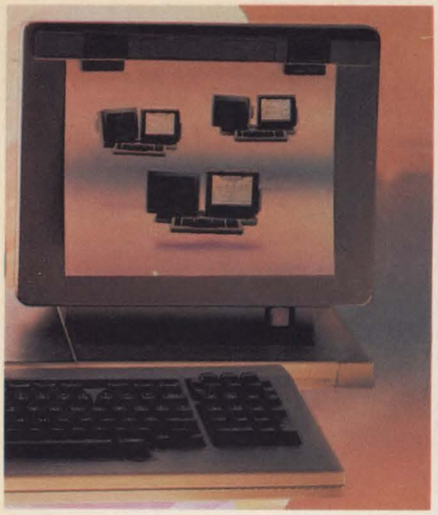
Mini-Micro Systems

A CAHNERS PUBLICATION
NOVEMBER 1981

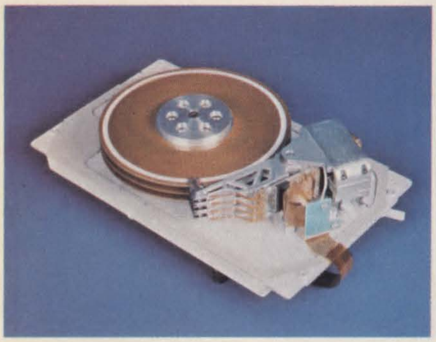
ADD-IN MEMORY BY THE BOARD

Shrinking an O. S. into VLSI

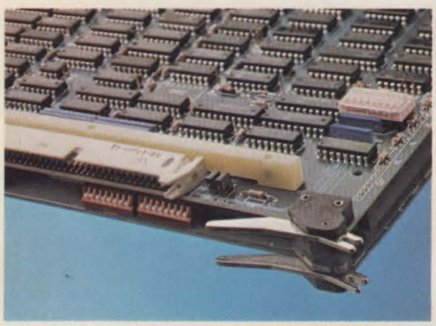
A stand-alone work station



Convergent Technologies' second-generation work station features RAM character storage and font-design software (see p. 195). Cover design by Gail Tavares; photography by Sollecito Photography; air-brush art by Dave Jenson, courtesy of Convergent Technologies.



Page 203. . .Improving Winchester performance



Page 211 . . . . .Speeding disk-drive access

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Mini-Micro Systems

A Cahners Publication

Vol. XIV No. 11 November 1981

FEATURES

For feature highlights, see p. 139

MINI-MICRO WORLD

DEPARTMENTS

More performance than you ever imagined — for $1995. If you're considering a DEC® terminal, C. Itoh now has two reliable alternatives that could easily change your mind.

Take our 132-column CIT 101, for example. Unlike DEC's VT100,® it includes full AVO performance — as standard equipment. You also get a 96 ASCII character set, plus 128 special characters. Characters may appear single-width and double-width, double-height. Reverse video, blinking, half-intensity and underscore may be used in up to 16 combinations. The cursor may be underline or block, blinking or non-blinking, or invisible to the viewer — all under computer control. There's raster graphics too. And 19.2K Baud asynchronous communications. Human engineered features include a non-glare screen and detached selectric-type keyboard. Of course, if all you need is 80-column capability, have we got a terminal for you.

The $1195 80-column terminal that performs like a 132. It's C. Itoh's CIT 80, the DEC VT52® emulator that's packed with features many big-ticket terminals don't offer. Things like smooth scrolling, soft setup mode, line drawing graphics and unidirectional RS 232-C printer port. A 19.2K Baud main port features X/ON-X/OFF protocol as well as full and half-duplex in conversation mode. Video attributes include blinking, underline, half intensity — even reverse video. You get CIT 101-type human engineered features too. Plus socketed firmware for maximum OEM flexibility.

Both terminals are backed by our 90-day warranty, fully field supported and ready for immediate shipment. So if you're thinking of getting a DEC terminal, consider the alternatives: CIT 80 and CIT 101.

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Breakpoints

REPORT CITES PROBLEMS WITH PANAFAX'S MV-3000 TRANSVERTER

A report by The Yankee Group, the Boston market analysis and consulting firm, raises serious questions about Panafax Corp.'s ability to deliver on schedule working models of its new MV-3000 Transverter facsimile device (MMS, July, p. 31). Announced last May, the MV-3000 is said to communicate with Group 2 and 3 fax machines and to receive and print data from computers and word processors. However, The Yankee Group report implies that Panafax may have difficulty actually producing a facsimile device that can print data directly from computers. The report says that a Panafax spokesman admits the May demonstrations of this feature were rigged; rather than printing data received from a computer, the MV-3000 used a character generator and direct-memory access to print a document.

The key to providing the computer/facsimile link may rest in a "black box" technology developed by a Minneapolis company called ICI (now Betacom) for Panafax's MV-1200 Group 2 machine, The Yankee Group says. The rights to that technology are being contested in court, and the report cites industry sources who claim that ICI's technology is crucial to the MV-3000's operation. Tied in with the technological questions relating to the facsimile unit, the report says, are potential pricing problems. The Yankee Group suggests that the unit may have been priced too aggressively at $7000 to $9000, making sales of the unit unprofitable. Matsushita, parent of Panafax along with Visual Sciences, may be balking at the pricing, and could restrict basic MV-3000 shipments (without the computer interface) to Panafax, the report says.

Frank Trischetta, director of marketing at Panafax, charges The Yankee Group's report "is totally inaccurate." While he does not dispute the claim that the initial product demonstrations were staged, he says several MV-3000s are operating in the field and claims ICI's black-box technology "has absolutely nothing to do with the 3000 whatsoever." The product is on schedule, Trischetta says, "and many hundreds of machines will be delivered during January." As for pricing, he says the units will be profitable, and he asserts that no strain exists between Panafax and Matsushita on the issue.

MOSTEK, MOTOROLA, SIGNETICS DEVELOP 16-, 32-BIT PROCESSOR BUS

Mostek, Motorola, Signetics/Philips and Thompson-CSF have agreed to support a high-performance μc interconnect structure that is said to handle single or multiprocessor systems and to provide 32-bit data and address buses. Called the VME bus, it will be implemented on boards meeting so-called Eurocard specifications, DIN 41612 and 41494. Besides supporting architectures to 32 bits, VME allows data transfers to 20M bytes per sec. in block mode. Mostek and Signetics are alternate sources for Motorola's M68000 16-bit μp. However, the companies say VME is not limited to 68000-based applications, although the bus evolved from Motorola's VERSAbus, which has been used on 68000-based systems for more than a year (MMS, October, 1980, p. 55). First board-level products meeting VME specifications will come from Motorola and will be marketed in Europe. Signetics expects to announce products within six months.

HI-G TO BRANCH OUT WITH PRINTER LINE

Look for component manufacturer Hi-G, Inc., Windsor Locks, Conn., to expand its business lines next month with the introduction of two low-end dot-matrix printers. Called the 9/80 and 9/132 for 80 and 132 columns, the printers will be manufactured completely by Hi-G. The company hopes its high degree of vertical integration will quickly establish it as a formidable competitor to such powerful low-end market forces as Epson America, Inc., and Okidata Corp. The 9/80 is priced at $995 and the 9/132 at about $1100 in fully featured, single-unit quantities. OEM pricing for the 9/80 is expected to be as low as $600 in 500-unit quantities. Both products operate at 150 cps bidirectionally and include nine-wire print heads that also are manufactured by a Hi-G division.

VAX BOARD SPEEDS TERMINAL THROUGHPUT

Look for the latest addition to Able Computer Technology's line of Unibus-compatible I/O controllers to show up at this month's Comdex show in Las Vegas. Called the VaxDZ, the single-board hex-wide device is designed to eliminate what executives at the Irvine, Calif., firm maintain is the VAX's Achilles heel—handling clusters of remote and local asynchronous terminals. The buffered device emulates Digital Equipment Corp.'s dual hex-wide DZ-11 multiplexer and comes with an I/O handler that permits the interrupt routines in the 32-bit supermini to handle 16 characters per line in the time normally required to handle two characters. The device runs on DEC diagnostics and can perform to degraded specifications using a standard DZ-11 handler should DEC modify the VAX's VMS operating system. Single-unit price for the VaxDZ is $4350.

TWO FIRMS SCRAMBLE TO MARKET WITH ETHERNET CONTROLLERS

Sources close to Interlan, Inc., Chelmsford, Mass., say the company will announce its first Ethernet controller late this month. Representing the firm's first product (MMS, October, p. 90), the controller will be compatible with Digital Equipment Corp.'s Q-bus processors and will be available for shipment in January. Interlan will follow this product with a DEC Unibus-compatible controller, then with an Intel Multibus-compatible product, scheduled for shipment in February and April, respectively. Prices for each product, according to the sources, will be in the $2500 to $4000 range. Interlan's announcements will come on the heels of two Ethernet-controller product announcements made by 3Com Corp. last month. The Mountain View, Calif.-based 3Com is starting shipments of a $2500 Q-bus Ethernet controller this month. 3Com's $300 Unibus controller is slated for deliveries beginning in January. The company has not announced plans for a Multibus-compatible Ethernet product, although 3Com chairman Bob Metcalf says his company will provide products that interface with non-DEC processors.

IBM TO OFFER CP/M FOR PERSONAL COMPUTERS

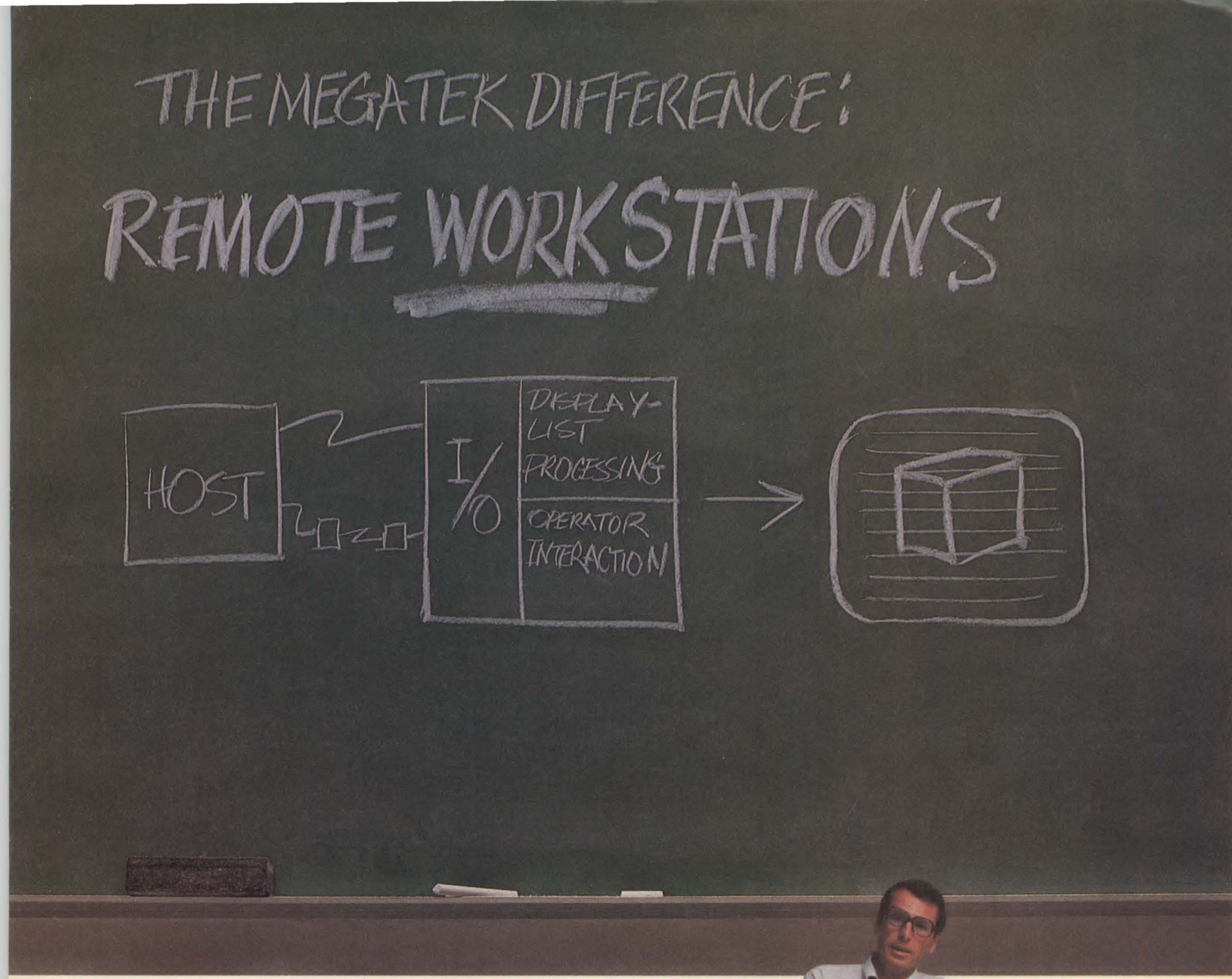
Pressure on IBM Corp. to offer the CP/M operating system for its personal computer may be mounting, and sources within IBM say the company will release that capability next month. The information follows an announcement last month by Lifeboat Associates, New York, of an operating system for the personal computer that can run CP/M application programs now on the market and be used for application development. Microsoft, Inc., the company that developed the operating system used on the personal computer—IBM personal computer DOS—also wrote the Lifeboat operating sytem. Industry observers will recall predictions that new business could be created as a result of the IBM announcement (MMS, October, p. 64). IBM also is expected to offer a graphics package next year.

LEXIDATA FOUNDER STARTS NEW GRAPHICS VENTURE

The founder of Lexidata Corp. is hoping to parlay his experience into a new graphics company bearing his name. Ikier Technology, Inc., Burlington, Mass., has developed a working prototype of a graphics system the company intends to start producing early next year. The company was formed by Hans P. Ikier, a founder of Lexidata who left that company about two years ago. Ikier will serve as chairman, while T. Colin Barton, most recently with Inforex and previously with Tektronix, serves as president. The company isn't saying much about its system except that it will be priced under $26,000.

STRATUS ANNOUNCES 'CONTINUOUS PROCESSING' MINICOMPUTER

Stratus Computer, Inc., Natick, Mass., has announced a Motorola 68000 μp-based multiprocessor system designed to compete with Tandem Computer's Non-Stop computer (MMS, August, p. 61). The Stratus/32 continuous-processing system incorporates multiple processors that can be used to back up an entire system, or only parts of it, such as a disk I/O controller. Redundant system μps function independently on the same 16-MHz clock cycle. Geared for the commercial market, the base configuration is called a processing module. A module includes 2M bytes of redundant memory for a total of 4M bytes, a CRT terminal with redundant communication controllers, two 14-in. Winchester-disk drives with 33M-byte capacities and redundant controllers, one streaming-tape drive, the VOS operating system written in PL/1 and a COBOL compiler. Price is about $135,000. The module can be expanded to handle as many as 64 terminals, 16 disk drives and 8M bytes of redundant memory. Processing modules can be hard-wired together through a high-speed coaxial cable with rates of 1.4M or 2.8M bytes per sec. at 750 ft., without repeaters. Communications support includes the X.25 protocol. Word-processing software is optional.



Whizzard 6200 raster-scan, line-drawing terminals are working remote workstations—fast, interactive, intelligent.

The Megatek difference starts with host-computer software. Wand 6200 is a computer-independent, Core-compatible Fortran package which organizes graphic information for maximum communication-line efficiency. Image segments can be dynamically extended, changed to a different color or line type, scaled, translated, or blinked with just a few simple commands.

Whizzard 6200 terminals can also be programmed with hundreds of graphic subroutines (e.g., the image of a bolt head). Instead of reconstructing such "instances" each time they are needed, the host computer simply transmits a subroutine ID number.

Swiftly interacting with the host computer at the "action" end of the communication line is an intelligent Whizzard 6200 memory-management I/O interface which maps subroutines, segments, and attribute information into a 64K-byte display-list memory (expandable to 128K bytes).

The final step, from memory to screen, is nearly instantaneous. Powered by a 32-bit proprietary processor, the Whizzard 6200 "graphics engine" processes display-list data into raster images at an average rate of 200 nanoseconds per pixel. Text can be displayed in eight hardware-generated character sizes. Twelve-bit vector coordinates (4096 x 4096 virtual display space) can be scaled up to 8X with full retention of fine-line detail. Images can be "Rasterized" into full-resolution hardcopy.

Monochrome or color, 512 x 512 or 1024 x 1024, every member of the Whizzard 6200 family is a complete graphics workstation, including desk, display monitor, keyboard, joystick, and optional data tablet. And all are upwardly mobile—up to the Whizzard 7200 series of 3D rotation-and-scaling raster/vector terminals.

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CIRCLE NO. 5 ON INQUIRY CARD

GE UNVEILS HARDWARE-ORIENTED SEARCH-AND-RETRIEVAL SYSTEM

Jumping into a market not previously addressed by the company, General Electric Co. introduced an LSI-based text search-and-retrieval system last month. Touted as competing primarily with software-oriented database-management systems, the GESCAN 2 provides search speeds in excess of 2 million characters per sec., a rate 100 times faster than that available from typical software sequential-search technology, the company claims. In operation, new information is added at the end of the system's existing database, an approach that avoids complex file manipulations for updates. Unlike software-oriented systems, the GESCAN 2 uses no indexing, abstracting or file inversion; the system's high scan rate permits sequential scanning of every word in the database for each user query. At the heart of GESCAN 2 is a text-array processor containing LSI circuits designed and developed at GE's Military and Data Systems Operations, Arlington, Va. Other components in the basic configuration include a repackaged Digital Equipment Corp. minicomputer with 128K bytes of memory, two 10M-byte cartridge-disk drives, an 80M-byte disk drive, a 180-cps printer and a CRT terminal. Price for this basic system will be $249,750, with first deliveries slated for January or February, 1982.

IDS TO BEGIN SHIPPING LOW-COST COLOR PRINTER

Integral Data Systems, Inc., will begin volume production and shipments next month of a low-cost commercial color-matrix printer introduced early this month. Code-named the "Prism" series, the first model was shown by the Milford, N.H., company as a prototype at this year's National Computer Conference in Chicago. End-user price for the printer, with graphics, is $1995; 100-unit OEM quantities are expected to be priced at about $1400. The printer uses a four-band ribbon—three colors and black—to mix a total of eight colors for output. Prism uses a nine-wire head with two rows of staggered pins. It prints at 120 to 150 cps in normal mode, and can print 200 cps in a high-speed data mode. Included are a 1.5K-byte RAM buffer and switch-selectable parallel Centronics or RS232 serial interfaces. Featured in the printer is a built-in cut-sheet feeder, but the printer also handles fan-fold paper to 15 in. wide. The company expects the printer to be used in small-business, scientific and medical data displays, personal work stations and computer applications in a market it estimates will reach $5 billion in 1986.

WANG REASSERTS ITS LEADERSHIP CLAIM

Wang Laboratories, Inc., Lowell, Mass., will reassert its claim as the leader in office automation over IBM Corp. and a host of other contenders with the introduction early this month of the Alliance 250, an office-information series system incorporating a new Wang database technology. The system's hardware is built around a CPU with 128K bytes of memory and work stations with 64K bytes of memory each. The database will have four main features: visual memory (a programmer list tool), document management, time management and a voice-message capability that runs on voice-equipped work stations.

TEKTRONIX ADDS COLOR MODEL TO 4110 GRAPHICS DISPLAY

Tektronix, Inc., will add a color terminal to the 4220 family of graphics displays the Beaverton, Ore., company introduced this spring. Called the 4113, the device shares the same local intelligence (an 8086) and data-communications capabilities (to 9600 bps) as other 4110 models. However, it features a 19-in., 60-Hz non-interlaced raster display that can show as many as 4096 shades of color. The 4113 has 4096 x 4096 addressable points that can be viewed in 640 x 480 blocks, allowing local zooming and panning. The display is compatible with Tektronix's graphics software, Plot 10. Deliveries of the 4113 will begin in January. It is priced at about $17,000.

RANDOM DISK FILES

Look for a number of vendors to introduce higher capacity Winchesters at next year's National Computer Conference. **Tandon Corp.,** Chatsworth, Calif., is set to unveil a line of 20M- and 30M-byte 5¼-in. devices that could be the first to sport dedicated servo surfaces and linear voice-coil actuators. The drives are under development at the company's Santa Clara, Calif., R & D facility and are set to go into beta-site testing early next year. The drives will maintain the same cut-out and depth dimensions as the de facto industry standard for small Winchesters, the 5¼-in. floppy-disk drive.

Also planning to use NCC as the kickoff point for a new line of high-capacity hardware is **Micropolis Corp.,** Chatsworth, Calif. One source says the company will uncork at least four 8-in. Winchesters in the 80M-byte-plus range, including a four-platter, 160M-byte device. All drives will use the same form factor as 1M-byte, 8-in. floppy-disk drives and will use double track-density (960 tpi) 3350 technology tied to run-length limited codes to boost bit densities to the 12,000-bpi range. Quantity pricing for the high-end hardware is said to be around $2500, with evaluation devices planned for the third quarter of 1982.

Look for Duarte, Calif., start-up **MegaTape Corp.** to unveil its first product offerings—a line of ½-in. tape-cartridge drives early next year. The rack-mounted drives will incorporate a proprietary two-reel cartridge with 1000 ft. of tape and will be designed to back up high-end 14-in. Winchesters. The new hardware will come in two versions—the MegaStor 200 (160M bytes) and the MegaStor 400 (300M bytes)—and will be available in evaluation quantities in the second quarter of 1982. OEM pricing for the 200 is set at $2300; the 400 at $2700.

The first high-capacity, half-height 5¼-in. floppy-disk drive could be announced early next year by **Drive Technology, Inc.,** a Santa Clara, Calif., start-up headed by former Shugart Associates co-founder Herbert Thompson. Drive Technology's new hardware reportedly will be compatible with controllers designed to handle Shugart's 1.6M-byte SA850 8-in. floppy-disk drive, and will store 3.2M bytes of data at 200 tpi. The new company plans to use alignment diskettes and test equipment supplied by **Dymek Corp.,** San Jose, Calif., and a spin-coated 5¼-in. medium from **Dysan Corp.**

Reports are circulating that **Control Data Corp.'s** 5¼-in. "Wren" drive may also show up for the first time at NCC '82, but at higher capacities than first planned. One source says the Wren, originally defined as a low-end 5M-byte stepper-motor device, will now appear as a 16M- to 30M-byte high-performance Winchester using a voice-coil actuator.

Also rumored to be in the works at CDC is a 480M- to 600M-byte 14-in. drive code-named Galileo. The five-platter drive is seen as CDC's answer to IBM's 3370 and 3380 drives (two Galileo spindles will fit into one cabinet) and could use either composite or thin-film read/write heads. Look for an announcement next year.

Shugart Associates' half-high 5¼-in. SA210 floppy-disk drive (MMS, July, p. 6) will make its first appearance in Xerox's soon-to-be-introduced Sabre line of electronic typewriters and word processors. The 210 can store 125K bytes of data and is reportedly priced at less than $90 per unit in quantity orders.

Single-board controllers capable of tying Winchesters and ½-in. streaming-tape drives to PDP-11 minicomputers operating DEC's RSX-11M operating system can be expected by the end of the year from **Spectra Logic Corp.,** Sunnyvale, Calif. The controllers will permit streaming at 100 in. per sec., and will make provisions for bit-by-bit verification and for error handling. Pricing is set at $3300 in 100-lot quantities with a one-time $500 charge for the I/O handlers. In the works at Spectra Logic for release early next year is a disk/streaming-tape controller for use with the VMS operating system on DEC's high-end 32-bit supermini. No pricing has been set.

Meanwhile, rumors are circulating that **DEC** itself may support streaming-tape backup for the first time early next year, according to one report. The company's Special Systems Group in New Hampshire is putting together a Q-bus configuration that will incorporate DEC's RM80 124M-byte 14-in. Winchester, a disk-tape controller designed in-house, and a ½-in. streaming-tape drive from an unidentified supplier.

Sample quantities of **Western Digital's** WD1010 single-chip Winchester controller can be expected by the second quarter next year. Second-source parts, developed in conjunction with the Newport Beach, Calif., semiconductor house, can be expected at the same time from **Intel Corp.** The new chips will handle as many as four Winchesters equipped with ST-506 or SA1000 interfaces and will replace a single-board controller developed by Western Digital around an 8X300 μp and 25 TTL parts. The NMOS WD1010 will handle all drive-control functions with the exception of data separation, sector buffering and error control. No pricing has been set.

Also due from Western Digital early next year is a series of four single-chip floppy-disk drive controllers designated the 279x series. The new parts will incorporate a data separator, a comparator and write precompensation circuits—features missing from the company's earlier 179x series. There is no pricing yet.

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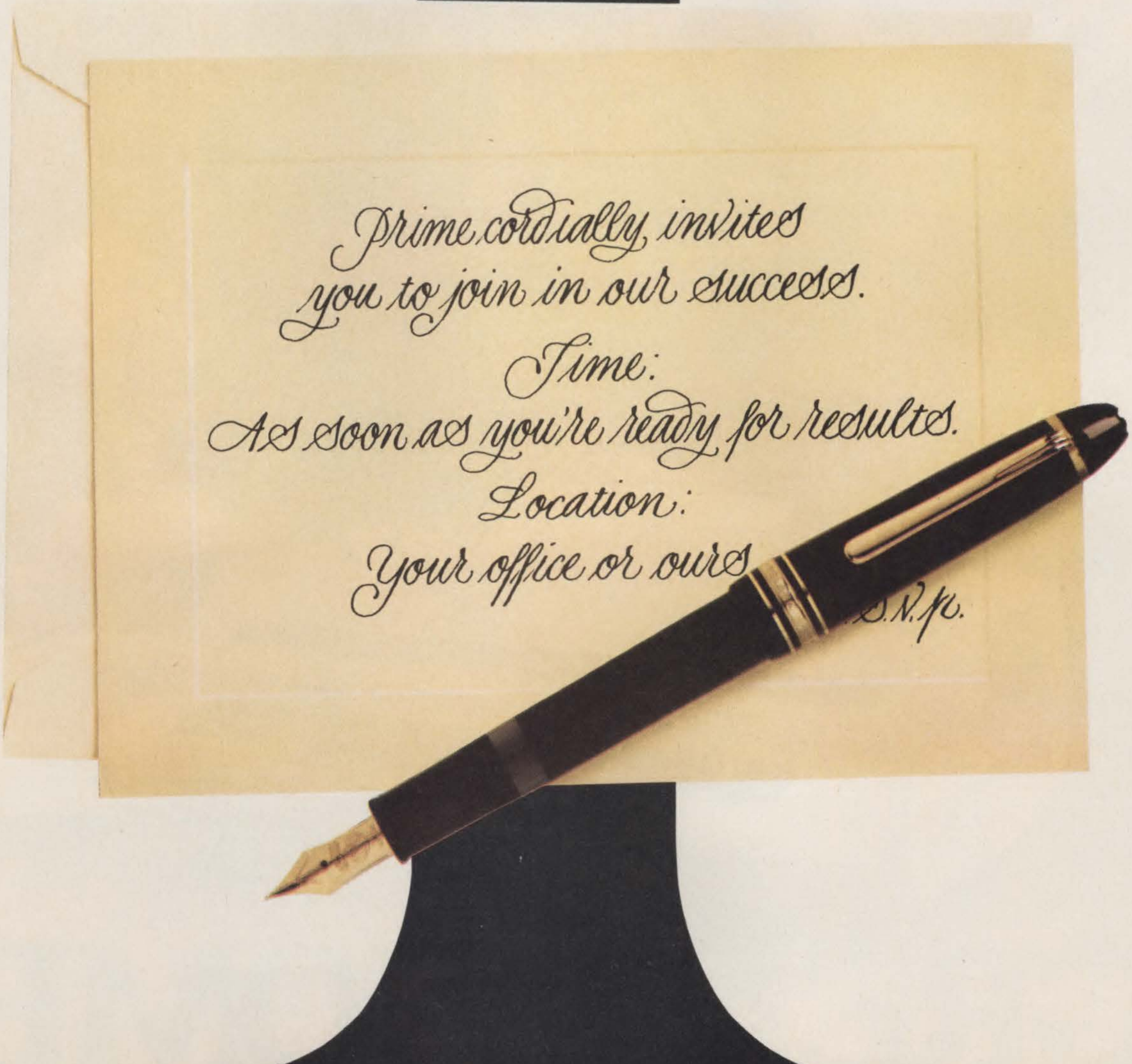

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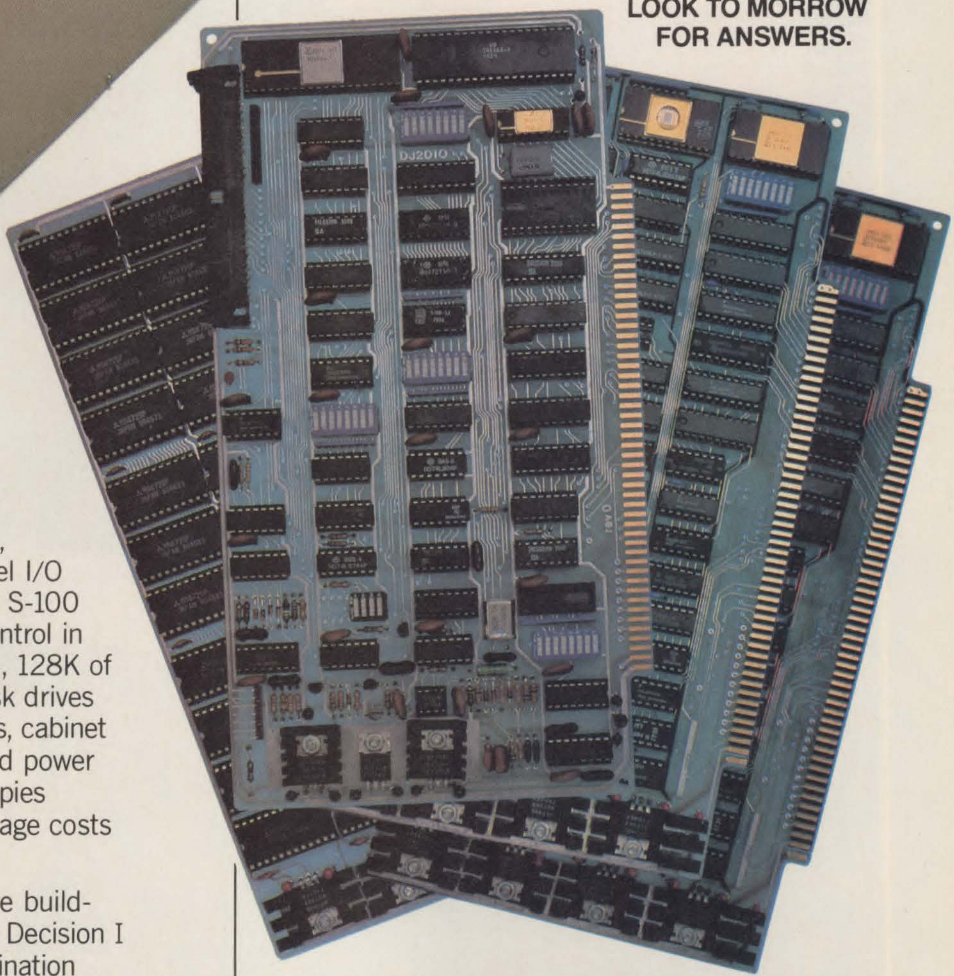
ION I

a multi-user Microcomputer.



management hardware, CP/M 2.2, M/BASIC 5.2, 3 serial and 2 parallel I/O ports, 14 I/O slots with S-100 connectors, supervisor control in both hardware and software, 128K of RAM and two quad-density disk drives (800K) with DMA controller. Plus, cabinet (either desk-top or rack-mount), and power supply. The same system with 8″ floppies and a full Megabyte of formatted storage costs $5,659. And, we offer OEM pricing.

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CIRCLE NO. 10 ON INQUIRY CARD

IBM sets OEM sights on peripherals

Vendors of peripheral products other than disk drives should not breathe easier because IBM picked Winchester-disk drives as the ammunition for its most recent attack on the OEM market. Their turn may be next.

That's the opinion of IBM watchers who see the stripped-down 8-in. Piccolo drive as the first in a line of OEM products that will eventually embrace printers, terminals and CPUs.

For its part, IBM is playing the part of a bashful giant and won't discuss its views on the OEM market. Company executives pass along questions concerning IBM's OEM intentions to public-relations officials who typically decline to discuss the matter.

The company announced its recent foray into the OEM market in September with a three-paragraph news release. The release stated that a special sales unit in the company's Data Processing Marketing Group is offering a 65M-byte, nonremovable, 8-in. disk-storage assembly, the model 680, to OEMs at a discount.

Since that announcement, an IBM spokesman has continued to downplay the size of the OEM sales unit while declining to discuss the company's views on the OEM market. "It's just a small sales unit," the spokesman says, adding that company officials involved in the OEM program will not be available for interviews.

Some observers of Big Blue see the discounted Piccolo as the vanguard of a major assault on the OEM market. Greg R. Leveille, director of custom research for the Gartner Group, Greenwich, Conn., says "IBM has entered the OEM business, and, coincidentally, they have entered it with a disk product. This is a major shift in philosophy. To the OEM, it implies that there are many other OEM products forthcoming." Leveille contends that the roots of IBM's decision to enter the OEM fray began in 1978. The company then decided that "to survive and prosper at the maximum rate during the mid- to late-1980s, it would have to become a low-cost producer in strategic areas," says Leveille.

Competition from rivals in the μc arena and the desire to enjoy the cost advantages of using the company's μc-based products rather than those of outside suppliers spurred IBM's decision to become a low-cost producer. Once the manufacturing capabilities are in place, the OEM market becomes attractive as a result of its potential for volume sales, Levielle says.

OEM marketing efforts for the 680 are centered in IBM's Data Processing Marketing Group, White Plains, N.Y. The 680 sales force is headed by Scott D. McVay who reports to G.P. Fusco, marketing director of the Data Processing Marketing Group. The salesmen who report to McVay are dedicated solely to OEM sales, says an IBM spokesman, but he won't reveal the size of the sales staff. The spokesman also declines to say whether IBM will offer products through McVay's organization.

The decision to pursue the OEM market came from IBM's corporate headquarters, says one analyst. "The division might have pushed for it, but the OEM program is a corporate move because corporate officers make all decisions of this nature," says Dale Kutnick, The Yankee Group, Boston, Mass. "It's apparent that IBM is going to get a lot more aggressive in the lower end of the market. It makes a lot of sense to go after the disk-drive market. To maintain high margins and profitability, they would want to produce disk drives by the thousands," Kutnick says.

The Gartner Group's Peter Wright believes IBM picked the 680 as one of the company's first OEM

LANIER JOINS SMALL-BUSINESS-COMPUTER MARKET

Lanier Business Products, Inc., Atlanta, has again branched out from its traditional line of word-processing and dictation equipment to introduce a small-business accouting system. Last June, the company expanded its product line with a source data-collection system (MMS, June, 1980, p. 14). The new computer, called Computereze, is available in two configurations. One, a floppy-disk-based system with 600K bytes per drive, includes an 80-cps printer and is priced at $7495. The second, priced at $11,495, has a 5M-byte Winchester disk and a 150-cps printer. Each system includes 96K bytes of internal memory. Lanier is offering seven application programs with Computereze: accounts receivable and payable, payroll, general ledger, job cost, sales-order entry and inventory. The system also can serve as a word processor.

products because, "It happens to be one of the product lines that doesn't have production problems right now." Wright expects the IBM OEM discount schedule (which ranges from prices of $4400 in single-unit quantities to $6600 in quantities of 500 or more) to come under pressure. But delivery capabilities and the company's reputation for quality will help offset what he sees as a high price that, "can go down a long ways." An IBM spokesman says the company does not see any problem with the pricing of the 680.

Levielle expects that the major weaknesses in IBM's OEM strategy will be high prices and an inability to offer state-of-the-art products all the time. "What IBM is really selling more than anything else is quality, quality, quality. If I were a vendor pitching against IBM, I would do an extremely professional job of documenting the reliability of my products," Leveille says.

"The IBM entry puts more pressure on the OEM community to stand behind the quality of their products and to make sure the prospects understand how reliable the products are. If non-IBM vendors can successfully convince prospects that they have quality equal to or better than IBM, then IBM doesn't stand a chance," Leveille says.

—Eric Lundquist

IBM enters OEM market with 8-in. disk drive

IBM's decision this fall to enter the OEM Winchester market with its 680 Disk Storage Assembly has provoked a number of opinions on what impact the move will have on systems integrators and vendors of high-capacity 8-in. rotating memories.

Essentially a stripped-down version of the two-year-old 8-in. 3310 Piccolo drive, the 680 will be offered in a six-platter, 64.5M-byte configuration. It could signal a major change in the market for high-capacity, high-performance 8-in. hardware, says one industry analyst. "IBM's move will help dignify the 8-in. Winchester as a major product classification, despite those who maintain that 5¼-in. devices are about to take over," says Raymond Freeman Jr., Santa Barbara, Calif., industry analyst. "The 680's impact will be felt on vendors planning to introduce 8-in. hardware in the 40M- to 80M-byte range, and will force those planning to introduce drives in the 80M- to 160M-byte range to rethink their product strategies."

Jim Porter, Mountain View, Calif., industry consultant and publisher of *Disk/Trend Report*, sees another dimension: "IBM has already delivered about 100,000 end-user versions of these drives," he explains, "and the company is well down the learning curve with it." An OEM, Porter goes on, will typically take evaluation drives from a number of vendors and compare them to see which works best in his system. "In the case of the 680, however," he says, "the OEM will be dealing with a known entity; he will assume that it works well. So why evaluate it?"

Industry analyst Raymond Freeman Jr.: *"IBM's 680 will help dignify the 8-in. Winchester as a major production classification."*

Porter points out, however, that while the 680 may be nothing more than a low-cost version of a highly successful product, only a certain class of OEMs will use it in quantity. "It has a unique interface as far as OEMs are concerned," he explains. "As a result, it will have more appeal to systems integrators capable of building their own controllers." Porter expects the 680 to appear in high-end systems in which terminal clusters are tied to superminis such as those offered by Harris Corp., Systems Engineering Laboratories and Nixdorf Computer Corp. Porter also anticipates that the drive will be used in mini-based CAD/CAM systems, and in small-business configurations that compete with IBM Corp.'s System 34-class hardware. "There is a definite demand for this drive," he says.

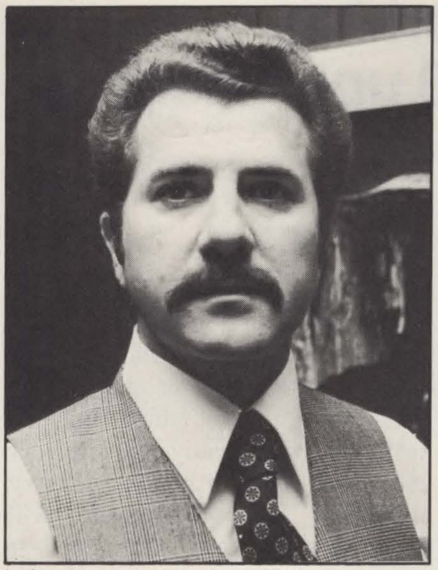
Many feel that this demand will exist despite the fact that the 680 is priced significantly higher than its closest 8-in. OEM competition. IBM has set the product's price at $4400 in orders of 500 units per year; evaluation drives are pegged at

$6600 each. In comparison, Priam Corp.'s 70M-byte model 3070, unveiled at NCC this year, is priced at $2950 in the same quantities, and Perkin-Elmer's 64M-byte drive is priced at $3800 in 100-lot orders. New hardware scheduled to be unveiled this year by Control Data Corp. may also hold a price advantage over the IBM entry. According to one report, CDC's 9.0551181-in. (230-mm.) Fixed Storage Drive (MMS, September, p. 10) will be priced around $2500.

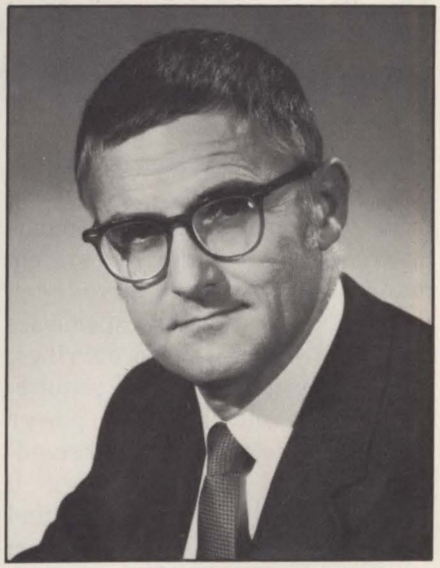
"IBM can be expected to push reliability and cost of ownership instead of raw hardware pricing," says Jim Moore, manager of computer memory services at Dataquest, Inc., Cupertino, Calif. "The MTBF figure for the 680 is set at 12,000 hours. Other OEM Winchesters are 'spec-ed' at 8000 hours."

But Newark, Calif-based industry analyst Andrew Roman feels that price may be a deterrent to IBM's plans to move aggressively into the OEM disk-drive market. "At the OEM level, any 8-in. drive priced at more than $2500 raises eyebrows," he says. "I do not believe that the 680 will have a legitimate impact on this market as a result." Instead, Roman feels that IBM's drive will hit hardest at vendors of 14-in. hardware. "This announcement will accelerate the erosion of the bottom end of the 14-in. market," he says. "I would not be surprised if a double-density 680 were to be announced very shortly."

Moore disagrees with Roman in part: "The 680 will move squarely against 8-in. hardware in the 80M- to 130M-byte and higher range," he says. "The 680 can also be expected to push 14-in. capacities." Porter notes that these assessments may be true, but stresses that no 14-in. drive competes against the 680. "Now, 14-in. action is at the 160M-byte level," he points out. "Vendors such as Ampex Corp., Fujitsu and Tecstor Inc. won't be hurt by the 680. Roman also calls attention to the 680's nonstandard interface and physical size and its lack of mounting hardware. "Whether this drive will be received with open arms remains to be seen," he says. Porter discounts the issue of size and interfacing, saying, "The 680 comes with an interface that is unique to the OEM market and does not include a controller. This is a short-term disadvantage, however, given the type of customer who will buy the drive. On the other hand, the drive has considerable resident intelligence that will make interfacing somewhat easier." Physical size of the drive (11.8 × 13.4 × 18 in.) also is unimportant, Porter says. "These drives will be designed into desk pedestals," he predicts. "The size of the drive is a minor limitation."



Industry analyst Andrew Roman: *"I do not believe that the 680 will have a legitimate impact on the 8-in. market."*



Jim Porter: "With the 680, *the OEM will be dealing with a known entity, so why evaluate it?"*

IBM's decision to test the OEM waters could be even more significant than the introduction of the 680 itself. "The nature of the OEM peripherals market has been changed by this announcement," Freeman says. "It can be expected that the 680 will not be IBM's only OEM product." Porter agrees, saying, "This could be the precursor of other OEM products from IBM. Not only does it have the product, but it has the sales and applications support that systems builders need." It also has the motivation, he adds. "IBM wants their share of the OEM peripheral business."

Dataquest's Jim Moore is also waiting for the other shoe to drop. At the top of Moore's list is the 8809 ½-in. streaming-tape drive and the yet-to-be-announced Ocotillo ½-in. tape-cartridge hardware long rumored to be under development at IBM's Tucson, Ariz., tape facility (MMS, March, p. 67).

Industry consultant James McCoy, Menlo Park, Calif., is also wondering what other surprises the mainframe giant has in store for the OEM peripherals market. "We don't know if IBM plans to offer what it already has in its hardware grab bag," he says, "or if there's a concerted internal effort under way to offer products that are adjuncts to its end-user business." If IBM is serious, McCoy says, then the 680 announcement is significant. On the other hand, he points out, the 680 could be just a probe. "IBM may be simply sticking its toe into OEM waters," he says. "Unfortunately, it may be years before we find out."

—John Trifari

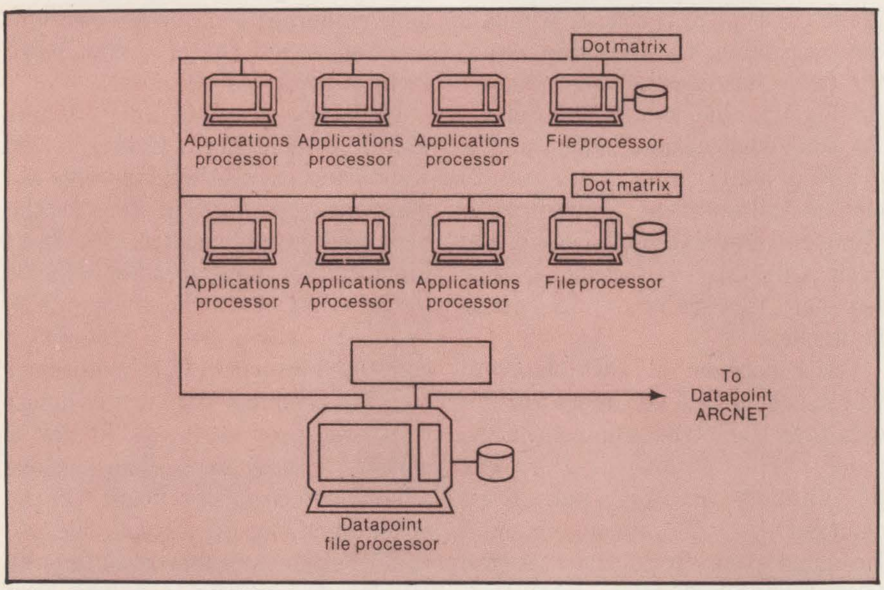
Datapoint networking provides TRS-80 upgrade path

Providing their customers with a clear upgrade path is a common problem for many personal-computer vendors. Several μc system manufacturers have introduced products with greater capabilities than their initial low-end offerings, but rapidly growing user requirements can outpace the power available from even high-end standalone μc systems. When such a situation develops, users may find themselves locked into a system that no longer supports their needs.

Tandy Corp., Fort Worth, Texas, has found a way around the upgrade barrier previously faced by users of its Radio Shack TRS-80 computers. In a joint announcement with Datapoint Corp., San Antonio, Texas, Tandy revealed the capability to link TRS-80 model II computers to ARCNET, the local-network portion of Datapoint's Attached Resource Computer (ARC) system. The interface board that permits this linkage incorporates an LSI chip just developed by Datapoint (See "Processor, disk, work station added...," p. 24) and will be manufactured by Texas Peripherals, Inc., a Tandy/Datapoint venture.

A coaxial-cable-based configuration, ARCNET operates at 2.5M bps, a speed that makes the network operation transparent to TRS-80 users. With its 8-bit addressing, the network theoretically can support 255 processors, although industry observers doubt a network will grow to that size. The smallest TRS-80 ARCNET system will consist of disk storage, a printer, a TRS-80 file processor and two TRS-80 application processors. The ARCNET interface boards for each model II computer will sell for about $450, and a $200 junction box is also required. For networks incorporating more than four processors, active, eight-port junction boxes that sell for $2000 each are required.

An additional benefit of the networking scheme is that Tandy users requiring more power will be able to hook Datapoint processors and peripherals to their networks. Datapoint ARCNET users, in turn, will be able to place TRS-80s on their networks. "The size and power of the TRS-80 system has taken a quantum leap forward," says Tandy president and CEO John Roach, "and Datapoint users have new flexibility in system development."



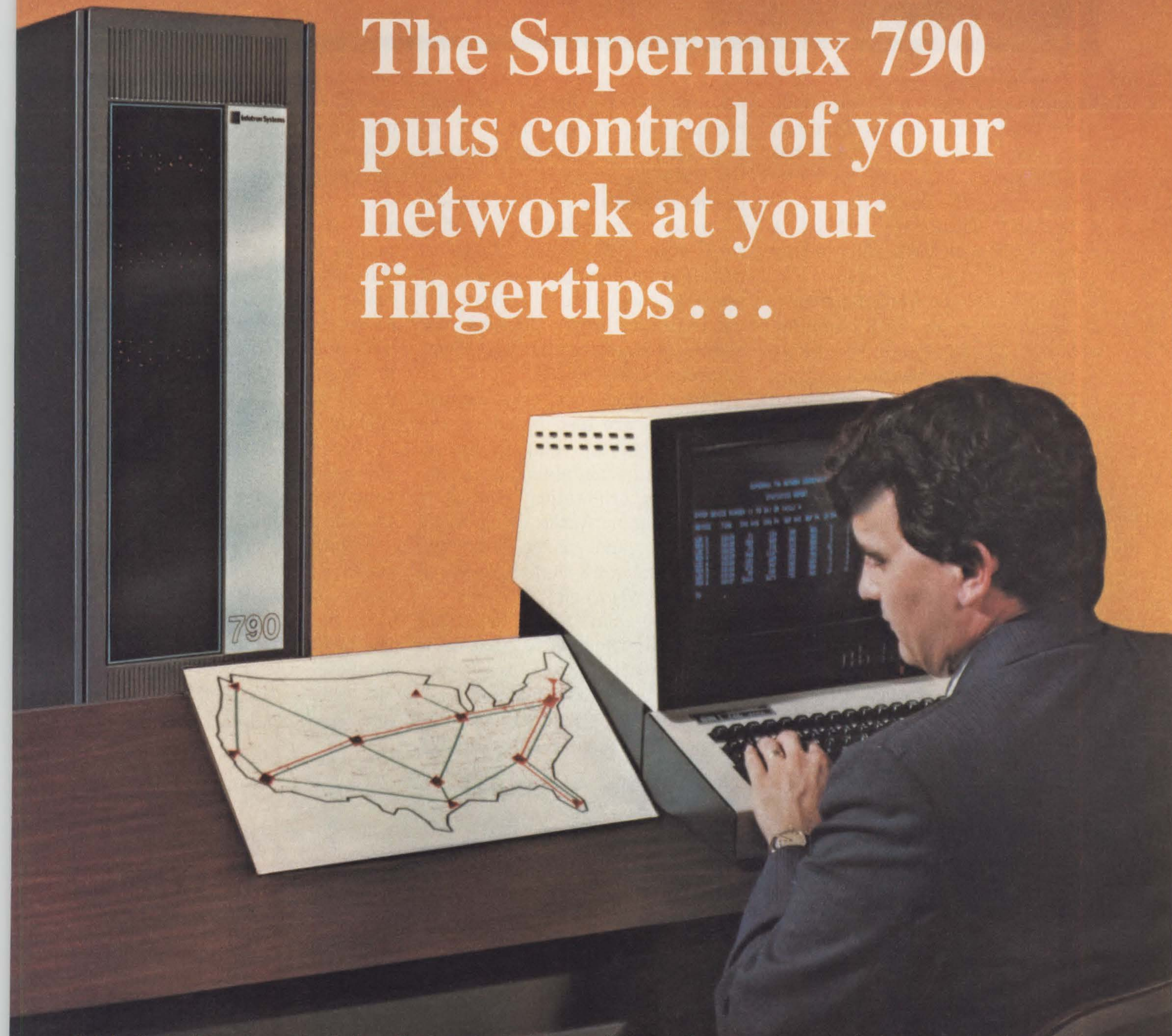
Using Datapoint's ARCNET local area network, *Tandy can now link its TRS-80 model II μcs. TRS-80s serving as file processors control disk systems and printers and support other TRS-80s that operate as application processors. By interfacing through a Datapoint processor, the Tandy network connects to an ARCNET network with Datapoint equipment.*

Roach believes little overlap exists between the power of Tandy and Datapoint products, and he says little direct competition for customers is likely to occur between the two companies. Harold E. O'Kelley, president and CEO at Datapoint agrees. "I don't believe there will be sizable competition between us and Tandy," he says. "Tandy will place the seeds in the market that we can capitalize on later."

The companies claim to have no plans for joint marketing efforts. However, H. Paris Burstyn, an analyst with The Yankee Group, Boston, Mass., predicts continued cooperation between the companies. "While neither Roach nor O'Kelley will admit to it, I think you will see a lot more joint ventures between the two companies," he says. As for the move to make ARCNET available to TRS-80 users, Burstyn says it's good from both companies' perspectives. "Tandy gets closer access to Datapoint technology, along with an upgrade path for TRS-80 users. It also brings Tandy instant respectability with business customers because of Datapoint's good reputation. Datapoint, on the other hand, gains a low-end work station plus Tandy's ability to manufacture in large volume."

While Tandy might want users to believe otherwise, it is not the first vendor to offer a networking capability for μcs. Two other companies are active in this

The Supermux 790 puts control of your network at your fingertips . . .



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CIRCLE NO. 12 ON INQUIRY CARD

field—Nestar Systems, Inc., Palo Alto, Calif., and Corvus Systems, Inc., San Jose, Calif. Each has shipped more than 100 networks incorporating the Apple II μc.

Nestar's Cluster/One Model A network came on the market in May 1980 (MMS, June, p. 155). The company chose the Apple II primarily because, "Apple, as a corporate strategy, has an interest in working with and encouraging other vendors to provide complementary products," explains Peter L. Hertan, vice president of marketing at Nestar. "Apple keeps us informed as products change, so our network can support the new products as soon as they are shipped."

The Cluster/One Model A operates over 16-parallel-wire cable at a data-transfer rate of 240K bps—considerably slower than ARCNET's 2.5M-bps rate. Hertan claims the rate is adequate, "because it's the best match for the I/O speed of an Apple II." An interface for the network sells for $395, and Nestar recommends a maximum of 65 processors per network, although the theoretical limit is 255. Nestar has no immediate plans to support other μcs on its networks, according to Hertan. "We expect Apple to remain the dominant supplier of personal computers; therefore, we don't believe we're limiting our sales opportunities by being oriented around the Apple II."

The Omninet networks shipped by Corvus are also based on the Apple II, but the company has no intention of maintaining an exclusive Apple orientation. Corvus is beta-testing networks using DEC's LSI-11 μcs, and the company will announce network support for S-100 bus μcs by year-end.

"One of the most important features of Omninet is that it is designed for multiple μcs," says Robert Wohnoutka, Omninet product manager. "We feel that the market is changing substantially, and if we were to choose one μc which one would we choose?"

Running on twisted-pair wires, Omninet operates at 1M bps and supports 64 devices. Wohnoutka says Apple IIs can handle the 1M-bps data rate because the $495 Omninet interface incorporates a custom chip for direct memory access (DMA). With DMA, there is no buffering of data entering the Apple II, which can then accept the faster input rate. Corvus attempts to support the μc's native operating system on Omninet, and the company offers licenses to μc vendors wanting to add the network to their systems.

Wohnoutka says Corvus plans to support TRS-80s on Omninet eventually, so he expects to compete with the Tandy ARCNET offering. But he doubts the two networks will compete directly. Hertan at Nestar also sees little direct competition and welcomes the Tandy network.

—Dwight B. Davis

PROCESSOR, DISK, WORK STATION ADDED TO DATAPOINT LINE

In conjunction with Tandy's announcement that it will offer ARCNET to TRS-80 users, Datapoint introduced several products compatible with its ARC systems. One, a mid-level processor/work station called the 8600, is the first Datapoint product to incorporate the LSI interface chip just developed by the company. (MMS, September, p. 5). This RIM (resource interface module) chip is the first such LSI interface product from any networking vendor.

With the 8600, Datapoint also unveiled the 8220, a non-intelligent video work station designed to operate with processors running Datapoint's Resource Management System (RMS) operating system. Both the 8600 and the 8220 provide ergonomic features, including 12-in. diagonal, amber screens, optional tilt and swivel bases and detached keyboards. Operating with an RMS processor, the 8220 work station becomes a fully functioning terminal and performs text editing, data processing and electronic-mail functions with the appropriate software.

Displaying 24 lines × 80 columns, *the 8600 processor permits 16 levels of screen brightness. The keyboard can be placed as far as 1m. from the terminal.*

With 128K to 256K bytes of main memory, the 8600 processor attaches to an ARC local network or operates in a stand-alone environment. Running RMS, the processor incorporates another new Datapoint product—a company-designed fixed disk. Using thin-film, 5¼-in. platters, the 9301 disk unit stores as much as 20M bytes. With extension units, the 8600 supports a maximum of 100M bytes. An integral 9301 cartridge-tape drive backs the disk unit. Operating at 56.3 in. per sec., the cartridge tape unloads the disk's contents in about 12 min.

The 8600 comes in four configurations. Designed to serve as an ARC applications processor, the 8601 with 128K bytes of main memory and a serial I/O port sells for $7500. The $10,950 8602 has enhancements that enable it to support attached terminal and disk systems. The 8620 system includes a Datapoint 9310 10M-byte cartridge-disk drive and a 1411 1M-byte diskette unit for backup. Priced at $28,500, the 8620 supports three additional 9310s for a total of 40M bytes. Using the 9301 disk units, the 8630 supports 20M to 100M bytes and sells for $33,500.


OEM 8775

Datapoint signs $102.5 million deal to market products overseas

In August, Datapoint Corp. acquired the right to market its products directly overseas, and now the company is exploring how to make best use of its $102.5-million investment. Until the deal was completed, Datapoint's access to the foreign market fell under a decade-old agreement in which TRW Inc. handled most (88 percent by one estimate) of Datapoint's international sales. TRW acted as a master distributor, moving Datapoint products through a network of largely TRW-owned subsidiaries. The 1970 Datapoint/TRW sales arrangement provided a means for then-fledgling Datapoint to reach the international market and provided cash, which the firm used to finance its domestic lease base.

The multi-million-dollar contract contained two major provisions: about $85 million of the $102.5 million is for the purchase of nine distributors, and the remaining $17.5 million goes for the purchase of direct marketing rights to 20 international distributors.

Distributors and customers in the overseas markets will "have a direct link to Datapoint," says Gerry Cullen, vice president of marketing and planning for the company. That link should improve volumes and margins for Datapoint, its new equities and its distributors, as well as making users, "feel more comfortable now that they are dealing directly with the factory," Cullen says.

The important international market contributes about 22 percent of the company's revenues. Three-fourths of the 22 percent comes from European sales, say company officials and outside estimates. Datapoint sells distributed data-processing and business-information systems, including Datashare and attached resource computer (ARC) systems.

Datapoint reports international revenues on a yearly—not quarterly—basis. For the fiscal year ending July 31, 1980, the company had international sales of $69.6 million out of total revenues of $318.8 million. The company has not yet reported its international sales revenues for the fiscal year ending July 31, 1981, but Stephen T. McClellan, an analyst with Salomon Brothers, New York, estimates that of total fiscal 1981 revenues of $396.2 million, international revenues will slip to about 20 percent of that total. The slippage is a result of a sluggish European economy and the TRW-to-Datapoint vendor transition, McClellan says.

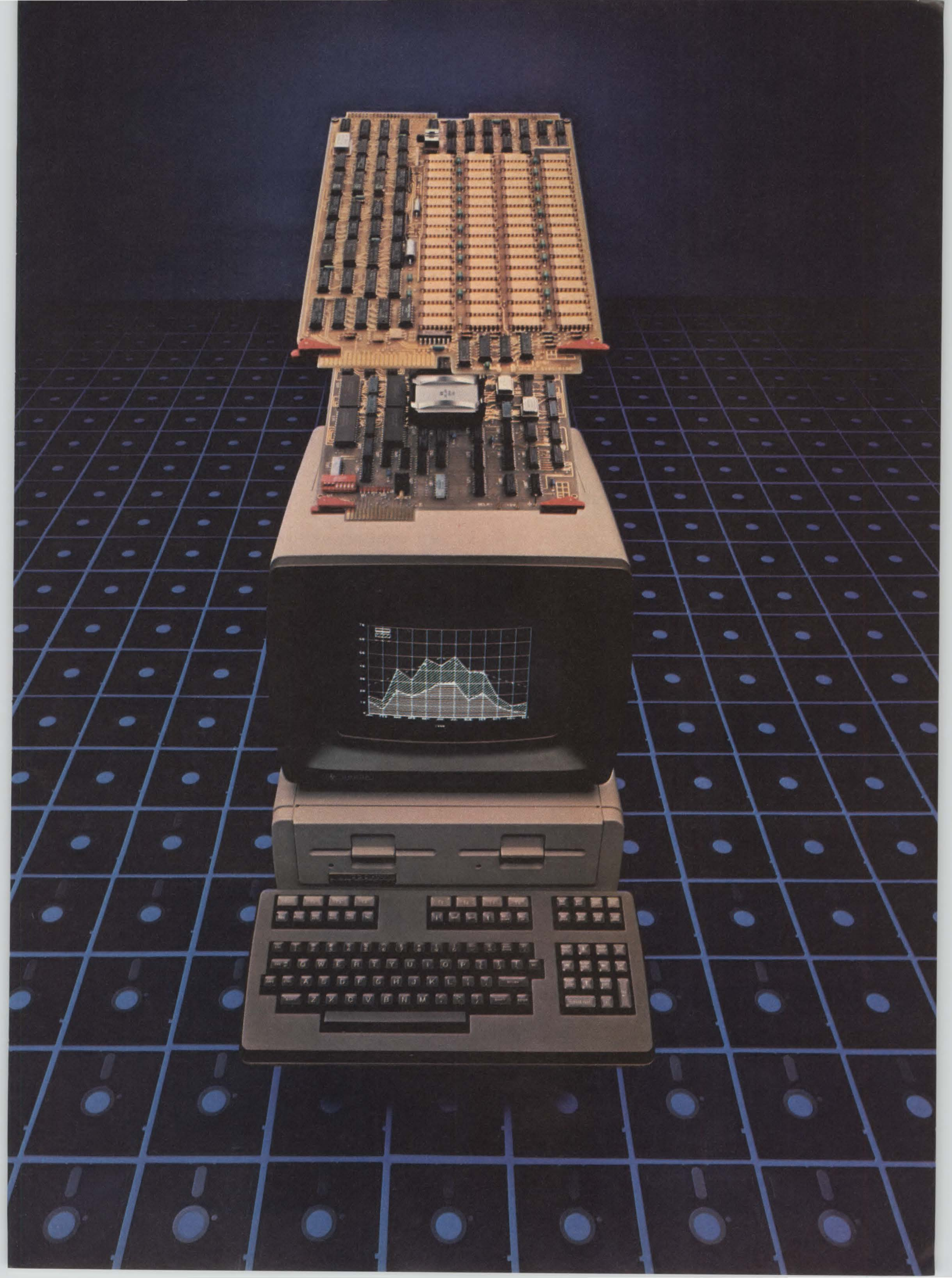
McClellan estimates the immediate effect of the purchase will hurt the company's margins as the firm pays servicing costs that generate revenues but little profit. In addition, Datapoint must build a European sales and service infrastructure, the size of which depends on which former TRW people leave the company and on what facilities remain following the severing of the TRW/Datapoint agreement, McClellan says. The Datapoint move into Europe under its own banner is "fraught with uncertainties and unknowns," McClellan says, but it was necessary. The immediate effect of the purchase will depress margins, but, over the next three years, sales volume will increase, and the benefits of direct-sales economies will enter the balance sheets. In the long term, McClellan predicts margin improvement.

The acquisition of seven of the nine TRW Inc. distributors is complete, while the acquisition of distributors in Canada and Spain is pending government approval. The seven distributors include four that were wholly owned by TRW and three that were jointly owned by TRW and non-U.S. companies. The seven distributors are in Australia, Austria, Brazil, The Netherlands, Switzerland, England and West Germany. Acquisition plans regarding the French subsidiary are unresolved following nationalization efforts in that country. Datapoint acquired a Danish subsidiary in February, 1981.

The purchase of the TRW distributors enabled Datapoint to enter the European market quickly under its own name and countered potential flagging enthusiasm from foreign dealers facing an uncertain future as the original 1983 expiration date neared.

"TRW did a good job, and sales from overseas built the lease base in the U.S.," Datapoint's Cullen says, "but as Datapoint grew it became more evident that we needed a direct presence in the international markets that was titled as a Datapoint office. Datapoint is now an international company and will handle all of its own sales and field service. "Only one thing would have expired in 1983, and that was the (TRW/Datapoint) business relationship," Cullen goes on. "We would still have had to buy equities, and the lion's share of the purchase would have been the same or more in 1983. The $17.5 million was the (direct marketing rights) buyout," Cullen says. "You want to get paid for the profits you're going to be losing in the transaction," regarding the $17.5 million.

Datapoint's European customer-services organization will support the company's overseas field-service



operations. Customer services will support both the newly purchased subsidiaries and independent distributors.

Cullen says Datapoint will considerably increase its sales and support staffs in Europe over the next year, but declines to predict how fast and large the staffs will grow. It is expected that Datapoint will slowly open a lease base in Europe.

The company's sales and support staff will not overlap with those of Inforex Inc., a data-entry systems company recently acquired by Inforex. "Inforex will stand on its own feet. The reason we bought Inforex was to approach a new market segment. We did a marketing survey between Inforex's and Datapoint's European customer lists, and only one customer overlapped," Cullen says.

As Datapoint digests its recent purchases, it may also have to contend with its former partner in the market. TRW is believed to be talking quietly with several U.S. firms about overseas sales and service marketing agreements.

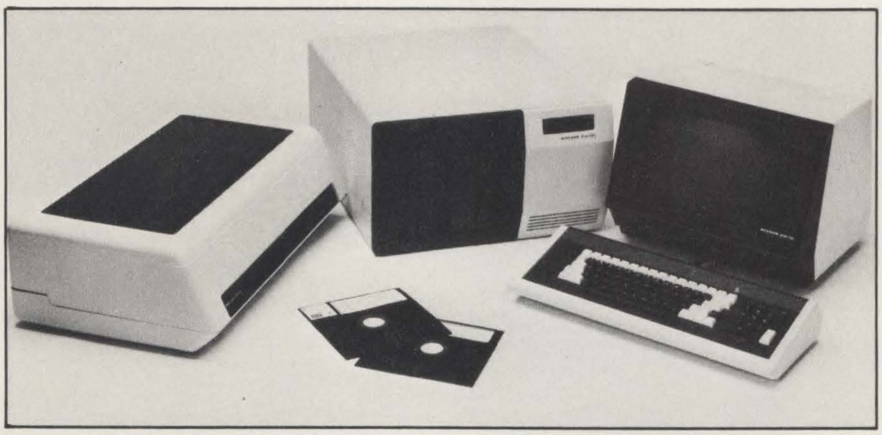
—Eric Lundquist

Western Digital, Telesoft first in market with subset compilers

While industry insiders and observers argue about the potential impact of Ada, debating whether the language will ever be accepted as a commercial standard universal language or find applications only within the military, Western Digital Corp., Irvine, Calif., and Telesoft Inc., San Diego, Calif., have formed their own conclusions. They are the first two companies to introduce Ada subset compilers to the commercial market. Other companies, including Intel Corp. and Control Data Corp., have compilers in the works.

Compilers, software tools to translate high-level languages into codes that can be executed by specific computers, are necessary for implementing application programs written in Ada, the Defense Department's evolving standard programming language. The Western Digital and Telesoft products can translate only subsets of the language, not full programs. Although limited in their abilities, subset compilers can be used in the interim, while full Ada compilers are being developed. Telesoft, which introduced its Telesoft Ada last August, and WD, which is announcing its microAda this month, are both aiming their products at software houses that want to begin working with Ada.

"Our customers are relatively sophisticated and have been pioneer users of other new languages in the past," says Craig Maudlin, vice president of Telesoft. "They're either customers who, because of their relationship to the Department of Defense feel the pressure to begin using Ada or customers who see the handwriting on the wall and know it is to their competitive advantage to be facile with the language."



Western Digital's new microAda compiler *runs on the company's new high-level language computer, the ME 1600.*

William Carlson, vice president and general manager of Western Digital and a past program manager for the Ada project at the DOD, notes that customers can begin writing production-quality software using microAda. "People who are going to write serious software would have a development schedule in which it may take them three to six months to design a program and another 12 months of coding," he says. "They can use the microAda for coding some of the algorithms and to write specs for the packages that will comprise the end application. By the time they're ready to write the final software in its entirety, our full Ada compiler will be available."

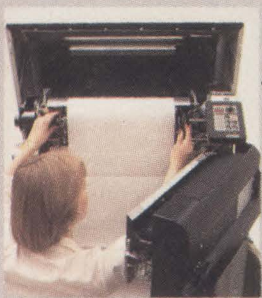
Telesoft Ada was developed while Western Digita held a 20-percent share of Telesoftware, Inc., now

Print faster and save money

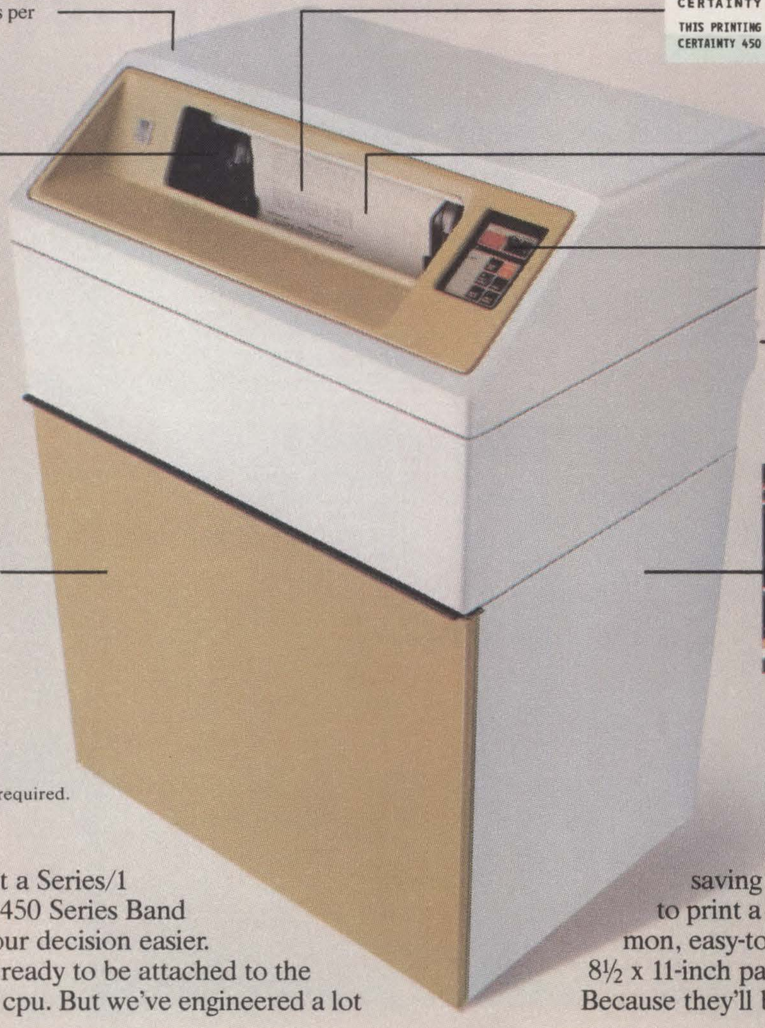
Attach your Series/1 to Control Data Band Printers

*Available in three models: 360, 720 or 1130 lines per minute.

```
THIS PRINTING WAS DONE BY CONTROL DATA'S
CERTAINTY 450 SERIES BAND PRINTER.
THIS PRINTING WAS DONE BY CONTROL DATA'S
CERTAINTY 450 SERIES BAND PRINTER. COMPRESSED
```



Speeds workflow
Our swing-out gate simplifies paper, ribbon and print band changes.

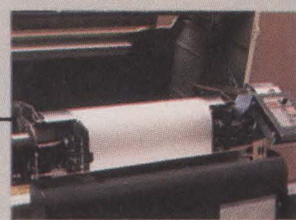


Clean, crisp impressions on one- to six-part forms from 4″ to 16.75″ wide.

*Improved diagnostics and status/fault indicators for faster servicing.

500-ft. connection
Now you can locate the printer up to 500 feet from the cpu.

Up to 40% less paper
Our compressed-pitch feature lets you print a full 132 characters on standard 8½-inch paper. Or 198 characters on 14-inch form.

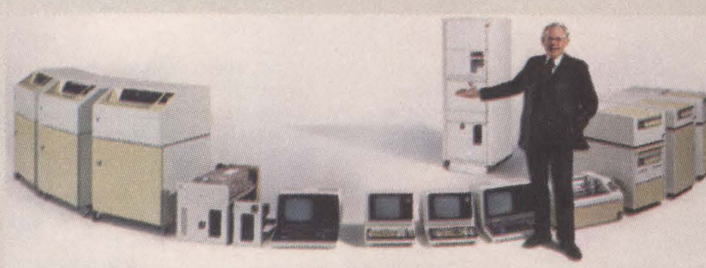


Designed for quiet environments
Quiet is already engineered into the printing mechanism and cabinetry.

*No software modifications required.

If you're thinking about a Series/1 system, our Certainty® 450 Series Band Printers might make your decision easier.

Of course they're all ready to be attached to the I/O bus of the Series/1 cpu. But we've engineered a lot of customer convenience and versatility into their design to give you a lot more than a basic printer for your money.



Three models to give you a wide range of printing speeds, for example. Up to 1130 lines per minute. And both our 360 and 720 lpm printers have a compressed pitch feature. Besides saving paper, this permits you to print a full 132 columns on common, easy-to-file, easy-to-reproduce 8½ x 11-inch paper.

Because they'll be in more offices than machine rooms, we've human-engineered their design. Our swing-out paper gate simplifies forms loading and ribbon changes. Even print bands can be changed simply in seconds.

You won't have to worry about service, either. More than 4800 Customer Engineers in our worldwide maintenance organization support our products.

Available Now
Our Band Printer is ready to help you get optimum performance from your Series/1. For data sheets and more information, call today, toll free. 800/328-3390.

CONTROL DATA CORPORATION

Addressing society's major unmet needs as profitable business opportunities

Telesoft Inc. Western Digital withdrew its share last spring to develop its own compiler in-house. The Telesoft compiler can perform full Ada syntax checking but will not produce code for some of the more complex Ada features, such as abstract data types. It runs only on Motorola Corp.'s 68000-based machines, but it is being enhanced to run on Intel's iAPX86, Digital Equipment Corp.'s VAX and IBM Corp.'s 370. Those versions should be available by year-end, says Maudlin.

Western Digital's microAda is an extended version of Telesoft's compiler, the technology that Telesoft licensed Western Digital to use. MicroAda can implement the same functions as Telesoft Ada, plus others, including access types, Ada subtypes for scalers and arrays, text I/O and real numbers. The compiler runs on the new Western Digital PAL (Pascal Ada Language) superMicro 16-bit computer.

Both Telesoft and Western Digital are developing full compilers, which they expect to have in production within the year. While the DOD holds the trademark on the name "Ada," commercial companies can use the name if they have full-language compilers in development. "The DOD recognizes that people haven't had time to implement full compilers yet," says Lt. Col. Vance Mall, U.S. Air Force representative to DOD's joint-program office. When companies release full compilers, he adds, they must submit their products to an Ada validation office in the DOD for approval. Using a validation test being developed under contract to the DOD by Softech, Inc., Waltham, Mass., the DOD will determine if compilers up for approval translate the language exactly as it is defined. The validation test, says Mall, is integral to the Ada concept of providing a standard software language. The test guarantees that compilers will implement only applications generated by Ada programs written according to the DOD definition of the language and will invalidate compilers that translate versions of Ada.

Western Digital plans to release its full Ada compiler in stages. Within the next year, the company will introduce a product called Ada 1.0, to be follwed by a full Ada compiler, Carlson says. Customers who purchase microAda, he says, will be able to trade that product in for its full purchase price when they're ready to move to Ada 1.0 or to the full compiler.

Although Telesoft's Maudlin will not elaborate on trade-ins, he said his company will "allow for upgrades once they are available." Both Maudlin and Carlson say the proliferation of application software written in Ada is inevitable. They contend that the time is right for companies to introduce products like theirs to the market.

"Everyone is concerned about the cost of software and the need to re-use packages across different vendors' product lines," Carlson notes. "Ada was specifically designed to be a vendor-independent language that can solve the software-portability problem." Indicating a trend in the acceptance of Ada, Carlson notes that the American National Standards Institute is balloting to decide if it should accept Ada as it is defined by the DOD or if it should modify that definition. The ANSI process, Carlson says, indicates serious industry interest in Ada. Outside the U.S., the Commission of the European Communities and the British and German governments, Carlson says, are funding projects for the development of compilers for nonmilitary uses.

The Western Digital microAda is priced at $2000 for a perpetual license, and the Telesoft Ada is priced at $2400.

—Frank Catalano

Higher level Ethernet protocols due this year

In a move aimed at easing connection of hardware and systems from outside vendors, Xerox Corp. plans to release the specifications of the higher level transport-layer protocols used with its Ethernet local-area network.

The Xerox announcement could come by year-end, says the head of one San Francisco Bay Area systems house, and may have significant bearing on Ethernet's chance of being accepted as a de facto industry networking standard. "This is what we'll need to interface our equipment to one of these networks," says Harry Saal, president of Nestar Systems, Inc., Palo Alto, Calif., referring to his company's Cluster/One Apple computer-based terminal configuration.

Ethernet takes care of line access through a contention method under which any device is free to take control of the network anytime the network is free. Should two devices attempt to take access simultaneously, both back off for a randomly calculated period of time before each tries again.

Some observers point out that, under a contention scheme, a device theoretically might never gain access. Those observers support the token method, a term derived from the process-control industry. This method uses a control algorithm to ensure that each device gets on a line. The IEEE 802 committee's proposal being circulated in a first draft provides for both (MMS, September, p. 19).

Levels three and four protocols to be announced by Xerox within the next few months go beyond link-level issues, however, says Charles Bass, co-founder of Ungermann-Bass, Inc., Santa Clara, Calif., a systems house that has worked with Xerox on the higher level local-area network protocols. Bass says Xerox will publish four or five composite protocols, one of which will enable users to deal with devices by name rather than by physical address.

Xerox will also unveil a "rendezvous" protocol, defining how connections are to be made between parties on the line, and a "bridge" protocol, which will permit control information to be inserted into a data stream.

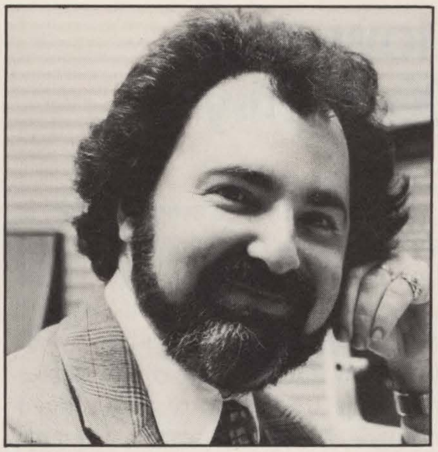
Xerox will also announce a protocol that will handle the control functions associated with the fourth, or transport-level, protocol as defined in the ISO model. These include end-to-end error control and acknowledgement, data sequencing, which ensures that packets sent from one destination to another arrive in the correct sequence, and flow control, which enables devices operating at different speeds to communicate with each other. "Until now, we have had peaceful coexistence between different devices using Ethernet links," Bass says. "Now, we'll have the rules and regulations needed for meaningful dialogue."

The Xerox announcement will also allow other communications formats to be used on an Ethernet line, Saal says. This move could ultimately go beyond the question of simply plugging non-Xerox hardware into the Xerox network. Which protocol is in use will be determined by a 16-bit "type field," Saal explains, with each protocol given its own identifying number. It is not yet known which identifiers have been assigned to which companies, but it is anticipated that one type-field identifier will be used to designate Digital Equipment Corp.'s DECnet protocol.

Other protocols that could be initially supported on the Ethernet link following the Xerox announcement reportedly are those used by Burroughs Corp. and the Department of Defense. It is not known whether a designator will be assigned to IBM's SDLC protocol.

For vendors that have developed proprietary protocols, such as the one Nestar offers on its Cluster/One Apple-based terminal systems, the announcement offers the opportunity of applying to Xerox for an identifying number for use in the 16-bit type field, or using one of the Xerox protocols scheduled for release this year. "We could go either way," says Saal. "When we see the specifications, we'll know which is more appropriate for us." Bass point out, however, that Xerox has not indicated how these protocol designators are going to be assigned. "It isn't sorted out yet," he says, "but they will be assigned conservatively."

The Xerox protocols scheduled for 1981 release will take the form of a document defining a model of the protocol and a series of programs that will demonstrate how the protocols work. Bass says these programs could appear in Pascal or Mesa, a Xerox system language. This language is like Ada, Bass says, and is used to microcode Xerox's 8000 series word processors and on its recently announced Star system (MMS, June, p. 23).



Harry Saal, president of Nestar Systems, Inc.: *"Protocol levels at the top should be fixed. At the lower levels, alternatives should be provided."*

But even after the release of the Xerox protocols, much work remains to be done, Bass says. "There are a myriad of issues in the domain of local-area network communications," he notes. "We've made a lot of progress, but we've got a long way to go." Among the issues to be resolved, he says, are the development of universal terminal protocols and a means of handling universal file transfers. Another issue, Bass points out, is defining communication between different word-processing formats so that two stations can use a common printer.

Saal stresses that these issues must be resolved, and that the industry's energies should be directed toward setting standards at higher protocol levels—not dissipated in controversey at the link level.

—John Trifari

H-P adds high-, low-end machines to 3000 family

Less than a year after Hewlett-Packard Co. beefed up its HP3000 series commercial processors with the Series 44 (MMS, January, p. 73), the Palo Alto, Calif., company has added a new high-end machine that promises to deliver more than twice the 44's power at only a 50-percent increase in price. At the same time, H-P has slipped in a new entry-level system and unveiled three new disk drives (See "New H-P drives feature intelligent controllers," p. 38). The new low-end processor is said to outperform the Series 30, the model it replaces, yet costs 30 percent less than that machine.

Carrying the HP3000 scepter is the Series 64, a 1-million instruction-per-sec. (MIPS) machine that uses a 32-bit data bus and memory organized around a 32-bit word. Company executives say the Series 64, while its hardware is arranged around a 32-bit word, remains software-compatible with previous 3000 systems.

That means the Series 64 is not the long-awaited 32-bit minicomputer from H-P. While there are hardware features that put the machine into the 1-MIPS class, the basic architecture of the Series 64 is identical to that of other HP3000s. Further, the Series 64 runs the same operating system as the rest of the line.

"We are committed to the HP3000's basic architecture," says computer systems division marketing manager, Robert Bond. A 32-bit system implies a new architecture, he adds, and changing the addressing scheme entails changing the operating system. "That will not happen with H-P's commercial systems," he says.

Instead, the company will expand

NEW H-P DRIVES FEATURE INTELLIGENT CONTROLLERS

Hewlett-Packard Co. has unveiled a line of four rigid-disk-drive subsystems aimed initially at captive applications built around the company's Series 1000 and 3000 superminicomputers and its line of desk-top processors.

Primary selling point for the new storage subsystems is the use of intelligent controllers. In addition to handling channel-command processing, these controllers will incorporate an extensive series of subsystem diagnostics, says Bob Hoke, marketing manager of the new line at H-P's Boise, Idaho, division. Each board in the controller will have its own microdiagnostic routines, he explains, while a series of microdiagnostics covers drive elements, such as the servo system and the read channel. "This level of on-board diagnostics hasn't been seen before," he says. "We have the capability to handle error correction on the fly, provide isolation of as much as 95 percent of drive failures and cut the mean time to repair to one hour."

H-P's controller design also improves the way intermittent failures are handled. These are problems that crop up while a job is running, but correct themselves when a repairman calls. Hoke says H-P's intelligent controllers include a macrodiagnostic routine that picks up these failures as they occur and logs them on specially designated maintenance tracks on the disk.

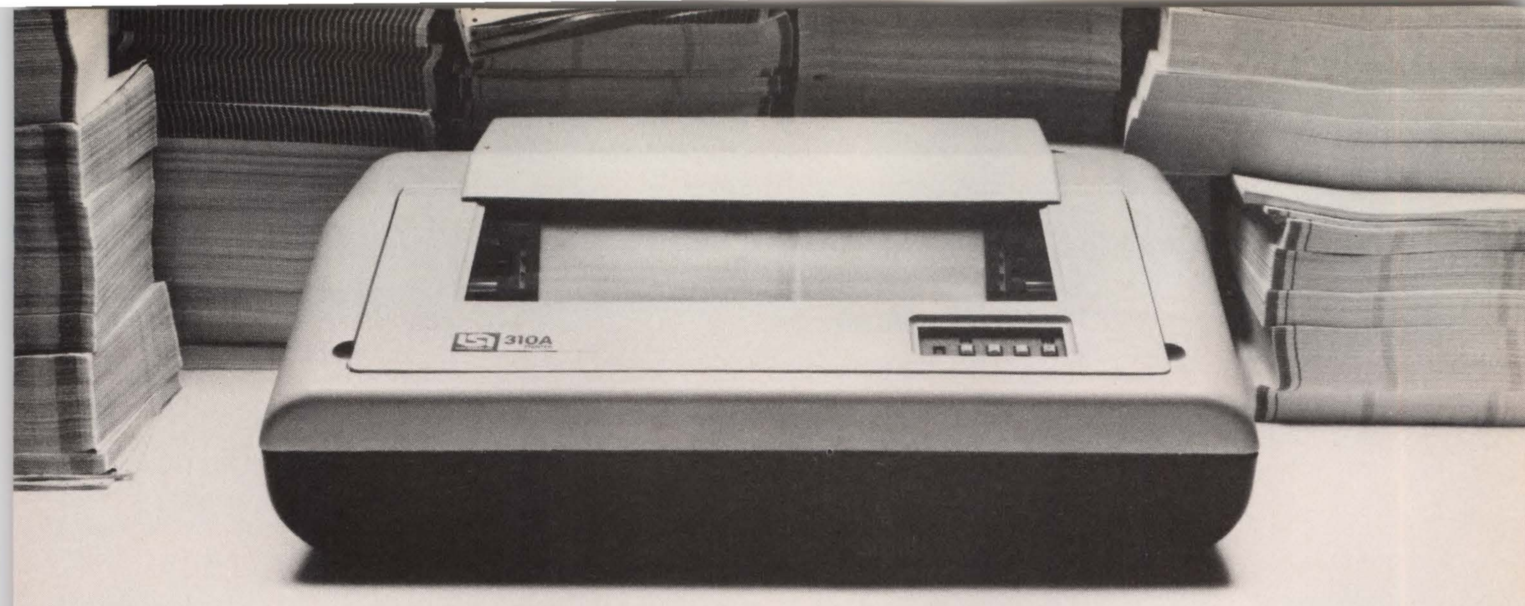
The series of drives announced by H-P comprise:

- The 7908 20M-byte, 8-in. Winchester-disk drive is built under license from International Memories, Inc., and is designed as an upgrade for the company's 14-in., 12M-byte 3340-technology "Amigo" device. The 7908 is priced at $9900 in single-unit quantities.
- The 7911 and 7912 14-in. Winchesters offer unformatted storage capacities of 34M and 64M bytes, respectively, and are priced in single-unit orders at $12,500 and $15,000. All three drives are available in stand-alone or rack-mount configurations, and incorporate a ¼-in. tape-cartridge drive for program loading and file backup.
- The 7935, H-P's largest disk offering to date, is a 14-in., 500M-byte drive that features a removable, sealed, seven-platter disk pack and ramp-loaded read/write heads similar to those found in IBM Corp.'s 3330-technology drives. Development of this drive reflected feedback from H-P's customers, Hoke says. "They were emphatic about removability. We got a very strong message."

To ensure seek reliability at the high track densities found on the 7935's removable disk packs (625 tpi), H-P added supplementary diagnostics to controllers used with this drive. Each time the 7935 powers up, the diagnostics go through an automatic head-alignment routine that compares absolute servo data written onto a dedicated servo surface with what H-P refers to as relative servo information —head-positioning data written onto three dedicated tracks on each data surface in the pack. On the basis of this comparison, the drive automatically makes the required head alignments when a new pack has been inserted or indicates to a user if head-alignment has exceeded a specified parameter.

The 7935 is priced at $27,500 in single-unit orders and is available only in a stand-alone enclosure. Evaluation versions of all drives will be available by year-end, with production quantities set for the first quarter of 1982.

—John Trifari



Hummm Economics.

First there was the Dumb Terminal® video display, a legend in its own time.

And now there's the Hummm Terminal™ Printer, a quiet revolution that's causing quite an uproar in the printer industry.

Quite simply, the 310A Hummm Terminal is the quietest printer in its class. With its Acoustic Quieter, it checks in at a soothing 56dBA, quieter than most typewriters and copy machines.

MODEL	CPS	PGS/8 HR DAY (50 LINES/PG)		NOISE LEVEL
		25% of Pg. Printed	50% of Pg. Printed	dBA
LSI 310A	180	960	811	56
DEC LA120	180	914	748	65
TI 810/820 RO	150	576	576	70
Centronics 704	150	582	582	65

But the Hummm Terminal isn't just quiet. It also gives you the fastest throughput around. In fact, it leaves the competition in the dust in typical applications, such as reports, tab runs, order entry, inventory, and other documentation.

HOW IT'S BUILT IS WHY IT'S BETTER.

Fine engineering is the key. The Hummm Terminal features logic-seeking 180 cps bidirectional printing. Space and blank character compression. High-speed slewing over spaces (most other printers don't speed up over spaces at all). And it can dump a full CRT screen instantly with its expanded buffer.

The Hummm Terminal is built to the same high specifications that made the Dumb Terminal the standard for an entire product category. What's more, the Hummm Terminal's print head is good for ¾ billion characters—3 to 4 times the competition's best. Which means less head replacement and maintenance costs for you.

FEW OPTIONS. A LOT OF STANDARDS.

You also get superior printing, including true lower case descenders and underlining, good for an original and five crisp copies on multipart forms. Not to mention a 9 x 7 character field standard (optional 9 x 9 or 9 x 12 for continuous printing), and optional foreign character fonts. And, naturally, the Hummm Terminal complies with FCC regulations.

All this at a hard-to-believe low price. So low, in fact, that you'll instantly know what we mean by Hummm economics.

So call your nearest LSI Authorized Distributor and ask him for some Hummm Terminal information. And when you do, fill out the coupon completely and send it to us. We'll send you a free Hum³ with over 3 billion combinations—and only one solution.

The Hummm Terminal. The quiet terminal that people just can't keep quiet about.

Lear Siegler, Inc. Data Products Division, 714 N. Brookhurst Street, Anaheim, CA 92803 714/774-1010. TWX: 910-591-1157. Telex: 65-5444.

Regional Sales Offices:
San Francisco 415/828-6941
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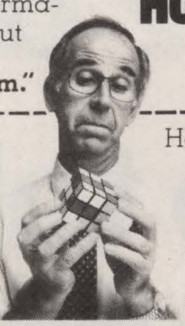
THE 310A HUMMM TERMINAL.

LEAR SIEGLER, INC. DATA PRODUCTS DIVISION

"Hummmm."



Hummm, Lear Siegler. You've certainly given me something to think about. I asked my distributor about the Hummm Terminal.

Here's his name along with my business card. (I realize that I can't get a Hum³ if I don't include my card.)

Name __________

Distributor __________

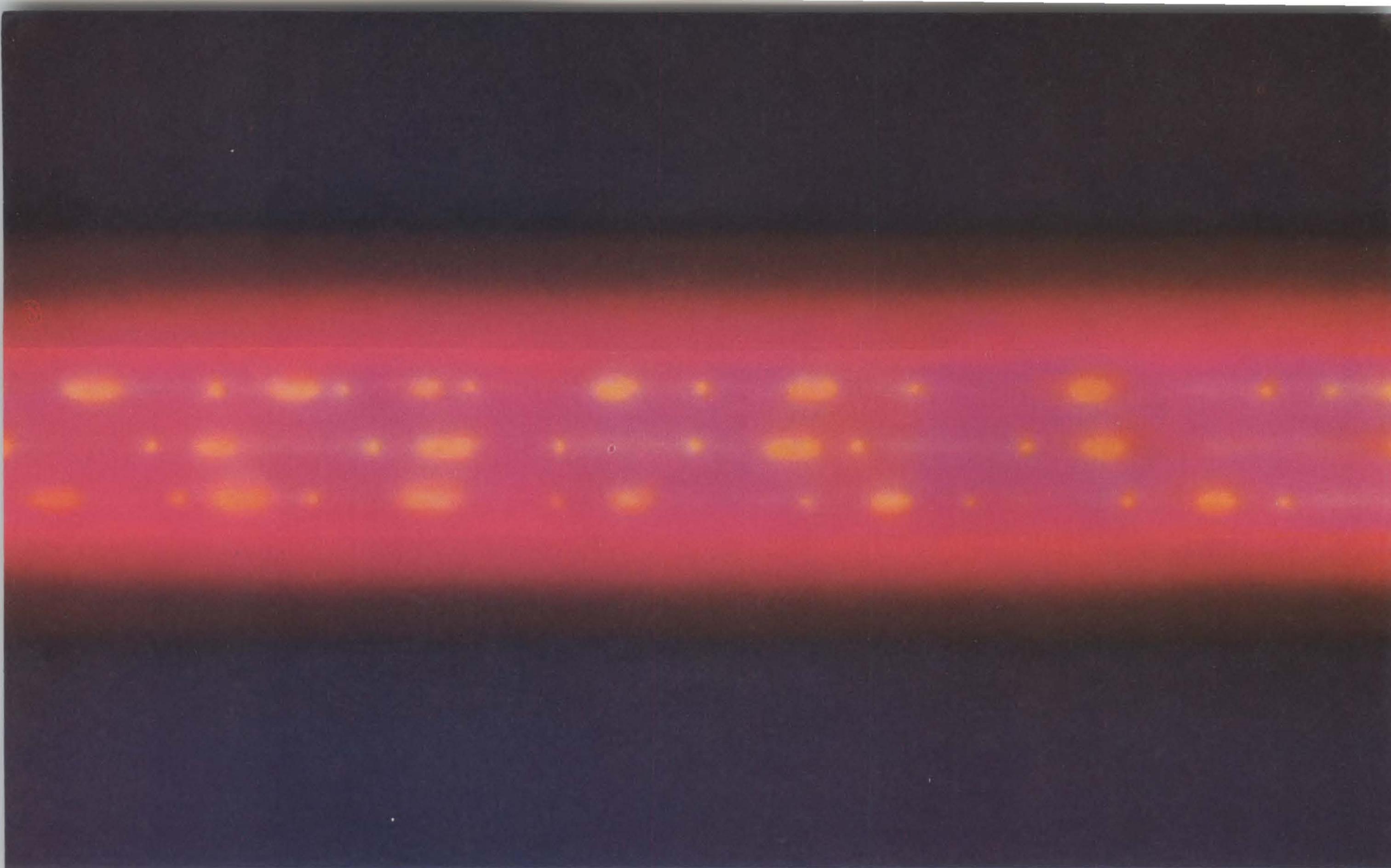
Distributor Sales Rep __________

Distributor Location __________

Distributor Telephone __________

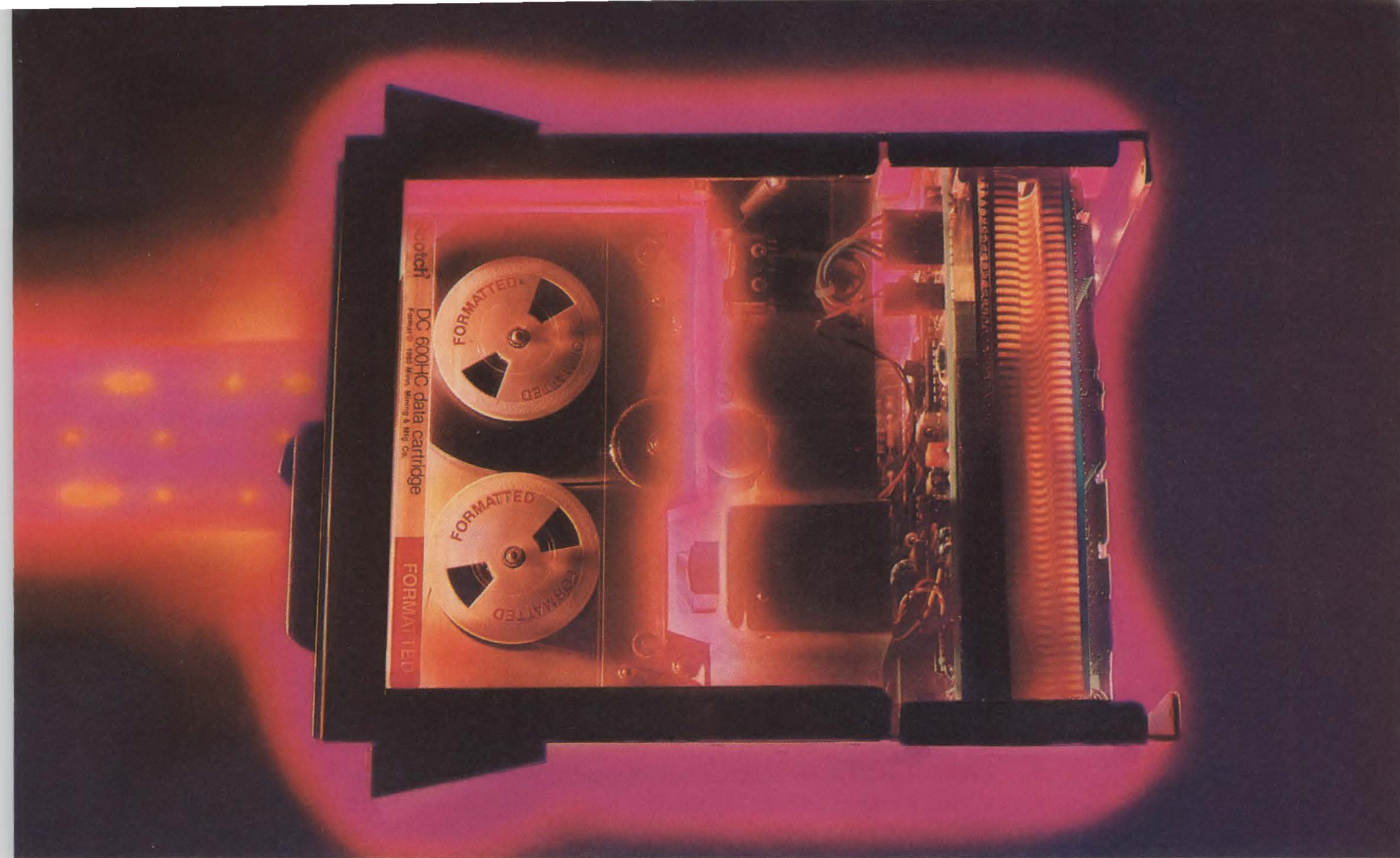
Lear Siegler, Inc., Data Products Division, 714 North Brookhurst Street, Anaheim, CA 92803. Attn: Adv. A

CIRCLE NO. 19 ON INQUIRY CARD



It takes real nerve to compare our ¼" back-up system with ½" drives.

It also takes 67 megabytes.



HCD-75: so much for so little.

Presenting the only 1/4" cartridge back-up system that'll go head to head with 1/2-inchers in the critical 30-70 Mbyte range.

The reason is simple. The 3M Brand HCD-75 Data Cartridge Drive System gives you 67 Mbyte per cartridge formatted. No other cartridge drive gives you so much capacity.

There's nothing medium about the medium, either. Each Scotch® DC 600HC cartridge is pre-recorded with permanent forward/reverse-reading block keys. They give you block-addressable storage. You get compact recording on all 16 tracks, with a density of 10,000 frpi, without rewinds.

The HCD-75 system, including drive and controller, is about one-fifth the size of a 1/2" tape drive. You don't have to put back-up and I/O plans on the back burner because of size constraints.

Interchange for the better.

Cartridges interchange quickly and easily. Tape-to-head alignment is ensured by a special sub-routine. It automatically aligns the read-write head and stepper motor controller to the tape edge each and every time the operator puts a cartridge in the system.

There's brain to this back-up, too. First, all its functions are handled through its controller. And second, there's minimal host involvement, so host time can be freed up for more critical functions.

All the reliability without high cost.

You can run one HCD-75 drive off the controller, or two, or three, or four. You still get all the reliability of the high-priced drives. The HCD-75 runs self-test routines to ensure proper operation. It gives you sophisticated error messages when faults are detected.

Advanced error-detection/correction routines keep working to deliver extremely low error rates. The micro-processor controls the drive functions; so potentiometer adjustments are a thing of the past.

Back-ups to go.

The total system—drive, controller, pre-formatted Scotch DC 600HC cartridges—is available to OEMs now. One at a time, or in evaluation quantities, you can take delivery on this reasonable, reliable, truly high-capacity alternative to 1/2" drives.

As close as your phone.

In fact, if you have been holding off on a back-up decision—or even if you haven't—make us put our back-up where our mouth is.

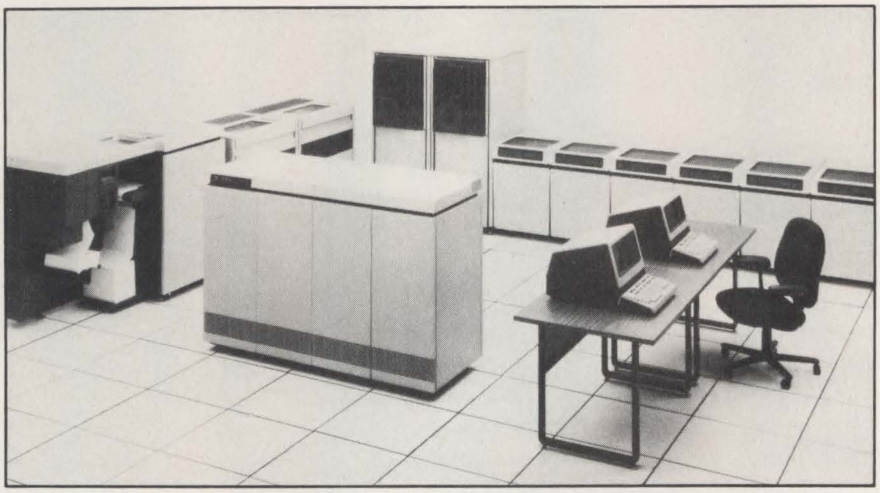
Call toll-free 800-328-1300. (In Minnesota, call collect: 612-736-9625.) Ask for the Data Recording Products Division. We'll give you the name of the 3M HCD-75 representative in your area. He's just waiting for the chance to show off his latest, greatest back-up.

Or write us at Building 223-5N, 3M Center, St. Paul, MN 55144.

3M hears you...

3M

CIRCLE NO. 20 ON INQUIRY CARD



The Series 64, *Hewlett-Packard Co.'s new top-of-the-line addition to the HP3000 series, is a 1-MIPS machine that uses a 32-bit data bus.*

the addressability of the HP3000 family. The first step in that plan was taken with the Series 64. Contributing to the improved performance of the Series 64, besides the 32-bit orientation of data bus and memory, is a dual arithmetic and logic unit (ALU) that performs 32-bit arithmetic in one cycle. Further, the new system is the first H-P commercial processor to use what the company calls hierarchical memory, cache memory used in conjunction with main memory. Additionally, a terminal processor has been included to improve transaction processing.

The ALUs, says David Butt, Series 64 product manager, are two independent pipelined 16-bit units connected via microcode. All operations are handled in microcode and are transparent to users, he adds.

The 32-bit-wide data bus links main memory—as much as 8M bytes of 200-nsec. 64K RAMs—with 8K bytes of high-speed (75-nsec.) ECL cache memory. Butt says the arrangement results in a 95 percent hit ratio—the probability of finding required data in cache rather than main memory.

The addition of an intelligent terminal processor also contributes to the Series 64's improved performance. Butt says the 6801 μp-based controllers off-load terminal-handling functions from the CPU. Direct-connection devices transmit at speeds as high as 19.2K bps over RS232 or RS422 lines. The system can handle more than 100 terminals.

H-P's new low-end machine, the Series 40, represents a price breakthrough for the company, officials say. A Series 40, including 256K bytes of memory, a 27M-byte Winchester-disk drive, a built-in tape-cartridge drive and four terminal ports, sells for $45,454. The low-cost peripherals package makes the price possible, the company says. Memory can be expanded to 2M bytes, and the system can handle as many as 56 terminals. Users of low-power HP3000s can upgrade to the Series 40 by exchanging processors.

The Series 44, until now H-P's top-of-the-line 3000, has not been forgotten. The machine is being upgraded with faster memory—150-nsec., 64K-bit RAMs on 1M-byte memory boards. Maximum memory is 4M bytes. Further, the price of a 1M-byte system has been reduced to $110,219 from last year's price of $126,000.

Series 64 prices start at $221,795, including a processor with 2M bytes of main memory, 12 terminal ports, a 120M-byte disk and a 1600-bpi tape drive. Additional main memory sells for $16,000 per megabyte.

All three processors use H-P's multiprogramming executve (MPE) operating system. H-P includes its database-management system, QUERY/3000; a data-entry and form-generating package, VPLUS/3000; and a keyed sequential-access package, KSAM/3000, all at no charge.

Data-communications support includes optional local or remote interconnection via X.25 to public packet-switched networks or with SNA networks under SDLC protocols.

—Larry Lettieri

Intel announces its first packaged system

Intel Corp. entered the packaged μc system business in November with the $27,500 system 86/330. The company claims the unit has four times the numeric-processing speed of a comparably priced mid-range minicomputer.

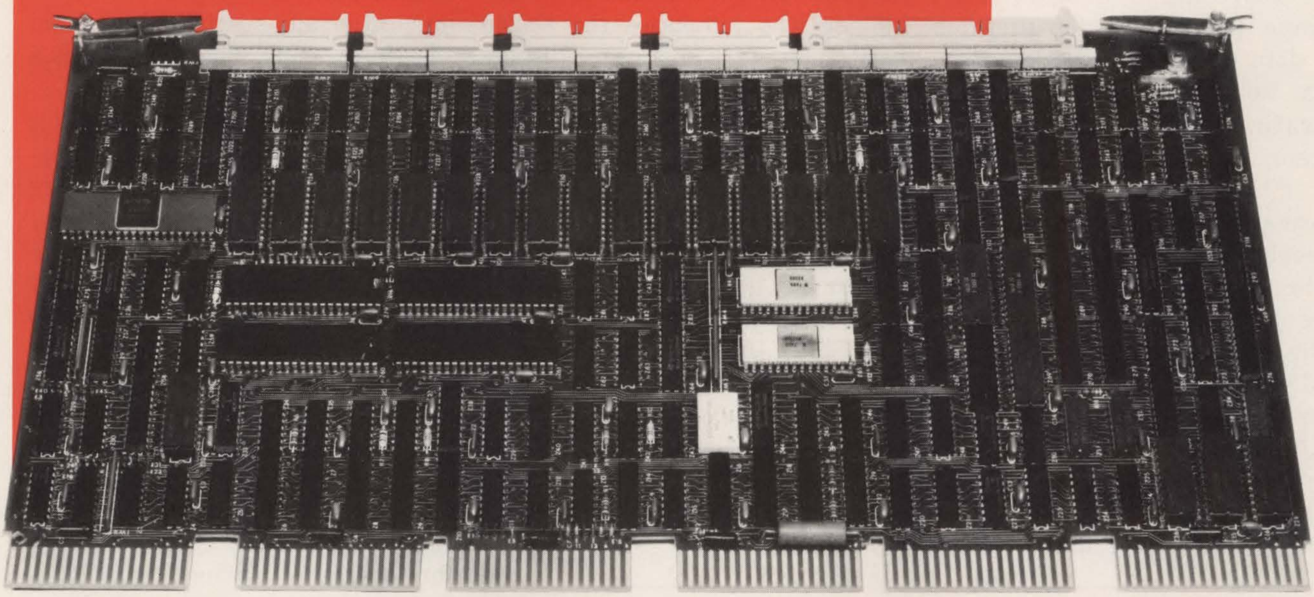
The move into this market takes on both industry leader Digital Equipment Corp. in the PDP-11/24 and 34/A class and some of Intel's own system builders using Intel boards and components.

"This is our first venture into the packaged-system business," says Bob Brannon, Intel's OEM μc systems marketing manager. He says the company is aiming its system at "STOMP," the sophisticated technical OEM market.

A FAMILY OF SOFTWARE-COMPATIBLE SMD CONTROLLERS FOR PDP-11 AND LSI-11

NEW!

COMPATIBLE WITH CDC AND FUJITSU 160MB MMD



Now you can get all you want from a single family of DEC®-compatible SMD controllers for your PDP®-11 and LSI-11® minicomputers. All the features, all the performance, all the compatibility. And all available now, from Dataram.

It is a proven family, started in mid-1979 with the S33/A, the industry's first DEC-compatible, single-board SMD controller with complete software compatibility. And evolving to today's eight price-performance leaders — four single-board PDP-11 compatible controllers and four dual-quad LSI-11 controllers, with RM02, RK07, RP06 and RK06 emulation.

All are software compatible with DEC's operating systems and diagnostics...all have the capability to drive up to four SMDs...all have multiple sector transfers, 2K of data buffering, and built-in self-test capability, standard...and all have operated with SMD drives from Control Data, Fujitsu, Ball Computer, Century Data, and Ampex, with capacities from 80MB to 300MB.

If you need SMD capability for your PDP-11 or LSI-11, one of our family of SMD controllers can fit right in. Call us today.

	RM02/05	RK07	RP06	RK06
PDP-11	S33/A	S33/B	S33/C	S33/D
LSI-11	S03/A	S03/B	S03/C	S03/D

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CIRCLE NO. 21 ON INQUIRY CARD

The 86/330 is based on a 16-bit iAPX 86/20 processor set, has 320K bytes of memory and uses the Multibus. Available as the model 86/331 19-in., rack-mounted version or the model 86/330 desk-top version, the system incorporates an 8-in., 35M-byte Priam Winchester-disk drive and a Shugart 8-in., 1M-byte floppy disk for program and data storage and backup. The iRMX 86 real-time, multitasking operating system manages the system. Intel offers BASIC, COBOL and C languages, plus its own Pascal-86, FORTRAN-86, PL/M-86 and Assembler-86.

The system's $27,500 single-unit price tag includes hardware, preconfigured iRMX 86 software and configurable iRMX 86 software and documentation. The price drops to $19,000 in quantities of 10, and, says a company official, to $15,000 in quantities of 100.

Intel also offers maintenance contracts for the system, including hardware and software supplied by outside vendors.

The packaged system allows system builders to "decompose" production costs as they succeed in the market—"something no minicomputer vendor can offer," Brannon says. He explains that a system builder who purchases the 86/330 needs only to add a video-display terminal to begin developing application packages. If the system builder develops a successful product, he can continue to buy systems or buy Intel boards and build his own systems. If the system continues to be successful, the OEM can continue to integrate backward from the board level to the component level, Brannon explains.

Brannon acknowledges that Intel's move puts it in competition with some of its OEMs that use Intel components or board-level products in their systems. "We will be a potential competitor (with OEMs) who add a low amount of value to the product," Brannon says.

Intel views two applications as especially appealing for 86/330 systems. The first is technical applications requiring rapid response times, including industrial automation, data acquisition, communication and specialized data and word processing. The second is as a program-development tool.

Intel officials claim the 86/330 is the only μc available with industry-standard boards, disks and software interfaces.

The system uses VLSI components, including an Intel 8087 floating-point processor and an 8086 processor, which work together at 100,000 Whetstones per sec., according to Intel.

The system has 320K bytes of memory, including 256K bytes of RAM using 64K dynamic RAMs. A total of 210K bytes is user memory for operating system, languages and user programs. The 86/330 is a single-terminal system that uses four slots of its six-slot chassis. The company plans to offer multi-user and 18-slot versions later, say company officials. As many as two processor boards can also be added.

Five software vendors will provide language compilers and development tools to support 16-bit iAPX 86 and iAPX 88 applications running under the iRMX 86 operating system. Compiler Systems Inc. and Micro Focus will offer COBOL, Microsoft will offer COBOL, a BASIC interpreter and a BASIC compiler, and Microsystems will offer Pascal. Intel's Universal Development Interface supports the third-party languages.

With the introduction of the 86/330 the company also reduced the price of its iRMX 86 operating system OEM license from $7500 to $6000. Incorporation fee schedule, depending on volume, is $130 to $300. —*Eric Lundquist*

MINIBITS

DIABLO ANNOUNCES LOW-COST DAISY PRINTER

Diablo Systems, Inc., Hayward, Calif., recently joined the race to market low-cost daisy-wheel printers (MMS, August, p. 9). In late September, the company introduced a 25-cps printer priced at less than $2000 in single-unit quantities. OEM pricing has not yet been specified. The printer is built around five modular assemblies: the printer mechanism, a control panel, a power supply, a two-bolt cover and a PC board. The board houses two 8-bit μps, an M6803 and an 8041. MTTR is about 15 min. if the boards are swapped during repair. Diablo claims an MTBF of 2500 hours.

TI REDUCES PRICES ON OMNI TERMINAL LINE

In a move the company says resulted from improved manufacturing technology, Texas Instruments Inc. is cutting prices 7 to 17 percent on selected models of its OMNI 800 data-terminal line. The model 840 RO impact printing terminal reflects the sharpest price cut, down 17 percent to $995. That terminal features an ASCII character set, a 9 × 7 dot-matrix print head, 110- to 9600-bps transmission rates and 75-cps print speeds. Price of the 810 RO printer has been reduced 13 percent to $1645. The 810 features a 9 × 7 dot-matrix character font, 110- to 9600-bps transmission rates, a 256-character receive buffer, an RS232C serial interface and a 150-cps print speed. A packaged 810, including a printer, an ASCII character set, an EIA interface, a vertical-forms control and a compressed-print option, has been reduced 12 percent to $1905.

TI lowered the price of a send-receive 840 RO version 7 percent to $1245. That system includes all the features of the 810 RO as well as a terminal with a typewriter-style keyboard and an automatic character repeat-option.

"Quantum fully intends to be the leader in 8-inch Winchester drives by 1982."

—Jim Patterson, President, Quantum Corporation

We have the very best people. People whose impressive credentials inspired a level of financial backing seldom seen in a company so young. A management team with 110 years' experience and 20 patents in computer peripherals. The same people who developed the first generation of low-cost Winchester drives. And the second. People who have demonstrated the ability not only to design a superior drive, but to produce it. In high volume. At low-cost. So you can count on reliable delivery of high-quality drives . . . always at a competitive price!

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CIRCLE NO. 22 ON INQUIRY CARD

First removable-only 5¼-in. Winchester shown at Comdex

The announcement of a set of media standards for a newly developed 5¼-in. disk cartridge—concurrent with the unveiling of drives capable of handling this type of media—has given systems designers yet another method of approaching the question of file backup for small Winchesters.

The disk cartridge is the result of the combined efforts of medium vendor Dysan Corp. and two vendors of 5¼-in. hardware—Santa Barbara, Calif., start-up DMA Systems Corp. and Seagate Technology, Scotts Valley, Calif. Last year, Seagate introduced the first 5¼-in. Winchester—a 6M-byte fixed-platter device called the ST-506 (MMS, April, 1980, p. 79).

DMA Systems' first drive, the 10M-byte Micro-Magnum 5/5, combines in a single package a conventional fixed-Winchester platter for file and program storage and the new Dysan disk cartridge (MMS, September, p. 44). Both the cartridge and the fixed-platter are driven from a common spindle.

The first Seagate drive to use this removable media, the 6M-byte ST-706, was announced last month, and is the first removable-only 5¼-in. Winchester to appear on the market. It is scheduled to be shown for the first time at the Comdex show in Las Vegas, Nov. 19-22.

With the exception of total capacity and the ability of interchange media, the device is essentially a carbon copy of the 12M-byte ST-512 announced by Seagate this year. Both drives incorporate thin-film read/write heads and operate at bit densities that exceed 10,000 bpi. Both feature track densities of 270 tpi (compared to 255 tpi for the ST-506), producing a total of 306 tracks per surface.

The ST-706 can be used as direct one-to-one backup for the ST-506, or it can be operated in a 2:1 backup ratio if tied to an ST-512. In the former case, controller firmware will have to be modified to permit data stored on the two-platter 506 to be mapped over to the single-platter

Ramtek quality at jellybean prices.

Now just $5,995 will get you a Ramtek 6211 Colorgraphic Terminal. The 6211 has 640 x 480/512 resolution. Your choice of sixteen colors displayed simultaneously from a palette of 64 *and* it's TTY and VT-100 compatible. You can plug right into your minicomputer or timeshare system.

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This special $5,995 price is an introductory offer and good only until December 31, 1981. Considering how popular jellybeans are these days, we suggest you call soon. Once you try the Ramtek 6211, we think you'll find it, well . . . tasty.

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Our Experience Shows

CIRCLE NO. 25 ON INQUIRY CARD


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Among FLEX's unique talents is the ability to handle the ball 20% to 70% faster than its DEC counterpart. Another, is its ability to handle dual-headed, double-density disk plays... a feature no other quarterback in the RX02 league can provide. Fully suited, the FLEX02 comes in two packages: two 8" single or dual-head floppies, one dual-width controller card, and power supply, **or** one 23MB, 8" Winchester (not available from DEC), plus one 8" floppy, a dual-width controller board, WINC™ interface, formatter, and power supply in a 5¼" DEC look-alike cabinet. Individual controller boards are also available. Whether you have RSX-11/M, RT-11V3A/B, I.A.S., CTS500 or CTS310 centering the ball, the FLEX02 is completely CPU transparent. And designed to take care of DEC software modifications with microcode changes only.

All this at half the DEC price, and with 30-day delivery.

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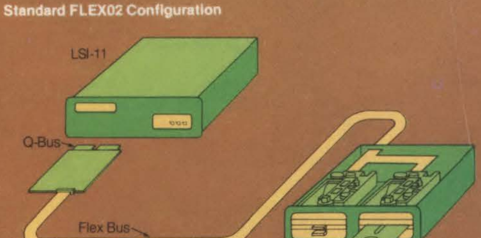
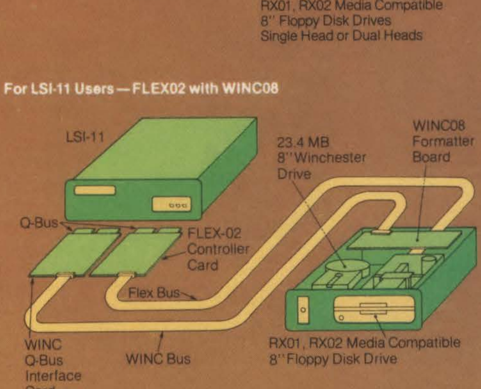
Standard FLEX02 Configuration



For LSI-11 Users—FLEX02 with WINC08



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CIRCLE NO. 27 ON INQUIRY CARD

706. In the latter, data can be mapped from one drive to another directly from one data surface to another, although only one-half of the data stored on a 512 can be accommodated. Transfer rates on the ST-706 are the same as previous Seagate Winchesters, permitting the use of existing data separators and controllers with only slight modifications. For example, one of the interface pins will have to be redesignated to indicate to the controller whether the cartridge has been installed.

Use of the removable-only cartridge drive will open a wide range of new applications for small Winchesters, say Seagate executives. At the low end, the device is seen as a direct 5M-byte upgrade for desk-top systems based on 5¼-in. floppy-disk drives. At the high end, incorporating disk-cartridge drives with high-capacity 5¼-in. fixed-disk Winchesters, such as the Seagate 38M-byte ST-538 (also scheduled to appear for the first time at Comdex), will permit manufacturers of μc-based systems built around 16-bit processors to compete directly against the higher level hardware now offered by minicomputer houses. "We don't consider t in these types of applications, even though the drives have more than enough capacity.

Such applications are not universal, however. One example is multi-user μc development systems in which a common disk file is shared. In these types of applications, large amounts of code must be rapidly loaded, compiled and stored so that another programmer can get onto the system. Other applications include point-of-sale systems in which pricing updates must be made frequently and μc-based graphics-display configurations in which large amounts of data must be loaded into the system and then pulled off the screen and stored.

Business applications—now the core of small-Winchester sales—may still be able to function easily with the floppy-disk drives used for Winchester backup on a transaction basis, with the tape-cartridge drives capable of duplicating an entire file. Mahon concedes that in such applications, use of a disk-cartridge drive leaves a hole in the market. For example, he notes, floppy-disk drives are widely used to disseminate applications programming, and use of disk cartridges for this purpose will be higher capacity disk-cartridge drives get rolling. "These drives will definitely have an impact on the market for floppy-disk hardware," he says. "It makes no sense to add a 2M-byte floppy-disk drive when higher performance devices, such as the ST-706, are available, unless, of course, hardware cost is an overriding consideration."

Roman notes that vendors of ¼-in. tape-cartridge drives may also feel the impact of the disk-cartridge devices. "These are not as desirable as disk-cartridge devices," he maintains. "They have different transfer rates and require the use of a different controller." In addition, he stresses, these drives are not designed to fit the form factor established for 5¼-in. rotating memories. Roman anticipates that removable-only drives, such as the Seagate ST-706, and fixed/

LOOKING AHEAD IN MMS

Watch for Mini-Micro Systems' annual special report on computer graphics in the December issue. A comprehensive product profile of computer-graphics terminals will lead off the feature section, which will be augmented by several other

Seagate Technology's ST-706 and ST-538

	ST-706	ST-538
Unformatted capacity	6.38M bytes	38M bytes
Transfer rate	5M bits/sec.	5M bits/sec.
Recording density	10,202 bpi using thin-film heads from Dastek Corp.	10,202 bpi using thin-film heads from Dastek Corp.
Track density	270 tpi	540 tpi
Number of cylinders	306	612
Number of platters	one	three

removable hardware, such as that announced by DMA, will propagate over the next few years. "A total of 8000 devices with removable cartridges will be shipped next year," he predicts. "The number will hit 450,000 by 1985—about one-third of all 5¼-in. Winchesters sold."

The reponse to this development by tape-cartridge-drive vendors will be in the form of hardware designed to fit the form factor established by the 5¼-in. Winchester, he maintains (MMS, July, p. 16). But, he says, there are still no formal plans on anyone's part to build such a drive. Nonetheless, he adds, "These vendors won't stand still."

Archive Corp. marketing vice president and co-founder Wes Theriault is one who fits this description. "Disk-cartridge drives will make waves," he says. "They're new and exciting, and, most certainly, they will have some impact on system design." Archive, he adds, is defining a tape-cartridge drive that will fit the smaller form factor established by 5¼-in. drives, but he won't say what medium the product will have.

Seagate's Mahon feels that even if tape-cartridge drives are redesigned with smaller form factors, they still will not compete effectively against disk cartridges in applications in which transfer rates are critical. Theriault concedes that faster transfer rate may be an advantage enjoyed by the newer disk cartridge, but that high medium prices may outweigh this advantage in the long run.

How questions such as these will be answered may not be known for some time. The ST-706 and ST-538 will most likely use stepper-motor-driven actuators. But whether any track-following servo information will be incorporated to compensate for the removability of the cartridge and for the 538's high track densities (540 tpi) has yet to be determined.

Evaluation versions of the ST-706 are targeted for the third quarter of next year, with volume production slated to begin during the second quarter of 1983. Pricing for the drive has not been firmly established.

Neither pricing nor delivery schedules for the ST-538 has been set.

—John Trifari

North Star's desk-top system marks shift in company emphasis

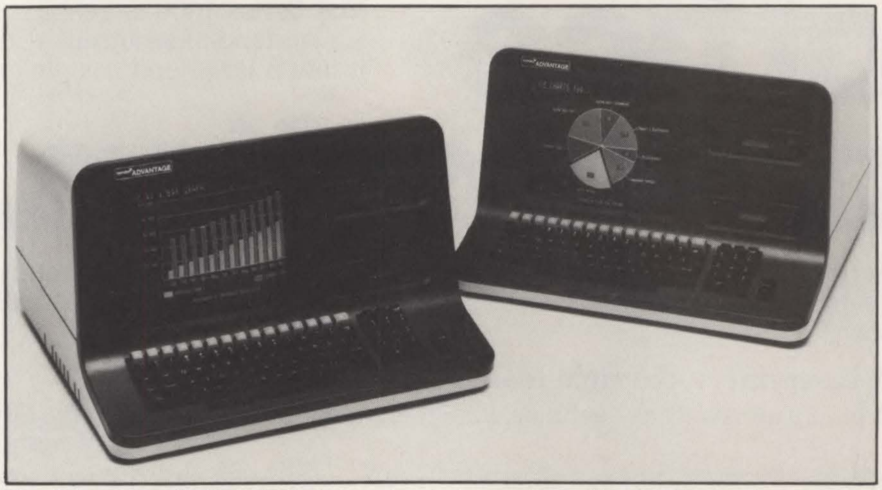
With the introduction of the Advantage, its first integrated desk-top computer, North Star Computers, Inc., has shifted its emphasis from engineering to marketing.

Founded in 1976, the San Leandro, Calif., company's first products were S-100 bus-based board-level computer components. These evolved into its Horizon line of Z80-based μc systems, first offered as kits and later as complete systems. The new system integrates the Z80 CPU in a stand-alone unit complete with a 12-in. display, a keyboard and two 5¼-in. floppy-disk drives. The system also uses a proprietary bus rather than the S-100.

Elliott Wassarman, vice president of marketing, says the proprietary bus will tie peripheral purchases to North Star and make the distribution network more dependent on the company. Along with traditional distribution methods, Systems will be offered on a private-label basis. Wassarman says the company is negotiating with several large firms for private-labeling contracts.

Priced at $3999 in single-unit quantities, the Advantage has 64K bytes of memory that will be expandable to 192K bytes. An Intel 8035 controls the two minifloppies and the keyboard. The chassis contains six slots for plug-in boards such as parallel interfaces, RS232C serial interfaces or the company's floating-point board.

The system's 12-in. screen displays 1920 characters or 240- × 640-pixel bit-mapped graphics. GDOS, a proprietary operating system developed for the Advantage, is key to the system's graphics



The Advantage, *Northstar's desk-top stand-alone system, offers 64K bytes of memory and bit-mapped graphics capability.*

capabilities, and a version of Digital Research's CP/M makes the system's graphics capabilities available to CP/M-compatible programs, Wassarman says. North Star also supplies its proprietary HDOS operating system, BASIC, COBOL and FORTRAN.

North Star's proprietary applications software package, ASP, is a standard feature. According to the company, ASP manages the system's resources and provides an indexed sequential-access method and a random file-management system interface for the application software. ASP software includes general business and accounting packages, and an application-development system is available for custom program development, says Wassarman.

By January, North Star plans to add 96-tpi floppy-disk drives and 5¼-in. 5M-byte Winchester-disk drives as options and a local area network is planned for late 1982. North Star began shipping Advantage in September. *—Larry Lettieri*

DEC, Rexon wooing office-machine dealers

Armed with discounts and promises of training and service aids, computer vendors are wooing office-machine dealers to entice the latter into adding small-business systems to their office-product lineups. Digital Equipment Corp., Rexon Business Machines Corp., Vector Graphic Inc and Point 4 Data Corp. have all launched campaigns aimed at luring office dealers into the reseller folds.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2
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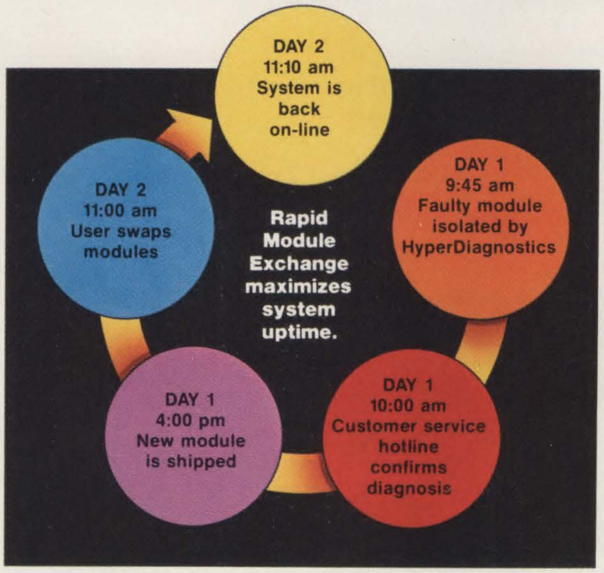
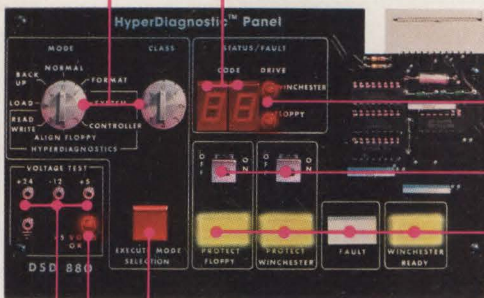
More reliable performance and easier maintenance.





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*This controller/interface is also available separately as the DSD 4140.

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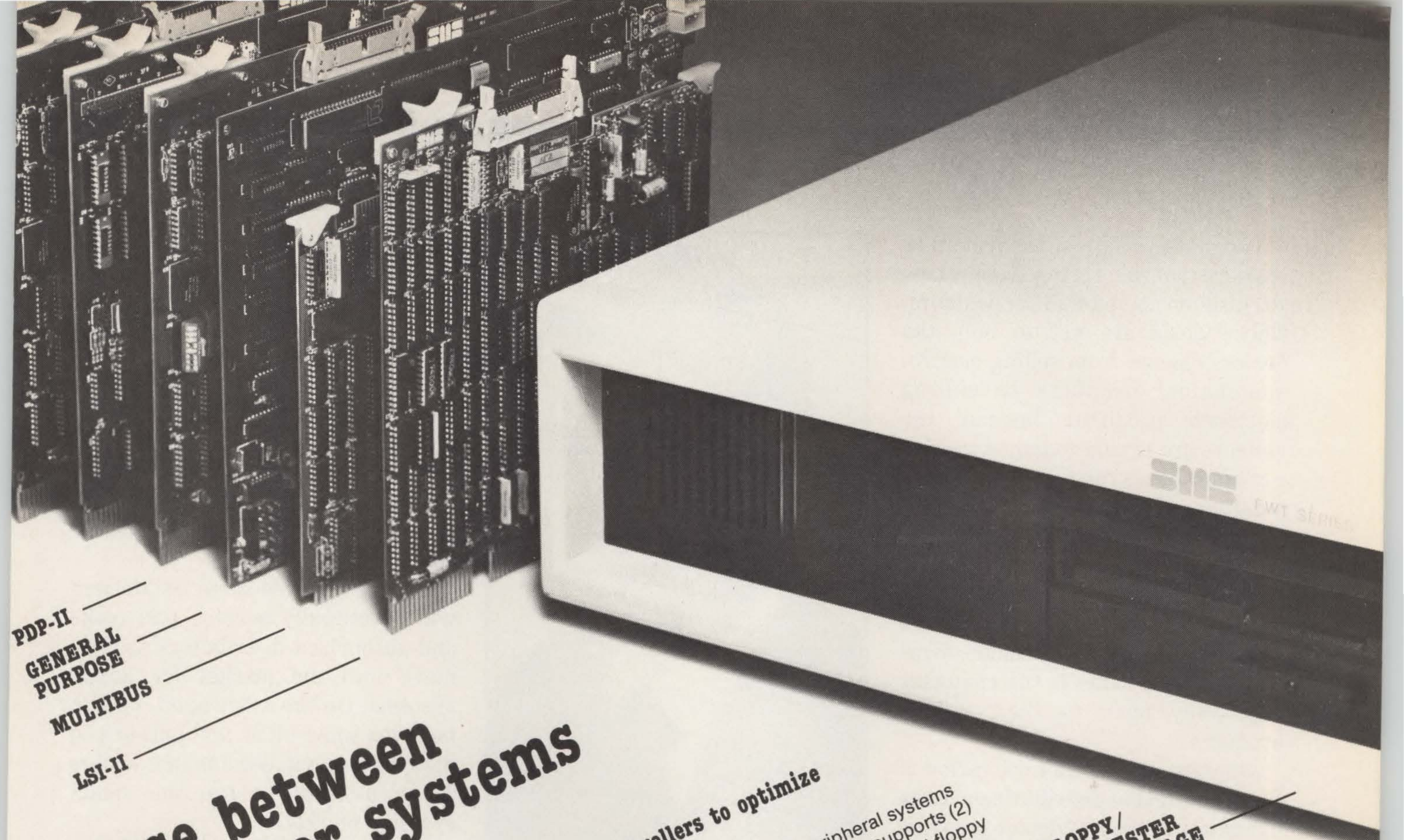
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UP TO 40 BYTES OF STORAGE

The move to sign office dealers as resellers doesn't spring from a new altruism on the part of the vendors, whose goals are not to help the dealers change from selling electromechanical products to selling electronic products. Instead, the vendors are trying to gain access to customer bases ranging from tens to hundreds of accounts built on direct sales calls. In the process, the vendors have stretched the traditional definition of a reseller from one that adds software or hardware value to a product to include firms whose added value is the customer base they open to the vendor's products.

DEC has started its exploration of the office dealer-distribution avenue by initiating the DECdealer program that offers 32 percent discounts on equipment in return for a promise from the dealer to move six systems per quarter. The office-dealer program raises the possibility of DEC resellers competing against the company's captive retail stores—competition that would increase when DEC launches yet another distribution channel by opening its product line to independent computer retailers.

DEC officials are reviewing candidates for the DECdealer program, and have outlined what types of office dealers they want and what those dealers can expect in return for passing muster.

The office-machine dealers, "are expected to add value in terms of selling expertise, local merchandising and local support," says Clarence M. Brooks, DEC's word-processing group manager. Brooks adds, "Most of these guys have their own base of customers that they have built over the years, and that is the base we're penetrating." DEC is counting on its service availability to draw dealers into the program.

The DECdealer program was kicked off at the National Office

Clarence M. Brooks, *DEC's word-processing group manager: "The market is expanding so rapidly that you need multiple distribution channels to service all potential buyers."*

Machine Dealers' Association (NOMDA) convention in July. The program centered around the DECmate 278 business system, which is the only announced member of the DECmate product family. The system, which uses an extended PDP-8 instruction set and includes business-oriented software application packages, sells for less than $10,000. The product's support plan includes a toll-free telephone number and on-site service. The support plan sells for $109 a month for systems with a letter-quality printer and word-processing software.

Brooks says DEC will look first at coverage in areas not under the DECstore umbrella. But the DECdealer and DEC retailer programs don't preclude the possibility of resellers competing against DEC's in-house sales and retailing force, Brooks acknowledges.

The evaluation that DEC uses on dealers is similar to the qualifications it seeks in potential OEMs. Those considerations include the dealers' ratings in customer surveys, their financial viability, reputation, marketing thrust, customer profile and location.

After becoming a DECdealer, an office-equipment supplier is eligible for the DECmate discounts, sales training, warranties, field-service support and cooperative promotional programs, including cooperative advertising.

Brooks believes some DECdealers will eventually become DEC OEMs and authorized distributors as they move into the market for larger systems. On the other hand, he also believes some OEMs and authorized distributors will become DECdealers in an attempt to tap the small-systems market.

Brooks says that the DECdealer program is a product of an expanding market rather than an expression of dissatisfaction by DEC with the volume of systems being moved by DECstores. "The market is expanding so rapidly that you need multiple distribution channels to service all potential buyers. We just couldn't open enough stores to capture the opportunity," Brooks says.

The office-machine dealers that are the objects of vendors' advances have a different perspective on the proposed vendor/dealer relationship. "What the manufacturers are basically looking for is our customer list," says Edward Ramos of Super Business Machines Inc., New York. Ramos is an Apple dealer and frequent speaker and seminar leader for office dealers considering the move to small-business systems. He estimates that of the 5000 NOMDA members, 10 percent are involved in selling information-processing equipment. Vendors are trying to lure dealers with discounts ranging from 30 to 41 percent, Ramos says.

Prospective dealers are looking for computer-sales training and help in financing the initial system purchases called for by the manufacturers. Ramos tells prospective dealers that entering the computer business will cost about $150,000 immediately, and that they can expect a negative cash flow for the first 18 months. Dealers are warned that a negative cash flow for that time span can lead to bankruptcy.

Rexon Business Machines Corp. sells, "exclusively through nonexclusive dealers," says Rexon vice president of marketing Ralph M. Armstrong. The firm has also begun to court office dealers to sell its RX line and offers a 35 percent discount in return for a commitment to sell 12 systems yearly. Rexon has 80 independent sales organizations in its dealer network, about four of which are office-equipment dealers. Service is performed through Rexon's service programs.

Armstrong sees the office dealers as a "natural distribution channel" and, not unsurprisingly, believes the Rexon distribution plan is superior to DEC's plan because the dealers don't have to face the prospect of competing against a Rexon end-user sales force.

DEC's Brooks won't project DECdealer-program growth, but a DEC spokesman says, "We look for this to become large eventually with perhaps hundreds of dealers." In the meantime, the DECstore program is expected to become more aggressive in its marketing style and is believed to be readying plans for direct sales that will see DECstore salesmen making outside calls rather than waiting for business to walk in from the street.

—Eric Lundquist

Computer-services acquisitions on the rise

Although overshadowed by the multi-billion acquisition deals being made by oil and chemical companies, takeover activity in the computer-services industry is 40 percent ahead of last year's pace, according to one index. In the first six months of 1981, 57 acquisition and merger transactions occurred in the computer-services industry. Those transactions represent a total cash and stock value of $244 million, according to figures compiled by Broadview Associates of Fort Lee, N.J., broker for potential merger partners. For the comparable 1980 time period, 40 percent fewer transactions occurred, carrying a total value of $164 million.

The increased merger and acquisition activity is partly a reflection of the expanding computer-services industry, which ranges from time-sharing firms using large computers for batch processing to companies offering industry-specific applications on minicomputer or μc-based systems, says Gilbert Mintz of Broadview.

The $15-billion computer-services business is expected to grow to $35 billion by 1985, according to projections developed by Input Inc., a Palo Alto, Calif., research organization. The $35-billion figure is based on processing services growing at a 6.4-percent rate to $18.8 billion in 1985; software services growing at 28.3 percent to reach $8.7 billion by 1985; and professional services growing at 16.5 percent to hit $7.5 billion by 1985.

Much of the merger activity and projected future growth is occurring in the software-services sector, which Broadview Associates further divides into packaged- and contract-related areas, and divides those areas, in turn, into smaller segments. Some acquisitions have received wide publicity, such as Management Science of America Inc.'s June purchase of Peachtree Software Inc., Atlanta, for $5.5 million. Last year, Peachtree had revenues of about $2 million.

Other acquisitions have attracted less attention. For example, Informatics Inc. purchased Professional Software Systems, Phoenix, Ariz., a Wang Laboratories Inc. OEM selling packaged software systems aimed at attorneys. Dyatron, Birmingham, Ala., which specializes in automotible-dealer computer services, bought Micomp Datasystems Inc., Colorado Springs, Colo., which sells minicomputer systems to group medical practices. Logica Inc., New York, the U.S. subsidiary of London-based Logica Holdings, has made an agreement to acquire Fryberg Systems Associates Inc., which sells DEC- and Tandem-computer-based banking systems. Concerning the increase in mergers and acquisitions, Mintz says, "Mergers in the computer-services area are generally motivated by a desire to secure a new product line or an expansion of an existing product line. People have stopped doing acquisitions just to send out a sexy press release or hokey up their stock."

When Management Science acquired Peachtree, the former "bought a copy of themselves, but aimed at the minicomputer market," Mintz says. In Dyatron's case, the acquisition enabled the company to extend its services into a new application area.

"One reason that there are so many acquisitions is that the people who are selling have the unique opportunity to have their cake and eat it too. The acquisition activity is a vehicle for the creation of wealth and it is also a career," Mintz says.

Mintz expects to see large companies begin to pursue acquisitions of computer service companies. "There are a number of companies outside the industry looking to get in." *—Eric Lundquist*

BOX SCORE OF EARNINGS

This table, which appears every month, lists the revenues, net earnings and earnings per share in the periods indicated for companies in the computer industry and computer-related industries.

Company	Period		Revenues	Earnings	EpS
Comsat	6 mos.	6/30/81	159,531,000	26,253,000	1.81
	6 mos.	6/30/80	142,232,000	19,018,000	2.20
Computervision	6 mos.	6/30/81	124,958,000	13,998,000	.51
	6 mos.	6/30/80	83,471,000	9,251,000	.37
Fujitsu	year	3/31/81	2,769,895,200	87,871,429	.11
	year	3/31/80	2,385,714,300	74,500,000	.10
General Instrument	26 wks.	8/30/81	447,624,000	41,363,000	1.40
	26 wks.	8/31/80	407,726,000	31,567,000	1.18
Gerber Scientific	3 mos.	7/31/81	25,956,000	1,064,000	.17
	3 mos.	7/31/80	22,765,000	3,636,000	.58
Harris Corp.	year	6/30/81	1,584,488,491	103,957,635	3.37
	year	6/30/80	1,307,646,802	79,682,432	2.63
Mohawk Data Sciences	3 mos.	7/31/81	73,532,000	1,081,000	.08
	3 mos.	7/31/80	78,297,000	4,605,000	.41
Molex	year	6/30/81	143,013,603	15,990,235	2.44
	year	6/30/80	121,523,387	14,844,981	2.28
National Data	year	5/31/81	75,666,000	7,508,000	.77
	year	5/31/80	60,129,000	5,670,000	.59
Plantronix	year	5/30/81	95,459,000	11,956,000	1.86
	year	5/31/80	84,123,000	8,010,000	1.26
Plessey	13 wks.	7/3/81	420,900,000	29,948,000	1.24
	13 wks.	6/27/80	367,700,000	22,268,000	.93
Savin	3 mos.	7/31/81	127,525,000	(2,265,000)	.40
	3 mos.	7/31/80	99,780,000	4,315,000	.65
Scientific-Atlanta	year	6/30/81	277,292,000	19,005,000	.90
	year	6/30/80	191,997,000	12,721,000	.65
STSC	3 mos.	8/31/81	7,009,000	151,000	.07
	3 mos.	8/31/80	6,350,000	461,000	.26
Sykes	6 mos.	8/31/81	19,420,036	3,664,432	.29
	6 mos.	8/31/80	8,797,627	877,482	.08
Western Digital	12 mos.	6/30/81	27,010,000	(471,000)	(.04)
	12 mos.	6/30/80	20,603,000	678,000	.05

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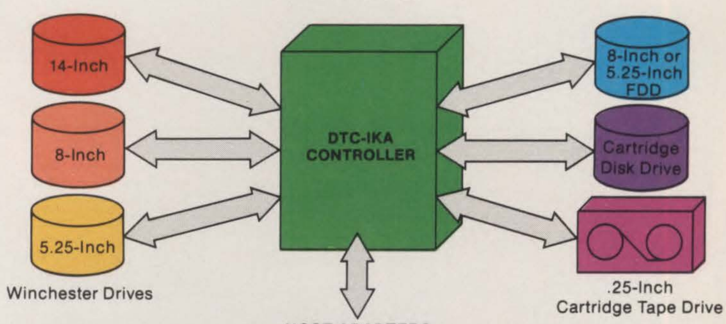

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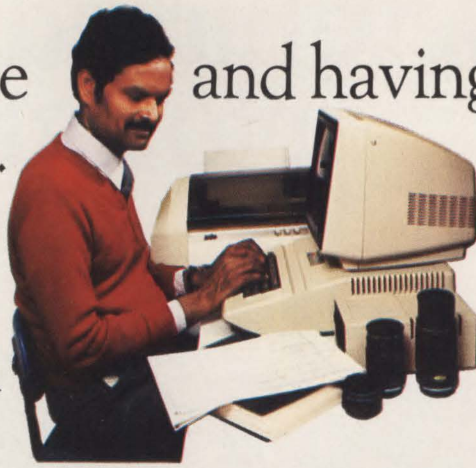

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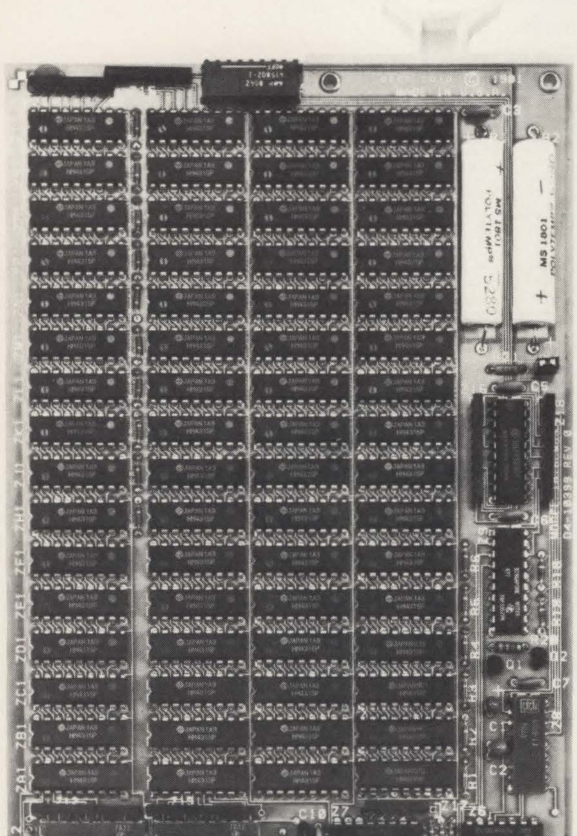

- 16K word ADD-IN memory replaces bulky core
- On-board battery back-up assures data retention up to a full week without external power
- Decodes 18 bit address and allows the RAM to start on any 4K boundary
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- High speed 450 ns memory chips
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- Long 3 year battery life
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The 1816 CMOS memory is another LSI-11, LSI-11/2 and LSI-11/23 compatible device from ADAC. It is ideal when it's important not to lose data during power outages. And it requires only a fraction of the space and power of comparable core memory. Contact ADAC for full details on this unique memory or any of our analog and digital function cards and complete systems for LSI-11.

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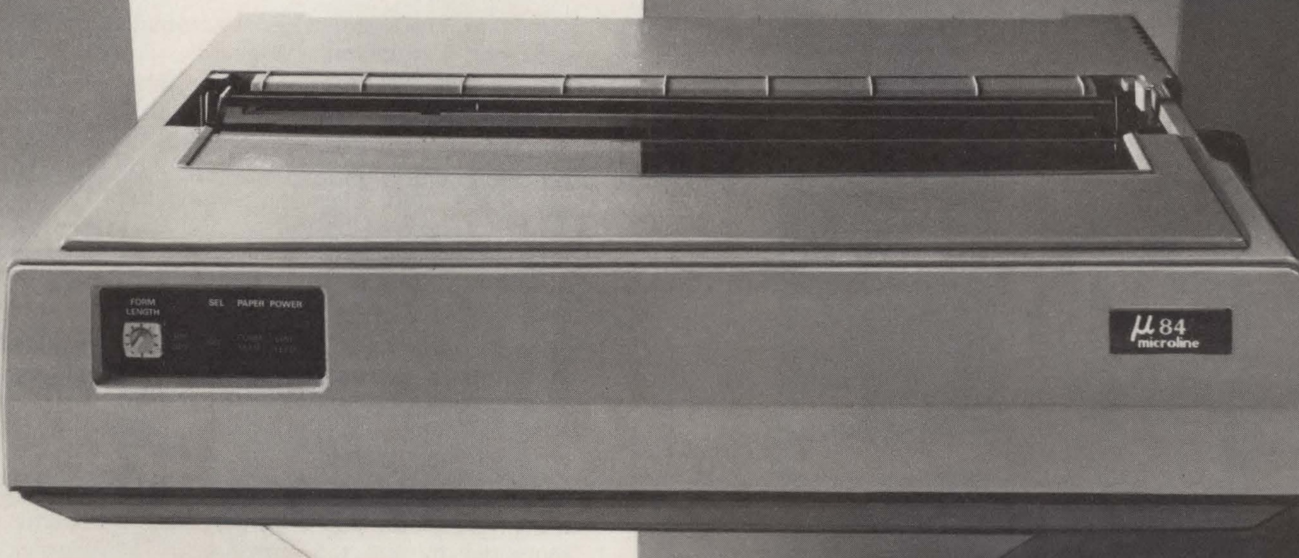

Making small printers for people who think big.

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CIRCLE NO. 69 ON INQUIRY CARD

Calendar

SHOWS & CONFERENCES

NOVEMBER

16-29 **CPEUG '81 (Computer Performance Evaluation Users Group),** San Antonio, Texas, sponsored by the National Bureau of Standards and the U.S. Department of Commerce. Contact: Peter J. Calomeris, CPEUG '81, National Bureau of Standards, A265, Technology Bldg., Washington, D.C. 20234, (301) 921-3861.

17-19 **Computerized Office Equipment Expo,** Atlanta, organized by the Kiver Group. Contact: Industrial & Scientific Conference Management, Inc., 222 W. Adams St., Chicago, Ill. 60606, (312) 263-4866.

19-20 **Western Educational Computer Conference,** San Francisco, sponsored by California Educational Computing Consortium. Contact: Ron P. Langley, Director, Data Processing Services, California State University, Long Beach, 1250 Bellflower Blvd., Long Beach, Calif. 90804.

19-22 **COMDEX '81,** Las Vegas. Contact: Peter B. Young, The Interface Group, 160 Speen St., Framingham, Mass. 01701, (617) 879-4502 or (800) 225-4620.

20-22 **Symposium on Small Computers in the Arts,** Philadelphia, sponsored by Philadelphia Area Computer Society, University of Pennsylvania, the IEEE Computer Society and IEEE Philadelphia Section. Contact: Dick Moberg, Symposium Coordinator, Symposium on Small Computers in the Arts, Box 1954, Philadelphia, Pa. 19105, (215) 243-8109.

DECEMBER

1-3 **Software Info International,** London, England, sponsored by *Infosystems* magazine. Contact: Robert A. Cycon, *Infosystems,* Hitchcock Publishing Co., Hitchcock Bldg., Wheaton, Ill. 60187, (312) 665-1000.

1-3 **Legal Info, The National Legal Automation Conference and Exposition,** Washington, sponsored by Legal Automation News. Contact: Kendall E. Burroughs, Program Chairman, Legal Info, 1730 N. Lynn St., Suite 400, Arlington, Va. 22209, (703) 521-6209.

1-3 **The International Information/Word Processing Association's 1981 Canadian Symposium,** Ottawa, Ontario, sponsored by the IWP. Contact: James J. Donio, International Information/Word Processing Association, 1015 N. York Rd., Willow Grove, Pa. 19090, (215) 657-6300.

1-4 **CMG XII International Conference on Computer Performance Evaluation,** New Orleans, sponsored by Computer Measurement Group, Inc. Contact: Donald R. Deese, General Chairman, FEDSIM, 6118, Franconia Rd., Alexandria, Va. 22310, (202) 274-8461.

2-4 **"Improving ADP Management under the Paperwork Reduction Act" Conference,** Washington, sponsored by the U.S. Professional Development Institute. Contact: U.S. Professional Development Institute, 12611 Davan Dr., Silver Spring, Md. 20904, (301) 622-0066.

6-9 **Data Training '81; Conference on DP Training,** Boston, sponsored by Warner/Wein Garten, Inc. Contact: Loretta Lillios, Warner/Wein Garten, Inc., 176 Federal St., Boston, Mass. 02110, (617) 542-0146.

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They're less expensive going in, and that's only the beginning.

Our printers also give you extra margins which no competitive printers can match. Here's how.

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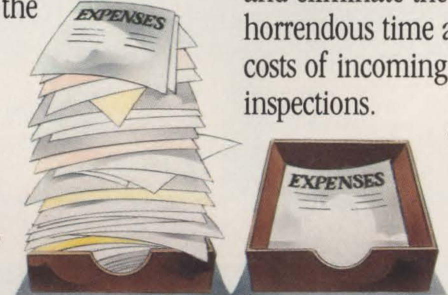
Spinwriter™ letter-quality printers have a mean time between failure (MTBF) of up to 3000 hours (that's about 18 months of normal operation), nearly twice the industry average. We've simplified their design and reduced parts counts by 60%. Result: fewer parts, less costly parts, better odds that the part you need is the part you have. Not to mention lower repair costs and administrative overhead.



Spinwriter printers, with an MTBF of up to 3000 hours, reduce your servicemen's labor and travel costs, administrative overhead and parts costs.

NEC printers have a mean time to repair (MTTR) as low as 20 minutes against an industry average of one hour. Meaning: your service force can become three times as productive.

Next, Spinwriter printers have a dead on arrival (DOA) rate of less than 1%, significantly better than the 5% other manufacturers consider acceptable. So with NEC, you can dock merge with confidence and eliminate the horrendous time and costs of incoming inspections.

All of which translates to the kind of value you take to the bank.

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2 COMBINED WITH ANSI INTERFACE: HIGH PERFORMANCE OFF-THE-SHELF.

By using the ANSI interface, these Compact Disk Drives let you take full advantage of state-of-the-art technology for both low-cost design *and* high performance. The standard makes a disk drive's interconnection to its controller easier. 3M has made sure that the new drives deliver the flexibility you need to support specific systems and applications.

The ANSI interface is microprocessor-based, and works efficiently at high data rates. The result: 3M drives are easy on customers' equipment overhead.

3 MIGRATION FROM 10 TO 60 MEGABYTES AND BEYOND.

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The 3M 8431 drive offers a total unformatted capacity of 10 megabytes on a single disk, with 8649 BPI and an average track density of 219 TPI. The 3M 8432, with two disks, delivers 20 megabytes, with the same bit and track density. The 3M 8533 offers 60 megabytes on three disks, with track density increased to 693 TPI. Modularly expandable, the drives offer you and your customers cost-effective increases in capacity from 10 to 240 megabytes.

4 THE "SUPER-CLEAN" AIR SYSTEM.

Because reliability is so critical to the operation of a sealed-environment disk drive, the drives have a specially-engineered super-clean air system (patent pending). A cast aluminum deck, for example, separates the heads and media from the motors: a feature that helps make 3M's super-clean air system distinct from ordinary systems. Air is cleaned to 10 particles per cubic foot/minute or less.

5 AND OTHER OUTSTANDING FEATURES.

Like microprocessor-controlled rotary actuators (patent pending), drive modularity, data separation and direct track addressing, and low power consumption. Right now, these new drives are the only ones that give you *all* of these features in one 8" Winchester package. It's time to evaluate them against the competition. For complete information write to:
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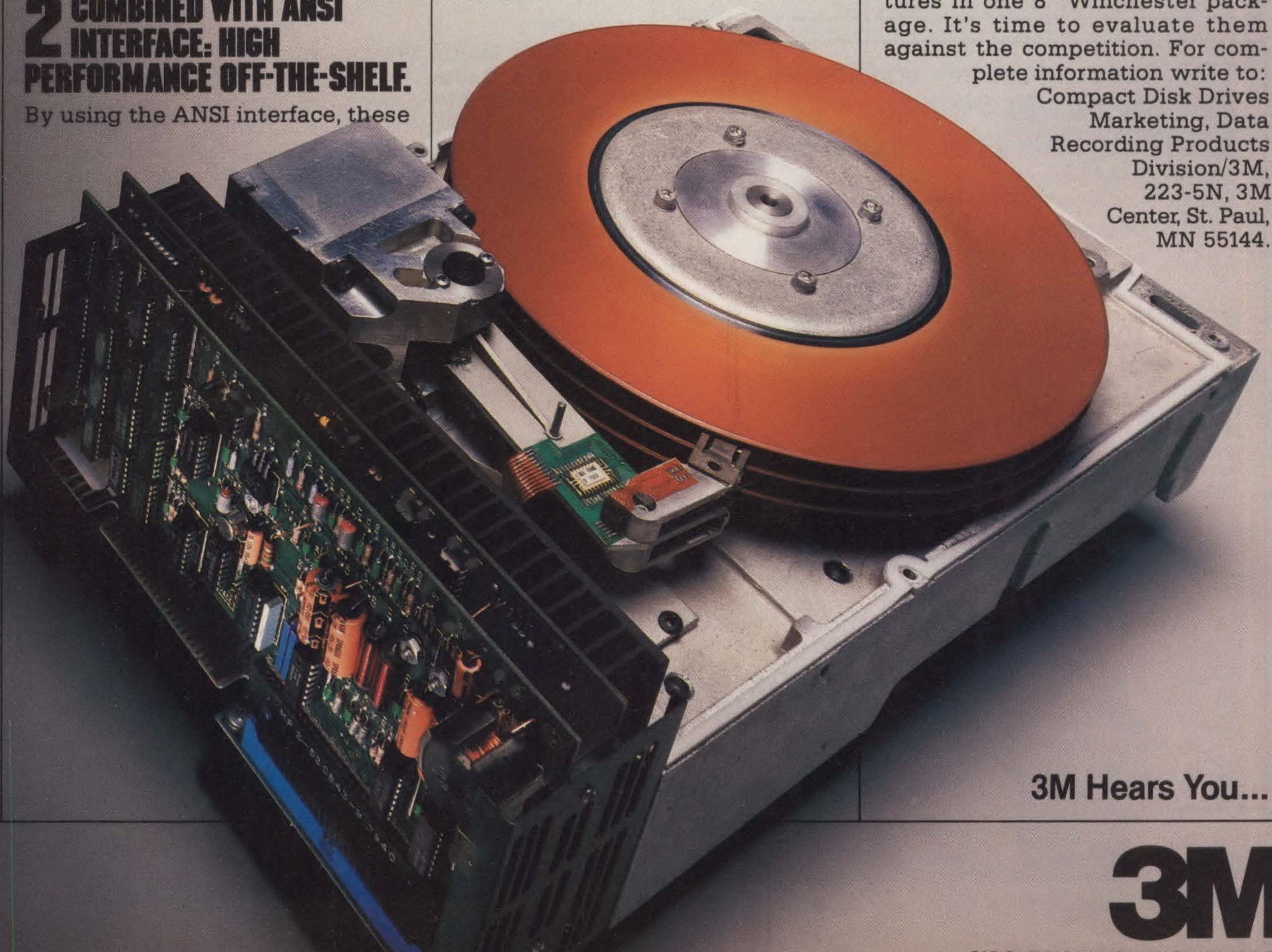

3M Hears You...

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Calendar

9-11 **1981 Winter Simulation Conference,** Atlanta, sponsored by American Institute of Industrial Engineers, Association for Computer Machinery: Special Interest Group on Simulation, Institute of Electrical and Electronic Engineers: Computer Society Systems, Man and Cybernetics Society, National Business Standards: Operations Research Division, Operations Research Society of America, Society for Computer Simulation, The Institute of Management Sciences: College on Simulation and Gaming. Contact: Lawrence Sashkin, Program Director, The Aerospace Corp., P.O. Box 92957, Los Angeles, Calif. 90009, (213) 648-5934.

10-11 **Plasma U.S.A. Symposium,** Monterey, Calif., sponsored by LFE Corp. Contact: Julie Dawson, Symposium Coordinator, LFE Corp., 1601 Trapelo Rd., Waltham, Mass. 02254, (617) 890-2000.

10-11 **"The Telecommunications Revolution: New Technologies, New Applications" Conference,** Washington, sponsored by The Energy Bureau Inc. Contact: Daniel Politi, Assistant Director of Planning, The Energy Bureau Inc., 41 E. 42nd St., New York, N.Y. 10017, (212) 687-3177.

15-19 **Gulf Computer Exhibition,** Dubai, United Arab Emirates, organized by Trade Centre Management Co. Contact: Diana Clifton Sewell, Seymour House, 17 Waterloo Pl., London, England SW1Y 4AR, 01-930-3881.

JANUARY

6-8 **Sixth Topical Meeting on Integrated and Guided-Wave Optics**, Pacific Grove, Calif., sponsored by Quantum Electronics and Applications Society of the IEEE and Lasers Technical Group of the Optical Society of America. Contact: OSA, Integrated Optics Meeting, 1816 Jefferson Pl., N.W., Washington, D.C. 20036.

12-15 **Communication Networks Conference,** Atlanta, produced by the Communications Networks Conference Management Group. Contact: Louise Myerow, Registration Coordinator, Communication Networks, Box 880, Framingham, Mass. 01701, (800) 225-4698.

15-16 **10th Annual Math/Science Conference,** Tempe, Ariz., hosted by Arizona State University, Department of Education. Contact: Nancy Watson, Conference Co-Director, 204 Payne Hall, Arizona State University, Tempe, Ariz. 85287.

20-23 **Internepcon Japan/Semiconductor International,** Tokyo, Japan, presented by the Cahners Exposition Group. Contact: Industrial & Scientific Conference MAnagement, Inc., 222 W. Adams St., Chicago, Ill. 60606, (312) 263-4866.

21-26 **43rd Annual National Audio-Visual Convention and Exhibit,** Anaheim, Calif., sponsored by the National Audio-Visual Association, Inc. Contact: Nora McGillen, Exhibit Manager, NAVA, 3150 Spring St., Fairfax, Va. 22031, (702) 273-7200.

26-28 **Advanced Semiconductor Equipment Exposition,** San Jose, Calif., managed by Cartlidge & Associates, Inc. Contact: Cartlidge & Associates, Inc., 491 Macara Ave., Sunnyvale, Calif. 94086, (408) 245-6870.

New Electrosensitive Paper with a whiter finish for higher quality print contrast. And it's delivered fast.

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Dennison Electrosensitive Paper meets your day-in, day-out requirements. But we can also engineer it for your special-application needs: ticketing, pressure sensitive labels, bar coding, imprinting, perforating, any sizes. Prices? Competitive in every roll size.

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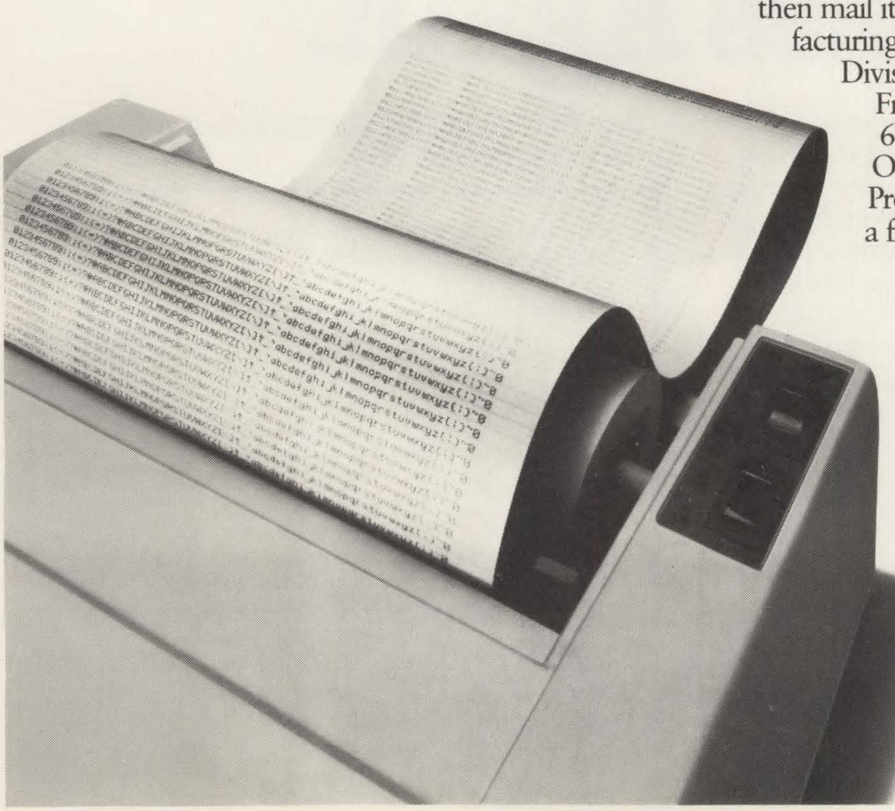


Dennison

Technical Papers

CIRCLE NO. 43 ON INQUIRY CARD

Cable television: blue sky or clouded horizons?

Aside from industry boardrooms and the brainstorming of engineering and marketing departments, it would be difficult to find a place other than Washington where the needs of the computer and communications industries so neatly parallel one another. As this issue went to press, the U.S. Senate was preparing to debate the most significant reform of communications law since the Federal Communications Act of 1934 was approved. At stake is a basic bottom-line issue of how much the federal government will allow the advances of communications and computer technology to go, how it will be regulated and to what extent such corporate giants as AT & T will be allowed to enter this lucrative market.

Most computer and communications representatives in Washington are focusing on this important legislation as a benchmark from which future economic growth will proceed. But in some areas of telecommunications, the worth of computer technology combined with communications networks is already evident.

Perhaps the most heavily publicized segment of the merging technologies is cable television, in which "interactive communications" has been at the heart of industry battles for lucrative franchises in the nation's largest cities. In the early days of its development a little more than three decades ago, the cable industry was hardware intensive, with companies seeking better and less expensive ways to get broadcast signals to areas that otherwise would be without the explosively growing television industry. Starting in the mid-1970s, cable's thrust was more on the software side, with such programming innovations as pay TV. Religious, sports, political and children's programming gained most of the credit for the industry's growth.

But technology changed again. With "Qube," the interactive cable television system constructed by Warner Amex Cable, Columbus, Ohio, and engineering innovations that provided as many as 150 channels of programming over one cable system, the industry became, once again, hardware intensive.

Today, cable operators building systems in major metropolitan areas are finding that they can offer subscribers much more than entertainment. Subscribers in Manhattan, for example, include banks that use cable channels as a private, leased network through which data communications can flow. In some suburbs of Dallas, cable subscribers have a wide array of information services at their fingertips. The services are offered by Sammons Communications, a major cable television company, and the Dallas newspapers. Similar newspaper-cable partnerships are under way in Danbury, Conn., Yuma, Ariz., and Eau Claire, Wis.

What does this mean to users of small computer systems? The good news is that with cable serving as a local loop, a relatively inexpensive networking arrangement can be made for business and residential subscribers. A time-sharing approach to data storage, with the head end of a cable system housing the CPU, is also possible.

The bad news, however, is that for all the industry's technological wizardry and a magnificent promotional effort, most systems are not interactive, meaning they are not equipped to handle such services as "teleshopping" or video games and other programs available to users of home computers. And while such services for cable subscribers are beginning to reach the market, operators with old, 12-channel systems—the bulk of the industry—are faced with the prospects of rebuilding to add more capacity before they can offer more services. Most industry spokesmen feel that the industry is still three or four years away from when computers in homes or businesses will be a major component of the cable industry.

But industry spokesmen are still optimistic about combining computers and cable. In the near future, ways will exist to link home computers with cable, says Hank Cicconi, vice president for engineering at Sammons.

One person has bet nearly $250 million that there will be a marriage of cable and computers. He is John

NEXT MONTH IN MMS

Watch for Mini-Micro Systems' annual special report on computer graphics in the December issue. A comprehensive product profile of computer-graphics terminals will lead off the feature section, which will be augmented by several other graphics-related articles, including:

- A look at a new hardware/software design technique that provides extremely fast three-dimensional raster graphics processing.
- A tutorial on digitizer resolution and accuracy.
- A survey of color-graphics terminals for VLSI.
- Two articles on the use of color graphics and computer animation for geophysics modeling.
- A look at the use of dot-matrix printers for both text and graphics printing.

Kelly, chairman of the board of NABU Manufacturing Corp., Ottowa, Canada. Kelly, who plans to market μc systems and software programs exclusively to cable operators in Canada and the U.S., says he is convinced cable is the best way to achieve networking because of its broadband capacity. He adds that he rejected using telephone lines because of the expense involved and because he feels the method is unsatisfactory. Besides, he says, cable must "commit to the computer industry for survival."

Until now, NABU has been in the business of manufacturing wireless converter systems for cable and μc systems. By joining his company's two product lines, Kelly has produced what he believes to be an attractive arrangement for cable operators.

Cable TV in Canada is different in at least two ways from its counterpart in the U.S. First, nearly 80 percent of the country is wired for cable, as opposed to around 20 percent in the U.S. Second, Canadian operators have not until now been able to offer their subscribers pay TV, a restriction that has encouraged innovation in other areas. Kelly's product appears to provide the kind of innovative service that Canadians may want to purchase as a way of maintaining subscriber interest in their overall product.

Meanwhile, U.S. cable operators are in the middle of a major construction binge. With nearly 250,000 new cable subscribers being added each month to the total of some 20 million, and with most major cities now committed to constructing systems, it is only a matter of time before penetration levels in most major markets approach the levels of the other side of our Northern border. When that happens, the industry will be looking for ways to compete effectively with other emerging communications technologies, including over-the-air pay TV and direct-broadcast satellite service to homes.

With the multiplicity of broadband services cable can provide, computer networking will become an increasingly attractive option for cable companies and their subscribers. Innovators such as NABU's Kelly will then be ready to supply the industry with the equipment and the software it needs.

—Arthur Hill

WASHINGTON BRIEFS

CONFERENCE ADVISED TO FOCUS ON ADP

Some 13,000 participants, an increase of 2000 over last year's total, listened to numerous speakers address ways of managing change at the Federal Computer Conference held in Washington in September. Addressing the gathering as its keynote speaker was Jack Borsting, Assistant Secretary of Defense and the Pentagon's Comptroller. He said that the Reagan Administration's new fiscal policies, which include a substantial reduction of federal programs and manpower, will add to the already-impressive dependence government has on automated data processing. He advised the audience to "focus on the potential of automated systems to improve mission productivity and help your users develop new operating approaches to use the new technology."

PENTAGON TO REVIEW ADP POLICIES

The Pentagon has initiated a major review of defense automated data-processing equipment acquisition and management policies. Behind the effort is a move to improve the effectiveness of automated systems, to reduce bureaucratic inefficiency in the purchase of hardware, to decentralize authority and to extend competition when practical.

FCC MAY ADD FREQUENCIES FOR COMMUNICATIONS

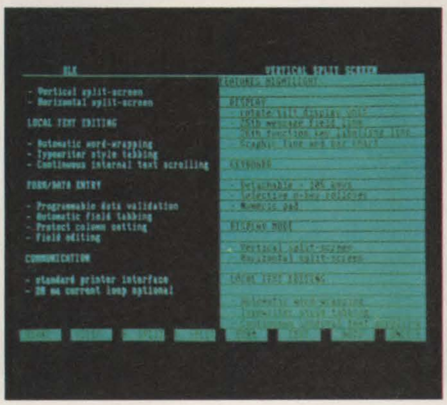
The development of significant databases connected by radio to end-user sites has led the Federal Communications Commission to conclude that additional frequencies in the private radio services may be allocated for digital communications. Users of these services include police and fire departments, businesses requiring mobile communications facilities and citizens-band radio. As an example of the kind of service that could be used more readily with additional frequency space, the FCC states: "A plumber on a house call discovers he does not have a part in his truck that is required to fix a garbage disposal. He contacts his base station, which is connected to a minicomputer that stores a parts inventory for the company. The plumber gets delivery data and cost information printed on his portable printer. He then processes the quantity and order-confirm codes, and the communication is completed."

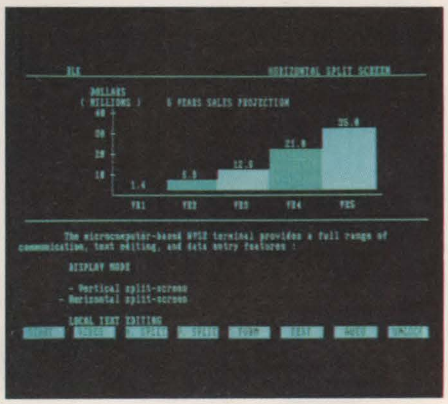
LAW WOULD EXEMPT DEFENSE-RELATED COMPUTERS

At press time, final action on a proposal to exempt purchase of computer equipment for defense and military-intelligence purposes from a law requiring competitive bidding procedures was still on a back burner. The provision, part of an overall Department of Defense authorization bill, would allow the Pentagon to use sole-source bidding, a practice that supporters say will increase product reliability and one that detractors maintain will promote wasteful spending. Both houses of Congress have completed action on the DOD authorization bill. But at last word, action to resolve differences between the two versions of the legislation was being delayed pending a decision by President Reagan to begin development of major new weapon systems.

Introducing the $995 Smart Terminal

ERGONOMICALLY ENGINEERED





Ergonomics. The science of designing machines for the humans who must use them. OEM's take note. Because ergonomics is fast becoming the determining factor in end-user selection of smart terminals. End-users are, after all, only human.

Enter the WY-100. The most ergonomically sound smart terminal for an economical price, list $995/unit.

The WY-100 is designed for that unpredictable species, Homo sapiens. Its fully tilting/rotating display and detached keyboard accommodate different working conditions and preferences. The green screen pampers eyes. Horizontal and vertical split screen capabilites with independent scrolling help a person do the impossible, be in two places at once. Why the WY-100 even understands that to err is human, ergo, screen editing and protected fields with data validation.

And there's more. Each WY-100 undergoes 96 hours of rigorous testing. So you can be sure that it will blink, dim, reverse, underscore and blank when you want. Plus you get 128 characters with upper and lower case, line drawing and graphics. And a keyboard with 105 keys including cursor pad, numeric pad, special modes and function keys.

The WY-100 knows that OEM's are human, too. Their needs are often different. So it's customizable. A systems programming manual is available.

Think economical. Think ergonomical. Think Wyse.

For complete specifications and an eye-opening ergonomical comparison chart, circle our reader's service no. or contact Larry Lummis at Wyse headquarters.

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CIRCLE NO. 44 ON INQUIRY CARD

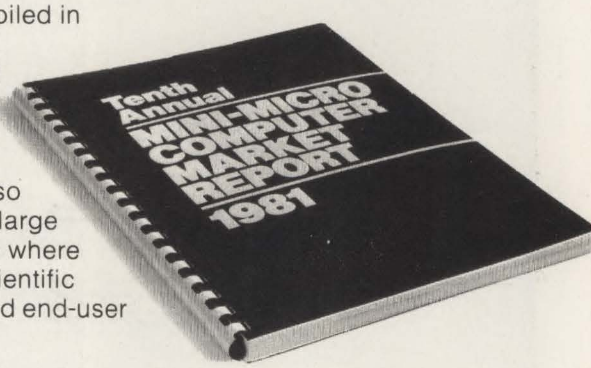
GET THE FACTS

About the $24 billion* minicomputer and microcomputer markets
The tenth annual *1981 Mini-Micro Computer Market Report* gives you the facts. It is the industry's most comprehensive survey covering purchases for the past year plus projected purchases during the next 12 months in 22 separate categories including minicomputers, microcomputers, tape and disk drives, CRT terminals, printers, modems, software and related equipment. For OEMs and end-users.

State-of-the-industry
If you are marketing to the minicomputer and microcomputer markets, the *1981 Mini-Micro Computer Market Report* is *must* reading. It gives you the key market trends in each and every product category. With it, you can:

- determine competitive positions
- evaluate current market shares
- determine projected changes in market shares
- identify emerging industry growth areas
- identify the major criteria used by purchasers to evaluate suppliers
- identify application trends
- analyze industry or product growth trends to better plan marketing directions

Most comprehensive industry survey
The *1981 Mini-Micro Computer Market Report*, compiled in conjunction with the computer industry's leading independent research firm, Dataquest, Inc., is based on responses received from more than 12,000 *Mini-Micro Systems* readers. Covered by the report are Third-Party OEMs such as systems integrators, specialized system OEMs, and, software houses. Also covered are the sophisticated end-users located at large corporations with volume requirements, at EDP sites where minicomputers interface with mainframes, and in scientific and engineering areas. The report gives you OEM and end-user buying plans separately.



Market Segment Data Base
In addition, you can get the specific buying plans of individual respondents for any of the 22 product categories covered by the *1981 Mini-Micro Computer Market Report* through our *Market Segment Data Base* (price upon request). For the facts about the $24 billion mini-micro computer markets, call your *Mini-Micro Systems* sales representative. Today.

*Projections based on statistics compiled for the *1981 Mini-Micro Computer Market Report*

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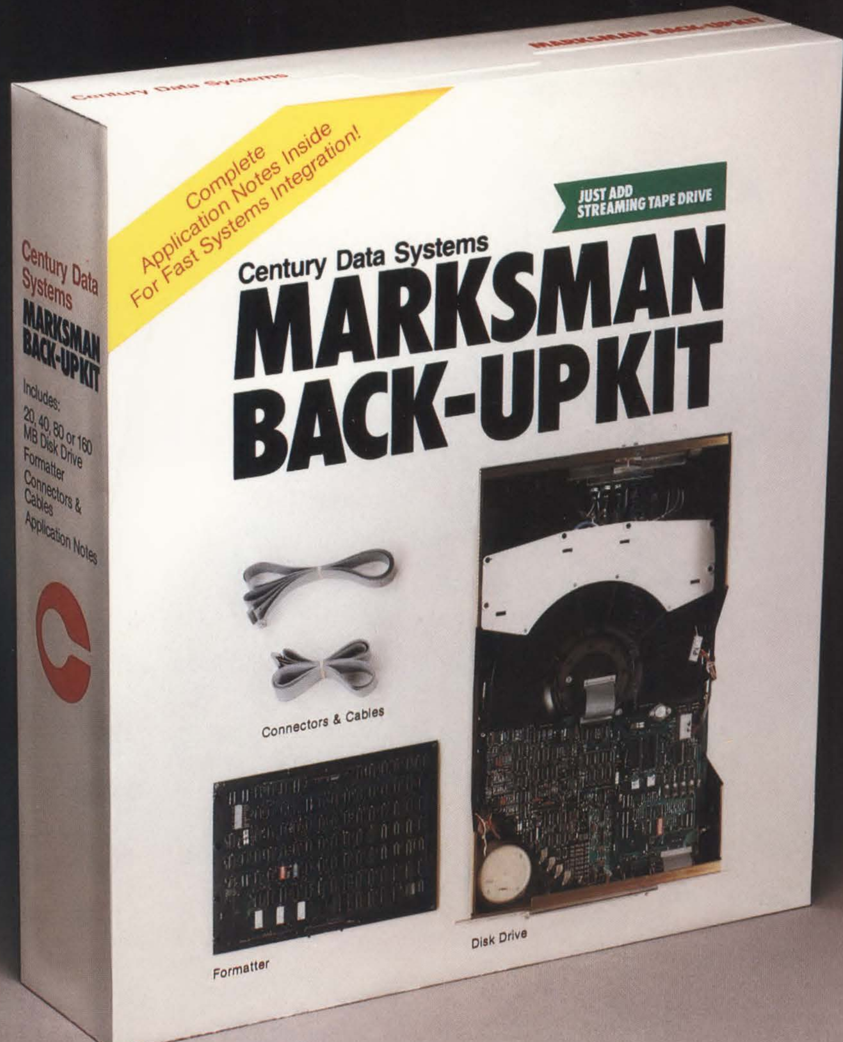
Century Data Systems
A Xerox Company

Drives for the 80's

Finally, an off-the-shelf answer to Winchester back-up.



Introducing the Intelligent Marksman Back-Up package. And the solution to the chronic problem of Winchester back-up.

And what a solution it is. Our new formatter is specially designed to control 20, 40, 80 or 160 MB Marksman Winchesters—and the Archive Sidewinder, Cipher Quarterback, or DEI Streamer ¼-inch tape drive for back-up.

A simple host adapter and software I/O drivers are all you need to tie into word and data processors utilizing interfaces such as S-100 or Multibus, and running operating system environments such as CP/M, MP/M, UNIX and others.

If that isn't enough, just one formatter will control two Marksman Winchesters, providing a system with a storage potential of 320 MB, in a minimum of space.

Continued on next page

Century Marksman drives: Because it's a jungle out there.

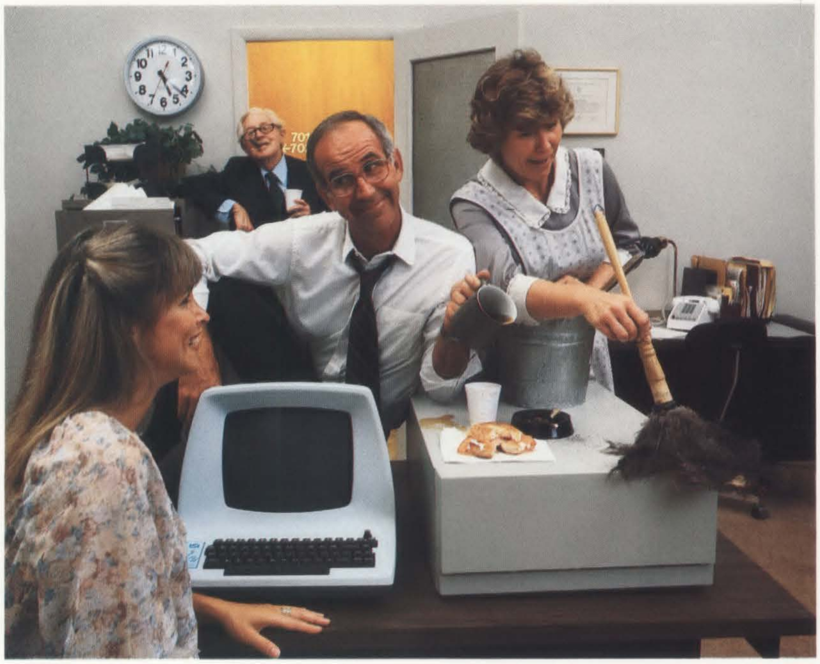
In the world outside the computer room, computer data faces constant danger.

The people out there smoke cigarettes and spill coffee. They raise dust and trip over power cords and do everything else no one would do inside the computer room.

Earlier generation disk drives just can't protect data from that kind of abuse.

But Winchesters can. A Winchester's sealed design makes it the perfect choice for any outside-the-computer-room application: Word and data processing, computer graphics, networked data storage, data entry, computerized numerical control and any other hostile environmental applications you can think of.

But ruggedness isn't the only advantage you get with a Winchester. There's also the massive storage capacities ranging up to hundreds of megabytes per drive. Which means you can build in a system's capacity to grow.



And finally, there's the Century Data Marksman Winchester. It combines all of these advantages with the lowest cost per megabyte in the industry.

So before you send any system out into the world beyond the computer room, be sure it's equipped with a Century Marksman Winchester.

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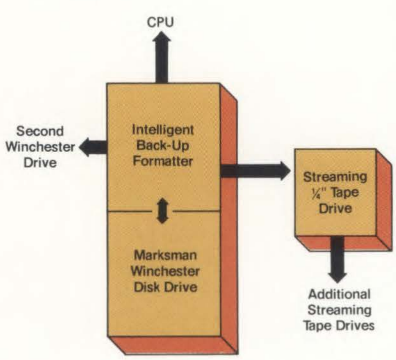
back-up. *Continued from first page*

A storage system independent of the CPU.

But back-up isn't nearly all our new formatter offers. You also get an independent data storage package that doesn't tie up valuable CPU time.

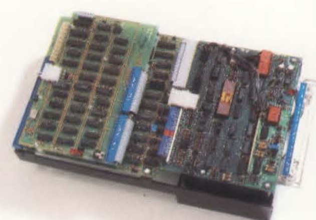


The formatter permits independent communication among all its interconnects: From disk to tape. Tape to disk. Or either drive to and from the CPU.

Which means operators can continue to use the CPU during back-up, and even interrupt the Winchester-tape intercommunication to pull out or insert data from the disk. Without specifically shutting down and restarting the back-up functions.

The advantages of streaming tape.

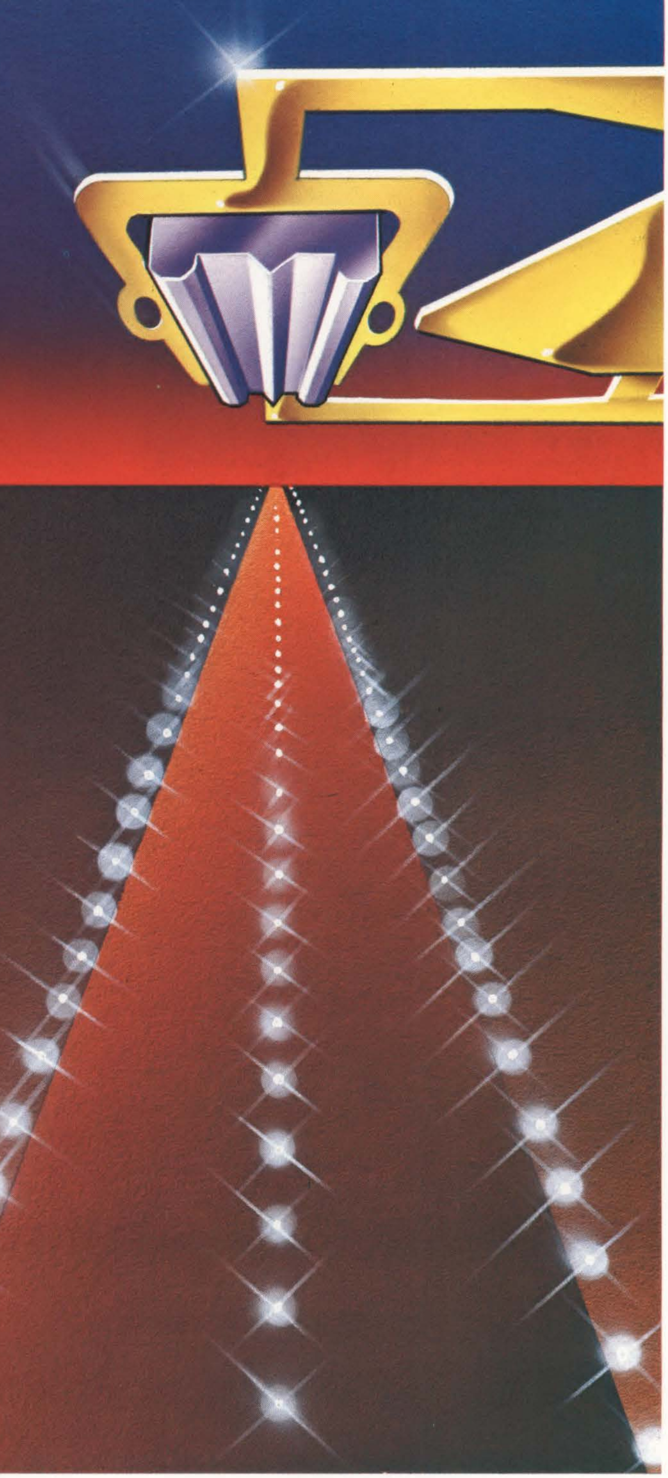
Compatibility with streaming tape back-up is another big plus of the new Century formatter. As a removable media, ¼-inch streaming tape is ideal for archiving data. It's also a low-cost, high-performance, no-maintenance tape option perfectly matched to the speed and capacity of a Winchester.



Available now.

Best of all, our new formatter isn't just a promise of something to come. It's available now, right along with our full line of Marksman Winchesters and full application notes.

So if you're an OEM, systems integrator or distributor, let's get together soon. And get the problem of Winchester back-up off your back once and for all.



Q: Why have you chosen Trident removable-pack drives for Japan, Mr. Kato?

A: Because of Century's design and commitment to quality.

Mr. Atts Kato is U.S. Manager for NELCO, the electronics subsidiary of Nissho Iwai—one of the largest international trading companies in Japan. The following is excerpted from an interview with Mr. Kato:

Q: After reviewing other manufacturers of removable-pack drives, what has brought you to Century?

A: Frankly, I've never seen such advanced facilities as Century's.

I've been involved in the computer business for twenty years, and have visited many U.S. computer companies. Century Data facilities for engineering, manufacturing and testing all indicate a serious commitment to disk drives.

This was a very important factor for me in selecting a manufacturer—one that can make hundreds of drives like Century has done for me.

Q: How are these drives being used in Japan?

A: We often sell the Trident drives to OEMs and systems houses, but we have other large end-users that buy quite a few. For example, Tokyo Electric Power, which is the largest utilities company in the world, and many Japanese broadcasting companies.

You see, the Japanese market situation is very similar to that of the U.S. Removable-pack drives are seen as having many desirable features, particularly storage capacity and removability. Winchesters are just now seen as becoming a good product to integrate into systems.

We see our disk business changing to Winchesters over the next few years, and this was another key reason why Century capabilities were so important to us.

As our demand for Winchesters grows, we will look upon Century to fill this need—particularly with their new products becoming available now and in the near future.

NELCO covers the entire Japanese computer market, offering individual components as well as totally integrated systems with extensive technical support capabilities for both hardware and software. And NELCO has chosen Trident removable-disk drives from Century Data Systems.

Now media compatible.

Our 300 MB Trident now provides full plug and media compatibility with other SMD-interface removable-pack disk drives. Now, Tridents can be integrated into systems without losing access to existing disk libraries.

If you would like to find out more about our proven drives and these attractive features, contact us at our address below, or feel free to give us a call.

For the full Story of the Century, please indicate the information you want, and we'll send it right away.

☐ Intelligent Marksman Backup Package
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☐ Trident Removable-Pack Disk Drives
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Before DEI came along, selecting the right ¼" cartridge tape drive to backup your star performer required a lot of searching.

Now there's one label, the DEI label, that has it all. From the original Funnel with file search and track select capabilities. To the super fast Streamer with a burst transfer rate of up to 450 Kbytes/sec. To the economical Streaker, designed specifically for Winchester backup. DEI has the hottest backup groups going. In fact, nobody else comes close. DEI high density cartridge tape drives for proven performance.

Put us at the top of your chart the next time you audition for backup. We'll quote you a price that'll be music to your ears.

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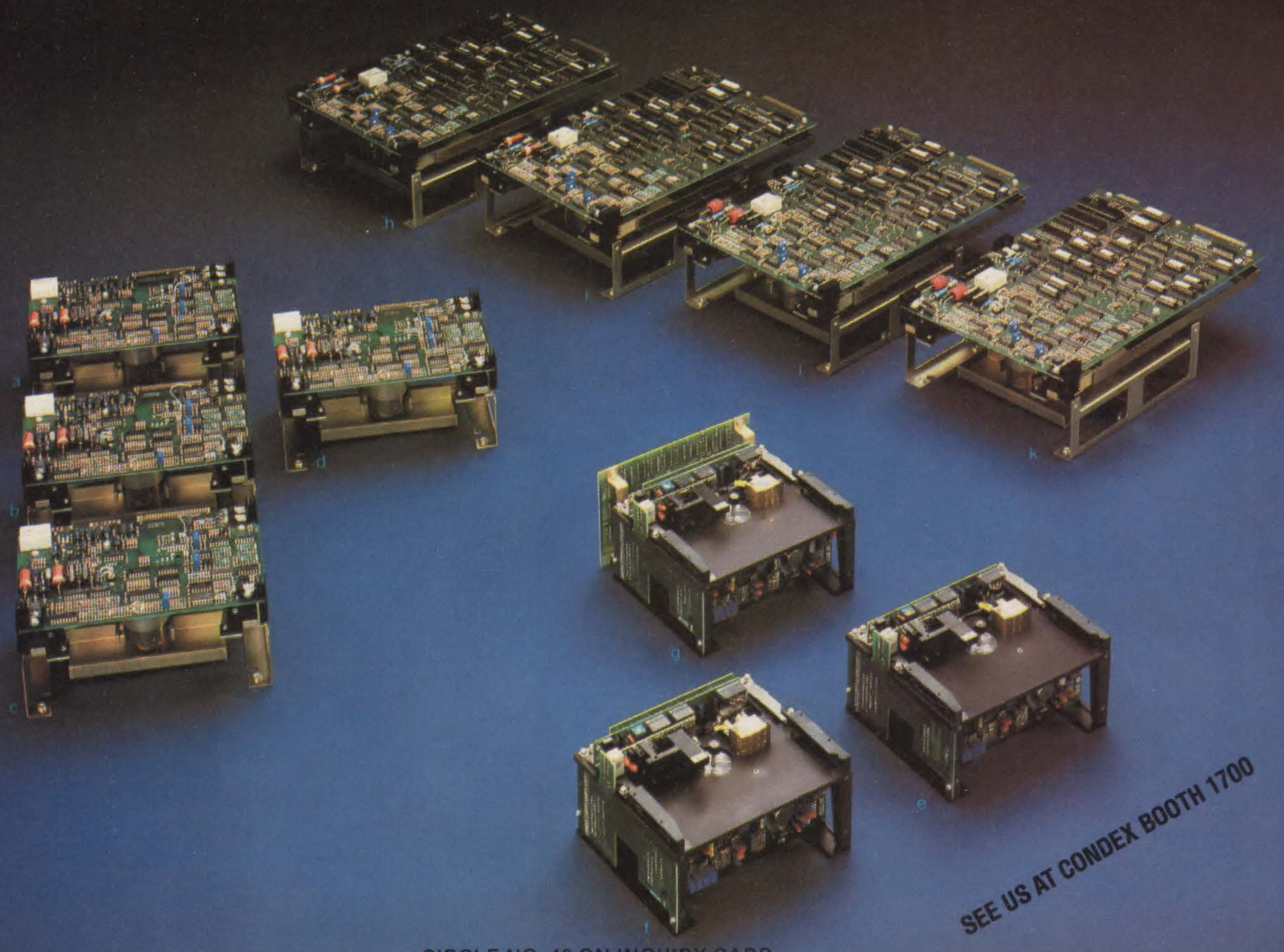
The Streamers
h. 10 Mbytes/30 ips
i. 10 Mbytes/90 ips
j. 20 Mbytes/30 ips
k. 20 Mbytes/90 ips



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An ideal situation. We'll improve without being different. Behind our new logo we'll be the same dedicated company you've come to rely on for high-performance, real-time computation. The same company that pioneered 32-bit minicomputers. And yes, the same company that designed the world's most powerful minicomputer: the CONCEPT 32/87.

Watch for our new identity. We're excited about it. You will be too when you see how we can fit perfectly into your computational needs.

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CIRCLE NO. 47 ON INQUIRY CARD

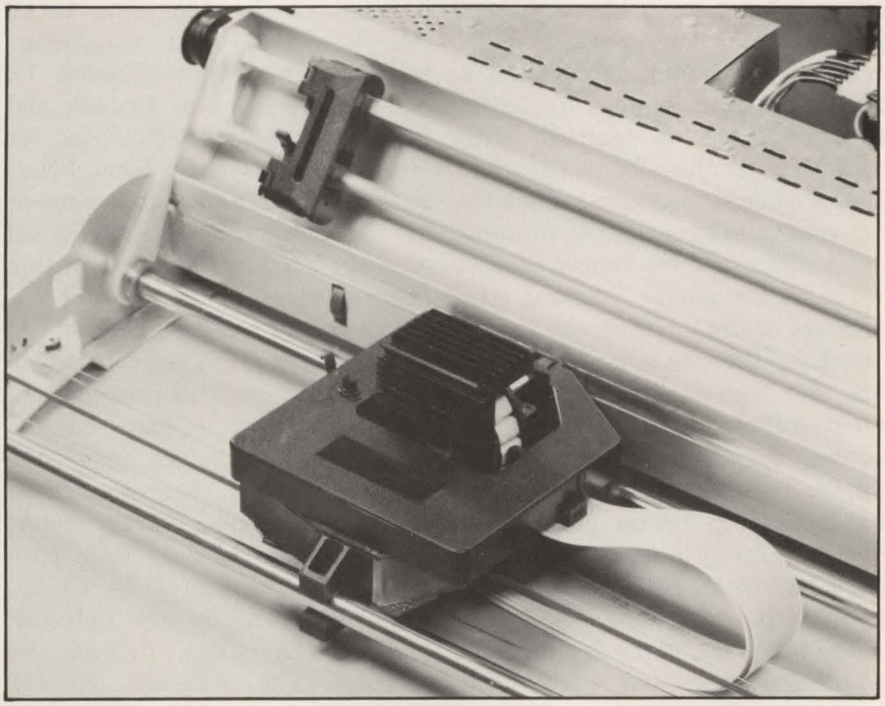
1981

Printek enters high-end matrix-printer market

The thought of yet another serial impact dot-matrix printer has caused some industry observers to exclaim "Oh no—not another one." But the market for high-speed, high-quality, versatile models continues to expand and beckon newcomers. The most recent entrants are from Printek, Inc., a Benton Harbor, Mich., start-up firm that offers two units with performance features and pricing geared to snare OEM and distributor accounts.

Printek is addressing customers that want to migrate from fully formed character, mid-range dot-matrix and low-end line printers to printers with added speed, quality and multifunctional ability. The market for high-end serial dot-matrix printers operating at more than 211 cps will boom over the five-year period until 1985. About 4900 units were shipped in 1980, and that figure will increase to 55,400 in 1985, a compound annual growth rate of 52 percent, says O. Ralph Finley, vice president and director of the *Electronic Printer Industry Survey* at Dataquest, Inc., a Cupertino, Calif., market-research firm.

The market growth may stem from users' increasing thirst for more speed and function. Finley points out that Dataproducts Corp.'s M200 printer, introduced in 1977, is one of the few 340-cps dot-matrix printers on the market in recent years. But it began to sell well only in the first two quarters of this year. Recently, however, other vendors have entered the niche, including Florida Data Corp., Mannesmann Tally Corp. and Okidata Corp. Centronics Data Computer Corp. is expected to join the field soon.



Printek's *new 920 serial matrix printer addresses the burgeoning high-end market for multifunctional units.*

With its two new 900-series models, Printek positions itself directly against Dataproducts, but Printek offers a lower price. The bidirectional models 910 and 920 for data-processing, letter-quality and business-graphics applications operate at 170 cps or 140 lpm and 340 cps or 270 lpm, respectively. Both printers can produce raster-scan-type graphics, make multiple passes of the print head on each line and work in word- and data-processing applications. Prices are $1695 and $2345, respectively, for the 910 and 920, in single-unit OEM quantities. OEM discounts will exceed 25 percent, the company says. "The list prices are almost 10 to 15 percent lower than the competition," says John C. Cooper, vice president of marketing.

Dataproducts' M200 printer operates in one pass of the 14-wire print head and does not produce graphics. It sells for $2650 in single-unit OEM quantities. The company's 180-cps model M120 matrix printer sells for $2250 in the same quantities. Neither model is geared for both data- and word-processing applications. Okidata's 350-cps model 2350, available in January, includes a nine-pin print head and optional 72- × 72-dpi resolution graphics. It sells for about $2200 in single-unit quantities. Florida Data's OSP/120 and OSP/130 models print as many as 600 cps in a single pass and are priced at $3000 and $3500, respectively, in single-unit quantities.

Both the Printek 910 and 920 print in a 9 × 9 matrix, the 910 with a nine-wire print head and the 920 with an 18-wire print head. Both models have a 144- × 144-dot graphics density, a 96 ASCII character set, underlining, super-script, subscript, descenders, double-width characters and a downloadable character set. The printer holds one standard font and four alternates. Line length is 136 cpl at 10 cpi and 227 cpl at 17.7 cpi. Each printer has an 1800-character buffer, slots for adding options and a universal power supply. An RS232 serial interface is standard, with optional parallel Centronics or Dataproducts interfaces available for $125 to $175 each. The printers use continuous-form fanfold paper.

For letter-quality printing, the printers overlap dots on the return sweep of the print head over the line. For high-quality printing, the 910 operates at 40 cps and the 920 at 80 cps. High- and low-quality text can be mixed to the character by implementing serial escape sequences. The printers are based on an 8-bit Intel 8051 I/O-oriented, 12-MHz μp.

The 920 is one of the few printers on the market with an 18-wire print head, says Ted Webster, editor of *Printout*, a printer-industry newsletter. "People in the U.S. have been talking about 18-wire heads for quite some time. Now they may be deliverable (in quantity)," he says. Webster points out that Siemens Corp. has a printer in Europe that incorporates an 18-wire print head, and that Integral Data Systems, Inc., also had a market-probe machine at this year's NCC. Webster is impressed with the 920's incorporation of the 18-wire head, and says the company is in the forefront of technology by using it. He adds that 18-wire heads rather than multiple print-head passes may be the way to achieve higher quality print. Printek obtains the head from three sources: Toshiba, Amperex and DH Associates. The head uses a closed-loop servo motor system, and paper is moved via a high-resolution stepper motor.

The company claims the printers are "second generation " in design: They were designed from the ground up to meet the regulations for sales in Europe and Canada. "The printer was built with regulatory VDE, CSA and UL testing in mind. It does not have to be retrofitted (like other manufacturers' printers)," says Thomas C. Yeager, president of Printek and former director of engineering for Heath/Zenith Data Systems. Printek is expected to do 30 to 40 percent of its business in international markets outside East Asia within three years.

The printer was designed and will be manufactured by the company in Benton Harbor. Seven patents are pending, including ones on the rotary encoder, which is on the carriage under the print head rather than on a servo motor, ensuring more accurate print positioning; the ribbon-drive mechanism; the paper-motion detector; and the extrusion behind the carriage. The company also has placed firmware under copyright protection.

The printer is modularly built and has a low parts count, says marketing vice president Cooper. He explains that field engineers will require only three components in their spares kits, and only 10 components will be stored in company depots. The printers' head carriage, power supply, boards and tractor mechanism are plug-in and easily replaceable. MTBF is estimated at 2000 hours and MTTR at less than 30 min.

Printek will have a national sales organization backed by representatives for large OEM accounts, and 20 to 25 North American regional distributors to handle sales and service. It has not signed any OEMs or distributors.

The company expects to manufacture 5000 to 7000 units in its first 12 months of operation. Evaluation units will be available this fall. Pilot production is scheduled for February, 1982, and volume manufacturing for March, 1982.

The firm will operate out of 25,000 sq. ft. of manufacturing space and 10,000 sq. ft. of R & D and administration space. It has obtained an undisclosed amount of venture capital from Frederick R. Adler, a New York-based entrepreneur who was instrumental in financing Data General Corp. in its start-up days. —*L. Valigra*

DEC gets serious about the office

Digital Equipment Corp. declared itself a serious contender for the office-automation sales dollar and capped a series of product introductions late last month with an electronic-mail software package.

In announcing the "Office Plus" program, DEC is attempting to quell past criticism that the company has a lackluster and disjointed approach to office sales. As part of the program, DEC is marshaling a dedicated direct sales force aimed at Fortune 1000 accounts, while providing commercial OEMs with new software and hardware ammunition to break into smaller accounts.

The Office Plus program is based on a series of products marketed by several of the company's individual product groups and is centered on the use of one terminal for a variety of functions.

"With a VT-125 video terminal, you will have the ability to do word

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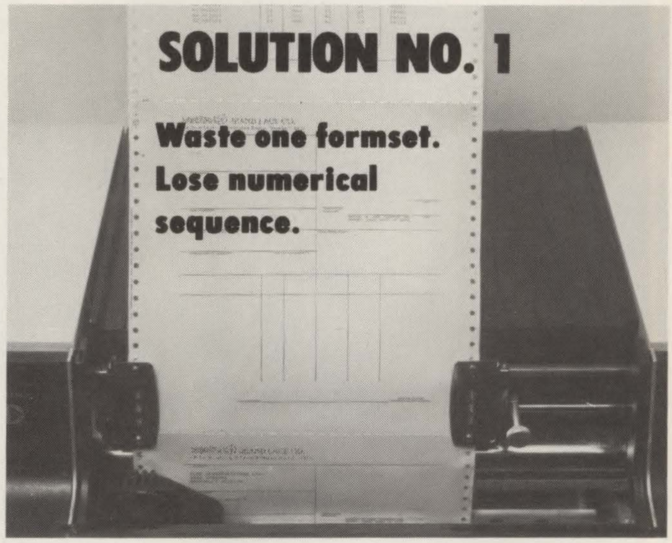

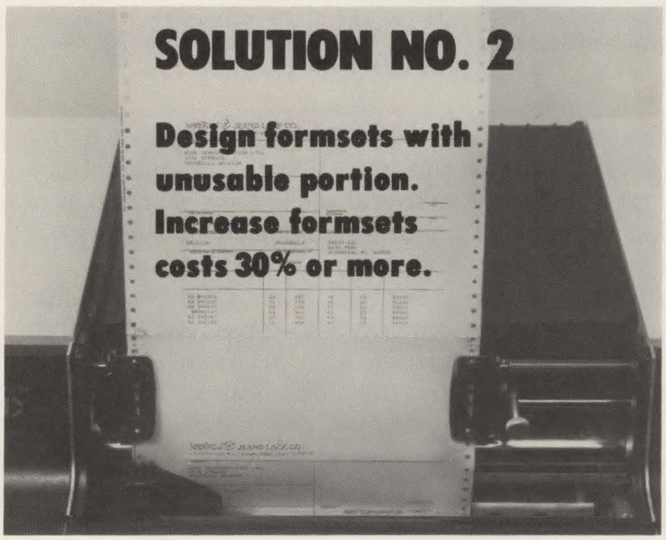

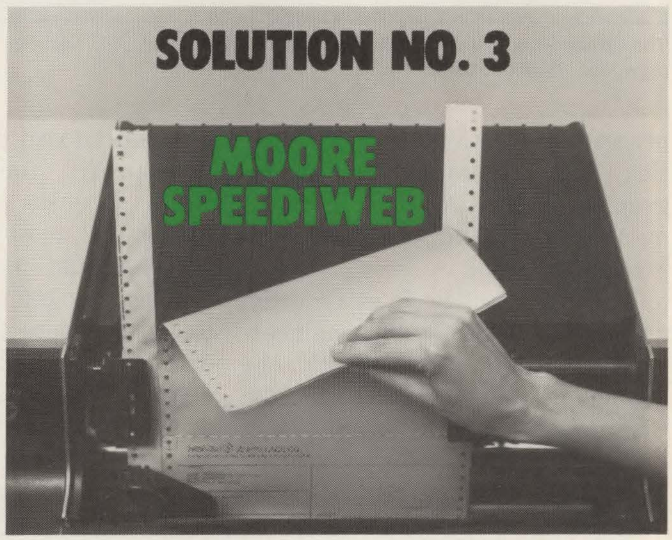

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MM/81

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CIRCLE NO. 48 ON INQUIRY CARD

The Office Plus *is designed to quell past criticism that DEC has a lackluster and disjointed approach to office sales.*

DEC's Office Plus program *will not infringe on the turf of the company's commercial OEMs, says Commercial Marketing Group manager David R. Fernald.*

processing, electronic mail, typesetting, data processing and business graphics," says David R. Fernald, manager of DEC's Commercial Marketing Group.

While the Office Plus program draws on marketing and engineering skills from throughout DEC, the major push is centered in the Commercial Products Group, one of DEC's four major product divisions. In the past, some industry analysts have seen DEC's office-sales efforts as lacking coordination among the firm's product groups.

In a May, 1981, report on DEC, Gartner Group analyst Donald H. Brown wrote, "The office-information and word-processing subsector represents one example of the company's inability to exploit the end-user markets successfully."

DEC started hinting at a coordinated effort to tap the office market last April, when it introduced DECtype 300, a word-processing package that runs on the company's CTS-300 commercial configurations. Since then, a series of products has been introduced bearing the corporate prefix, including DECmate (MMS, August, p. 71), DECword, DECset and, most recently, DECmail (MMS, August, p. 6).

When the DECmail software was unveiled in late October, DEC also detailed its Office Plus program, designed to underscore the company's commitment to office sales and to mark the start of a more aggressive marketing effort.

DECmail is a layered product designed to run on VAX/VMS systems. It carries a basic price of $20,000 for a fully supported system or $12,000 for a non-supported package. Features include remainders, calendars, filing and limited word processing.

The first version of DECmail, expected to be installed at customer locations by next month is a single-node product, which means multiple DECmail systems will not easily communicate. DECmail runs on 32-bit VAX-based systems and will not run on the company's PDP-11 systems except for 11-based systems communicating with a VAX through DECnet communications networking products. Fernald says multi-node DECmail offerings are in the works.

DECmail is an outgrowth of the company's in-house electronic-mail system that runs on PDP-11 computers. DEC has been using its mail system for the past four years and has 3500 active users.

To support the Office Plus program, DEC has formed dedicated sales and service groups. A dedicated sales force consisting of "several hundred" salesmen will sell the products in each of the company's sales districts, Fernald says. A central software-support team will also deal solely with Office Plus products, and there will be an Office Plus support organization within each commercial product group. There will also be a hot-line support center.

"In general, we will be focusing on Fortune 1000 accounts through the dedicated sales force and on smaller accounts through our com-

Systems Group System 2800 computers. They're making people stand up and take notice.

But then Systems Group products have always appealed to those who appreciate sensible value, high performance, unmatched reliability and prompt, courteous service.

Through the years, Systems Group product acceptance in Z80 CPU, disk controller, I/O and memory boards have been the result of some very purposeful and carefully thought out engineering. Not to mention strict industrial quality production standards.

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System 2800 computer systems are designed for a single user with 64K of memory or for up to as many as six separate users with additional add-in memory. They can easily expand as your organization's needs grow.

You can handle up to 8000 customers and 24,000 inventory items in our lowest cost dual floppy model and much, much more in our 40M byte hard disk models. And you can connect up to 12 terminals or printers and other add-on Systems Group floppy, tape and hard disk single or dual drive subsystems.

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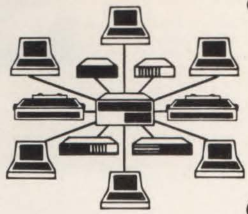

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1985
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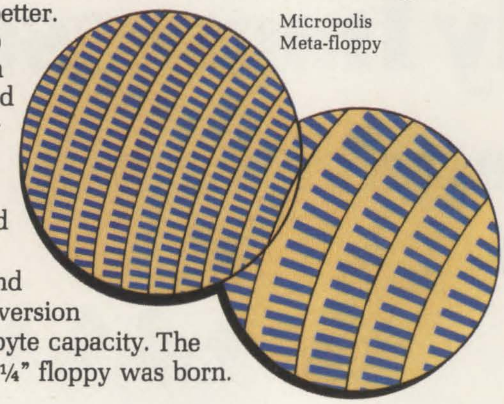
CIRCLE NO. 49 ON INQUIRY CARD

Some plain 96/100 TPI

FACT: We invented 1 megabyte technology.

When the mini-floppy, with less than 100 kbytes capacity was introduced in 1976, we had a choice. Go along with the rest or do better. We chose to do better. Within a year we doubled both bit density and tracks per inch, resulting in a single sided floppy with 0.5 million bytes and a double sided version with one megabyte capacity. The high capacity 5¼" floppy was born.



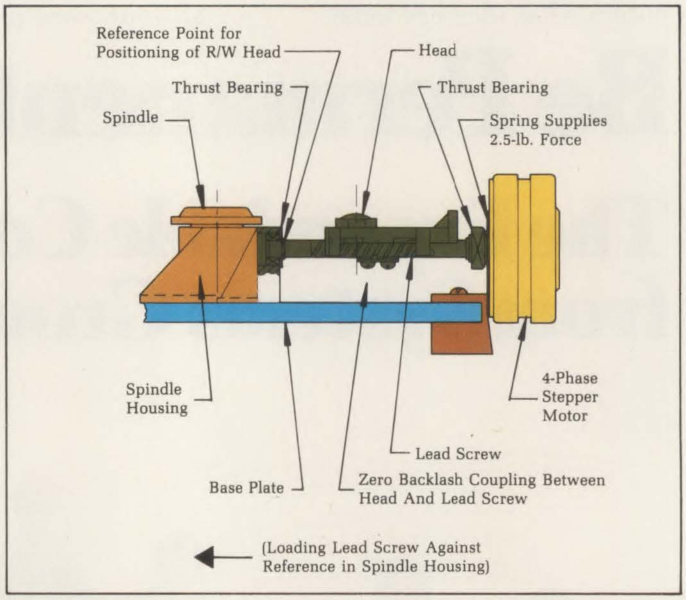
FACT: It took solid engineering to do this.

To quadruple capacity, yet keep interchangeability at the highest level, was no easy task. It took solid, innovative engineering at all levels. The result:

• **Disk Centering Mechanism** - In our drive, the center of the diskette fits over a profiled spindle and is clamped into place while the spindle rotates to assist centering. This technique assures precise centering to within 250 μ-inches and eliminates disk crunching problems.

• **Head Positioning Accuracy** - A precision ground stainless steel leadscrew with metal follower provides more precise positioning than the run-out sensitive pulley and belt approach used by others. Use of a four phase stepper motor and four steps per track averages the effects of all stator and rotor poles, resulting in $\pm$ 83 μ-inches positional accuracy.

• **Temperature Compensation** - Our temperature compensation loop includes only the diskette, pre-loaded leadscrew and spindle housing. The baseplate is specifically excluded since its expansion is compensated by a proportional change in the preload of the leadscrew. This approach consistently limits temperature variations to $\pm$ 250 μ-inches.



• **Balance Between Speed & Accuracy** – We chose 10ms track-to-track positioning and 380 kbps transfer rate as an optimum balance between speed on one hand, and accuracy and interchangeability on the other.

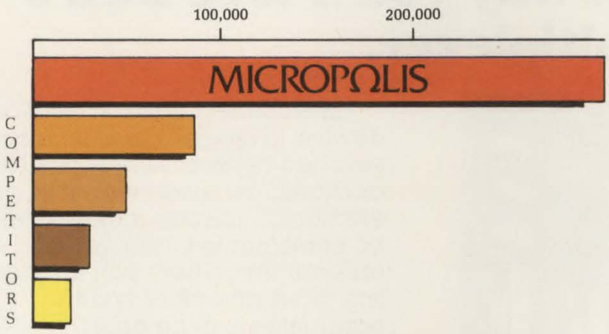
• **Silent Operation** - In band type drives an annoying chatter results from the head's travel from track to track. Our precision stainless mechanism eliminates this noisy irritation.

FACT: Our drives really work.

While others are still learning, our 96/100 TPI drives are operating reliably in systems all over the world. So well, in fact, that we're extending the warranty to 12 months on new OEM agreements. Design and process controls learned years ago, coupled with effective quality control, assures drives ready to work in your system.

facts about 5¼" floppies

FACT: We've delivered more 96/100 TPI drives to OEM's than all others.



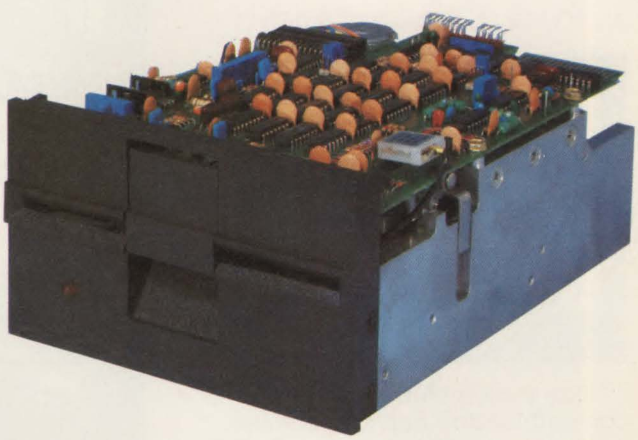
To date we've delivered over 200,000 double track density drives; more than all of our competitors combined. Hundreds of manufacturers of successful small business systems have selected Micropolis drives for their cost effectiveness and proven reliability.

FACT: We're producing more than one each minute.

If you need high performance floppies on time, and in quantity, come to Micropolis. We're producing over 500 a day... and expand ing. Expansion includes a new 60,000 square foot plant planned for occupancy by year end and dedicated completely to 96/100 TPI floppy production.

FACT: We've invented again - A 2 megabyte 5¼ inch floppy.

At NCC we introduced a new 2 megabyte floppy, made possible by again doubling density to 12,000 bits per inch. Micropolis' Model 1117 has 6ms track to track positioning, 500 kbps transfer rate and a host of features including a "chassis within a chassis" for unparalleled electrical shielding and resistance to mounting effect. Industry standard mounting and bezel permit easy introduction into existing systems.



So you win both ways with Micropolis. If you need 96/100 TPI floppies now, order our field proven 1015/1016 series. If you're working on a new system, design in our 2 megabyte Model 1117, the high performance "chassis within a chassis" floppy.

For more information phone us or write on your letterhead.

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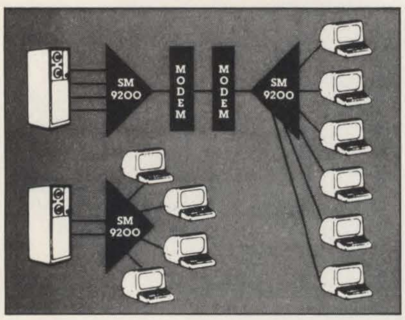
Positions available for talented people.

Is switching data a problem?

Then here are four reasons why you'll love DCC's switching multiplexer.

DCC's SM9200 Switching Multiplexer offers all the advantages of statistical multiplexing—reduced telephone line costs and error free messages. But our Switch Mux also offers you Port Contention, Port Selection and Data PABX.

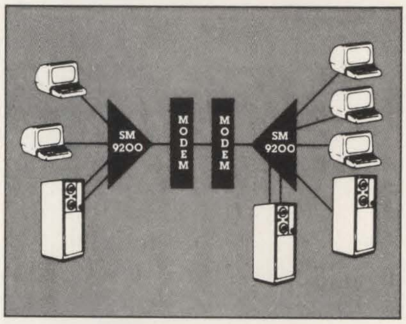
1. Port Contention



The Switch Mux allows a user to contend for any host port in either the local or remote location. Rotary group selection, speed conversion and unbalanced configurations are also standard. Costs savings are realized by reducing the number of computer ports and the size of the multiplexer configuration.

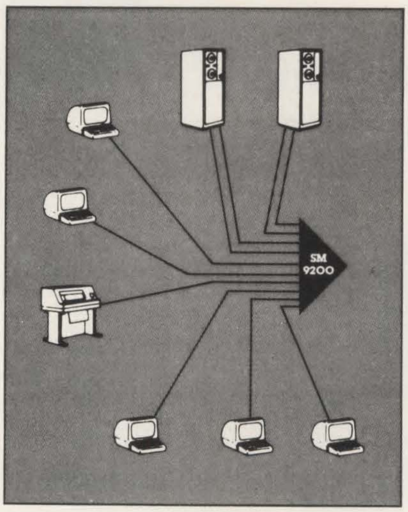
2. Port Selection

You can connect any terminal to any computer or terminal locally within your facility, or remotely to any port within another facility.



Using the advantages of statistical multiplexing, these facilties can be located thousands of miles apart.

3. Data PABX



Interconnect up to 64 local data devices to create a total intrafacility switched network. Functions such as shared computer resources and electronic mail can inexpensively be implemented. Through an optional supervisory port, connection status and other system parameters can be easily displayed.

4. $2,200 . . .

Domestic U.S. price for a standard 4 port model starts at $2,200 FOB Germantown, Maryland. Delivery is within 30 days.

Call or write DCC's Data Com Marketing Department for full details on how the SM9200 can help solve your networking problems and save you money.

Options available with the SM9200 Switching Multiplexer:

- **BISYNC Support**
- **Reverse Flow Control**
- **Autobaud**
- **Supervisory Port**
- **Backup high speed link**

DCC

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It's the CHARACTRON

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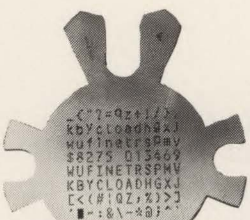
Reproduced from an unretouched photograph of a CHARACTRON CRT.



Why suffer with display terminals that show only part of your output? Or if you do get a 132-column display, why suffer eyestrain trying to read it?

The innovation that makes all other 80- and 132-column display terminals and their dot matrix characters seem primitive is the DatagraphiX CHARACTRON® CRT. A DatagraphiX exclusive that literally stencils letter-perfect characters on the screen with an electron beam. Sharp, clear, fully-formed characters that are even easier to read than most hard-copy computer printout pages.

No more wasted time and money on programming to reformat the computer output to 80 columns. No more lost computer time and wasted paper running hard-copy printouts to see the complete 132-column picture.

The DatagraphiX 132-X series has a model with just those features you want. From the simple character mode 132-1, to the DEC-compatible 132-1D, to the advanced editing, block mode 132-2.

You don't have to spend a fortune either. The DatagraphiX 132-X series of display terminals feature a surprisingly low factory price, or liberal terms if you prefer to lease. Also there are more than 100 convenient locations for factory-direct service. It is a combination unmatched by any other manufacturer.

There's no waiting either.

Delivery is from stock for most orders. But don't just take our word for DatagraphiX display superiority. Send us the coupon today and we'll arrange a live demonstration right in your facility. You have to see it to believe it.

Yes, I want to see your letter quality display terminals.

- ☐ Please call me to make arrangements for a demonstration of the low-cost 132-1 ☐, 132-1D ☐, 132-2 ☐.
- ☐ I am interested in receiving information on the 132-1 ☐, 132-1D ☐, 132-2 ☐.
- ☐ I am interested in receiving information about your advanced editing terminals 132A, B ☐, 132-70 IBM-compatible system ☐.

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MMS/11-81

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CIRCLE NO. 51 ON INQUIRY CARD

mercial OEMs," Fernald says. He adds that the Office Plus products will not infringe on the turf of DEC's commercial OEMs.

"The commercial OEM is dramatically different from the technical OEM in that the commercial OEM's development depends on software to a far greater degree," Fernald explains. "The OEM channel still adds value in terms of specific software packages. We in the office group are not entering into an all-out effort to develop applications beyond the normal word-processing, data-processing text-processing, electronic-mail and networking products," he says.

Fernald says DEC is considering products that incorporate voice capabilities, but voice technology is still some years away from maturity. The company is not expected to enter the PBX market.

Fernald contends that DEC is not late in entering the office market. "The key is having a service organization that understands the distributed-systems business, having user-friendly systems, having mature communications and integrating the whole thing in one terminal." He says DEC is alone in possessing all the key ingredients.

In addition to the electronic-mail product, DEC also introduced several other commercial products during September and October:

- DBMS-32, a CODASYL (Conference on Data Systems Languages) database-management system for VAX machines.
- A business-graphics package.
- DECword and DECword/DP.

DECword/IP $8500 is an layered application-software product that will add concurrent word-processing capabilities to PDP-11 systems. It is DEC's first RSTS/E-based time-sharing word-processing application. DECword is a packaged, PDP-11/34-based system that handles four to eight concurrent users and is priced at $50,000.

DECset is a $200,000 VAX-based system designed to integrate publishing into commercial applications in which in-house publishing is required.

—Eric Lundquist

DP teams fixed Winchester with cartridge drive

Data Peripherals, a Sunnyvale, Calif., removable-cartridge, disk-drive maker, enters the fixed-medium 8-in. Winchester-disk-drive market this month with a 40M-byte device. Called the DP400, the hardware is said to be data-format- and interface-compatible with the company's Lynx, a removable-only 8-in. cartridge drive introduced last year (MMS, August, 1980, p. 13).

Nicknamed Puma, the fixed hardware gives Data Peripherals a drive in the storage-capacity class of Quantum Corp.'s Q2000 series and Shugart Associates' recently introduced SA1100 (MMS, October, p. 24).

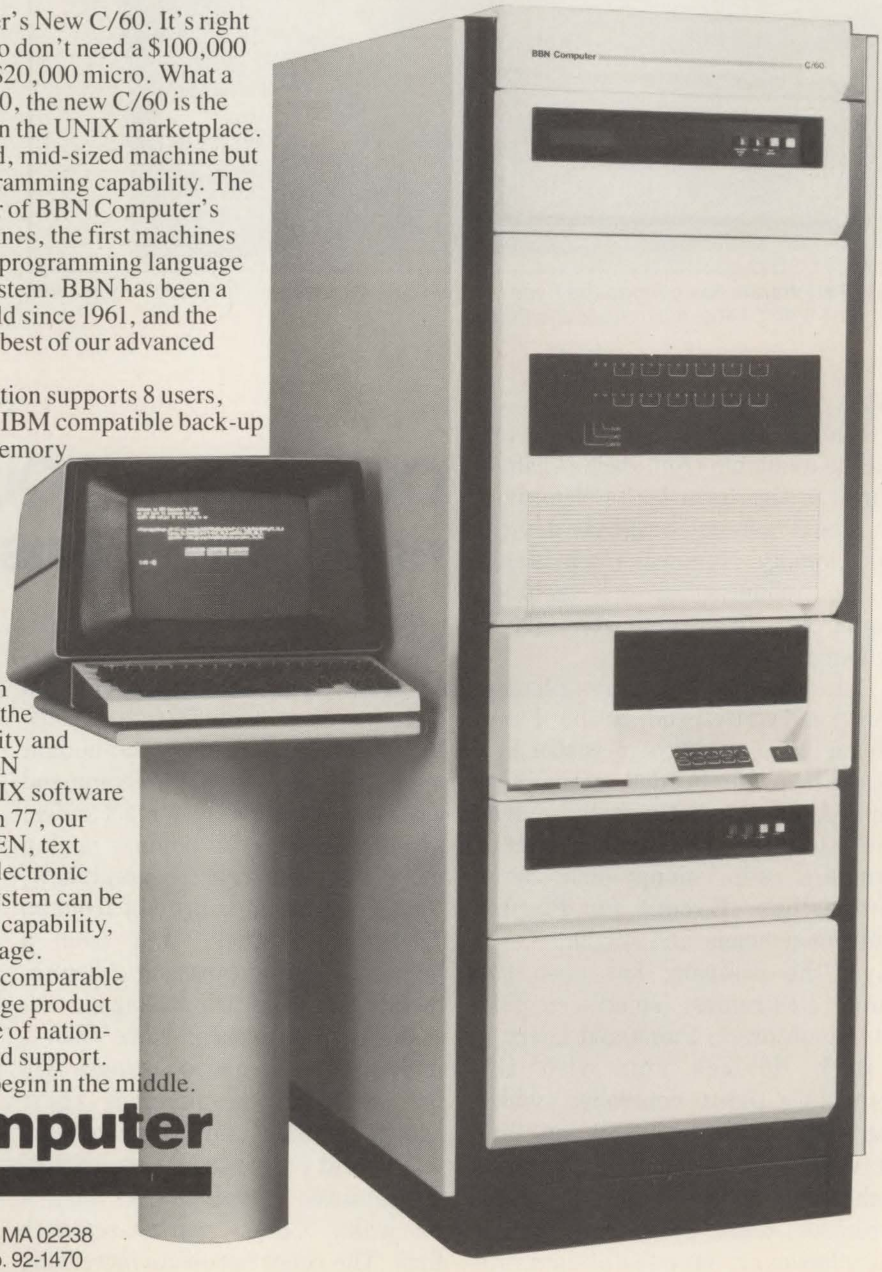
How the Puma and Lynx compare

	Puma	Lynx
Unformatted capacity	44.08M bytes	11.02M bytes
Transfer rates	874K bytes/sec.	874K bytes/sec.
Positioning times		
track/track	15 msec.	15 msec.
average	60 msec.	60 msec.
Rotational speed	3600 rpm	3600 rpm
Track density	610 tpi	478 tpi
Number of platters	3	1
Platter size	200 x 63.5 mm.	
Dimensions	4.62 x 8.55 x 14.25 in.	
DC voltages	+24V DC, +5V DC, −12V DC	
Interface standard	Similar to SA1000	

Data Peripherals expects to sell Puma in tandem with Lynx to provide 10M and 40M bytes of fixed and removable storage on separate spindles. Aimed at storage subsystems builders designing fixed- and removable-medium systems, the duo offers the inherent advantages of two spindles, say company officials. Designed to run on the same controller as well, Lynx and Puma will be offered at "very aggressive prices," says company president John Kevill.

When Puma deliveries begin in February, the drive will be sold with Lynx in large OEM quantities for less than $3000, says Kevill. In comparison, Control Data Corp.'s single-spindle, fixed/removable Lark disk drive is priced at $2700, but that drive's capacities—8M and 8M bytes—are much lower than those of Lynx/Puma at 10M and 40M bytes. CDC is reportedly raising Lark's capacities to 16M and 16M

Our story begins in the middle.



Introducing BBN Computer's New C/60. It's right in the middle, for those who don't need a $100,000 mini but need more than a $20,000 micro. What a story it is. At under $50,000, the new C/60 is the price/performance leader in the UNIX marketplace.

The C/60 is a mid-priced, mid-sized machine but it's a giant in systems programming capability. The C/60 is the newest member of BBN Computer's growing family of C Machines, the first machines optimized to execute the C programming language and the UNIX operating system. BBN has been a pioneer in the computer field since 1961, and the new C/60 incorporates the best of our advanced technologies.

C/60 standard configuration supports 8 users, with 80 Mbytes fixed disc, IBM compatible back-up tape, a ¼ Mbyte of main memory and BBN-UNIX software. And the system is readily expandable to 64 users, with 600 Mbytes mass storage and 2 Mbytes of main memory.

The C/60 fully supports UNIX, the growth operating system of the 80's. With UNIX and the C language, the highest software productivity and portability is achieved. BBN Computer's full line of UNIX software includes UNIX V7, Fortran 77, our innovative screen editor-PEN, text processing software, and electronic mail. And of course, our system can be enhanced with networking capability, BBN-Net, our unique heritage.

BBN Computer offers incomparable customer service, a full range product line, and the rare advantage of nationwide single vendor sales and support.

If you want to finish first, begin in the middle.

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Data Peripherals *has entered the fixed-medium 8-in. Winchester-disk-drive market with the 40M-byte DP400, nicknamed the Puma.*

bytes, however.

(Similar single-spindle hardware will be available from Perkin-Elmer Corp. in the form of its Vanguard 8C, also a 16M- and 16M-byte device. Additionally, Memorex Corp. is said to be resurrecting its troubled model 201 fixed/removable drive, announced in 1980.)

Data Peripherals' three-platter, four read/write-head DP400 Puma uses a linear voice-coil actuator in a closed-loop, embedded servo system. A brushless DC motor drives the spindle. The DP400 meets standard 8-in. floppy-disk drive dimensions. Except for Puma's additional heads and media, Kevill says, the company has used the same electronics, spindle motors and actuators in Puma and Lynx.

Both devices run with the company's DP910 controller, which can daisy-chain as many as four drives. The controller is pin-compatible with Shugart's SA1000 interface. Data Peripherals' interface, however, has a faster data rate than the SA1000 interface and uses parallel track selection making it similar, but not identical, to the SA1000. The DP910 with a Puma and Lynx will sell for less than $4000, Kevill adds.

Both drives reportedly have the same number of sectors per surface as Digital Equipment Corp.'s RL02, a 10M-byte top-loading cartridge drive that uses 3330 technology. This feature makes the Puma and Lynx compatible with DEC's Unibus and Q-bus.

Heads for Puma are custom-built by Data Peripherals' sister company, Information Magnetics Corp. Both firms are subsidiaries of Computer and Communications Technology, Inc., Santa Barbara, Calif. Kevill says he expects Data Peripherals to produce as many Lynxes as Pumas in 1982.

—Larry Lettieri

Overweight? Questions on nutrition? Consult a computer

"Good morning and congratulations. This is your friendly computer again, with the news that you have increased your life expectancy by a full two years since you bought me. This morning, I recommend that you jog steadily for 3.7 miles, and I would advise against having more than one egg for breakfast." Those helpful hints are not from an "electronic mother," but from a home computer operating a health-monitoring software package.

Within four years, more than 1 million home-computer owners will use software to monitor their health, exercise and diet, according to a recent report from International Resource Development, Inc., a Norwalk, Conn. market-research firm. The report projects increasing popularity for the next step in home medical electronics, a market growing 40 percent annually for such products as blood-pressure and pulse-rate monitors and electronic thermometers.

The report focuses on the trend among consumers toward preventive medicine. Sales figures for personal-health products and an increase in physician talk shows on television may support the trend, but some computer industry observers are skeptical about the boon that may result for software developers supplying such programs.

The success of such software packages is difficult to predict, despite the encouraging study. Suppliers of μc software are concentrating development efforts

Just $308* buys you a complete OEM mini-cartridge recorder that's ready to operate.

Why spend time and money on digital recorder design when EPI offers a complete, ready-to-use mini-cartridge recorder at such a low price?

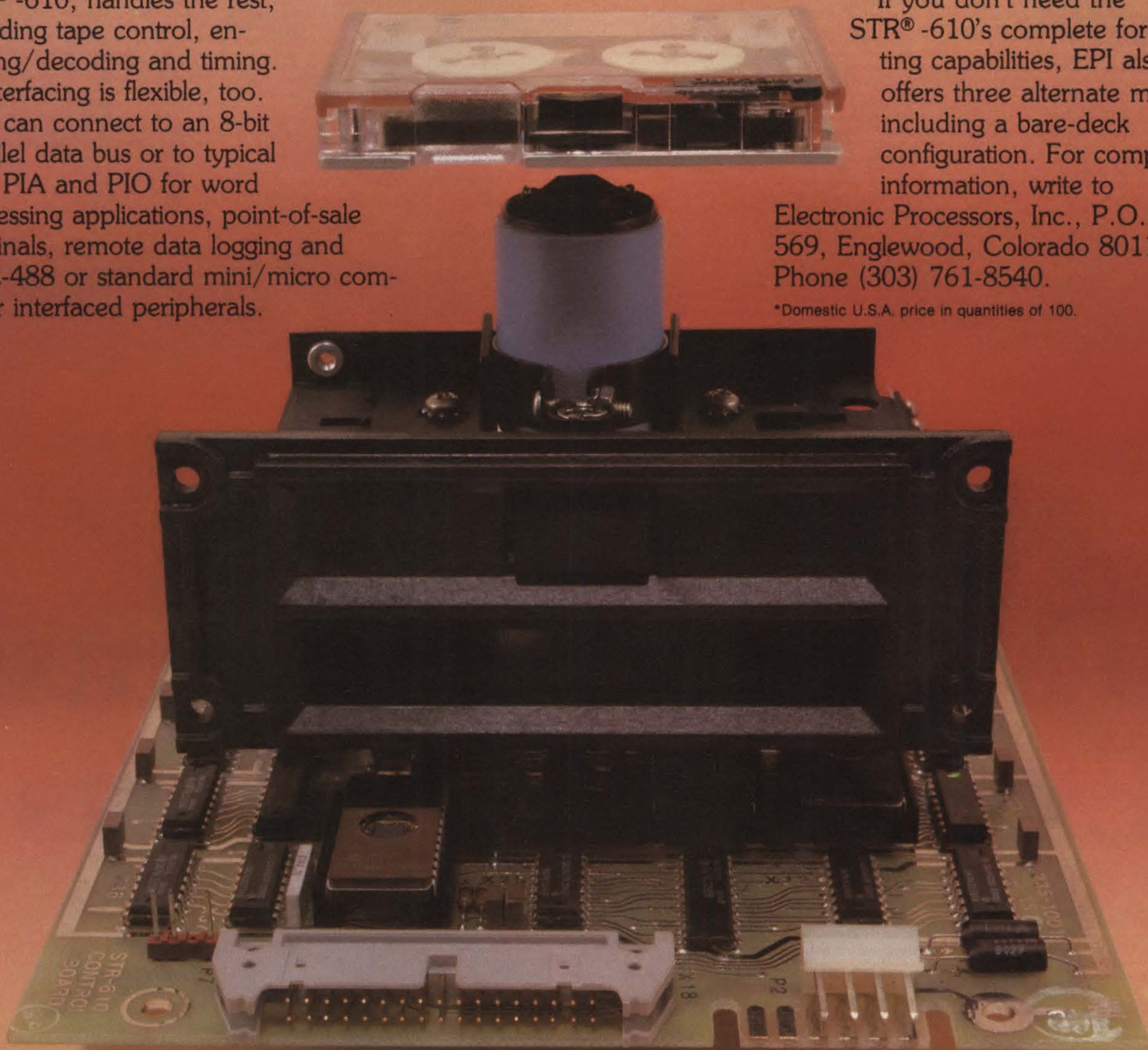
With the STR® -610, you simply supply power, data inputs and a few control commands. The STR® -610, handles the rest, including tape control, encoding/decoding and timing.

Interfacing is flexible, too. You can connect to an 8-bit parallel data bus or to typical PPI, PIA and PIO for word processing applications, point-of-sale terminals, remote data logging and IEEE-488 or standard mini/micro computer interfaced peripherals.

The STR® -610's extremely high data reliability is ensured by EPI's exclusive Speed Tolerant Phase Encoding Recording technique (STPER™), and typical EPI attention to QA/QC results in guaranteed unit-to-unit compatibility.

If you don't need the STR® -610's complete formatting capabilities, EPI also offers three alternate models, including a bare-deck configuration. For complete information, write to Electronic Processors, Inc., P.O. Box 569, Englewood, Colorado 80110. Phone (303) 761-8540.

*Domestic U.S.A. price in quantities of 100.



Let EPI remember for you

ELECTRONIC PROCESSORS INCORPORATED

EI/1

CIRCLE NO. 53 ON INQUIRY CARD

Called "MP/M II™"

MP/M II, the multiuser extension of our CP/M operating system, answers the lucrative business community demand for small scale distributed processing. Smart OEM's, language companies and application programmers are enthusiastically extending their offerings to satisfy this "new" market.

MP/M II Features

Record locking and file locking ensure data base validity when multiple users access the same data.

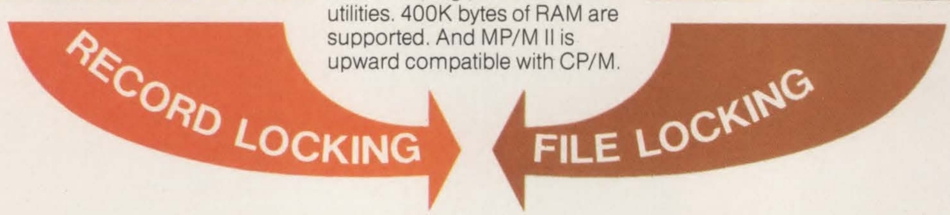
With 32 megabyte file capacity, you can daisy-chain 16 state-of-the-art disk drives, at 512 megabytes each. This gives you on-line storage of 8 gigabytes!

Fast performance is a certainty. Dispatch time between users requires as little as 600 microseconds.

Encrypted passwords provide security for user files and directories.

Time and date stamps indicate your last update of an application file and either last access or file creation.

Additional features provide increased performance with exceptionally low system overhead through streamlined housekeeping plus 30 refined utilities. 400K bytes of RAM are supported. And MP/M II is upward compatible with CP/M.



Substantial Capabilities Included

Major utilities in the MP/M II package include our RMAC™ assembler, LINK-80,™ LIB-80™ run time library manager, and RDT™ debugger.

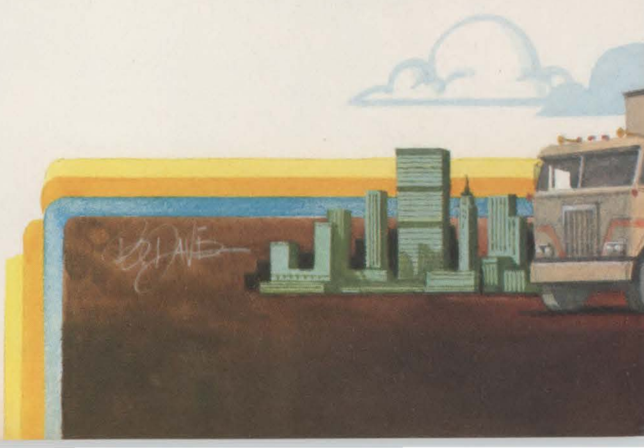
Network capability: Your product's growth to CP/NET™ is provided in MP/M II.

To Language & Application Companies:

You're seizing the time-perishable market advantages of MP/M II. Its five manuals help extend your products to multiuser status, with accuracy and speed. LINK-80's overlay facilities help produce a higher quality. LINK-80, RMAC and RDT are powerful development aids — which don't cost you a thing.

Compatible software accelerates your entry into the multiuser market. All programs running under CP/M also run under MP/M II. This means important continuity. Couple that with a built-in growth path, and you're protecting the future of your business with MP/M II.

Extend CP/M® to Multiuser Systems: Extend Your Profits



To Hardware OEM's:

The profitable impact of multiuser configurations is profound. Compare your sum-of-the-boxes pricing: Multiuser vs. single user. No question about it. Your next move will be to re-forecast sales quotas and profit margins. MP/M II is the key. With the market demand you read about, the act of extending your systems to MP/M II will bear handsome rewards. Your next step is equally clear. Have our marketing group expedite the MP/M II data sheet, OEM price list and contract. Here's an even more positive approach. Why not call our marketing group as your first priority?

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Control-C Software, Inc.
Digital Research
Ellis Computing
Laboratory Microsystems
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Micro Focus, Inc.
Microsoft
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Ryan-McFarland Corp.
Sorcim Corporation
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To Dealers, Distributors, System Houses:

It takes less effort to make more money by selling multiuser systems. Selling an upgrade path is easier than moving dead end, dedicated systems. MP/M II means hard disks, multiple printers and terminals—add-ons right through full networking environments. One sale can truly generate cash for an extended period. So call your OEM for delivery of MP/M II based systems.

Every new market has its share of easy sales. For a while, somebody will take those orders hand over fist. Your share of that business will probably depend on a single factor: Your ability to get product *first*.

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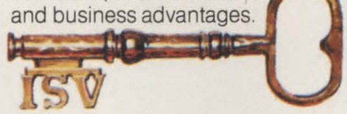
Over 250,000 microcomputers use our operating systems. Over 300 OEM's and 400 independent software vendors (ISV's) use our products as the basis of thousands of applications. These are listed in our CP/M Compatible Catalog. Over 25,000 copies, per edition, generate ISV's sales. FORUM, published quarterly, and ISV seminars provide technical and business advantages.



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Multiuser demand is more than a trend. The MP/M II market is a fact of business life. It elevates the microcomputer with larger scale capabilities, and a larger dollar/sale market base. You only get one chance to make a good first (market) impression. Now is the time. We're here to help. **Call (408) 649-3896,** or write: Digital Research, P.O. Box 579, Pacific Grove, CA 93950. Europe: Vector, Intl., Leuven, Belgium, 32(16)202496 Far East: Microsoftware Assoc., Tokyo, Japan, 03-403-2120

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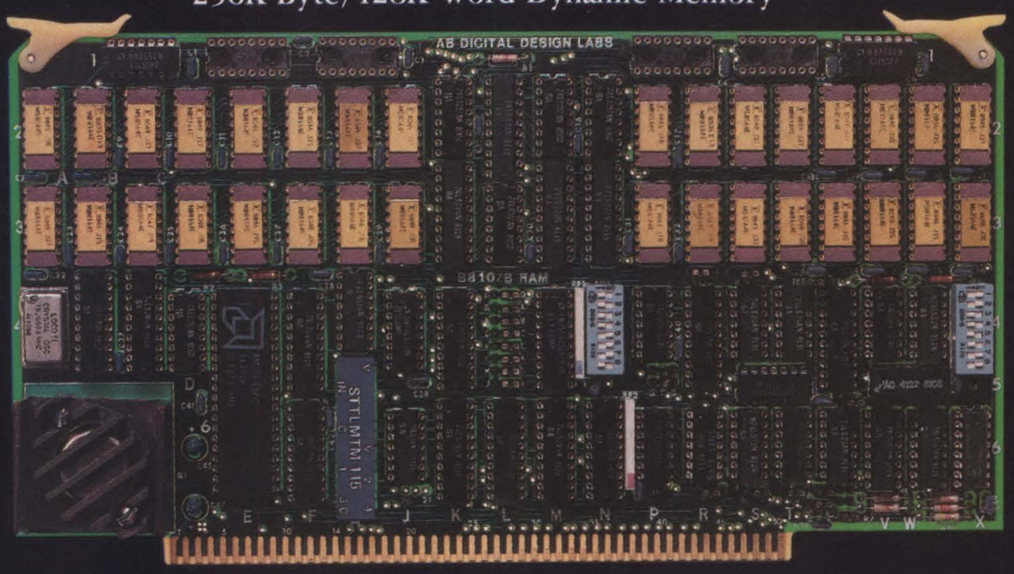
256K Byte/128K Word Dynamic Memory



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- Extended Addressing or Port Selection in 16K increments
- 150 ns Access, 270 ns Cycle
- Precise Memory Timing Module designed by Engineered Components Corporation for the B810/B
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- Full DMA capability with Intelligent Refresh ™

(parity option ICs not shown)
†EXTENDED INTRODUCTORY PRICE

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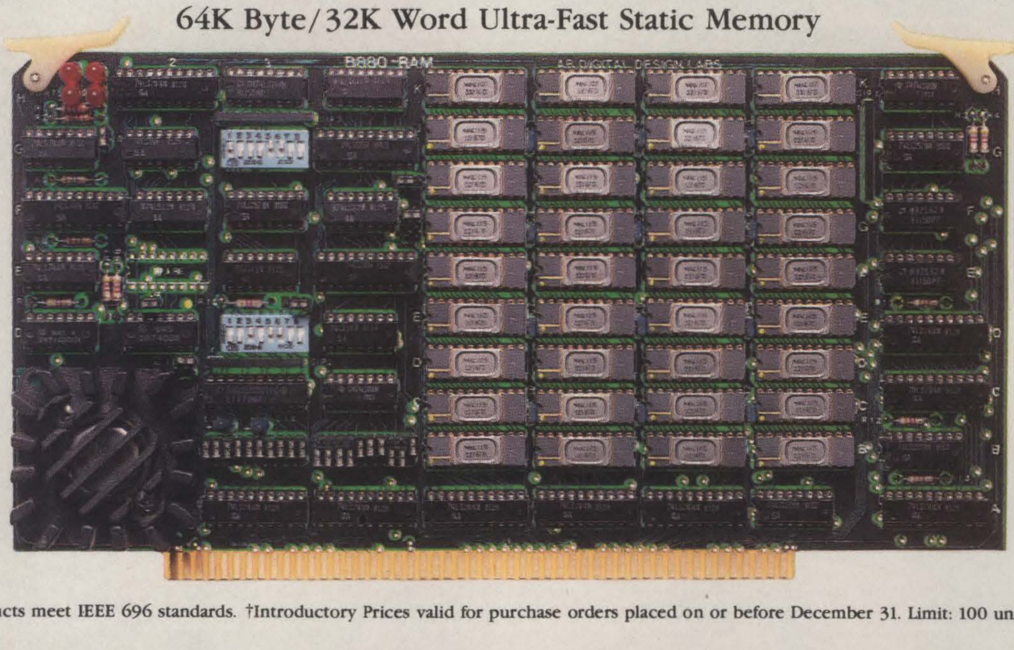
B880 RAM

64K Byte/32K Word Ultra-Fast Static Memory



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- Extended Addressing or Port Selection
- Access and Cycle time less than 85 ns
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CIRCLE NO. 55 ON INQUIRY CARD

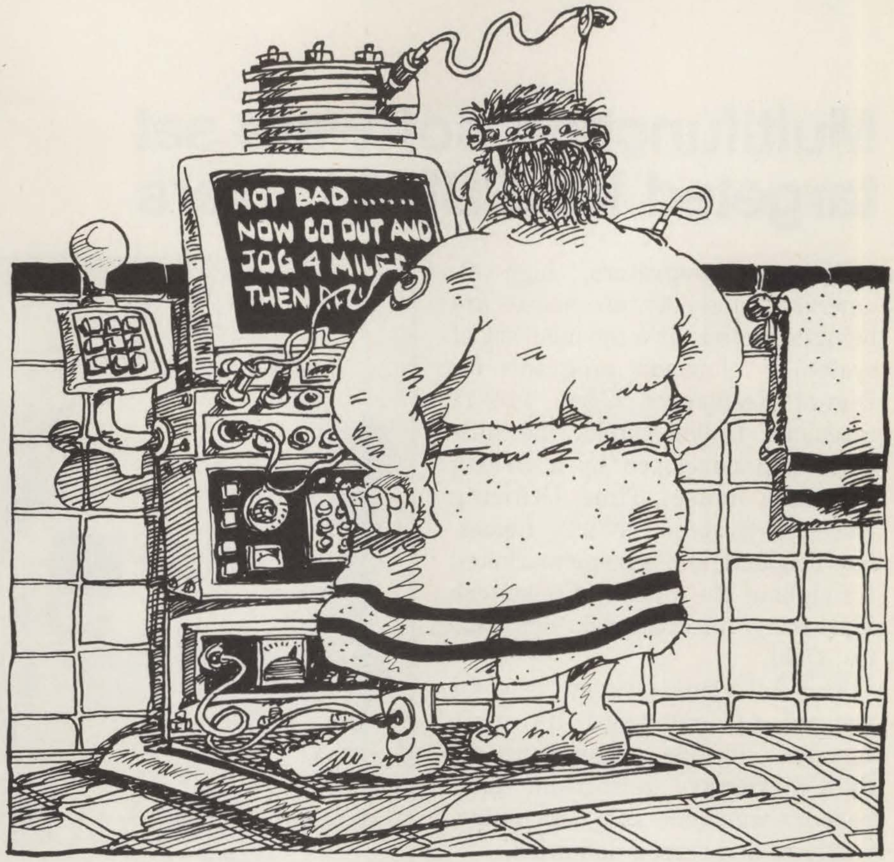


Illustration by Jon McIntosh

on business packages, especially in the wake of new μc entrants from Xerox Corp. and IBM Corp. But as one observer notes, "For $50 a package, anyone will shoot for it."

Others, however, believe such packages are overdue. "I'm surprised I can't buy a (comprehensive) package today," Says Kenneth G. Bosomworth, president of IRD. A comprehensive package, he says, would include information relating to mortality rate, age, alcohol consumption, menus and exercise. Pieces of such a package are available individually he adds. And, some services do supply the information, but not for use on a home computer.

Few seeds have been planted in this potentially lucrative market. Apple Computer, Inc., Cupertino, Calif., is among the few personal-computer manufacturers to offer a health package, which was released only four to five months ago. Called Diet Analysis, the $45 package for the Apple II and III μcs was provided by an independent programmer. It helps dieters assess carbohydrate, mineral and other nutrient intakes and relates the information to age, sex, frame size and weight. In recording food intake, it can help an overweight, underweight, or normal person plan meals.

Apple expects to sell hundreds to thousands of Diet-Analysis programs through its 2500 worldwide dealers, a company spokesman says. This distribution network may be the key to success of health packages. A successful package must be sold in volume because of the increasing costs of developing and marketing programs, says Frederick R. Adler, Adler & Co., a New York venture-capital concern that backed Data General Corp., and 40 percent of whose ventures are medical-related companies. Adler says a need for health packages exists but that a company that supplies them must offer several because they are limited-market products.

Adler is skeptical, however, about using software to maintain health. "Weight control is discipline. People who are health-conscious will be anyway; they don't need a computer." He says such programs should be linked directly to consulting a physician and having a physical examination. Most people, he contends, would rather go to their physicians for health problems.

The IRD report, however, contends that consumers may be as wary of health software as they are of physicians. The report predicts a cultural trend away from complete reliance on physicians and the health-care establishment toward more self-care and self-reliance. Bosomworth acknowledges that using a software program without consulting a physician is a sensitive safety issue, especially among physicians. Packages must include ways to flag abnormal vital signs and recommend a visit to a doctor.

Software packages for home computers are not subject to the same regulatory requirements as are medical devices, according to the IRD report. Thus, software sales may not be impeded by bureaucratic constraints, as are medical devices.

Some computerized health services, including General Health, Inc., Washington, and the Life Extension Institute, Bloomington, Minn., use computerized databases on life expectancy and on the impacts of alcohol, obesity and hypertension.

Bosomworth believes it is unlikely that such services will repackage their health plans for home use because such a practice might jeopardize the health services' business. But he expects medical information to be available through services such as videotex, the Source, Compuserve and two-way cable TV. *—L. Valigra*

Multifunction software set targeted for PDP-11 users

Systems integrators, high-volume users and software houses are being targeted for a modular set of system-development programs for Digital Equipment Corp. PDP-11 machines. Called Cupid, the software was developed by a British software house, Time Utilizing Business Systems (TUBS), Leicester, England, and is being marketed throughout the U.S. by Consultech Marketing International, San Carlos, Calif.

The full Cupid system sells for around $14,000, and its main functions include report writing, data-dictionary definition, database-management and data entry, retrieval and screen definition.

Nick Meek, TUBS' chairman, says Cupid is aimed at users of any PDP-11 with rigid-disk storage and a VT-52- or VT-100-compatible CRT terminal. Operating systems under which Cupid runs include RT-11, CTS 300, RSTS (E), CTS 500 or TSX Plus.

Cupid is already being used widely in Europe and DEC uses the product internally in an accounts-receivable operation. The system has one major U.S. OEM, Digital Systems, Pensacola, Fla., described as "the biggest DEC OEM in Florida." Digital Systems has been owned since early 1980 by a leading U.S. computer-services firm, University Computing Co.

TUBS took a booth at the National Computer Conference in Chicago this year where it quoted the endorsement of Don Ewing, head of software at Digital Systems. "Digital Systems had been looking for a year for a general-purpose report writer to operate under CTS 300 in a 64K-byte environment when we discovered Cupid and TUBS," said Ewing. "The Cupid product blended readily with our data structure via intermediate indexes and offered manual or automatic formatting and different file-accessing sequences."

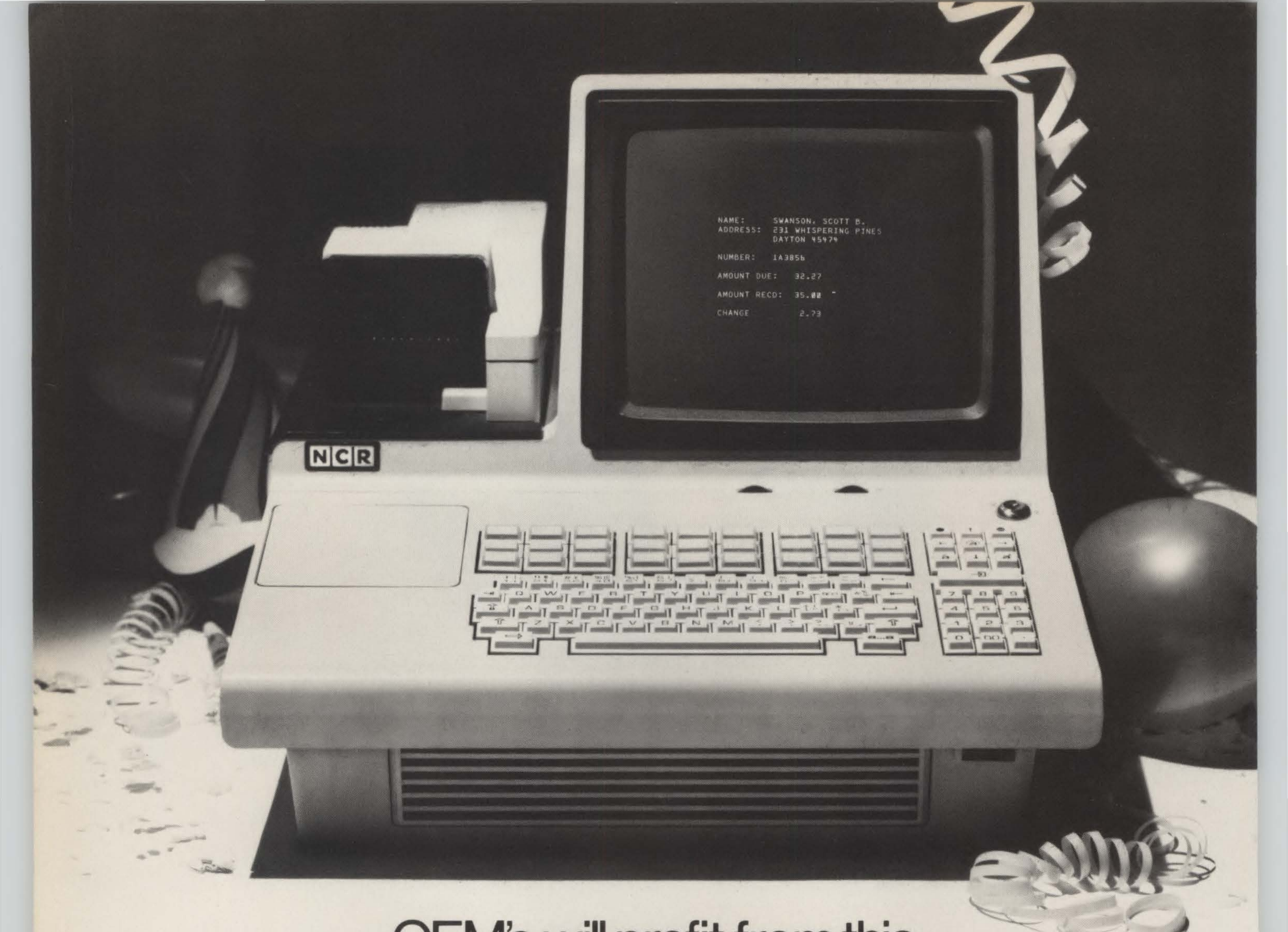
Nick Meek, chairman of Time Utilizing Business Systems *(TUBS), notes that his company's new software programs are aimed at systems integrators, end users and software houses using DEC PDP-11 machines.*

Meek says Digital Systems sold $30,000 worth of Cupid software in its first year of handling the product. He says Digital Systems chose Cupid in preference to U.S. competition and that the company has supplied copies of the report-writer version to 30 sites across the U.S.. Consultech will market the full version of Cupid in the U.S., he says, including file- and data-entry definition facilities.

File-definition facilities enable a user to define the name, location, description and size of a file and to define data items in a record in terms of size, type, description and possible values. Records can be redefined to obtain multiple record types for any file, and multiple keys can be defined for data-record retrieval. On the data-entry definition side, Cupid can be used to format a data entry screen, define the input field sequence and amend data-entry jobs. The report writer, which can be purchased separately for about $5000, enables the user to format the report layout, use as many as 99 files for any report, specify totaling, arithmetic and updating functions and allow multiple control breaks on change of data.

Meek says that TUBS is paying Consultech a one-time fee for developing a U.S. marketing strategy for Cupid but will receive a royalty on subsequent sales. Consultech has concentrated until now on finding distributors in Europe for U.S. products, he adds.

—Keith Jones



OEM's will profit from this "SURPRISE PARTY" It's the NCR 2950.

You want the finest cash control system for your customers, at a price they can afford. That's why you look at the NCR 2950 terminals, built by the company that developed practical cash control. Then comes the surprise!

The 2950 is a lot more than a cash control terminal. It's a small countertop computer that uses the BASIC language. This means it's a snap for you to customize the 2950 to handle your customers' special projects such as statistical reporting and budget projections, to mention just two possibilities.

Enhancing the unlimited applications of the 2950 are the following features:

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Of course the control features you'd expect in an outstanding cash control system are part of the 2950: cash drawer, change computation, and individual accountability. Then tie those features into automatic reading of account numbers via an OCR wand reader, online access to a mainframe computer, and 80-column printer — a great system becomes super!

One feature of the 2950 package that should come as no surprise is the support you can call on. We have over 16,000 field engineers in more than 1,200 offices to back-up our equipment wherever it goes.

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See the 2950 at COMDEX '81, Booth 104.

CIRCLE NO. 57 ON INQUIRY CARD

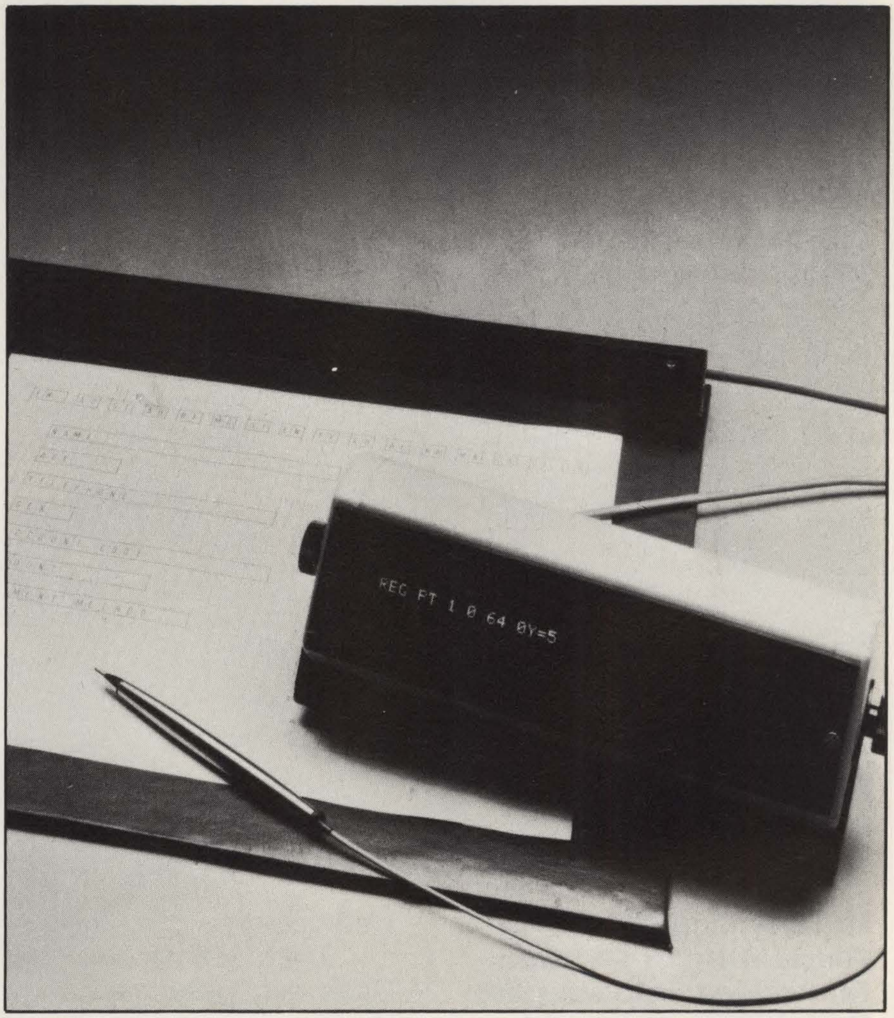
Handprint data-entry terminals offer CRT alternative

Direct handprint data-entry terminals offer one of the few alternatives to CRTs for data capture at a source. They also offer several advantages that should attract systems integrators looking at applications in which a data originator might find using a CRT terminal awkward, intimidating or humiliating. Potential uses for handprint terminals include Telex-logging and data collection in hospitals and factories.

At least one U.S. company, Pencept, Inc., Waltham, Mass., is selling a handprint-recognition system, although this segment of computer technology usually has been concentrated in Europe. In Britain, at least three companies have handprint systems on the market. Two of them, Micropad, Ltd., and Image Data Products, Ltd., are setting up sales operations in the U.S., and the third, CTS Recognition, is seeking representation.

With its British headquarters at Wimborne, Dorset, England, Micropad has established a U.S. subsidiary, Micropad, Inc., Chicago, which is seeking distributors and shipping evaluation quantities to systems integrators. Bristol-based Image Data Products has appointed two agents—marketing Technology, Inc., to operate from New York and Washington, and Media Systems, Inc., to work from Boston. CTS of London plans to enter the U.S. market in 1982 "if approached by the right distributors," says managing director John Bendall.

The three products differ in many details, but the biggest difference lies in their character-sending technologies.



Telepad from CTS Recognition *is one of the three handprint data-entry terminals offered by British suppliers. Telepad includes a pad, a writing pen, an RS232 interface, a character display, character-recognition and document-formatting hardware and μp-based hardware.*

The Micropad product, called Micropad, employs a technique developed at the British government-backed National Physical Laboratory and was the first to be used commercially. Beneath the writing surface are two electrically conducting carbon-coated layers, each with a voltage gradient along the edge at a right angle to the gradient on the other. When the air gap between the layers is closed by the pressure of a writing implement, the resistive contact generates a combination of voltages that define the X and Y coordinates of that point on the character being written.

Image Data's product, the Data Tablet, is based on an electromagnetic method developed at Hatfield Polytechnic. A special writing pen incorporates a microswitch, which is activated when the pen is pressed into the writing surface. A magnetic flux is induced through a coil in the tip of the pen and generates signals in a matrix of electrical connections

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The Dual-Mode 200 also features letter perfect print you will be proud to use for business letters and reports. Letter Mode speeds range from 42 cps to 60 cps.

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laminated between the outside surfaces of the pad.

Telepad, the CTS system, employs a technology from another major British research center, Salford University. In this case, a pen transmits a low-frequency sine wave that can be picked up by the Telepad, even if the paper is not resting directly on it. As a result, the Telepad can be concealed under the writing desk, an advantage over the other two products.

One of the most fundamental advantages of handprint pads over CRT terminals is that hard copy is generated simultaneously with data capture. This saves the cost of a hard-copy printer and the effort involved in filling in a document and then keying. Moreover, data are recorded only once by one person, so there is less risk of human error.

An equally important but less obvious advantage over a CRT terminal is that data can be entered randomly on a handprint terminal far more quickly and easily. Instead of moving a cursor across the CRT screen to the relevant field, a handprint-terminal user simply moves his hand to the required position on the form, just like form-filling in a non-computer environment. In this way, handprint terminals are better suited to random data-entry jobs, such as taking orders over the telephone. They are also more acceptable to users who object to the complexity of using a CRT.

Handprint terminals can provide an effective alternative to handprint-reading OCR systems. Handprint pads can examine the way a character is formed and its shape because they process the X and Y coordinates of each point on the character as it is written. As a result, a pad is less likely to confuse an "8" with a "B", or a "5" with an "S". Moreover, even if the pad system misreads a character, the mistake should be obvious to a user because all systems on the market include a display that shows what the recognition logic has picked up. If the character has been rejected or misread, a user can re-enter it by rewriting it in the same position.

All three British systems allow a high degree of character variability. They can distinguish between the ways of writing the number "4", for example. All of them can accept the full alphabet in upper case, as well as numerals and some special characters.

Software for handling format control for different documents can be down-loaded to a pad system from the host computer. The coordinates of each character must be transmitted to the host along with the character code, unless the system includes page buffering or the characters are entered on the form serially. But serial-entry applications do not take advantage of the random data-capture capability of handprint pads, thus defeating one of their main purposes.

The three British pad systems are priced at $3000 to $4000. Each includes a pad, a writing pen, an RS232 interface, a character display, character-recognition and document-formatting hardware and μp-based software. On Micropad and Telepad, the display unit shows one line at a time, while Data Tablet comes with a 21-line × 80-character display screen.

Two additional features provided on the Data Tablet are graphics recognition and a touch-activated keyboard. Image Data Sources say the graphics facility makes the Data Tablet especially suited to applications in which pictorial information is accompanied by a description, such as a police report describing a crime. The keyboard can be used to enter confidential information and other details that should not be written.

An optional feature on Micropad is Q-sign, a signature-verification capability aimed at electronic funds-transfer applications. With this option, the host computer holds a file of digitized signatures of authorized users. A Micropad user can call his own digitized signature from the host by entering his personal identification number. He then writes his signature on the Micropad and the Q-sign logic compares it with the stored signature. If the two match, any transaction information entered on the Micropad by the user is assumed to be valid.

One of the most promising applications for handprint terminals may be in collecting telephone orders. Among the first such users in Britain is a major supplier of meat products, Scot-Bowyers, Ltd., which has provided its telephone-sales clerks with five Data Tablets from Image Data. Scot-Bowyers sees handprint data capture at the source as more reliable than providing conventional CRT terminals for subsequent batch data-entry forms.

—Keith Jones

NEXT MONTH IN MMS

The December issue will feature Mini-Micro Systems' annual special report on computer graphics. Leading off the report will be a comprehensive survey of computer-graphics terminals. Other scheduled articles related to the graphics theme will include:

- A look at the new hardware/software design technique that provides extremely fast three-dimensional raster graphics processing.
- A look at the use of dot-matrix printers for both text and graphics printing.

Mini-Micro Systems will present its sixth annual report on printers in the January, 1982, issue. The report will include product profiles and comprehensive surveys of serial and impact-line printers. Also scheduled is a look at a new low-cost color-graphics printer.

European UNIX user group attracting new members

UNIX users are alive and well and spreading in Europe, as evidenced by the last European UNIX User Group (EUUG) meeting held at Nottingham University, England, in September. The group holds meetings every six months. The Nottingham meeting differed from earlier ones because it included a separate exhibition and series of presentations for non-EUUG attendees on UNIX, UNIX-like and UNIX-based systems.

The show was attended by potential UNIX users from about 170 commercial organizations, as well as by group members. As in the U.S., UNIX is starting to find favor in Europe outside its traditional academic stronghold, although educational centers still dominate the EUUG membership.

European software houses are jumping on the UNIX bandwagon, hoping to break into the U.S. market with products that can be supported by UNIX or UNIX-based systems.

For example, at the Nottingham University session, the British software house, Micro Focus Ltd., presented a version of its ANSI '74 standard compiler, CIC COBOL, tailored for use on UNIX systems. Speaking at the show, Micro Focus managing director, Paul O'Grady, pointed out that the UNIX version of CIS COBOL enables programs written under the CP/M operating system to be converted to run under UNIX with a simple recompile. COBOL is available on a wide range of μcs and a CP/M version has been available on Intel 8080- and Zilog Z80-based systems for two years. Those systems now include Apple II machines running under CP/M.

CIS COBOL has achieved significant sales success in the U.S., where it is marketed through a Micro Focus sales office in Santa Clara, Calif. The company's main sales thrust is concentrated in the U.S..

Development of the UNIX version of CIS COBOL was carried out by the Santa Cruz Operation, a California software house. O'Grady pointed out that Santa Cruz wrote the run-time compiler for UNIX CIS COBOL in the UNIX systems development language, C, thus providing it with portability between machines that support UNIX. So far, UNIX CIS COBOL is available on all Digital Equipment Corp. PDP-11- and LSI-11-based systems running UNIX Versions 6 and 7, but Micro Focus anticipates supplying the product for Zilog Z8000-, Motorola 68000- and Intel 8086-based systems.

EUUG PLANS BENCHMARKS, APPRAISAL SERVICE

Benchmarking of UNIX-based and UNIX-like systems is being carried out by the European UNIX User Group, EUUG, which also plans to establish a service for appraising UNIX-oriented systems software and applications packages produced by worldwide software houses. The first of its benchmark findings will be published this year in EUUG's November/December newsletter.

Speaking at the EUUG conference held at Nottingham University, the group's chairman, Alan Mason, said that the benchmarks will cover Western Electric's UNIX plus all the systems demonstrated at the Nottingham exhibition. Those include UNIX-based ZEUS from Zilog, ONIX from Onyx, XENIX from Microsoft and Perkin-Elmer's Workbench VII, as well as UNIX-like systems, including IDRIS from Whitesmiths, CROMIX from Cromemco and UNIFLEX from South West Technical Products. Mason pointed out that C/70 from BBN Computer Corp., Cambridge, Mass., will be benchmarked using a transatlantic link to the Arpanet packet-switched network. UTS on Amdahl mainframes will also be benchmarked.

The proposed appraisal service will provide vendors with a detailed product review, which they can use to promote the product. Mason also stated that EUUG is preparing a UNIX software catalog.

Mason also said that the EUUG is establishing Special Interest Groups, SIGS, including one for commercial users. But he was against establishing a separate group for commercial installations, such as the USR/GROUP started last year in the U.S. He welcomed commercial users into EUUG and stated that USENIX, the U.S. group for university users, is "too academic."

He added, however, that EUUG will make necessary distinctions when organizing SIG meetings and will distinguish between commercial and university users, users of Western Electric UNIX and other systems and users with licenses for binary versions and source-code versions.

Based at the Department of Electrical Engineering at Heriot Watt University, Edinburgh, Scotland, Mason has been a UNIX user for several years. Although EUUG is dominated by British users who began the group five years ago, membership is spreading throughout Europe. The first Continental meeting was held this year in Amsterdam, the Netherlands, and the next meeting will take place in Paris, France. Worldwide contact is maintained through the exchange of newsletters between EUUG, USENIX, USR/GROUP and AUUG and CUUG in Australia and Canada, respectively.

Product Highlight: Dynabyte 5505.

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DYNABYTE Business Computers

CIRCLE NO. 60 ON INQUIRY CARD

Among those attending the EUUG meeting *at Nottingham University, England, were (from left) Theo de Ridder, a lecturer at the De Maere institute in the Netherlands; Dave Brailsford, a computer science lecturer at Nottingham and an organizer of the September seminar; Alan Mason, chairman of the EUUG; and Roger Henry, a lecturer at Nottingham and the seminar chairman.*

O'Grady says that UNIX CIS COBOL sells for $1200 in the U.S.

Task portability between CP/M and UNIX Version 7 is offered by a family of commercial applications packages soon to be marketed in the U.S. by Compact System International Inc., N.Y., an operation established by the British software house, Compact Accounting Services Ltd., another exhibitor at the Nottingham show.

Compact's packages for CP/M machines are written in a BASIC similar to the Business BASIC 3 interpreter from SMC Corp., Bridgewater, N.J. BB3 was written for the Zilog Z8000, the 16-bit μp that forms the basis of the Onyx Corp. C8002 μc, one of the hosts for UNIX Version 7. The packages are tailored by Compact to run under UNIX 7 on the C8002.

Compact's managing director, Peter Bronson, says the packages for CP/M and UNIX 7 are functionally identical to each other. To convert from a CP/M machine to UNIX 7 on the C8002, a user needs only to transfer data files, an automatic process involving an RS232 back-to-back cable link. Bronson notes that the UNIX 7 packages will also run under two UNIX-based operating systems, Onyx's ONIX system and Zilog's ZEUS (Zilog-enhanced UNIX system). The CP/M packages are available for the Multivision computer from Applied Digital Data Systems Corp. and will be available later for the North Star Horizon and Intertec Superbrain. Compact has also tailored its packages to run under the operating systems on Nixdorf and MAI Basic Four computers.

—Keith Jones

Commodore offers COMAL for its Pet computers

Commodore Machines in Europe is strongly supporting COMAL, a structural language for educational applications. COMAL is described as being "55 percent like Pascal," while offering BASIC-type interactive operating features, such as immediate syntax-error indication. COMAL is used in most schools in Denmark and on very limited basis in the U.S. by owners of Commodore Pet machines.

A small U.S. COMAL user group is headed by Len Lindsay, Madison, Wis. A former Commodore employee, Lindsay was the founder of the user publication and *PET GAZETTE*.

In Europe, the disk-based version of COMAL is widely used, and, as a result, Commodore backs the development of a COMAL ROM board for Pet systems.The board might be available later in a version for the company's new VIC μc series. The main problem with the disk version is that it occupies 26K bytes of main memory on a 32K-byte machine.

COMAL was developed in Denmark around 1974 to 1975 by Borge Christensen and Benedit Loefstedt. Christensen is a senior lecturer at a teacher training college at Tonder, Denmark, while Loefstedt is a former computer-science lecturer at the University of Aarhus, in Denmark. Christensen describes COMAL as "kindergarten FORTRAN." He believes that COMAL's structure is also similar to Ada, the real-time language of the U.S. Department of Defense and could be considered a kindergarten version of that.

Called COMAL 80, the existing version of the language will be enhanced with some significant extensions when it appears on a ROM board. They will include facilities for calling external procedures in different languages. If required, BASIC will be available in background on Pets fitted with the COMAL board. Not surprisingly, Commodore intends to charge for the board, even though the the disk version is free.

—Keith Jones

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CIRCLE NO. 63 ON INQUIRY CARD

Louis Doctor introduces Raster Technologies Inc.

Last year, Louis Doctor wandered through the Siggraph '80 convention hall wearing a student's badge. Last August, at the Siggraph '81 graphics show in Dallas, Doctor stood on the other side of the exhibition booths as president of Raster Technologies Inc. displaying a $10,800 graphics controller.

Within a year, Doctor and John Torborg, a co-researcher at Rensselaer Polytechnic Institute's Center for Interactive Computer Graphics, now Raster Technologies' vice president of engineering, recognized a need for a display device for geometric modeling. They realized that a controller with at least a five-year market life would require 64K chips. The pair approached RPI, which could not offer financial backing, but did offer space and development facilities. RPI is an equity holder in Raster Technologies. They parlayed the perceived need for a graphics controller incorporating 64K RAMs into a product scheduled to enter production this January. Their efforts have attracted $250,000 worth of venture capital from VenRock Inc., New York, and Doctor says the initial investment will be buttressed in October by $1 million from several venture-capital firms. For the two 23-year-old entrepreneurs, the move from lab researchers to corporate officers has been rapid, but Doctor believes there is a need for their controllers in the market. He also believes that the difficulties of incorporating 64K RAMs into graphics controllers will give Raster Technologies an early market penetration.

The company's first product, the Model One raster-scan display controller, offers a graphics system with software-selectable dual-mode operation of 512 × 512 pixels for imaging or 1024 × 1024 addressable points for line drawing.

Both modes use the same memory, "but it is either crunched up and deep for images or spread out and thinner for lines," Doctor says. He claims that Model One obviates the need for users to purchase separate systems for imaging and line-drawing applications. The Model One's image memory can be expanded to 768K bytes of 64K RAMs contained on one PC board. Under the pixel-array mode, the system stores as much as 24 bits of information for each on-screen pixel, while under the 1K × 1K mode, each point stores as much as 6 bits.

The controller's ability to allow displays to show a partial view into a 1K image array or a full-screen 1K image is unique, Doctor says.

The increased capabilities and image-memory bit-price savings result from using 64K RAMs instead of 16K RAMs and required far more technical skill than moving from 16K to 64K chips in a typical minicomputer memory, Doctor says. "In a conventional computer system, the memory is almost a peripheral to the whole system and it's nearly as easy as unplugging four boards and plugging in one board using 64K chips to upgrade the memory," Doctor says. "In color-raster systems, the memory is a more integral part of the system because the video must be generated as the memory is updated. You're forced to refresh the screen and generate that color video signal out," Doctor says.

Systems using 16K RAMs typically use a variation of a dual-ported architecture that enables users to refresh the screen and to perform random updates simultaneously, Doctor says. "When you change to 64K RAMs you can't use dual-ported architecture. We had to design the entire system from scratch," he says.

Successfully incorporating 64K RAMs hinged on making the best use of every image-memory cycle. In a standard video signal, about 70 percent of the time is used to refresh the screen, while in the remaining 30 percent, the beam is either retracing or blank. "We had to update the memory during that 30 percent of time and, therefore, had to make the best use of about one-third of the time that everyone else has," Doctor says.

Raster Technologies hardware solution included adding a vector generator and pixel processor. The vector processor off-loads repeating line-generation commands from the CPU, with an average 700,000-per-sec. writing rate. The controller uses a 68000 16-bit μp with 32K bytes of RAM and 24K bytes of PROM.

The controller's command set offers software interfaces compatible with FORTRAN user-application programs. The Model One is aimed at presentation-graphics, image-processing, CAD 3D-solids-modeling and general-purpose graphic applications, Doctor says.

—Eric Lundquist

People in the news...

James D. Lindner has been appointed president of Exxon Office Systems, International S.A., Stamford, Conn. Before joining Exxon, Lindner was with IBM Corp., most recently with IBM's General Business Group, International. He will be based in Geneva, Switzerland,

and will be responsible for sales, service and support of Exxon Office Systems products outside the U.S.

Micro Five Corp., Irvine, Calif., has appointed **Thomas H. Elrod** to executive vice president, a new position. He will manage engineering, manufacturing, administration and finance operations.

Terry D. Martin has been named a vice president of Intersil, Inc., Cupertino, Calif. Formerly managing director of process technologies, he is now responsible for managing wafer-fabrication technologies for the company's semiconductor division.

Mark Butler has been promoted to technical manager for very small-business systems at The TRW-Fujitsu Co. He was previously manager of technical marketing support. He will supervise product planning and marketing and field-technical support.

Barbara Babcock has been appointed manager of office-automation marketing, information systems division, of Data General Corp., Westboro, Mass. She will coordinate product planning and management for Eclipse information-systems products.

George H. Franco has been elected senior vice president of operations at General Datacomm Industries, Inc., Danbury, Conn. He will be responsible for the company's engineering, manufacturing, quality-assurance and systems-engineering operations.

Dan Chambers, formerly MOS memory marketing manager for National Semiconductor Corp., has joined the electron division of NEC Electronics USA, Inc., Sunnyvale, Calif., as distribution manager. He is responsible for developing distribution sales programs.

Jon Kotcher has been promoted to marketing manager, copier products division at Panasonic Co., Secaucus, N.J. He was formerly product manager, photocopier division, at the company.

PrintaColor Corp., Norcross, Ga., has named **Douglas R. Kraul** to head its engineering staff. Formerly with the Portable Products Division of Motorola, he will supervise plans to expand PrintaColor's color-graphics ink-jet printers.

Joseph B. Smith, has been appointed vice president of manufacturing operations for Priam Corp., San Jose, Calif. He was formerly with Shugart Associates as vice president of rigid disk-drive operations.

Richard W. Walliser has been appointed president of finance and administration at Alphacom, Inc., Campbell, Calif. He was formerly manager of corporate financial planning at Rolm Corp.

Joseph O'Donnell has been named general manager of the Keyboard North America section of the computer products division, General Instrument Corp., New York. He has been with the company since 1979.

Jim Coe has been promoted to vice president of marketing for Fujitsu Microelectronics, Santa Clara, Calif. He will be responsible for marketing, strategy and engineering-support duties for the company's μps and memory products.

Art Stabenow has been appointed vice president, Semiconductor Division, and group director of linear ICs at National Semiconductor Corp., Santa Clara, Calif. He has been with the company since 1979 and was most recently group director of special products.

Robert L. Faulkner has been promoted to vice president of engineering at the Basic Four information-systems division of Management Assistance Inc., Santa Ana, Calif. He was formerly director of central engineering at the company.

Charles W. Swan Jr. has joined Forward Technology Inc., Santa Clara, Calif., as vice president of finance and administration. He was formerly director of finance for the computer products division at Racal-Milgo Inc.

Formerly controller at Digital Pathways Inc., Palo Alto, Calif., **Ainslie J. Mayberry** has been promoted to vice president of finance, a new position. She will be responsible for quarterly financial reporting and worldwide credit management.

Robert A. Pecotich has been promoted to director of μp and μc products at American Microsystems, Inc., Santa Clara, Calif. He will be responsible for marketing, design and product engineering.

Stephen T. Kirk has been appointed product manager for laboratory computer systems at Cyborg Corp., Boston. Formerly a marketing specialist at Digital Equipment Corp., he will be responsible for marketing the ISAAC laboratory data-acquisition system.

Ralph Johnson has been named to the new position of executive vice president of Cylix Communications Network, Memphis, Tenn. He was formerly vice president of GTE Telenet.

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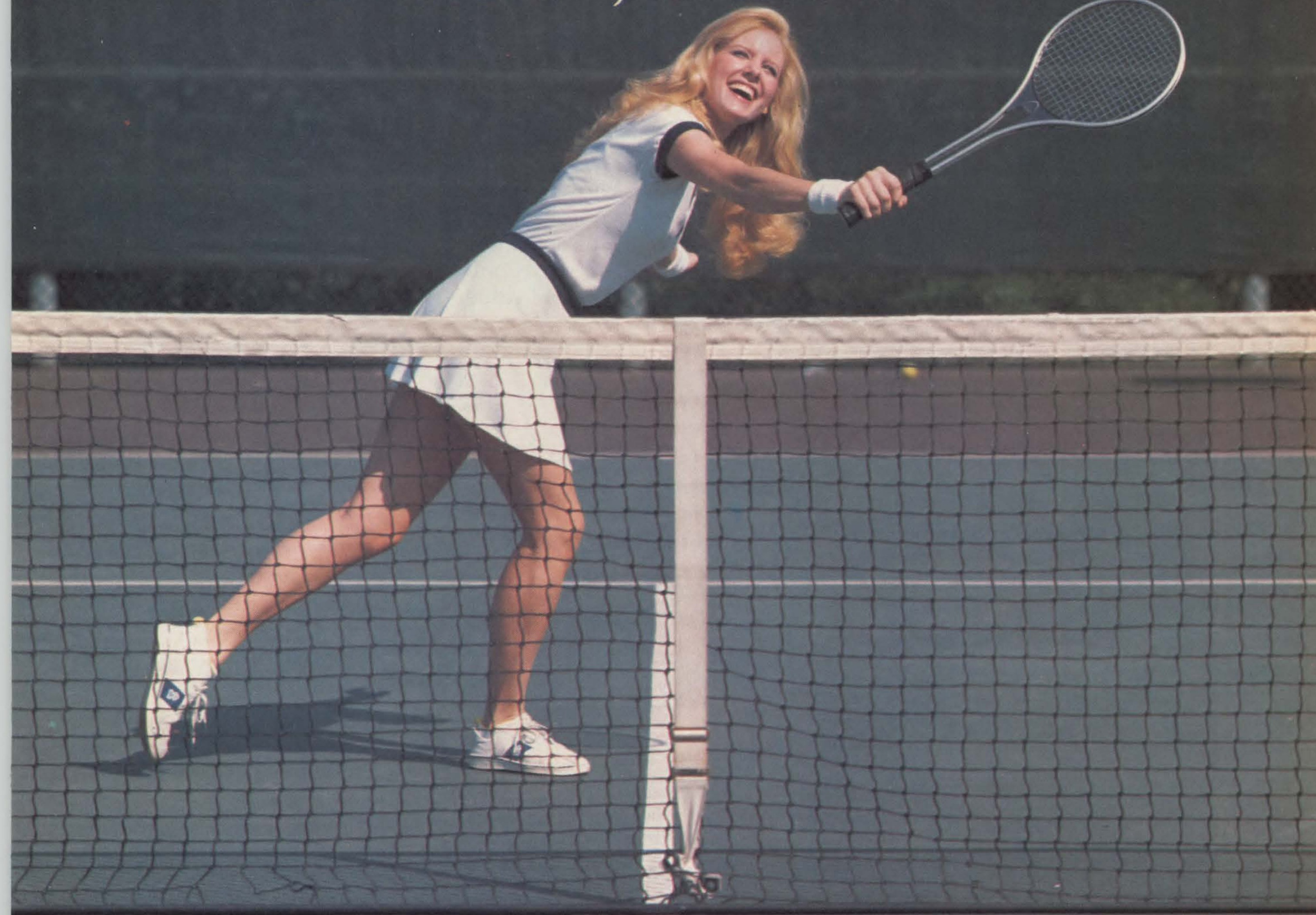

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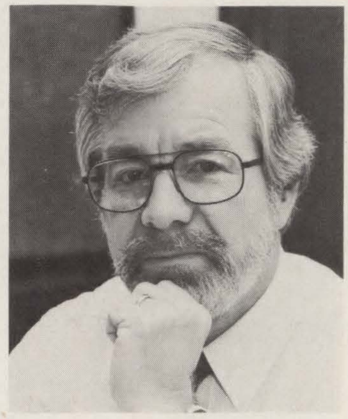
Editorial

Lessons to be learned



(Last month in this column, we cited a lesson computer manufacturers can learn from the U.S. auto industry's plight in competing with Japanese auto makers. A speech given earlier this year to a computer industry seminar by Rep. James Shannon [D., Mass.] contains an extension of that lesson from autos to semiconductors to computers. We think his remarks deserve a wider audience.
—Lawrence J. Curran)

The U.S. faces no greater economic challenge than responding to Japanese industrial competition. Japan's high-technology challenge is clear and immediate. The ability of Japan's auto industry to meet American standards more thoroughly and rapidly than our own companies will continue to imperil our industrial base, no matter what short-term measures the federal government approves. Too few people in Washington recognize that the auto-import issue is not just a three-year problem, but a high-technology, production-management crisis that will be with us for at least a decade.

The Japanese have a cost advantage over U.S. producers per car landed here of $1000 to $17,000. There are two basic explanations, each accounting for about 50 percent of the Japanese cost advantage. First is ineffective process engineering; the U.S. has much older plants and equipment. Second is the human-relations factor: the adversarial labor, management and government relations of U.S. industry versus the gung-ho clan cooperation of a Japanese factory.

Our once-clear dominance in the [semiconductor] field has eroded into a head-to-head fight. The U.S. led with the introduction of the 16K-bit RAM, but the new 64K RAM was introduced by Japan and the U.S. simultaneously. A major concern is that, as they did with small cars and small copiers, the Japanese will make a significant advance on the enormous personal-computer market.

It takes years to develop successful, quality programs and to change the Marine Corps attitude of plant foremen. It's a lot easier to complain about the level of federal taxation, the burden of regulations and the unresponsiveness of government. It's much more comfortable to talk about Japanese subsidies, dumping, low wages and something called "Japan, Inc., " than it is to analyze the reasons for a company's defects and turnover rates.

We in Washington are going to try to create a climate in which sound business decisions can be made, but that's all we can do. The harder part of the job—the more significant part of the job—is left to you. The greatest threat to the American economy is not foreign competition. It is our domestic adversarial perspective. Business and labor can work with government and with each other to achieve a consensus for an industrial policy.

the Supermicro.

and requires no special environment. Zilog provides a complete eight user system, including system software, 256 KB of main memory, a 24 MB Winchester disk and 17 MB tape cartridge back up, along with expansion capabilities, all for only $29,950. (U.S. list.)

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CIRCLE NO. 66 ON INQUIRY CARD

Letters

CAD SERVICES

To the editor:

Malcolm L. Stiefel's article, "CAD/CAM spells productivity" (MMS, July, p. 115), is an excellent overview for potential CAD/CAM users. Under "Alternatives to turnkey systems," Graphics Manufacturing Systems, Inc. (GMS), Santa Ana, Calif., should have been mentioned. GMS runs a CAD/CAM service bureau, using AD-20004 software, written by Manufacturing & Consulting Services, Inc. (MCS). Our service bureau will be using MCS's newest product, Anvil-4000, as soon as it is available.

GMS services include training, consulting, system-time rental, software, N/C tape generation and systems integration. As part of our service bureau, GMS will manufacture EDM electrodes, N/C parts, dies or molds. Several of our clients are Fortune 100 companies.

In the consulting, software and systems integration areas, GMS will install complete CAD/CAM systems. This includes computer(s), plotter(s), paper-tape punch/readers, post processors or whatever the client needs to do the job. Several complete systems have been sold across the country. Additionally, GMS has supplied post processors for AD-2000 users worldwide.

Although a lot of companies are headquartered in Santa Clara, Calif., MCS is not one of them, as stated in the article. MCS is located in Southern California, with facilities in Santa Ana and Irvine.

Douglas A. McKinley
Director of Marketing
Graphics Manufacturing Systems, Inc.
Santa Ana, Calif.

CP/M ADVANCEMENTS

To the editor:

We at Word Works are involved in word processing and μc consulting, and we specialize in WordStar and

Letters

CP/M-compatible micro systems. Therefore, I was especially interested in Mr. Cherry's article "Evaluating word-processing software" (MMS, April, p. 123)—I thought it was very informative—and R.A. Baumann's letter (July, p. 103).

Anyone who can characterize the WordStar word-processing package and the CP/M operating system under which it runs as being inferior systems really belonging to the hobbyist market (as Mr. Baumann does) is rather out of touch with the latest trends in the WP/small business computer market. It is true that Digital Research's CP/M has led a rather underground existence in the past. (It used to be that the only place you could get a computer running CP/M was at one of those "hobbyist" computer stores.)

However, in the last few months developments have occurred on the CP/M front. Xerox has come out with the Xerox 820, a dual floppy-drive system with an integrated video terminal organized around a Z80 processor and 64K bytes of main memory. The remarkable thing is that Xerox has decided it is not in the software business; the 820 uses the CP/M 2.2 operating system, and every piece of software offered is a CP/M-compatible product produced by an independent vendor.

Xerox has not tried to conceal the independent origin of most of this software. One exception is its Letteright WP system, which is actually a minimally modified version of WordStar (some command codes have been changed). Xerox is not alone. Wang has announced a CP/M option for its Wangwriter systems, and CPT Corp. has a CP/M option for its machines. In the same issue as Mr. Baumann's letter, MMS reported that Hewlett-Packard will be marketing a CP/M-based microsystem (July, p. 5). And others are coming.

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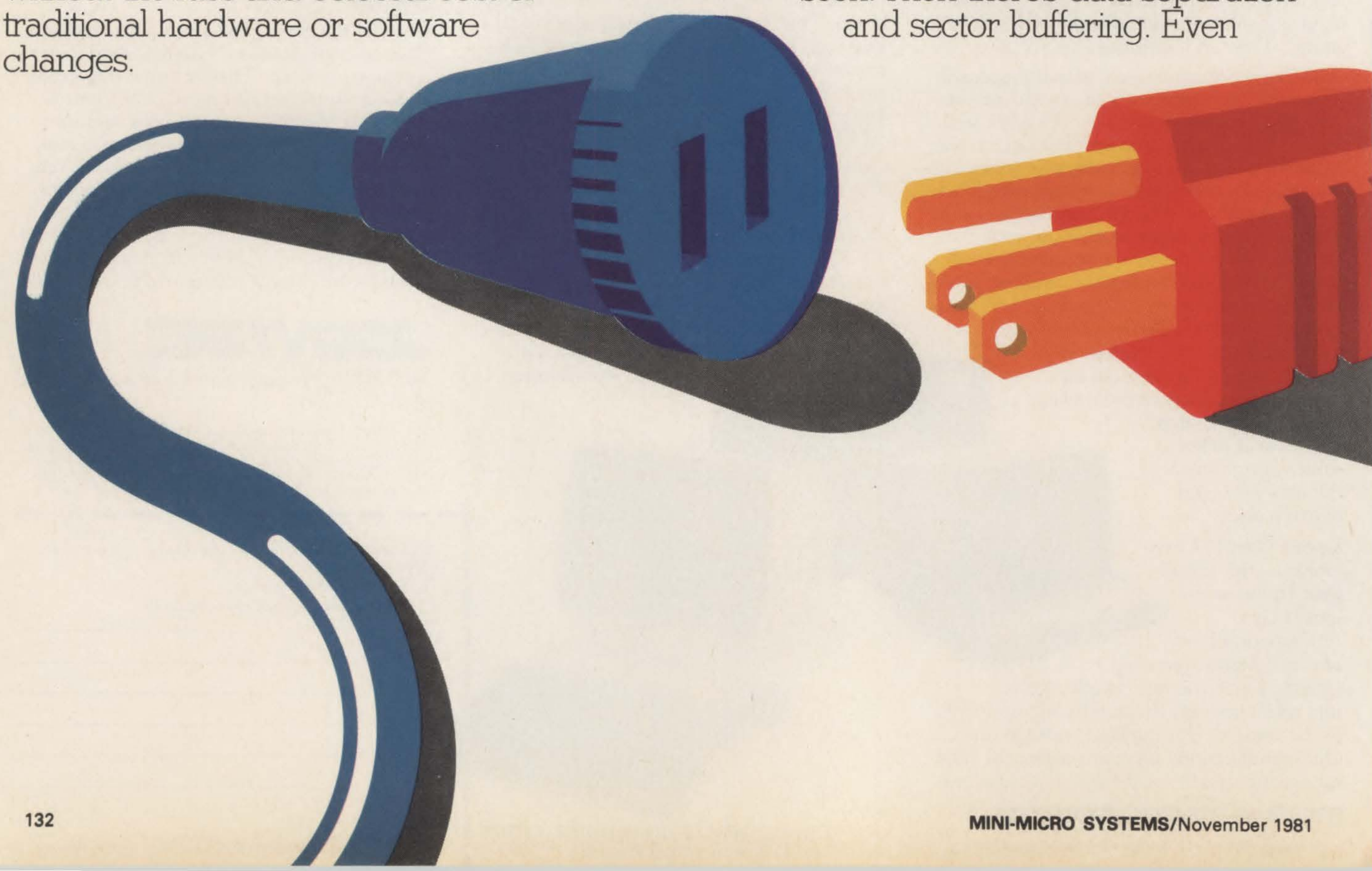

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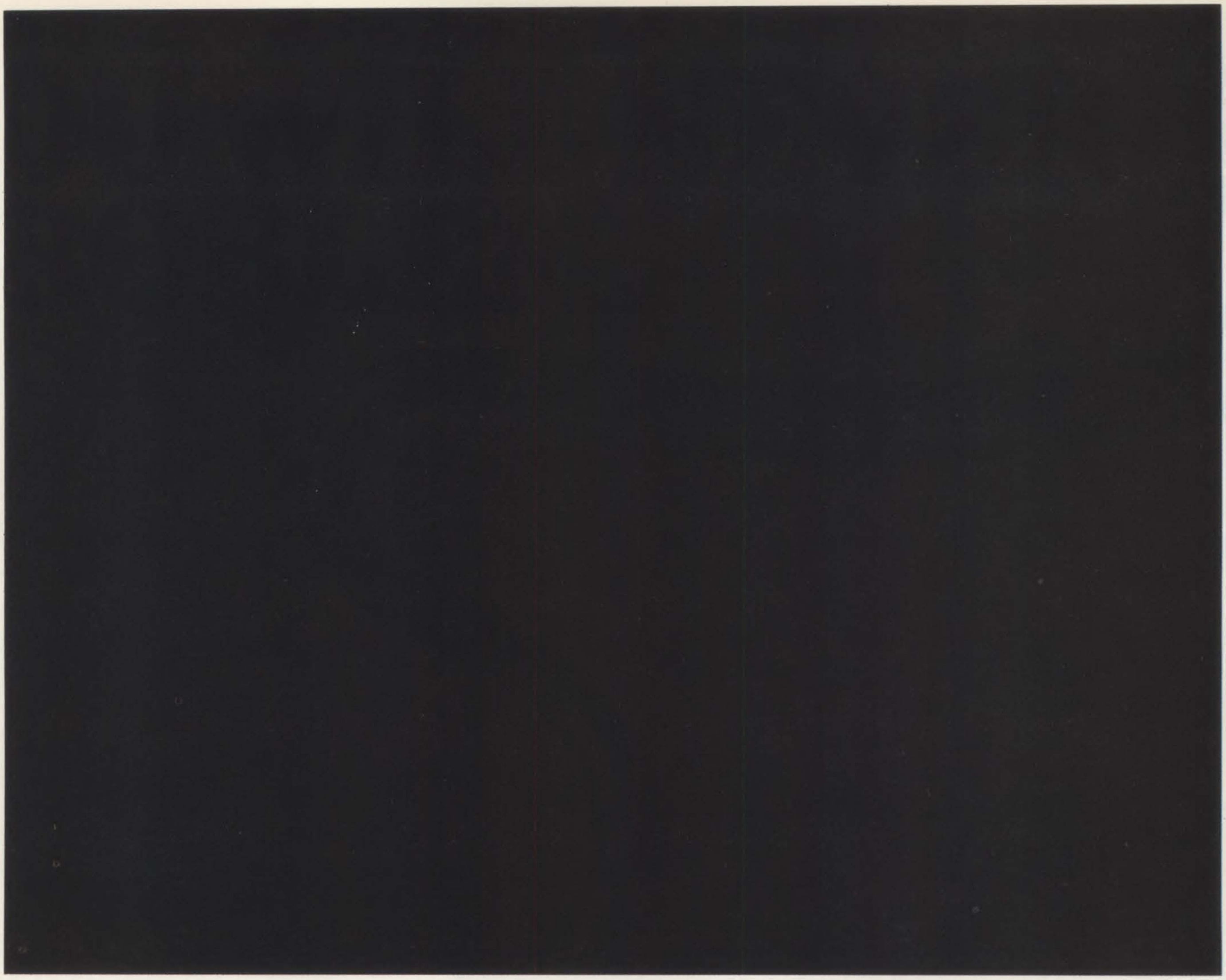

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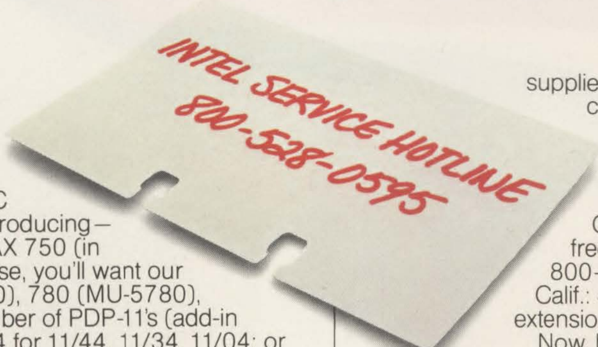

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CIRCLE NO. 74 ON INQUIRY CARD

With all these well-known hardware vendors offering CP/M-based systems, far from being limited to hobbyist systems, CP/M has a clear shot at becoming the industry standard operating system for small-business computers in the 1980s.

Mr. Baumann also seems to have some misinformed technical opinions, which are best capsulized by his statement that "[Real WP productivity] lies with...direct screen display (instead of a serial terminal), immediate editing (instead of WordStar's slow scrolling to next occurrence)." If I understand him correctly, he seems to be saying that some processors (like the Apples) can directly access the video display (and therefore instantly change selected portions of the display), whereas a separate video terminal connected to the computer via a cable connection (usually RS232 standard) is inherently unable to modify the display except by resending most of the data (a fairly slow process).

This is false. Most recently designed video terminals provide escape sequences by which lines or portions of lines can be rapidly inserted or deleted from the video display. A WP system such as WordStar using these escapes at a high data rate can drive a terminal every bit as effectively as it could drive a direct display. (WordStar can also drive a direct display.)

At Word Works, we have three CP/M machines configured to run WordStar: One is connected to a Zenith Z19 terminal through an RS232 port operating at 9600 bps, and the other two machines have direct display video drivers. The system hooked up to the Zenith is the fastest of the three, but the terminal configurations have nothing to do with this.

Edwin W. Meyer
Word Works
Cambridge, Mass.

PASCAL COMPILERS

To the editor:

I enjoyed your article concerning cross-compilers for Pascal (MMS, July, p. 20).

DCS is a manufacturer of μc systems and recently introduced an 8086-based system that is a compatible upgrade to our DCS/80 (8080 base), of which there are more than 200 in the field. We have offered the DCS/80 with three different Pascals (UCSD, Pascal/MT, Pascal/M) depending on whether the customer wants native or P code.

We now offer Pascal compilers (FORTRAN, BASIC, etc.) for the DCS/86 (8086-based). It is really erroneous to imply that time-shared mainframes are superior for high-level language development. Our DCS/86 has the programming facilities of a minicomputer because it is a minicomputer. As a matter of fact, it exceeds the capabilities of traditional minicomputers with multiprocessor capability, 1M-byte address range and faster instruction execution.

As far as price/performance is concerned, the DCS/86 system, ready for Pascal (FORTRAN, etc.) development, is half the price of the Pascal cross compiler alone. Regardless of the cross-compiler, the customer needs the target 8086 hardware anyway to run his program, which increases the price even more.

A complete 8086-based system with terminal, printer and software is less than $10,000. This enables the user not only to do Pascal development, but also to run his programs and provides support for additional languages.

Gerald Nadler
Distributed Computer Systems
Waltham, Mass.

T7000 Terminal

- *ANSI X3.64 Terminal*
- *80 x 25 rows on a 12" diagonal screen*
- *Optional touch panel*
- *Blink, blank, reverse video, half-intensity and underline*

System 100

- *68000 Processor*
- *20MB-900MB hard disk storage*
- *Up to 14MB of main memory*
- *Supports up to 96 intelligent terminals*

System 150-IT

- *68000 Processor*
- *Up to 1.5MB main memory*
- *Single-user intelligent terminal*

System 150-FS

- *68000 Processor*
- *Up to 1.5MB main memory*
- *2, 5¼" floppy disk drives (1.92 MB or 320KB)*

System 100-DT

- *68000 Processor*
- *2, 8" dual-sided, double-density floppy disks (2.4MB)*
- *Up to 3MB of main memory*
- *Supports 4 dumb terminals*

System 150-WS

- *68000 Processor*
- *10MB hard disk—5¼" floppy disk for back-up*
- *Up to 1.5MB main memory*
- *Single-user or multi-user operating system (multi-user version supports 4 terminals)*

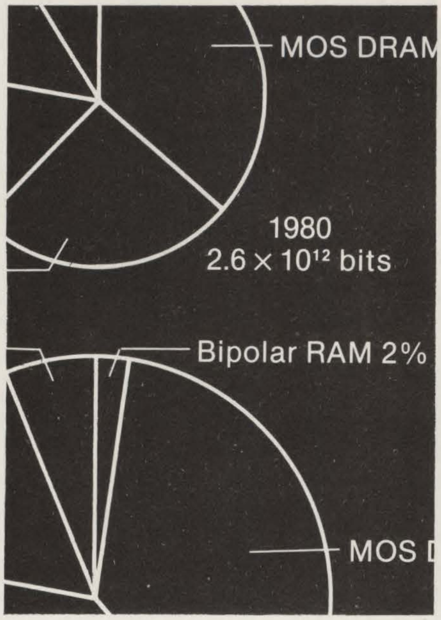
MG8000 Graphics Terminal

- *Same features as T7000 Terminal*
- *Monochrome graphics—400 x 300 pixel resolution*
- *Simultaneous support of text and graphics features (2 independent graphics planes for animation)*
- *Optional touch panel*

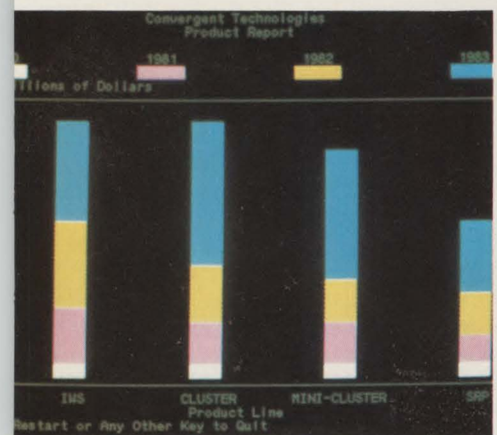
System 110-DT

- *68000 Processor*
- *1, 8" dual-sided, double-density floppy disk (1.2MB)*
- *Up to 1.5MB of main memory*
- *Ideal single-user workstation for video-disc and simulation*

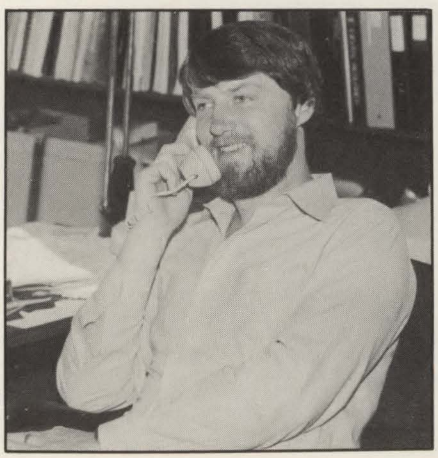
CIRCLE NO. 75 ON INQUIRY CARD



141 If variety is the spice of life, the add-in memory board market for minicomputers is one of the tastiest dishes around. There's a flavor to suit just about every end user's and OEM's palate. Some boards are built for work with specific processors. Others can be hung on μc buses. Four or five years ago, core-memory devices owned the market outright. Now, most boards use the latest off-the-shelf technology: semiconductor static and dynamic RAMs. For a complete profile and a comprehensive product survey, see contributing editor Malcolm Stiefel's article on p. 141 . . . And, for an in-depth look at the memory market and its latest trends, check out the article on p. 165. It's a crowded market for manufacturers of add-in memories, and nowhere is it more fiercely competitive than in the DEC-compatible arena . . . An analysis of trends in memory technology finds that faster memory access, lower power requirements and significantly lower cost per bit have brought about the turn to semiconductor memory. For more information, please see the article that starts on p. 171 . . . The 64K dynamic RAM will succeed the 16K DRAM as the most popular device ever produced by the semiconductor industry. That's one of the key findings of Dataquest vice president Daniel Klesken, whose article begins on p. 179.

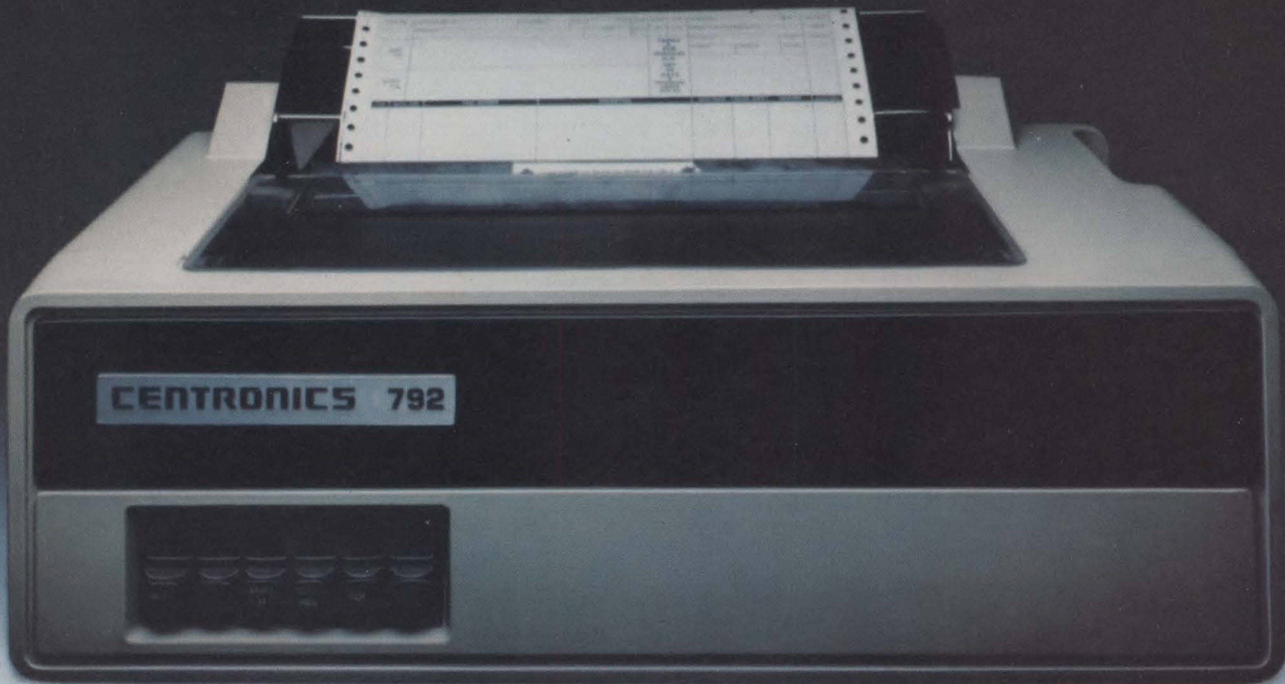


195 In most computer display systems, the character set is stored in ROM. The advantage of this approach is that all elements of the set are in permanent residence and available for quick access—an arrangement suitable for most routine computer applications. Nevertheless, a ROM-based character set is limited in the number of characters available, and in flexibility. Sets usually are limited to 128 characters, and a separate ROM is needed for each character set. Many users—especially companies or in-house departments specializing in graphics or typography—require multiple type styles, varying fonts or a wide selection of graphic elements for creating designs on a display screen. A soft, RAM-based character set provides these capabilities, and this is the approach used in Convergent Technologies' information work station series of computers. For a complete description, see the article that begins on p. 195.



227 Gary Kildall can barely sit still. He's talking about the things he plans to do with a new research and development group he's setting up with his Pacific Grove, Calif., company, Digital Research, Inc. "High-resolution color graphics. Voice synthesis and recognition. Sensors and effectors for machine interfaces. These are just a few." Kildall, 39, has a lot to smile about these days. His firm, best known for the single-user 8-bit μc operating system, CP/M, has just received a couple of shots in the arm: one from a group of venture capitalists, another from IBM Corp. Not that Digital Research really needed either one of them. The six-year-old company has watched its sales increase one hundredfold since its founding. Projections put next year's sales at $10 million. That's not bad for a company that started in a children's playhouse in Kildall's backyard with $500 and some systems hardware. For an interesting look at an interesting company, see associate editor Larry Lettieri's story on p. 227.

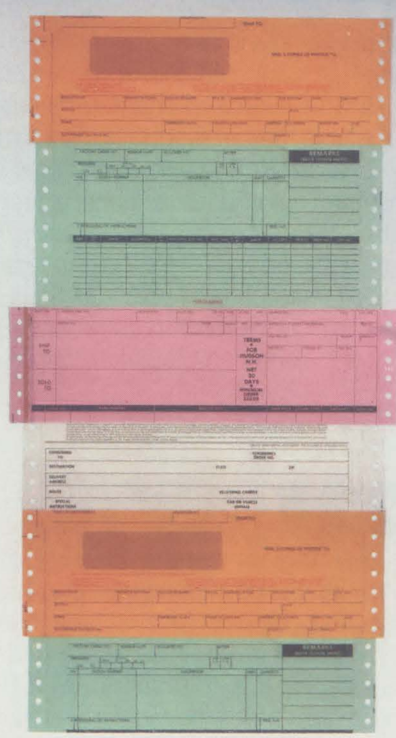
DEMAND PERFORMANCE.



The Centronics 792. It's the only true demand document printer available today and the choice of OEM's and end-users with a critical need for high performance in multipart document applications. For example: Bills of lading. Hotel invoices. Car rental contracts. Purchase Order and Work Order forms. Ticketing. And here's why no competitive printer can match it.

MULTI-PART FORMS – Like these samples of Invoices – Purchase orders – Work orders – Shipping documents – up to 12 parts printed clearly from first to last copy.

NO SPACE WASTE – Compact design for installation on limited counter area; or if you wish, pedestal mounted.



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These are just a few key reasons why we believe the Centronics 792 is the best and most versatile Demand Document Printer for your application. The 792 represents Centronics commitment to performance, dependability, and service. Which is why Centronics is the No. 1 choice of computer professionals, in major industry brand preference studies.

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CIRCLE NO. 78 ON INQUIRY CARD

PRODUCT PROFILE

Add-in memory suppliers offer varied menu

MALCOLM L. STIEFEL, Contributing Editor

The future for this often-ignored market is bright, with sales to pass the $10-billion mark by the end of this decade

If variety is the spice of life, the add-in memory board market for minis is one of the tastiest dishes around. There's a flavor to suit just about every end user's and OEM's palate. Some boards are built for work with specific processors, notably the Digital Equipment Corp. PDP-11 series and its offspring, the LSI-11 and VAX-11; others can be hung on μc buses, such as the ubiquitous Multibus, the STD and the S-100. Four or five years ago, core-memory devices owned the market outright. Now, most boards use the latest off-the-shelf technology: semiconductor static and dynamic RAMs (SRAMs and DRAMs).

A typical memory board holds from 64K to 512K bytes of storage, organized into 8- to 64-bit-wide words, depending on the requirements of the host processor or bus. The board also contains logic for decoding address and control signals, and a data buffer to facilitate the transfer of data into and out of the memory. Some boards also incorporate error detection and correction, battery backup and other features that are useful in many applications. Some house ROM instead of RAM or mixtures of ROM and RAM.

But there is little razzle-dazzle, nowhere to be found are the gee-whiz goodies intended to turn the heads of buyers of, say, printers or graphics terminals. Most of the mind-boggling stuff is in the chips; the board vendors win customers with pricing, reliability and service, rather than with creative design. "Making a memory board is a plumber's job, as opposed to a designer's job," says Steven McGinness, product marketing manager for National Semiconductor Corp.

Maybe so, but that doesn't make it a dull market. On the contrary, the market is growing explosively, and it continues to attract new players. The ultimate beneficiaries of the fierce competition are the system integrators, who can readily obtain the boards that meet their needs at attractive prices, and who can look forward to further gains in price/performance characteristics as

LONG-LIFE SRAM BACKUP WITH LITHIUM-IODINE BATTERIES

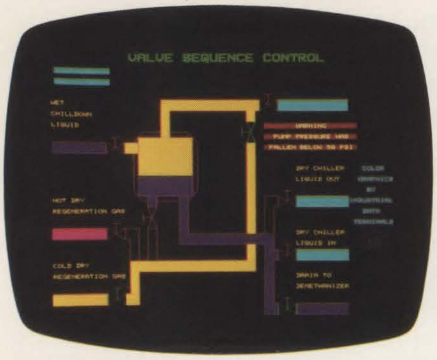
Loss of power in semiconductors erases memory. A common technique to overcome this memory volatility is to use batteries. The approach is restricted to SRAMS; DRAMS require too much power for refresh to make battery backup practical.

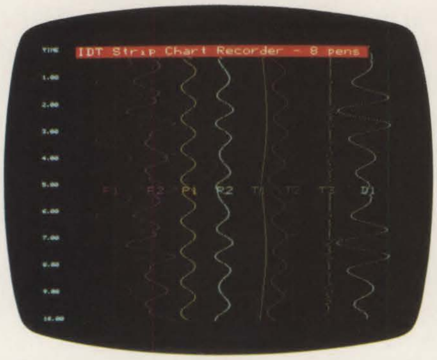
But batteries have their own deficiencies. Standard batteries can swell and leak, destroying contacts and adjacent electronics, and batteries typically last only about two years, regardless of their current. Labor cost to replace a battery can sometimes exceed the cost of the battery itself.

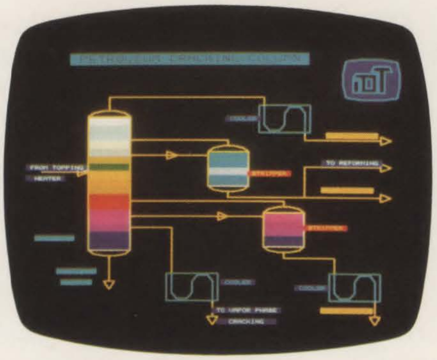
Catalyst Research Corp., Baltimore, Md., makes a lithium-iodine battery (see Figure) for low-power CMOS SRAMS that overcomes many of these problems. The company, a manufacturer of cardiac-pacemaker batteries, claims that these units last 10 years or longer at room temperatures. The cells tolerate short circuits, overcharges and overdischarges without heating, venting or exploding. Cells can be connected in series or parallel to provide data-retention power for memory boards.

Catalyst also offers a memory-backup module called BRM—a PC board that incorporates a lithium-iodine cell and a switch. In normal operation, the switch passes system power to the RAM board with less than 50 mV drop at 10 mA. If system power falls below 4.5V, the BRM signals the memory board to prevent false memory writes. At 3V, the RAM is switched to BRM battery power, and another BRM pin goes low to reflect this state. Read and write access to the RAM are denied until system power is returned; the sequence is then reversed, with switching at 2.1V and 4.6V.

Bubble Breakthrough





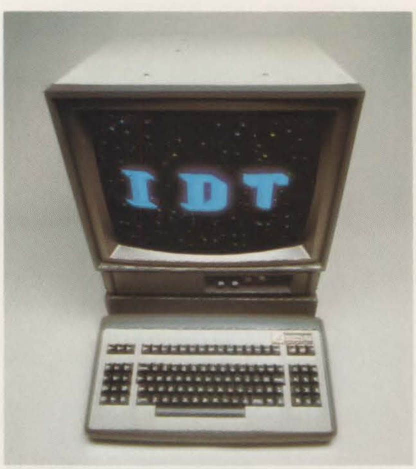


IDT 2200. First and only color graphics terminal with bubble memory!

The IDT 2200, with bubble memory storage in the terminal, establishes a new standard in color graphics capability and reliability. Non-volatile bubble memory allows you to retain permanent displays in the terminal, and ensures data integrity even in the harshest environment. Bubble memory unburdens your host computer of memory requirements and dramatically reduces transfer time to the terminal. With its increased megabit capacity, you can build and store permanently an entire library of pictures and subpictures in the terminal. And it's fast, providing rapid, reliable displays.

Other improvements make the 2200's powerful proprietary features even more effective. 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 up to three full-color display memory planes. IDT 2200 with bubble memory. The newest reason why we're earning a reputation for cost-effective performance in color graphics terminals.

- **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.**



Customer-configured...performance-proven.

- **Rapid display of graphics with bubble and subpicture architecture stored within the terminal. High-speed, high-resolution presentation. 512 x 512 individually addressable pixels.**
- **Subpicture architecture unburdens host, reduces memory requirements and transfer time.**
- **Subpicture architecture, using BUBBLEPICS™, MACROGRAPHICS ™ and VECPICS™, with auto-write and auto-erase capability, permits the creation of complex displays and high-speed animation with relatively simple programming.**
- **Specialized character routines like MACROFONT™ and MICROFONT™ allow characters to be drawn in many sizes with shadow, bold face and variable spacing vertically and horizontally.**
- **Terminal's intelligence allows simplified programming using high-level ASCII commands. Communications require no special handlers or drivers, just a standard RS 232 serial interface. Binary and 8-bit parallel inputs also available.**
- **Flexible packaging: rack mount, desk top or OEM configurations.**
- **Special function capability built into the keyboard for programming flexibility.**
- **Interfaces available for selected color or black and white printer/plotters.**
- **Can be configured to suit your present needs and easily expanded later. We specialize in a building block architecture.**

*A Trademark of Tektronix, Inc.

Industrial Data Terminals Corp.
173 Heatherdown Drive, Westerville, Ohio 43081 (614) 882-3282

CIRCLE NO. 79 ON INQUIRY CARD

Chips account for about one-half the cost of building a board; the rest goes into other material, assembly and testing.

succeeding generations of chips become available.

The market: swinging toward 64K DRAMs

A 1981 study by Mackintosh Consultants Co. Ltd. forecasts a 270-fold increase in annual worldwide shipments of memory chips for computer applications between 1980 and 1990, from 2.6 trillion to 700 trillion: a compound annual growth rate of 75 percent. At the same time, the dollar value of the chips will go from $1.3 billion to $22 billion, climbing at 32 percent a year. The difference in volume growth and value growth reflects the expected erosion in cost per bit as new devices, such as 256K RAMs, hit the market during the decade.

Chips account for about one-half the cost of building a board; the rest goes into other material, assembly and testing. If this relationship remains fixed, the board market should reach approximately $11 billion by 1990.

For a system integrator, the decision of whether to buy boards or to build them in-house depends primarily on the number of units needed. One thousand units a year seems to be the magic number, according to industry sources. Most systems builders purchase fewer than 1000 boards a year; those that need more, such as CPU manufacturers, tend to buy the chips and fabricate their own boards.

The future market is tied almost completely to the demand for semiconductor memories; core memories are quickly disappearing from the market. In the product table, only Micro Memory supplies core boards. Core will survive, but only in applications in which

ABOUT THE TABLES...

The accompanying product table summarizes the major characteristics of minicomputer/μc add-on memories and add-in memory boards manufactured by respondents to our call for data. Only manufacturers of "merchant-market" add-in and add-on products were solicited. Proprietary minicomputer systems builders ("traditional mini OEMs"), such as Digital Equipment Corp., Hewlett-Packard Co. and Data General Corp., whose memory products are designed only for their own systems, were not solicited. "Nontraditional" systems builders such as Texas Instruments Inc., Intel Corp. and Cromemco were solicited only for data on their merchant-market memory products, including memory products sold primarily for use in "other-label" systems. Users of "traditional" OEM minicomputers are advised to contact the manufacturers of those systems first.

The following notes refer to symbols and abbreviations used in the table.

- SRAM = static RAM, DRAM = dynamic RAM, BRAM = RAM with battery backup, UMC = universal memory module.
- Where multiple capacities are shown, separate boards are furnished, each with one of the specified capacities. D = dynamic switching; P = parity.
- S(n) = segmentation on n-byte boundaries; B = bank select; E = extended addressing.
- M = memory is socketed; T = board is tested and burned in.
- S = unpopulated or semi-populated board is furnished with sockets.

BUBBLES AND CACHE: THE TORTOISE AND THE HARE

"Bubbles and cache" may sound like a vaudeville act to invoke nostalgia among old-timers, but to computer users, it conjures up memories of a more modern sort.

Bubbles, of course, are the cute little serial memories that give fabricators fits. Texas Instruments Inc. and National Semiconductor Corp. are two of the latest industry luminaries to drop bubbles from their component product lines like so many hot potatoes. Others, such as Intel Corp., are hanging in there because they still expect the bubble-memory market to be enormous, particularly if the price/performance ratio of bubbles ever matches that of disk drives. Bubbles were conceived to fill the access-time gap between the microseconds of main memories and the 10s of milliseconds of disk drives. But because the bubbles aren't all that fast or inexpensive, they have found only limited application so far, mostly in terminals and in environments that are hostile to the moving parts of disk drives. Their promise may some day be fulfilled, but it will be an uphill struggle.

At the other end of the performance spectrum are the super-quick cache memories such as those made by Able Computers, Inc., as plug-compatible replacements for Digital Equipment Corp.'s PDP-11 cache memories. The cache, usually incorporating bipolar RAMs, typically doubles the throughput of a computer in scientific, CAD/CAM and other applications that require frequent access to memory.

Access to cache is much faster than access to main memory. However, because of its high cost, cache is implemented as a relatively small memory (4K or 8K words versus 512K words or 1M word for main memory). All information is sought from cache first; if it is not in cache, it is retrieved from main memory and placed in cache while it is being used. The principle of locality of reference states that instructions in a program repeatedly call on memory locations that are near each other; once an instruction or data word is stored in cache, there is a high probability that it will be referenced again. The hit ratio of a cache memory defines the probability that a given memory reference will be satisfied in cache rather than in main memory. The larger the cache, the larger the hit ratio and the better the throughput. Hit ratios of 95 percent or more are common.

Because of its expense, however, few vendors have offered cache memory, even though it is well established. Ironically, cache is a hare in performance, but a tortoise in the market; bubble memory is the reverse. The trouble is, bubble remains a bear to build.

Manufacturer	Board characteristics				
	Type (Note 1)	Capacity (bytes); word length (bits) (Note 2)	Segmentation (Note 3)	Maximum clock frequency (MHz)	Typical/ maximum current (mA)
MULTIBUS					
Advanced Digital Technology	DRAM	64K to 96K; 8/16 + 6 ECC	S(32K), B, E	2.0	2500/3000
	DRAM	128K to 1M; 8/16 + 6 ECC	S(16K), B, E	2.5	3000/3500
Bubbl-Tec	bubble	92K; 8		1	400/500
Central Data Corp.	PROM	128K; 8/16 D			300/500
	SRAM	32K; 8/16 D	S(16K), E		4100/5800
	DRAM	128K; 8/16 D	S(16K), E		1700/2300
Comark Corp.	DRAM	64K to 512K; 8/16 D, P	S(128K), B, E	22-1184	2000
Heurikon Corp.	SRAM	16K to 32K; 8	B, E	2.0	
	DRAM	64K to 512K; 8/16 D	B, E	2.0	2000/3000
Intel Corp.	DRAM	4K; 8/16	S(4K)		800/1700
	bubble	128K or 512K; 8			300/2400
	DRAM	16K; 8/16 D	S(4K), E	25	2700/3300
	DRAM	32K; 8/16 D, P	S(4K), E	25	3200/4000
	DRAM	64K; 8/16 D	S(4K), E	25	3000/3800
	DRAM	64K; 8/16 D, P	S(4K), E	25	3200/4000
	DRAM	128K; 8/16 D, P	S(4K), E	25	3600/4600
	DRAM	256K; 8/16 D, P	S(4K), E	25	3600/4600
	DRAM	512K; 8/16 D, P	S(4K), E	25	3500/4800
	DRAM/EPROM	8K, 32K; 8 D	S(4K), E		3000/3820
	DRAM/EPROM	16K, 32K; 8	S(4K), E		3000/3820
	EPROM	16K; 8	S(4K)		2100/2700
	EPROM	64K; 8/16	S(4), E		
Micro Memory, Inc.	Core	32K; 8/16	S(4K)	1.0	1000/3750
	DRAM	512K; 8/16	S(4K)	2.0	1400
	Core	8K to 16K; 8	S(4K), B	1.0	1000/2000
	Core & PROM	32K; 8	S(4K), B	1.0	1000/2000
	Core	16K; 8/16	S(16K), B	1.25	800/3000
National Semiconductor	DRAM	128K; 8 + 1P/ 16 + 2P	S(4K), E	2.5	
	DRAM	512K; 8 + 1P/ 16 + 2P	S(4K), E	2.5	3200/3600
	DRAM	16K to 64K; 8/16 D	S(16K), B, E	1.5	2000/3000
	DRAM	16K to 64K; 8	S(16K), B, E	2.0	2000
	EPROM/PROM/ROM	32K to 128K; 8/16 D	S(16K), B, E	1.4	1700/2700

Memory chip characteristics			Price and delivery				
Model number/ type (Note 1)	Organization (n x m bits)	Access time (nsec.)	Fully assembled unit price (Q=1; Q=100) (Note 4)	Unpopulated unit price (Q=1; Q=100) (Note 5)	Delivery time (weeks ARO)	Date first shipped	For more information circle no.
	16K x 1	150	$1850 to $2050; $1125 to $1350 M, T		4 to 6	9/79	313
8264	64K x 1	150	$2350 to $8650; $1425 to $5300 M, T		4 to 8	9/80	314
TIB 0203	92K x 1	2500	$2400; $1500 M, T			12/79	315
2758, 2764/ PROM	1K x 8, 8K x 8		$185; $120 M, T	$185; $120 S	6	3/80	316
6104/SRAM	4K x 1	200	$1445; $925 M, T	$815; $520 S	6	3/80	317
4116/DRAM	16K x 1	150	$1775; $1135 M, T	$700; $450 S	6	6/80	318
4116	16K x 1 or 64K x 1	350	$940 (64K), $1450 (128K), M, T		4	9/81	319
	4K x 1		$595 to $895; M, T		4 to 6		320
	32K x 1, 64K x 1	200	$1833 to $6115 M, T		4 to 6		322
5101	128 x 1		$1150, T		stock	1976	323
7110-1	1M x 1	4800	$1600 to $6250; $1215 to $4360 T		4	12/80	321
2110	8K x 1	120	$705 T, M		stock	8/81	324
2110	8K x 1	120	$955 T, M		stock	8/81	325
2117	16K x 1	120	$1150 T, M		stock	6/76	326
2118	16K x 1	120	$1310 T, M		stock	8/81	327
2164	64K x 1	200	$1810 T, M		stock	8/81	328
2164	64K x 1	200	$3195 M, T		stock	8/81	329
2164	64K x 1	200	$3995 M, T		4	8/81	330
2117	16K x 1	120	$980 T, M		stock	1/80	331
2117	16K x 1	120	$1185 M, T		stock	1/80	332
2708	2K x 8		$360 M, T		stock	1976	333
2716/2732	4K x 8		$570 M, T		stock	1/79	334
			$1275; $975 T		4	12/79	335
4164		150	$2000; $1500 T		3	8/81	336
			$725 to $849; $592 to $680 T		4	1/78 to 8/78	337
			$790; $690 T		4	1/79	338
			$875; $690 T		4	12/80	339
5290	16K x 1	200	$1430 M, T		4	6/81	340
4164	64K x 1	200	$3645 M, T		4	8/81	341
MM5290, 5298	16K x 1, 8K x 1	200	$1210; $910 M, T		4	6/78	342
MM5290	16K x 1	200	$1300 to $1730	$910 to $1211 M, T	4	12/80	343
2758, 2716, 2732, 2764, 2316, 2332	1K x 8, 2K x 8 4K x 8 8K x 8	400		$570; $428 S	4	8/81	344

Manufacturer	Board characteristics: Type (Note 1)	Capacity (bytes); word length (bits) (Note 2)	Segmentation (Note 3)	Maximum clock frequency (MHz)	Typical/ maximum current (mA)
MULTIBUS					
	DRAM/PROM/ROM	4K to 16K; 8/16 D	S(4K), B, E	1.5	4100/4600
	EPROM/PROM/ROM	16K to 32K; 8/16 D	S(4K or 8K), B, E	1.4	100/1400
Plessy Microsystems	SRAM	64K; 8/16	S(16K), B, E	5.0	/1500
	DRAM	512K; 8/16 + 6 ECC	S(16K), B, E	2.0	1500/2000
	DRAM	64K; 8	S(16K), B, E	2.0	/1500
Relational Memory Systems, Inc.	DRAM	256K; 8/16	S(64K), B, E	4.0	300
	SRAM	16K; 8/16 D	S(4K), B, E	5.0	400
	DRAM	64K; 8/16 D	S(16K), B, E	4.0	150
Syscom, Inc.	PROM	64K; 8/16	S(4K), B		1600
Texas Instruments	DRAM	(64K, 128K, 256K, 512K)/16 + 6 ECC	S(4K), E		
Zendex Corp.	SRAM	16K; 8/16 D	S(64K), B, E	5.0	1200/1500
	DRAM	128K; 8/16	128K, E	5.0	900/1000
STD BUS					
Applied Micro Technology, Inc.	SRAM	16K; 8	S(16K), B, E	6.0	2500
	DRAM	64K; 8	S(16K), B, E	6.0	200
	EPROM/RAM	32K; 8	S(8K, 16K, or 32K), B, E	6.0	150
Desert Microsystems, Inc.	DRAM	64K; 8	S(64K), E	5.0	/800 to 870
	PROM	64K; 8	S(16K, 32K, or 64K), E	5.0	280
Digital Dynamics, Inc.	DRAM	2K; 8	S(1K)	2.5	360/580
	PROM	32K; 8	S(8K), B, E	4.0	380/600
Enterprise Systems Corp.	SRAM	8K; 8	S(4K), B, E	4	300/1000
Matrix Corp.	RAM/EPROM	32K; 8	S(4K)		
Mostek	DRAM	16K to 32K; 8	S(8K, 16K, 32K)	4.0	375/600
	EPROM	16K; 8	S(4K or 8K)	4.0	800/1200
	UMC	32K; 8	S(4K, 8K, or 16K)	4.0	800/1200
	SRAM	4K to 8K; 8	S(4K or 8K)	4.0	600/1000
	SRAM	2K to 4K; 8	S(2K or 4K)	4.0	700/1000
	DRAM	128K; 16 + 1P	S(16K), B, E		3000
	DRAM	256; 16 + 5 or 6 ECC	S(16K), B, E		4560
	DRAM	2M; 32 + 7 ECC	S(64K), E		7700
Transwave Corp.	SRAM	8K; 8		4	900

Memory chip characteristics			Price and delivery				
Model number/ type (Note 1)	Organization (n x m bits)	Access time (nsec.)	Fully assembled unit price (Q=1; Q=100) (Note 4)	Unpopulated unit price (Q=1; Q=100) (Note 5)	Delivery time (weeks ARO)	Date first shipped	For more information circle no.
ROM: MM2308, 2316E, 2708, 2716. RAM: MM4027, 4116	ROM: 1K x 8, 1K x 16; RAM: 4K x 1, 16K x 1	200 (RAM), 400 (ROM)	$780 to $1077; $585 to $808 M, T		4	6/79	345
MM2308, 2316E, 2708, 2716	1K x 8, 1K x 16	400		$343 to $377; $258 to $283 S	stock	8/79	346
HM 6116LP	2K x 8	120	$2200 T		10	12/80	347
HM 4864	64K x 1	275	$4750 T		10	6/81	348
4716	16K x 1	275	$700 T		10	4/79	349
		210	$2600; $2160 M, T		2	9/81	350
		150	$745; $460 M, T		2	6/80	351
		250	$995; $560 M, T		2	1/80	352
2716, 2732, 2532	2K x 8, 4K x 8		$495; $380 M, T		4	11/80	353
4532, 4164			M, T		4 to 6	4/81	354
MK 4118-2	1K x 8	150	$1504; $1203 T		4	8/81	355
4116	16K x 1	300	$1280; $825		4	6/80	356
2114	1K x 4	150 or 400	$325; $260 M, T	$120; $96 S	1	1/80	357
4116	16K x 1	250	$700; $560 M, T		1	10/79	358
		250	$200; $160 M, T	$125; $100 S	1	1/81	359
2118, 4116	16K x 1	250	$750 to $950; $525 to $665 M, T		4	2/81	360
2716, 2732, 2764				$195; $137 S	4	10/80	361
6514	1K x 4	450	$295 M, T		10	4/80	362
2716, 2732	2K x 8, 4K x 8			$225; $180 S	6	6/80	363
444	1K x 4	450, 250	$550; $395 M, T		2-4	9/80	364
2716			$170 to $490 M, T				365
MK 4116	16K x 1	200 or 350	$235 to $275 M, T		2	2/79	366
MK 2716	16K x 8	450	$499		2	9/79	367
MK 2732	4K x 8	450	$160		2	9/79	368
MK 4118	1K x 8	250	$245 to $295 M, T		2	6/79	369
HM6514	1K x 4	300	$399 to $450 M, T		2	6/80	370
MK 4116	16K x 1	135	$3145 M, T		4	10/77	371
MK 4116	16K x 1	135	$5180 to $5280 M, T		4	8/80	372
MK 4564, MK 4116	16K x 1	135	$7995 M, T		6	8/81	373
2114	512 x 8	450	$262; $222 M, T			5/81	374

Manufacturer	Board characteristics: Type (Note 1)	Capacity (bytes); word length (bits) (Note 2)	Segmentation (Note 3)	Maximum clock frequency (MHz)	Typical/ maximum current (mA)
S-100 BUS					
Bubbl-Tec	bubble	46K; 8		1	400/500
Cromemco, Inc.	SRAM	64K; 8	S(32K), B, E	4.0	1700
	RAM	16K; 8	S(16K), B	4.0	1300
	SRAM	4K; 8	S(4K), B	4.0	800
	PROM	8K to 32K; 8	S(8K, 16K, or 32K), B	4.0	1400 to 2100
Dynabyte	DRAM	64K; 8	S(16K), B, E	4.0	
IMS International	DRAM	64K; 8 P	S(1K), B, E	4	600
Ithaca Intersystems, Inc.	DRAM	64K; 8/16 D	E	4	510/1000
	DRAM	256K; 8/16 D	S(64K), E	4	900/1020
Measurement Systems & Controls	DRAM	64K; 8	S(16K or 64K), B	4.0	700
Micro Memory, Inc.	Core	8K; 8	S(8K)	1.0	1000/1500
PolyMorphic Systems	DRAM	16K to 48K; 8		1.8	
	DRAM	16K; 8		1.8	
	DRAM	8K; 8		1.8	
Seattle Computer Products	SRAM	16K; 8	S(4K), B	8.0	1500/
	SRAM	16K; 8/16 D	S(4K), B	4.0	1600/
	SRAM	64K; 8/16	S(64K), E	5.0	2000/
Static Memory Systems	EPROM/SRAM	64K; 8	S(2K), E	4.0	600
Vector Graphic	DRAM	64K; 8	S(16K), B	4.0	950/
DEC LSI-11 MICROS (Q-BUS)					
Adac Corp.	SRAM	32K; 16	S(4K), B, E	2.0	800
Bubbl-Tec	bubble	46K; 8		1	400/500
Dataram Corp.	DRAM	64K; 18	S(8K)	2	1500/1700
	DRAM	256K; 18	S(32K)	2	2400/2600
	DRAM	256K; 18	S(32K)	2	2000/2500
	DRAM	1M; 18	S(128K)	2	3100/3300
Micro Memory, Inc.	Core	16K to 32K; 16	S(4K)	1.0	1000/4500
Mostek	DRAM	64K; 16 + 2P	S(4K), B		1600
	DRAM	256K or 512K; 16 + 2P	S(4K), B, E		6550 to 8430
National Semiconductor	DRAM	64K or 256K; 16 + 2P	S(4K), B, E	1.0	2500/2800
	DRAM	256K; 16 + 2P	S(4K), B, E	1.0	
PEBX, Inc.	DRAM	256K; 8/16 + 6 EEC D	B, E	2.0	400/1700
Texas Instruments	DRAM	128K, 192K, 256K; 16 + 2P	S(8K), E		

Memory chip characteristics			Price and delivery				
Model number/ type (Note 1)	Organization (n x m bits)	Access time (nsec.)	Fully assembled unit price (Q=1; Q=100) (Note 4)	Unpopulated unit price (Q=1; Q=100) (Note 5)	Delivery time (weeks ARO)	Date first shipped	For more information circle no.
TIB 0203	92K x 1	7000	$1200; $750 M, T			6/81	375
4116		150	$1495		stock	1979	376
4050-2		200	$495		stock	1977	377
21L02		450	$295		stock	1977	378
2708, 2716	2K x 16, 1K x 16, 1K x 8	450	$295 to $345		stock	1976	379
		150	$595; $360 T	$595; $360	2	1977	380
4116	1K x 16	200	$543; $439 M, T		stock		381
4116	16K x 1	200	$995 M, T		4-6		382
4164	64K x 1	200	$3500 M, T				383
4116	64K x 1	200	$760; $470 M, T		stock	2/79	384
			$650; $600 T		4	9/77	385
4116, 2716	16K x 1	200	$390 to $450; $234 to $270 M, T		2		386
4104	4K x 1		$390; $234 M, T		2		387
4108, 2708	16K x 1	200	$290; $174 M, T		2		388
4044	4K x 1	200	$265 to $280; $170 to $185 M, T		1	6/79	389
4044	4K x 1	200	$280; $185 M, T		1	7/80	390
2167, 1400	16K x 1	70 to 100	$1295; $810 M, T		1	7/81	391
TMM 2016, MB 8128, HM 6116	2K x 8	200	$680; $500 M, T	$140; $95 S	3	7/81	392
4116	16K x 1	150	$975; $604 T		6 to 8	10/80	393
6504/SRAM	4K x 1	350	$1295; $995 T		4	6/81	394
TIB 0203	92K x 1	7000	$1200; $750 M, T			6/79	395
4116	16K x 1	200	$645; $430 T	$495; $330 (half-filled)	8	7/78	396
4164	64K x 1	200	$1935; $1290 T		16	12/81	397
4116	16K x 1	200	$1950; $1310 T	$1150; $770 (half-filled)	8	10/79	398
4164	64K x 1	200	$5850; $3930 T		16	10/81	399
			$990 to $1350; $800 to $990 T		4	8/76	400
MK 4116	16K x 1	135	$600 M, T		4	8/78	401
MK 4564 or MK 4116	64K x 1 or 16K x 1	135	$2075 to $3125 M, T		4 to 6	6/81	402
5290	16K x 1	200	$700 to $1900 M, T		2	10/80	403
4164	64K x 1	200	$2090 M, T			10/81	404
4116	16K x 1	200	$2300; $1472 T		4	9/80	405
4532, 4548, 4164					4 to 6	6/80	406

Manufacturer	Board characteristics				
	Type (Note 1)	Capacity (bytes); word length (bits) (Note 2)	Segmentation (Note 3)	Maximum clock frequency (MHz)	Typical/ maximum current (mA)
DEC PDP-11/05 THROUGH 11/60 MINIS (UNIBUS)					
Able Computer	Bipolar RAM	8K; 16 + 6 ECC or 16 + 2P			2100 to 5000
	Bipolar RAM	64K; 18			4000
Dataram Corp.	DRAM	256K; 18	S(32K)	2	2700/3000
	DRAM	256K; 18	S(32K)	2	2700/3000
	DRAM	1M; 16	S(128K)	2	3500/3800
	DRAM	1M; 16	S(64K)	2	7500/7500
	DRAM	4M; 16	S(256K)	2	5900/6300
Imperial Technology, Inc.	DRAM	512K to 2M; 16/32 D	B	1.3	3500
Mostek	DRAM	128K or 256K; 16 + 2P	S(4K or 8K), B, E		3000
	DRAM	1M; 32 + 7 ECC	S(128K), B, E		
National Semiconductor	DRAM	256K; 16 + 2P	S(4K), E	2.22	3500/3500
	DRAM	128K; 16 + 10 ECC	S(4K), E	2.22	3500/3500
	DRAM	1M; 16 + 2P	S(4K), E	2.22	
	DRAM	512K; 16 + 10 ECC	S(4K), E	2.22	6500/7000
Systime, Inc.	DRAM	128K; 16	B, E	1.5	
	DRAM	512K; 16	S(256K), B, E		3800
Trendata/Standard Memories	DRAM	128K; 16			2250/2800
	DRAM	1M; 16	E		2250/5500
DEC PDP-11/70 AND VAX MINIS					
Dataram Corp.	DRAM (VAX-11/780)	512K; 32	S(64K)	2	1300/1400
	DRAM (VAX-11/750)	256K; 32	S(32K)	2	1100/1300
Intel	DRAM (VAX-11/780)	1M; 64K + 8 ECC		1.7	2300/4000
	DRAM (VAX-11/750)	512K; 32 + 7 ECC		1.7	1400/2600
Mostek	DRAM (VAX-11/780)	512K; 64 + 8 ECC	S(256K), B		2630
	DRAM (PDP-11/70, VAX-11)	256K; 32 + 7 ECC	S(256K), B		2040
National Semiconductor	DRAM (VAX-11/780)	512K; 64 + 8 ECC	S(4K), E	2.35	2200/4200
	DRAM (PDP-11/70, VAX-11/750)	256K; 32 + 7 ECC	S(4K), E	2.0	1660/2460
Systime, Inc.	DRAM (PDP-11/70)	256K; 8/16/24/32	B		3850
	DRAM (VAX-11/750)	256K; 32	B		3850
	DRAM (VAX-11/780)	256K; 32	B	1.65	12500
Trendata/Standard Memories	DRAM (PDP-11/70, VAX-11/750)	256K; 39			1400/2500
	DRAM (VAX-11/780)	256K; 72			1500/3100

Memory chip characteristics			Price and delivery				
Model number/ type (Note 1)	Organization (n x m bits)	Access time (nsec.)	Fully assembled unit price (Q=1; Q=100) (Note 4)	Unpopulated unit price (Q=1; Q=100) (Note 5)	Delivery time (weeks ARO)	Date first shipped	For more information circle no.
2147-3P	4K x 1	55	$3500 to $3750; $2450 to $2625 M, T		8	8/78	407
2141-2	4K x 1	120	$13,500; $9450 M, T		12	8/77	408
4116	16K x 1	200	$2125; $1410 T	$1260; $820 (half-filled)	8	4/78	409
4116	16K x 1	200	$2205; $1480 T	$1325; $880 (half-filled)	8	2/79	410
4164	64K x 1	200	$6615; $4440 T		16	7/81	411
4116	16K x 1	200	$9000; $6800 T	$6150; $4645	8	6/81	412
4164	64K x 1	200	$27,000; $20,400 T		16	11/81	413
	64K x 1	200	$5000 to $9000; $4000 to $7500 M, T		4 to 8	8/80	414
MK 4116	16K x 1	135	$1415 to $1535; M, T		4	6/77	415
MK 4564 or MK 4116	64K x 1 or 16K x 1	135	$7485 M, T		6	1/82	416
5290	16K x 1	200	$1950 M, T		2	5/80	417
5290	16K x 1	200	$2000 M, T		4	6/80	418
4164	64K x 1	200	$6525 M, T			1/82	419
4164	64K x 1	200	$3995 M, T			10/81	420
4116	16K x 1	200	$2000; $1200		4	1978	421
4164	64K x 1	200	$8000; $6000 T		8	12/81	422
4116	16K x 1	200	$1600; $900 M, T		stock	1/78	423
4164	64K x 1	200	$6400 to $8000; $5000 to $7000 M, T		stock	4/81	424
4116	16K x 1	200	$3060; $2310 T	$1700; $1285	8	7/80	425
4116	16K x 1	200	$2400; $1800 T		8	7/80	426
2121	32K x 1	200	$3440; $2750 M, T		8	12/80	427
2121	32K x 1	200	$2315; $1850 T		8	9/81	428
MK 4116	16K x 1	135	$2275		4	12/79	429
MK 4116	16K x 1	135	$1950 M, T		4	12/80	430
5290	16K x 1	200	$2950 M, T		4	6/80	431
5290	16K x 1	200	$1900 M, T		4	5/81	432
5290	16K x 1	200	$4000; $2000		6	6/81	433
4116	16K x 1	200	$7000; $2500 T		6	8/81	434
4116	16K x 1	200	$5000 T		6	7/81	435
4116	16K x 1	200	$1800; $1100 M, T		stock	4/79	436
4116	16K x 1	200	$1800; $1100 M, T		stock	8/79	437

Manufacturer	Board characteristics				
	Type (Note 1)	Capacity (bytes); word length (bits) (Note 2)	Segmentation (Note 3)	Maximum clock frequency (MHz)	Typical/ maximum current (mA)
6800-BASED MICROS					
Applied Logic, Inc.	SRAM	8K; 8	S(4K)	1.0	1400
	SRAM	32K; 8	S(16K)	2.0	2200
Micro Memory, Inc.	Core	8K to 16K; 8	S(4K), B	1.0	900/1800
	DRAM	64K; 8	S(4K), B	2.0	900/200
	SRAM	32K; 8	S(4K), B	2.0	1200
Wintek Corp.	RAM	16K; 8	S(4), B	1.0	50
	EROM	16K; 8	S(16K)	1.0	500
	RAM	2K; 8	S(2K)	1.0	300
OTHER MINICOMPUTERS, μCS					
Dataram Corp.	DRAM (PDP-8/A)	128K x 12; 12	S(16K)	2	1000/1800
	DRAM (P-E 3200)	512K; 32	S(64K)	2	2800/2800
	DRAM (DG Nova 3)	256K; 16	S(32K)	2	1900/2300
	DRAM (DG Eclipse)	256K; 16	S(8K)	2	4500/5000
	DRAM (V77-600)	512K; 16	S(64K)	2	5500/6200
Forethought Products	DRAM (AIM 65)	48K; 8 + 1P	S(4K)	1.0	950
General Micro Systems, Inc.	EPROM/ PROM/ROM (AIM 65)	64K; 8			
Imperial Technology, Inc.	DRAM (DG Nova, HP 1000)	512K to 2M; 16/32 D	B	1.3	3500
Mostek	DRAM (DEC PDP-8)	64K; 12	S(4K), B		3000
Trendata/Standard Memories	DRAM (P-E 16)	32K; 22			56/810
	DRAM (GA 220/110)	128K; 16			1100/1500
	DRAM (CA LSI 2/4)	64K; 16	B		1800/2400
	DRAM (Honeywell 60 Level 6)	64K; 22			250/1000
	DRAM (HP 1000)	512K; 17	E		1000/1500

Memory chip characteristics			Price and delivery				
Model number/ type (Note 1)	Organization (n x m bits)	Access time (nsec.)	Fully assembled unit price (Q=1; Q=100) (Note 4)	Unpopulated unit price (Q=1; Q=100) (Note 5)	Delivery time (weeks ARO)	Date first shipped	For more information circle no.
2102L	1K x 4	450	$250 M, T		4	3/80	438
2114L	1K x 4	200	$595; $415 M, T		4	2/81	439
			$725 to $849; $592 to $680 T		4	7/76	440
4116		150	$550; $400 M, T		3	11/80	441
4104		200	$625; $450 M, T		3	11/80	442
4027	4K x 1	450	$299; $179 T	$39; $24	4	6/76	443
2716, 2708	2K x 8, 2K x 8	450	$99; $59 M, T	$39; $24 S	4	6/76	444
5101L	256 x 4	450	$289; $179 T	$39; $24	4	6/77	445
4116	16K x 1	150	$6110; $4575 T	$3375; $2530	8	4/81	446
4116	16K x 1	150	$6630; $4375 T	$3700; $2575	8	4/81	447
4116	16K x 1	200	$2970; $2215 T	$1835; $1375	8	6/79	448
4116	16K x 1	200	$3520; $2630 T	$2375; $1765	8	6/79	449
4116	16K x 1	150	$9860; $6510	$5800; $3830	16	7/81	450
4116	16K x 1	200	$550; $413 M, T		2 to 3	7/80	451
2758, 2716, 2732	1K, 2K, 4K			$230 M, T			452
	64K x 1	200	$5000 to $9000; $4000 to $7500 M, T		4 to 8	8/80	453
MK 4116	16K x 1	135	$1480 M, T		4	11/79	454
4116	16K x 1	200	$600; $300 M, T		stock	8/80	455
4116	16K x 1	200	$1800; $1200		stock	2/78	456
4116	16K x 1	200	$1100; $900 M, T		stock	3/78	457
4116	16K x 1	200	$1300; $800 M, T		stock	4/80	458
4164	64K x 1	150 or 200	$5400; $3700 M, T		stock	7/80	459

Most systems builders purchase fewer than 1000 boards a year; those that need more, such as CPU manufacturers, tend to buy the chips and fabricate their own boards.

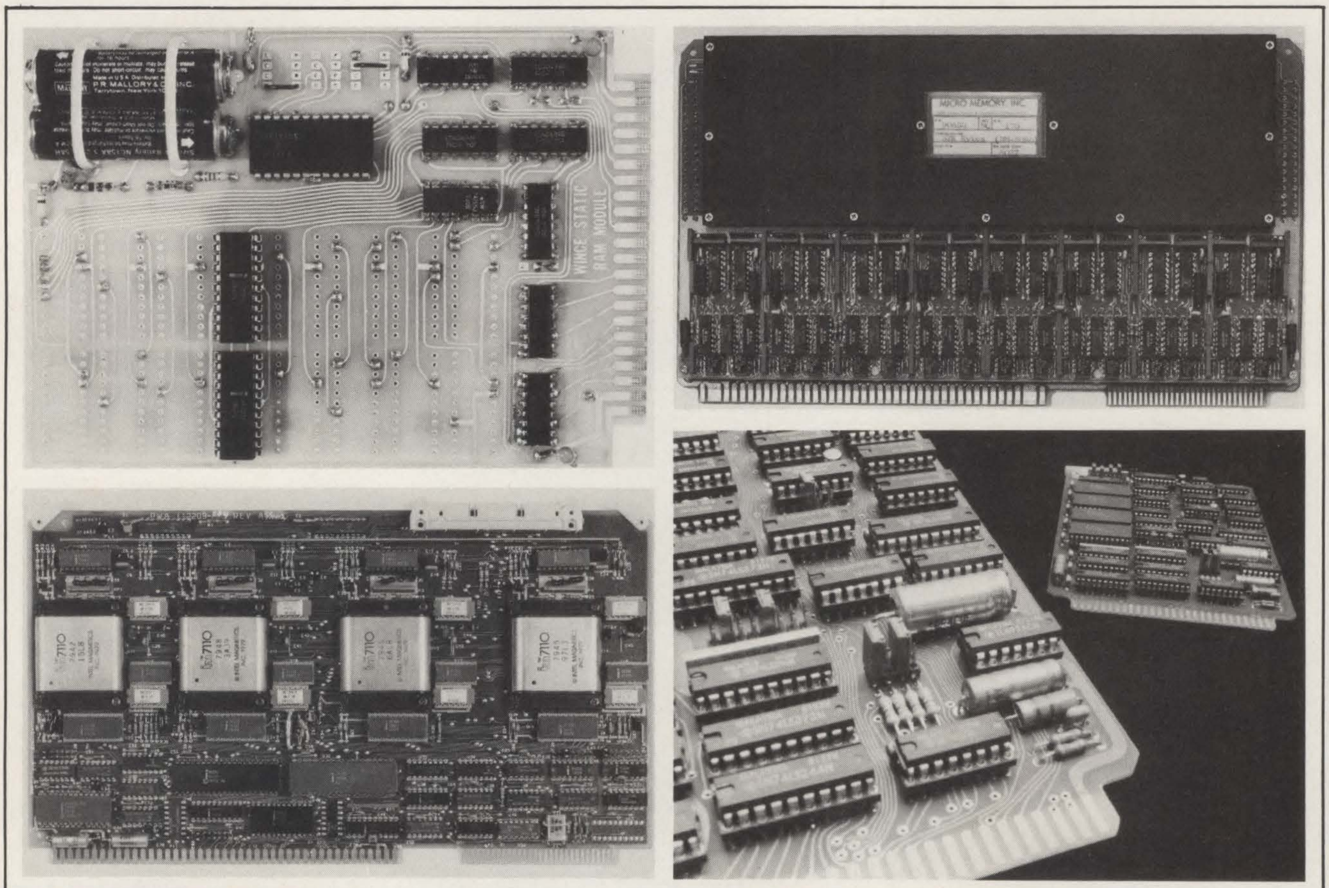
nonvolatile memory is a requirement and the use of battery backup to maintain semiconductor memory during power outages is not practical.

Dynamic RAMs are more popular than static RAMs because of their superior density (64K DRAMs have been available for a few months; the largest SRAMs hold 16K bits) and lower price per bit. The lower unit price stems from the simpler design of the DRAM; its storage element is a capacitor, while the SRAM storage element is a flip-flop composed of several transistors. The DRAM is expected to lead in popularity, despite the speed advantage and lower power requirements of SRAMs that make them the choice in many applications.

Boards based on 64K RAMs are appearing on the market in increasing numbers, supplanting the older 16K boards. The process has been slow, because the normalized unit price of 16K boards remains lower than the price of 64K boards, although the prices are converging. Daniel Klesken of Dataquest, Inc. (see "64K dynamic RAM...," p.179) pointed out this year that use of the 64K RAM entails fewer devices per board, less power per bit and fewer boards per system than use of 16K RAMs. Thus, at the crossover point, the cost of the 64K chip will be four times the cost of the 16K chip, plus \$3 to \$4 to account for the additional economic benefits of the 64K chip. The 16K chip, selling for \$2.50 in the first quarter of 1981, should sell for \$2 at the crossover point, and the 64K chip should sell for \$11 to \$13 at the crossover point, which should be reached by the year-end. Thereafter, 64K boards should proliferate their spread, slowing only when the 256K chip appears during 1984. Sales of 64K-chip boards are expected to peak in 1986; the 256K devices will begin to overtake them thereafter.

Survival of the independents

When the new devices become available, small, independent vendors, rather than the semiconductor houses themselves (the major memory-board vendors) will probably introduce the first products. The independents survive on their capability to beat Intel Corp., Mostek Corp., National Semiconductor Corp. and Texas Instruments Inc. to the punch in introducing new



Four approaches to memory retention. *"Wince" static RAM module (upper left) from Wintek Corp. uses two size AA NiCad batteries to hold memory contents during power-off conditions for as long as one year. The 6800-bus module can accommodate 2K bytes in multiples of 256 and has write protection. Micro Memory, Inc.'s model MM-8086 32K-byte board (upper right) for Intel's iSBC μcs uses nonvolatile core. At lower right is Intel's iSBC 254 bubble-memory board with capacity of 512K bytes. The model 3702 E²PROM board (lower right) from Solar Wind Systems, Inc., is an STD-bus-compatible memory based on the Intel 2816/2815 nonvolatile memory chip. The board holds 8K bytes and will retain data for 10 years without batteries. Read access time is only 250 nsec., and the board generates its own wait states for the 20 μsec. required to complete an erase/write cycle.*

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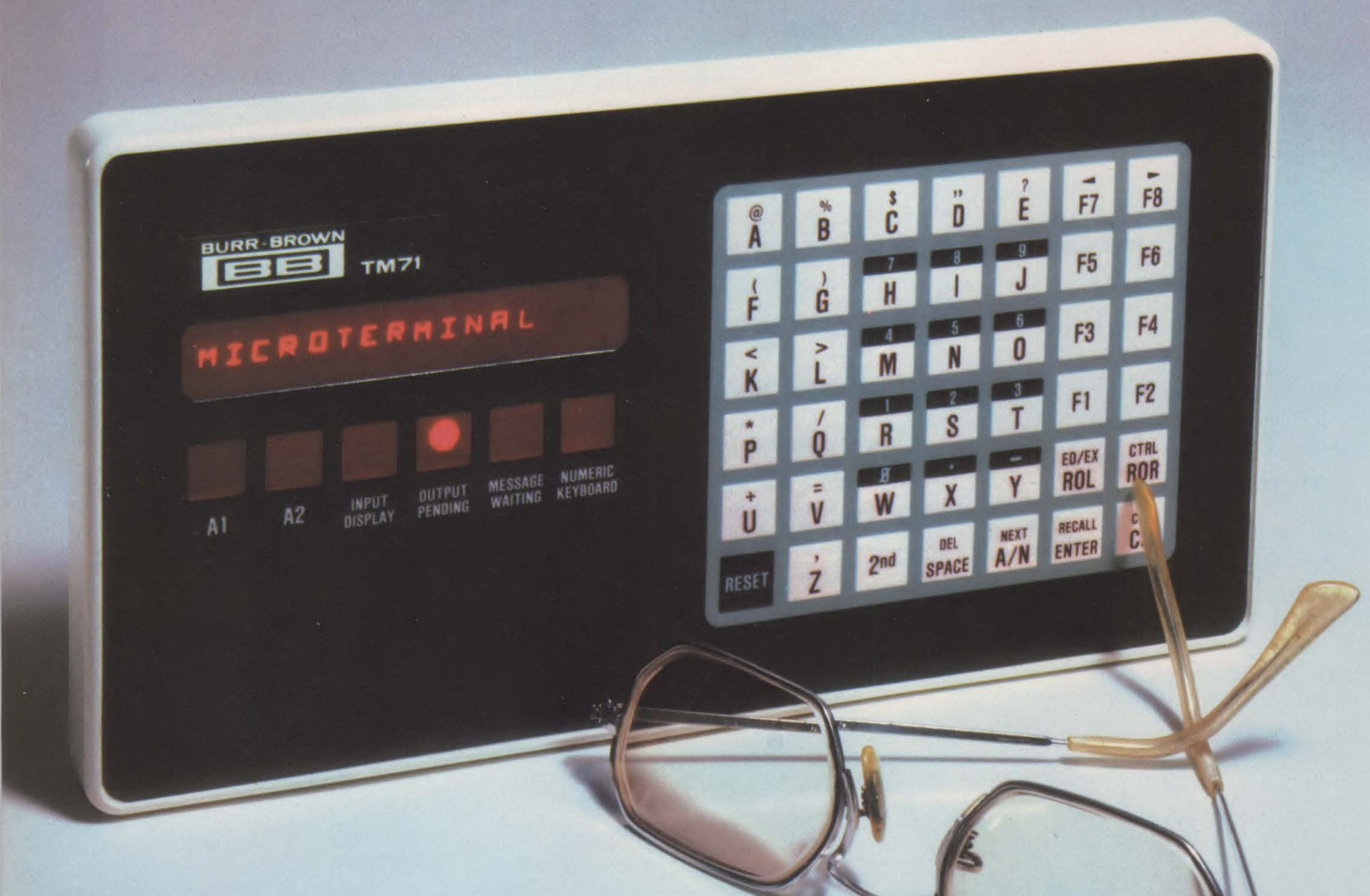

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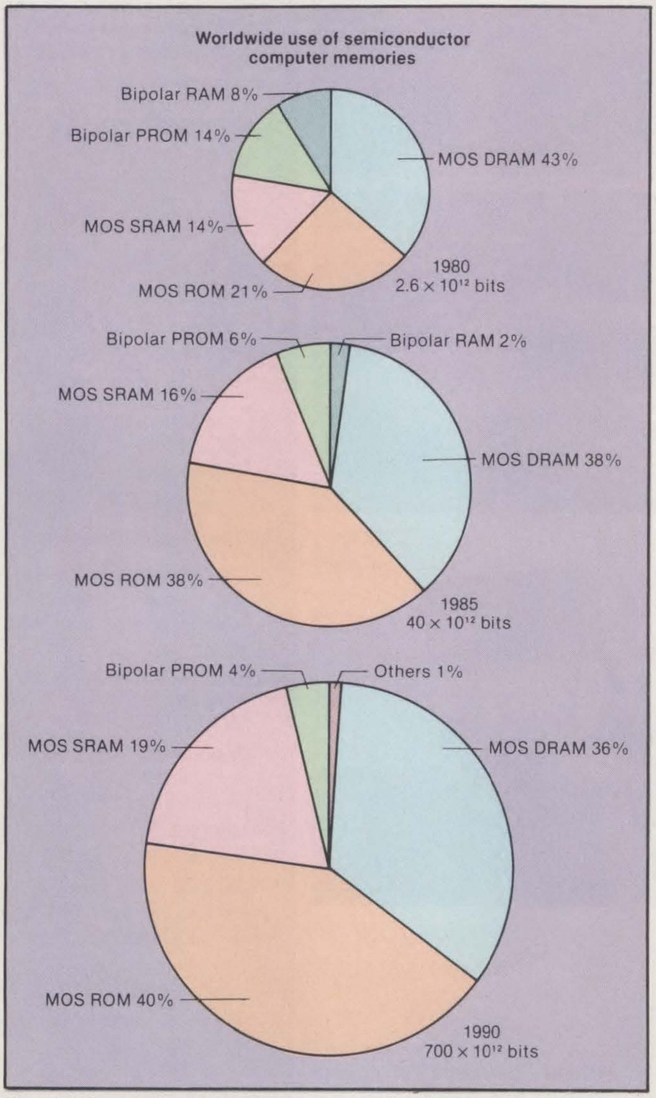
Dynamic RAMs are more popular than static RAMs because of their superior density and lower price per bit.

products because the independents have much shorter design cycles. Finally, the major suppliers will make their announcements and gradually build their market shares, forcing the independents to find still newer wrinkles to stay ahead of the game. For example, Advanced Digital Technology in 1977 was the first to offer a Multibus-compatible board having error detection and correction, claims Joel Korelitz, marketing vice president. Since then, others have begun to offer the feature; Advanced Digital now sells a board that holds 1M byte of memory—a capacity that the major manufacturers have yet to match.

Boards feature ECC, battery backup, segmentation

The interest in on-board error detection stems from the vulnerability of DRAMs to soft (transient) errors that cause the value of a bit to be reversed in a read or write operation. Users quote observed error rates from two or three errors per million device-hours to several hundred errors per million device-hours. DRAMs are generally susceptible to system noise and radio frequency interference from nearby equipment. The 64K DRAMs, in particular, are touchier than the 16K parts because of the relatively small capacitor charges stored for each bit. They are sensitive to alpha particles, cosmic rays at high elevations and voltage-source fluctuations, as well as to other noise sources. The newest chips are coated to relieve the alpha-particle problem, but the other problems persist. On-board error-correction circuitry offers a solution, although it is not universally accepted.



Worldwide market for computer applications *of semiconductor memory is expected to grow at an average annual rate of nearly 75 percent through 1990. Source: "Memory Business Opportunities in the 1980s," available from MacKintosh Consultants, Inc., San Jose, Calif.*

Some vendors supply batteries on the board or on separate boards to protect the data in semiconductor RAM in the event of power failure. Battery backup is usually feasible for SRAM boards, on which relatively low data-retention currrents are required, but not for DRAM boards, on which refresh signals must be furnished at 2- to 4-msec. intervals to retain the charges on the storage elements. Adac Corp. offers an on-board nickel-cadmium battery for its CMOS SRAM boards, for example. The NiCad batteries are rated at three years of life when recharged at least 40 hours a week and can deliver 180 mA-hours at 25°C when power is off, retaining data as long as 168 hours. Catalyst Research Corp. offers a lithium-iodine battery for CMOS RAMs that exhibits 10 years of shelf life (without recharging) and as much as one year of data retention (see "Long-life SRAM backup...," p. 141).

Almost every vendor furnishes a segmentation feature, permitting the starting address of the memory on a given board or on various memory blocks on the board, to be set by the system integrator as needed. Coupled with this feature, many 16-bit boards operate in address spaces that are much larger than the span of on-board memory. For example, Static Memory Systems' S-100 board supports extended addressing to expand system memory to 512K bytes, although each board has a capacity of only 64K bytes. The address range recognized by a given board is in the interval (n)(64K) to (n + 1)(64K), where n = 0, 1, ...7. Advanced Digital Technology offers boards with 24-bit addressing to accommodate a 16M-byte address space. ■

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.

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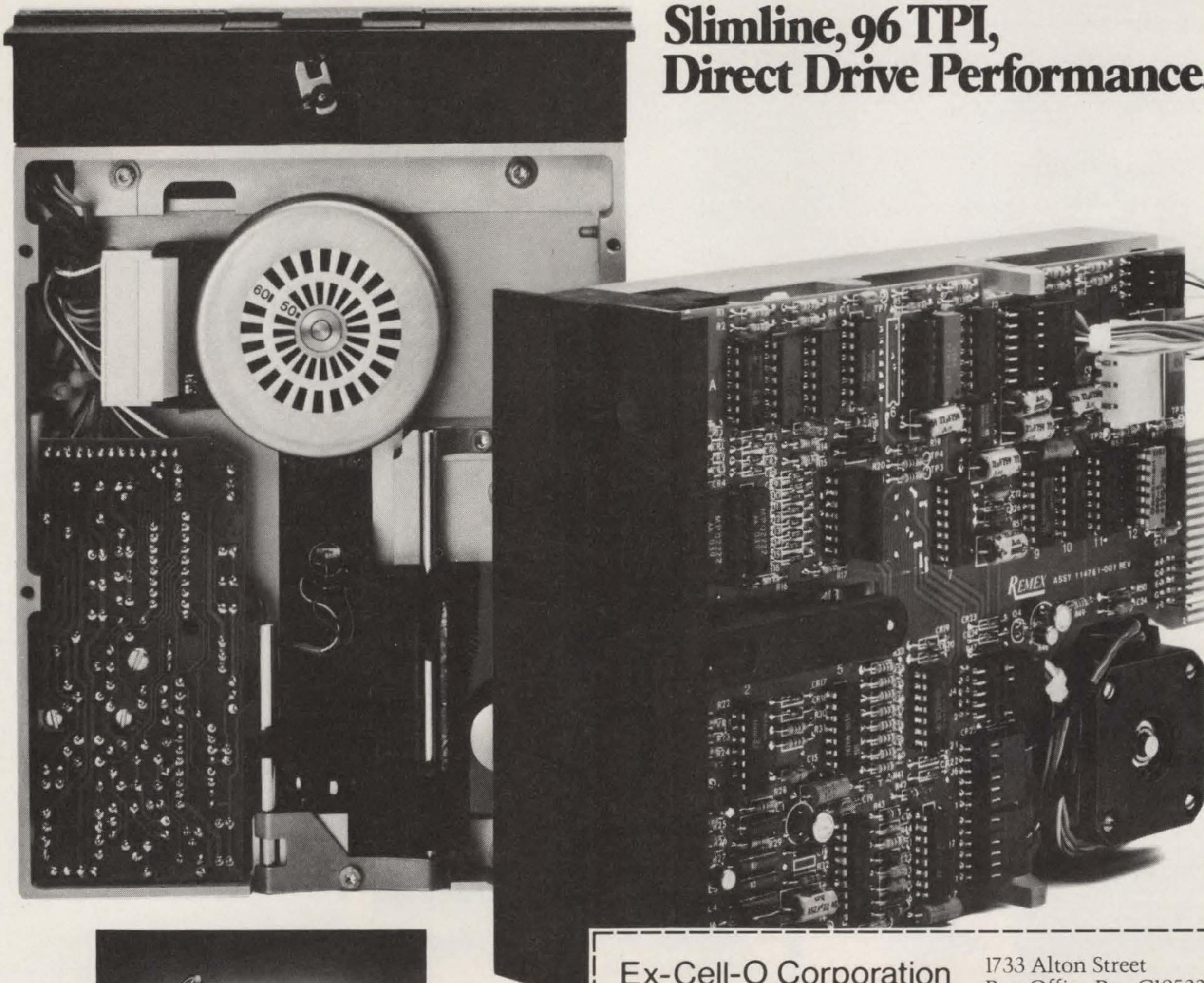

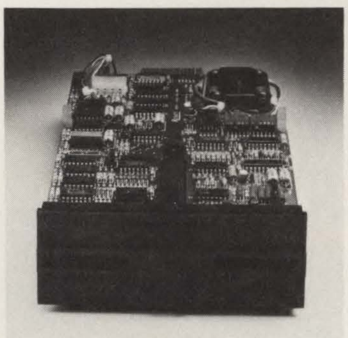

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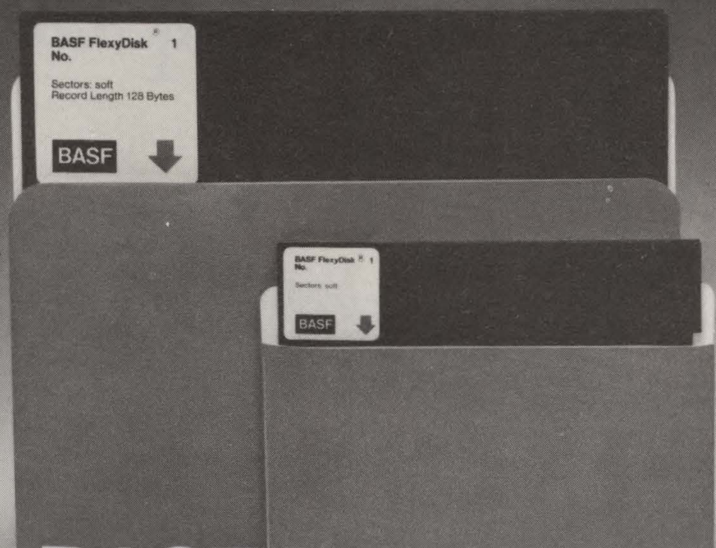

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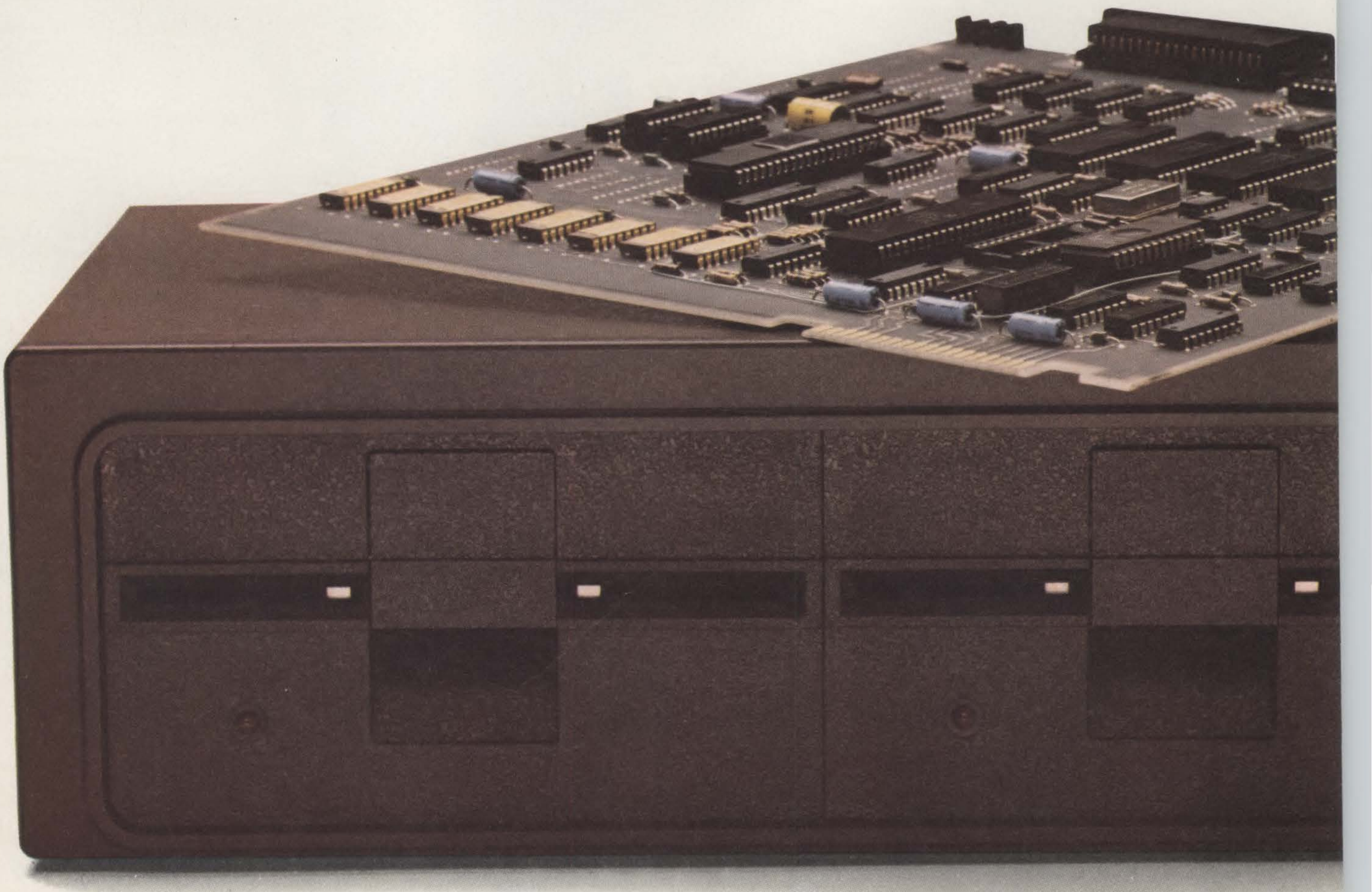

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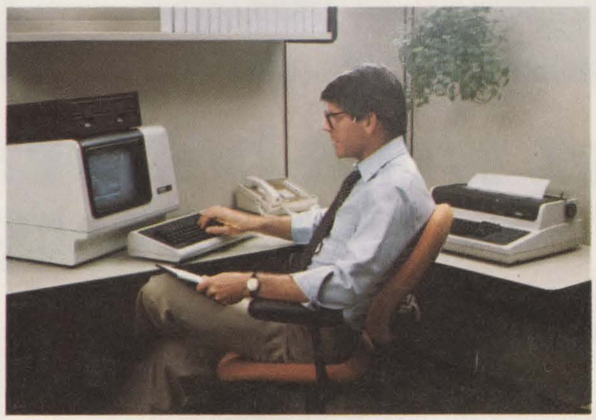

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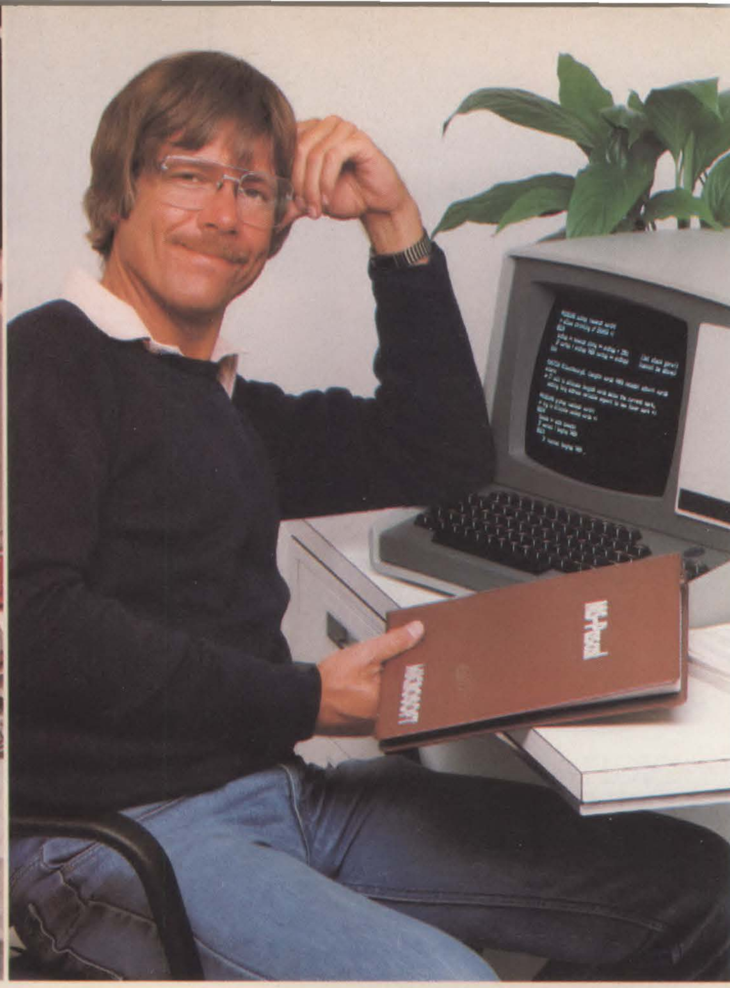

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CIRCLE NO. 86 ON INQUIRY CARD

MEMORY MARKET TRENDS

Competing in the DEC-compatible add-in memory market

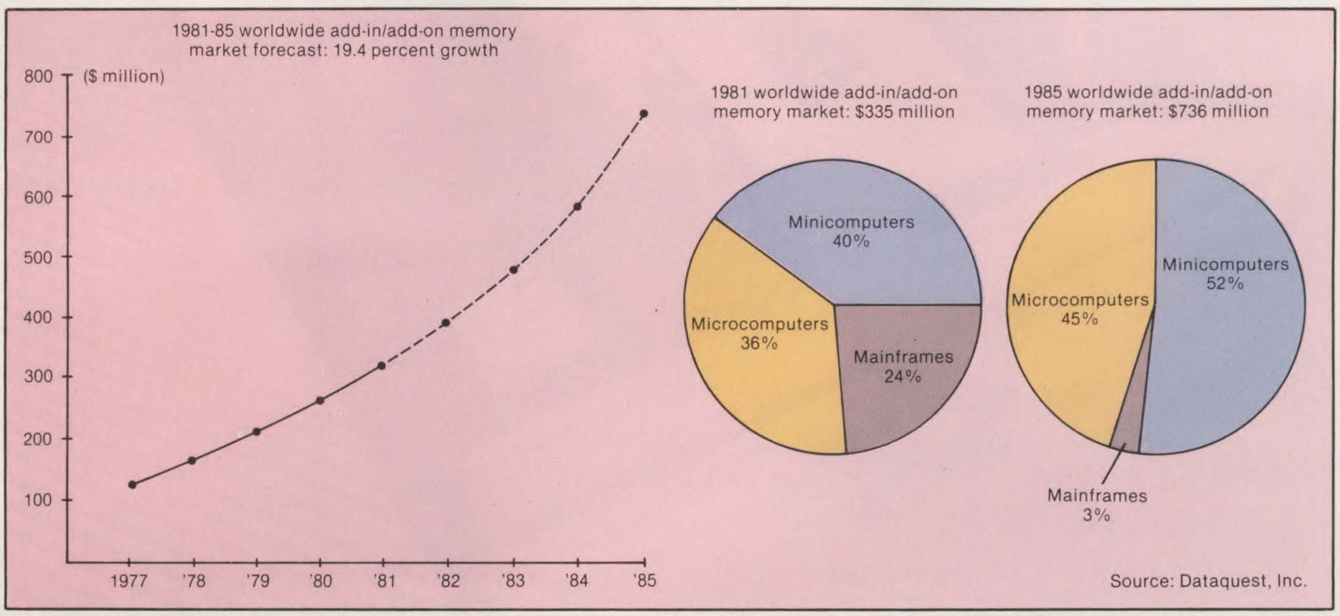
AL FURST, Electronic Business Magazine

Board prices have hit an all-time low, and some vendors suspect the market hasn't yet bottomed

It's a crowded market for manufacturers of add-in memories, and nowhere is it more fiercely competitive than in the Digital Equipment Corp.-compatible arena. Counting semiconductor manufacturers, medium-sized assemblers and garage shops, more than 30 companies occupy the DEC-compatible field. Why are so many independents getting into the act? For one thing, DEC has a huge installed base—VAX units alone exceed 2000 units, according to one estimate. Secondly, it's an easy market to penetrate because DEC's products are modular in design, making it easy for suppliers to manufacture standard substitutes.

With all the activity, it's small wonder that board prices hit an all-time low this fall, and some vendors suspect that the independent market has not yet bottomed.

DEC, too, recently changed the complexion of the \$100- to \$150-million add-in industry by repricing its board products. In response to market conditions, DEC disclosed in late September that it was lowering prices



The mainframe memory market *is largely add-on and IBM-compatible, notes James Moore, manager of Dataquest's Computer Memory Industry Service. The explosive growth in add-in systems for minicomputers and μcs, IBM's consistently aggressive mainframe pricing policy for add-on modules and the still-unsolved technological problems with the speed of transmission from add-on boxes to mainframe host computers are all contributing to the declining market share for mainframe memory, Moore says.*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DEC recently changed the complexion of the $100- to $150-million add-in industry by repricing its board products.

30 to 40 percent on boards for its 32-bit VAX and 16-bit PDP-11 lines. In some cases, price reductions could range as high as 58 percent on selected PDP-11 boards using DEC's patented Unibus structure.

Because DEC has a larger installed base than any other minicomputer company, the move could squeeze profit margins even tighter for independents that sell less expensive, sometimes higher performance—but not necessarily fully warranted—boards into DEC's largely OEM base. There are, however, compelling reasons for board makers to wait out current softness. The worldwide market for add-in boards and add-on boxes will grow 19.4 percent a year to $736 million in 1985 from $335 million in 1981, says James Moore, a memory expert at Dataquest Inc., a Cupertino, Calif., market research firm. The company also estimates that minicomputer/μc boards will account for 97 percent of total add-in/add-on memory revenue in 1985, an increase from 76 percent in 1981.

Fighting the price war

Even before DEC announced the latest round of price reductions, the first since it lowered prices 13 percent and 16 percent, respectively, on two members of its LSI-11 μc family last January, DEC-compatible boards supplied by independent vendors were sometimes selling for about one-third what they went for the previous year. In mid-September, for example, prices on high-end VAX-11/780-compatible boards, which DEC was selling for a little less than $20,000 in single-unit quantities, sold for $5000 or less. A year earlier, the street units were selling for $15,000.

"To give you an idea of what kind of a dogfight it is," says John Underwood, director of Fabri-tek Inc.'s Minneapolis-based Systems Division, "we had some excess 16K and 32K boards that we'd written off. I tried to sell them at $100 a piece and got underbid." Fabri-tek, which left the add-in market several years ago after the chip makers jumped into the board end of the business in volume, now makes only core-memory add-ons for DEC's PDP-11 line. "We took our lumps and got out," says Underwood, "and I don't regret leaving one bit."

Everyone has a horror story. Joseph Priapi, marketing support manager for Intersil Inc.'s Systems Division, part of General Electric Co., says, "It doesn't take a whole lot of capital to get into the add-in market." In a recent competition, he adds, "We heard a quote of $780" on a VAX-11/780 board. Intersil had introduced a similar board six months earlier for less than $4000.

"I can see the same thing happening (in the μc area), but maybe not as rapidly," predicts Priapi. He says Intersil recently announced a 0.5M-byte Multibus board using 64K devices, for $5295. "Six months from now, it might be selling for 50 percent of that," he says. "That's the trend."

Priapi says Intersil, which does about 40 percent of its business in the add-in mini, μc and custom-memory business and the remainder in IBM-compatible add-on memory, is now "looking more to the value-added type of product." Intersil, he says, wants to remain a supplier of systems rather than individual board products to combat the continuing price erosion.

"On occasion, the market can get very competitive," agrees George Robillard, manager of Texas Instrument Inc.'s memory and μc board operations. Accordingly, TI, which supplies add-in boards for DEC's LSI-11, PDP-11 and VAX/780 machines, is "attacking that market from the point of view of a leading-edge technology," Robillard contends. Robillard says that TI shipped the industry's first 64K dynamic RAM board this year. The 64K DRAM technology "allowed us to get higher memory density on the board, thereby freeing space for other features, such as error detection and correction," Robillard says. "We expect to see more competition in the high end as 64K DRAM technology becomes more readily available to the competition," he adds.

"From where we sit, DEC seems to be getting stronger," adds John Gilligan, president of Dataram Corp., Cranbury, N.J. A $24-million-a-year add-in/add-on business, Dataram does about 40 percent of its business in DEC-compatible hardware. But with today's softness in pricing, Gilligan wouldn't be surprised if semiconductor manufacturers are having second thoughts about remaining in memory-component manufacture. "It can't be a big percentage of their numbers," he says.

Some independent vendors, too, insist that the market's pricing problems have finally bottomed, a view shared by Peter Durant, a DEC memory product manager. Durant, who asserts that DEC is not about to start a price war with the independents, says, "I don't think the market is going to go much lower." DEC's prices, he contends, "will be what they are when this market softness goes away."

Board prices could take another downward turn, however, if and when DEC introduces higher rated RAM 64K technology into its 16K VAX and PDP lines. DEC has been selling boards with 64K RAM chips on machines in its LSI-11 family since July. Durant admits that DEC is looking at 64K technology for other applications.

Chip prices, meanwhile, will continue to decline as manufacturing technology becomes increasingly sophisticated, predicts Rene Vishney, an analyst at Creative Strategies Inc. Metal oxide will drop further in price, as 64K chips proliferate, Dataquest's Moore concurs. "In 1983," he adds, "we'll probably see 256K."

Market divided

Despite rumors that some DEC-compatible board

Despite rumors that some DEC-compatible board makers are dumping products to clean inventory, vendors and analysts are divided about whether there's an industry shakeout in the offing.

makers are dumping products to clean inventory—or to get out of the business altogether—vendors and an analysts are divided about whether there's an industry shakeout in the offing.

Long-time DEC-watcher Adolf Monosson, president of American Used Computer, Inc., and publisher of the *Monosson on DEC* newsletter, is dubious about the plug-compatible board business. "I would suspect there's not much margin in it now," he says, "and eventually, I think, the whole business is going to disappear."

But Stephen Dube, an analyst at Dean Witter Reynolds Co., takes a less drastic view. Even if DEC adopted a more aggressive pricing strategy, he says, the smaller and more flexible independents will remain active as long as there's a potential for profit. The business will continue to be based in the technical and scientific area, he adds, in which users are "effectively building systems." Commercial end users, by contrast, are less likely to unscrew the back of a computer and substitute one board for another, he notes. "For them, it's just more aggravation than it's worth."

Emphasis on reliability

Because maintenance and support are such key selling points for DEC, the independent vendors also have been forced to beef up their support apparatuses. Miles Efron, vice president for marketing at Trendata Corp.'s Standard Memories Division, Santa Ana, Calif., says his company recently offered a four-year warranty on all DEC-compatible products. With 4000 VAX 11/780-compatible boards in place and about 50 percent of total sales in the DEC arena, Efron nevertheless insists that the 15-year-old firm is "healthy and hardy."

Thomas Knight, director of memory systems for National Semiconductor Corp. says that he, too, is optimistic about his company's opportunities in the years ahead, particularly because of the firm's emphasis on reliability and performance. National boasts an annual failure rate of less than 1 percent on its add-in boards and a dead-on-arrival rate of less than 0.5 percent. The DOA rate for the rest of the industry is 5 percent, Knight says. In addition, he says, chip and board maker can lower manufacturing costs by building boards in Hong Kong, where labor costs are lower than in the U.S.

Cambex Corp., formerly Cambridge Memories, felt confident enough about the DEC market to introduce a new line of add-in memories this year for the VAX-11/780, the LSI-11 and the PDP-11 Unibus families. "If we were only in this area, it would indeed be a dangerous place to be," admits Joseph Kruy, president and chairman. The firm, however, which posted $8 million in sales for fiscal year 1981, is a volume importer of semiconductor chips from Japan for its IBM add-in products. "When you buy chips in large quantities, you take advantage of quantities of scale," Kruy claims. "Because of our large volume of business, we're getting chips cheaper from the Japanese than the transfer price from a semiconductor company's components division to its systems division." As a result, Cambex expects to give the other DEC-compatible board makers a run for their money.

Nevertheless, customized products, even DEC-compatible ones, don't appear to be affected by the volatility that prevails in the standard board market, several vendors acknowledge. Board prices in that sector remain stable, says Russell Summers, vice president and general manager of Electronic Memories & Magnetics Corp.'s Severe Environment Systems Co. Summers says E M & M saw the writing on the wall in the mid-1970s when it withdrew from the off-the-shelf board business. It now markets only high-volume customized orders for OEMs.

"There are just too many people in the MOS end of the (add-in) business," agrees Al Horowitz, product sales manager for Ampex Corp., Redwood City, Calif., that's one reason why "prices have been slashed to the bone." In the DEC-compatible market, Ampex sells only add-on PDP-11 systems and MOS replacement memories for so-called DEC mainframe Systems 10 and 20 markets, which Horowitz says, keep "rolling along."

Why DEC?

There are reasons, though, why the independents have chosen to make boards primarily for use in DEC machines. In the first place, DEC has a huge installed base. Secondly, "it's a lot easier to penetrate the DEC market than it is the Data General Corp. market," says Daniel Clarke, a product marketing manager for Intel Corp., which sells into both markets. Clarke says DEC's buses and products are more modular in design, so it's easier for competitors to manufacture standard substitutes. Also, DEC carries basic product-line design into its next generation of machinery, assuring plug-compatible manufacturers a longer life span for their products.

Finally, DEC—which can't operate as a third-party vendor, in part because it has an extensive field-service staff to support—has remained somewhat aloof from the price war on boards. If DEC's recent price reductions are any indication, however, this policy may be changing. The independents are monitoring the situation carefully. ■

Al Furst is computer editor of *Electronic Business* magazine.

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CIRCLE NO. 89 ON INQUIRY CARD

Trends in memory boards and systems

SCOTT STEVENSON, National Semiconductor Corp.

Add-in memory continues its evolution from core to semiconductor to complete systems on a single board

Rapid advances in semiconductor technology since 1978 have caused semiconductor storage to displace cores as the dominant state of the art in memory systems. Faster memory access, lower power requirements and significantly lower cost per bit have brought about the turn to semiconductor memory. While core still holds a corner of the applications arena, 16K and 64K RAM offer the system designer increased memory capacity while freeing board space; advances in ROM technology offer higher speeds and densities at reduced costs; and multifunction memories provide added design flexibility.

Concurrently, today's market reflects decreasing semiconductor prices and an increasing potential for independent manufacturers of add-in memory. The core-memory market, in contrast, has a life expectancy of only several more years, leaving remaining suppliers in fierce competition for the limited customer base.

RAM technology trends

Most erosion in core use in the past two years has been attributed to the 16K RAM, which quickly became a high-volume-production memory technology. In addition to cost advantages, the 16K RAM offers performance and density improvements that cannot be achieved with core.

Trends established by the 16K RAM are amplified by the 64K RAM. Again, physical memory space condenses fourfold, freeing additional board real estate for increased memory capacity or control-function enhancements. Further advances in RAM technology will include single-voltage 16K dynamic RAMs, 16K CMOS and 16K static RAMs. CMOS and single-voltage 16K RAMs require only minimal power to operate. From a systems' viewpoint, cost savings are created by eliminating large power supplies. Conversely, static RAM requires more power, but yields extremely fast components. These devices have consistently lagged behind dynamic RAMs in density. A single cell in a DRAM provides 1 bit of memory, while three cells are required for a static memory. For this reason, the densities achievable with statics will remain a step behind.

	1978		1979		1980		1981	
	M bytes	Percent	M bytes	Percent	M bytes	Percent	M bytes	Percent
Total	15,824		35,235		51,474		73,660	
Core	6330	40	10,570	30	12,869	25	14,732	20
MOS	9494	60	24,665	70	38,605	75	58,928	80
Source: International Data Corp.								

Table 1. Total U.S. *minicomputer memory shipments.*

With 64K RAM, the day of the 1M-byte board has arrived. Just 20 years ago, 4K bytes of memory required a separate chassis and weighed more than 100 lbs.

Each fourfold increase in chip density, from 1K through 64K (with 256K in the future), has brought greater speeds and greater system reliability. As the volumetric space for a given amount of memory decreases, the associated access time also decreases with attendant increases in system performance. For example, the 16K RAM occupies only one card, while the 4K unit requires four cards to accommodate a memory system that supports the total address range. The result is a decrease in the number of RAMs and support circuits needed to deliver the maximum amount of memory capacity. On a per-bit basis, system reliability is greatly enhanced, because there is one-fourth as many components subject to potential failure.

Table 1 compares the mix of core memories versus MOS RAMs used in minicomputer systems though 1981. The figures indicate that core has been losing market share steadily since 1978, although annual shipments are slightly higher each year during the period analyzed.

Table 2 shows the dramatic acceptance and success of the 16K RAM. A glimpse at 1981, however, shows the

Most erosion in core use in the past two years has been attributed to the 16K RAM, which quickly became a high-volume-production memory technology.

64K chip capturing a substantially higher share of the mix. Although it is not reflected in Table 2, the 4K RAM is still in use. Prices for 4K RAM stabilized when 16K RAMs became dominant. A 16K RAM sells for substantially less than did a 4K RAM, and the cost per bit of a 64K RAM is rapidly approaching that of a 16K RAM. It can be expected that 64K RAMs will be the dominant level of integration starting in 1982.

Chip size	1978		1979		1980		1981	
	M bytes	Percent	M bytes	Percent	M bytes	Percent	M bytes	Percent
4K	475	5	493	2				
8K	1424	15	1973	8				
16K	7595	80	22,199	90	34,745	90	47,142	80
32K								
64K					3869	10	11,786	20
Total	9424	100	24,665	100	38,605	100	58,928	100

(M bytes purchased)

Source: International Data Corp.

Table 2. Semiconductor *chip size expectation.*

	Revenue ($ millions)	Unit shipments	Average unit price
1979	$ 4700	116,000	$40,500
1980	$ 6000	135,000	$44,400
1981	$ 7900	165,000	$47,900
1982	$10,300	200,000	$51,500
1983	$13,000	235,000	$55,300

Source: International Data Corp.

Table 3. Worldwide *minicomputer sales forecast.*

Continued use of core will be limited to applications requiring a nonvolatile memory. For example, in the military market, which continues to account for the lion's share of nonvolatile core-based memory, operational stipulations often require that a system be programmed at one physical location for later transport to another site without data loss.

ROM technology trends

Today's ROM product line offers the abilities of both core and semiconductor products. Like core, ROMs are nonvolatile but offer high speeds and densitites. Software for ROM-based devices is written, tested and corrected using core or RAM-based systems. Once the software is fully debugged, it is entered into ROMs and PROMs as a fixed or unchangeable program. EPROMs can be reprogrammed as needed, but the cost is relatively high. The fixed program of firmware of the ROM family device generally controls systems-hardware functions in applications requiring nonvolatile memory.

Automated equipment performing tasks that remain constant, such as precision drilling and pipeline-flow control, depend on firmware for operating instructions. In these applications, which are usually implemented with μcs, a machine operator pushes the on button, and the system is automatically provided with basic information and instructions.

In the larger computer classes, ROM-based products are used for storing programs and utilities, such as BASIC interpreters, in addition to being used as firmware. Software is stored on disk or tape, and then transferred to RAM as needed. Using ROM as a software-storage medium eliminates the transfer time from disk or tape to RAM. System speed capabilities are improved. However, ROMs consume available memory-address space, decreasing the usable main memory.

Multifunction memories

The new breed of so-called multifunction memories performs parity or error-checking and correction functions that previously required multiple cards or were handled by a CPU. These functions can now be handled by single-chip solutions, such as the DP8400 expandable error-checking-and-correcting (E^2C^2) device from National Semiconductor Corp. Combined with single-chip LSI dynamic RAM controllers, the LSI devices give the systems designer added flexibility in backplane-slot use. Peripheral control, I/O formatting and other functions can now occupy card space.

Bleak future for core vendors

Add-in memory suppliers have evolved from three main types of backgrounds. First on the scene were the vendors that initially entered the market to produce core. Many still are producing core, but have also moved into the semiconductor-memory market. Plessey Microsystems, Electronics Memories and Magnetics and Fabri-Tek, Inc., evolved in this manner. Second are firms such as Intel Corp., National Semiconductor and Texas Instruments Inc., which began by producing memory coponents and later offered add-in memory to sell more of their own components. In the third category are firms that had no prior involvement in core or semiconductor-component manufacturing.

Approximately one-fourth of the add-in suppliers produce core memories. Although much of the market has moved to semiconductor RAM, core makers feel that their limited market will remain viable for several more years. As a result of market shrinkage, some manufacturers, such as Fabri-Tek, are abandoning general add-in core-memory production to concentrate on custom core memories. The remaining suppliers will vie for the limited customer base, with few new customers entering the picture.

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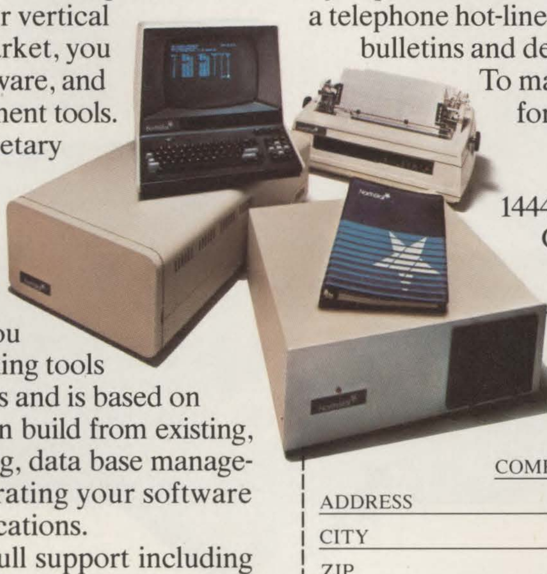

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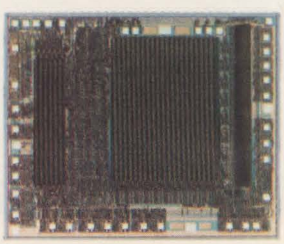
8-Bit Microcomputer Benchmarks

Processor	TMS7000	Z8	8051	6801
Clock Rate (MHz)	8	8	12	4
Binary Addition (μs)	4	3	6	13
BCD Addition (μs)	6	12	12	22
Block Move (μs)	1112	1785	3307	4584
Table Search (μs)	283	544	326	645
Binary to BCD (μs)	184	236	229	650
BCD to Binary (μs)	55	63	46	130
Bit I/O (μs)	13	15	10	33
Total (μs)	1657	2658	3936	6077
Relative Performance	1.00	0.62	0.42	0.27



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Chip design innovation

At the very heart of our 8-bit chip is TI's newly developed Strip Chip Architecture Topology (SCAT). It's a unique memory-like array-structured chip, integrating architecture and layout. SCAT establishes separate, easily accessible control and data paths that interconnect the active elements without taking up valuable chip space.

Smaller chips ... lower costs

The significantly smaller chip size of the TMS7000 family means significantly lower costs. And lower prices. It also means a unique ability to add new family members quickly and easily — by simply inserting new areas on the chip for additional memory capacity or functions. For example: EPROM, CMOS, communications devices and more, are on the way right now.

Required Memory Space

Benchmark	TMS7000	Z8	8051	6801
Binary Addition	4	4	7	6
BCD Addition	5	14	14	14
Block Move	10	20	33	27
Table Search	11	17	20	14
Binary to BCD	16	19	23	30
BCD to Binary	47	82	50	66
Bit I/O	15	16	17	23
Total (Bytes)	108	172	164	180
Relative Efficiency	1.00	0.63	0.66	0.60

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- Nine addressing modes enhance the inherent flexibility of an already powerful instruction set.
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CIRCLE NO. 91 ON INQUIRY CARD

The new breed of so-called multifunction memories performs parity or error-checking and correction functions that previously required multiple cards or were handled by a CPU.

Market characteristics

More than 40 independent suppliers offer add-in memory, but the top nine vendors account for more than 80 percent of sales. Among the top nine major vendors, Mostek Corp., Dataram Corp., Intel and National Semiconductor account for nearly 50 percent of total minicomputer-add-in-memory sales.

Independents produce add-in memory for more than 20 minicomputer lines, with the greatest emphasis on the more popular Digital Equipment Corp. and Data General Corp. products. To prosper, independents must outperform these firms in delivery, price, features, reliability or technology. Many end users are hesitant to purchase "foreign" memory, forcing independents to offer substantially greater price/performance. Consequently, savings offered by independents can be more than 50 percent.

In addition to competing with each other, independents face greater pressure from the major minicomputer manufacturers that are closing the gap in price, delivery and performance. The lower margins that result may force some independents out of the market. The pricing fray already under way in the 16K RAM arena is adding to competitive pressures, and the RAM price erosion will become even more pronounced once 64K RAMs are available in production volumes. The vertically integrated firms that also produce RAMs will have much greater pricing flexibility.

Using bulk RAM today as a system peripheral has become a cost-efficient reality. NSC's 2M-byte NURAM, for example, is claimed to have a lower five-year life cost than equivalent storage using floppy disks. Non-RAM producers may find themselves locked into fixed price/purchase agreements that could affect margins as open-market prices erode to lower than the fixed price.

The worldwide minicomputer market represents the greatest potential for independent makers of add-in memory. This market will expand at an annual rate of nearly 30 percent through 1983 (Table 3). ■

Scott Stevenson is director of engineering, memory systems, at National Semiconductor Corp., Santa Clara, Calif.

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MEMORIES

64K dynamic RAM market will soar

DANIEL L. KLESKEN, Dataquest, Inc.

Steadily declining device prices will result in unprecedented success for this ubiquitous semiconductor component

Suppliers of small systems, OEMs and sophisticated end users alike are becoming fascinated with the possibility of a worldwide 64K dynamic RAM market that could exceed $2 billion by 1984. The 64K DRAM will succeed the 16K DRAM as the most popular device ever produced by the semiconductor industry, and will be that industry's first $1-billion product.

The early years

Unit volume for the 1K dynamic RAM peaked in 1975, and the 4K volume peaked in 1978; 16K DRAM unit volume can be expected to peak in 1981 (Fig. 1), and 64K volume can be expected to peak in 1986 or 1987, at more than 400 million units. The interval between the peaks of product life cycles is lengthening for each generation of devices. While there was a three-year span between the peaks of the 1K and 4K DRAM and between the 4K and 16K DRAM life cycles, it will probably be five or six years between the peaks of the 16K and the 64K DRAM. This interval is primarily the

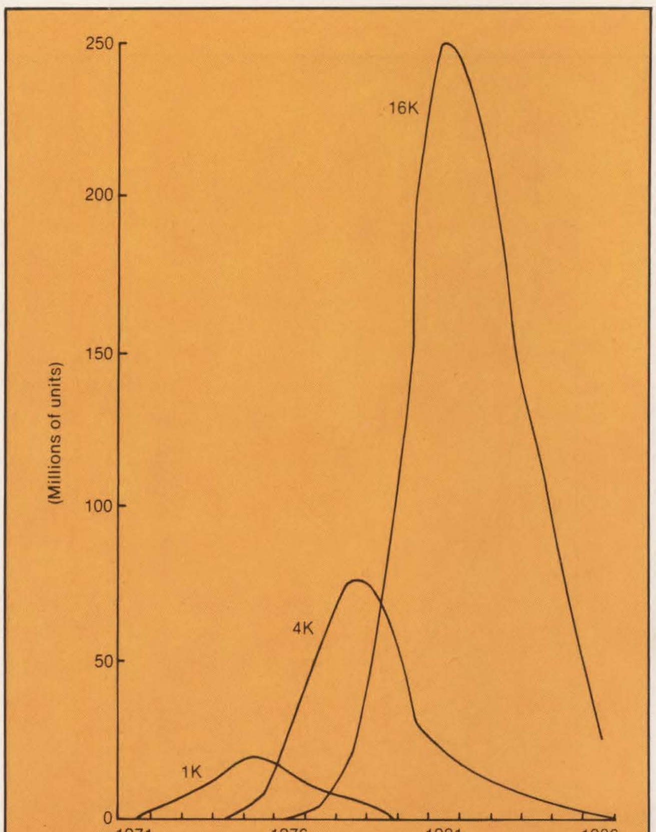

Fig. 1. Worldwide shipments of 16K MOS DRAMs *can be expected to be triple those of 4K DRAMs, just as 4K DRAM shipments peaked at triple those of 1K DRAMs.*

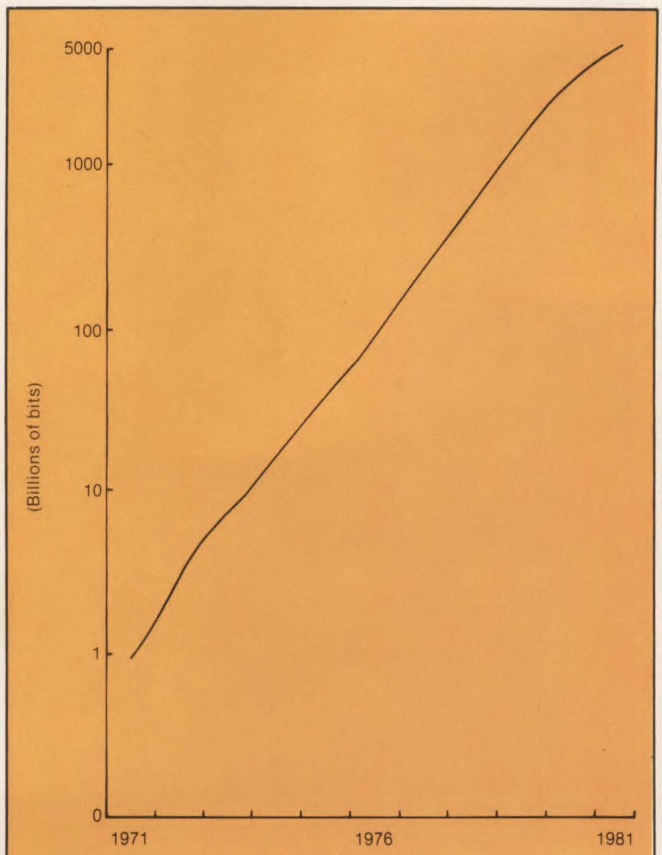

Fig. 2. DRAM bit shipments *increased at a 137-percent compound annual rate growth between 1971 and 1981.*

The combined shipments of 4K, 16K and 64K DRAMs should reflect a 95-percent compound annual growth rate between 1975 and 1986.

result of the technical difficulty of producing the 64K DRAM device and the expected difficulty of producing each succeedingly higher density DRAM.

The number of bits shipped each year has increased substantially because of a rapid buildup in unit shipments and a fourfold increase in the bit capacity of each succeeding device. DRAM bit shipments increased at a 137-percent compound annual growth rate between 1971 and 1981 (Fig. 2).

Price decline spurs shipments

The combined shipments of 4K, 16K and 64K DRAM bits should reflect a 95-percent compound annual growth rate between 1975 and 1986 (Fig. 3). In the 1970s, the number of bits shipped doubled every year. One reason for this phenomenon was the steady price decline of memory devices. Lower prices motivated computer manufacturers to add more computer memory to each new generation of products. Another reason is that the main memory of minicomputers and mainframes is composed almost entirely of DRAMs. A standard minicomputer in 1976 had a maximum of 256K bytes of memory. Mainframe computers of the late 1970s had as much as 8M bytes of memory. Today's minicomputers have a 4M-byte capacity, and mainframes hold as much as 32M bytes.

The increased use of memory in terminals, peripherals and small computers has also contributed to the bit explosion. Many terminals and peripherals that previously used fewer than 8K bytes of memory now use 32K, 48K and even 64K bytes. Manufacturers have expanded the memory spaces of personal and small-business computers from 16K or 32K bytes to 128K and 256K bytes. The increase in memory capacity per system and the higher unit shipments of the systems combine to generate the bit explosion.

Small companies will benefit first

Most 64K DRAM unit volume in 1981 and early 1982 will go into small-systems applications, including small-business computers, test instruments and other systems made primarily by small manufacturers. In general, smaller manufacturers can respond more quickly and produce the 64K DRAMs faster than can large computer and systems companies. Both small and large manufacturers have design cycles of about six months, but small manufacturers have much shorter qualification and acceptance requirements.

Major computer manufacturers will probably not use 64K DRAMs until 1982 and beyond. (Hewlett-Packard

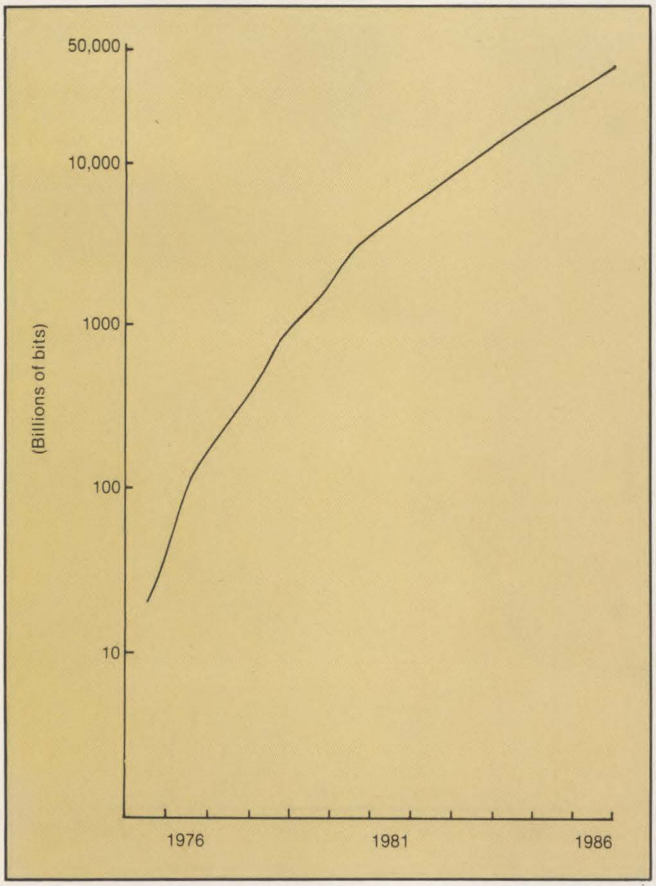

Fig. 3. Combined shipments *of 4K, 16K and 64K DRAM bits doubled each year in the 1970s.*

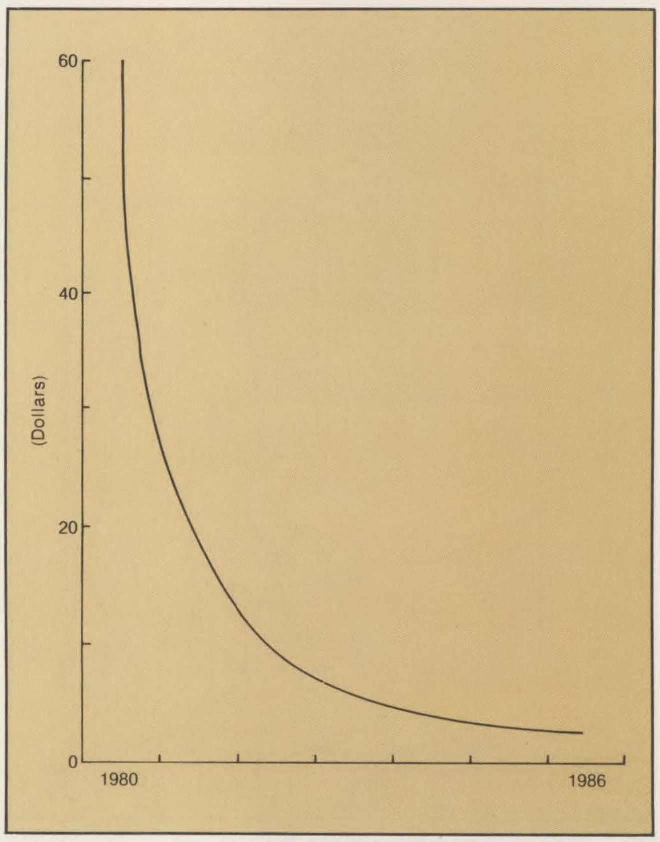

Fig. 4. 64K MOS DRAM average contract and spot market prices *for all package types, device speeds and quantities.*

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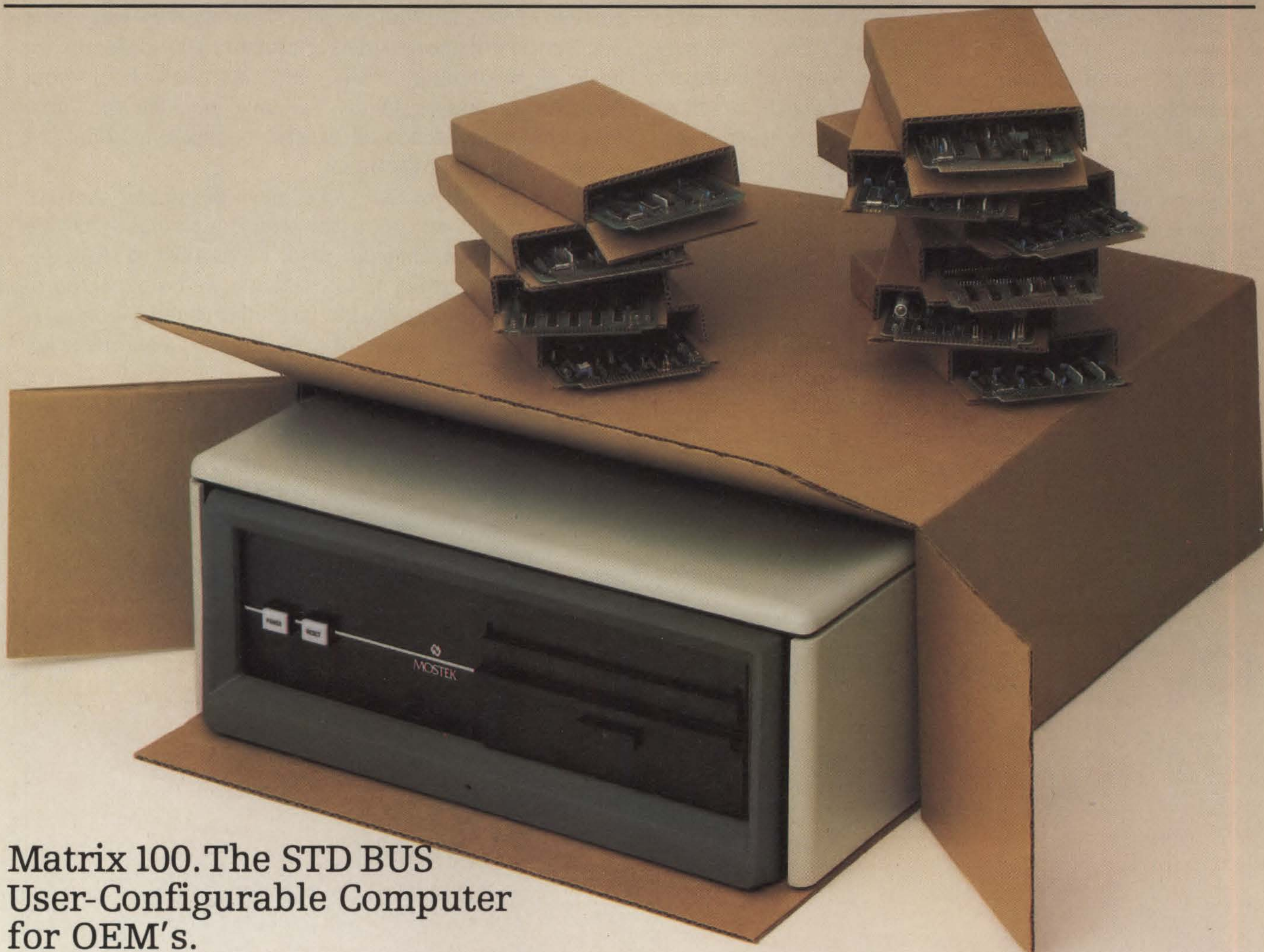

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CIRCLE NO. 95 ON INQUIRY CARD

Most 4K DRAM unit volume in 1981 and early 1982 will go into small-system applications, including small-business computers, test instruments and other systems made primarily by small manufacturers.

Co. is an exception; the company uses the 64K DRAM in its HP-1000L small business computer.) This is because of large manufacturers' relatively long qualification cycles and their more conservative approach, resulting from large investments in the 16K dynamic RAM. These dollars cannot be shifted overnight; they must be moved cautiously. The biggest concern of the large computer manufacturers is quantity and uniformity of supply.

64K market grew slowly

The first 64K DRAM was introduced about three years ago by Fujitsu Co., but the devices are still in sampling stages and limited production. The 64K DRAM market has not achieved the success predicted for it four years ago. Several factors slowed its progress, especially the technical difficulty of producing the device and the limited supply and attractive prices of 16K DRAMs in 1978 and 1979. This situation encouraged suppliers to produce the 16K RAM rather than the 64K RAM. Also, prices of 16K RAMs dropped to about $3 in the second half of 1980, and users preferred the low-priced 16K RAM to the 64K RAM, which was then $40 to $80. The price gap between the 16K RAM and the 64K RAM is closing rapidly—a trend that will favor the 64K RAM.

The lack of an industry-wide standard also appears to be delaying volume unit shipments of the 64K RAM, although a standard should be emerging soon. Companies now offer devices that vary in the number of refresh cycles, in whether pin 1 is connected and in the distribution of access times. Suppliers also differ on the issue of redundancy. Most manufacturers should conform to an industry-wide standard in much the same way that they followed Mostek Corp.'s lead in the design of 4K and 16K DRAMs.

Suppliers will probably be mass-producing the 64K DRAM by 1982, and industry-wide unit volume can be expected to grow through 1986. From 1980 to 1986, the average selling price of 64K DRAMs can be expected to plummet (Fig. 4), as worldwide dollar revenues on sales soar, based on forecasts of unit shipments and average selling prices (Fig. 5).

The price decline of the 16K DRAM that began in the second quarter of 1980 continues in 1981. The worldwide average selling price of 16K DRAMs was about $2.50 in the first quarter of 1981, and should drop to lower than $2 by year-end. Fig. 6 presents the prices of

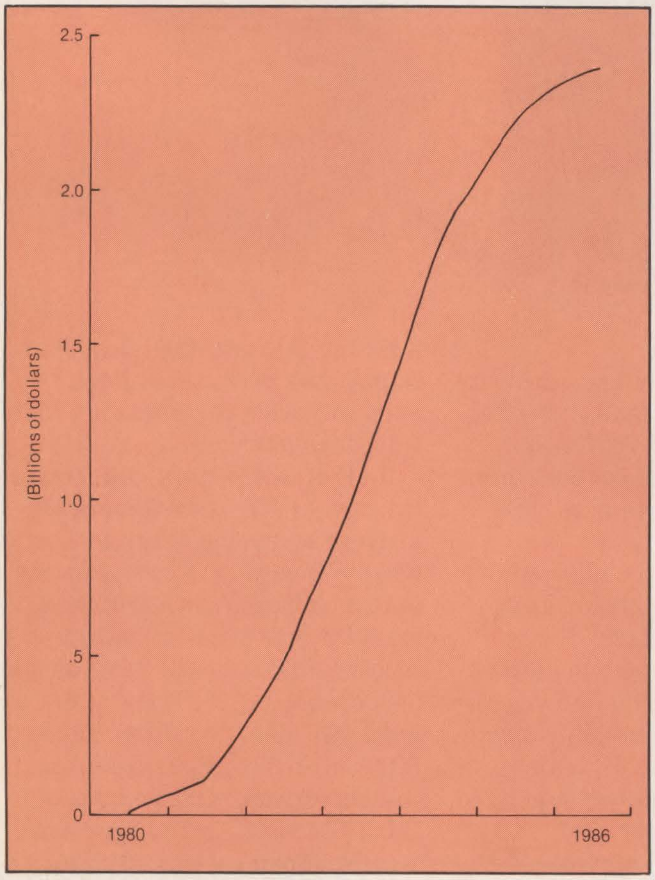

Fig. 5. Estimated worldwide *64K DRAM revenues.*

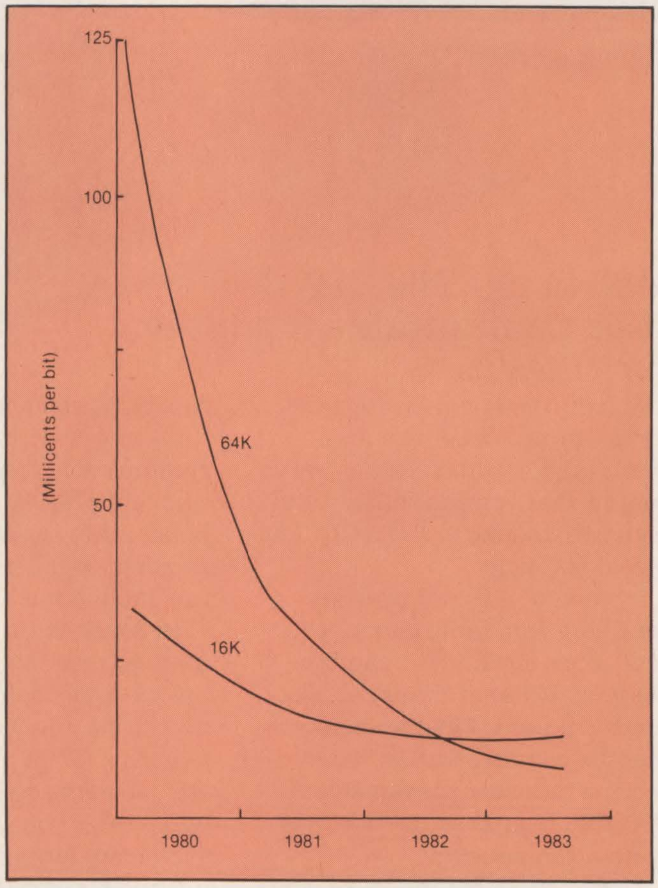

Fig. 6. Average selling price *per bit for 16K and 64K RAMs. By the third quarter of 1982, 2 bits of 64K DRAM memory should cost less than 1 bit of 16K DRAM memory.*

By the time 4K DRAM unit volume peaked in 1978, Japanese suppliers had captured 13 percent of the worldwide market.

16K and 64K DRAMs computed on a millicents-per-bit basis. By the third quarter of 1982, a bit of 64K DRAM should sell for less than a bit of 16K DRAM.

64K DRAM capacity should exceed demand during 1981 because more than a dozen suppliers are shipping the devices, and most users have at best reached limited production use of the device. The industry will probably ship 5 million units this year and 30 million in 1982. Demand probably will not catch up with capacity until 1983 or 1984, when annual unit-volume requirements should exceed 100 million units. Supply and demand should be in reasonable balance in 1984 and 1985, which should result in some profit margins for suppliers.

When will the price of the 64K DRAM be competitive with the price of the 16K DRAM? That will happen when the 64K DRAM price is four times that of the 16K DRAM, plus $3 to $5. The added price is a result of the 64K DRAM's system advantages over the 16K device, including fewer devices per board, less power per bit and fewer boards per system. The price of the 16K DRAM will then be approximately $2, so that in the second quarter of 1982, the price of the 64K DRAM should be about six times $2.

Foreign suppliers challenge

American suppliers were the major participants in the early days of the 4K DRAM. In the early 1970s, Japanese suppliers were few, but by the time 4K DRAM unit volume peaked in 1978, Japanese suppliers had captured 13 percent of the worldwide market. Intel Corp., Mostek Corp. and Texas Instruments Inc. were the early participants in the 16K DRAM race, but in 1980, 40 percent of 16K DRAM units shipped were Japanese. Of the 16 suppliers of 16K RAMs at the end of 1980, seven were American, six Japanese and three European.

Nine suppliers were sampling or producing 64K DRAMs at the end of 1980, including five Japanese and four American. At that time, there was one more Japanese than American suppliers. No Western European suppliers were sampling the device.

The 64K DRAM generation will be an exciting period in the semiconductor industry and, like the generation before it, will prepare users for the next exciting step: the 256K dynamic RAM. ■

Daniel L. Klesken is vice president and director, semiconductor industry service, Dataquest, Inc., Cupertino, Calif.

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New RAM chips drive memory market

PETER REINECKE, Texas Instruments Inc.

From cores to semis, giant steps are being made in memory ability and capacity

Riding the crest of the latest development in semiconductor RAM technology, a new generation of self-contained, add-in memory boards is about to boost the storage capacity of minicomputers in megabyte chunks. Built around the 64K-bit dynamic random-access memory (DRAM) chip, single-board memories for minis or high-end μp-based systems occupy little space and pack all the control and error-checking functions to qualify them as complete memory systems. The availability of single-board, 1M-byte capacity, main-memory systems could not have come at a better time. In this era of high-level programming languages, more storage than ever is needed for memory-hungry software.

Semiconductor RAMs make the expansion of a computer system's main memory relatively simple, but it wasn't always that way. In early core-memory days, enlarging memory capacity involved significant costs because cores require a large overhead in support electronics. Core costs also rose if it became necessary to operate the computer system at higher speeds.

System designers, however, can look back nostalgically at cores for their nonvolatile, non-dissipative qualities and high reliability. The relatively high failure rates of core systems can be largely attributed to support electronics rather than to memory arrays.

If any single factor helped hasten the demise of core memories, it was the rapid decline of semiconductor-RAM prices (Fig. 1). Semiconductor memories also provide certain technical advantages over cores. For example, interfacing the memory with logic circuits is simple, and even different logic technologies are electrically compatible. IC packages are highly standardized, and compact, uniform systems can be easily modularized. Fig. 2 provides a comparison of equivalent memory-capacity core and semiconductor systems

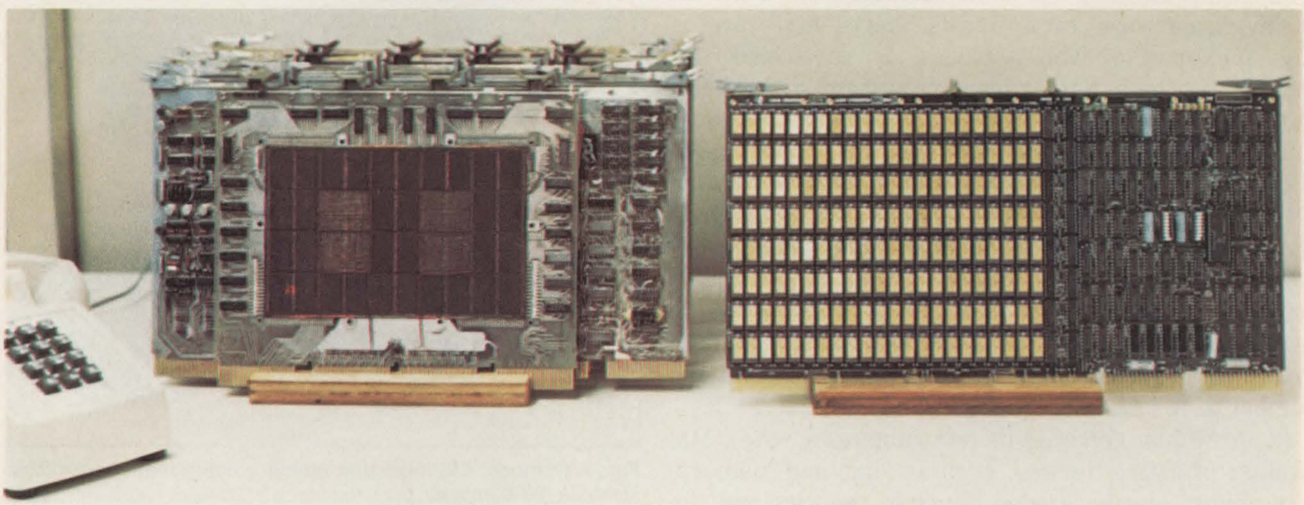


Fig. 2. Core memories can't match semiconductor RAMs *in size, weight or power consumption as shown in this photo of equivalent-capacity memory systems. The single-board RAM (r.) also contains its own error-detecting-and-correcting circuitry.*

In early core-memory days, enlarging memory capacity involved significant costs because cores require a large overhead in support electronics.

from a size, weight and power-consumption standpoint.

As the economies and technology of core memories began to wane, the fortunes of semiconductor devices stood on the threshold of a bright new era. DRAMs became the most popular devices for main-memory systems of large computers, minis and some μp-based equipment, but other semiconductor technologies moved into new memory applications. For example, in very high-speed cache memories, writable control stores and the processing sections of computers, bipolar ECL devices became popular. NMOS and bipolar chips filled the slots for the slower writable control-store systems in medium-speed computers.

In high-speed applications, DRAMs run a poor second to bipolars. Static bipolar memories are faster than DRAMs because they do not depend on a refresh cycle. DRAM data are stored on the inter-electrode capacitances of MOS transistors, which must be periodically recharged to prevent stored information from leaking. Static RAMs, however, operate on the flip-flop principle; data latched into the memory device remain stable indefinitely as long as power is delivered. To compensate for their relative lack of speed, DRAMs pack many more bits on a single silicon chip.

Traditional roles reversed

In the early days of the computer industry, it was axiomatic that hardware costs far exceeded the cost of software. However, the past 10 years have witnessed a revolution in digital and memory-component development. Integration techniques have evolved from small-scale through medium-scale to large-scale and very large-scale. This technological breakthrough in semiconductor processing and manufacturing has turned the hardware/software ratio upside down—hardware is now inexpensive, and software is expensive. As inexpensive, high-density memory systems and LSI and VLSI logic reached maturity, computer designers could combine the 10-year hardware- and software-development cycles into computer systems with significant performance improvements. A 1980 version of Digital Equipment Corp.'s PDP 11/44 is 100 times more powerful than its 1970 ancestor (Fig. 3). Advanced memory systems have also become pervasive over the years. A modern computer's storage capacity is more than 60 times greater than it was previously, yet the number of ICs has merely tripled.

In previous generations of computers, the total number of active devices, such as logic and memory, was almost evenly divided between the CPU and the memory. Recently, however, several developments have shifted the balance toward memories. These developments include price. The price of DRAM in 1975 was about 0.20¢ per bit; today, it is less than 0.002¢ per bit. The use of high-level languages spurred demand for more memory because languages do not use memory space as efficiently as do assembly and low-level software (Fig. 4). While logic design is a well-developed art, it is simpler to implement a logic sequence with a microprogram stored in memory than with ICs and combinatorial logic. Modern computer systems can be called memory-intensive because a

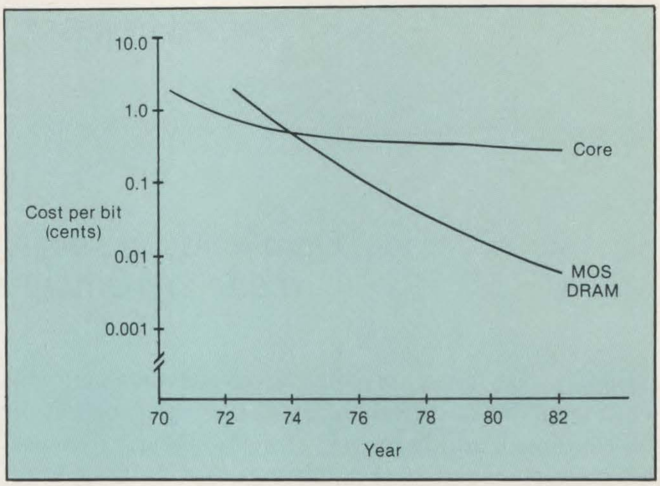


Fig. 1. Memory cost per bit *continues to fall because of fast-paced MOS dynamic random-access memory (DRAM) development. Core memory lost the price battle to semiconductor RAMs as far back as 1974.*

Year	1970	1980
Minicomputer class	PDP 11/20	PDP 11/44
Relative cost	1	1
Relative reliability	1	1
Relative performance (millions of instructions per sec. (MIPS) x memory capacity)	1	128

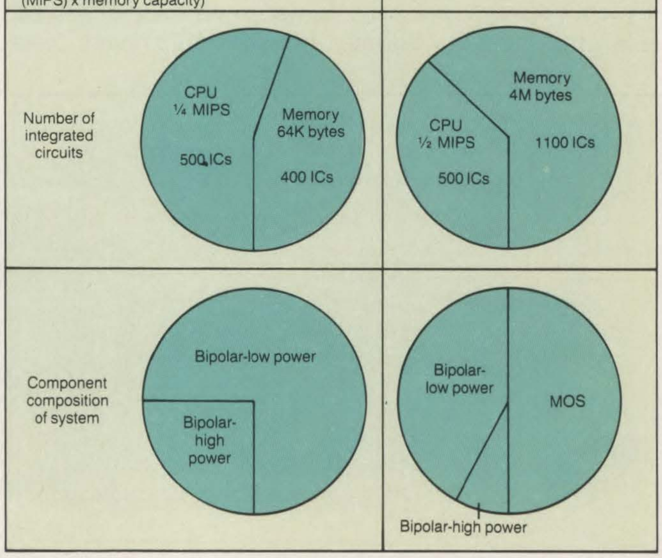


Fig. 3. Compact LSI logic and memory components *dramatically increase minicomputer performance and storage capacity. Today's minicomputer is 128 times more powerful than its 1970 cousin and packs 64 times the memory capacity. System reliability does not suffer despite the huge influx of digital functions.*

larger portion of the total number of active devices is concentrated in the memory subsystem.

A soft error creates a hard problem

In the core-memory days, all errors were hard. DRAMs have spawned a new type of memory error, called the soft error. Soft errors are a phenomenon associated with a semiconductor medium; they were unknown in core memories, a magnetic medium. A DRAM stores data in the form of an electrical charge on a

ERROR DETECTION AND CORRECTION

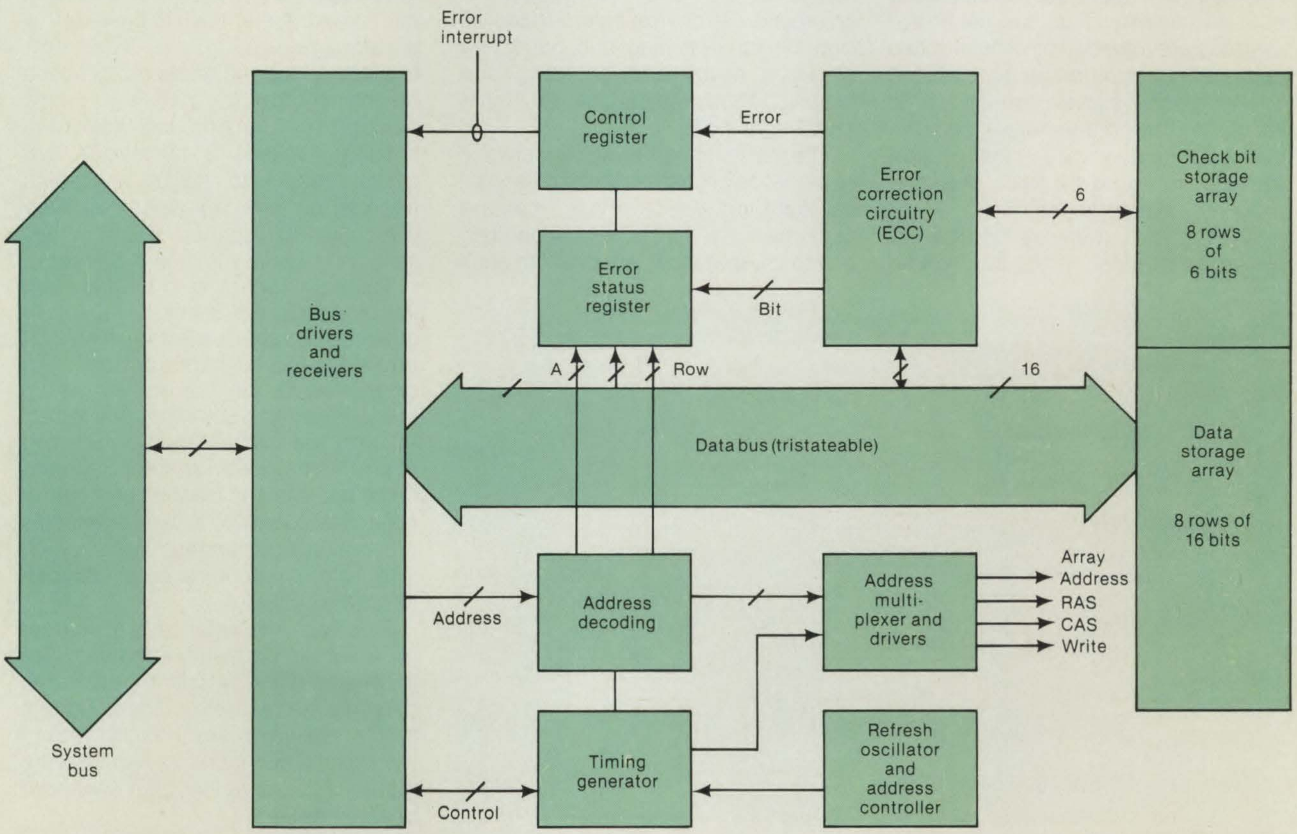
The error-correction logic on the TMM20000 and TMM40010 memory boards operates in two modes. During a write operation, 6 check bits are generated for each 16 bits of data originating on the system bus. The check bits are stored in a dedicated memory area at the same address as the data word. In read mode, the memory system uses three time phases. First, data and check bits from a selected memory address are stored in the error-correction circuitry (ECC) and the internal data bus is put into the high-impedance state. Next, the ECC checks and conditionally corrects the data. In the last phase, correct data are placed on the system bus. The ECC computes so-called syndrome bits, storing them in an error-status register. The bits indicate the location of any single-bit errors and the occurrence of any double-bit errors.

With the error-correction schemes employed, single-bit error correction over a data field of 16 bits enhances reliability 50 to 60 times as compared to data storage without error-detection-and-correction circuitry (EDAC). The result is that the memory subsystem has a failure rate that is five to 10 times lower than any other part of the computer system.

Every error-detection algorithm has an overhead burden consisting of check bits stored concurrently with the data. These bits enable the error-detection circuitry to determine whether an error has occurred and in what bit position it has occurred. The amount of additional storage required for the check bits varies nonlinearly with the size of the associated data field. For example, performing double-bit error detection and single-bit error correction on an 8-bit data field requires 5 check bits; however, a 64-bit field requires only 8 check bits. Thus, EDAC operations performed over larger data fields have lower overhead percentages. To minimize the overhead that results from check bits, the error-detection-and-correction circuitry should handle 64-bit or larger data fields.

However, large data fields imply a performance penalty. The use of large data fields in minicomputers and μcs that have 8- or 16-bit data-bus widths can severely degrade performance. For example, if an 8-bit μc uses a 64-bit data field for error detection and correction, 72 bits (64 bits of data plus 8 check bits) must be retrieved during every cycle to read 8 bits of data. During a write operation, a more subtle problem, caused by using a 64-bit data field, occurs. Every time an 8-bit byte is written to the memory, a 72-bit field must be retrieved, new check bits must be computed, and the whole field must be restored in the memory.

While these operations can be performed automatically by the memory systems, they impose severe restrictions on total system-cycle time. To obtain the best trade-off between performance and storage overhead requirements, TMM20000 and TMM40010 series memory boards use a modified Hamming code with a 16-bit data field and 6 check bits. This represents a storage overhead of 37.5 percent, while the performance degradation remains comparatively small.



As the economies and technology of core memories began to wane, the fortunes of semiconductor devices stood on the threshold of a new era.

capacitor. The capacitor is the capacitance between the gate and source terminals of an MOS transistor, the basic building block of a DRAM. Because of the extremely small size of each MOS transistor, the charge stored on the capacitance is also very small. Unfortunately, small amounts of ambient radiation that can occur discharge the capacitance. And, when radiation, called alpha particles, strikes the silicon, the resulting discharge can cancel or alter the original charge. Radiation does not damage the DRAM, but it does erase the original data, causing a soft error.

A soft error is generally non-reproducible. It is the error that occurs when a data bit read from a memory location differs from the data bit that was originally written. However, upon rewriting and re-reading the same memory location, correct information is obtained indefinitely. Thus, soft errors are random and non-repeatable, and as such, they are very difficult to detect and correct. A hard error, on the other hand, represents an actual device failure and will repeat itself indefinitely. The detection and correction of memory-system hard errors present no difficulties.

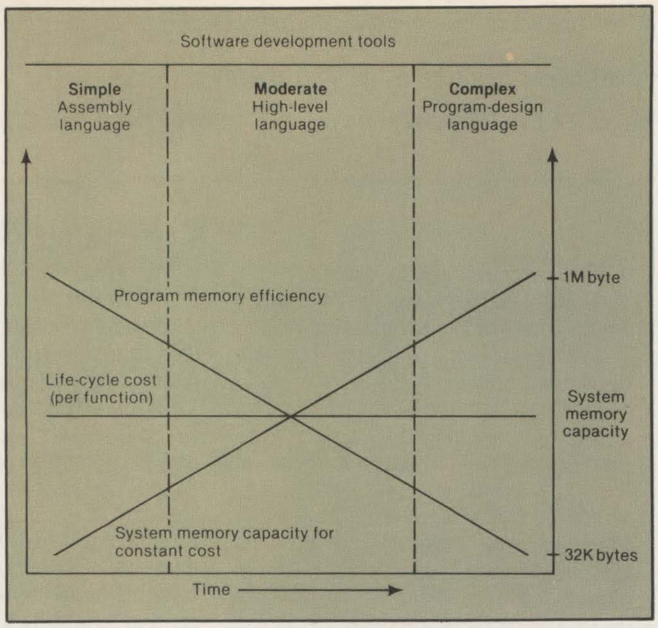


Fig. 4. Life-cycle costs *of new systems remain stable as long as the large code-to-memory requirements demanded by high-level languages are offset by the declining costs of semiconductor memories.*

Because of the semiconductor construction of almost all available memory systems, the predominant failure

TI UNVEILS 1M-BYTE BOARDS

Texas Instruments Inc. recently introduced its TMM20000 and TMM40010 memory boards that use a 64K-bit DRAM. The single-board systems are intended to eliminate two of the most persistent problems faced by designers—power distribution to widely scattered memories and the performance degradation that accompanies multiple-board, chassis-mounted configurations.

On the two memory boards, all storage, control, interfacing and error-checking functions to implement as much as 1M byte of RAM are contained on one PC board. An advanced LSI device incorporates all circuitry for detecting and correcting single-bit errors and detecting and logging double-bit errors on each 16-bit data word.

The basic design principles are the same for both boards. Major differences occur in the size, shape, memory capacity and interfaces, depending on the computer system in which each is designed to operate. The boards are organized around an internal 16-bit data bus. Transceivers connect the internal system bus to the external or computer-system bus. Data transfers are performed under the direction of the control register and timing generator. The address-decoding circuitry includes a DIP switch that permits users to select a starting address on any 16K-word boundary with the TMM20000, and on any 4K-byte boundary for the TMM40010.

Parameter	TMM20000	TMM40010
Target system bus	PDP-11 Unibus*	Multibus**
Physical size	8.5 × 15.5 in. (hex)	6.8 × 12 in.
Number of back-panel slots required	1	1
Capacity per board (M bytes)	1	0.5
Power requirements	5 VDC	5 VDC
Power consumption (W, operating)		
Timing (nsec.)		
Write	60	160
Read	400	370
Cycle	670	720
Reliability—MTBF in years	8	11

*Trademark of Digital Equipment Corp. *Trademark of Intel Corp.

The computer-system program can interact with the memory board to enable interrupts based on single-bit errors, double-bit errors or both. This error-interrupt function serves as an entry point into a software routine that extracts the address and bit position of errors from the error-status register. Once the rate and location of memory failures are known, a user schedules preventive maintenance on the system before non-correctable, double-bit errors occur.

A refresh oscillator and a counter generate all necessary internal cycles to ensure data retention within the dynamic-storage array. These refresh cycles are transparent to the rest of the system, so that users can treat the memory board as though it consisted of static RAMs.

The use of high-level languages spurred demand for more memory because languages do not use memory space as efficiently as do assembly and low-level software.

mode is soft. Hard errors associated with the memory system have been reduced significantly because of the reduced number of ICs required to control the memory array. Not long ago, a typical memory subsystem used 600 bipolar ICs to control 64K bytes of memory, compared to today, when 40 to 50 ICs control 1M byte. And ICs, mainly MOS types, operate with less power dissipation than bipolars, resulting in greater system reliability and reduced hard errors. Moreover, improved semiconductor processing, manufacturing and testing techniques contribute substantially to reducing device failures in modern computer systems.

To reduce the effects of soft errors, memory systems use dedicated circuitry for error detection and correction (EDAC) (Fig. 5). The EDAC circuit is often contained within a single LSI device. Previous error-correction schemes required so much discrete logic circuitry that additional boards were needed in the system. But each board added to a computer system increases power consumption, reduces reliability and degrades system performance as data are shuffled between boards via a back-panel connector or cable. Such problems have been overcome by the development of sophisticated digital circuits and the inclusion of EDAC. ■

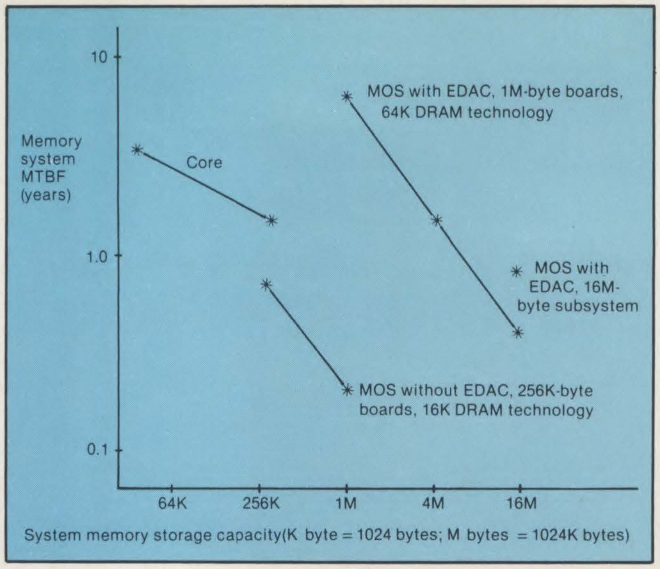


Fig. 5. System failure rates decline *as error-detecting-and-correcting circuitry is incorporated into system memory boards. Although storage capacities of current memory boards are growing, memory system MTBF has improved.*

Peter Reinecke is product engineering manager, integrated memory systems, for Texas Instruments Inc., Stafford, Texas.

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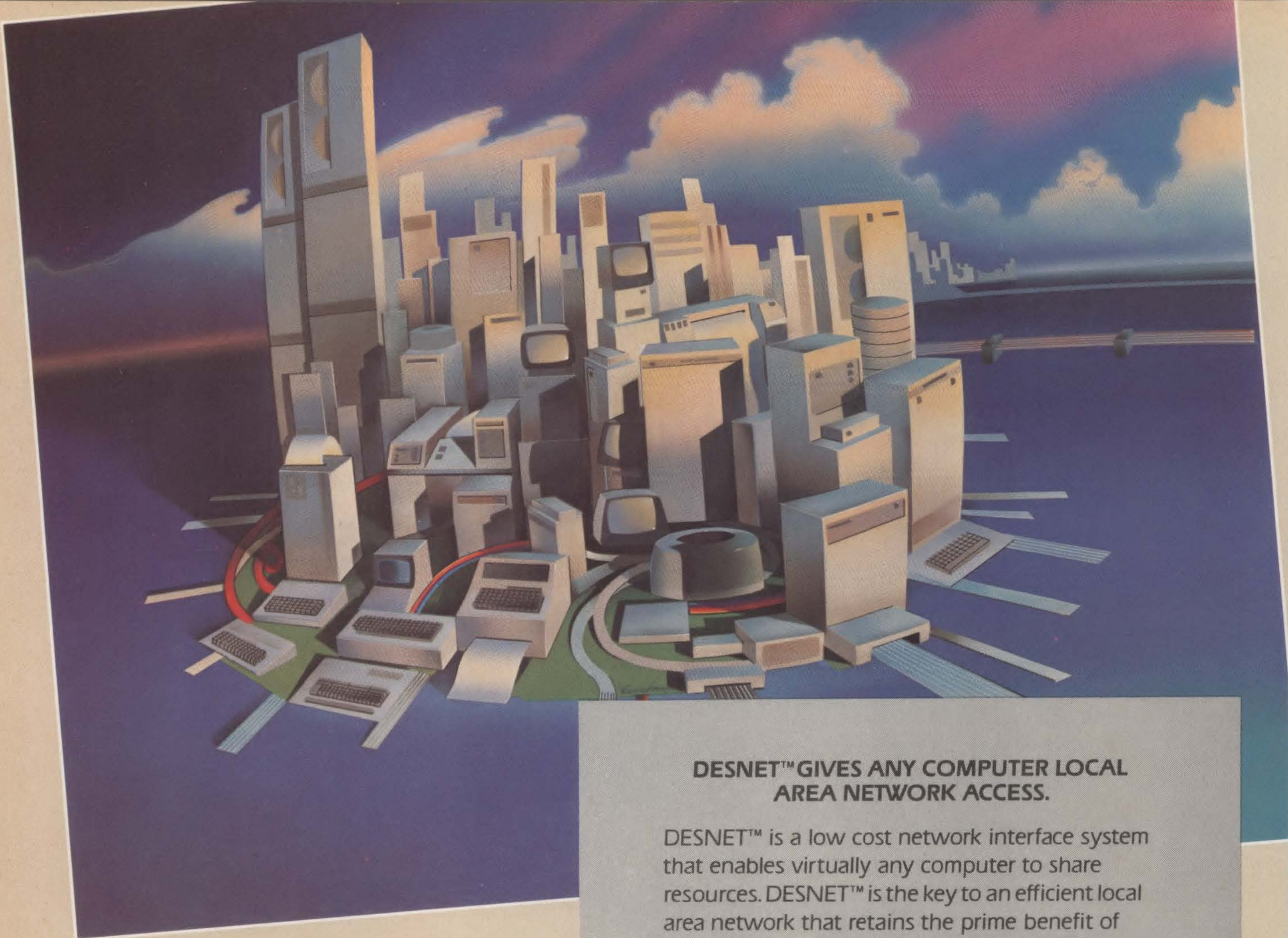

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MEMORY

A RAM-based character set

PAULINE LO ALKER and RICHARD LOWENTHAL,
Convergent Technologies

RAM character storage and font design software give users an unlimited range of text characters and symbols

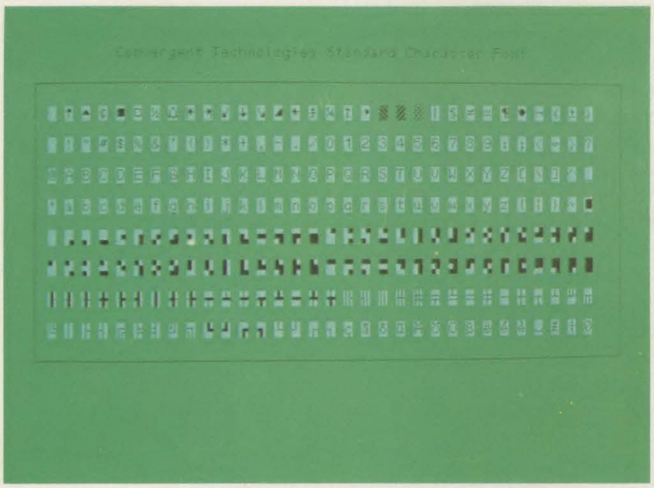


Fig. 1. Convergent Technologies' *standard character set provides 256 soft elements that allow the characters to be customized, replaced or changed dynamically from an application program.*

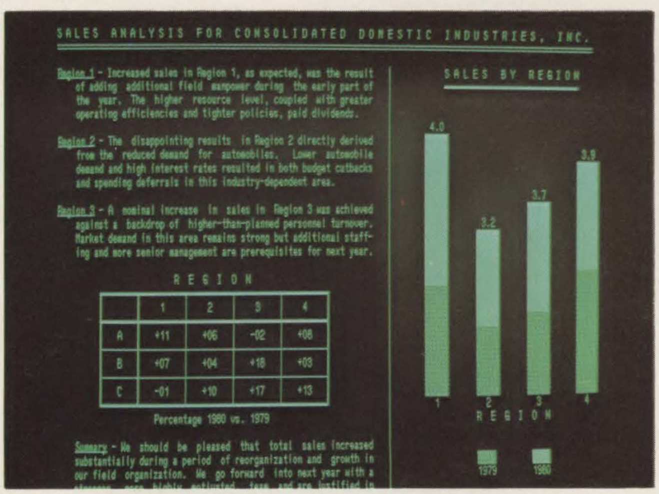


Fig. 2. Business graphics *using Convergent's font package illustrates design elements and shading available to create tables and graphs.*

In most computer display systems, the character set is stored in ROM. The advantage of this approach is that all elements of the set are in permanent residence and available for quick access—an arrangement suitable for most routine computer applications.

Nevertheless, a ROM-based character set is limited in the number of characters available and in its flexibility. Sets are usually limited to 128 characters, and a

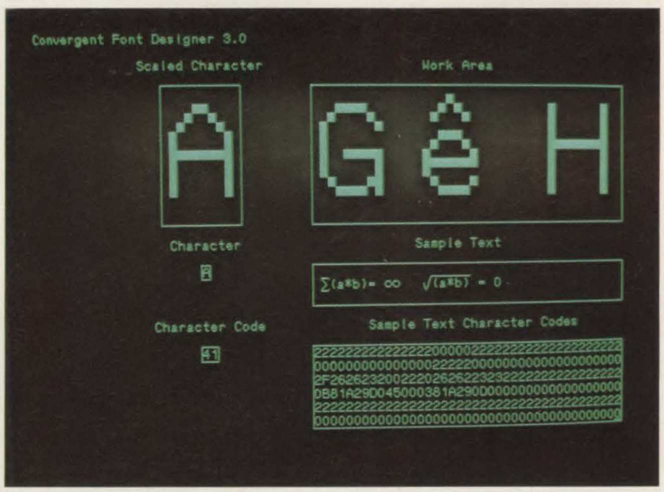


Fig. 3. Interactive font-design package *divides screen into six frames for scaled character, normal character, character code, work area, sample text and sample-text character code.*

separate ROM is needed for each character set. Many users—especially companies or in-house departments specializing in graphics or typography—require multiple type styles, varying fonts or a wide selection of graphic elements for creating designs on a display screen. A soft, RAM-based character set provides these capabilities, and this is the approach used in Conver-

Having the character set reside in software instead of being fixed in ROM allows the characters to be modified and stored on disk.

gent Technologies' Integrated Work Station (IWS) series of computers.

The RAM-based character set

The Convergent Technologies standard character set provides 256 elements (Fig. 1). In addition to alphabet, numbers and other customary typewriter marks and symbols, the set includes items for preparing mathematical or scientific copy and for creating flowcharts, organization tables and bar charts, with light or bold boxes, connecting lines and several types of shading (Fig. 2). Most significant is that having the character set reside in software instead of being fixed in ROM allows the characters to be modified and stored on disk. New typefaces or graphic elements can be created interactively and copied onto disk for permanent retention. The character set can optionally be expanded from 256 to 512 elements.

Fonts saved on disk or being used in the IWS can be merged through the use of several I/O commands. Part or all of a stored font file can be read into or written from the font memory, starting at any character position. A sample text can also be created and examined in turn as it would appear in each of the type fonts on file.

Software for design

Convergent's interactive font designer software facilitates creating new character elements. On loading

FONT RAM ARCHITECTURE

Convergent Technologies' Integrated Work Station system uses a row-buffer architecture to achieve high-level video control and display performance.

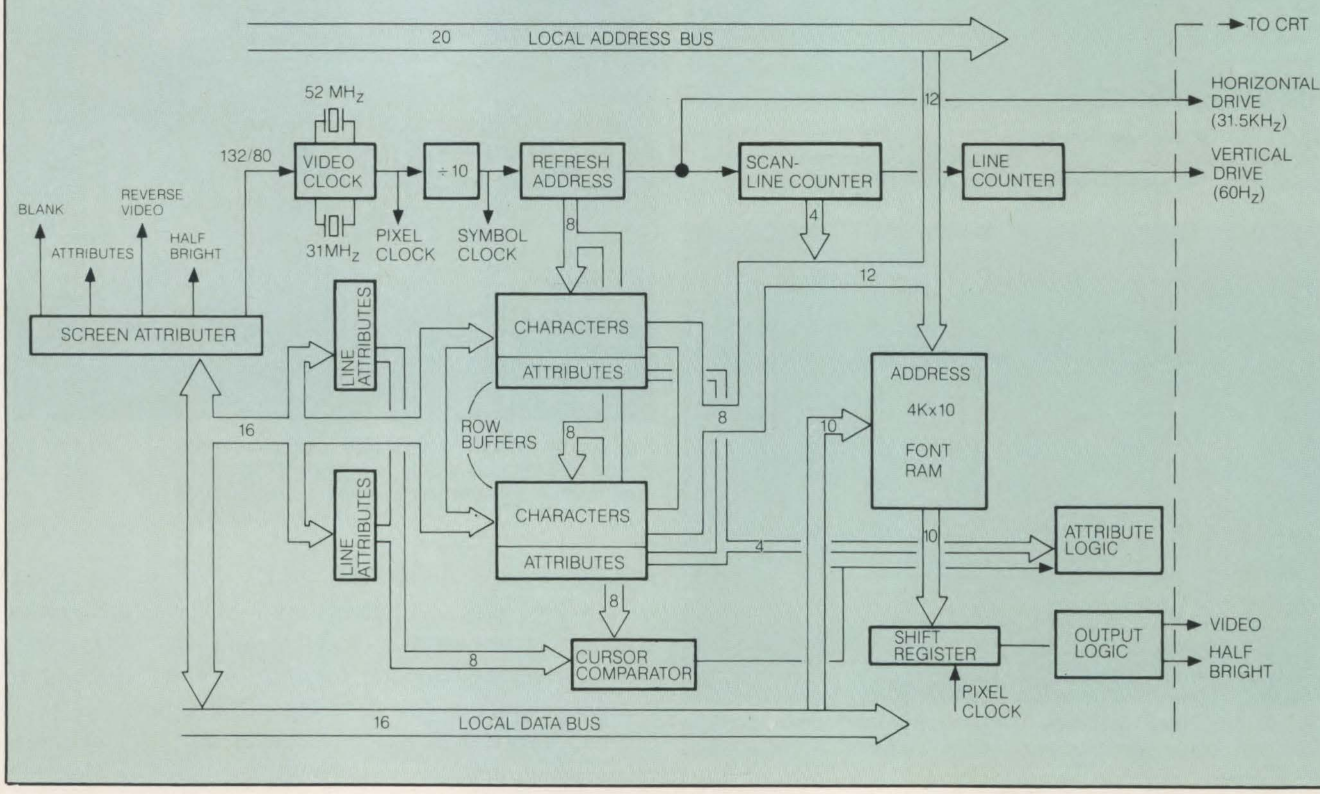
The IWS display is 34 lines deep and operates at both 80 and 132 cpl. Character cells are of comparatively high density—10 × 15 pixels. In addition, 16 combinations of attributes are available for each character, including any combination of underline, reverse video, half-bright or blinking.

The architecture that provides these features is based on row buffers consisting of high-speed bipolar RAMs that can contain as many as 256 8-bit character codes and 4-bit character-attribute codes. The character codes are combined with 4 bits of scan-line address, representing each of the 15 scan lines of the character cell, to form a 12-bit address to the font RAM.

The font RAM contains 10-bit data words for each of the 256 characters represented by the 8-bit code from the row buffers. All 10 × 15 locations of the character cell are user-definable. Ten 4K × 1 HMOS RAMs make up the font RAM.

OEM or user options include font-RAM expansion from 256 to 512 characters, user-definable cursors, line attributes and character modification.

The video subsystem hardware was designed to be expanded for many applications. Hardware for the expanded 512-character set consists of a second PC board mounted on the video-control board and joined by two 40-pin connectors. The interface was designed to allow implementing any reasonable choice of features.



CONVERGENT'S SECOND GENERATION

Innovative use of 64K-bit RAMs is one key design element that helped launch Convergent Technologies' second-generation computers. The new family of multifunction desk-top work stations being introduced here offers 0.5M bytes of disk storage, an adjustable display and all control electronics.

Designated the AWS work station, Convergent's newest computer is based on the Intel 8088 μp, the latest member of the 16-bit 8086 family. Each station provides as much as 512K bytes of RAM, a high-quality 80-character × 28-line video-display unit and optional mass storage.

Disk-storage options include both minifloppy and single- or dual-5¼-in. Winchester-disk drives mounted in a lectern that serves as a copy holder. Floppy disks are loaded into the top of the lectern module toaster-style.

Work-station hardware and software architecture is modularly designed to offer selective application entry points and multiple upgrade paths for OEMs. Without software modifications, a stand-alone system can be upgraded to a local network.

The AWS family consists of four members, including:

- The AWS-210 which has 128K to 512K bytes of RAM, no mass-storage devices and can be used only as a cluster station;
- The AWS-220, which has 128K to 512K bytes of RAM, and a 5¼-in. floppy-disk drive with a formatted capacity of 315K bytes and can be used as a cluster station or as a stand-alone system;
- The AWS-230, which includes two 5¼-in. floppy-disk drives for a total formatted capacity of 630K bytes; and
- The AWS-240, which offers 256K to 512K bytes of RAM, a minifloppy and a 5¼-in. Winchester-disk drive with a total formatted capacity of 5.3M bytes and can be used as a stand-alone system, as a master station or as a cluster station.

The AWS line incorporates Convergent's CTOS operating system for real-time, multitasking operation and supports COBOL, FORTRAN, BASIC, Pascal and assembly languages. A word-processing software package is also available.

Prices for the AWS, in volume quantities, range from $3000 to about $10,500.

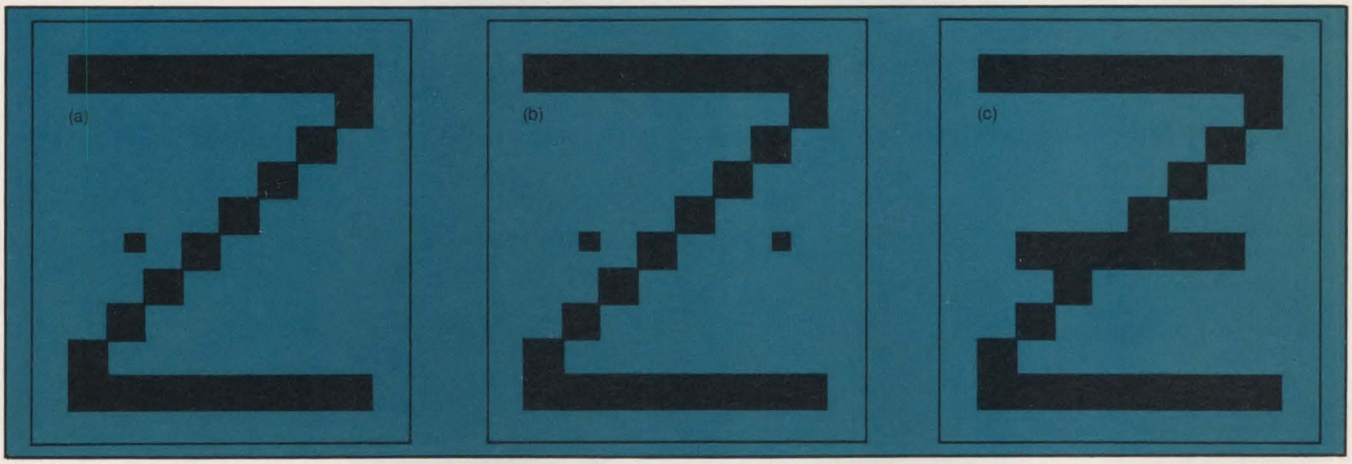


Fig. 4. Creating new characters. *A standard letter Z is converted into a European-style letter (with crossbar) using font-designer commands to (a) mark the selection, (b) bound the selection and (c) connect the mark and bound. Manipulation is performed in the screen's scaled character frame.*

the font designer, the display screen is divided into six frames (Fig. 3). The character being created or modified appears in the "character" box in its true size and simultaneously appears enlarged in the "scaled-character" box. Each pixel of the 10 × 15 dot matrix can be turned on or off independently, or groups can be controlled or moved simultaneously (Fig. 4). The "sample-text" frame shows the letter or character as it will appear when printed adjacent to other characters or symbols to ensure that size, style and placement are appropriate and aesthetically pleasing.

In this way, the sample-text frame provides powerful editing and debugging. A designer does not need to create one or more characters, load a word-processing program, examine the new letters and re-load the font designer. Instead, the designer sees the effects of his work as he creates each letter or element.

For creating a new font, the software provides a copy of the standard character set to be used. A designer can call up the characters one at a time, modifying each—for example, redesigning to create an italic or script style—or call up characters and replace them with new ones. In this way, a user could be provided with, for example, the Roman alphabet from the standard character set, plus Greek, Arabic and Cyrillic alphabets, or unwanted characters could be replaced by other graphic symbols. ■

Pauline Lo Alker is vice president of marketing, and **Richard Lowenthal** is manager of mainframe hardware engineering at Convergent Technologies, Santa Clara, Calif.

Choosing a VLSI-compatible system

PETER PALM, Intel Corp.

VLSI offers expanded modularity for operating systems; the intended application will determine the most appropriate system

By integrating more functions into silicon, very large-scale integrated (VLSI) circuitry lowers the cost of μcs and improves their performance and ease of use. But the advent of VLSI raises a question: which μc operating systems enable a user, especially an OEM, to take advantage most quickly of these hardware improvements? This question can be answered by examining the characteristics of available μc operating systems in the light of VLSI advances.

An operating system's intended application is a key consideration in its selection. No operating system is ideal for every application and customer. For this reason, designers tend to optimize operating systems for specific types of applications.

Microcomputer operating systems fall into two categories: systems optimized for efficient development of new software and those optimized for efficient execution of existing software (Fig. 1). Development-oriented systems tend to sacrifice performance to ease of use, while execution-oriented systems make the opposite trade-off. It is tempting to characterize the two types of systems as either end-user-oriented (execution) systems or OEM (development) systems. But such a categorization is inadequate because many end users are concerned with software development, and many OEMs are concerned with software execution.

Development- versus execution-oriented

In the 8-bit μc world, CP/M and Intel's ISIS (Intellec development system) operating systems are good examples of products targeted at efficient software development. In the fast-growing 16-bit μc segment, ISIS (Series III) and the UNIX operating system and derivatives, such as XENIX, fill the development need. Software developed with one of these operating systems is often executed on another machine running an execution-oriented operating system. As more development throughput is required, such as compilations per hour, users move from single-terminal, single-task systems (such as CP/M) to multiterminal systems (such as UNIX or MP/M) and to multiprocessor development systems (such as Intel's NDS-1).

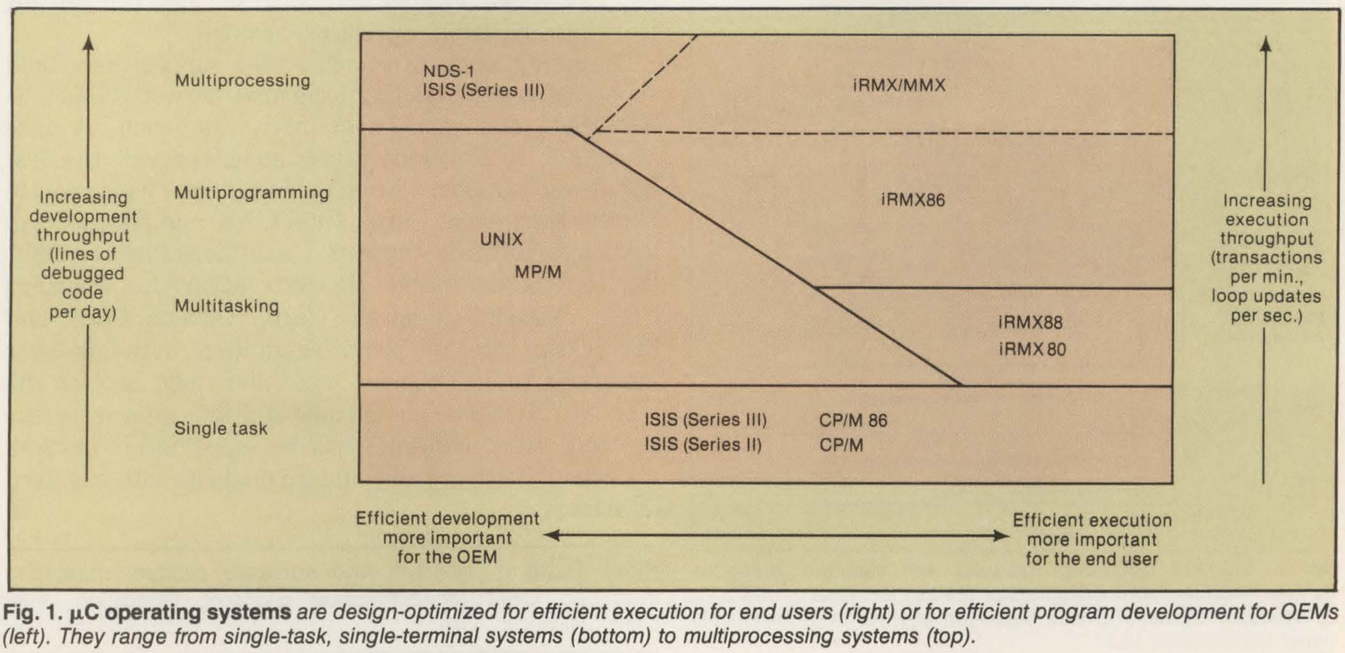


Fig. 1. μC operating systems *are design-optimized for efficient execution for end users (right) or for efficient program development for OEMs (left). They range from single-task, single-terminal systems (bottom) to multiprocessing systems (top).*

An operating system's intended application is key in its selection.

Most μc systems are execution-oriented and are often most critical for OEMs who must stay competitive in price and performance. Rapid program development is usually secondary to efficient software execution. An OEM can gain a significant competitive advantage by using an operating system that provides faster execution times, less expensive investment, ease of use and the ability to be upgraded.

Operating system vendors, including Intel, have designed a range of products for different needs. CP/M, for instance, is a logical candidate for 8-bit μc applications, in which only single-task execution is required. For 16-bit applications, multiprogramming-type operating systems, such as MP/M, iRMX 86 and iRMX 88, are more appropriate because they take advantage of the 16-bit processor's power. An OEM for whom real-time execution is important might consider iRMX 86. If background program development is crucial, MP/M might be a better choice. For highest performance, users should consider multiprocessing operating systems, such as iRMX/MMX800.

Other selection criteria

Although the intended application is paramount, other considerations are important in selecting an operating system. The overriding factor in light of current trends is probably the ability of a system to keep pace with the impact of VLSI on μc performance and cost. This consideration entails several selection criteria, including transferability, multiprocessing architecture, configurability and interfacing to modules.

First, an operating system should be easy to transfer—at least in part—into VLSI silicon. Putting an operating system into EPROM, for example, can improve speed and lower cost. Vendors should state which operating system functions will be integrated into silicon, and when.

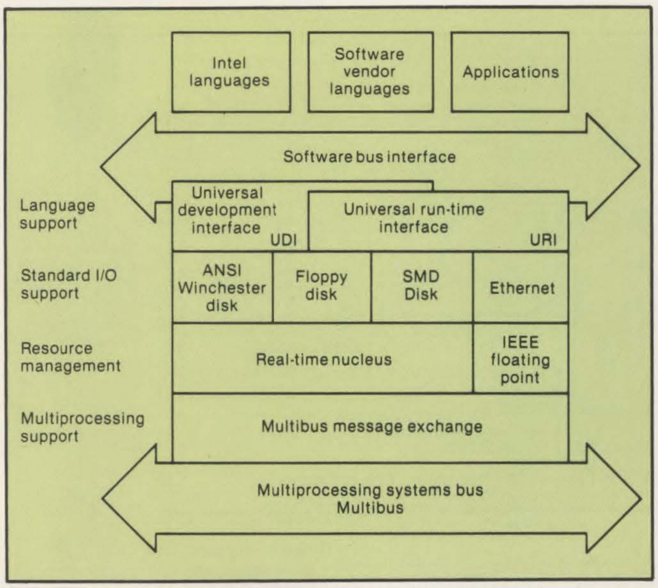


Fig. 2. Layered operating systems *with standard interfaces, standard modules and configurability are key elements in designing μc operating systems to take maximum advantage of lower cost, higher performance VLSI.*

An operating system should provide support for multiprocessing, and VLSI has made multiple-μc systems practical. OEMs should look for operating systems with multiprocessor architectures or other features that ease the move to multiprocessing. Such systems typically include fast context switching, task-to-task communication, synchronization and memory message passing features. For example, the new iMMX800 Multibus message-exchange software allows 8- and 16-bit, master-to-master and master-to-intelligent-slave single-board computers to multiprocess loosely on the Multibus multiprocessor bus.

Modularity is another important criterion in selecting an operating system. The iRMX 86, for example, consists of layers of modules that can easily be moved into silicon as required (Fig. 2). This modular design has enabled Intel to develop a new component dubbed 80130 Operating System Firmware (iOSF) that integrates a timer, an interrupt controller and the iRMX 86 kernel.

An operating system should include standard interfaces to modules. For example, iRMX 86 uses a standard object-oriented format for interfaces to jobs, tasks and message primitives. At a higher layer, iRMX 86 offers standard device-independent interfaces to drivers for the new 8089/8272-based Winchester- and floppy-disk controllers and other device controllers. The interface itself eventually will move into silicon. Only standard interfaces will allow this to occur.

An operating system should also provide industry-standard interfaces to popular program-development languages, such as Intel's universal development interface (UDI) and universal run-time interface (URI). Intel's new UDI/URI-compatible languages, FORTRAN 86, Pascal 86, PLM/86 and ASM 86, can run on any UDI/URI-compatible operating system.

Operating systems should either support or should soon support the leading local-area networks, such as Ethernet, and global-area networks, such as X.25 2780/3780. In November, iRMX 86 will provide the first high-level support for Ethernet, the tri-corporate Digital Equipment Corp., Intel Corp. and Xerox Corp. local-area network standard. Prestigious firms committing to Ethernet include Hewlett-Packard Co., Siemens Corp., Nixdorf Computer Corp., Olivetti Corp. and Zilog Corp. Intel will provide high-level, data-link-layer interfaces to an Ethernet controller (iSBC 550) on the standard Multibus, via the new Multibus interprocessor protocol (MIP). Ethernet will be supported in iRMS 86 via iMMX. These are all standard modules with standard interfaces. ■

Peter Palm is systems and software product marketing manager, OEM Microcomputer Systems Operation, Intel Corp., Hillsboro, Ore.

8" Cartridge Drive Shopping Guide

	IOMEGA Alpha-10	CDC Lark	DP100 Lynx
User Available Capacity			
M Bytes per Cartridge	✓10	6.7	✓10
M Bytes per Fixed Disk	0	✓6.7	0
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Spare Capacity, K Bytes per Drive	✓447	98	123
Average Positioning Time, MS	✓35	50	60
Data Transfer Rate, M Bytes per Sec.	✓1.1	✓1.2	0.9
MTBF, Hours	✓8,000	6,000	6,000
Reliability,			
Soft Read Errors	10^{10}	10^{10}	10^{10}
Non-Recoverable Errors	10^{12}	10^{12}	10^{12}
Power, Watts	✓35*	100	100
Dimensionally Compatible with Diskette Drive (SA 801 R)	✓YES*	NO	✓YES
Start / Stop Time, Sec.	✓2/5	120/60	90/30
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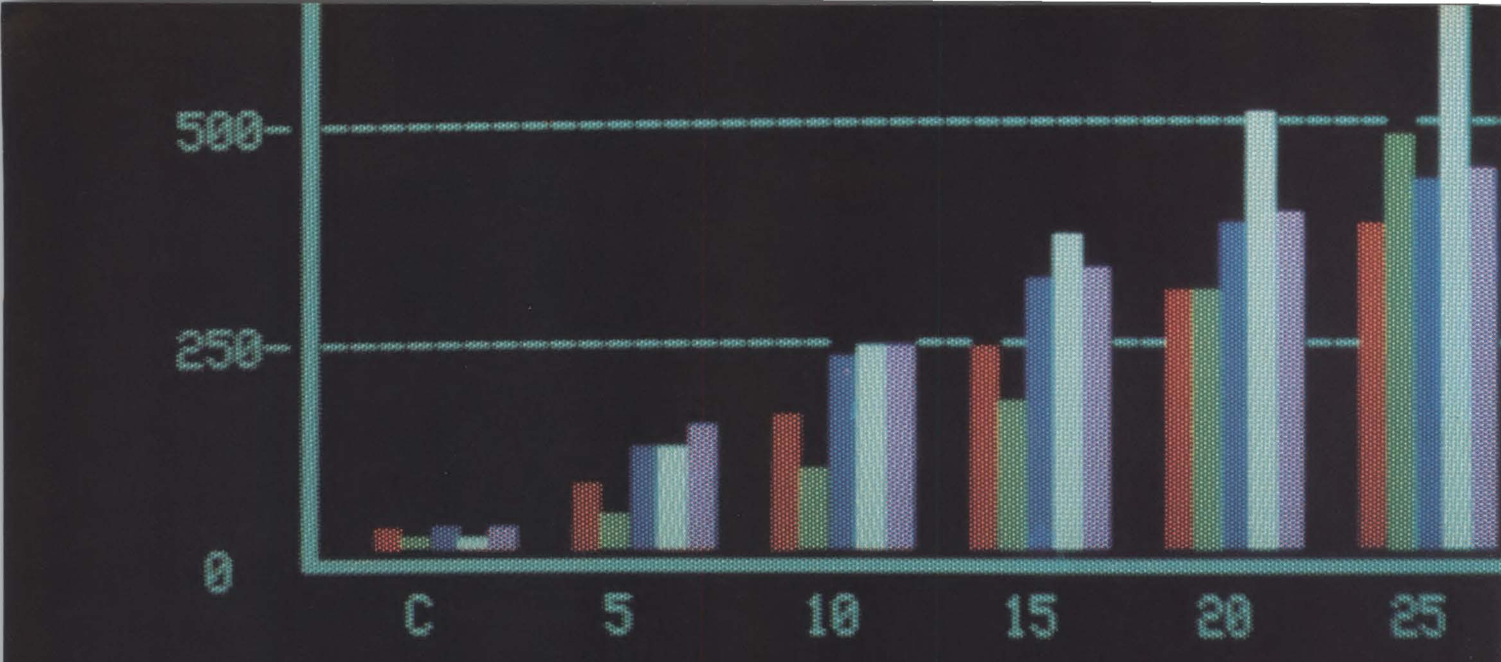

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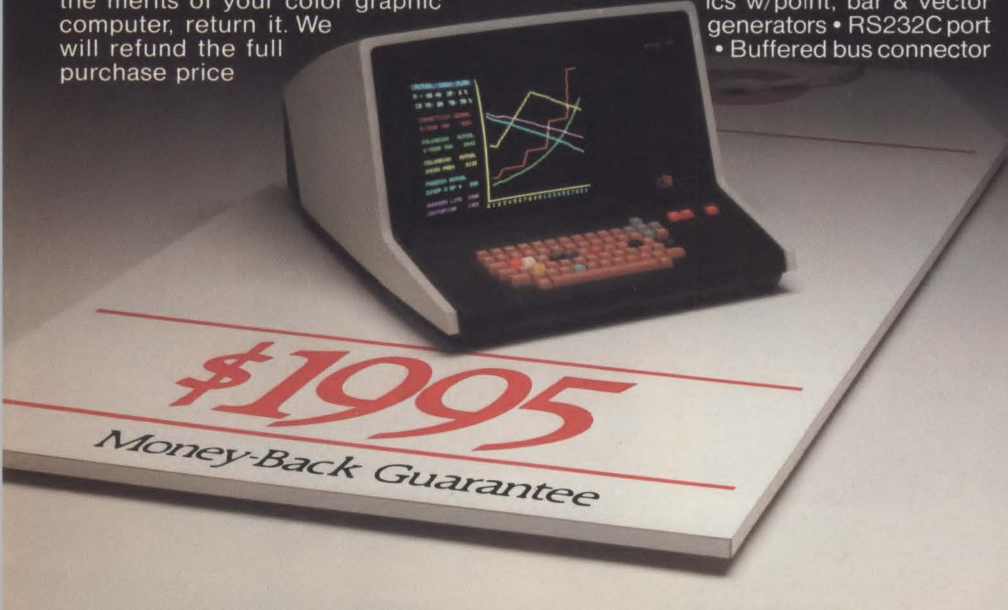

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CIRCLE NO. 112 ON INQUIRY CARD

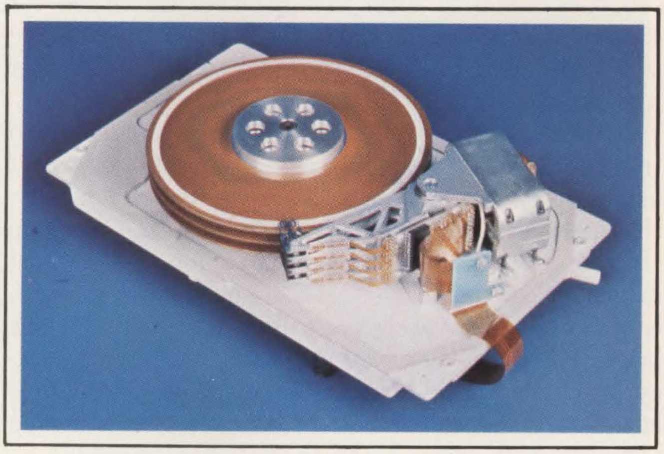
Wringing higher performance from 8-in. Winchesters

TED SCOOROS and DAVE BRODSKY, Shugart Associates

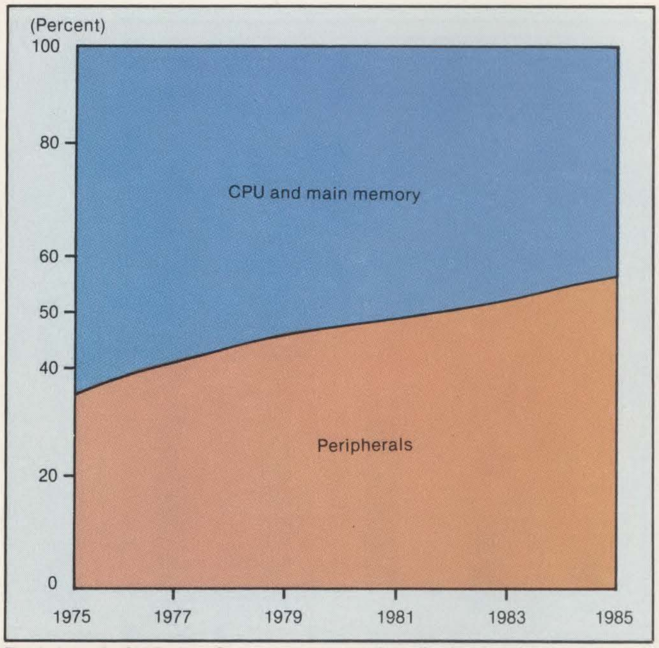
Closed-loop servo mechanism increases positioning precision and reliability and reduces access times

Continued reductions in processor-electronics prices are resulting in peripherals representing a larger percentage of the hardware cost of small-computer systems. The result is a trend for systems integrators to demand smaller, less expensive peripherals or to move to shared-resource system architectures.

To answer this demand, several disk-drive manufacturers are introducing compact products. An example is Shugart Associates' SA1100 series of 8-in. Winchesters, (MMS, October, p. 00), which achieve high-performance characteristics formerly associated only with large devices. Doubling both the storage and the economy of 8-in. drives, the SA1100 exceeds the requirements of the large multi-user systems for which it is intended



Track density *is 172 tpi on Shugart's original SA1000 Winchester-disk drive and 500 tpi on the new SA1100.*



Peripheral device prices *are a continually increasing portion of hardware expense as processor-electronics prices decrease.*

with a 33.9M-byte capacity and a \$50 to \$75 cost per megabyte. The key to this dual accomplishment is the design, which combines elements of various proven sophisticated technologies for maximum cost efficiency with minimal technological risk. In addition to greater storage capacity and economy, the SA1100 series achieves greater positioning accuracy, reduced access time, increased reliability and the ability to be upgraded easily.

Accurate positioning improves track densities

The trend toward better performance in smaller drives has spurred the industry to develop higher accuracy closed-loop servo-positioning mechanisms along with the existing open-loop designs. A closed-loop arrangement has been implemented on the SA1100, which uses the proprietary Fastrak system to maximize positioning precision and to improve track densities and access times.

With Fastrak, positioning information is prerecorded

A closed-loop arrangement has been implemented on the SA1100, which uses the proprietary Fastrak system to maximize positioning precision and to improve track densities and access times.

on the bottom surface of the drive's bottom disk. A single-chip μc enables the actuator-mounted servo head to read the servo information and to position the actuator over the correct cylinder. Positioning precision is achieved through the servo head, which is mechanically coupled to the data heads by the actuator assembly. This enables reducing or eliminating the effects of mechanical and thermal tolerances associated with typical stepper motors.

The key in this type of positioning system is position feedback. The Fastrak continually provides precise servo information, which is used to position the data heads. A stepper motor, on the other hand, uses a sequence of pulses. After 10 step pulses are sensed, for example, the data head should be on track 10, but there is no positioning feedback signal to tell the system that it is on track 10.

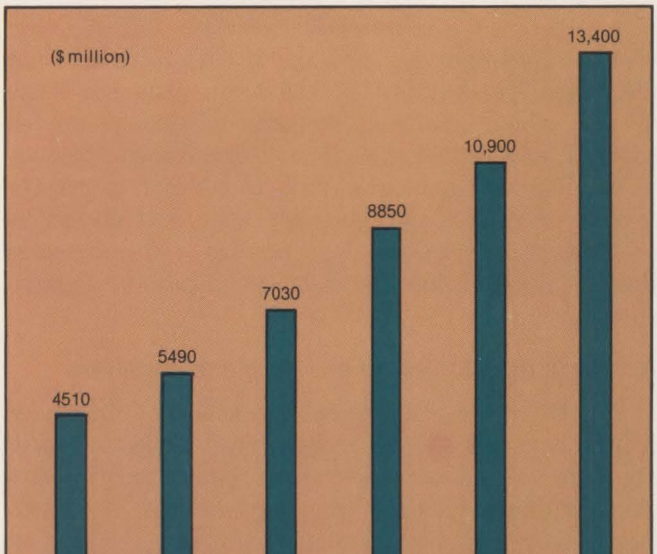
Drives having stepper motor positioners have limited track density as a result. Because the positioning is not as accurate, each track must be wider to accommodate the mechanical and thermal tolerances of the open-loop stepper system. This is acceptable for the low-cost drives used in smaller stand-alone systems with capacity needs of 15M bytes or less. However, the new larger and multi-user systems demand greater accuracy, which the closed-loop servo actuator makes possible at a modest increase in cost. The improved positioning of the servo-controlled system reduces track width by approximately two-thirds. For example, the track density is 172 tpi on Shugart's original SA1000 8-in. Winchester-disk drive and 500 tpi on the new SA1100. With three times as much storage capacity per disk surface (6.78M bytes versus the SA1000's 2.67M bytes), the SA1104 (two platters and three available data surfaces) provides 20.3M bytes capacity. The SA1106 (three platters and five data surfaces) provides 33.9M bytes.

A closed-loop servo system significantly reduces access time by correlating the overall seek distance with its actual position. This generates an optimal acceleration/deceleration curve for each length seek. An open-loop actuator system, on the other hand, with no position feedback, requires more cautious movement and results in longer access times.

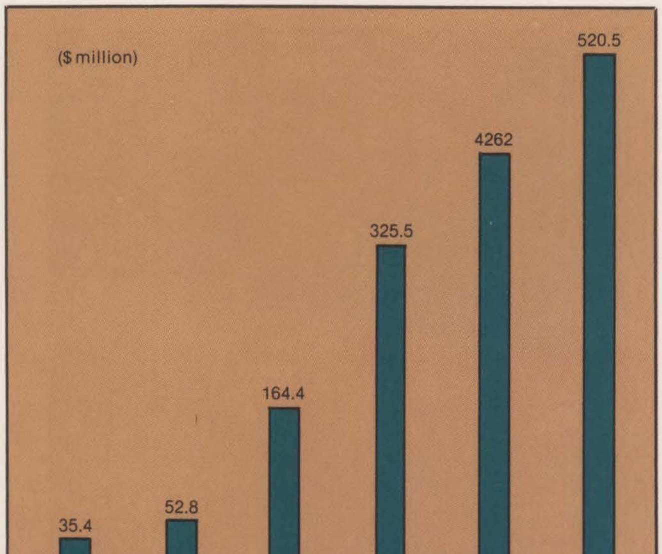
Reliability is improved

The closed-loop servo positioning system also promotes reliability because it uses fewer mechanical components than a typical open-loop actuator positioner with its stepper motor. The stepper motor, a mechanically based design, uses minimal control electronics. The closed-loop servo system, on the other hand, has very few mechanical parts; its complexity lies in its circuitry. The result is a simpler and more economical design.

Another reliability feature is the drive's brushless +24V DC spindle motor. AC power is not needed; a single model of the drive can be used for all applications worldwide, reducing disk-drive and spare-parts inventories for users. The DC motor controls speed with a variation of less than 1 percent. High reliability is achieved through the use of fewer mechanical parts and elimination of lateral loads on spindle bearings from the



Worldwide sales of small-business computers *will continue to climb for the next few years.*



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The closed-loop servo positioning system also promotes reliability because it uses fewer mechanical components than a typical open-loop actuator positioner with its stepper motor.

belt of an AC motor.

Shugart takes design simplification a step further. The initial SA1100 production drives, to be shipped in early 1982, will use approximately 250 discrete components on two PC boards. In late 1982, Shugart will offer full custom LSI electronics with the drive, reducing the component count from 250 to about 50 to 60 and eliminating one of the PC boards. Discrete models can easily be upgraded by adding an LSI board with a significantly lower parts count, giving the LSI version better overall reliability. LSI circuitry also will increase the SA1100's projected mean time between failure (MTBF) by approximately 25 percent to about 10,000 power-on hours.

The eight Shugart-designed LSI circuits will include five ICs associated with the servo-positioning system, a five-channel signal preamplifier, a read/write chip for further amplification and signal processing and a DC motor controller for precise spindle-speed control.

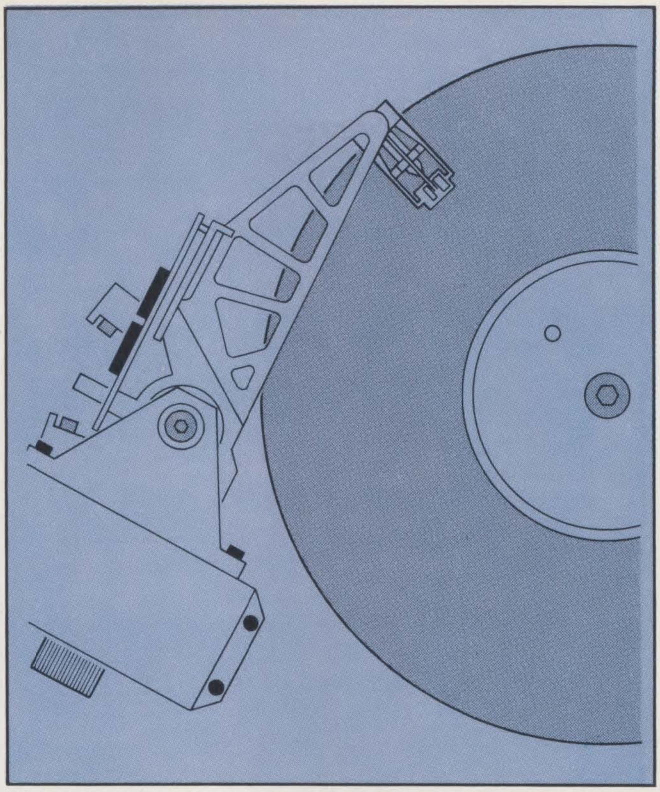
Another feature to enhance reliability is the SA1100's dedicated head-landing/shipping zone, which prevents head and disk damage and provides maximum data protection. The drive's heads are automatically moved to this zone when the drive is powered down, when DC power is lost or when the disk is moving at less than 80 percent of normal operating speed. Once in the landing zone, the heads are held in place by an automatic actuator parking lock. An automatic spindle brake also keeps the disk from rotating when power is removed. During shipment, an easily accessible manually operated shipping lock holds the heads in the landing zone and prevents the spindle from rotating.

The ability to upgrade is critical

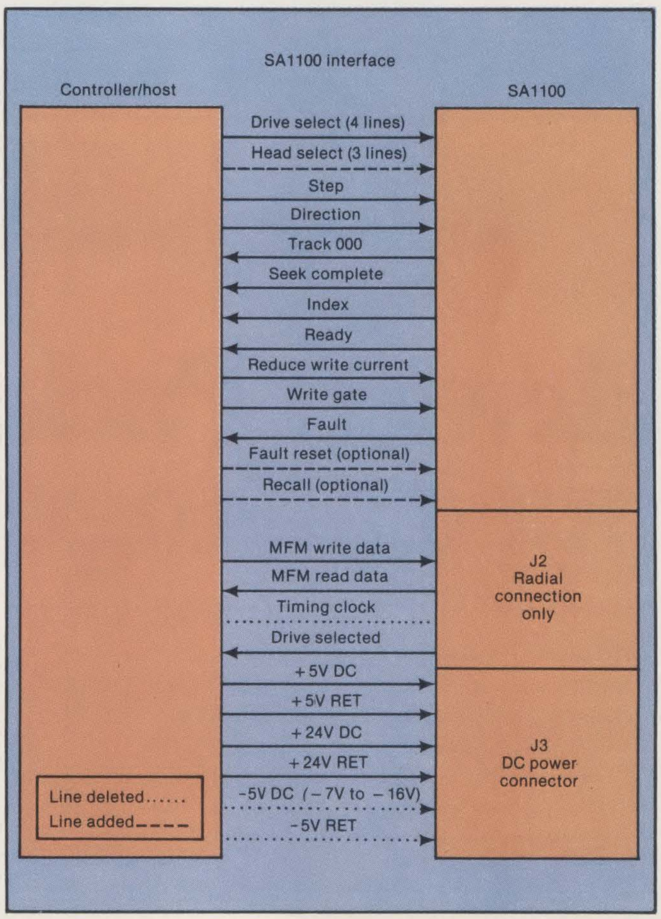
The ability to upgrade a system, especially an industry-standard product as popular as the SA1000, is a critical consideration. The SA1100's package size, mounting points and environmental specifications are identical to those of both the SA1000 and the SA801/851 8-in. floppy-disk drives. The SA1100 and SA1000 are plug-compatible, featuring the same track capacity and data rate.

Interface compatibility with the SA1000 simplifies integrating the SA1100 into a system with the backup and I/O peripherals. Integration can be accomplished using the SA1400 series of controllers, which handles as many as four drives in any combination of fixed and floppy or fixed and ¼-in. streaming tape.

To upgrade the SA1000-based system, minor hardware and software modifications are required. In the



The Fastrak closed-loop servo system, *showing the underside of the bottom platter with the servo head mounted on the actuator assembly (lower left). The servo head, coupled to the data heads, positions them over the correct cylinder from positioning information prerecorded on the underside of the bottom platter.*



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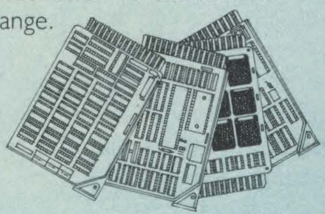

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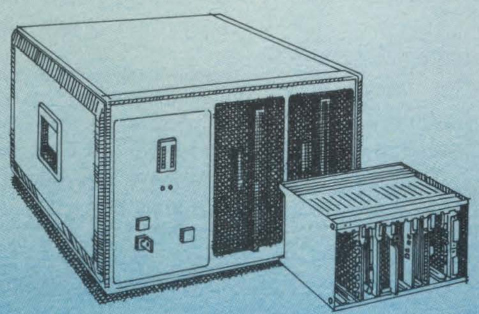

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The eight Shugart-designed LSI circuits will include five ICs associated with the servo-positioning system, a five-channel signal preamplifier, a read/write chip for further amplification and signal processing and a DC motor controller for precise spindle-speed control.

hardware area, a third head-select line in the read/write data cable must be activated. The device controller must access this line to address the five read/write heads on the SA1106. Most SA1000 controllers already provide for this extra head-select line.

The SA1100 interface also includes two optional input signal lines not available with the SA1000. One is a fault-clear line that remedies unsafe conditions, such as a head drawing too much current, and the other is a recal line that commands the selected drive to position the read/write heads to cylinder 0 and reset any seek-error conditions—a task formerly handled by the controller.

In the software area, minor updates must be made to the operating system and controller software to address more cylinders (the SA1000 has 256 cylinders; the higher capacity SA1100 has 650). These changes can be easily made by an OEM or a system integrator.

Manufacturers designing new drives face the choice of whether to use the new thin-film head technology. Although strides in thin-film technology are being made, thin-film heads are not yet available in volume production from multiple sources. In addition, this is not yet a proven, reliable technology. As a result, designing thin-film heads into disk-storage systems presents significant risks.

Existing ferrite-head technology, such as that used in the SA1100, remains the most suitable for today's drive-performance levels and will continue to accommodate increased performance levels in the near future. The Winchester technology used in most of today's products is a mature, proven technology available in high volume at ever-decreasing per-megabyte and per-function costs.

Many other directions are also being examined. The adaptation of big-drive features to smaller, lower cost units such as the SA1100 is just the beginning. A driving force behind this trend is the widespread use of the closed-loop servo-positioning technique. While the open-loop actuator positioner with its stepper motor nears the end of its performance potential, the servo positioner is just getting started in low-cost drives. ■

Ted Scooros, marketing product line manager, Shugart Associates, Sunnyvale, Calif., is responsible for the marketing and technical management of 8-in. Winchester product line, and **Dave Brodsky** is engineering manager for the SA1100 rigid-disk product.

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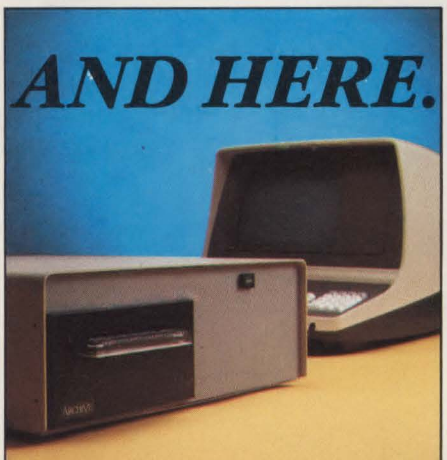

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The demand by system integrators and designers for faster computer access to disk drives has generated a new caching technique using an algorithm that reduces seek time and rotational latency delays—the greatest bottleneck in most systems—at least 60 percent. This innovative departure from traditional approaches is called the Turbo disk file cache.

Developed by MiniComputer Technology, the Turbo single-board subsystem uses the μp power of its disk-controller host. It is transparent to the operating system, is inherently error free, does not use main memory, is effective for all operating systems and does not slow throughput as do some of the classical track-caching methods.

Traditional methods hamper mini-micros

Cache-memory techniques such as least recently used (LRU), track caching and sector look ahead, have been increasing access speed in mainframes for some time. Most caches have been implemented in main memory and CPU operating systems; less frequently, they reside in controllers or large semiconductor storage devices. But these classical approaches to higher speed memory have disadvantages, especially in smaller systems (see "The drawbacks of previous approaches to cache," p. 216).

Implemented in main memory, caches require a substantial amount of CPU time for supervisory tasks; thus, they are impractical for small systems. Sector look ahead or track-caching concepts are expensive, and because they often make the disk unavailable while reading an anticipated file segment, they can even slow a system while caching unneeded data.

With LRU, cache lookup via operating-system (OS) software is sometimes slower than would be rereading a sector. Similarly, if a solid-state disk replacement is used, access time can be higher than when data is accessed directly on the main disk because it takes time to find the drive on which the data reside.

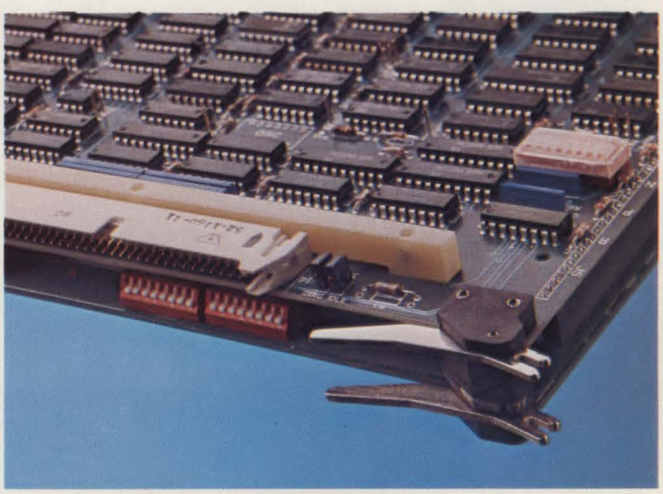
Traditional caching technology is also OS-specific, so a caching method that enhances one system may not improve, or may even degrade, another.

What is Turbo?

Turbo, which interfaces with MCT's EDC-21 controller and supports Digital Equipment Corp.'s PDP-11 and VAX Unibus minicomputers contains 128K bytes of dynamic RAM with transparent refresh, which enables caching of 256 sectors at 512 bytes per sector. When added to one of MCT's emulating disk controllers (EDCs), Turbo improves disk I/O throughput by 60 to 90 percent.

Unlike traditional caching techniques, in which the fast buffer memory is part of the computer system's main memory (Fig. 1) and under the control of the main CPU and its operating system, Turbo's cache memory is outside main memory, under partial control of the intelligence built into the EDC (Fig. 2). As many as four Turbo boards can be added to an EDC, providing 1024 sectors of cache memory, a total of 512K bytes.

The Turbo has been used in several sites throughout



MCT's Turbo-21 disk-file cache *uses a special algorithm to reduce seek time and rotational latency delays.*

Unlike traditional caching techniques, Turbo's cache memory is outside main memory, under partial control of the intelligence built into the EDC.

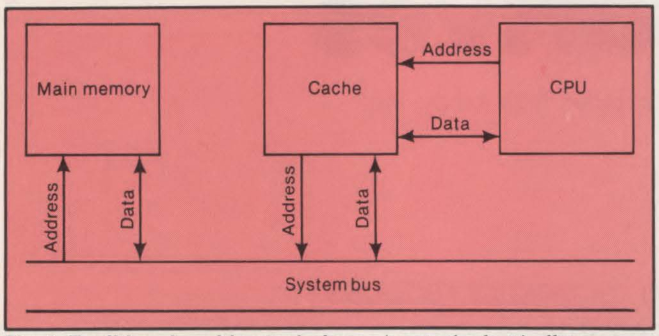


Fig. 1. Traditional caching techniques *locate the fast buffer memory between main memory and the CPU, where it is controlled by the computer's operating system. The drawback to this approach in small computers is that most of the memory is used to run the operating system and little is left to implement cache.*

the U.S. At one location, it was used on a PDP-11/60 multi-user access system with a DEC system disk, a DEC memory cache option and Turbo connected to a CDC9766 user disk. Over a 36-hour period, the system CPU was active for 9.7 hours, during which there were 478,000 user-disk I/O requests and 1.66 million sectors transferred. Turbo reduced total latency time from 3968 to 1002 sec., total seek time from 1312 to 442 sec. and total user-disk I/O time from 5280 to 1444 sec.

At another location with a PDP-11/34, RSTS-E, a lightly used in-house development system and a CDC9448 as a system disk, Turbo improved overall performance 60 to 90 percent, depending on the application and the number of jobs being run.

At a third location a PDP-11/34-like CPU with 256K bytes of memory and a special-purpose OS designed for multi-user terminal-access configurations, Turbo, when connected to the CDC9760 as system disk, improved performance about 60 percent.

How Turbo works

Turbo does not depend on the operating-system structure, as do most other caching techniques. Instead, it eliminates disk seeks to frequently used data. The MCT cache contains all of its software in on-board PROM, which talks directly to the disk and frees the CPU of the supervisory task. All the data in the cache are current. Further, power failures do not affect data integrity, and the Turbo cache does not limit the size of the disk subsystem.

The key to Turbo's operation is its new caching algorithm. In the past, cached data have been disposed of according to an LPU algorithm: The block of data that has gone unaccessed the longest is replaced by the nearest block of data.

MCT has modified the traditional LRU algorithm by having it consider past use and the probability of future use. A special hardware design allows Turbo to determine in less than 15 msec. whether a sector is within the cache. This operation occurs in parallel with

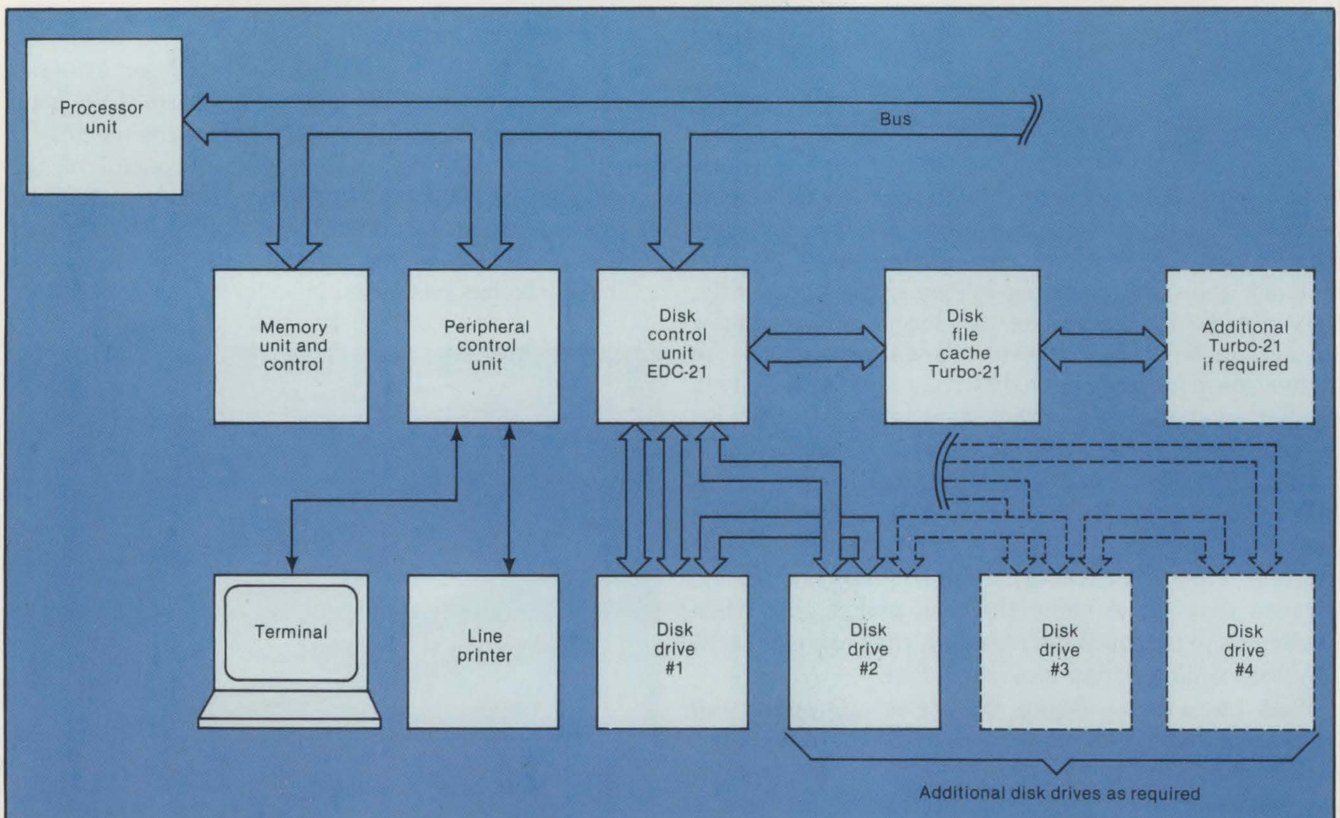


Fig. 2. Turbo's cache memory *is external to the main memory and controlled by an external processor on the disk-control unit rather than by the CPU. This arrangement permits high-speed memory in small computer systems.*

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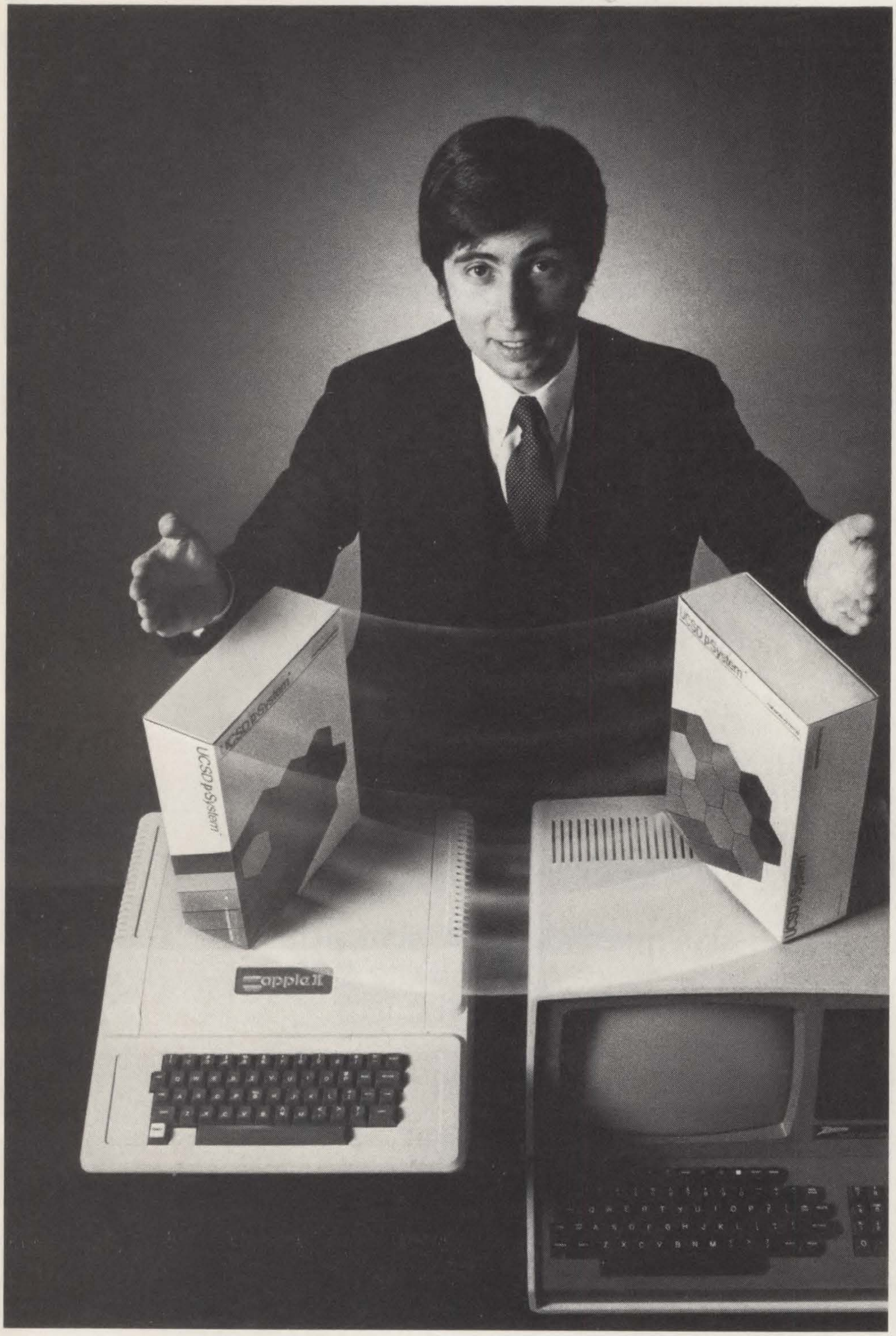

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CIRCLE NO. 119 ON INQUIRY CARD

Turbo does not depend on the operating-system structure as do most other caching techniques. Instead, it eliminates disk seeks to frequently used data.

the functions of an MCT-emulating disk controller, so the caching operation does not degrade the performance of the system.

Each sector in the cache has an identification key and count. The key consists of the drive, cylinder, head and sector numbers (2/11/5/6, for example), and the count is an 8-bit field, which consists of a lock bit and 7 count bits.

When the host operating system requests a data transfer, the EDC transmits the identification key of the desired data to Turbo to determine if it is in the cache. If it is, the disk is not accessed, and transfer from the cache begins immediately.

When a sector not in the cache is referenced, the counts are scanned in round-robin fashion to find a candidate for deletion. Counts that have the lock bits set are not considered as candidates. Turbo does not set the lock bit on the last unlocked sector in the cache, preventing the possibility of an endless loop.

If the operation is a write to the disk, or the referenced sector was not in the cache, the operation continues as if the cache had not been attached. Data being transferred are written into the cache so they will be available for a future transfer.

In the cache-memory subsystem, which consists of the EDC and Turbo, the data-source location is transparent to the main processor and its operating system (Fig. 3). The EDC acts as a front-end pre-processor for Turbo. Through the host computer's bus-interface logic, the main CPU issues the drive, the cylinder, the head, sector, the word count and the memory address of the data transfer to the EDC's 2901 bipolar μp. If the command is not a read, write or write/check, the EDC completes the command without communication with Turbo. Otherwise, the controller decodes these values, transmits information to another 2901 processor on Turbo and issues a command. This process determines whether the data transfer will come from the disk or the cache.

When the command is received, Turbo begins searching for the key in the key/index RAM (Fig. 4). It executes a table-lookup function in the key/index comparator and responds with a hit or a miss.

If no match is discovered, Turbo selects the next deletion candidate and the on-board μp reports a miss to the EDC. The controller then issues the necessary transfer function to the disk drive. The EDC's I/F reads the data into cache memory as they are transferred to or from the disk. During the transfer, Turbo μp inserts the new key into the key list, updates its count and finds a new candidate for deletion.

If the requested key is found, Turbo prepares to transmit data or monitor write-data, based on whether the function was a read or a write. It then reports hit to

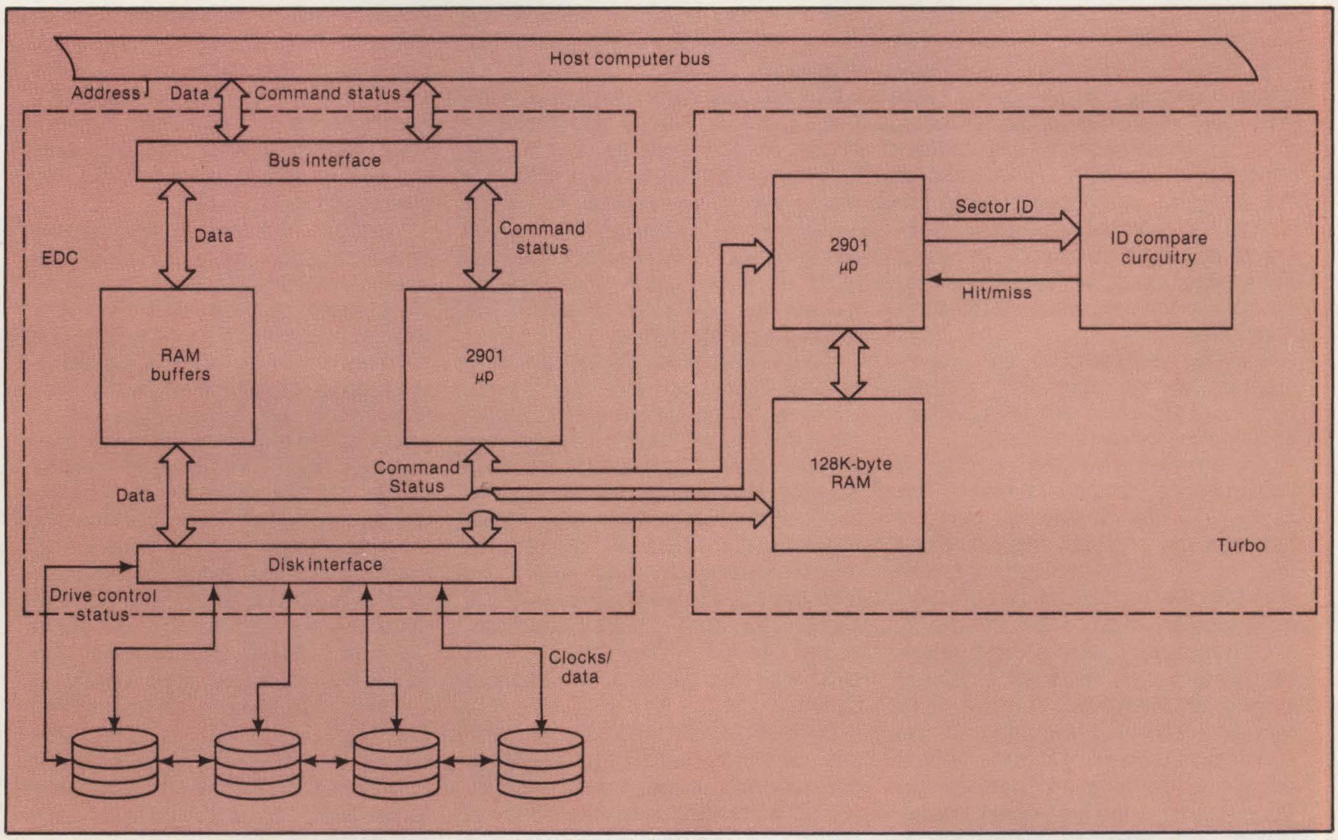

Fig. 3. In the Turbo approach to cache, *the memory (128K bytes of RAM) is only a small part of the total subsystem. Before a request gets to the cache, it passes through a 2901-based preprocessor in the EDC board and then to another 2901 on the Turbo board.*

In the cache memory subsystem, which consists of the EDC and Turbo, the data-source location is transparent to the main processor and its operating system.

the EDC if the function was a read or miss if the function was a write.

If the EDC reads a hit from Turbo, it does not initiate any disk operations. Instead, it asserts ready for data, which causes the data interface to begin the transfer. During the transfer, Turbo updates the count associated with the key and finds a new deletion candidate if the hit occurred on the current deletion candidate.

At the end of transfer from either the disk or Turbo, the EDC updates the requested word count by 256 words. If data still remain to be transferred, a new Turbo request is made; otherwise the EDC reports the status of the transfer to the host processor.

Faster lookup time

A table-lookup method allows the cache lookup and update to occur in parallel with the EDC controller at disk speeds or greater. A table lookup takes less time

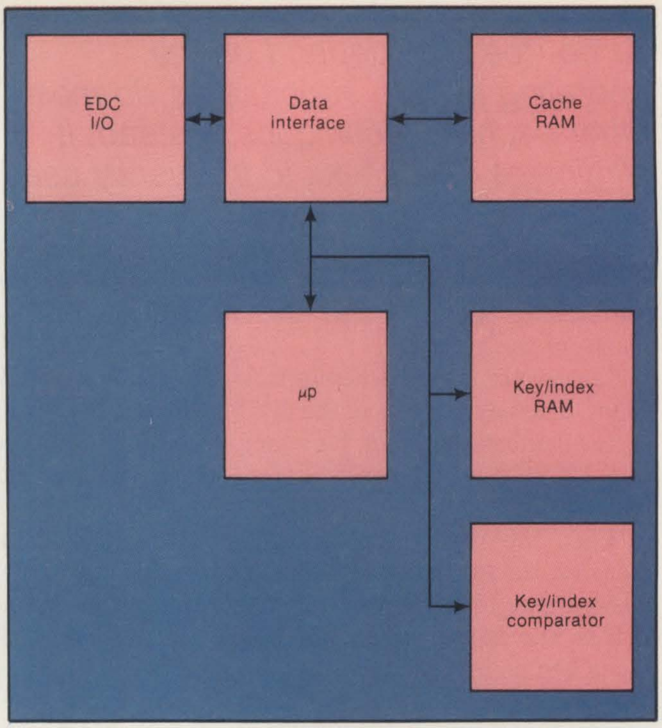

Fig. 4. Commands from the EDC to the Turbo *pass through a data interface that signals the processor to begin searching the key/index RAM for a key. Then the key/index comparator scans the lookup table for the listing. If found, it sends a hit signal to the interface and the μp proceeds to look up the site.*

DRAWBACKS OF PREVIOUS APPROACHES TO CACHE

A common disadvantage of typical cache programs is that most of their execution time is spent repeating a few main routines and a number of instructions. These may be simple loops, nested loops or a few procedures that frequently call each other. In most cases, many instructions are localized in a few areas of the program, a concept called the locality of reference. If active segments of programs can be retrieved from a fast cache or buffer memory, total execution time can be significantly reduced.

Caching subsystems are implemented by an operating system cache, a solid-state disk replacement or a controller-resident cache.

An operating-system cache is implemented in main memory. The cache or fast buffer is inserted between the CPU and main memory (Fig. 1). To make this arrangement effective, the cache must be considerably faster than main memory.

Conceptually, operating-system cache memory is designed to use the locality of reference. When a read request is received from the CPU, the contents of a block of memory words containing the location specified are transferred into the high-speed cache. When the program references a location in the block, its contents are read directly from the cache. Because main memory is not referenced, the computer's processing speed is increased.

The correspondence between the main memory blocks and those in cache is specified by a mapping function. When the cache is full and a memory word is referenced that is not in the cache, a decision as to which block should be replaced by the new block must be made. The rules for making this decision constitute the replacement algorithm.

Operating-system cache can store several blocks at any given time. However, when implemented in main memory, the number is usually very small—fewer than 1000 words—because of the cost of memory and associated lookup hardware. Applying a memory-cache system to mass-storage devices would be impractical. The main drawback of the operating-system cache approach, either within main memory or externally, is the lack of memory capacity.

Solid-state disk replacement memories are intended to replace head-per-track disk drives. Memory volatility is a problem in this kind of application. The solid-state concept is practical only in small amounts of storage, and the cost typically exceeds that of the replaced disk at about 1M byte. To use the semiconductor disk as a cache device, these operating systems require software modifications. Unfortunately, the software takes processor time, usually is not supported by the host vendor and can be difficult to install.

Controller-resident cache or sector-lookahead techniques are sometimes implemented in the disk-controller unit to shorten access time to slow devices, such as disks or tapes. The success of this technique is based on the probability that the CPU will access the block of data immediately following the one it has just accessed. It takes less time to read several blocks of data while the disk heads are on the cylinder than to reposition the heads later. The problem is that many operating systems organize data in such a way that the odds of several accesses within the same block decrease as data fragmentation on the disk increases. Many operating systems that incorporate lookahead caching solve this problem by allocating storage in larger chunks. However, this remedy can result in a large part of the storage area remaining unused.

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2. Mail Subscriptions	1,533	1,808
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I certify that the statements made by me above are correct and complete. G. F. Taylor, (signed) Vice President

MCT has solved the lookup problems with hardware that scans 256-sector IDs in less than 15 μsec.

than a disk-seek.

The major problem of past LRU-caching schemes is that it often takes considerable time to search the cache to determine whether a sector is present or absent. If the disk controller has to wait for a cache lookup before issuing a seek, a low hit-rate in the cache could degrade, rather than enhance, disk performance. Another complication is that transfers often span several sectors. If the cache takes longer to report a hit or miss than it takes for an inter-record gap to pass under the heads, a full rotation could be lost in the case of the miss.

MCT has solved the lookup problems with hardware that scans 256-sector IDs in less than 15 μsec. It takes an emulating disk controller longer to select a drive and transmit a cylinder number, so the cache search occurs in parallel with the setup. The time for the gap between sectors to pass under the read heads is about 50 μsec. with 32 per track. Because Turbo operates in parallel with its emulating disk controller, it can only increase performance, never degrade it.

Fast lookup time requires an extensive algorithm that enables table management to occur in parallel with data transfer. Turbo can delete an old entry and insert a new one into the cache tables in less than 256 μsec. It takes 423 μsec. to transfer a sector of data to or from a 10-MHz disk and 264 μsec. to transfer to or from a 16-MHz disk. In both cases, the table management is completed before a new transfer request can be initiated.

Additional performance improvement features

Although the Turbo disk file cache operates transparently to the operating system, three features have been added to the Turbo that require host software changes to implement. These features further enhance the total effect of the Turbo on the operating system. They are:

- Lock, which causes the selected sector or sectors to be locked into the cache memory until an unlock is issued. As many as 254 sectors can be locked in the cache.
- Unlock, which enables the selected locked sector or sectors to be unlocked from the cache memory.
- No cache, with which the sector or sectors will not be cached if they are not already in cache. ■

Arthur Roshon is vice president of engineering and supervises new-product development at MiniComputer Technology, Inc., Palo Alto, Calif.

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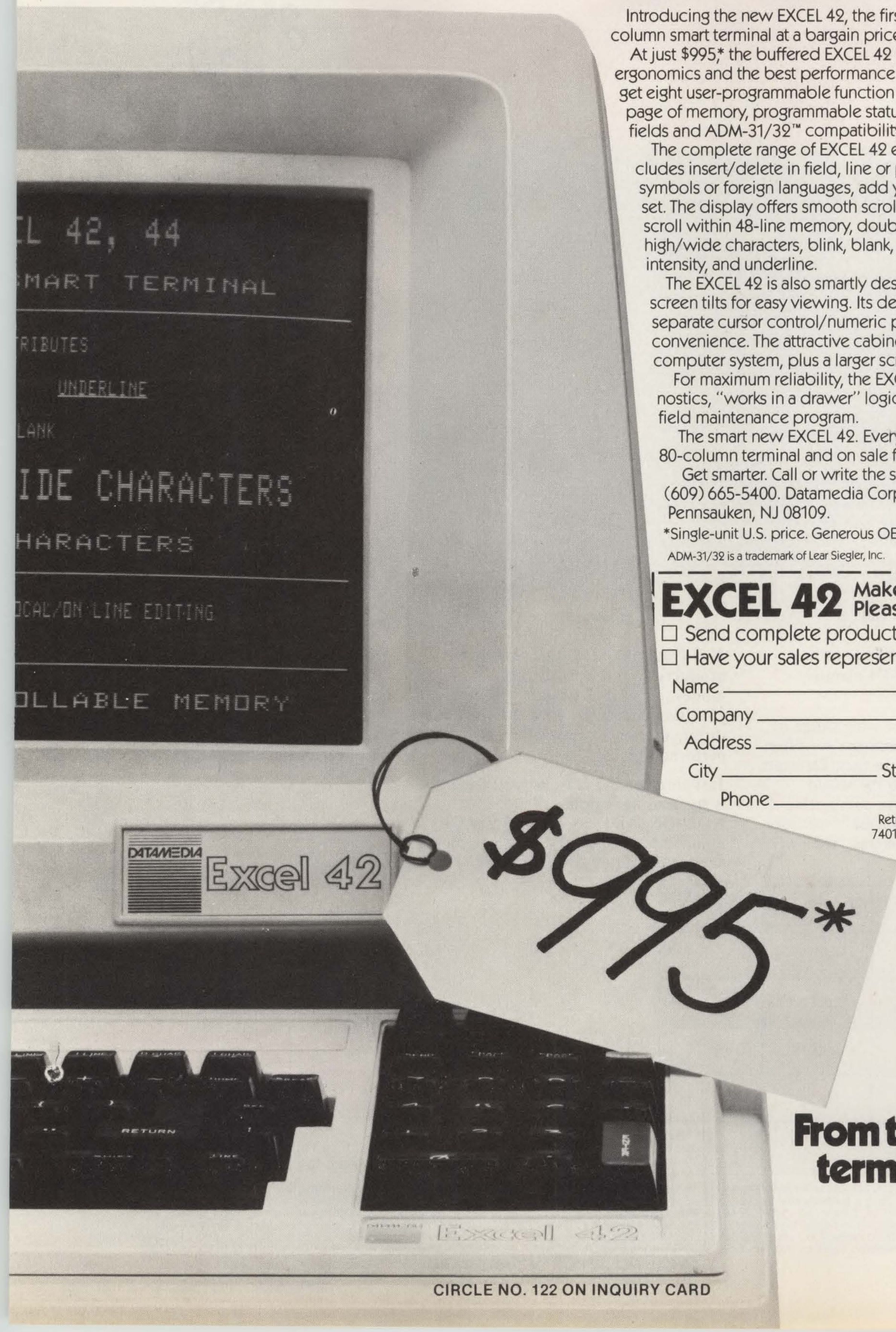

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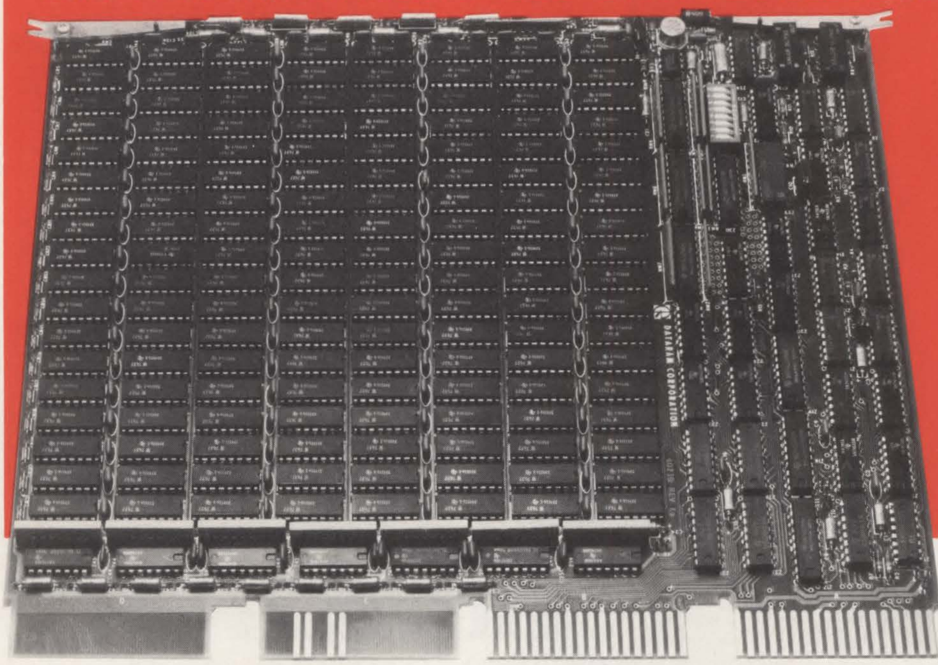

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CIRCLE NO. 123 ON INQUIRY CARD

TECHNOLOGY: DISK DRIVES

Refining head design in high-density minifloppies

OTTO BUTSCH, Micro Peripherals, Inc.

Advances in several parameters cope with the problems that surface when track density doubles

There has been a significant evolution in the past year in the design of 5¼-in. floppy-disk drives. The number of tracks per inch has risen from the industry standard for minifloppies of 48 tpi to 96 or 100 tpi. Doubling track density doubles capacity but also leads to design problems. More closely spaced tracks call for more precise head placement or data are lost. The solution to the problems involves changes in magnetic heads and cores, data tracks and guard bands, ferromagnetic material and head rotation. The systems builder must be familiar with the interactions and trade-offs of these parameters to make an intelligent choice among minifloppy drives.

Fig. 1 shows a magnetic recording head assembly of the type used with double-sided floppy-disk drives. The upper side 1 head is gimballed; the lower side 0 head is rotationally fixed and is known as a button head. In earlier two-sided floppy disk drives, both heads were gimballed, resulting in misalignments that caused excessive diskette wear. The asymmetric design illustrated eliminates that problem (MMS, May, p. 159). The use of special lapping processes to polish and shape the heads and to round sharp edges and corners helps prevent medium wear, increasing diskette life by a factor of three or four.

The erase core of the read-write element (Fig. 2) is structurally similar to the read-write core. The erase core trims the edges of a written track while the drive is in its write mode to prevent crosstalk between tracks. In the past, the erase core lacked a backbar—the magnetic yoke section connecting the pole pieces on the side opposite the gap—to increase flux density through the core. It was eventually determined that improved erasure and noise reduction made it worthwhile to use a backbar in the erase core as well as in the read-write core, and now that is standard.

A special filler is inserted between the core sections

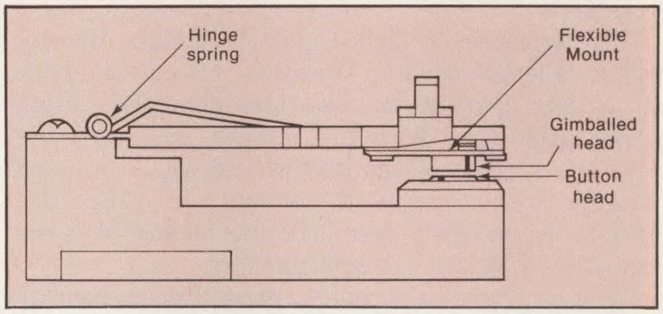

Fig. 1. The magnetic head assembly *for double-sided minifloppy drives now uses gimballed head above, flat-surfaced button head below. This asymmetric design eliminates the excessive diskette wear that resulted from the previous design, in which both heads were gimballed.*

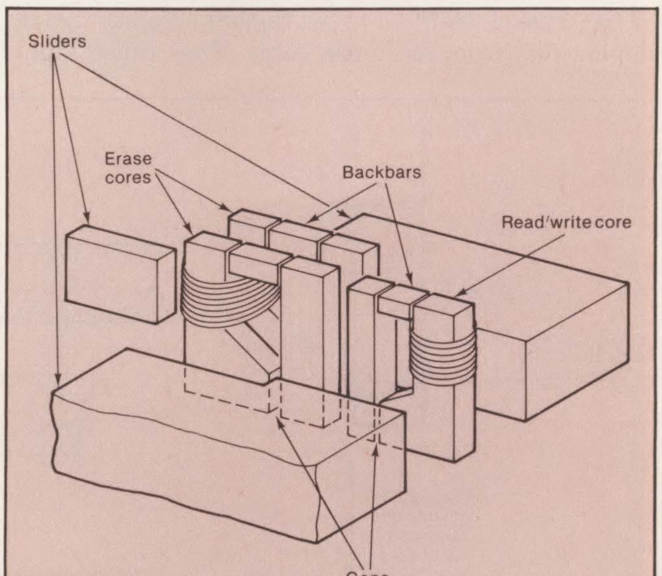

Fig. 2. The read/write element *is a wire-wound core. A gap in the core provides a low-permeability path for the magnetic flux and allows the flux to find an easier path through the ferromagnetic material of the diskette.*

The erase core of the read/write element is structurally similar to the read-write core.

to keep the magnetic properties of the gap constant and to protect the gap from contaminants that would change the flux density. Both of these goals are achieved by "bonding" the magnetic poles with a low-permeability material, usually glass. The same material is also used to bond the magnetic cores to the head (Fig. 3).

Data tracks and guard bands prevent erasure

The position of a magnetic recording head relative to a rotating diskette (Fig. 4a) is critical in preventing accidental erasure on adjacent tracks. Fig. 4b illustrates a tunnel-erase configuration, in which a data location on the diskette passes the central read/write core, and then passes the two flanking erase cores. In the write mode, the erase cores trim the edges of the data track as it is written, although with a slight lag relating to the distance, L, between read/write and erase gaps.

This lag causes a slight reduction in data capacity because a length equal to L must be left unused at the end of each data section. The "straddle-erase" design corrects this loss. With this method, the two erase cores are exactly adjacent to the read/write core, and the gaps are also adjacent, so that L = 0. But this efficient arrangement sees little use because it is not compatible with the industry standard.

The guard band (G) includes a strip that lies beneath the erase head, plus an additional tolerance called a safety margin. This margin allows the head assembly to experience a positioning error normal to a data track, without the erase head reducing the flux in the adjacent track.

The strips of width F are the regions occupied by the fringing flux from the erase cores. They cause slight additional reductions in the width of the data track, in addition to the erasure within the guard band that occurs directly beneath the erase core. In the specifications of drive manufacturers, these fringes are required

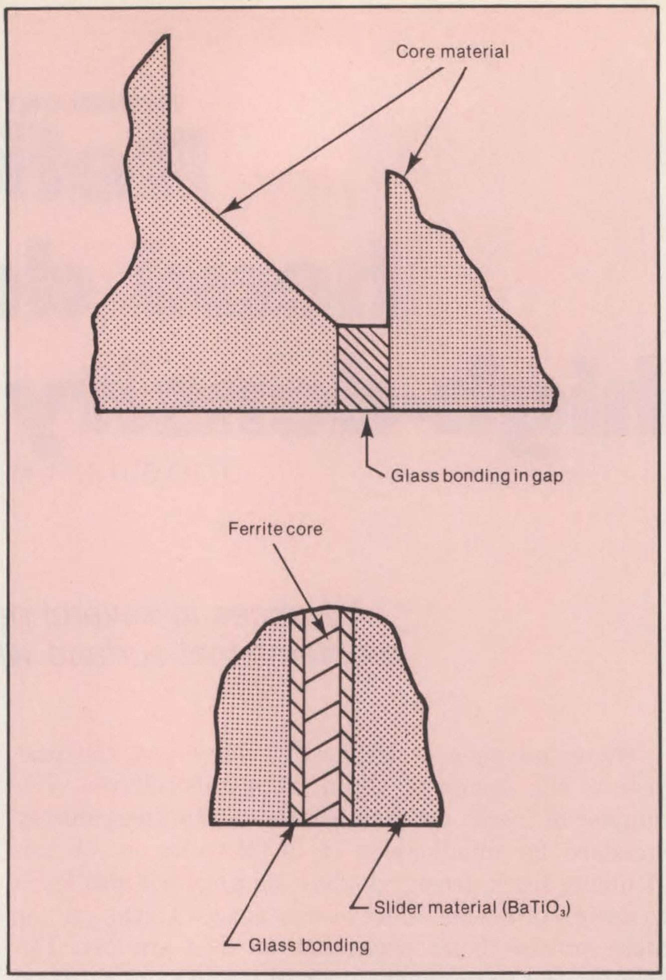

Fig. 3. Glass bonding *keeps gap dimensions constant and protects the gap from contaminants that might affect its magnetic properties. Glass bonding is shown in the gap of a read/write or erase core (top panel) and between the ferrite core and the slider material (bottom panel).*

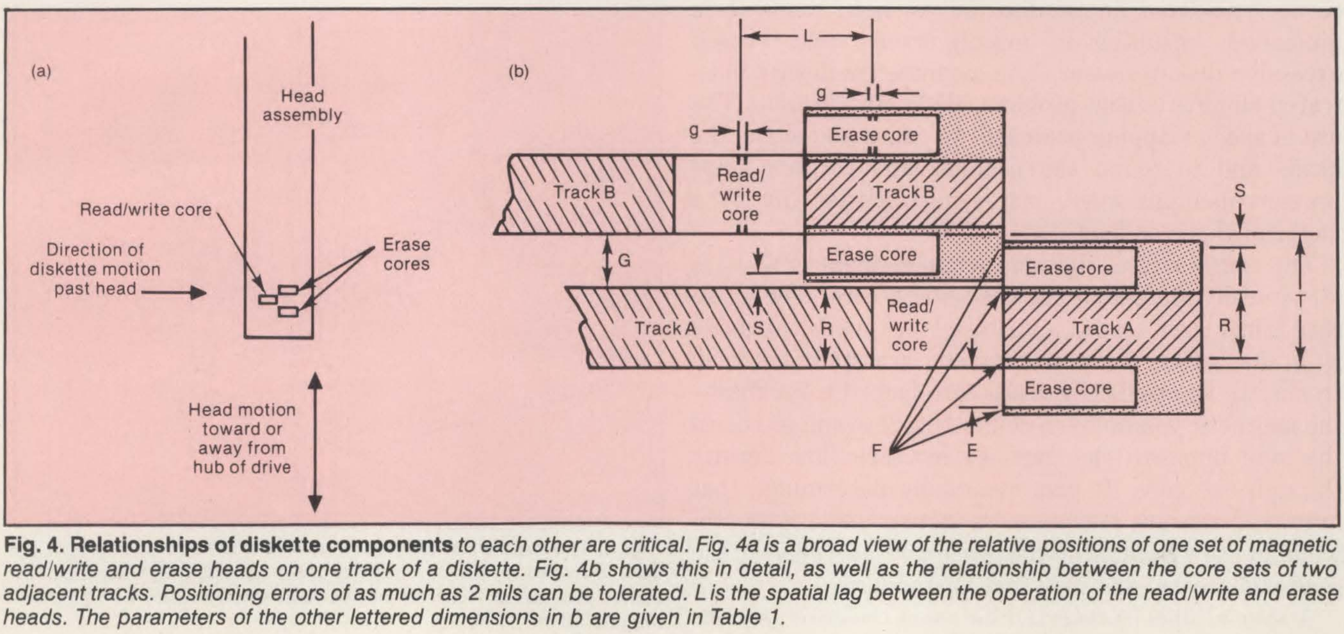

Fig. 4. Relationships of diskette components *to each other are critical. Fig. 4a is a broad view of the relative positions of one set of magnetic read/write and erase heads on one track of a diskette. Fig. 4b shows this in detail, as well as the relationship between the core sets of two adjacent tracks. Positioning errors of as much as 2 mils can be tolerated. L is the spatial lag between the operation of the read/write and erase heads. The parameters of the other lettered dimensions in b are given in Table 1.*

Parameter (in mils) \ Drive type	48 tpi	Wide-head 96 tpi	Narrow-head 96 tpi
Track spacing, T	20.8	10.4	10.4
Read/write core, R′	13	6.25	5.25
Data track, R	11.7	5.63	4.73
Erase fringe, F	0.65	.31	.26
Erase core, E	6	3.5	3
Safety margin, S	1.8	.65	2.15
Guard band, G	7.8	4.15	5.15
Effective read width, R_r	9.7	3.63	2.73
Reduced write width, R_w	11.5	4.28	4.73
Combined reduced width, R_{rw}	9.5	2.28	2.73

Table 1. Typical head/diskette *parameters as a function of drive type.*

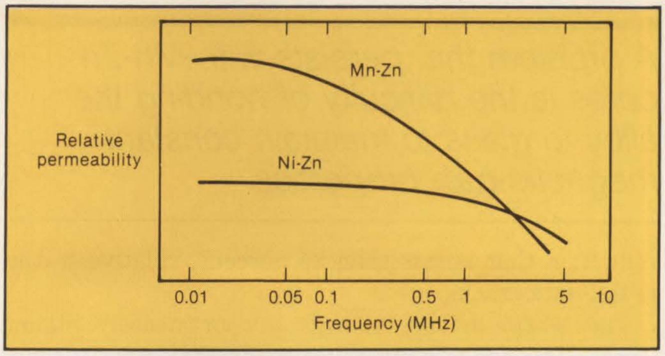

Fig. 5. Magnetic effectiveness *of manganese-zinc alloy is greater than that of the nickel-zinc alloy in the frequency range for minifloppies, which is from 0.25 to 0.5 MHz.*

to restrict data track reduction by no more than 10 percent. The fringes also help prevent accidental erasure in adjacent tracks by representing the leading edge of the erase field.

Table 1 lists head/diskette parameters for a 48-tpi drive, a 96-tpi drive with a standard 6¼-mil head and a 96-tpi drive with a 5¼-mil head. Head-positioning error is 2 mils (a reasonable maximum value). The values underlined are the independent design variables —track spacing, widths of read/write and erase cores and fringing-flux width. The other values are derived from these. For example, the safety margin, S, can be derived (using the notation of Fig. 4) as $S = T - R' - E$, all three terms on the right being design variables. Some results are immediately apparent from the table: The 48-tpi drive provides wide margins for error with negligible reduction in write width and a read-width

GLOSSARY

Backbar—The yoke element of a magnetic recording or erase core.

Bonding—Joining of the pole pieces of a magnetic core with a low permeability material that fills the gap; glass or epoxy can be used. The same material is also used in bonding the core to the magnetic recording head.

Button head—A curved or flat magnetic recording head having no freedom of rotation.

Cocking—A design modification in which the magnetic head is rotated by approximately ½ degree relative to the radius of the diskette, parallel to the plane of the diskette. The purpose of the rotation is to ensure even erasure of inner tracks.

Erase cores—The magnetic cores on a recording head that erase data and noise from the diskette.

Fringing flux—The magnetic flux that extends beyond the lateral boundaries of the magnetic core that is causing the flux. It is particularly significant in relation to erase cores.

Gap—The separation between the poles of a read/write or erase core where reading, writing and erasure of data occur.

Gimballed head—A magnetic recording head having two axes of rotation, allowing it flexibility in its contact with the diskette.

Guard band—The unused space between data tracks on a disk or diskette that safeguards against crosstalk and accidental erasures of adjacent tracks while writing.

Lapping—The fine-polishing of magnetic recording heads to reduce diskette wear.

Manganese-zinc (Mn-Zn)—A ferromagnetic alloy having superior properties for magnetic read/write and erasure, but difficult to bond.

Nickel-Zinc (Ni-Zn)—A ferromagnetic alloy that has been standard in magnetic recording heads, but which is facing replacement by Mn-Zn.

Positioning error—Error in location of magnetic-recording head and, therefore, of read/write and erase cores when a data track is accessed. The error is in a radial direction (toward or away from the hub of the drive) and can result in reduced sensitivity in reading a track or accidental erasures of adjacent tracks while writing.

Read-write core—The magnetic core on a recording head that reads or writes data on the diskette.

Safety margin—The tolerance width within a guard band. A positioning error that remains within the safety margin will not cause accidental erasures of adjacent tracks during the write mode.

Side-1 head—The magnetic-recording head on the upper side of a two-sided drive. On a floppy or minifloppy drive, this is generally a gimballed head.

Side-0 head—The magnetic-recording head on the lower side of a two-sided drive. On a floppy or minifloppy drive, this is generally a button head.

Sliders—Sections of a magnetic-recording head that contact the diskette surface while supporting the cores.

Straddle erase—A design in which there is no lag between the action of the read/write core and the trimming action of the erase cores. The erase cores are adjacent to the read/write core with gaps aligned.

Track spacing—The space between adjacent data tracks on a disk or diskette. Track spacing can be measured between any corresponding points on adjacent tracks, such as between center lines or between their inner or outer edges.

Trimming—The action of the erase cores in erasing the edges of data tracks to avoid crosstalk between adjacent tracks.

Tunnel erase—A design in which the two flanking erase cores are placed so that they follow the read/write core relative to points on the rotating diskette. The lag distance between the read/write and erase gaps slightly reduces available data storage capacity, but this design is the industry standard.

A problem that persists with Mn-Zn cores is the difficulty of bonding the alloy to glass to maintain constant magnetic-gap properties.

reduction that is less than 20 percent, relative to the initial data track.

The 96-tpi drives undergo proportionately higher losses. The use of a narrower read/write core protects adjacent tracks from the effects of positioning errors during write operations. The narrower core leaves a greater margin for safety between data tracks—2.15 mils—so that a 2-mil positioning error does not affect an adjacent track.

However, the narrower core, while offering this additional safety margin, is not superior to the wider core in every respect. The signal (flux through the read/write gap) that can be read is directly proportional to the width of the data track, and, if no positional error occurs during the write operation, the available signal will be stronger with the wider core. This is shown in Table 1, in the larger values of R and R_r when the 6¼-mil core (rather than the 5¼-mil core) is used.

Assuming that erase-core properties remain constant, there is a critical position error above which the 5¼-mil read/write core would yield better results and below which the 6¼-mil core would yield better results. A simple calculation shows that this breakpoint occurs for a position error of 1.55 mils.

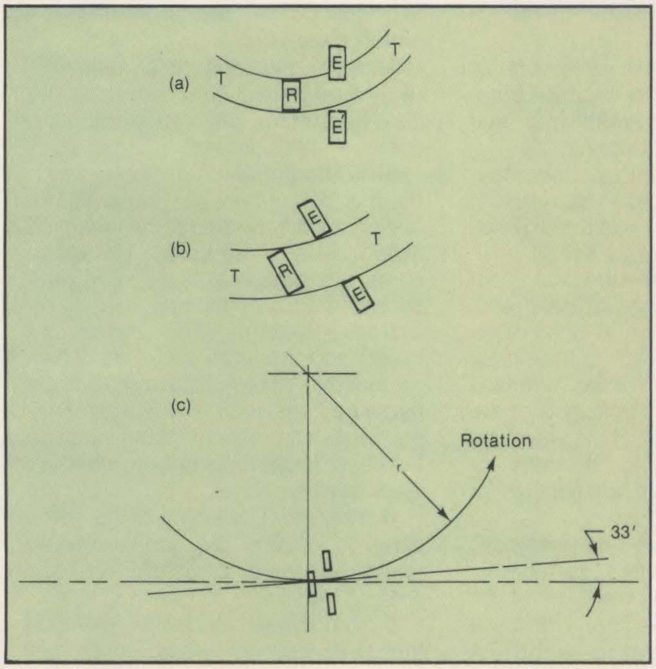

Fig. 6. Inter-track curvature *causes erase distortions resulting from asymmetry. Diagram A shows the positions of the read/write gap (R) and the erase gaps (E and E′) relative to inner data track (T). Because of inner-track curvature, erase gap E cuts too deeply into the track, and erase gap E′ separates from the track. In B, the magnetic cores—and therefore the gaps—have been rotated to correct this effect. The correction used by many manufacturers is about ½°. Diagram C presents this same situation in a less exaggerated form, where r = inner-track radius. Here, the manufacturer has corrected the distortion with a 33′ of arc head rotation.*

Choosing the right ferromagnetic material

Designers use a manganese-zinc alloy rather than the nickel-zinc alloy used previously for read/write and erase cores. Mn-Zn combinations provide better magnetic properties. The flux density available at the gap for writing data is 67 percent greater than for the nickel-zinc cores, and the sensitivity in reading data is 40 percent greater. The Mn-Zn core loses its advantage over the Ni-Zn core at data rates higher than 1 MHz. However, the frequencies for minifloppies lie between 250 and 500 KHz (Fig. 5), so this effect is not a significant liability for the Mn-Zn core.

The use of the Mn-Zn alloy in these recording heads was previously impractical because it had porosities that would lead to reductions in field, bad definition and chipped gaps. However, a new process, in which the alloy is produced under higher pressures, has reduced porosity.

A problem that persists with Mn-Zn cores, however, is the difficulty of bonding the alloy to glass to maintain constant magnetic-gap properties. Bonding must occur in an inert atmosphere, usually nitrogen. This requires new equipment and techniques. Some manufacturers have used epoxy as a bonding material to circumvent this requirement, but most epoxies or adhesives "creep," or change dimensions with changes in temperature and humidity, imparing—long-term stability. Therefore, many manufacturers are staying with Ni-Zn cores until new equipment is available, at which point they will convert to Mn-Zn with glass bonding.

Head rotation

The innermost tracks on a disk or diskette are subject to erase distortions because the curvature of these tracks presents the head assembly with asymmetries. The erase core closer to the hub of the drive suffers excessive overlap of the data track (Fig. 6A), while the other erase core experiences a comparative lack of overlap (Fig. 6b). To correct this effect, one manufacturer has rotated the head by 33′ of arc, making the inner tracks symmetrical (Fig. 6c). Asymmetries in outer tracks, on which data densities are greater, are not a liability when this strategy is employed. It is unclear whether head-cocking will diminish compatiblity with drives from other manufacturers and whether rotation improves performance.

Performance and compatibility requirements will be more severe in all parameters affecting minifloppy-head design as future drives move to higher track densities. The availability of the improved drives is bound to place greater stress on all of the primary structural factors, which will lead to further evolution in minifloppy-head design. ■

Otto Butsch is vice president of R & D at Micro Peripherals, Inc., Chatsworth, Calif.

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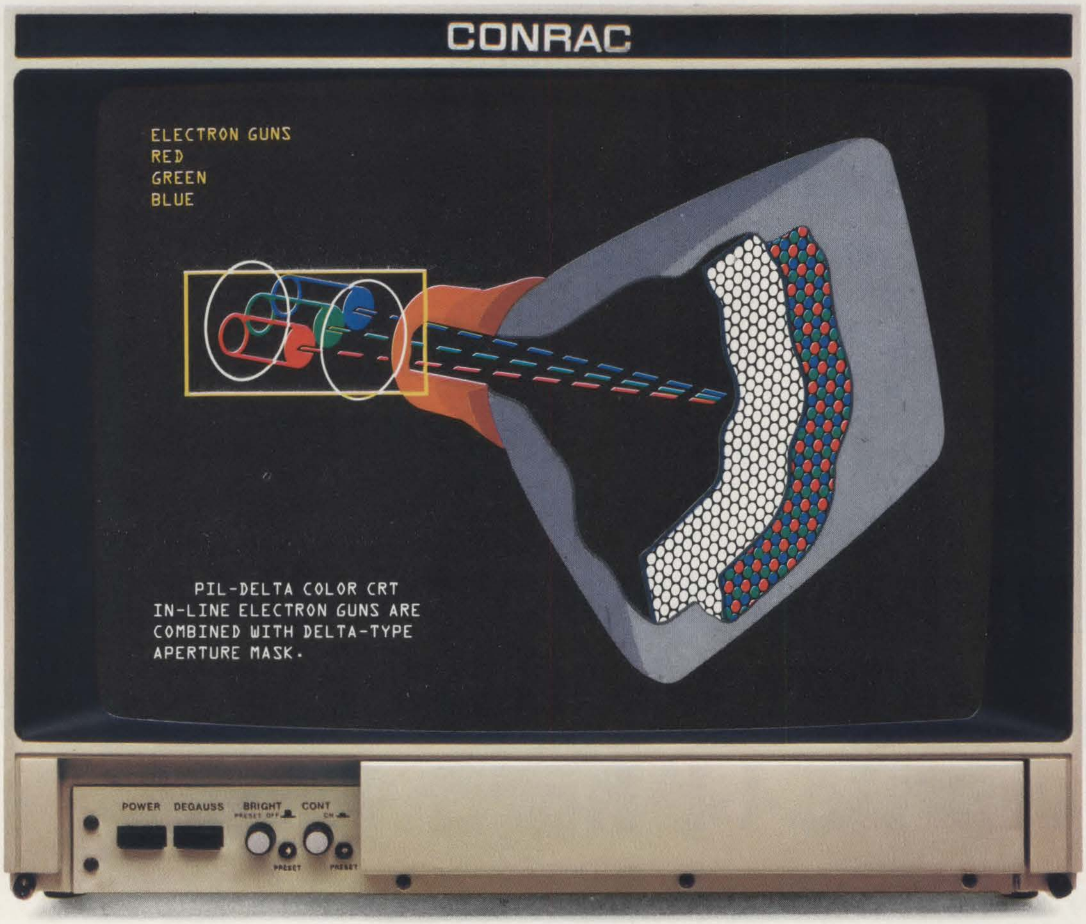

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CIRCLE NO. 127 ON INQUIRY CARD

COMPANY FOCUS

Digital Research and CP/M move into the big time

LARRY LETTIERI, Associate Editor

. . . with a couple of shots in the arm: one from a group of venture capitalists and the other from an IBM endorsement

Gary Kildall can barely sit still. He's talking about the things he plans to do with a new research and development group he's setting up within his Pacific Grove, Calif., company, Digital Research, Inc. "High-resolution color graphics. Voice synthesis and recognition. Sensors and effectors for machine interfaces. These are just a few," he says.

He's asked how much he will be involved.

"Plenty," he says beaming.

Kildall, 39, has a lot to smile about these days. His firm, best known for the single-user 8-bit μc operating system, CP/M, has just received a couple of shots in the arm: one from a group of venture capitalists, another from IBM Corp.

Not that Digital Research needed either of them. The six-year-old company has watched its sales increase one hundredfold since its founding. Sales for this fiscal year are expected to reach $6 million. Projections put next year's sales at $10 million. That's not bad for a company that started in a children's playhouse in Kildall's backyard with $500 and some systems hardware. Until the recent infusion of venture money, Digital Research had been self-funded.

Kildall's firm reflects the rapid growth in the μc industry in general. Insight Onsite, a San Jose, Calif., market-research group, predicts that the number of

ESTIMATED WORLDWIDE μC MARKET

	1979	1980	1981	1982	1983	1984	1985
Hardware							
Units (thousands)	300	440	640	890	1190	1520	1890
Value ($ million)	1300	1930	2800	3960	5300	6800	8500
Software							
Average value per system ($)	400	600	800	930	1025	1070	1130
Sales ($ million)	120	260	500	830	1220	1630	2130
Percent commercial	25	50	60	65	70	73	75
Commercial sales ($ million)	30	130	300	540	850	1190	1600
Percent consumer	75	50	40	35	30	27	25
Consumer sales ($ million)	90	130	200	290	370	440	530
Demand ($ million)	420	730	1150	1670	2280	2900	3640
Commercial	150	400	770	1230	1800	2370	3050
Consumer	270	330	380	440	480	530	590
Total (hardware and software—$ million)	1430	2190	3300	4790	6520	8430	10,630
Percent software	9	12	15	17	19	19	20

Source: Insight Onsite

Foremost among Digital Research's divisions is the operating systems group, which is 'very substantial with good management and direction.'

small, μc-based systems in use will reach nearly 2 million by 1985, with a value of $8 billion. In contrast, the number this year is only 640,000 units valued at $2.8 million.

In the same time span, the sales of μc-related software are expected to grow from about $300 million to $2.1 billion, with 75 percent coming from business-applications software. More importantly, the ratio of the value of hardware to the value of software in these systems will change dramatically. Insight Onsite says that by 1985, 20 percent of a system's cost will lie in its software, compared with 12 percent in 1980.

Expansion like that can be scary for a small company lacking skilled managers. And to keep up with its customers, Kildall believes, a company must match the growth rate of its industry. With that in mind, after rejecting several hopeful investors, Kildall accepted a deal with a consortium of venture-capital firms, primarily "because of their management expertise...their ability to help in a rapidly growing industry," he says.

In July, Digital Research secured an undisclosed amount of money from four firms headed by T.A. Associates, Boston, and including Hambrecht & Quist, San Francisco; Page Mill Partners, Palo Alto, Calif.; and Venrock Associates, New York. In return, the four received a minority interest in Digital Research. Two representatives of the investors, Jacqueline Morby of T.A. Associates and Larry Mohr of Hambrecht & Quist, will join Digital Research's board of directors.

Digital Research vice president Dorothy McEwen, who is Kildall's wife and the company's co-founder, hopes the investors' management talents will help the company's planning. "In the past," she says, "we made changes when we saw a need. We can't do that anymore." Kildall adds, "It's too difficult to predict your staffing and space needs." McEwen says the funds will help bring in experienced management personnel. Additionally, the company will be divided into operational and product groups.

Foremost among Digital Research's divisions is the operating systems group. Kildall says the group is "very substantial, with good management and direction." CP/M is the flagship and has become the de facto operating system in the μc industry. Digital Research estimates that there are more than 250,000 CP/M installations and that more than 300 OEMs implement CP/M on more than 350 different systems.

Xerox Corp. and Hewlett-Packard Co. gave CP/M the nod when they made it available with their small systems. But the nod that mattered most was IBM's endorsement of CP/M-86—CP/M's 16-bit kin—for its personal computer announced in August. Under the arrangement, Digital Research will supply CP/M-86 as an alternate operating system for the IBM machine. The program will be customized for the 8088 CPU, a 16-bit processor with an 8-bit data bus used by IBM.

Such contracts are lucrative, and although Digital Research won't divulge the amounts, the contracts may be the reason that the company has changed the way it prices the product. A one-time fee of $50,000 previously bought an OEM customer the CP/M source listing and the right to make as many copies of it and its documentation as needed. Under the new license plan, the fee is $60,000, documentation costs are $10,000, and customers are limited to 10,000 copies of the software. If more copies of CP/M are needed, the OEM pays a $2-per-copy royalty or $60,000 for the right to make unlimited copies. The change was made, says Digital Research's marketing director John Katsaros, because of "increased demand" for the product. "CP/M has helped OEMs sell a lot of hardware," he says. "It's a more valuable product today than before."

Not all Digital Research efforts succeed as well as CP/M, however. The company's multi-user, multitasking operating system, MP/M, didn't spark much imagination after a couple of years on the market. "MP/M suffered

KILDALL: CP/M AND BEYOND

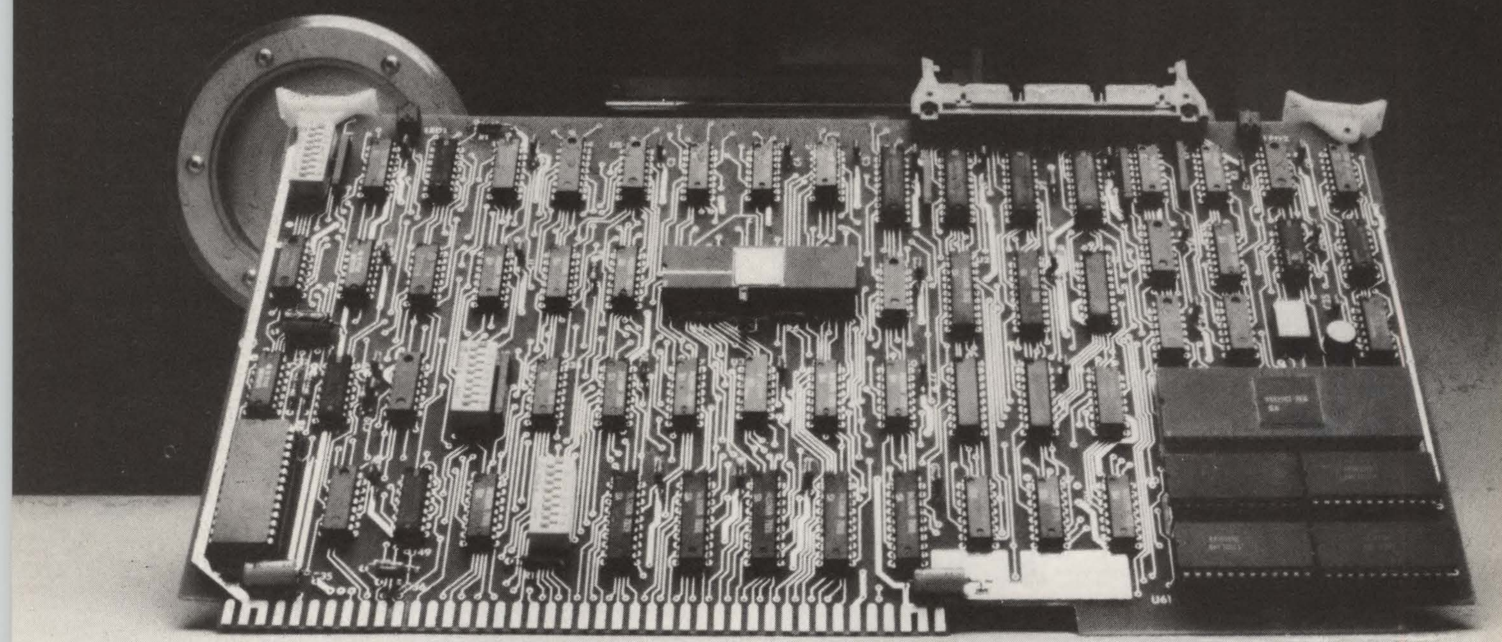
Intel Corp.'s loss was Gary Kildall's gain. While a consultant developing a programming language for Intel's (and the industry's) first 8-bit μp, Kildall independently designed what he called a control program for μcs. It was the first 8-bit operating system. He called it CP/M and offered Intel the chance to help develop it further. Intel said, "no thanks," and the rest is history.

CP/M has outgrown its hobbyist's sneakers and has donned the wing tips of big business, as has Kildall's Digital Research, Inc. But Kildall retains the exuberance of someone embarking on a new adventure. With the help of money received from the venture-capital deal, Kildall's R & D group will delve into new areas, some of which at first glance seem to have no bearing on his company's direction. Using the sonar sensor from a Polaroid "One Step" camera is one instance. "It's a good example of the kind of sensor a computer can read," Kildall explains. But he's talking only in terms of "investigation."

On the more serious side, Kildall expects to investigate problems posed by what he calls the miniaturization of systems. Pointing to Adam Osborne's portable machine (MMS, July, p. 23), Kildall says, "Personal machines with limited resources need streamlined software. We have to build software to match a machine's capability."

Commenting on Ada, the Defense Department's programming language, he says, "I'm not sure what its ramifications are yet, but Ada has forced us to think about language design. We've stagnated in language design; we're just redoing the old ones." His R & D group will be investigating Ada-related topics, he adds.

The little guys have done it again.



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CIRCLE NO. 128 ON INQUIRY CARD

Lucrative contracts with IBM and Hewlett-Packard may be the reason Digital Research has changed the way it prices CP/M.

from its own limitations and from market weakness," says Katsaros, explaining that the package lacked the file- and record-locking features essential for a multi-user system. The company reworked MP/M and released it as MP/M-II this summer. Katsaros says several systems OEMs are expected to offer MP/M-II with their hardware, and at least 15 language companies have expressed intentions to support it.

As Digital Research has grown, so has its competition. Two rivals to MP/M-II are UNIX, the operating system Bell Laboratories developed for minicomputers, and OASIS, from Phase One Systems, Inc., Oakland, Calif. These systems' multi-user and multitasking

Digital Research recently accepted *a deal with a consortium of venture capital firms "to help in a rapidly growing industry." From left are Larry Mohr, an investor with Hambrecht & Quist; Jacqueline Morby, the lead investor, of T.A. Associates; Gary Kildall, president of Digital Research; Dorothy McEwen, vice president, and G. Gervaise Davis III, Digital Research's counsel.*

capabilities put them squarely on MP/M-II's turf. Kildall also expects competition from XENIX, a UNIX-like system from Microsoft, Bellevue, Wash. However, he thinks MP/M-II's niche lies in systems priced at less than $12,000, while XENIX is better suited to higher priced hardware. Ironically, many of Microsoft's programming languages run under CP/M. The company's consumer division sells a plug-in board for personal computers that permits those machines to run CP/M. Sources estimate that 20 percent of all Apple computers sold contain that board.

CP/M-compatible operating systems are also springing up. Although Kildall claims that they have no effect on CP/M sales—"They get limited exposure and die off"—they do represent a threat to CP/M's sovereignty because of possible copyright violations. Says Katsaros, "Making a CP/M-compatible system means taking some of our material. If we find that, we will go to court." The crux of CP/M compatibility, however, is language support and utilities, neither of which the lookalikes have, he says.

Meanwhile, work continues on CP/M. Version 3.0 is due this fall. Kildall is concentrating on the 8086 version, and says that he has "some commitments" for a version for Motorola's M68000 μp. A program to study Intel's 32-bit iAPX-432 in also under way.

Kildall intends to put more emphasis on programming-language development. He says the company will add support for those languages that the software houses it deals with don't have. A major step toward strengthening Digital Research's in-house programming talent was taken in September when the company acquired Compiler Systems, Inc., Sierra Madre, Calif. The firm, best known for CBASIC, was started by language guru Gordon Eubanks. It will become the foundation for Digital Research's language division with Eubanks as vice president.

Industry analyst David Gold, San Jose, Calif., believes that the steps being taken by Digital Research make sense. "I expect the company to continue to grow CP/M horizontally, adding more machines." Further, he anticipates vertical activity and more multi-user, MP/M-II-like software. "The next step could be applications packages," he says.

One OEM customer, systems builder Dynabyte, Inc., Milpitas, Calif., looks for similar activity from Digital Research. Vice president of marketing Michael Seashols, who says that 95 percent of his firm's Z80-based systems are shipped with CP/M or MP/M, expects "more utilities, languages and database-management software." Concerning the impact of CP/M, Gold says, "It's interesting, given the number of vendors and products in this business, that a level of standardization has emerged." The environment needed CP/M, he continues, but Digital Research just didn't have the clout to make CP/M a standard.

IBM's imprimatur has helped. Gold says it's a further endorsement of CP/M by the community itself. Phase One president Howard Sidorsky agrees: "Opening microcomputing to more people than before is good for everyone in the industry."

Regarding Digital Research's venture money, Gold says, "People now see this business as one with long-term potential. It's not a cottage industry anymore." Sidorsky calls the funding a smart move. "Typically, software companies are not cash-hungry. Digital Research will likely be doing things with that money that won't be obvious."

"Four years ago," says Gold, "if anyone had said that there would be a de facto operating system in the small-system world, people would have laughed." Now, Gary Kildall is the one laughing. ■

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CIRCLE NO. 129 ON INQUIRY CARD

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If you know our Series 5000 table top computer line, you know that *good* things come in small packages.

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Not only does our high performance Winchester subsystem include error detection with automatic error correction, its extreme speed is comparable to that of large main frame hard disk systems.

A 20K program loads in less than one second, about 10 to 12 times as fast as a floppy.

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The 5000 SX comes standard with lots of extras, starting with a fully terminated S100 mother board. Add to that 64K dynamic RAM modules, with parity, of course, and receptacles for your CRT and Printer that turn on with the main power switch.

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CIRCLE NO. 130 ON INQUIRY CARD

NETWORKS

Tailoring local-computer networks for the business world

OEMs, system houses and other local-network vendors are using tough criteria in selecting systems for business users

Local-computer network (LCN) manufacturers expect to play a major role in the booming business market for personal computers. And with good reason. Business operations are founded upon the communication and sharing of data, the two primary services provided by networks. Many bankers, brokers, travel agents, doctors and other personal-computer users are using systems to access remote databases via long-distance networks. Local networks will offer these users the additional advantages of distributed data processing and the sharing of expensive peripherals. But to succeed in the business market, OEMs, system houses and other local network vendors will have to tailor their systems to the needs of business users.

In evaluating local-computer networks, OEMs often use five selection criteria:

- Does the network provide software and hardware modules for off-network communications?
- Does the network provide standard business features, such as file security, error checking, expandability, multiple upgrade paths, custom interfaces and a multitasking capability?
- Does the network support existing operating systems and high-level languages to facilitate development of value-added enhancements?
- Does the network provide subsystems for common applications?
- Are network components and service for them readily available and cost-effective?

Communications: the important consideration

Appropriate communications features are the most important consideration in evaluating local-computer networks. Network-communications services should be accessible to application software written in high-level languages. Most local networks include high-level entry points for intra-network communication. Nestar's Cluster/One network (MMS, June, p. 135), for example, which networks as many as 64 Apple computers, allows Pascal programs to access intra-network-communica-

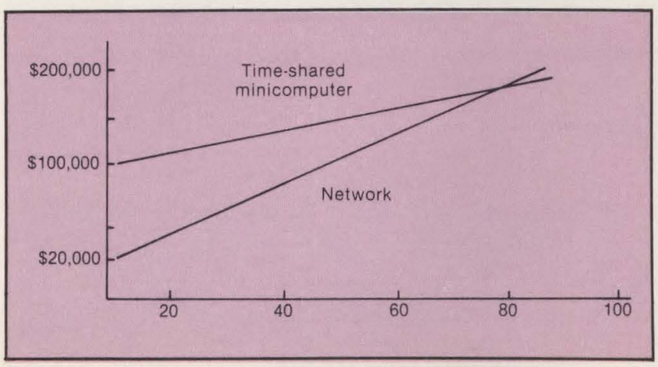

Fig. 1. System cost *as a function of the number of stations.*

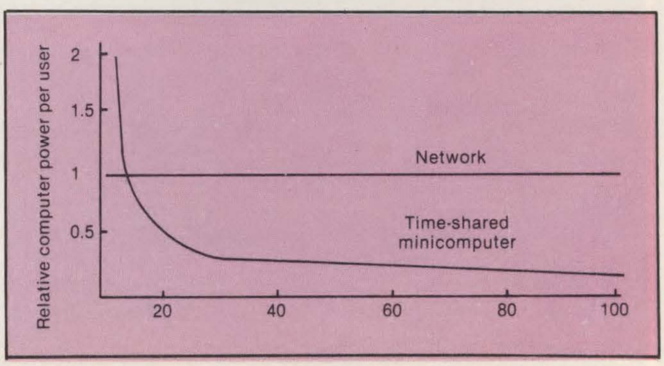

Fig. 2. Computation power *as a function of the number of stations.*

Appropriate communications features are the most important consideration in evaluating local-computer networks.

tions services through simple high-level entry points. Communication with other networks is another matter. Here, designers are faced with the fact that no standardized protocols exist for high-level data exchanges. Standard protocols for the lowest (gateway) layers exist, and most vendors (including IBM Corp. in some countries) ensure that their networks match it. However, standard protocols that define the format of the messages that pass through those gateways do not exist. Most LCN manufacturers would like to make their systems internet-compatible, but must do so on a network-by-network basis. OEMs must do the same for the foreseeable future.

Flexible security features should be commonplace in LCN business-applications systems, but they are not. Some office-automation systems have no file security other than that built into their electronic-mail systems. High-level data integrity is essential in business, and must be obtained with minimal software.

For example, two clerks should not perform read/modify/write cycles on one database simultaneously, unless each knows that the other is also performing the cycles. Otherwise, the clerks will write inconsistencies into the data. In one scheme to prevent this, users and system managers can assign public, group or private access rights to read, write, create and delete file material. Use is controlled by exclusive, shared, and mixed modes. A system of cooperative locks allows controlled use of mutual data. Password options provide additional security, and a system-autostart feature allows the automatic down-load of programs into user stations at power on, for secure, publicly available turnkey applications.

Maintaining data reliability

Although some business users question the reliability of data transactions in a distributed system, a comprehensive error-checking feature, such as the one in Nestar's Cluster/One, is rare in low-end LCNs. The Cluster/One performs a checksum on all bus and

QUESTIONS TO ASK THE MANUFACTURER

Number of stations	• How many stations can be supported? • Incremental cost of adding users? • Incremental performance degradation with added users?
Security features	• Which are available: passwords, locking, controlled access, encryption?
Data loss protection	• Is the system susceptible to single failure points? • Are backup facilities available and easy to use? • Can work stations function if the network is down?
Topography	• What is the maximum cable length allowed? • Flexibility of topographies? • Cost of repeater devices to extend the network? • Types of cable available?
Station communications	• Can network stations communicate directly with each other? • With stations on similar networks? • With mainframes? • With stations on dissimilar networks?
Enhancements	• Are systems such as electronic mail, print servers and file servers available for the network? • Is the system simply hardware, or is enhancing software well integrated into it?
Support for languages and OS	• Is the network transparent to popular operating systems (such as CP/M) and the most popular high-level languages? • Does the user have to penetrate more than one level of software to reach data?
Memory	• A network may support many users. Will it support the memory to serve them? • How many hard disks can the network accommodate?
Service	• Does a realistic service plan exist for the product? • Is it cost effective?
Business features	• Does the network provide file security, error checking, scalability, multiple upgrade paths, flexible custom interfaces and multitasking capability?
Cost factors	• What is the cost per user? • How does the cost per user decline as the number of users increases?

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It's compatible with any rigid disk moving head storage module drive and many others. The Qualifier offers revolutionary benefits to anyone involved with rotating media drives: original equipment manufacturer, system marketer, service company, user or media manufacturer.

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THE DISK DRIVE QUALIFIER

By Pioneer Research

CIRCLE NO. 50 ON INQUIRY CARD

Although some business users question the reliability of data transactions in a distributed system, a comprehensive error-checking feature such as the one in Nestar's Cluster/One is rare in low-end LCNs.

file-access data; redundancy is built into the system to check all packet transmissions and prevent the transmission of errors. Error checking in an LCN is an important selling point.

Networks should be more than a series of personal work stations connected to storage and a printer by cable. Systems need built-in hardware and software capabilities, such as high-level languages, that will enable system enhancement through value-added features. Competitive networks for business applications support COBOL, Pascal and other business-oriented high-level languages and operating systems.

Unfortunately, many networks depend on software that is not transparent to the operating system in use. For example, a user may be unable to access distant files with an application program unless those files have been transferred to a local disk. In a network such as Cluster One, any file in mass storage can be accessed from any local station. Network commands look like common disk I/O commands to the local CPU. Business users should not have to penetrate two or three levels of software to reach their data.

LCNs: cost, availability and service

Two commonplace alternatives to local-area distributed computing are personal-computer networks and time-shared minicomputers. The graphs in Figs. 1 and 2 assume that minicomputers, including multiple-megabyte disk storage, sell for $100,000, and that the terminals used sell for $1000 each. The processing power of the minicomputer is 10 times that of a personal computer. For a comparable network of personal computers, the per-station price is $2000. A shared-file server station with disk storage is priced at $20,000. The charts show the price and power of the two systems as a function of the number of user stations. For this comparison, the power per user is greater for the local network when the number of stations is more than 10, and the cost is lower when the number of stations is less than 80. For a system with 20 stations, each local-network user has twice the computer power for half the price.

Some advertised products never become available. The fundamental rule for OEMs in selecting products is prudence. OEMs should build on a proven product and ensure that documentation exists. They should also explore rent/lease options, and check with customers. OEMs can sometimes realize trade-offs between the higher cost of larger, well-known companies and the savings of smaller ones. If a product is modular and expandable, it can be upgraded.

More than 3000 offices in private industry are using LCNs. Many networks have been in place long enough to have grown incrementally, exercising the expandability designed into the original system. Nestar networks, for example, are serving in general-office environments, schools, travel agencies, real-estate offices and amusement parks.

LCN maintenance and service resources are generally immature. But a recent survey indicates that the overwhelming first concern of buyers is after-sale service. Large computer companies have service centers and regional service organizations, and other companies contract with third parties for service or channel service through their dealers and distributors. Some encourage buyers to service their own systems.

From a customer's viewpoint the best solution to any service problem is to replace the affected part quickly. Service should be transparent to the customer. For this reason, many manufacturers implement a policy of immediate parts swapping, accelerated replacement, dealer training and distributor-staffed service centers.

Cooperative arrangements between manufacturers and OEMs seem to be growing. Nestar and other companies have undertaken cooperative advertising efforts with companies that add value to products. A percentage of the OEM/'s advertising is refundable, the exact amount being based on product sales. ■

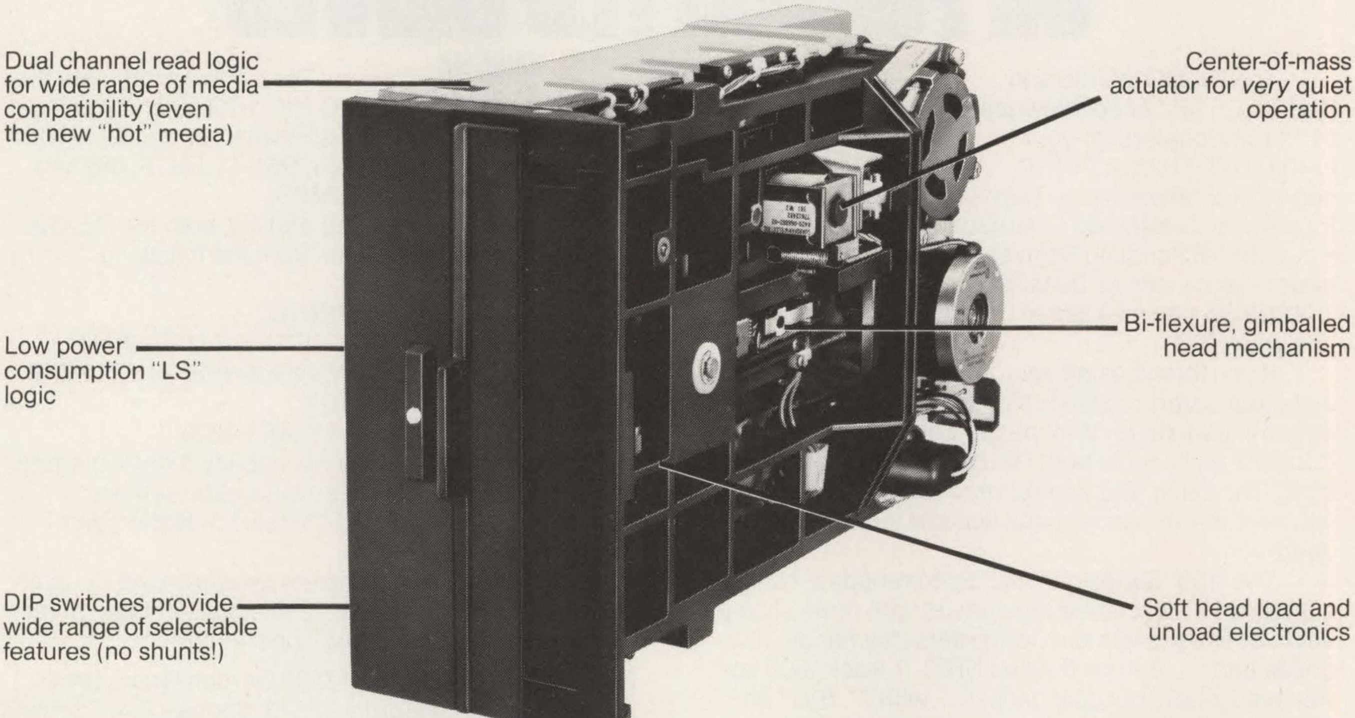
NEXT MONTH IN MMS

Watch for Mini-Micro Systems' annual special report on computer graphics in the December issue. A comprehensive product profile of computer-graphics terminals will lead off the feature section, which will be augmented by several other graphics-related articles, including:

- A look at a new hardware/software design technique that provides extremely fast three-dimensional raster graphics processing.
- A tutorial on digitizer resolution and accuracy.
- A survey of color-graphics terminals for VLSI.
- Two articles on the use of color graphics and computer animation for geophysics modeling.
- A look at the use of dot-matrix printers for both text and graphics printing.

Mini-Micro Systems will present its sixth annual report on printers in the January, 1982, issue. The report will include product profiles and comprehensive surveys of serial and impact-line printers. Also scheduled is a look at a new low-cost color-graphics printer.

Now our double-sided 8″ floppy is even *better*...



The OEM industry has always needed an 8″ double-sided flexible disk drive. But not the problems that were associated with it, like excessive media wear. Noise. Or big power requirements.

So, applying our leadership in disk technology, we developed the 9406-4. It's a true storage peripheral (not a converted program loader) that in double-density mode provides up to 1.6 million bytes of unformatted storage. With its industry compatible interface and mounting hardware, the 9406-4 is ready to be plugged into the most demanding OEM applications.

Our bi-flexure head design protects against media damage because *both* heads move out of the way of media during insertion or removal. They're gimballed, too, so they can always follow the plane of the rotating floppy disk. And the electronic soft head load/unload entirely eliminates the need for mechanical or pneumatic dampeners.

Noise? You won't hear much, because of our new center-of-mass actuator and our new stepper motor. And because we used low-power Schottky "LS" circuitry and power reduction, the 9406-4 will draw minimal DC from your power supply. No negative voltage is needed.

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We make a complete family of 8″ and 5¼″ floppy drives, and they're all ready for delivery. So call your ARROW or KIERULFF distributor, your Control Data rep, or our OEM Product Sales people in Oklahoma City. 405/324-3160.

CONTROL DATA

Addressing society's major unmet needs as profitable business opportunities

CIRCLE NO. 131 ON INQUIRY CARD

DILOG TAPE COUPLERS FOR STREAMING OR FORMATTED DRIVES FOR DEC 11*

The DILOG DQ130 and DU130 are μP based intelligent ½″ Tape Couplers for your LSI-11, 11/2, 11/23 or PDP-11 computers respectively. They're the only Couplers • for standard start-stop or streaming mode operation • capable of handling 8 drives • proven reliability and performance with an installed base *in excess of 1,000 units* • all on a single quad board that plugs into your CPU.

If you intend using your streaming tape drive in a standard start-stop mode and later wish to employ streaming mode for Winchester back-up, DILOG Couplers will handle both. You don't need to change a thing. The Dilog 'Backup/Restore' stand-alone driver software will implement and support streaming operation.

The '130' Series can also accommodate two standard ½″ formatted tape drives with three slaves each, or two stand-alone formatters that handle four drives each... 9-track 800 bpi NRZI, 9-track 1600 bpi PE, or 800-1600 bpi dual density... with 7″, 8½″ or 10½″ reels and read/write speeds from 12.5 to 125 ips and data transfer rates to 200,000 bytes per second.

The Couplers emulate the DEC TM-11/TS-03 and you'll get full software compatibility with RT-11, RSX-11, RSTS, IAS and MUMPS.

As for tape drive compatibility, both the DQ130 and DU130 interface drives from the following manufacturers:

AMPEX	PERTEC
CIPHER	TANDBERG DATA (IDT)
CONTROL DATA	WANGCO (PERKIN ELMER)
DIGI-DATA	TDX
KENNEDY	EMI (SE LABS)

To insure ease of maintainability & data integrity the Couplers incorporate an automatic self-test feature, with card-edge LED status indicator, and data protect feature.

Write or call for complete details on the Coupler that lets you mix or match up to eight ½″ tape drives for standard or "streaming" operation.

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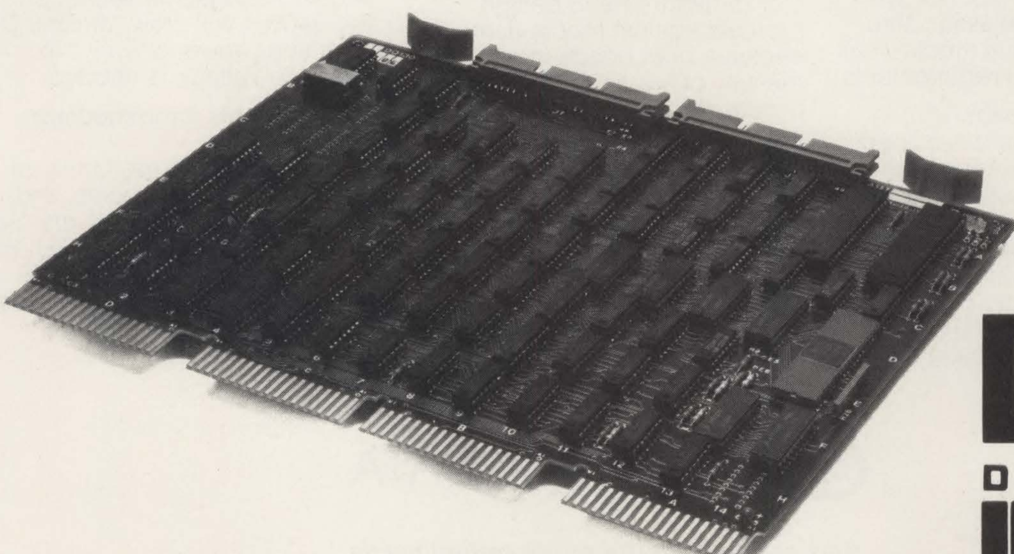
*Trademark Digital Equipment Corp.



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NUMBER 1 FOR DEC-11

CIRCLE NO. 142 ON INQUIRY CARD

NETWORKS

Taking aim at system degradation

PETER R. BOLTON, Bolton Associates

Micromation's M/Net uses multiprocessing to improve μc performance

Most single-processor network systems provide satisfactory data-access times as long as the number of users is small. But as more users are added, the lone processor becomes overworked, and access time can be substantially slowed. One solution to this problem is a multiprocessing network system such as the one devised by Micromation. Micromation's M/Net gives each user his own CPU and memory, enabling the system to handle multiple users without the performance degradation suffered by a single-processor system (Fig. 1).

Hardware is Z80-based

M/Net's multiprocessor architecture is based on a master processor board containing a Z80A CPU running at 4 MHz, plus 64K bytes of RAM with 200 nsec.-access time. Each user terminal has a satellite processor with a Z80A and 64K bytes of RAM to decrease processing and memory-access time. All components are connected via an S-100 bus, allowing fast communication between the master and satellite (Fig. 2). A single cabinet houses the components.

In terms of storage, the system offers the Doubler, a single- and double-density floppy-disk-drive controller that provides as much as 2M bytes of memory using a double-sided floppy-disk drive and a hard-disk controller that allows 21M bytes or more on an 8-in. Winchester drive. Winchester data backup is provided by a ¼-in. streaming tape.

In an eight-user M/Net system with a hard-disk drive, the 17-slot motherboard has 13 PC boards, including one master processor card, two multi-user I/O boards, eight satellite boards, a hard-disk controller and a Doubler floppy controller. Additional slots are available for custom interfaces or added I/O.

An important multi-user feature is M/Net's allocation of 62K bytes of usable memory to each user. In a typical single-processor multi-user system, each user has only

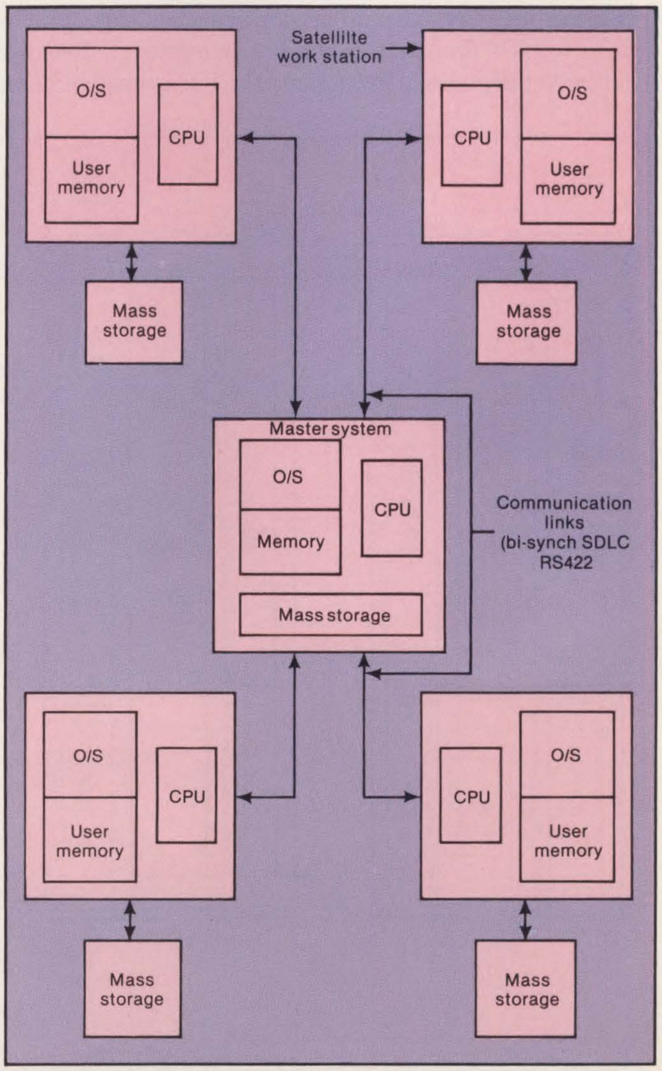


Fig. 1. In a traditional network, *independent satellite computers communicate with the master computer via a communications link. Redundant use of mass storage and printers adds flexibility but is expensive. Each satellite uses valuable memory to store the operating system. Processor-to-processor data exchanges are limited to transmission rates.*

The block-move command feature allows memory to move at processor speeds from the master to the satellites in 256K-byte blocks.

48K bytes of program transient memory because 16K bytes are used to transfer data from the Z80 processor to each work station (Fig. 3).

M/Net also incorporates the block-move command, which is part of the Z80's instruction set. This allows memory to move at processor speeds from the master to the satellites, and vice versa, in 256K-byte blocks. In most single-processor systems, memory is transferred byte-by-byte, a much slower process.

Because each user has a CPU and RAM on a satellite card, direct memory access is kept off the system bus. In standard multi-user systems, bank-switching is often employed as a means of establishing separate memory banks within the system. When a user needs program memory, the processor searches through the banks until it finds one that's not being used. Because each M/Net user has a processor, the bus is used only for I/O functions, which are handled by the master processor (Fig. 4).

M/Net is a fully interrupt-driven system. As soon as a character is generated at a work station, the master CPU is interrupted and directs the signal to the satellite card. The master then resumes its task.

The master also dynamically allocates satellites. The first user of the day is automatically assigned satellite number one. When he finishes, that satellite is assigned to the next user requesting program time. If the first user returns and starts another program, he is assigned to another satellite. The two major benefits to this feature are that a user can run programs at several satellites from one console and that fault tolerance is inherent in dynamic allocation of satellites. If a user's satellite fails, the program automatically is assigned to run on the master or another free satellite. When all satellites are busy, additional users must wait until a satellite is free.

User software is CP/M-compatible

CP/M-compatibility was a prime consideration in the design of M/Net. CP/M-compatible languages including BASIC, COBOL, and FORTRAN and various application

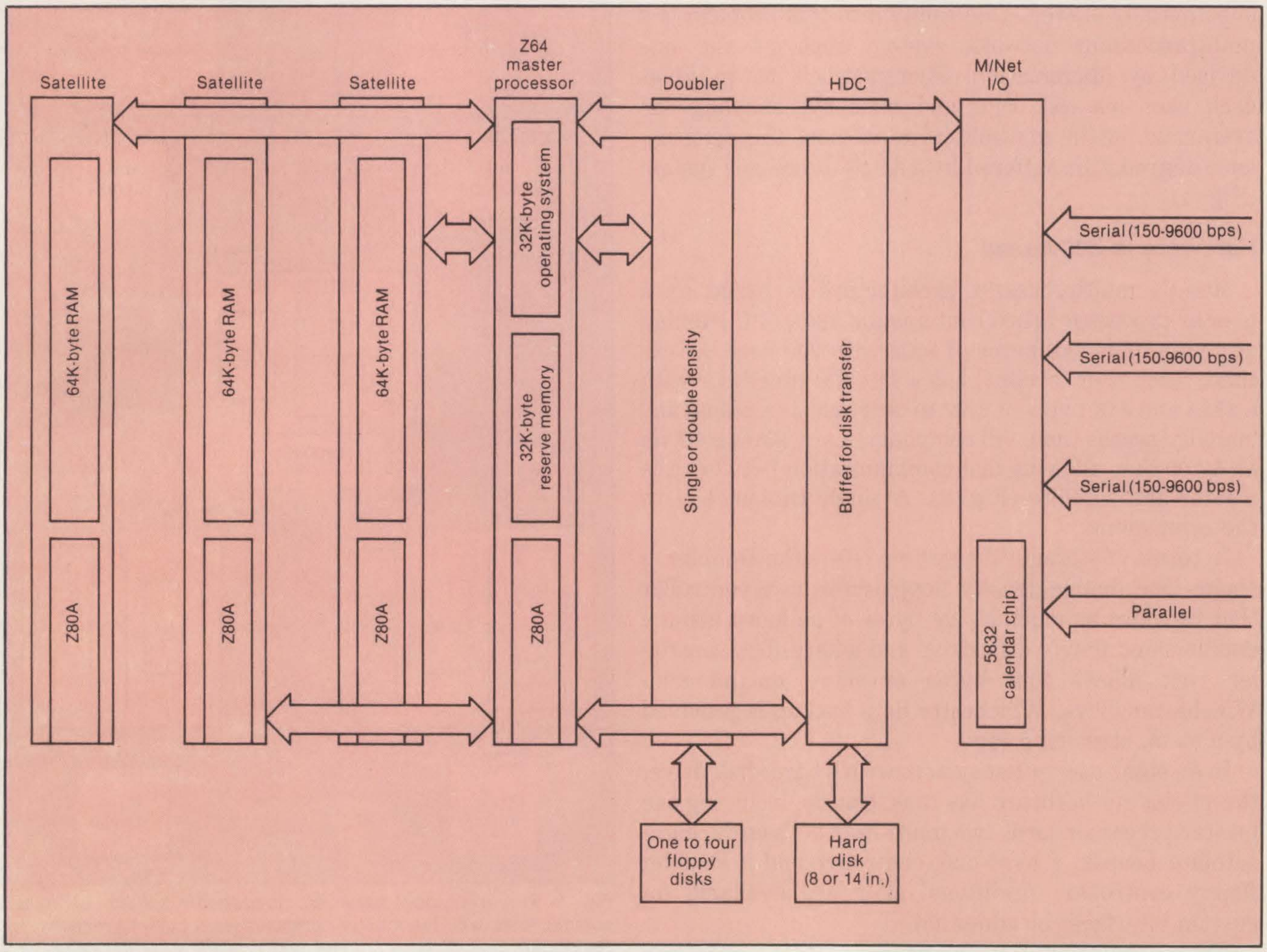
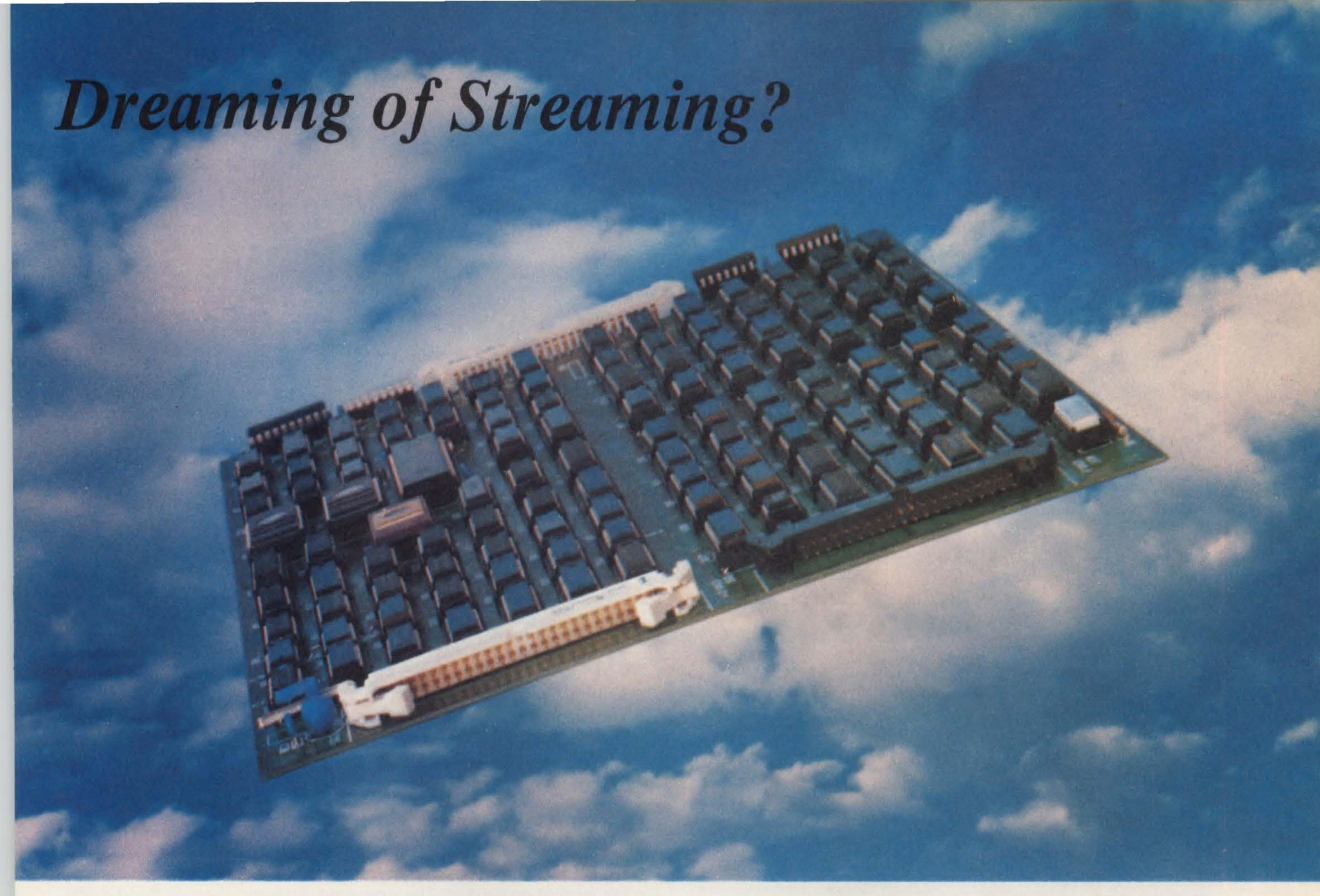


Fig. 2. In the Micromation M/Net concept, *program-data transfer among satellites, master and controllers is performed on the bus. The I/O on the bus is transparent to the satellites and does not interrupt their independent operation. Bus activities are coordinated through the master Z64 processor. Communication to terminals is via the M/Net I/O board with selectable baud rates from 150 to 9600 bps.*



Introducing the GYPSY™, the first complete streaming solution

Convenient, low-cost, dependable backup solution for your Winchester disk? Probably one of the most complex questions you face. The answer is the GYPSY, the fastest, most versatile disk/tape controller on the market.

VERSATILITY. The GYPSY offers a unique set of backup, restore, and access features including:

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- Backup and restore at a streaming tape rate of 90K bytes/second
- File oriented backup and tape file search capability, allowing selective backup and restore

PERFORMANCE. With a burst transfer rate of two megabytes/second and average data throughput of 450K bytes/second, the GYPSY is the highest performance disk/tape controller available. A single command allows the user to backup 20M bytes of data in less than four minutes.

ADAPTABILITY. The GYPSY offers innovative solutions to disk, tape, and host interfacing. Disk interfaces include Century Data Systems and Priam, as well as the industry standard SMD. The GYPSY supports all major 1/4" tape drives, Archive, DEI, Cipher, and TEAC. Host interfaces have been extremely simplified; the GYPSY can communicate with any host via a simple parallel interface, or by utilizing one of ADES' many economical host interface adapter boards.

SYSTEM SOLUTION. Looking for a system solution? ADES offers complete disk/tape memory subsystems, integrating the GYPSY, streaming tape, and 8" or 14" Winchester disk drives ranging from 10 to 160 megabytes. Our SYSTEM 8 and SYSTEM 14 provide the user with leading edge hard disk technology and all the performance and versatility of the GYPSY.

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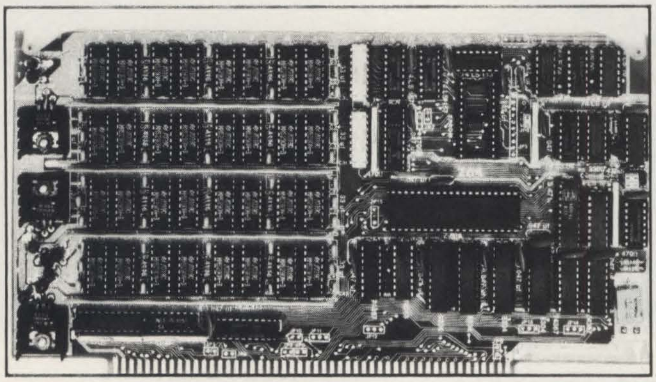
CIRCLE NO. 133 ON INQUIRY CARD

M/Net's multiprocessor architecture is based on a master processor board containing a Z80A CPU running at 4 MHz, plus 64K bytes of RAM.

tools, including word processing, general ledger and payroll, are inexpensive and available worldwide.

CP/M was also important in developing a new operating system—database operating system (DBOS) —unveiled in August and designed for Micromation by Microconcepts, Inc. DBOS, developed for multi-user hard-disk systems, includes an embedded database-management system with multi-keyed ISAM, file protection, passwords and rapid data handling for the multi-user environment.



Micromation's Z64 processor board, *which contains a Z80A CPU and 64K bytes of dynamic RAM, is the cornerstone of the M/Net multiprocessor system.*

DBOS offers significant time and performance improvements over MP/M in terms of multi-user applications, but CP/M compatibility was mandatory to provide the machine transportability to run CP/M-based programs on M/Net systems.

The system's database-management feature is tailored for a multiprocessor network such as M/Net, which is speed- and performance-oriented. Each user can work with the entire system data bank, and, because any file can be indexed by using as many as 16 separate IASM keys, data-retrieval time is reduced. Automatic file updating and sorting further cuts search times.

DBOS assigns as many as 255 hierarchical passwords to users to restrict data access and file add-or-delete privileges. Simultaneous file updates are avoided because users are automatically locked out of accessing a file that is being changed. This file lockout disengages automatically after a file update has been completed.

Price and performance compared

Price for an eight-user M/Net system with terminals and printers (but without application software) is approximately $35,000 (Fig. 5). An eight-user, redundant single-user system can sell for more than $50,000

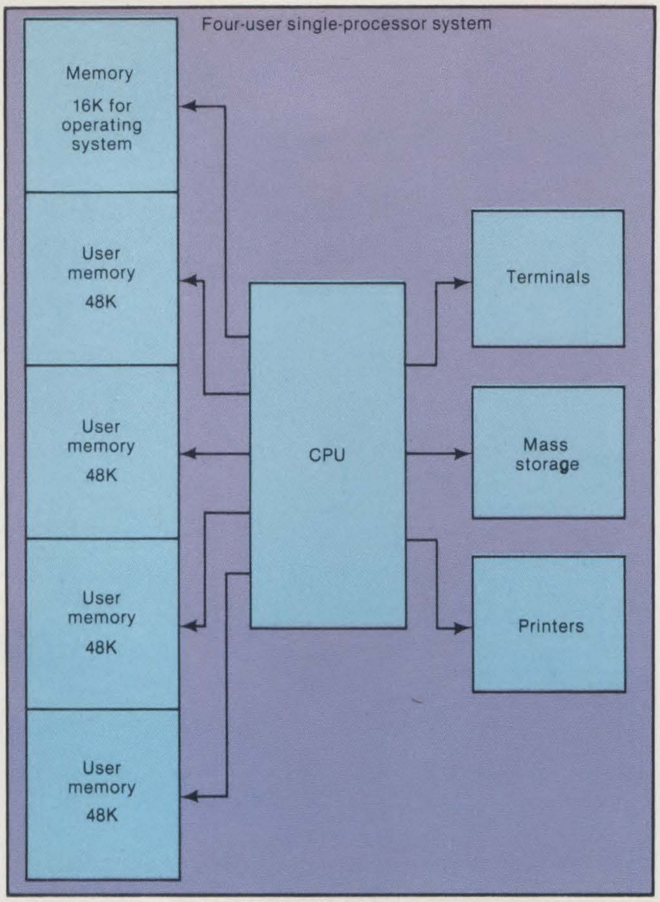


Fig. 3. Single-processor, multi-user memory *is bank-selected by the system processor. The operating system is held in the top 16K bytes of memory, and each user is allocated 48K bytes for programs. Each additional on-line user degrades system performance.*

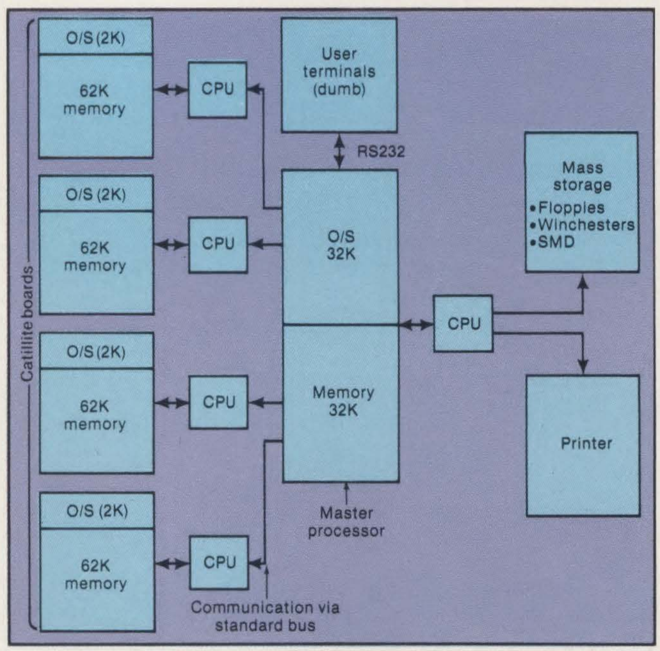


Fig. 4. In the Micromation M/Net system, *each user has an independent processor with memory. The operating system resides in the master processor. Translation from single-user CP/M to multi-user MP/M occurs in the top 2K bytes of memory of each satellite. Each user has 62K bytes of memory for program execution. The master processor coordinates all activity on the bus, including I/O to terminals and disk or tape peripherals. The remaining 32K bytes in the master is used for buffering I/O and providing backup if a satellite fails.*

The system's database-management feature is tailored for a multiprocessor network such as M/Net, which is speed- and performance-oriented.

(also without application software). To stay within cost budgets, the single-processor system adds users while drastically reducing system performance. For example, working from a hard disk, a user needs 21 sec. to perform a simple disk-file routine. With two users, it takes 39 sec., with three, 59 sec. and with four, 80 sec. M/Net significantly improves those performance speeds. Executing the same routine, one M/Net user spends only 7.6 sec. Adding a second, third and fourth user, the time increases to only 8.4 sec. (Fig. 6).

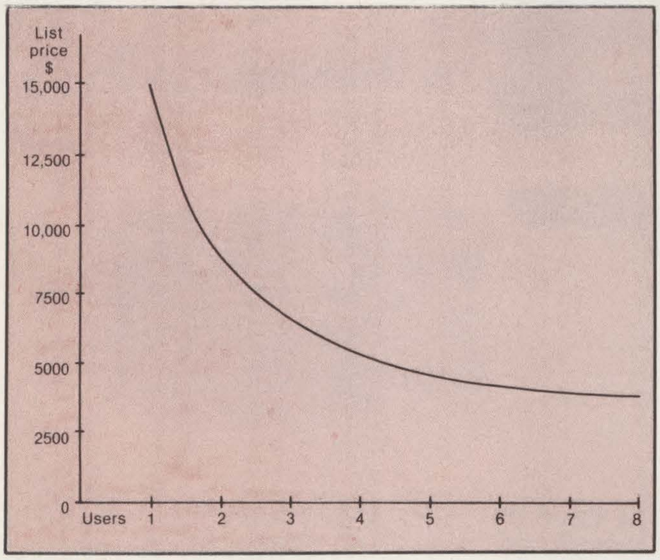


Fig. 5. M/Net's cost per user *decreases dramatically with the first four users. Optimal use of peripherals occurs after four users. The purpose of multi-user systems is to have a number of users share the peripherals—the most expensive items—without degrading system performance.*

Product evolution

The design of M/Net began with the company's first products. With the development of the Doubler floppy-disk controller, the Z64 computer card (with a Z80A processor and 64K bytes of RAM) and a multiple I/O board in 1978, the company quickly grew from supplying boards to OEMs and hobbyists to packaging single-user systems for the small-business-systems market. Micromation added high-capacity Winchester disks to the existing system in late 1979 in anticipation of a demand for multi-user systems.

Once Micromation committed itself to the multi-user systems market, a bigger decision lay ahead: Which architecture would be most cost-efficient for the user? The simplest choice would have been to use the then-standard single-processor system. CP/M-compatible software was available, and the 8-bit processor had proven its reliability and economy. The drawback was

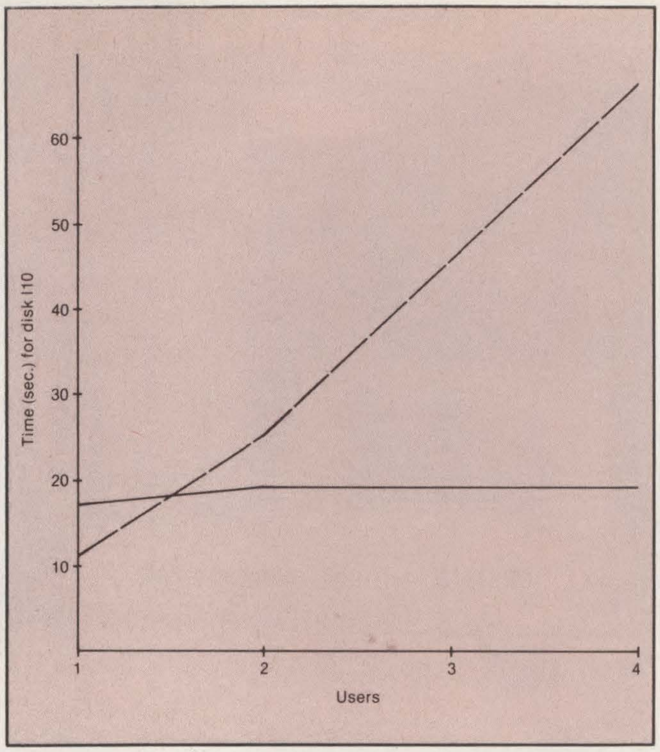


Fig. 6. Comparison of I/O times—*M/Net versus a single-processor, multi-user system with the same peripherals—shows that when more than one user is involved, M/Net's combination of satellite processors and master processor transfers data faster. Each system performed the same Microsoft BASIC disk routine 10 times.*

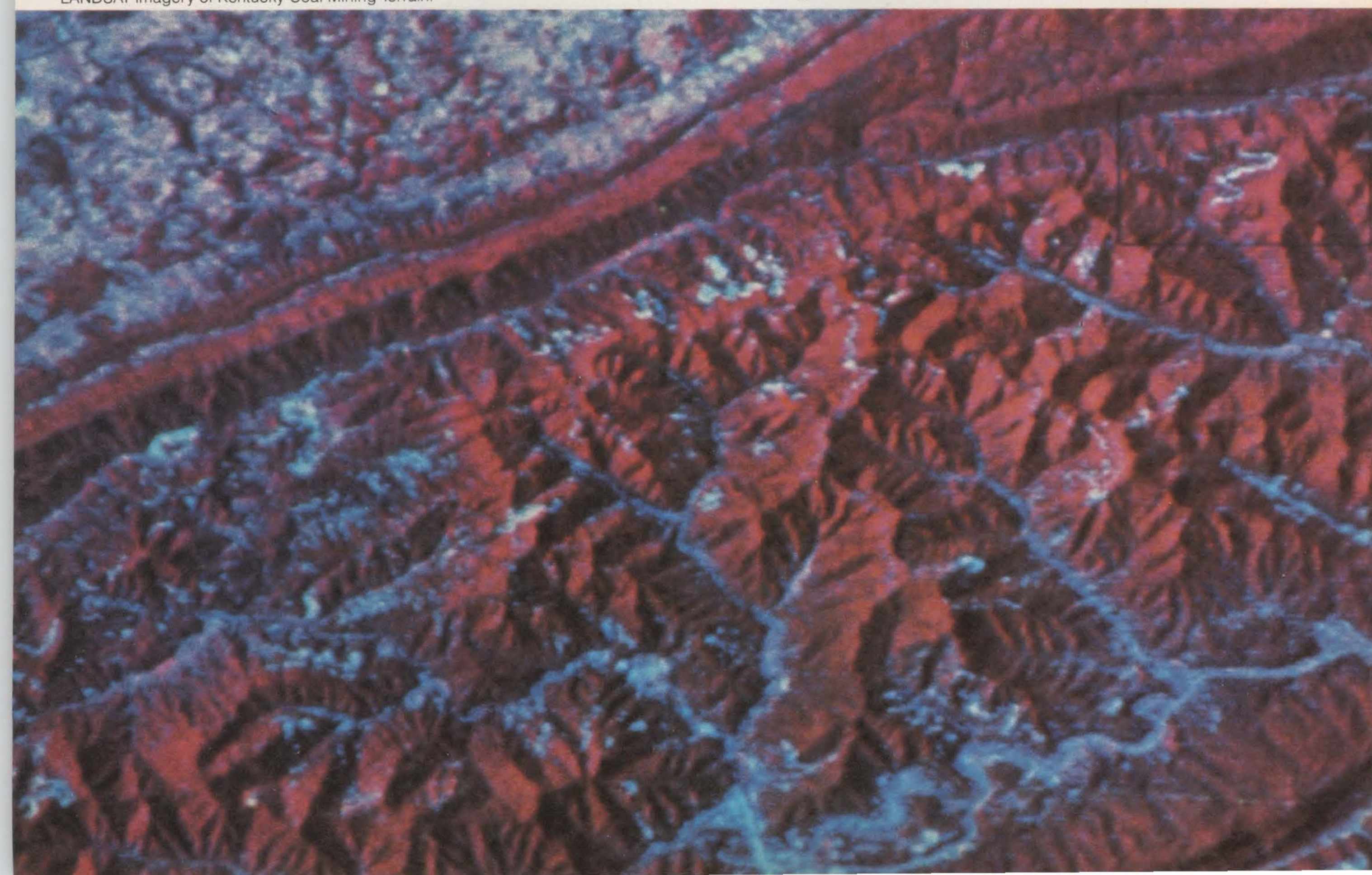
performance degradation. A second option was to design the system around a 16-bit processor, an ideal candidate for a multiprocessor, multi-user network. The problem here was the dearth of 16-bit software. Users would have had a powerful system, but nothing to run on it.

Micromation's decision was to design the Z64 with a Z80A and 64K bytes of RAM. Packaged on one board, this became the key element of the multiprocessing M/Net.

Next, the company examined the most appropriate bus. Intel Corp.'s MultiBus was initially considered because it was better defined than the S-100 and it offered a higher level of performance. The S-100 bus, however, offered a number of advantages. It was less complex and already working in Micromation's single-user computer system. The S-100 is easy to manufacture and is popular with users. Despite its lower performance history, the S-100 is growth-oriented, and Micromation was confident that its performance could be improved. Finally, the ready supply of engineers with S-100-bus experience would shorten development and repair time. Micromation plans to mix voice and data on a voice-grade phone line to aid in remote diagnostics. The company also intends to establish data links to mainframes and commercial networks via communications interfacing and software. ■

Peter R. Bolton is a technical consultant with Bolton Associates, Oakland, Calif.

LANDSAT imagery of Kentucky Coal Mining Terrain.

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NETWORKS

WangNet: a bold step forward?

WALTER A. LEVY, Edgewood Computer Associates, Inc.

Wang's local-networking system shows imaginative use of coaxial-cable technology and a hint that Wang is branching out

When Wang Laboratories Inc. announced its WangNet local-area network system last March, it did more than jump on an already-crowded bandwagon. The Lowell, Mass., firm introduced the most far-reaching solution to the problems of local-area networking yet to issue from a major computer-systems manufacturer. Thanks to its pioneering use of broadband coaxial-cable technology, WangNet can handle video, voice, facsimile and surveillance information as well as massive amounts of data. No other network scheme matches WangNet's gargantuan information-handling capacity.

WangNet is a technically strong product, and Wang's large installed base underscores the network's potential inpact. But there is a negative side, also. As a proprietary product, WangNet strikes yet another blow to the fragile efforts of the engineering and user community to erect local-area network standards before the tower of Babel gets too high. Moreover, it will be some time before WangNet is available. The product is still in the laboratory—as are most other announced networks—and is not expected to work its way through beta tests before mid-1982. Nevertheless, because of its implications, WangNet merits early examination.

WangNet is a broadband system based on standard CATV coaxial cable and components. WangNet uses frequency division multiplexing to divide the 350 MHz of bandwidth available from CATV technology into three independent bands: an interconnect band comprising a large number of point-to-point data channels, a 12M-bps time-shared channel called Wangband and a utility band that can be used for surveillance, instrumentation or teleconferencing.

WangNet's basic architecture (Fig. 1) consists of a main trunk cable looped on itself so that the cable passes each user device drop twice. The two parallel-cable segments are used separately for transmission and reception. Each connected device transmits on one side of the cable and receives from the other. As compared to the "mid-split" type of cable system, in which transmission and reception are frequency separated (Fig. 3), this method avoids the requirement for a head-end amplifier and provides twice the transmission capacity at the price of a double-cable installation (roughly 20 percent more than the price for a single-cable installation).

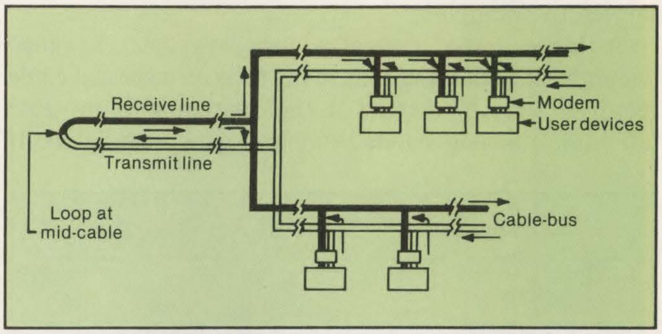


Fig. 1. In the WangNet cable architecture, *the main trunk is looped so that it passes each user device twice, to permit both transmission and reception. The WangNet cable is a single continuous loop, doubling back on itself. Each connected device has two separate ports to the cable: one for sending and one for receiving.*

Cable-borne information is distributed to outlets via four-port cable taps placed at convenient locations along the main trunk (Fig. 2). The taps support drops to three wall-mounted information outlets and a reserve for expansion. Line-extender amplifiers are required to maintain signal levels. WangNet has a 2-mile maximum-distance limit.

Allocating the frequency spectrum

WangNet allocates a portion of the cable's frequency spectrum to three service bands: interconnect, utility and Wangband:

- Interconnect band. Within this band, Wang and

By embracing broadband CATV technology, Wang has taken the high road from the viewpoint of long-term benefit to users.

other manufacturers' devices can communicate at speeds as high as 64K bps, via RS232C or RS449 interfaces.

• Utility band. This band is reserved for conventional 6-MHz video channels. Wang has not yet implemented control functions and interface devices for this band.

• Wangband. This band is reserved for a 12M-bps contention-type channel intended to link Wang computer systems and word-processing systems. It is not available for use with non-Wang products.

A significant portion of the frequency spectrum of the cable is unallocated. One can only speculate whether Wang has other products in the wings that use this capacity, or simply cannot figure out what to do with the excess. It would not be surprising, however, if Wang is considering the addition of a voice-switching service to WangNet.

(A large PABX typically supports 2000 to 4000 telephones. Switching that many calls on a coaxial cable requires 3.2M to 6.4MHz if the switching is in 8KHz full-duplex analog bands, which is easily available. If the switching is done in 64K-bps digitized voice bands, the cable bandwidth requirement is 80M to 160MHz. That, too, is available.)

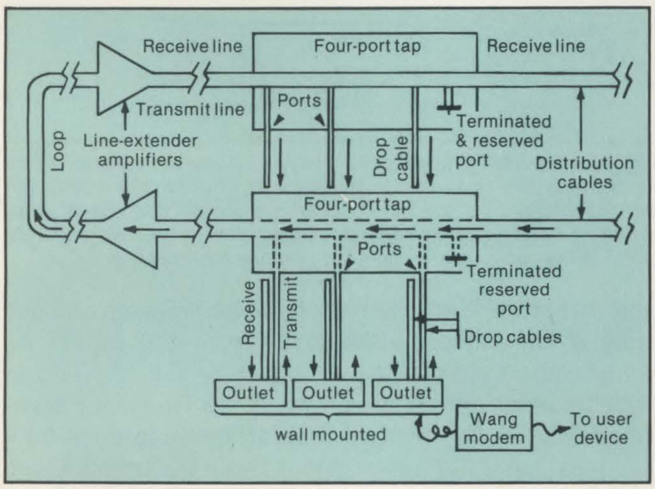


Fig. 2. Details of WangNet cable, *illustrating taps and amplifiers. Line-extender amplifiers assure adequate signal distribution along an entire cable. Four-port taps provide access to the main cable from user wall outlets.*

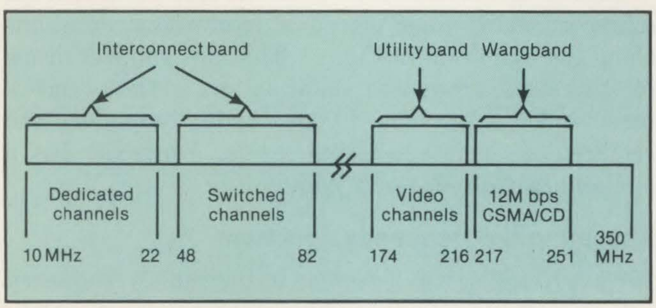


Fig. 3. WangNet frequency allocations. *WangNet provides many transmission services by taking advantage of cable's 350-MHz capacity. Note the extensive reserved zones.*

Device	Price
Interconnect Band	
9.6K-bps fixed-frequency modem	$850
64K-bps fixed-frequency modem	$1250
9.6K-bps frequency-agile modem	$1250
DataSwitch (includes CRT and floppy disk; printer is extra)	$12,000
WangBand	
Cable Interface Unit	$3800

Table 1. WangNet *component prices.*

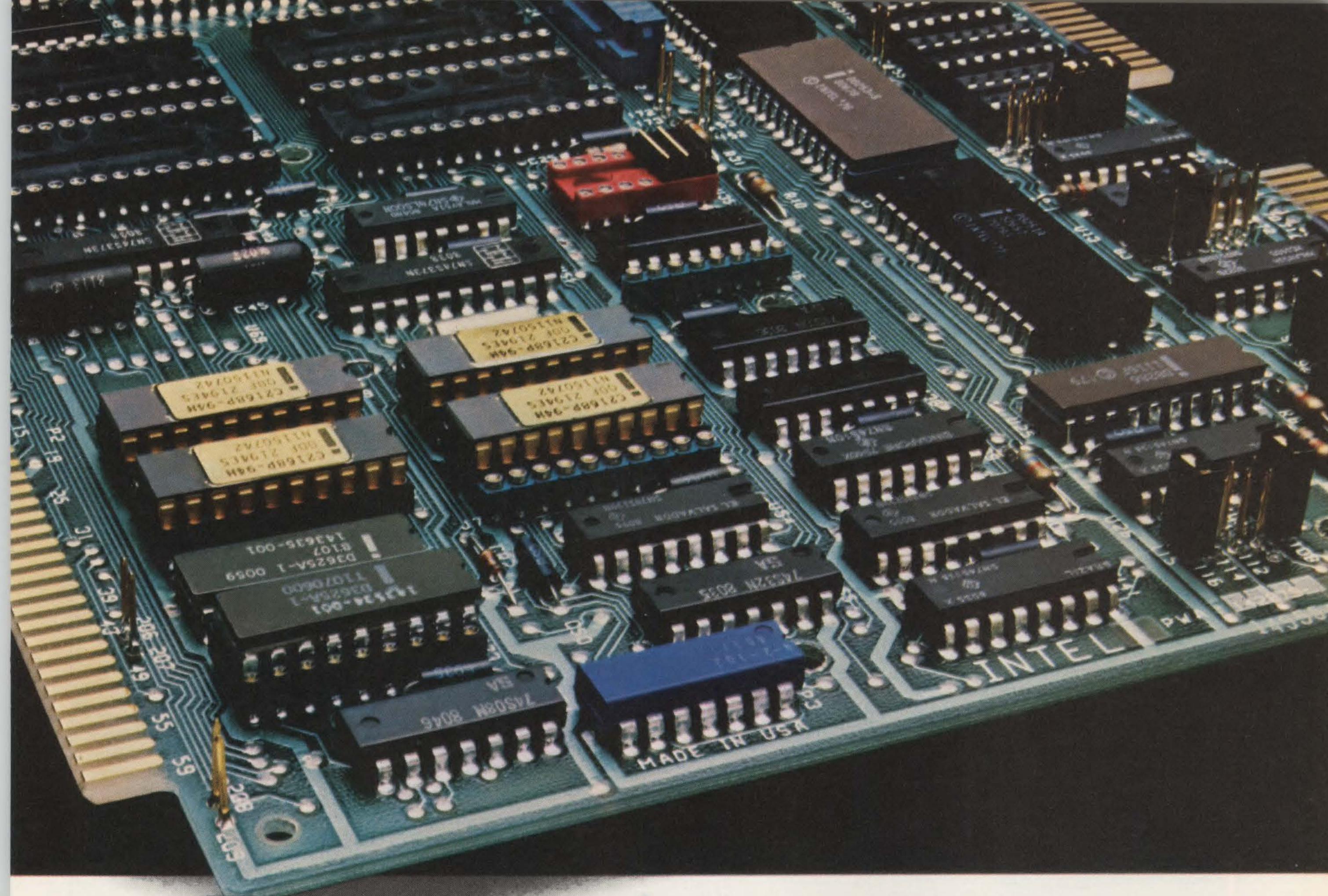
WangNet does not directly provide protocol conversion or gateways to other computer networks. It does support auto-dialer operation in the interconnect band, permitting off-network but compatible terminals to be called as though they were on-network. WangNet's two functional bands are likewise separate. Users of WangNet can overcome these limitations by using Wang computer systems to perform gateway functions. A Wang system can provide a link between the WangBand and the interconnect band. Wang has announced that its computer systems will support X.25 and SNA, and its systems now support bisynchronous communications. As a result, a user might be able to construct the required gateways by appropriate use of these computers.

How WangNet works

WangNet uses frequency-division multiplexing to provide two kinds of interconnect band channels, dedicated and switched:

• Dedicated channels. A pair of user devices is assigned to a dedicated channel by being equipped with modems whose frequencies are set to the channel (Fig. 4). The devices provide full-duplex transmission at speeds as high as 9600 or 64K bps, depending on whether an RS232C or an RS449 modem interface is used. Channel assignments can be changed only by operation of a manual switch.

• Switched channels. This 34-MHz band is divided into 256 channels, each able to support full-duplex communication between a pair of user devices at speeds as high as 9600 bps (Fig. 5). Devices are interconnected via variable-frequency (frequency-agile) modems whose frequencies can be set to any of the 256 channels in the band. Modems are assigned to channels by a device called the Wang DataSwitch in response to user requests. A protocol similar to that employed by telephone switchboards governs channel assignments. The DataSwitch polls each user device for call-placement requests via a special pilot channel within the switched-channel band. When it finds an active request, the DataSwitch either assigns the caller and callee modems to an available channel or advises the calling user that the callee is busy.



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CIRCLE NO. 137 ON INQUIRY CARD

It will not be surprising if Wang is considering the addition of a voice-switching service to WangNet.

The interconnect band is clean and simple to use; it imposes no protocol restrictions or compatibility requirements on its users. On the other hand, it solves no problems of speed, code and protocol conversion for a user with multiple types of devices. The separation of transmission paths and signaling path in the interconnect band permits the DataSwitch or a similar device to perform call placement for any type of device, requiring any available bandwidth. Thus, by simply changing modem parameters and frequency assignments, the interconnect band could be extended to video conference calls, voice calls or very high-speed digital data calls for inter-computer file transfers, interfaces permitting.

The WangBand contention channel is accessed via a cable interface unit (CIU) that contains a modem and performs high-level protocol functions. A Wang computer is linked to this unit via standard Wang 4.27M-bps twin-ax cable. The CIU's high-level functions rely on the Wang computer.

WangBand uses an interesting combination of techniques to link communicating devices. To resolve channel-access conflicts inherent in a contention system, it uses the same techniques employed in Xerox's Ethernet: carrier sense, multiple access with collision detection (CSMA/CD). This is possible because CSMA/CD's logical and timing characteristics are independent of any modulation scheme, whether baseband (Ethernet)

Band	Frequency Allocations	User connection requirements	Channel/band characteristics	Control methods	Data rates	Wang hardware required
	10 to 12 MHz (32 dedicated (channels)	RS232C from user device to modem	Full-duplex, transparent, dedicated channels for multipoint or point-to-point communications	Fixed-channel assignments with no master control over channels	As high as 9600 bps	One crystal – controlled, fixed-frequency modem per user-device communications port
Interconnect (dedicated)	12 to 22 MHz (16 dedicated channels)	RS449 from user device to modem	Full-duplex, transparent dedicated channels for multipoint or point-to-point communications	Fixed-channel assignments with no master control over channels	As high as 64 bps	One crystal – controlled, fixed-frequency modem per user-device communications port
	22 to 48 MHz	Reserved Frequencies				
Interconnect (Switched)	48 to 82 MHz (256 channels)	RS232C from user device to Frequency Agile Modem, RS366 for autodial	Full-duplex transparent channels for switched point-to-point communications	Frequency agile modems with a DataSwitch assigning channels for each session	As high as 9600 bps	One frequency-agile modem communications port, plus one Wang DataSwitch per WangNet system
	82 to 174 MHz	Reserved Frequencies				
Utility	174 to 216 MHz (seven 6-MHz channels allocations)	Type F 75-ohm, dual-captive, manually terminating plug from video equipment to user outlet	Standard CATV video channels	N/A	N/A	None
WangBand	217 to 251 MHz (contention for approximately 65,535 Wang VS, OIS and 2200 systems)	RG-59/U 75-ohm BNC/TNC dual-coaxial connection from Wang serial I/O controller to CIU	Virtual circuits	Carrier-sense multiple-access with collision–detection; CSMA/CD), binary – exponential backoff	12M bps (fixed)	One CIU per Wang system connected to WangBand
	251 to 350 MHz	Reserved Frequencies				

Table 2. The functional *and performance characteristics of the various portions of the WangNet.*

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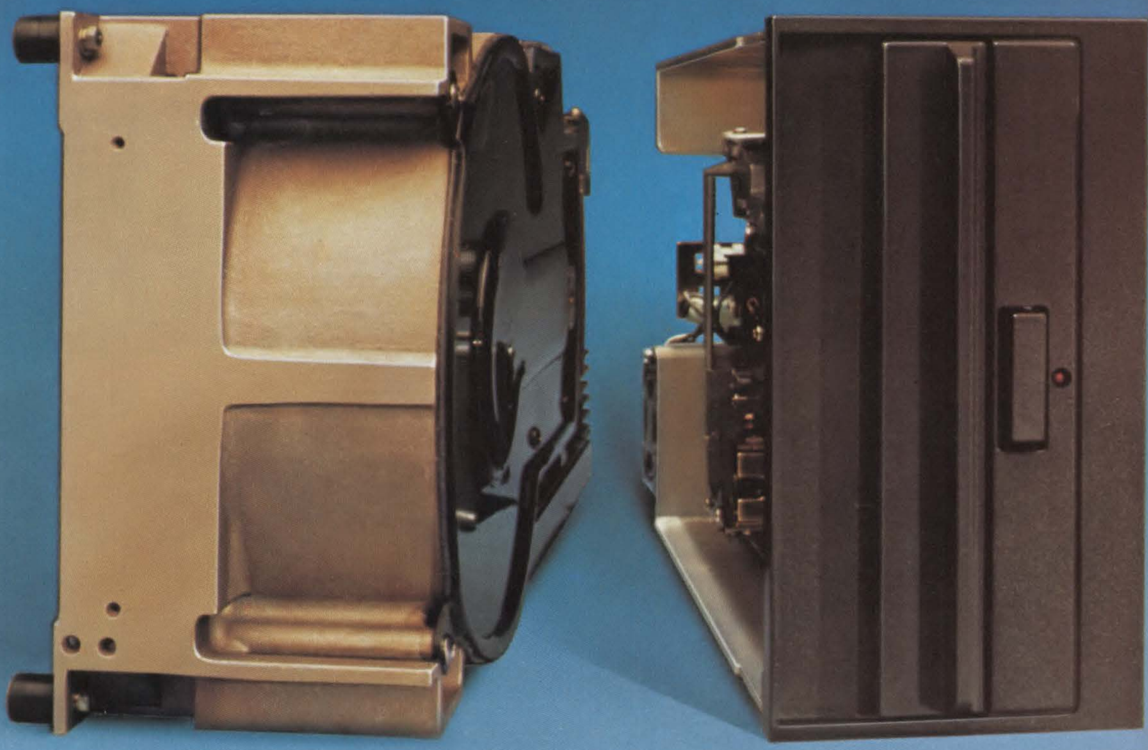

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CIRCLE NO. 138 ON INQUIRY CARD

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The WangBand contention channel is accessed via a cable interface unit that performs high-level protocol functions.

or broadband (WangNet). WangBand similarly borrows from packet switching in its data-transmission protocol. Data are framed in packets, using the conventions of HDLC, and the schemes for transmission, acceptance and acknowledgement are similar to but not identical with CCITT X.25 Level 2. The method for establishing data calls between users bears some resemblance to IBM SNA session establishment.

How WangNet competes in cost

The initial component prices established by Wang for 1982 deliveries (Table 1) are about the same as the prices for similar components offered by other networking suppliers. The basic CATV components (cable, connectors, line-extender amplifiers) are existing commercial products. The cost of this basic cabling is, in any case, almost totally dominated by installation-labor costs rather than by component costs and, therefore, depends on the complexity and status of building, local labor rates and the local competition for electrical contracts.

Wang will charge extra to engineer, install and integrate a WangNet system for users. Because component prices are comparable, one can assume that charges for engineering will be comparable to those of other suppliers. In any case, price comparisons should be made between similar systems and not between individual components. For example, Data PACX (port contention) systems sell for about $10,000 and $400 per connected terminal plus twisted-pair wiring. This can be fairly compared with the interconnect band price of $12,000 $1250 per connected terminal (for the modem) plus a portion of the price of the cable. The interconnect-band approach has to work off a cost disadvantage of more than $800 per connected terminal—not a very easy task on the surface. But frequency-agile modems, a comparatively new product, are not yet receiving the benefits of high-volume production, whereas older products are.

Wiring costs may also influence the relative costs of these systems. A port-contention system requires a star network with two separate twisted pairs of wires from each terminal to the switching system. WangNet uses a tree or loop of coaxial cable. Therefore, the amount of wiring required for WangNet can be expected to be much less than that required for a star network. This may mean lower wiring costs for WangNet then for older technologies and may partially offset the higher price of WangNet hardware.

Similarly, the $3800 price on the Wangband CIU might seem high compared to the $500 to $1200 prices being quoted for baseband network-channel interfaces. However, the CIU is a fairly sophisticated device. It uses a Z80 μp with 128K bytes of memory—64K bytes for programs and the remainder for user data buffers. The CIU performs a substantial set of higher level functions, such as user-to-user session establishment and management, off-loading the connected Wang host system, in addition to data-transmission control. The price of the CIU must be evaluated in this context.

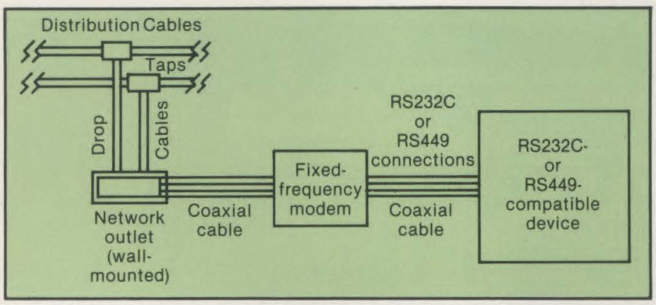


Fig. 4. Dedicated channel interface to the WangNet interconnect band. *Permanent device-to-device communications are provided by the dedicated-channel portion of the interconnect band.*

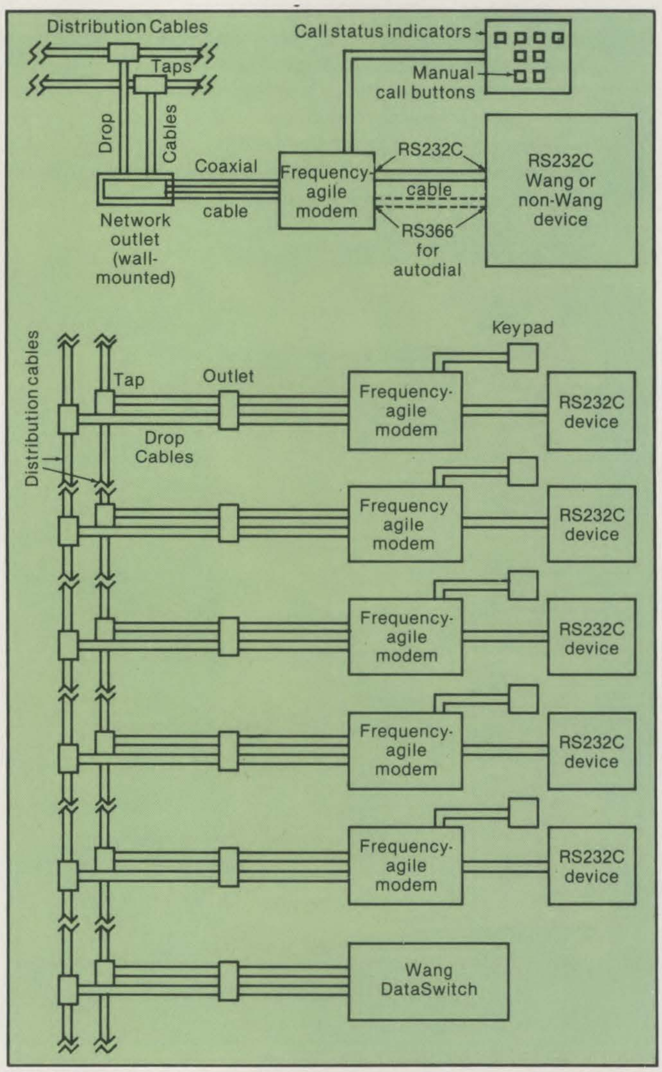
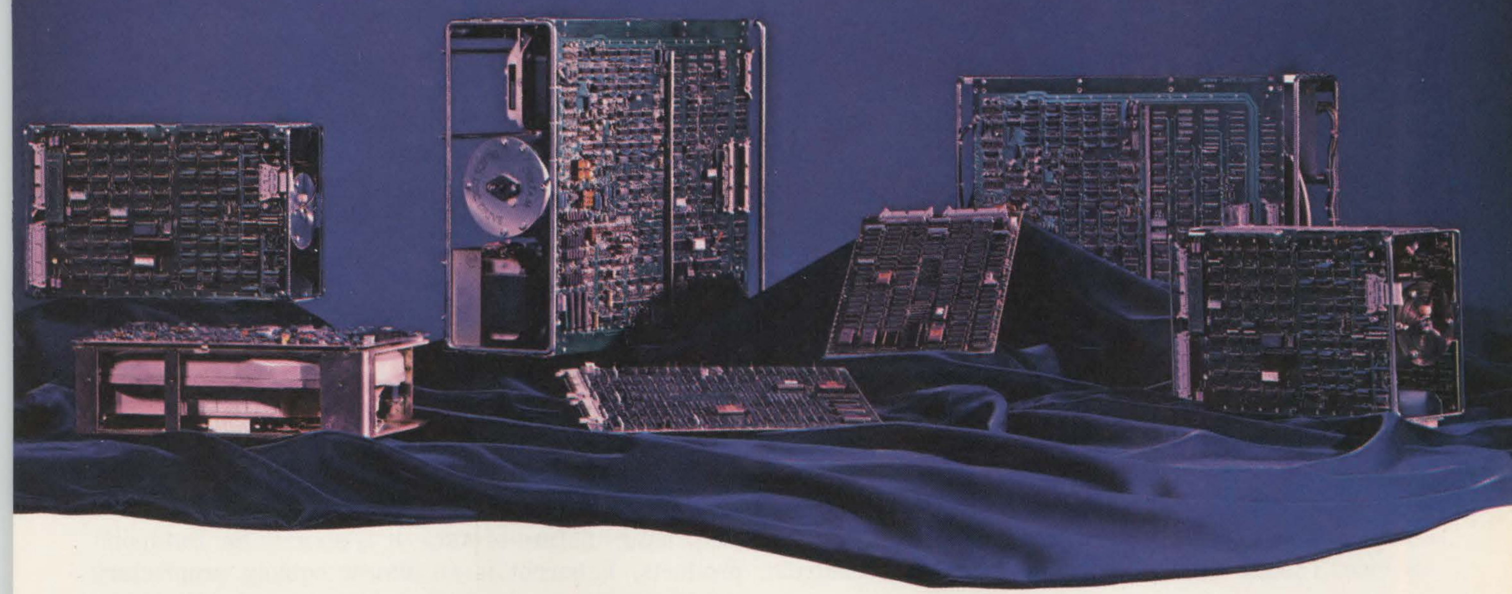


Fig. 5. Details of user interface. *Switched channels on the WangNet interconnect band. The switched portion of the interconnect band permits many devices to place calls quickly, using the fast switching availability of the Dataswitch for call setup. Once a call is set up, the WangNet service is transparent to users.*

PRIAM'S WINCHESTER COLLECTION



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CIRCLE NO. 139 ON INQUIRY CARD

WangNet allocates a portion of the cable's frequency spectrum to three service bands: interconnect, utility and Wangband.

In sum, by embracing broadband CATV technology, Wang has taken the high road from the viewpoint of long-term benefits to its users. The FDM method of using CATV cable provides far more capacity than does the baseband approach characteristic of Ethernet or ARC and infinitely more capacity per channel than data-switching PABX systems (to 56K bps) or port-contention systems (to 19.2K bps).

Given the state of the development of these systems, it appears that the broadband coaxial-cable technology is more expensive than the baseband. Prices of $800 to $1300 are not being quoted for the RF cable modems required for broadband systems compared to less than $500 for Ethernet transceivers, their functional counterparts. The companies quoting these prices, however, are just beginning to market their products, and they lack sufficient manufacturing and installation experience. As a result, users should not assume these prices are realistic or stable. Given the volume sensitivity of electronic manufacturing, prices will ultimately depend more on how many of a device are manufactured than on the apparent complexity of the device. Thus, a user who installs a flexible broadband system such as WangNet may believe he is initially paying more for a long-life open-ended system only to discover later that the system did not really cost more than the alternatives.

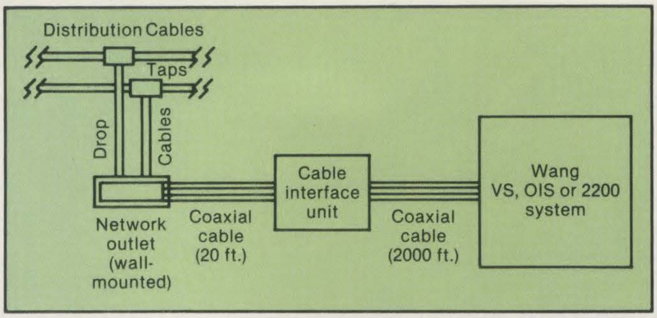
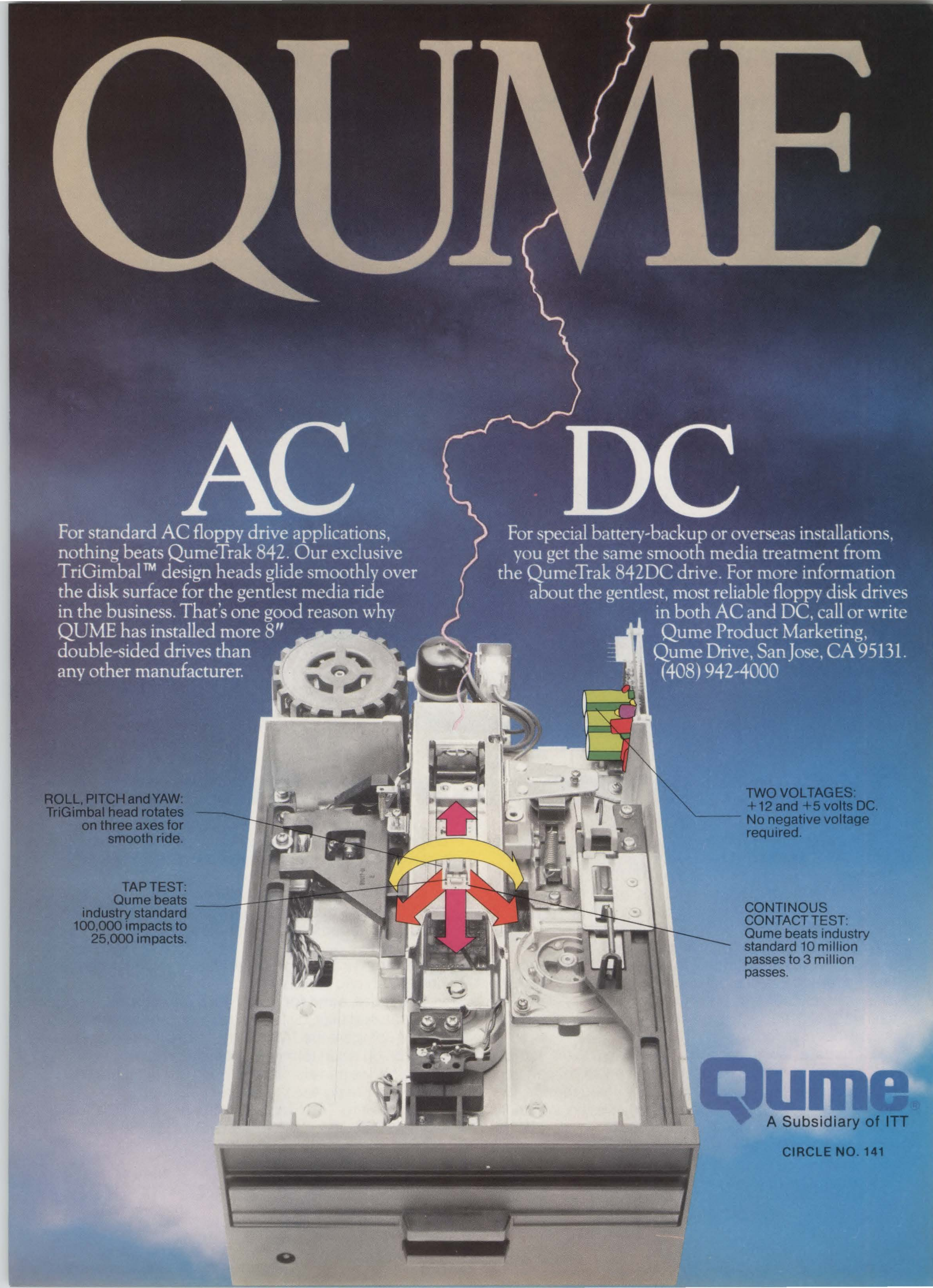


Fig. 6. Wang system interface on the Wang band. *Wangband provides a high-performance interconnection facility for Wang computers and word-processing systems.*

Wang's strategy, reflected in the design of WangNet, combines a courageous commitment to long-term product goals with a realistic understanding of the company's competitive position. Wang's principal competitors with local-area networks for distributed processing and office automation are Datapoint and Xerox, each of which has a high-speed, contention-type, local technology. The WangBand gives Wang a competitive equivalent. Datapoint's ARC network has been in use for several years. Datapoint makes no bones about the proprietary nature of ARC—it is strictly for Datapoint products. Ethernet is an almost equally proprietary product of Xerox, not withstanding its promotion as an industry standard. Although Xerox has published much data on Ethernet, and helped several small companies to become manufacturers of Ethernet components, Ethernet is still in beta test at selected user sites, and Xerox must reserve the right to modify the system in the face of broader experience.

Wang has indicated that it will cooperate with other vendors interested in building WangBand-compatible devices in the future, thus offering the possibility of competition between Ethernet and WangBand as the standard. Although Xerox has made its Ethernet designs available, the network is in use only inside Xerox and at a few beta test sites. Numerous organizations have objected to establishing an Ethernet standard, offering technical and business reasons. In the highly competitive domestic market, it is not reasonable to assume that many manufacturers would allow a large competitor's un-installed product to become an industry standard. IBM and AT & T, because of their dominant roles, can make their technologies become de facto standards but Xerox cannot. ■

Walter A. Levy is president of Edgewood Computer Associates, Inc., a New York consulting firm specializing in data communications, distributed processing and mini-computer applications.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CIRCLE NO. 143 ON INQUIRY CARD

A new role for magnetic tape

DENNIS H. MATHIAS, 3M Co.

Tape manufacturers see a bright future as technology for backup systems continues to evolve

The accelerating trend toward hard-disk storage hasn't diminished the need for magnetic tape, but it has changed it. Magnetic tape is rarely used today for primary on-line data storage, but because its new role as a backup medium for hard disks is critical, its continued use is assured.

Most early computer systems stored data on reels of removable, transportable tape, suitable for off-line filing. Very little on-line, resident storage existed, so little was vulnerable to destruction from operating power loss or other electronic or physical catastrophes. The development of resident-disk storage greatly improved system speed, capacity, throughput and sophistication, but these advantages carried a price: greater vulnerability to irretrievable destruction. For example, IBM's recently announced 3380 disk system stores 2500M bytes. This is a great stride foward, but it carries with it five or six times the risk of data loss compared to 300M- to 500M-byte fixed-disk systems.

With this trend toward fixed resident disks, tape has taken on a new glamour. The prime candidate for backup has been right here all along.

For the foreseeable future, tape systems for backup should be able to keep pace with growing disk-system capacities (Fig. 1). Today's typical backup strategies include:

- One or two reels of 100-ips, 1600-bpi, 40M-byte tape or a 67M-byte 3M HCD75 data cartridge can back single-disk cartridges with capacities as high as 30M bytes, data modules (the original Winchesters) and 8-in. hard-disk systems.
- Two reels of 200-ips, 6250-bpi, 150M-byte computer tape can back disk packs (storage modules) with capacities as high as 300M bytes. Users will tolerate one operator intervention during a backup dump; if more than two reels are necessary, manufacturers may encounter user resistance.

In a backup function, high-performance tape drives with precise start-stop capabilities are not of primary importance. Streamer drives are smaller, simpler, slower and less expensive than the high-performance tape drives. Although streaming-tape drives can be built to less demanding specs than formerly, the tape itself takes on new importance, particularly as resident-disk systems increase in speed, volume and density.

Fortunately, tape manufacturers can provide off-the-shelf answers to some just-emerging backup problems. For example, the IBM 3350's 300M-byte capacity taxes the limits of most computer tape. But manufacturers

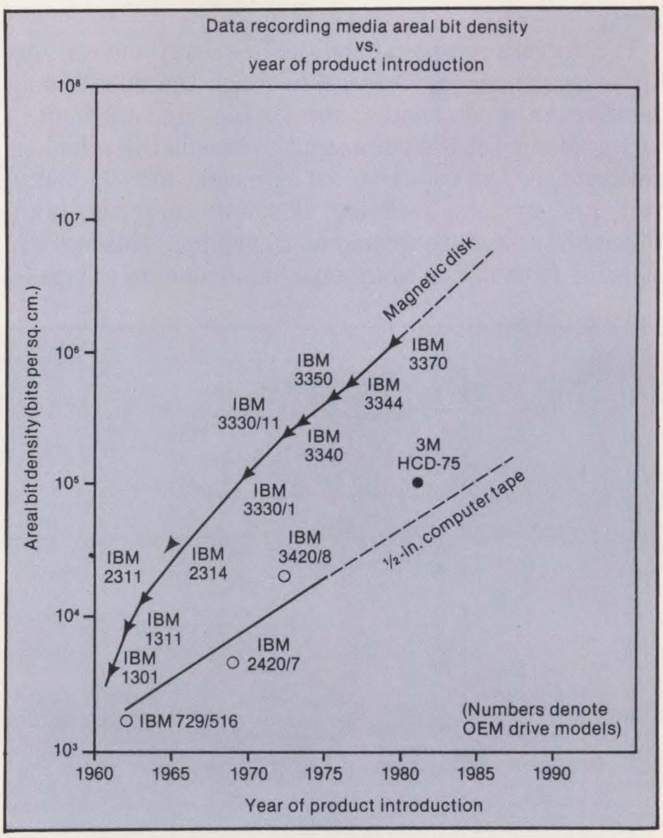


Fig. 1. Although it has a lower areal density *than disks, tape is a cost-effective backup because it is less expensive. Trend lines for areal density are shown as essentially parallel, indicating the likelihood that tape's cost-effectiveness will not diminish.*

Fortunately, tape manufacturers can provide off-the-shelf answers to some just-emerging backup problems.

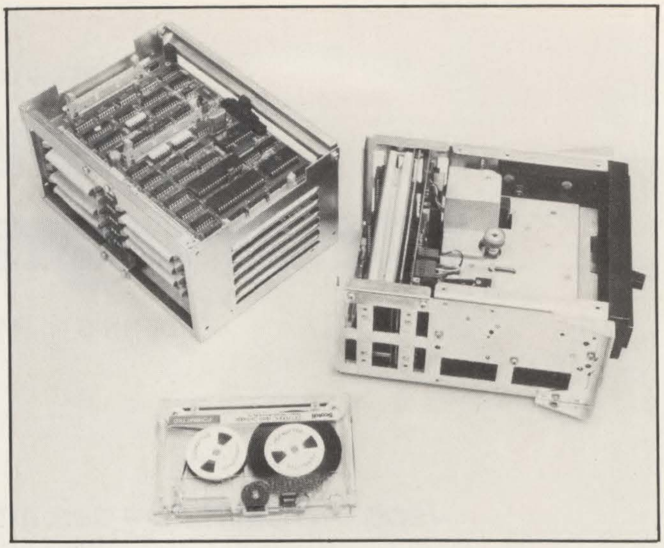
can meet the challenge of even the two-spindle, 2500M-byte 3380.

Manufacturers are competent in three levels of computer-tape technology, but only the first level has been explored. That technology is standard gamma-iron oxide, with coercivity of 300 oersteds, which provides a 6000-bpi density—sufficient for most digital applications. This level requires only that manufacturers continue to provide unblemished tape surfaces, making them as perfect as possible, and that designers provide drive systems that read and write around occasional imperfections, which could cause data loss.

Audio- and video-tape users have just touched upon the second level of computer-tape technology, which has coercivities of 500 to 700 oersteds and densities as high as 60K bpi. This level, which is only now being used in a few data-recording applications, uses better-performing cobalt-doped gamma-iron oxides, stabilized magnetite, chromium dioxide and other substances.

Even the third level is a commercial reality in audio work. Using fine metal particles, third-level tape has coercivities of about 1100 oersteds and potential densities as high as 100K bpi. Few tape drives on the data-processing market are geared for the two higher levels.

The necessary tape capabilities are ready and waiting for principal on-line storage to reach the speeds and densities tape can handle, and for tape-drive manufacturers to market the equipment to handle these higher performance tapes. The 3M Mincom HCD-75 data-cartridge system uses the DC600HC cartridge with 500-oersted tape, recording at 10,000 bpi. This system includes 16 tracks on ¼-in. tape, equivalent to 64 tracks on a 1-in. width. 3M's 1-in.-wide instrumentation tape typically records as much as 60 bpi on as many as 42 tracks, and higher density ½-in. tapes featuring higher coercivity pigments, can be expected.



Controller formatter module *of the HCD 75 cartridge-drive system (left) can be attached to the drive module or can be placed as far as 15 ft. away. Each module can control four drive modules. The system uses the ¼-in. DC-600HC data cartridge (foreground).*

Far from being in a buggy-whip pattern, the tape industry has a good present and a bright future. One recent guesstimate is that about 4½ million miles of ½-in. computer tape have been produced for the data-processing industry to date. That's equivalent in length to about nine round trips to the moon. But as data processing continues to grow and the need for backup burgeons, the tape yet to be produced could make that estimate obsolete. ■

Dennis H. Mathias is tape products development manager for the Data Recording Products Division of 3M Co., St. Paul, Minn.

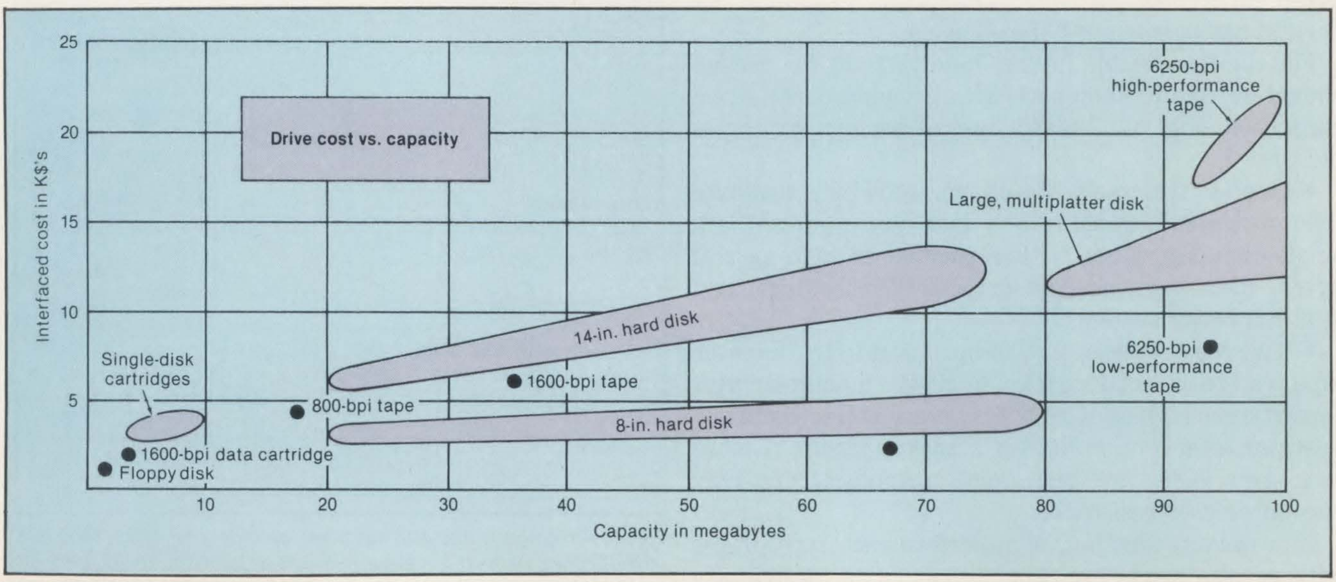


Fig. 2. Cost/capacity diagram *illustrates the relative positions of storage alternatives. The asterisk shows 3M's high-capacity HCD 75 tape-cartridge drive.*

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CIRCLE NO. 145 ON INQUIRY CARD

APPLICATIONS: SPEECH SYNTHESIS

Hatching the 'electronic parrot'

Superminis and μcs team up at Milton Bradley to produce games that talk back to players

Not long ago, computerized speech processing was just another branch of artificial-intelligence research, conducted in university and industrial laboratories on $1-million mainframes. But the lure of a mass consumer market, which demands both portability and affordability, has brought speech processing out of mainframes and into μcs in the form of electronic games.

The transition from mainframes to μcs, however, involves more than simply developing and down-loading programs; it requires a partnership of systems from superminis to μcs. Such is the case with talking games, such as MB Electronics, Inc.'s "Milton".

Evolution of Milton

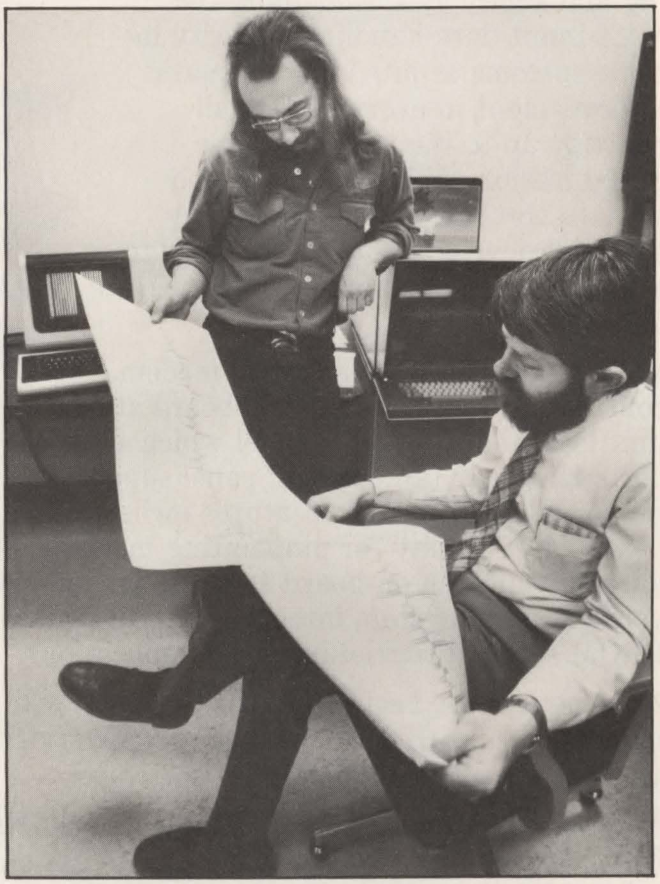
Introduced last year, Milton is a voice-response, word-matching game housed in a 10-in.-diameter plastic case. It is μp-controlled and pre-programmed in 12K bytes of ROM, and responds audibly to push-button commands with synthesized phrases from a 90-word digitally recorded and internally stored vocabulary.

Electronic games evolved as spin-offs of research on devices for industrial automation, education and aids for the handicapped. As the consumer market grew, however, electronic-game development has also affected speech research.

Paul Ahrens, director of advanced research at MB Electronics (a subsidiary of Milton Bradley Co., Springfield, Mass.), says that computerized speech synthesis and recognition is basically a predictive-coding and signal-processing application. Much of the pioneer work, he says, was done by Signal Technology, Inc., Sunnyvale, Calif., which markets the interactive-language system software package. ILS is a research tool that pre-filters digital data and displays waveforms graphically.

Given the state of the art in computer technology, creating speaking electronic toys or games appears to be relatively simple. A human speaker records words with varying inflections onto magnetic (audio) tape. The signals are then encoded by an A/D converter and recorded on disk or mag tape.

When a sufficient vocabulary is accumulated, the



Technicians at MB Electronics *inspect a printout showing a digitally converted and reconstructed waveform. In addition to reducing data content, technicians adjust the signal to compensate for the speaker and amplifier characteristics in the final product.*

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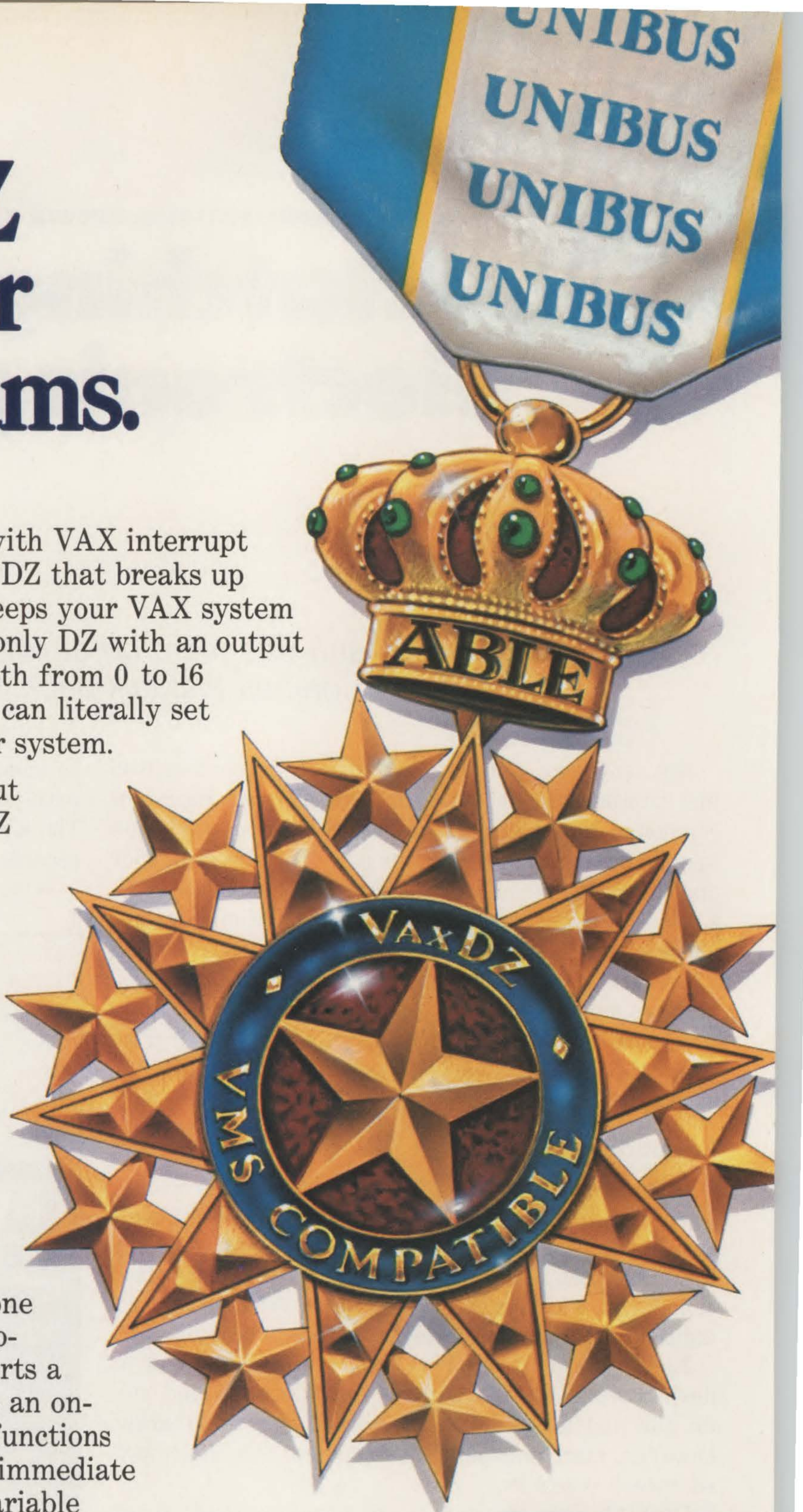

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CIRCLE NO. 146 ON INQUIRY CARD

Electronic games evolved as spin-offs of research on devices for industrial automation, education and aids for the handicapped.

proper words for the game being developed are selected and placed in the ROM, the speech chip, of the game's μp. The μp can then reproduce phrases, under control of a stored program, through a small D/A converter, amplifier and speaker. In practice, Ahrens says, speech conversion and preparation require a combination of off-the-shelf and custom-developed computer hardware and software.

The computers coordinate

The heart of MB Electronics' speech-synthesis system is a VAX-11/780 with 2.5M bytes of internal memory, a floating-point accelerator, 352M bytes of disk storage, a magnetic-tape drive, an eight-line terminal multiplexer and a DR11-B high-speed interface.

Three Tektronix graphics terminals are used for waveform display and manipulation, and several VT-100 terminals support program development and execution. Five Motorola and Intel μp systems develop and assemble game-control programs. Now independent, these μp system will eventually be tied to the VAX for program cross-assembly and storage.

Installed in 1980, the system was enhanced last December by the addition of a specially configured, combination real-time A/D converter and DMA device. This unit, which consists of an analogic converter and a Motorola M6800 μp, pre-processes the information for file storage on the VAX system at 10,000 16-bit samples per sec.

"Real-time data conversion and storage has greatly speeded our speech research and development," Ahrens says. "Prior to acquiring the VAX, we used a pair of μp systems as data-collection points, sent the data to the company's central computing system for analysis and massage, then brought final data back to the μps for loading onto speech chips.

"The data path was a 9600-bps ASCII code link, which kept the process slow," Ahrens continues. "With our present system we can convert, transfer and load data as much as 20 times faster than before."

Speech synthesis

The production of artificial speech begins in an anechoic chamber, in which whole words (not syllables) are recorded and then played back to verify fidelity. Recorded signals are converted and stored in 5-min. segments; approximately 146 min. of speech can be stored on a 176M-byte disk pack.

At a 160K-bps sampling rate, the quality of the digitally recorded and reproduced material is indistinguishable from that of the original analog recording. To achieve that fidelity in a consumer-level electronic game, however, is neither physically nor economically practical. Fitting all electronic and reproduction components into an easily portable housing, as in the case of Milton, means restricting speaker diameter to 2 in., obviating the need for a high-fidelity signal.

More important, retaining all the digital information from the original conversion requires a prodigious memory—already the most expensive component in small electronic games.

"Milton, which sells for $60 to $70, stores a 90-word vocabulary, plus programs, in a 12K-byte ROM," says Ahrens. "That means instead of a 160K-bps data rate, you need a 1K-bps encoding rate. Otherwise, the cost of ROM becomes prohibitive."

This is the most complex part of speech synthesis: reducing the amount of information in the digital signal by a factor of more than 100, while preserving intelligibility and a semblance of oral expression with compact, low-cost reproduction components.

Using Tektronix 4014 and 4010 graphics terminals on-line to the VAX-11/780, MB Electronics engineers call up digitized information for each word and display waveforms showing frequency and amplitude against time. Pitch periods, which delineate basic vocal-cord

"Milton," displayed here by Paul Ahrens, *director of advanced research at MB Electronics, uses a speech chip equivalent to the two ICs shown in the foreground.*

The heart of MB Electronics' speech-synthesis system is a VAX-11/780 with 2.5M bytes of internal memory, a floating-point accelerator, 352M bytes of disk storage, a magnetic-tape drive, an eight-line terminal multiplexer and a DR11-B high-speed interface.

response, are mapped and analyzed to define essential characteristics of tone and enunciation. The waveform can then be segmented and restructured to compensate for μp and small-speaker characteristics, and to reduce the data further before loading into speech chips for the final product.

The result is an audio signal that contains much less digital information than the original, but is still comprehensible. Except to a trained eye, the displayed analog waveform is nearly indistinguishable from the original. Aurally, Milton's "voice" approximates telephone-receiver quality.

Except for the ILS display package, speech R & D programs originate in-house. Except for some FORTRAN control routines for the DR11-B, programs are written in Pascal for easier interpretation. The VAX system will soon have five DR11-B high-speed interfaces to support four analog I/O units in addition to the DMA converter device now in use. Then, says Ahrens, speech R & D will progress even faster.

"Much of the effort is toward both raising the sophistication and lowering the cost of speech-response products," Ahrens says. "Until now, price is partly driven by the cost of ROM. We're looking for ways to solve that problem, both by control of bit density and through economical programming." ■

NEXT MONTH IN MMS

Watch for Mini-Micro Systems' annual special report on computer graphics in the December issue. A comprehensive product profile of computer-graphics terminals will lead off the feature section, which will be augmented by several other graphics-related articles, including:

- A look at a new hardware/software design technique that provides extremely fast three-dimensional raster graphics processing.
- A tutorial on digitizer resolution and accuracy.
- A survey of color-graphics terminals for VLSI.
- Two articles on the use of color graphics and computer animation for geophysics modeling.
- A look at the use of dot-matrix printers for both text and graphics printing.

Mini-Micro Systems will present its sixth annual report on printers in the January, 1982, issue. The report will include product profiles and comprehensive surveys of serial and impact-line printers. Also scheduled is a look at a new low-cost color-graphics printer.

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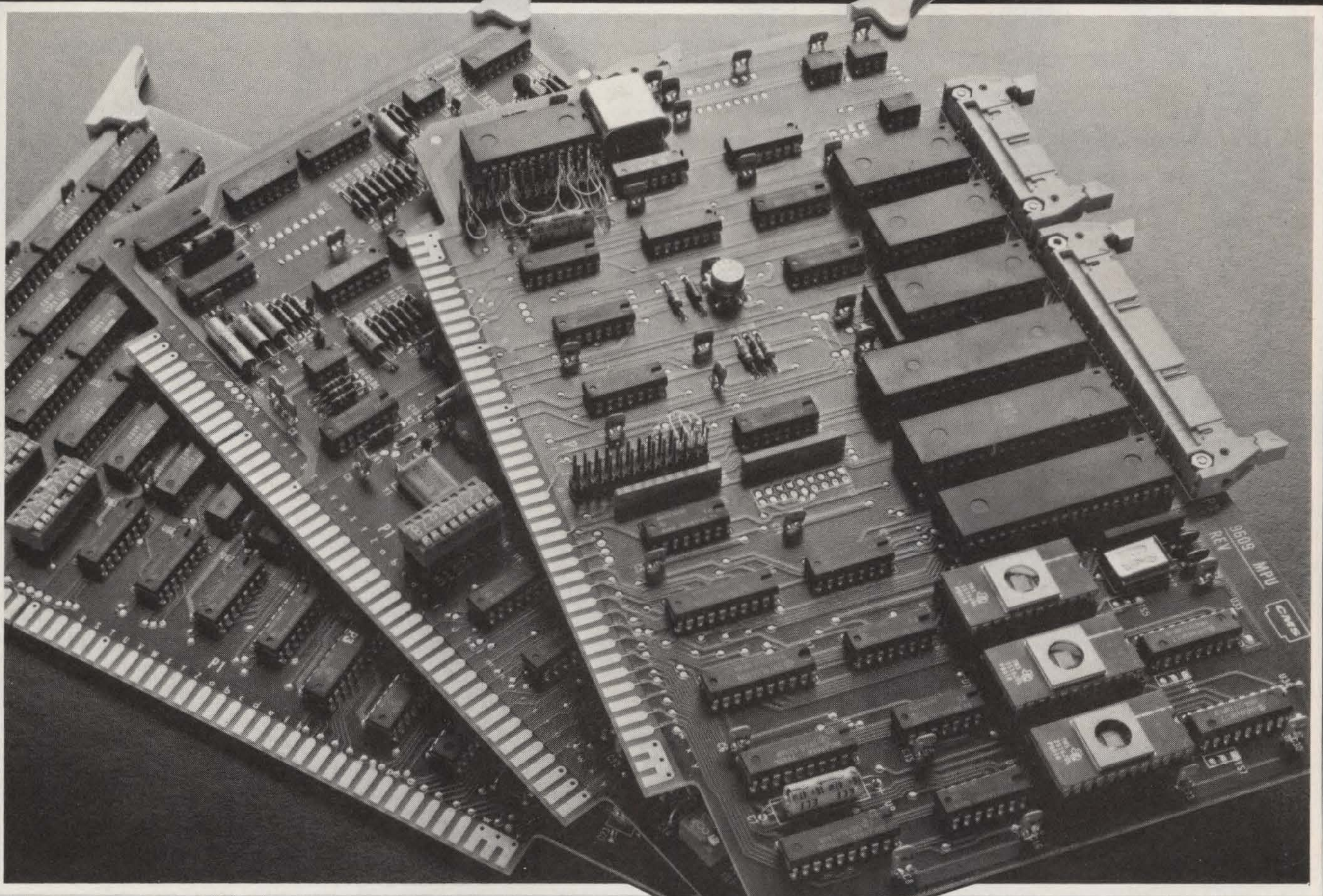

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CIRCLE NO. 148 ON INQUIRY CARD

P-E targets new low-end system for commercial sales

A month after releasing its RQL/32 relational query language and report-writing software package to the commercial 32-bit market, Perkin-Elmer Corp., Oceanport, N.J., is attempting to dive deeper into commercial waters with the introduction of a low-end 3200 series computer, the 3210.

Richard Donnelly, product marketing manager for Perkin-Elmer, expects the 3210 to do well in the business-computing market, particularly among commercial transaction-processing users. The system's price, starting at $49,900, and its application software and compatibility with larger 3200 machines, should appeal to that market, he says.

Since announcing its first 32-bit system in 1974, Perkin-Elmer has installed more than 4500 machines —about 75 percent of those in the scientific/technical arena. Sales in the commercial market have been picking up since the introduction of the 3200 series in 1979, however, and Donnelly estimates that about 45 percent of current sales are to nontechnical users. He says that figure should increase with the 3210 release.

Perkin-Elmer plans to concentrate its marketing efforts for the new system on users of 16-bit Digital Equipment Corp. and Data General Corp. systems. "The 3210 should be attractive to those users who want to move up to 32-bit performance," Donnelly explains. "It (the 3210) fills a price gap left open by our competition."

Donnelly says a 3210 configuration selling for $58,700 compares to DEC's lowest priced 32-bit system, the VAX 11/750, selling for $89,900, or Prime's 250-II, selling for $65,500. The lowest priced configuration of DG's new MV/6000 32-bit machine sells for more than $25,000. "The 3210 is designed for price-sensitive users who require 32-bit performance as well as upward mobility," Donnelly adds.

Arun Taneja, manager of processor products in DG's information-systems division admits that a price gap exists in the market but says that, as 32-bit technology evolves, more companies, including DG, will fill that gap. "There are a lot of applications open to low-end 32-bit systems that high-end 16-bit machines cannot handle because of addressability problems or their inability to process large data arrays," he says. "It's a step function to go from 16- to 32-bit systems, but soon we'll see a much smoother progression."

The basic 3210 system includes the 3210 CPU, 512K bytes of memory, 16M bytes of cartridge-disk storage, 16M bytes of Winchester-disk storage, a Perkin-Elmer model 550 console terminal, a power supply and battery backup, a memory error logger, a loader and a real-time clock. The 3210 is packaged in a 30-in.-high cabinet.

With true 32-bit data and memory paths, the 3210 CPU provides a memory-management system for memory segmentation, relocation and protection under operating-system control. The system's dual-bus architecture consists of a

The basic 3210 system, *designed for commercial use, includes a CPU, 512K bytes of memory, 16M bytes of cartridge-disk storage, 16M bytes of Winchester-disk storage and a console terminal.*

multiplexer bus to interface slow devices, such as printers, terminals and card readers, and an enhanced DMA bus with an 8M-byte-per-sec. bandwidth and four ports for fast secondary storage devices, such as disks and tapes. An optional floating-point processor providing 48 double- and single-point instructions is also available.

The system supports as much as 4M bytes of directly addressable main memory, expandable in 512K-, 1M-, and 2M-byte modules using 16K or 64K RAMs. While the 64K chip, supplied by two Japanese manufacturers, is available only with the 3210, it will eventually be phased into the rest of the 3200 product line, Donnelly says.

The integrated cartridge-/Winchester-disk-drive storage system can be configured with 16M, 48M or 80M bytes of Winchester storage plus an additional standard 16M bytes of removable-disk storage. Manufactured by Ampex, the storage system uses 14-in. platters.

Software-compatible with Perkin-Elmer's 3220, 3230 and 3240, the 3210 incorporates the company's OS/32 operating system and is also offered with Perkin-Elmer's version of UNIX, Edition VII Workbench. For commercial applications, the machine runs COBOL, RPG II, Reliance, DMS32 and RQL/32. Scientific languages include Pascal, COROL 66, BASIC II and CAL MACRO.

Besides commercial transaction processing, the 3210 is also targeted at scientific-research, CAD/CAM, simulation/training, seismic-exploration and aerospace and weapons applications.

A complete commercial development system with two terminals, a CP180 printer, Reliance and COBOL software sells for $63,900. A technical development system, including two terminals, MTM and FORTRAN VII software, is priced at $56,900.

—Frank Catalano

8-in. Winchester drives aimed at Naked Mini line

A family of 8-in. Winchester-disk drives, aimed at integrating Winchester technology into the Naked Mini 4 product line, has been introduced by Computer Automation, Irvine, Calif. Sources at CA's

Naked Mini Division say major changes in peripheral packaging and pricing will allow OEM customers with LSI-2 or NM-4 computers to maximize profit margins.

Designated the model 45621, the drives are available in 5M-, 10M- or 40M-byte capacities, with integral 1M-byte quadfloppy backup units offered as bundled sybsystems or unbundled component parts. The subsystem package includes Shugart Associates and Quantum Corp. drives, as well as a controller chassis, power supply and interconnect cables.

CA sources say the drives and components are being sold at prices below those of the original manufacturers—a strategy with which CA hopes to gain a reputation as being "flexible to the needs of the OEM customer."

The 5M-byte subsystem sells for $5300; the 10M-byte version for $5700; and the 40M-byte version for $7700. **Computer Automation, Naked Mini Division,** 18651 Von Karman, Irvine, Calif. 92713.

Circle No 241

Sperry adds software, PC boards to V-77 line

A stand-alone transaction-processing software system that supports as many as four Sperry UTS-10 buffered CRT terminals on a V-77 minicomputer with 64K bytes of main memory has been introduced by Sperry Univac. Called Minito, the system operates under the VORTEX operating system with the firm's PRONTO transaction monitor.

Minito uses a 10M-byte cartridge-disk drive with controller and a 200-cps printer. The V-77 VORTEX I operating system, PRONTO transaction monitor, various utilities and a file editor are also included.

The system includes a set of pre-packaged circuit boards for the V-77-800 system. The set includes two CPUs, a cache, a memory-mapping board, interconnection cables, power-fail mechanisms and a real-time clock. The new offerings are aimed at first-time or small-systems users, software houses, systems integrators and other third-party participants.

Minito software is licensed for $2000. V-77-800 board sets are priced at $22,000, plus a $275 monthly maintenance fee per set. **Sperry Univac, Minicomputer Operations,** 2722 Michelson Dr., Irvine, Calif. 92713.

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- Dimensions identical to industry standard minifloppies.
- Track density 270 tpi.
- Recording density 10202 bpi.
- MTBF: 11000 POH.
- Delivery: 90 days ARO.

Cii Honeywell Bull
OEM Division

Cii Honeywell Bull : 78340 Les Clayes-sous-Bois, France. Tél. : (3) 462.70.00.
Sunninghill - Berkshire - Great Britain. Tel.: (0990) 23491.

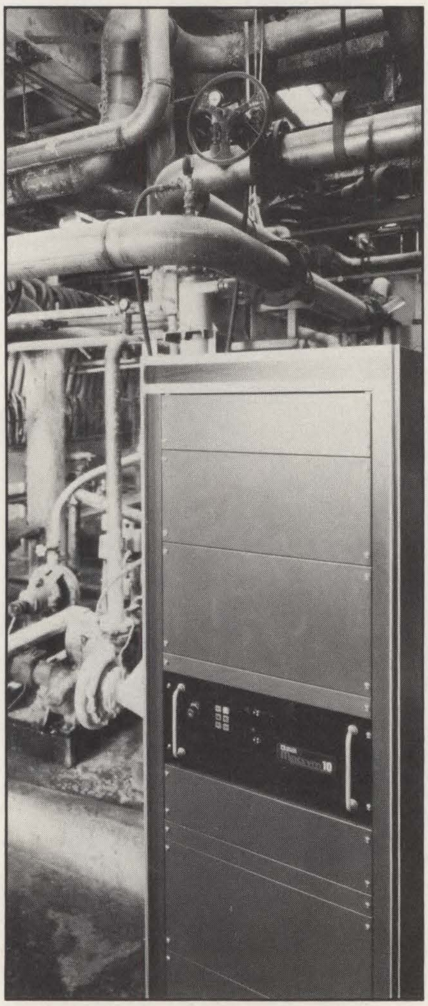
Feldman, Calleux & Associés

CIRCLE NO. 152 ON INQUIRY CARD

New Products

Macsym 10 withstands harsh factory settings

A computer system for harsh environments is available from Analog Devices, Norwood, Mass. Called the Macsym 10, the system is targeted at industrial OEMs for real-time process-control and test-and-measurement applications. Incorporating solid-state memory, the Macsym 10 eliminates the need for tape-cartridge or floppy-disk drives, cutting the number of moving parts that could jam or break down in industrial settings.



Analog Devices Macsym 10 system for harsh environments *is targeted at real-time process-control and test-and-measurement applications.*

Sold in 32K- or 40K-byte user PROM models, the system contains Intel Corp. 2732 n-channel MOS chips.

A basic system includes a 16-bit processor with floating-point firmware; 96K bytes of RAM, expandable to 128K bytes; an A/D I/O controller, a PROM board, MAC BASIC software, and software and hardware manuals. The Macsym 10 also includes a real-time clock, battery backup protection and communications via an RS232C port or a 20-mA current loop.

Analog Devices offers 27 signal-conditioning cards, which interface the system to industrial sensor and actuator devices and can be used on the company's Macsym 10, 2 and 20 systems. Isolated and non-isolated thermocouple strain-gauge, RTD and analog-input multiplexer cards are also available. The controller manages data-acquisition interfaces and isolates the digital bus shared by the CPU, memory and other peripherals from the low-noise analog bus.

Users can develop their own programs on the Macsyn 10 by connecting a CRT terminal and a floppy-disk-drive unit to the system via the RS232C port. Once programs are developed and debugged, they can be burned into PROM using Analog Devices' PRP01 programmer.

The Macsyn 10 can be operated within a 5 to 50°C temperature range and is available with NEMA 12 enclosures to protect against dust. A system with 96K bytes of RAM and space for 32K bytes of user PROM is priced at $12,300. A 128K-byte RAM and 40K-byte PROM system is priced at $13,400. Delivery is six to eight weeks. **Analog Devices, Inc.,** 3 Technology Way, Norwood, Mass. 02062. **Circle No 243**

New Systems

Tektronix introduces integration unit

The model 8540 μc development lab provides a hardware/software integration facility for software developed with a host computer. The unit can be interfaced to a host computer via an RS232C terminal port, and data rates are selectable to speeds as high as 9600 bps. The 8540 can be connected to the host via data sets (modems) or with a hard-wired connection for local configurations. The unit's program memory can accommodate as much as 128K bytes of program code that can be substituted for prototype memory. The program memory can be mapped to reside at different logical addresses, enabling emulators to be used to support the addressing abilities of 16-bit chips. Price is $10,900, an optional host interface package sells for $400, and a PROM programmer sells for $1650. Emulator prices range from $4000 for 8-bit emulators to $6500 for 16-bit emulators. **Tektronix, Inc.,** P.O. Box 1700, Beaverton, Ore. 97075.

Circle No 244

Computer has 19 RS232 ports

The Q1 68000 computer incorporates 19 RS232 ports for program-selectable synchronous and asynchronous communications at speeds as high as 19.2K bps. SDLC/DMA communications to 800K bps are optional. The system includes an 8-in. floppy-disk drive, a Winchester disk with tape-cartridge backup and a CPU in a 19-in. rack. The Winchester stores 20M bytes of data, with an additional 20M bytes optional. The floppy disk comes with support software to enable media from IBM and CP/M to be converted. The 8-MHz 68000 processor uses a 16-bit external data bus and has 32-bit internal values. The system has 16M bytes of addressable memory, a 256K-byte main memory, an eight-color 80- × 24-in. CRT display and a 100-station keyboard with numeric pad and function keys. **Q1 Corp.,** 125 Ricefield Ln., Hauppauge, N.Y. 11787.

Circle No 245

Burroughs announces document systems

The S 6000 intelligent document-processing system operates as a free-standing system, connects to a host computer or communicates with a remotely located computer. The unit includes 12 to 36 pockets and processes as many as 545 documents per minute. The unit performs reading, sorting, data capture, correcting, fine sorting, a variety of reporting functions and transfer of completed data to a host or central computer by data communications or tape. With single or dual readers, the S 6000 reads MICR- and OCR-encoded documents. Mixed readers are available for applications involving credit-card receipts, utility bills and other kinds of payment documents. Prices range from $62,000 to $125,000. Lease rates are $1900 to $3800 a month. **Burroughs Corp.,** Detroit, Mich. 48232.

Circle No 246

Microtex unveils image-processing system

The model 7400 image-processing development system features a VT-103-based desk-top work station, which includes an LSI-11/23 μp computer system, a data-acquisition subsystem, as many as two Reticon line-scan or matrix-photodiode cameras and 10M bytes of data storage. The μp includes a floating-point processor, 226K bytes of memory, a memory-management module, two serial lines and a clock. The system also has a 9M-byte Winchester disk and a 1M-byte floppy disk, a 6800 image- and signal-processing data-acquisition subsystem, a video terminal and keyboard and RT-11 software, including FORTRAN IV. **Microtex,** 80 Trowbridge St., Cambridge, Mass. 02138.

Circle No 247

Data-processing system uses CP/M

The Inspector 200 turnkey data-processing μc system, intended for manufacturing, engineering and quality-control data processing, includes an 8085 and an 8088 μp, both operating at 6 MHz. This enables the system to run 8- and 16-bit software using the CP/M or the CP/M 86 operating system. The system includes 64K bytes of RAM, dual double-density floppy-disk drives with 1M byte of mass storage, a 150-cps, 80-column printer and a CRT terminal. Other features include applications software, cables, instructions, floppy disks and printer paper. Applications software includes extended BASIC, a budgeting and planning package and a statistical-analysis program package. FORTRAN, Pascal, inventory control and a QA/incoming-inspection reporting package are optional. The system is priced at $12,950. **Pragmatic Designs, Inc.,** 950 Benicia Ave., Sunnyvale, Calif. 94086

Circle No 248

10000 Cartridge Drives Delivered.

SOME PROMISE, SOME DELIVER.

Cynthia D.100 a family of fixed and removable compact disk drives.

- Cartridge drives: 10 and 20 Mbytes formatted.
- Fixed Winchester drive: 60 to 120 Mbytes formatted.
- Interface: the same across the family.
- Compact: 12" x 6" x 21".
- Delivery: 30 to 90 days ARO.
- Advanced technology: 500 to 900 tpi - Thin film heads - Embedded servo tracking.
- Proven products: ten thousand cartridge drives being used in the world.
- DC 2100 Controller for simple integration.

D.160

D.140

D.120

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OEM Division

Cynthia Peripheral Corporation: Palo Alto – California – 94303 – USA – Tel: (415) 856.8181.
Cii Honeywell Bull : 78340 Les Clayes-sous-Bois, France. Tél. : (3) 462.70.00.
Sunninghill – Berkshire – Great Britain. Tel: (0990) 23491.

Feldman, Calleux & Associés

CIRCLE NO. 154 ON INQUIRY CARD

Introducing a new standard in 160 megabyte, 14-inch Winchester disk drives.

Replaces the CDC 9730, DEC RM80 and others. Here is a new standard in 14-inch Winchester disk drives — the Sapphire 160 from Tecstor. A 160-megabyte fixed disk drive that is a direct replacement for Control Data Corp.'s 9730, DEC's RM80 and other high density Winchester drives. The Sapphire 160 has an SMD-compatible interface with execution of instructions performed by microprocessor-controlled electronics.

Available now. The Sapphire 160 is a mature product, is in production, and is available now. Utilizing up to four fixed disks, the Sapphire 160 disk drive, with 6400 bits per inch and 600 tracks per inch, can operate in non-air conditioned environments. It is ideal for expanded data storage with today's new generation of minicomputers.

In an ancient tradition. According to Greek legend, the Sapphire gem could preserve its wearer from envy, protect against captivity and serve as the key to understanding the sayings of the oracles. Tecstor's Sapphire 160 disk drive is in the same tradition. It preserves vital data records, it protects through specially designed data security features, and it can be a key element within an OEM system.

Backed by experience. Tecstor was founded by five principals who have many years of experience in manufacturing, engineering and marketing peripheral products, especially Winchester disk drives. They are committed to the OEM marketplace. Dedicated to providing the high quality products and responsive support and service that OEM's expect. And, as a new company, Tecstor has substantial capital financing through a number of blue chip venture capital firms. And, Tecstor has a 32,000 square foot manufacturing facility to handle the most demanding production requirements.

To find out how Tecstor's Sapphire 160 can be your new standard in Winchester disk drives, call or write today to arrange for an OEM evaluation unit.

TECSTOR

"We have the experience"

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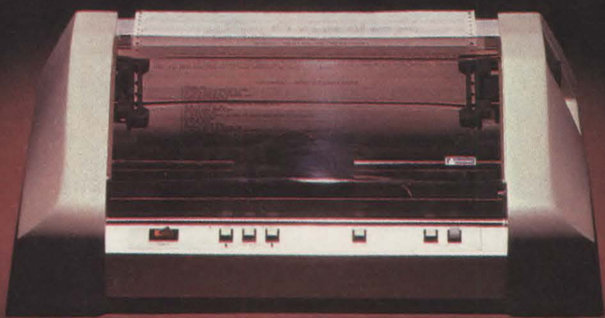
(714) 842-0077

SEE US AT COMDEX BOOTH 295

CIRCLE NO. 155 ON INQUIRY CARD

The important plus in matrix printers:

grafixPLUS.™



Since their introduction in mid-1980, the Anadex high-resolution DP-9500 Series matrix printers have set new standards for printer quality and performance. All models feature the rugged Anadex 9-wire print head that combines long life with resolutions of 72 dots/inch vertical and up to 75 dots/inch horizontal. With this kind of resolution, fineline graphics (under data source control) and razor sharp characters are pluses built into every printer.

Performance Plus

The full standard ASCII 96 character set, with descenders and underlining of all upper and lower case letters, is printed bi-directionally, with up to 5 crisp copies, at speeds up to 200 CPS. Models DP-9500 and DP-9501 offer 132/158/176 and 132/165/198/220 columns respectively. Print densities are switch- or data-source selectable from 10 to 16.7 characters/inch. All characters can be printed double-width under communications command.

Interface Plus

Standard in all models are the three ASCII compatible interfaces (Parallel, RS-232-C, and Current Loop). Also standard is a sophisticated communications interface to control Vertical Spacing, Form Length and Width, Skip-Over Perforation, Auto Line Feed, X-On/Off, and full point-to-point communications.

Features Plus

As standard, each model features forms width adjustment from 1.75 to 15.6 inches, shortest-distance sensing, full self-test, 700 character FIFO buffer (with an additional 2048 characters, optional), and a quick-change, 6 million character life ribbon.

Quality Plus

Beyond the built-in performance of the grafixPLUS series printers, the engineered-in quality and support are equally important. The result? Approval of both UL and FCC, Class A; operating noise levels under 65dbA; and a nationwide service organization second to none.

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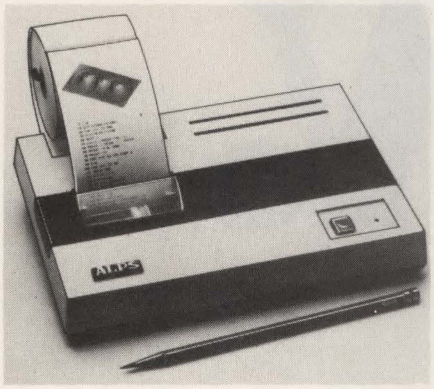
CIRCLE NO. 156 ON INQUIRY CARD
SEE US AT COMDEX BOOTHS 1415-1419

printers



Alps offers graphics printer

The model 1200 microminiature alphanumeric-graphics printer uses four pens to create four-color graphics. It produces alphanumerics in 15, 18, 24 or 36-cpl and writes 6 cps in the smallest size. Model 1100 uses one pen and creates alphanumerics in 10- to 40-cpl sizes and writes 12 cps in the smallest size. The printers are available as stand-alone units or as the printing mechanism alone. Both models use two stepping motors, one to move the pen in the X-axis, and the other to move the paper in the Y-axis. The motors in the four-color units have 0.1-mm. increments; those in the one-color units have 0.2-mm. increments. The one-color stand-alone printer sells for $325, and the four-color stand-alone sells for $450. The mechanism-only units sell for $140 and $180 for one and four colors, respectively. **Alps Electric, Inc.,** 100 N. Centre Ave., Rockville Centre, N.Y. 11570. **Circle No 249**

Dataroyal announces 165-cps printer

The IPS-5000-C 165-cps dot-matrix printer features programmable intelligence, international character sets, graphics and an RS232 or a parallel interface. The unit enables users to select print styles via control codes and to mix the styles and sizes with graphics in a single document. The printer uses a 96-character USASCII set with true descending characters and underlining. Custom character sets are optional. A cut-forms version, the IRS-5000-CF is also available. Price is $1595 for an 80-column unit and $1695 for a 136-column version in single-unit quantities, with OEM quantity discounts available. **Dataroyal Inc.,** 235 Main Dunstable Rd., Nashua, N.H. 03060.

Circle No 250

Digital Associates announces band printer

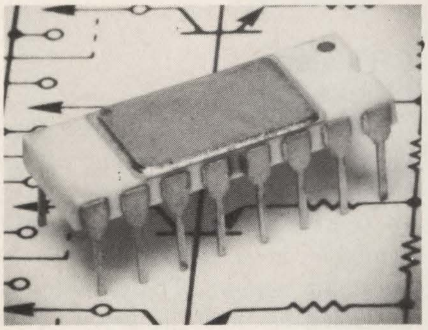
The model DAC 3121 1200-lpm band printer features a fully enclosed cabinet, a diagnostic LED status display, a static eliminator, a forms-length selector switch, a 12-channel VFU, a DAVFU, front and rear control panels and switch-selectable 6 or 8 lpi. The unit can be equipped with a custom controller/interface. Price is $14,975. **Digital Associates Corp.,** 1039 E. Main St., Stamford, Conn. 06902.

Circle No 251

Card printer holds 250 cards

The model PK 972 cassette feed matrix card printer holds as many as 250 single- or multi-part tab cards, in a removable cassette and dispenses them upon command into the printing section. The device includes a 5 × 7 impact matrix head that prints on as many as four cards from 0.006 to 0.018 in. thick and an ASCII set, including lower case, scientific notations and enhanced characters. The device prints 49 cpl and 39 lines on impact-sensitive paper or through inked ribbon. The unit's controller includes a graphics subset and pin plotting. Interfaces include Centronics-compatible parallel or RS232C. **Practical Automation, Inc.,** Trap Falls Rd., Shelton, Conn. 06484. **Circle No 252**

data acquisition



D/A converter replaces DAC-100

The bipolar, monolithic DAC-100 D/A converter, a replacement for PMI's DAC-100, includes thin-film resistors that allow 10-bit linearity, an internal reference, 300-nsec. settling time, a 6V to 18V supply range and 100-mW power consumption. The device is available in 16-pin ceramic packaging with three temperature ranges and 883B processing. The 8-bit DAC100DDQ3 sells for $11.85, the 9-bit DAC100BCQ3 sells for $20.20 and the 10-bit DAC100ACQ3 sells for $30.90 in 100-unit quantities. **Micropower Systems, Inc.,** 3100 Alfred St., Santa Clara, Calif. 95050.

Circle No 253

Harris offers monolithic D/A converter

The 12-bit HI-562A monolithic D/A converter for commercial-instrumentation and military applications is compatible with Analog Device's AD-562, Precision Monolithics' DAC-12 and Burr Brown's BBV-862 converters. The CMOS-, TTL-compatible system features dielectric-isolation technology and a 300-nsec. to $\pm 1/2$ LSB. The unit is available in a 24-pin ceramic package and wafer-level laser-trimmed dice. A commercial version sells for $19.20; prices for military versions start at $58.30 in 100-unit quantities. **Harris Corp., Semiconductor Group,** P.O. Box 883, Melbourne, Fla. 32901.

Circle No 254

IEE unveils serial data converter

The 26685-OX series of μp-based serial data converters, offers full-duplex RS232C, 20-mA current loop and RS422 differential-TTL input. Features include switch-selectable data rates from 110 to 19,200 bps and an auxillary 7-bit parallel input port with strobe, ready and device-select control lines. The unit's parallel-data output drives vacuum fluorescent or neon plasma displays or LCDs, depending on model. Price is $150 in 100-unit quantities. **IEE, Inc.,** 7740 Lemona Ave., Van Nuys, Calif. 91405.

Circle No 255

New Products

accessories and supplies

CRT visor blocks glare

This anti-glare CRT screen visor blocks light, intensifies contrast and sharpens images. It adjusts to fit 15- to 21½-in.-wide terminals and is available in narrower widths for microfilm readers. The visor can be extended as much as 6½ in. from the screen. It is made of .080 rigid plastic and attaches to equipment with self-adhesive dual-locking fasteners. The unit also functions as a privacy screen for terminals used in open spaces. Price is $19.95 in single-unit quantities, with quantity discounts available. **Devoke Data Products,** 3780 Fabian Way, Palo Alto, Calif. 94303. **Circle No 256**

Adjustable table supports μcs

This μc table features a 16-in.-deep keyboard surface that adjusts vertically on 1-in. centers from 24 to 28 in. high. The table also includes a 16-in.-deep, 30-in.-high monitor surface. Both 30- or 42-in.-wide tops have radiused corners and soft edges. **Smith System Manufacturing Co.,** P.O. Box 43515, St. Paul, Minn. 55164. **Circle No 257**

Rack stores unsoldered and soldered boards

The VH-3 storage rack for soldered and unsoldered PC boards stores as many as 90 boards and can be adjusted to hold any size boards. Removing the center insert provides storage for 45 boards as large as 18 in. It is available in standard or anti-static construction, accommodates boards as thick as 3/16 in. and stores boards in vertical or horizontal positions. **Henry Mann, Inc., Hampton Division,** Huntingdon Valley, Pa. 19006.

Circle No 258

THE CONCEPT 108 DISPLAY TERMINAL

The 132-column choice.
Everything you've been looking for in a display terminal.

ERGONOMICS

- High-quality, high-resolution display
- Detached, matte-finish keyboard with click-positive touch and N-key rollover
- Tiltable display available filtered and in a variety of phosphors
- Recessed, hooded screen

ECONOMICS

$1230.
OEM quantity 75.

HDS
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3700 Market Street □ Philadelphia, PA 19104 □ 215-382-5000

FUNCTIONOMICS

- 80- or 132-column display
- Eight pages of display memory (four pages standard)
- True windows
- Programmable function keys
- Networking between multiple communications lines (up to three)
- Multiple user-selectable/definable character sets (up to four)
- Non-volatile memory
- All terminal commands are executable from the keyboard and all communications lines
- And much more...to provide the best terminal for the development of a wide range of applications

Boston — (617) 329-3510; **New York City Area** — Infocon: (201) 624-1372; **New York State** — Naco Electronics: Syracuse: (315) 699-2651, Rochester: (716) 223-4490; **Delaware** — Infocon: (302) 239-2942; **Washington, DC** — International Systems Marketing: (301) 986-0773; **Los Angeles** — (213) 541-9303; **San Francisco** — (415) 692-4184; **Canada** — CAIL Systems: Toronto: (416) 362-1063; **Belgium** — Belcomp: 097/25 22 88; **France** — Walton: 1 226 06 90; **Sweden** — Allnovo Data AB: 08-25 62 02; **Switzerland** — Mitek AG: 01-66 22 52; **United Kingdom** — Shandell Systems Ltd.: 02407-2027; **West Germany** — COMKO Computer Systems mbH: 221-48 30 51.
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Over the past seven years we've earned a name for ourselves by making the best magnetic media in the business. Precision magnetic media — Diskettes, Mini Diskettes, Diagnostic Diskettes, Rigid Discs, Disc Packs, and Disc Cartridges — all certified to be 100% error free both on-track **and** between the tracks.

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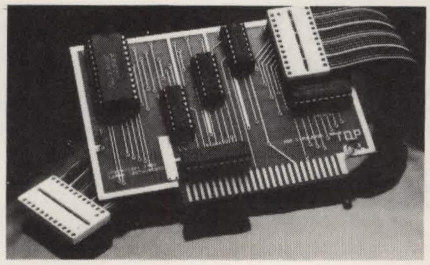
CIRCLE NO. 176 ON INQUIRY CARD

New Products

memories



Lamar announces ROM simulator

This ROM simulator, a block of RAM in a host computer, aids in developing software for a target computer. The ROM simulator replaces the ROM, PROM or EPROM in the target computer via the ROM socket, a 24-pin DIP connector and a ribbon cable. The simulator resides in an Apple II-based development system. The double-sided unit is solder-masked and includes silk-screened legends and gold-plated contact fingers. It contains 2K bytes of CMOS static RAM and the logic necessary to switch control of the address and data bus from the Apple II to the vendor's Superkim ROM sockets. Price is $295. **Lamar Instruments,** 2107 Artesia Blvd., Redondo Beach, Calif. 90278.

Circle No 259

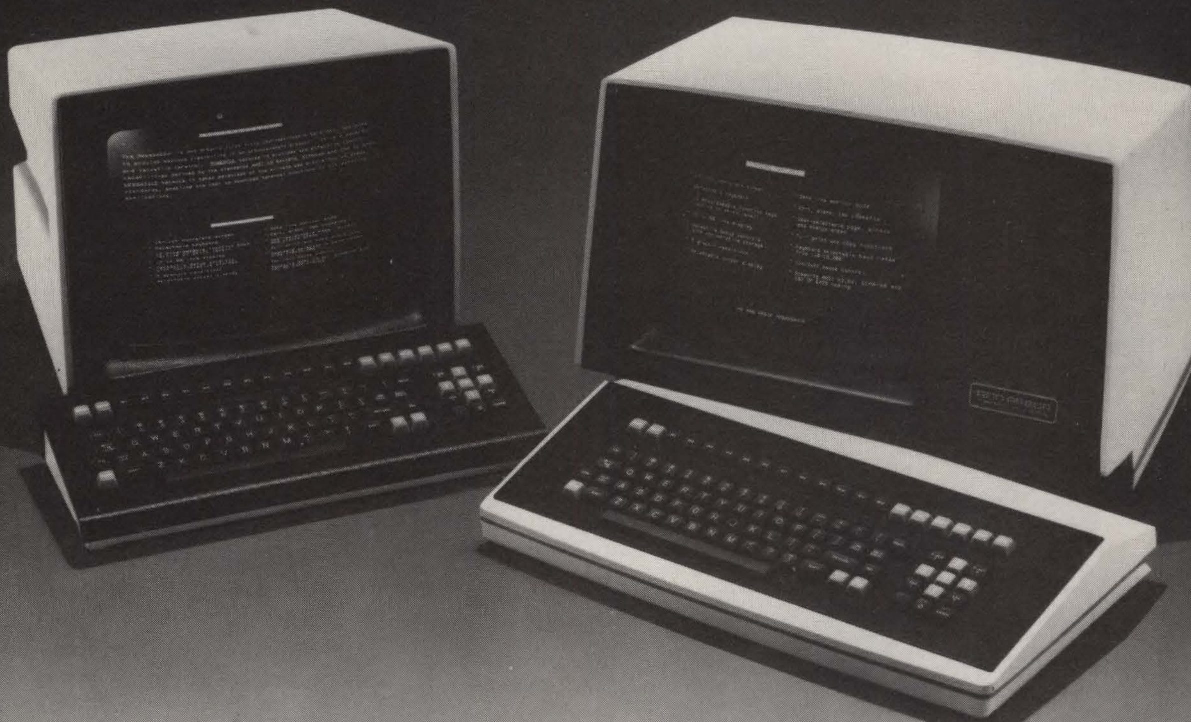
Mostek announces DEC add-in memory card

The MK8075 add-in memory board includes an on-board switch that enables users to configure it for Digital Equipment Corp.'s PDP-11/70 or VAX-11/750 computers. The board is available with 64K or 256K bytes of error correction memory. The board features an access LED, a power-on LED and an on-line/off-line switch that can be used to remove the board from the backplane electronically. Prices are $1650 for the 256K-byte board and $1485 for the 64K-byte card, with quantity discounts available. **Mostek Corp.,** 1215 W. Crosby Rd., Carrollton, Texas 75006.

Circle No 260

THE ANN ARBOR AMBASSADOR™

SETTING THE NEW STANDARD IN PRICE AND PERFORMANCE



- Large 15-inch non-glare screen
- 60-line (4800 character) display
- Both Zoom and Scroll control, local and remote
- Selectable scrolling region
- 5 Graphic Renditions: bold, blink, blank, reverse-video and underline
- 5 Area Qualifications: protect, guard, numerics, justify and security
- 22 Cursor controls, including set, read, save, restore and move 1 to N
- 12 Tab controls, including column and field tab stops, and tab with justify
- 13 Erase controls
- 12 Edit controls, including the ability to locally rearrange data on the screen
- 13 Send controls and modes, including Meta Key Mode for 8-bit data transmission
- 10 Print controls and modes, including local and remote copy, and print format control
- 11 Receiving modes, including slow scroll and pause
- 11 Operator convenience modes, including selectable cursor
- 6 Setup lines permit review and control of terminal modes, send and print parameters and diagnostics
- 48 Function keys hold up to 64 down-loaded strings for transmission or internal execution
- Supports ANSI X3.64, ECMA-48, and ISO DP 6429 coding
- Ann Arbor quality throughout
- And much, much more!

We think you'll find the Ann Arbor Ambassador not only powerful and flexible, but easy to use. Call us for more information at Ann Arbor Terminals, Inc., telephone (313) 663-8000. Dealer and distributor inquiries welcomed.

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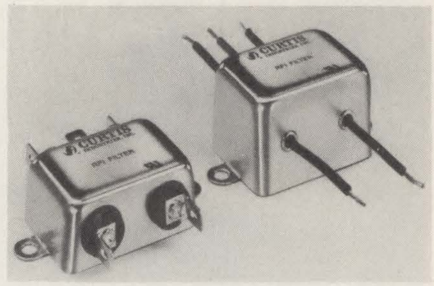
CIRCLE NO. 177 ON INQUIRY CARD

design aids

Charts provide Z80 references

The "Micro Charts" for Z80 CPU μcs include data on a 8½- × 11-in. plastic chart. Tables include instruction set, disassembly, ASCII, hex to decimal, compare versus jump, effect on flags, interrupt structure, pinout, cycle times, memory map, diagrams, addressing and powers of two. The charts sell for $5.95 each, plus $1 per order for postage and handling. **Micro Logic Corp.**, Dept. MM, P.O. Box 174, Hackensack, N.J. 07602. **Circle No 261**



Curtis offers RFI noise filters

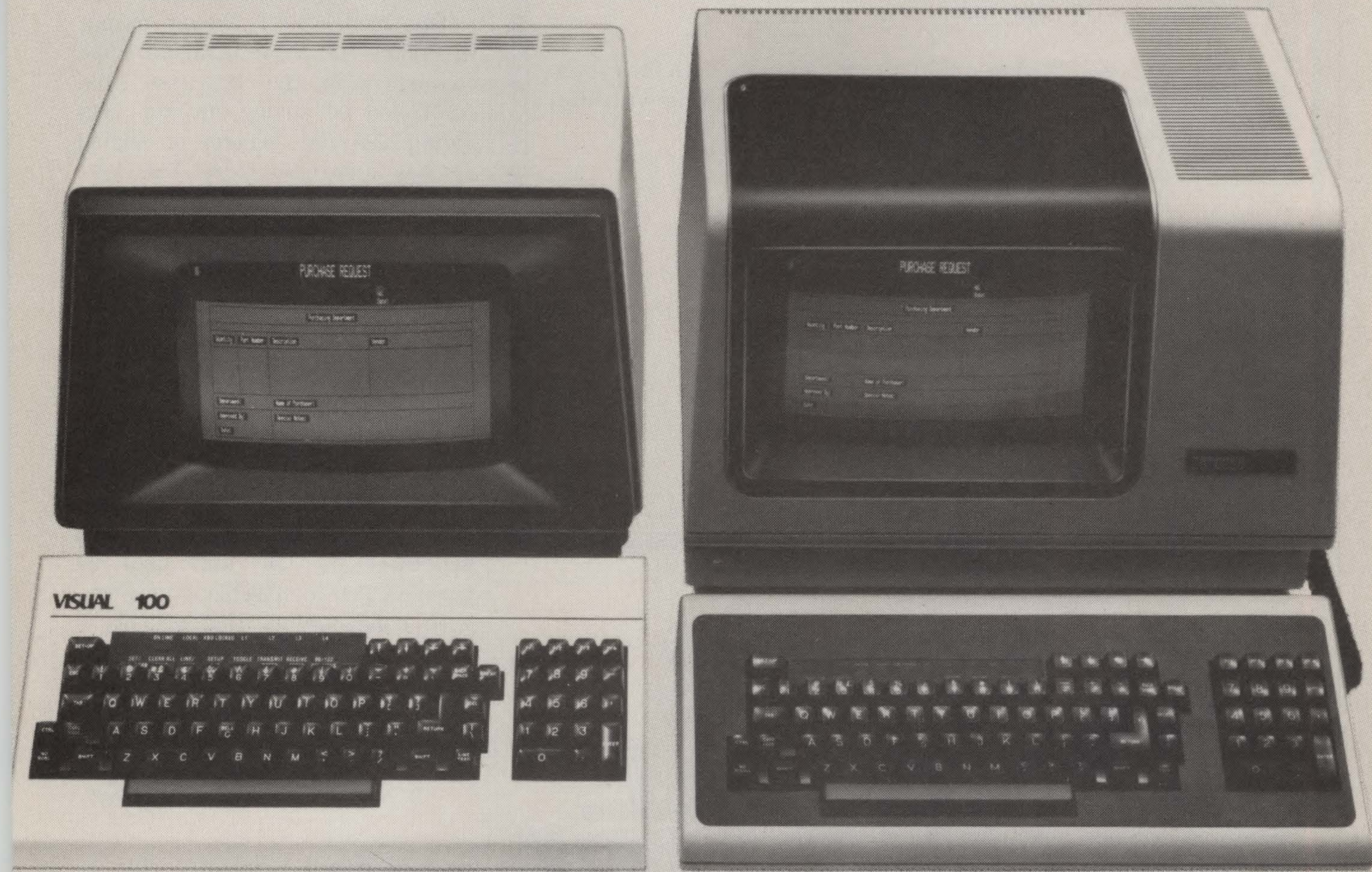
The Series F1100 RFI noise filters for solving power-line radio-frequency-interference problems in data-processing and other electronic equipment are available in 3A, 6A, or 10A models, 115/250VAC and 50/60 Hz. Designed with wire leads or quick-connect terminals, F1100 models provide fit, form and function interchangeability with standard units. Prices range from $5 to $6 in quantities of 100 units or less, with quantity discounts available. **Curtis Industries, Inc.,** 8000 W. Tower Ave., Milwaukee, Wis. 53223. **Circle No 262**

VIM announces test system

The Spectra I system for incoming inspection and wafer pre-test applications measures intensity (brightness) and hue (color) of any illuminating light source. The system operates in a subdued ambient-light environment without the need for a special enclosure. An auto-zero feature nullifies effects of ambient light and compensates for variations resulting from temperature drift. Other features include a built-in front-panel adjustable current generator, two DPMs for direct, simultaneous read-out of intensity and hue and a photo-detector unit. The DPM for intensity also functions as a DVM with 19.99V range. Price is $3495 in single-unit quantities. **Versatile Integrated Modules,** 1283-A Mountain View-Alviso Rd., Sunnyvale, Calif. 94086.

Circle No 263

Freedom of choice.



VISUAL 100 Digital VT 100®

These two terminals not only look alike—they act alike. But ours is a little better.

The new VISUAL 100 is 100% compatible with the DEC VT 100,® right down to the spacing of the keys and the roll of the keyboard. Neither your operator nor your software will know the difference. Except your operator will appreciate the superior human engineering features of the VISUAL 100 like the non-glare screen, adjustable viewing angle and low slung keyboard.

Further, the Advanced Video package and current loop interface that are optional with the DEC® terminal are standard with the VISUAL 100. And we've added an optional Buffered Printer Interface with independent baud rate, independent parity and printer busy via XON XOFF protocol or control line.

Although we think the VISUAL 100 is a little better than the VT 100®, we priced it a little lower. Plus it's from the Company that's delivered thousands of terminals emulating DEC, Hazeltine, Lear Siegler and ADDS. Call or write us today.

VISUAL See for yourself

Visual Technology Incorporated
540 Main Street, Tewksbury, MA 01876
Telephone (617) 851-5000, Telex 951-539

CIRCLE NO. 178 ON INQUIRY CARD

New Products

interfaces and controllers

ICS announces analog-output interface

The model 4871 analog output interface is a general-purpose coupler with the IEEE-488 bus-controlled DC analog outputs, providing 488 bus control of analog devices connected to it. The 4871 can operate as a listener or a talker. It has four analog-output channels with user-selectable output-signal ranges of 0V to +10V, −10V to +10V or −4 to −20 mA. Features include self-test upon turn-on and internal, external and software calibration. Internal auto-cal provides zero and full-scale calibration of the DC output of each analog channel; external auto-cal reads values at the output of the external device that generates it. The unit uses 24 parallel, TTL-compatible input lines, with handshaking, that accept as many as 24 bits. Price is $1295 in single-unit quantities, with quantity OEM discounts available. **ICS Electronics Corp.,** 1620 Zanker Rd., San Jose, Calif. 95112.

Circle No 264

Perkin Elmer offers fiber-optic converter

This single-channel fiber-optic converter communications interface connects remote RS232 devices to the vendor's 16- and 32-bit computer systems. The interface supports asynchronous transmission speeds as high as 19.2K bps over distances as far as 1 km. Applications include use in corrosive and explosive atmospheres, in which electrical interference exists or over long distances between the host computer and remote devices. The unit also includes two converters and 98½ ft. of optical cable. Price is $2130. **Perkin-Elmer Corp.,** Data Systems Group, 2 Crescent Pl., Ocean Port, N.J. 07757.

Circle No 265

graphics

Ramtek announces graphics display system

The model RM-9450 graphics/imaging display system features context switching, display-list processing, high-resolution fonts, clipping, textured lines, filled polygons, pan and zoom, erase, local functions and a cursor. The system is available with resolutions of 640 × 512 pixels at 25/30 or 50/60 Hz refresh rates, and 1280 × 1024 pixels at 25/30 Hz refresh rates. Memory configurations provide 8 bits of refresh memory in the 640 × 512 version, and 4 or 8 bits of refresh memory in the higher resolution model. The system can display 256 colors simultaneously from a selection of 16 million. Prices range from $19,450 to $30,350, depending on resolution and interactive device options, with volume discounts available. **Ramtek Corp.,** 2211 Lawson Ln., Santa Clara, Calif. 95050. **Circle No 266**

Usgraphics offers graphics consoles

The "React" line of programmable controller-compatible industrial-graphic consoles, for use with Modicon, Texas Instruments, Allen-Bradley and Square D programmable controllers enables users to translate a controller's memory into real-time color graphics. The device includes a picture editor for drawing custom displays of each application. The displays are then linked to the programmable controller through a program written in industrial graphics BASIC. It stores all display and program information within the console and displays information with inquiry/response system. Price ranges from $9000 to $14,000. **Usgraphics,** 14348 Proton Rd., Dallas, Texas 75234.

Circle No 267

Display system generates graphics

This µp-based graphics display system provides multi-user graphics and imaging capabilities, using raster-scan display technology. Program-selectable resolution ranges from 512 × 240 to 1280 × 1024 elements, with as much as 32 bits per pixel. The system generates more than 20,000 vectors per sec. Graphics generation includes conics, circles, rectilinear graphics and multi-font alphanumeric characters. Single-unit price is $30,000. **DeAnza Systems, Inc.,** 118 Charcot Ave., San Jose, Calif. 95131.

Circle No 268

QUME

When your work is important you need Qume print quality.

Simple mechanism. Beautiful print.
Our new MicroDrive™ print mechanism is the simplest and most reliable yet invented, featuring a unique Kevlar® direct-drive belt which provides the highest print accuracy in the history of daisywheel printing. For data and word processing, Qume's SPRINT 7™ and SPRINT 9™ daisywheel printers and terminals offer the best price/performance, plus great terminal service from the nationwide G.E. network. With several RO and KSR models available, Qume can supply the most demanding letter-quality requirements. For more information about the hottest new printers and terminals on the market, call or write Qume (408) 942-4000, 2350 Qume Drive, San Jose, CA 95131.

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CIRCLE NO. 180 ON INQUIRY CARD

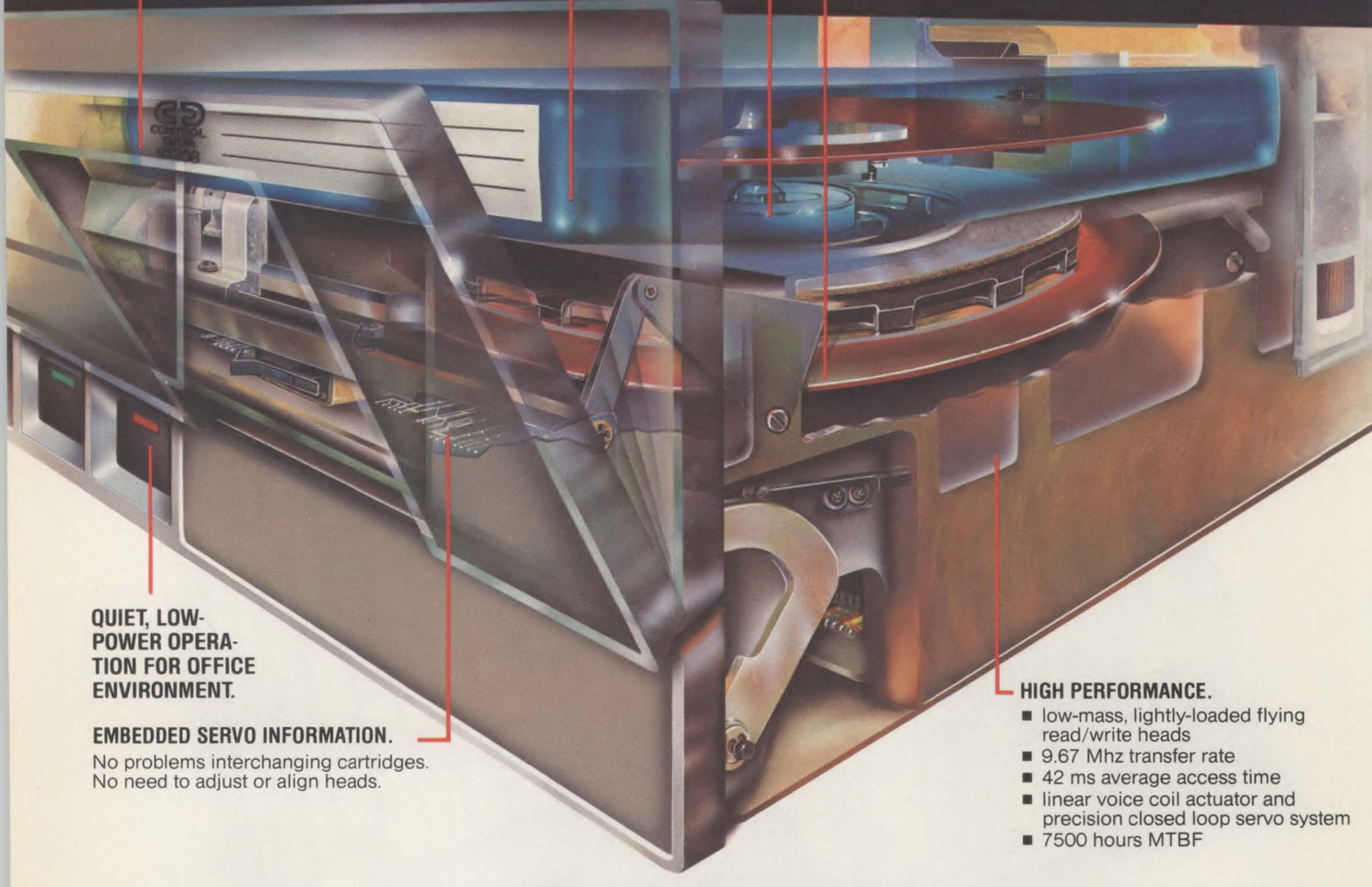
The LARK™

SOLVES BACK-UP AND OFF-LINE STORAGE PROBLEMS. Besides 8 Mbytes of *fixed* storage, Lark gives you 8 Mbytes of *removable* storage—per cartridge. Simplifies back-up and gives users both flexibility and growth capacity.

EQUIPPED WITH SMD INTERFACE. The 9455 Lark includes power and I/O module. And it's equipped with an SMD interface so you can use a common controller for the Lark and many other drives. But the 9454 Lark uses host power, and includes a new Micro Family Interface should you want to design your own controller.

COMPACT SIZE AND PACKAGING FLEXIBILITY. You can design smaller, more efficient systems. The Lark is the width of a floppy disk drive. In fact, you can mount two units horizontally or three vertically in a standard 19-inch rack.

EXCEPTIONAL RELIABILITY. Since the Lark is totally sealed during operation, no external air is forced across either the fixed module or cartridge disk surfaces.



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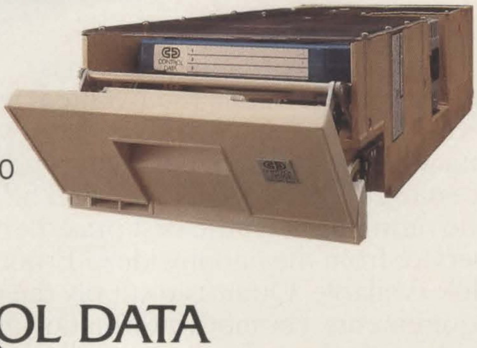

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Our new TouchTerm™ 80 terminal makes operating a terminal as easy as touching the screen with your finger . . . it's that simple!

One touch puts you in touch with your computer, in virtually any application from data base inquiry to factory data entry. Operators with no training can use your computer with the confidence of an expert.

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The Ampex TouchTerm™ 80 terminal: It's the new and perfect way for OEM's to differentiate their product from the competition and increase sales. For the information that'll give your business that extra touch, touch bases with Harvey Hirsch, Ampex, Memory Product Division, 200 N. Nash Street, El Segundo, California 90245. (213) 640-0150.

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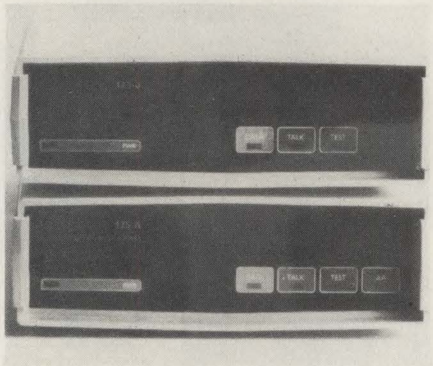
CIRCLE NO. 182 ON INQUIRY CARD

New Products

datacomm



CDS unveils dial modem

The CDS 125 dial modem for the Canadian Telidon videotex system operates full duplex at data rates of 150 bps in one direction and 1200 bps in the other direction. The unit includes an optional up/down, speed converter that buffers speed differences and allows the terminal and computer to operate full duplex at 1200 bps and provides a 16-character FIFO. In small quantities, a stand-alone configuration sells for $235 and $250 for the originate and answer units, respectively. An up/down converter sells for $26. **Concord Data Systems Inc.,** 442 Marrett Rd., Lexington, Mass. 02173. **Circle No 269**

Emulation processor supports 32 lines

The CC-6 basic emulation processor, which emulates IBM 3704 and Memorex 1270 communications controllers, uses the vendor's network-control software. The unit supports one or two IBM 370-compatible host computers and as many as 32 asynchronous, bisynchronous or mixed communications lines at speeds as high as 9600 bps. As many as four lines can be configured as wideband lines at speeds as high as 56K bps. Other features include mixed terminal/protocol support, terminal translation, auto-dial/auto-answer, automatic baud-rate detection and code conversion. Rental rate for a CC-6 supporting four asynchronous lines is $1100 per month; a unit supporting four asynchronous and four bisynchronous lines is $1300 per month, and eight asynchronous and eight bisynchronous lines is $1400 per month. **Computer Communications, Inc.,** 2610 Columbia St., Torrance, Calif. 90503. **Circle No 270**

KMW introduces protocol converter

The Series II 3270fs protocol converter enables users to attach ASCII asynchronous CRTs and printers to an IBM mainframe using IBM 3270 subsystem emulation. The unit supports as many as eight CRTs or printers at 150- to 19.2K-bps data rates. The unit includes a set of tables for cursor control and keyboard functions that handle 3270 screen emulation. Attributes for as many as six types of asynchronous terminals can be stored concurrently and selected on a port via switches or keyboard entry. **KMW Systems Corp.,** 8307 Hwy. 71 W. Austin, Texas. 78735.

Circle No 271

Novation introduces automatic-answer modem

The Bell 103-compatible Auto-Cat direct-connect modem communicates at 300 bps over dial-up telephone lines using a modular jack. The unit includes automatic-answer, manual-answer and manual-originate data modes. It operates in full- or half-duplex and features local and remote-loopback test functions. Pressure-sensitive switches on the end of the Auto-Cat case select its answer or originate functions, and LEDs indicate the unit's operating status. The unit connects to a computer via an RS232 interface. The modem is priced at $249 in single-unit quantities. **Novation, Inc.,** 18664 Oxnard St., Tarzana, Calif. 91356.

Circle No 272

Why pay for terminal cables you already have?

With the Teltone Data Carrier System, wherever there's a telephone, you can now have a computer terminal, using your existing PABX wiring.

This means you can now talk to a customer while your terminal talks to the computer. At the same time, over the same phone. At different frequencies—so neither conversation interferes with the other.

You're saving the cost of cabling, you're saving the cost of a phone-hogging modem. And you're gaining unheard of mobility and ease of computer access.

With all this, you don't sacrifice a bit of performance. The exclusive Teltone DCS tranceives up to 9600 bps, full duplex, asynchronous data. And since the data doesn't go through your PABX, it's compatible with any system.

So if you're a data systems manager fighting the tangle of problems associated with cable or limited distance modems, consider using the existing wiring in your buildings.

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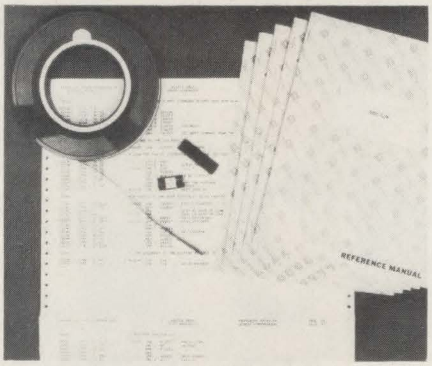
CIRCLE NO. 185 ON INQUIRY CARD

New Software



Wintek unveils PL/W cross assembler, compiler

This relocatable cross assembler, PL/W language cross compiler and cross linker runs on 6809 μps. The assembler supports nested macros and conditional assembly. PL/W is a block-structured language modeled on PL/1, which supports control structures required for structured programming. A floating-point/scientific package is also provided. All programs are written in ANSI-standard FORTRAN for 16-bit or larger machines. Prices are approximately $1000 per program, or $3400 for a complete package. **Wintek Corp.,** 1801 South St., Lafayette, Ind. 47904. **Circle No 273**

Software package offers UNIX features

The Unica software-instrument package for Z80 systems offers UNIX-like facilities and commands to CP/M users. Commands support redirection of standard I/O, connection of subsequent commands via "pipes," extended filenames with user numbers and wild-card filenames based on pattern-matching rather than character-masking. Commands include SR, which searches multiple files for a pattern; SP, a spelling-error detector with a 20,000-word dictionary; LN, which forms links (aliases) to files; SC, a source-file comparator with resynchronization; SRT, a file sorter; LS, an intelligent directory lister; CAT and HC, which do vertical and horizontal file concatenation; and DM, a disk-mapping utility. The standard package sells for $95; with XM-80 language and documentation, price is $195. **Contact Knowlogy,** P.O. Box 283, Wilsonville, Ore. 97070. **Circle No 274**

CDS unveils data-management system

The Symbolic Dynamic Access Method (SDAM) data-management system, written in BASIC, runs on μcs under the CP/M and MP/M operating systems. Features include multiple keys, direct key search, dynamic key maintenance, a file-creation program, partial (generic) search, sequential processing, file locking and a file-refreshing program. The file-access routines are provided in source code; a programmer initiates simple statements and performs data management by invoking SDAM routines. The system on 8-in. single-density floppy diskettes sells for $150. **Computer Development Specialists of Long Island, Inc.,** Suite 23, 90 Broadhollow Rd., Melville, N.Y. 11747. **Circle No 275**

IGS announces graphics-support package

The IGOR 1 software package provides real-time support for graphics applications requiring high image-update rates and operator interactivity. The package runs on DEC PDP-11 or VAX-11 computers connected to local or remote Sanders Associates' Graphic 7 vector-refresh or Graphic 8 raster-display systems. Features include multitasking debugging support, and a set of I/O primitives. Applications include telemetry data processing, real-time simulation, command and control and range safety. License fees begin at $3500. **Interactive Graphic Systems, Inc.,** Suite 225, 20969 Ventura Blvd., Woodland Hills, Calif. 91365. **Circle No 276**

New Software

ABC Computers announces business software

The Accounting by Computer system for Hewlett-Packard Co. desk-top personal computers, generates reports from accounting transactions. Applications include interactive accounts receivable, accounts payable, inventory control, general ledger and payroll. The multi-company system provides statements, transaction journals, CRT customer-account inquiries, trial balance, balance sheet, profit-and-loss statement, aged A/P and A/R reports, depreciation schedules, general journals, inventory receivings and sales reports, payroll registers, W-2s and all related month-to-date and year-to-date information for each module and integrated-system totals. List price is $500, including user manuals and sample user test data. **ABC Computers,** P.O. Box 7529, Tahoe City, Calif. 95730. **Circle No 277**

Networking facility provides transparent access

The TSX-NET networking facility for DEC LSI-11 and PDP-11 computers, runs under DEC RT-11 or S & H computer systems' TSX or TSX Plus operating systems. TSX-NET provides transparent access to remote files and devices down to the block and record level by system utilities and user programs, enabling peripherals to be shared. It permits OEMs and users to install software patches remotely over dial-up phone lines. With the package, an RT-11 or TSX Plus system can exchange ASCII files with non-DEC systems or DEC RSTS or RSX systems. A routine collects statistics on data-transfer and error rates. Single-site licenses sell for $750, with multiple-site licenses, OEM discounts and regional distributorships available. **Glenn A. Barber and Associates,** 110 W. Broadway, Suite 304, Glendale, Calif. 91204. **Circle No 278**

...expanding to eight Satellite Processors at down-to-earth cost!

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The background to the MARINER system is a photograph of the Lagoon Nebula, which can be seen with the aid of binoculars in the constellation Sagittarius.
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MICROMATION

CIRCLE NO. 187 ON INQUIRY CARD

Booklet features μc products

μC products from several vendors are detailed in a catalog. The 48-page booklet features books, accessories, peripherals, LSI-11 μcs, hardware and software. The catalog also covers system configurations, prices and technical information. **ComputMart Corp.,** P.O. Box 568, Dept. 004, Cambridge, Mass. 02139.
Circle No 279

Pamphlet features bus-relay interface

The model 4874 IEEE 488 bus-relay interface is described in a brochure. The four-page booklet describes the system's multiple relay configurations, relay programming modes and external-event-monitor input. The brochure also covers functions and accessories. **ICS Electronics,** 1620 Zanker Rd., San Jose, Calif. 95112.
Circle No 280

Booklet features electronic programming

A line of NC and CNC programming systems is covered in a catalog. The 20-page publication describes the LC-4000 intelligent terminal and the Numeripower in-house programming system. The catalog lists software, auxiliary software, intelligent terminals, tape punches, printers, CRTs, plotters and floppy-disk units. **Numeridex Inc.,** 241 Holbrook Dr., Wheeling, Ill. 60090. **Circle No 281**

IDC wiring system featured in a bulletin

The Quick/Connect point-to-point wiring system is described in a brochure. The 12-page booklet, which includes dimensional drawings and specifications, details prototype socket boards, computer interface boards, μc boards and Q/C tooling and wiring procedures. **Robinson Nugent, Inc.,** 800 E. Eighth St., New Albany, Ind. 47150. **Circle No 282**

Manual lists power protectors

A line of power protectors for line-voltage stabilization is detailed in a catalog. The 24-page, illustrated catalog describes μps, ferroresonant constant-voltage stabilizers, μc/minicomputer stabilizers and the Solatron/Acuvolt. The catalog provides operating specifications, selection guidelines and applications. **Sola Electric,** 1717 Busse Rd., Elk Grove Village, Ill. 60007.
Circle No 283

Guide details test instruments

A line of electronic test-and-measurement instruments is described in a buyers' guide. The catalog details bench and hand-held service DMMs, high-performance DMMs, IEEE-488-programmable instruments, the System 300 parametric test system and the Systems 2 hall-effect measurement system. The guide covers theory of operation, design considerations, applications and ordering information. **Keithley Instruments, Inc.,** 28775 Aurora Rd., Cleveland, Ohio 44139.

Circle No 284

Digital multimeters examined in brochure

The series 6400 and 6500 digital multimeters are detailed in a catalog. The eight-page brochure describes the systems' self-diagnosis, flashing annunciator signals; null and filter modes; scale/offset; and percent deviation. The catalog also details dual-mode resistance measurement capability, an LCD readout, a rechargeable battery and applications. **Weston Instruments,** 614 Frelinghuysen Ave., Newark, N.J. 07114.

Circle No 285

Bulletin discusses software-support

A line of software-development and support tools is described in a brochure. The six-page bulletin details random and sequential disk accessing, string-processing facilities and enhanced source-code maintenance. The brochure also covers service and support capabilities and a CBASIC software directory listing. **Compiler Systems, Inc.,** 37 N. Auburn Ave., P.O. Box 145, Sierra Madre, Calif. 91024.

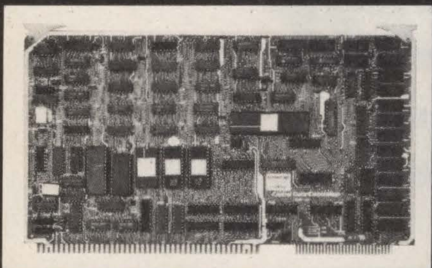
Circle No 286

Guide details measurement products

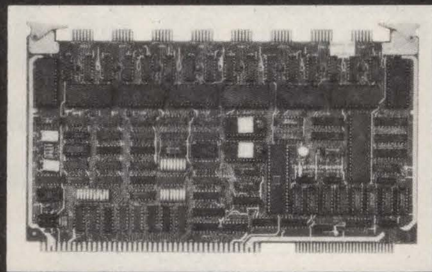
More than 500 electronic products for precision measurement and control are described in a short-form guide. The 50-page book includes data-conversion products, signal-conditioning products, temperature instrumentation, digital-panel instruments, power supplies, computational circuits, measurement-and-control subsystems and systems and component-test systems. The guide provides specifications, prices and a list of technical publications. **Analog Devices,** Route 1, Industrial Pk., P.O. Box 280, Norwood, Mass. 02062.

Circle No 287

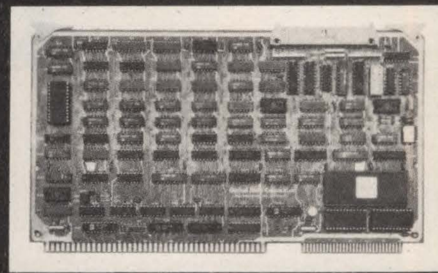
MORE NEW STARS FOR THE MULTIBUS* FROM CENTRAL DATA



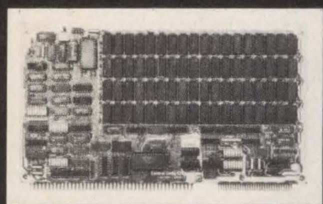
Z8000* Memory Management Processor Board features 4MHz Z8000 running with unique paged/segmented memory management. Includes interrupt controller, interval timers. Can also support PROMs and 9511 APU. Multi-User operating system available. Standard Board $795
Monitor PROMs $90
9511 APU $265



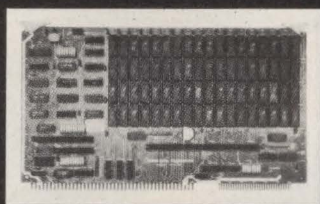
Intelligent Octal I/O Board provides 8: RS-232 ports controlled by on-board 2650 microprocessor. 16K of dual-port RAM allows data transfers with no bus overhead. Includes standard terminal driver program, can hold 4K custom driver program in PROM. $700.



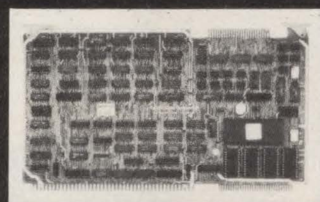
ANSI Winchester Controller fully conforms to the proposed ANSI standard for 8" winchester disk drives. Custom microprogramming available to interface with other disk drive interfaces. Controls up to eight drives. $550.



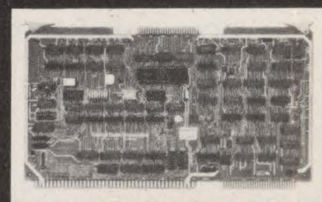
32K-128K Dynamic RAM Board features low power consumption, standard parity checking, and ultra-high reliability.
32K-$530 96K-$1080
64K-$800 128K-$1350



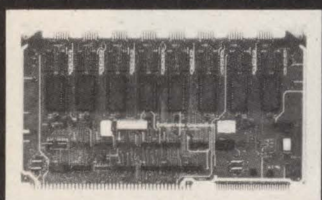
Static Ram Board adds either 16K or 32K of static memory to a Multibus system. 16K – $620
32K – $1100



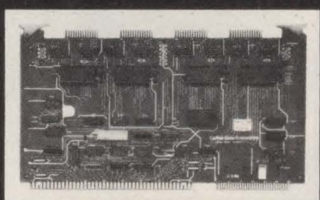
Cartridge Disk Controller Board provides DMA transfers to or from cartridge disk drives with capacities of 10 or 20 Mbytes. $435



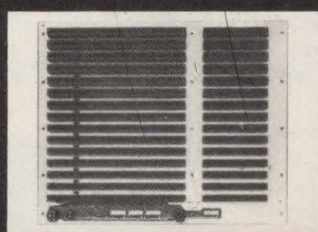
Double Density Floppy Disk Controller adds from one to four double density standard sized floppy disk drives, either single or double-sided. $315



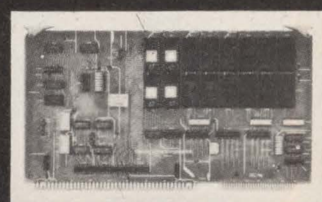
Octal Serial Interface Board allows up to eight EIA RS-232 interfaces. $330



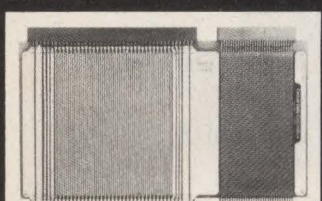
Quad Serial Interface Board hooks up to four EIA RS-232 interfaces to your system. $280



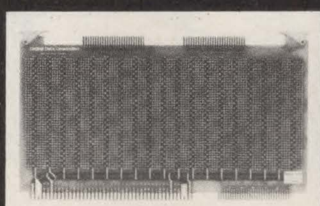
Mother Board can hold up to 15 Multibus cards with both P1 and P2 provided for each card position. $315



PROM Board allows the user to hook between 1K and 128K of PROM to a Multibus system. $140



Extender Board will raise a board being tested up to a height of 6.9 inches. $60



Prototyping Board will accommodate up to 95 16-pin sockets, allowing the user to wire wrap a prototype circuit. $55

*Multibus is a trademark of Intel Corporation
Z8000 is a trademark of Zilog Corporation

Central Data Corporation

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4 MHZ Z80A, 64K RAM, 32K ROM, 32 I/O BITS AND SERIAL PORT is only the beginning for the MCPU-800 single board microcomputer. Memory mapping and I/O space expansion under software control assure maximum system flexibility. Optional software includes a hard working Monitor, a control oriented 2K BASIC, and a full function 8K BASIC. Both Basics allow ROM-able statements. Many applications may be served by this card alone, although full STD bus compatibility is maintained for simple customization. 16K RAM MCPU-800 from $675, full 64K for $1175.
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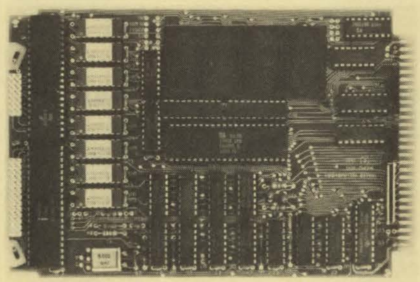

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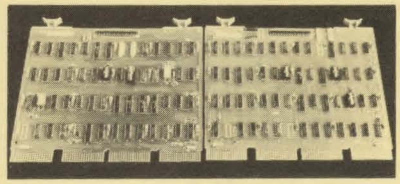

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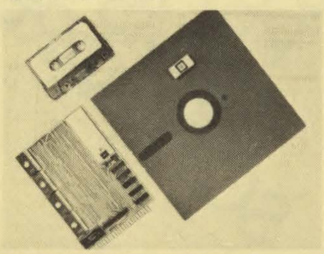
6800 Family Software



SOFTWARE: WIZRD multitasking DOS, editor, assembler, C, PL/W, PASCAL, FORTRAN, 16K BASIC

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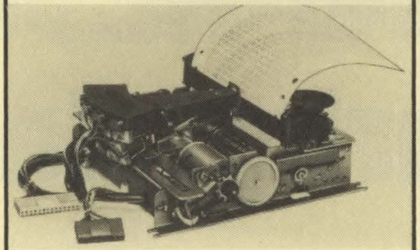

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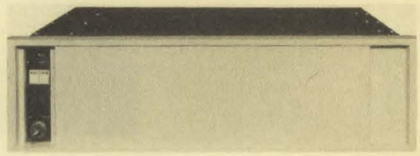

This single-board CPU is contained in front-loading, 6-slot "universal" chassis with separate power supply. The chassis features a virtual control panel. It can house the lower-end Series 1000, 64KB CPU and also permit expansion to the Series 5000 CPU with up to 512KB. Memory parity check and battery back-up are available.

All systems run under: IRIS, IOS, BITS, BLIS/COBOL, VMOS, etc. For complete information contact Bytronix, 2701 E. Chapman Ave., Fullerton, California 92631.

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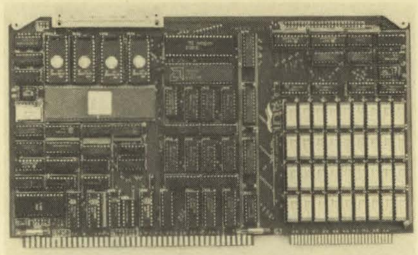

6800 MULTIBUS SINGLE BOARD COMPUTER. The PM68K combines an 8 MHz 68000 processor with up to 256K bytes RAM and 32K bytes EPROM, 2 level memory management, 2 multi-protocol serial I/0 ports, 5 16-bit timers, multi-master capabilities and a single +5v power requirement to provide reliable, high speed and low cost processing. UNIX, ADA and PASCAL software will be available in the first quarter of 1982. **PACIFIC MICROCOMPUTERS, Inc.,** PO Box A81383, San Diego, CA 92138 (714) 565-2727.

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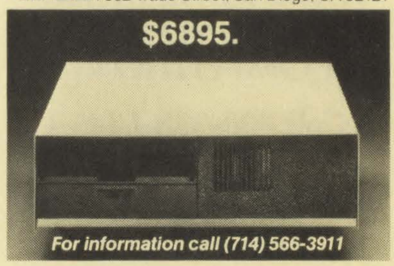

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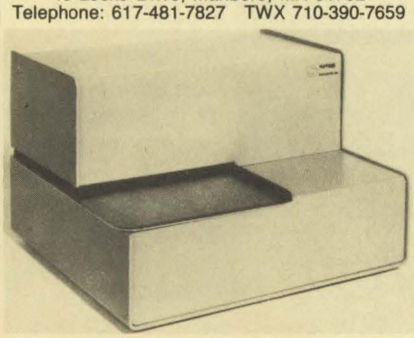

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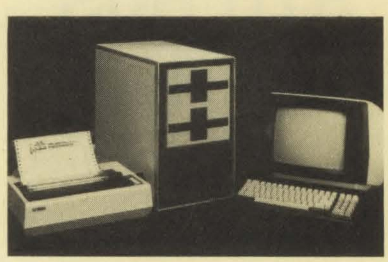

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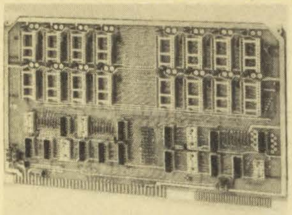

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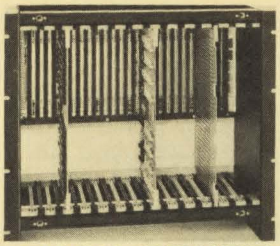

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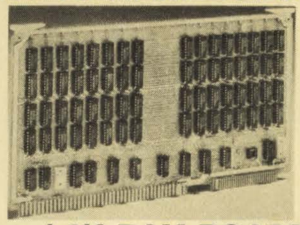

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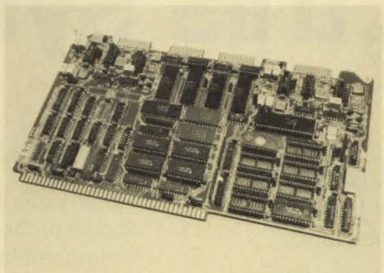

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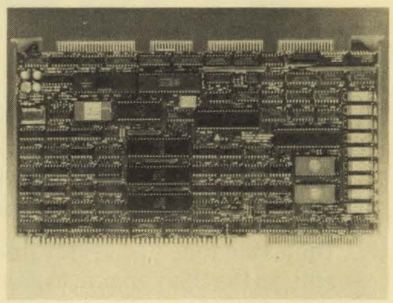

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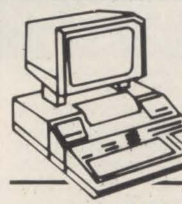

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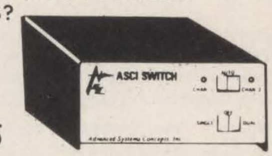

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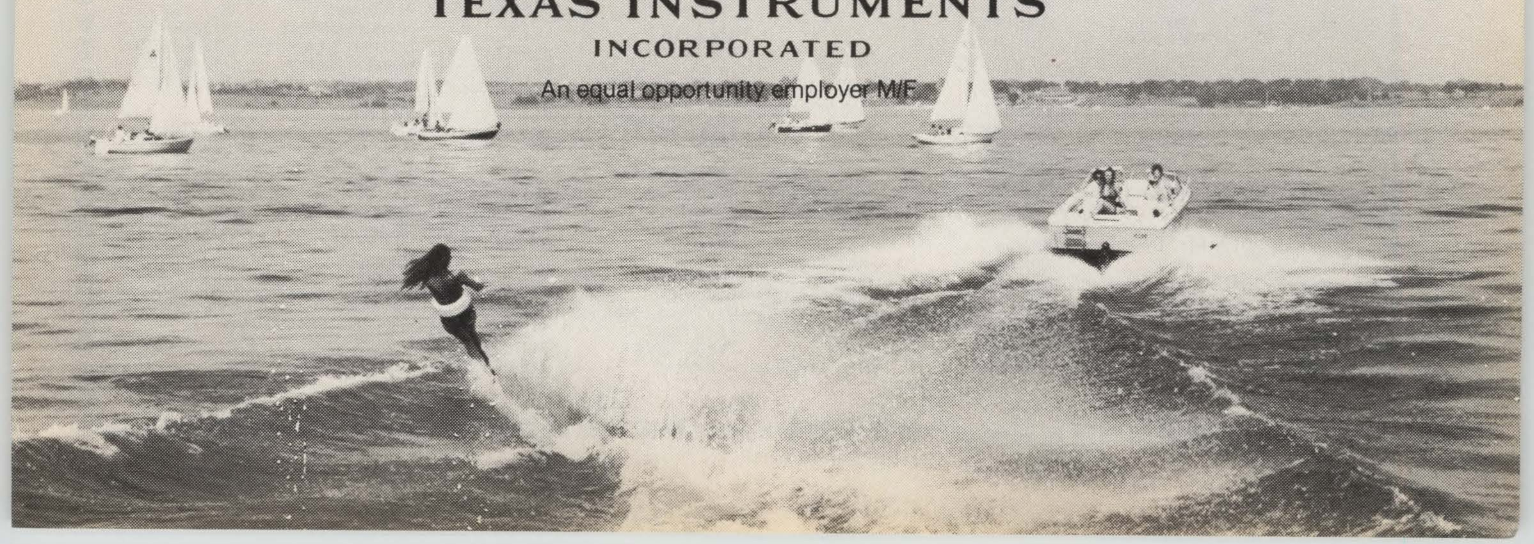

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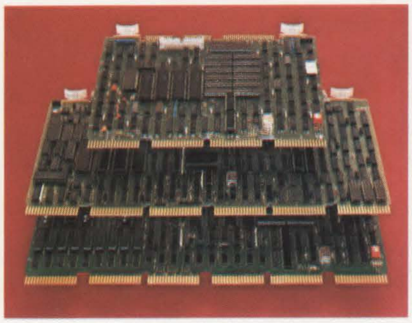

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