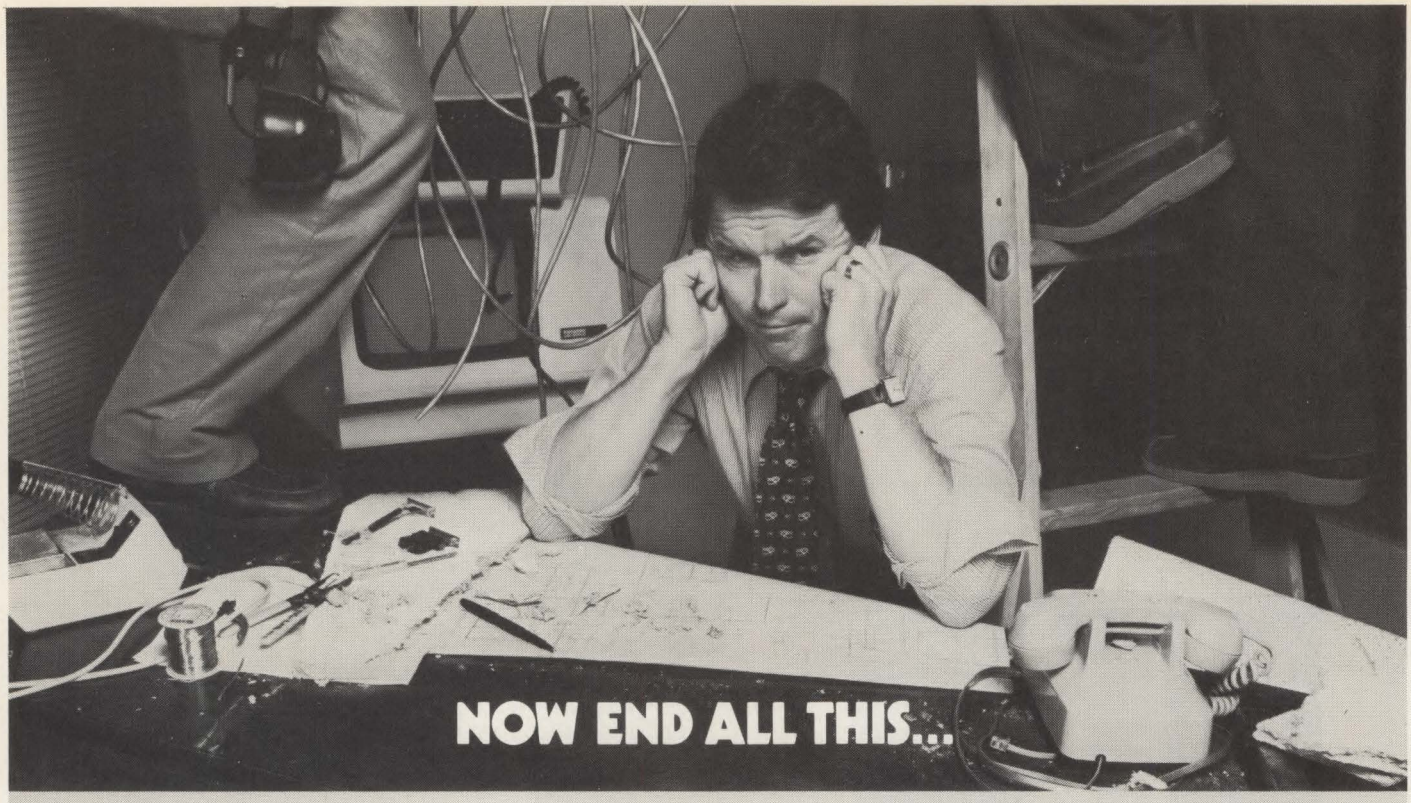

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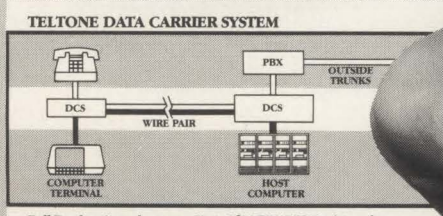

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CIRCLE NO. 118 ON INQUIRY CARD

buy a stripped-down tube." Cottrill notes, Beacon does some CAD applications, such as drafting and schematics.

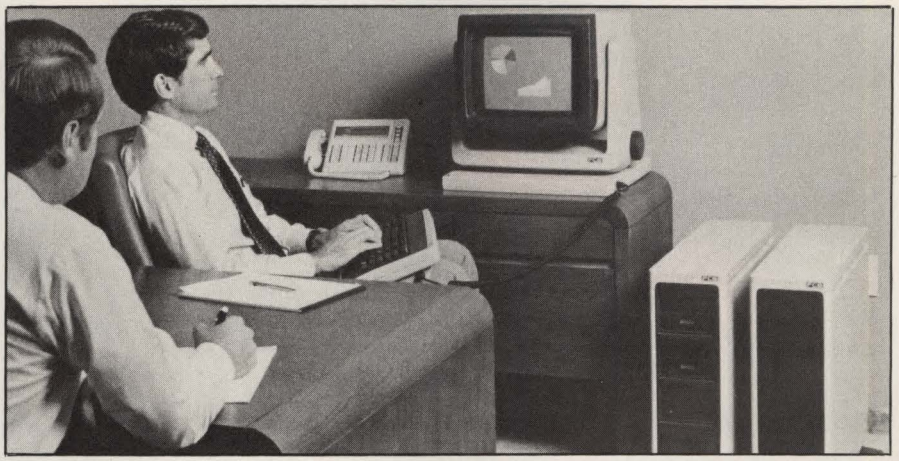
Looking more to the CAD/CAM market is Lexidata Corp., Billerica, Mass. The company recently introduced the System 2000 family of intelligent raster terminals. The first family member, the model 2400, is a black-and-white terminal that has 1280 × 1024 resolution graphics and a 50/60-Hz refresh rate. It is based on the Motorola MC68000 microprocessor, and has a single-board VDT memory.

A basic configuration consists of an electronics bay with the MC68000 (64K bytes of ROM, 32K or 128K bytes of RAM), five processor option slots, two RS232 interface ports, a 19-in. black-and-white monitor and a detachable 85-key ASCII keyboard with 12 user-definable keys and an integral joystick. Single-unit prices for the 2400 begin at $11,000, and 200-unit quantities are priced at about $7100 each.

The 2400 is designed to be expanded by OEMs. Serial ports, peripheral storage devices, RAM and custom interfaces can be added in the five option slots. An 11- × 11-in. data tablet is optional.

Software for the product includes programs for chained vectors, circle and area flood graphics and multiple character sizes. Packages include Tektronix 4014-compatible graphics, text, cursor and cursor and tablet input; and Lexidata firmware with graphics-control functions such as intensity and text style. The 2400 supports Lexidata's raster graphics protocol, which uses an English command structure, and a Tektronix Plot-10-based protocol, which includes absolute vectors, point and incremental plot modes and dashed vectors.

The display can be programmed into a four-way split screen, with one work space for pan and zoom, one for graphics and text menus, one for single-line scroll and one for logging error messages or annotating keyboard functions. Each adjustable work space is configured with a graphics and text cursor.



One of the newest entrants *in the mid-range graphics terminal market is the Florida Computer Graphics Beacon. The product is built modularly for expansion and integrates data-processing, word-processing and data-communications functions with graphics.*

The low-end 2000 family is a mid-range product, says David A. Luther, industry marketing manager for Lexidata. He targets the CAD/CAM, graphic arts, imaging, process-control and simulation markets for the product. Sales are aimed at OEMs, such as Calma Co., Prime Computer, Inc., and government contractors; third-party software houses; service bureaus; and start-up companies.

A typical OEM-configured system includes a host minicomputer, systems software, applications software, communications and a Lexidata display. While OEMs may want to add software or special interfaces, start-up companies may want to offer a totally configured system for less than $100,000.

The product's raster memory is part of the MC68000 address space, so separate address registers and counters are not needed. Firmware ROM is written in high-level languages for faster and less error-prone code. The product includes 64K RAM chips in the program memory.

A Tektronix video hard copy unit is available for the product, which later will include a gray scale. Future 2000 family members are medium- and high-resolution color displays with programmable color images.

Another contender hitting the low-end, mid-range graphics terminal market is Nippon Computer. The NJC-I1402 raster-scan graphics terminal, priced at $9950 in single units, will be sold through OEMs and distributors. The intelligent terminal, targeted at CAD/CAM applications and for use as a stand-alone word processor, is pegged as a stand-alone graphics computer that includes dual-sided, double-density, 8-in., slimline floppy-disk drives totaling 2.4M bytes of storage. Based on a Z80A microprocessor, it also includes a microprocessor-based, high-speed, 8-bit processing unit.

The 14-in. green phosphor raster display has an 804- × 960-dot resolution. The product had an RS232C interface. Standard user memory is 64K bytes, and graphics memory with 64K-bit dynamic RAMs is 274K bytes. As a graphics terminal, the NJC-I1402 uses Tektronix Plot 10 software. Software includes the NDOS operating system.

First shipments of the product were scheduled for mid-May.

—L. Valigra

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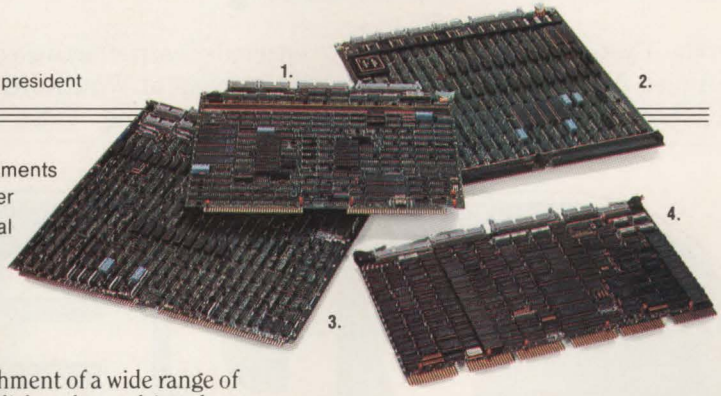

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CIRCLE NO. 106 ON INQUIRY CARD

VCR backup is cost-effective, but lacks credibility

Corvus Systems Inc., San Jose, and Alpha Microsystems, Irvine, Calif., have a monopoly on a reportedly cost-effective solution to the problem of Winchester backup: use of a home video cassette recorder. The method's advantages include a capacity of more than 100M bytes per tape, low media cost and data integrity (through cyclic-redundancy-checking error correction and redundant-recording techniques) that equals floppy-disk drive performance. But despite those advantages, and the enthusiastic customer response Corvus and Alpha Micro claim for VCR backup, industry analysts do not expect the technique to win wide acceptance.

Alpha Micro's director of future systems development, Robert Currier, says part of the problem is the emphasis on the speed of such alternatives as streaming-tape backup. "True, VCR backup is much slower. But rather than speed, we emphasize convenience," he says. "Using our AM-610 VCR controller board, the time-of-day clock incorporated into our system software and any programmable VCR, backup can be accomplished in the middle of the night without operator intervention."

Currier says Alpha Micro's ultimate customer base of small-business end users are happy with the ease and reliability of VCR backup, but the biggest selling point is its cost-effectiveness. "A streaming-tape drive with controller costs in the neighborhood of $2000 in single-unit quantities," he says. "And our VCR controller board with an ordinary VCR costs only slightly less. But the real savings comes in media. You can get 20M bytes on a $35 cartridge, so media for 100M bytes costs $165. Compare that to 100M bytes on a $12 video tape."

Bill Lanfri, district manager for Corvus, lists the same advantages and liabilities for the Corvus Mirror. "And the advantages win," he says. "Over half our Winchester systems are shipped with the Mirror controller board, and more are added later. We've had no problems with data reliability. The system writes each piece of data four times. Yet backup of our

Robert Currier, *Alpha Micro's director of future systems development: "True, VCR backup is much slower, but we emphasize convenience."*

5M-byte Winchester takes only about 11 min."

But Ray Freeman Jr., president of Santa Barbara, Calif., consulting firm Freeman Associates and author of *Resolving the Disk Backup Dilemma*, discounts the chances of VCR backup's making inroads into the OEM backup market. "VCRs weren't designed for recording digital data," says Freeman, "and the redundant recording techniques necessary for data integrity make them unacceptably slow for anyone other than the hobbyist or the owner of a small-business system who wants to use the VCR for other purposes."

Also a factor, Freeman says, is that a consumer product for entertainment simply doesn't have credibility in a computer environment, a sentiment that Alpha Micro's Currier echoes. "A computer person used to 6250-bpi tape drives looks askance at a VCR," he admits.

Andy Roman, an industry consultant based in Newark, Calif., agrees. "Besides," he says, "computer-service organizations are not equipped to deal with VCRs. And even though there are cost advantages, VCR backup won't take off without marketing. And the VCR manufacturers have no active program."

Perhaps the final comment on VCR backup's fate in the OEM market is the demise of the only company yet to offer an OEM VCR-backup subsystem, Burlington, Mass.-based Pixel Corp.

Yet Alpha Micro and Corvus say they will continue to offer their VCR controllers, and Alpha Micro's Currier says he'll even lend technical assistance to any company interested in implementing such a board. "The more companies the better," says Currier. "As I see it, the only thing VCR backup lacks is credibility." —*Kevin Strehlo*

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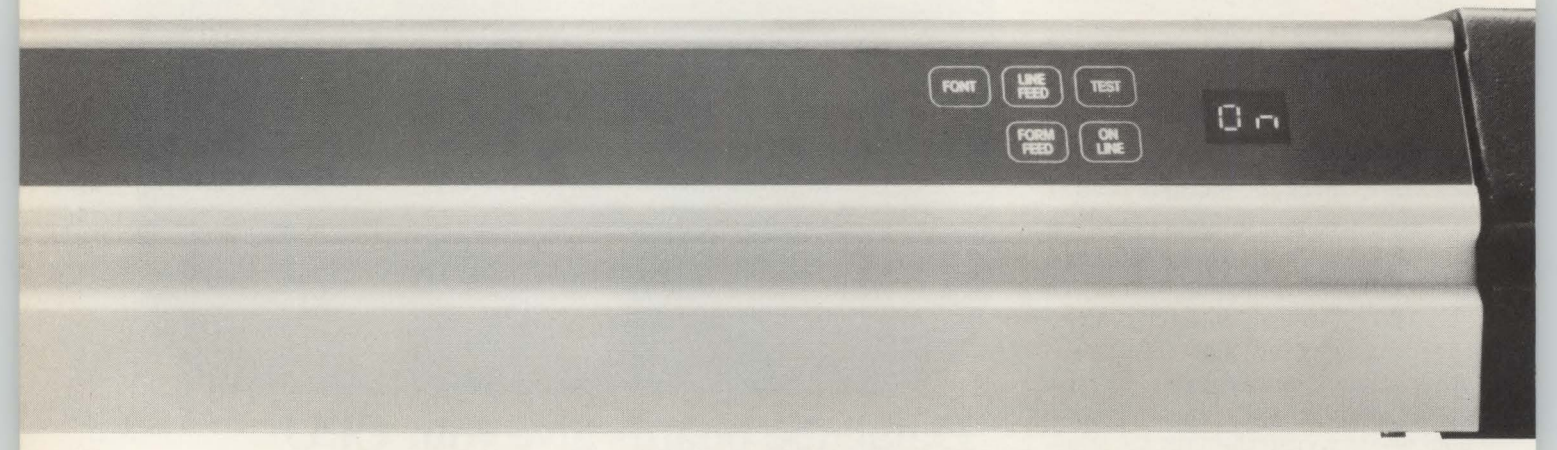

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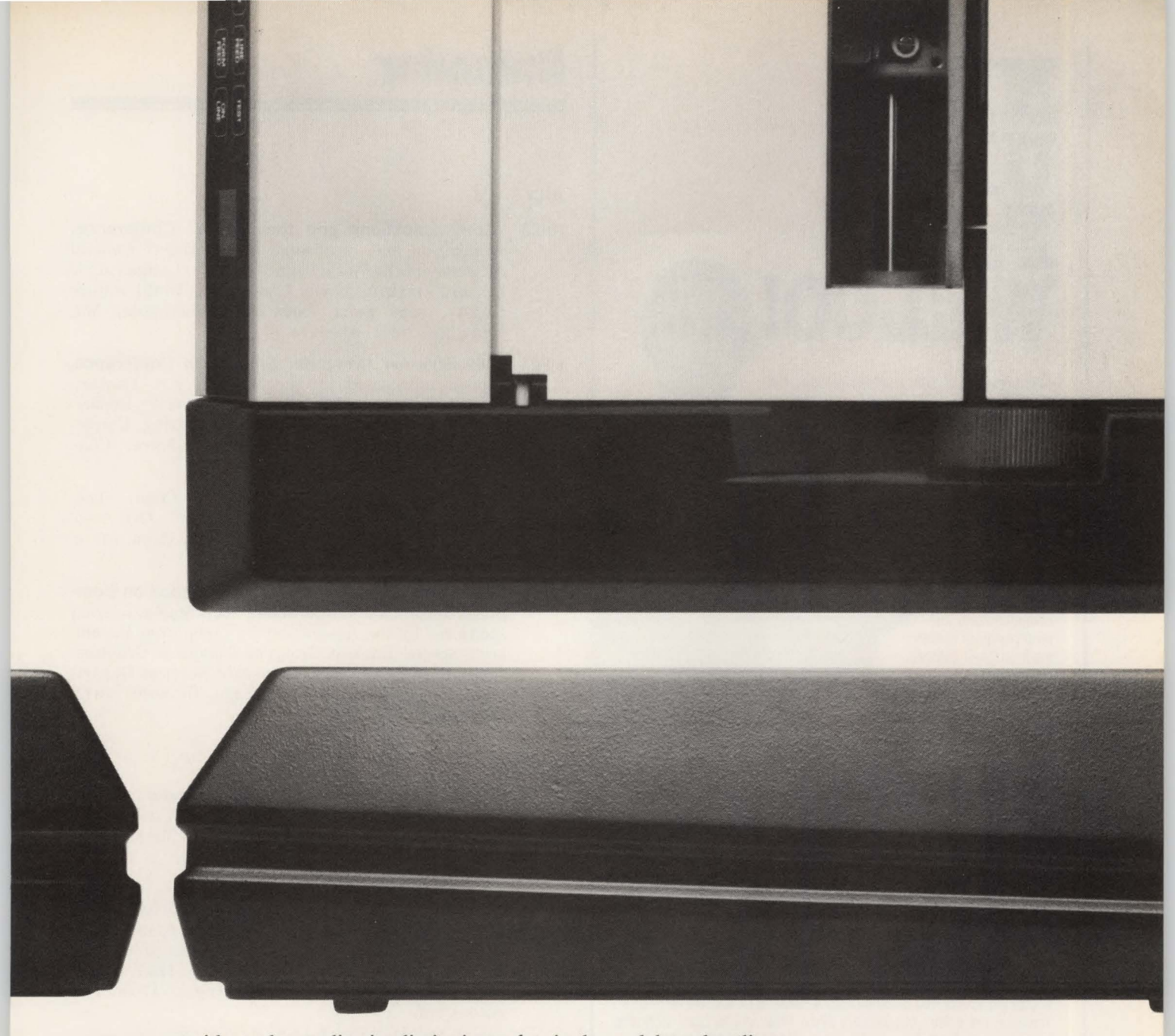

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GENERAL ELECTRIC

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Calendar

JULY

18-22 "Communications and the Future" Conference, Washington, D.C., sponsored by the Fourth General Assembly of the World Future Society. Contact: Eric Seaborg, 1982 Assembly Committee, World Future Society, 4916 Saint Elmo Ave., Bethesda, Md. 20814-5089, (301) 656-8274.

19-21 1982 Summer Computer Simulation Conference, Denver, sponsored by the ISA and SCS. Contact: Marvin F. Anderson, General Director, SCSC, Department of Electrical & Computer Engineering, University of Colorado, 1100 Fourteenth St., Denver, Colo. 80202, (303) 629-2685.

21-23 CADD Systems Seminar, Danbury, Conn., sponsored by Orr Associates, Inc. Contact: Orr Associates, Inc., 21 Chambers Rd., Danbury, Conn. 06810, (203) 748-8044.

26-30 SIGGRAPH '82, Ninth Annual Conference on Computer Graphics and Interactive Techniques, Boston, sponsored by the Association for Computing Machinery's Special Interest Group on Computer Graphics. Contact: SIGGRAPH '82, Convention Services Department, 111 E. Wacker Dr., Chicago, Ill. 60601, (312) 644-6610.

AUGUST

10-11 The Future of The Communications Industry, New York, sponsored by The Yankee Group. Contact: The Yankee Group, 89 Broad St., Boston, Mass. 02110, (617) 542-0100. Also to be held August 17-18, Palo Alto, Calif.

10-11 "The Uncommon Carrier: New Opportunities in Carrier Services" Seminar, New York, sponsored by The Yankee Group. Contact: The Yankee Group, P.O. Box 43, Harvard Square, Cambridge, Mass. 02138, (617) 542-0100. Also to be held August 17-18, Palo Alto, Calif.

15-18 Second International Computer Engineering Conference and Exhibit, San Diego, Calif., sponsored by the Computer Engineering Division of the American Society of Mechanical Engineers, 345 E. 47th St., New York, N.Y. 10017, (212) 644-7100.

18-21 Asian Computer & Business Equipment Expo, Hong Kong, sponsored by the Cahners Exposition Group. Contact: Cahners Exposition Group, 222 W. Adams St., Chicago, Ill. 60606, (312) 263-4866.

26-27 Microprocessor/Computer Control of Hydraulic Systems Seminar, Milwaukee, Wisc., sponsored by the University of Wisconsin-Extension. Contact: John M. Leaman, Department of Engineering & Applied Science, University of Wisconsin-Extension, 929 Sixth St., Milwaukee, Wisc. 53202, (414) 224-4189.

SEPTEMBER

8-10 International Symposium on Electromagnetic Compatibility, Santa Clara, Calif., sponsored by IEEE, EMC-S. Contact: Evangelos Tonas, EMC Sympo-

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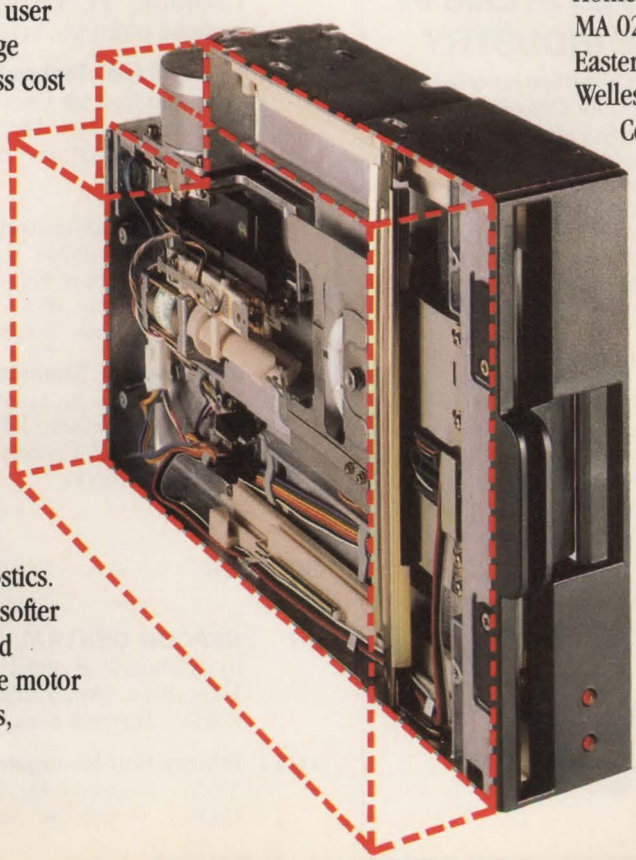
West Coast Office: 8939 S. Sepulveda Blvd., Suite 330, Los Angeles, CA 90045, (213) 670-7346



NEC's new Model FD 1165 diskette drive doubles your storage capacity—from 1.6MB to 3.2MB—without doubling your space.

CIRCLE NO. 92 ON INQUIRY CARD

Calendar

sium, P.O. Box 70577, Sunnyvale, Calif. 94088-4577, (408) 743-6027.

9-10 DPMA Conference and Business Exposition, Tampa, Fla., sponsored by Pinellas, Polk and Tampa Chapters of the Data Processing Management Association. Contact: Stan Allen, Chairman, Tampa Chapter, DPMA, P.O. Box 2045, Tampa, Fla. 33601.

14-16 Wescon '82 High-Technology Electronics Exhibition and Convention, Anaheim, Calif., sponsored by Electronics Conventions, Inc. Contact: Eileen Algaze, Communications Coordinator, ECI, 999 N. Sepulveda Blvd., El Segundo, Calif. 90245, (213) 772-2965 or (800) 421-6816.

14-15 "Requiem for Paper: The Voice & Electronic Mail Explosion" Seminar, New York, sponsored by The Yankee Group, P.O. Box 43, Harvard Square, Cambridge, Mass. 02138, (617) 542-0100. Also to be held Sept. 28-29, Sunnyvale, Calif.

15-17 LAN '82: Local-Area Networks Conference, Los Angeles, sponsored by Information Gatekeepers. Contact: Information Gatekeepers, Inc., 167 Corey Rd., Brookline, Mass. 02146, (617) 739-2022.

20-24 COMPCON FALL'82, Washington, D.C., sponsored by the IEEE Computer Society. Contact: COMPCON FALL '82, P.O. Box 639, Silver Spring, Md. 20901, (301) 589-3386.

20-24 The International Symposium on Subscriber Loops and Services, Toronto, Canada, sponsored by the IEEE. Contact: John D. Fahey, General Committee Chairman, Fl. 22, 393 University Ave., Toronto, Ontario M5G 1W9, (416) 599-6264.

21-23 International Technology Exposition, San Francisco, sponsored by Control Data Corp. Contact: W.M. Shaffer, Control Data Corp., 8100 34th Ave., S., Minneapolis, Minn. 55440, (612) 853-5748 or (800) 328-1870.

21-23 Southeast Computerized Office Equipment Expo, Atlanta, sponsored by Cahners Exposition Group. Contact: Cahners Exposition Group, 999 Summer St., Stamford, Conn. 06905, (203) 964-0000. Also to be held Oct. 5-7, Dallas, Texas.

21-25 International Business Equipment Exhibition, Jakarta, Indonesia, sponsored by the Indonesian Government. Contact: Jeff Wolf, TMAC, 680 Beach St., Suite 428, San Francisco, Calif. 94109, (415) 474-3000 or (800) 227-3477.

OCTOBER

5-7 NEPCON CENTRAL '82, Rosemont, Ill., sponsored by Cahners Exposition Group. Contact: Cahners Exposition Group, 222 W. Adams St., Chicago, Ill. 60606, (312) 263-4866.

11-14 Information Management Expo & Conference, New York, sponsored by Clapp & Poliak, Inc. Contact: Clapp & Poliak, Inc., (800) 223-1956.

Getting the jump on DEC*-compatible Winchesters

You've got to keep hopping to be a winner in the DEC-compatible world, and Charles River Data Systems has been out front with innovative technology for eight years. Now we've taken a big jump ahead with our new RLX3010 disk, featuring removable Winchester backup, RL02 software compatibility, and 22-bit addressing.

TWO DISK SUBSYSTEMS		
Model	Main Storage	Backup
RLX3010	31.2MB fixed Winchester (=3RL02)	10.4MB removable Winchester (=1RL02)
RLX3001	31.2MB fixed Winchester (=3RL02)	1.0MB double-sided floppy

TWO SINGLE-BOX COMPUTER SYSTEMS	
Model	Description
RLX3010B	Same as RLX3010, plus built-in Q-bus backplane
RLX3001B	Same as RLX3001, plus built-in Q-bus backplane

- Q-bus compatibility under RSX-11M, RT-11
- LSI-11 processor, memory, and interface cards available
- Complete system in 7-inch enclosure
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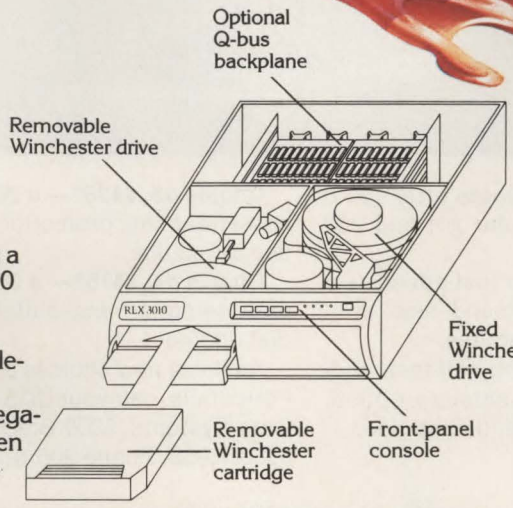
Optional Q-bus backplane and floppy backup, too

To build a potent yet remarkably compact, economical single-box system, choose the RLX3010B with built-in backplane. Just plug in LSI-11 processor, memory, and interface boards, and cut cost, space, cabling, and power requirements significantly. And for even greater economy, there's the RLX3001 with RX02-compatible floppy backup (see chart).

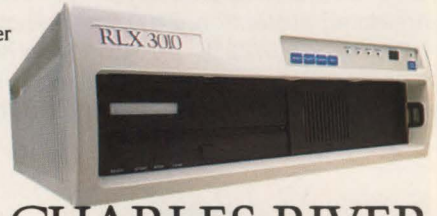
For more information, contact Charles River Data Systems, 4 Tech Circle, Natick MA 01760, (617) 655-1800; Western Region (602) 863-7739; Europe (44) 4955-56545.

Removable Winchester backup

Introducing a uniquely sensible approach to Winchester backup: a second Winchester. The RLX3010 combines a 31.2-megabyte, 8-inch, fixed Winchester with a 10.4-megabyte, 8-inch, removable-cartridge Winchester. Each on a separate spindle. Use all 41.6-megabytes for data and programs. Then use the 10.4-megabyte cartridge for program swapping or high-speed, file-oriented backup. With the fixed disk running. A front panel diagnostic console permits off-line testing.



The RLX3010 fits in a 7-inch-high table-top or rack-mount enclosure. Yet it's equivalent to four DEC RL02s (at 40 inches tall and 300 pounds).



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Choice #2, $775* — a 201C now offering self-test, end-to-end test (half-duplex mode), built-in satellite option, and a talk/data selector switch. 2400 bps, dial-up line.

*Single unit prices.

Choice #3, $425* — a 202T with self-test capability and anti-streaming protection as new features. 0-1800 bps, dedicated line.

Choice #4, $475* — a 202S featuring new self-test, talk/data selection and built-in satellite option. 0-1200 bps, dial-up line.

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CIRCLE NO. 120 ON INQUIRY CARD

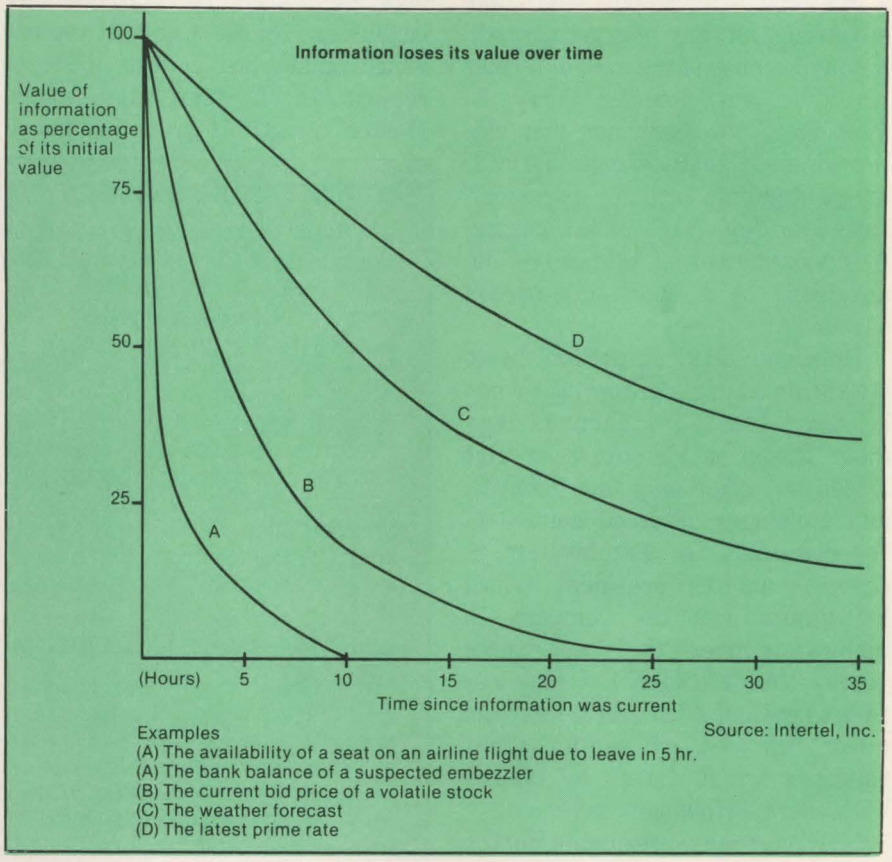
Created by Dayner/Hall, Inc., Winter Park, Florida

Intertel's Horton caters to 'uptime' fanatics

David F. Horton welcomes the impatient of the networking world, those who want to kick out the front of a CRT screen if they do not get 3-sec. response time. As recently appointed president of Andover, Mass.-based Intertel, Inc., he leads a company whose business is to understand the difference between 98- and 99-percent uptime and that specializes in network-management and -control for time-critical applications.

"Users have changed as the complexity of networks has changed," says Horton, who joined Intertel in early March after three years at Prime Computer, Inc., most recently as vice president of corporate development. He characterizes the new users not as technicians, but as impatient business types who are just beginning to understand the costs of downtime.

A tough and responsive attitude fits the bill for the small company aiming to provide the mortar that binds the networks of corporate giants and keeps networks alive by anticipating problems before they occur. Some of these users can recite how much business passes through their network each minute of the day, says W. Harry Vickers, vice president of corporate development for the company. Examples, he says, are major airlines, which can process $10,000 worth of information per min., and brokerage firms, which can process more than $1 million per min. "Applications in which we make our mark are those in which the value of the transaction over time degrades rapidly. There is a fundamental difference in 98- versus 99-percent (uptime), for example, the volume of transactions at a bank," he notes. About 52 percent of Intertel's customers are financial institutions, says C. David Hetrick, vice president of marketing.



The mark Intertel is making is no different than the one it has focused on over the past two years (MMS, March, 1980, p. 83). Its bread-and-butter Series 90 network-control-and-management system recently was enhanced as the 90/15, which monitors network performance. The 90/15 helps network operation managers anticipate, identify and isolate performance problems, in the electrical part of a network. It also can store information about those problems in a database. Data are displayed in color or black and white on local or remote terminals. "As networks get more complex, few companies know what is on them," Horton explains, citing a need to know who is on the network and to measure and/or anticipate problems.

Horton explains that some large network users employ 15 to 20 night-shift people, who manually sort service-report and trouble tickets. The market to automate this procedure is enormous, he says. The market might have been as large as $80 million in 1981, and Intertel led the field with about 30 percent of the sales, followed by Ralco-Milgo, Inc., Codex Corp. and General Datacomm Industries, reports J. Thomas Markley, president of JTM Associates, a Plymouth, Mass., network consulting firm. Although the market will enjoy a

30-percent annual growth rate over the next five years, Markley does not expect any near-term major technological breakthroughs.

Markley points out that Intertel is in a good technical position to take advantage of any market growth, mainly because of the skill of former president and founder Jerry L. Holsinger, now chairman and vice president of engineering. "Jerry is an outstanding, brilliant engineer," says Markley. "One of the company's weaknesses is that Jerry did not bring in a day-to-day person earlier."

Holsinger tried unsuccessfully to step aside as president in 1978 when he hired IBM Corp. alumnus Seymour Rosen as his successor. But Rosen left after only nine months, and Holsinger resumed control of the company. He was hesitant in choosing another president, which he admits cost the company in innovation over the past three years. "(As president), I had less time to get out with users. I get the most fun out of seeing what solutions are for users by talking with them," Holsinger says.

New company president Horton is in a somewhat tense position to prove himself under the watchful eye of the founder. Holsinger, other members of the company and those who know Horton well exude confidence in Intertel's new leader. Nearly all reiterate two remarks: Horton is very bright, and he has strong interpersonal skills.

"Dave gets people with divergent interests to work together in the same direction, which is a key asset for the chief executive officer," says Kenneth Fisher, former president of Prime and Horton's former boss. The two men have had a working business relationship for about 12 years. Fisher adds, "Integrating people is a challenge. That's why this skill is the key one. He'll bring all of the Intertel talent to bear on the issues that will focus the company."

Fisher calls Horton a sustaining doer, not a flash in the pan, and says that when the two worked for Honeywell in Minneapolis, Horton was promoted to manage the lackluster North Central region, which ranked last in sales of the 14 regions. In one year, says Fisher, Horton turned his group around to get the top slot for three years.

At Prime, Fisher says, Horton learned to work at growth for the sake of profit, another important factor in running a small company. "He can keep his eyes focused on the numbers part of the business as well as people, products and market."

Important to Horton's reign over the $23-million company is keeping

BASIC FOUR LOSES BATTLE WITH EX- DEALER

A Boise, Idaho, judge recently refused to grant Basic Four an injunction that would have prevented its former dealer, Hubco Data Products, from "tampering" with the BOSS operating system. The move is the latest in a protracted legal battle, and will enable Hubco—at least temporarily—to pursue its business of opening Basic Four systems to disk upgrades and non-Basic Four terminals by eliminating what Hubco says are artificial restraints in the operating system. Hubco claims, for example, that Basic Four has sold systems with 35M-byte disks, but has limited access to only 10M bytes through artificial operating-system barriers. Customers were then charged as much as $5800 per drive for a BOSS upgrade to access the 35M bytes already available. Basic Four says it still may seek a permanent injunction and is pressing other claims against Hubco, which it dropped as a dealer. Meanwhile, Hubco's antitrust suit against Basic Four—which includes charges of tying arrangements with Sorbus—is still pending.

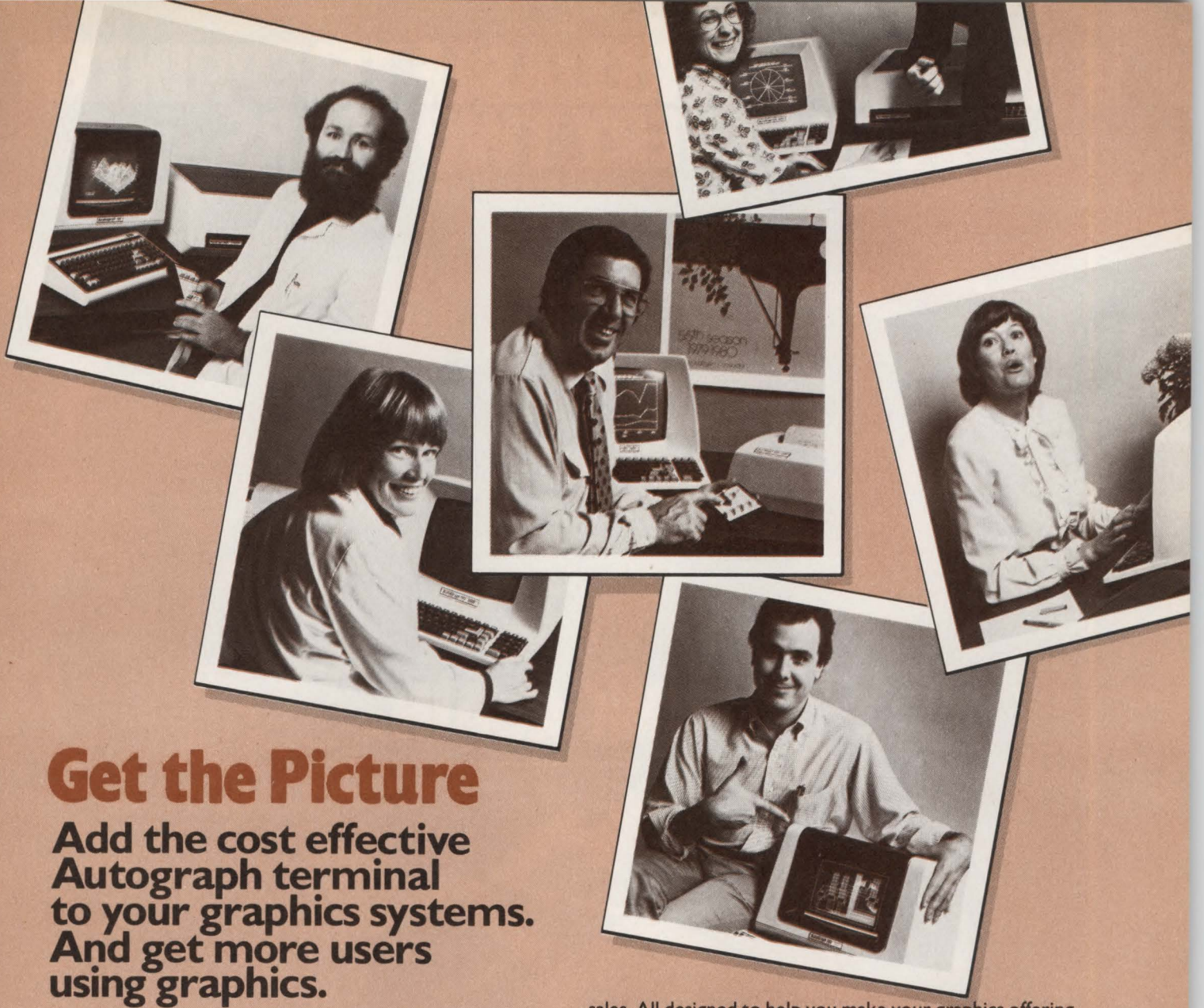
VECTOR GETS NEW PRESIDENT

Almost two months after chairman Bob Harp's exit from Thousand Oaks, Calif.-based Vector Graphics, Inc. (MMS, April, p. 5), co-founder, chief executive officer and former president Lore Harp announced the appointment of a new president and chief operations officer, Fred A. Snow. Snow had served for 15 years in top-level marketing and operations positions with Honeywell Information Systems, Inc. He was most recently vice president for marketing planning and research operations, with responsibility for business products and strategic and financial planning. Snow will supervise engineering, manufacturing, international and domestic sales, marketing, communications and quality assurance at the small systems vendor. Among his many HIS assignments was developing a U.S. minicomputer dealer network.

BOX SCORE OF EARNINGS

This table lists the revenues, net earnings and earnings per share in the periods indicated.

Company	Period		Revenues	Earnings	EpS
Burroughs	3 mos	3/31/82	990,088,000	27,103,000	.65
	3 mos	3/31/81	756,485,000	22,250,000	.54
Computer Automation	9 mos	3/31/82	50,566,000	585,000	.29
	9 mos	3/31/81	56,610,000	1,215,000	.60
Honeywell	3 mos	4/4/82	1,261,000,000	55,500,000	2.48
	3 mos	3/29/81	1,210,800,000	52,300,000	2.31
Intelligent Systems	12 mos	3/31/82	24,557,383	3,210,040	1.15
	12 mos	3/31/81	18,775,303	1,590,681	.70
Int'l Teleph. & Telegr.	3 mos	3/31/82	3,950,226,000	162,735,000	1.10
	3 mos	3/31/81	4,119,252,000	166,463,000	1.13
Perkin-Elmer	9 mos	4/30/82	766,860,000	41,881,000	.97
	9 mos	4/30/81	819,209,000	55,283,000	1.28
Ramtek	9 mos	3/31/82	33,428,000	1,908,000	.72
	9 mos	3/31/81	25,120,000	992,000	.37



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A few eye-opening words for graphics-oriented OEMs:

Our Autograph terminals give you a terrific preview of the information on your graphics systems.

Not quite as good as the preview you get on a Tektronix terminal.

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For about a third the price of the Tektronix tube.

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Low prices and very favorable OEM discounts help you put more graphics on more desks for more users. For more sales. All designed to help you make your graphics offering the most cost effective available.

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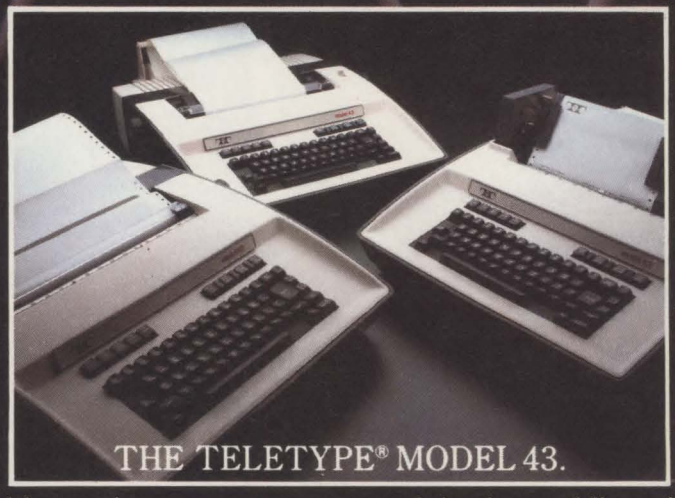

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Imagine an MTBF of over 4½ years. That's the kind of reliability you can expect from the Teletype® model 43KSR, based on current field experience.

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More importantly, the 43 actually goes a long way toward improving system reliability instead of weakening it, as is often expected with a mechanical device.

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CIRCLE NO. 117 ON INQUIRY CARD

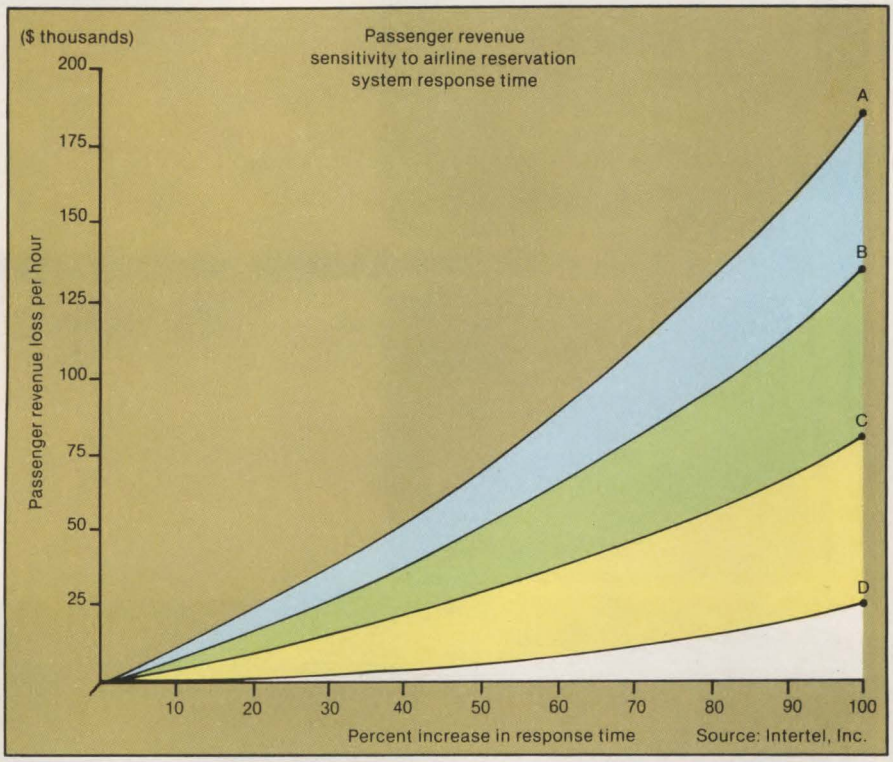
it focused in its vertical niche, and controlling growth in a potentially explosive market. He is establishing long-term growth objectives. "The lull in the economy is an opportunity to gear up for growth," he says. Horton does not believe Intertel is in a position to offer a total network solution, including computers, networks and control elements. "You can try to do everything, which is impossible for Intertel, or you can help the customers to do what they want." Horton's brand of IBM-like handholding includes a company quota for managers "starting with me," he says, to spend time with customers. Horton plans to make one customer call a week. Hetrick adds that about 26 percent of yearly revenues go to marketing and customer service.

Vice president of corporate development Vickers says that Intertel is bringing the power of computing to bear on communications problems. "We all know the data-processing area well enough to stay out of it," he says.

There is no indication Intertel will achieve the same booming growth of $7 million to $93 million that Prime did in the three years Horton spent there. Intertel has paced itself on a 25-percent annual growth rate. It downplays its modem business, which contributes less than 10 percent to revenues. No near-term venture-capital or equity infusions are in store, Horton says. The company just received an $8-million line of credit from Chase Manhattan, New England Merchants and the Deutsche banks, and is in good liquidity shape, he adds.

Horton says his biggest task now is sorting through available opportunities for the company, which will go public when it is in the best interest of the stockholders to do so, he adds. "We'd rather get the basic engine running smooth and fast before taking on outside pressures," says Horton. —*L. Valigra*

For the second time in the company's history, Intertel founder Jerry L. Holsinger (left) has stepped aside *to welcome a new president, David F. Horton (second from left), the former Prime vice president of corporate development. Others on the management team are vice president of corporate development. Harry Vickers (second from right), founder of Entrex, and C. David Hetrick, vice president of marketing (right).*



The relationship between hourly revenue loss and increases in response time *of an airline reservation system for four hypothetical airlines. Airline-reservation networks are particularly sensitive to downtime and increased terminal-response time. The longer a reservation sales agent waits for information responses, the fewer the people that can be served, which results in less revenue. Airline A boards 35 million passengers annually, airline B boards 25 million, airline C boards 15 million, and airline D boards 5 million. Airline A could lose $180,000 per hour if system response time increases from a nominal 2 sec. to 4 sec. (100 percent).*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The results of that achievement are the S/20 and S/120 microECLIPSE™ systems you see here.

Those who have been working with our 7" x 9" micro boards will be pleased to hear that the S/20 follows that form factor. And those used to our 15" form factor will be pleased to hear that the S/120 follows that tradition.

Both the S/20 and the S/120 have the ECLIPSE instruction set and standard Data General I/O buses. You can also take advantage of all the code, all the interfaces, all the peripherals already available.

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Like the other computers in the ECLIPSE family, the S/20 and S/120 have some highly reliable reliability features. Like automatic self-test on power up. Byte parity on the S/20. And on the S/120, an advanced error checking and correction technique implemented through a "sniffing" function. (So called because it continuously scans memory looking for single bit errors before they can multiply into hard-to-fix multiple bit errors.)

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And even better news for everyone who is already doing so with our ECLIPSE family of computers.

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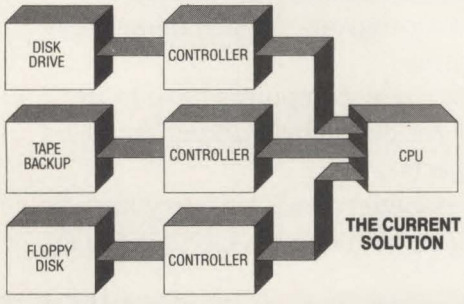
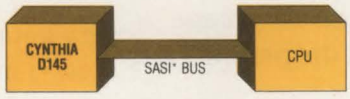


THE CURRENT SOLUTION



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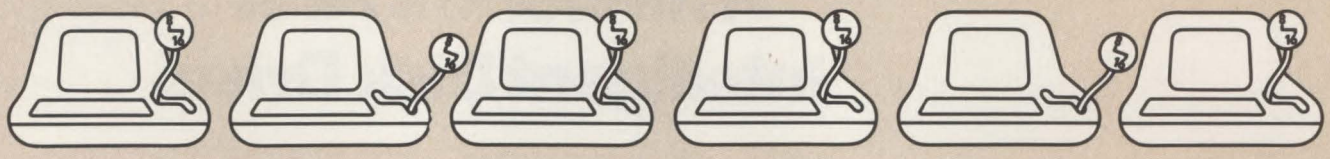

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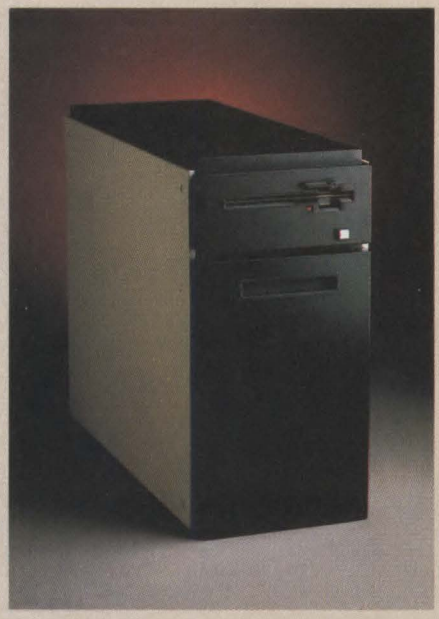

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CIRCLE NO. 85 ON INQUIRY CARD

France builds UNIX environment with Pascal

While most of Europe seems to agree on UNIX-like and UNIX-based operating systems as the way for further development of minicomputers and microcomputers, the French have opted for Pascal rather than C as the language with which to create the UNIX environment and make it portable. Pascal's popularity in France and the complete definition of the language by the International Standards Organization are two major reasons for its selection. The UNIX kernel and utilities have been rewritten in Pascal.

The French intend to incorporate tools and utilities in a Pascal UNIX similar to those in the Western Electric offering, but that meet the needs of Pascal users. French schools teach Pascal as the standard for building systems software.

The Honeywell Level 6 minicomputers, plus three microprocessors —Intel Corp.'s 8086 and Motorola's 68000 and 6809—are among the machines chosen for the Pascal-flavored UNIX. Versions for Digital Equipment Corp. LSI-11 and PDP-11 machines, Hewlett-Packard Co. computers and the Zilog, Inc., Z8000 could be available later. Most versions are expected to appear in the U.S. "C has been influenced to a large degree by the DEC architecture and the PDP-11," says Michel Gien, leader of France's Pascal project, Sol, which is based at the French Computer Technology Research Center, INRIA, near Paris. "It is not obvious that C is better than Pascal in NS16000-based machines or Honeywell minicomputers," for example. He adds, though, that programmers used to C will not like Pascal, and vice versa.

Before embarking on the Pascal development project, the French studied the problems involved in transporting a UNIX environment between machines with a C compiler.

The Pascal system is also called Sol. Problems that may arise with Pascal were detected by replacing chunks of C coding with parts written in Pascal. As part of this experimental comparative work, the researchers wrote a C compiler for Level 6 that accepts UNIX version 7.

At a recent meeting of the European UNIX User Group in Paris, Gien explained that Sol is backed by various French organizations, including INRIA itself, government-owned telecommunications laboratory CNET, a group of universities and some leading French software houses, Cerci, Steria and ECA-Automation. Sol's goal is to provide tools for any French team in industrial, commercial or academic R&D.

Sol backers chose a UNIX-type environment because it is simple, powerful and self-contained, and does not depend on the assembler language of the host machine. The French hope that Pascal will prove as accommodating as C in portability.

Two years into the four-year project, Sol is achieving what it set out to do, Gien says. The first phase, which concentrated on developing ISO-standard Pascal compilers, has resulted in the successful second phase of putting the core elements of the language onto machines that include the Level 6, the Intel 8086, the Motorola 68000 and the National Semiconductor NS 16000. A version for the Motorola 6809 is on the way. Two other minicomputer families receiving treatment similar to that of the Level 6 are the Reality 2000 and Mitra series from the French based manufacturers, Intertechnique and SEMS. Reality 2000 is based on the Microdata Reality family. The recent phase involves integrating the Pascal kernel and Pascal utilities into UNIX. The number of Pascal instructions is about equivalent to the number of C instructions in the source UNIX kernel, Gien says. He expects the Pascal UNIX to be operational by year-end.

Sol is being "tuned" to suit Pascal users with features such as Pascal syntax editors, but its advantages over UNIX are not confined to Pascal, says Gien. He notes that Sol is written to be optimized on each type of hardware, and to assure portability and language efficiency by finding the minimum code required to move instructions from one machine to another, Gien explains. Pascal uses instructions, rather than the pointers commonly used in writing C.

Gien believes that Sol is easier to understand and learn than C-based UNIX, both for users and for systems programmers poring through a Pascal-written source listing. In other respects, Sol resembles Western Electric's UNIX. The shell resembles UNIX Version 7, and has the Berkeley extensions. The text editor and source-code control systems are also similar. Verified comparisons between the C and Pascal versions do not yet exist.

Research institutes will get the Sol source code "almost free," as with UNIX, says Gien. He predicts that Sol's price will compare favorably with that of UNIX, even with the reduced prices announced for UNIX by Western Electric late last year.

A version of Sol for DEC LSI-11 and PDP-11 machines is being developed at the University of Tunis in North Africa. Gien points out that work at Tunis is largely independent of the industrial orga-

nizations cooperating with INRIA on the other versions, so the Tunis offering may not be suitable for commercial use. But Gien believes that it could be modified to meet commercial needs.

Pascal compilers already exist for some of the machines targeted for Sol. But Gien stresses the need for all the compilers to comply with the ISO standard to ensure portability.

Gien hopes to contact potential users or vendors of Sol in the U.S. The French organizations engaged in the developing, testing and application of Sol have established "Club Sol," which is open to non-French members.

—Claire Gooding, software editor of Computer Weekly *and chief editor of* Software, *both based in the U.K.*

'Parallel' computer may hold key to new architectures

Parallelism may be the key feature of future computer architectures—the ultra-powerful "fifth-generation" machines that the Japanese see as handling functions other than the limited numerical-processing of conventional computers.

One approach to parallelism is to use a technique called dataflow to execute multiple instructions simultaneously. A working prototype of a dataflow computer was the subject of a paper at a recent conference on fifth-generation concepts in London. The presenter was Dr. John Gurd of the Computer Science Department at the University of Manchester in England.

Dr. Gurd and his colleague, Dr. Ian Watson, are leading a team funded by the British government's Science and Engineering Research Council that aims to have a dataflow computer ready for use on the national scientific network operated by SERC within two years. Its architecture will allow computer scientists to test data-driven languages that transcend conventional von Neumann computer architecture. These languages reject the von Neumann approach of executing instructions one at a time through sequential memory-access operations under the control of a program counter. Instead, the data circulate through the dataflow machine in the form of packages of information, each with a token that indicates which node in the network contains the required primitive instruction for executing it.

A matching unit in the system collects the packages with the same tokens and sends them to the same node. The primitive function at each node could be a copy, an add, a subtract, a multiply or a divide. As it passes through the node, the packet picks up the instruction and moves on to a processing (arithmetic) unit for execution.

A switching unit controls the flow of packages between the input/output unit, which could be a conventional computer, and at least one complete circular dataflow system. The prototype working at Manchester has one ring, with five processors in parallel. Gurd notes that the machine for the SERC network will have four complete dataflow rings operating in parallel within two years. Each of the five 24-bit processors in the single-ring prototype at Manchester is configured around six American Micro Devices, Inc., 2900 series bipolar bit-slice microprocessors. The overall throughput is about 3M bits per sec.

On the commercial significance of the dataflow computer, Gurd re-

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CIRCLE NO. 33 ON INQUIRY CARD

marks, "We have been pushing dataflow just for applications like weather forecasting. But the Japanese have identified dataflow as a possible approach for the fifth generation—as one approach to parallelism. The Japanese are interested in enormous amounts of computing power even for consumer products."

But Gurd sees the technology as most valuable to the market between the consumer sector and the user community for the expensive and not very versatile super computers, such as the Control Data Corp. Cyber 205 and Cray Research machines. These machines essentially execute only one instruction at a time, but do so very quickly and efficiently.

The prototype dataflow machine at Manchester, which became operational late last year, occupies a 19-in. rack, but Gurd says that future dataflow computers could be reduced to desk-top size. Gurd believes that a commercial version would sell for tens of thousands—not millions—of dollars.

"The difficult part of dataflow technology is the software, not the hardware," Gurd notes. At Manchester, Gurd's team has been testing the hardware using the dataflow language ID (Irvine Dataflow), developed by Professor Arvind at the University of California, Irvine. Arvind is now based at the Massachusetts Institute of Technology, as is another dataflow team led by Professor Jack Dennis. Dennis's team has developed a language called VAL (Value Oriented Algorithmic Language). In Japan, the Nippon Telephone and Telegraph laboratories have a team working with a language called Valid.

Another dataflow team is at French research laboratory CERT, Toulouse, where a machine and a language, both called LAU, have been developed.

In a demonstration using ID, the Manchester team demonstrates the effectiveness of parallelism with tasks such as computing sums of the numbers 1 through 700, for example. Processing time is reduced proportionately as additional processors are activated.

The input/output unit is a conventional 16-bit computer based on the Digital Equipment Corp. LSI-11 processor. On the SERC network, the four-ring machine will use a front-end computer on the level of a DEC VAX. —*Keith Jones*

DEC software houses show off their products in Holland

The recent Europe Software '82 in Utrecht, the Netherlands, provided an ideal showcase for the Dutch software industry, including several large Dutch houses specializing in Digital Equipment Corp. systems and software. Most products were applications packages aimed mainly at users in the Netherlands, but several packages possessed much wider applicability and could interest DEC system integrators in the U.S. Dutch vendors enjoy a major advantage over software houses in many other parts of continental Europe in that most of their personnel speak English, the official second language of the Netherlands.

Products at the show included Formatext-11, a combination of word processing and data entry, Apollo, a parameter-driven DIBOL code generator intended to reduce programming time dramatically, and the ASDEC financial-

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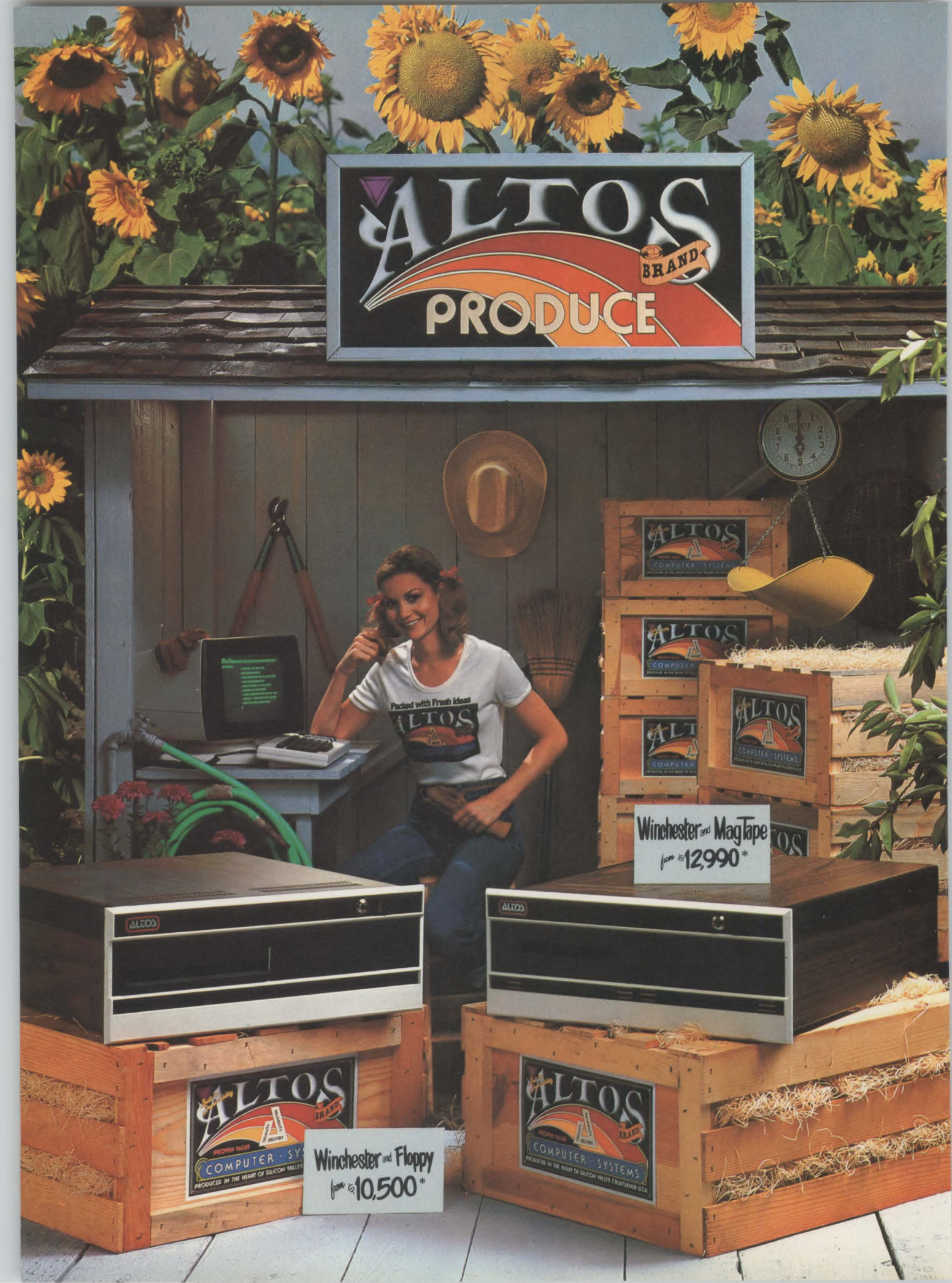
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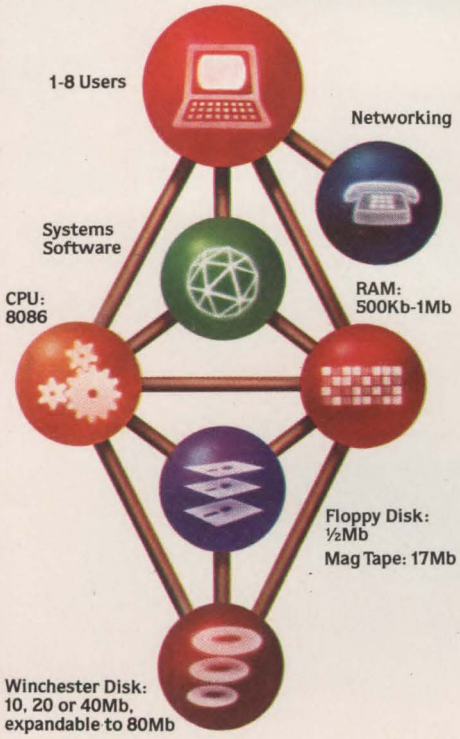

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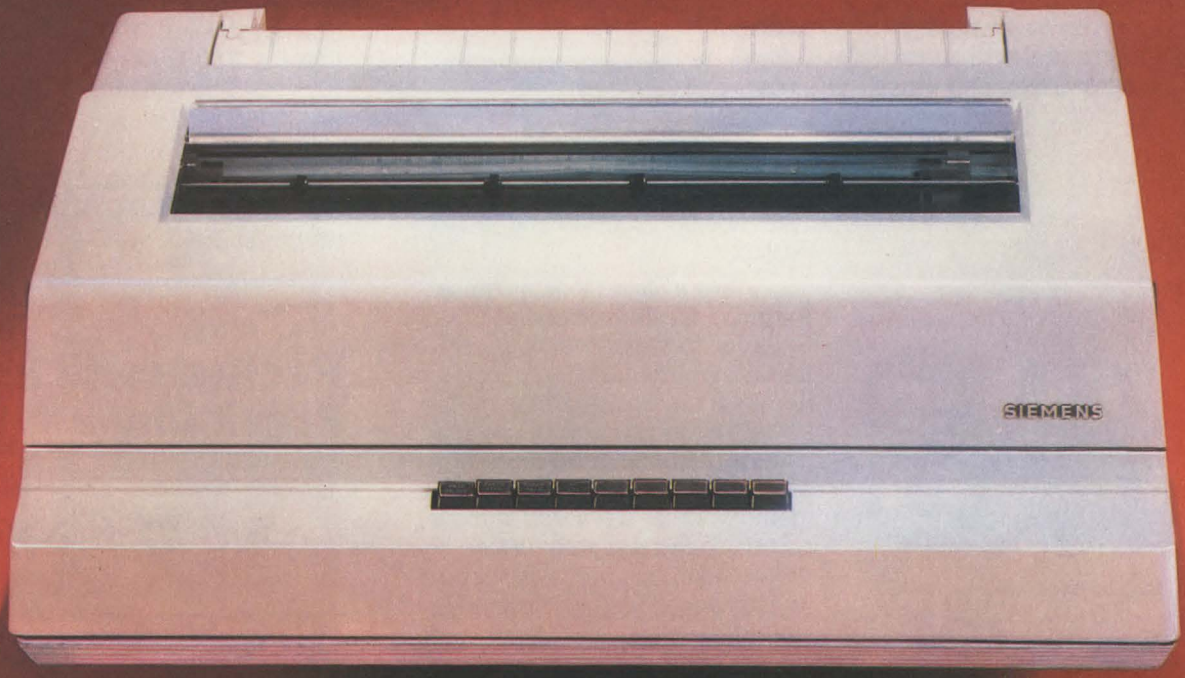

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administration system for multinational applications that interfaces with production-control and -planning systems.

Formatext-11 is from Amsterdam-based Infonet Automation Services, a division of the ARC computer services group that, in turn, is a subsidiary of the largest Dutch banking organization, Algemene Bank Nederland NV. Infonet support manager Martin de Wolff notes that Formatext-11 is being run on a PDP-11/44 by a major English-language user, The Commonwealth Agricultural Bureau of Farnham Common, England, which uses the system to capture abstracts from thousands of agricultural scientific papers. De Wolff explains that the package offers the powerful validation and field-definition facilities of a system dedicated to data entry without the restrictions of maximum field lengths and screen boundaries. It is aimed at applications involving formatted texts such as in catalogs, directories, dictionaries and encyclopedias. Infonet uses the system to capture medical abstracts for *Excerpta Medica*, published by Dutch publisher Elsevier of Amsterdam. Infonet sales manager Jan Koning is seeking representatives in the U.S. for Formatext-11, and estimates that U.S. prices will be about $15,000 a copy.

Apollo was developed by Minihouse Nederland BV of Gouda near Rotterdam, an independent DEC specialist with a staff of 80. Apollo developer Leen Kuiper notes that the package was written in DIBOL (there are 100,000 DIBOL statements in a complete package) and that the system can be hosted by a PDP-11 or VAX machine. The company plans to transport the system to Data General Corp. and Hewlett-Packard Co. machines for which there are DIBOL interpreters. Modules in Apollo can generate DIBOL coding for screen generation, file description, file manipulation (including sorting) and report writing. "The programs generated by Apollo should be error-free. If not, you can blame the developers," says Kuiper. "In Minihouse, we have already used Apollo to generate an inventory-control system with 90 program modules. It was completed in two days."

The first outside user to implement systems with Apollo will be the Dutch police force based in the Hague, the administrative capital of the Netherlands. Apollo will be used to generate systems for maintaining files on vulnerable buildings and stolen goods.

Minihouse general manager Theo Mulder quotes 25,000 Dutch guilders (about $11,000) per user organization rather than per copy for the full source of Apollo. Kuiper says documentation translation is the only non-trivial aspect of tailoring Apollo for users of English.

ASDEC was developed by Multi Function Computers BV of Culemborg near Utrecht, which, like Minihouse, is an independent DEC specialist and has about 100 staffers. Software manager Robert van Agteren says ASDEC is used in the U.S. by mailing-equipment manufacturer Van Dam Machine Corp. of America, West Paterson, N.J. Multi Function developed ASDEC for Van Dam's parent, the $2-billion Dutch multinational, NV Buhrman Tetterode. There are 20 worldwide Buhrman sites running the system. He notes that ASDEC is upwardly compatible across the DEC family from the LSI-11 through PDP-11 to VAX systems, and can be tailored to local accounting practices, character sets and languages. Price is 35,000 guilders (about $15,000) per copy, reduced to one-fourth for the fourth and other copies. Other features include Pilot, a report generator, priced separately; interfaces to the Multipas production-administration system; and interfaces to a powerful network-planning system called Wasp, which employs critical-path-analysis techniques. —*Keith Jones*

IBM SOFTWARE FROM HOLLAND TARGETED FOR U.S.

A BASIC interpreter and a family of applications packages tailored to U.S. users of the IBM Corp. personal computer were unveiled at Europe Software in Utrecht by Holland Automation International BV before the firm's U.S. exhibition debut at the National Computer Conference in Houston.

Describing itself as "Europe's leading micro software house," Holland Automation maintains offices operating in France, Britain and West Germany as well as in the Netherlands, and set up shop in the U.S. last year in Santa Ana, Calif. Holland Automation U.S.A., Inc., has supplied commercial packages to 100 CP/M sites, says parent company chairman Tom van der Loo.

The packages for the IBM machine are MS/DOS compatible and can be customized for accounting practices in various countries, says Alan Routledge, head of the Santa Ana operation. The packages include general ledger, accounts receivable, accounts payable, inventory, invoicing and sales analysis.

The Formatext-11 data-entry and word-processing system *from Infotext Automation Services was demonstrated at the Europe Software 1982 show in Utrecht, the Netherlands.*

IBM 3232 ASCII

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It's a pleasant sound. No clicking or clacking. Little more than a gentle rustle that's usually masked by other ambient noises. The IBM 3232 Model 51 has a non-impact, multi-element matrix print head. Instead of banging away at the paper, imaging is done by electronically removing dots from the special aluminum-coated paper, exposing easy-to-read characters.

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And now, to top it off, you can order the IBM 3232 through our IBM-authorized distributor network. This means you can have one on your desk fast. It's the kind of thing we'd like to shout about, but making a lot of noise doesn't seem appropriate for the quietest high-speed terminal we've ever offered for the money.

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Laymen are target users of μc database machine

The vendor of a low-cost back-end database system for μcs is looking for OEM affiliations. West German electronics giant AEG Telefunken AG, which owns word-processor supplier Olympia, launched the system, called Synfobase, at April's Hanover Fair. The company claims that any μc can interface with the desk-top contents-oriented database machine. It simultaneously processes as many as 32 data sets and contains a patented single-board associative memory system that relieves the host computer of all data-comparison tasks. The machine is priced at $9000.

Synfobase is marketed in the U.S. by Corem International Inc., McLean, Va., which is 90 percent owned by AEG. It is Corem that is seeking OEM opportunities, and the product's origins lie firmly in the U.S. The recognition (associative) memory at the heart of the machine was developed by Sydney Lamb, a lecturer at Rice University in Houston, Texas. An associative memory is faster than conventional memory because it locates records by directly examining the contents of those records rather than by searching for them indirectly through the use of an index. Lamb started work on his invention six years ago at Yale University, New Haven, Conn., and then quit academic life to concentrate on the REM project. His development company, Semionics Laboratories, took the other 10 percent of Corem after Lamb sold the REM patents to AEG last year. The West German company says it acquired the REM "despite tenacious competition, particularly from Japan."

Synfobase is configured around an STD bus and includes a Zilog Inc. Z80 μp and 64K RAM for running a software module called Synpatico, which handles database interrogation dialogs with a user. Lamb says Synpatico works with any operating system software on the host μc. He admits that some special interface software may need to be written, but that is available at no cost from Corem.

The database files are held on a Seagate Technology-compatible, 5¼-in. Winchester-disk drive in the Synfobase "box." Capacity range is 4M to 12M bytes. Another feature is an RS232 interface, which is the only physical link between Synfobase and the host computer.

The REM is the only Synfobase system component that employs a totally innovative design, says Lamb. It is available on one PC board and comprises 8K bytes of RAM and proprietary logic that handles comparisons. The logic is implemented in standard devices, but Lamb notes that they will be replaced later by gate arrays fabricated by AEG.

One use favored by AEG for demonstrating the Synfobase facilities is a car owner's application questionnaire. The user keys the instruction "show," and then keys one of several fields in each record, such as "owner," "model," "color" or "year". The user then keys the instruction "if" followed by a condition such as a make of car. If it is a Porsche, the user keys "If make = Porsche." Synfobase then retrieves all the Porsches in the file and shows owners, models, colors and years.

The user then selects vehicles from the list that satisfy additional criteria such as color and year built. For example, the user could key "from these show color and year if year >= 1970, color = blue." The machine can sort by year, model or some other field. —*Keith Jones*

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CIRCLE NO. 75 ON INQUIRY CARD

U.S. firms join forces to keep technology edge

Government officials are monitoring an effort by companies in the semiconductor and computer industries to establish a joint-venture R&D corporation. The objective of the venture is to counter Japan's government-aided semiconductor and computer industries and to ensure the U.S.'s technological lead in semiconductors and computers.

About 15 companies indicate interest in participating. They are NCR Corp., Burroughs Corp., Sperry Rand, Digital Equipment Corp., Xerox Corp., Control Data Corp., Mostek Corp., United Technologies Corp., Signetics, Rockwell International, Motorola, Inc., Honeywell Information Systems, Harris Corp., National Semiconductor Corp. and Advanced Microcomputer Systems, Inc. The joint venture is expected to concentrate in six major areas: needs assessment, CAD/CAM, future facility automation, packaging, software production and high-level circuit and mainframe projects.

The plans call for a task force to be established this summer to undertake final design of the joint venture, including the question of whether it will be a nonprofit or profit-making entity. When the task force completes its work, it will go to the U.S. Justice Department and the Federal Trade Commission to ensure that the joint venture does not create anti-competitive problems in those industries. Government officials report that the anti-competitive problems would be reduced substantially if the results of R&D projects are given the widest possible distribution.

Government officials say they will be interested primarily in which companies participate in the joint venture, how participation is determined and how the results of the R&D programs are distributed. The government would be concerned if all of the companies in an industry or industries joined in the venture. The rule of thumb is that the fewer companies that are involved, the less likely is the chance of a violation of the antitrust laws.

The government's guidelines for joint ventures in R&D provide that "Industry-wide research projects that include many or all firms in a line of commerce, as well as projects involving the dominant firm or firms in an industry, pose antitrust concerns. These are more likely to restrain competition in innovation than more limited projects involving a few firms with lesser market shares. A firm which knows that many or most of its competitors are not vigorously pursuing independent research because of a joint project may relax its own efforts and acquiesce in a slow moving, passive, unimaginative joint research program." It also states that "the scope and duration of the project are other important factors."

Proper structuring can minimize a joint-venture project's adverse impact on competition. A project that is narrow in scope and short in duration would be less likely to have anti-competitive consequences than a broader or lengthier one. Confining joint activity to the earlier phases of the innovative process rather than extending it to the application stage of production or marketing is a means of lessening any possible adverse effects on competition.

Trade barrier bills disputed in Congress

The semiconductor and computer industries disagree over a legislative package that will be debated by the Congress this summer. One measure, called the Reciprocity Act, was introduced by Sen. John Danforth (R.-Mo.), chairman of a Senate Finance Subcommittee. It would give the President authority to retaliate against the products or investments of any major foreign countries that discriminate against American investments, products or services.

The Reciprocity Bill may be coupled with the High Technology Trade Act (S.2356), introduced by Sen. Gary Hart (D.-Colo.) Alan Cranston (D.-Calif.) and John Heinz (R.-Pa.), which proposes bilateral negotiations to eliminate curbs against this country's high-technology export products.

The semiconductor industry supports both bills. The computer industry opposes reciprocity, but favors high-technology legislation.

The semiconductor industry's position was set forth by W.J. Sanders III, president and chairman of Advanced Micro Devices, Inc., at a Senate Finance Subcommittee hearing. He said it is urgent that both trade legislations be passed this year so that it "will result in the opening of world markets to our exports, and address more effectively industrial policies that disrupt those markets.

"The semiconductor industry—and high-technology industries as a group—are probably the most severely affected by the new forms of market barriers that the bill is

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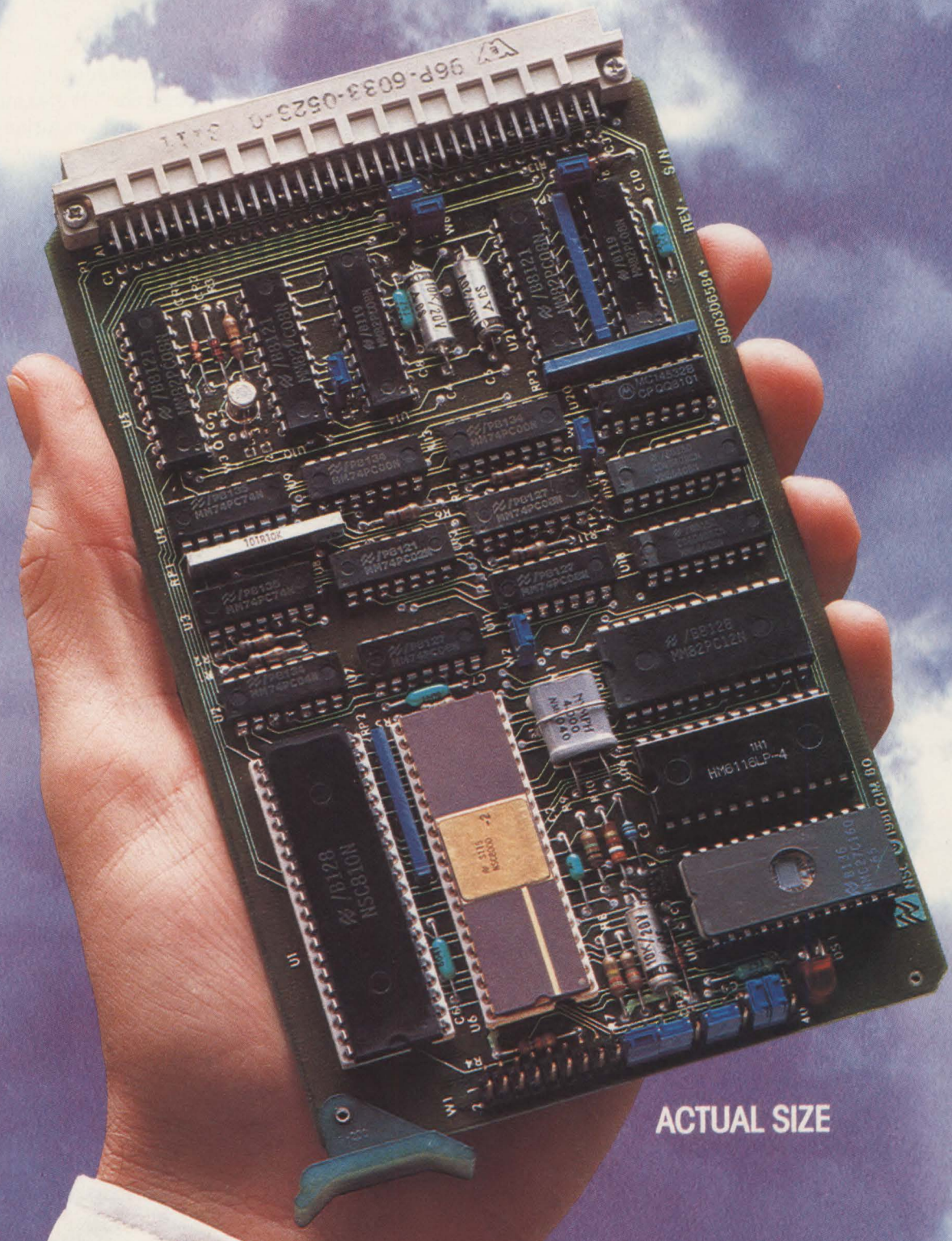

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CIM-604 – 19-inch Card Cage (18 slots)
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Printing Speed	10	150	150	120	120	200
(Char. per Sec.)	12	180	180	—	—	120
	12.5	—	—	150	150	—
	13.3	200	200	—	—	—
	15	—	—	180	180	150
	16.4	—	—	200	200	164
Enhanced	10	—	—	—	—	100
Expanded Print (Double Width)		Yes	Yes	Yes	Yes	Yes
Dot Addressable Graphics (Dot/In., H/V)		60/72	60/72	75/72	75/72	72/72
Max. Line Width (In.)		8.0	13.2	8.0	13.2	13.2
Audible Alarm		Opt.	Opt.	Opt.	Opt.	Yes
Out-of-Paper Sense		Yes	Yes	Yes	Yes	Yes
Ribbon, Continuous Loop Cartridge (Yds)		30	30	30	30	30
Interfacing:						
Parallel Cent. Comp.		Yes	Yes	Yes	Yes	Yes
RS-232-C Serial		Yes	Yes	Yes	Yes	Yes

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designed to address. What is disturbing about this challenge is that ultimately we won't be able to compete successfully unless markets are opened and the effects of foreign industrial policies are dealt with," Sanders said.

Where U.S. companies and workers have high export potential, the bill reported by this committee must direct U.S. negotiating priorities to attack market barriers that frustrate U.S. competition, he added. This is especially true where a protected home market serves as a base from which foreign industries offer extremely aggressive competition in the U.S. and in third-country markets. It is most likely that he was referring to Japan.

Sanders says procedures provided by statute are required to identify foreign market barriers, establish national priorities and find solutions to obtain additional market access and national treatment. "We also need a political mandate and legal authority for negotiations," he said.

He predicted that the semiconductor industry will grow from $15 billion in sales last year to $60 billion by 1990 if the reciprocity and high-technology bills are passed.

The computer industry's opposition to the reciprocity bill was expressed by the Computer and Business Equipment Manufacturers Association. It argued that if reciprocity is carried to the extreme, no product could be imported into this country unless an equal amount of the domestic brand of the product were exported. In a statement filed with the Finance Subcommittee, CBEMA said, "Some people have suggested that United States Trade Policy should be based on what they conceive to be a new principle of retaliatory bilateral reciprocity. As members of the subcommittee know, this principle taken to the extreme, would require that for every product imported into the United States from a given country there would be one similar product exported to that country from the United States."

Illustration by Jon McIntosh

Supporters of reciprocity argue that it is needed because the International General Agreement on Tariffs and Trade (GATT) is inadequate to meet current U.S. trade problems. They also argue that current U.S. laws also cannot deal with the trade problems of the future.

CBEMA, however, rejected both arguments. The association said retaliatory bilateral reciprocity trade policies in the 1930s led this country into the Depression. It told the Committee, "There is no reason to believe that the results of such a policy of retaliatory bilateral reciprocity would be any different in the future. Each country would seek special arrangements exclusively benefitting its trade. The result was and would be a dramatic increase in barriers and distortions resulting in a dramatic collapse of world trade."

CBEMA said a trade policy based on negotiations and multilateral trade rules will achieve benefits for this country. It also argued that some adjustments to the current international trade mechanisms are needed. CBEMA is especially interested in easing restrictions on the free flow of investments. "For example, barriers to international investment flows, to international information flows and to international trade in services are not currently subject to any effective international discipline." The association said it supports legislation that would give the President the authority to enter negotiations involving foreign barriers to international investment, services of informational flows.

A Senate staff member reports that the best thing the reciprocity bill has going for it is the desire of Congress to pass a tough trade bill in this election year. Most of the

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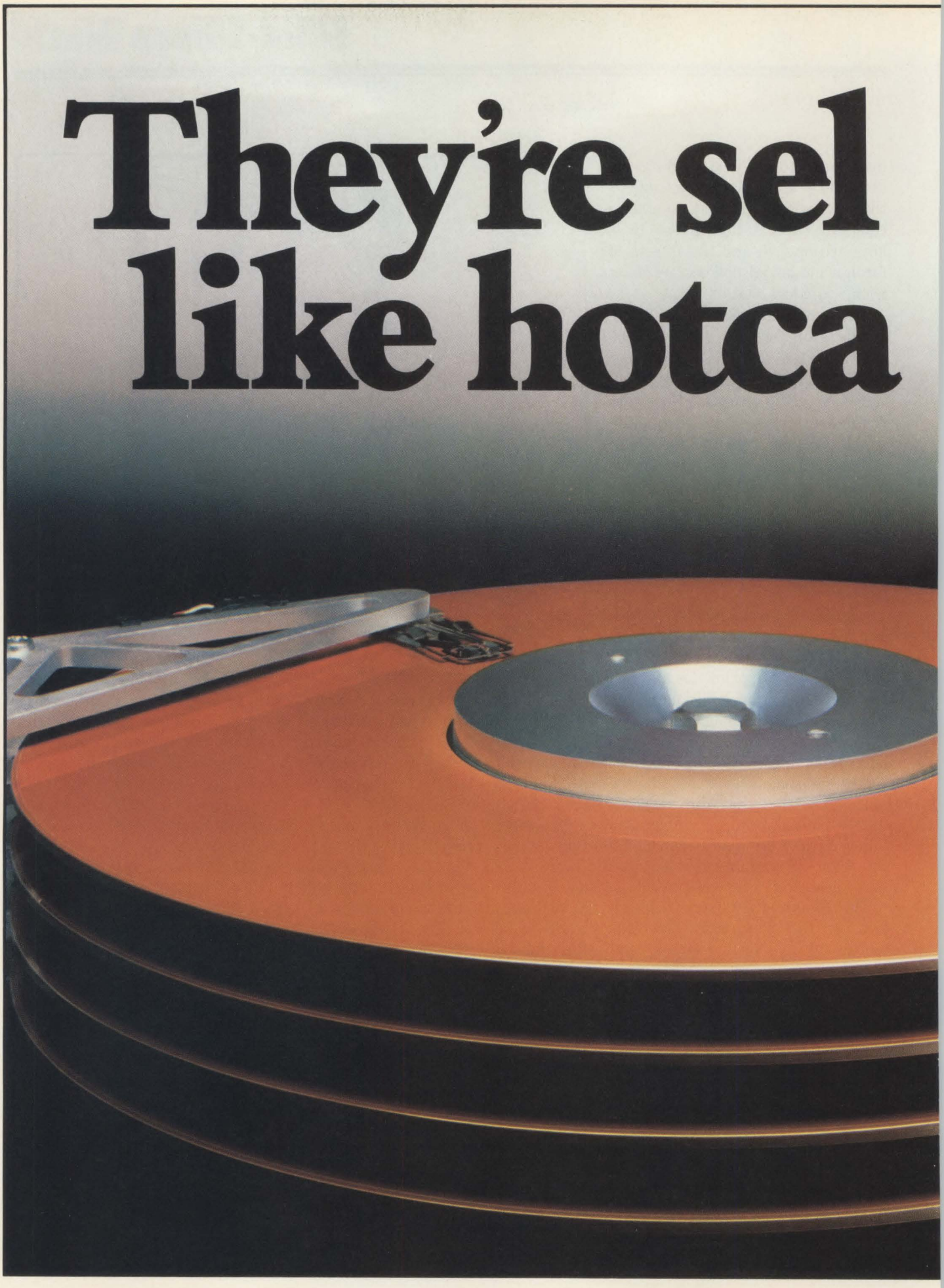

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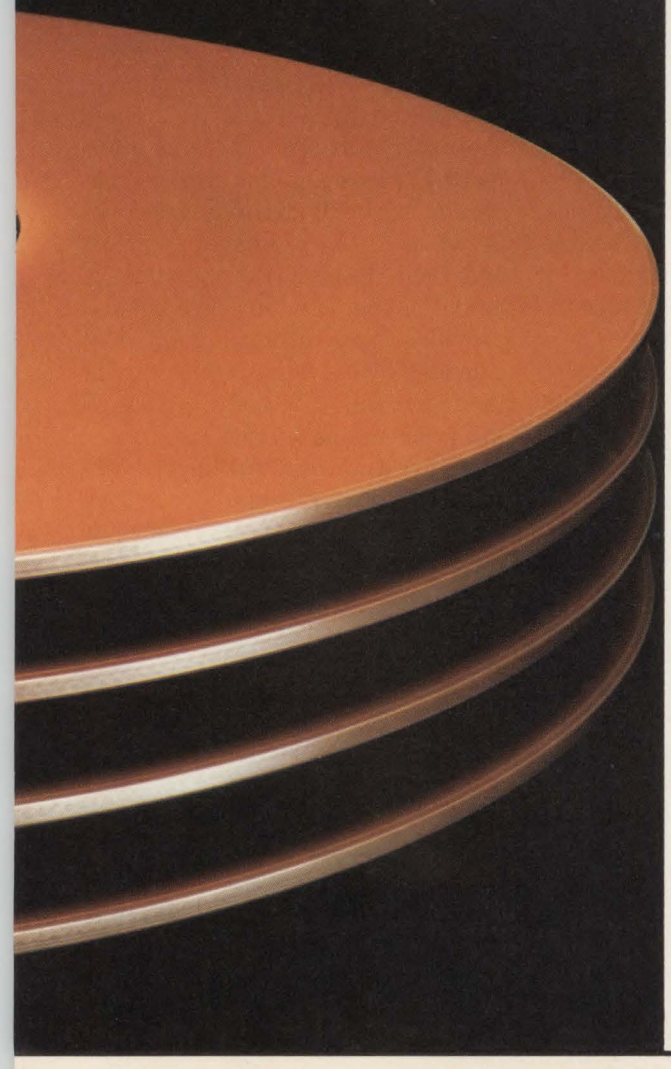

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Reagan Administration, however, are expected to oppose it. William Brock, the White House's Special Trade Representative, opposes the bill except for a provision to deal with countries that don't offer the U.S. free access in the "services," sector. The State Department is also against it. The AFL-CIO supports the legislation, as do many members of Congress from areas of the country hardest hit by imports.

The High Technology Act is supported by almost all of the groups involved in the legislation. Its biggest handicap could be how high-technology products are defined. The broader the definition, the more complex the bill becomes. Greater complexity will make it more difficult to satisfy everyone with an interest in it, for example, should its coverage be confined to the electronics and aerospace industries, should medical devices be included, or, as one Congressional aide suggested, should it include American agriculture products. The aide said some people believe American agriculture products are the highest technology products produced by the U.S.

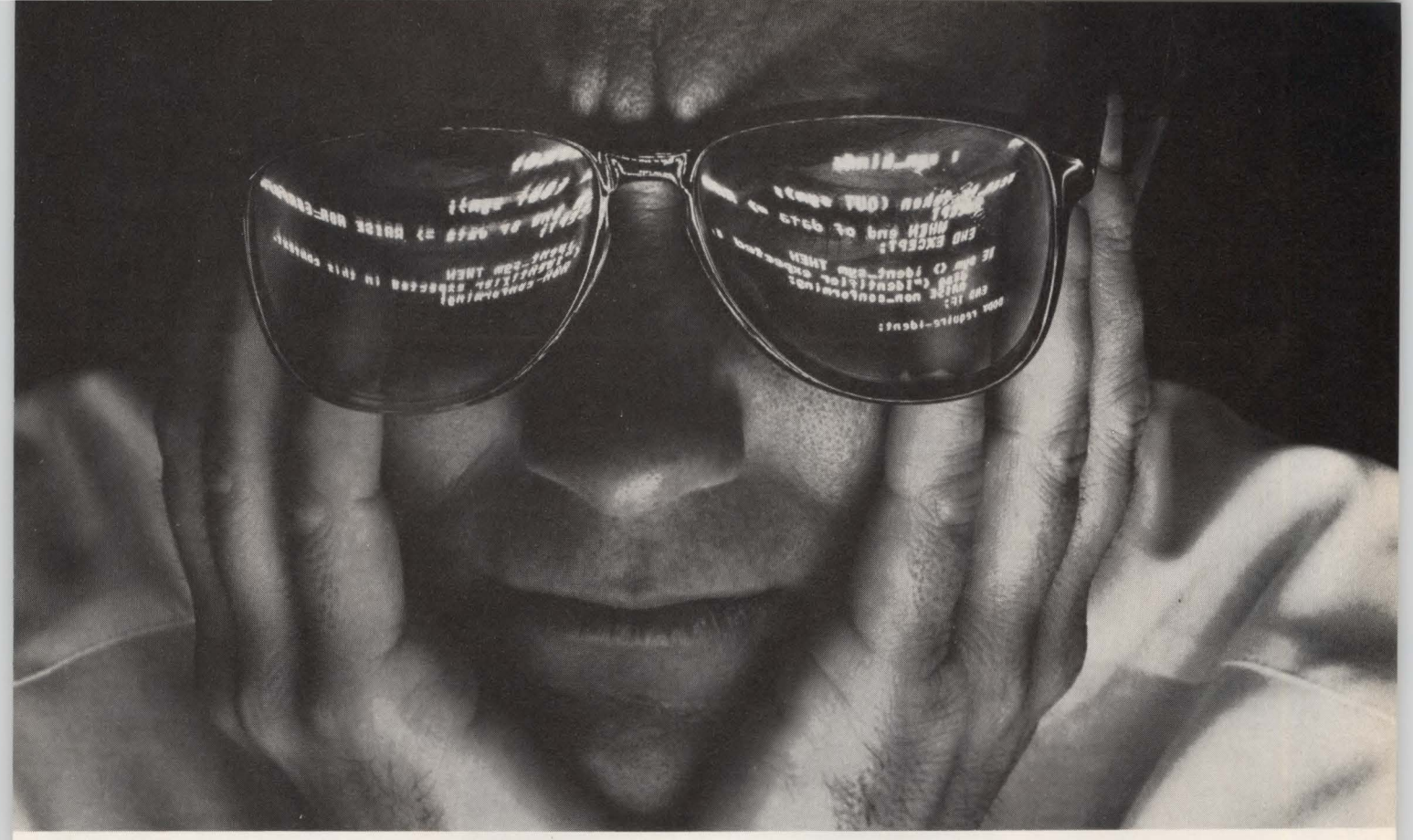
CBEMA supports Telecommunications Bill

The Computer and Business Equipment Manufacturers Association has become an enthusiastic supporter of the Telecommunications Bill now moving through the House of Representatives. The section of the bill that won CBEMA's favor specifically prohibits the Federal Communication Commission or the states from regulating the information-processing industry. Language in the bill was changed at CBEMA's request to make it clear that the regulatory sections were not referring to terminal and informational processing equipment when they discussed FCC regulatory responsibilities.

H.R. 5158 does give the commission a mandate to consider the needs of dependent markets in the regulation of transmissions. For example, a computer manufacturer could complain that a transmission service was configured in a manner that impeded the deployment of new technologies in computers, and the FCC would be obliged to consider requiring the carrier to offer a variation in that service. But section 201C grants no authority to regulate the dependent markets themselves. The regulatory authority of the commission is limited to transmission.

The House Communications Subcommittee pointed out that the Telecommunications Act will affect the information-processing industry in only four ways:

- **National defense:** The President and the Commission can require any person to supply telecommunications under certain emergency situations and in time of war (Sec. 262).
- **Interconnection:** The commission establishes technical requirements for the interconnection of terminal equipment to transmission services (Sec. 241). These standards ensure that competition is not impeded and that equipment functions without damaging the network or impairing the national defense. The commission should thus establish standards for the manner in which terminal equipment connects with a transmission service, but such a standard could not prescribe the internal characteristics of the equipment or prescribe a level of performance for the equipment. The commission could also establish a standard for a transmission service that would ensure the availability of the type of capacity needed for a dependent market (such as distributed data-processing systems or information-retrieval services) to continue to develop on a competitive basis. The obligation to establish separate prices and allow interconnection to inside wiring does not apply to cabling between computers and proximately located peripheral devices.
- **Carrier involvement:** H.R. 5158 protects users of regulated transmission services by prohibiting common carriers from burdening those users with direct or indirect costs of the carriers' participation in competitive markets, such as information processing, and from engaging in anti-competitive practices between their regulated services and their unregulated, competitive activities (Sec. 211 (c)). The bill also provides that terminal equipment provided by carriers installed under tariff remains subject to regulation for a transitional period.
- **Investigatory authority:** The commission may require only such information as is necessary to perform its duties under the act. Because the information-processing industry is not regulated, the forms of information the commission can require from it are tightly circumscribed. In the case of terminal equipment, the functions of the FCC are limited to the preceding three items. In considering remedial action regarding common carriers, the bill expressly restricts the commission to the use of information on the effects of carriers on the competitiveness of the information-processing industry to that which is publicly available (Sec. 510).



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CIRCLE NO. 22 ON INQUIRY CARD

Exhibitors continue to flock to SIGGRAPH

The ninth annual SIGGRAPH conference on Computer Graphics and Interactive Techniques, scheduled July 26-30 in Boston, is expected to be bigger than last year, says the show's general chairman Elaine Sonderegger. In early June, some 145 exhibitors had been signed, compared to 136 that showed up in Dallas last year. Attendance, however, is expected to be 10,000 to 15,000—not a significant difference from last year's 11,000.

This year, the tutorial courses will number 24, up from 18 last year, and they're divided into four categories: CAD/CAM, animation/visual syntheses, business graphics and general computer graphics information. Three CAD/CAM courses include "introduction to CAD," given by Bertram Herzog of Herzog Associates, and "solid modeling," co-chaired by University of Rochester educators Herbert Voelcker and Aristiees A.G. Requicha. In the animation category, Hanna Barbera's Marc Leboy will discuss 2D computer animation.

The business graphics category comprises eight sessions, including graphics and databases, chaired by Decision Resources' Doug Neal, and graphics design and information graphics, chaired by Aaron Marcus of Lawrence Berkeley Laboratories. Also included in this category will be a course called "presentation and publication graphics," chaired by Joel Orr of Orr Associates. In the general computer graphics category, an introduction to computer graphics will be chaired by Marceli Wein of the National Research Council of Canada, and the University of Michigan's Richard Phillips will give a course on low-cost graphics.

The courses will run the first two days of the show, and will be held not only in the Hynes Auditorium, but in six nearby Boston hotels, including the Copley Plaza, the Colonnade, the Boston Park Plaza and the Sheraton Boston.

The fact that many of these courses are introductory is a response, says Sonderegger, to previous complaints that SIGGRAPH in the past has been too state of the art and research oriented. "At this year's SIGGRAPH," she explains, "there's something for everyone."

A full technical program comprising some 35 technical papers and 11 panel discussions is also planned. The technical papers are mostly state of the art, and topics include image generation, Euro-graphics, graphics standards, modeling, user interface, hardware architecture and database applications.

Panel discussions will run concurrently with the technical sessions at the Sheraton and the Hynes Auditorium. These panels, comprised of approximately four members each, will discuss topics ranging from acquisition of venture capital to CAD/CAM to health and safety issues in computer graphics.

One panel, called "professional work stations," will be chaired by Andries van Dam of Brown University. "Voice recognition as an input technique" will be chaired by Exxon's Richard Rabin, and "business graphics: what is it?" will be chaired by David Luther of Lexidata Corp. Tektronix Inc.'s David Straayer will lead a panel on the "impact of graphics standards."

Also included in this year's show will be vendor forums. Sonderegger explains that these forums are intended to give vendors a chance to present products to interested end users away from the hustle and bustle of the exhibit floor. These forums are in four categories: future applications, hardware trends, business graphics and CAD/CAM.

The SIGGRAPH exhibit opens on the second day of the show, and such companies as Apple Computer, Inc., IBM Corp., Tektronix, Megatek Corp., Ramtek Corp. and ISSCO will present products. *—Nancy Love*

MINIBITS

MINI MEMORY PRICES DROP WITH 64K-BIT CHIP USE

The adoption of 64K-bit memory technology has spurred a series of minicomputer-system and memory price cuts. With the introduction of the VAX 11/730 in May, Digital Equipment Corp. offered a 1M-byte board of 64K-bit memory at $9000, and priced a 4M-byte addition at $24,000. It followed with a reduction for 16K chip memory on a 256K-byte board of 69 percent to $2400 and cut a 4M-byte VAX 11/780 increment 60 percent to $22,000. DEC has limited the 64K memory to the 730 and 750, but indicates it will follow a similar pattern with the 780. At Data General Corp., 64K-bit chips have been added for the MV/8000 32-bit mini, taking maximum memory to 12M bytes from 4M bytes and reducing add-on memory as much as 50 percent by packaging as much as 2M bytes on a single board. A 1M-byte module dropped from $28,000 for 16K RAM to $16,000 for 64K RAM. Meanwhile, Prime Computer, Inc., cut add-on memory as much as 47 percent from $36,000 for 1M byte of 16K RAM to $19,000 for 1M byte of 64K RAM. The company dropped prices of its 250 II, 550 II and 750 systems to reflect the new memory prices. At Honeywell Information Systems, Inc., 64K RAMS were used to up the minimum memory on a DPS/6 32 to 256K bytes from 128K, while system pricing dropped from $27,500 to $26,000. A DPS/6 32 with 256K bytes of memory dropped from $26,500 to $24,500.

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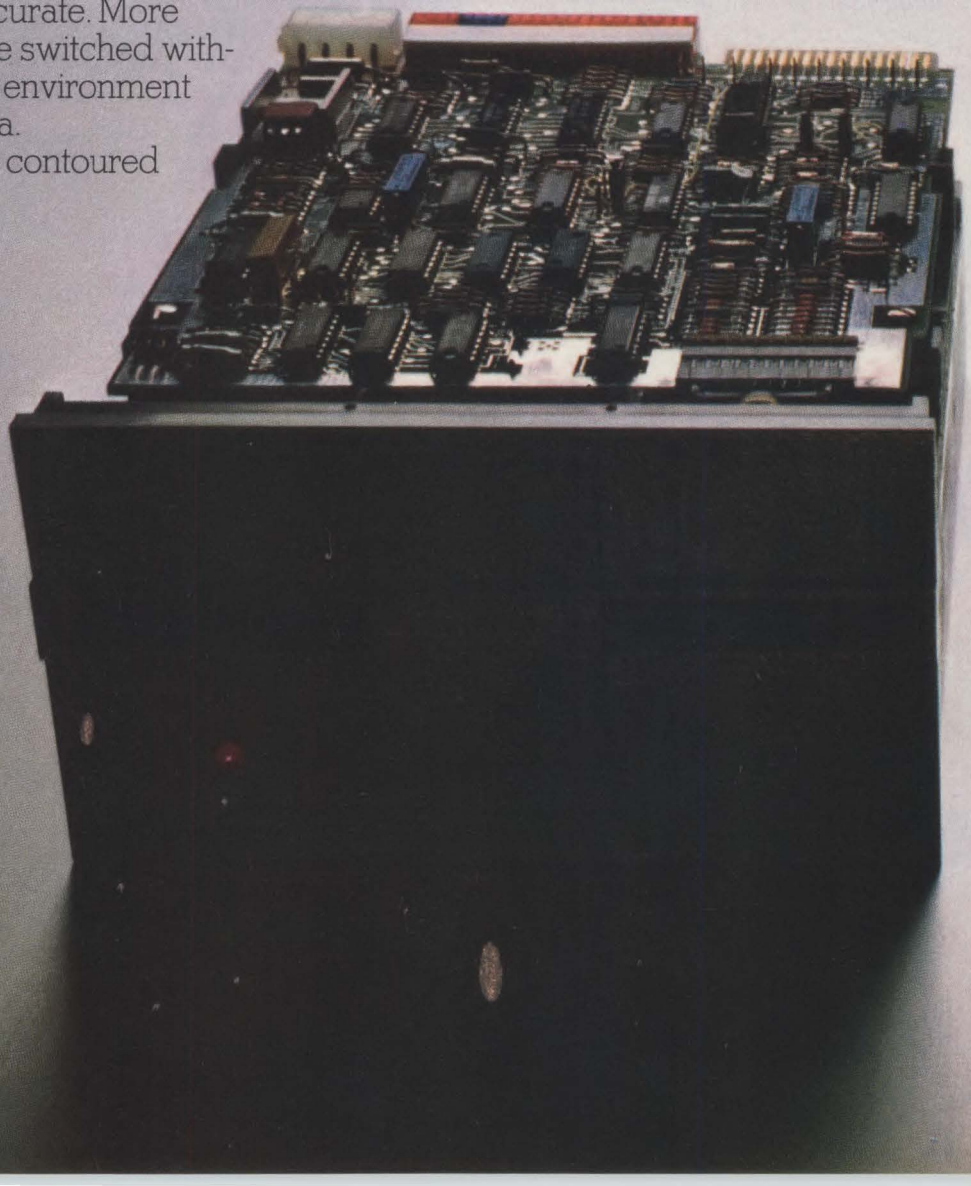

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fied with remarkably rugged engineering. Like 4-point aircraft-type shock mounts, which make it virtually unaffected by shake-ups around the office. And an automatic spindle and actuator lock, to protect the heads and media.

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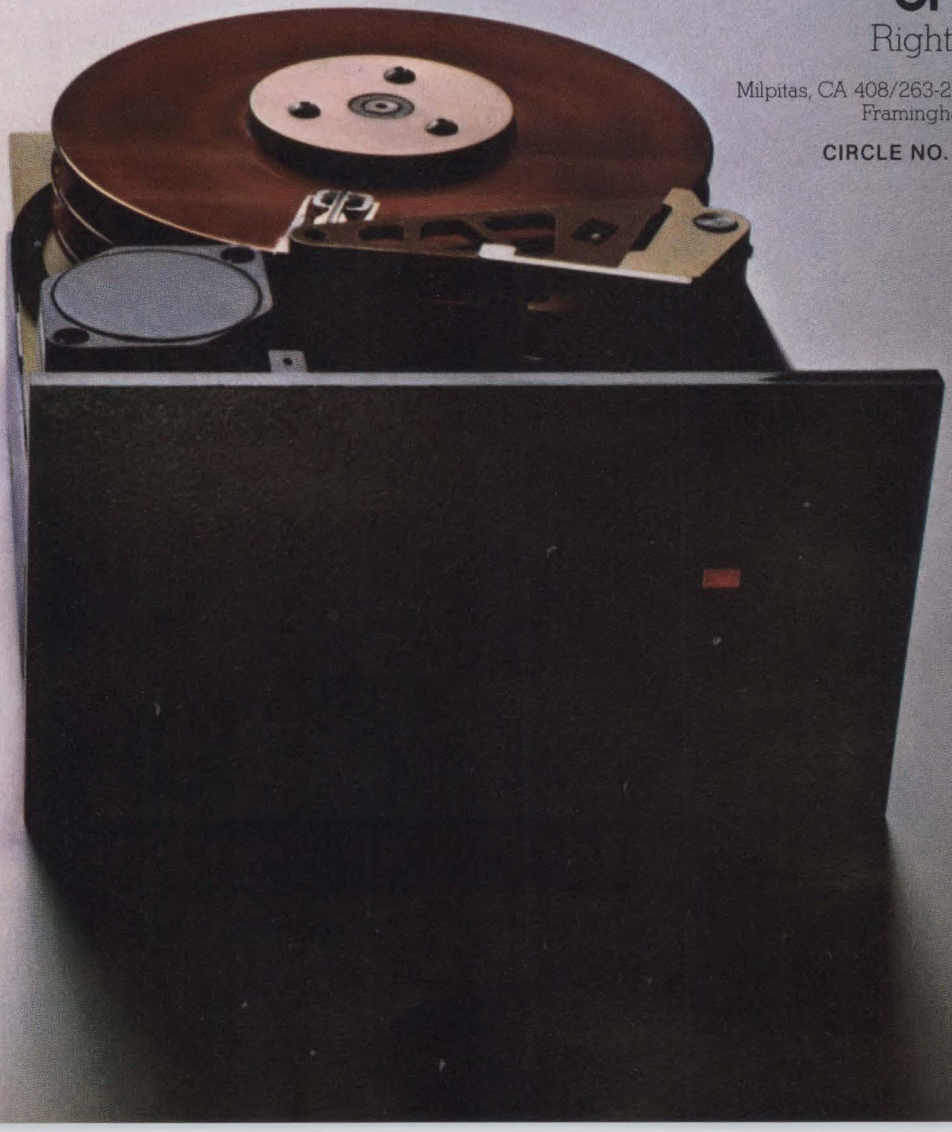

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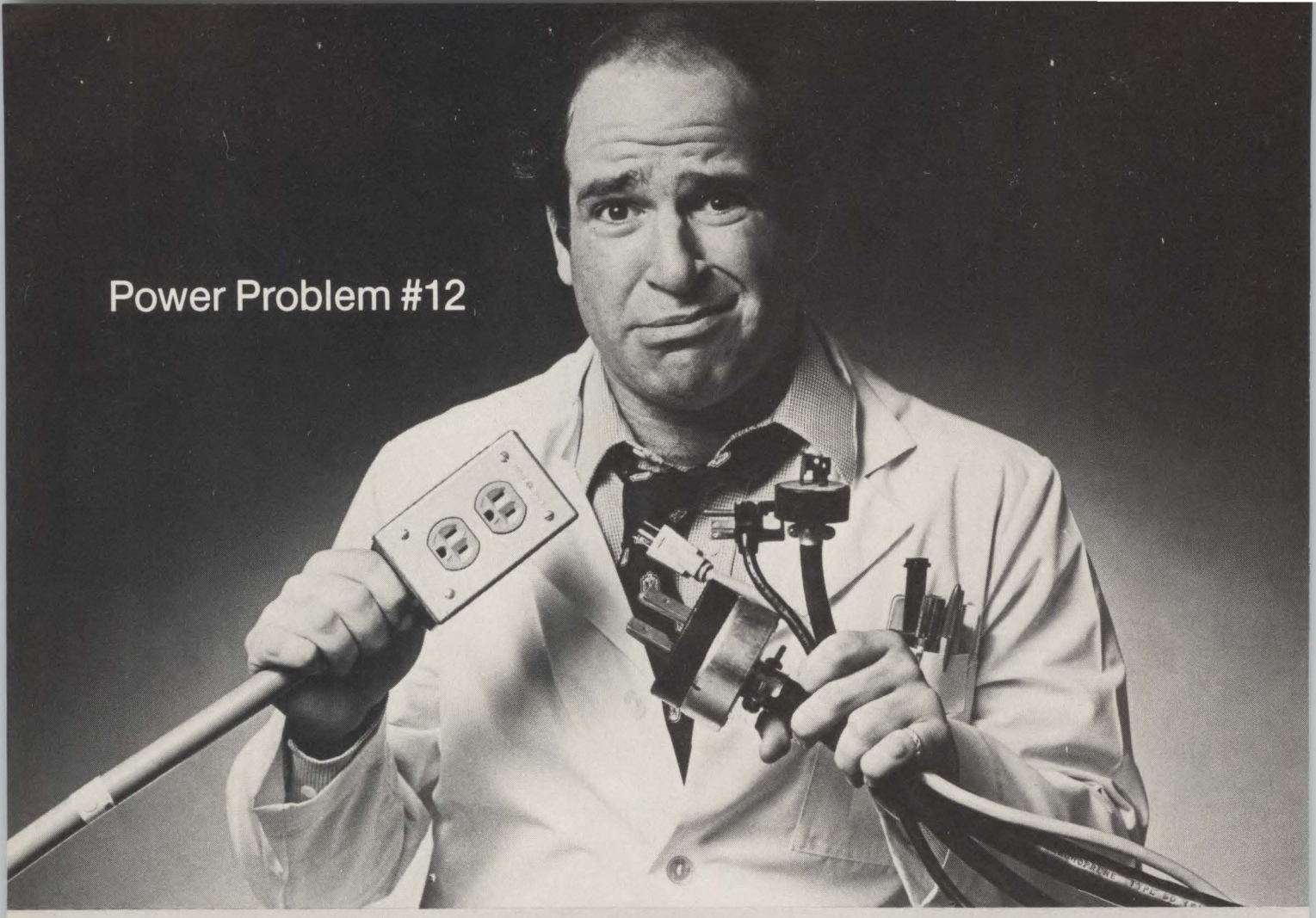

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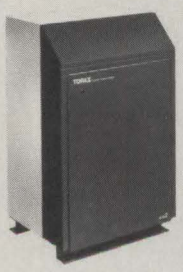

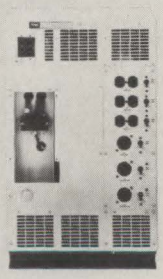

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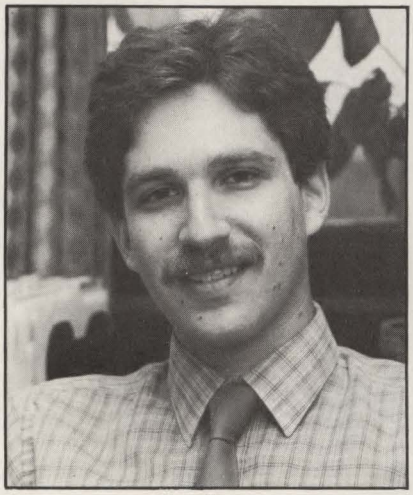

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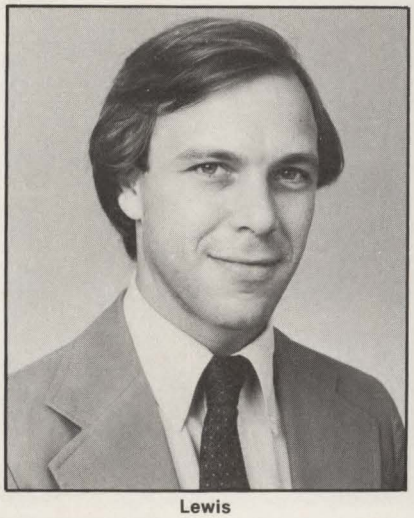

Lewis

A three-year growth plan we undertook to expand and strengthen the editorial staff on *Mini-Micro Systems* has come close to completion with the additions of David Freedman and Geoffrey C. Lewis. Both are associate editors, and both have been contributing to the magazine for a few issues. David works with executive editor Alan Kaplan in the Boston office to solicit and develop contributed feature articles, while Geoff covers the burgeoning small systems beat from our Manhattan office.

David comes to us from GML Corp., a computer-based quantitative research and publishing organization in Lexington, Mass., which assists members of our editorial staff in their research. David was editor of *Computer Review* at GML and director of the firm's computer hardware database service. He previously taught physics at the Peddie School, Hightstown, N.J.

David studied journalism at Northwestern University, and went on to earn a B.A. in physics from Oberlin College, Oberlin, Ohio. He has published articles on computer topics and on geophysics research he performed at the Massachusetts Institute of Technology. David has also lectured on plate tectonics, which is the study of continental shifting, and on astronomy.

Before opening our New York office in April, Geoff Lewis had covered computer, word-processing and office-automation developments for business and trade publications for more than four years. Most recently, he was senior editor for *Electronic News*. In that capacity, Geoff reported and wrote news stories and feature articles about computer peripherals, small-systems and office automation. His duties also included supervision of a national network of correspondents, plus editing and layout to produce the paper's peripherals section and small systems pages.

Before assuming direction of EN's peripherals and small-system coverage, Geoff was an associate editor there and assistant editor for *Word Processing World*, a monthly magazine. He has a B.A. in journalism and American studies from Lehigh University, Bethlehem, Pa., and has taken advanced courses in economics and magazine production.

S. Henry Sacks

S. Henry Sacks
Vice President/Publisher

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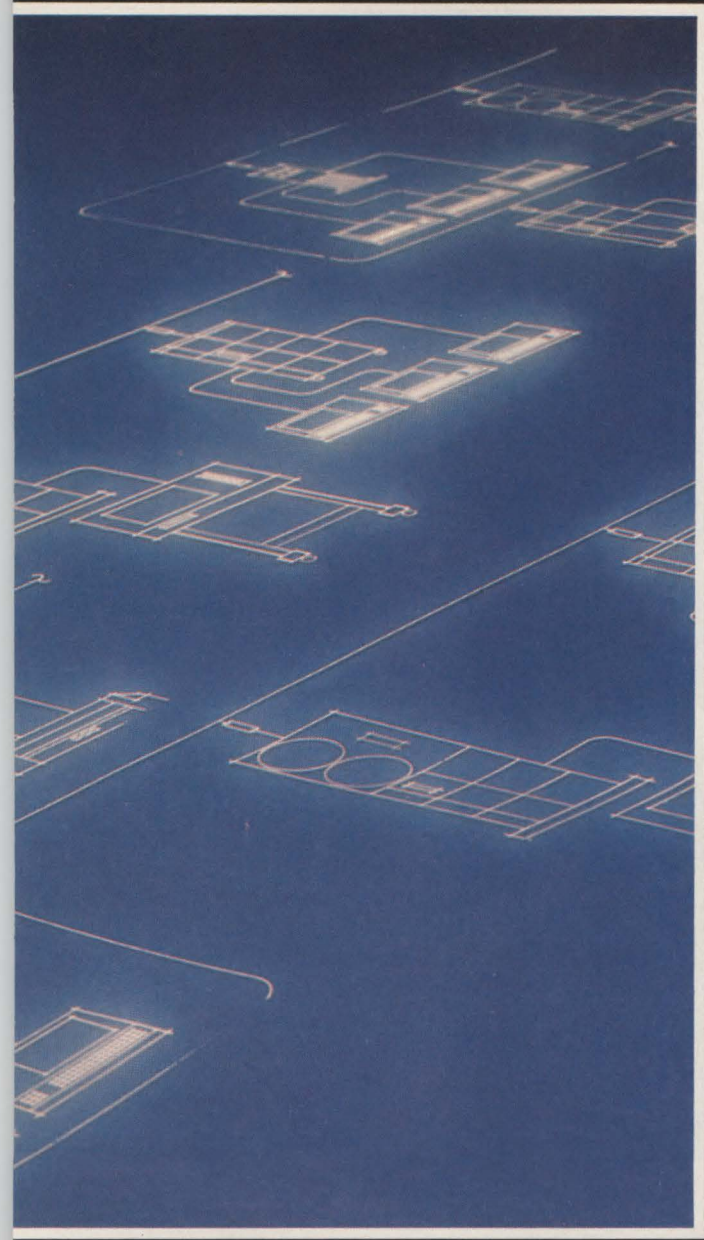

Today, the OEM with big plans is thinking Zilog's System 8000, the Supermicro. This is the breakthrough general purpose microcomputer that easily stands comparison with minis such as the PDP 11/70.† For $29,950, the System 8000 gives you 256 KB of ECC memory, a 24 MB Winchester disk and 17 MB cartridge tape back-up. It is available in both 8 and 16 user configurations, with up to 4 MB added memory and higher capacity disks.

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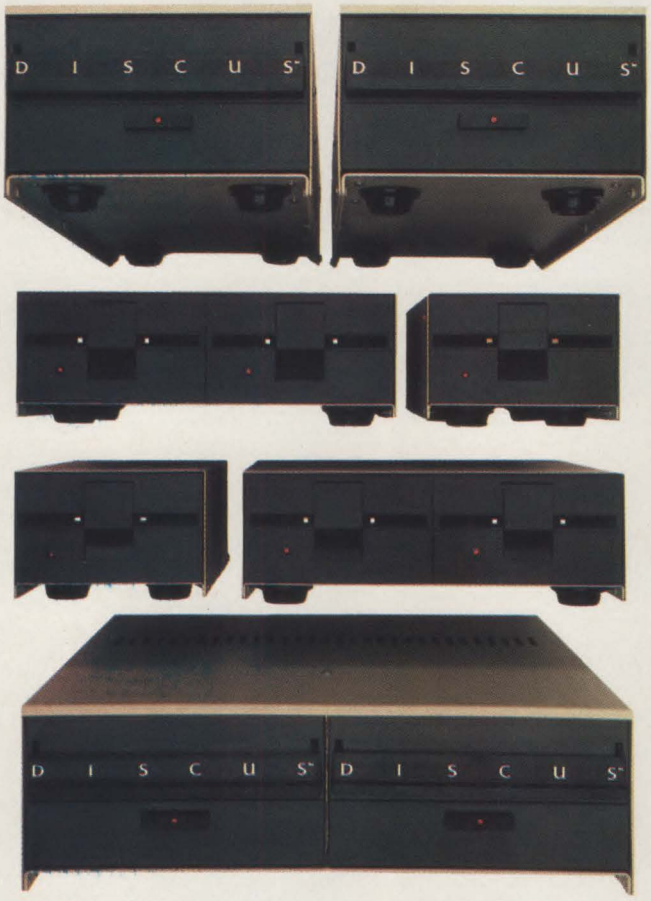

DMA answers. Standard, accumulator transfer floppy disk controllers can stall your microcomputer system's CPU for as long as 160 milliseconds. Just to access and transfer a sector of data to main memory. If CPU processing speed and system performance are critical, you need something better. That's where Morrow Designs' new intelligent Disk Jockey DMA™ controller comes in. This new breed of perpherial handles both 5¼" and 8" drives and can read almost any format in existence. Speed? Your CPU runs at full tilt while the DMA controller seeks and gathers a sector of data. How? Information transfers to and from main memory occur as "cycle steals" from the system bus. And the missing memory cycles are transparent to the CPU totalling only two milliseconds instead of the usual 80.

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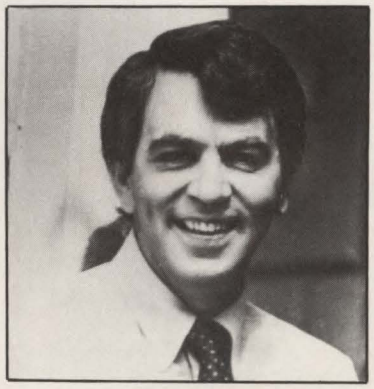
MEETING THE JAPANESE CHALLENGE

(Sen. Paul Tsongas [D.-Mass.] addressed members of the International Business Center of New England recently on the topic of trade with Japan. His remarks included some comments about high-technology imports and exports that are broadly applicable to the computer industry. We think they deserve a wider audience and have excerpted some of the highlights here.

Lawrence J. Curran)



Sen. Tsongas

The United States economy is facing the greatest external challenge in its history. The challenge is being mounted by the Japanese. The issue is U.S. competitiveness in the world. There is reason for alarm, because the Japanese are beating us in many areas, and they are beating us badly. Even on the frontiers of high technology, where the United States is the leader, the Japanese are challenging us as never before.

The U.S. trade imbalance with Japan ballooned to $10 billion in 1980. It widened further to $18 billion in 1981. This year we are sliding $25 billion deeper in the hole in our trade with Japan. Already, Japanese companies have nailed down 70 percent of the world market in the newest generation of memory chips: the 64K RAM. The same companies now are aiming for the 256K RAM market. That will be the arena for the next round in the battle for supremacy over the all-important computer chip.

And there will be a formidable Japanese challenge in other high-technology fields: robotics, bio-engineering—you name it. How can we respond to the challenge? What further resources are required? That is a question I have been asking myself for several months. At first I had high hopes for reciprocity as the answer to our trade problems. By reciprocity I mean U.S. reprisals against Japan or other countries where we encounter barriers to American exports—an eye for an eye, a tooth for a tooth.

But I have concluded that lockstep reciprocity would be a mistake. It likely would trigger a cycle of protectionism between the United States and its trading partners. Protectionism is no answer. It is an opiate that would lull us into complacency while the real problems underlying our economy persist.

Let me make some specific proposals for meeting the Japanese challenge. First, labor and management must adopt a more cooperative, less confrontational spirit. A new cooperative spirit can lead to all-important gains in productivity. Labor should recognize the need for automation to keep U.S. industry competitive. In return, management should accept responsibility for minimizing displacement of workers and for retraining them.

Continued on next page

Editorial

Second, we need to expand sharply U.S. investment in research and development. In particular, the government should underwrite research and development in areas that private enterprise deems too risky or long-range, but that promise an eventual bonanza in higher U.S. productivity.

As a further spur to technological innovation, the U.S. ought to unleash joint research ventures. They are multi-company, pooling arrangements for research too broad for any single company to undertake. They are scarce in this country because of antitrust laws that create needless uncertainty and because of a lack of economic incentives (see "U.S. firms join forces...," p. 85). We ought to pass the legislation necessary to galvanize joint research.

Third, we must train our people for the high-technology age. Widespread computer literacy is still a mirage on the horizon. Our universities are low in engineering faculty. Laboratory equipment is obsolete. Engineering programs are overcrowded. The United States must strengthen its schools. We should expand education budgets. I propose more graduate student loans, not less. I propose more money for modernizing laboratory equipment, not less. I propose more enrollment in universities, not less. I also urge establishing teacher retraining centers to combat teacher burnout and to update teacher's expertise.

Industry can do much to gird up high-tech education. The Massachusetts High Technology Council is a pioneer in calling on its members to contribute 2 percent of their research-and-development budgets to universities. I applaud these companies for their philanthropy. I urge others to follow their example.

Fourth, in settling disputes over regulations, business and government must negotiate more, litigate less. We need more cooperation regarding regulatory matters. Rigidity about regulations can be counterproductive, both for U.S. industry and for the overall economy. The fault is not one-sided. Both regulators and businessmen must adopt a more cooperative spirit. Again, the Japanese experience is instructive. Though Japanese business and government are often bitter antagonists over regulation, they manage to resolve their differences through persuasion and conciliation, not by coercion.

Fifth, we must encourage savings to generate more investment in American industry. The savings rate in the United States is far too low, only one-fourth the rate in Japan. It is self-evident that the only way to build the industry capacity we will need for tomorrow is to save—and invest—more today.

Finally, we must redouble our efforts to expand exports. The Japanese aggressively promote exports. We must see to it that American companies compete for exports on an equal basis with companies of other nations. I propose that we enact export-trading-company legislation to guarantee U.S. companies equality in the foreign marketplace. We should also expand the Export-Import Bank to ensure financing of U.S. exports on the same terms other nations provide for their companies. We have been losing export business because American companies have had to operate at a competitive disadvantage. Recently, Kawasaki Heavy Industries won a contract to supply subway cars to New York City because the Japanese government offered a $126-million loan at 12.25-percent interest. No U.S. firm could arrange financing terms to match. We can no longer afford to lose business of this kind. We must ensure that U.S. industry competes for exports on an equal footing.

We have the means at our command to meet the Japanese challenge. We must act before it is too late.

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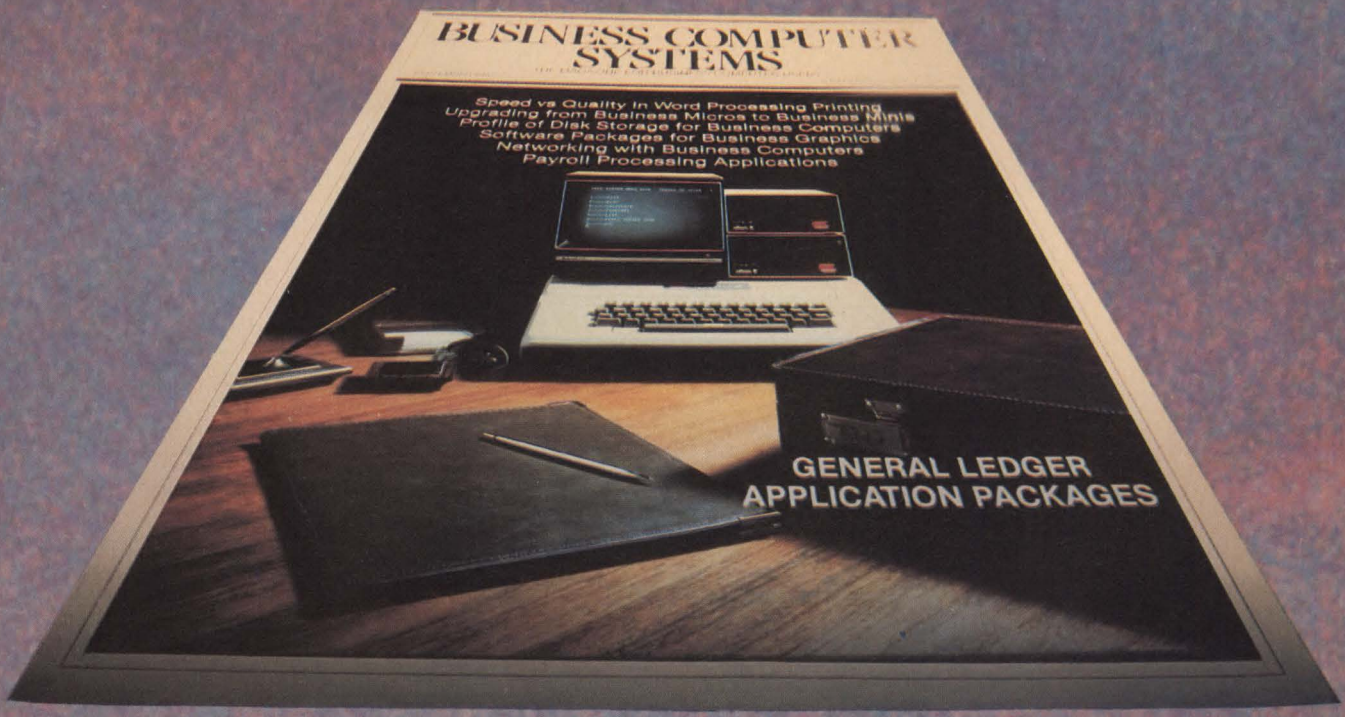

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CIRCLE NO. 59 ON INQUIRY CARD

RELOCATABLE ASSEMBLER

To the editor:

Thank you for including our relocatable assemblers in the New Software section (MMS, January, p. 280). However, the product was misstated as running "on the Motorola 6800 and RCA 1802." The MACRO-68 and MACRO-18 execute on CP/M-based microprocessor systems, assembling code for the Motorola 6800 and RCA 1802, respectively.

Roger C. Tjarks
Product Manager
Syscon Corp.
San Diego, Calif.

ZENTEC CORRECTION

To the editor:

Our recent press release to you seems to have lost something in the transcription.

The following are corrections to your Breakpoint announcement of our product, the Series 2000 (MMS, May, p. 5).

Disk capacity is as many as four Winchester drives, with floppies substitutable for two of them. The four drives are contained in two disk-storage modules.

Work-station capacity is 16K bytes, not 16M bytes.

Prices are suggested end-user, not OEM, prices. Lowest quantity-one suggested end-user price is, in fact, $8950.

Bill Potts
Product Manager, Systems
Zentec Corp.
Santa Clara, Calif.

NEXT MONTH IN MMS

Microcomputers will be the cover theme in the August issue of Mini-Micro Systems. The feature section will be anchored by three comprehensive product profiles: desk-top computers, single-board microcomputers and software—transportable 8-and 16-bit operating systems.

Mini-Micro Systems will also take a close look at a new, growth-oriented, dual-processor desk-top system that accepts both 8- and 16-bit industry-standard software as well as industry-standard expansion boards.

Application articles will review innovative approaches to using microcomputers in manufacturing and scientific environments.

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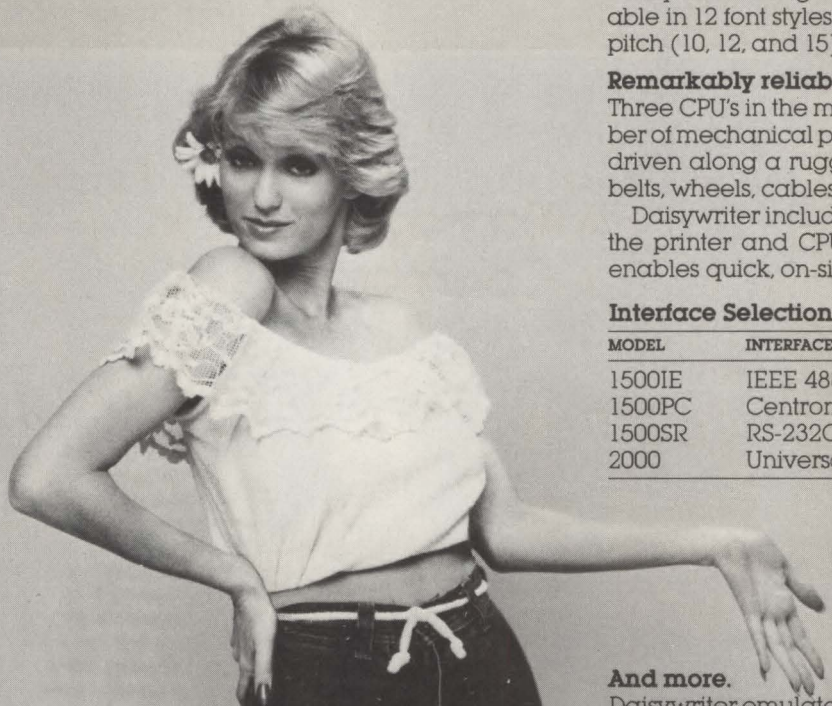

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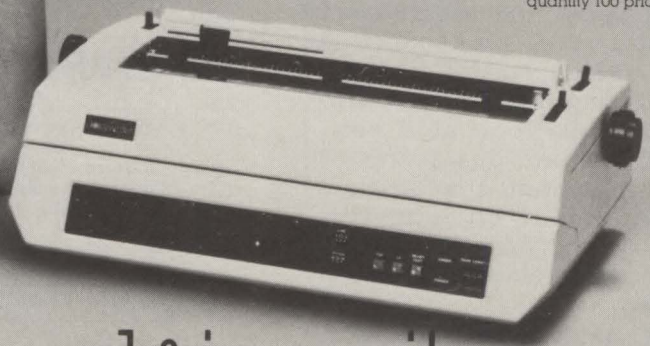

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CIRCLE NO. 23 ON INQUIRY CARD

The American computer industry puts 'Theory Z' to the test

By Kevin Strehlo
Associate Editor

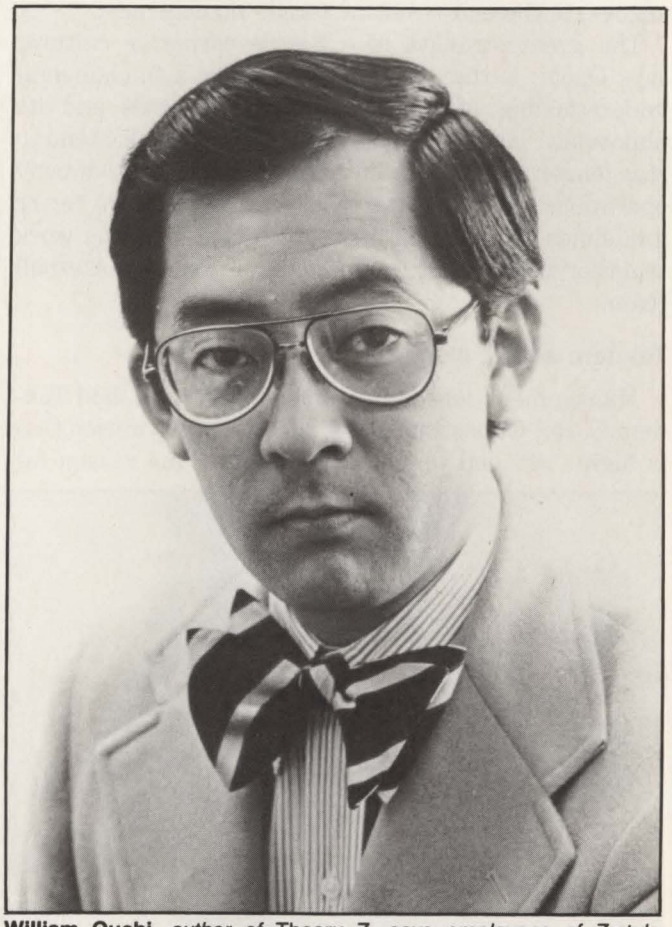
Fueled by William Ouchi's best-selling management study, *Theory Z*, and fanned by the Japanese computer industry's success in markets that were once exclusively American domain, interest in Japanese management style burns brightly in the U.S. computer industry. Many companies are openly adapting elements of the organization and philosophy of their Japanese competitors.

But Ouchi warns that the change from a typical "Type A" U.S. management style to a Theory-Z, Japanese-influenced style is far from simple, and that programs such as quality-control circles will not accomplish anything without a corresponding change in the overall corporate culture. And Richard Pascale, who teamed with Anthony Athos to write *The Art of Japanese Management*, doesn't foresee many changes as profound as the move from Type A to Type Z, despite the claims of many executives.

The contrast between Ouchi's Type A and Type Z companies derives partially from Douglas McGregor's elucidation of the two basic assumptions that can underlie a management method in *The Human Side of Enterprise*, a book written while McGregor was a professor of industrial administration at the Massachusetts Institute of Technology. The philosophy of an A company assumes workers cannot be trusted; thus, A-style managers operate autocratically. Z-style managers view employees as a company's greatest resource and assume employees want to do good work and will, given the chance.

But Theory Z goes further. Based on his research on successful American and Japanese companies, Ouchi found the following common Z characteristics: lifetime employment; slow evaluation and promotion; nonspecialized career paths, which encourage employees to be experts in their companies rather than in their professions; implicit control mechanisms that heed the impact of symbolic behavior; collective decision making and responsibility; and wholistic concern. Type A companies, on the other hand, are marked by high turnover, rapid advancement, extreme specialization, a "the buck stops here" philosophy governing decision making and responsibility and heavy reliance on bottom-line financial control systems.

Pascale, however, says that in many cases, Theory Z generalities do not apply to successful Japanese companies. He warns that the move to boost productivity and best the Japanese by adapting Japanese management techniques may be a case of misunderstanding the Japanese success story.



William Ouchi, *author of* Theory Z, *says employees of Z-style companies share an understanding of the corporate goals and philosophy.*

"There's a big fad right now about Japan," says Pascale. "The healthy part of that fad is that it gets us to reflect on the conventional wisdom of our business schools and culture." The unhealthy part, says Pascale, is that focusing on Japanese companies' use of implicit control mechanisms and participative management ignores the fact that many Japanese success stories are cases of U.S. companies being beaten at their own game.

Pascale says Honda's goal of achieving a wider market for motorcycles is an example of Japanese success resulting from better marketing strategy than the U.S. competition. Further, it was implemented

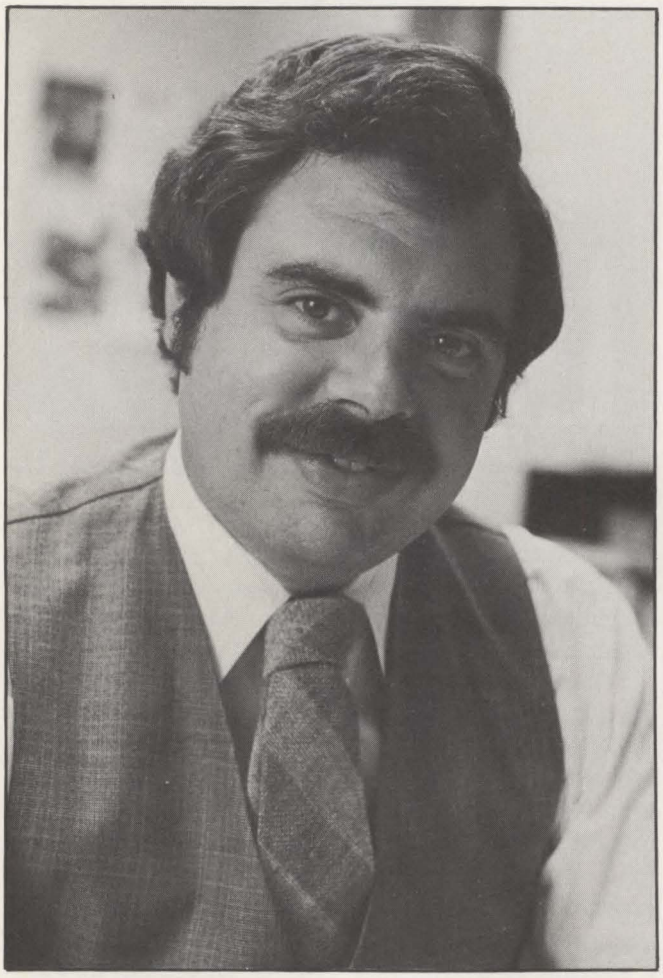
using one of America's favorite tools: advertising.

But Pascale agrees with Ouchi on one fundamental point. "Great companies," Pascale says, "whether Japanese or American, do not just make money. They also make meaning for people." And that trait, Ouchi argues, is the end result of Z-style management.

The great strength of a Z-style corporate culture, says Ouchi, is that all employees share a fundamental understanding of the corporation, its goals and its philosophy. Employees of a Z-style company also tend to stay longer and develop intimate knowledge of company operations. Ouchi says employees then require fewer guidelines and restrictions to make decisions and work together with the grace and skill of a good basketball team.

Tandem sets Z example

Management consultants including Pascale laud Tandem Corp., Cupertino, Calif., as a U.S. corporation that is highly attuned to the Z philosophy. One reason for this may stem from Tandem's origins.



Tandem's Jim Katzman *believes the company's employees are more willing to support the implementation of decisions because the workers are encouraged to participate in the decision-making process.*

"We're all from Hewlett-Packard Co.," says Tandem vice president Jim Katzman about the co-founders and most of the original employees of Tandem, "and that explains a lot of things about us." H-P reportedly was the most influential model for Ouchi's archetypal Z-style company, and Tandem has followed suit. "I certainly agree that we're a Z-style company," says Katzman.

It shows in everything from Tandem's Friday afternoon beer busts to its thorough teaching of the company philosophy to employees. Katzman's reasons for involving people in decision making—people who have input into a decision give stronger support during the decision's implementation—could have come from Ouchi's lips. Tandem's other Z-style attributes are many. The result, Katzman says, is that turnover is 6.7 percent, compared to the overall average in Silicon Valley of almost 29 percent. And productivity, as measured by the average revenues generated per employee, was more than $100,000 in fiscal year 1981, nearly double the $50,000 average achieved by American Electronics Association member companies.

Although Tandem is a success story, it's unclear whether that success results more from the company's Z-style management philosophy or from the fact that company president Jim Treybig invented a better mousetrap—fail-safe computing for transaction procession—aimed at a largely untapped, growing market. Nor can the company's heavy, A-style emphasis on the bottom-line be ignored: Tandem uses its own computers to keep daily tabs on operating results.

Similar questions are raised when the subject is IBM Corp.—another company Ouchi studied. As with Tandem, one wonders how much of IBM's success is the result of a shared corporate culture and how much is the result of the legendary accuracy and completeness of its planning process. Theory Z fits, but even Bob Hanko, who heads IBM's quality-circles program, wonders where Theory Z leaves off and IBM begins.

"One thing that bothers me about Theory Z is all the emphasis on consensus decision making. There's room for a little conflict—and I don't mean in a negative sense," he emphasizes. "IBM has proven that contention can be a viable management tool."

More than a passing fad

At Irvine, Calif.-based Toshiba America, Inc., there are no doubts as to the efficacy of Theory Z. "When you look at what the Japanese are doing in the computer business, it becomes apparent that their business style is as important as their technical prowess," says John Rehfeld, vice president and general manager at Toshiba America. "Even in that business style, 95 percent of what they do is the same as what we do. But it's the

final 5 percent that's critical, and that's what's involved in what Ouchi calls Theory Z."

Rehfeld believes that Japanese management techniques are here to stay. "I don't believe it's a fad," he says. "You're talking about a company's underlying value system. People who come in and work for us say they're tired of changing jobs every three or four years and would like to settle down. We tell them that if they work hard, and continue to work with honesty and integrity, there will continue to be a job available for them throughout their lifetime."

The company replaces the typical career ladder, on which people move within their profession via strategic jumps from company to company every three to five years, with an internal advancement path that might see a salesman move into marketing and then into accounting.

"In Japan, the average senior manager has been involved in six different career disciplines," Rehfeld says, "and Toshiba wants to reap the benefits in cooperation and understanding of a company that comes from that broadness."

Rehfeld is nothing less than enthusiastic about Theory Z, but one source close to the company says the system is not without problems and points out fundamental flaws. He says the peer pressure to put in long hours is immense—the three senior Japanese employees work nightly until nine o'clock, and a dozen or so cars are in the parking lot every evening and weekend. "I didn't have any time left for my family," says one former employee.

And Brad Spencer, a management consultant to Toshiba, says Toshiba America has a long way to go before it's truly Theory Z. "It'll be 1999 before the Americans really understand the consensus decision-making process," he says, noting that at Toshiba, the program is a function of one individual—perhaps a contradiction in Theory Z terms. "The key is Rehfeld," he explains. "Without someone like him, who won't give in to the temptation to veer from that tough path toward Z, all they've gained could be lost overnight."

The contrast

Japanese organizations	*vs.*	*American organizations*
Lifetime employment		Short-term employment
Slow evaluation and promotion		Rapid evaluation and promotion
Non-specialized career paths		Specialized career paths
Implicit control mechanisms		Explicit control mechanisms
Collective decision making		Individual decision making
Collective responsibility		Individual responsibility
Wholistic concern		Segmented concern

Source: Theory Z

Ouchi's view *of the fundamental differences between the operation of Japanese and American companies.*

Disagreement over quality-control circles

Many management experts agree that transition to a Z-style company offers advantages, and several companies have introduced programs that involve the ubiquitous quality-control circles or participative management as a means of boosting productivity.

A quality-control circle involves a small (no more than 12-member) group of volunteer employees who identify and solve problems that impede work. They are

Motorola's plan to increase productivity

Participative Management Program	Type of employee affected	Number of employees affected	Program focus	Criteria for success	Frequency of bonus payments	Average bonus to date
Plan I	Those involved in operational aspects of the business	11,000	Amount, quality and cost of materials required for production	Improvements in current cost, inventory and delivery standards	Monthly	Over 10%
Plan II	Those responsible for management of operations	2000	Effective management of Plan I, plus pricing and marketing strategies	Profit margin improvements	Quarterly	Slightly under 15%
Motorola Executive Incentive Plan (MEIP)	Those involved in strategic decision-making	750	Effective business management with emphasis on strategic planning 3-5 years out	Yearly improvements in profit and productivity	Yearly	Not available

Source: Motorola Inc.

Motorola Inc.'s Participative Management Program *consists of three separate plans for different worker categories. The executive annual bonus reportedly can reach 40 percent, equivalent with the incentives offered by some of the largest Japanese firms.*

given extensive training in the use of statistical problem-solving tools and brainstorming techniques, and they are trained to avoid problems that lie beyond the circle's scope. Many companies claim success with quality circles; some of these programs—for example, National Semiconductor Corp.'s Target Analysis Process (TAP)—use the concept, but don't train the participants in problem-solving techniques.

Pascale says many quality-circle programs may be nothing more than simplifying a complex process. He notes that many Japanese companies that use quality-control circles in Japan don't use them in the U.S. "Matsushita bought the Motorola plant in Chicago 10 years ago, but that plant doesn't have quality circles to this day," Pascale says. "A quality circle works only if the atmosphere is right."

In that fairly typical U.S. plant, Matsushita management decided the situation called for not a Theory Z approach, but a thoroughly Type A, get-tough policy. As Pascale and Athos write in *The Art of Japanese Management*, the new division manager "began slashing costs, furloughed all production employees for one month, forced early retirements, demoted redundant supervisors, eliminated cost-of-living increases and dismissed one-third of management." These are hardly the actions of a Z-style company as described by Ouchi.

And it is Ouchi who underscores what may be the most fundamental problem with the implementation of quality-control circles as a first step toward Japanese-style management and productivity. "Ultimately, a process of organizational change cannot succeed without the direct and personal support of the top person in the hierarchy," he writes. "If an organization begins by being rigidly hierarchical, evolutionary change must begin at the top of that hierarchy."

Richard Pascale, *co-author of* The Art of Japanese Management, *questions the claims of some American firms that they have moved to a Z-style approach, and points out that Japanese companies often use American techniques to succeed.*

Motorola's participative approach

Management consultants generally agree that only a thoroughgoing move toward participative management has a chance of paying off. In *Theory Z*, for example, Ouchi writes: "A major electronics firm has recently embarked on a major organizational change. Currently it has large order backlogs and high profits, but two recent market surveys indicate that newly introduced Japanese products have superior characteristics and quality at a lower price." The company is Motorola Inc., and Ouchi's discussion of accomplishing a successful change to a Z-style company matches how outside observers characterize Motorola's key players: managers that, as a result of corporate success, "feel more secure as individuals" and "more willingly share power."

Motorola's changes are spelled out in "The Motorola Participative Management Program," which recognizes that the success of quality-control circles is often fleeting. The Participative Management Program incorporates techniques much like circles, but emphasizes that those efforts are not external to the main corporate culture. "PMP is not a separate program or system in parallel with our present management system. PMP is how our company will be managed," states the document. Pascale and management consultant Spencer sound similar warnings, but Ouchi puts it best: "If top management feels that they've done something worthwhile by telling someone to go and fix the hourly workers with a QC circle, then they're just fooling themselves. If a participative style is installed through the use of a quality circle, with no other understanding or support by top management, what you have done essentially is created a deviant subculture. The dominant culture will always take the subculture and turn it back into what it used to be."

Time will tell if Motorola's participative management program will succeed. But the company recognizes the difficulty of what it is attempting. "The Motorola

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CIRCLE NO. 39 ON INQUIRY CARD

Participative Management Program is not a pat formula or set of procedures which may be mechanically applied with the expectation of automatically achieving a totally cooperative and productive system," says company literature. That admission is unusual, given the self-congratulatory nature of most industry talk about new management programs.

One impressive feature of the Participative Management Program is financial incentives for all employees (see "Motorola's plan to increase productivity," p. 117). These incentives are on par with annual bonuses given to the employees of Japan's largest firms at the conclusion of a financially successful year.

Also unusual by U.S. corporate standards is that the plan has been brought along slowly. It dates back to 1974, and, says the program's corporate director, Hank Bried, it is just now beginning to bear fruit. "We have been able to allow decisions relating to budgets, specific dollar expenditures, delivery goals and quality goals to be made at the lowest possible organizational level," he says.

Preparing for the transition

Despite many management consultants' belief that quality-control circles cannot stand alone, Ouchi says they can be useful tools. One company to which he served as consultant—Beaverton, Ore.-based Tektronix, Inc.—makes extensive use of quality circles. But first, the groundwork is carefully laid.

"I had to sell myself, and then sell the idea to all levels of management," says Cheryl Lynch-Spencer, one of 20 quality-circle facilitators at Tektronix. "It took all my time for the first six months at the company."

Jay Shimada, an assistant professor at Portland State University, who studied the quality-control circles Lynch-Spencer led, agrees that preparation was necessary. "The solution of a quality-circle problem often requires cooperation or technical assistance from other parts of the organization," says Shimada. "If there's no political support, it won't fly. But Tektronix management has been very strong in supporting its Tekcircles."

Shimada says that his study of Tekcircles is the first scientifically accepted verification of the circles' effectiveness. His research shows an improvement in workers' attitudes and a decrease in product rejection as compared to a control group.

Although Ouchi won't discuss his recommendations to Tektronix, the mark of his Z-style can be seen in the company's statement of corporate philosophy, which Lynch-Spencer and other Tektronix employees confirm is a daily influence.

In contrast, an implementor of quality-control circles for Honeywell cannot connect his efforts to what various Honeywell spokesmen, including chairman and chief executive officer Edson Spencer, have characterized as a larger effort to achieve egalitarian management. The quality-control implementor is unfamiliar with Honeywell's other programs, which indicates the company has not yet achieved the integrated corporate philosophy that is the foundation of true Z culture.

Semiconductor plant learns

Zilog, Inc., at its Nampa, Idaho, wafer-fabrication plant, has successfully implemented a Japanese management style. The style is based on concepts that have been developing in the U.S. since the 1950s, says Zilog.

The key concept at Nampa is that teams are responsible for a complex of actions, rather than just the routine of a single equipment station on an assembly line. In a typical semiconductor plant, every wafer changes hands 43 times, says a Zilog spokesman. But at Nampa, only eight passes occur at major changes in the product, and teams are responsible for as much as a supervisor handles in a traditional plant, including hiring, training and disciplining team members.

Manny Fernandez, then president of Cupertino, Calif.-based Zilog, says the system works because "each of the eight changes is big and important enough to warrant a sense of ownership."

Zilog says the annual attrition rate of the Nampa plant is 2 percent, compared with rates that range to 55 percent in Silicon Valley. Yields are said to be 25 percent higher than at Zilog's more traditional wafer-fabrication facility in Cupertino.

Some observers wonder whether the success of the Nampa system depends on the small-town isolation of the plant. They say turnover is low because Idaho does not have the intense competition for skilled workers that exists in Silicon Valley.

A Zilog spokesperson replies that gains such as those achieved in Nampa are not as easy to come by in Silicon Valley, and the recent departure of Fernandez to start a new company underscores the difficulty of the task in that hotbed of entrepreneurial activity.

Management consultant Spencer says the difficulty with trying to implement Theory Z, as illustrated by Fernandez's deaprture, is a cultural one that may prevent Japanese management style from ever taking strong root here.

"American corporations and American culture reward the great individual achievement," says Spencer. "Americans want to be rugged individualists. That's why America turns out so many entrepreneurs and so few cooperative team players. Everyone wants to run things his way. Everyone wants to be John Wayne." ■

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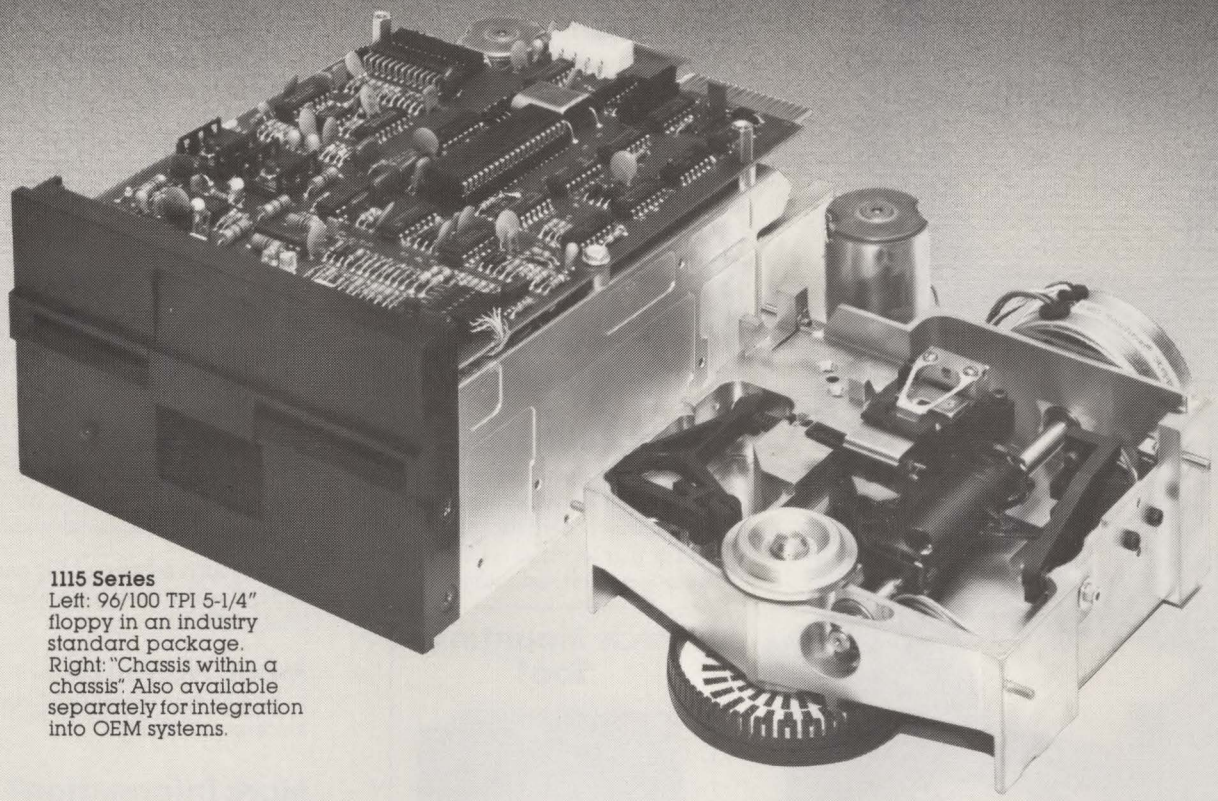

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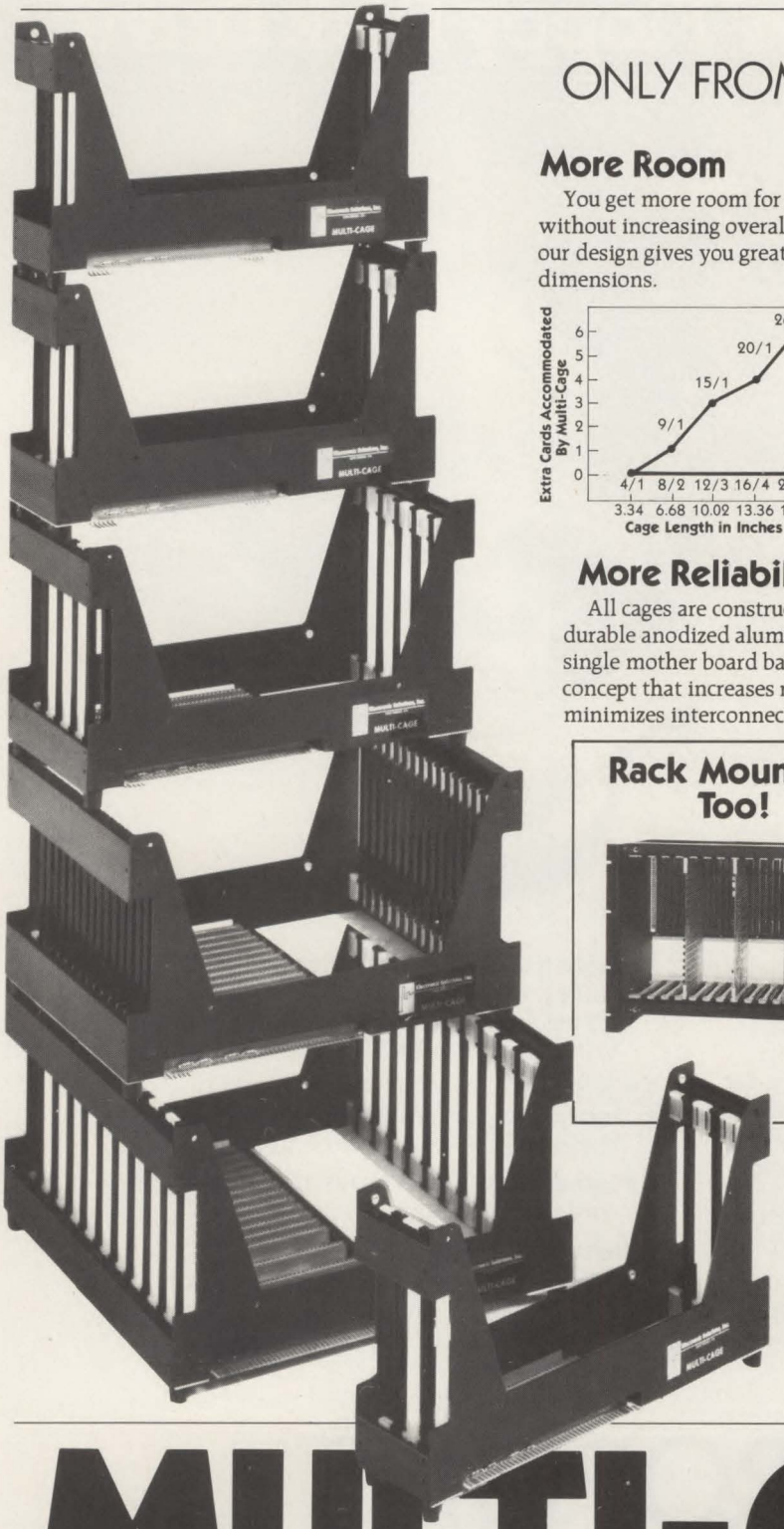

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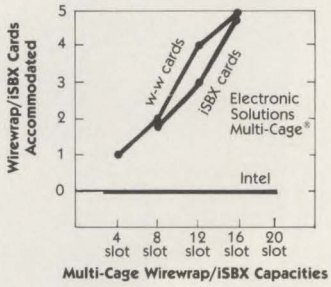

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CIRCLE NO. 52 ON INQUIRY CARD

New LSI chips are changing complexion of the modem industry

By Dwight B. Davis
Associate Editor

What has been a gradual trend toward the large-scale integration (LSI) of modem components may be accelerating, thanks to the availability of products that incorporate more modem functions on single chips and to the use of relatively new monolithic technologies that improve the basic modulate/demodulate operation. The increased availability of such sophisticated chips, say some industry players, could reshape the modem business over the next few years.

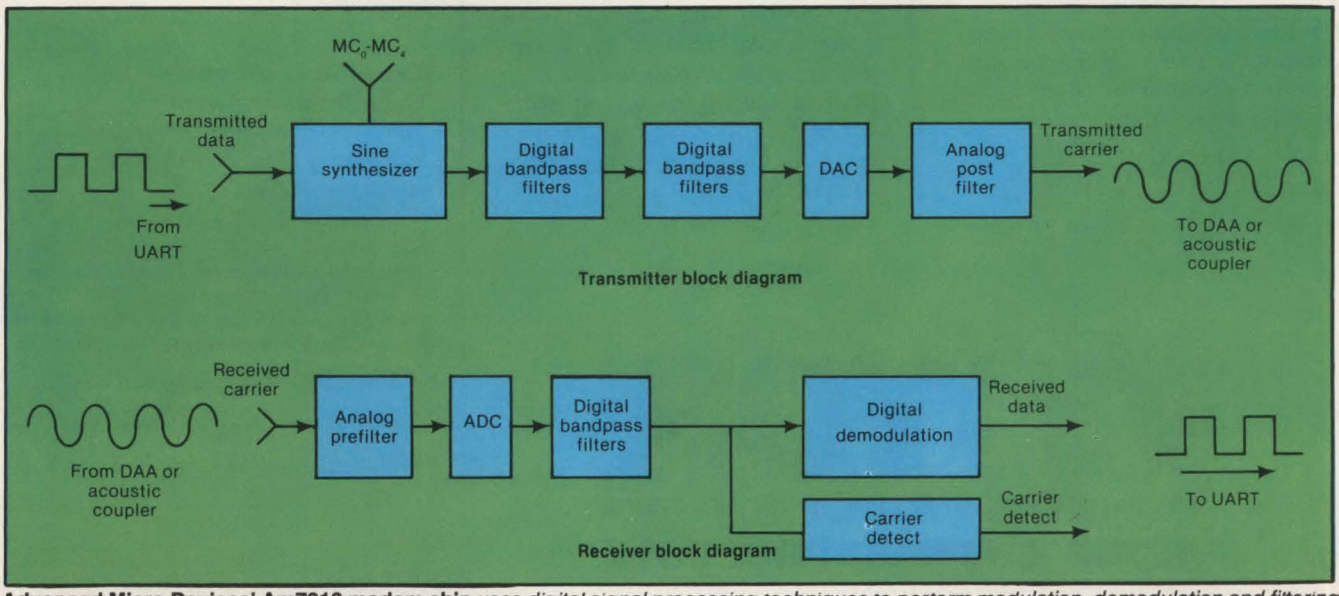
While the entire modem market will change somewhat because of LSI chips, most observers agree that near-term activity will center in the low- to medium-speed (300 to 2400 bps) area. "You'll see the initial impact of LSI at the low speed, where there is high volume and where features and flexibility aren't such issues," predicts Jim Morrissey, director of modulation products marketing at Codex Corp., Mansfield, Mass. The high-speed modem market in which Codex competes is very feature sensitive, he says, noting, "I don't see the move to LSI chips as having any significant impact on our business for some time."

Several semiconductor companies, including Motorola Inc. and Rockwell International Corp., have for some time sold components that provide various modem functions. Lesser known companies, such as Cermetek Microelectronics Inc., have also been active in this field, often in proprietary development arrangements with modem manufacturers. However, chips offering a new level of complexity are now becoming commercially available.

No true 'modem-on-a-chip'

Despite the growing complexity of modem chips, no single LSI component yet performs all the tasks required of a modem, and many believe such a comprehensive chip is unnecessary. While it is practical to place the signal-processing functions—including analog-to-digital (A/D) and digital-to-analog (D/A) conversion and a filtering technique—on a single chip, the modem's interface to the phone line is best left to other components, says Ron Ruebusch, product marketing manager for communications circuits at Advanced Micro Devices, Inc., Sunnyvale, Calif.

This modem/phone-line interface is especially important when connecting to the public telephone network because this interface falls under FCC regulations to protect the Bell network from hazardous voltages generated by attached equipment. Until 1977, when Part 68 of the FCC rules was issued, modems were required to connect to the dial-up network through Data Access Arrangements (DAAs) sold by Bell. Under Part 68, independent manufacturers began developing their own protective circuitry, which still requires FCC



Advanced Micro Devices' Am7910 modem chip *uses digital signal processing techniques to perform modulation, demodulation and filtering functions. On-chip analog-to-digital converters (ADC) and digital-to-analog converters (DAC) in conjunction with a digital signal processor eliminate the need for external analog filters. (UART = universal asynchronous receiver/transmitter; DAA = data access arrangement)*

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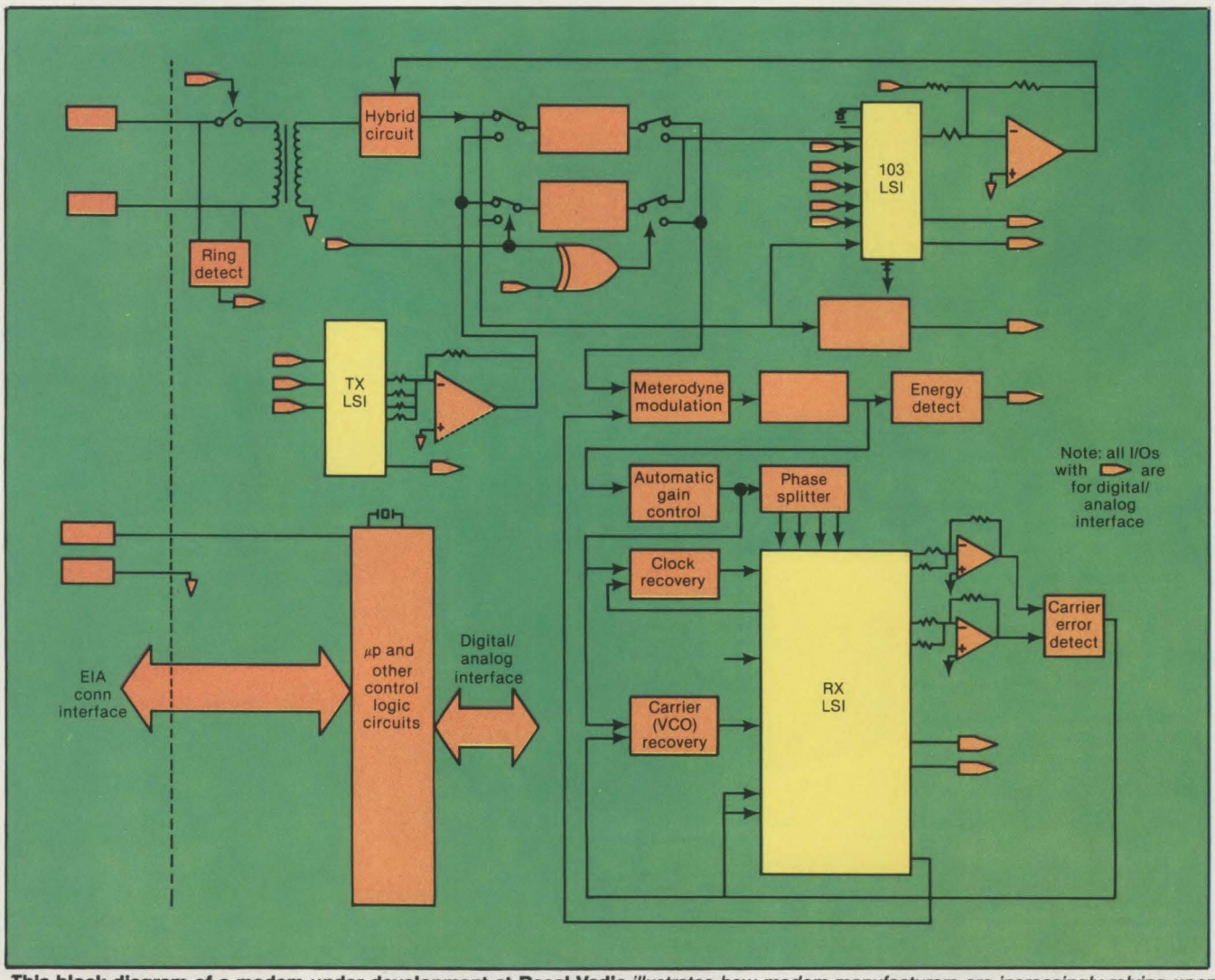
Such independent circuits typically use transformers to protect and isolate the line from the modem, Ruebusch says, noting that it requires high-voltage processes to implement these functions in ICs. "The same factors that make the high-voltage process good for withstanding these higher voltage transients also work against you when you're trying to build dense circuit structures," he claims.

"The interface requirements demand one type of technology—basically a bipolar technology—and implementing the complex modem functions on a chip point to the use of a dense MOS-type structure. It's a classic case where more integration doesn't buy you anything but higher costs."

Other semiconductor companies may differ in their opinions about placing both the signal-processing and the interfacing functions on the same chip, but all the chips now available require additional elements before they can be classified as complete modems. This chip limitation, coupled with many users' requirements for such modem functions as auto-dialing, diagnostics and multiplexing, leaves plenty of room for traditional modem manufacturers to design enhanced products based on the chips.

Competing with semiconductor firms

While acknowledging that semiconductor companies could become a source of competition in the industry, most modem manufacturers believe their place is secure because of the value they add to the chips. "The semiconductor manufacturers might try to go direct," says Raghu Sharma, president of MultiTech Systems, Inc., New Brighton, Minn., "but I don't see much



This block diagram of a modem under development at Racal-Vadic *illustrates how modem manufacturers are increasingly relying upon various LSI components in their product designs. The 103 LSI chip is the TMS99532 jointly developed by Racal-Vadic and Texas Instruments, and the transmit (TX) and receive (RX) components are custom chips jointly developed by Racal-Vadic and RCA. The microprocessor is an 8-bit Intel 8048.*

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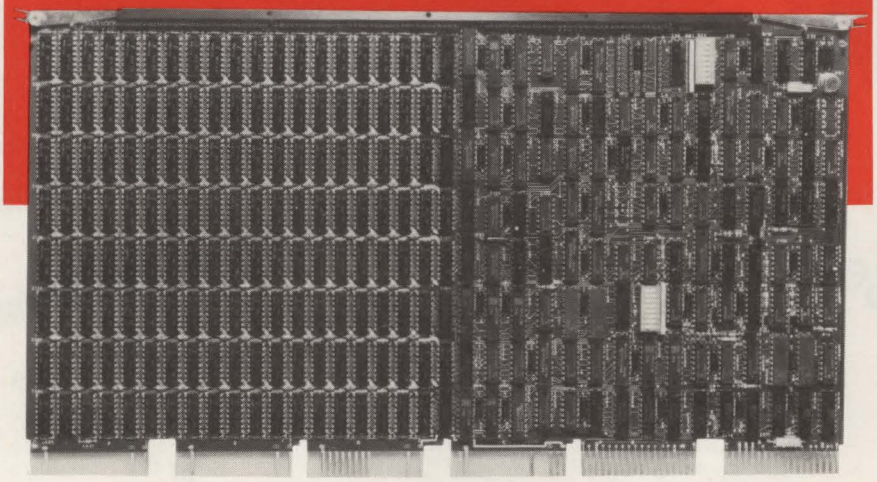

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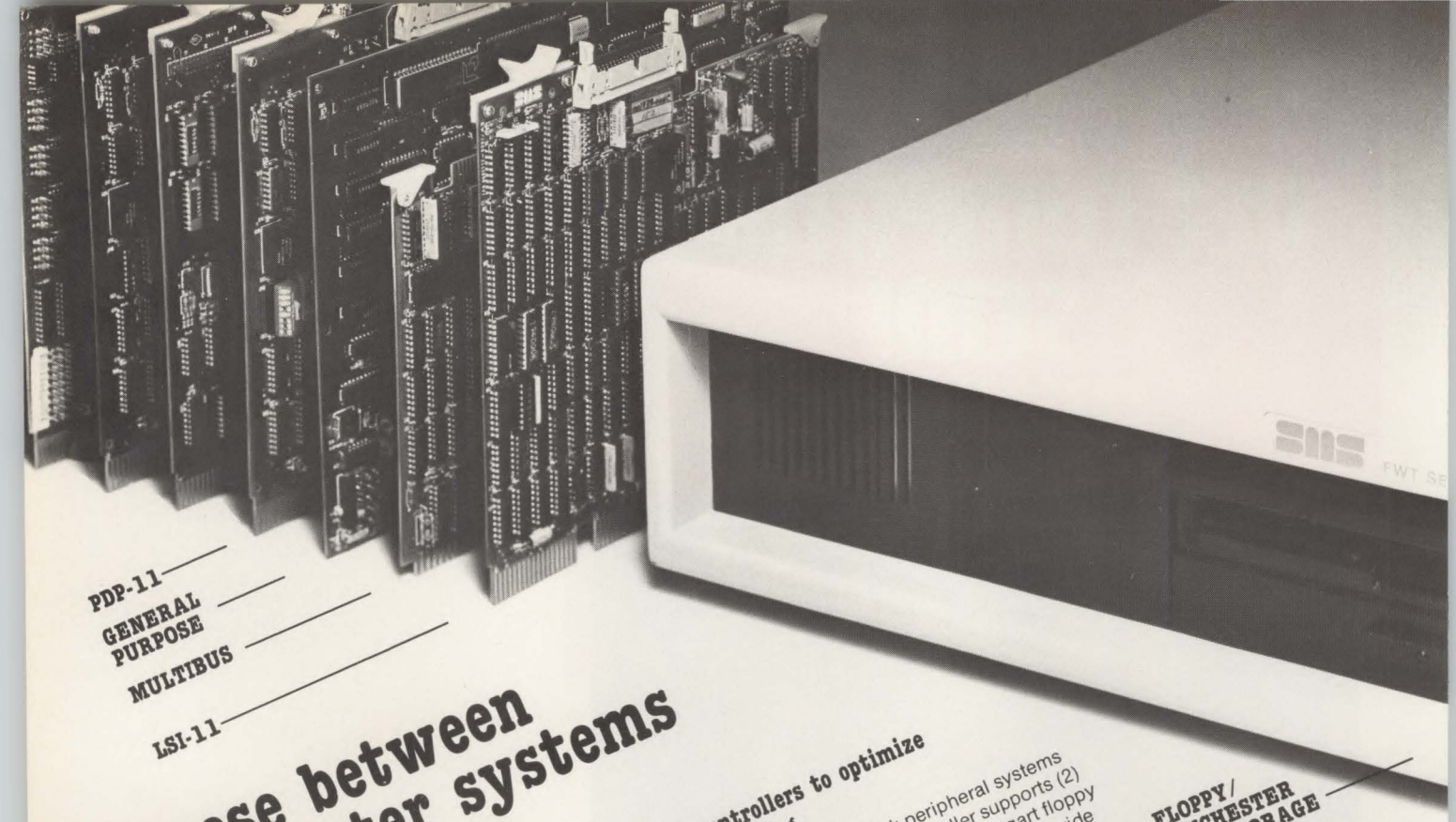

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success in that for them. The chips are being designed by engineers who know only about IC building and about some parts of the modem. When the semiconductor companies run into problems outside their areas of expertise, I think they'll have to go to the modem people who have been in the business for some time."

George Grumbles, vice president of marketing at Universal Data Systems, Huntsville, Ala., also believes semiconductor companies pose little threat to traditional modem vendors, at least in the near term. "If and when a chip set will deliver a performance and flexibility equal to a stand-alone box, then the semiconductor makers will be more viable competition," he says. "At this point, that's not the case."

Although LSI modem components have already fueled a spurt of activity in the development of modular modem boards that can be integrated in microcomputers, terminals and other devices, Grumbles believes few manufacturers of these devices will choose to design their own integral modems. Non-modem engineers have always been reluctant to cross over into the analog world, he says, and he expects this hesitation to remain even as more comprehensive digital chips become available.

The technical expertise of the terminal manufacturers is not a threat, he says, noting, "We have supplied our modems to OEMs for the 12 years we've been in business. These customers have always had the capability to (design modems) themselves if they wanted to do it, but they chose not to.

"It's like building a power supply," he continues. "It appears simple, but how many companies are there building power supplies because there's more to it than just getting a transformer and hooking some capacitors and some voltage regulators to it?"

The semiconductor companies' view

At Texas Instruments Inc., Larry Woodson, marketing manager of TI's Bell-103-compatible chip (MMS, June, p. 67), says, "It's true that we will have difficulty selling directly to the terminal manufacturers. These people are uncomfortable with the technology, so it's going to take people who are in the modem business to take and use this circuit."

Ruebusch at AMD takes a different view of the potential market for the Am7910 chip, due this year. "I don't see why a reasonably sophisticated terminal manufacturer shouldn't be able to do the modem design himself," Ruebusch says. "Obviously, the modem manufacturer will mark up the price to cover his expenses and provide some profit, so the terminal manufacturer going that route will have a cost disadvantage against a terminal manufacturer that builds its own."

Regardless of who actually builds LSI-based modules for integration into terminal devices, the growing availability of such modules raises the issue of their impact on the stand-alone modem market. Tom McShane, vice president of marketing and sales at Racal-Vadic, Sunnyvale, Calif., believes the future is bleak for simple, low-speed stand-alone modems. "The plain vanilla data pump won't survive on any basis except price, and even that strategy is a losing one," he says.

"The stand-alone modem will become more complex in order to survive," says McShane. "It will do such things as automatic dialing, error detection and correction, encryption/decryption and possibly digital voice." He notes that many modems already available, including Racal-Vadic's new two-board quad modem (see

CHIP DESIGN—ANALOG VERSUS DIGITAL FILTERS

Two of the most complex commercial modem chips yet developed come from Texas Instruments Inc. and Advanced Micro Devices, Inc. Developed jointly by TI and Racal-Vadic, the TMS99532 chip is a Bell 103/113-type device operating in the 0- to 300-bps, full-duplex range. The Am7910, which will be available from AMD this year, conforms to both the 103/113 and the Bell 202 (1200-bps, half-duplex) specifications, along with the CCITT international equivalents, V.21 and V.23. Aside from the different modem speeds addressed by the TI and the AMD chips, the two products also differ in their on-board filtering techniques.

The TI chip employs switched capacitor filtering, a technology also used on custom chips Novation designed for its modems. David Lyon, director of engineering at Novation, says the commercial availability of the switched capacitor filter technique represents one of the key LSI advances for modems in recent years.

AMD, on the other hand, chose to place a digital signal processor on its Am7910 to perform digital, rather than analog, filtering. "We feel the digital filtering gives a more stable and predictable performance," says Ron Ruebusch, product marketing manager for communications circuits.

"The switched capacitor filter is much more susceptible to changes in power-supply voltage, and it can drift with time and temperature," Ruebusch claims, "because you're dealing in the continuous-analog domain. In a digital circuit, a one is a one; you have to degrade that a long way before it becomes a zero."

Lyon responds, "The switched capacitor filtering technology allows for a much smaller silicon area and much less power dissipation than the digital filters. It's true that discrete analog filters are susceptible to drift, but if you look into monolithic switched capacitor filters, you'll find that the tendencies toward drift and environmental changes are very low."

"Quad modem includes...," p. 263), are too complex to be easily integrated into terminal devices.

Grumbles at UDS believes even simple, low-speed boxes may be viable for some time. Open a stand-alone modem for a personal computer, he says, and you'll find a lot of very inexpensive discrete components. "You don't have to get very expensive in an equivalent LSI device to lose a lot of ground against low-cost components," he says.

The coming of smart modems

David Lyon, director of engineering at Novation, Tarzana, Calif., says, "The stand-alone module will never go away. It's not always convenient ahead of time to configure your host (computer or terminal) with communications functions, and you've already got a large installed base of equipment without integral modems. So people will very often opt to have their host-type devices without the communications function, and will buy the stand-alone unit and move it around to wherever they need it."

Lyon does expect a design change for these stand-alone boxes, however, "I expect the stand-alone modems to be made cheaper and smaller by removing the mechanical lights and switches, and by replacing the big data connector with something smaller, such as a two-pin connector. The lights, switches and extra leads are there just to control the modem's options," he explains, "and they have nothing to do with data transfer."

Rather than incorporate these bulky mechanical components, more and more stand-alone devices will be designed as "smart" modems, Lyon says. "In these modems, the commands and options come as characters from the host over the transmit data line."

Mike Winters, Novation's national product support manager, expects "an absolute explosion in the 1200-bps modem market in the next few years." He says the next generation of personal computers will probably demand 1200-bps communications—up from the 0- to 300-bps level common today—and he thinks only LSI chips will be able to solve this requirement in a cost-effective way. "The 1200-bps modem is an extremely complicated device," he says, "and the only way you can produce such a modem at a price the consumer will pay is to go to LSI." ■

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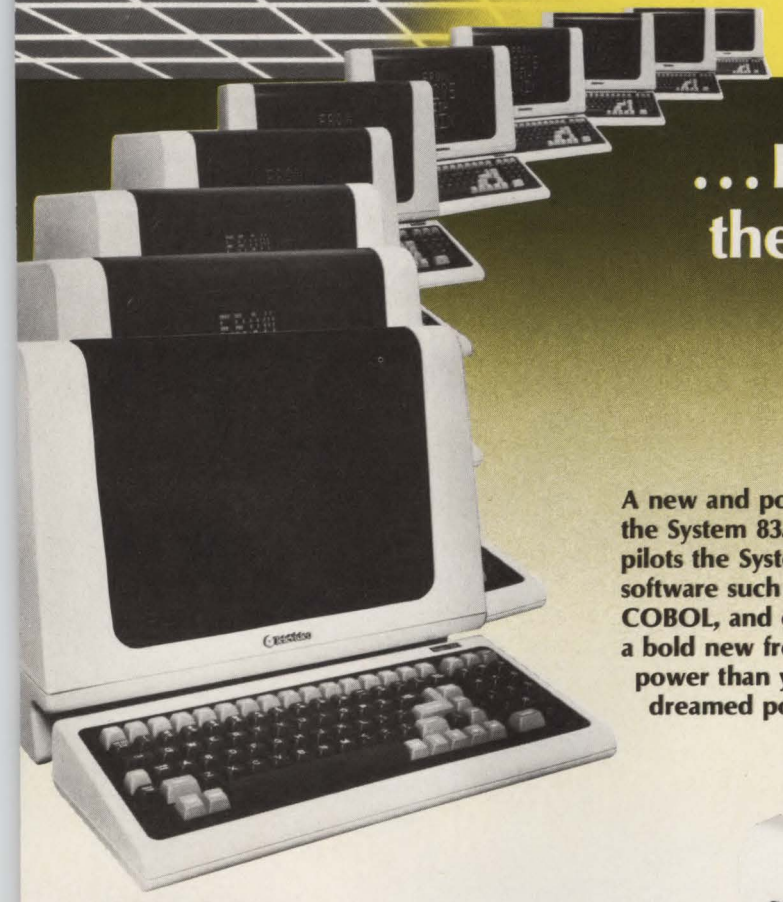

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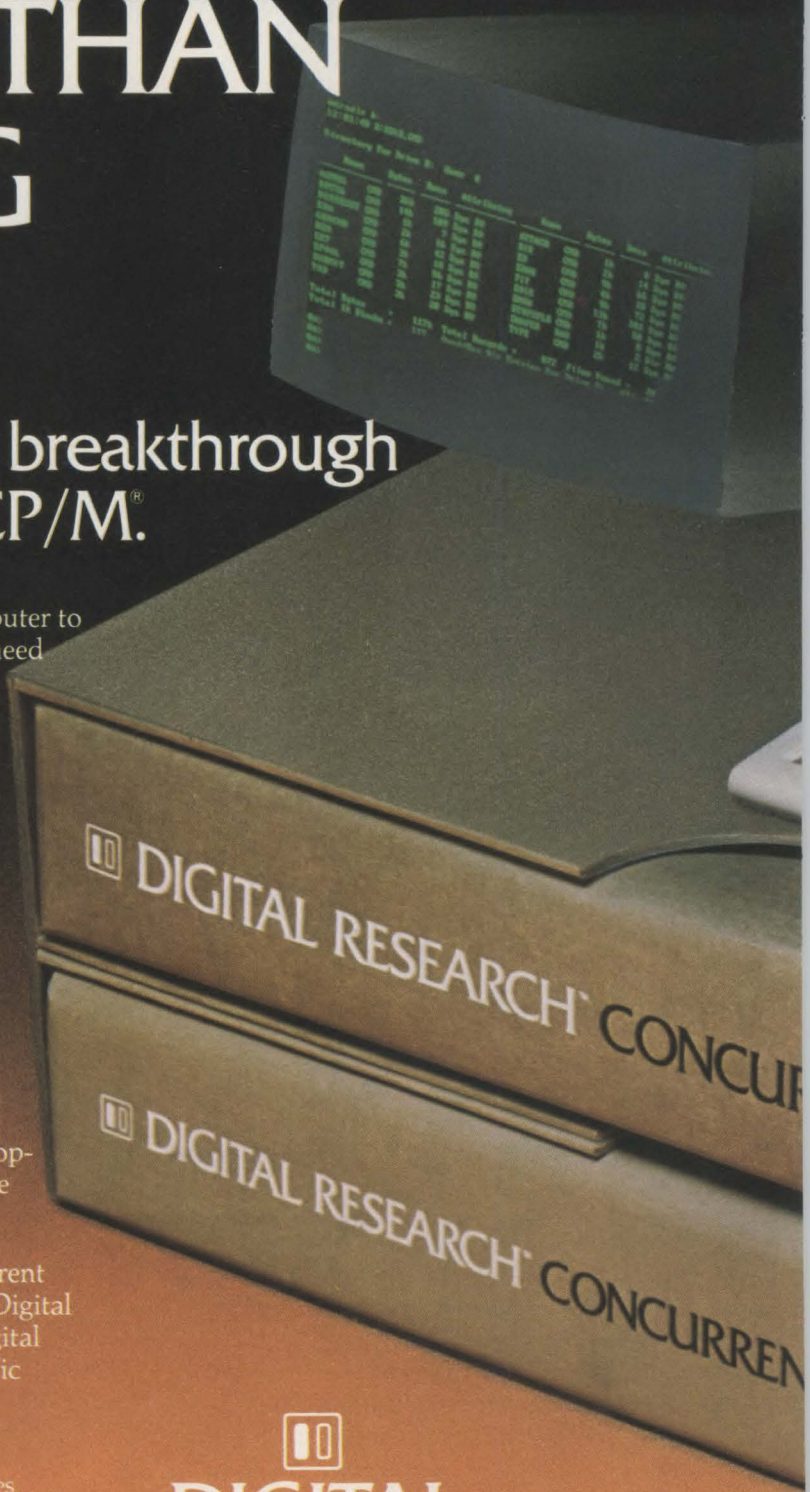

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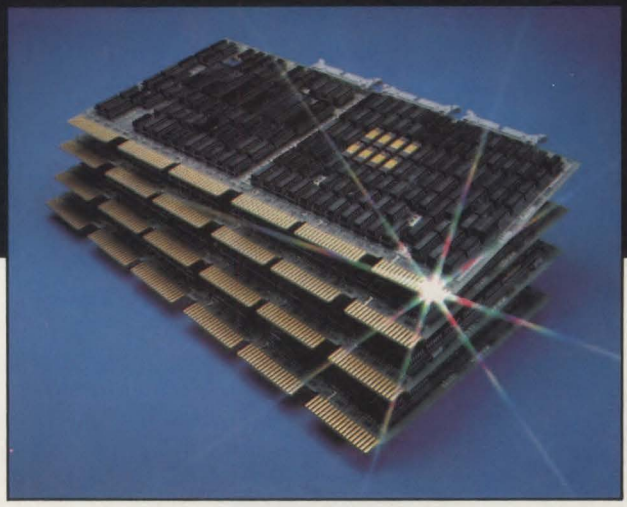

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CIRCLE NO. 21 ON INQUIRY CARD

Microcomputer standards process runs gamut from frustration to fruition

By Nancy Love
Assistant Editor

The Microcomputer Standards committee of the IEEE Computer Society, despite various problems within individual subcommittees, is plodding away in its efforts to establish standards for microprocessor bus structures (MMS, October, 1980, p. 13). At the same time, the committee is looking at various aspects of microcomputer languages, such as operating systems and information transfer.

More than a dozen subcommittees are in various stages of development—from frustration to fruition. Perhaps some of the most interesting groups, in terms of past history and continuing sagas, are the microcomputer bus standards subcommittees. Two subcommittees, Multibus (P796) and S-100 Bus (P696), are neck-and-neck in the race to complete their standards.

The proposed S-100 ("S" for standard, "100" for 100 pins) standard specifies all mechanical, electrical and timing requirements of the bus, and will handle 16-bit data transfers and 24-bit memory addressing. Also defined are DMA (direct memory access) and bus-master protocols.

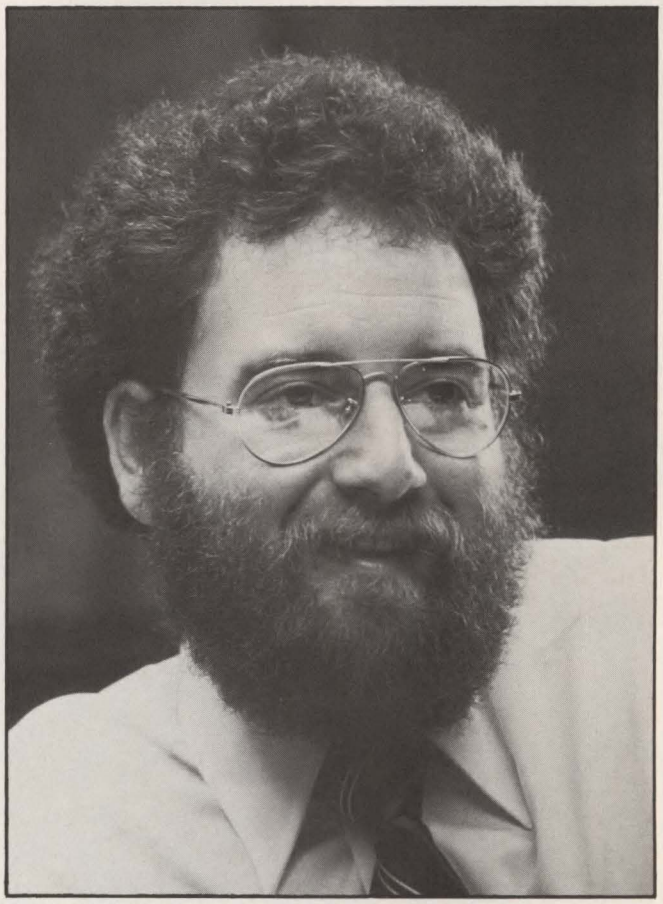
The S-100 bus traces its roots to the "Altair" bus structure developed by the pioneering MITS in the 1974 to 1975 time frame. The current S-100 standard effort dates back to the second San Francisco Computer Faire in 1978, says subcommittee chairman Mark Garetz. "There was no de facto standard; everybody was doing little bits and pieces their own way," explains Garetz. "It was time for the manufacturers to stop wasting so much time worrying about compatibility with other manufacturers and standardize to make sure everybody's product worked with everybody else's."

Garetz claims the S-100 draft is 99 percent complete. The only stumbling block is entering the draft into a word processor. Because all technical issues have been resolved for more than a year, he says, it's merely a matter of waiting for the IEEE Standards committee to meet in November, at which time Garetz expects the S-100 to become a standard.

The Multibus subcommittee, which chairman Rich Boberg calls long-winded, is attempting to define and standardize the de facto 8-bit system bus developed and used by Intel Corp. But P796 has been plagued with a nomenclature technicality, which in Boberg's view has considerably slowed Multibus standardization.

The S-100 uses decimal instead of hexadecimal notation in numbering its address data lines, and some members believe that Multibus should comply with that standard, Boberg says. The Multibus has always used hexadecimal notation, he adds, and the debate resulted in the formation of a nomenclature subcommittee. While there is still disagreement regarding nomenclature, Boberg thinks it will not further delay draft standardization efforts.

Boberg terms the nomenclature issue trivial, but he explains that some people believe all bus standards should use the same nomenclature. He is optimistic about the standard, however, and expects it to be approved by September. "The Multibus is a lot more stable technically than the S-100," he says. Boberg gives two reasons for that stability. One is that the Multibus has Intel's backing. Secondly, many products can be created around the Multibus, and it can be



S-100 Bus subcommittee chairman Mark Garetz: *"It was time for the manufacturers to stop wasting so much time worrying about compatibility with other manufacturers and standardize to make sure everybody's product worked with everybody else's."*

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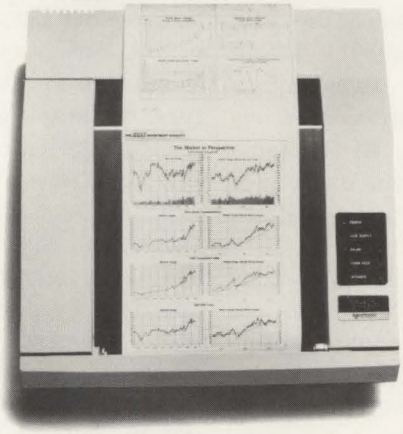

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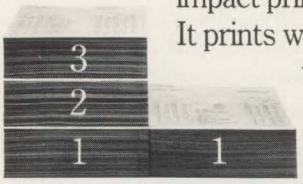

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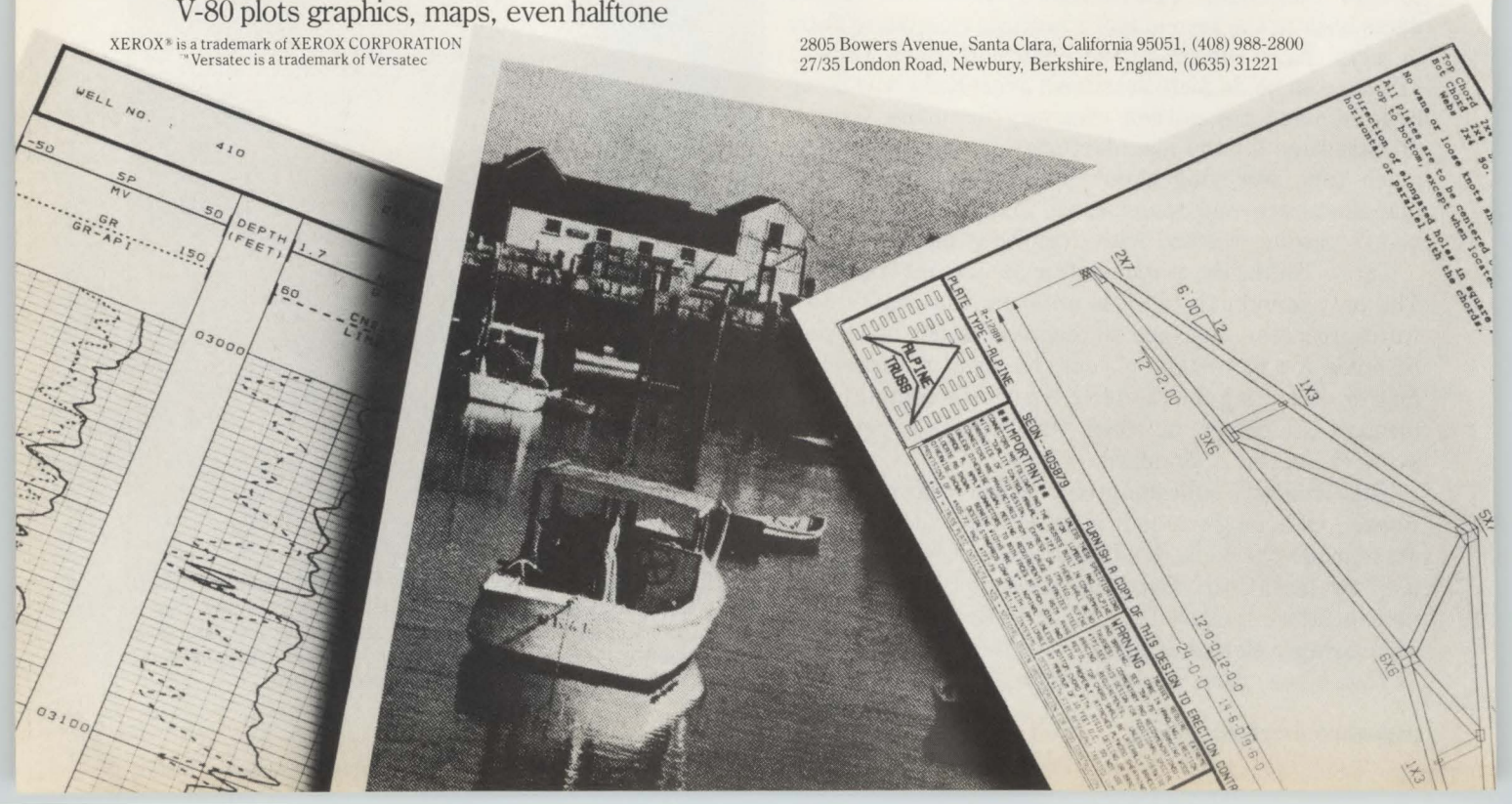

geared to many application levels.

The STD bus subcommittee (P961), says chairman Matt Biewer, also hopes to gain industry-wide recognition through a draft that combines physical, logical and electrical specifications assembled by an STD manufacturers group, and timing specifications established by the IEEE groups. The STD bus, the combined effort of Pro-Log Corp. and Mostek Corp., is often used in industrial board-level products. "There are approximately 50 or 60 manufacturers making products for the bus," says Biewer, "and I think they would appreciate having it standardized." Biewer predicts that finalization will happen in the last quarter of 1982.

In addition, other bus subcommittees have joined the fray at the often-frustrating product-authorization-request (PAR) stage. At that stage, a group seeks the IEEE project number that allows it to begin working-group activities. The I/O Expansion Bus and the Versabus are two subcommittees now at this stage.

Leon Adams, I/O Expansion Bus subcommittee chairman, says his group is working on the preliminary draft and hopes to move it out of the committee stage this quarter. The group is working with a derivative of a bus used by such companies as Intel and National Semiconductor Corp. "The bus that we plan to have complete," explains Adams, "is one that we plan to keep compatible with the existing Intel iSBX bus." A few enhancements may be added, but the group is working on that problem.

Intel's iSBX product line includes 2.8- × 3.7-in. boards that can plug directly onto its iSBC Multibus boards for system expansion for parallel or serial I/O, for instance. The 8- or 16-bit bus is also called the "piggyback" bus because the small form-factor I/O expansion modules plug onto platform or focal single-board computers, as opposed to an edge card.

Multibus subcommittee chairman Rich Boberg *says his subcommittee has been plagued with a nomenclature technicality that has considerably slowed standardization.*

The trend toward miniaturization in VLSI will result in much more power on a single board, says Adams, and for a systems designer to dedicate all the I/O of a board with these higher power levels is more confining. The I/O expansion bus affords user-configurable I/O expansion at low cost, Adams says. "Therefore, we expect to see it become more popular as we migrate toward

THE LONG ROAD TO MICROPROCESSOR STANDARDS RATIFICATION

- Interested IEEE members organize a meeting, at which time they offer suggestions on what they hope to accomplish. A charter can be drawn at this time.
- At the same time, a request is made to the parent committee (the Microprocessor Standards committee) in New York, for a working number. This is known as a product authorization request (PAR) and gives the working group the official permission to work on a standard.
- Meetings continue until the subcommittee develops a proposed draft standard.
- After months or years of work, the subcommittee submits its proposed draft to the Microprocessor Standards committee for publication in IEEE journals such as *Computer* or *Micro*.
- When publication occurs, the proposed draft enters the public comment stage, at which time the public can respond either positively or negatively to any points within the published draft.
- After all public comments have been addressed in writing by the subcommittee, it revises its draft to address the negative comments. The revised draft is submitted by the Microprocessor Standards committee to the Computer Standards committee for approval as an IEEE Computer Society standard.
- The Computer Standards committee puts the draft out for mail ballot, at which time its members vote on whether they are satisfied that the draft is an appropriate standard, but more importantly, that its procedures are in order.
- If approved, the draft standard then returns to the New York headquarters of the IEEE Standards Board, which also reviews it. If the procedures within the draft are acceptable, it is published as an IEEE standard.
- If no negative comments are received about this publication, the draft is finalized and sent for standardization to the American National Standards Institute, of which the IEEE is a member. If it becomes an ANSI standard, the document continues to the International Standards Organization for international standardization.

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single-board or minimum-board systems," he says.

Adams says his seven-member committee seems to agree on the technical issues, so he hopes to avoid the delay other subcommittees have experienced. Adams hopes to have a first-round draft this quarter.

Steve Leibson, chairman of the Versabus subcommittee, explains that his group plans to standardize the Motorola PROVISION D4 specification of the Phoenix, Ariz., semiconductor maker's Versabus. His newly formed 20-member group, like Adams's, is in the PAR stage.

Leibson says his group is very optimistic about standardizing the Versabus. "Motorola has provided us with a technically solid standard to begin with," he says. "We won't have too many problems." A first draft has been moved out of committee, and Leibson says he's "shooting for a final draft for next year."

Jim Moyer, chairman of the Future Bus subcommittee (P896), thinks his committee is lagging in their efforts to find a reliable medium-cost, high-performance manufacturer- and processor-independent bus. One reason, says Moyer, is that his group is in the "invent mode"—developing the technical basis for a proposed standard.

Because most committee members are busy, P896 has been meeting sporadically, but Moyer hopes the group is not too many months away from a final draft. With luck, he says, they could have a draft ready for publication at year-end. Given the publication bottlenecks, he predicts that standardization won't happen before March, 1983.

Languages relating to microprocessors are also experiencing problems in standardization. The Binary Floating Point Arithmetic subcommittee (P754), headed by Dave Stevenson, published its most recent draft in the March, 1981, issue of the IEEE's *Computer* magazine. This standard addresses the need to specify methods of implementing the arithmetic on a chip.

The group is deciding on warning modes, says Stevenson. It previously voted to keep normalizing mode in the draft. This mode normalizes the most significant bit in the fractional parts of a floating-point number. The question is whether to mention warning mode in an Appendix or to delete it.

Stevenson says P754 has had "major dissenters all along the way" on a technical basis. For example, the implementation of a feature is often not justified by experience. On the other hand, some members argue that technical superiority cannot be proved until the feature is implemented. "The fact is that if you never have a standard, you won't have an implementation," says Stevenson. "It's a vicious circle." Stevenson's committee work is "proceeding well at this point," he says, and they plan to move their draft out of committee by the end of the summer.

P854, the Radix Free Floating Point subcommittee, is attempting to generalize the 754 standard by removing the latter's dependency on binary arithmetic. The newly formed 854 subcommittee, however, is having delay problems, says chairman Dr. William Cody. "We have to be upward-compatible with the 754 standard," he says, "so we can't publish until 754 finishes." Although Cody's seven- to eight-member committee basically agrees on technical details, Cody estimates that it will take a year and a half to two years after 754 finishes before his committee is done.

Subcommittees are also addressing other software issues. Work on one such committee, Extending

μc STANDARDS SUBCOMMITTEE STATUSES AT A GLANCE

Code	Project	Status
P694	μp Assembly Language Mnemonics	Final draft ready for publication this summer. Estimated standardization date: approximately one year.
P695	Relocatable Object Code Format	Final draft ready for publication. Publication estimate: September.
P696	S-100 Backplane Bus	Draft published. Standardization estimate: November.
P754	Binary Floating Point Arithmetic	Draft published last year is under revision. New draft publication estimate: end of summer.
P755	Extending High-Level Language Implementation for μps	Draft published last year is out for public review.
P796	μc System Bus (Multibus)	Draft published and is out for Computer Standards Committee ballot. Estimated standardization: September.
P854	Radix-Free Floating Point Arithmetic	Working group still formulating first draft. Estimated standardization: a year after P754.
P855	μp Operating System Interface (MOSI)	Committee working on new draft, almost complete. Standardization estimate: approximately one year.
P856	μp Software Benchmark	Committee just organizing. No draft yet.
P896	Backplane Bus (Future Bus)	Draft under revision. Could have final draft by Christmas. Standardization estimate: March.
P949	Media Independent Information Transfer (MIIT)	Draft in process of publication. Due to go out for mail ballot in September.
P961	STD Bus	Draft estimated to be submitted for publication in September.
P...	I/O Expansion Bus	Committee working on draft; estimated for completion third quarter.
P...	VERSAbus	Committee working on first draft, to be completed next year.

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High-Level Language Implementation for Microcomputers (P755), has been proceeding for about three years. The IEEE published a draft last year, and the draft is out for a Computer Standards committee mail ballot. The subcommittee is addressing the issue of using high-level languages to implement programs for small, dedicated computer applications.

Chairman Rick James says some negative comments have been received, stemming from people's impression that the committee is trying to change language standards. "The bulk of the complaints are concerned with a fear that we're trying to change languages in general, when we simply want to improve their implementations," James says. The committee is concerned with microprocessor applications, not the general use of the language. As a result of the confusion, James recently added the word "implementation" to the subcommittee's title.

James's committee is also working on a rationale paper to explain the draft. "It's unusual for a committee to put out a rationale paper," says James, "but many of them need them. The floating-point standard, for example, had two or three rationale papers published at the same time as the standard." There was much dissent on that committee, he adds, and the papers helped to explain different viewpoints and why one position was chosen over another.

James says his committee is working at an average pace and that standardization will occur "very soon, if we can overcome the objections. If we stumble on the objections, it's hard to say when the draft will be published," he concludes.

The Microprocessor Software Benchmark subcommittee (P856) reports it is in the early stages of development. "It's really too early to tell," says chairman Steve Diamond. "We have a charter, and we're working on the specific details of our objectives." P856 plans to standardize a software benchmark, a tool for evaluating microprocessors while they solve tasks.

Diamond's subcommittee has had only one or two meetings, but is trying to "move ahead as fast as possible." Diamond gauges final committee membership at eight to 10. The committee does not plan to rate microcomputers in general, he says, "but rather to provide tools for the user to do that himself, depending on his applications needs."

One subcommittee whose work seems to be winding down to a conclusion is P694, Assembly Language Mnemonics. A draft was published and went out for comment at the end of 1979, and the subcommittee is now revising the draft. Chairman Wayne Fischer admits it has not been finalized as quickly as he had hoped. Ideally, he says, every committee member could devote full time to every committee, and standardization work would progress much more quickly. In addition, some members have dropped out of Fischer's committee. Fischer says most of the subcommittee members agree on the draft, and this summer's meeting plan calls for approving a final draft.

Tom Pittman's committee, Relocatable Object Code Format (P695), is at a standstill, waiting for its final draft to be published. "Typical lead time for publication is about three months," Pittman says, "and I suspect we should have our answers by fall at the latest." The committee's vote will depend on the nature of the comments received because many negative comments could delay publication. Publication could be in the third or fourth quarter.

The Microprocessor Operating System Interface, or MOSI, subcommittee (P855) has a draft standard now, says chairman Jack Cowen. "If we're lucky," he says, "we'll have a standard to submit to the MOSI committee for additional approval by the subcommittee itself. There's a 90 percent chance we'll be able to accomplish that soon." The committee is revising the draft for the third time.

Cowen feels his committee is unique in its draft content. Contrary to what its name implies, says Cowen, 855 is not trying to standardize an interface. "We're trying to standardize an interfaced operating system, and that's a big difference. It's doesn't mean I'm trying to tell the operating-system designer how to build his operating system. I'm just saying, 'Here's an interface you can support in other ways than directly on an operating system.' We're trying to be very careful that the MOSI doesn't put any handcuffs on how you can look at the interface," says Cowen. "MOSI has got to be operating-system independent. And that's not a very fun thing to try to do." Cowen hopes to get a yes vote for publication in a few months, and optimistically estimates standardization to be about a year away.

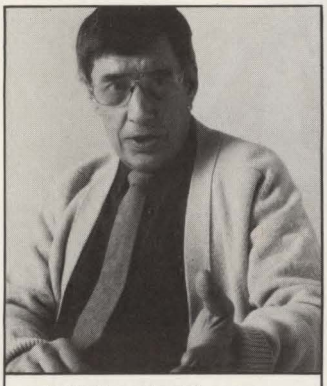
Bob Davis's Media Independent Information Transfer, or MIIT, committee (P949) "is moving fast for a standardization process," says one member. He adds, "This one is shooting like a rocket."

The draft has been submitted to the parent committee—the Microcomputer Standards committee—and is out for public comment. The committee started only last summer. "We expected to go forward reasonably fast," Davis says, and credits his committee's accelerated activity with the top-down approach it initiated to help it decide what it wanted to accomplish. Davis says, "Other committees have gotten bogged down because they have many proposals to consider, with considerable differences of opinion among the proponents of each proposal." Outside response has been favorable and he expects draft finalization in about a year. ■

Ada: The View From Abroad

NO. 2 IN A SERIES

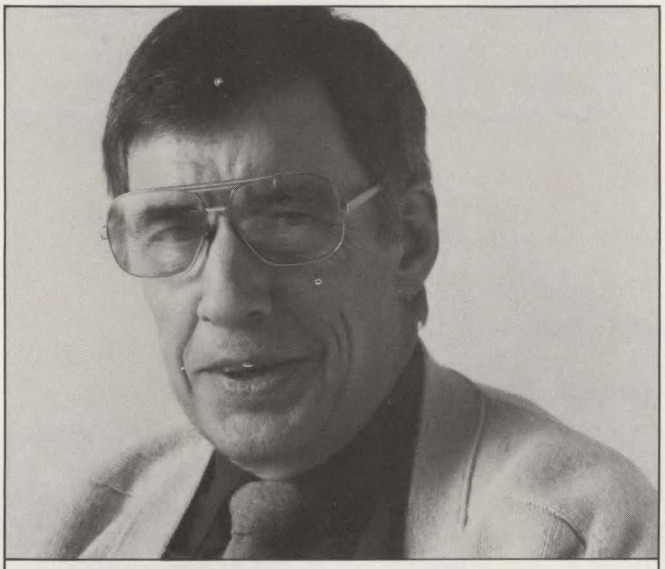
When the Department of Defense published the proposed Ada standard in July, 1980, it was one step behind an aggressive Swedish group. Dr. Jonas Agerberg, heading the Swedish Defense Research Institute's Ada evaluation team, scooped the world with the first published version of the standard document. The fact that the Europeans beat their U.S. colleagues to the punch is one indication of the intense European interest in this new language. Another indication is Dr. Agerberg's Ada in Sweden group, an organization that now numbers over one thousand members. We spoke with Dr. Agerberg at his Stockholm apartment to learn more about European Ada activities and how Ada will affect Europe.



"National pride was the biggest obstacle to European adoption of any one language. Ada is the solution, a genuine international effort."

WD: You've been one of Ada's more active supporters. What first attracted you to the language?

AGERBERG: I began looking for Ada long before it existed. As a specialist in automatic control, I was searching for a modern alternative to FORTRAN. I, and my colleagues on various European committees, began to examine the options – HAL, JOVIAL, CORAL 66, PEARL and others. They all had limitations. More important, though, it became apparent that national pride was the single biggest obstacle to Pan-European adoption of any existing language or development of a new language. Ada is the solution to this Gordian Knot. Although it was U.S. funded, it was a genuine international effort.



"If Western Digital succeeds in running full Ada on a small machine, the SuperMicro, you'll silence many of the language's critics."

WD: Do you think all of Europe will embrace Ada?

AGERBERG: Eventually. For a simple reason. Ada is a reality. There has been talk in every country of developing a standard, highly portable industrial language. Now the Long Term Procedural Language efforts in Europe, America and Japan – the Purdue Workshops – have voted to invest their energy in developing successful Ada programming environments. The Council of the European Communities stopped funding language development and is supporting Ada. Those of us who have been close to the search realize that Ada is an excellent solution, and that we must throw our weight behind it or we'll go on searching forever.

WD: A few critics have charged that Ada is both too complex and yet incomplete.

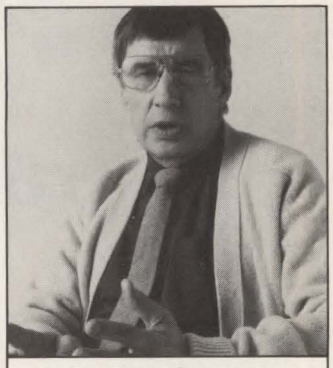
AGERBERG: Perhaps there is no perfect language. Yet, I ask, what's better than Ada? It is a large language, but very carefully constructed. It has features I find in no other single language, such as high level tasking, separate compilation, generics and standard packages. Is it too large? Last December I conducted the world's first hands-on Ada course, as you well know, using Western Digital's 16-bit SuperMicro system and MicroAda. If you succeed in running full Ada on such a small machine, as you say you will, the critics will be silenced.

WD: Since you mentioned our SuperMicro system, we can't resist asking, how do you rate it as an Ada machine?

AGERBERG: Well, so far I've run only your MicroAda subset on it. Still, the SuperMicro has the architecture to become an efficient, low-cost Ada learning tool. And for many users, it will be the logical program development system.

WD: One final question: What is Ada's future likely to look like?

AGERBERG: The sky is the limit. Today the world is awaiting a full and complete Ada compiler that will run on some fairly accessible machine. Given that, Ada becomes much more than a language. It becomes a new technology that will provide the foundation for a proliferation of markets and products. The future is bright – and near enough to touch.



"Ada is much more than a language. It's a new technology that will provide the foundation for a proliferation of markets and products."

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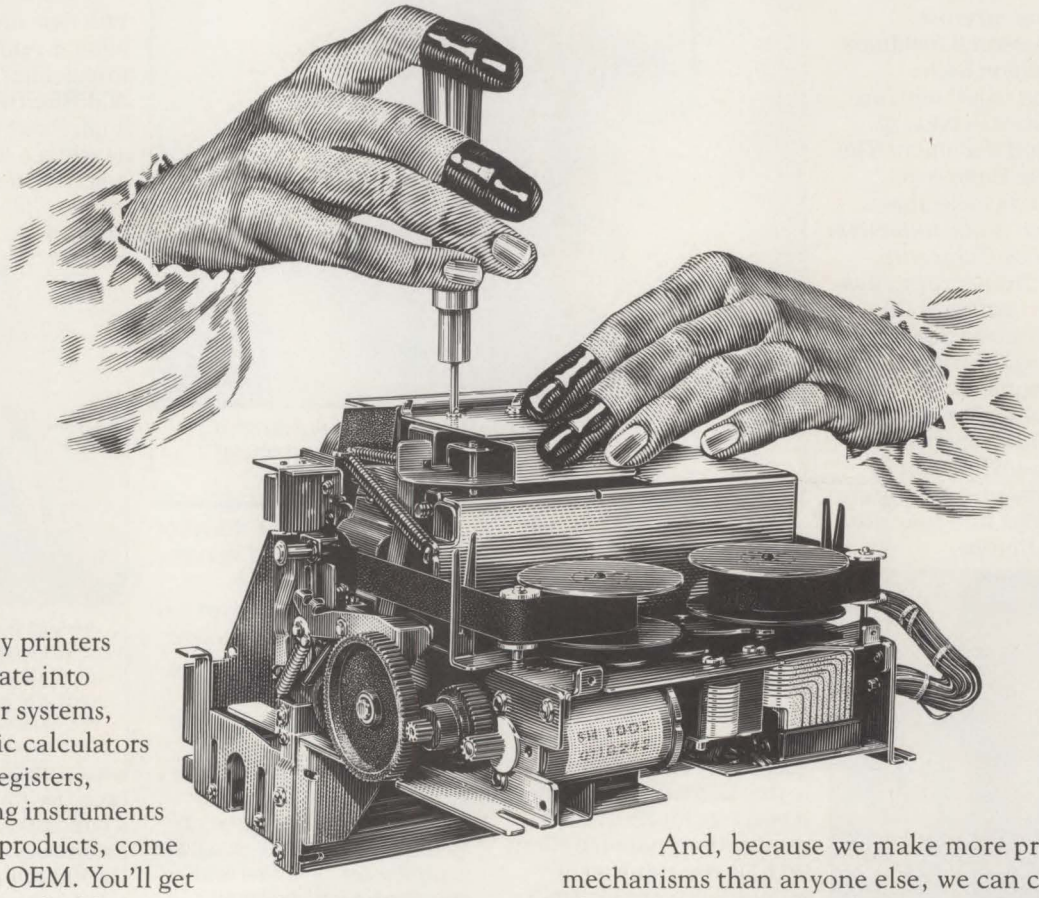

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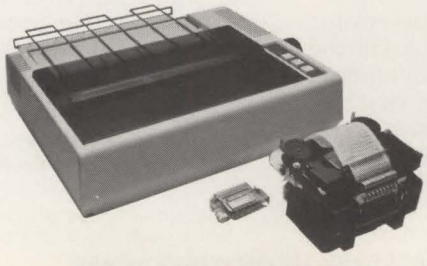

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Micro MRP answers small manufacturers' needs

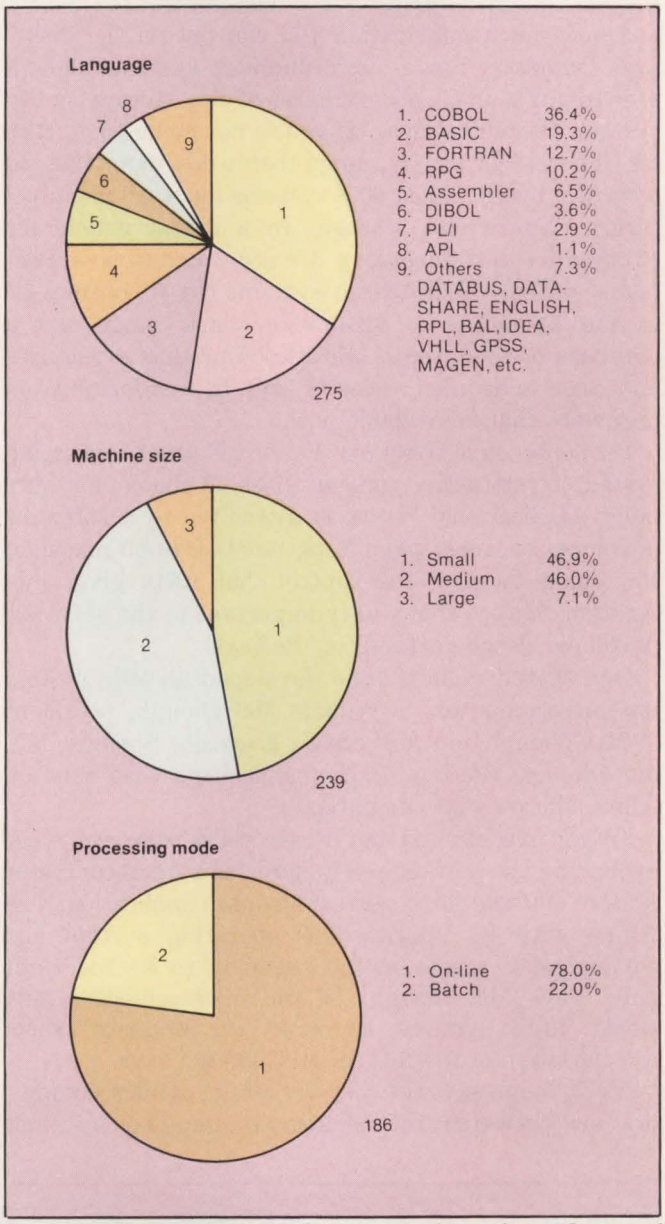
By Eric Lundquist
Associate Editor

Materials requirements planning systems—once the province of large computers—are being developed for microcomputers. System builders hope to reach a new market consisting of small manufacturers unable to afford more expensive systems, but aware of the need to bring a computer's analytical capabilities to bear on plant efficiency.

Although definitions of MRP vary, the systems should perform several tasks. A user must be able to calculate material requirements based on inventory, open orders, purchase orders, manufacturing capabilities and master-production schedules. With the proper information, the system helps develop manufacturing plans and recommended material purchase schedules. The system should provide enough information to project cash needs to fulfill the production plans based on inventory, purchasing and shop-floor conditions. Most important, the system should be interactive, allowing the flexibility to incorporate changes in business plans and economic conditions.

"The market for microcomputer-based MRP systems is enormous. If you look at the number of companies that could use a microcomputer and microcomputer software, the numbers are staggering. You will see a trend where more and more packages become available for micros," says Christopher Gray, a vice president at Manufacturing Software Systems Inc., Williston, Vt., which evaluates software. The company has done extensive evaluations of mainframe and minicomputer MRP systems. It is starting to evaluate microcomputer-based MRP and has identified several offerings (see table, p. 147).

The market may grow dramatically, but only a few offerings are now available, representing a total installed base of several hundred. With the definitions of micro, mini and mainframe computers blurring, system price is developing as the most reliable yardstick differentiating computer classes. Gray sees the market for micro-based systems developing around companies with yearly sales starting at about $1 million and having fewer than 100 employees, but adds that what a company does is as important as its size. "The market for micro-based MRP is not dependent so much on the size of the company as on the size of the database and the amount of activity," says Gray. MRP systems tend to be modular in implementation, and micro MRP prices start as low as $3000 for floppy-based systems and climb to about $40,000 for fully configured hard-disk-based systems. Large mainframe MRP systems can run to hundreds of thousands of dollars.



Features of computer-related systems, *drawn from "Survey of commercially available production management systems" by Computer Aided Manufacturing-International, Inc.*

Micro-based MRP is becoming possible because of the availability of faster microprocessors and increased storage capacity through Winchester-disk technology,

says Ernest Pennente, a New Jersey-based software consultant and developer.

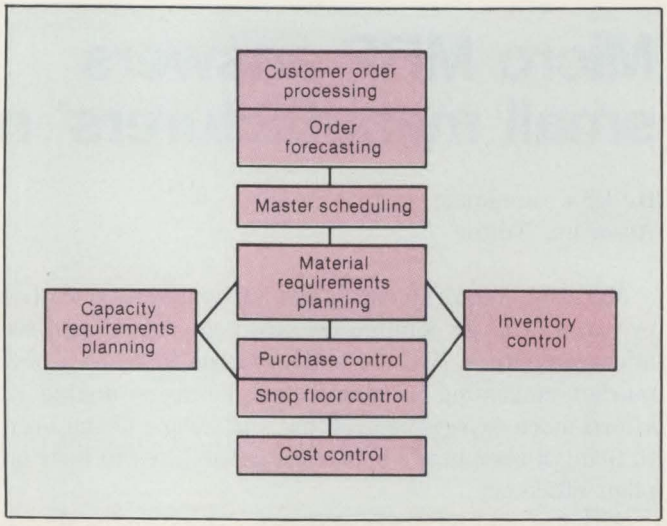
"The real problem with an MRP system is not how fast it can do computing, because the computing in MRP is not very sophisticated. The important factor in doing MRP on a microcomputer is how fast you get to the disk and how much information you can put on the disk," says Pennente. Some microcomputer systems allow a user to put as much as 80M bytes of disk storage on the system. Pennente says, "If you're not going to do MRP for General Motors, you can probably do a damn fine job with 80M bytes." Most MRP systems for small manufacturers require less storage. In a recent article for *Production and Inventory Management Review*, Pennente stated, "Micro-based systems can fit businesses in the $1-million to $20-million sales range and a database of 5000 items, and 25,000 product structures and 3000 scheduled receipts will fit comfortably on hardware that is available now.

Pennente says Western Electric's UNIX operating system is attractive among those available for MRP micro applications. "UNIX is attractive to a software developer because, when I upgrade to a 16-bit machine, I'm going to need the control that UNIX gives me. Another feature that's very important to the software developer is the portability," he says.

One system builder who developed an MRP system for microcomputers is William McCullough, president of McCullough and Associates, Excelsior Springs, Mo. McCullough markets Impac, a package that runs on Alpha Micro 16-bit computers.

"When we started out three years ago, we were eyeballing the market really hard for a microcomputer system suitable for a serious business application. The Alpha with its multitasking operating system and sophisticated access method seemed to be the right one," says McCullough. In the microcomputer MRP world, 16-bit systems, especially the Motorola 68000, are the wave of the future, McCullough says.

McCullough says the cost advantage of microcomputers far outweigh the constraints imposed by their architecture. He describes himself as a cost/performance enthusiast, and says that past advances in performance came from software developments, but, "Today, we see the ability to increase performance by the type of hardware that you are using," as well as software. McCullough markets his MRP system through a dealer network. The company has 28 firms licensed to sell MRP software, 25 of which are dealers. The systems are sold in packages that allow a dealer to install a system modularly. A typical system includes a 128K CPU, six serial ports, two terminals and a 10M-byte Winchester.



The major functions of a commercial system *show the system's typical image. Source: Computer Aided Manufacturing-International, Inc.*

McCullough says he has sold systems into companies with as little as $500,000 in yearly revenues. That installation is running some basic inventory-control packages, but has not yet installed MRP. Installing the MRP is not a technical problem, but instead one of developing the expertise to use it, McCullough says.

Micro Manufacturing Systems, Columbus, Ohio, sells an MRP package that runs on CP/M-based systems. Development of the system started about three years ago, and the first system was put into the field about

COLUMBIA READY TO TEST MRP SYSTEM

System developers at Columbia University's Digital Research Laboratory are looking for a test site for one of the more advanced microcomputer MRP systems yet developed.

The developers have taken the Japanese inventory and manufacturing theories of "just-in-time" production and turned it into an inventory and MRP system written in C and running on UNIX-based microcomputers.

Instead of developing a stringent production schedule, the Japanese-based plan allows items to be pulled through as they are needed and leads to "zero inventory," says Chris Boyd, a researcher working on the project. The developers have not selected on which microcomputer the system will run.

The researchers are looking for a small discrete-parts manufacturer for the system implementation, which is expected to take place in September. The manufacturing concern would have to pay hardware costs and associated expenses.

Boyd says that using UNIX, the developers could do the programming in one-third the usual time.

one-and-one-half years ago. "There's a need for microcomputer-based MRP systems out there," says company president Larry Fox. "There's a lot of small manufacturers in the $1-million to $5-million range that can't afford to go with a minicomputer and the software and support personnel required for a minicomputer," Fox says.

Fox believes that people talk about microcomputer-based MRP systems, but very few such systems are available. "People are talking only about what is happening today. True MRP goes out over several time spans to a given horizon," Fox says. ■

REPRESENTATIVE MICROCOMPUTER MRP SYSTEMS

Vendor	System	Function	Language	Hardware	Price	Users
Compumax	Bill of Materials Materials	inventory control, MRP, bill of materials	BASIC	CP/M micros	$350 (software only)	75
Digital Research Lab, Columbia University		MRP in modules	C	UNIX-based micros	development project	
Key Systems, Inc.	MCS	seven modules cover MRP and finance	COBOL	micros using CP/M, MP/M, OASIS	$100,000 for 7 modules with hardware	5 +
McCullough & Associates	IMPAC	inventory, bill of materials, production control, MRP	BASIC	Alpha Micro	$3000 per module	50 +
Micro Manufacturing Systems	MCS 2	MRP, inventory control, custom orders, capacity requirements	BASIC	CP/M-based micros	$5400 (software only)	50 +
Online Applications	MicroMfg	bill of materials	RM/COBOL	systems running RM/COBOL	$2000	1
R.A.I.R., Inc.	Micro MRP	modular MRP functions	BASIC	Onyx	$40,000 with hardware	20

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CIRCLE NO. 17 ON INQUIRY CARD

Tektronix plans for the future with Clark County plant

By Frank Catalano
Associate Editor

With its new production facility in Clark County, Wash., Tektronix, Inc., is out to increase profits from its oscilloscope product line by cutting manufacturing costs. Although companies constantly strive to cut costs, few in the electronics or computer industry have taken an approach that's as ambitious as Tektronix's.

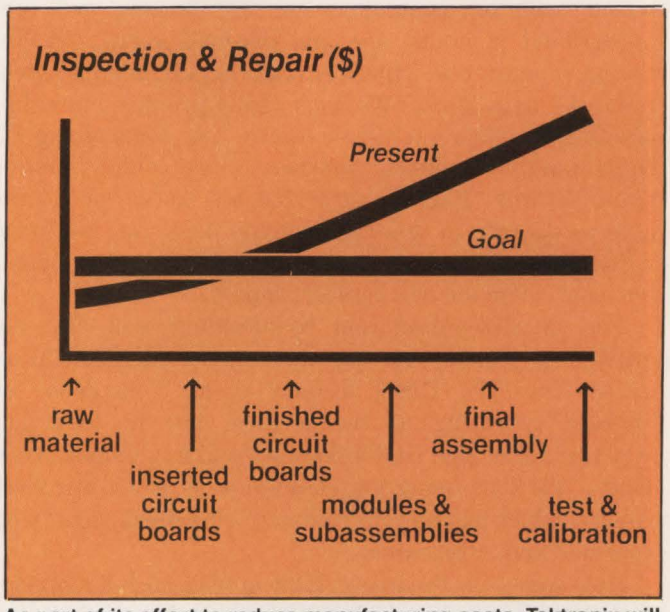
Company officials regard the new facility as one element in an effort to recapture and maintain its share of the oscilloscope market. A study by Dataquest, Inc., a Cupertino, Calif., market-research firm, says that although Tektronix controled 67 percent of the oscilloscope market in 1979, that share has been eroded over the past two years by U.S. and Japanese companies coming out with low-priced, general-purpose products on a commodity basis. In response, Will Hott, operations and planning manager of the company's Instruments Division, says that Tektronix, traditionally known as a technology-driven manufacturer of high-priced products, is now striving to reposture itself in the changing instrumentation market.

"In looking at our new products and some of those that we haven't announced yet, the fundamental goal of the company is to provide increased price/performance," says Hott. "Parallel to that objective, however, the company is also trying to provide the highest quality product money can buy. To balance the two, we'll have to raise profit margins by cutting manufacturing costs." He says that by doing so, Tektronix will be able to lower prices and become more competitive.

Evidence of that effort is the 500,000-sq.-ft. Clark County plant, which is being outfitted with state-of-the-art production equipment for the assembly of the company's newest and lowest priced line of oscilloscopes, the 2200 series, as well as the 460 series. Besides manufacturing activities, the plant will also house the business and engineering offices of Tektronix's Instrument Division. Much of the equipment will be computer-controlled and will tie into a central system so that shop-floor data can be processed for business planning. The plant will also include a new material-handling system, an automated storage-and-retrieval system and automated test equipment.

Shop-floor systems, most of which are still in the development stages, will report to Tektronix's Beaverton, Ore., headquarters through a hierarchy of installed systems. An IBM Corp. 3038, which performs processing and business-data storage for the company's four divisions, heads the hierarchy. The 3038 links to an IBM 4341 in Clark County over HYPER channels—used by engineering—and a microwave link—used by production. The 4341 performs central data storage and processing for the division and also contains a Manufacturing Resource Planning package (MRP II) supplied by Martin-Marietta. Two Digital Equipment Corp. VAX 11/750s—the only computers of their kind in the Pacific Northwest, says Hott—and a VAX 11/780 are linked off the 4341 via a Tektronix-developed communication package. The 11/780 controls engineering systems, and the 11/750s, one of which is for backup, control production systems. A range of computer systems on the shop floor, including DEC PDP 11/34s and LSI 11/23s, control production processes. Those systems will tie into the 11/750s via DECnet.

Lionel Kreps, manager of engineering services at Tektronix, notes the company's central organization allowed each of the divisions to decide what systems to link onto the IBM computers. The only constraint was that any implemented system ultimately had to report to the central computer. "As part of the divisionalization process," says Kreps, the central organization basically said 'OK, you guys have a business to run; go



As part of its effort to reduce manufacturing costs, Tektronix will carry out inspection activities *throughout the assembly process. In doing so, the company hopes to reduce the cost of repairing a finished product.*

off and run it. Just be aware that you have to furnish us with certain data."

At the Clark County plant, the Instruments Division employs an overall test in choosing equipment: each system must be flexible and responsive to changes—not only in product lines over time, but also in component and subassembly types moving through assembly.

Although the plant will handle assembly activites for only a few product lines during its first two years of operation, Hott says, each of those lines has many options. Each member of the 2200 family of oscilloscopes, for instance, contains the same basic circuit board, but components in those boards are subtly different. Rather than set up a separate circuit-board assembly system for each family member, the Instruments Division is developing a random-board-insertion system that automatically adjusts itself to accommodate options.

"We don't want to be running one type of board through the equipment, break down the system, set it up again and then run another type," says Kreps. "We'd like to run boards through randomly, regardless of whether they're for the 2200, 2300 or whatever."

Ultimately, he says, as a board runs through the insertion system, the equipment will be able to insert a diode, for instance, into a specific location on the board. If the next board on the line requires a different type of diode, however, or a diode of the same type inserted into a different location, the equipment will be programmed to automatically adjust itself to accommodate the necessary changes.

Kreps says that the random-board insertion system, which will be controlled by LSI 11/23s, will be operational in about one and one-half years. "We're trying to automate what has traditionally been a batch process," says Hott. "We don't really produce individual family members in high volumes, but, considering all those family members together, we're a high-volume manufacturer. Each system that we install has to be able to operate in this high-volume mode and perform whatever task it is intended to perform on not just one, but each member of a product family."

The flexible-automation requirement will also be applied to robots that the instruments division integrates into the Clark County plant. One robot is already operating at the facility, but it does not represent the type that Tektronix will implement, says Hott. "We'll be using smart microprocessor-controlled robots, which can be programmed to handle a variety of routines and subroutines."

Hott says that the most viable applications for robots include storage, in which robots can take components and subassemblies in or out of storage bins, and assembly, in which robots can replace shop-floor personnel doing repetitive, mundane or hazardous tasks.

Tektronix's new 500,000-sq.-ft. Clark County, Wash., plant *is being outfitted with state-of-the-art production equipment for the assembly of the company's general-purpose oscilloscopes.*

The Instruments Division also plans to automate activities other than assembly, including inspection, storage and retrieval and materials handling. As a means of reducing repair costs of assembled products, the division will inspect the parts as they come in for assembly. Although equipment to test incoming parts has not been decided upon, Hott says, those that are put in place will tie into the VAX 11/750, enabling failure rates of parts to be monitored and recorded. If a part develops a history of failure, its vendors will be notified to take corrective action. Subassemblies will also be tested as they move from process to process, and those test results will also be recorded in the 11/750.

In the final inspection area, where finished boards will be tested before assembly into oscilloscopes, two GenRad systems are in place, and a third is scheduled to be operating within the next few months. Kreps says that the division hopes to automate the board-testing procedure to the point at which boards designed for any product family will move through the test system on a conveyer belt, and the system will automatically perform required tests.

As components, subassemblies and finished oscilloscopes continue through the plant, they must be stored between processes. Hott says the division will probably use revolving computer-controlled carousels. He says that a DEC PDP 11/34 will control the system, moving a carousel to a designated location so that a user or a robot can insert or remove parts. The 11/34 will also report stock status of parts and subassemblies to the 11/750s as parts enter or leave storage.

Various material-handling systems to transport parts and subassemblies through the plant are being evaluated, and Hott says the strongest contender so far is an

overhead monorail system. The system includes a carrier, or arm, which is suspended from a track and holds three or four bar-coded totes. Each tote stops at a location if its bar code matches a bar-code reader at that

AUTOMATED WAREHOUSE: THE BUILDING THAT ISN'T

It looks an awful lot like a building—four walls, a floor and a ceiling—but it's a machine. And besides being a subject for an argument in semantics, it's a great tax write-off.

Tektronix's two-year-old, $21-million automated warehouse has not only improved the efficiencies of storage-and-retrieval activities in the company and provided better record-keeping and inventory control, but also has helped improve cash flow. Roughly 40 percent of the structure is taxed as captial equipment because three of the warehouse walls are supported by frames on which storage bins are located. Rather than the 30- to 40-year depreciation allowance of typical buildings, that 40 percent of space is depreciated over 10 years. Dick Carnahan, manager of distribution warehousing at Tektronix, says the depreciation rate improves the company's investment capability. "It allows cash to flow back into the company at a faster rate to offset the original investment," he says.

But taxes are only part of the overall savings Tektronix has derived from its warehouse. Carnahan estimates that, by providing better control of inventories, the facility is saving the company approximately $2 million a year.

The 193,000-sq.-ft. building/machine stores about 130,000 part lines used in the assembly of Tektronix's products. Approximately 45 percent of those parts are from outside vendors, and the remaining are company-made. On an average day, about 2000 part lines enter the facility, and 15,000 leave. Each part line can consist of just one item or as many as 150,000 items.

Between the time they are received and when they are shipped, parts are inspected, packaged, counted and stored. About 65 percent of parts received are small, such as circuit-board components. Such parts are stored in the "mini-load" system, consisting of 24 50-ft.-long aisles of 29½-in.-high shelves. A conveyer belt moves the parts through those aisles, and a stacker crane sets them into storage on the shelves. Larger items, called pallet items, are stored in 11 325-ft.-long aisles of 49½-ft.-high shelves. Forklift-like storage/retrieval trucks move materials through that area and into designated locations.

Hardware for the automated storage-and-retrieval system was supplied by Eaton-Kenway, Salt Lake City, Utah.

As parts move through the warehouse, they are tracked by an on-line computer system—two DEC PDP 11/70s. Data, such as part number, vendor identification, quantity, due date and purchase-order number, are fed into the system via Tektronix 4025 terminals in work areas throughout the facility. Personnel can locate a part almost instataneously at any stage of the storage process. The 11/70s also control the material-handling systems and determine where parts will be stored.

Software was designed by Eaton-Kenway and modified by Tektronix. Each night, warehouse activity data are shipped to the corporate IBM 3038 system via paper tape. The information is fed through Tektronix's MRP system and processed for business use in billing, scheduling and inventory control.

The 3038 processes weekly part orders from the Tektronix divisions and sends the orders to the 11/70s in the warehouse. The 11/70s sort the orders according to due dates and generate a pick list to plan weekly shipments to the assembly area.

Carnahan says that, over two years of operation, the system has reduced delivery times by 75 percent, compared to the previous system. "Our goal is to be not more than three days early now," he says, "but never late." So far that goal has been met. Carnahan says that studies of the system show that 99.7 percent of all items ordered are delivered on time.

Approximately 65 percent of the 130,000-part lines stored in the automated Tektronix warehouse *are housed in the miniload section. Two DEC PDP 11/70 computers keep track of where each part is in the storage process.*

location. The bar-code system also allows the VAX 11/750 to track the parts as they move through the plant.

The Martin Marietta MRP II software package, which runs on the IBM 4341 computer, ultimately receives data from the systems on the plant floor and converts that data for use in running the business activities of the Instruments Division. Each Tektronix division will have its own MRP II system, but data from the divisions still must be reported daily to the IBM 3038 in Beaverton for storage in a central database.

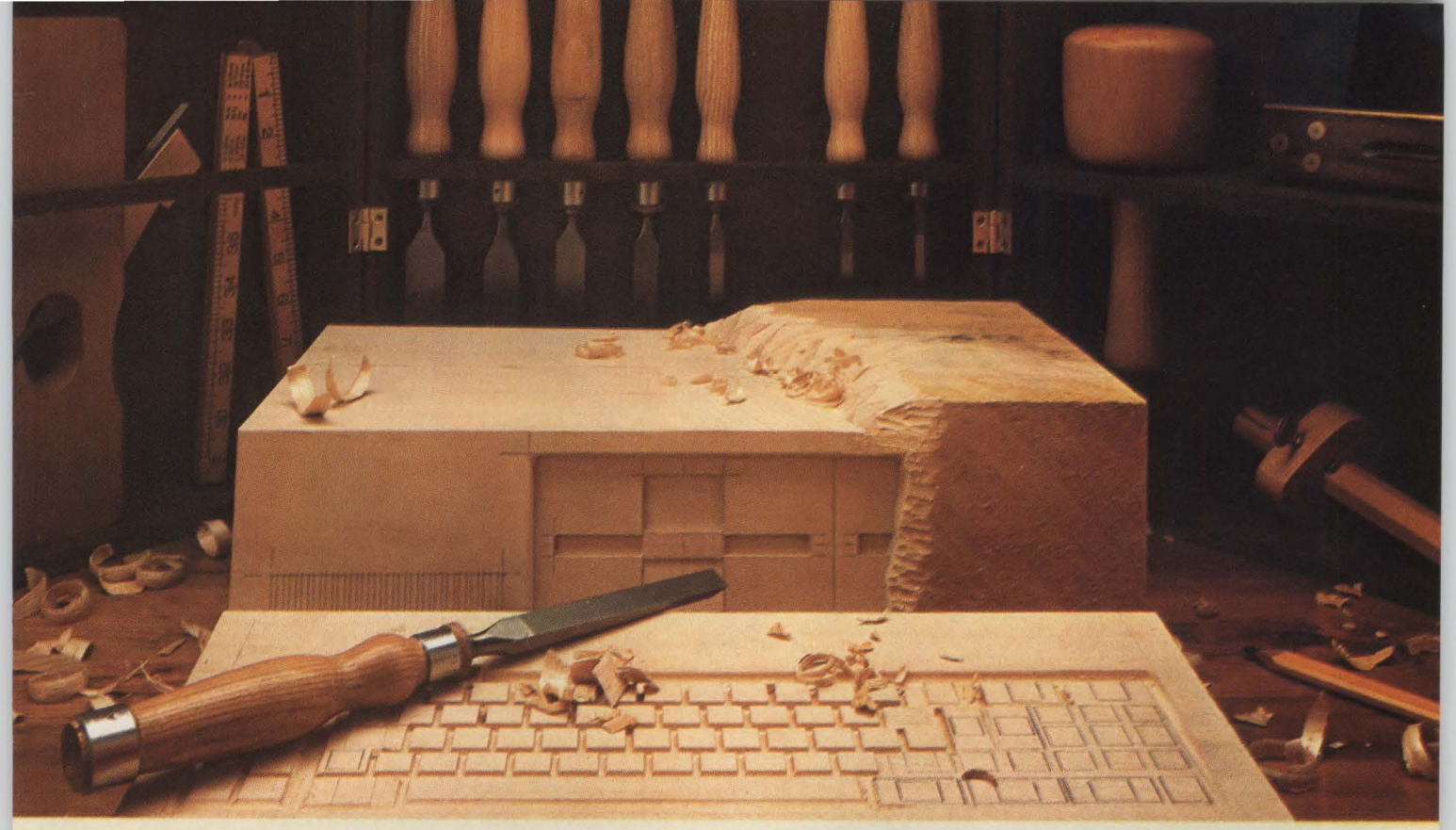
Hott notes that the MRP II package is available in modules and, therefore, need not be implemented all at once. Thus far, the Instruments Division has purchased and is testing and debugging, the inventory-control, business-planning and production-control modules. The division is also considering purchasing and costing modules.

"Our goal is to become a Class-A MRP company," says Hott. "I don't think any other $1-billion company has ever attempted that."

Although Hott says the purpose of implementing all this automation into the Clark County facility is to "take labor out of products and thereby lower manufacturing costs," he adds that "Tektronix is not going to fire all of its people and hire a bunch of robots." He says manual labor will be used in facets of the production process in which it is not "technologically or economically feasible to employ machines." People will also be used on the shop floor to operate equipment and to input production data into the computer system.

Although the plant personnel will perform blue-collar tasks, they'll work in a white-collar environment. The manual-assembly area is carpeted, and workers sit at desk-like work stations. But the work area was designed not only with aesthetic considerations, but also with functional considerations in mind. The modular work stations, for instance, can be disassembled and reconfigured as production processes change. Furthermore, the carpet in the work area dissipates static electricity better than vinyl asbestos tile, which is normally used in such areas.

Tektronix spokespersons are quick to point out that much of what is planned for the Clark County plant is still in the design stage, and many plans may change. But Charles Taylor, a senior Dataquest analyst, notes that the mere fact that the company is taking a stab at improving manufacturing-cost efficiencies is significant. "A lot of companies are fighting Japanese attacks by going to Singapore and Hong Kong for their manufacturing tasks," says Taylor. "Tektronix is planning with the future in mind, and, in the long run, it will be to their benefit." ■



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CIRCLE NO. 38 ON INQUIRY CARD

Gould courting system houses, OEMs

By Eric Lundquist
Associate Editor

As the role of the system integrator increases in importance in the developing industrial-automation market, end-user-oriented companies are courting system builders. One of the latest courtships involves Gould Inc., which is attempting to develop a network of OEMs and system houses within its Factory Automation Division.

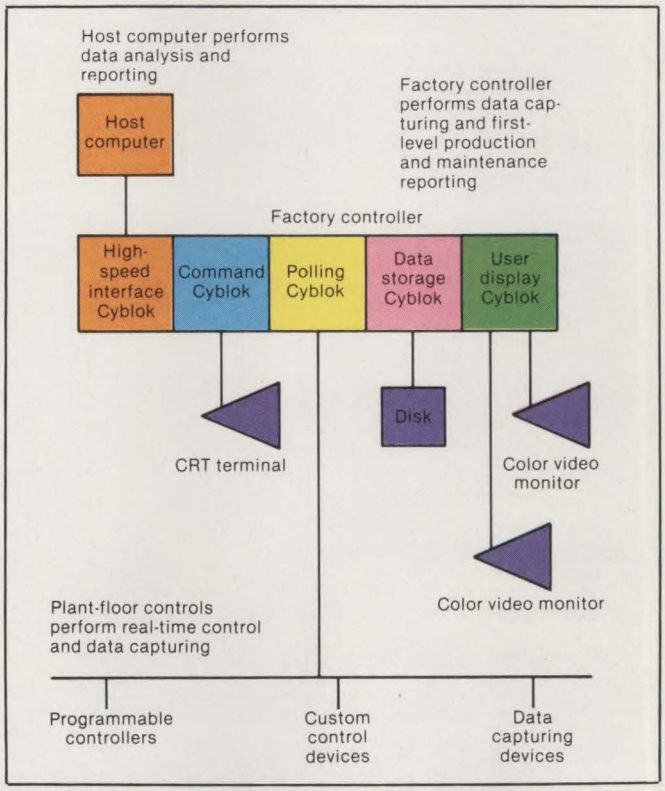
Once signed on, the system houses will develop and adapt Gould's Autofactor hardware to vertical markets. Robert H. Ryan, director of strategic marketing planning for the Factory Automation Division, says the company is evaluating system houses and markets and expects to announce its first Autofactor system houses soon.

Autofactor is a factory-management system that uses microcomputer-based factory-floor monitoring and display subsystems with high-speed parallel communications to Gould's 32-bit minicomputers. The systems use a number of independent processor modules called Cybloks. A basic Factory Controller system for first-level production monitoring uses four Cybloks.

The command Cyblok supports system-level interaction with the Factory Controller. With the command Cyblok, an operator specifies the format and content of the production reports as well as which reports are available. A polling Cyblok polls programmable controllers and other devices and transfers the information to other processors. A user-display Cyblok takes information from the polling processor and displays it on a color video monitor. A fourth Cyblok processor is used for data storage on an 80M-byte Winchester-disk subsystem.

The Autofactor system extends the plant-monitoring system beyond the first level and allows the addition of a larger computer by using a high-speed interface Cyblok. With the larger computer, the system performs statistical analysis, database management and similar functions.

The Factory Automation Division is a unit of Gould's Electronic Systems Group whose products include programmable controllers, factory monitors, servo motion drives, distributed controls, pressure and temperature transmitters and transducers and digital imaging and graphics systems. In a statement accompanying the formation of the OEM and system-house network, J. Lawrence Doherty, vice president and general manager of the division, said, "We believe we have designed the most responsive, flexible, expandable and available modular production-management system yet introduced. We recognize, however, that in a few industries, the ability to successfully apply even extremely flexible systems such as our Autofactor products requires a level of specialization best found in custom-design houses and specialized OEMs."

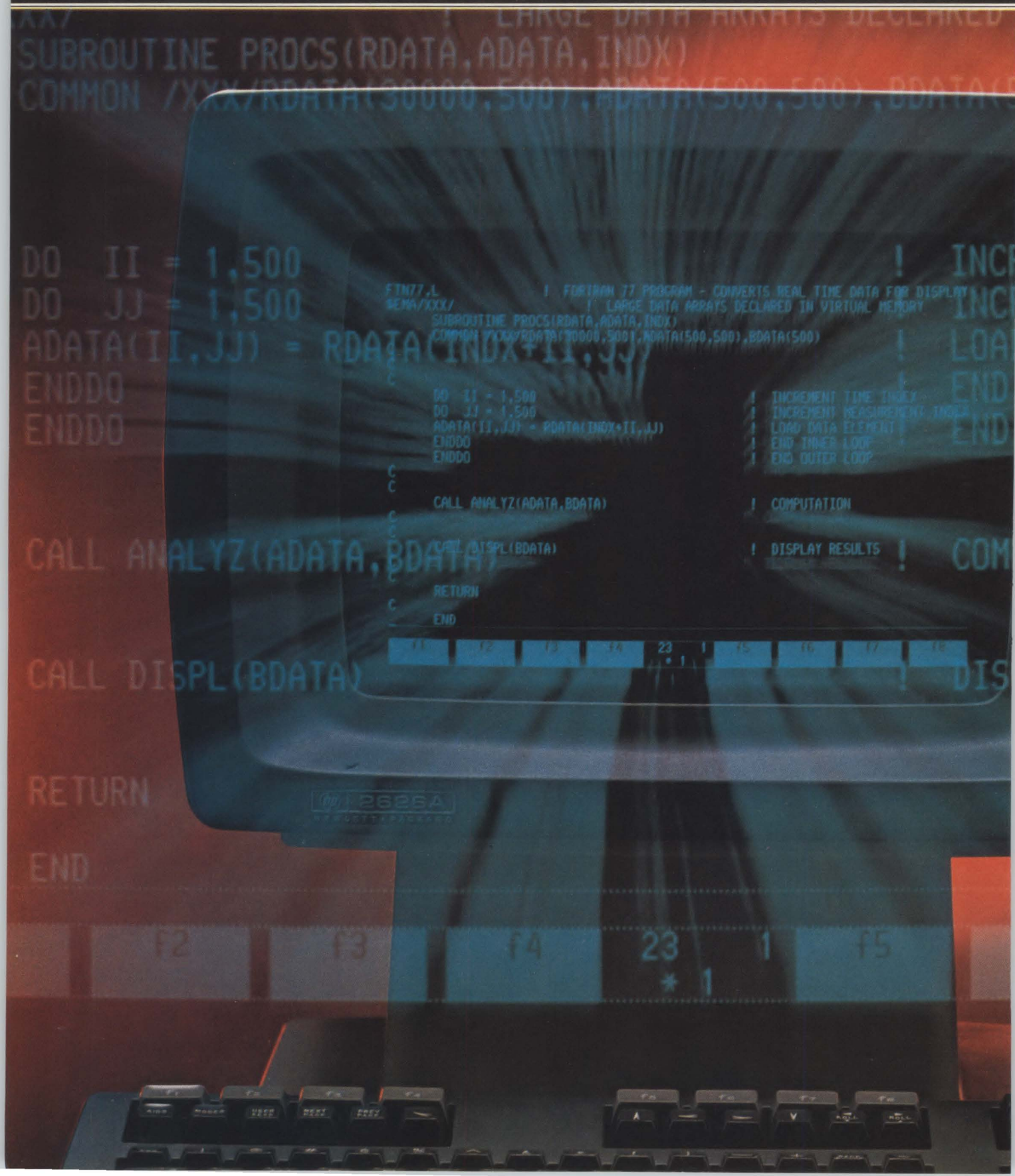


Gould's first-level production monitoring system *uses four independent processor modules called Cybloks.*

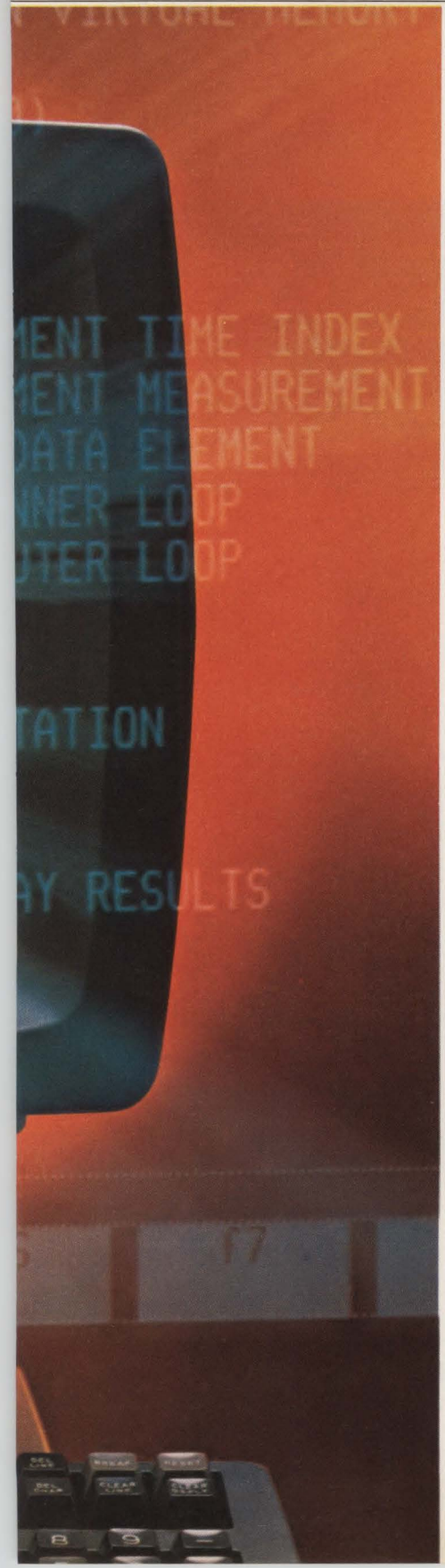
Director of marketing planning Ryan says many system houses deal with stand-alone products, but not too many address the integrated market in the OEM sense. Part of the reason for the lack of system houses has been the difficulty of developing multiple levels of communications. He notes, however, that some Japanese firms have successfully developed that integration, and U.S. companies must develop it if they want to compete. "The integration of the factory floor starts with being able to interface with the various machines that are out there," Ryan says.

For companies such as Gould with high growth objectives, effective networks of systems houses are a necessity, he says. ■

The HP 1000 you'd think you were



Model 65: sitting at a mainframe.



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Gordon Watson,
Vice President/General Manager,
Naked Mini Division,
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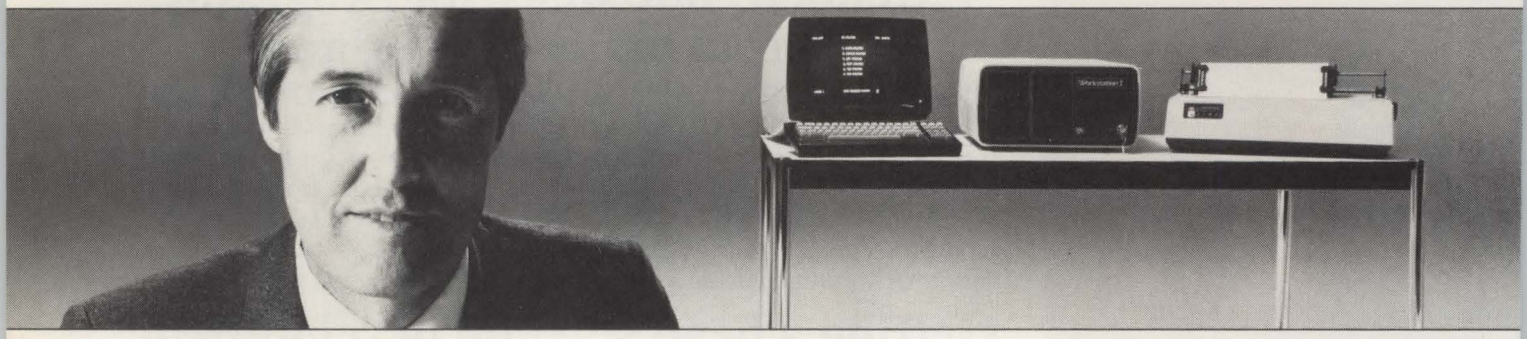

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CIRCLE NO. 29 ON INQUIRY CARD

Robot systems lack communication software

By Eric Lundquist
Associate Editor

Robot system developers trying to bridge the gap between the robot work cell and external computers are finding that, although robot communication software is steadily improving, considerable development must be accomplished before industrial robots can mesh with a factory's operations.

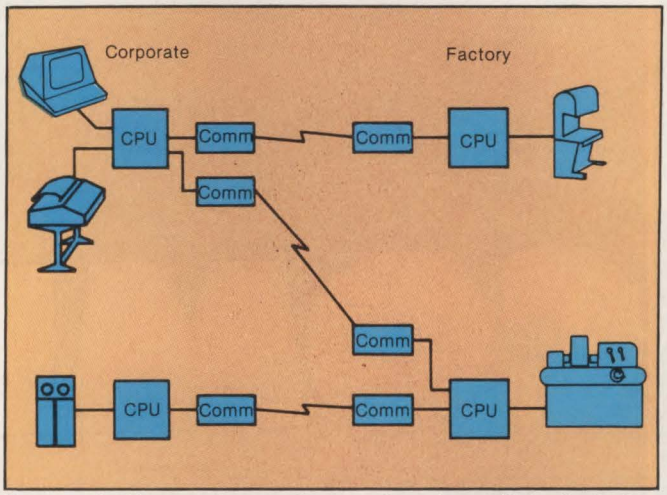
While there are several areas of robot technology that require significant advances—vision, tactile sensing and advanced programming languages—communication software holds greatest potential for immediate benefits to the robot and factory-automation market.

Robot-system developers haven't neglected the need for more advanced communication software. In a paper presented at the Robot VI conference this year, Tom Thomas, manager of engineering planning at Cincinnati Milacron Co., Lebanon, Ohio, detailed 12 areas in which communication software requires improvement.

Thomas's list includes support for transmission rates of at least 9600 bps. "Lower rates may cause the exchange of large amounts of information during the robot's cycle to slow down the application, thereby lowering productivity rather than raising it," Thomas stated. The second item listed was the need for a common protocol. Thomas stated that use of an obscure or special-purpose protocol "may increase system cost or delays in implementation due to reprogramming of the local area network."

Other needs cited by Thomas include:

- the ability to load both the robot operating system and the application program up from robot to host and down from host to robot,
- security checking by passwords as part of the loading procedure,
- immediate notification to the host computer of any error condition detected by the robot,
- the ability for the host computer to reply to those robot error messages that offer an operator a choice of possible actions,
- the ability to initiate communications at any time from either end of the link,
- emulation of switches and push buttons by host-initiated messages to allow remote control of a robot's cycle,
- the ability to modify the robot's program during operation,
- the ability to notify the host computer, in response to its request, of the status of all software switches and indicators, the value of numeric variables and the state of I/O contacts,
- the ability for the robot to report to the host computer its position, both logically within its program and physically in real-world coordinates or servo angles.

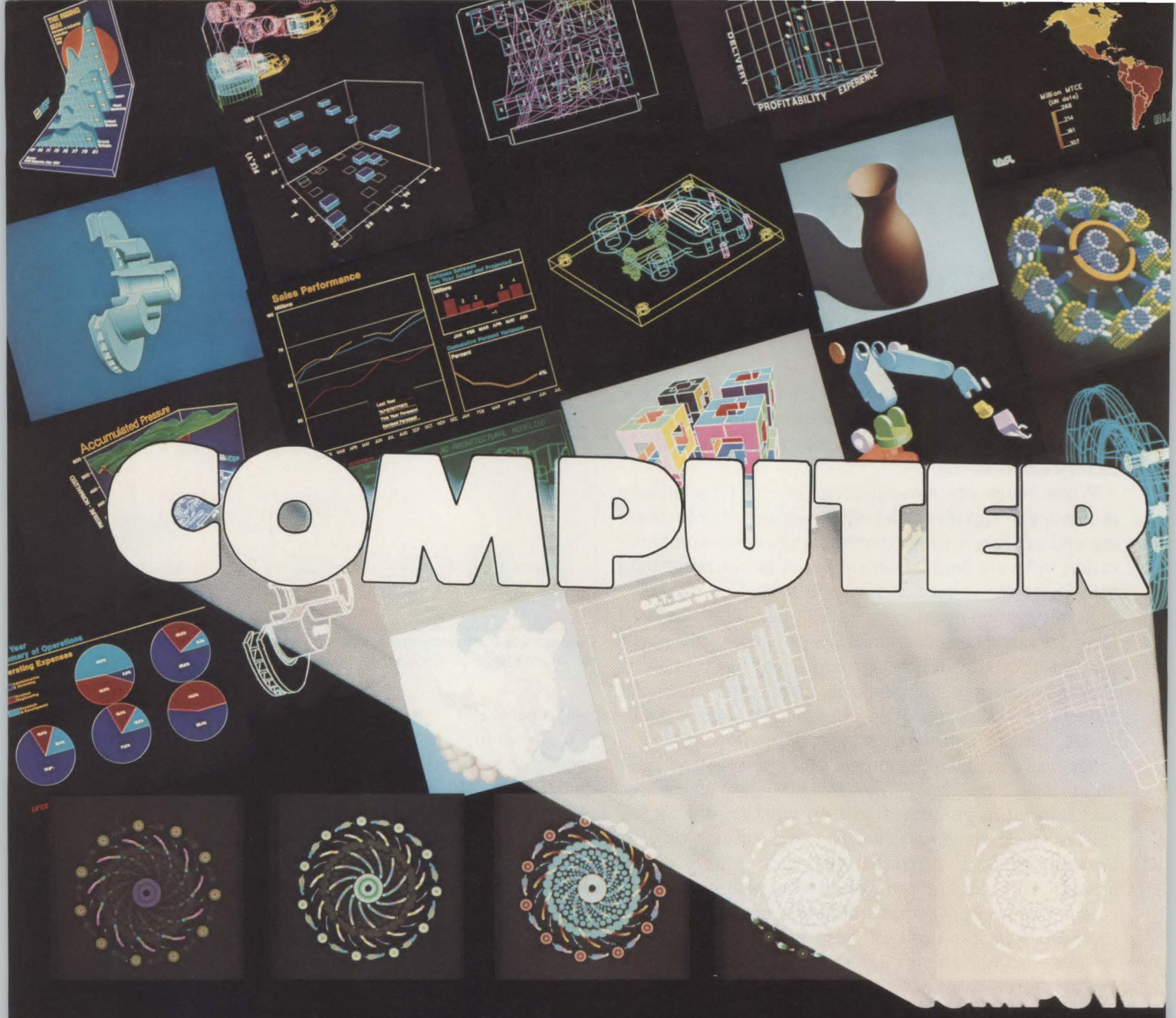


Communications and computers *are the prime vehicles for factory automation. Source: Creative Strategies International.*

Communication software provides the ability to develop a hierarchical controlled local-area network. Thomas stated that the availability of the communications features "should make computer-controlled manufacturing even more attractive to robot users because they provide several special advantages for robots, even if no other devices are connected to the host computer. In any application which entails several robots working together, the benefits of hierarchical control could well justify the cost of the local-area network, the host computer and the related software necessary to implement such a system."

Mitchell Weiss, chief engineer at United States Robots, Conshohocken, Pa., agrees that a need exists for more advanced communication software, but disagrees with some of Thomas's suggestions. Weiss agrees that a common interface standard should be developed, but he doesn't expect it to happen. "The general-purpose plug-in robot may not be possible," he says.

Weiss says few companies are now looking for local-area networking when considering purchasing a robot, and the large companies that are considering LANs, including General Motors and International Harvester, have issued their own specifications. With most factory-automation investment dollars coming from the large companies, it may be worthwhile to develop machine interfaces to those specifications rather than wait for the development of a standard, Weiss maintains. ■



For more than a decade, *Mini-Micro Systems* has tracked computer graphics products and advocated their use. We've seen graphics hardware and software first developed by the defense establishment, the space program and academia revolutionize drafting, process control, engineering, simulation, animation and business and personal microcomputing. Mini/micro users no longer ask, "What is computer graphics?" Instead they ask, "How can I get some today?"

Color systems were state of the art a few years ago but are now numerous and affordable. Today, 3-D systems represent the state of the art, and this issue takes an exclusive look at one of them: a general-purpose system from Megatek Corp.

The $2-billion-a-year graphics industry has a lot to offer system integrators and end users in every price range. In keeping with the geometric growth of this market, this year's special report on computer graphics is longer than *Mini-Micro Systems*' previous two graphics issues (December, 1980 and December, 1981) combined. Rather than explain the basic technologies as past issues have done, this special report details the four main components of modern graphics systems: processor hardware, graphics software, input peripherals and output peripherals.

Three articles on graphics hardware integration show how diverse systems priced from

$6000 to $100,000 all rely on multiprocessor architectures. Steven Cope of Ramtek Corp. discusses terminal-oriented, low-cost graphics; Dave Luther of Lexidata Corp. describes specialized graphics processors; and Paul Benger of Applicon, Inc., explains the advantages of turnkey graphics systems.

Graphics I/O peripherals are the most specialized graphics hardware, and selecting the wrong ones can cut a graphics system's performance in half. To protect readers from these pitfalls, graphics consultant Joel Orr explains how to choose between tablets, joysticks, mice and other graphics input devices, and Peter Duffield of Advanced Color Technology explains ink-jet hard copy in the context of current output peripherals.

On the software side, Jim Warner of Precision Visuals and Anders Vinberg of ISSCO discuss software standards and the revolutionary standards and the revolutionary movement toward device independence. For commercial end users, editor Mal Stiefel contributes a product profile on business graphics software packages.

Patrick Kenealy
Associate Editor

Many organizations and individuals provided graphics for this special report. Mini-Micro Systems *sincerely thanks Applicon, ISSCO, Lexidata, Peter Pathe, Precision Visuals, Ramtek and Raster Technologies.*

COMPUTER GRAPHICS

Bringing true 3D imagery to color raster graphics

DALE ROARK and HIRAM FRENCH, Megatek Corp.

Electronic stereopsis combines color, real-time simulation and user-interactive technologies

Convincing a viewer that stroke and raster video displays can create true 3D images is not a simple feat. Even the most sophisticated computer graphics systems present 2D representations of 3D objects. In critical engineering and scientific application markets, a major goal of graphics manufacturers is to present images that are so realistic the viewer believes he is seeing actual objects rather than representations of those objects.

2D representations of 3D data

Available computer graphics equipment typically provides 2D perspective, orthographic or isometric projection of 3D objects. Depth queuing (Fig. 1) enhances 2D representations by diminishing the intensity of the most distant portions of an object. Shading can also make 2D objects look more like 3D. None of these methods, however, offers true 3D in the sense of presenting different images to each eye.

A cost-effective way to "trick" the brain into thinking that it is seeing objects in space, not on a screen, is stereopsis, a technique that presents different views of the same object to each eye.

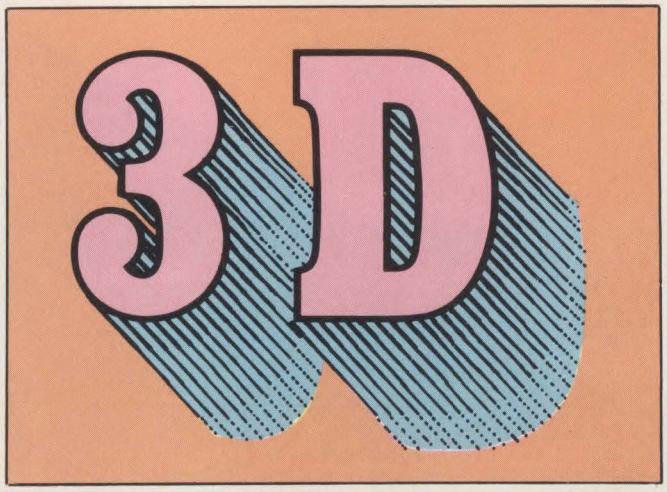


Fig. 1. Depth queuing *makes parts of object that are "closer" to a viewer brighter because brightness falls off with "distance." This technique, as well as perspective and shading, suggests 3D to a viewer rather than presenting true 3D images.*

When a binocular (two-eyed) individual looks at something, his brain receives two slightly displaced images, one from each eye. The brain interprets this displacement, called parallax, as a 3D image. By providing a user with true stereoscopic 3D viewing as an adjunct to proven color raster graphics technology, researchers at Megatek and the Massachusetts Institute of Technology are now experimenting with some

The techniques discussed in this article are experimental techniques employed by the Advanced Graphics Laboratory at Megatek Corp. These experiments in true 3D color graphics do not imply that Megatek is now marketing or intends to market such products.

technologies that allow users to manipulate data while viewing it in true 3D.

Last year, Genisco began selling a system that employs a vibrating mirror (Fig. 2) to provide the illusion of depth (MMS, December, 1981, p. 81). While effectively using the brain's ability to integrate a series of dynamic mirror-produced apparent images into one 3D picture, the need to view the mirror while hooded restricted the viewplane, allowed only one user at a time to view the display and reduced interactivity with keyboard, joystick or tablet.

Another visual 3D technique called "anaglyph" (Fig. 3) employs blue and red glasses with images displayed in those colors, a method used in comic books and some 3D movies. Because the viewer is looking at either red or blue to get his image, this method cannot provide true color.

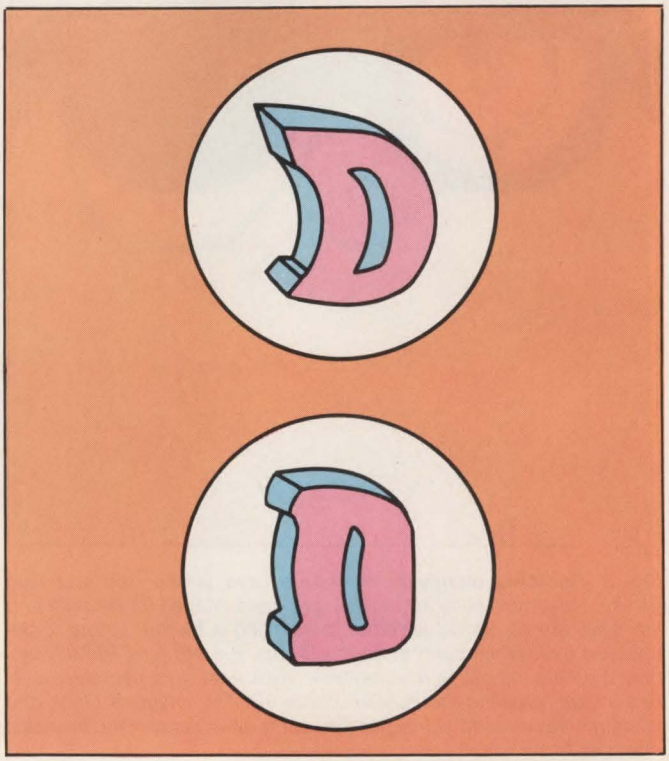


Fig. 2. Vibrating mirror display *simulates true 3D by projecting changing images on an alternately concave and convex flexible mirror for direct viewing. The brain integrates the image data received from each eye.*

COMPUTER GRAPHICS

If the computer were to rotate the display so that it always faced the viewer, the user could see all sides of a display.

Only electronic stereopsis meets all four of the key criteria for color 3D capabilities: dynamic, real-time manipulation of data; no dependence on viewing angle; simultaneous viewing for multiple users; and true color. Stereopsis uses electronically controlled stereo viewing glasses and normal raster display hardware. Existing graphics software is easily adapted to generate the dual images required to create a stereoscopic image with raster displays because the hardware can refresh the screen at the rates needed by the eyes and brain.

Principles of operation

Electronic stereopsis users wear a pair of eyeglasses with eyeshades for viewing in strong ambient light and lenses of lead lanthanum zirconate titante (PLZT) wafers. The lightweight glasses offer freedom of viewing angle, movement and screen orientation.

Each pair of glasses is connected to a belt-mounted power supply and sub-controller the size of a telephone pager, and as many as four belt units are connected by cable to the main controller. A pulsed voltage from the main controller causes the PLZT lenses to switch alternately in about 1 msec. from clear to opaque and back to clear (Fig. 4). This creates a shutter effect, which, because it is synchronized with alternating

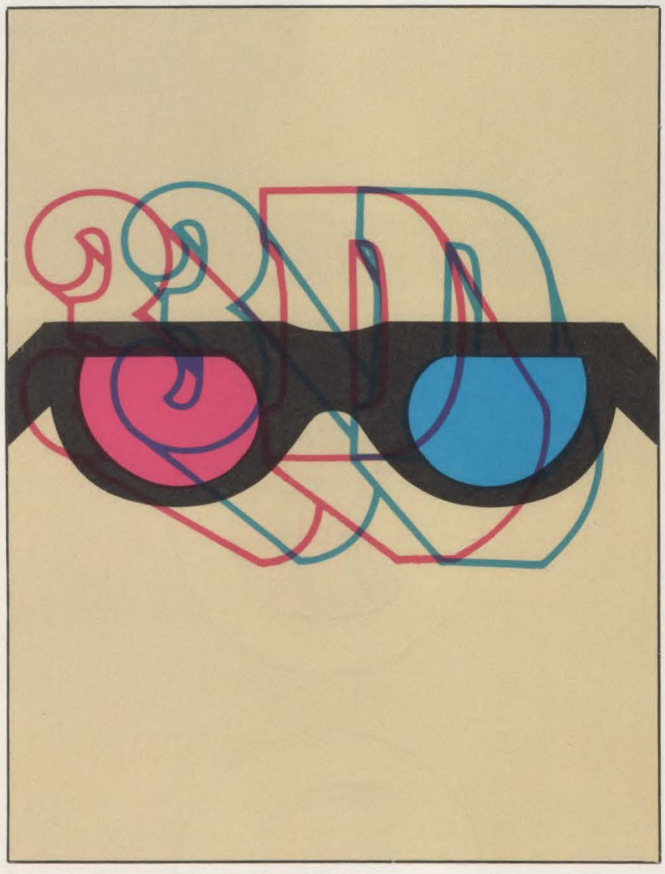
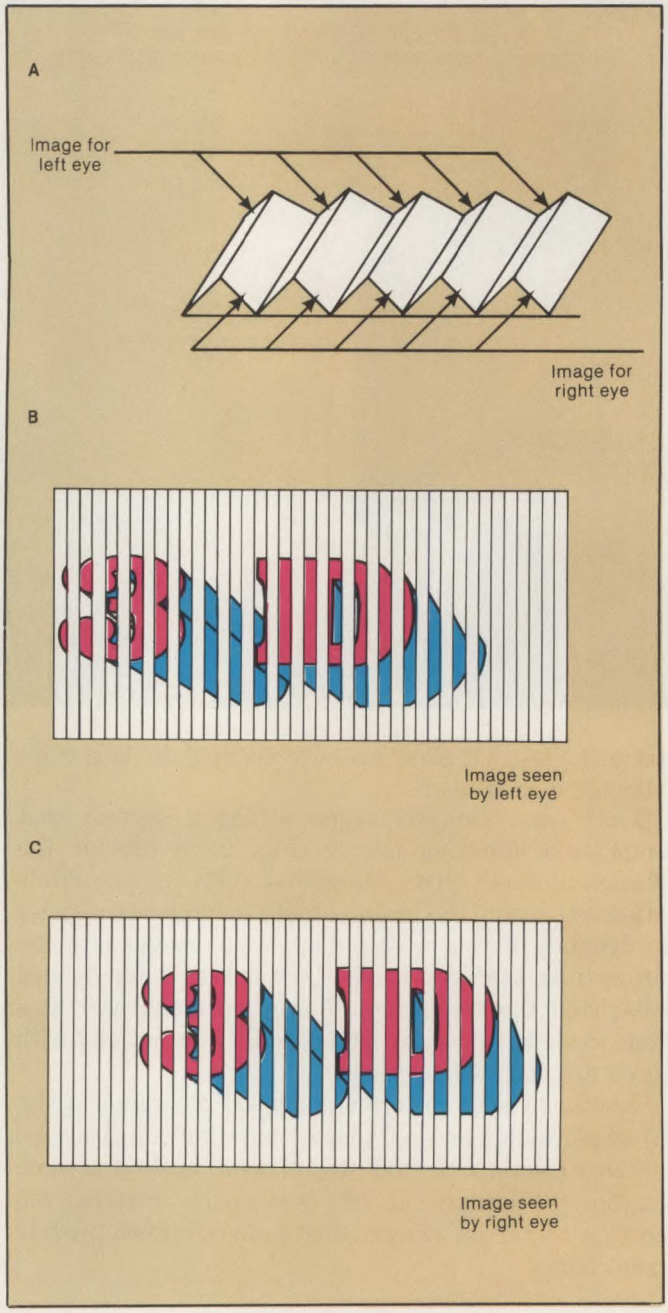
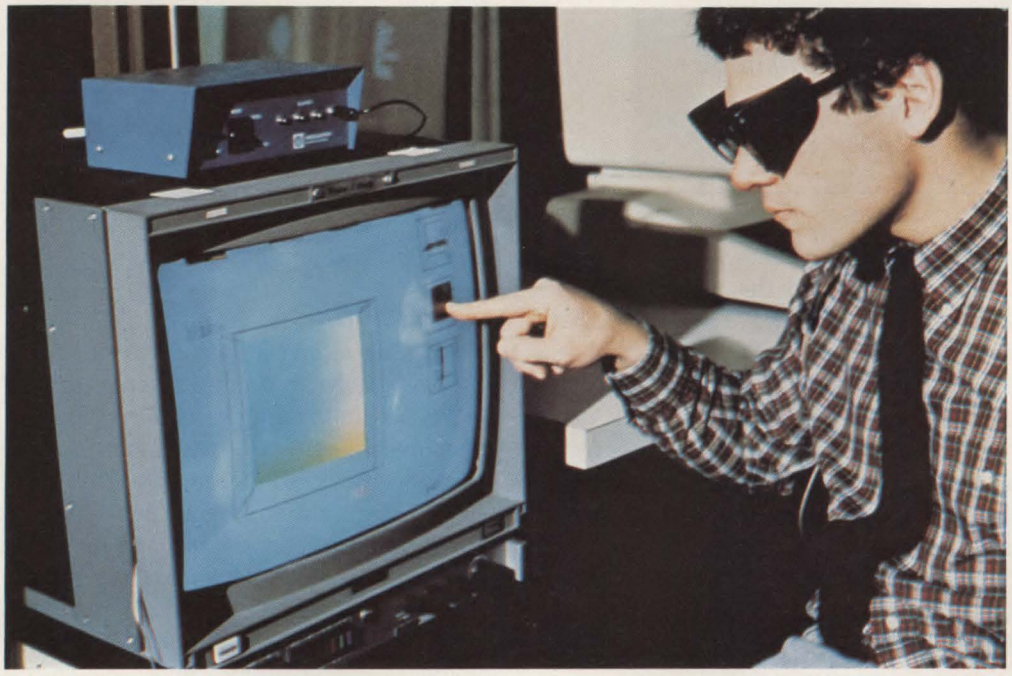


Fig. 3. Red/blue anaglyph technique *uses familiar red and blue glasses used with early 3D movies. Separate images for the right and left eyes are displayed together, presenting a blurred image to the unaided eye. When seen through glasses, the red lens lets through only the blue image, and vice-versa. Thus each eye perceives only one image, creating the illusion of true 3D. The image is black and white, however—and some people seem not to discern the intended effect at all.*



Lenticular images, *used for hard-copy production of 3D images, use a surface divided into thin, multi-sided ridges (A). One image is displayed on the same side of each ridge, and another image is displayed on another side. Several images can be displayed on one surface (a two-imaged surface is depicted here). When viewed at the appropriate angle and distance, each eye sees a different set of ridge sides, and thus a different image, for a true 3D effect.*

USE OF STEREOPSIS AT MIT

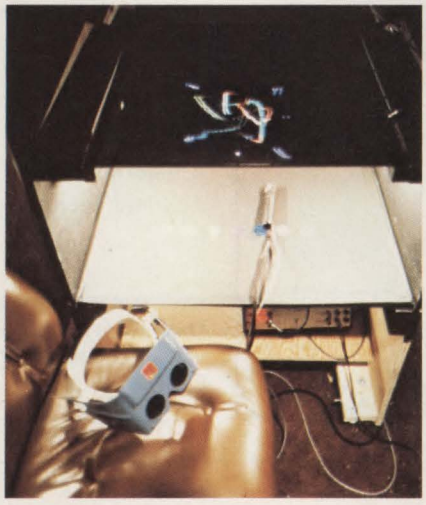


Researchers at the Massachusetts Institute of Technology's Architecture Machine Group have been working with computer graphics and man/machine interface technology for more than 15 years. Their goal is to provide computer systems that are essentially as easy to talk to as good friends, says Andy Lippman, assistant professor of media technology and head of a group studying effective methods of providing true 3D visuals.

Lippman, along with researcher Scott Fischer and other faculty members, researchers and students, is conducting many experiments using electronically controlled PLZT ceramic glasses. This group of nearly 40 has been experimenting with every 3D technology, including red/green anaglyph, Polaroid projection, relief projections and lenticular printing.

"A major obstacle commonly confronted when dealing with 3D is its past history of comic books and bad movies, which is viewed as kind of hokey by the professions where 3D would appear to be the most valuable," Lippman notes. "For instance, the medical profession should be very enthusiastic about the many possibilities 3D representations of data would provide, but they don't appear to be.

"Another problem is that 3D has never before been provided within a complete working environment. A user should gain all the benefits of 3D without sacrificing all the utilities he's accustomed to in the 2D graphics



MIT's experimental 3D project *allows the user to interact directly with image. A touch-sensitive screen (top) lets the user modify images continuously by running a finger across a reference scale on the screen. A half-silvered mirror is used to project 3D image into space inside a box (bottom). Users can create 3D designs in the box using a wand as an electronic paintbrush. The wand contains a magnetic detector that enables the computer to track the wand's movement through a magnetic field set up in the box. When the magnetic detector is wrist-mounted, the user can "grab" and manipulate projected objects with his hand.*

world. That means he needs 3D input mechanisms, 3D display mechanisms and 3D hard-copy capabilities. And those are the things we are working on," he adds.

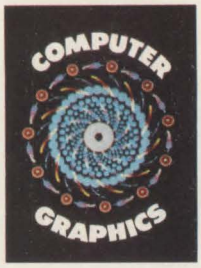
One example of the research undertaken at MIT is 3D map generation. Viewers can learn their way around an area by "driving" through a 3D replica of the area.

Another innovative MIT research project, called "put that here," uses the stereoscopic glasses with a half-silvered mirror placed in front of the video screen. The video image is reflected in the mirror, which the viewer can still see through. When the viewer's hands are brought into the viewplane, they appear as ghostlike images that can manipulate the displayed images. In a sense, the hands are mechanized gloves able to grab and move weightless objects.

While the team of researchers has experimented with 3D chess playing, more practical applications are seen in robotics, medical and scientific applications.

The combination of sensors, electronically controlled stereo glasses, the mirror and appropriate programming provides true interactive 3D. 3D hard copy is being developed using lenticular surfaces on which images are interleaved across thin ridges.

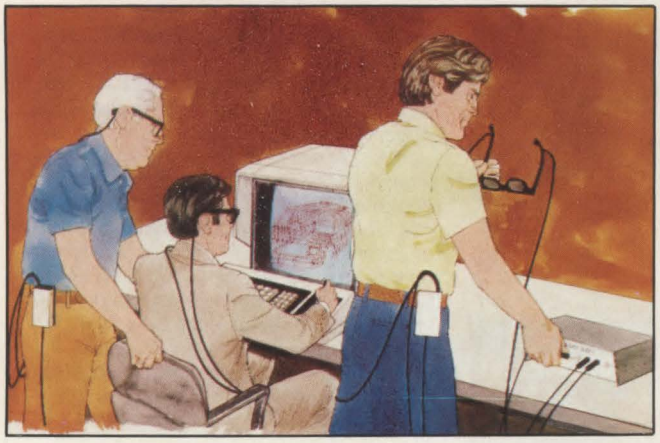
The MIT group has also developed a facial-identification system. More than 8000 3D images of faces have been recorded on an optical video disk. The faces are then viewed stereoptically with the glasses, and facial composites are changed interactively to "build" a face. The concept is that of the "Identikits" used in police work.



Only electronic steropsis meets all of the key criteria for color 3D capabilities.

images displayed on the screen, allows the left eye to see only the "left-eye view" and the right eye to see only the "right-eye view." The views are alternated at a normal refresh rate of 30 Hz per eye, and the image-processing software calculates the required binocular disparity necessary to simulate parallax depth queuing.

An additional benefit of the Megatek-MIT approach over fixed 3D viewing techniques is that viewer movement can be sensed by the computer, and this motion data can be incorporated by the processor in its parallax routines. Thus, it would be impossible for the computer to rotate the display so that it always faces the viewer, and in that way allow the user to see all sides of a displayed entity by walking around the display. Although that would restrict viewing to only one viewer at a time, even that problem is expected to be overcome when advances in microminiaturization allow replacing the PLZT "shutters" with self-contained flat-screen displays. Current technology permits receiving audio parallax information from miniature speakers on the eyeglass earpieces. Such a combined visual/audio system could simulate, for example, what would be seen and heard by a sailor walking through a ship's engineroom passageways.



Applications

Megatek is investigating various methods of achieving more realistic 3D for its computer graphics systems. Stereoscopic viewing is one method that is relatively economical, easy to implement and extremely user friendly. Several stereoscopic systems designed by Megatek are already being field-tested by users.

The applications of stereoscopic computer graphics are endless. Aircraft and other vehicle trainers and simulators; medical imaging including axial X-ray tomography; industrial and architectural design; meteorological, cartographic and oceanographic displays; chemical, physical and biological modeling; and military simulators and "battle boards" are only a few that come immediately to mind. Eventual creative and mass-recreational applications are mind boggling; one can only attempt to imagine how movie makers George Lukas and Steven Spielberg might employ the Megatek-MIT technologies. ■

Dale Roark is director of engineering and **Hiram French** is vice president of marketing at Megatek Corp., San Diego, Calif.

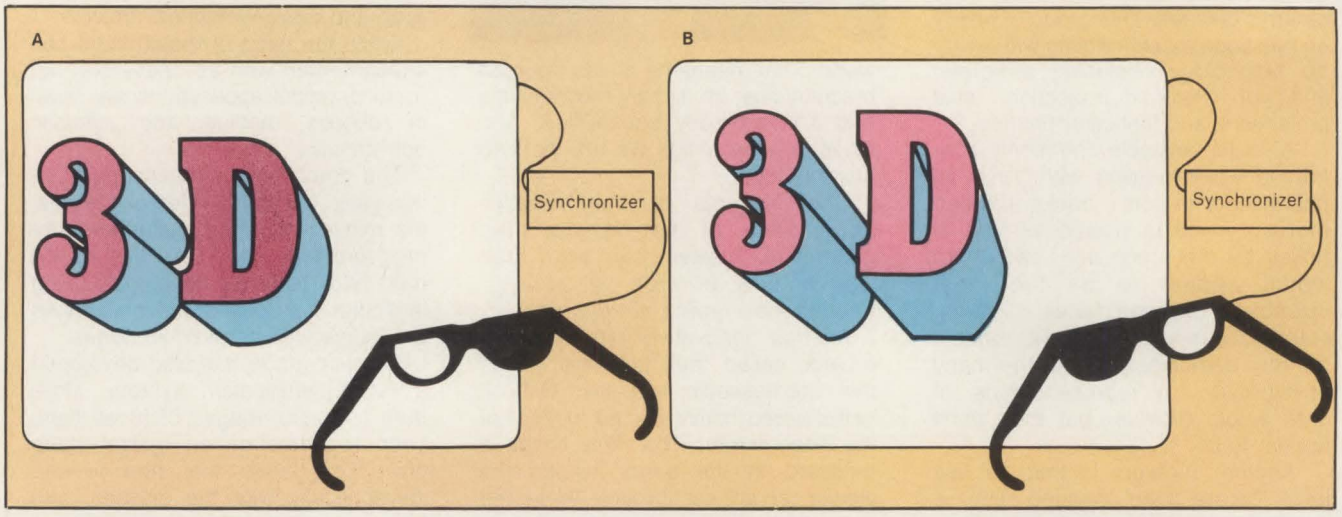


Fig. 4. Stereopsis technique for 3D images *uses glasses whose left and right lenses alternate images on screen. When the right lens is opaque (A), the screen image is portrayed from a viewpoint slightly to the left; 1/30 sec. later, a viewpoint from the right is displayed as the left lens is made opaque (B). These separate views for each eye simulate the effect of parallax on actual vision resulting from the distance between the two eyes—just as a finger held in front of one's face appears to jump from side to side as the left and right eyes are alternately opened and closed.*

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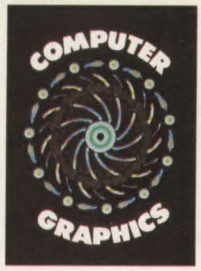


General-purpose graphic terminals unburden hosts

STEPHEN V. COPE, Ramtek Corp.

Local intelligence and software flexibility provide a cost-effective solution to diverse graphics needs

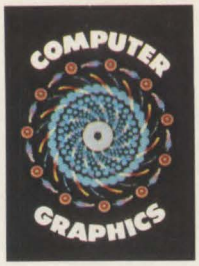
Computer graphics systems have traditionally been geared to highly technical users, but recently the graphics market has broadened to include many nontechnical users who want to use graphics to solve business, drafting and design problems. Ramtek's solution to these problems is a general-purpose terminal that offers sufficient local graphics functionality to unburden a user's host computer, and lets the user design his own applications or implement popular off-the-shelf software. In hardware, the general-purpose concept is realized internally through a sophisticated interplay of CPU and memory, and externally through interfaces to a wide range of input and output devices. In software, an easy-to-use graphics language is suitable for use by both programmers and nonprogrammers.

Fig. 1. The Ramtek 6211 intelligent graphics terminal *features integral microprocessor and memory, a detachable keyboard and a light pen. The terminal displays 16 simultaneous colors from a palette of 64 and sells for about $6000.*

Localized graphics and software optimize systems

Unlike turnkey graphics systems or "dumb" terminal-based systems that depend almost entirely on a host computer for processing, Ramtek's 6000 series is designed for assimilation into existing data-processing systems. Graphic manipulations are handled locally in individual terminals, freeing the host computer to perform the more complex high-level functions necessary to implement the desired applications. And when a user wishes to use information in an existing database to create graphics, or manipulate large amounts of data before generating graphics, the Ramtek terminal can take full advantage of the host's power. This shared-processing approach saves users from paying for the dedicated CPU in a turnkey system, but also saves them from the communications delays and host-performance degradation of dumb-terminal systems.

A major advantage of the intelligent graphics terminal approach is software flexibility. On the one



CGL code resides in PROM, and 12K of subroutine RAM stores CGL commands for creating repetitive graphic elements.

hand, users of 6000 series terminals can develop their own applications using Ramtek's firmware-based Color-graphics Language (CGL), which contains simple English commands for creating graphics primitives, such

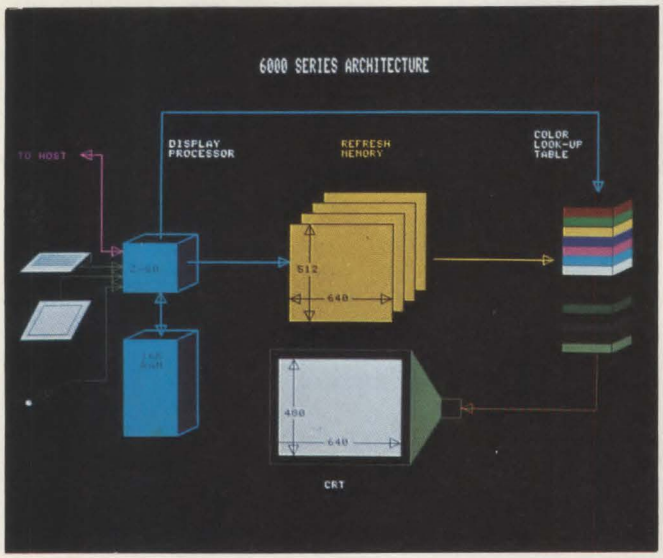


Fig. 2. 6000 series architecture. *Graphics input from a host computer or from the terminal's keyboard, graphics tablet or light pen is processed by a Z80 microprocessor. The processed data draw graphics into the screen's refresh memory, program the video look-up table, or are stored for later recall. Graphics drawn in the refresh memory are assigned colors via the look-up table, and are converted to analog signals that are displayed on the CRT screen.*

as circles and rectangles, while on the other hand, the 6000 is compatible with off-the-shelf application-software packages. The terminals interface with most popular commercially available graphics-software packages, and Ramtek has developed a Software Affiliation Program to ensure the compatibility of its hardware with graphics packages made by major software vendors. The benefits of this are seen in both the traditional graphics markets and the newly emerging ones.

In a traditional engineering/scientific environment, a Ramtek terminal can be used with a minicomputer or mainframe already installed in the lab, performing a function such as finite-element modeling. It also can take advantage of commonly used CAD software, such as PDA Engineering's PATRAN. Or it can emulate Tektronix's popular 4014 terminal, enhancing existing Plot 10 software by adding color.

Business users of the 6211 can use Ramtek's ASCII command set or pre-packaged graphic software such as ISSCO's DISSPLA or SAS's SAS/GRAPH.

Integral micro off-loads host processor

The Ramtek 6211 is based on a 4-MHz Z80A microprocessor CPU, a memory-map circuit that lets the CPU address as much as 512K bytes of processor memory and an interrupt-priority circuit for interrupt arbitration. The interplay of the local CPU and memory provides sufficient local graphic capability to serve a user efficiently without burdening the host computer.

A four-plane refresh memory lets the 13- or 19-in. monitor display 16 colors at once. Resolution is 640 × 480 pixels. In conjunction with a video look-up table, the refresh memory permits simultaneous storage of more than one picture. With two four-color pictures residing in two planes each, users can switch from one picture to another without redrawing delays. The planes can also be divided so that graphics are stored on three planes and alphanumerics are stored on the fourth. A user could receive alphanumeric prompts from the host computer, for example, and build an eight-color graphics picture using the other three planes. Furthermore, each plane can be segmented to create features such as 16-color graphics islands in a screen of text.

The 6211 uses two other types of memory. CGL code

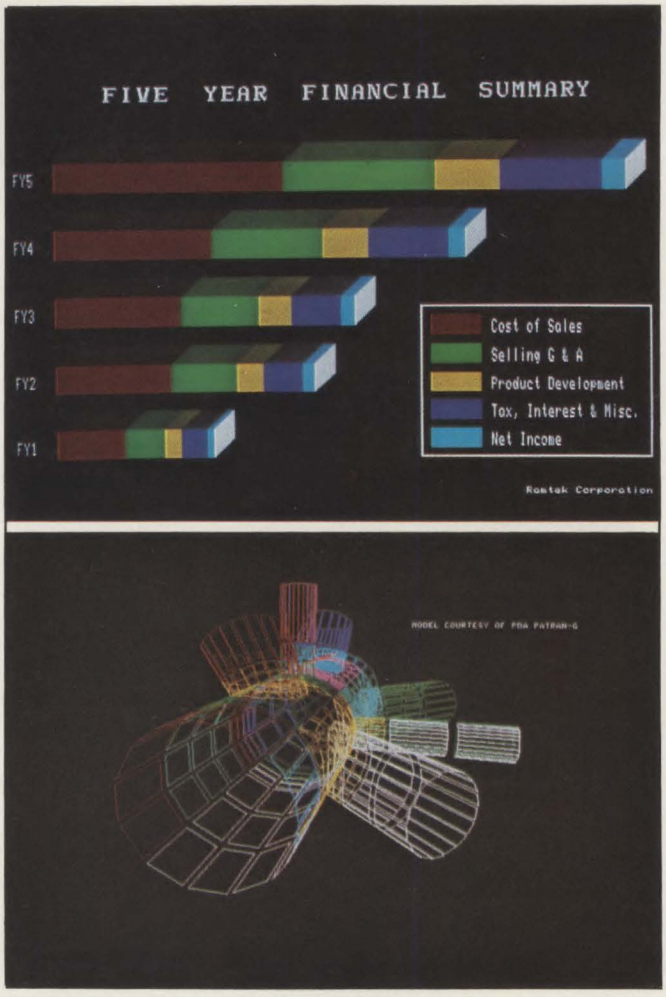


Fig. 3. Dedicated and third-party software *provide diverse capabilities. On the top is a business graphic produced by Ramtek's CGL graphics command set. On the bottom is a finite-element model created with PDA, a product of PDA Engineering.*

resides in PROM, and 12K of subroutine RAM stores CGL commands for creating repetitive graphic elements. For example, if several pictures require a drawing of an automobile, the commands used to create the automobile can be stored in subroutine memory and recalled when needed.

Because CGL subroutines are stored locally, the terminal need not take the time to retrieve them from the host. And when a graphic representation such as a strip chart needs updating, the terminal need acquire only the new data from the host and combine it with locally stored information. Stored subroutines can be activated either from the host or from the terminal's 16 programmable function keys.

Software

CGL's ability to build complex images by combining simple but powerful commands can best be shown by a simple program used to create a bar chart. The first command

(SPBL 100,100)

tells the 6000 series terminal to set the plot base line (SPBL) at screen coordinates 100,100. The second command

(M 100,100)

tells the processor to move the current operating point to coordinates 100,100 because the chart to be drawn should start at the beginning of the base line. The third and final command

(BARX. R 10 20 40 60 80 70 85 90 100 120)

actually draws the chart.

The term "BAR" tells the processor to draw a bar chart; "X" to draw the chart parallel with the x axis (horizontally); and "R" to draw the chart relative to the operating point's current location. The numbers following "R" designate the height of each bar.

CGL does not permit use of true variables—such manipulations must be performed in software on the host computer—but it does use a relative address register. By incrementing this register and drawing lines relative to its value, a simple subroutine can draw many parallel lines.

In effect, CGL is compatible with all other languages. Programmers can write in CGL or refer to CGL subroutines in host-resident programs written in another language. For example, once a COBOL program has generated the data necessary to create a picture, the 6211 terminal can take over formatting and producing the picture. CGL commands are passed to the 6211 by writing or "printing" bracketed statements to the terminal's port as if they were text. Full Tektronix Plot 10 emulation can be achieved simply by adding calls to CGL commands, thus making all software created for the popular Tektronix 4014 green-on-green terminal available on the multicolor 6211. ■

Stephen V. Cope is vice president, engineering, at Ramtek Corp., Santa Clara, Calif.

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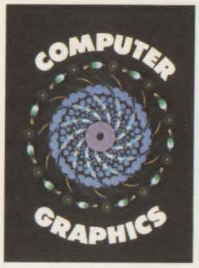
CIRCLE NO. 57 ON INQUIRY CARD

Photo courtesy of Michael Potmesil, Image Processing Lab, Rensselear Polytechnic Institute



Integrating an interactive graphics system

DAVID LUTHER and WALTER ANDERSON, Lexidata Corp.

The distributed-processing approach to graphics requires components matched to the application and to each other

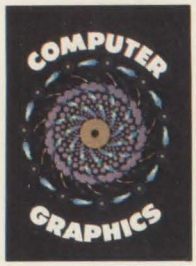
The system integrator designing an interactive computer graphics system can choose from a larger selection of hardware and software components than ever before. Selecting the best components, however, does not necessarily yield a competitive graphics system (see table). Components must work well together in parallel, under conditions matched to their application. This can be particularly important in the design of multiprocessor, distributed graphics systems.

Matching the components to the application

The design of a graphics system depends largely on its application. A system integrated to offer only those features important to an application can nearly equal

Application	Disk size	Disk bandwidth	CPU bandwidth	CPU arithmetic	Display resolution	Display colors	Display bandwidth
Animation	medium-high	medium	high	high	medium-high	high	high
Architecture/ engineering	medium	medium	medium	medium-high	medium-high	low-medium	medium
Business graphics	low-medium	low-medium	medium	medium	medium-high	medium-high	high
Mapping (cadastral)	nigh	high	high	high	high	low-medium	high
Mapping (thematic)	medium	medium	medium	medium-high	medium-high	medium	medium
PC CAD	medium	medium	medium	low-medium	medium	medium	medium-high
Schematic	low-medium	low	low-medium	low-medium	medium-high	low	medium
VLSI	high	high	high	medium	medium-high	medium-high	high
2D mechanical	low-medium	medium	medium	medium-high	medium-high	low-medium	low-medium
3D mechanical	medium	low-medium	medium-high	high	medium-high	low-medium	medium-high
3D solids	medium	medium-high	high	high	medium-high	high	medium

Graphics component requirements *vary with application. A system is less cost-effective if a component outperforms the application or the other components.*



High-performance devices are ineffective if the components with which they work cannot support them at their optimum level of performance.

the effectiveness, at a far lower cost, of a system built around all highest performance components—the largest disk, the fastest CPU and the biggest, brightest display.

Each system component should be matched to the capabilities of the other components. High-performance devices are ineffective if the components with which they work cannot support them at their optimum level of operation. An 8-bit microprocessor, for example, should not be used as the host for a fast display processor, and a supermini-based system should not be held back by slow off-line storage and serial communications. Such mismatching leads to bottlenecks and a corresponding drop in price/performance.

Compatibility considerations also apply to the new generation of memories. Fast static RAMs are expensive but can boost display processor performance if matched

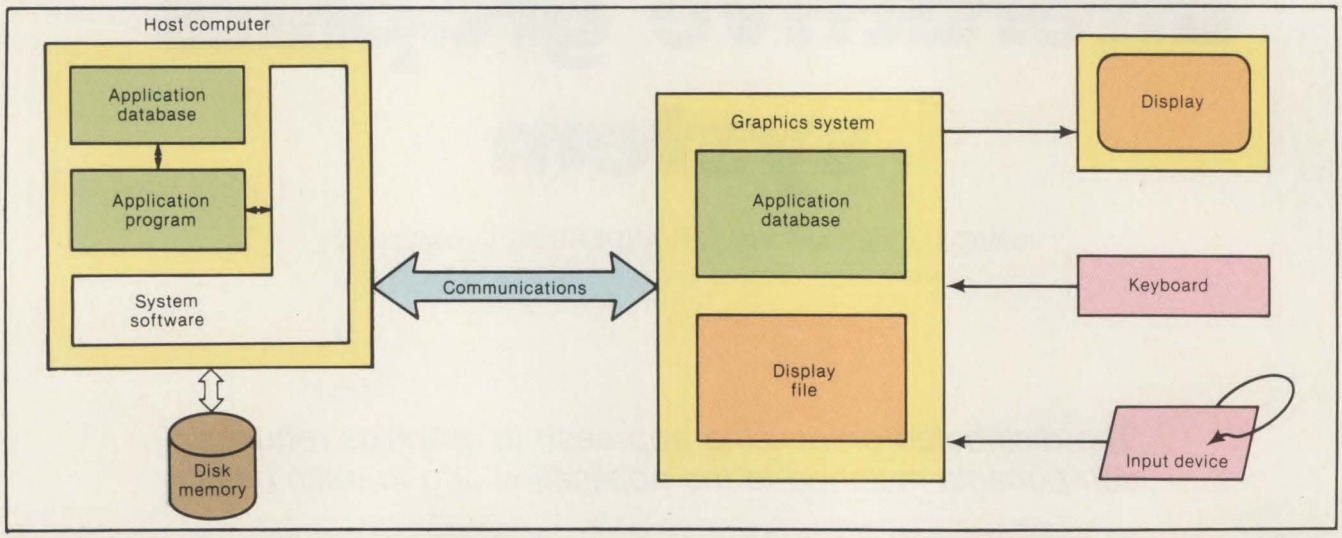


Fig. 1. Distributed-processing graphics system structure *consists of a host and a separate processor for graphics manipulations. Graphics database information can be down-loaded from the host to the graphics processor, so that user modifications to the image are processed locally. Input devices can also be supported locally, and data are transmitted to the host through large buffers.*

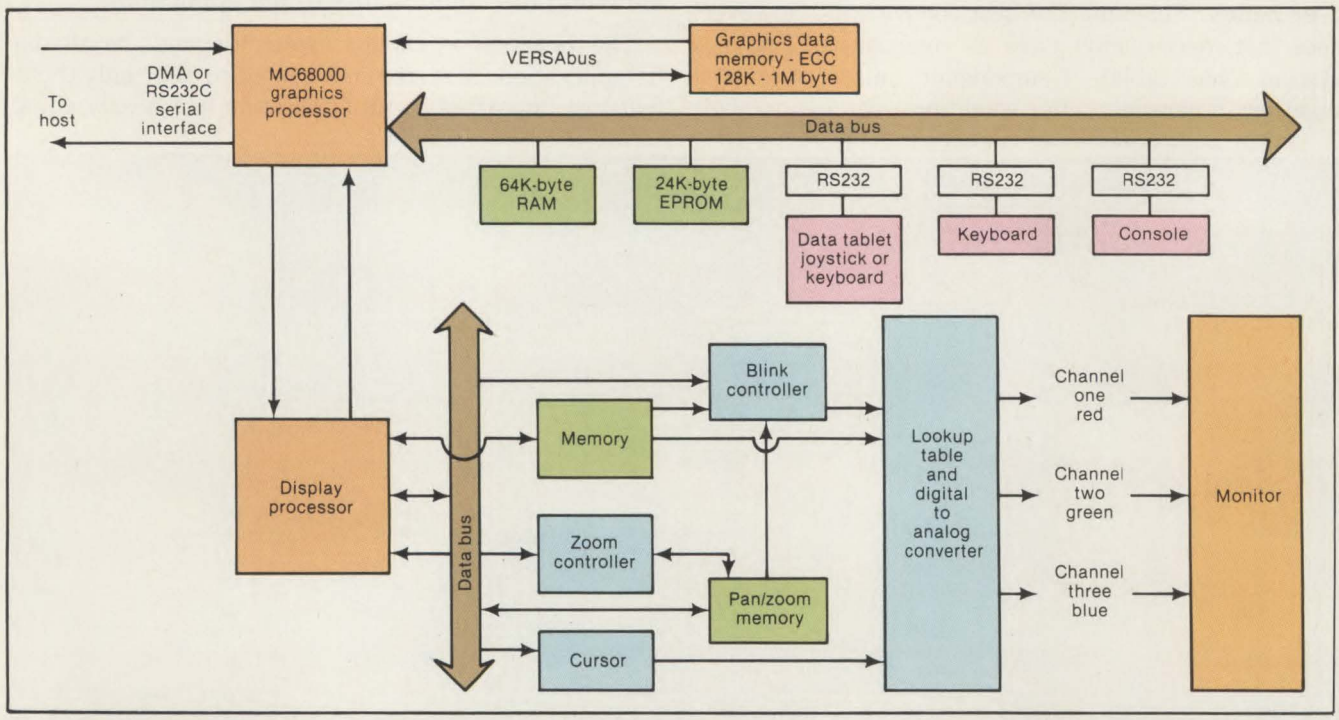


Fig. 2. Lexidata 8100/GS graphics processor *consists of a 16-bit graphics processor with graphics and database manipulation capabilities and a display processor for converting vector commands to raster data. Input device interrupts are also processed by the graphics processor, leaving the host free for applications software and heavy computation.*

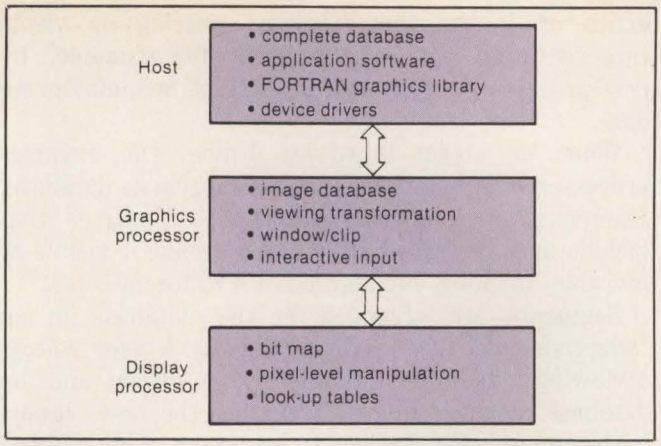


Fig. 3. Distribution of 8100/GS software functions *leaves the host processor free of image-drawing and manipulation functions and of input interrupt processing, all controlled by graphics-processor software. Display-processor software converts graphics-processor commands and image-segment attributes into pixel-level data.*

to high-performance microprocessors. Lower priced graphics systems, on the other hand, can off-load their hosts using slower, higher density dynamic RAMs.

Software design must also be matched to the system and its applications. The database structure should strike a balance between the complexity needed to handle useful attributes and the simplicity required to facilitate editing and processing, given the CPU's capabilities.

Distributed graphics systems

CAD/CAM, VLSI design, mapping, simulation and most of today's commercially popular applications require the editing, rotation and windowing of complex images. These functions can require significant amounts of processing and can produce bottlenecks in host-dumb terminal type systems.

A distributed hierarchy of processors, software and databases can in many cases allow system components to operate at levels closer to peak performance (Fig. 1). Multiple CPUs can each be optimized to perform to a set of functions, allowing the use of less powerful processors and lowering the risk of one processor's work load tying up the entire system.

Additionally, by supporting interactive peripherals such as a data tablet, a keyboard or a joystick locally, data can be interpreted, echoed and buffered without host intervention. Data can be sent to the host in large buffers, eliminating the need for the host to process an interrupt for every byte. Also, practical graphics is possible over RS232 communication links, which are often more acceptable for physically separate users and host-computer resources.

The distributed approach to graphics also has potential problems. The need for processor interaction increases the complexity of the software and of intra-system communications. The system must also avoid retransmitting data from an intelligent display to the host for each change to the database.

The Lexidata 8100/GS is an example of a multiprocessor, distributed graphics system (Fig. 2). Used with a host, the system provides three distinct levels of processing.

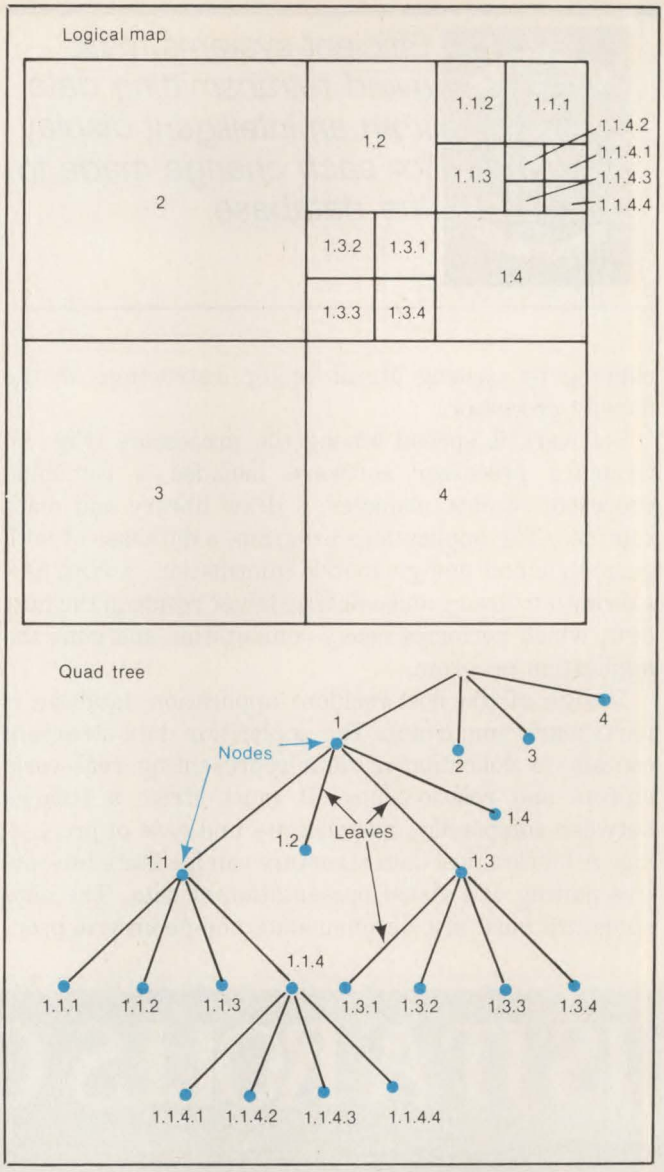
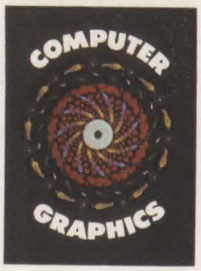


Fig. 4. Lexidata's adaptive quad tree database structure *in the graphics processor is based on a logical map of image segment data. Each segment, representing a line, polygon or other primitive, is assigned to a quadrant or subquadrant of the logical map. The quadrant tree database corresponds to this map and is made up of nodes and leaves. A node represents a quadrant or subquadrant that is itself divided into smaller subquadrants, while leaves represent the subquadrants into which the nodes are divided. The graphics processor traverses this tree, following only those leaves that represent image segments that appear in the viewing window selected by the user.*

The lowest level processor in the 8100/GS is a high-speed, bipolar display generator designed to maintain a raster bit map by converting vectors into a raster format, filling areas and performing other pixel-level functions.

The other processor is a 16-bit, 8-MHz Motorola MC68000 acting as a graphics processor. The 68000 maintains a host-down-loaded database of geometric information about the objects to be drawn. It also performs viewing transformations and windowing/



Efficient systems must avoid retransmitting data from an intelligent display for each change made to the database.

clipping by passing literal vector instructions to the display processor.

Software is spread among the processors (Fig. 3). Graphics processor software includes a command processor, a data manager, a draw library and math routines. The applications program, a database of both geometric and non-geometric information, a FORTRAN subroutine library and a device driver reside in the host CPU, which performs heavy computation and runs the application program.

Design of the host-resident application database is particularly important. The application data structure contains a collection of data representing real-world objects and relationships. It must strike a balance between complexity, interactivity and ease of processing. A hierarchical data structure can facilitate interactive editing and visual presentation of data. The data structure must also accommodate non-geometric properties of objects that have no bearing on visual representation but can be used, for example, by post-processing programs to extract manufacturing data.

When an object is to be drawn, the graphics processor calls up graphics segments from its database. Segments are composed of output primitives that include lines, assigned attributes to make it visible or invisible, blinking, highlighted or a different color.

Segments are arranged in the database in an "adaptive quad tree" format (Fig. 4). A user selects a viewing window on the object to be drawn, and the database manager quickly traverses the tree, ignoring segments that are not to be drawn. The selected segments are sent to the display processor for conversion to raster format and output. If the user changes the viewing window, the graphics processor retraverses the tree to select the appropriate segments.

Because dedicated processors handle dynamic transformation, windowing and raster conversion, the host is free to maintain system resources such as large disks, hard-copy devices and communications, and to execute application software and computational analyses. ■

David Luther is industry marketing manager and **Walter Anderson** is vice president of corporate engineering at Lexidata Corp., Billerica, Mass.

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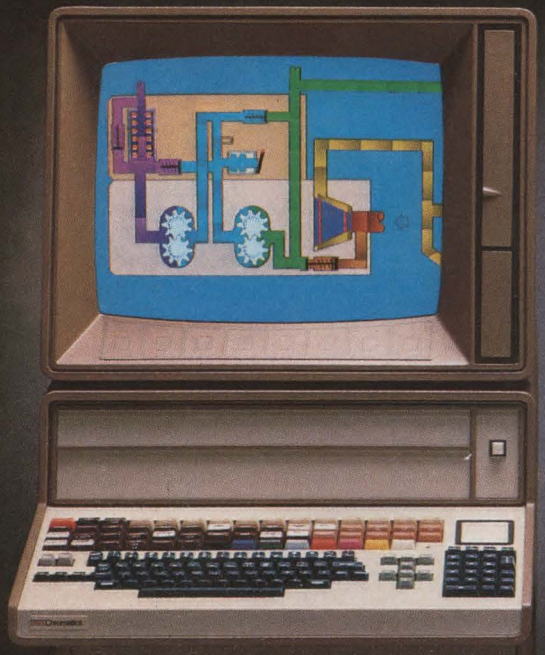

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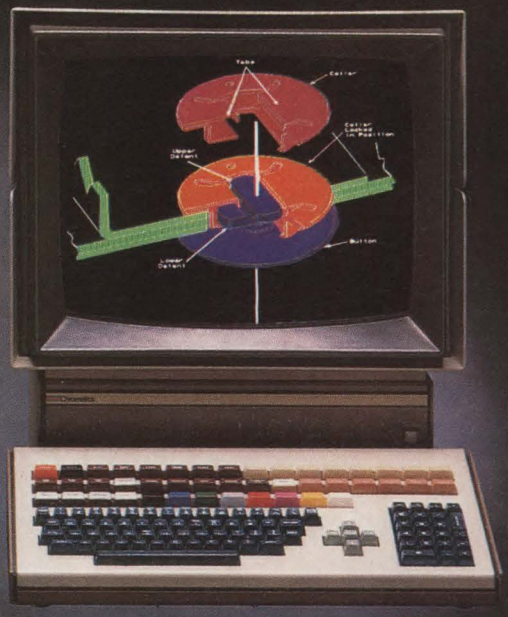

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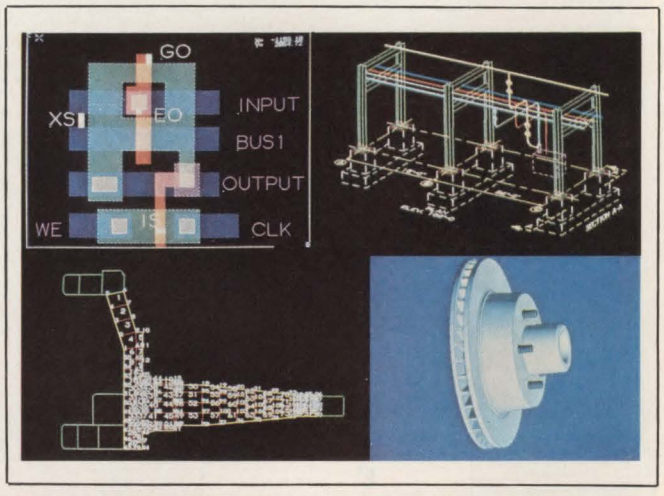
Turnkey CAD/CAM systems offer more leverage

PAUL E. BENGER, Applicon, Inc.

The single-source solution may be less expensive than you think

Computer-aided-design and computer-aided-manufacturing (CAD/CAM) systems are seen as important weapons in the fight for renewed U.S. industrial productivity. According to Dataquest, a Cupertino, Calif., market-research firm, CAD/CAM vendors sold more than $1 billion worth of equipment in 1981. While the number of graphics hardware suppliers numbered in the hundreds, more than two-thirds of all CAD/CAM sales were in the form of turnkey systems sold by Applicon, Inc., Calma Co. (part of General Electric Co.), Computervision Corp. and Intergraph. Why the success of expensive turnkey systems in this day of transportable software and microelectronics? In a word—leverage. By realizing huge economies of scale in hardware integration, software development and service and support, turnkey systems can often provide the best long-range price/performance ratios.



Applicon packaged software *is available for general-purpose and specialized applications. Clockwise from top left are screen output from a circuit-layout package, a drawing-dimensioning package, a solids-modeling package and a stress-analysis package. Because they can amortize software-development costs over large user bases, turnkey vendors can sell most packages for far less than users could pay to develop them in-house.*

Turnkey CAD/CAM in context

To see what a turnkey CAD/CAM system provides as opposed to a graphics service bureau or a buyer-configured building-block system, consider the components of a generic CAD/CAM system:

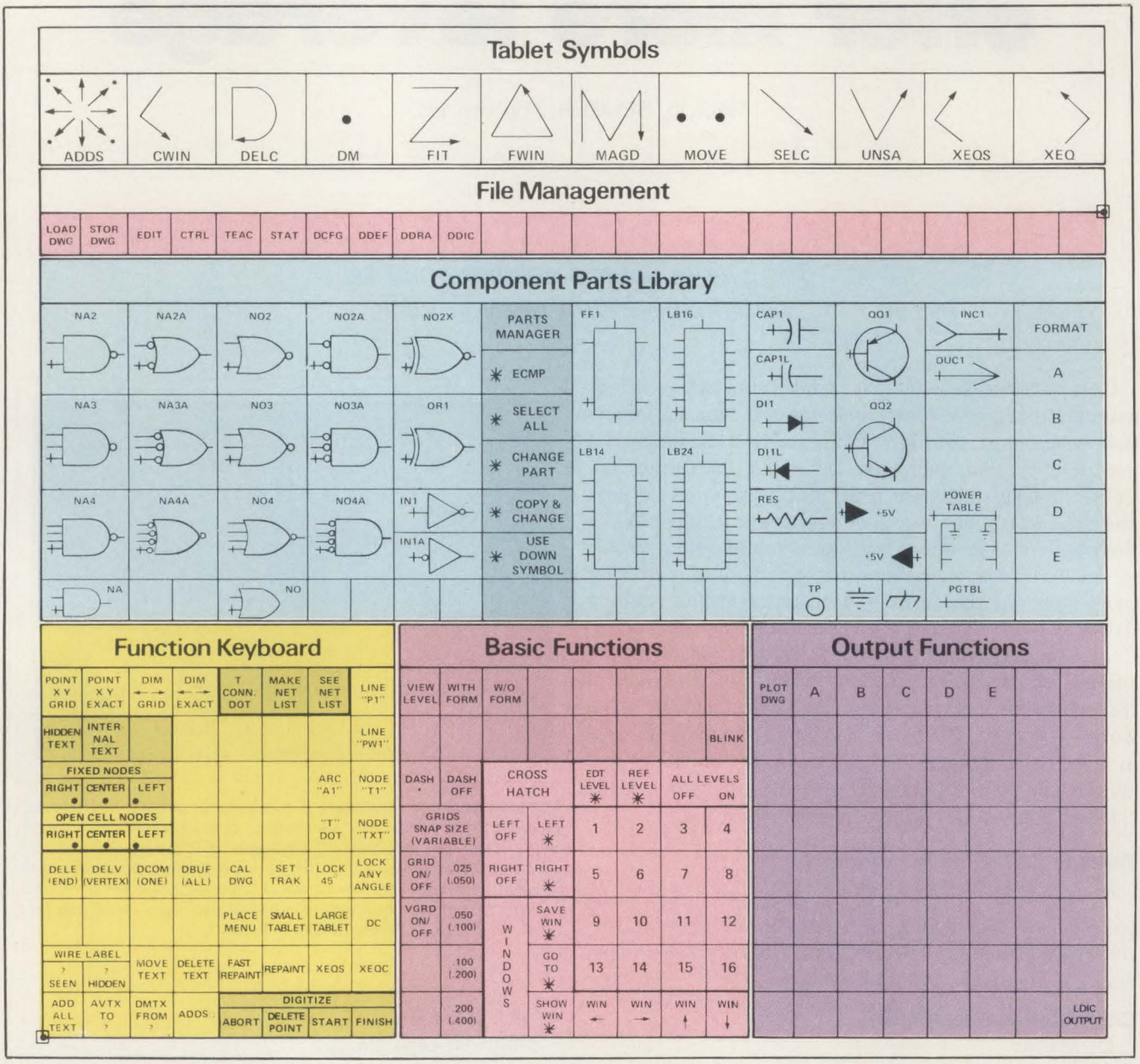
Computational facilities
- Computer
- Main memory
- Graphic display controller
- Disk storage
- Magnetic-tape storage
- Peripheral drivers
- Telecommunication interfaces

To minimize central-processing costs, Applicon systems are based on industry-standard computers and operating systems.

Work stations
- Graphics displays
- Alphanumeric terminals
- Graphics tablets
- Stylus or light pen
- Function keyboards
- Digitizers
- Hard-copy devices

Peripherals
- Plotters
- Paper-tape readers/punches
- Line printers

Software
- Operating system
- Database-management system
- Telecommunication drivers
- Database formatters
- Programming interfaces
- Editors
- Diagnostics
- Application software



Schematic-drawing tablet overlay *allows Applicon users to draw, move, delete and align symbols with only a few touches of a stylus. Other tablet areas are used for file management, system commands, output management and other user-defined command sequences.*

Remote computing services and local service bureaus offer the least expensive initiations into CAD/CAM. A user's initial investment is minimized because payment is based on use-dependent processing, software and communications costs. User-site hardware is rented or leased and is usually limited to one or more work stations with basic input and output peripherals. Expensive, infrequently used peripherals are maintained at the central time-sharing site and are available on a pay-as-you-use basis. Graphics is addictive, though, and as applications grow to where in-house graphics systems are more cost-effective, users often find themselves dependent on the service bureau's proprietary software and locked into the non-transportable databases they've created.

Once users decide to bring computer graphics in-house, they must choose between integrating a system or buying from a turnkey vendor.

The proliferation of attractively priced graphics processors, terminals and peripherals and the availability of third-party graphics systems and applications hardware have inspired many companies to "build" their graphics systems in-house. Company managers compare the cost of buying most of the items on the list above to monthly time-sharing bills, and pull out their checkbooks. Their disillusionment usually comes in three stages.

First, they realize that hardware integration is more complex than plugging a bunch of compatible devices into their overworked mainframe or assembling them around a stripped-down OEM minicomputer. Second, they realize that graphics systems software development is much more expensive than commercial programming and that adapting general-purpose packages to specific applications can be equally trying. Third, they realize that only the best planned in-house systems have easy upgrade paths.

Turnkey graphics systems are initially more expensive than time-shared or building-block systems, but are pre-integrated, pre-documented and pre-proven in hundreds or thousands of installations in dozens of general applications. The turnkey vendors' large installed bases allow them to amortize software- and hardware-development costs against many current and future customers. To protect their own software investments, turnkey system vendors must provide solid upgrade paths; to reduce their software-development costs, they usually sponsor active user groups.

Turnkey graphics hardware

The Applicon system (Fig. 1) is a popular turnkey graphics system that has been applied to diverse CAD/CAM applications for more than 12 years. To minimize central-processing costs, Applicon systems are based on industry-standard computers and operating systems. Applicon's entry-level and mid-range systems are based on a Digital Equipment Corp. PDP-11 minicomputer with the RSX-11/M operating system, while the high-performance version relies on a DEC VAX computer with VMS operating system.

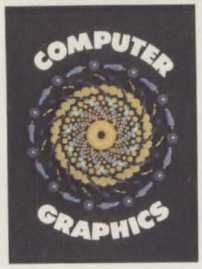
Fig. 1. Applicon's Series 4000 turnkey CAD/CAM system *is built around a Digital Equipment Corp. PDP-11 or VAX minicomputer and Applicon's proprietary graphics processor. Single-workstation, black-and-white systems sell for less than $100,000. Applicon offers more than 120 general-purpose and application-specific software packages from the Series 4000, which also runs third-party software.*

The graphics processing facility (GPF) features a dual-processor architecture: a DEC PDP-11 with 216K-byte main memory and an Applicon 32-bit minicomputer—Graphics 32—with 224K-byte memory. Using the most popular minicomputers provides substantial economies of scale and eliminates the need to expend development resources on operating systems, utilities, diagnostics and communication software. Accordingly, Applicon can concentrate on user-oriented work-station features (Fig. 2).

For example, the Graphics 32 in the Applicon Series 4000 system addresses those work-station functions that general-purpose minicomputers cannot effectively handle. It controls all display functions such as vector clipping, zooming and windowing, and provides memory to display multiple graphic and alphanumeric display planes. An operator can toggle on or off different graphic views, alphanumeric menus and status information on a single display without waiting for a full repaint from the GPF main memory.

A second key use of the Graphics 32 in improving the human interface to the system is the manner in which it accepts operator input. An electronic tablet with stylus is the primary input device for the Applicon system. A user can draw various strokes on the tablet that the Graphics 32 interprets as executable commands to construct geometry, select entities or edit graphics and text.

The work-station tablet can also accept partial or full-service menu overlays from which the user can select frequently used command sequences (macros) by dotting the appropriate menu key with the stylus. The multi-plane display memory and dual-purpose graphics tablet allow one screen to display both alphanumeric and graphic data, and one tablet to accept graphic input and system commands. A keyboard for rapid entry of



Driven by existing and prospective customers, turnkey CAD/CAM vendors have made corporate commitments to improve documentation.

alphanumeric data completes this very integrated graphics work station.

Application software—key to functionality

Software development for diverse CAD/CAM applications in PC-board, IC, mechanical, architectural and structural applications is the single biggest development effort of a horizontally integrated system vendor. Applicon offers more than 120 2D and 3D general-purpose and application-specific software packages. Software development is an ongoing activity and provides increased performance, greater throughput and quicker response to meet new markets.

This development is responsive to technology pull and to market shove. Technology pull takes many forms. For example, more cost-effective hardware components, more computationally efficient solids-modeling and hidden-line-removal algorithms can improve performance for users in many applications. Market shove comes from competitive pressure and from meeting the expanding needs of the customer base.

Turnkey vendors have a tremendous advantage over in-house system integrators in meeting the expanding needs of the customer base. Turnkey user groups pool their experience and help to define and prioritize new-product development by the CAD/CAM vendor.

The availability of software from a turnkey vendor doesn't preclude the use of third-party software. In the Applicon system, for example, the use of the RSX-11/M operating system permits the use of thousands of engineering software programs for CAD/CAM activities, including numerical-control tape preparation, piping, interference checks, design-rule checks, automatic routing and finite-element modeling. With a thoughtfully designed system architecture that permits controlled data-structure access, users can program for unique or proprietary applications in BASIC, FORTRAN or Assembler—and be assured of program integrity and database compatibility.

Fig. 2. Applicon's Series 4000 work station *stresses simplicity and ergonomics. The multi-plane display generates graphics and alphanumerics. The tablet and stylus can be used for graphic input or command menu selection. The 19-in. display module tilts, swivels and adjusts vertically on a pneumatic column. The work surface measures 30 × 60 in., is low glare and is height-adjustable.*

Support—the neglected cost

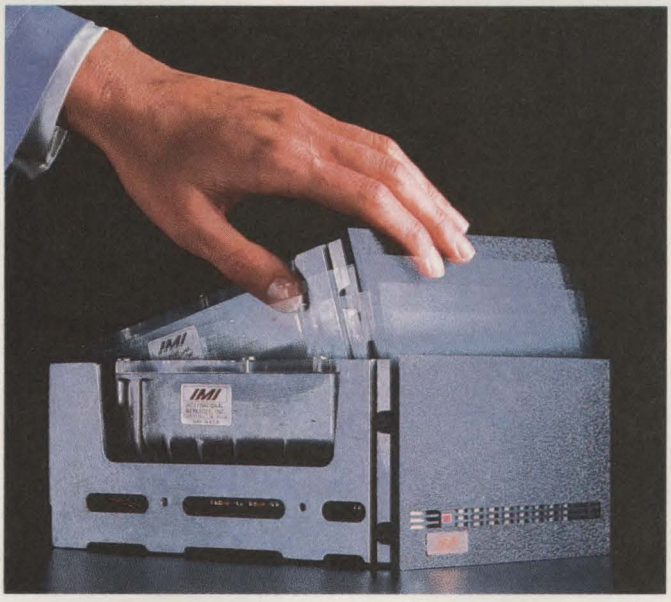
An often overlooked or undervalued aspect of a turnkey vendor's business is ongoing training, documentation and support. Educating system users in applications requires a knowledge of the system and of the application. Experience shows that training is not a one-time initial effort for each new customer, but an ongoing effort over the life of the system. New operators, casual users and new applications must be introduced to the system. The more experienced CAD/CAM-buying organizations do not find it cost-effective to have their highly productive users perform this function. Instead, they increasingly rely on the experience and shareable resources of their system vendor. In a classroom/lab environment with the latest equipment, software and educational media, the dedicated training staff of the turnkey vendor provides the most cost-effective training.

Documentation is another important support function that has too frequently been overlooked. Too often a system was delivered with marginal or nonexistent manuals, and the user paid a severe penalty. Without readable, detailed, updated manuals, it took much too long for new operators to become productive and even longer for the full capabilities of the system to be understood. Driven by existing and prospective customers, turnkey CAD/CAM vendors have made corporate commitments to improve documentation and now usually provide excellent manuals for training and reference.

Service is the third oft-neglected support cost. The necessity of single-source support for the total CAD/CAM system has become increasingly apparent to users. Preventive and remedial hardware maintenance, software support services and applications consultation constitute a set of services that a turnkey vendor can provide from one centralized location. ■

Paul E. Benger is director of product integration at Applicon, Inc., Burlington, Mass.

IMI reinvents the 5¼" Winchester. And backs it with a 2-year warranty.



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To ensure that 5000H drives withstand harsh treatment without sacrificing data integrity, the media is thin-film plated. Thin-film plating is orders of magnitude more shock resistant than ferric oxide coatings and many times harder. Because it's not easily damaged, data is not easily lost, and the drive remains in service.

Thin-film plated media also allows greater bit densities, as much as 10,700 bpi. This has enabled IMI to up the unformatted storage capacity of the 5021H drive, for example, to 21 Mbytes.

And to improve data integrity even further, we've maintained industry standard formats and transfer rates with lower track densities.

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To protect the heads and disks, we've recessed the head/disk assembly inside a rigid, die-cast frame enclosure. Integral shock mounts at the center of gravity insulate the head media interface from the environment.

Besides reducing acoustical noise, this 2-piece design minimizes vibration and shock loads transferred to the heads and disks during installation and use. Even the printed circuit boards utilize the shock-mounted design to lessen stress on the components.

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5000H Series drives have a deeply finned die-cast base and cover that increase both the stiffness of the structure and the surface area for heat transfer.

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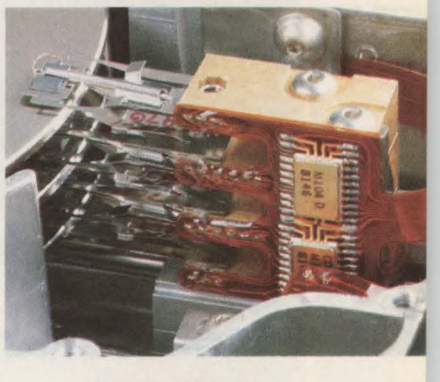

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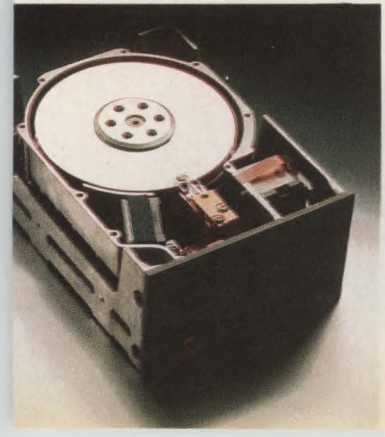

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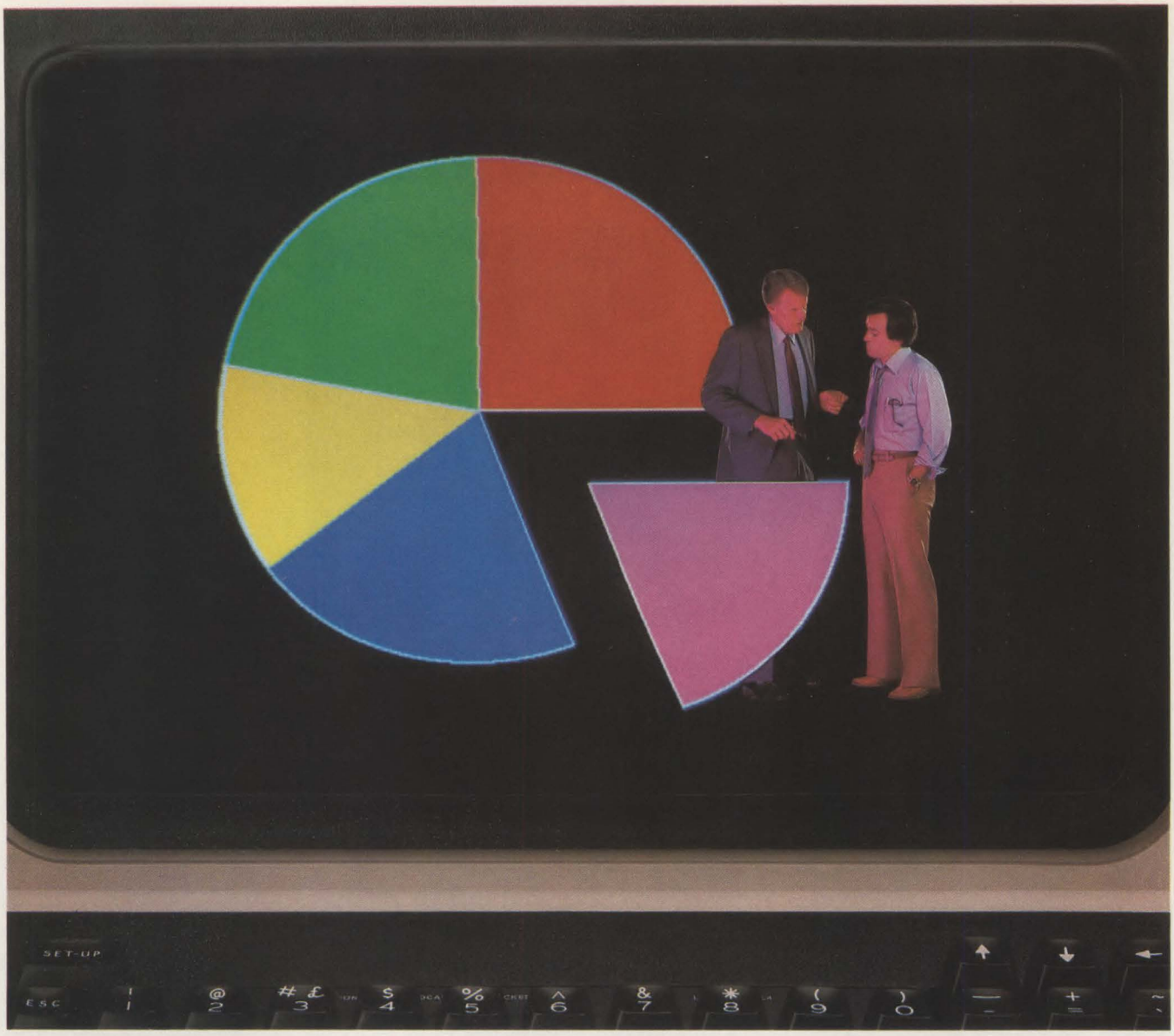

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If you do not have existing business graphic software, the ID-100 is a help here also. The terminal is programmed (firmware) to perform complex graphic tasks using simple commands. We call it POWER-graph. You can create your own color graphic displays using your existing application software if you wish. POWER-graph gives you full vector and cursor control, circle/arc generation and color fills. Under POWER-graph, ID Systems' Virtual Image Management System allows you to window an image, select different origins and scale its size to create multiple displays.

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COMPUTER GRAPHICS

A new niche for ink-jet printers

PETER DUFFIELD, Advanced Color Technology, Inc.

By meeting color graphics hard-copy requirements, ink-jet printing is finally catching on

The CAD/CAM market is worth $480 million to $2.1 billion, depending on what research firm's figures you believe. While the research firms derive conflicting market revenue totals, they agree that the graphics market is growing at more than 40 percent per year. Just as general-purpose computers require line and serial printers, graphics systems require hard-copy units. Color graphics systems are the fastest growing segment of the CAD/CAM industry, and their popularity has created a hard-copy vacuum. Venture Development Corp. analyst Wendy Abramowitz echoes other industry analysts, saying, "The printer/plotters that offer color capabilities will reign supreme in 1986." Today, ink-jet, impact, photographic and xerographic technologies are used for color hard copy. Diverse as they seem, the technologies compete in the same market and are measured by the same general specifications.

Advanced Color Technology's ACT I color video copier *sells for less than $10,000 and connects to its host via a Centronics parallel interface or an RS170/343 video interface. It generates 125 color shades using ink-jet technology.*

Color video copier requirements

Requirements for video copiers vary according to the application in which their host color-video systems are employed. Applications vary from business graphics to CAD/CAM to graphic design to PC-board design. In most applications, the principal requirement is for image quality, a measure very different from image resolution, which is measured quantitatively in dots per inch. Image resolution is not a factor in print quality per se because it affects only the size of the copy. Because a video screen contains a fixed number of picture elements to be copied, increasing the resolution of the copier simply reduces the size of the copy produced. It is desirable, however, that the copier vary the ratio of horizontal-to-vertical resolution to match the ratio on the video monitor; otherwise, circles on the monitor are not copied as true circles. Image quality is affected by three major factors:

- **Line and edge definition,** which are important in applications involving extensive line work, such as

Because dot size can be controlled, an optimum combination of paper and ink can be reached that provides both good area filling and line definition.

mechanical designs, schematics and text.

- **Area filling,** which means that solid areas should be free of streaks and voids, and shaded areas should be uniform. Uniform filling is most important in applications such as business graphics, in which aesthetics are a major consideration.
- **Color accuracy,** which depends on color purity, intensity (saturation) and freedom from contamination such as bleeding. Many color video systems vary the intensity of the colored dots on the video monitor and thus work with more colors than the six basic colors plus black and white. Several thousand color shades are often available. The color video copier ideally should be able to reproduce all the color shades displayed on the video monitor. For applications in which color is used purely as a third dimension to aid in the clarification of data, color accuracy is not important.

After image quality, copy speed is the most important measure of color-video-copier performance. Copy speed is critical because the video system generally is unavailable for image processing while hard copy is being produced. Hard-copy delays have cost implications and can lead to operator frustration.

For most cost comparisons, only two factors need be considered—capital expenditure and cost per copy—both of which vary considerably. A video copier that uses plain paper has the advantage not only of low cost per copy, but also of convenience in paper procurement. Unit costs for most color video copiers vary inversely with copy speed and image quality. High-volume applications most easily justify (and amortize) fast expensive units such as the Xerox 6500, but high capital expenditures will become more difficult to justify as the average prices of color graphics terminals fall.

Technology	Advantages	Disadvantages
Ink jet	Good print quality Low cost per copy	Minimal field reliability data
Ribbon	Low cost per copy Low capital cost	Inconsistent print quality Noisy
Photographic	Excellent print quality Transparencies possible	Very high cost per copy Restricted copy size
Xerographic	Good print quality Low cost per copy Transparencies possible	High capital cost Restricted copy size Bulky equipment

Table 1. Color hard copy trade-offs.

A CLOSER LOOK AT INK-JET TECHNOLOGY

Ink-jet printing is a fairly broad term describing techniques in which drops of ink are projected onto a surface to form a permanent image. These techniques can be conveniently divided into three technologies: "continuous jet," "drop on demand," and "impulse jet" all of which have been employed in commercial products.

In **continuous-jet** printing, drops are formed continuously from the breakup of a jet of liquid ink. Liquid jets are naturally unstable, breaking into drops under surface tension forces (Fig. A). Stimulating the jet at its natural frequency produces extremely uniform-sized and -spaced drops. The ink jet is formed by forcing ink under pressure through an orifice or nozzle. A drop-charging process modulates the drops: when a voltage is applied between the electrically conductive ink jet and an electrode surrounding the jet at its break-off point, the drops acquire an electrostatic charge as they break from the main jet. By selectively charging or not charging the drops and deflecting some of the charged drops into a gutter, the stream of drops can be effectively switched on and off. An image is produced by combining this binary switching with some method of scanning the stream of drops over the paper. Scanning can be achieved using a drum and lead screws (drum plotter) or by moving the paper past a fixed array of jets. Another common scanning technique, used principally in alphanumeric printers, provides a periodic stairstep voltage function to the drop-charging electrode, causing the stream of drops to scan through a mini-raster equal in amplitude to the height of the printed character.

The continuous-jet technique has the advantage of high speed, with drop-production rates from a single jet potentially as high as 0.5 MHz, but more typically in the 50-KHz range. Handling the ink drops that are not needed to form the image is a problem, however. A high percentage of the total drops, must often be recirculated into the pressurized ink supply or discarded.

Drop-on-demand ink-jet printers don't require ink recycling because ink drops are produced only when required. These "impulse" printers produce a pressure pulse in a volume of ink having an exit nozzle or orifice, and an inlet for ink replenishment (Fig. B). A piezoelectric crystal attached to the wall of the chamber usually

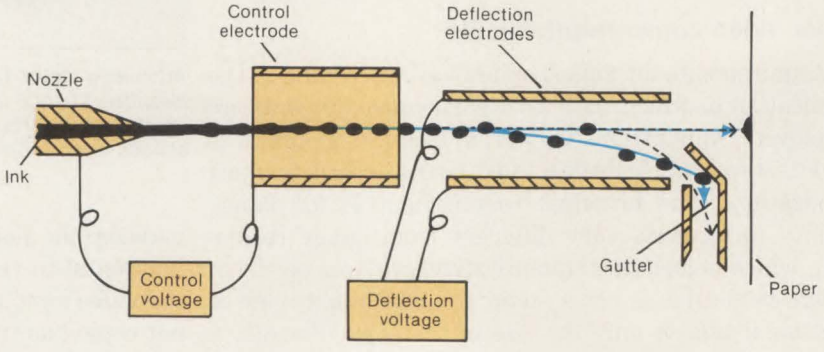

Fig. A. Continuous-jet system.

Lastly, ease of use and reliability are requirements common to all applications because video copiers are operated mostly by design engineers, graphic artists and people unfamiliar with printer technology.

Competitive technologies

Ink-jet printing techniques have been employed for more than 10 years in a variety of applications. Although ink-jet technology has not revolutionized the printing industry, it has, over the years, found niches in which it offers advantages over alternative technologies. One of these niches is color printing of digital data—copying images from color video screens, for example. Table 1 summarizes the advantages and disadvantages of today's major color hard-copy techniques. Table 2 provides more specific information on

	Technology	No. of colors and shades	Resolution (dpi)	Time for 8 × 11 copy (min.)	Maximum copy size (in.)	Cost per copy	Approximate equipment cost
Advanced Color Tech. ACT I	ink jet	125	85 × 40 to 140	1.5	12.1 × ∞	20¢*	$9000
Printacolor HR8002	ink jet	7	85 × 90	3	10.7 × 8	10¢	$5000
Trilog Color Plot 100	ribbon	7	100 × 100	3.25	13.2 × 11	24¢	$12,000
Ramtek 4100	ribbon	4	70 × 70	3.5	13.1 × ∞	31¢	$12,000
IBM Corp. 3287	ribbon	4	100 × 100	6	12 × ∞	15¢	$6800
I.D.S. Prism 132	ribbon	8	84 × 84	5	13.2 × ∞	15¢	$2500
Integrex CX80	ribbon	7	65 × 75	5	8 × ∞	15¢	$2000
Matrix 3000	photographic	∞	140 × 150	3	8 × 10	$6	$8000
Dunn 631	photographic	∞	140 × 150	3.5	8 × 10	$6	$12,000
Xerox 6500	xerographic	7	100 × 100	0.33	6.4 × 13.75	5¢	$31,000

*10 if regular computer paper is used

Table 2. Color-video-copier specifications.

generates the pressure pulse. The crystal configurations employed range from circular disks to cylindrical tubes. (Pressure pulsers are not limited to piezoelectric crystals, as demonstrated by Canon, which recently described an ink-jet printer using a miniature heater to generate and collapse a vapor bubble in the ink at frequencies as high as 10 KHz.) Ink is prevented from flowing from the nozzle by a slight negative pressure in the ink chamber. Following a pressure pulse, a drop of ink is ejected from the nozzle to form a spot on the paper. Replenishment of the ejected ink occurs through the ink inlet. The process of refilling the chamber after drop ejection usually limits the maximum drop-production rate—typically only a few KHZ—considerably slower than continuous ink jets.

Impulse jets are frequently arranged in arrays to increase print speed. Scanning techniques for image formation include drum and lead screw and shuttle mechanisms with incremental paper feed.

The main attractions of the impulse jet are its simplicity and low cost. Apart from speed considerations, the main drawbacks are its sensitivity to mechanical shock and the need to exclude air from the ink system.

Intermittent jet is the least encountered of the three techniques. Drops of ink are pulled electrostatically from an orifice by applying a high electrical potential between the ink in the orifice and an electrode. Ink leaves the orifice in a stream of charged drops that are guided by other electrodes to form the desired image on the paper. The shortcomings of this technique are its complex, high-voltage electrode arrangement and its slow drop-production rate of 1 to 2 KHz. Its major advantage is that the diameter of the orifice needed for a given drop size can be much larger than that of continuous or impulse jets, reducing the possibility of orifice-blockage problems.

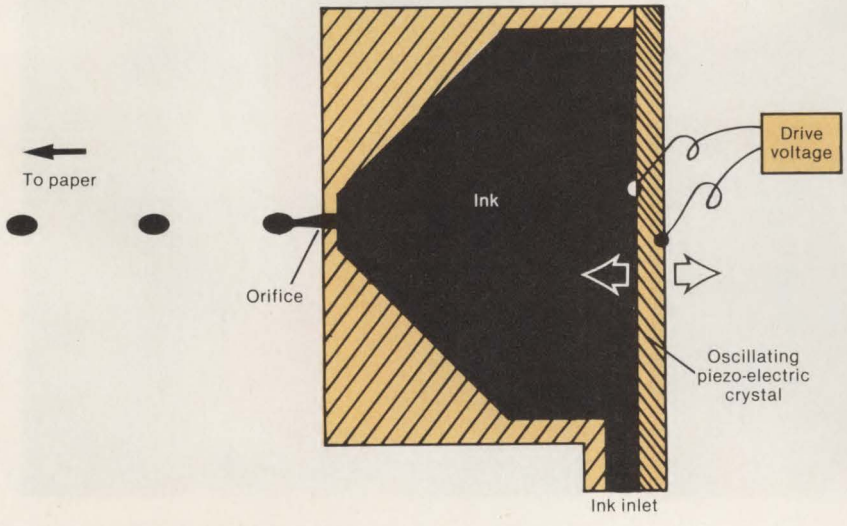

Fig. B. Drop-on-demand (impulse) system.

COMPUTER GRAPHICS

In most applications, the principal requirement is for image quality, a measure very different from image resolution.

commercially available color video copiers.

Color-ribbon printers are basically impact matrix printers with three- or four-color ribbons. Colors are arranged along the length of the ribbon or across its width. The printers print one color at a time on a line-by-line or page-by-page basis, shift the ribbon and repeat the process for each color. Color-ribbon printers offer low cost per copy because they use plain paper and have relatively low amortized ribbon costs. With the exception of color-ribbon shifting mechanisms, color-ribbon printers use common matrix-printer technology and, as a result, are inexpensive. The recently introduced Integrex CX80 represents the least expensive color video copier for less than $2000. Ribbon printers are noisy, however, and produce inconsistent print quality because ribbons deteriorate with use. Print quality also suffers from the inability to produce the overlapping dots needed to achieve continuous color in filled areas.

Photographic color video copiers form images on 8- × 10-in. Polaroid color print material. The photographic material is not exposed directly to a color video screen, but to a high-resolution black-and-white moni-

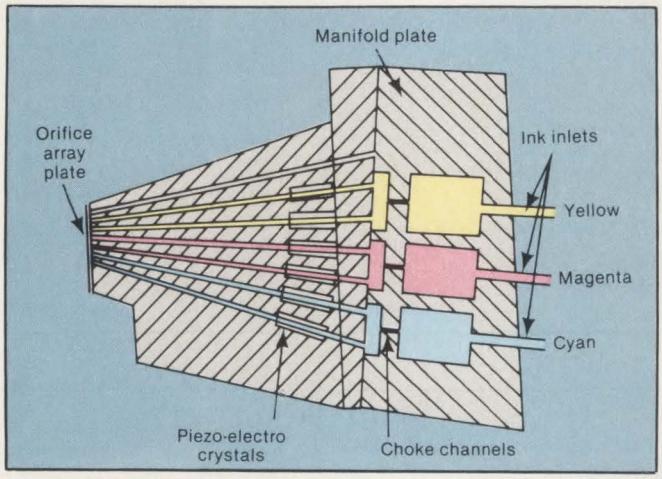

Fig. 1. The ACT-1 ink-jet print head *is a modified version of the Siemens PT80i. Shown here in section, the head is divided into three sets of four jets. Using inks in the three subtractive colors in combination, the additive primaries (red, blue, green), as well as black, can be produced.*

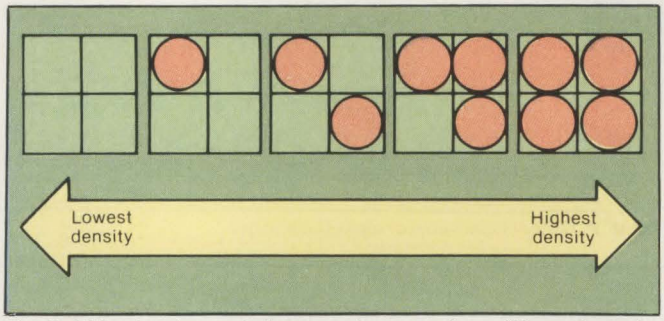

Fig. 2. Dithering *is a technique used to reproduce different intensity levels of the same color. Each pixel on a graphic system's monitor is represented by four dots on the hard copy arranged in a 2 × 2 dot matrix, as above. By varying the number of dots printed from zero to four, five levels of color intensity can be produced for each of the three primary colors. When combined, these generate 125 color shades.*

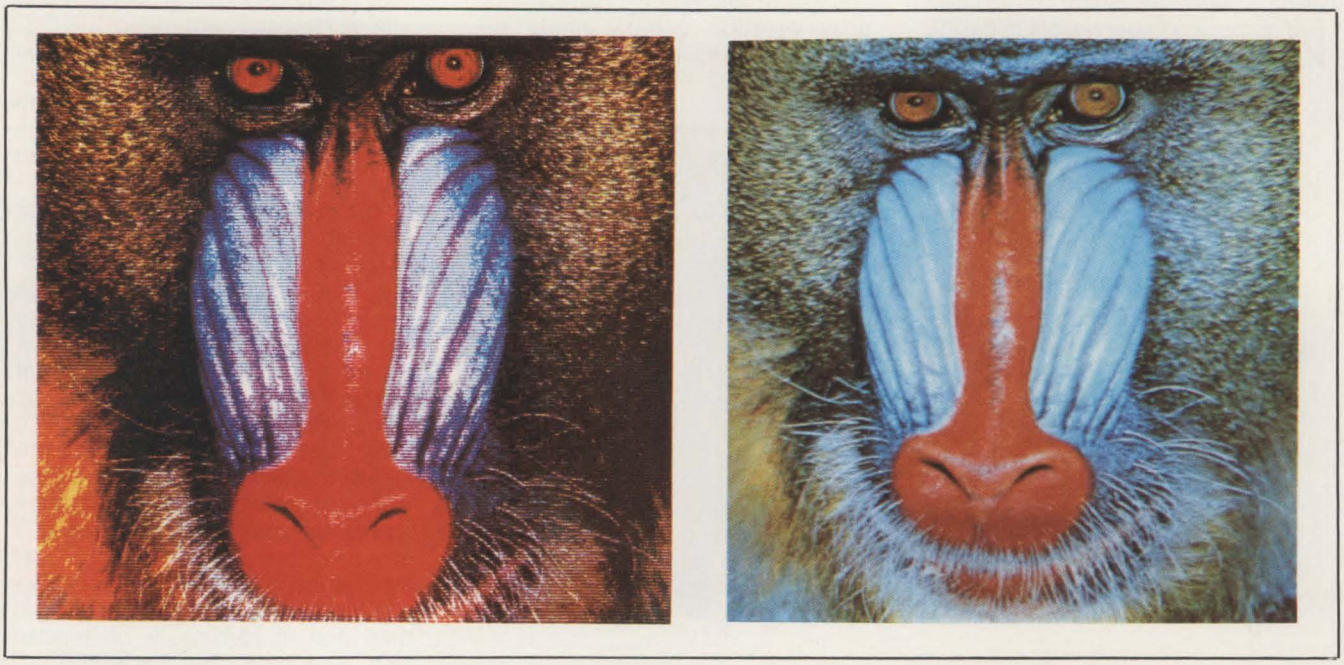

Fig. 3. Ink-jet output of a color video image. *Using its ability to display 125 color shades, the ACT I produces an excellent approximation (left) of a 1024-color image from a Lexidata graphics display.*

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Powerful alphanumeric operation is also provided, displaying 80 characters by 33 lines with separate display memories for alpha and graphics modes. The VISUAL 500 provides switchable emulations of the DEC VT52,® Data General D200, Lear Siegler ADM-3A, and Hazeltine 1500 terminals. The VISUAL 550 is a block mode terminal which complies to the ANSI X3.64 standard.

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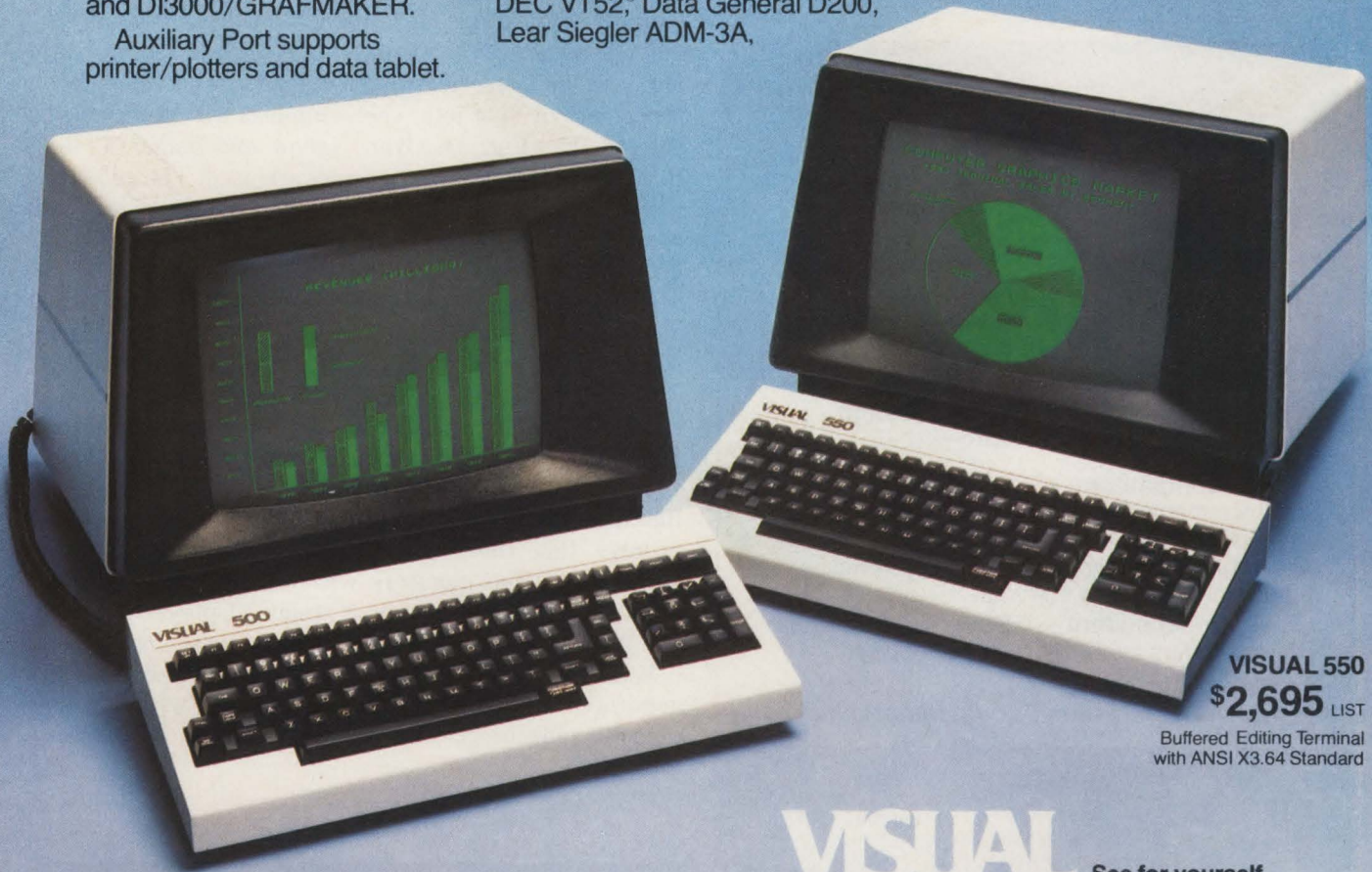

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CIRCLE NO. 124 ON INQUIRY CARD

The ACT I can approximate the color shades that are displayed by those video systems that employ point-intensity variation.

tor built into the copier. Three successive exposures of the red, blue and green portions of the video image are made of the monochromatic screen through appropriately colored filters. Photographic copiers produce superb print quality on both paper and transparent film. A significant drawback, however, is the price of the Polaroid material—about $6 per copy—and this price increases if several attempts are required to obtain the correct exposure settings.

Xerographic images from video can be generated with a Xerox color copier (model 6500) equipped with a color graphics printer module. Digital data from the video system modulate a laser beam that in turn scans a charged photoreceptor drum. The exposed drum picks up toner and transfers it to paper or to clear plastic for transparencies. This process happens three times, once for each of the three primary colors.

The print quality of the xerographic copy is generally good, and color accuracy and saturation are excellent, but color uniformity in large filled areas and color registration can sometimes present problems. Cost per copy, at about 5¢, is the lowest of all, but image size is limited to only 6.4 × 13.75 in., even more restrictive than the Polaroid material. The major disadvantages are high price (about $35,000) and large size, which dictates a permanent location.

Ink-jet technology compares favorably with the other copying techniques. Print quality is good, but depends heavily on the paper and ink selected. Because dot size can be controlled, an optimum combination of paper and ink can be reached that provides both good area filling and good line definition. A significant advantage of ink-jet copying over other techniques is that it can simultaneously image all three or four colors, thus simplifying data handling and color registration, and minimizing production time.

At less than 2 min. for an 8½- × 11-in. copy, ink jet is second only to the Xerox in terms of speed. Cost per copy compares with that of other plain-paper devices. Equipment cost is lower than that of photographic or xerographic copiers, but higher than for some ribbon printers.

The ACT I color video copier

Advanced Color Technology Inc.'s ACT I is a drop-on-demand ink-jet copier developed for color video-copying applications. It is based on the Siemens PT80i print head and mechanism. Its print head features an array of 12 piezoelectric-driven jets subdivided into three sets of four jets, each supplied with a different colored ink (Fig. 1). Cyan, yellow and magenta, the three subtractive primary colors are used. The additive primaries—red, blue and green—and black can be produced by printing one color on top of another because the inks are transparent.

The ACT I can approximate the color shades that are displayed by those video systems that employ point-intensity variation. Using a technique called dithering (Fig. 2), the ACT I produces 125 color shades, yielding very acceptable reproductions of the hundreds or thousands of colors on a color video screen (Fig. 3).

The ACT I offers user-selectable aspect ratios as a function of variable horizontal dot spacing. This ensures that the copier can be adjusted to a wide variety of video monitors without the copy showing significant X-Y distortion. Circles displayed on the monitor are copied as reasonably accurate circles.

With graphics applications and large filled areas in mind, ACT I's ink cartridge was designed with a large capacity able to provide as many as 3000 copies per cartridge. ■

Peter Duffield is vice president, research, and co-founder at Advanced Color Technology, Inc., Chelmsford, Mass.

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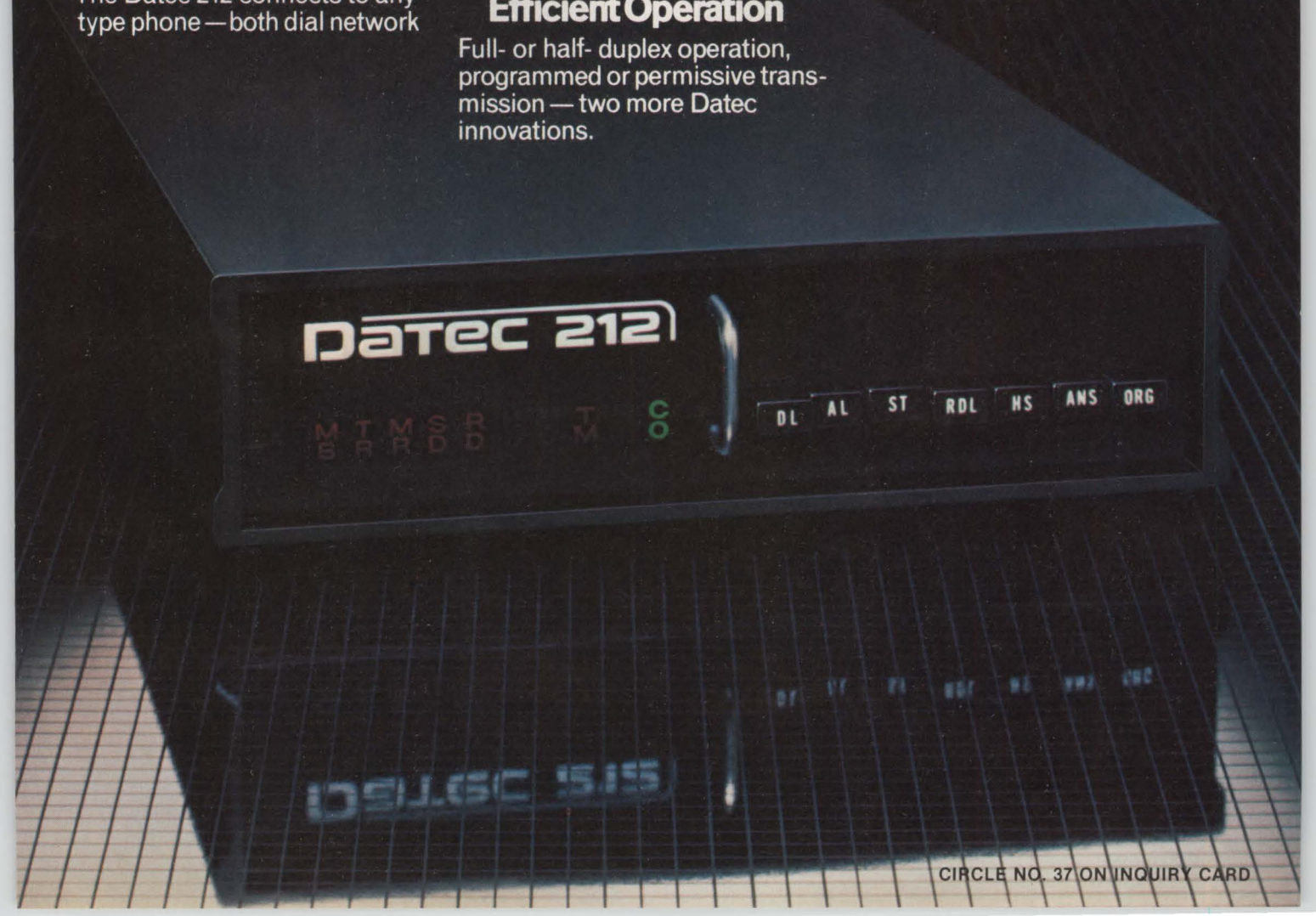

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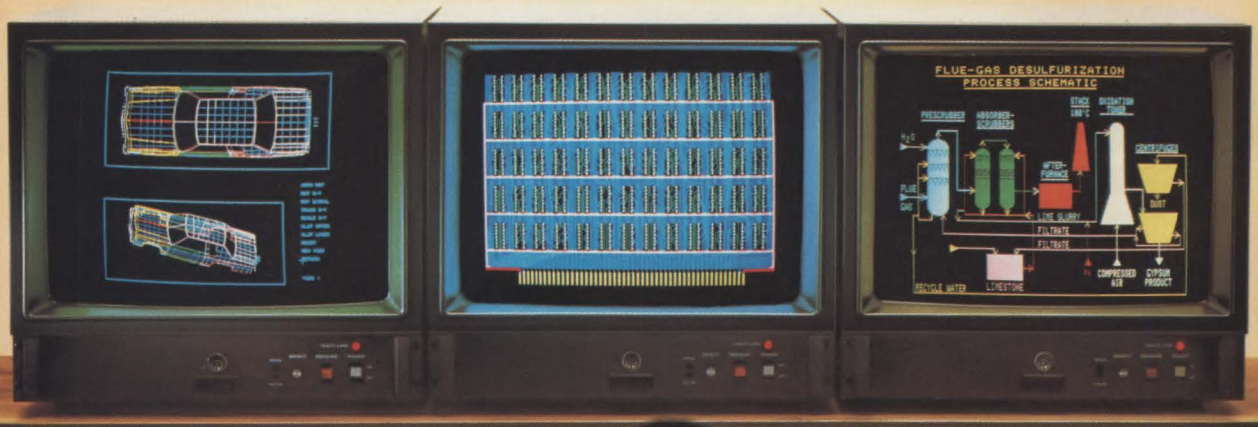

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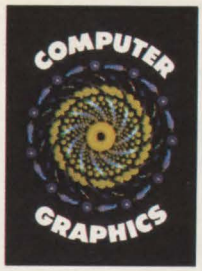


How graphics systems get the picture

DR. JOEL N. ORR, Orr Associates, Inc.

A survey of graphics input devices

Special input peripherals are as important to medium- and high-resolution computer graphics systems as keyboards are to dumb terminals. Graphics output peripherals display and print high-resolution multicolored pictures and command considerable media and buyer attention. In working graphics systems, though, input peripherals command the lion's share of each operator's time. Input peripherals such as digitizers, light pens, joysticks and rasterizers are tools used to get pictures into computers. They're part of virtually every graphics system and terminal, but their applications and specifications are misunderstood by almost everyone but their users.

What graphics input peripherals do

Graphic input devices serve three major functions. First, they are used to get pictures into a computer. Input devices accept maps, seismograms, engineering blueprints and other line drawings, as well as continuous tone imagery, such as remotely sensed data and advertising art.

Secondly, the devices are used to move cursors on the displays of their host graphics systems, and lastly, they are used for function selection. One selection method uses menus—specially designated areas of digitizer boards laid out similarly to keyboards. Function names and symbols are placed inside of squares, in a grid in the menu section of the digitizer. The software associated with the digitizer converts points in the menu area to user-specified functions. A second selection method uses a screen menu, with which, using the graphic input device as a cursor-control unit, functions are selected on the graphic display. In a third method, an operator uses a stylus on the digitizing tablet to draw simple characters or symbols that the host recognizes as cues invoking predefined commands. A curlicue, for example, might invoke a function to connect two lines.

Graphics-input-device selection

To select an input device for a graphics system, a

GLOSSARY OF GRAPHIC INPUT DEVICES

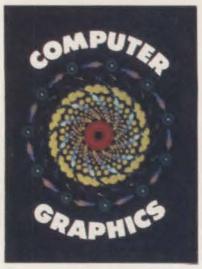
Accuracy: Correspondence between the input device's indications and the real world.

Cursor: The moving part of a digitizer tablet, usually a stylus or puck.

Repeatability: A device's consistency of indication; the range of values resulting from repeated digitizing of the same point.

Resolution: The number of distinguishable points per linear unit of measure.

Location in space: The key factor communicated to a graphics system by a graphic input device. This information can be direct, as in the case of the digitizer tablet, which sends x and y coordinate values to the system; or indirect, as with menu boards, which cause named graphic elements to appear at previously designated locations.



Gaze-directed input units bounce a low-power laser beam off a user's eyeball to determine the direction of gaze.

user must first analyze the source data, asking questions such as What am I trying to digitize? How big is it? How movable? How heavy? Is it translucent? Do I care about color? As in any equipment acquisition, the user must weigh what he wants to do against the physical, logical, software and economic constraints of his environment. He must access performance, price and compatibility.

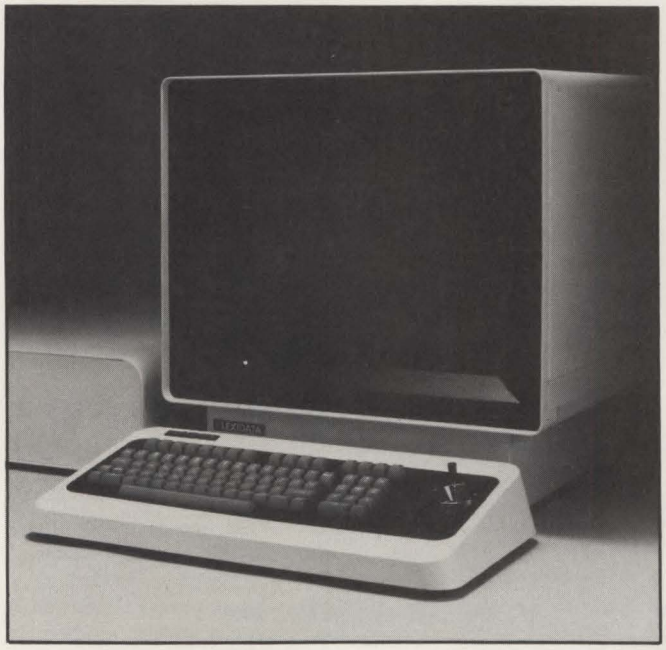
Input-device performance is described in terms of resolution, accuracy, repeatability and, to a lesser degree, speed. *Resolution* measures how close together two points can be and still be recognized as two separate points. *Accuracy* refers to the correlation between measurements output by the graphic input device and actual real-world measurements (see Glossary, p.195). *Repeatability* measures the ability of an input device to produce consistent results when digitizing the same set of points many times.

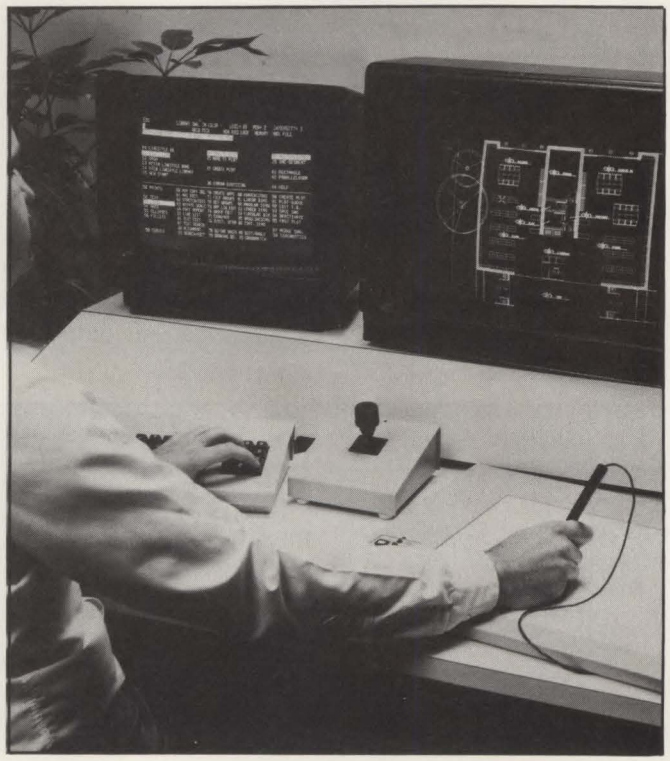
Quantitative measures of speed are commonly used to measure display and plotter output rates, but graphics input speed depends more on the operator than the hardware. Cameras and raster scanners read data faster than digitizer tablets, but within device types, input rates are similar. A final performance parameter is device intelligence. Many input, display and output devices today have powerful microcomputer systems integrated into them or into their controllers. A potential buyer must determine how much intelligence is required for rotation, translation and other forms of encoding in relation to the system into which the input device is to be integrated.

Input-device prices are tricky to calculate. They range from less than $600 to more than $500,000. When figuring costs, a user should consider not only the purchase price of the device but also the price of the hardware interface between the input device and the other parts of the graphics system, the cost of developing appropriate software and the cost of maintenance. On complex devices, the cost of monthly maintenance can be very significant.

The last group of selection criteria can be classed as environmental constraints. Most important among them are operational environment, computational environment and operator sophistication. Operational constraints include temperature, humidity, vibration, static electricity and dirt tolerances.

An input device's computational environment dictates interfacing requirements. Graphics input devices offer serial, parallel and video interfaces and generate raster and vector position data. For example, if a host system works on data in vector format, a vector input device is required. If the data are to be manipulated in raster format, a raster input device is required. Data can be gathered in raster format and converted to vector format, but this requires highly specialized and expensive software. Vector data can be converted within a computer into raster format slightly more easily. However, these considerations must be carefully examined, as conversions are typically "computer-gobbling" tasks.





Graphics input devices *are an important part of ergonomically designed work stations. The CalComp IGS workstation (right) uses a joystick, a tablet, and a keyboard. The Lexidata 2400 (above) uses a keyboard supplemented by an integral joystick.*

A final constraint could be a human one. Depending on the application and the type of graphic input device under consideration, special operator skills may be required. For example, stereo-compiler operators are highly skilled and trained. On the other hand, some graphic input devices are operated instinctively and require little or no operator training or skill.

Input peripheral equipment

Digitizer boards are electromechanical vector graphic input devices that typically resemble a drafting board with a movable cursor. They are used to enter drawings into computer graphics systems by taping the drawing to the surface of the digitizing board and placing the cursor over points whose coordinates are to be entered. Often called simply "digitizers," major subgroups of these boards include:

- Free-cursor digitizers, in which the cursor is a low-mass device at the end of a flexible piece of wire. They allow greater ease of use with menus where the cursor must be moved about quickly from one location to another.
- Constrained-cursor digitizers, in which the cursor slides along a gantry that traverses the entire digitizing board area. They work in an upright mode and allow an operator to release the cursor without its falling to the ground.
- Motorized-cursor digitizers, in which cursor motion is effected by motors driven by an operator-controlled joystick. They combine the best features of both free-cursor and cursor-contrained units, but usually add some expense. Resolution can be 0.001 in., and accuracy can be as high as 0.003 in.

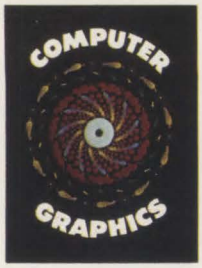
Digitizer boards are available off the shelf in sizes from 11- × 11-in. tablets to 48- × 60-in. back-lit translucent boards. Other sizes can be produced on special order. Small, low-resolution units are available for as little as $600. Large, motorized, back-lit, high-accuracy units sell for $20,000.

Gaze-directed input units bounce a low-power laser beam off a user's eyeball to determine the direction of gaze. This information is then used like any other positional information. An experimental device developed to enable pilots of high-speed military aircraft to manipulate controls when other resources fail, it has been used experimentally by the Massachusetts Institute of Technology's Architecture Machine Group with a spatial data-management system. Price is in the low

GRAPHIC-INPUT DEVICE VENDORS

For more information about graphic-input devices, contact the vendors listed below or circle the appropriate number on the Reader Service Card in the back of this issue.

Digitizer boards	Circle No
Altek Corp., Silver Spring, Md.	409
Auto-trol Technology Corp., Denver, Colo	410
CalComp, Anaheim, Calif	411
Calma Co., Sunnyvale, Calif.	412
Data Technology, Inc., Woburn, Mass	413
Gerber Scientific Instrument Co., Hartford, Conn	414
GTCO Corp., Rockville, Md	415
Hewlett-Packard Co., Palo Alto, Calif	416
Houston Instrument, Austin, Texas	417
Keuffler & Esser Co., San Antonio, Texas	418
Kurta Corp., Tempe, Ariz	419
Numonics Corp., Lansdale, Pa	420
Science Associates Corp., Southport, Conn	421
Summagraphics Corp., Fairfield, Conn	422
Talos Systems, Inc., Scottsdale, Ariz.	423
Tektronix, Inc., Beaverton, Ore	424
Joysticks, trackballs, dials	
Aydin Controls, Fort Washington, Pa.	425
Genisco Computers, Irvine, Calif	426
Measurement Systems, Inc., Norwalk, Conn	427
Megatek Corp., San Diego, Calif.	428
Sanders Associates, Inc., Nashua, N.H.	429
Tektronix, Inc., Beaverton, Ore	430
Light pens	
Information Control Corp., Los Angeles, Calif	431
Sanders Associates, Inc., Nashua, N.H.	432
Line followers	
Altman Associates, Inc., Stamford, Conn.	433
Laser-Scan, Ltd., Cambridge, England	434
Stereo compilers	
Autometric, Inc., Falls Church, Va.	435
Hasp, Inc., Loveland, Colo	436
Kelsh Instrument Division, Baltimore, Md.	437
Kern Instruments, Inc., Brewster, N.Y.	438
Keuffler & Esser Co., San Antonio, Texas	439
Matra Technology, Inc., Los Gatos, Calif	440
Systemhouse, Ltd., Ottawa, Ontario, Canada	441
Wild Heerbrugg Instruments, Inc., Farmingdale, N.Y.	442
Touch digitizers	
Elographics, Inc., Oak Ridge, Tenn	443
TSD Display Products, Inc., Bohemia, N.Y.	444
Touch panels	
Carroll Manufacturing Co., Champaign, Ill	445
Magnavox Display Systems, Fort Wayne, Ind	446
Raster scanners	
Ad-Tech, Inc., Park Ridge, Ill	447
Altman Associates, Inc., Stamford, Conn.	448
Broomall Industries, Inc., Broomall, Pa	449
Dest Data Corp., Sunnyvale, Calif.	450
Image Graphics, Inc., Fairfield, Conn	451
Kongsberg Data Systems, Randolph, N.J.	452
Optronics International, Inc., Chelmsford, Mass	453
Planning Research Corp., McLean, Va	454
Sci-Tech North American Corp., Bedford, Mass	455
TV cameras	
General Electric Co., Syracuse, N.Y.	456
Interpretation Systems, Inc., Lawrence, Kan.	457
Quantex Corp., San Carlos, Calif	458
Spatial Data Systems, Inc., Goleta, Calif.	459
Whole-earth digitizers	
Honeywell Avionics Division, St. Petersburg, Fla	460



Input-device performance is described in terms of resolution, accuracy, repeatability and, to a lesser degree, speed.

thousands.

Joystick, trackball and mouse devices all contain potentiometers (variable resistors), the settings of which can control the location of a cursor on a display screen. The joystick is a spring-loaded rod that can be tilted in any direction. The direction of the tilt is usually used to indicate the desired direction of motion for the cursor, while the angle of inclination determines the speed of cursor motion.

The trackball is a ball set into a pocket in which it physically contacts potentiometers. The ball is rolled with the palm of the hand, and the cursor is usually made to move in the direction of the roll at a rate corresponding to its rotational speed.

A mouse is a graphic input device that functions, in essence, like an upside-down trackball that can be rolled on any flat surface.

While users often indicate preferences for either joystick, trackball or mouse devices, studies indicate that none is inherently superior to another; all are approximately equal in terms of ease of use. Prices range from $100 to $750.

Light pens are stylus-shaped pointing devices that sense light emanating from a display screen. Timing and synchronization circuitry determine the point on the display at which light is detected. Light pens contain light-sensing electronics in the stylus or optical fibers to route the screen light to the light-detection circuit. Proponents of the light pen claim that its similarity to the traditional tools of the drawing-maker is a great advantage, as is the directness of the pointing action. Detractors cite low resolution and the need to hold the pen up to the screen at a difficult angle. Price is about $150 to $400.

Line followers electromechanically identify and follow lines, transmitting the coordinates of points at which the line changes in direction, thus providing pure vectorized output. Semiautomatic in operation, line followers require a full-time operator. They feature extremely high accuracy and moderately high speed, and are useful primarily for highly convoluted linear imagery, such as topographic maps with little or no text, because they do not handle text easily. Prices start at $50,000.

Potentiometers are variable resistors, such as volume controls on radios. Banks of potentiometers are used on some systems for controlling a variety of graphic input functions, such as entering rotation angles. In Tektronix direct view storage tube displays, potentiometers (sometimes called thumb wheels in this context) position the cursor on the display. The devices are convenient for entering magnitudes. Price range is $100 to $800.

Raster scanners are drum or flatbed devices containing a strong light source and a precision diode array or other light-sensing device. The head traverses the image area in a raster pattern, and transmits information to the controlling computer on a pixel-by-pixel basis.

Raster scanners are relatively fast input devices, but do not provide intelligence along with the data. Thus, there is no way of telling from the input of a raster device that two pixels are associated with a particular line. No text recognition is available. However, raster scanners are the leading candidate for the input end of fully automatic digitizing devices (five years from now). Some raster scanners can discriminate between colors in source material. Resolution is as much as 1200 lines per in. Accuracy is similar to resolution, and speed is as much as 30 min. for a 40- × 60-in. area, depending on resolution. Prices start at $40,000.

Stereo compilers, designed for use with 9-in. photographic plates, are not easily modified for other formats. They have been used to collect data from stereo pairs of aerial photographs for several years. Many of these units have now been computerized by the addition of digital shaft encoders. Though expensive, stereo compilers are extremely stable and accurate from a mechanical viewpoint. However, they are slow and not convenient for low-resolution digitizing. Resolution and accuracy ranges down to several microns. Price range is $65,000 to $500,000.

Touch digitizers are overlays for CRT displays that sense location of physical contact through the touch of a finger. They are used primarily for menu selection and secondarily for cursor control. Sensing technologies employed include light-beam interruption, sonics and capacitive. Resolution ranges down to 0.01 in., and price range is $800 to $3000.

TV cameras can be used as raster input devices. The analog output of the TV camera is converted into digital format by standard electronics. Resolution depends on the Videcon tube optics or the charge-coupled device array. Prices start at $3000.

Whole-earth digitizers are inertial navigation devices converted for surveying use. They contain gyroscopically stabilized platforms calibrated at positions of known coordinates and elevation, from which they determine the coordinates of the new location to which they are moved. Still in experimental stage, these digitizers are expected to revolutionize large surveying projects. Prices start at $150,000. ■

Dr. Joel N. Orr is chairman of Orr Associates, Inc., Danbury, Conn., a computer graphics consulting firm.

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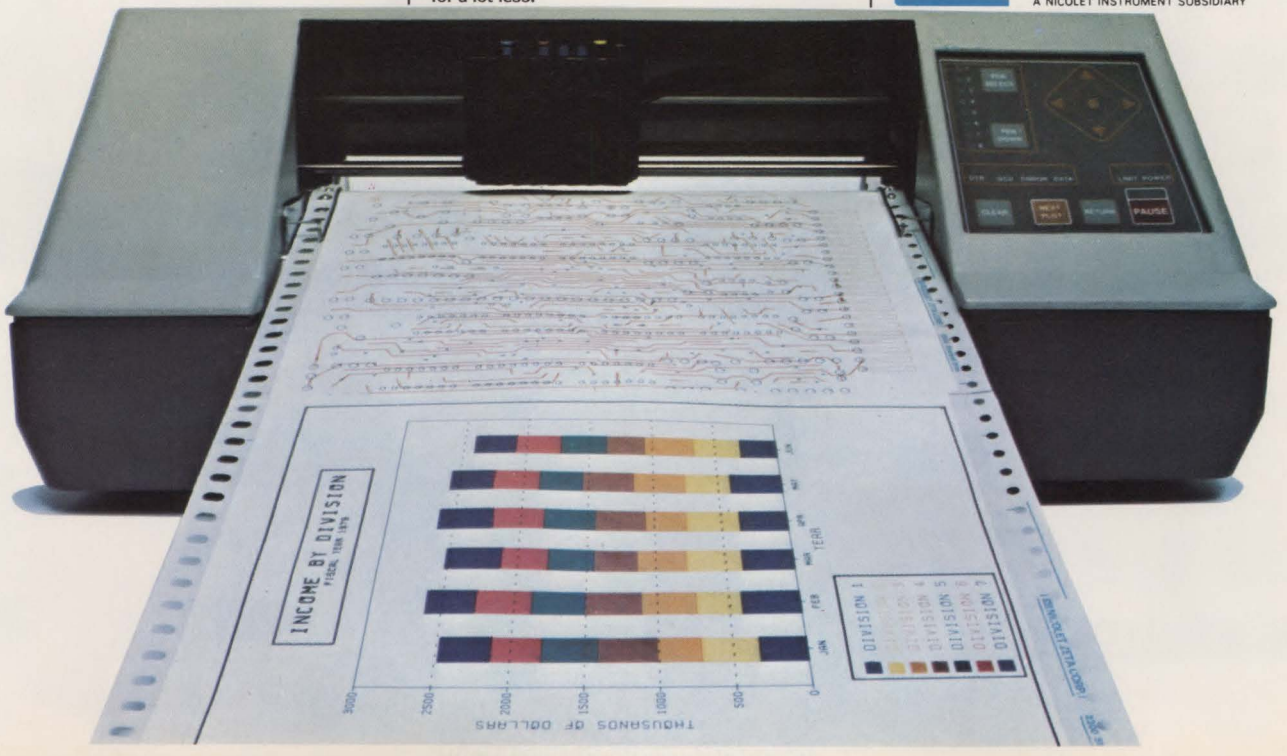

CIRCLE NO. 95 ON INQUIRY CARD

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CIRCLE NO. 115 ON INQUIRY CARD

Implementing standard device-independent graphics

JAMES R. WARNER and NIKOLAUS J. KIEFHABER, Precision Visuals, Inc.

Core standard routines allow application programs to keep up with new graphics hardware

Device independence has been a graphics software buzzword for nearly a decade. Today it's a reality. In the past, graphics applications software was bound to specific host systems, and major reprogramming was often required when obsolescence of a display or the need for a new type of hard copy called for transporting the application to a different device. The primary goal of device independence is for a single application program to work with diverse input and output peripherals.

In a device-independent system (Fig. 1), application programs call on a standardized set of device-independent graphics routines (functions) that in turn call on "virtual" graphics input and output devices. What makes these devices virtual are device managers —separate routines dedicated to each device—that convert device-independent routines into device-dependent hardware commands. The way the device-independent and device-dependent modules communicate is almost as important as what they have to say to each other.

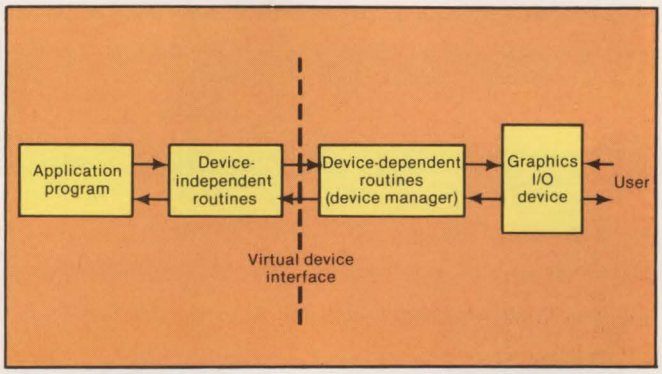
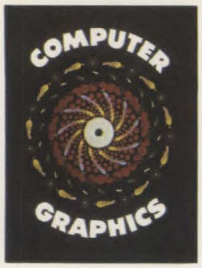


Fig. 1. Device-independent graphics software modules *keep applications programs from becoming obsolete as hardware environments change. Application programs call on standardized, device-independent graphics routines. Dedicated device managers for each I/O device translate these device-independent commands into device-dependent commands. To take advantage of a new or better I/O device, a user need only write a device manager for it. His application program does not change.*

Components of the Core

Before 1976, design and development of device-independent graphics packages were done empirically because no recognized methodology existed. In 1976, the Graphics Standards Planning Committee of The Association for Computer Machinery's Special Interest Group for Graphics (ACM/Siggraph) was formed and chartered to investigate approaches to device independence. The investigation was aimed at developing a methodology and a set of functional capabilities for a



Device-level features can be used for selective erase and real-time image manipulation on beam-directed refresh devices.

device-independent toolbox.

In the summer of 1977, the design for the Core graphics system, an initial package of device-independent graphics routines, was presented for evaluation by the graphics user community. Two years and several review cycles later, the 1979 Core system proposal [1] was released.

Since 1979, more than 20 organizations, including Precision Visuals, Hewlett-Packard Co., Bell Northern Research, Aydin Controls and Tektronix, Inc., have implemented levels of the Core system, making it the de facto standard for device-independent graphics. The Core system was the starting point for sanctioned graphics standardization efforts now under way within the American National Standards Institute (ANSI) and the International Standards Organization (ISO), and will have a significant impact on any sanctioned standard. Its highlights include:

System and device control. The Core system defines modular initialization and termination procedures for both the system itself and for virtual graphics devices. It does not specifically define the binding of a virtual graphics device to a physical graphics device; this is done normally as part of the program load sequence. For example, an application program loaded with a Core system implementation might assign virtual device A to a Ramtek color raster display and virtual device B to an HP table-model plotter. Both devices would then be available to the application program.

A virtual device must be both initialized and selected before output can be routed to the device or input obtained from it. Initialization binds the virtual device to the application program, and selection opens the communication paths between the Core system and the device manager.

Positioning and non-text output primitives are the fundamental commands that define objects in 2D or 3D

HARDWARE FOR DEVICE-INDEPENDENT GRAPHICS

	Flatbed plotters	Drum plotters	Table plotters	Microfilm recorders	Scanline	Storage tubes	Beam-directed medium performance	Beam-directed high performance	Frame-buffer monocolor raster	Frame-buffer color raster
Moves and draws	H	H	H	H	S	H	H	H	H/S	H/S
Colors	1-4	1-4	1-8	option	1-4000	1	1	option	1	4-16,000,000
Intensities	N/A	N/A	N/A	256	S	N/A	1-16	1-16	N/A	H
Line styles	H/S	H/S	H/S	H	S	H/S	H/S	H/S	H/S	H/S
Line widths	S	S	S	H	S	H/S	S	S	S	S
Pens	H	H	H	S	S	S	S	S	S	S
Polygon edge styles	solid	solid	solid	solid	solid/ interior	solid	solid	solid	solid/ interior	solid/ interior
Polygon interior styles	empty/ shaded	empty/ shaded	empty/ shaded	empty/ shaded	empty/ shaded/ pattern	empty/ shaded	empty/ shaded	empty/ shaded	empty/ shaded/ pattern	empty/ shaded/ pattern
Polygon interior patterns	S	S	S	S	S	S	S	S	H/S	H/S
Polygon interior colors	N/A	N/A	N/A	H	H	N/A	N/A	N/A	N/A	H
Polygon fill	S	S	S	S	S	S	S	S	H/S	H/S
Text fonts	varies	varies	varies	many	N/A	few	few	few	few	few
Text justification	H/S	H/S	H/S	S	S	S	S	S	H/S	H/S
Character gap	H/S	H/S	H/S	H/S	S	S	S	S	S	S
Character sizes	many	many	many	many	S	few	few	few	few	few
Device-level segment display file	N/A	N/A	N/A	N/A	N/A	some	H	H	N/A	some
Selective erase	N/A	N/A	N/A	N/A	N/A	N/A	H	H	"undraw"	"undraw"
Highlighting	N/A	N/A	N/A	N/A	N/A	N/A	H	H	H/S	H/S
Dimensionality of device (2-D or 3-D)	2-D	2-D	2-D	2-D	2-D	2-D	2-D	3-D	2-D	2-D
Image transformations	S	S	S	S	S	S	H/S	H	S	H/S
Real-time motion	N/A	N/A	N/A	N/A	N/A	some	H	H	some	some
Display area resolution	$10^5 \times 10^5$	semi-infinite	$10^4 \times 10^4$	32K × 32K	semi-infinite	3K × 4K	2K × 2K	4K × 4K	up to 1K × 1K	up to 2K × 2K
Viewing area	rectan-gular	rectan-gular	rectan-gular	rectan-gular	rectan-gular	rectan-gular	square	square	rectan-gular	rectan-gular
Color lookup table	N/A	N/A	N/A	N/A	S	N/A	N/A	N/A	N/A	H
Background color	N/A	N/A	N/A	N/A	S	N/A	N/A	N/A	N/A	H
Interactive or passive	P	P	P	P	P	I	I	I	I	I
Graphics input	N/A	N/A	N/A	N/A	N/A	yes	yes	yes	yes	yes
Pick input	N/A	N/A	N/A	N/A	N/A	S	H/S	H/S	S	H/S

H = supported in hardware; S = must be simulated in software; H/S = some devices support in hardware, other must simulate; N/A = not available.

relative or absolute coordinate systems. Objects are defined starting at the *current position*, a continually updated world coordinate reference point.

Move primitives change the current position.

Line primitives draw visible lines from the current position to other world coordinate points, which in turn become the current position.

Polyline primitives draw one or more lines from the current position through a set of world coordinate points.

Polygon primitves are sets of three or more points that define closed areas.

Marker primitives are symbols that can be output to mark the current position. Five standard markers are supported on all graphics devices. Some devices support additional special symbols such as oil wells and dollar signs. A marker is always referenced by an index. The device manager determines the mapping from this index number into a hardware-generated symbol on a target display device.

Attributes for positioning and non-text primitives define the general characteristics of output primitives. Each attribute is defined by a device-independent integer label.

Color defines the color of all non-text primitives. Individual color-table entries can be defined by red/green/blue or by hue/saturation/intensity color models.

Intensity defines the relative brightness of lines, polylines, markers, polygons and text strings.

Line style defines the style—solid, dashed, dotted, etc.—of lines and polylines.

Line width defines the relative width of lines, polylines and polygon edges.

Polygon edge style defines the appearance of the borders of polygon primitives (e.g., "draw the border" or "don't draw the border").

Polygon interior style defines the appearance of the interior of polygon primitives (e.g., empty, filled or patterned).

Marker symbol defines the symbol used to represent subsequent marker primitives.

Text primitives define character strings that are output as graphics primitives on a graphics display device. Text primitives can be output in three quality levels:

String precision, which uses the graphic device's hardware character generator to draw the entire string;

Character precision, in which individual characters are drawn in hardware with an explicit move before each character; and

Stroke precision, with stroke-generated, monospaced or proportionally spaced characters.

Attributes for text primitives define the appearance of text strings on a display device.

Character path determines the direction of the string.

Character font defines the character set—italic, simplex Roman, etc.—to be used for the string.

Character justification defines the horizontal and vertical alignment of the string with respect to the current position (e.g., "left, bottom" or "center, top").

Character size defines the width and height of an individual character in a string.

Character gap defines the spacing between individual characters in a string. This is useful in typesetting applications.

Character base defines the orientation of the baseline of a string of characters in the world coordinate system.

Segments are collections of output primitives. A segment is, metaphorically, a snapshot of an object taken with a virtual camera. The picture on a display device is composed of the images of one or more segments. The Core system supports two types of segments:

Temporary segments are simply convenient mechanisms for grouping primitives. These segments have no names. When the display surface of a graphics device is cleared, the images of all temporary segments are lost.

Retained segments are named by the application program. The Core system maintains a data structure for them. Once created, a retained segment exists in the segment data structure until explicitly deleted by the application program. The program can change the name of the segment and make it visible or invisible. A retained segment can be highlighted, for example, by blinking, or can be PICKed using the PICK function.

Modeling transformations allow an application program to specify transformation of subsequently created segments in their own coordinate systems before they are mapped onto a virtual display device. Translation, scaling, rotation and shearing transformations are defined in a 4×4 transformation matrix, and individual transformations can be merged to form a composite modeling matrix. Modeling transformations are useful in manipulating a prototype object in the world coordinate system to form one or more desired objects.

Viewing transformations map 2D or 3D regions of the world coordinate system (measured in meters, inches, light-years or other user-specified units) into corresponding 2D or 3D regions of the virtual coordinate system (a unit cube).

For 2D applications, the viewing transformation maps a rectangular window in the x-y plane onto a rectangular viewport in the virtual coordinate system. All or part of a world coordinate object that lies outside the window can be clipped at the borders of the window before the object is mapped into virtual coordinates.

For 3D applications, the viewing transformation defines the position, orientation, line of sight and lens configuration of a virtual camera in the 3D world coordinate system. The viewfinder of the virtual camera is the window. Objects visible in the viewfinder are mapped onto the virtual coordinate-system viewport. Orthographic, perspective and oblique projections can be defined. 3D clipping planes may be enabled to generate cutaway views of a 3D object.

Image transformations manipulate retained seg-

Virtual graphics input functions allow application programs to request input data from light pens, digitizers and other input devices.

ments (images of a world coordinate object) in the virtual coordinate system. An image transformation is often used in conjunction with a graphics input device to scale, rotate or translate a segment on a display surface, frequently in real time.

Virtual graphics input functions allow Core system application programs to request input data from crosshair cursors, light pens, digitizers and other input devices. A device manager sends the virtual input request to a physical input device associated with the graphics display. Six virtual input devices are supported:

BUTTONs return a positive integer value.

LOCATORs return a single virtual coordinate *(x,y)* pair.

VALUATORs return floating-point values in the range ($0.0 \leq$ VALUE ≤ 1.0).

KEYBOARDs return strings of characters.

STROKE devices return streams of virtual coordinate pairs (e.g., for digitizing).

PICK devices return the name of a visible segment on a display device.

Which device manager maps virtual input requests into physical input requests depends on which physical graphics input devices are available in a given graphics system. For example, a storage tube might use the crosshair cursor for both LOCATOR and PICK input and the terminal keyboard for BUTTON, VALUATOR and KEYBOARD input. A tablet interfaced to the storage tube might be used for STROKE input. By definition, a passive device cannot support graphics input functions.

Inquiry functions allow application programs to inquire about different aspects of the Core system at execution time. At the device-independent level, programs can inquire about the current position, the most recent error detected, the borders of the window and other aspects of the current state of the Core. Application programs can also inquire about different characteristics of an initialized display device, such as its aspect ratio, the availability of graphics input and the current attributes of retained segments.

The virtual graphics device interface

The virtual device interface is a small (1K-byte) buffer of op codes that links the device-independent part of the Core with the individual device managers, each of which appears the same to the device-independent routines. A device manager accepts virtual commands from a device-independent routine through this interface and converts them into command sequences that can be understood by the target device.

The "location" of the virtual device interface determines both the extent of its vocabulary and hence, the sophistication of the individual device managers.

Many device-independent packages define a virtual device command vocabulary that represents the *intersection* of the capabilities of all graphics devices. Typically, this amounts to the ability to draw a line and perhaps define color. All other device-independent capabilities are mapped into move and draw primitives by the device-independent routines. The move/draw virtual device interface allows for rapid development of new graphics device managers. The device manager has only to map virtual move and draw commands into device-dependent moves and draws.

Disadvantages. Several potential drawbacks must be considered. Limiting all output primitives to moves and draws in the device-independent level precludes the generation of hardware text and hardware markers on a target device. Stroked text and markers also increase the communication bandwidth from the computer system to the display device. For example, the number of bits sent across the communication link to draw the character S might be 100 times greater for a stroked character than for the ASCII equivalent of the character. This bandwidth increase can be a critical problem over low-speed (1200 bps or lower) communication links.

A simple device manager implies a complex set of device-independent routines. Character generation and shaded polygon fill algorithms executing as part of the device-independent routines cannot be down-loaded into intelligent graphics devices or satellite processors.

Device intelligence. An alternative to the stroked virtual device interface is to move the virtual device interface "closer" to the application program and increase the vocabulary of commands sent to the device managers. Under this strategy, the device-independent routines perform coordinate conversions, error processing and system-level bookkeeping, but let the device managers do most of the work.

To take advantage of as many hardware device features as possible, the optimal virtual device interface accepts a virtual vocabulary representing the *union* of capabilities available on all graphics devices. With this placement, the device-independent routines assume that every device can do everything.

With such an interface, the device manager uses the hardware features of an output device wherever possible and ignores unsupported functions (e.g., the color attribute on a monochromatic display). Furthermore, if a function is not available in hardware, it can be simulated in software. An example is the crosshatching of polygonal areas on systems without hardware polygon fill.

There are several advantages to this approach:

- The "location" of the interface allows full access to

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Precision Visuals' DI-3000 implements the Core system as a set of programs callable from FORTRAN and other higher level programming languages.

the latest peripheral hardware and firmware features.

- Device-level features can be used for selective erase and real-time image manipulation on beam-directed refresh devices.
- Dynamic color look-up table changes and hardware pan/zoom functions can be accessed on raster frame-buffer displays.
- Sophisticated device managers can run directly on intelligent processors that serve as front ends for display devices.
- Leaner device-independent routines consume fewer resources in the host computer.
- Communications bandwidth between the CPU and individual devices is minimized by the use of native-mode protocols wherever possible.

The potential disadvantage to this higher level device interface is the added complexity it brings to the device manager. Each device manager must interpret and process a rich command vocabulary that is often beyond the capabilities of the target device. The device manager for a plotter, for example, would have algorithms to simulate polygon fill by shading and simulate dashed lines by using a stroking pattern. It would also ignore color look-up tables and graphics input commands.

How a device-independent graphics system works

Graphics software systems have traditionally been entirely resident in the host computer system at execution time. The device-independent routines were tightly interwoven with any graphics data structure and with the device manager(s), and were loaded as a monolithic task with the user's application program.

With the increased intelligence in the new generation of graphics hardware and more powerful networking capabilities in most computer systems, most graphics packages are run as a *series* of tasks often on different CPUs. Precision Visuals' DI-3000 graphics software package implements the Core system as a set of

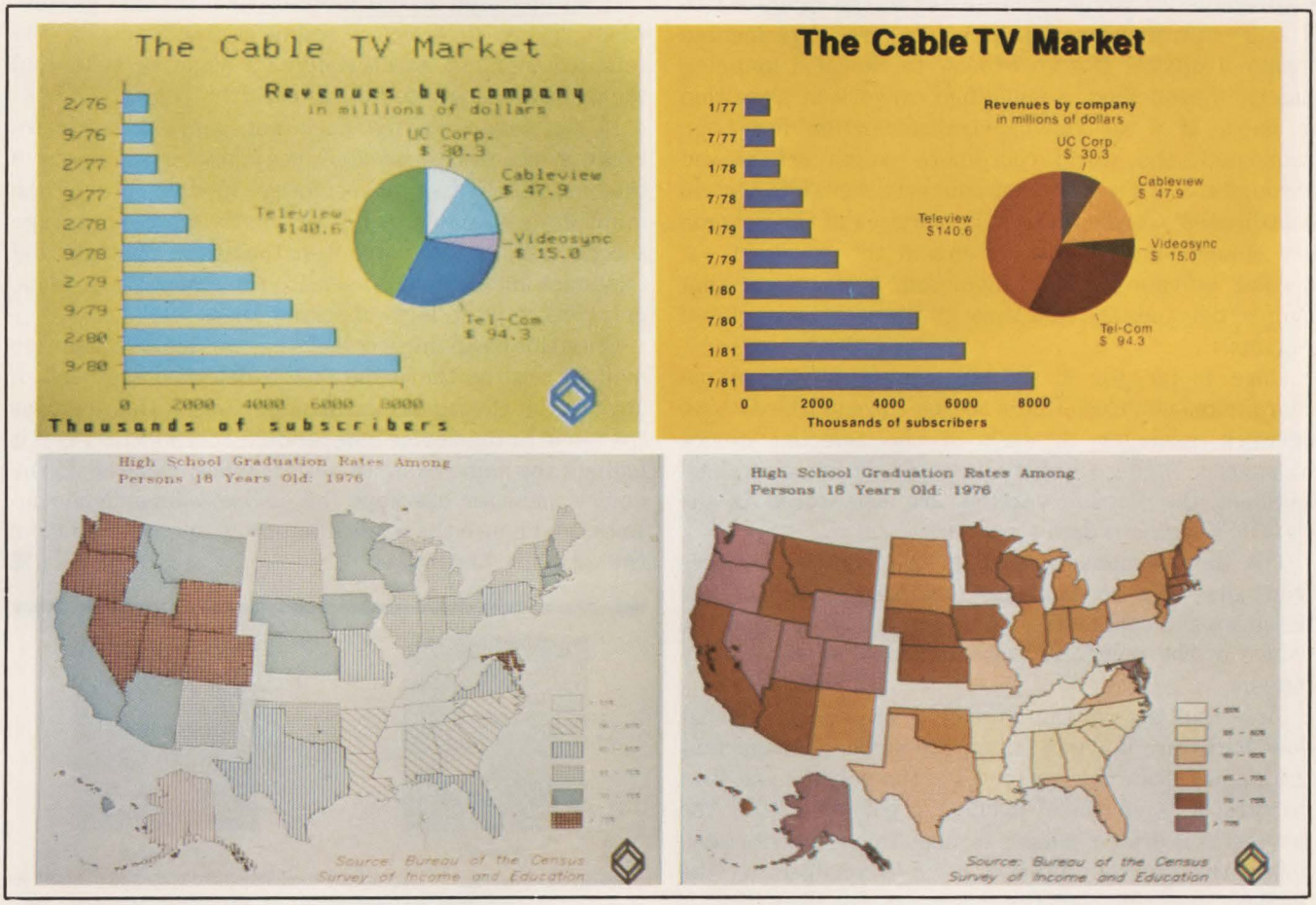


Fig. 2. Device-independent graphics output. *The image on the left above was generated on a Ramtek 6211 color raster terminal. The image on the right above was generated by the same program, with minor color changes, using the Xerox 350 color-slide-production system. The image on the left below was generated on a Hewlett-Packard HP7580A pen plotter. Color attributes were automatically mapped into one of the eight pens on the H-P plotter. The image on the right below was generated by the same program using an Applicon ink-jet plotter capable of solid-color polygon fill.*

The virtual device interface is a small (1K-byte) buffer of op codes that links the device-independent part of the Core with the individual device managers.

programs callable from FORTRAN and other higher level programming languages. DI-3000 functions as a network in which the device managers are the master nodes, and the device-independent routines are the slave nodes.

For example, an application program needs to draw a polygon. The programmer calls one of four DI3000 subroutines, depending on whether the polygon is 2D or 3D or absolute or relative. The device-independent subroutine does some quick error checking to assure that a segment is open and that the number of parts in the polygon is legal. Then, all the world coordinates in the polygon are sent to a coordinate transformation pipeline that converts 2D or 3D world coordinates to displayable 2D virtual coordinates in the range -1 to $+1$. Two transformation pipelines are implemented inside of DI3000. If a 2D window to viewport mapping has been requested, a simplified conversion algorithm is used. If a 3D viewing transformation has been requested, the world coordinate points are passed through a 4×4 matrix that converts them into virtual coordinates. Concurrently, the vertices of the polygon are clipped against the borders of the viewport. (A special polygon-clipping algorithm guarantees that clipped polygons are sent through the network as closed regions.)

Once a polygon has been converted to virtual coordinates and closed, it is routed through the DI-3000 network manager to each of the selected device managers. If the polygon is created within a retained segment, the polygon vertices are also stored in the DI-3000's segment data structure.

The device manager accepts the polygon vertices from the network manager and draws the polygon based on the capabilities of the target device and the values of the polygon's edge and interior style attributes.

To output the polygon on a color raster display that does hardware polygon filling, the device manager has the display draw the perimeter of the polygon and then provides a "seed point" inside the polygon. After the perimeter is drawn, a move is made to the interior seed point, the desired interior color is enabled on the display, and the display's hardware fill algorithm is invoked. Once the perimeter of the polygon has been drawn, only a few bytes of information must be sent to the display to move to the seed point, set the appropriate interior color and start the fill process.

To output the same polygon on a pen plotter that doesn't offer hardware polygon fill, the plotter's device manager would first have the plotter draw the perimeter of the polygon. Then it would automatically convert the device-independent routine's interior fill command into a series of parallel vector or crosshatch patterns that are sent to the plotter. Device managers, then, can take advantage of capable output devices and compensate for less capable ones. Identical application programs become device-independent and, without adjustment, can run with different hardware (Fig. 2).

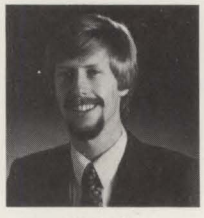
Graphics input goes through similar steps in the opposite order. Suppose an application program must be able to "pick" objects from the screen to move or delete them. The application program specifies a target device and calls the device-independent routine for PICK input, a routine that returns the name of a visible segment on a display device. The device-independent routine checks that the target device supports hardware PICKing and sends the PICK request to the appropriate device manager, such as the one for the light pen. Data are returned from the pen through the device manager, through the virtual device interface, and then through the device-independent routines to the application program.

If an operator at the interactive terminal "misses" when trying to select a segment, the name of the retained segment is returned as a negative value and the operator is advised of his error.

If the target device does not support hardware PICKing, the device manager searches for segments in the host-resident segment storage module rather than in display's memory. An algorithm in segment storage accepts a coordinate value from the device manager and traverses all visible PICK-sensitive segments (e.g. lines, polygons, text strings) checking for a "HIT".

Once this checking is completed, the segment storage module returns the name of the detected segment, if any, to the calling device manager which then returns the name to the device independent routines just as if it had got the name from its target device. Once again the device manager has kept the device-independent routines, and hence the application program, isolated from the graphics hardware. ■

Warner



Kiefhaber

James R. Warner is president and **Nikolaus J. Kiefhaber** is director of software development at Precision Visuals, Inc., Boulder, Colo.

This article is a modified and updated version of one that appeared in the October, 1981, issue of IEEE Computer Graphics and Applications.

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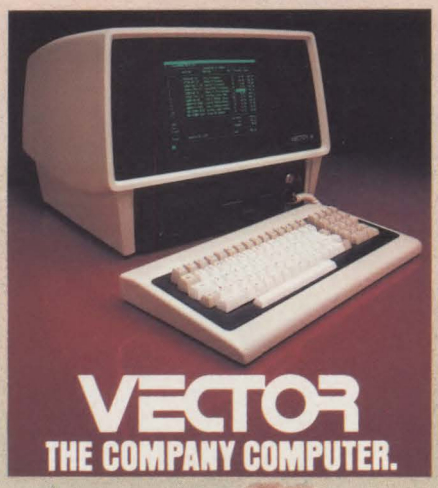

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COMPUTER GRAPHICS

Software revenues to parallel graphics boom

MALCOLM L. STIEFEL, Contributing Editor

Affordable hardware and good business software are giving business executives easy-to-use graphical data

A number of forces are converging to fuel a demand for computer-generated graphics that will foster a market for business graphics systems variously estimated at $4 billion to $6 billion by the end of the 1980s. That will represent growth from a 1981 range of $200 million to $400 million. The software portion of that market alone has been estimated as growing from $6 million last year to $120 million by 1990.

The major forces shaping the business graphics market are:

- the increasing desire of business executives to seek charts and graphs, rather than tabular data, to discern patterns and highlights derived from computer-stored business statistics;
- the availability of inexpensive, compact processors and memory, plus high-resolution color graphics terminals, which have made business graphics systems economically feasible for many users;
- the availability of good business software for those systems.

Good business software is on the market today, but most of the business community has only limited use for

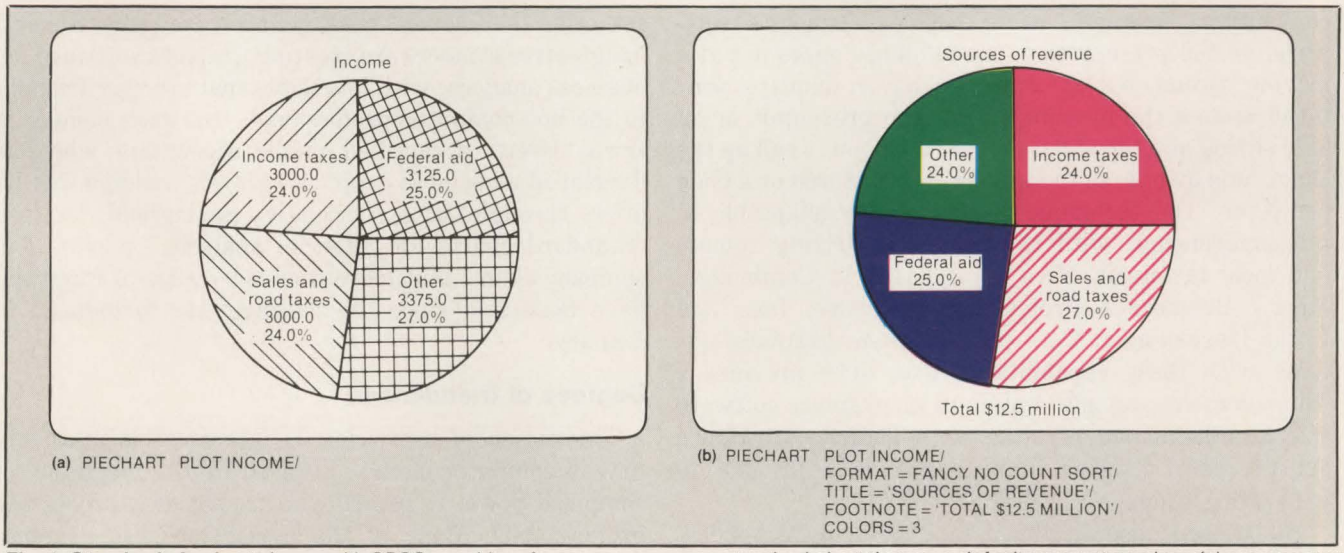
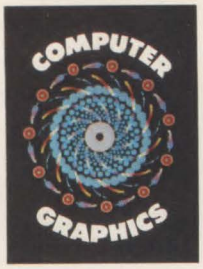


Fig. 1. Standard pie chart *drawn with SPSS graphics. A user can request a standard chart that uses default parameter values (a) or can enter commands to customize the chart (b).*



The notion of user-friendly interfaces is relatively new in computer circles, inspired by the migration of computer power to people who are not data-processing professionals.

it. The most important business graphics application is the preparation of material for presentation at briefings and other group meetings. Business graphics software and systems will find a ready and willing market in organizations that regularly prepare many briefings. The other application—analysis of a firm's day-to-day operations—will continue to lag in popularity. Managers cost-justify presentation graphics systems in terms of drafting and art-services savings; they have a more difficult time proving the productivity gains of analytical graphics systems.

The vendors have recognized this problem for some time and have oriented most of their products toward presentation-graphics applications, as opposed to analysis applications. Such companies as Digital Effects and Iconix couple their graphics software with a slide-making service; their customers create image tapes on in-house systems and send the tapes to processing centers for production of slides and overhead transparencies. Other companies, such as Computer Pictures Corp., Cortex, Graphics Concepts and Management Graphics, are content to provide interfaces from the graphics software to slide-making devices that may be furnished by the vendor or by a third party.

One of the most fascinating and important trends in presentation graphics is emerging almost unnoticed: a few vendors are beginning to offer systems that bypass the slide-making process—the most costly and time-consuming step in presentation graphics.

In these systems, the charts are prepared in the conventional manner, using business graphics software. In the presentation, the audience gazes not at a moving screen, but at computer-driven displays scattered around the meeting room. The presenter, or an aide sitting at a terminal, presses a button to call up the charts one by one, as though they were stored on a slide projector. The technique is also readily adaptable to teleconferencing, with the computer driving remote and local terminals. Two firms based in Cambridge, Mass.—Business & Professional Software, Inc., and Lotus Development Co.—offer business graphics systems with these capabilities. Also, SPSS provides a "management-preview" option in its graphics software that permits managers (or an entire audience) to view a set of chart displays in sequence as a prelude to generating slides.

But there is also activity in internal-analysis applications, in which businessmen use the graphics as tools in

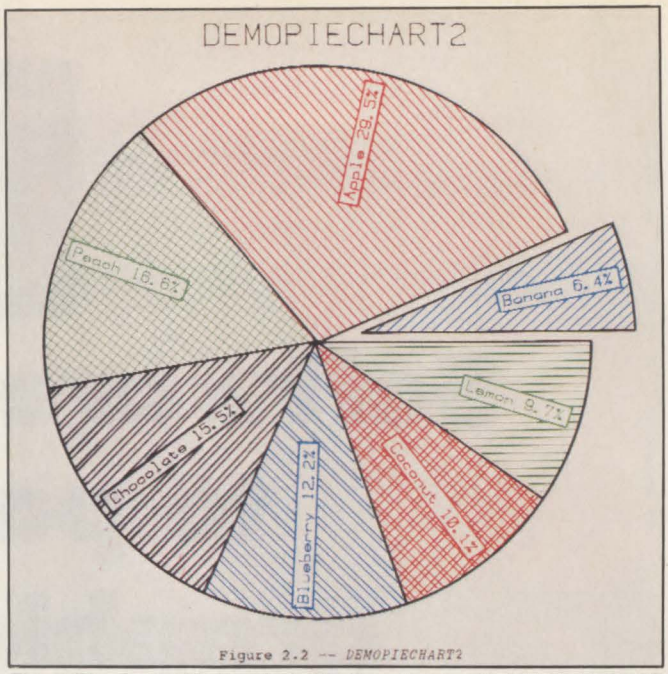


Fig. 2. Pie chart with "exploded" slice, *drawn with STSC's HPPLOT program on the HP 7221 plotter.*

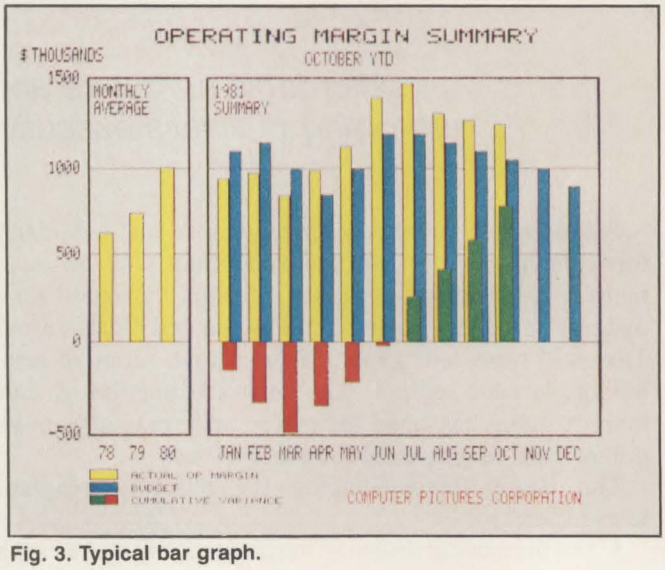


Fig. 3. Typical bar graph.

assessing the financial health of their company. Several imaginative pioneers are creating graphics software for business analysis, with interfaces that are user friendly to the non-computer professional. One such pioneer is Irwin Jarett, a certified public accountant who has developed a business graphics analysis package that he offers through IMJ & Associates, Springfield, Ill. (see "Standard charts for financial analysis," p.213). The company claims that more than 200 copies of Fingraph have been sold since the package was introduced in January.

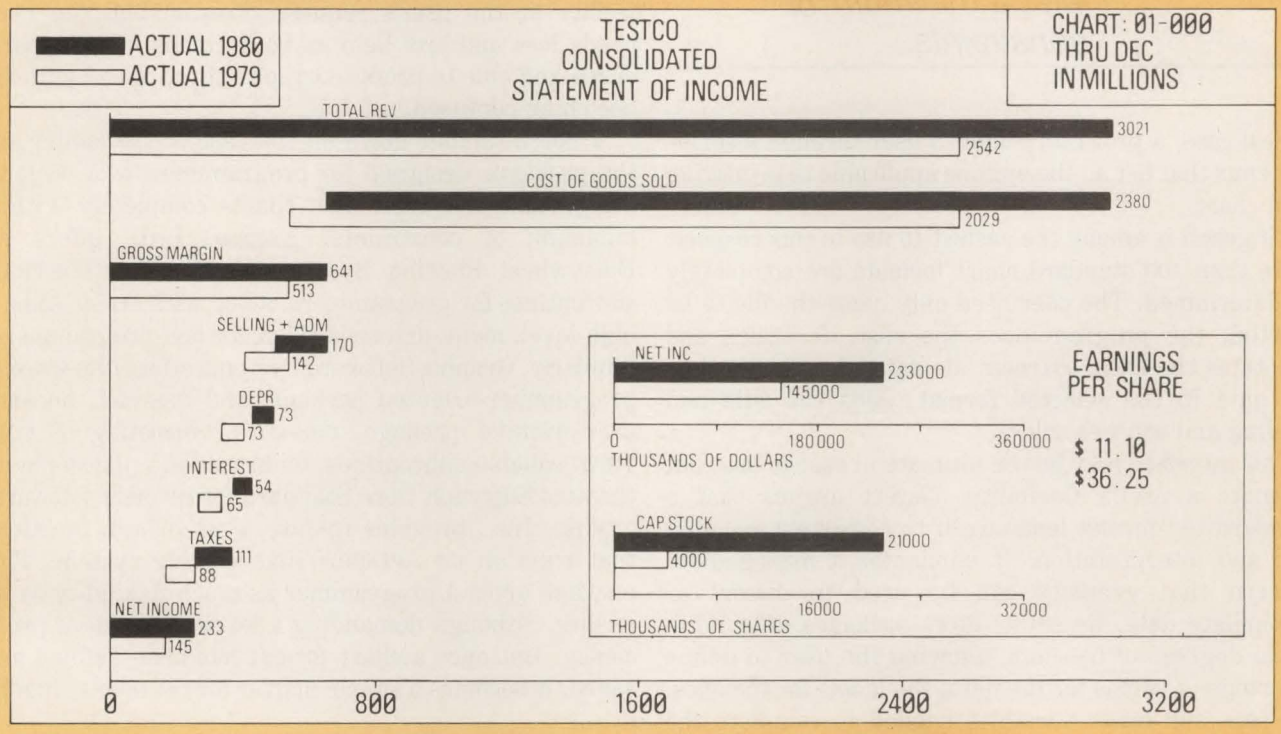
Degrees of friendliness

The notion of user-friendly interfaces is relatively new in computer circles, inspired by the migration of computer power to people who are not data-processing professionals. Many of the newer business graphics packages are completely in tune with this concept. In a

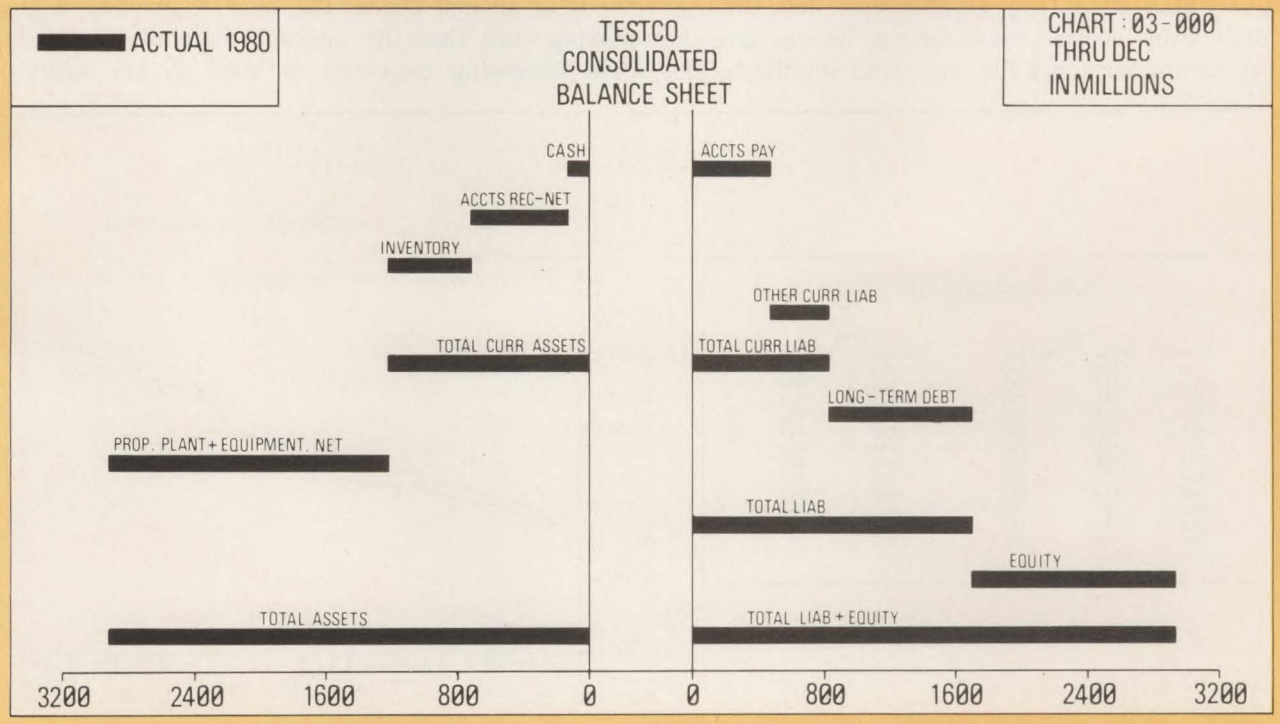
STANDARD CHARTS FOR FINANCIAL ANALYSIS

Standard charts for financial analysis like this typical company's income statement and balance sheet are available from IMJ & Associates. IMJ's Fingraph program displays every income statement in the top format and every balance sheet in the bottom format. The intent is to help business analysts zero in on a company's strengths and weaknesses at a glance. In each chart, current-year figures appear in solid blocks, and previous-year figures in unshaded blocks. The entire layout of each chart is predefined, from the locations of the axes to the positioning of totals, subtotals, titles, labels and legends on the page. Fingraph standards call for monochromatic charts only.

Your Income Statement



Your Balance Sheet



A notch further down on the ease-of-use ladder are the packages designed for programmers who want to design and plot their own charts completely with a minimum of constraints.

typical case, a program guides a user through a series of menus that list all the options applicable to preparing each chart.

Fingraph is among the easiest to use in this respect. More than 100 standard chart formats are completely predetermined. The user need only name the file to be charted; the program does the rest. It scales and annotates the axes, extracts the data of interest, plots the data in the selected format, adds the title and shading and chooses colors.

This interface may be the ultimate in ease of use, but it limits a user's flexibility. (Jarett argues that a standardized format lends itself to consistent recognition and interpretation. It eliminates a management concern that graphics can be used to distort or manipulate data, he says.) Most packages offer additional degrees of freedom, allowing the user to define the range of values for the data, the labels for the axes, the title and other variables needed to complete the chart. These packages also specify default values for the variables, so that the user can create a chart with relatively little effort (Fig. 1). Moreover, once the user has defined his desired chart format, he can save the format parameters on a file and recall the file to plot new sets of data.

Fine distinctions exist even within this group of packages. For example, Strobe, Inc., provides a display menu in its Strobe Plot software, leading the user step-by-step through the choices of variables. Graphics Concepts demands a bit more of the user of its INFOgraf package. This high-level command language is somewhat analogous to a job-control language. The program prompts the user through the terminal display to enter commands via the keyboard, and it provides a help facility at the user's request. Presumably, the user needs less and less help as he becomes more experienced and able to produce graphs at top speed without becoming confused.

A notch further down on the ease-of-use ladder are the packages designed for programmers who want to design and plot their own charts completely with a minimum of constraints. Escape, Ltd., offers its Daisywheel Plotting System, a set of 60 FORTRAN subroutines for programmers, along with Daisy-Aids, a high-level, menu-driven package for non-programmers. Similarly, Graphic Software Systems offers GSS-Core, a programmer-oriented package, and GSS-Plot, an end-user-oriented package. GSS-Core, consisting of FORTRAN-callable subroutines, embraces the philosophy of the ACM Siggraph Core Standard for graphic software.

STSC, Inc., provides HPPlot, a set of APL functions that runs on its APL-Plus time-sharing system. This package gives a programmer as much flexibility as he wishes, although demanding a level of technical proficiency. But once a chart format has been defined and saved, it becomes a simple matter for the user to invoke it.

It may be fair to observe, then, that no one type of business graphics software package is suited to the needs of all end users. The user must shop around, making sure that the package matches his level of data-processing expertise as well as his hardware

Calculator Sales 1979 - 1980
(000's)

Month	1979 Plan	1979 Actual	1980 Plan	1980 Actual
Jan :	339	343	401	398
Feb :	341	345	413	408
Mar :	348	352	417	411
Apr :	357	360	426	419
May :	359	365	429	419
Jun :	364	369	439	426
Jul :	369	370	445	439
Aug :	375	382	457	450
Sep :	379	394	470	480
Oct :	384	399	481	-
Nov :	389	393	489	-
Dec :	396	396	498	-

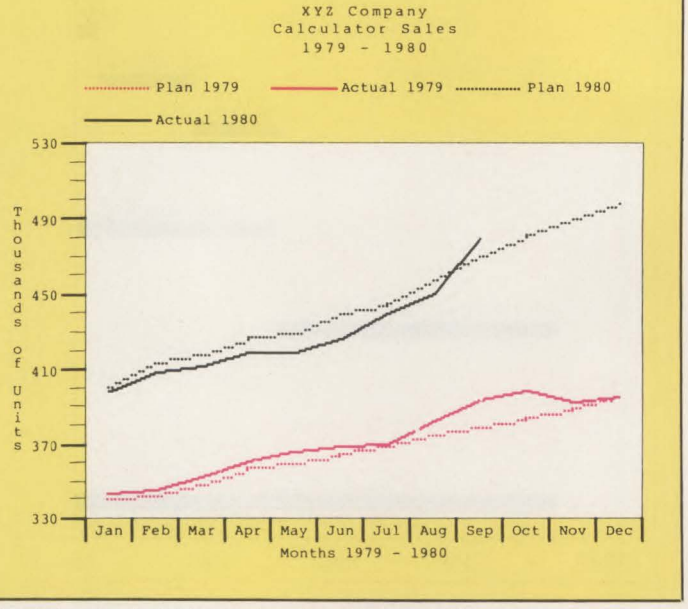


Fig. 4. Typical line graph *produced on a daisy-wheel printer with the Daisywheel plotting system from Escape, Ltd.*

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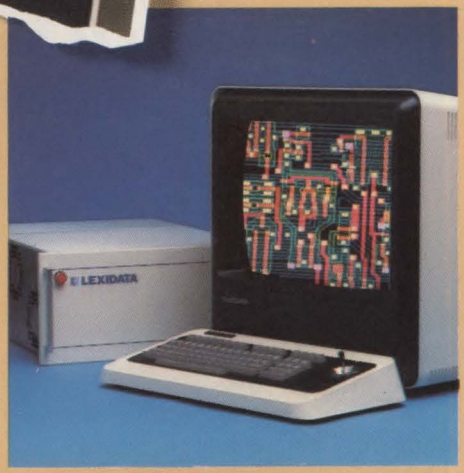

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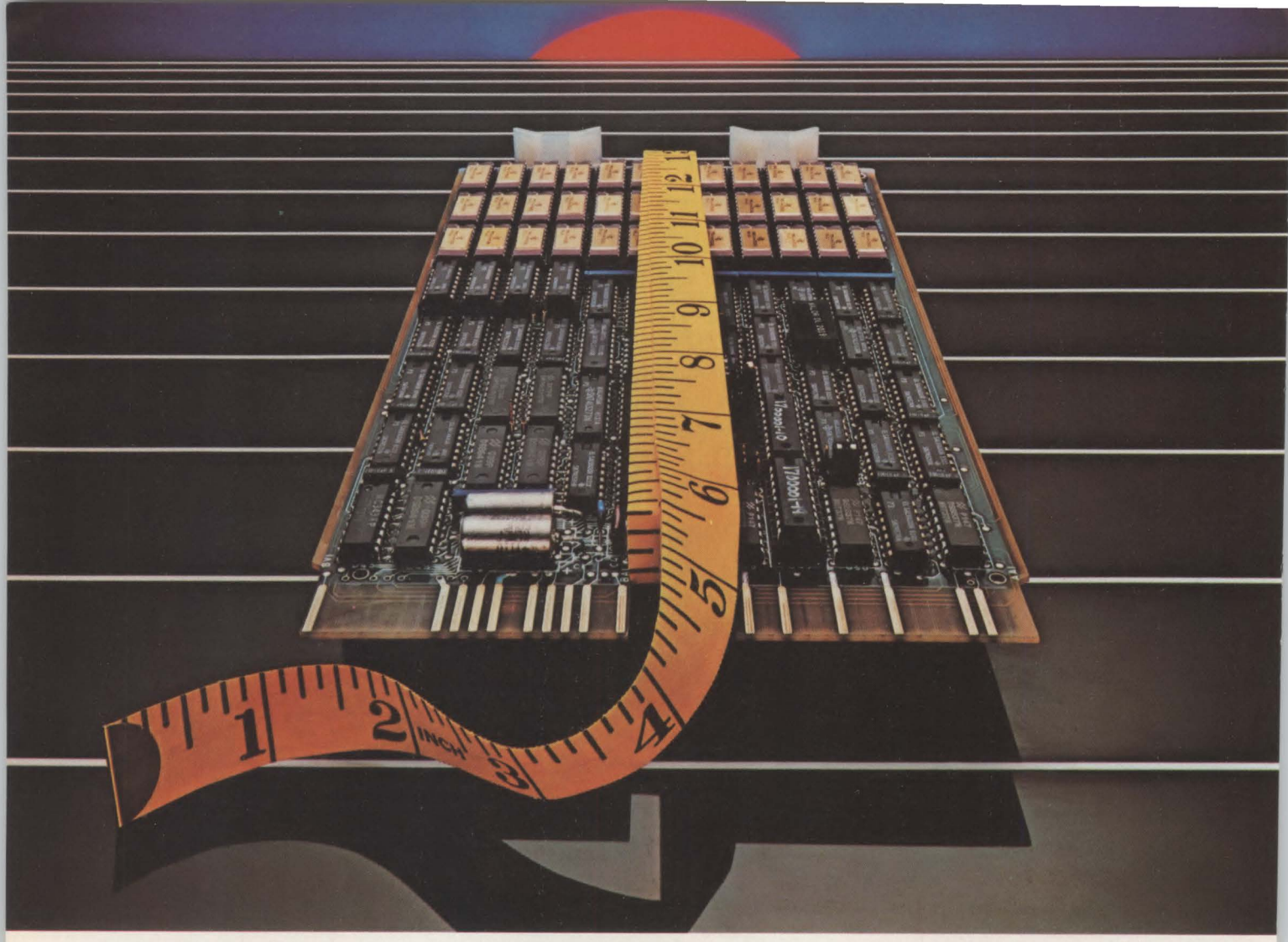

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TI MEMORY BOARDS

System	TI Series	BYTES/BOARD 64K	128K	256K	512K	1M
LSI-11*	TMM10010[1]		X	X		
PDP-11*	TMM20000[2]			X	X	X
VAX*	TMM30000				X	X
Multibus†	TMM40010A[2]	X	X	X	X	

[1]Parity optional [2]EDAC standard

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†Trademark Intel Corp.

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CIRCLE NO. 119 ON INQUIRY CARD

The future of business graphics will be marked by the gradual replacement of computer-based slide-making systems.

configuration, and that it generates the types of charts he wants.

Types of charts

Every business graphics package in the product table (p. 218) can generate the three most popular types of charts: bar charts, pie charts and line graphs.

The pie chart (Figs. 1 and 2) is commonly used to depict a small set of data that can be expressed in percentages. The typical chart is a closed circle, although a user can call for one or more slices to be "exploded" from the rest of the pie, as in Fig. 2. The user can also specify titles, labels for each slice, the radius of the pie, the shading or colors to be used and whether to display percentages or absolute quantities or both.

The bar chart is perhaps the most commonly used, and some very elegant software has been developed to exploit it. As shown in Fig. 3, charts can be grouped (actuals in yellow, side by side with budget figures in blue), stacked (yellow and blue on top of red) and hidden (yellow and blue behind green). Again, the user is free to define scaling, labeling, placement of axes, colors and shading. Bars can radiate up and down from the x-axis, or back and forth from the y-axis, at the user's discretion.

The simplest form, and perhaps the least popular, is the line graph (Fig. 4). It is most useful in displaying more or less continuous functions of time, although it doesn't have the visual impact of the bar chart,and an observer must work a bit harder to interpret it.

A number of packages also handle other types of charts: Escape, Ltd., offers block chart formats for organization charts and block diagrams. Cortex, Inc., supports scatter plots in its business graphics package. Cortex is also one of several vendors to provide a variety of type fonts in its package—for use in highlighting, foreign-language charts and special effects. Digital Effects, for example, gives the user a choice of solid, outline and italicized fonts, in light, medium and bold weights (Fig. 5). Graphic Concepts offers block and italic fonts in three weights, as well as Greek and script lettering.

Future prospects

The future of business graphics will be marked by the gradual replacement of computer-based slide-making systems with presentation systems composed entirely of computers, terminals and large-screen video projectors. This will be a long process because it will require the audience—and, perhaps more important, the performer—to accept the grainy quality and "jaggies" that are evident in today's color raster displays. The software is already here, but the market must be primed.

Another trend in data-analysis applications will be toward charts in standard canned formats. Users will gladly sacrifice flexibility for convenience and ease of understanding. This will simplify the software because the program will be asked to make fewer decisions and deal with fewer variables.

But one thing won't change: 100 years from now, a chart will still be worth only a thousand numbers. ■

(Names of companies that furnish graphics software were obtained from the S. Klein Directory of Computer Graphics Suppliers. *The vendors provided the information listed in the table. For more information about the directory, contact the publisher, Technical & Business Communications, Inc., 730 Boston Post Rd., Sudbury, Mass. 01776.)*

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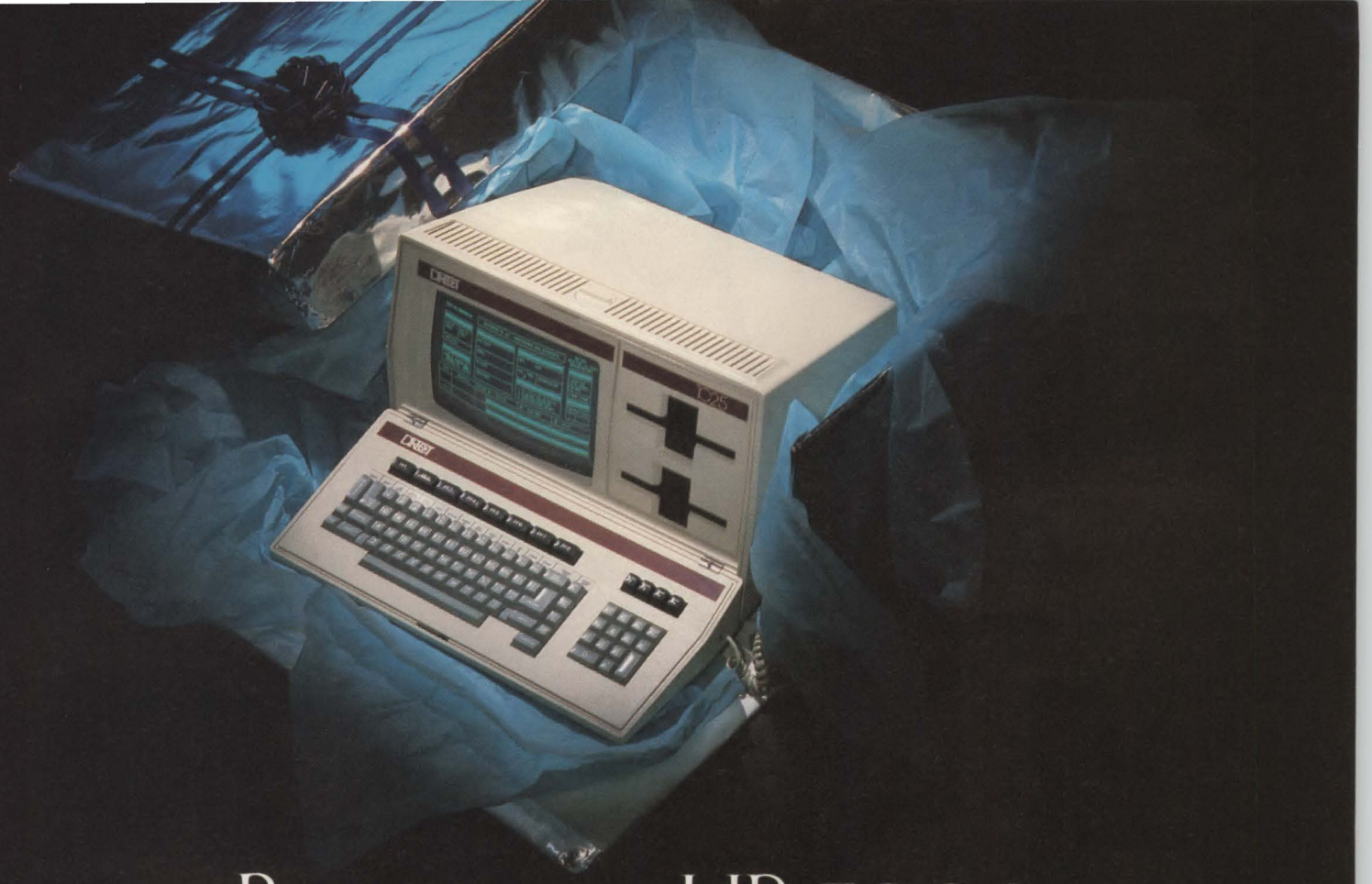
ROMAN

Fig. 5. Specialized set of type fonts *available to users of Digital Effect's Business Visions software.*

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

BUSINESS GRAPHICS SOFTWARE PACKAGES

Company Package	Systems supported	Operating systems supported	Memory required (bytes)	Price	Supplied on	Notes and special capabilities	Circle no.
Apple Computer							**300**
Applegraphics II	Apple II, Apple II Plus with language card	DOS	64K	$75	diskette	graphic utilities designed for development of Pascal graphic applications	
Apple Plot	Apple II Plus	DOS	64K	$75	diskette	simple plotting program for presentation graphics	
Apple Business Graphics	Apple II, III	Apple DOS, SOS	64K (II), 128K (III)	$175	two 5¼-in. floppies	grey scale and color support; English commands	
ASK Computer Systems							**301**
GRAFMAN	HP 3000 Series	MPE	256K	$8000	magnetic tape	formats data from MANMAN database into variety of charts, graphs; users must be running at least one MANMAN package to use GRAFMAN	
CADCOM Division							**302**
CAD2D	Honeywell DPS6 Series, Prime computers, DEC PDP-11, VAX	GCOS MOD 400, PRIMOS, RSX-11/M (4.0), VMS	256K per user	$33,000 (perpetual license)	magnetic tape or disk cartridge	drafting, line drawing, bar graphs, pie charts, etc.; user-defined procedures; completely interactive; supports both color, direct-view storage CRTs, plotters, cameras	
Computer Pictures Corp.							**303**
Trend-Spotter	Chromatics CG Series	CP/M	1M	N/A	diskette	analytical graphics package; full range of statistical functions plus automatic create and output mode for high-speed performance updates; universal interface to all mainframes for direct data download	
Cortex Corp.							**304**
CORTEX-EDDS	DEC VAX	VAX/VMS	480K	$5500	magnetic tape	a device-independent, color software package; runs on DEC Professional Series	
Cromemco							**305**
Fontmaster	all Cromemco graphic systems	CDOS, Cromix	64K	$595	diskette	character and/or font generator; menu-driven	
Slidemaster	all Cromemco graphic systems	CDOS	64K	$595	diskette	digital paint system; menu-driven	
CS2/DataBase International							**306**
*PLOT-TX				$395	8-in. diskette	a 100%, Tektronix PLOT 10-compatible package with expanded features	
Data General Corp.							**307**
TRENDVIEW	DG Eclipse	AOS, AOS/VS	500K	$3000	tape, diskette	supports DG Dasher G300, D450 terminals; interactive, nonprocedural commands; line, pie, bar charts; auto-default of all parameters	
DICOMED							**308**
Micromedia	Apple II	Micromedia	48K	$5000	diskette	produces 35mm slides of text, graphs, charts	
Dicomedia	PDP-11	RSX-11M	128K	$75,000	diskette	a freeform artist's tool that allows the creation of charts, graphs, text as well as freeform art	
Digital Effects, Inc.							**309**
Business Visions	DEC DECSystem 10, 20; Harris, Prime, Hewlett-Packard computers	VSAPL or equivalent	250K	$12,000	tape	2D, 3D capabilities; prompt-driven for nonprogrammers; access to APL graphing primitives for programmer to customize charts and develop new chart forms; independent device drive-packets support multiple output modes	



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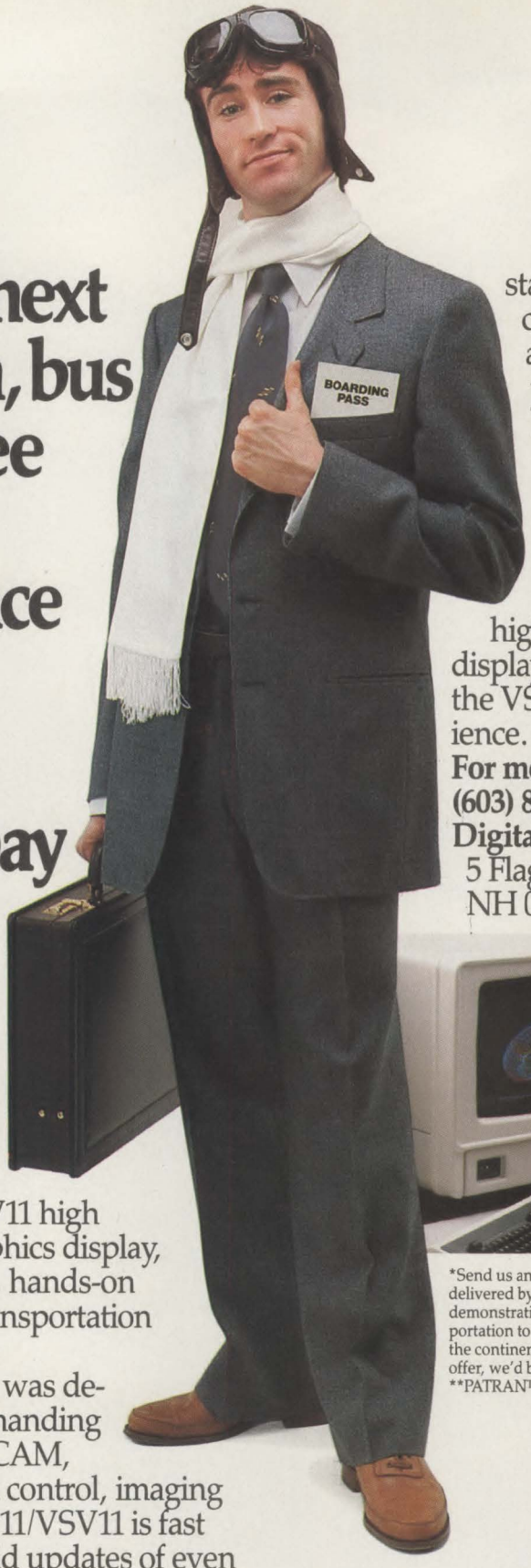

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BUSINESS GRAPHICS SOFTWARE PACKAGES

Company Package	Systems supported	Operating systems supported	Memory required (bytes)	Price	Supplied on	Notes and special capabilities	Circle no.
Escape Computer Software, Inc.							310
Daisy-Aids	8080, Z80	CP/M (2.0 or greater)	64K	$275	single-density IBM 3741; 5¼-in. Xerox 820	complete menu-driven system for creating bar, line, scatter, pie, block graphs with daisy-wheel or thimble-type impact printers; requires no programming experience	
Daisywheel Plotting	8080, Z80	ANSI FORTRAN Compiler	64K	$600	single-density IBM 3741; magnetic tape	collection of FORTRAN subroutines that generate graphics on daisy-wheel or thimble printers; line, bar, scatter, pie graphs; characters can be plotted in various sizes	
Graphic Business Systems, Inc.							311
Quick-Chart	SuperSet	SuperSet OS	virtual	$6000	½-in. magnetic tape	interactive chart design language integrated with time series database; built-in data manipulation, transformation; chart designs are saved, can be used in batch environment for volume production of graphic reports	
Quick-Map	SuperSet	SuperSet OS	virtual	$6000	½-in. magnetic tape	interactive mapping language for thematic mapping; uses state, county, Zip code, census tract, user boundaries; full text, symbol overlay capabilities; easy interface to user data files	
Graphics Concepts							312
INFOGRAF	Prime 50 Series; DEC VAX; IBM, CDC computers	PRIMOS, VMS, VM/CMS, NOS/BE or NOS	varies	$14,000 to $21,000		interfaces to more than 30 devices, including B&W and color CRTs, plotters, film recorders; designed to directly interact with user's DBMS package	
Graphic Software Systems, Inc.							313
GSS-CORE Graphics Subroutine Library	DEC LSI11/XX, PDP 11/XX; HP 3000; Apple II+; IBM PC; Northstar Advantage; Altos; Victor 9000; Dynabyte; Florida Computer Graphics; Forward Technology	CP/M, UNIX, RT-11, TSX, RSX-11M, MPE	25K	$500 (single user); $2000 (multi-user)	5¼-or 8-in. floppies; 9-track magnetic tape	more than 30 graphic output devices supported via plug-in device drivers	
GSS-PLOT Plotting Utility	same as GSS-CORE	same as GSS-CORE	35K	same as GSS-CORE	same as GSS-CORE	same as GSS-CORE	
Hewlett-Packard							314
HPDRAW	HP 3000 Series 30, 33, 40, 44, III, 64	MPE IV	512K	$4000	HP-installed		
HP 3000 Business Graphics Package	HP 3000 Series 30, 33, 40, 44, III, 64	MPE IV	512K	$10,750	HP-installed		
DSG/3000	HP 3000 Series 30, 33, 40, 44, III, 64	MPE IV	512K	$6300	HP-installed		
HPEASYCHART	HP 3000 Series 30, 33, 40, 44, III, 64	MPE IV	512K	$3000	HP-installed		
Graphics Presentation PAC	HP-85A	HP	32K	$200	disk, tape	bar, line, pie charts; text graphs	
Graphics Presentation PAC	HP-87A	HP	96K	$250	diskette	on-screen editing; lines, arcs; bar, line, pie charts; text graphs	
Iconix Corp.							315
AUTOGRAF	Chromatics CG1599	Chromatics Disk OS	32K	$15,000	diskette	modular packages for generation, transmission of color charts, text, diagrams, maps	
IMJ & Associates, Inc.							316
FINGRAPH	DEC PDP-11, VAX	RT-11, TSX-Plus, RSX-11, RSTS, VMS	64K	varies	RL01, RL02 tape	a graphic management information system that applies to financial, operating data	

BUSINESS GRAPHICS SOFTWARE PACKAGES

Company Package	Systems supported	Operating systems supported	Memory required (bytes)	Price	Supplied on	Notes and special capabilities	Circle no.
Information Builders, Inc.							317
FOCUS	IBM PC	DOS	64K	TBA	diskette	will be compatible with FOCUS on host processors	
Intelligent Systems Corp.							318
Intelligent Graphics Systems	Intelligent 8000, 8300 Desktops, Terminals	CP/M	64K	$260 to $895	diskette	interpretive graphics language; has 150-plus English commands; for creating color graphics applications	
EXECUGRAPH	Intelligent 8300 Series CP/M, 8000 Series CP/M Desktops	CP/M	64K	$115 to $150	diskette	converts Peachtree Software's general-ledger package to color graphs with trends, comparisons, variances	
CATS-80	Intelligent 3650 Series	FCS	32K	$1735 to $2300	diskette	color graphics authoring system for industrial/business training; no programming knowledge necessary	
Trendspotter	Intelligent 3650 Series	FCS	32K	$525 to $695	diskette	information graphics; scales time series data using bar, line, area graphs; trend smooth, lead, lag of data; linear projections, moving averages	
ISSCO Graphics							319
DISSPLA	DEC VAX, Prime Virtual systems, Perkin-Elmer 32xx	VMS, OS/32, PRIMOS		$19,500 plus	tape	library of high-level graphic art; line, bar, pie charts; 3D surface charts, maps, contours	
TELL-A-GRAF	DEC, IBM, Prime Virtual, Perkin-Elmer systems	VMS, OS/32, PRIMOS		$19,500 plus	tape	conversational English business-graphics application program for graphic art, line, bar, pie charts, text pages	
Lifeboat Associates							320
GRAF-TALK		CP/M	48K	$450	diskette	editor standard; generates bar, pie charts and line art; works with retrofit ADM-3A, Televideo, IDS-100 terminals	
Lotus Development Corp.							321
Executive Briefing System (EBS)	48K Apple II or II+ with Applesoft ROM or 16K RAM card or Apple III in II emulation mode	DOS 3.3	48K	$199	diskette	presentation package for business, professional users; comes with 8 fonts in B&W, color; proportional spacing to 72 characters per line; capacity to 32 slides per diskette; compatible with 33, 34 sector binary files; special effects; spiral, cut, dissolve has automatic run time or can run automatically	
Alphabytes	same as EBS	DOS 3.3	48K	$25	diskette	add-on text fonts for EBS; available on B&W, color, decorative diskettes; offers EBS user 80 type faces	
Management Graphics, Inc.							322
GRAFAX	HP 2647A, 9872C	BASIC	32K	$1500	cassette	menu-driven; for pie charts, bar graphs	
Nicolet Zeta Corp.							323
ZChart	most minicomputers	all	64K	$750	floppy disk, magnetic tape, paper tape, source listings	a FORTRAN program that produces multi-color line, bar, variance, pie charts created in an interactive session by user's response to English questions	
Precision Visuals, Inc.							324
DI-3000	CDC; DG; IBM; DEC 10/20, PDP-11, VAX; Harris; HP 1000/3000; Honeywell; Prime; Sperry Univac		256K	$8000 to $12,000	magnetic tape	an integrated system; a package of 160 user-callable subroutines; device-, machine-independent; full conformance with Core System Graphics standard	

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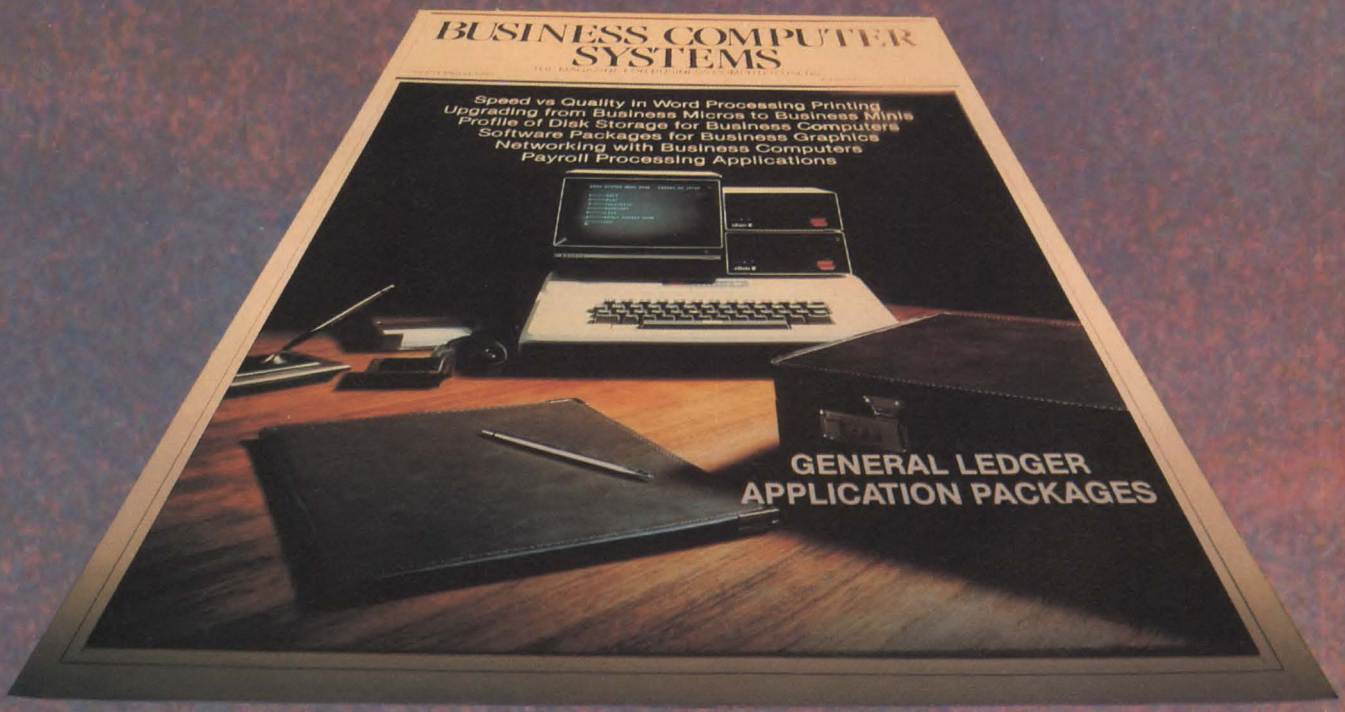

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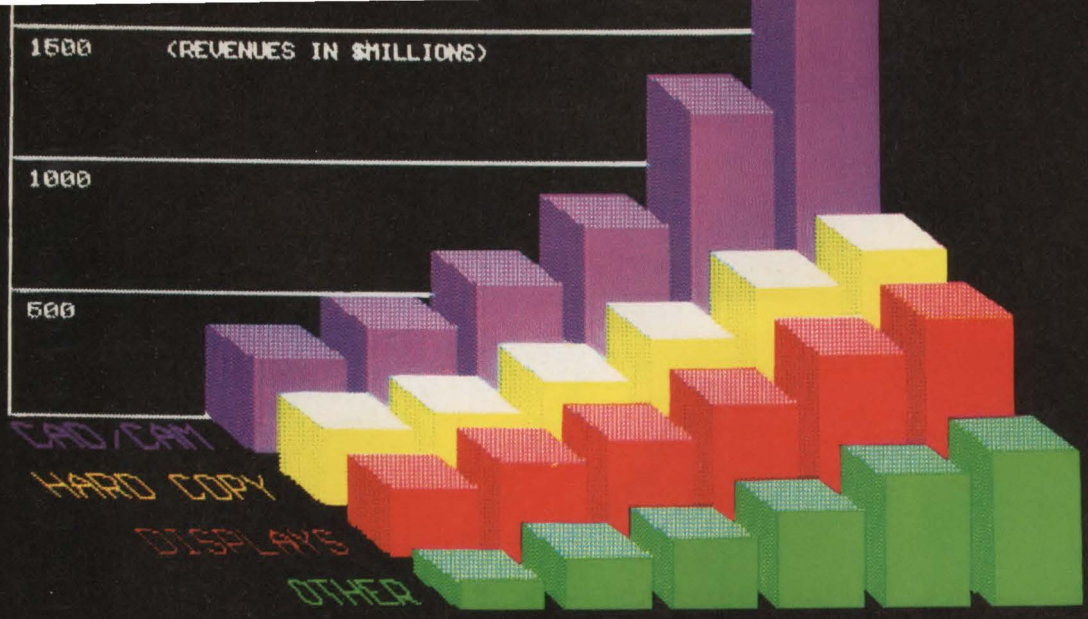
GRAFMAKER	same as DI-3000		256K	$6000	magnetic tape	an integrated system of machine-, device-independent graphic tools for designing, viewing line, bar graphs, pie charts; a package of user-callable subroutines; generates simple, sophisticated graphs	
Contouring System	same as DI-3000		256K	$3000	magnetic tape	plots randomly positioned and gridded data; "quick look" mode generates preview maps; labels major contour lines and relative minimum, maximum points in gridded data; builds triangulation plots; optional snapshot debugging commentary; differentiates between major, minor contour lines	
Selanar Corp.							**325**
PL-100S	DEC PDP-11, VAX	RT-11, RSX, VMS	2K to 16K	$2500	magnetic tape	object-, source-code versions available; works with Selanar graphics board for VT-100 terminals	
PL-3DS	DEC PDP-11, VAX	RT-11, RSX, VMS	3K to 4K	$3000	magnetic tape	same as PL-100S	
Selva Systems, Inc.							**326**
DAISYGRAF	Z80- and 8080-based systems	CP/M version 2.2	48K	$295	8-or 5¼-in. diskette	generates high-quality graphs using dot-matrix and daisy-wheel printers; all data are verified before graph generation; blank forms can be printed for use in data collection; many graphs can be plotted on one page and/or integrated with text	
SPSS Inc.							**327**
SPSS Graphics	DEC VAX, Prime	PRIMOS, VMS	256K	N/A	tape	publication-quality bar, line, pie charts; multiple charts on one page; graphs may be previewed on terminal before drawn for hard copy; integrated with SPSS's data-analysis system	
Strobe, Inc.							**328**
Strobe Business Graphics Package	most minicomputers	CP/M, DOS, RT-11	32K	$995	5¼-and 8-in. diskettes		
STSC, Inc.							**329**
HPPLOT	VAX-11 Series	VMS	100K	$1500	tape	produces four-color line plots, bar and pie charts using HP 7221 flatbed pen plotter series; may be licensed to operate under STSC's APL*PLUS/2000 language processor for VAX or on APL*PLUS time-sharing service	
T & W Systems, Inc.							**330**
T-SQUARE	LSI-11	USCD Pascal	64K	$2247	8-in. diskette	general-purpose graphics produces transparencies for presentations, ads, artwork, graphs; digitizer input, plotter output	
CADAPPLE	Apple II Plus	USCD Pascal	64K	$1247	5¼-in. diskette	same as T-SQUARE	
Xiphias							**331**
Videograph/Ramtek	Ramtek 6214	USCD Pascal	128K	$15,000 (software) $35,000 (hardware)	8-in. diskette	16-color display; 64-color palette; 640 x 480 resolution; average 4 to 6 graphics per hour; limited animation	
Videograph/AED	AED 767	USCD Pascal	128K	$20,000 (software) $45,000 (hardware)	8-in. diskette	256-color display; 16M-color palette; 640 x 480 or 575 x 783 resolution; anti-aliasing; average 4 to 6 graphics per hour; extended animation	



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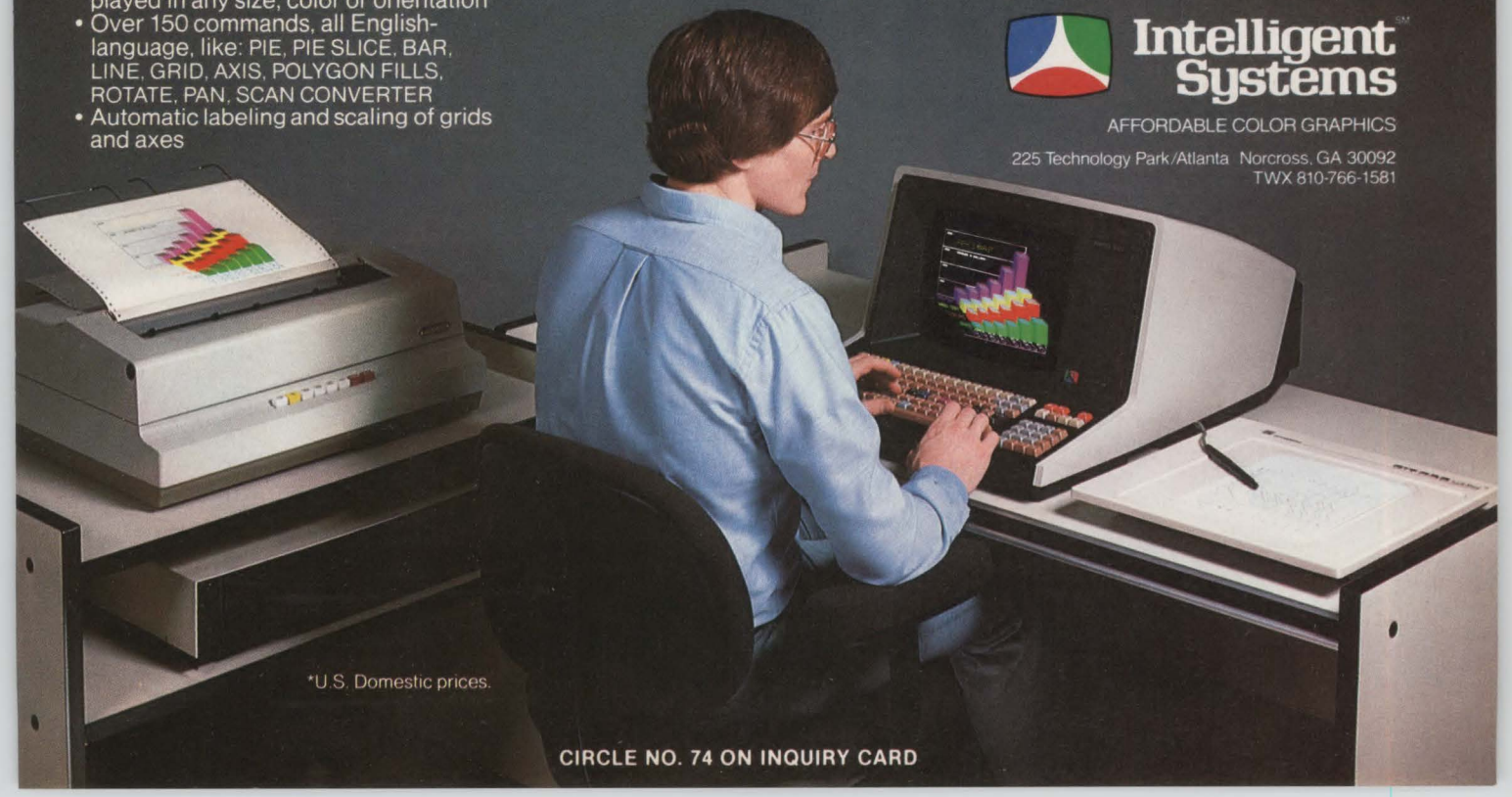

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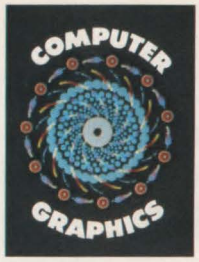


Device-intelligent graphics software

ANDERS VINBERG, ISSCO

Graphics software can provide a level of display adaptability beyond device-independence

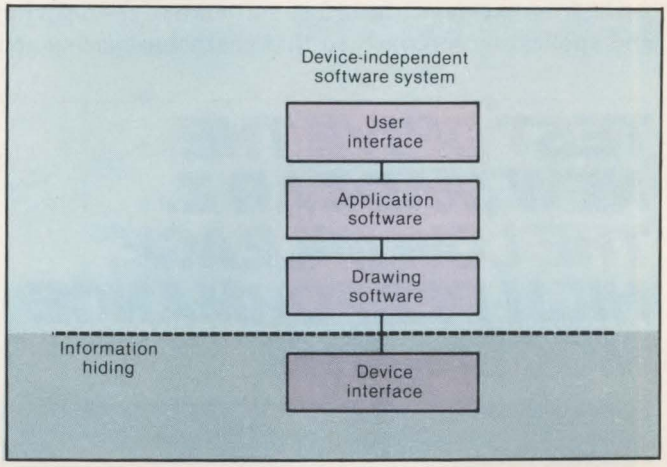
A graphics applications program is often run on more than one output device. It can be time-consuming and costly to adapt a program to each device, but software can provide features that allow graphics to run on any device without user modification. Two approaches to graphics software—device independence and device intelligence—offer different levels of output adapability.

Device-independent software

A device-independent graphics system is one that can be adapted to work with all graphics output devices. A new device with unusual characteristics will require some software changes, but after these changes, user instructions should produce graphics on the new device as it would on any other. The motivation for device independence is economic, because the potential cost of converting applications programs to each new output device could be prohibitive.

The device-independent structure of ISSCO's Tell-A-Graf and similar graphics software systems consists of four modules:

- **the user interface,** which, as in Tell-A-Graf, is an English-like command interpreter. The user interface can also be menu- or prompt-driven.
- **the application software,** which can design graph types, such as bar and pie charts, and ensure that no conflict exists between chart and text placement.
- **the drawing software,** which uses the chart parameters and the data to place the graphics primitives, such as lines, arcs, text and color, in the appropriate positions.



Device-independent software *consists of four modules. Information in device interface software is hidden from other software, so that displays are created independently of output device characteristics.*

- **the device interface,** which translates these primitives into a language the device understands.

Device-independent software keeps the device interface software hidden from the other software so that the applications and drawing software create displays without regard for the output device. Because of this "information-hiding" technique, graphs appear almost identical on different output devices except for overall image characteristics such as size and resolution.

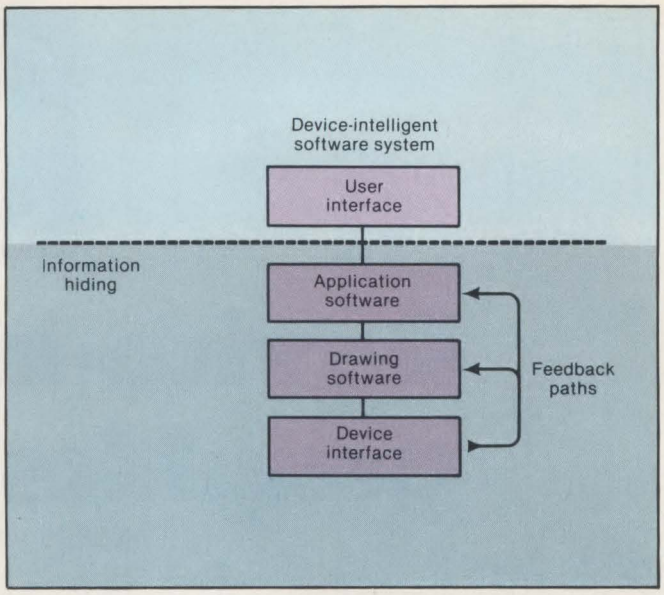
Device-intelligent software

Device independence assumes it is acceptable to send the same graphics display to different devices, but

Device-intelligent software can contend with the fact that the output device used is not always the one to which the display should be adapted.

output devices have idiosyncrasies that can affect graphics quality. Low-resolution CRT devices, for example, require relatively large text; other CRTs are cell-oriented, able to place text only in certain locations of the screen; still others restrict text size or orientation. For such devices, graphics elements must be adjusted to fit the text restrictions. Different CRTs may also behave differently when two graphics items occupy the same location: elements can be hidden, and colors can mix or smear. Finally, a graph that looks good on one device simply may not look as good on another. Software that can adjust the elements of a graphics display to suit the quirks of different output devices can be called "device-intelligent."

Device-intelligent software uses the same structure as device-independent software, but provides feedback paths from the device interface software to the drawing and application software so that character spacing and placement, shade patterns, layout and other characteristics can be adapted to the output device. Information hiding occurs between the user interface and the rest of the software so that the output display adjustments are user-transparent.



Device-intelligent software *has the same four modules as device-independent software, but feedback paths provide application and drawing software with information on output-device characteristics from device-interface software. Images can be optimized for one device and previewed on another. Information hiding occurs only between user interface and other modules, keeping process user-transparent.*

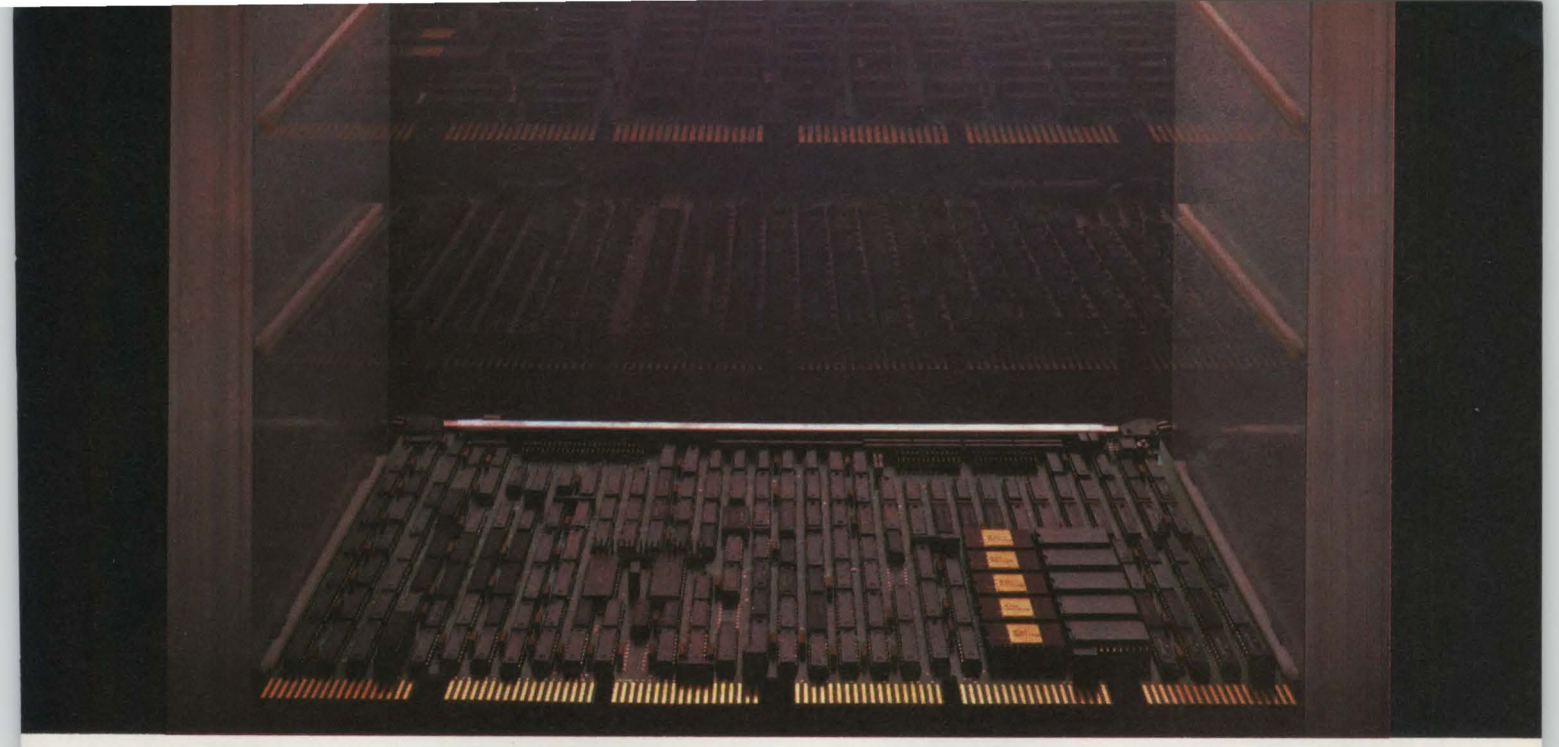
Such software can also be designed to contend with the fact that the output device used is not always the device to which the display should be adapted. Graphics displays intended for hard-copy output, for example, are usually previewed on a CRT, and it is useful to preview the image on the CRT as it will appear on the hard-copy device. To do this, the software can provide a feedback loop to the drawing and application software from a device other than the one used. The display can then be created for the hard-copy device and displayed on the CRT. The software might use "device" and "layout" commands to distinguish the preview and intended devices. By writing

```
DEVICE IS RAMTEK MODEL 6211
LAYOUT IS SLIDE,
```

for example, a user can preview a slide output on a CRT.

Device-intelligent software allows the user to produce a device-optimized graph by choosing a data file, the information to retrieve from the file, a chart type, a layout type and an output device. The user need not worry about the display characteristics of the output device because the software makes the necessary modifications. ■

Anders Vinberg is vice president of development at ISSCO, San Diego, Calif.



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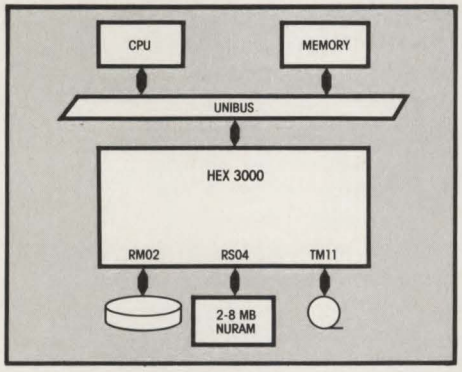

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CIRCLE NO. 68 ON INQUIRY CARD

A bright future for single-purpose networks

WALTER A. LEVY and HARRIET F. MEHL,
Edgewood Computer Associates, Inc.

Modular systems can become 'local networks,' thanks to the availability of LAN technology in DP product lines

The local-area-network industry today resembles the computer industry of the early 1960s. LAN components, architectures and marketing strategies are as diverse as those of the early computers. General-purpose networks, integrated voice/data switches and port-contention systems use different approaches to integrate voice, office, process-control and data-processing equipment from multiple vendors into functional LANs. The lack of intra- and inter-application hardware and software standards may slow acceptance of these systems. Thanks to their one-vendor, one-application design, a new breed of LAN—single-purpose networks—has a bright future. Standards battles are fiercest among general-purpose LAN suppliers. One group of network products, the single-purpose networks, is less involved in the standards debate—with good reason.

Single-purpose versus general-purpose networks

Single-purpose LANs are systems of computer modules and terminals of a common manufacture that a user can assemble into a multiple-device integrated processing system. These modular systems are LANs because a local-networking technology is available as part of the manufacturer's distributed-processing product line.

In single-purpose LANs, the networking technology and the data-processing application are highly integrated. The communications portion of a single-purpose system has no life of its own; it exists as an access method, permitting programs in one module to exchange data with programs in another.

Fig. 1 shows a single-purpose LAN applied to a process-control problem. The end user of this system would purchase the computers, terminals and networking facilities; install the equipment; develop the application programs; and integrate the system. The

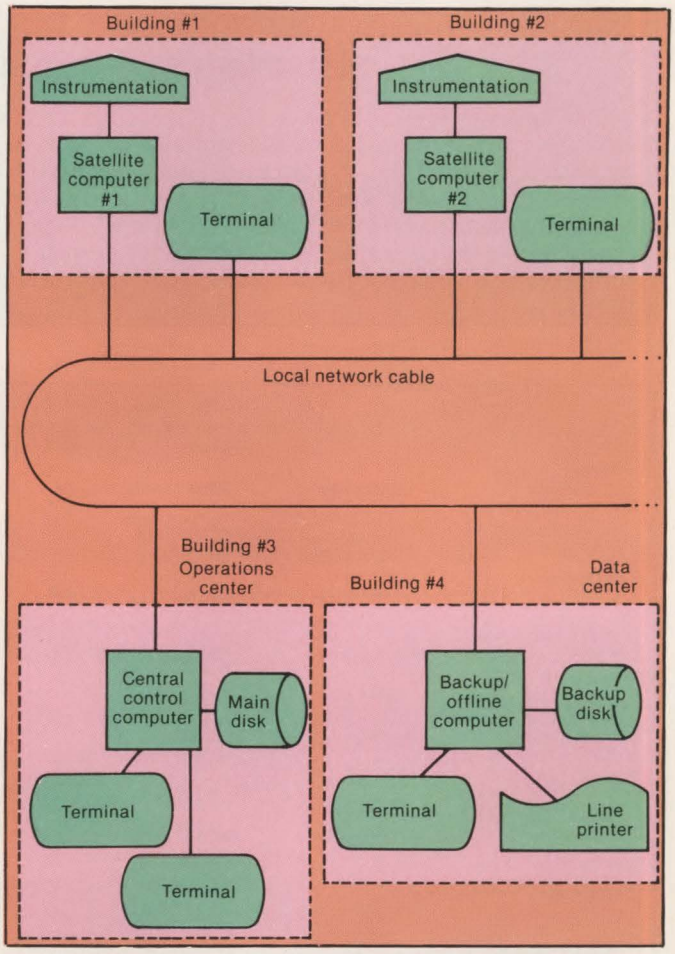

Fig. 1. A process-control application using a single-purpose local network *is distributed through four buildings, two of which contain the process equipment and two of which are administrative. A satellite computer drives the instrumentation connected to the process equipment in each of the two processing buildings; the central control computer and operations center are in a third building; and a backup for the central control computer is in a fourth building, where it might share space and personnel with another data center. All four computers are linked via an LAN. In the configuration above, the LAN is dedicated to the process-control application and is sold as an integral part of the process-control system. A similar system could be configured using a general-purpose LAN interfaced to standard process-control components. Using a broadband, general-purpose LAN, a user can arrange remote visual supervision of plants via video cameras.*

(Editor's Note: This is the last in a three-part series of profile articles on local-area communications. The first (MMS, February, p. 227) discussed cable-based, general-purpose local networks using bus and ring architectures. The second (MMS, March, p. 147) discussed matrix-switched networks that use star architecture and twisted-pair wiring.)

In single-purpose LANs, the networking technology and the data-processing application are highly integrated.

computer system need not be specially designed for process-control applications (reliability considerations apart). Software permitting, the same elements could be used to construct a multiple-location business data-processing system, another "single purpose."

General-purpose networks have a life separate from a user's equipment. They are utilities that perform a data-switching function without becoming involved in user applications. They are usually more complex and costly than the network facilities of single-purpose networks and are usually turnkey-installed by their vendors.

Types of single-purpose networks

All the products listed in the accompanying tables qualify as single-purpose LANs: they are networked extensions of microcomputer manufacturers' product lines that a user assembles into working systems. They all use baseband signaling on a distributed bus or ring architecture but use various control methods and kinds of cables. Their network interfaces are always implemented in an I/O card that plugs onto a host mini's main bus and a software module that performs datalink access-control functions. The interface between a user's application and the network is an inter-program call to the network access software module. Three major types of single-purpose networks share these traits:

- **Single-source work-station systems** consist of an integrated product line of computers, microprocessor-based work stations, disk files, printers and terminals

REPRESENTATIVE SINGLE-PURPOSE LAN PRODUCTS

The products covered in this article are described in four tables. Table 1 gives summary data on the kinds of networking technology used in each of these systems. All of these systems operate baseband, with one TDMA channel. A wide range of transmission speeds and protocols is used, but Ethernet techniques seem to be the most popular. Table 2 describes the elements of the single-source work-station systems. Table 3 indicates which computer and operating systems are supported by memory-level networking systems. Table 4 indicates which mainframes, operating systems and peripheral equipment are supported by the various host-computer local networks.

Table 1: SINGLE-PURPOSE LOCAL-NETWORK TECHNOLOGIES

	Cable type	Maximum network length	No. of nodes or stations	Data transmission rate (bps)	Channel access method/protocol	Comments	Equipment type (Ref: Tables 2, 3, 4)
Corvus Constellation	32-wire bus	200 ft.	64	60K bytes (480K)	polled by master		3
Corvus Omninet	1 twisted pair	4000 ft.	64	1M	CSMA		3
Cromemco C-Net	twin-ax	2000 m.	255	880K*	CSMA/CD	*now operating at 500K	2
Digital Microsystems HiNet	2 twisted pairs	1000 ft.	32	500K	polled by master		2
Interlan Ethernet Controllers	Ethernet						3
Data General Multiprocessor Communication Adapter	multiwire bus	2400 ft. (150 ft. between nodes)	15	625K bytes*	program-controlled ring configuration	*1M-bps operation possible if nodes are 40 ft. apart, and maximum 4 computers	4
Digital Equipment DECdataway	3 twisted pairs	15,000 ft.	31*	56K	polled, multidrop	*PDP-11 may support 63 terminals instead of 31 subsystems	4
IBM Corp. 8100 Loop	2 twisted pairs	3200 m.*	64	9.6K	transmit/poll/receive cycles	*loops of 2000 m. can transmit at 38.4K	4
Prime Computer Primenet	coaxial	3000 m.	16	10M	token-passing scheme		4
Nestar Systems Cluster/One Model A	16-wire bus	1000 ft.	65	30K bytes (240K)	CSMA/CD		3
Scientific Data Systems SDSNet	RG 11A coaxial	1000 m.	255	1M	CSMA/CD		2
3 Com Corp. Ethernet Controllers	Ethernet						3
Three Rivers PERQ	Ethernet						2
Xerox Corp. 8000 Network System	Ethernet						2
Zeda Computer Infinet	1 twisted pair	3000 m.	30	100K	CSMA/CD		2
Zilog, Inc. Z-Net	RG-59/U coaxial	2000 m.	255	800K	CSMA/CD		2

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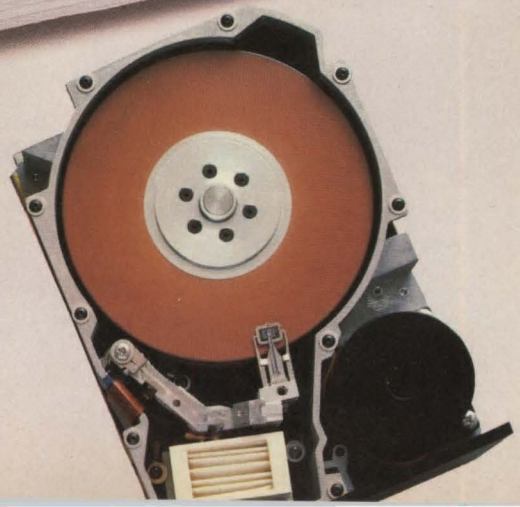

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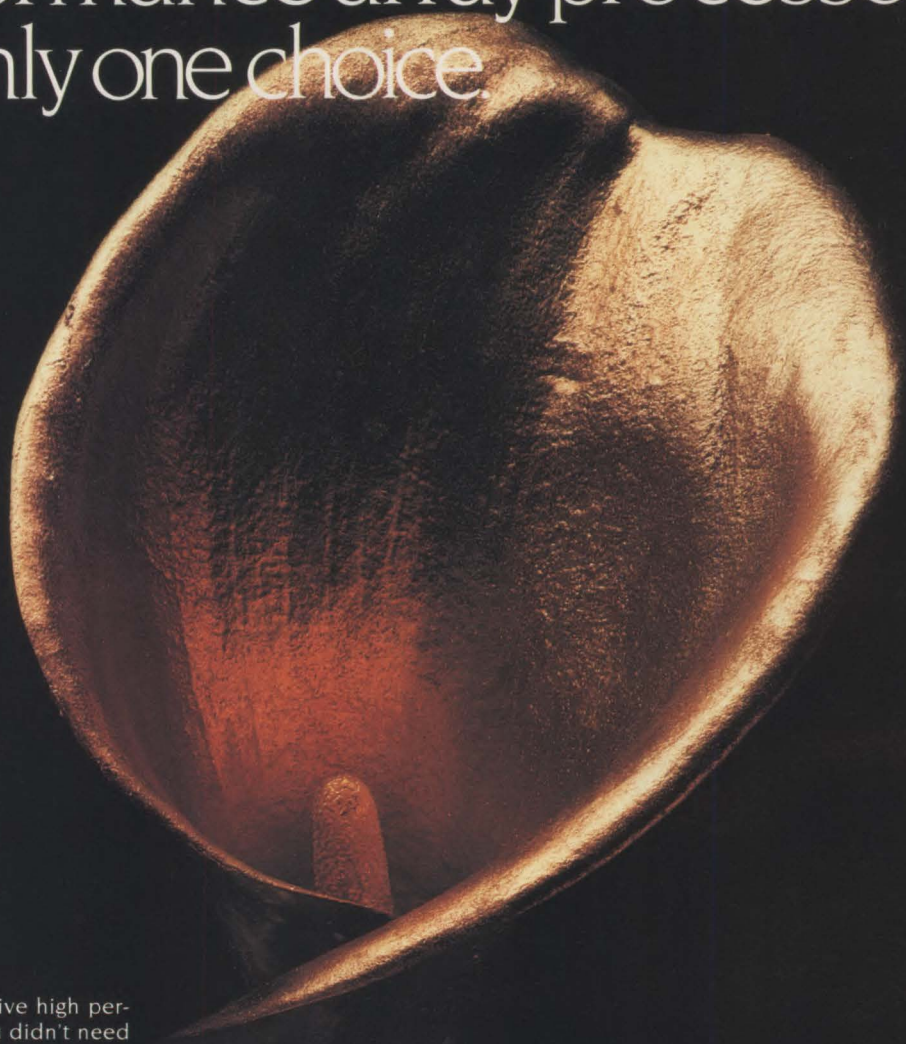

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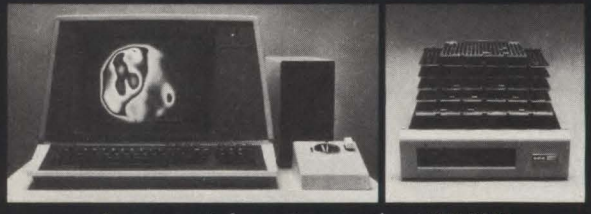

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CIRCLE NO. 18 ON INQUIRY CARD

Single-purpose LANs are networked extensions of minicomputer manufacturers' product lines that a user assembles into working systems.

with a local-networking capability, all manufactured by one supplier and sold under a common logo. System elements tend to be small and inexpensive, suitable for industrial, office-automation, small-business and limited-capacity data-processing applications.

- **Memory-level interface LAN products** are add-on devices that interface with popular microcomputers and minicomputers. The LAN supplier typically provides a plug-in interface card, software modules that work under the computer supplier's operating systems and network cable and connectors. Memory-level network products interface with the computers they support "in memory," using interprogram calls and I/O interrupts. The suppliers of memory-level networks favor Digital Equipment Corp. PDP-11 and Data General Corp. Nova products.
- **Host-computer LANs** consist of an integrated product line of computers, terminals, printers and other auxiliary devices with special LAN facilities. They are offered by relatively large and well-established computer suppliers and are oriented for 16-bit minicomputers or larger systems. The IBM Corp. 8100 Local Loop and the DEC DATAway for the PDP-11 are examples. Host-computer LANs are single-source and generally intended for larger and sometimes more specialized applications than the smaller work-station networks.

The differences among these three kinds of networking systems are not technology-oriented, but more a function of the suppliers' product lines and positions in the market. ■

Walter A. Levy is president, and **Harriet F. Mehl** is on the research staff, of Edgewood Computer Associates, Inc., Hillsdale, N.J.

Table 2: SINGLE-SOURCE WORK-STATION SYSTEM HARDWARE

Components, features	Cromemco C-Net	Digital Microsystems HiNet	Scientific Data Systems SDSNet	Three Rivers PERQ	Xerox 8000 Network System	Zeda Computers InfiNet	Zilog Z-Net
Video work stations							
• no disk	Yes	Yes	Yes	No	No	Yes	Yes
• with floppy disk	Yes	Yes	Yes	No	No	Yes	Yes
• with hard disk	Yes	Yes	Yes	Yes	Yes	No	Yes
Shared resource devices							
• disk file	11M bytes	11M-23M bytes	31M-62M bytes	No	10M, 29M, 58M bytes	Yes	10M bytes
• printer	Yes	Yes	Yes	No	Yes	Yes	Yes
• communication gateway	No	No	Yes	No	Yes	No	Yes
• master control unit	No	Yes	Yes	No	No	No	No
Comments	RS232 and S-100 interfaces available			Work stations have hard disks and may have printer or communication interfaces			Any computer can be interfaced to node controller via RS232C port

Table 3: HOSTS SUPPORTED BY MEMORY-LEVEL NETWORKING SYSTEMS

Manufacturer, model	Corvus Constellation	Corvus Omninet	Interlan Ethernet Controller	Nestar Systems Cluster/One Model A	3 Com Corp. Ethernet Control
Host equipment supported	Apple II, DEC LSI-11, Tandy TRS80 I & II	Apple II & III, DEC LSI-11	DEC LSI-11, PDP-11, VAX	Apple II	DEC LSI-11, PDP-11, VAX
Operating systems	Apple DOS 3.3, Pascal, SOS	Apple DOS 3.3, Pascal, SOS	RSX-11M, RT-11	Apple DOS, Apple Pascal	RSX-11, RT-11, VMS
Interface bus type	Q-Bus, S-100 Bus	Q-Bus S-100 Bus	Unibus, Q-Bus	Apple Peripheral Slot	Unibus, Q-Bus
Comments	Corvus provides master controller and supplies I/O drivers for supported operating systems	Constellation software available	Software drivers available	Shared-resource software and network software available	UNET software for UNIX users; network drivers for DEC operating systems

Table 4: EQUIPMENT SUPPORTED BY HOST COMPUTER LOCAL NETWORKS

Host computer	Data General	Digital Equipment	International Business Machines		Prime Computer
Equipment supported	Multiprocessor communication adapter	DECdataway	8100 Loop	4331 Loop	Primenet
Manufacturer, Model	Data General Nova, Eclipse	DEC PDP-11 & VAX	IBM 8100	IBM 4331	Prime Series 50
Operating systems	RDOS, RTOS, AOS/VS, AOS	VAX/VMS, RSX-11M, RSX-11M PLUS	DPPX, DPCX	DOS/VSE, OS/VS1	PRIMOS
Terminals, devices supported	Nova, Eclipse	DEC terminals, PDP-11/23-based subsystems	IBM printers, terminals, controllers	IBM printers, terminals, controllers	Series 50 computers
Special applications		manufacturing	retail and banking systems		
Comments	connects 15 computers in a ring				Primenet supports as many as 16 of models 250, 550, 750, 850

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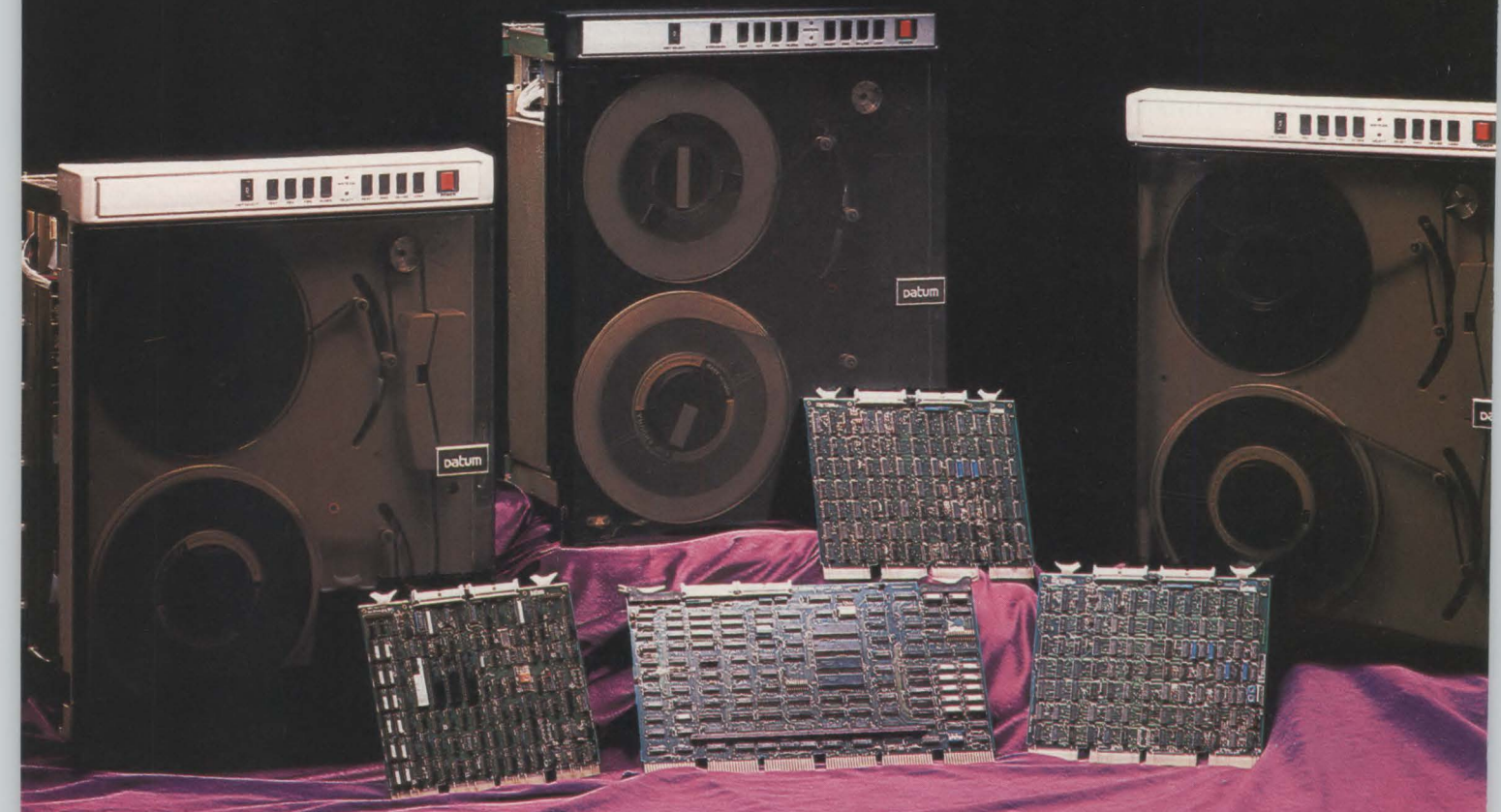

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CIRCLE NO. 49 ON INQUIRY CARD

Multi-user application development system speeds database development

LOWELL DUNN, Systems Group

New microcomputer operating system simplifies customizing application programs

An integrated business application system written in assembly code allows system integrators or end users to develop customized application programs through a simplified menu-driven process. Business Express was developed by Systems Group, Orange, Calif., to run on the firm's Z80-based 2800-series business computers, and will soon be available for 68000-based systems. It supports printers, terminals and disks through a self-contained multi-user operating system consisting of three modules: a real-time executive, a network database manager and an application processor.

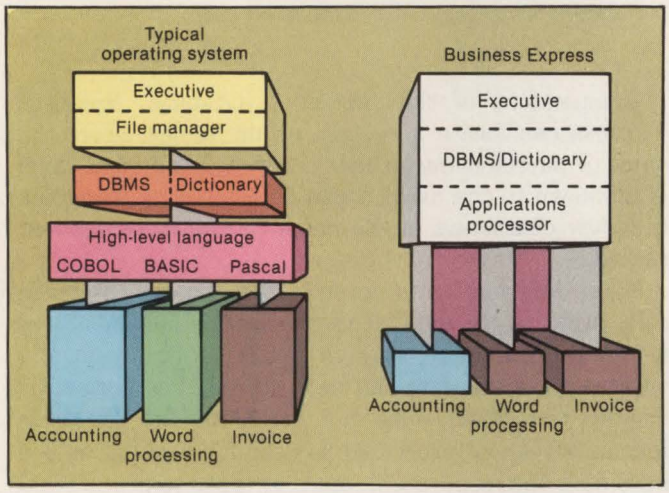

Fig. 1. Comparison of operating-system architectures *shows relative simplicity of Business Express. In a typical operating system, database managers and dictionaries form a central interface between the operating system and the application environment, generally created in a high-level language. In Business Express, these functions are combined in three modules: the executive, the database manager and dictionary and the application processor. The file manager has been eliminated and its functions incorporated into the Business Express database-manager module.*

Real-time executive module

The software's real-time executive implements the multi-user operating system with an optimized interrupt handler that controls memory allocation, I/O and system scheduling (Fig. 1).

During operation, the entire Business Express program is continuously resident in 96K of memory and accessible by all users. Database applications require 2K of memory for each user, while word-processing applications require 8K. This compares with the 48K required under standard operating systems such as MP/M or OASIS. The only additional memory space a

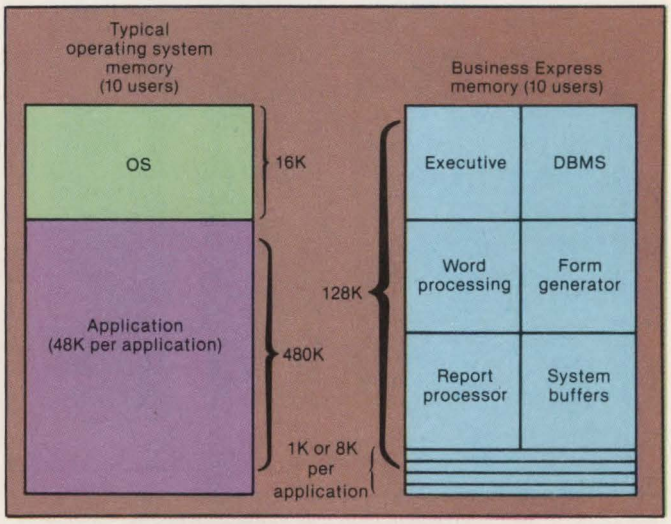

Fig. 2. Memory requirements *for individual Business Express users are 2K for database applications and 8K for word-processing applications. All modules required to process applications reside in RAM, requiring user memory only for current program data. For a 10-user system, a traditional operating system typically requires a minimum 496K of memory compared to 196K for Business Express.*

The database architecture provides a 'forms-within-a-form' feature that allows a user to expand one field into an entirely new form.

user needs is for the current program's data (Fig. 2).

Because the entire Business Express program is memory resident, its multi-user handling capabilities are enhanced. With a minimum 196K RAM, 10 users can simultaneously input data, generate reports or perform word processing on a Z80 with minimal speed degradation. In a performance benchmark conducted by Systems Group, Business Express was found to be six times faster than MP/M and OASIS in I/O processing. Business Express operated six consoles at 9600 baud without degradation, while MP/M and OASIS operated one console at the same baud rate before degradation occurred. The software supports a combination of 20 terminals and/or printers, four hard-disk devices and a tape drive. The upcoming 68000 version will allow as many as 128 operators to use the system.

Software drivers support multiple hard-disk drives logically as one drive, treating individual drives as only disk addresses. The on-line file can use as many disk drives as required, with the disk driver resolving those addresses. The software accesses approximately 10 million records, and the 68000 version is expected to expand this total by a factor of 256.

Starting with 16K for a small system, Business Express uses as much as 144K of memory for disk buffers. When the buffer space is filled, the least used records are stored on the disk by a buffering algorithm that frees memory space for new records (Fig. 3).

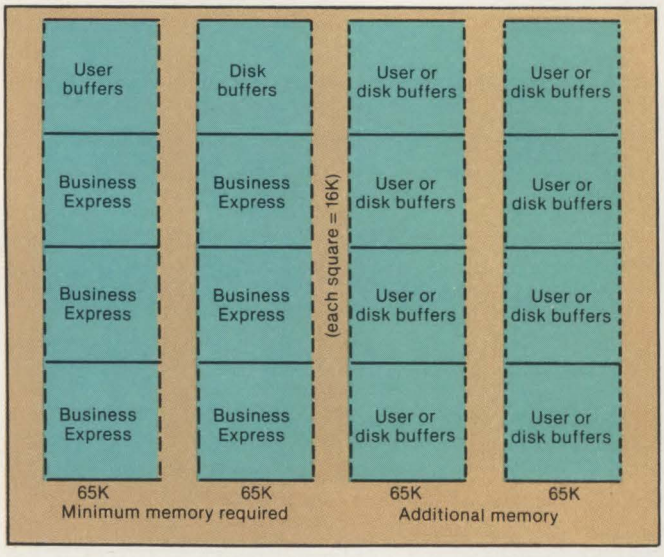

Fig. 3. Memory is allocated in 16K increments *to user buffers or disk buffers. Allocating memory to user buffers allows as many as 20 users to operate the system concurrently. Allocating memory to disk buffers keeps the performance of the system high. The best rule of thumb is to use the smallest number of 16K blocks that supports the number of users operating the word processor concurrently, at two word-processor users per 16K, and allocate the rest of the 16K blocks to disk buffers.*

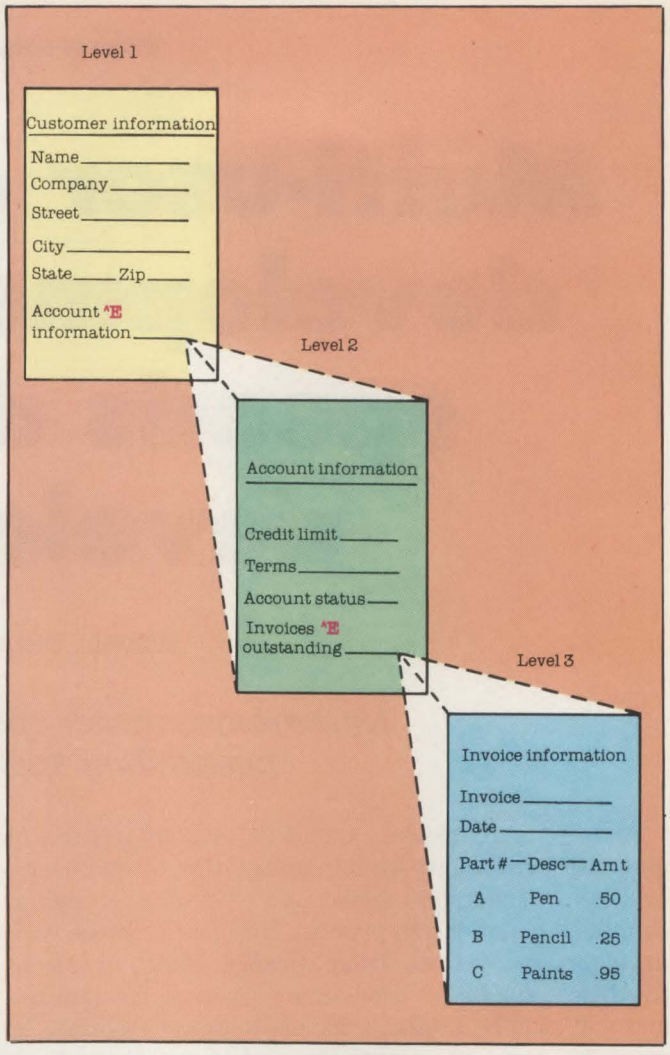

Fig. 4. Form-within-a-form mechanism *allows a user to expand one field into an entirely new form. Any and all fields designated as a form within a form can be expanded into a separate form by hitting "Control E." The new form can occupy an entire screen, or a split screen along with the form that called it. Every form expanded from a single field can have any or all of its fields expanded into other forms. The process can be implemented five levels deep.*

Independent of the size of a database, Business Express can locate a record within ¼ sec. after the name or partial name as been entered. If a record name is unknown to the user, it can be located by using the first few characters of the name to locate the nearest record.

When information is entered, the system automatically backs up the data into a transaction file and stores it on a tape or floppy storage device. In the event of a system crash, all data can be restored. The automatic backup, however, does not back up the database format: a manual procedure is used for backing up the hard disk onto separate floppies or tapes to protect and restore the format. The transaction file can also be used to transport the software to another 2800 computer or to a 68000-based system.

Data security is provided by passwords, each assigned one of 15 "rings," or levels of user access. Each password's access level determines commands, input and output forms or fields of information that can be

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The user answers the displayed menu questions and designates an x, y address to indicate where the new field is to appear on the screen.

accessed by operators. Access levels are set during the form-generation process, and passwords are assigned access levels as a separate command.

A multi-user environment requires an appropriate record-lockout scheme. Business Express allows all users to read the same record even when a user is changing the data. The second user that tries to write the same record gets an immediate indication that the record is busy, and is prevented from writing.

Database manager module

A network database manager handles the system's internal operations. The database architecture provides a "forms within a form" feature that allows a user to expand one field into an entirely new form. The new form occupies an entire screen or shares a split screen with the form that called it. Forms can be implemented five levels deep (Fig. 4).

While defining input data forms, any field can be defined as a "list field" to allow an infinite number of entries. Each of these entries can also be linked to other data entries. This data can then be recalled by using a mini-scroll function that moves the last entry down to the second line on the screen, with the most recent entry shown on the first line. The ESCAPE key can be used to scan the entire list, and the RETURN takes the user to the next field.

The user communicates to the database manager through forms and descriptors, part of a menu-driven process requiring no program coding. By answering menu prompts, a user can create records, lists or new forms. To begin this process, the user types DEFINE (or DE) to invoke the DEFINITION command. The DEFINITION command then displays three choices: define a RECORD, define a LIST or define a FORM (Fig. 5).

Records and lists must be defined before a form can be created. To define a record, the operator assigns a record name, defines individual fields and determines security levels and data masks associated with each field. Creating a list requires naming the list and identifying the sort fields.

A form is generated by answering menu prompts that define the name of the form, the name of each field, the x and y coordinates of field prompts, the location that data will appear on the screen, the type of data-entry fields, the masks and type of mathematical manipulations required of the data. The ACCESS command then allows the user to input or access data. Any number of forms can be generated to implement an application.

A variable-record format makes field and record size definition unnecessary. This allows the user to compress data: if a field is defined and there are no data to enter, no storage space is used on the disk. It also allows adding or deleting fields without affecting the database. This variable-record format slightly decreases the software's performance, but frees the user from guessing at field and record sizes.

The forms generator is used to call up the desired form when adding a new field. The user answers the displayed menu questions and designates an xy address to indicate where the new field is to appear on the screen. To delete a field, the undesired field is located with the cursor and eliminated by depressing the delete command key.

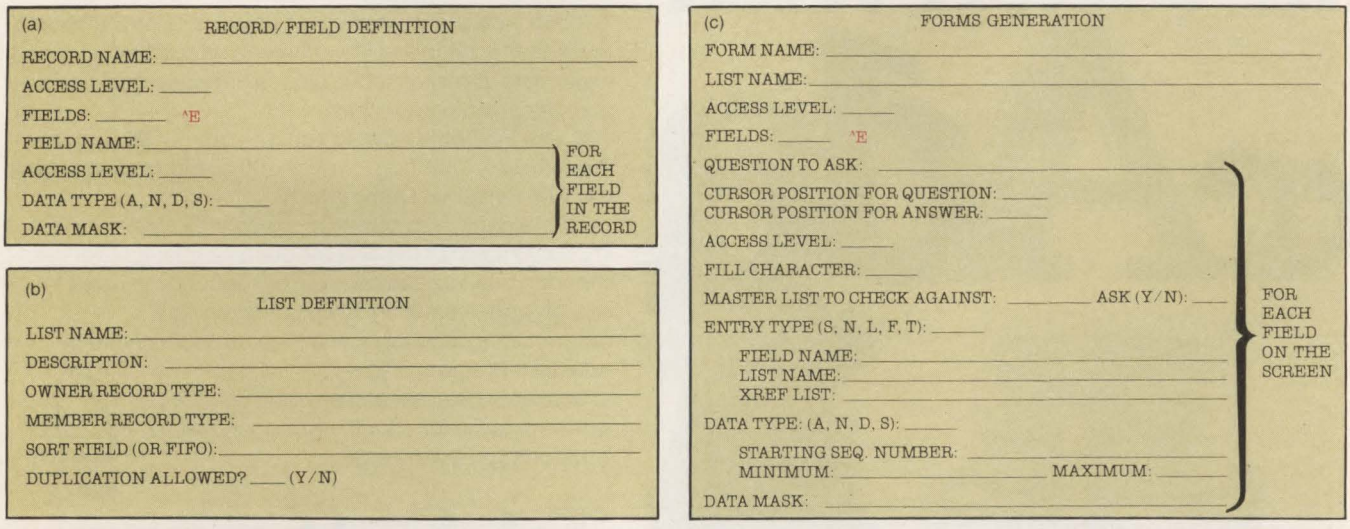

Fig. 5. DEFINITION function *allows a user to define a RECORD (a), a LIST (b) or a FORM (c). Records and lists establish the structure and relation of data within the system and must themselves be defined before a form can be defined. Records are named, fields are defined, security access levels are assigned, and, in some cases, data masks are associated with fields. Lists are named, sort fields are identified, and restrictions (such as "Is duplication allowed") are noted. Forms are defined in much the same way. Each form has a name, and the generation of a form identifies the list being accessed. The screen position, data masks and field sizes are also identified. Once records have been defined, any number of forms can be generated to access the records, each with its own variation—such as where the fields are presented on the screen or the size of the data fields.*

A word-processor module in the application-processor module can access all system data through the report-generating process, as well as check spelling.

To change the number of characters displayed on a field, the user performs the same procedure used to call up a form. The menu used to create the field asks for the number of screen-fill characters desired. By moving the cursor to this question, the user can add or decrease the number of fill characters.

Business Express does not require user maintenance, except rebuilding the database from the transaction file after a system crash. Space is automatically reallocated by the database manager when records are deleted. The database manager also controls data handling to the disk, and is free to make logical images of the disk without an intermediary file manager.

Application processor module

The application processor module consists of an input forms generator, an output report generator and a word processor.

The forms and report generators generate customized application programs. By answering menu prompts, a user can define data input forms and printer or console output forms. Compiling and linking is not required. Changing a forms or report format involves calling up the form with the DEFINE command, moving the cursor to the desired field and typing the change.

A word processor in the application-processor module can access all system data through the report-generating process, as well as check spelling. The forms-generation and COMMAND commands allow generating applications in languages other than English.

For users who do not wish to design their own applications from scratch, Systems Group offers an accounting package that includes general ledger, accounts receivable/payable, payroll, sales order entry, purchase order entry, total inventory, mail lists and customer information. Users can modify it to their business needs with the application processor or use it as is. A medical and legal application example will be released by year-end, and others will follow.

CP/M programs can be run on the System 2800, but not at the same time as Business Express. CP/M-generated source files can be read, however, allowing the same CP/M application to be created and run with Business Express. A later version of the 2800 will offer a CP/M emulator allowing simultaneous operation of CP/M programs and Business Express applications. ■

Lowell Dunn is vice president of engineering at Systems Group, Orange, Calif. He coordinated the efforts of American Computing Enterprises in developing Business Express.

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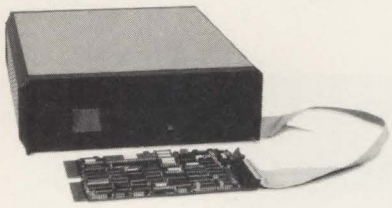

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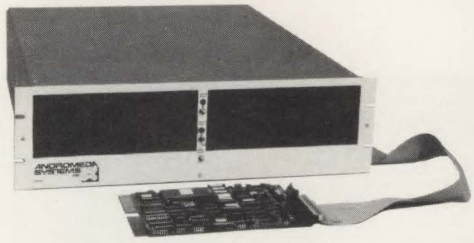

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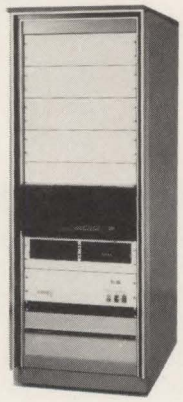

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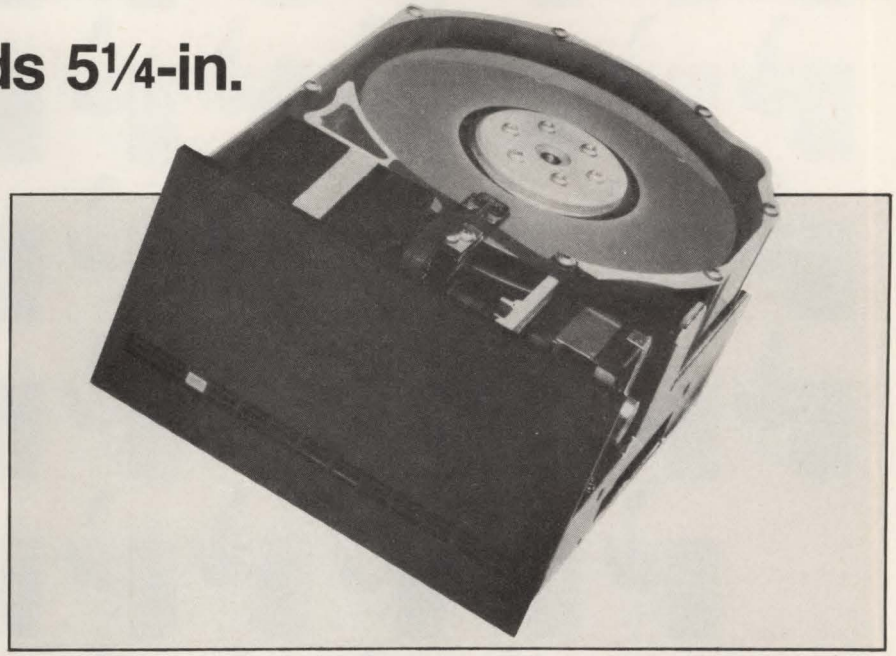
CIRCLE NO. 8 ON INQUIRY CARD

Seagate expands 5¼-in. Winchester line



Latest additions to Seagate's ST-400 line of 5¼-in. Winchesters *include the single-platter, 6M-byte ST-406 and the 19M-byte, three-platter ST-419. The 12M-byte, two-platter ST-412 (above) was announced this year in the wake of Seagate's decision to drop the ST-512, the first small Winchester to use thin-film read/write heads. All ST-400 series drives use shorter gap length manganese-zinc ferrite heads.*

Seagate Technology, Scotts Valley, Calif., has expanded its ST-400 series 5¼-in. Winchesters to include a low-cost, single-platter, 6M-byte version and a three-platter, 19M-byte device. With the exception of the number of platters and heads, both drives are essentially identical to the company's ST-412, a 12M-byte, two-platter device announced early this year as a replacement for the company's canceled ST-512, the first small Winchester to be designed around thin-film read/write heads (MMS, January, p. 17).

All three drives use shorter gap length manganese-zinc ferrite read/write heads—a technology that many vendors feel will be more than adequate to meet the increasing storage capacities foreseen for 5¼-in. hardware in the immediate future. As a result of using these types of heads in place of conventional nickel-zinc ferrite components, all three ST-400 series drives operate at bit densities of 9074 bpi (compared to 7690 bpi for the two-platter, 6M-byte ST-506, the first 5¼-in. Winchester to be announced), and 345 tracks per in. (compared to 270 tpi for the ST-506).

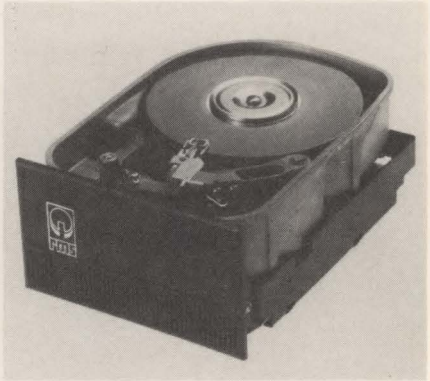
The new drives incorporate the same number of cylinders as the ST-512 (306) and operate at 10,417 bytes per track—the same byte density as the earlier ST-506 drives—thus permitting the use of ST-506 controllers. Also incorporated into the drives are on-board microprocessors that provide a buffered seek that drops average access time to 85 msec. (including head-settling time).

Seagate's new offerings come when pricing pressures in the low-end 5¼-in. Winchester market show little sign of abating (MMS, April, p. 97). Seagate executive vice president Finis Conner says the ST-419 will be priced at $1230 in 100-lot orders, and the ST-412 will be priced at $1030. Most directly impacted by pricing policies of Seagate's competitors, however, will be the 6M-byte ST-406. Conner has set the price of this Winchester at $785 in 100-lot orders, but notes that this price will drop. He does not comment on how far he anticipates that it will go, however.

Production versions of the ST-412 are available now; the ST-419 and the ST-406 will be available during the fourth quarter. —*John Trifari*

Seagate Technology, Suite C, 340 El Pueblo Rd., Scotts Valley, Calif. 95066. **Circle No** 332

5¼-in. Winchesters offer high capacities



The C series of 5¼-in. Winchester-disk drives stores 6.38M, 12.75M, 19.13M and 25.5M bytes on one, two, three and four platters, respectively (unformatted). Capacities can be increased 50 percent with an optional Data Express II data separator. Another optional Data Express I separator provides MFM coding and 5-MHZ data rates. All models offer 383-tpi track densities and 5M-bps transfer rates and feature manganese-zinc heads and electrical brakes. In 100-unit quantities, the RMS 507 sells for $935, the RMS 514 is $1165, the RMS 519 is $1330, and the RMS 526 is $1486. Data Express I sells for $197, and Data Express II sells for $250. OEM discounts are available. **Rotating Memory Systems, Inc.,** 1701 McCarthy Blvd., Milpitas, Calif. 95035. **Circle No** 333

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3. AM-1042 (winchester)	32MB	2.4GB	512KB	3MB	2	26	A	B	AMOS*
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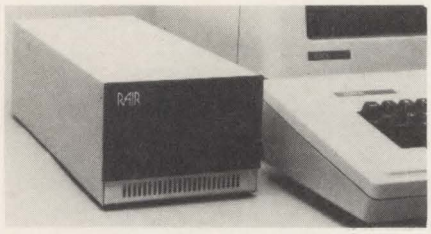


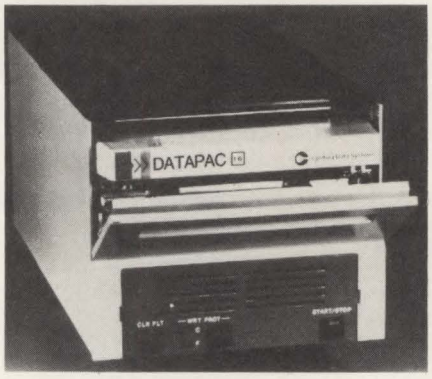
Drive provides storage for Xerox computer

The model 505 5¼-in. Winchester-disk drive provides 5M bytes of formatted storage for the Xerox 820 personal computer. It offers an average access time of 95 msec. and a data-transfer rate of 5M bps. The 505's intelligent disk controller features full sector buffering, error detection/correction and fault detection. With host adapter and CP/M software driver, the 505 sells for $3500 in single-unit quantities. **Rair Computer Corp.,** 4101 Burton Dr., Santa Clara, Calif. 95050.

Circle No 334

Winchester stores 16M, 32M bytes

The C2048 OEM cartridge disk-drive system for multiterminal



word processors and business and general-purpose minicomputers provides 16M bytes of removable storage and 32M bytes of fixed storage. The drive features one removable disk and three fixed disks, a data-transfer rate of 1.208M bytes per sec. and an average seek time of 30 msec. A ventilated, 3600-rpm spindle disperses air over the drive's disks, balancing temperatures, reducing off-track error and improving data integrity. OEM price is less than $3000, without a controller. **Century Data Systems,** 1270 N. Kraemer Blvd., Anaheim, Calif. 92806. **Circle No** 335

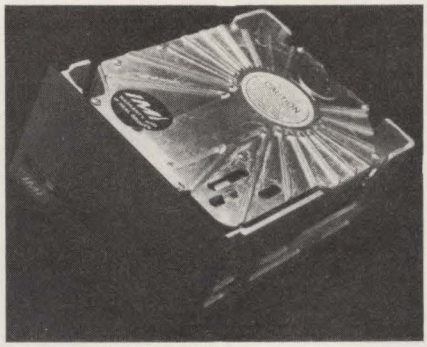
Kit for Apple II adds 5M bytes

A 5M-byte hard-disk system kit for Apple II microcomputers in-

cludes a 5¼-in. drive and a Xebec S-1410 controller. It offers 22-bit error detection and 11-bit error correction, a full sector data buffer and single-command disk initialization. An Apple II host adapter, DOS or CP/M software, a 115V/230V power module, a cable set and a cabinet are also available. Price, including instructions and documentation, is $1299; drive and controller assembly are $999. **Xebec,** 432 Lakeside Dr., Sunnyvale, Calif. 94086. **Circle No** 336

Winchesters are shock resistant

The 5012H and 5018H ST 506-compatible 5¼-in. Winchester-disk drives use two-piece chassis, plated media and air recirculation. The drives also have head stack-located preamps and linear cartridges with self-aligning suspension systems.

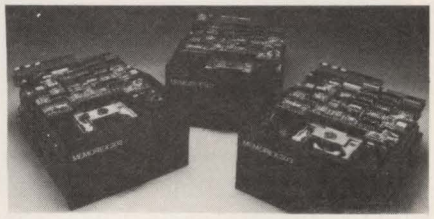


Transfer rate is 648K bps, and average access time is 85 msec. The 5012H stores 12.76M bytes and sells for $775 in OEM quantities; the 5018H stores 19.14M bytes and is priced at $885. **International Memories, Inc.,** 10381 Bandley Dr., Cupertino, Calif. 95014.

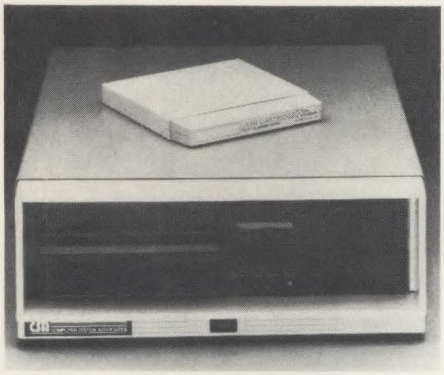
Circle No 337

Minifloppy line stores 250K, 500K, 1M bytes

These 5¼-in. floppy-disk drives for word-processing systems, intelligent terminals and home and business microcomputers include single-sided/double-density and double-sided/double-density configurations. Data-transfer rates range from 125K bps in single density to 250K bps in double density. Average access time ranges

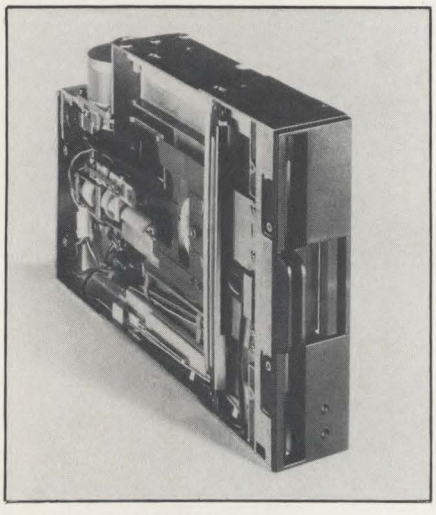


from 84 msec. to 150 msec. Prices are $250 for the 250K-byte model 301, $330 for the 500K-byte model 302 and $420 for the 1M-byte model 303, all in 100-unit quantities. **Memorex Corp.,** San Tomas at Central Expressway, Santa Clara, Calif. 95052. **Circle No** 338



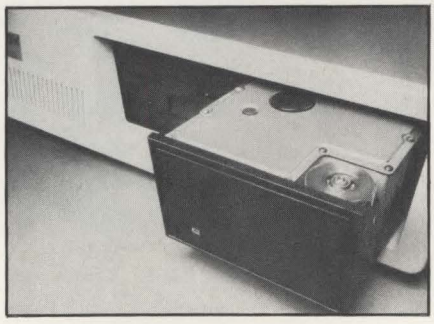
Cartridge Winchester is removable

The Lynx 10M-byte cartridge Winchester can be removed from an MDOS-based Motorola Exorcisor system, while other users share it. The drive runs standard Motorola MDOS and all supported programs without modification by emulating 16 double-sided floppies on-line. Single-unit price is $8275. **Computer Systems Association, Inc.,** 7562 Trade St., San Diego, Calif. 92121. **Circle No** 339



Half-height floppy stores 1.6M bytes

The FD 1165 8-in. floppy-disk drive stores 1.6M bytes and is half the height of conventional 8-in. floppies. The double-sided, double-density device features a μp-controlled head-loading mechanism, a 250K-bps transfer rate and a 3-msec. track-to-track access time. Price is $525 each in quantities of 100 and $395 each in quantities of 300. **NEC Information Systems, Inc.,** 5 Militia Dr., Lexington, Mass. 02173. **Circle No** 340



Winchester expands IBM personal computer

The DSI-514 5¼-in. hard-disk fits inside a floppy-disk slot on IBM's personal computer and provides 12M bytes of formatted storage. Average access time is 153 msec., and transfer rate is 5M bps. The system runs under IBM DOS. Software includes a diagnostics program, a hard-disk formatter and an installation/configuration program. Price, including disk controller board, power supply, cabling and software, is $2695, with quantity discounts available. **Davong Systems, Inc.,** 1061 Terra Bella Ave., Mountain View, Calif. 94043. **Circle No** 341

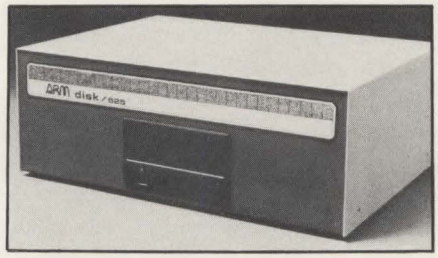
Winchester provides removable backup

The WD505 removable 5¼-in. Winchester-disk drive, uses a microprocessor with internal PROM for control of cartridge insertion and removal, track-location calibration and drive motor control. The unit uses an ST506 interface that is transparent to most controllers. Formatted capacity is 5M bytes, average access time is 35 msec., and data-transfer rate is 5M bps. Price is $495 in OEM quantities. **Western Dynex,** 3536 W. Osborn Rd., Phoenix, Ariz. 85019.

Circle No 342

Winchester subsystem adds storage to computers

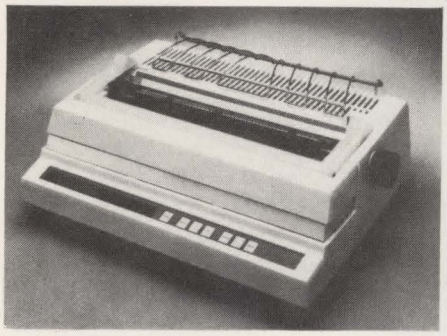
The ARMdisk/525 Winchester-disk subsystem provides 30M bytes of formatted storage for Radio Shack's TRS-80 and other small-business computers. The device, which uses an SASI bus structure, features a multiplexing facility that allows sharing by four hosts of similar design. Average access time is 70 msec., and data-transfer rate is 5M bps. The subsystem is supported by TRSDOS-compatible operating systems. With disk controller, rotating memory system drive and cables, the ARMdisk/525 is priced at $3395 for the 7.5M-byte system, $3995 for the 15M-byte system and $6695 for an expanded 30M-byte system. Host adapters and multiplexing are priced separately. **Automated Resource Management,** 3613 W. MacArthur Blvd., Santa Ana, Calif. 92704. **Circle No** 343



Cartridge tape stores 21M bytes

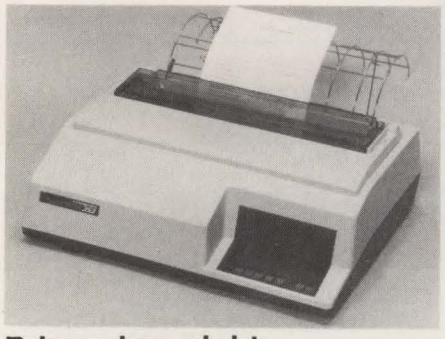
The model TFS 903 cartridge magnetic-tape system for DEC's LSI-11/2 and LSI-11/23 computers contains a single quad card controller and a Kennedy cartridge-tape drive. It provides as much as 21M bytes of storage per cartridge. The system is software-compatible with all DEC operating systems and with UNIX using a TM-11 driver. Two cartridge drives can be connected radially to the 2901 microprocessor-based controller. Other features

include four-track read-after-write serpentine recording, 30-ips recording speed and a start/stop mode that allows for incremental backup. The TFS 903 sells for $3900. **Aviv Corp.,** 6 Cummings Park, Woburn, Mass. 01801. **Circle No** 344



IBM-compatible unit prints at 40 cps

The LQ40 IBM plug-compatible daisy-wheel printer for IBM System 34/38 minicomputers produces letter-quality copy at 40 cps. The unit contains an IPI-34 interface and prints bidirectionally at 132, 158 or 198 characters per line. It handles six-part forms as wide as 16 in. Options include a pin-feed platen, unidirectional and bidirectional tractor feed, single- and double-tray sheet feed and dual-tray envelope. The LQ40 sells for $4695 in single-unit quantities. **BDS Corp.,** 115 Independence Dr., Menlo Park, Calif. 94025. **Circle No** 345



Printer has eight character sets

The Printstation 350 matrix printer for data-, word- and business-processing applications features eight resident character sets, switchable serial/parallel in-

INCOMPARABLE.

Pigments and pixels can both arrest an instant for eternity—but, their comparison fails after that. So too, digital image processing and computer graphics. Some may claim to give you both in the same system, but with today's technology, it can't be done well. Either, it's a digital image processing system or a graphics system. At COMTAL, we provide certain graphics capabilities, but not at the expense of the image processing architecture.

Also, image processing is not the same as image display. Some "image processors" are little more than a refresh memory pumping data through a display buffer. And if it's a software-based system, forget real-time, interactive operations.

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Since the inception of digital image processing, COMTAL has set the pace. We continue to offer the most sophisticated systems commercially available. We offer standard systems at unrivaled prices. We offer features that no one else can offer: ■ *Continuous Zoom*—image magnification from 1x to 512x in 2/30 of a second; various interpolation techniques available. ■ *Virtual Refresh Memory*—a Winchester disk-based system that stores up to 300 megabytes—eliminates the need for large RAM. ■ *Full-Resolution Graphic Planes*—512^2 or 1024^2 graphic planes can be manipulated in 1/30 of a second. ■ *Image Combination*—two 250K byte matrices can be combined in real time through arithmetic functions; output can be interactively modified in real time. ■ *Mapper*—image rotation, axis translation, scaling, and other spatial alterations in less than a second. ■ *Freeze-Frame*—any displayed image can be captured in real time and stored in memory.

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Image of Mona Lisa processed by Combined Logic Research, Hollywood, CA, on a COMTAL Vision One/20 using histogram equalization and function memory modifications for brightness, contrast and color correction.

4x zoom using pixel replication.

More choices.

No one gives you the choices that COMTAL does. From standard systems to advanced engineered systems, you can be confident that COMTAL will meet your specific needs: (See Product/Feature Matrix)

More Experience.

No one has COMTAL's ten years' experience, and no one offers the level of support we do. We build state-of-the-art while others have it on their drawing boards. We support our systems with the full resources of 3M, a worldwide service organization, and a full on-site acceptance-testing procedure. It's what you would expect from the innovative leader.

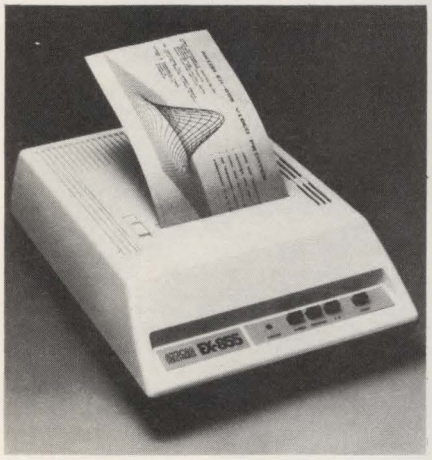
Incomparables.

Mona Lisa's elusive smile defies comparison. It is quintessential art. In image processing, COMTAL is the state of the art. We invite your comparisons. But, measure for measure, we think you'll judge us incomparable. COMTAL Corporation, a subsidiary of 3M, 505 West Woodbury Road, Altadena, CA 91001 Telephone (213) 797-1175.

COMTAL

		■ Image Resolution and Bit Depth ■ Number of Images (i) & Graphics (g) In Typical Configuration	Function Memory Processing	Small Area Processing	Real-Time Arithmetic	Dual User Capability
Image Display/ Processing	8000-R Model 30	512^2 x 8 3i, 4g	■			
	8000-R Model 65	1024^2 x 8 3i, 4g	■			
Stand-alone Image Processing	VISION ONE/10	512^2 x 8 4i, 4g	■	■	■	
	VISION ONE/20 Model M8	512^2 x 8 7i, 8g	■	■	■	■
	VISION ONE/20 Model M10	512^2 x 8 15i, 8g	■	■	■	■
	VISION TEN/24	1024^2 x 8 4i, 8g	■	■	■	■
	VISION ONE/12	$256^2/512^2$ x 12 3i, 12g/1i, 4g	■			
Image Input	Digital Video Input Processor	Acquires and digitizes filmed images illuminated by a light table; integrates as many as 256 frames; images can be transferred to a VISION ONE/20 or host computer.				

terfaces and pin-addressable graphics. The device offers 200-cps bidirectional logic-seeking printing and handles single sheets, fan-fold paper and demand documents interchangeably. The series includes the 352 with communications formatter and the 353 with multipass capability at 50 cps. Single-unit price for the 352 is $1795. The 353 is priced at $2495. OEM volume discounts are available. **Centronics Data Computer Corp.,** Hudson, N.H. 03051. **Circle No 346**



Unit prints from video display

The model EX855 electrostatic video printer converts displayed data, complex graphics, text in any size or font and foreign symbols or hieroglyphics directly to hard copy with resolution of as many as 650 dots per line. The unit connects to a standard video jack. Printing speed is 12 sec. per screen at normal resolution and 24 sec. at high resolution. The EX855 accommodates paper as wide as 5 in. Model EX1650 accommodates 8½-in.-wide paper. Single-unit price is $1595, with quantity discounts available. **Axiom Corp.,** 1014 Griswold Ave., San Fernando, Calif. 91340. **Circle No 347**

Thermal printer has parallel interface

The TH 240P thermal printer offers a parallel interface and

alphanumeric and graphics capabilities. The unit prints 80-character lines at 240 lpm or 320 cps and produces a 24-line CRT screen page in less than 6 sec. Price is $840 in single-unit quantities and $470 in quantities of 500. **Olivetti OPE,** 505 White Plains Rd., Tarrytown, N.Y. 10591. **Circle No 348**

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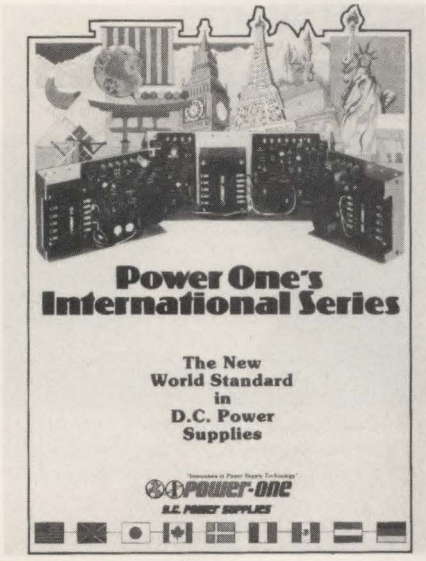
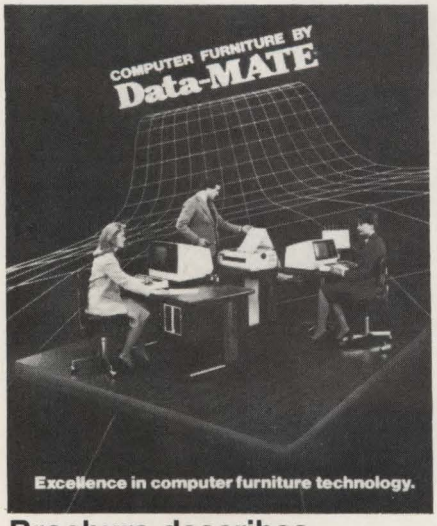


Power supplies described in brochure

A line of power supplies for electronics is featured in a color brochure. The booklet provides specifications and prices for 44 models of the International Series and details requirements of worldwide safety agencies, including VDE, UL, CSA, IEC, BPO, ECMA and CEE. The brochure also includes outline and mounting diagrams and photographs of each case size. **Power-One,** Power One Drive, Camarillo, Calif. 93010.

Circle No 349



Brochure describes computer furniture

A line of computer furniture is featured in a 16-page brochure. The publication covers adjustable and stationary stands for printers and CRT terminals, computer desks and stations and accessories, including copy holders and baskets, supply shelves, add-an-angle wedges to form work stations and multiple outlet consoles and strips. **The Maine Manufacturing Co.,** 46 Bridge St., P.O. Box 408 Nashua, N.H. 03061. **Circle No 350**

Brochure describes printer line

The vendor's line of Silent/Scribe printers is described in a color, six-page brochure. The brochure features the DP-9000A, DP-9500A and the DP-9620A series. A chart lists print speed, printing capability, line spacing, tabbing, slew rate and alternate character fonts. The booklet also covers communications controls, such as form length, tab stops, character-set selection, line width and auto line-feed set/reset. Other listed information includes interfacing methods, size and power requirements. **Anadex, Inc.,** 9825 De Soto Ave., Chatsworth, Calif. 91311. **Circle No 351**

Networking information featured in brochure

Multiplexers and nodal processors for data concentration, error protection, routing, traffic management and digitized voice transmission are featured in a 12-page brochure. The booklet details the vendor's 600 STDM's, 6000 series Intelligent Network Processors, group band multiplexers and front-end processors. The brochure is one of four in a series covering modems, switching and control products, network products and network applications. **Codex Corp., Marketing Communications,** MS 2-12B, 20 Cabot Blvd., Mansfield, Mass. 02048.

Circle No 352

Brochure describes multidrop concentrator

The Micro900 multidrop concentrator is described in a brochure. The eight-page brochure explains how multidropping works, transparent polling in a minicomputer environment, statistical multiplexing, expansion and reconfiguration. Other details include configuration considerations; operating characteristics; installation and troubleshooting; and support features for computers and terminals manufactured by DEC, DG, H-P, Wang and others. A table of Micro900 multidrop concentrator specifications and a block diagram are also included. **Micom Systems, Inc.,** 20151 Nordhoff St., Chatsworth, Calif. 91311.

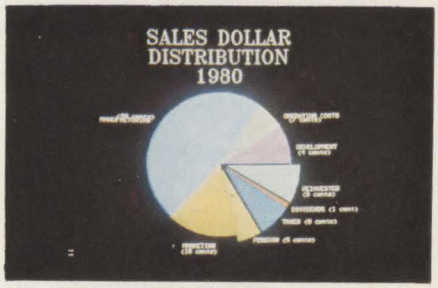
Circle No 353

Microcomputer software simplifies graphic applications

Now that color graphics hardware prices have come within range of so many buyers, graphics software has become something of a stumbling block. Writing graphics applications packages is time-consuming and can require specialized knowledge, especially because languages commonly used on microcomputers, such as BASIC and FORTRAN, are not designed with graphics in mind. The Intelligent Graphics Systems (IGS) language for color graphics is a high-level, interpretive language that can be used alone or called as a subprogram by other languages to add color-graphics routines to existing programs.

IGS is written in assembly, and runs on 32K bytes of memory in an Intelligent Systems Corp. 8000I series color microcomputer or terminal. The 8000I has 480 × 384 dot addressable graphics resolution and is available with a plotter, a digitizer and a color camera.

IGS is based on the ACM SIGGRAPH Core Graphics System, satisfying



Pie chart created with IGS *is constructed with simple commands. Slices can be filled with a variety of patterns in different colors.*

Core Levels I, II and III for INPUT, Level I DIMENSION and Level I OUTPUT, with features that give OUTPUT similar to Levels II and III. Also provided are business graphics features resembling those in mainframe packages such as Tell-A-Graf and Dissppla, letting users create complex bar charts, pie charts and other graphics with simple commands. Using a microcomputer, however, cuts installation and communications costs. And because of the time required to send vectors over communications lines, local microcomputer-based graphics systems can be faster than remote

The 8000I graphics system *supports IGS software for I/O device-independent graphics. Available peripherals include plotter, digitizer and color ink-jet printer.*

mainframe-based systems.

IGS accepts commands in a form similar to the way a user visualizes a display: PIE, BAR, CIRCLE and RECTANGLE are all legal commands. The software maps all input data as if the data were to be output on a "normalized device," a hypothetical device with a 1:1 aspect ratio and high resolution acting as a common denominator of all real-world devices. IGS assigns normalized device coordinates to incoming data, applying rotation, pan, zoom and scale as necessary, regardless of the input device used (light pen, keyboard, digitizer) or the output device intended (CRT, plotter, printer).

Output data are processed through the device manager, which consists of the device control block, the physical I/O block and the device driver; it is the only portion of code within IGS that is device dependent. The device control block supplies a table of the output device's physical characteristics, including resolution and aspect ratio. The normalized device coordinates are then multiplied to suit those characteristics, and the vectors that comprise the display are created for the specific output device. The device driver translates the vectors into the commands to operate the device. A device needs no intelligence except the functions CLEAR, CHANGE COLOR and DRAW LINE. Finally, the physical I/O block selects the appropriate I/O port, baud rate and serial or parallel transmission, and the image is written to the device. A new device can be supported by adding a new device manager, without changes in existing programs.

IGS lets users define a viewport, representing the active portion of an input or output device.

When using an input device, only data within the established input viewport are accepted by IGS. All out-of-bounds data are clipped before the display is mapped to the normalized device. If a map of the U.S. is traced on a digitizer, for example, the entire map will be input if the viewport is set equal to the entire digitizer surface. If a user defines his viewport as the upper right quadrant of the digitizer, only the northeastern states will be input, regardless of the portion of the map that is traced.

Before outputting the display, the user can define a portion of the physical output image area as the logical image area, scaling down the image. Within this logical image area, the user can define an output viewport, designating the active display area. IGS maps the input data from the normalized device to the entire logical image area, then displays only the data that appear within the user's output viewport. This is particularly useful when outputting to a plotter, where different paper sizes may be used, or where several independently created displays are combined on one sheet of paper. When displays are previewed on the CRT screen, the logical size of the CRT is normally set to its physical size.

IGS commands simplify the construction of pie charts. The command PIE SLICE calculates the shape of the polygon needed by the slice and fills the slice with a color. The fill method optimizes results for different output devices through a scan converter, a block of device-independent code that converts polygons into the vector slices of which they are composed. The scan converter obtains the device resolution from the device control block, and samples the polygon for vectors at a rate compatible with this resolution. A high-resolution device, such as a plotter, requires

more closely spaced vectors than a lower resolution device, such as a CRT terminal. As the scan converter samples the polygon, it compacts the shape, reusing vectors where possible. Finally, the vectors are drawn, filling the shape.

The sampling rate and fill angle are variable, so polygons can be filled with diagonal lines or cross-hatching by being sampled less frequently. In addition, IGS has a table from which fill patterns such as asterisks or dots can be selected. The IGS fonts are device independent, and are created with stroke procedures rather than masks. Three text fonts are supplied in ROM in the IGS terminal version; seven fonts are called from disk in the desk-top version. Text angle, size, character slant and spacing can all be varied. This would not be possible with character masks. Text size, for example, is selected as a percentage of a standard size. Text-size matching creates characters of the same physical size on a set of output devices, a feature useful for transparency overlays.

Prices for the 8000I series terminals start at $4900, with desk-top computers starting at $8800.

Intelligent Systems Corp., Intecolor Drive, 225 Technology Park/Atlanta, Norcross, Ga. 30092. **Circle No 354**

Software converts micros to multi-user systems

MuSys NET/82 slave processors and an enhanced TurboDOS CP/M-compatible operating system enables users of North Star Horizon computers to convert single-user microcomputers to multiprocessor, multiterminal systems. The S-100-based NET/82 Z80A processor supports as many as eight terminals, each with 64K bytes of RAM. By adding TurboDOS with bank-switched memory, the configuration supports as many as 16 terminals or

printers. Price for single-user TurboDOS is $250, and the same package with a print-spooling feature is $300. A multi-user configuration sells for $750. A NET/82 64K-byte slave processor is $1195. **MuSys Corp.,** 1451 Irvine Blvd., Suite 11, Tustin, Calif. 92680. **Circle No 355**

Package provides arithmetic support

Pascal MT+86, an implementation of the ISO Pascal standard, uses the Intel 8086 microprocessor and the 8087 numeric co-processor to support floating-point real numbers for scientific applications, decimal arithmetic for business and ROM-able code for industry. The package provides a compiler and assembler to generate 8086/8088 relocatable object files, a linker to generate an executable file from the relocatable compiler output, a run-time support library, a disassembler, a symbolic debugger and library routines to perform tasks ranging from transcendental functions to interrupt handling. **Digital Research, Inc.,** 160 Central Ave., Pacific Grove, Calif. 93950. **Circle No 356**

Facilities expand Harris computers

These software products for Harris computer users include Skeep, a stand-alone package for tape archival storage of files. It uses a tape format like the Keep/Fetch format. The package provides its own database for tape-library management and facilities for updating, purging and querying locations of files. VMGR, an ISAM file-management system that replaces the Visp package, is compatible with Visp files, routines and utilities, and provides concurrent writing by multiple users. Single-CPU licenses for Skeep and VMGR sell for $500 and $950, respectively. **McHugh, Freeman & Associates, Inc.,** 6333 Odana Rd., Madison, Wisc. 53719. **Circle No 357**

CP/M package provides form completion

The Forms-3 Microsoft BASIC programs for CP/M-based microcomputers are designed to simplify filling in single- and multiple-page forms. They let a user reposition the form to compensate for non-typewriter spacing. The Grid program prints a grid on a form to be filled in. The Table program builds a control table using page number, data-field length, justification, data identification and grid coordinates. The Form program, using the control table, enables a user to enter data for each form entry. Data from a seprate file can be included in the output to the form. Price of Forms-3 is $40. **Elliam Associates,** 24000 Bessemer St., Woodland Hills, Calif. 91367. **Circle No 358**

Program offers search and replace

The Search 34 interactive library member utility for the IBM System 34 computer lets users locate and replace specified character strings. A user can select a source or procedure member, a group of members or all library members. Processing results can be printed or displayed on the IBM 5251 display station, highlighting each portion of a line where the requested character string was located or replaced. Search 34 is licensed for a one-time charge of $350 per computer. **Greg**

Dinger & Associates, 126 Alto St., San Rafael, Calif. 94901.

Circle No 359

DBMS supports TRS-80, CP/M microcomputers

The Super database-management system for TRS-80 and CP/M microcomputers provides transaction posting, stored arithmetic, calculated fields, multi-disk operation, disk sort on 40 fields, label printing and user defined reports. Data can be reformatted and transferred between databases. A selection routine compares fields, finds keywords and selects ranges. Special features support inventory and accounting applications. A user's manual sells for $25. The Super for TRS-80 microcomputers sells for $250; a version for CP/M microcomputers is $300. **Institute for Scientific Analysis, Inc.,** P.O. Box 7186, Wilmington, Del. 19803.

Circle No 360

Utility compares CP/M files

InterComp, running under CP/M ON Z80-based machines, compares two CP/M text files and reports all differences to diskette, console or printer. The package is intended for word-processing and programming applications, in which it obviates rereading entire files with each revision. A user can define comparison parameters, specify options to equate upper- and lower-case letters, specify similar lines to be paired and define percentage of similarity desired. InterComp can also compare object code files. Retail price is $295. **Ithaca Inter-Systems, Inc.,** P.O. Box 91, Ithaca, N.Y. 14850. **Circle No 361**

File-maintenance generator is menu driven

The FileMaster interactive, menu-driven package generates and compiles RPG file-maintenance programs that access as many as 10 files. The system performs data-entry edit checking for indexed, sequential or direct files. Any field in a file can serve as a key field. FileMaster produces screen displays, menu entries, procedures and documentation reports for each maintenance program. The display design facility lets users customize screens, make audit-trail reports, define system-default parameters and receive "Help" key, on-line assistance. Introductory price is $995. **Professional Computer Resources, Inc.,** 2021 Midwest Rd., OakBrook, Ill. 60521.

Circle No 362

Harris Corp. adds two superminis

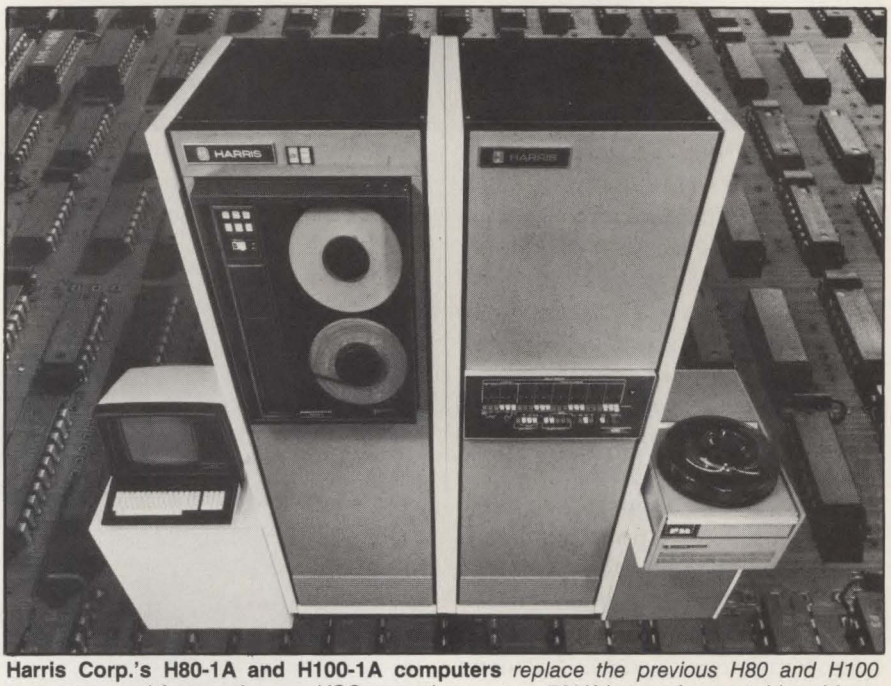
The Computer Systems Division of Harris Corp. has added two computers to its line of 48-bit minicomputers. Thanks to a new operating system and extended memory features, the models can run programs with four times the amount of code executable on previous Harris systems.

The H80-1A and the H100-1A replace the previous H80 and H100 computers and feature the new VOS operating system, 768K bytes of executable address space and high-density memory. The models support as many as 32 concurrent users, include as much as 6.14M bytes of virtual memory and are designed around a system bus capable of aggregate transfer rates as high as 19M bytes per sec.

The models are based on a new CPU with an 18-bit program counter that allows more executable code per user than previous models. Both machines use a memory word length of 48 bits and are compatible with other Harris products. The H100-1A resembles the H80-1A but includes a flexible I/O structure for interfacing bulk storage devices and other peripherals to its system bus. Both models support as many as 24 logical I/O channels.

The VOS operating system is compatible with the previous operating system, Vulcan, but is designed to take advantage of the extended memory features. VOS implements a fully automated database for RJE protocols and incorporates autodial, automatic scheduling and load-control features. VOS runs a new Harris word-processing package, Muse, and supports programming in FORTRAN, BASIC, COBOL, Pascal, APL, RPG, Assembler, SNOBOL and FORGO.

The H80-1A is priced at $44,950, and the H100-1A is priced at $55,000. Both machines are available now. Field upgrades are priced at $9500. VOS without source code is available immediately to users of Harris computers at no charge, or at $3000 with source code. Maintenance price is $100 per month.



Harris Corp.'s H80-1A and H100-1A computers *replace the previous H80 and H100 computers and feature the new VOS operating system, 768K bytes of executable address space and high-density memory.*

Harris Computer Systems, a division of Harris Corp., 2101 W. Cypress Creek Rd., Ft. Lauderdale, Fla. 33309. **Circle No 363**

Four-Phase's Series 5000 aimed at office market

Four-Phase Systems, the Cupertino, Calif., distributed-processing-equipment manufacturer acquired this year by Motorola, Inc., has introduced a series of 32-bit systems with an array of new display terminals, software and personal-computing options aimed at enhancing the firm's position in the office-systems market.

The Series 5000 products are said to be the first in a family that is expected to replace the company's Series IV line. Initial offerings include three models ranging from a System 500 supporting as many as four work stations and 0.75M bytes of main memory to the 800, supporting as many as 128 work stations and 6M bytes of main memory. However, the company says the basic architecture, which employs a 32-bit CPU and Motorola, Inc., MC68000-based I/O processors, could eventually support as many as 48M bytes.

The first product scheduled for delivery is the mid-range System 700, which supports as many as 96 terminals and is due the first quarter of next year. It includes 1.5M to 3M bytes of main memory, as much as 1.1G bytes of disk storage, a dedicated service system, 25- to 150-cps character printers, 600- to 1350-lpm line printers and communications at speeds as high as 9600 bps. A typical configuration with 200M bytes of disk, one line printer, 16 character printers and

64 work stations, is priced at $475,800 and can be leased for $18,000 per month. All software is separately priced, says a company spokesperson, and pricing and delivery dates for the 500 and 800 are not yet available.

The new terminals for the Series 5000 consist of three Fastrak models. The basic 1920-character CRT is the FT 40, a high-volume data-entry terminal. The Z80A-based FT 50 and 60 offer advanced functions such as loadable character sets (as many as four on the 50 and 16 on the 60), full video attributes, segmentation, business graphics, serial and/or parallel printer ports and capabilities for supporting personal-computing and touch-screen options. The 50 and 60 have 4356-character horizontal displays, and the companion 55 and 65 have 6144-character, vertically oriented displays.

The personal-computing option provides the CP/M operating system and requires an additional card and a separate disk-drive cabinet accommodating as many as four 5¼- or 8-in. floppies. Four-Phase says it will support Sorcim's SuperCalc, Digital Research, Inc.'s CBASIC, Pascal, PL/1 and other off-the-shelf packages. The touch-screen option offers 32 programmable screen areas.

With the 5000s, the company also introduced an initial version of a broadband coaxial-cable local-area network. Net IV supports asynchronous or bisynchronous communications at a maximum speed of 19.2K bps. It also supports as many as 120 low-speed chanels, each of which can accommodate 200 devices. The company plans to add protocol-conversion capability for interfaces to Ethernet, Wangnet, X.25 and other networks. The company also introduced a voice store-and-forward option.

Four-Phase Systems, Inc., 10700 N. DeAnza Blvd., Cupertino, Calif. 95014. **Circle No 364**

Production system includes graphics

The Graphwriter hardware-software system includes more than 40 programmed business graphic formats, including bar, pie, line and special-purpose charts. With each format program is an input form specifying the data inputs required for customization. System hardware includes an HP-85 microcomputer and a color pen plotter. An eight-pen system sells for $14,800 to $18,000, depending on the number of formats purchased. **Graphic Communications, Inc.,** 200 Fifth Ave., Waltham, Mass. 02254. **Circle No 365**

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CIRCLE NO. 133 ON INQUIRY CARD

Racal-Vadic quad modem includes 2400-bps device

Incorporating a newly developed 2400-bps, full-duplex modem, a VA3400 (1200-bps, FDX), a Bell-type 212A (1200-bps FDX) and a Bell-type 103/113 (0- to 300-bps, FDX), the VA4401 quad modem from Racal-Vadic can automatically or manually originate calls to, and answer calls from, all four of these modem types. The Sunnyvale, Calif.-based company also offers its new 2400-bps device—the highest speed modem ever sold by Racal-Vadic—in a single-modem configuration, the VA4403.

Targeted at companies with large, diverse corporate networks and at time-sharing users, the VA4401 permits existing Racal-Vadic customers to double their previous data rate limit of 1200 bps, while still enabling them to fall back to power speeds when line conditions are poor or when communication with lower speed modems is necessary. Although the quad modem features an automatic idle self-test, it doesn't check errors to drop automatically to a lower operation speed if conditions become poor.

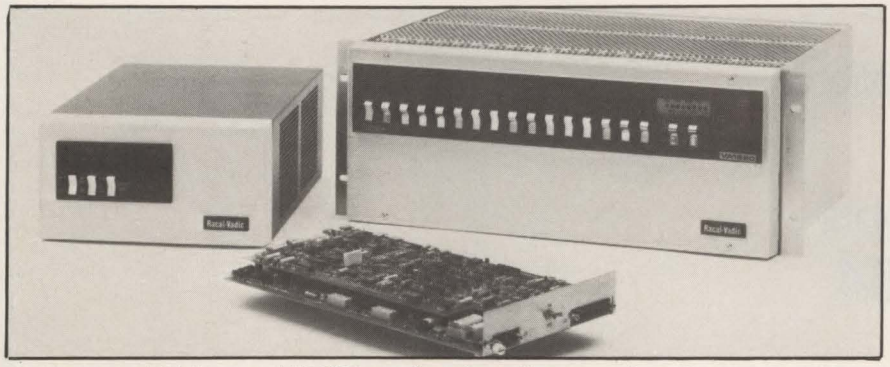
The VA4401 does provide automatic adaptive equalization to allow the modem receiver to change its filtering. This capability lets the device adapt itself to different telephone-line conditions involving amplitude roll-off, phase delay frequency offset and carrier phase jitter. The device incorporates a 16-bit Fairchild 9445 microprocessor to perform analog signal processing functions for all four modems.

Racal-Vadic's new VA4400 series conforms to the international CCITT V.22 bis recommendation for 2400-bps, full-duplex operation over a two-wire line. A future international version of the series will combine the V.22 bis device with a 1200-bps, full-duplex V.22 modem.

The VA4401 quad modem offers a direct connection to a single phone line, permitting all asynchronous ports to be served by a single telephone number. The unit automatically determines if the modem it is communicating with is 2400 bps, 1200 bps or 0 to 300 bps, and operates at the highest possible speed. The quad modem is also compatible with the VA811 single-/multi-line automatic dialer.

In single quantities, the VA4401 quad modem sells for $1945. A single VA4403, containing just the new 2400-bps device, sells for $1745. Quantity discounts can reach the 30- to 35-percent range. **Racal-Vadic,** 222 Caspian Dr., Sunnyvale, Calif. 94086.

Circle No 366



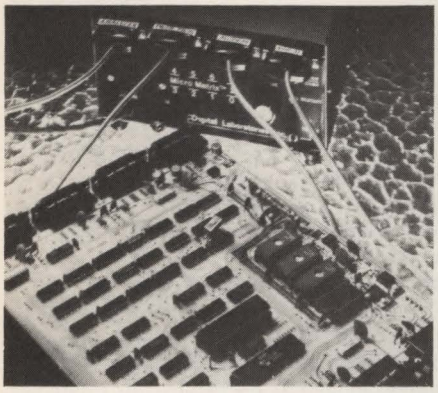
As many as eight, two-card VA4401 quad modems *(foreground) can fit in one Racal-Vadic 7-in.-high rack-mount chassis (right). The quad modem is also available in a compact stand-alone chassis (left) for remote terminal use.*

Multiplexer provides terminal communication

The DM 900 statistical multiplexer enables as many as nine asynchronous terminals to communicate over one telephone line or digital communications facility using the HDLC Level II protocol. The unit features autospeed from 110 to 9600

bps, a switch-selectable supervisory console port, user-programmable flow control, down-line configuration loading, diagnostics and network and terminal-port loopback. Port selection and contention are optional. Price is $1550 in OEM quantities. **Datagram Corp.,** 11 Main St., East Greenwich, R.I. 02818. **Circle No 367**

Components



Programmable data switch configures I/O environment

The Micro Matrix II Z80-based line-switching unit accommodates as many as eight computers, terminals, printers, modems, instruments or other serial data units. The unit allows RS232, current-loop or TTL to be used in any arrangement. It accommodates asynchronous and bisynchronous transmission at speeds as high as 9600 bps and provides every possible combination of connections, allowing all eight transmitters to send to any one or more of the eight receivers. As many as 16 connection arrangements can be created and stored in memory. One port can be permanently in control, or various ports can obtain command under supervision of a Z80. To switch from one arrangement to another, the command port need only transmit a precedence code. All connection changes occur within 7 μsec. The Micro Matrix II is priced at $995. **Digital Laboratories, Inc.,** 600 Pleasant St., Waltham, Mass. 02172. **Circle No 368**

NCC Breakpoints

and an injection-molded case that is in volume production.

ADDS is preparing its entry into the color-CRT market. An earlier attempt—which was shown privately at the 1981 NCC—was deemed too costly and returned to engineering. At this year's show, a low-resolution, four-color version was shown with a projected $900 retail price tag.

TeleVideo introduced the Intelligent I, an enhanced version of its model 950 VDT, with 64K bytes of RAM, a Z80 microprocessor and three I/O ports including an RS422 interface for communications at 800K bps (MMS, April, p. 6). Price is less than $2000. TeleVideo also previewed its model 970, the first terminal offering from the Sunnyvale, Calif., company not modeled on an established design.

Hazeltine Corp. introduced the Esprit II, a buffered editing terminal with a detached keyboard and a non-glare CRT screen. The terminal is compatible with most Hazeltine 1500, ADM 3A and Regent 25 applications. List price is $645. Also new from Hazeltine is the Executive 10 terminal with an extensive remote command set programmable status line and function keys, video highlighting, line drawing and a horizontal split-screen display for $1195.

Digital Equipment Corp. announced the VAXstation, the first member of a family of high-performance graphics work stations. The VAXstation 100 subsystem includes a 19-in., high-resolution, monochromatic, 60-Hz raster display; a 103-key keyboard; a local display processor with display buffer; and a pointing device. The work station connects to VAX computers via fiber optics through the Unibus interface, which supports two work stations. Price for the work station with a Unibus interface is $10,550. A graphics tablet is priced at $1700.

C. Itoh Electronics Inc.'s emulation of DEC's VT-100 terminal has been extended by a $1500 CIG-201 graphic card that gives the CIT-101 VDT Tektronix 4010/4014 compatibility. Adding the Z80-based CIT-188 personal computer upgrade kit to the CIT-101 or DEC's VT-100 terminal creates a 64K CP/M computer for $2825 more than the terminal. The CIT-161 with eight primary colors or 64 programmable combinations offers color VT-100 emulation for a retail price of less than $2700.

One-year-old **Envision Corp.**, San Jose, Calif., unveiled its first products—color graphics terminals and printers aimed at OEMs. The terminals use a 640 × 480 bit-mapped raster-scan display, an Intel 8088 and the NEC 7220 graphics chips. Three models are available. The 210 offers rudimentary alphanumerics and graphics for $3450. The 220 has all 210 functions plus the NEC 7220, Tektronix compatibility, zoom, pan and vector drawing for $4950. The 230 advanced display has all 220 features plus scaling, rotating, area fill and local storage and manipulation of graphics objects for $6950. Envision's model 420 color printer uses two 8088s and an 18-wire dot-matrix mechanism. Graphic print speed is 300 cps; letter-quality speed is 100 cps. A multi-cartridge ribbon and carriage-control system handles as many as four ribbon cartridges. The 420 sells for $3950.

A SHOWCASE YEAR FOR PRINTERS

Anadex, Inc., added to its Silent/Scribe line of low-noise printers with the DP-9620A dot-matrix printer. Speeds range from 100 cps for a 13 × 9 dot matrix to 200 cps for a 7 × 9 dot matrix. For graphics, the $1025 DP-9620 has a horizontal or vertical resolution of 72 dpi.

Okidata Corp. announced the second member in its Pacemark series of serial printers, the 2410. This printer operates at 85 cps in letter-quality mode and at 350 cps for data-processing applications. The two-color Pacemark 2410 uses a nine-wire print head that prints bidirectionally in both the data-processing (with a 9 × 9 matrix) and draft (with a 17 × 9 matrix) modes. For word-processing applications, the 2410 prints unidirectionally with a 17 × 15 matrix.

Dataproducts Corp. unveiled the second member of its daisy-wheel printer family, the DP-35 35-cps letter-quality printer. The $1200 low-noise printer uses Dataproducts's single-action hammer design, and has a print head that rotates 90 degrees away from the platen for easy print wheel changes.

Facit Data Products unveiled the model 4544, a 225-cps color matrix printer. The new addition to the family of Facit printers employs the company's Flexhammer print head with nine radially mounted flexible metal hammers. Priced at $4695 for end users, the 4544 comes with a four-color ribbon, each color occuping ¼ in. vertically.

As a result of the recent merger agreement with **Computer Peripherals, Inc.**, the 9380E E-series of line printers were shown by **Centronics Data Computer Corp.** (MMS, March, p. 51). The family operates at speeds from 300 to 1200 lpm.

Nicolet Zeta hopes to jump on the business graphics bandwagon with the Zeta 8 tabletop continuous-speed 810 plotter. Three years in the making, the plotter includes dual 8088 microprocessors and uses a proprietary sensing mechanism to determine which pens are being used: liquid roller or fiber tip. Plot generation speed is 20 ips.

Lear Siegler's Versaprint 500 serial dot-matrix printer operates at 45 cps in the near-letter quality mode and 180 cps in the draft mode. The nine-wire printer has dot-addressable graphics, and optional color print capabilities provide hard copy such as bar charts and diagrams. Price is $1695.

Epson America, Inc., privately showed a prototype, 110-cps ink-dot printer that uses a 24-wire head. Three reservoirs hold three different color inks, each of which is dispensed through eight wires. The printer is targeted for U.S. availability next year.

Two unannounced printers said to be aimed directly at the low-cost 80-column market were shown by the Anaheim-based OEM Data Products Division of **Siemens Corp.** A needle impact unit runs at 80 cps, while the other model, employing an ink-jet print head, achieves 150 cps. Both units form characters in a 9 × 9 dot matrix. Siemens says the ink-jet model will cost less than its latest available ink-jet unit, the 2712, which is priced at $3200 in single units and $1700 each for more than 100 units. Siemens hopes to

Continued on p. 268

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AMERICA. WE'VE GOT A JOB TO DO.

NCC Breakpoints

formally launch the two printers early next year.

Cii Honeywell Bull's U.S. subsidiary, **Cynthia Peripheral Corp.**, showed a prototype MP60 non-impact magnetic printer that has been expected to be shown for at least two years. The MP60 can print as fast as 8000 lpm with a resolution of 240 dpi. Units may sell for about $20,000 in OEM quantities of 100. The end-user price will be about $60,000. Availability will be in 1984, with initial evaluation units in the second half of next year. The printer is based on transfer of a magnetic toner image from a hard drum to plain paper using a monocomponent toner. The company says it is also working on a disk drive incorporating thin-film heads with multiple layers and a thin-platter disk that will replace oxide disks. By 1984 to 1985, the company expects to offer a 5 ¼-in. disk drive with four platters holding 400M bytes of information.

Polaroid Corp., Cambridge, Mass., entered the computer peripherals market with a prototype 8 × 10 color film recorder that digitizes video signals into instant photographic color hard copy. The VideoPrinter model 8 has a suggested retail price of $6000. It is expected to be available this fall. The model 8's image processor digitizes the video signal and matches contrast and density and can determine 256 tonal levels for each color. The product is aimed at CAD/CAM applications such as satellite data imaging, radar weather reporting and medical imaging. The system connects to the host computer's analog video signal. The product is the result of the recent purchase by Polaroid of 23 percent of **Image Resource Corp.**, a California company that designs and manufactures the video-film recorders.

SOFTWARE'S ROLE GROWS

Look for **Digital Research, Inc.**, Pacific Grove, Calif., to move into graphics via a joint development and marketing agreement with Wilsonville, Ore., software house **Graphic Software Systems, Inc.** The plan is to develop standard graphics commands that can be used with Digital's compilers and operating systems to drive displays, plotters and other graphics-output hardware. Part of the plan, too, is to follow the emerging standards of groups such as ANSI, ISO and the North American Presentation Level Protocol. (Tektronix, DEC and Intel recently adopted the PLP syntax.) The first Digital graphics software includes a subroutine library, GSS Lib; a general business graphics package, GSS Plot; and a Tektronix Plot-10-compatible package, GSS 4012. All are expected to be ready this quarter.

Meanwhile, Digital Research used NCC to unveil a pair of programmer productivity tools. Display Manager and Access Manager are aimed at the firm's 8-bit operating systems; 16-bit versions are in the works, however. Digital Research also said that version 3 of 8-bit CP/M will be available in September. This latest is said to take advantage of the extended memories showing up on 8-bit micros and includes file enhancements and new utilities.

While network management and control products are common elements of telecommunication networks, they have not yet received much attention in the realm of local-area networks. **Sytek, Inc.**, Sunnyvale, Calif., may be the first LAN vendor addressing this function, with its Network Control Center (NCC), appropriately introduced at the NCC. The $18,000 product is based on an MC68000 microprocessor and provides three basic functions—network management, network monitoring and data encryption. Initially, the NCC software prompts the user through loading of the network configuration and desired control parameters. If a channel at a particular frequency on the broadband network becomes overloaded, for example, the user may program the NCC to automatically shift some of the traffic to another channel by resetting the frequency-agile modems at some of the network nodes.

Executives who cannot type are targeted users for a voice recognition facility now available with The Last One, a system that generates BASIC programs from simple English instructions (MMS, October, 1981, p. 78). The voice module, built by **Scott Instruments**, Denton, Texas, adds $900 to the $600 cost of The Last One software package. It will be available from TLO distributors such as **Crown Computing** of Scotts Valley, Calif., and **Southwest Microcomputer Systems** of San Diego. Southwest generated 14 lines of BASIC input coding with about 120 statements in a few minutes at a demonstration, and claims it needs only one hour to generate a complete client management program with about 80 lines and more than 400 statements.

PICK OS MIGRATING TO IBM SYSTEMS, TOO

Computer Distributors, Inc., Bellevue, Wash., has set its sights on expanding the Pick minicomputer market with an exclusive license for the IBM Series/1. CDI, an IBM value-added remarketer (VAR), is expected to have the basic Pick package up in August and will follow with a version that will include IBM 3270 communications. The company also is expected to add IBM 4300 and Personal Computer implementations of the Pick operating system (under non-exclusive agreements). The Personal Computer is expected to be funneled into the VAR third-party channel later this year when a version with a 10M-byte Winchester is released.

NEXT MONTH IN MMS

Microcomputers will be the cover theme in the August issue of Mini-Micro Systems. The feature section will be anchored by three comprehensive product profiles: desk-top computers, single-board microcomputers and software—transportable 8- and 16-bit operating systems.

Mini-Micro Systems will also take a close look at a new, growth-oriented, dual-processor desk-top system that accepts both 8- and 16-bit industry-standard software as well as industry-standard expansion boards.

Application articles will review innovative approaches to using microcomputers in manufacturing and scientific environments.

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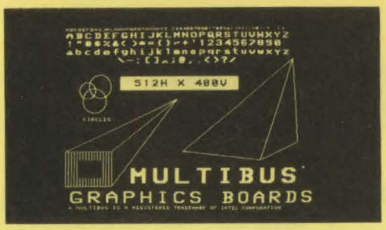

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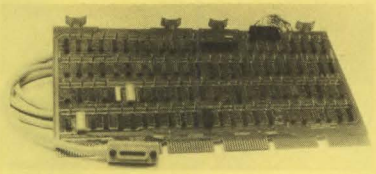

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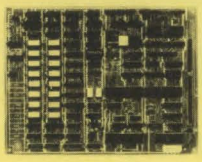

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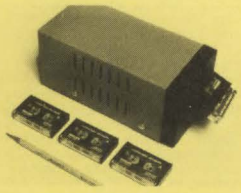

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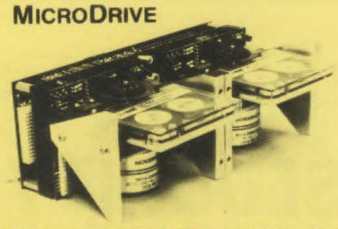

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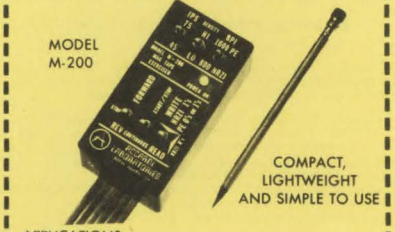

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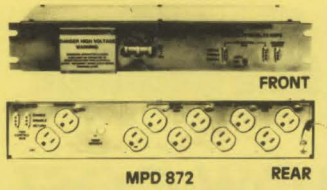

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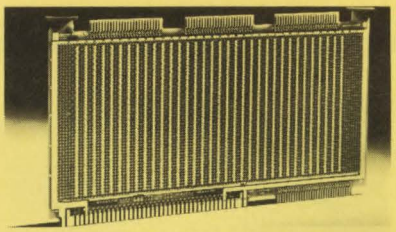

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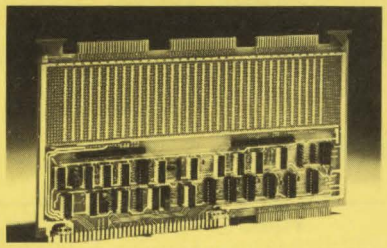

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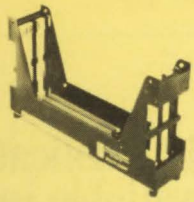

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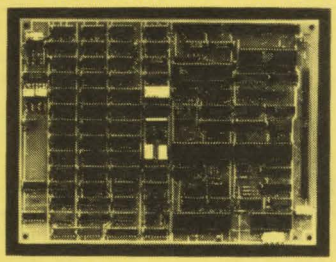

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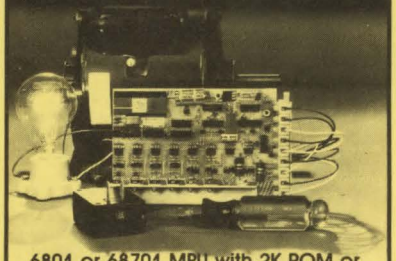

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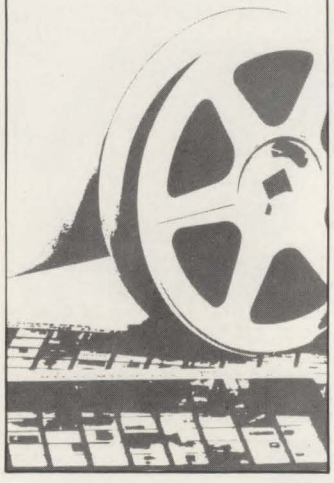

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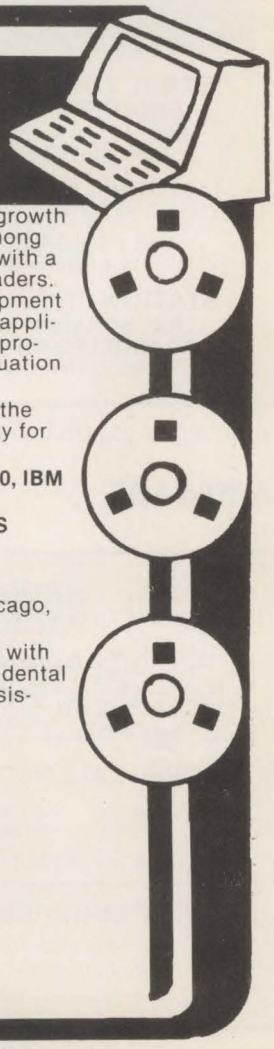

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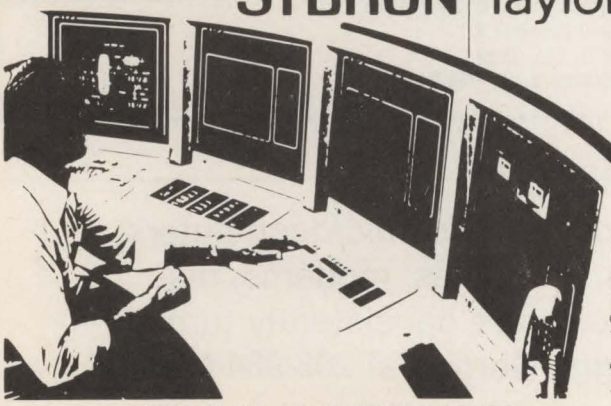

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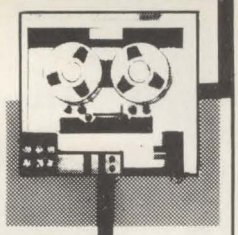

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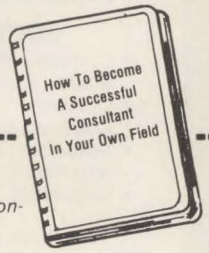

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