

Mini-Micro Systems

A CAHNERS PUBLICATION

JUNE 1982

vax11/780

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pdp8

**Another
milestone
for DEC**

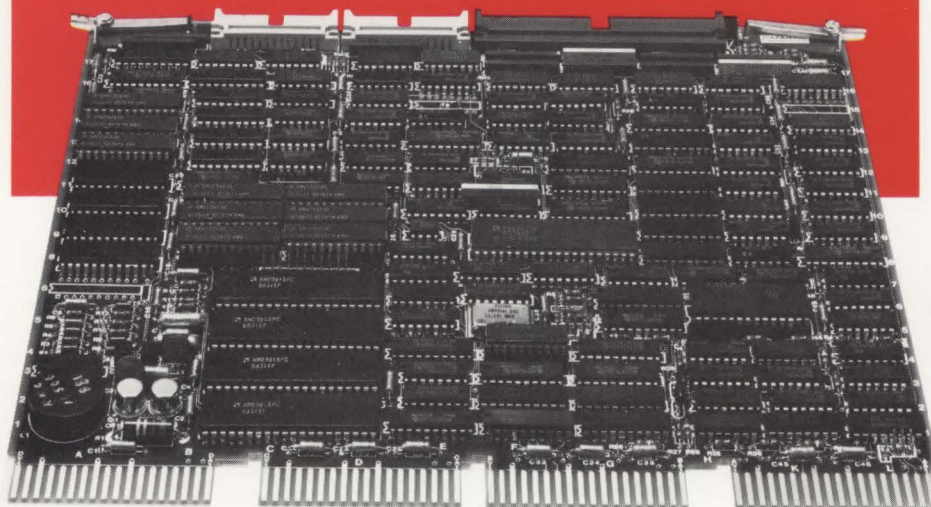
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CONTROLLER	DESCRIPTION	COMPATIBILITY
C03	Cartridge disk controller	RK05
C33	Cartridge disk controller	RK05
T03	NRZI mag tape controller	TM11/TU10
T04/C	Mag tape streamer coupler	TM11/TU10
T04/N	NRZI mag tape controller	TM11/TU10
T04/D	Dual density mag tape controller	TM11/TU10
T34/C	Mag tape streamer coupler	TM11/TU10
T34/N	NRZI mag tape controller	TM11/TU10
T34/D	Dual density mag tape controller	TM11/TU10
T36	Dual density mag tape controller	TM11/TU10
T34/T	GCR mag tape controller	TM11/TU10
S03/A, S04/A	80 MB/300 MB SMD controller	RM02/RM05
S03/A1, S04/A1	80 MB/160 MB SMD controller	RM02
S03/B	80 MB/300 MB SMD controller	RK07
S03/C	200 MB/300 MB SMD controller	RP06
S03/D, S04/D	96 MB CMD controller	RK06
S33/A	80 MB/300 MB SMD controller	RM02/RM05
S33/A1	80 MB/160 MB SMD controller	RM02
S33/B	80 MB/300 MB SMD controller	RK07
S33/C	200 MB/300 MB SMD controller	RP06
S33/D	96 MB CMD controller	RK06

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CIRCLE NO. 2 ON INQUIRY CARD

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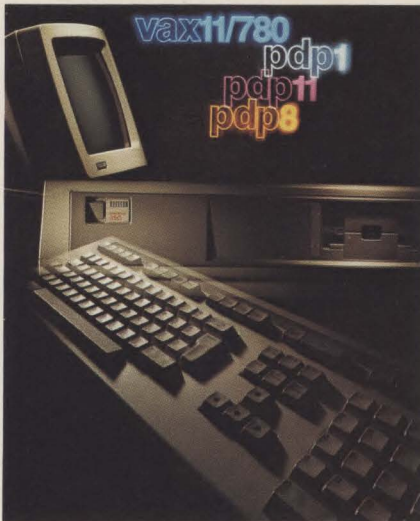
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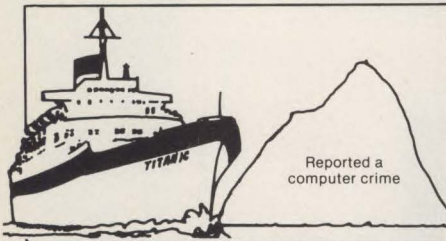
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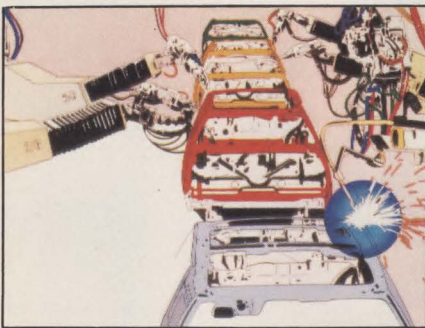
CIRCLE NO. 3 ON INQUIRY CARD



When Digital Equipment Corp. officially celebrates its 25th anniversary this summer, it expects to do so as a major contender in the rapidly expanding personal-computer market, having launched a family of three personal computers (see p. 15). Cover photo by Steve Grohe, Boston; art direction by Vicki Blake.



Page 251 Security for minis, micros



Page 175 Systems in Industry



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Mini-Micro Systems

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When you ask some people about backup — they back off.

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CIRCLE NO. 4 ON INQUIRY CARD

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TI 99000-BASED SYSTEM HITS TECHNICAL SNAG

Technical problems reportedly have pushed back Texas Instruments Inc.'s plan to launch the Business System 300, its first computer based on the TMS99000 16-bit μ p. The company planned a late May introduction of the 300, but has postponed the introduction "somewhat indefinitely" because unspecified hardware problems made plans for third-quarter deliveries unfeasible. The system is the second in the packaged Business Systems line, following the 9900-based Business System 200 introduced early this year. The 300 is expected to replace the DS990 model 3 and some versions of the model 4 and, like the 200, will be sold through TI authorized dealers. Like the 200, it will run TI's DX10 operating system or UCSD p-System, and comes in a desk-top terminal package. With a variety of 5¼- and 8-in. Winchester-disk options having capacities as high as 43M bytes, the 300 is expected to span the \$10,000 to \$20,000 price range.

EPSON AXES 16 DISTRIBUTORS, FAVORS ITS OWN

Epson America, Inc., has abruptly terminated 16 independent distributors. Replacing them are 12 new Epson-owned and -managed distributors. Part of the rationale for the terminations, a company spokesperson explains, is that Epson does not want distributors selling competing brands. This is especially true because Epson is releasing the first of its personal-computer products this month, the HX-20 portable terminal, in the U.S. A new Epson affiliate, called Comrex International, has been established under Y. Kimm to manage the distributors. Three new factory warehouses will support the distributor activities. Among those terminated were some that handled only Epson products, and some that handled a line of μ cs as well as other vendors' printers. One distributor says Epson handled the matter fairly. Distributors were given 90-day notices on May 1. Epson's recent change of some sales and marketing management may have triggered the changes. Epson was expected to show the HX-20 at the National Computer Conference, along with a prototype color ink-jet printer with 32 nozzles.

OEM VERSION OF DEC PERSONAL COMPUTER COMING AT COMDEX

The introduction last month of Digital Equipment Corp.'s first personal computers (see "DEC stirs personal-computer market. . .," p. 15) may seem to have left DEC's traditional OEM base out in the cold, but the company this month is introducing hardware aimed at correcting that impression and warming the hearts of OEMs seeking a low-end system. At this month's Comdex show, DEC is expected to launch the LCPO5, a member of the personal-computer family designed for both technical and commercial OEMs. It will have the same F-11 processor used in the high-end Professional 300 series and the same external packaging, but will include a standard LSI-11 Q-bus instead of the unique PC 300 bus, and will replace the proprietary POS operating system with a choice of any standard Q-bus operating system. A configuration with a built-in 5M-byte Winchester-disk drive is expected to be priced at less than \$10,000 in single-unit quantities.

NEW FIRM READINGY 32-BIT, UNIX-BASED SUPERMINI

A minicomputer start-up company hopes to introduce its first product sometime this fall. Pyramid Technology, Inc., Palo Alto, Calif., is readying a 32-bit supermini that runs UNIX System III. The Pyramid computer is aimed at the DEC VAX-11/780 market, yet is priced substantially less than that hardware. The machine has been designed to be extensible: It can be upgraded from the smallest to the largest configuration without making the initial hardware obsolete. The firm's three co-founders are Edward Dolinar, most recently with Rolm Corp.'s mil-spec computer division; Albert Gaynor from the brokerage house L.F. Rothschild; and Robert Kelley, formerly with STSC Inc., a timesharing company. Pyramid received \$3 million in venture capital in February and expects to seek additional funding as soon as the first systems are out the door.

Breakpoints

METAFRAME INTRODUCES PRINTER WITH EXCHANGEABLE ELEMENTS

One-yr.-old Metaframe Computer Corp., Nashua, N.H., founded by Wang Laboratories, Inc., alumni, planned to announce at NCC what the company claims is a very simple printer that uses dot-matrix and daisy elements interchangeably. Called the Dotsy Printer Center, the device is available in a floor-standing unit with an acoustic cover for about \$1400 in single-unit quantities. OEM discounts are about 25 percent. Changing the heads requires only snapping them in and out, and removing the daisy also requires taking off the hammer. The Dotsy prints 150 cps with a Qume or Diablo daisy element. The elements can be changed in less than 1 min., the company says. Much of the printer is under software control, including the motor power and stepping sequence. Not including PC boards, the printer contains 47 mechanical and 18 electronic parts. The cartridge has three components. It also includes a 2K buffer, and serial and parallel Centronics-compatible interfaces. Dotsy is the first product from the company, which was formed to develop an Intel 432 32-bit μ p for separate sale. The company still is in conceptual stages with the Intel product, but is developing its own software for a chip to be used in high-power small computers in several years. A company spokesman says the chip may be priced as low as \$20 to \$50 within three years.

ENGLAND'S TORCH BRINGS COMMUNICATING μ C TO U.S.

Torch Computers, Ltd., Cambridge, England, this month will unveil a local-area network, multi-station μ c system aimed at large organizations in the U.S. The Torch system supports as many as 250 stations on a 250K-bps bus LAN called Econet. Configured around a Zilog, Inc., Z80, each station hosts a Digital Research, Inc., CP/M look-alike called CP/N. Super Torch will appear this year. Based on the Motorola 68000, it hosts a UNIX-like operating system called Davros, which will offer CP/N upward compatibility, according to the firm. Communication software supports local or remote links to network a Torch station and other Torches, other computers, the Telex network and videotex networks. Color-graphics and word-processing software are standard. COBOL-80, BASIC-80, Pascal and FORTRAN from Microsoft are available. A Torch spokesman says one major customer has been lined up in New York. The company will open a sales office in Boston.

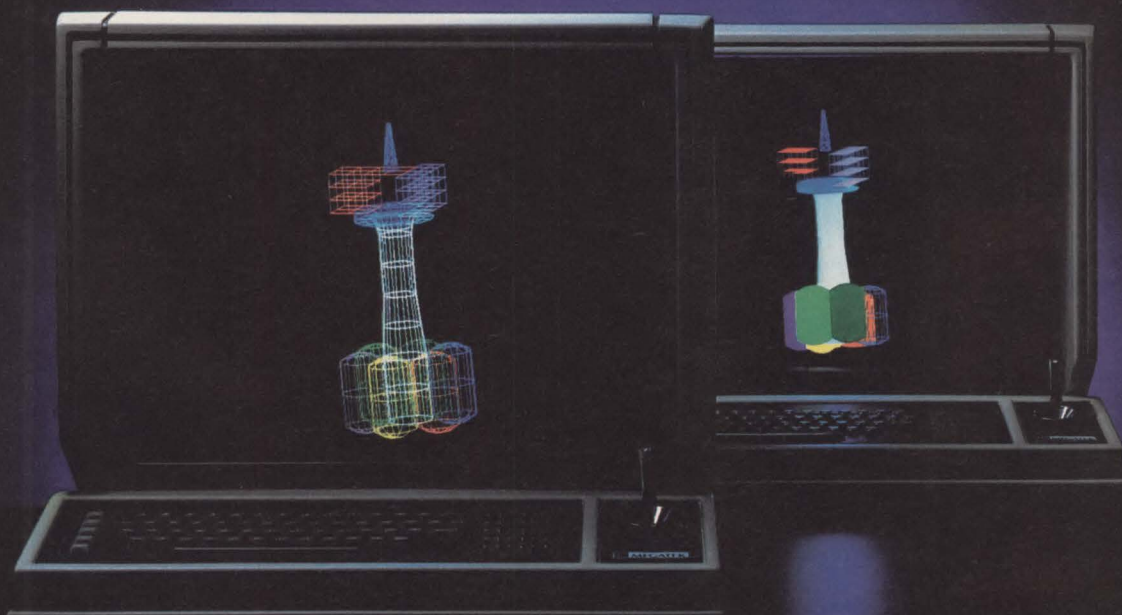
NAKED MINI OFFERS UNBUNDLED WORK STATION

The Omnix 16-bit multi-user business system, scheduled for announcement by the Naked Mini Division of Computer Automation at NCC, marks the division's first incorporation of third-party software and peripherals, and an entry into a new market: selling to systems houses that add value via vertical application software. But more interesting for traditional Naked Mini OEMs and system integrators is Omnix's cousin, the Workstation 1. The system is available in a configuration similar to the Omnix with a CRT terminal, a printer, a 10M-byte Winchester-disk drive and a 1M-byte, 5¼-in. floppy-disk drive, or in versions unbundled component by component down to a bare chassis. A Naked Mini spokesperson says a customer can begin by buying the complete system. Later, when increased volumes warrant, the customer can buy the system without drives, for example. Although only Naked Mini's 4/04 CPU board can be used in the Workstation 1, a source close to the company says the Workstation 2, due next March, will accommodate CPU boards from other vendors built around an unspecified industry-standard bus and a wide range of processors, including the Z80 and MC68000.

NEW ENTRY FOR FAIL-SAFE TRANSACTIONS MARKET

Anaheim, Calif., start-up Western Resource Technology Inc. will enter the fail-safe transaction-processing market pioneered by Tandem Corp. WRT's first system will link redundant Digital Equipment Corp. PDP-11/23s or 11/24s via a hardware interface that is being tested. WRT spokesman John Sutherland says the systems will run applications written for DEC's RSX and RSTS operating systems without modification. The company is seeking venture-capital funding and expects to ship its first system during the third quarter.

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Megatek has pioneered dynamic interactive refresh graphics systems for years. Ten to be exact. Our Whizzard 5000 was the first advanced high-quality vector stroke generator. The 7000 modular, high-performance 3-D stroke system followed. Then, the 7250 dynamic, high-speed color raster system and 7290 system, which combined stroke and raster workstations powered by one Megatek Graphics Engine.[™] All industry firsts.

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CIRCLE NO. 6 ON INQUIRY CARD



SOFTTECH MICROSYSTEMS PLANS UCSD P-CODE FOR DISPLAYWRITER

Softech Microsystems, Inc., will have a higher profile as a result of the recent appointment of marketing-oriented John Splavec as president of the San Diego-based vendor of the UCSD p-code operating system. Sources close to the company say Softech will soon release that operating system for the IBM Corp. Displaywriter. Splavec has no comment on the impending Displaywriter release, but says he expects Softech to use the leverage of p-code portability to crack the IBM-oriented Fortune 1000 market. The company is expected to strengthen its application-software position soon via an acquisition. This follows Softech's anticipated introduction at NCC of UCSD p-code for the MC68000 μ p and the company's demonstration of 5¼-in. disks written in a new universal disk format that Softech claims can be read by any computer with 5¼-in. floppy-disk drives and an LSI-based controller.

RANDOM DISK FILES

Shugart Associates' customers reportedly were treated to a private showing of some of the Sunnyvale, Calif., Xerox subsidiary's upcoming products at the recent NCC in Houston. Among the aces in Shugart's hand is a half-high, 5¼-in. floppy-disk drive, and a half-high, 5¼-in. Winchester with a 6M-byte capacity and a price tag of less than \$400. Sources say that the company showed a prototype of a micro-floppy disk drive about 3½-in. in diameter. All are expected to be announced by year-end.

Shugart is also said to be planning to upgrade its SA600 5¼-in. Winchester-drive family with a 12.76M-byte device. The company's SA1100 8-in. Winchester line will also get a boost with a 40M-byte model, sources say. Pricing information is not available.

Optimem, the Shugart Associates division charged with developing an optical mass-storage system, expects to ship limited quantities of the laser-based hardware to customers for beta tests by year-end. The official product introduction is slated for late 1983. According to a Shugart source, the hardware, which will write once and read many times, will store 1G byte of information per surface. Several models with various capacities will be available. Despite the exit in mid-March of Optimem general manager Jim Burke, the project is on schedule, says the source, who denies rumors of budget cuts at the division. Peter Lloyd, who, along with Shugart marketing vice president George Sollman, developed Optimem's strategic marketing plan while both were at Xerox Magnetics, has filled the vacant general manager slot. The Optimem hardware will probably be manufactured at Shugart's Sunnyvale facility.

Cambrian Systems, Inc., Westlake Village, Calif., vendor of test equipment for disk drives, reportedly plans to plunge into the media business this year and will develop a line of thin-film platters for 8- and 5¼-in. Winchesters. One source says Cambrian has pulled in the engineering talent needed for the project from Burroughs's nearby Westlake disk-drive facility and is looking for venture funding for the operation.

High-capacity 8-in. media developed by San Jose-based **Lanx Corp.** to accommodate perpendicular recording (MMS, September, 1981, p. 163) could show up next year on a number of small Winchesters, including enhancements to a line of drives reportedly scheduled for announcement this year by International Memories, Inc., Cupertino, Calif. One source says the IMI hardware, designated the Series 8000, will initially offer capacities in the 100M-byte range using thin-film media, and will be the size of a 1M-byte, 8-in. floppy-disk drive. Lanx, meanwhile, is reported to be using one of IMI's older 7710 series drives—the first 8-in. Winchester series to be announced—as a test frame for its new media. Information on drive and media pricing and initial capacities for drives equipped with media-oriented to perpendicular recording is unavailable.

Unconfirmed reports in the San Francisco Bay Area indicate that **IBM Corp.'s** long-awaited Ocotillo series ½-in. tape-cartridge drives may appear in pilot production quantities this month, with 500 pre-production units scheduled to be shipped by the end of the summer. According to one source, IBM plans to unveil the drives designed for high-capacity Winchester backup and announce their immediate availability during the fourth quarter of this year.

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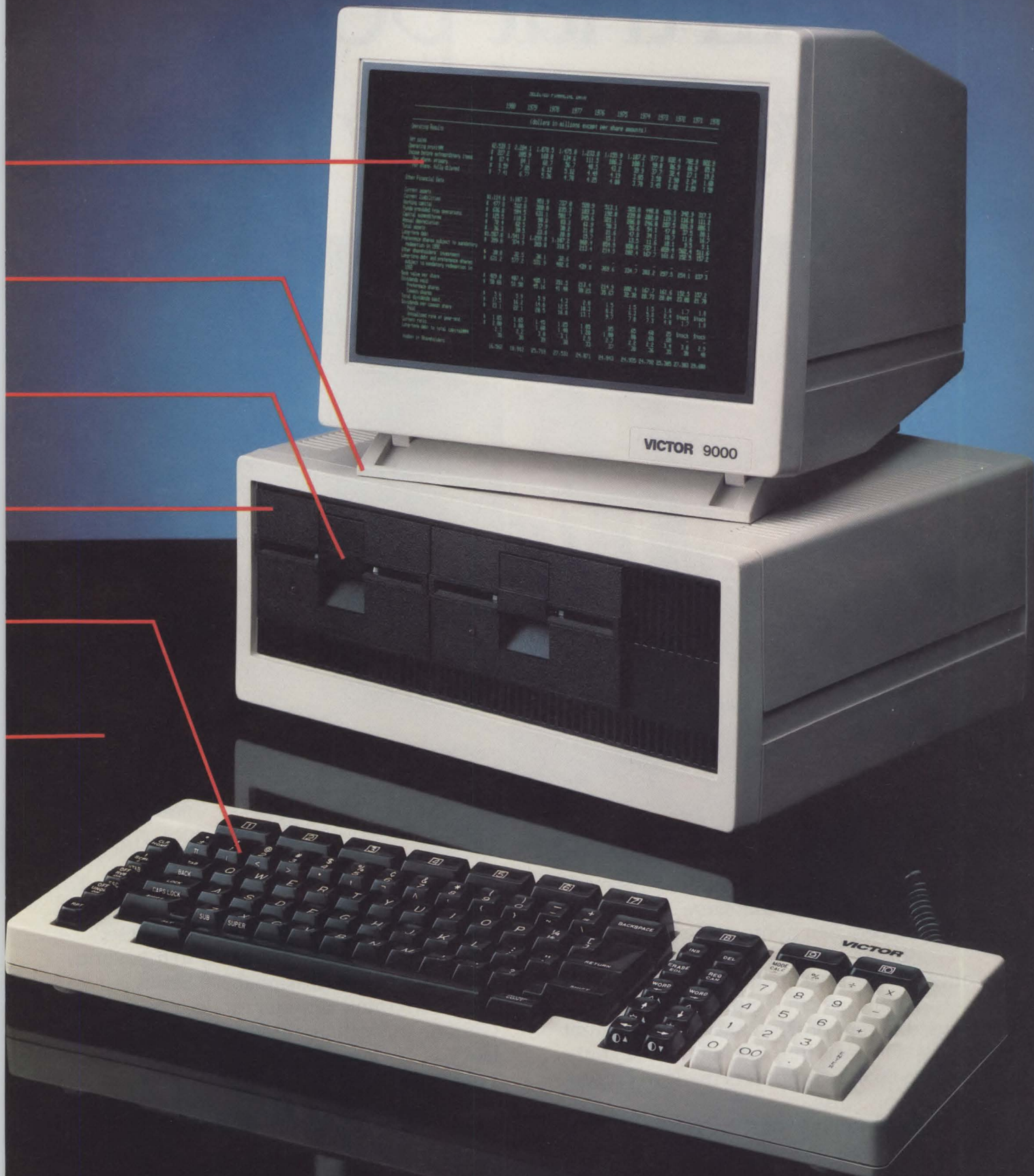
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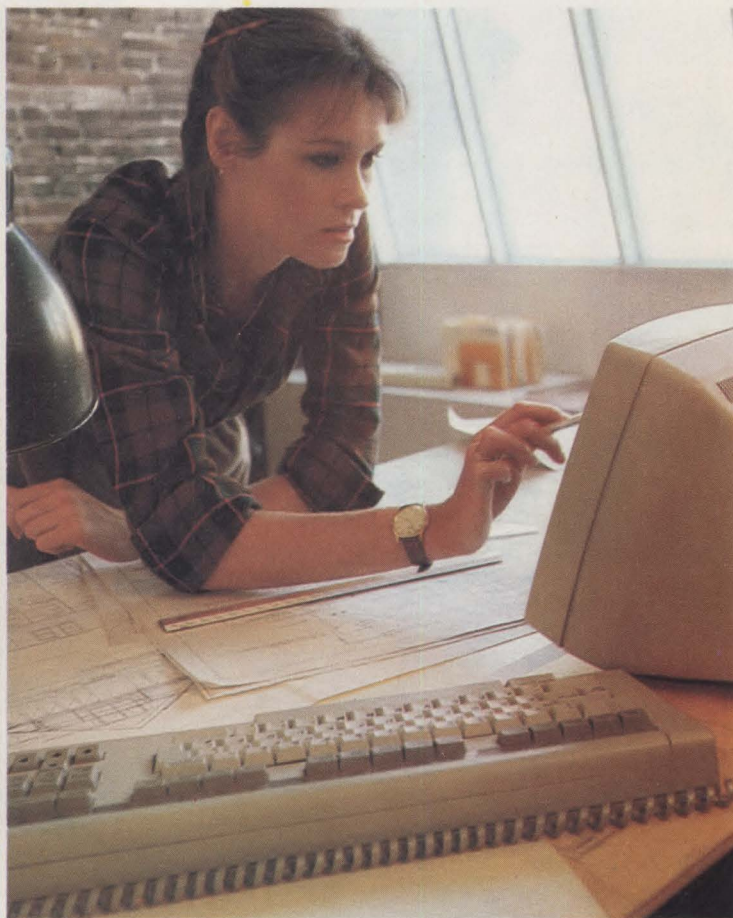
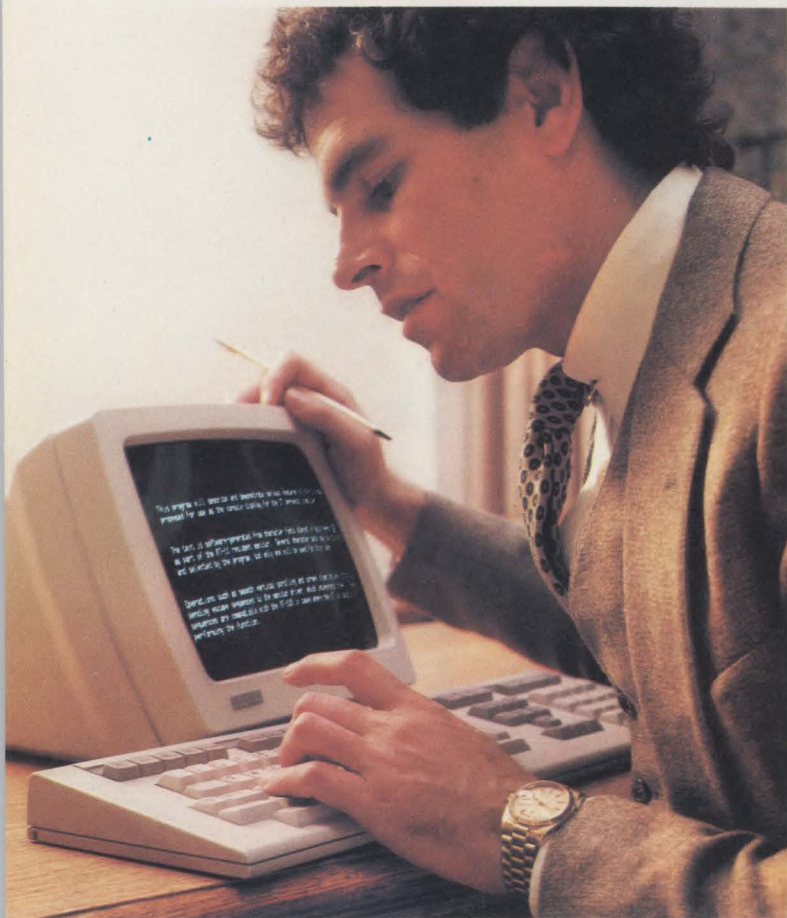
Victor Financial Data

(Dollars in millions except per share amounts)

	1980	1979	1978	1977	1976	1975	1974	1973	1972	1971	1970
Operating Results											
Net sales	\$1,200.0	\$1,200.0	\$1,200.0	\$1,200.0	\$1,200.0	\$1,200.0	\$1,200.0	\$1,200.0	\$1,200.0	\$1,200.0	\$1,200.0
Operating expenses	(400.0)	(400.0)	(400.0)	(400.0)	(400.0)	(400.0)	(400.0)	(400.0)	(400.0)	(400.0)	(400.0)
Operating income	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0
Other income	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Income before taxes	\$900.0	\$900.0	\$900.0	\$900.0	\$900.0	\$900.0	\$900.0	\$900.0	\$900.0	\$900.0	\$900.0
Income taxes	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
Net income	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0
Other Financial Data											
Current assets	\$1,200.0	\$1,200.0	\$1,200.0	\$1,200.0	\$1,200.0	\$1,200.0	\$1,200.0	\$1,200.0	\$1,200.0	\$1,200.0	\$1,200.0
Current liabilities	(400.0)	(400.0)	(400.0)	(400.0)	(400.0)	(400.0)	(400.0)	(400.0)	(400.0)	(400.0)	(400.0)
Working capital	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0
Total assets	\$1,200.0	\$1,200.0	\$1,200.0	\$1,200.0	\$1,200.0	\$1,200.0	\$1,200.0	\$1,200.0	\$1,200.0	\$1,200.0	\$1,200.0
Total liabilities	(400.0)	(400.0)	(400.0)	(400.0)	(400.0)	(400.0)	(400.0)	(400.0)	(400.0)	(400.0)	(400.0)
Total equity	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0
Per share data											
Earnings per share	\$8.00	\$8.00	\$8.00	\$8.00	\$8.00	\$8.00	\$8.00	\$8.00	\$8.00	\$8.00	\$8.00
Dividends per share	\$1.00	\$1.00	\$1.00	\$1.00	\$1.00	\$1.00	\$1.00	\$1.00	\$1.00	\$1.00	\$1.00
Book value per share	\$10.00	\$10.00	\$10.00	\$10.00	\$10.00	\$10.00	\$10.00	\$10.00	\$10.00	\$10.00	\$10.00
Market price per share	\$20.00	\$20.00	\$20.00	\$20.00	\$20.00	\$20.00	\$20.00	\$20.00	\$20.00	\$20.00	\$20.00
Price-earnings ratio	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Dividend yield	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Return on assets	66.67%	66.67%	66.67%	66.67%	66.67%	66.67%	66.67%	66.67%	66.67%	66.67%	66.67%
Return on equity	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%
Debt to capitalization ratio	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Interest coverage ratio	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
Fixed assets to total assets	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Capital expenditures	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0
Depreciation and amortization	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0
Research and development	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0
Goodwill	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0
Other intangible assets	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0
Other assets	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0
Other liabilities	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
Other equity	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0	\$100.0
Total equity	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0	\$800.0

VICTOR 9000

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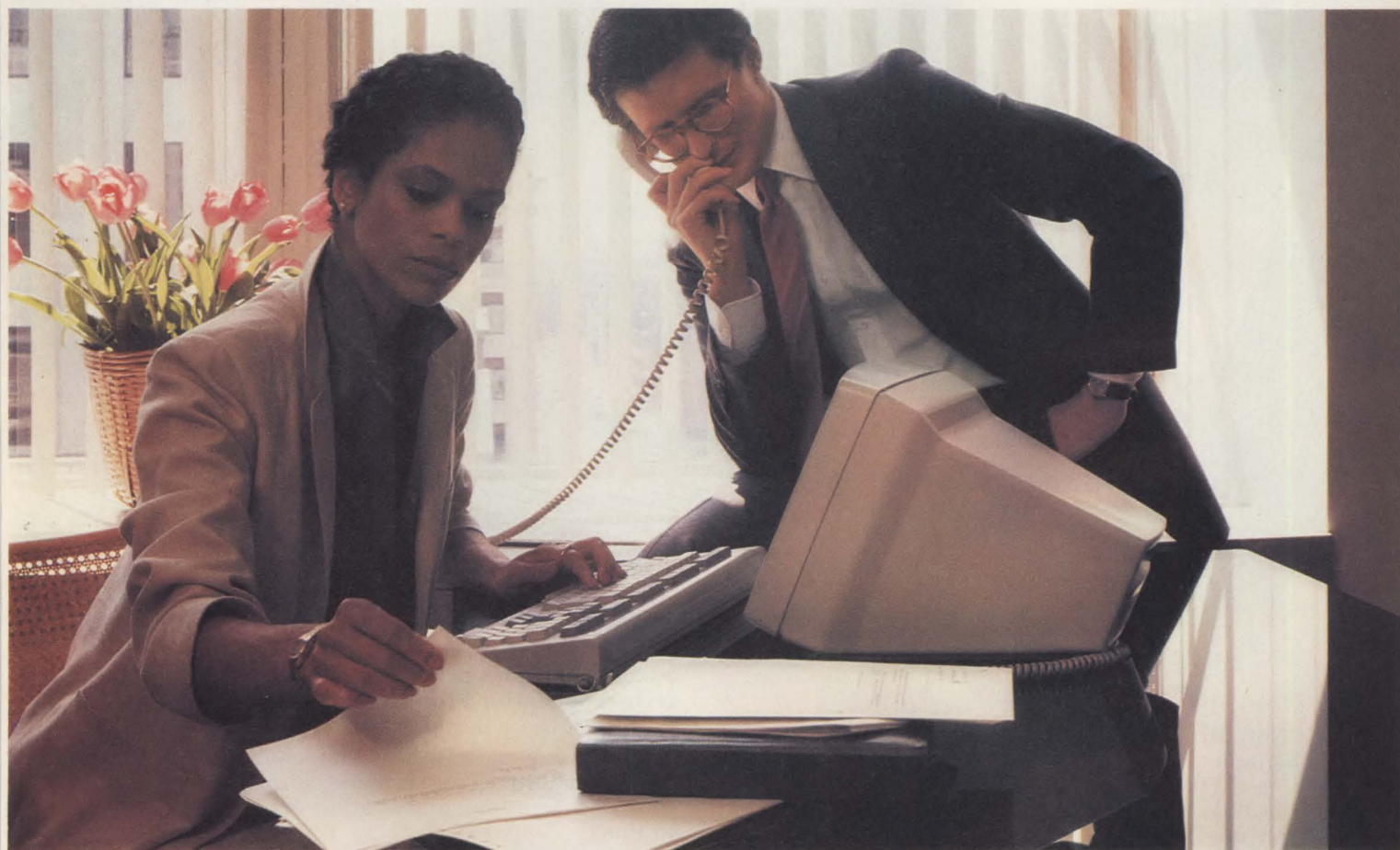
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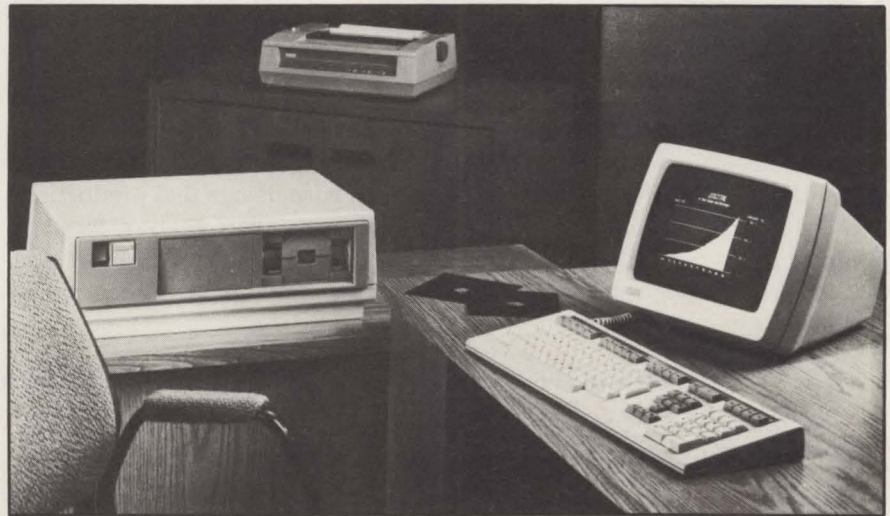
CIRCLE NO. 8 ON INQUIRY CARD

DEC stirs personal-computer market with three newcomers; OEM version coming

When Digital Equipment Corp. officially celebrates its 25th anniversary this summer, it expects to do so as a major contender in the rapidly expanding personal-computing market, having launched a family of three personal computers last month.

DEC officials regard these personal computers as the first in a family that will be broadened, most immediately with the addition of an OEM version of the 300 series, the LCP05, to be introduced at the Comdex show this month in Atlantic City, N.J. DEC's strategy for the personal-computer market centers on a single PC series package that has been fitted with three different single-board μ cs and software repertoires to address three market segments:

- The basic personal computer, developed as the PC 100 and to be sold as the Rainbow 100, has an 8-bit Z80 processor and a 16-bit 8088 and is aimed at the middle to upper reaches of the "industry-standard" personal-computing market. At an



Professional 325, one of Digital Equipment Corp.'s new line of personal computers, features a PDP-11 instruction set, dual 5¼-in. floppy-disk drives, a 12-in.-diagonal bit-map graphics display and a dot-matrix printer.

entry-level price of \$3495, users can choose a DEC version of CP/M designed to run packages written for either processor or they can opt for Microsoft's MS-DOS.

- DEC is addressing the secretarial/clerical work-station market with the PC 200, a replacement for the DECmate stand-alone word-pro-

cessor/small-business system. DECmate II, as it will be known, uses the same 6120 (PDP-8) processor as its predecessor, but with the less expensive package it shares with the other PC products, DECmate II offers a major price reduction over DECmate I. An entry-level version with basic word-processing soft-

AFTER 25 YEARS, DEC SHIFTS GEARS

Digital Equipment Corp.'s move into the personal computer market, a pet project of president and founder Kenneth Olsen, is both a significant shift in direction for the \$4-billion-a-year minicomputer giant and a logical extension of the company's philosophy over the past quarter-century.

The shift came this year when the company created a Small Systems group under vice president and group manager Andrew C. Knowles III to deal exclusively in the specification, development and manufacturing of products that will sell for less than \$10,000. The group incorporates terminal products, retail products, word-processing and commercial OEM product groups of the disbanded

computer products group.

"We've put the product experience of 25 years into this line and, as a company, I think we are capable of being a key supplier in the personal-computing space. We have put in place the organization to sell products for under \$10,000," Knowles says. He also points to DEC's experience as a high-volume manufacturer.

The evolution of DEC's philosophy is related to the advent of the low-cost μ c and its impact on the interactive computing applications that fueled DEC's phenomenal 25-year growth.

"We are now entering a period where the nature of computing is changing, where personal computers will be attached to local networks and

file servers and from there to remote mainframes, and he (Olsen) wants to be in the forefront of that movement," explains Robert E. Montemerlo, manager for programmable terminal products at the Terminal Products group, which is largely responsible for the design and manufacture of the DEC personal computers.

Knowles adds, "This (DEC's entry into the personal-computer market) makes us more capable in an interactive computing sense. We are moving from dispersed computing to truly distributed. In the future, we will be talking about file servers (for desk-top computers) instead of time sharing."

ware is \$3745, or 26 percent less than a comparable DECmate I. With a near-letter-quality printer, the price is \$4445.

• The PC 300 consists of two managerial work-station models, the Professional 325 and 350. They are based on the F-11 (PDP-11 equivalent) processor and will be offered with a number of managerial productivity aids as a "third-generation" personal-computer family. The Professionals are the products that will tie into larger DEC systems and corporate net-

works. They also are aimed squarely at the market niche occupied by such advanced work-station products as Convergent Technologies' AWS/IWS and Fortune Systems' 32:16. The 325 and 350 are \$3745 and \$4995, respectively, including a proprietary operating system that incorporates a version of DEC's RSX-11M.

To take advantage of economies of scale in both design and production, the three PC lines share a package that consists of a systems unit (housing the processor, mass-

storage devices and I/O ports); a free-standing CRT display with a tilting base and brightness/contrast controls; and a detached keyboard with a standard ASCII layout, 20 function keys, a cluster of editing keys and an inverted "T" cursor-control pad.

The three separately priced elements are linked by "user pluggable" cables with the keyboard plugging into the display, which in turn plugs into the systems unit. This arrangement, says Robert E. Montemerlo, manager for program-

MAINTAINING VENDOR CONTROL OVER APPLICATION SOFTWARE

DEC plans to keep a tight grasp on application-software development for the PC325 and PC350 desk-top computers. Because even the routines for driving the keyboard and display are not ROM-resident in PC systems, organizations that wish to create PC325/350 application software—for their own use or for sale—are expected to purchase a "Professional Toolkit" of drivers, utilities and reserved commands that runs only in a PDP-11 RSX-11M/M-Plus or VAX VMS environment. The resulting product is a self-contained run-time package that places little demand on the PC's minimal internal operating system.

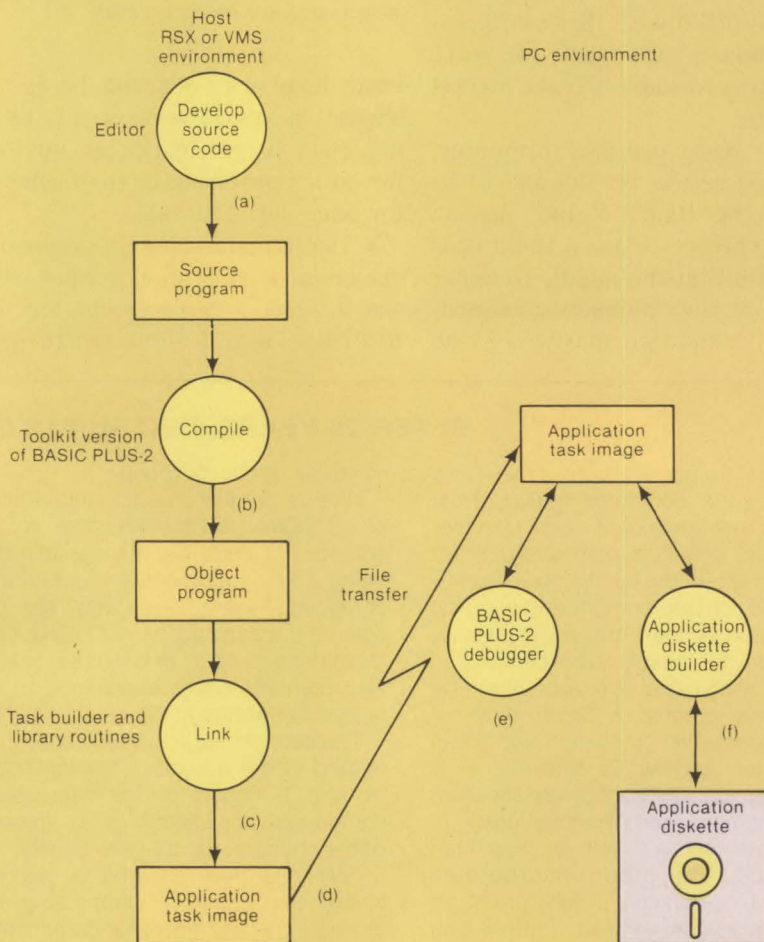
Although this approach forces prospective PC software developers to use a minicomputer for anything more than BASIC source code—at least initially—it should appeal to

existing PDP-11 and VAX commercial users planning to expand their distributed data-processing operations. Unlike companies that suddenly discover that Manager A's personal

computer can't run Manager B's database, existing DEC mini users that expand with Professionals can be assured of total compatibility at all levels.

—Alan R. Kaplan

DEC's PC program-development process. (a) Source code is entered and edited on host PDP-11/23 or VAX-11/750, or on Professional using the PC editor. (b) Source code is compiled on host using Toolkit version of language. (c) Program task image is generated on host from compiled object code using RSX-11M Task Builder, which calls on BASIC-PLUS-2 Object Time System, RMS-11K library, Professional system software service routines (which include keyboard and display drivers, end-user menus and help messages), graphics package and FMS library. (d) Application task image, consisting of compiled source code plus external routines linked by Task Builder, is transferred to PC, where it is debugged (e) and then recorded (f) on diskette using Application Diskette Builder.



mable terminal products in DEC's terminal products group, is the result of president and founder Kenneth Olsen's requirement that users be able to configure the systems without the systems unit using desk-top space. An optional vertical stand is \$99.

The standard PC monitor is a 12-in. monochrome CRT displaying 24 lines \times 80 or 132 characters. All PC series products include ROM-resident VT-100 terminal emulation. The standard CRT is priced at \$325, and a color monitor is \$1325.

The standard low-profile keyboard, a product of a 2-yr. development effort, is said to meet stringent German VDE ergonomic criteria. It is priced at \$245 on the PC 100 and 200 and \$295 on the 300.

The series includes a new minifloppy-disk drive that DEC is manufacturing under licensing rights from T&E Engineering, Gardena, Calif. The drive accommodates two double-density, 96-tpi, 5¼-in. floppies, each storing 400K bytes. The drive uses two heads on a single actuator, but future

versions are expected to incorporate four heads and double-sided media. DEC says the T&E design was selected because it enabled DEC to get dual media in the space of a single, standard 5¼-in. drive.

The major packaging difference among the PCs is the choice of a small or slightly larger system box. Standard on the 350, the larger box has a larger power supply and houses a 5¼-in. Winchester-disk drive as well as the standard minifloppy drive (on the 350). The latter incorporates two diskettes

...AND A TIGHT HOLD ON HARDWARE

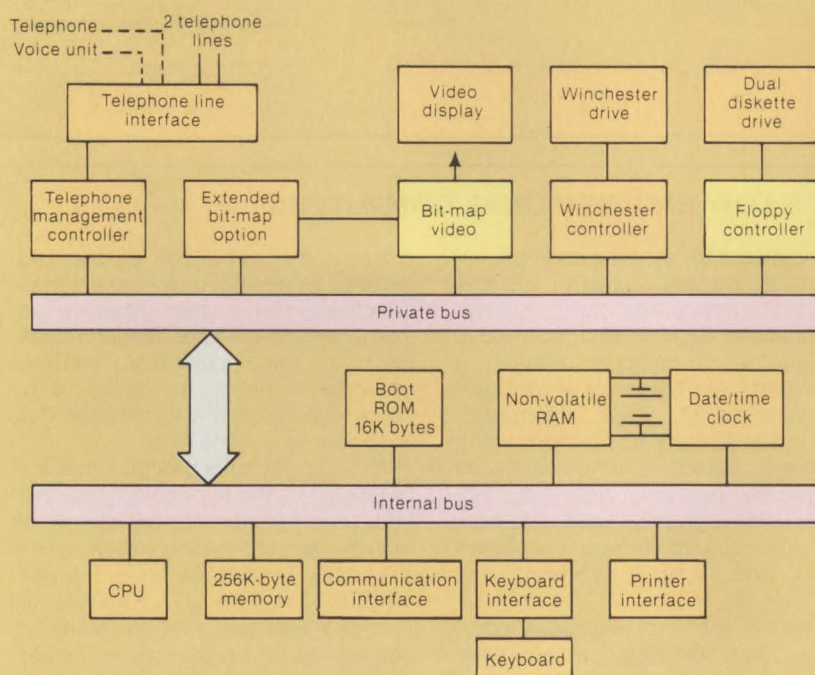
DEC's Professional 325 and 350 hardware is no less locked up than the software, a feature sure to delight corporate data-processing managers who, besides being concerned with the use of their companies' desk-top computers for space-invader games, have had to contend with a plethora of disparate video, real-time and control boards.

The Professionals' six-slot auxiliary card cage and system motherboard both use form factors, connectors and

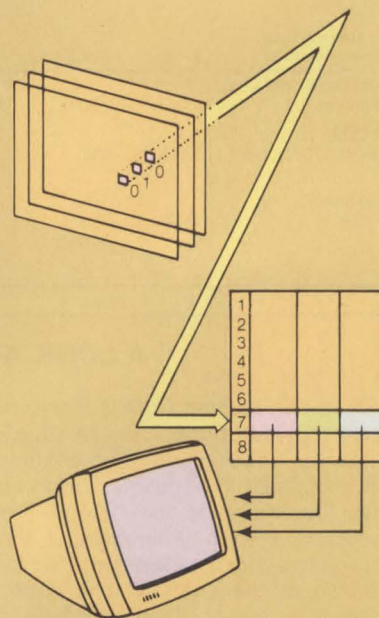
bus organizations not seen elsewhere in DEC's product lines. The motherboard accepts two small 128K-byte memory boards that lie parallel to and above it. Option cards are inserted from right to left into the fully enclosed card cage after releasing a hinged side cover. There are no edge connectors on the 5- \times 12-in. option cards. Instead, the cards connect to the private bus with zero-insertion-force DIP connectors. The 350 system is delivered with two of the six option

slots occupied by bit-mapped video and floppy controller cards (highlighted in block diagram). The floppy data separator is on a separate, smaller board located outside the cage, as are the 350's phone cards.

—Alan R. Kaplan



Professional 350 system block diagram



Extended bit-mapped color option provides three planes of bit-mapped storage 960 horizontal \times 240 vertical pixels. Each pixel is associated with one of eight unique values. The color map translates these values into a specific color combination of red, green and blue. There are four blues, eight reds and eight greens, which can be combined into 256 colors.

Mini-Micro World

driven by one spindle. The PC 100, 200 and 325 can be ordered with the large box and the dual floppy-drive unit.

The company has configured hardware throughout the series so that users without computer expertise or special tools can set up systems, install options or perform board-swap service. Packaging has been simplified to the degree that users will be expected to plug a chip into the system board to install the

300's \$225 floating-point option, Montemerlo says.

DEC officials concede that missing from the initial PC releases is a product on which hardware value-added resellers and OEMs can base new systems. The 300s are the only members of the series with anything approaching a traditional card cage, but DEC officials say they will not allow non-DEC add-ins onto that proprietary bus or within any PC series box. That decision was

prompted by the need to provide low-cost service on a high-volume product, Montemerlo explains.

However, Andrew C. Knowles III, vice president and group manager of DEC's Small Systems group, says another version of the PC box will be introduced in time for the Comdex show this month (see "OEM version of DEC personal computer coming at Comdex," p. 5). That system, the LCP05, will be based on the F-11 processor and will

System	Price	MPU	Memory/expansion	Floppy disk (bytes)	Winchester disk (bytes)	Operating system	Languages
Digital Equipment Corp. Professional 325	\$3745	F-11	256K/no	dual media (800K)	N/A	Professional Operating System (POS)	BASIC, p-System with Pascal, FORTRAN
Professional 350	\$4995	F-11	256K/no	dual media (800K)	(5M)	POS	BASIC, p-System with Pascal, FORTRAN
Convergent Technologies AWS 200	\$6100	8086	128K/512K	single (630K)	N/A	CTOS	BASIC, COBOL, FORTRAN, Pascal
AWS 240	\$9900	8086	128K/512K	single (630K)	(5M)	CTOS	BASIC, COBOL, FORTRAN, Pascal
Fortune Systems 32:16 System 1	\$4995	MC68000	128K/1M	single (1M)	(5M, 10M, 20M)	UNIX	BASIC, COBOL (run time), COBOL Compiler, FORTRAN, Pascal, C
Radio Shack TRS-80 model 16	\$4999	Z80/MC68000	128K/512K	single (1.25M)	(10M)	TRSDOS	BASIC, COBOL, FORTRAN, Assembler, Macro Editor Assembler, Assembly Language Development System
Data General Corp. Enterprise 1000	\$7195	mN602	64K/no	dual (380K)	N/A	Enterprise OS	Business BASIC
Digital Equipment Corp. Rainbow 100	\$3245	Z80/8088	64K/256K	dual media (800K)	(5M)	CP/M 86/80, MS-DOS	BASIC, C
IBM Corp. Personal Computer	\$2895	8088	16K/256K	single (160K)	N/A	PC DOS, CP/M 86, p-System	BASIC Extension, FORTRAN, Pascal, COBOL Compiler, Macro Assembler
Radio Shack TRS-80 II	\$3499	Z80A	64K/no	single (486K)	(8.6M)	TRSDOS	BASIC, COBOL, FORTRAN, Assembler, Macro Editor Assembler, Assembly Language Development System

A LOOK AT DEC'S LOW-END PERSONAL COMPUTERS

Digital Equipment Corp.'s Rainbow personal computer has a dual-processor architecture that enables one processor to handle I/O functions while the other runs applications. The operating system determines if the application being loaded is written for the z80 or the 8088. If it is a z80 application, a special routine converts the z80 calls for processing by the 8088, while the z80 manages both the CRT and disk operations.

The Rainbow includes 64K bytes of RAM and is the only member of the PC family to offer memory upgrades. As much as 256K bytes can be added. A 64K-byte board is \$495, and the 192K-byte board is \$1095.

Rainbow software is unbundled,

and both the CP/M 86/80 and optional Microsoft MS-DOS operating systems are \$250. DEC is also selling general applications such as Microsoft BASIC (\$250), a C compiler (\$500), a Microsoft Multiplan spread-sheet analysis (\$275), Select Information Systems' Select word-processing package (\$595) and a series of accounting packages from BPI ranging from \$195 to \$650 each. Additions are expected to include concurrent CP/M and UCSD p-System, DEC sources say.

The PC 200 is positioned a notch higher than the Rainbow. However, under the skins, the DECmate II has the same 6120 that powered its predecessor. The 64K-byte system

supports the same disk as the 100 and can be equipped with an external Winchester for \$4200, including an interface card. Another option, a \$225 RX01 or RX02 controller, enables DECmate I users to attach 8-in. floppy-disk drives to the DECmate II for transporting existing files.

Although terminal products manager Robert E. Montemerlo emphasizes that there seems to be plenty of market life left in the PDP-8-based DECmates, Small Systems group vice president Andrew C. Knowles III acknowledges that a version of the PC 300 with its F-11 processor eventually will be marketed through the Word Processing group.

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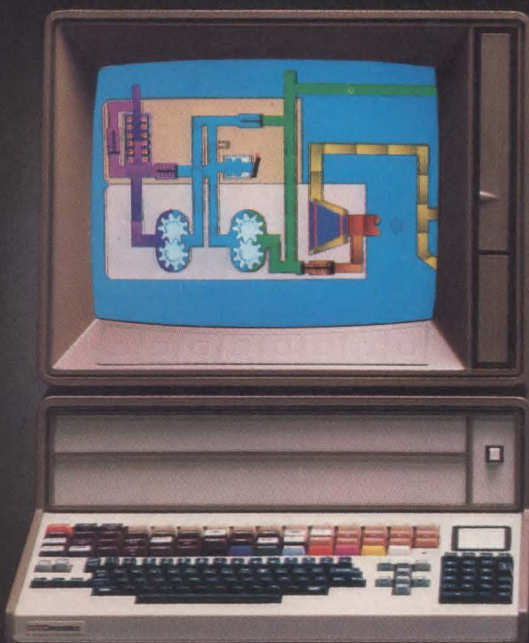


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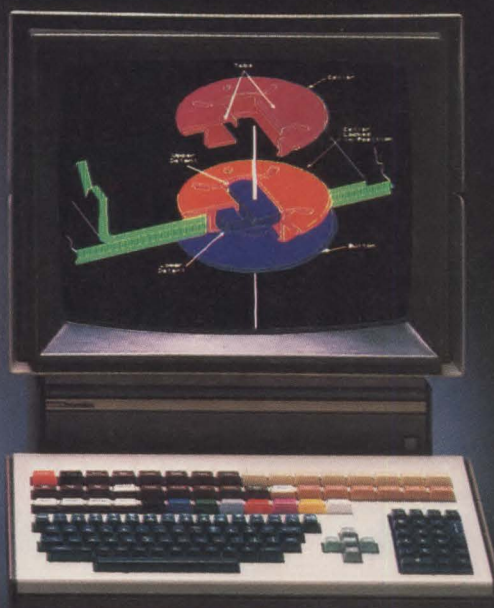
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CIRCLE NO. 10 ON INQUIRY CARD

use the standard PDP-11 Q-bus architecture to facilitate attachment of third-party hardware. "It will be aimed at our traditional (commercial and technical) OEMs who want a public bus," Knowles says.

In the meantime, Montemerlo maintains, the Rainbow 100 will be "wide open" to OEMs developing the type of add-on options that have proliferated around Apple Comput-

er, Inc., and International Business Machines Corp. products. For example, he says, he would be surprised if a third party does not quickly develop an external bus extender for the 100.

The Rainbow has space for three daughter boards. One space would be used by the memory-expansion option, and a second is for an \$845 graphics board. The board supports

color or monochromatic, bit-mapped graphics with high resolution at 800×240 and low resolution at 320×240 . The latter (standard television resolution) was selected not to enable users to hook the Rainbow to their televisions, but to enable the Rainbow to act as a videotex terminal, Montemerlo explains.

The third space on the Rainbow is for an extended communications

PROFESSIONAL MARKS THIRD-GENERATION PC FOR DEC

In the Professional 325 and 350, Digital Equipment Corp. has piled on the bells and whistles to come up with what it sees as a third-generation personal computer.

The first and second generations are represented by the 8- and 16-bit μ ps found in the PC 100 and characterized by single-task execution, simple commands and rudimentary filing. The third generation, says terminal products manager Robert E. Montemerlo, will be marked by a multitasking system with consistent user interfaces (that is, those supplied by DEC), sophisticated file management, multiple concurrent communications capability and high-level development tools.

DEC, which layers a user-friendly menu interface onto its RSX-11M to produce a run-time POS (Professional operating system) package for the PC 300s, plans to make that operating system the standard for the third-generation personal computer, much as CP/M has been the standard for the first two, Montemerlo says.

As the leader of the third generation of personal computing, DEC sees the 300s fulfilling several needs. Basically, they serve as high-functionality, multitasking personal computers/small-business systems (although multiterminal versions are not yet announced). But they are also seen as network products, tracing their roots to an advanced terminal developed as the VT-134 at the Terminal Products group. In the first instance, the 300s are expected to appeal to computer retailers selling the systems with a vast array of third-party packages to be offered by DEC. In the second, DEC will primarily address its existing customer base and vie with International Business

Machines Corp., Xerox Corp. and Wang Laboratories, Inc., for a slice of the ever-sweeter corporate office-information network pie.

"The Professional is very appropriate for the Fortune 1000 accounts that need a personal computer tied to a network," says Small Systems group vice president Andrew C. Knowles III. He adds that the 300s will support Ethernet by next summer and will attach to DECnet, SNA and X.25 networks.

The 325 and 350 are based on the F-11 three-chip processor, which is said to have the performance of a PDP-11/23 or 24. The two are configured with what resembles a miniature card cage that accepts user-installable, DEC-supplied, special-purpose boards. Memory is added by layering small daughter boards over and parallel with the system's motherboard. The 350 has four open slots, and the 325 has one.

Both 300 series models include 256K bytes of non-expandable RAM and a two-floppy drive. The 325 supports a second floppy, and the 350 supports an internal Winchester disk. The 300s feature monochromatic bit-map graphics with 960×240 resolution.

The 300s are the only members of the PC family with a bundled operating system. At introduction, their software repertoire included BASIC (\$195), an enhanced communications package with advanced VT-100 formatting (\$195), UCSD Pascal (\$975 including p-System and with FORTRAN and Pascal separately priced at \$250 and \$375, respectively), VisiCalc (\$250) and VisiTrend (\$275).

The 325's only hardware option is a floating-point adapter. However, the 350 includes several options, includ-

ing a built-in Winchester disk (\$3500), a real-time interface card for process control and similar applications (\$595) and an extended bit-map board for color graphics (\$895). It also supports a telephone-management system, a card that includes two 1200-bps modems on-board. This \$895 device includes voice-digitizing circuitry and can be configured with a standard telephone handset and an optional \$295 recording unit similar to a dictation machine. Software for these options has not been released.

To help make POS a standard, DEC has worked for a year with independent-software suppliers to compile a library of POS applications. But early last month, DEC had commitments from 25 vendors to supply 81 software packages for the 325 and 350 by September, when initial customer shipments are scheduled. The list of vendors includes Visicorp, Softech, Desktop Software, BPI, NPL, Aardvark, Cortex, Ferox, IIS, Jarett, Learning Tools, Inc., PCD Systems, Pacific Data Systems, Ross Systems, Structural Programming, Timberline Associates and White Smith. Their packages include a number of financial-modeling and spread-sheet packages (such as VisiCalc, VisiTrend, Moneytrack and Fingraph) as well as products for list management, scheduling, menu planning, tax planning, resource management, property management and cost management.

The third-party products and those to be written in-house by major end users are developed on a DEC 11/23 or higher system running a Programmers Toolkit, priced separately at \$4000 and supporting BASIC (\$1755) or FORTRAN (\$2185).

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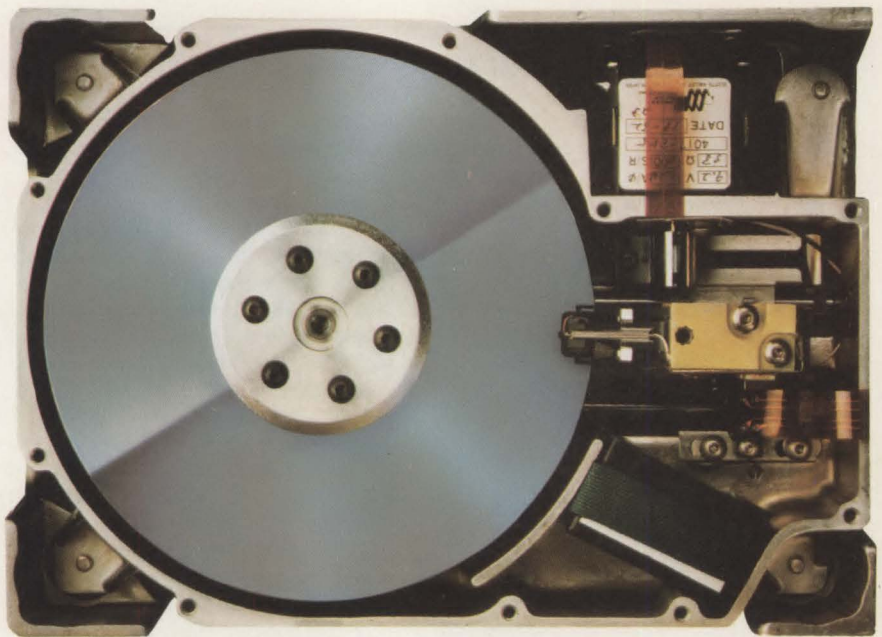
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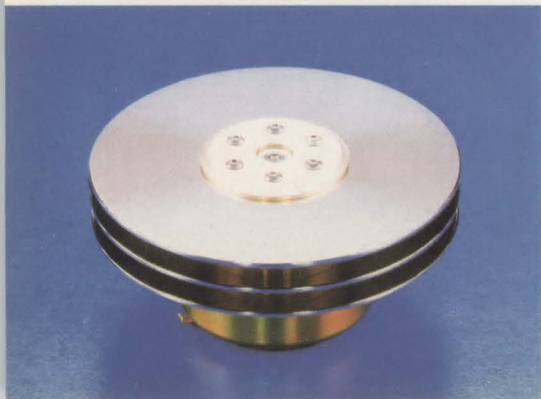
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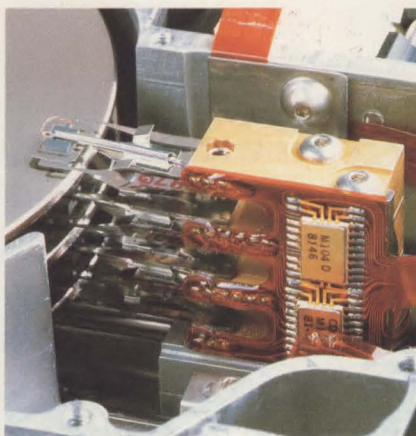
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No. of Disks	1	2	3	1	2	3
RPM	3600	3600	3600	3600	3600	3600
BPI	9706	9706	9706	10,700	10,700	10,700
TPI	303	303	303	303	303	303
Bytes per Track	10,417	10,417	10,417	11,459	11,459	11,459
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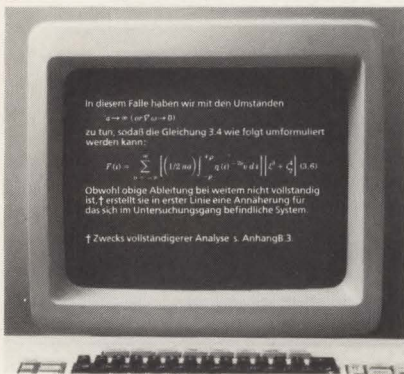
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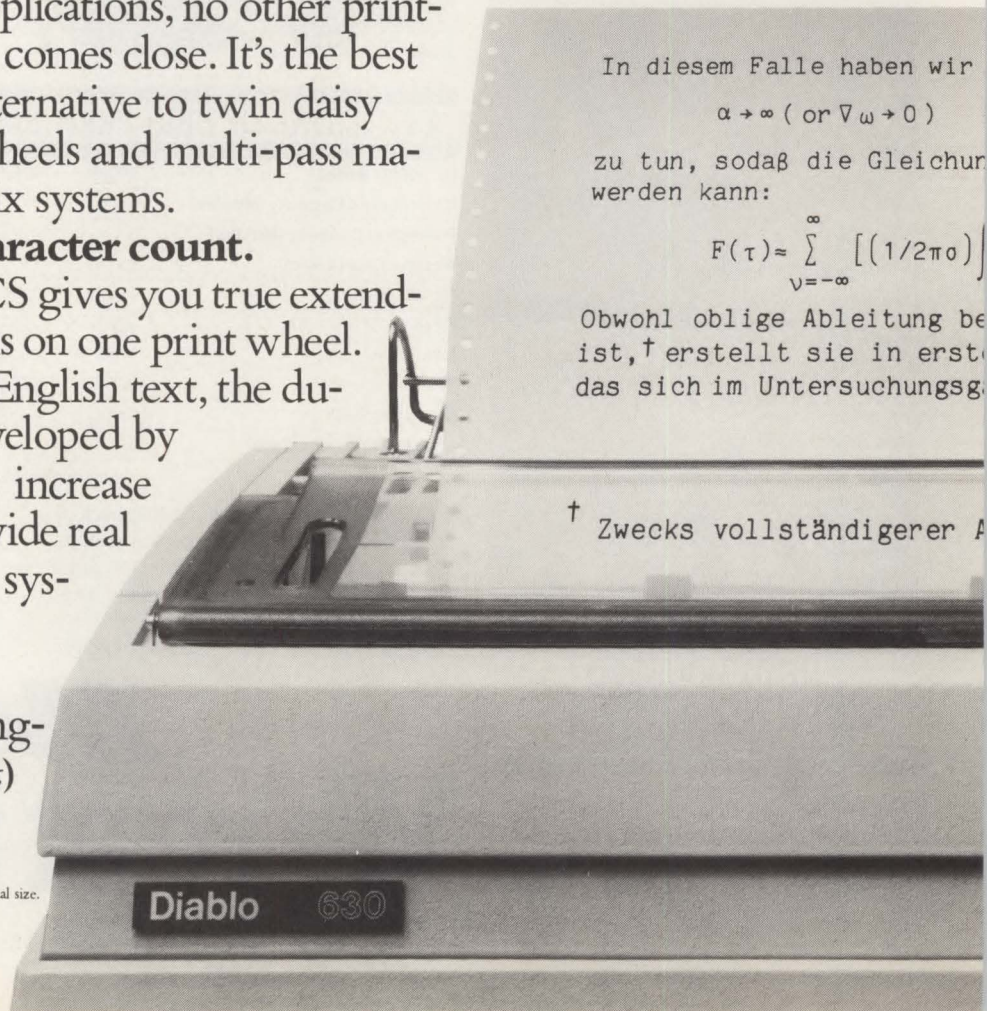
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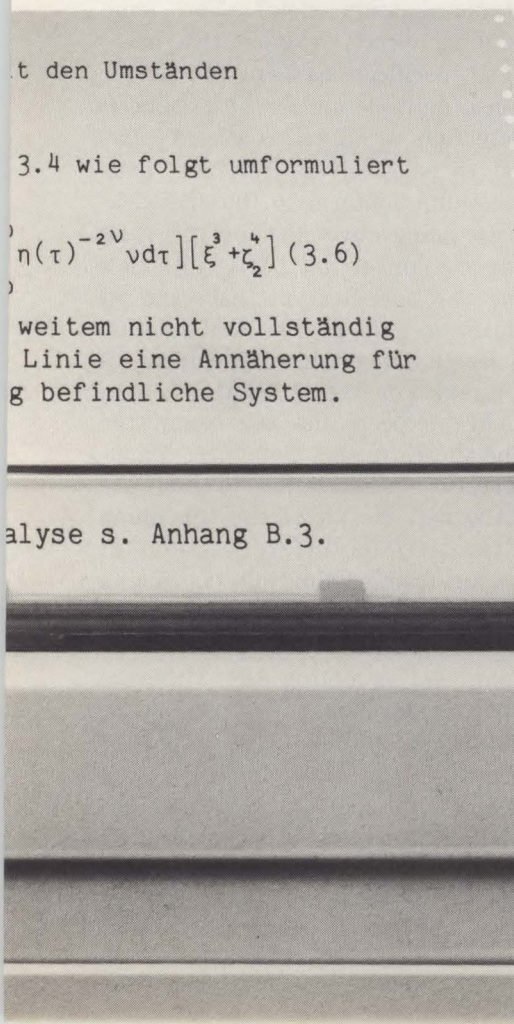
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CIRCLE NO. 12 ON INQUIRY CARD



feature that includes a second RS232 port and an RS422 port. The latter is said to have an 800K-bps channel and can be used to attach an external 5M-byte Seagate Technology Winchester-disk drive (available from DEC for \$3700 with interface). The extended communications board is priced at \$500 and includes a DMA interface for bit synchronous transmission.

Like its competitors, DEC will support the use of third-party packages with a listing and certification program. At the lowest level, DEC will list programs that it has looked at and believes will work. At the second level, DEC has seen the program work and it has been recommended by DEC customers. At the highest level, DEC will support programs it has tested itself.

Service for the PC series hardware and software is "aggressively priced" and available in a number of ways. On-site service can be as low as \$34 a month for the PC 100, Montemerlo says. DEC also plans to open 162 walk-in service centers for module repairs by September. A WATS-line telephone service will be available for software assistance on supported products.

Marketing policies for the three PC lines rely on existing DEC channels, although Montemerlo points out that far more emphasis will be placed on second-tier outlets. (These include several programs already administered by the Small Systems group, such as the DEC retail stores, authorized terminal distributors (that have handled the VT-180 CP/M kit for VT-100 terminals) and DEC dealers.

DEC is opening new channels in non-DEC sales for low-volume buyers. The machines will be available from Computerland retail stores and from Hamilton-Avnet industrial distributors, offering 500 to 600 outlets. Knowles says the machines can be ordered from those sites

now, and will be stocked this fall. He adds that DEC is gearing to build 100,000 or more systems in the first year of production.

Knowles says the DEC direct sales force will concentrate on the Fortune 1000 customer base, where, Montemerlo points out, "We break even on 50 or more units." Volume sales of PC 100s and 300s are expected among large DEC users, who will receive hardware and software quantity discounts at the 20-unit-per-year level.

The PC series will be sold with a new sales contract that, Montemerlo says, for the first time will impose the same discount structures and conditions across all marketing groups. Although the contracts will permit special terms and conditions to be added as marketing groups require, they are designed to provide uniformity in ordering throughout DEC and will be extended to other product lines, he says.

—Geoff Lewis

Ungermann-Bass/Fujitsu deal promises first Ethernet chips

In the race to market LSI chips that incorporate the Ethernet local-area-network specification, it appears the first to succeed will be Ungermann-Bass, Inc., and Fujitsu Ltd., which announced a joint-development agreement for this purpose just two months ago. If the partners meet their projected schedule of first shipments starting next month, with quantity shipments by the fourth quarter, their Ethernet chip set will appear before products being developed in two other highly publicized efforts—one at Intel Corp. and a joint-development effort between Mos-tek, Corp. and Advanced Micro Devices, Inc.

LSI chips that implement Ethernet, the LAN specification initiated by Xerox Corp. and promoted by Xerox, Digital Equipment Corp. and Intel, must decrease the high cost of Ethernet interface. With prices for these interfaces in the \$1000-plus range, such communications controllers often sell for more than the equipment people want to connect to the network (MMS, May, p. 6). Availability of Ethernet chip sets is expected to lower these prices to

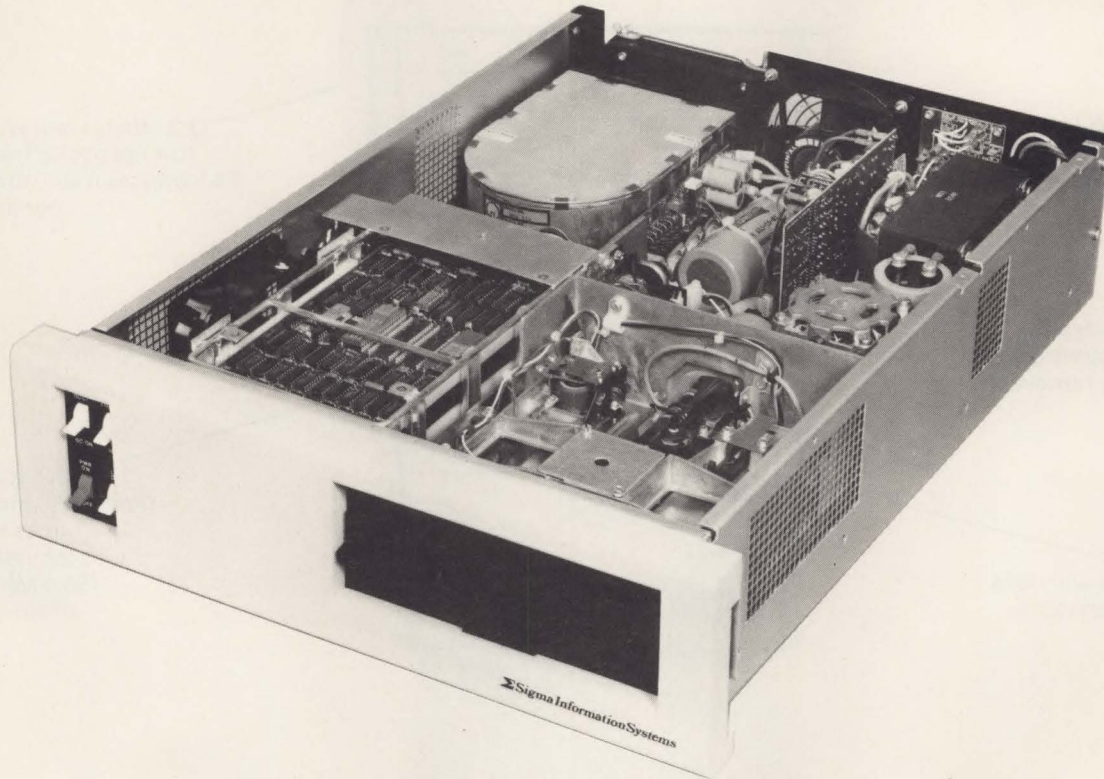
\$200 or less.

Even with the promise of lower interface prices, the Ethernet chip developers are working under a standardization cloud. The long-running effort to avoid two base-band specifications using the carrier sense multiple access with collision detection technique (CSMA/CD) has yet to be resolved. Ethernet does not quite conform to the specifications being developed by the IEEE 802 committee on LANs, although the two specifications have moved closer over the past several months.

Ralph Ungermann, president of Ungermann-Bass, Santa Clara, Calif., expects the 802 committee and the European Computer Manufacturer's Association to embrace Ethernet. He views the remaining Ethernet/802 difference—one of packet-frame delimiting—as easy to resolve. Even if Ethernet should move to the 802 approach, rather than 802 accepting the Ethernet spec, Ungermann says, "putting the 802 spec on our chips would be trivial. A possible change is not really an important issue for the chips, but it would be a real problem in terms of retrofitting the hundreds of Ethernet networks out

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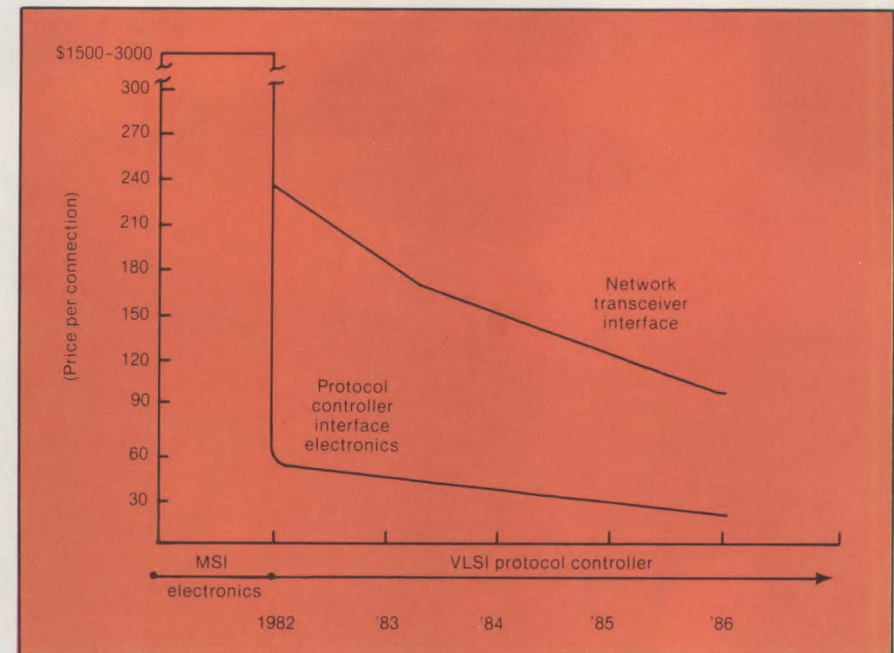
The Ungermann-Bass/Fujitsu relationship has been in effect for more than a year, Ungermann says, and the partners plan to develop other LAN chips. Ungermann-Bass performed the system and logic design for the Ethernet chips, and Fujitsu did the circuit design to place the specifications in silicon.

One reason the Fujitsu chips will reach market so rapidly, says Ungermann, is that the chips incorporate nothing beyond the straight level 1 and 2 Ethernet spec. (Levels 1 and 2 refer to the physical and data-link layers of the International Standards Organization's Open Systems Interconnection model.) One chip of the two-chip set uses bipolar technology and performs the Manchester encoding/decoding of network data. The second VLSI circuit uses CMOS technology to implement the level 2 CSMA/CD access technique.

"We put no functions on the chips above level 2," Ungermann says, "because there are no standards above that level. Intel has put an enormous amount of work into a very specific buffer-management scheme that they will implement in their chips. This scheme may or may not be appropriate for whatever higher level standards are developed." The level 2 chip from Mostek and AMD will also incorporate on-board buffer management.

At Intel, Ronald T. Yara, strategic marketing manager, says the DMA buffer-management scheme the Intel chips will incorporate will not be invalidated by future standards. "Buffer-management facilities have nothing to do with the OSI model," he says. "It's just a generic function that makes it simpler for the processor to implement the higher levels, whatever they end up being."

If the Ethernet chips don't provide such generic facilities as buffer management, Yara says, the



As VLSI chip sets implementing the Ethernet protocols become available this year, Intel predicts, the OEM price for the controller electronics will drop to the \$60 to \$100 range, and will continue to decline in following years. Intel also expects LSI techniques applied to the transceiver electronics to cause the transceiver prices to fall. Total OEM interface costs—including both the controller and transceiver electronics—should be about \$125 by 1985, the company says, with end-user interface prices two to 10 times that level.

attached processor will be required to handle them. "The facilities we will provide on our chips will be for handling the transmitted information, not for dictating ultimate rules to manage the information."

Another difference Ungermann expects between the Fujitsu chips and the Intel circuits, which will be shipped in sample quantities by this year's fourth quarter, is the general-purpose nature of the former. "Even though our chips won't have buffer management on-board," he says, "they won't necessarily be simpler than Intel's, because we designed them so they could be used with virtually any computer bus. It's an extremely general-purpose interface, so it could be used in a low-end product, such as a Z80-based μ c, up to a high-end product, where you could have a minicomputer bus running the chip.

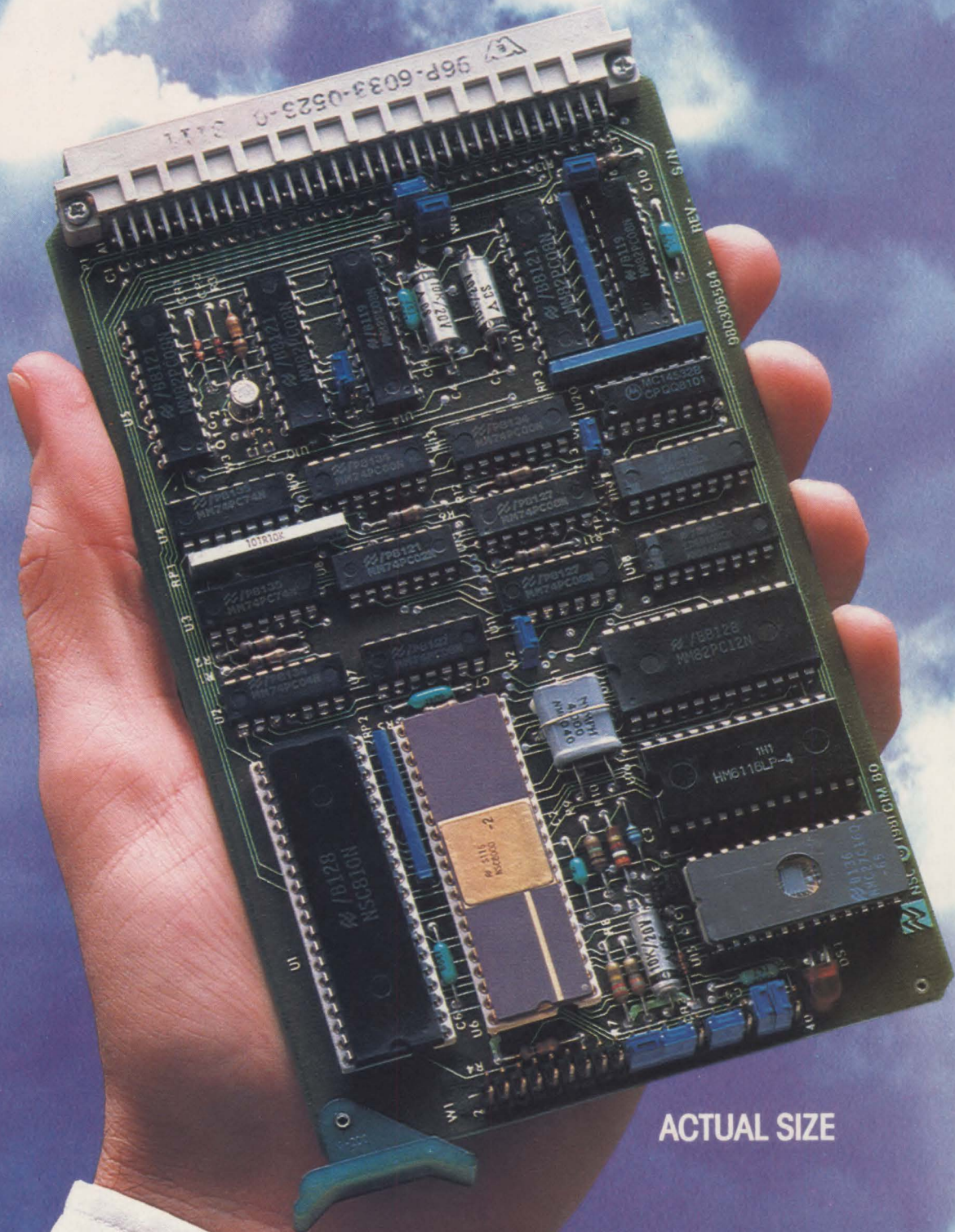
"Intel's chip set is ideally suited to Intel's buses," Ungermann says. "To use it on something else, you

will have to do some reworking around the periphery of the chip."

Yara admits that the Intel chips will be optimized for operation with its μ ps, and that it requires some work to connect the circuits to other types of devices. "It's always possible to design a universal chip," he says. "But the penalty of having it universal is a higher cost." Intel projects that its two-chip set will sell in large quantities in the \$60 to \$100 range. Ungermann declines to comment on the pricing of the Fujitsu chip, but says, "We expect our product to be competitive with any other products on the market."

Mostek, Carrollton, Texas, and AMD, Sunnyvale, Calif., are attempting to optimize their chip set for use with several μ ps by making some of the chips' pins programmable, says Jim Vittera, program manager of Mostek's Ethernet effort. The processors slated to be supported by the Mostek/AMD chips are the 8086, the 68000, the Z8000 and the LSI-11 family.

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Both Mostek and AMD are developing their own silicon design for their level 1 serial interface adapter (SIA) chip and the level 2 local-area network controller for Ethernet (LANCE) chip, although the companies are trying to ensure

that their respective designs use common logic. Each company is taking the engineering lead on one of the chips, with AMD focusing on the bipolar SIA, and Mostek concentrating on the n-channel LANCE. Vittera says the companies'

first-pass silicon products will be out in the first quarter of 1983, with production-quality second-pass silicon chips expected by the third quarter of 1983.

—Dwight B. Davis

Low-end VAX gives DEC more muscle with OEMs

Digital Equipment Corp., credited with breathing life into the 32-bit superminicomputer market when it introduced the VAX-11/780 4½ years ago, again is pumping adrenaline into the demand for those typically end-user systems by targeting the new low-end VAX-11/730 at OEMs.

The timing of the introduction is good, despite disappointing third-quarter profits of about 7 percent and in light of a back-to-back major announcement with the company's

personal computers (see "DEC stirs personal-computer market with three newcomers," p. 15).

"It's a hell of a time to accelerate the products (out the door)," says analyst John Adams of Adams Harkness and Hill, Inc., Boston. "If you have a good new product, you want to get it to market as soon as you can."

Although the company intends to sell its typical but unspecified ratio of the products directly, it is, for the

second time in recent months, expanding its OEM push. Within the past six months, DEC introduced the VAX-11/751, a rack-mounted version of the VAX-11/750, both of which are available as OEM units. The new VAX-11/730, widely known by the code name Nebula, is DEC's first big push to offer traditional 19-in. packaging to OEMs.

For \$28,500, an OEM gets a three-board, 32-bit processor, 1M byte of memory comprised of 64K-bit MOS dynamic RAM chips, a VMS operating-system license and warranty, and a 10½-in. rack-mountable box. OEMs buying quantities of 100 or more receive a

VAX FAMILY SPECIFICATIONS

Hardware	VAX-11/730	VAX-11/750	VAX-11/780	VAX-11/782
Word length (bits)	32	32	32	32
Virtual address space (G bytes)	4.3	4.3	4.3	4.3
Maximum program size (G bytes)	2	2	2	2
Circuit technology	programmed array logic	low-power bipolar Schottky	TTL Schottky	TTL Schottky
Implementation	integrated circuits (LSI)	gate arrays (LSI)	ICs (MSI)	ICs (MSI)
Memory type	64K ECC MOS RAM	64K or 16K ECC MOS RAM	16K ECC MOS RAM	16K ECC MOS RAM
Memory capacity (M bytes)	5	8	8*	8
Cache memory (K bytes)	none	4 (bipolar)	8 (bipolar)	8 (bipolar each processor)
User control store	none	KU750, 20K bytes	KU780, 24K bytes	KU780, 24K bytes each processor
Buses	Unibus (1 standard)	Unibus (1 standard, 1 optional), Massbus (3 optional)	Unibus (1 standard, 3 optional) Massbus (4 optional), DR780 parallel interface (1 optional)	Unibus (1 standard, 3 optional), Massbus (4 optional), DR780 parallel interface (1 optional)
Instruction set	244 instructions, 9 address modes, 6 data types	244 instructions, 9 address modes, 6 data types	244 instructions, 9 address modes, 6 data types	244 instructions, 9 address modes, 6 data types
Access control	4 hierarchical protection modes	4 hierarchical protection modes	4 hierarchical protection modes	4 hierarchical protection modes

* (12M bytes in multiprocessor configurations, including 2 MA780 shared-memory subsystems)

Software

The following major languages and software packages are available for all VAX models:

Operating system—VMS (includes VAX-11 RMS file management system, VAX-11 FMS forms management system, SORT, MAIL and other utilities)

Programming languages—VAX BASIC, VAX-11 BLISS-32, VAX-11 C, VAX-11 COBOL, VAX-11 CORAL 66, VAX-11 FORTRAN, VAX-11 Macro Assembler, VAX-11 Pascal, VAX-11 PL/I, PDO-11 languages and utilities (compatibility mode)

Utilities, packages—DECnet-VAX, VAX-11 common data dictionary, VAX-11 Datatrieve, VAX-11 DBMS

**TANDON IS
NO LONGER
COMPETING
IN THE
DISK DRIVE
BUSINESS.**

YOU CAN'T CO YOU'VE GOT NO

That's quite a claim. How can we make it? Quite simply, because no one else is trying to do what we've set out to do.

In the words of our President, Sirjang Lal Tandon: "Tandon Corporation has been built on a strategy of producing high performance micro-computer peripherals at prices so low

unlike all other disk drive manufacturers' businesses.

How?

To start with, we make more of what goes into our drives than any other manufacturer. 80% of the cost of every drive consists of parts we actually make ourselves.

This assures that we can control



that they increase the markets for the computers themselves. If we can help the computer industry create a reliable \$200 or \$300 'home' system with meaningful capacity — not just a game or toy — most households will be able to afford one. Then we will see a real mass market.

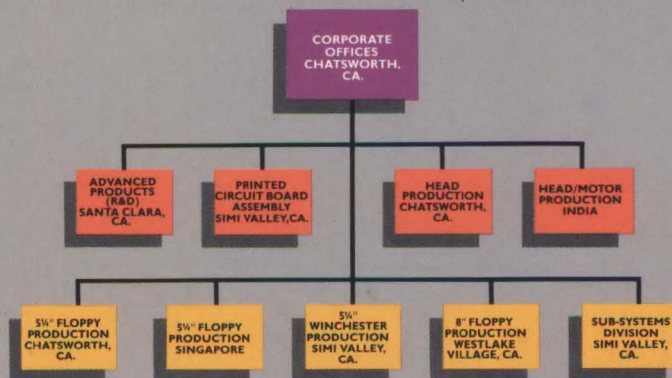
"At the upper end, if we can give small business and personal computers 10 to 50 times their current memory/storage capabilities at a practical cost, we will enlarge the market for more sophisticated desktop systems, and of course, our own market as well."

To accomplish this, we have designed and organized our business

the quality of each critical component to our own high-level specifications.

It also allows us to engineer advanced designs from the start that lend themselves to more efficient mass production and higher overall performance.

We make sure that our production



MPETE WHEN COMPETITION.

capabilities exceed our orders by at least 50% so we are always in a position to deliver.

And we use separate production facilities for each of our product lines, keeping their individual priorities distinct to further increase productivity and, ultimately, throughput.

We also offer our customers the most generous guarantee in the industry, to back up the reliability we've achieved.

And finally, we offer our customers a very broad line of drives—16 models in all. So we're the single

source that can meet almost any need.

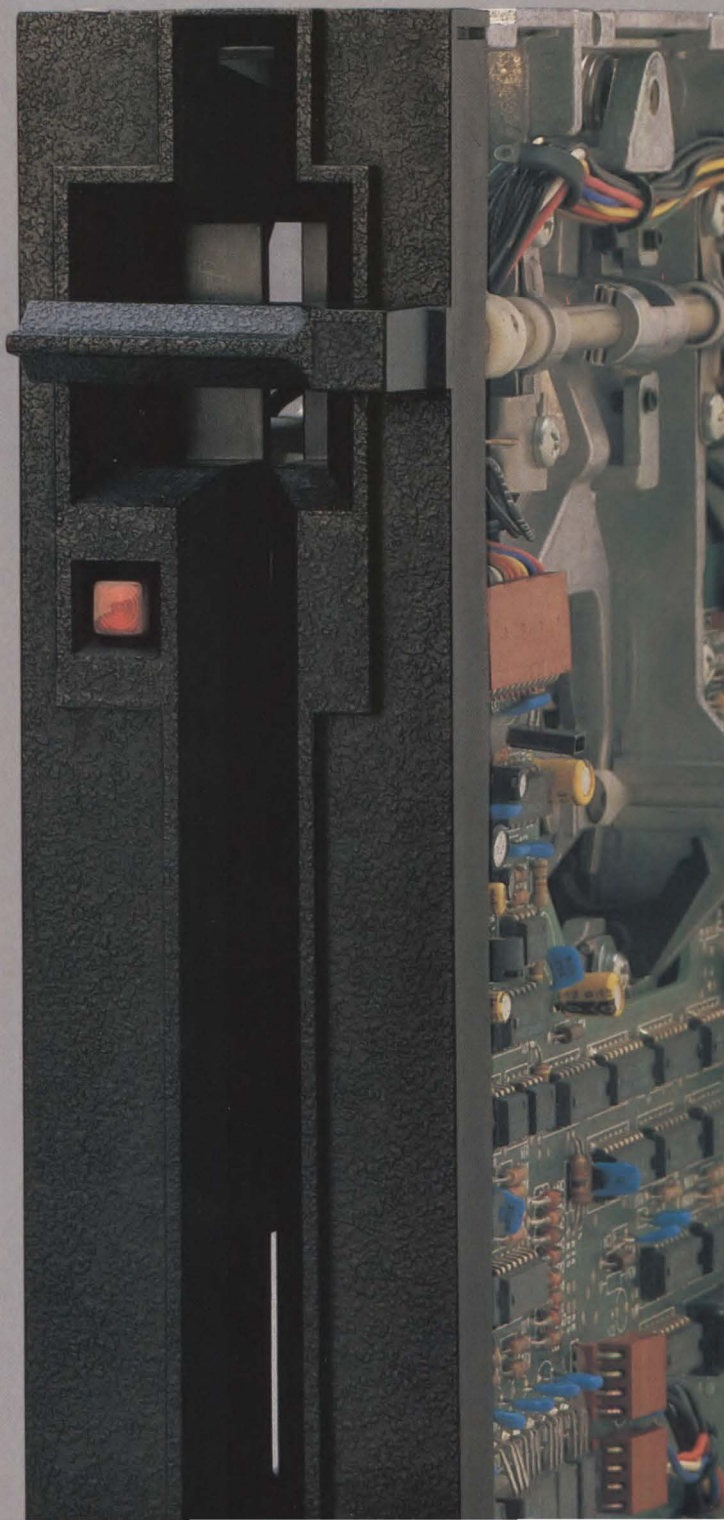
Has it worked?

You decide. In three short years we've become the world leader in small disk drives, shipping more of them than anyone else.

And now we're introducing five new floppy and Winchester drives that push prices lower and capacities higher than the industry has ever seen.

That's why we say we're not competing in the disk drive business.

Times have changed. Three years ago, Tandon wasn't considered competition. Now we don't consider the competition.



WHAT COULDN'T FIVE TIMES.

average, including head settle and latency is 195 msec. And because of our patented head design, you also get zero load time. Without the noisy, messy and complex circuits and components associated with head loading.

31MB CLOSED-LOOP 5 $\frac{1}{4}$ " WINCHESTER

The TM703 5 $\frac{1}{4}$ " Winchester is among the highest capacity drives in its class with over 30MB unformatted capacity typically found only in larger 8" and 14" drives. All at the performance and prices only Tandon's vertical integration and ultra-high production capabilities can deliver.

The TM703, with microprocessor-controlled intelligence, buffers position information and computes the fastest, most efficient positioning path.

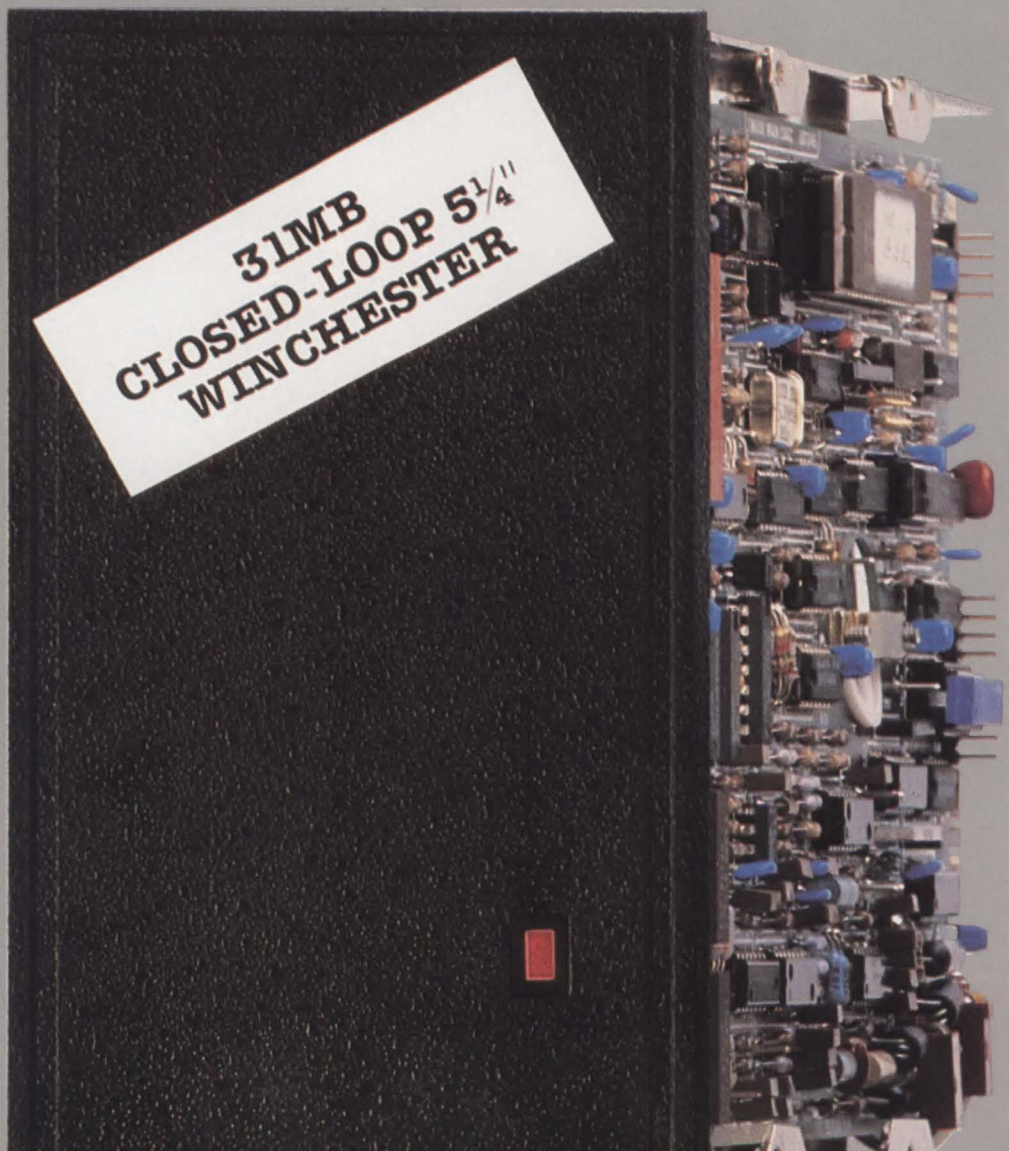
Its track-to-track access time of 5 msec with an average of 39 msec and maximum of 85 msec is complemented by a quick 2 msec head settling time. And it has the industry standard interface, power supply and package dimensions.

The TM703 is the fast, low-cost way to put big system performance in a compact desktop microcomputer.

ULTRA-LOW PRICE 5 $\frac{1}{4}$ " WINCHESTER FAMILY

Here's another example of what happens when you make more of what goes into what you sell.

It's our 1-, 2- and 3-platter Winchesters with 6.4MB per platter priced



WE JUST DID BE DONE.

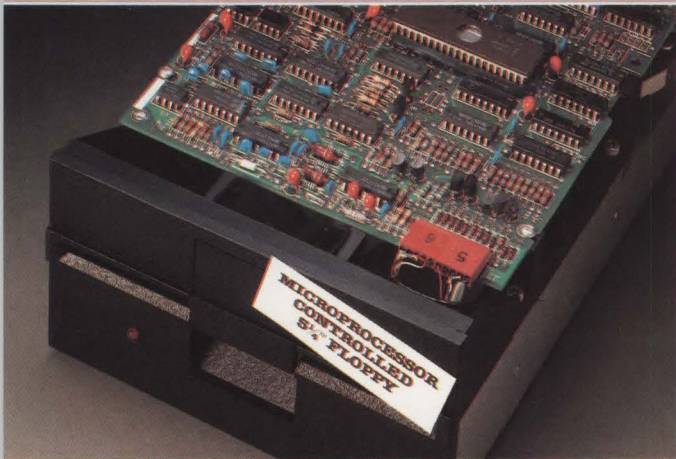
Last year was Tandon's second full year in the disk drive business and we passed everyone else in combined volume shipments of 5¼" floppy, 5¼" Winchester and 8" floppy drives.

This year we will ship our millionth drive. Next year we will ship our second and third millionth — many of which will be from our newest group of low-cost, high-performance drives.

Here's a glimpse of what they'll look like.

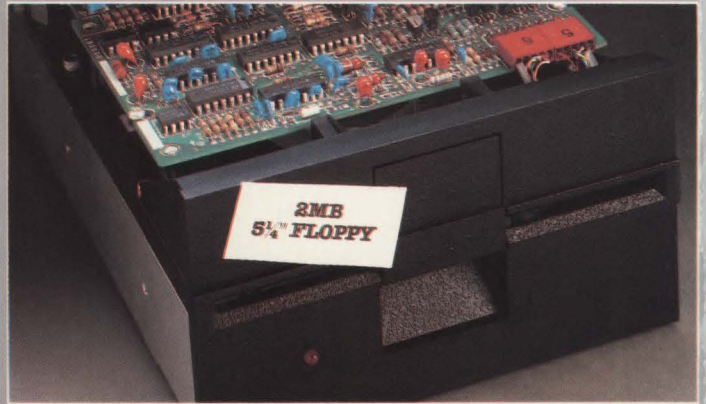
TM101 MICROPROCESSOR-CONTROLLED 5¼" FLOPPY

Now you can get the advantages of a microprocessor-controlled 1MB drive at Tandon's low prices.



The clear benefits of microprocessor control include improved 96 TPI track accuracy, automatic motor speed adjust, automatic initialization on power-up with internal drive diagnostics, and reduced componentry for increased reliability and improved MTBF.

It also offers ease in serviceability—



all adjustments can be made with the P.C. board in place. And it has an industry-compatible interface.

Only Tandon, with our high degree of vertical integration could bring you such a reliable, yet capable drive for an extremely low price.

2MB 5¼" FLOPPY

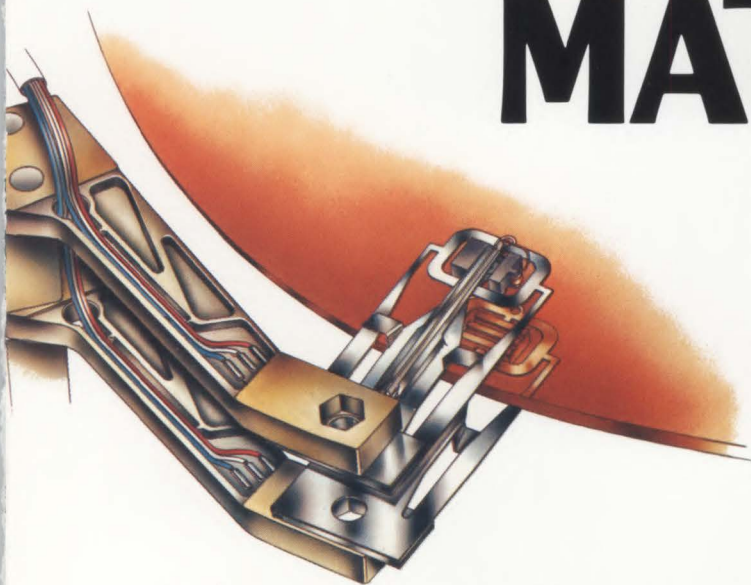
This 5¼" floppy, the TM102, now exceeds the capacity of all larger standard 8" floppy disk drives. Compared to traditional 5¼" floppies, you can expand your present storage capacity by a factor of 2, 4, or even 8 without changing your cabinet size or power supply requirements.

It's also designed to permit easier, faster Winchester back-up. With only two diskette changes for 5MB. All in ½ the time of previous 5¼" floppies.

And, this double-sided, 96 TPI floppy is microprocessor-controlled, reducing components while improving performance and reliability.

Track-to-track it's only 3 msec—the fastest access time in the industry. Its

NOBODY CAN PRICES BECAUSE MATCH OUR



We weren't always the only company with the highest technology and lowest prices in disk drives.

We used to be just the only company with the highest technology and lowest prices in recording heads.

After just one year in business, we captured 80% of the available world market for floppy disk drive heads.

Then two years into the business, we applied our manufacturing know-how and technical expertise to building the lowest-cost, high-performance, high-reliability 5¼" floppy disk drives available. Guess what happened.

A year later we had 65% of the double-sided 5¼" floppy drive market, and a quickly growing share of the single-sided market. We soon followed with a new 5¼" Winchester drive and an 8" ThinLine™ floppy.

Then we really started to grow, doubling and tripling our sales annually. Now things couldn't be going better.

And honestly, we attribute our suc-

cess in the disk drive market to the same factors that spawned our success in the head market.

Innovative engineering and design. The industry's highest degree of vertical integration. And the industry's most advanced manufacturing capabilities.

ENGINEERING & DESIGN

We have a group of creative engineers—separated from the mainstream of our business—who begin the process of making peripherals the Tandon way.

This select group does our R&D with one charter: design the future of microcomputer peripherals.

They figure ways, using Tandon's resources, to break new ground in product price and performance standards.

Standards that go well beyond conventional limitations.

VERTICAL INTEGRATION

When you sell products made up of other manufacturers' parts, it's very difficult to drive your price down and quality up to make your own product more affordable and stimulate your own market.

This is a predicament that most other disk drive manufacturers are in. Not Tandon.

We manufacture all of our own heads—the most critical and expensive part on a drive—from raw materials

MATCH OUR NOBODY CAN TECHNOLOGY.

up. We've done so for seven years.

Our quality is uncontested, as many other disk drive manufacturers will attest.

But vertical integration doesn't stop there.

We also improve quality and lower costs by producing the second and third most critical and expensive disk drive parts—the stepper motors and circuit board assemblies. We have one of the most advanced manufacturing operations in the U.S., devoted entirely to producing finished boards.

Actually, there's only 20% of the total cost of our drives that we don't make ourselves.

For that, we have multiple qualified sets of suppliers as a safeguard. Because we will never let our suppliers limit our capacity to deliver or to grow.

If Tandon promises the goods, the goods will be delivered.

MANUFACTURING

At Tandon, we keep all of our production lines capable of producing at least 50% more than we currently have orders for. It only makes sense, considering our growth and our customers' growth.

We also design every facility for complete flexibility to expand several times over. With minimum effort.

Since our manufacturing facilities are a key element in our total plan, each facility receives considerable attention. And capital.

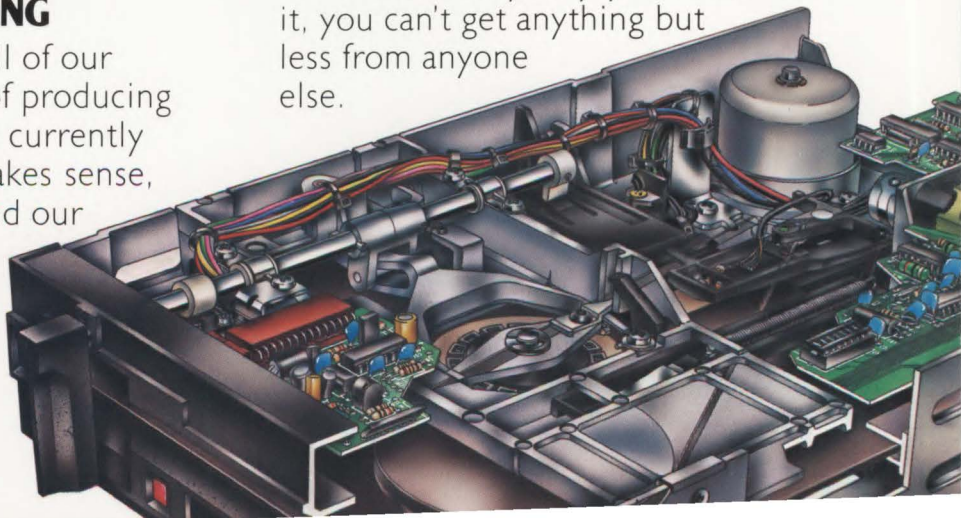
Each year we invest large sums of money into manufacturing operations, assuring that the latest in fully automated equipment is being used to provide consistently high quality products.

Each of our product lines has its own facility in a different geographic location. They all have their own personnel, engineering, procurement, and quality control responsibilities. And one charter: ship one product line only. In volume.

We don't think priorities and needs for one product line should get in the way of the other.

Now that we've told you our secret to success, take a closer look at our products. And consider putting them in yours.

Because any way you measure it, you can't get anything but less from anyone else.



AND NOW WE'RE MAKING WHAT COULDN'T BE MADE.

Introducing the 105% product guarantee.

What that means is that we sit down with you before delivery and mutually agree on specifications and incoming inspection criteria that meet your needs.

On delivery, if a product fails to meet these criteria to your satisfaction, it will be repaired or replaced free of charge, and on your next shipment, you will receive a 5% discount over and above your contract price on the number of units that failed to meet your inspection.

For example, if ten units do not meet the inspection criteria on any shipment, and you notify us within 90 days, we'll repair or replace them. And give you a 5% discount on ten units with your next shipment for your trouble.

It's your assurance that we're dedicated to providing the most reliable

drives in the business. And it makes good business sense for us.

Why?

It gives us even more timely feedback to learn exactly what you look for



in product reliability. And that helps us improve the quality of all Tandon products.

It's also an incentive for our manufacturing people to produce drives of a rugged yet precise quality—the 5% discount on returned drives comes out of their budget.

We think it's the best guarantee in the business. For you and for us.

about 30% below the industry-standard cost.

The TM500 series of Winchester drives proves that our goal of providing business with low-cost, high-capacity desktop computers is not only feasible, but is now becoming a reality.

These new drives offer a track-to-track access of 2 msec, averaging 206 msec with an average access with ramped seek of 110 msec. The head settle time is 15 msec.

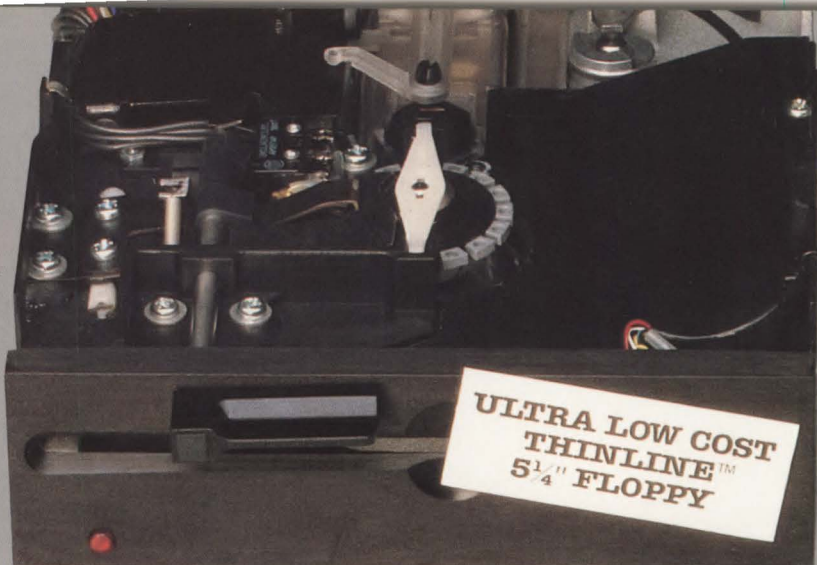
The new TM500 series gives micro-computer manufacturers more system performance than ever before at prices like never before.

ULTRA-LOW PRICE THINLINE™ 5¼" FLOPPY

Tandon introduces the half-height 5¼" floppy. That's right, half-height, not two-thirds-height. At less than half the industry-standard cost.

Very high volume OEMs can now achieve the optimum amount of value-added with the best performance/cost ratio mechanics-only drive in the business.

This drive is specially designed for new application markets. Such as ultra-low cost home computer systems requiring the cost/performance not attainable



with conventional full height drives.

It's also finding its way into other new applications requiring half-height, such as below-keyboard word processing systems and electronic typewriters, or portable briefcase-type computers.

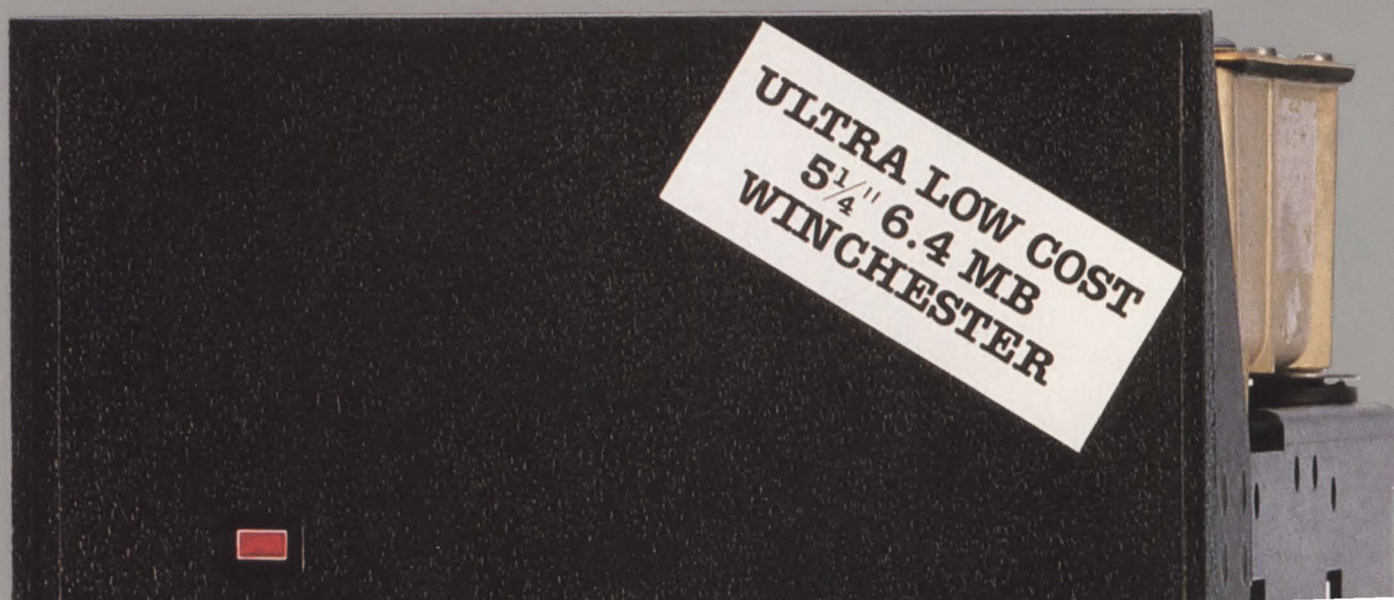
This 48 TPI drive comes in a single-sided 250K bytes version with a track-to-track access time of only 20 msec.

Its average positioning time is 267 msec, with a head settle time of 20 msec and zero load time.

From the people who gave you the first half-height 8" floppy, now the same benefits in a 5¼" floppy. The TM50.

Now that you've seen our five newest innovations in low-cost/high-performance disk drives, you've seen the trend for Tandon's future in micro-computer peripherals.

More of the impossible at impossibly low prices.



NOBODY CAN MATCH OUR FACTS. NOBODY CAN MATCH OUR FIGURES.

FINANCIAL HIGHLIGHTS

	<u>'80</u>	<u>'81</u>	<u>6 Months of '82</u>
NET SALES (000):	\$22,761.	\$54,152.	\$55,991.
NET INCOME (000):	1,507.	4,505.	5,770.
EARNINGS/SHARE:	.21	.52	.55
TOTAL ASSETS (000):	15,688.	49,725.	116,983.

FISCAL YEARS ENDING IN SEPTEMBER. '82 FIGURES OCTOBER-MARCH.

On first thought, you'd think any serious business connected with the microcomputer industry's explosive growth would have to be successful.

But in the microcomputer peripheral business, you have to be able to keep up with that explosive growth just to keep ahead on your orders.

If you fall short, you lose market share.

If you overstock, you pay your profits out to inventory storage; so naturally your R&D dwindles.

If you can't keep your technology up with some of the most innovative companies in the world, you get ignored.

It costs a lot to win. And even more to lose.

So why even bother?

Because this is what it looks like as a winner:

Between 1977 and 1981 our sales grew from \$1.3 million to \$54.1 million. In the first six months of this year we have already surpassed all of last years sales. \$55.9 million with the best six months to go.

In 1981, INC. magazine ranked us as the 5th fastest-growing company in the U.S.—and second fastest in the computer industry.

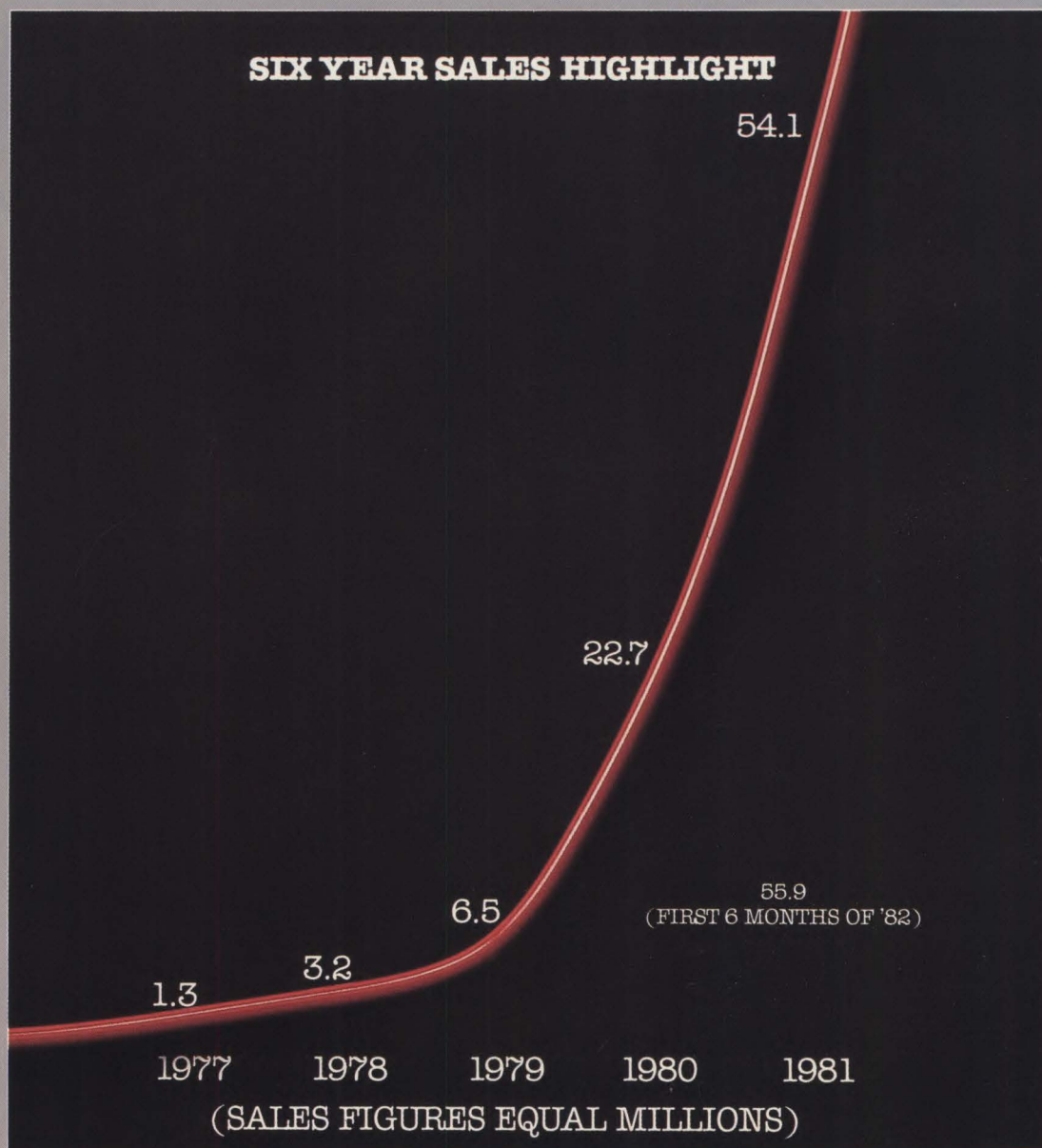
The same year, we made an initial and secondary public offering of stock raising over \$70 million—part of which was invested in expanded manufacturing facilities and general working capital.

Did we make a mistake?

We don't think so. The 1981 market for our products was \$500 million and in 1983 is expected to hit \$1.8 billion.

And no matter how you figure it, the fact is, we're the leaders.

Because nobody, but nobody, ships as many 5¼" floppy disk drives, high capacity 5¼" Winchesters and 8" ThinLine™ disk drives as Tandon.



HOW WE MADE OUR COMPETITORS' BUSINESS OUR BUSINESS.

NEW TM50 5¼" THINLINE™ FLOPPY



48TPI SSR 250K Byte

TM100 5¼" FLOPPY



48TPI SSR 250K Byte



48TPI DSR 500K Byte



96TPI SSR 500K Byte



96TPI DSR 1M Byte

NEW TM101 5¼" FLOPPY



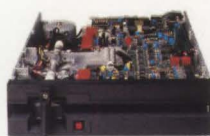
96TPI DSR 1M Byte

NEW TM102 5¼" FLOPPY



96TPI 2M Byte

TM848 8" THINLINE™ FLOPPY



48TPI SSR 800K Byte



48TPI DSR 1.6M Byte

TM600 5¼" WINCHESTER



6.4M Byte



9.6M Byte



14.4M Byte



6.4M Byte



12.8M Byte



19.1M Byte



31M Byte

NEW TM500 5¼" WINCHESTER

NEW TM703 5¼" WINCHESTER

With the widest selection of 5¼" floppy and Winchester drives and state-of-the-art ThinLine™ 8" floppies from the lowest cost producer in the business.

We did it with constant industry firsts. Like the first ultra-low cost 5¼" ThinLine™ floppy. The world's lowest-priced 5¼" Winchester family. Microprocessor-controlled floppies at the price of standard floppies.

And with Winchesters that push the limits of capacity and performance higher than ever before.

All from the one company that makes more of what we sell than anybody else. In larger quantities than anybody else. With the boldest guarantee in the industry.

And best of all, from one source. Tandon.

Tandon

THE MOST SUCCESSFUL DISK DRIVE COMPANY YOU EVER HEARD OF

Tandon Corporation, 20320 Prairie Street, Chatsworth, California 91311, (213) 993-6644 TWX: 910-493-5965

Regional Sales Offices: Woburn, MA (617) 938-1916 • SeaGirt, NJ (201) 449-7720 • Tucker, GA (404) 934-0620 • Elmhurst, IL (312) 530-7401
Plano, TX (214) 423-6260 • Newport Beach, CA (714) 675-2928 • Sunnyvale, CA (408) 745-6303 • Frankfurt, West Germany 0611-392081,
Telex: 411547.

ThinLine is a trademark of Tandon Corporation.

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30-percent discount, bringing the price to about \$20,000, says Lucien R. Philippon, product manager. Systems can be configured in a 42-in.-high cabinet with prices beginning at less than \$50,000.

Philippon says the 64K-bit dynamic RAM and small box size are not the only DEC firsts in the product. Programmable array logic chips also are incorporated into a VAX family product for the first time. Each VAX-11/730 system incorporates 100 PALs, which are used to boost performance while consuming lower power and offering a 4:1 reduction in density over conventional ICs. The PALs are used in the CPU and peripheral controllers. Another DEC first is the worldwide introduction of a product outside the U.S.: it was aired in late April at the Hanover Fair in Germany. Philippon expects more than 40 percent of both box and system sales to be in Europe. Overall DEC sales to Europe are about 30 percent. DEC also spread its wings to offer a box including a software license.

The new unit has 30 percent of the performance of the VAX-11/780 at 20 percent of its CPU price. Virtual address space and maximum program size is the same as other VAX siblings at 4.3G bytes and 2G bytes, respectively.

Though all VAX family members are compatible through Version 3 of the VMS operating system, they incorporate different technologies. Philippon explains that the VAX-11/780 architecture was developed using technologies available in 1976 and 1977. DEC's goal on that product was to get VMS up and running. The VAX-11/750 uses the same architecture and operating system as the VAX-11/780, but brought custom gate-array technology into the game. "The goal for the VAX-11/730 is packaging and cost control," Philippon says, adding that cost is one major reason why gate arrays



Digital Equipment Corp.'s VAX-11/730 32-bit minicomputer supports interactive graphics work stations using DEC's VS-11 terminal for engineering design, as well as educational and commercial applications with as many as 24 concurrent users. The VAX-11/730 uses 64K-bit RAM chips for a maximum memory of 5M bytes, and can be configured as a single-cabinet system with prices beginning at less than \$50,000.

were not used in the product.

One bright note for the VAX-11/730 is DEC's return to the standard hex board form factor rather than the extended hex boards used in the higher end models. "Part of our strategy for OEMs is the 'rack-and-stack' business for single-cabinet systems. This means hex size," he says. The board size is the same as that for PDP-11s, thus giving PDP-11 OEMs an upgrade path, he adds.

The VAX-11/730 is based on AMD's 2901 and 2911 bit-slice μ ps and uses the Unibus. The rack has 12 slots, five of which are for memory boards. Add-on 64K memory boards are priced at \$9000 for 1M byte, \$16,000 for 2M bytes, \$21,000 for 3M bytes, \$24,000 for 4M bytes and \$50,000 for a package of 10 1M-byte boards.

The FP730 hardware floating-point processor is available separately. Floating-point instructions are in hardware and microcode. The FP730 module fits into a pre-wired slot on the VAX-11/730 backplane. Price is \$3995.

Additionally, the VAX contains a multifunctional intelligent controller called the DMF32, which hooks into the Unibus. It supports DMA functions for several I/O devices, improving terminal response times and moving entire screens of data. One DMF32 is standard. OEMs can buy the controller for \$3995.

The DMF32 contains an asynchronous multiplexer and eight lines with data rates between 50 and 19.2K bps. Six lines are for local terminals, while two lines have split speeds and full modem control for remote terminals. The controller also contains a single-line synchronous interface for intersystem communication. Synchronous line support includes DDCMP, SDLC and HDLC protocols. DMF32 also acts as a DMA interface for line printers or as a 16-bit parallel interface for other devices.

An integrated disk controller runs as many as four RL02 10M-byte disk drives or as many as three RL02 drives and a 121M-byte R80 disk drive. The disk controller occupies a

dedicated backplane slot.

The new VAX has two redundant TU58 tape-cartridge drives that are used to load system microcode, languages and application programs and to run diagnostic tests.

Software for the VAX-11/730 includes enhanced versions of the VMS operating system, COBOL and FORTRAN; VAX-11 C and other compilers; VAX-11 PSI, which supports major U.S. and European packet-switching protocols; information-management software such as VAX-11 DBMS and VAX-11 Datatrieve; and advanced DECnet-VAX software.

VMS has been improved to support new hardware and software, enhanced terminal and file handling, communications and management tools for system maintenance. Performance in intensive terminal-output applications, for example, has been doubled, the company claims. The VAX-11 RMS records-management system for VMS now has better buffer handling, key compression for shorter single-key ISAM files and stream files for the new VAX-11 C file structures.

VAX-11 C, an extension of the C language developed at Bell Laboratories, compiles as many as 3000 lines per min., similar to speeds for VAX-11 FORTRAN compilations, the company says. The VAX-11 compiler was specified for VMS, but many UNIX routines are available or emulated in the run-time library.

The Nebula product will not be available as just a board set in the near term, as is the Quadrabyte 32-bit board set from Gould S.E.L. (MMS, May, p. 17), priced at \$14,000.

DEC's Philippon declines to comment about a single-board VAX product, but says it is misleading to consider the VAX-11/730 such a product, even though it does have a single 32-bit data path on one board. "Considering a data path on one board to constitute a single-board

computer (in and of itself) is like saying 'single-chip μ c,'" he says. That board, he adds, does not contain all the required memory controllers and I/O functions.

Philippon says there is no overlap between the VAX-11/730 and /750 products in the market. An entry-level VAX-11/730 system, configured in a 42-in.-high cabinet with a DMF32 communications controller, 20M bytes of disk storage, an LA120 DECwriter III printer and a VMS

operating system with full support, warranty and installation, is priced at \$48,900. That is about half the price of the /750 system version, Philippon says. Additionally, the /730 performance is about half that of the /750, he adds.

First deliveries of the board- and system-level VAX-11/730 products were scheduled to begin late last month. Deliveries are quoted as 60 to 90 days after receipt of order.

—L. Valigra

Quantum taking lead in 8-in. OEM Winchester shipments

Despite the increasing availability of higher capacity (12M- to 25M-byte), 5¼-in. Winchesters and plans by many vendors to offer even higher performance, higher capacity hardware, the demand for low-cost 10M- to 40M-byte, 8-in. Winchesters will continue to accelerate at a strong pace, fueled by the growing demand for μ p-based small-business systems and word processors, says an executive at one of the few disk-drive companies founded for the express purpose of building this size drive.

"Systems in these categories are growing at a rate of 40 to 50 percent per year," says Steve Berkley, marketing vice president at Quantum Corp., Milpitas, Calif., "and most of them originally used 8-in. floppy-disk drives for system and file storage." As a result, he says, there continues to be a growing, built-in market for 8-in. fixed-disk hardware. "We're replacing one of the floppies in these systems with a higher capacity Winchester," he explains, "and right now, we're replacing them at a rate of 150 drives per day, six days a week."

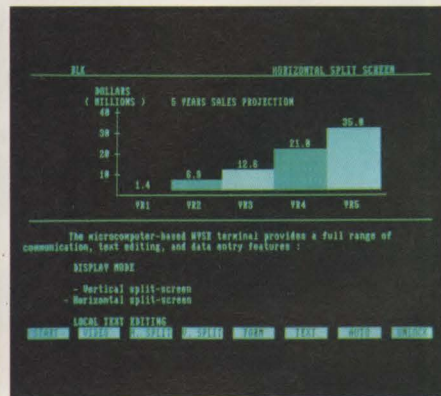
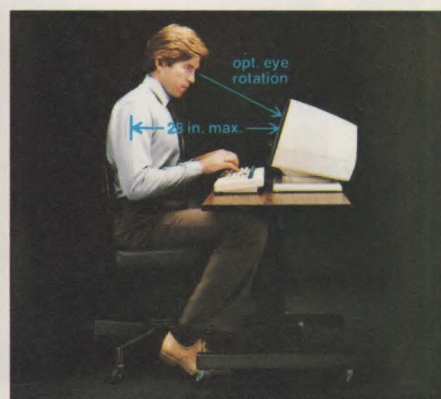
That adds up to a lot of hardware, Berkley goes on, noting that Quantum, founded only two years

ago by a number of executives from Sunnyvale, Calif., disk-drive rival Shugart Associates and from Sunnyvale-based subsystem builder Systems Industries, Inc. (MMS, May, 1980, p. 47), did \$13.8 million in business at the close of its fiscal year last March. Next year, he says, Quantum is looking at \$50 million in revenues from the sale of 8-in. Winchesters, and expects to double that figure by the end of fiscal year 1984.

Most of next year's increased revenues will come from the company's existing Q2000 series 10M- to 40M-byte Winchesters, Berkley says, with newer products expected to contribute to 1984's earnings. "Right now, 65 percent of our revenues come from our Q2040 40M-byte drives," he explains, with 30 percent coming from sales of the company's 20M-byte Q2020.

Sales of Quantum's 30M-byte Q2030 drive account for only 2 percent of sales, while its 10M-byte Q2010 accounts for only 3 percent, a figure that reflects the dominant market share held by Shugart's 10M-byte SA1004 8-in. Winchester. "Between the two companies, we're shipping close to 90 percent of all low-cost 8-in. Winchesters," Berk-

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Mini-Micro World

ley says. Quantum's Q2040 is priced at \$2450 in 100-lot orders; Shugart's 10M-byte SA1004 and Quantum's Q2010 are both priced at \$1400.

In terms of numbers, Berkley goes on, Shugart's lower capacity drive is shipping in larger volume in markets where both companies compete. In terms of overall revenues from the sale of 8-in. Winchesters, however, he says, Quantum is posting larger numbers. Moreover, he does not anticipate that Quantum's position of revenue leadership will change. "It's a question of volumes," Berkley explains. "The servo systems and voice-coil actuators proposed by many vendors of higher capacity, higher performance 8-in. drives will remain a production constraint." What it all comes down to, he says, is that no one knows how to build drives using these actuators in large numbers and at low cost.

Shugart's 5M- and 10M-byte SA1000 Winchesters are open-loop drives that use split-band actuators driven by stepper motors—a lower cost, lower performance design derived from the company's floppy-disk drives.

In an effort to get higher performance and higher capacity from an actuator system that could be produced in high volumes, Quantum developed a "hybrid" actuator design. Instead of using stepper motors and split-band actuators to move the read/write heads, the company connected a torque motor directly to a pivot arm onto which the read/write heads are mounted. And, instead of using the incremental steps of a stepper motor to determine head locations, coarse positioning on the Quantum drives is handled by an optical encoder that comprises a scribed glass scale, an LED and a receiver. Fine positioning needed to keep the heads on track is derived from track-location data encoded onto a dedicated sector on the data

surfaces of each disk.

While more producible, this type of actuator offers lower performance than the closed-loop servo/voice-coil combination used by other vendors of high-capacity 8-in. hardware. It does, however, give Quantum's products a performance edge compared to stepper motor-driven drives. Average positioning time on the 10M-byte Q2010, for example, is pegged at 60 msec. compared to 70 msec. for Shugart's SA1000. Use of both coarse- and fine-positioning techniques also gives Quantum hardware an edge on capacities. Shugart's SA1000 provides 256 tracks per data surface at 172 tracks per in.; Quantum's hardware handles 512 tracks at 345 tpi.

Vendors of voice-coil drives also stress higher performance. International Business Machines Corp.'s 3310 Piccolo drive, the only other high-capacity (64M-byte), 8-in. fixed-disk drive to be installed in large volumes, operates at an average access time of 27 msec. This drive provides 359 tracks per surface at a track density of 450 tpi.



8-in. Winchesters roll off the Quantum assembly line. Assembly begins at the head of a "clean tunnel" (background) Quantum uses in place of the clean rooms used by Winchester vendors. In a clean-tunnel environment, purified air blows down over the line while assembly personnel work through plastic curtains. Completed drives in the foreground await shipping and testing. Quantum is shipping 8-in. hardware at the rate of 150 drives a day.

Berkley does not see the Piccolo as a direct competitor of Quantum's hardware, however. "There are two reasons," Berkley says. "First, it would be rare for an OEM to be evaluating our drive and a higher performance device such as the Piccolo with the idea of selecting one or the other."

Second, Berkley goes on, IBM and Quantum are pursuing different markets. IBM, he says, is selling 8-in. hardware to system designers that are not constrained by the physical dimensions of the cutouts and depths originally specified for the floppy-disk drives in small-business systems and word processors targeted by Quantum.

Just how much 8-in. hardware with capacities of more than 30M bytes will be shipped over the next few years depends on whom you ask.

Jim Porter, Mountain View, Calif., industry analyst and publisher of *Disk/Trend Report*, remains conservative when estimating the amount of 30M- to 200M-byte, 8-in. hardware to be shipped, regardless of performance level. Porter estimated that 16,000 8-in. drives in the 30M- to 200M-byte range would be shipped by U.S. vendors this year, with that figure climbing to 39,000 next year, and to 85,000 in 1984. He concedes, however, that he may revise his figures upward, based to a certain extent on the amount of hardware that Quantum is shipping.

Newark, Calif., industry analyst Andrew Roman anticipates higher levels of demand, especially for IBM and Quantum hardware. "These two companies control 90 percent of the market for OEM 8-in. drives in the 25M- to 100M-byte range," he says, with Quantum alone accounting for 85 percent of this hardware. Roman predicts that a total of 50,000 OEM Winchesters in this capacity range will be shipped in 1982, bringing Quantum's share of the pie to more than 38,000 drives.

Quantum's own figures are slightly lower. At a ship rate of 150 drives a day, six days a week, Quantum plans to move 46,800 drives, more than 30,000 of which will be 40M-byte devices.

"The real test for OEM Winchester vendors is how quickly production can be ramped up," Berkley says,

noting that the company plans to quadruple its manufacturing space and to ship at the rate of 600 units a day by late summer of this year. "The real winners will be those that are geared up to meet high-volume demands."

—John Trifari

DG offers 2 more systems based on microEclipse chip

Data General Corp. moved last month to replace aging commercial 16-bit minicomputers with 16-bit μ cs. On the heels of its March introduction of a 16-bit technical μ c (MMS, April, p. 17), DG followed in May with two commercial μ c systems based on the same micro-Eclipse chip. These were accompanied by a commercial OEM version of the Enterprise desk-top computer based on a microNova and a new Eclipse-based commercial system.

The microEclipse-based systems, the CS series 100 and 200, are replacements for earlier CS 10, 50 and 100 computers. Jim Ryan, DG's director of marketing for small business systems, says, "The CS series 100 eclipses the higher end of the CS 10 and C 3 range and goes through the middle of the CS 50 in the number of CRT terminals supported and in price/performance. The CS series 200 begins where the high end of the CS 50 line was and goes beyond the CS 70."

The CS series 100, priced from about \$20,000 to \$40,000, has 128K to 512K bytes of main memory and 5M to 54.2M bytes of fixed-disk capacity. It supports as many as nine CRT terminals, including one control terminal. It is offered with the recently enhanced version of DG's RDOS operating system, which, a company spokesman says, replaces the ICOS operating system

throughout the CS line.

Disk options for the CS 100 include new 5M- and 15M-byte, 8-in. Winchester-disk drives, manufactured by DG, and previously available 12.5M- and 25M-byte versions.

The CS series 200 is available in microEclipse and Eclipse versions. The microEclipse model has 256K bytes of main memory, expandable to 512K bytes and supports 13 to 16 terminals, depending on the application. The Eclipse-based 200 is expandable to 1M byte of main memory and supports 25 terminals. Disk options include 15M-, 25M-, 73M- and 147M-byte Winchester disks for a maximum of 638M bytes of fixed-disk capacity, or as many as four 277M-byte disk packs can be attached for a total of 1.4G bytes of removable-disk capacity.

The CS series 200s include enhanced RDOS or AOS operating systems, a license for which is bundled into the purchase price, which is expected to range from \$25,000 to \$50,000 in the microEclipse version and from \$45,000 to more than \$100,000 in the Eclipse version.

With the addition of RDOS as the standard commercial systems operating system, DG officials say, language mobility is achieved in Business BASIC and Interactive ANSI 74 COBOL throughout the CS

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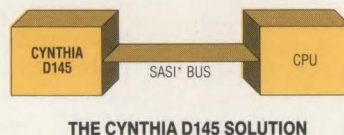
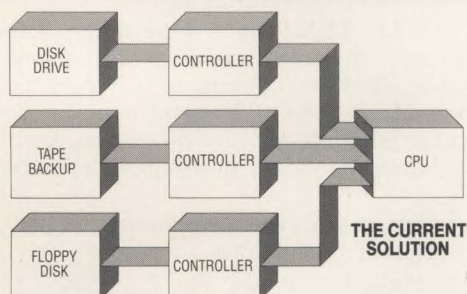
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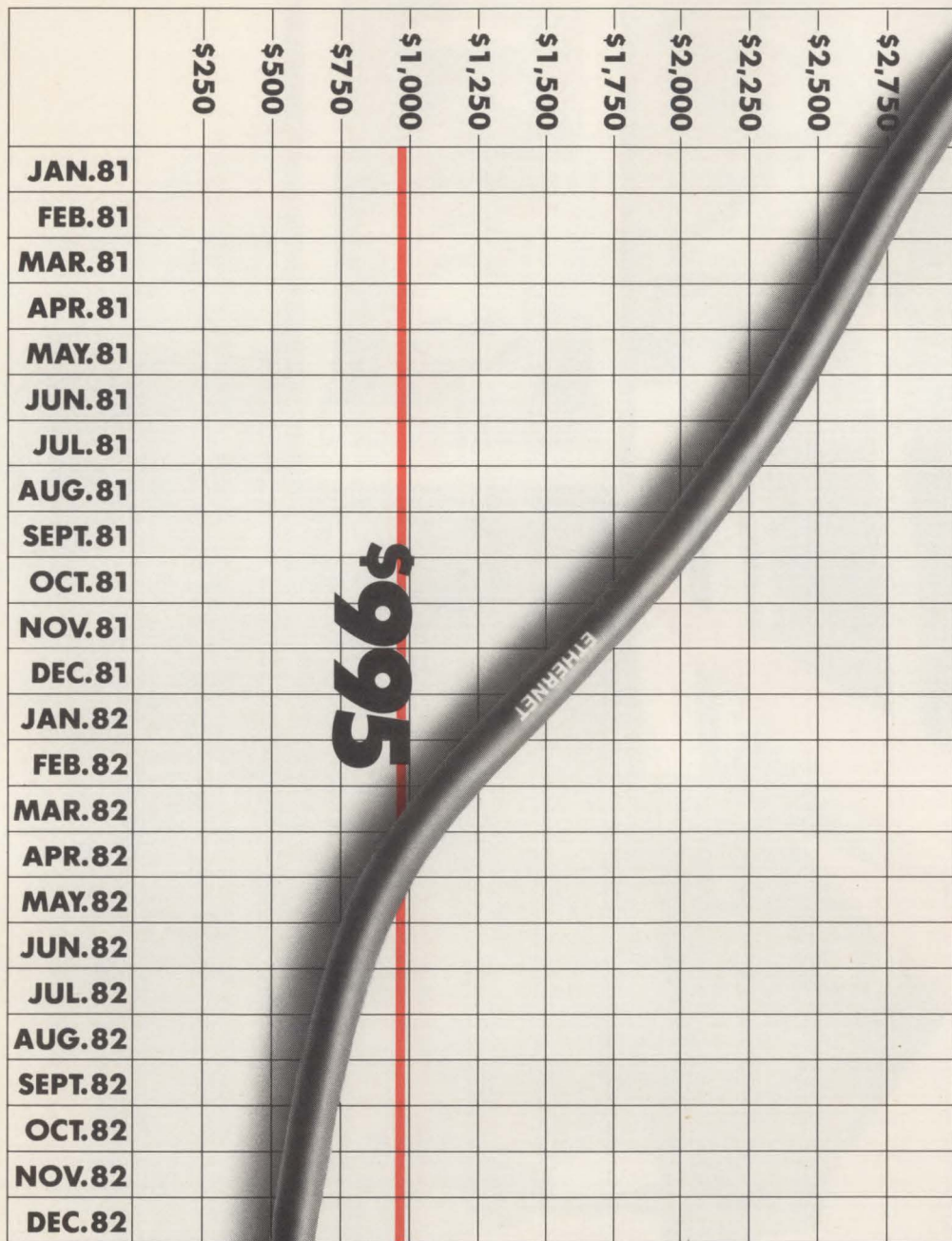
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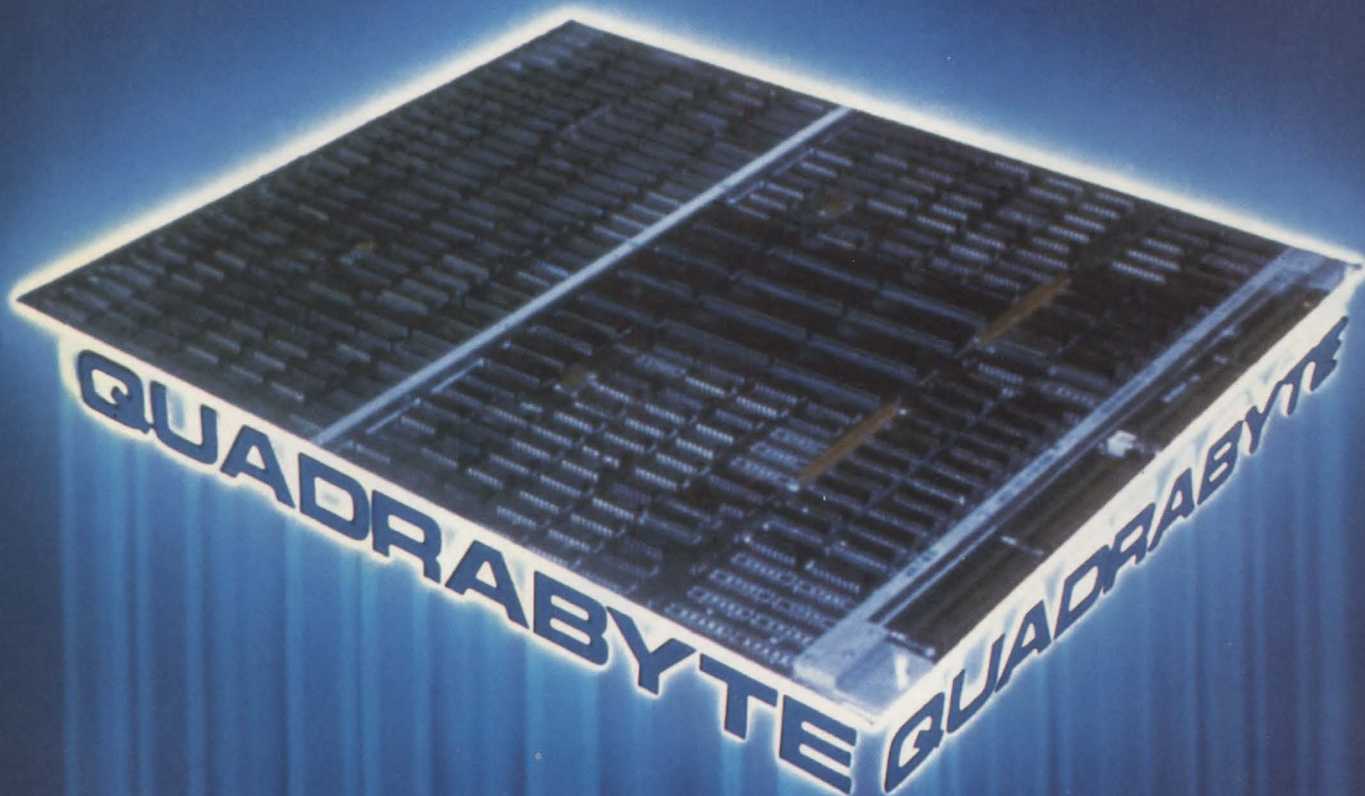
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product line and into DG's high-end MV series of 32-bit computers. Previously, commercial systems were sold with the ICOS operating system, supporting COBOL only or with DOS or RDOS supporting Business BASIC. Now, the company claims, OEMs can transport Business BASIC or COBOL applications throughout the product range.

DG is offering the CS/5 in response to changing OEM requirements, says John H. Crawford, vice president and general manager of the small systems division. "OEMs can now enter the (CS) product line at any level," he says, noting that the \$6000 to \$15,000 CS/5's MP/OS operating system also supports Interactive COBOL and Business BASIC.

Crawford says the CS/5 helps support the increasing OEM trend toward addressing vertical markets with all system sizes. Calling the vertical marketing trend "more and more pronounced," he says the addition of the CS/5 and the use of two languages throughout the line will enable OEMs to support a single software product through a whole range of hardware.

The CS/5 will be sold initially only through the DG OEM channels, but will later be offered through the retail and distribution channels that handle the Enterprise. The systems are both based on the microNova nN602 processor, but the CS/5 is available with the new 5M- and 15M-byte drives in addition to the 2.5M-byte Winchester previously available on the Enterprise 3000.

DG's small systems division is also implementing new software-marketing programs for its OEMs to offer both general-purpose tools and to facilitate the marketing of third-party packages. The tools include three Business BASIC packages: the BusiTEXT word-processing, BusiPEN graphics and BusiGEN program-development packages. BusiTEXT, developed by



Data General Corp. has introduced two more microEclipse-based systems to its 16-bit μ C system.

an unidentified outside vendor, runs on all three new CS products, while the BusiPEN and BusiGEN products run only on the CS Series 100 and 200. Pricing for the packages had not been set at press time.

A second program for independent software vendors, is scheduled for this month. Crawford says the program will enable software OEMs

to take advantage of DG distribution channels. Three levels of DG involvement will be offered: DG will support packages it has tested and has seen successfully installed at the highest level; at the second level, DG will jointly market products it has qualified; and at the third level, DG will list available products.

—Geoff Lewis

Mentor enters CAE market with 32-bit networked system

The fledgling computer-aided engineering market is expanding rapidly as a number of start-up companies push to get their products into the field. The most recent company to announce a product is Mentor Graphics Corp., Portland, Ore. Founded in 1981 by a group of ex-Tektronix, Inc., employees, the company expects to make its first deliveries this fall of a system that includes hardware and a series of interrelated application

programs aimed at logic designers. In the process, Mentor joins such firms as Hewlett-Packard Co., Daisy Systems Corp. and Metheus Corp., all of which have recently announced CAE products.

Mentor's Idea 1000 system combines work stations based on 32-bit processors and mass storage into a local network sharing a database.

There are six programs in the application set. Structured logic design assists engineers in creating

and capturing logic diagrams. Interactive logic simulation is an interactive tool designed for MOS and TTL logic applications. Project communications provide communications capabilities among the network nodes to allow team design efforts. Document preparation is a word processor. Outputs lets an engineer transfer a completed component and its connection information to a design layout system or to an external logic simulator. Mentor initially will not provide the logic simulator or the computer-driven layout system. Programming tools help designers prepare their own applications software.

Each work station, or network node, is built around a 32-bit CPU from Apollo Computer, Inc., Chelmsford, Mass. The system uses two Motorola MC68000 processors. Each work-station node includes a high-resolution (800 × 1024) raster-scan display, a graphics input tablet, 3.5M bytes of program memory and as much as 66M bytes of Winchester-disk storage. An electrostatic printer is optional.

Mentor's Idea 1000 is priced at \$83,000 per station for what it calls a typical four-station network. Work

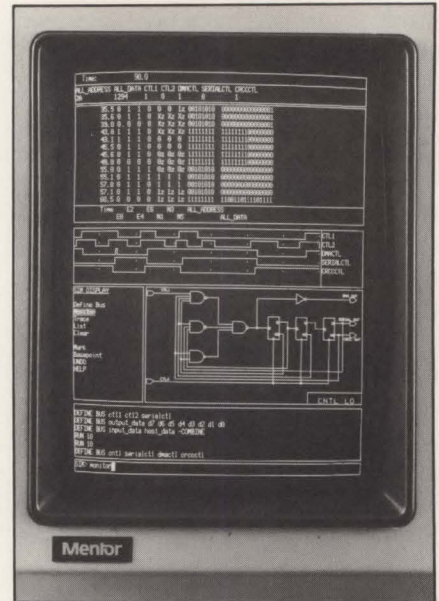
stations are priced at \$69,000 in quantities of 10.

The system uses Apollo's UNIX-like Aegis operating system. It can segment the display screen and, among other things, handle multiple tasks on a single work station.

Competition in the CAE market is growing fast. Large companies such as H-P have also announced products for CAE applications. The HP9836A desk-top computer, for instance, is aimed at logic designers. But activity among smaller firms is furious, too.

Since making its first delivery last November, Daisy Systems has shipped 24 systems for logic designers. That gives the 2-yr.-old company a fairly good head start in what promises to be a booming business. Daisy's hardware can serve as a stand-alone work station or it can be networked like the Mentor system. Single-station price is \$75,000, with discounts for volume purchases.

Metheus introduced a CAE system in April. Though not yet delivered, the Omega 400 is a \$22,000 graphics subsystem designed to run with Digital Equipment Corp. minicomputers.



Mentor Graphics Corp.'s Idea 1000 is a structured logic-design system that assists engineers in creating and capturing logic diagrams.

Among those planning CAE systems are Valid Logic Systems, Inc., Sunnyvale, Calif., founded by Jared Anderson, who started Two-Pi Corp., an International Business Machines Corp.-compatible systems company; Cadtec Corp.; and Computer Aided Engineering, Inc., an H-P spin-off.

—Larry Lettieri

DECnet Phase IV to add Ethernet connections, SNA gateway

Since it introduced its Digital Network Architecture in the mid-1970s, Digital Equipment Corp. has progressed through three phases of DECnet software and hardware, with each phase building on the earlier one's functionality. Now, the Maynard, Mass.-based company has announced its DECnet Phase IV program. Adding such features as Ethernet local-area-network compatibility, a functional connection between DECnet and International Business Machines Corp.'s Systems

Network Architecture and support for new DEC operating systems and processors, the Phase IV products will begin appearing late this year (see table).

With Phase IV, the underlying DECnet software will support networks containing a maximum of 1000 CPUs, compared to the 255 nodes supported by Phase III software. Similar in price to the \$2000 to \$8600 earlier version, Phase IV software will connect systems running RSX, VAX/VMS or

TOPS-20 and will support some models of the new Professional personal computer line (see p. 15).

Along with its new functionality, the Phase IV release incorporates all the features available in DECnet Phase III. John Adams, manager, distributed systems marketing and planning, says the overall DECnet networking concept is more important than any of its individual features. "Networking used to be an add-on option tying together separate systems," he says. "The real

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It's a flood. It began in 1978 and has been rising ever since.

The flood is software packages for the VAX computer family. There are a few good values among them—but watch out. There are also a lot of duds, especially among data-base management software.

You may already have one of these DBMS's installed on your VAX computer. If you do, you're familiar with some of their many problems: poor documentation, slow execution times, and limited data-base functionality. Above all, you also see user-level features that remind you of the early days of interactive computing.

The cause of these problems is easily explained. Soon after DEC announced the VAX, several companies noticed a great opportunity and rushed to market with their DBMS software. Some of them quickly converted their products to the VAX from other hardware. A few others took their academic research projects and tried to make them viable commercial products. If only good data-base software could be created so easily!

We took a fresh approach. Our years of experience in commercial data-base systems taught us what we and other companies had done well and had done poorly. VAX users in the 1980's, we reasoned, deserved and wanted better than the software flaws of the 1970's. So we decided to design and implement a completely new data-base system. We hired a large team of experienced software designers and documentation writers. And we spent three solid years designing and documenting our software from the ground up.

In 1982, you will see the results of our work—a DBMS for the 1980's. Whether you're a research scientist, a corporation executive, or a novice, you can immediately use our DBMS productively from your terminal. Even in the

middle of a command, you can access our on-line documentation without opening our users manual. If you're a programmer, you can also use our DBMS from any language that supports the VAX/VMS procedure-calling standard—languages such as FORTRAN, COBOL, MACRO, BASIC, and PASCAL. And we have not sacrificed performance for usability. We exploited the unique architecture of the VAX to give you the fast execution times and throughput that will not appear in other software for years to come.

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ception, will pay \$40,000 for our DBMS software. With a voucher, you will spend only \$28,000 for software worth at least \$40,000—a respectable return on investment of 43% in these inflationary times.

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The voucher comes with your company's name on it and it is not transferable. Therefore, the information that you list on the coupon must be accurate and complete. The voucher expires two months after we formally release our software, so you will have to act promptly when we notify you of the release date.

Of course, we may still spend some money to market our software to those of you who do not respond to our voucher offer. But by that time, we hope to have quite a large mailing list as a result of this advertisement, so we will have to advertise very little.

We have chosen to remain anonymous until we release our DBMS. Otherwise your many telephone inquiries would seriously distract us from our development work. We also want to test our marketing concept and prove that VAX owners are value-conscious in their software selection. Despite our anonymity, we can assure you that we are a respected company with substantial assets and an excellent reputation for software expertise and customer service.

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MM-6-82

message in our Phase IV announcement is that the network is becoming the system."

Underlying most of the hardware components to be introduced during the three-year Phase IV implementation is a connection to the 10M-bps baseband Ethernet LAN developed by Xerox Corp. and supported by DEC and Intel Corp. DEC's products will span the Ethernet spectrum, from coaxial cable, through transceivers and controllers to various communications servers and gateways.

Although several independent manufacturers already offer Ethernet transceivers and DEC-compatible controllers, (MMS, May, p. 6). Adams says DEC will manufacture its own products in these areas. The company's first controller, designated DEUNA, will be Unibus-compatible, will sell for approximately \$3500 and will be available by mid-1983.

Configured on two full hex boards, the DEUNA performs the basic Ethernet functions such as carrier sense multiple access with collision detection (CSMA/CD), cyclic redundancy checking, packet encapsulation/decapsulation and data-link-layer functions. It also provides hardware address recognition and incorporates a μ p-based DMA controller. A 2K-byte buffer handles outgoing packets, and 13 2K-byte buffers are included to receive incoming data.

One characteristic separating the DEUNA controller from some of the other Ethernet controllers available is its relatively sophisticated diagnostic capability, says David C. Cleveland, DEC's Ethernet product manager. These diagnostics check the electronics in both the local and the remote controllers and in the transceivers. "If a fault is found, the controller won't transmit," Cleveland says.

The transceiver electronics, which are removable for easy

replacement, include a triple-redundant guard circuit to prevent a faulty node or transceiver from monopolizing the network with a constant transmission. Responsible for implementing the CSMA/CD functions, the H4000 transceivers also incorporate a loopback test capability. To prevent network disruption when adding or removing the H4000s, DEC uses a technique by which small holes are drilled in the coaxial cable in preparation for the transceiver attachment.

Priced from \$200 in quantities of 500 or more to \$300 in quantities of one to 99, the H4000 transceivers will be on the market by year-end. Because the first Ethernet controllers won't be available from DEC until 1983, the first transceiver sales will probably be to OEMs and end users who want to place the transceivers on Ethernet cable before snaking it through their buildings, Adams says. DEC plans to market network repeaters and controllers for Q-bus processors and for the Professional 300 personal

computers.

Another group of Phase IV products will fall under the category of communications servers. The first of these devices, due early next year, will be a gateway device connecting DECnet networks to SNA networks. This "black box" SNA gateway will provide DECnet access through a VAX computer; a later SNA gateway device will interface directly to the Ethernet LAN.

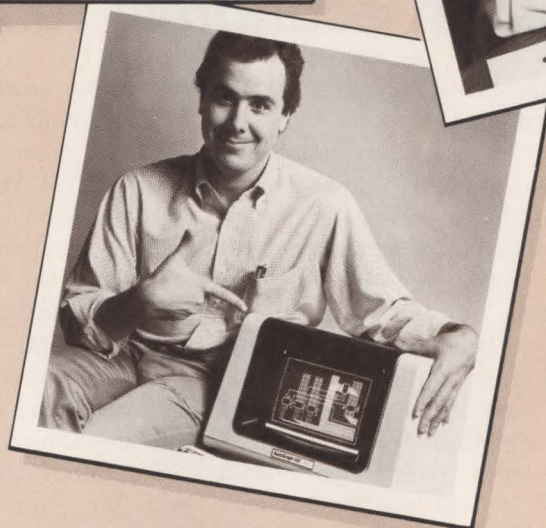
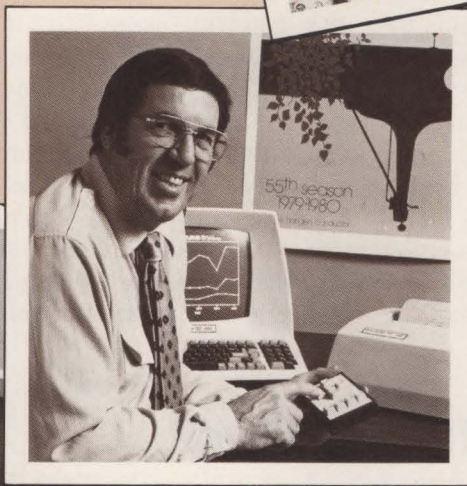
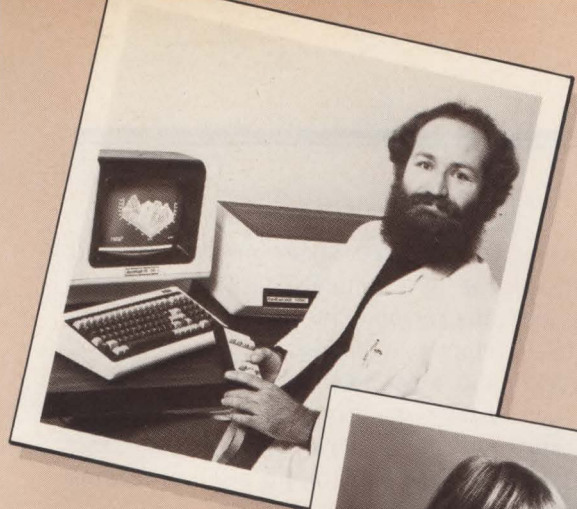
Larry Twaits, SNA gateway product manager, says, "Our goal is cooperative computing between the DECnet and the SNA environments. We're not trying to compete with IBM because our products don't serve the same needs as IBM products."

DEC offers several IBM-emulation products that link as single devices to SNA, but the SNA gateway is the first product linking the entire DECnet networking environment to SNA. Adams notes that this network-to-network capability is growing in importance because DEC expects about 80 percent of its CPUs

**DECnet Phase IV
program product summary**

Product	Availability	Price	Program
Ethernet physical channel hardware			
H4000 transceiver	late 1982	\$200-\$300 (depends on quantity)	Repeaters
Transceiver cable	late 1982		
Ethernet coaxial cable	late 1982		
Ethernet communication controllers			
DEUNA (Unibus controller)	mid-1983 (target)	about \$3500	Q-Bus controller Professional 3XX controller
Communication servers			
SNA gateway (non-Ethernet based; VAX/VMS access)	early 1983 (target)		DECnet router DECnet terminal server X.25 gateway Ethernet SNA gateway
DECnet Phase IV host software			
VAX/VMS and DECnet-VAX	mid-1983 (target)		TOPS-20 Professional 3XX
RSX and DECnet-RSX	early 1984 (target)		

Availability of the DECnet Phase IV products appearing to the left of the broken line is set or targeted as indicated. Those products on the right of the line will be available during the overall Phase IV implementation period, which will span the next three years.



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CIRCLE NO. 23 ON INQUIRY CARD

to be networked in some fashion by the end of this decade. He also says the connection to SNA is an obvious requirement for DECnet because "60 to 70 percent of the resources our customers want to access are in SNA environments."

Providing a functional translation of DECnet operations into SNA environments and vice versa, the

SNA gateway essentially incorporates four communication servers—network management, remote job entry, 3270 emulation and a user application interface. The network-management server offers such functions as line loopbacks, line traces and up-line dumps to the VAX computer connected to the gateway. The RJE operation essentially pro-

vides a file-transfer mechanism, and the 3270-emulation server permits any terminal in the DECnet environment to appear as a 3270 terminal to the SNA hosts. While users can't easily modify the SNA gateway software, Twaits says, they can write specific application programs for attachment to it.

—Dwight B. Davis

Small-system vendors bank on economic recovery

Few industry executives are ready to predict when an economic recovery will take place, but some small-system makers are already preparing for a resurgent market with new products and strategies. Among them are Basic Four Information Systems, General Automation, Inc., and Computer Automation.

Basic Four recently launched a two-pronged effort that brackets its small-business systems and takes it for the first time into the low-end, desk-top computing market.

The Tustin, Calif.-based Management Assistance, Inc., subsidiary, which saw recession and the negative effects of foreign-currency transactions halve its growth rate to 8 percent last year, has entered the desk-top μ c market through one acquisition and one OEM agreement.

The acquisition involves RCO Corp., an Albuquerque, N.M., Basic Four dealer. RCO developed the Business BASIC/Micro operating system that enables a dual Z80-based Direct, Inc., intelligent terminal to run applications written in Basic Four's Business BASIC.

Although RCO introduced the system last year, end-user shipments have not started because negotiations with Basic Four began soon after the introduction, says RCO president Patrick Riley. The

system has since been reintroduced by Basic Four as the S/10.

Riley, who will stay on as president of Basic Four Business Products Corp. (as RCO will be known after the acquisition is complete) won't comment on the terms of the takeover, but sources close to MAI indicate that the transaction involves a \$3-million cash payment and additional payouts based on future sales.

At Sunnyvale, Calif.-based Direct, Inc., marketing vice president R. Scott Brown says only that the four-year order from Basic Four is a "multimillion-dollar contract." Direct is furnishing Basic Four with a version of its OA 1000 programmable terminal, which uses 96-tpi Micro Peripheral, Inc., drives instead of standard 48-tpi mini-floppies; and a derivative of its VP 800B terminal, which Basic Four is selling as the \$3300 Office Display Terminal for use with new office-automation packages developed for larger Basic Four Systems by RCO.

William J. Rigby, Basic Four group vice president of marketing, denies that the addition of the \$5995 S/10 was prompted by the arrival on the market of other low-end systems designed to run Basic Four software. He characterizes the S/10 as an expansion of Basic Four's market. The company has tradition-

ally sold to companies with \$1 million to \$25 million in annual sales, and now it can sell into the less-than-\$1-million company market, he says. "We are strategically positioning ourselves for the next five years in this business," Rigby says. "We see a strong small-business-systems market—especially at the low end."

The S/10 is expected to fulfill several marketing needs for Basic Four. Primarily, it opens the low-end market for the company, whose former low-end system, the S/80, will continue to sell for \$15,990. To reach the low-end market, the company plans to establish retail channels in addition to its direct and dealer sales organizations. No retailers had been signed at press time.

For the Basic Four customer base, the S/10 is being pitched as an office-automation work station that can be attached to larger systems. An RCO-written word-processing package is available, and Basic Four encourages the development of third-party software packages written in BB/M. The system also runs portions of Business BASIC applications down-loaded from larger Basic Four systems, and emulates a Basic Four 7270 terminal. CP/M is optional.

At the high end, a more powerful product has long been anticipated to take Basic Four beyond the 710 line, an 8-bit system that is limited to 512K bytes of main memory, 600M bytes of disk storage and 32 serial

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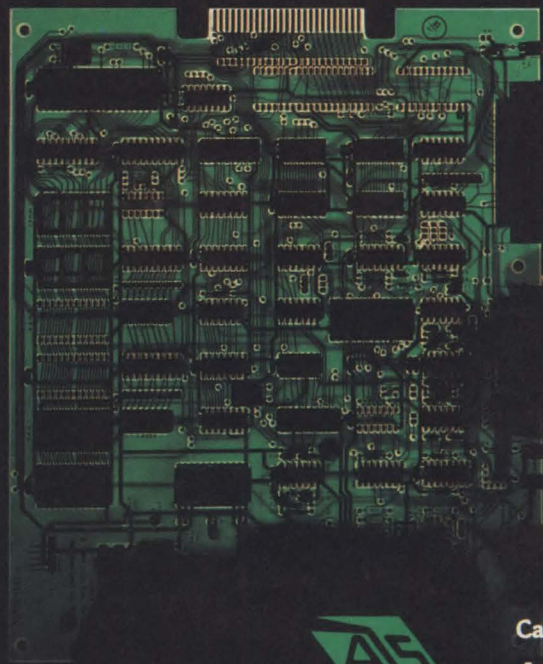
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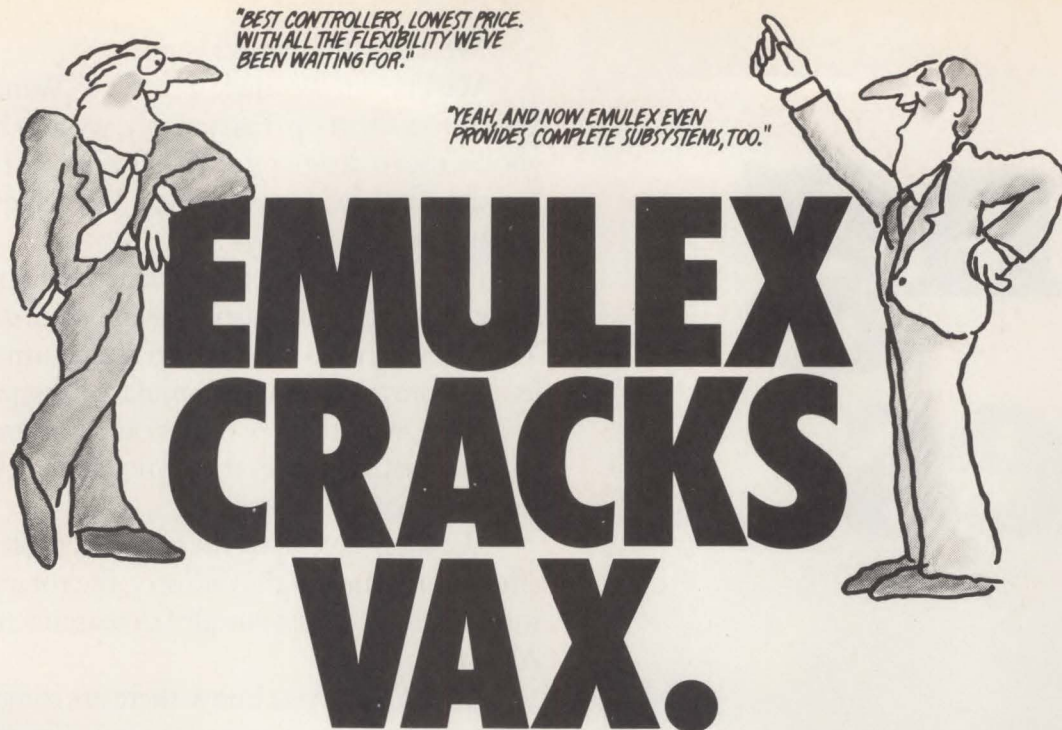
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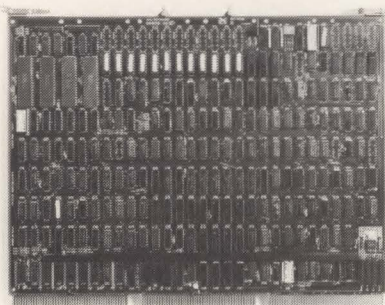
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devices. Basic Four has filled that gap with the 810, a hybrid 32-bit system powered by three 16-bit, arithmetic-logic units based on Advanced Micro Devices 2901 bit-slice processors. It is the first Basic Four system to use virtual-memory architecture.

The 810, described as a 32-bit machine because it uses a 32-bit memory path, supports 1.5M to 2M bytes of main memory, as many as eight disk-drives (Century Data 154M-byte Winchester or 75M-byte disk packs) and as many as 64 serial devices. A basic configuration with 1.5M bytes of RAM, one Winchester drive, a 45M-byte streaming-tape drive, a 150-cps printer and one terminal is priced at \$117,679, and a fully configured version sells for more than \$250,000. BOSS/VS, a virtual implementation of Basic Four's Basic Operating System Software (that includes a new modified binary-tree file system, is bundled into the purchase price.

Basic Four's Orange County, Calif., neighbor, General Automation is also positioning itself for a resurgence in the small-systems market. The company, under president Leonard Mackenzie's 2-yr.-old turnaround regime, fought its way into the black last year after net losses of \$15 million in 1980. However, for the first half of fiscal 1982 (ended January 31), the company saw its sales decline to \$52 million from almost \$64 million the previous year, and recorded a \$660,000 net loss.

The Mackenzie regime has eliminated some 500 positions or about 21 percent of the work force and closed two unprofitable operations. Now it has launched its first major product: the series 900. The 900s are a family of 16-bit minicomputers based on the Advanced Micro Devices 2903 bit-slice processor and designed to replace the company's 16/200 and 400 models. In addition, the 900s are expected to provide an upgrade

MINIBITS

AM INTERNATIONAL FILES FOR REORGANIZATION

Troubled AM International, Inc., a graphics- and information-processing-equipment supplier, has filed for reorganization under Chapter 11 of the Federal Bankruptcy Code. AM's Canadian subsidiary has also filed for reorganization. The company has no similar plans for its other subsidiaries, but negotiations are pending about a filing for AM's leasing company. "As a result of AM's recent losses and write-downs, its deficient net worth and high debt levels, the company needed concessions from a broad base of lenders," says AM chairman, president and chief executive officer Joe B. Freeman Jr. "However, the complexity of our debt structure and the magnitude of interest concessions required were proving too great a barrier to overcome." Freeman adds that AM plans to continue operations.

FLORIDA DATA, BROTHER SIGN AGREEMENT

Florida Data Corp., Melbourne, Fla., and Brother Industries, Nagoya, Japan, have signed an agreement that includes licensing FDC's print head and mechanism technologies. Under the agreement, Brother will manufacture FDC's high-speed data- and word-processing printers. Brother, with Mitsui & Co., Ltd., will have marketing rights for FDC products in Asia and Australia. Brother will also manufacture FDC's proprietary triple-paper-path print mechanism for the firm's domestic and European markets, enabling FDC to accelerate high-volume production. FDC might purchase Brother's 24-pin print head that incorporates FDC's magnetic-stored-energy technology.

TI MARKETS SINGLE-CHIP MODEM

Offering Bell 103 series compatibility, a single-chip modem from Texas Instruments Inc. provides the modulation, demodulation and filtering functions to implement a serial, asynchronous communications link. A TI spokesman says the new TMS99532 modem is the same chip designed for Racal-Vadic, Inc., and incorporated by that company in its Type 103 modem board (MMS, March, p. 131). The TMS99532 operates at 300 bits per sec. and communicates in originate and answer modes and in simplex, half-duplex and full-duplex configurations. The modem chip can be connected to the telephone network by one of two methods—using a speaker, microphone and resistor/capacitor network or by direct connection through a data-access arrangement. In 100-unit quantities, the 18-pin chip packages sell for \$23.50 each (plastic) or \$33.50 each (ceramic).

TIMEX WATCHES PERSONAL-COMPUTER MARKET

The time is right for the personal computer to leave the office and enter the home and school—or so says Timex Corp., which plans next month to start marketing a \$99.95 version of the Sinclair Research ZX81. Timex Computer Corp., a recently established affiliate of the Waterbury, Conn., watch manufacturer, plans to move the product through some 100,000 retail outlets throughout North and Central America and the Caribbean. Timex, which has been manufacturing the compact Sinclair Z80A-based μ c at its Dundee, Scotland, facility for 18 months, will offer the product as the Timex Sinclair 1000. The Timex version, with 2K bytes of RAM, has twice the memory of the standard ZX81, which the Cambridge, England-based Sinclair sells by mail order in the U.S. for \$150. In addition, Timex will offer a new communication option for \$99.95 that includes a 300-bps modem and plugs directly into a modular telephone jack. Timex Computer vice president Daniel D. Ross, a veteran of Intel and Memorex Corp. leasing operations, says Timex plans other computers from Sinclair and other sources.

COST.



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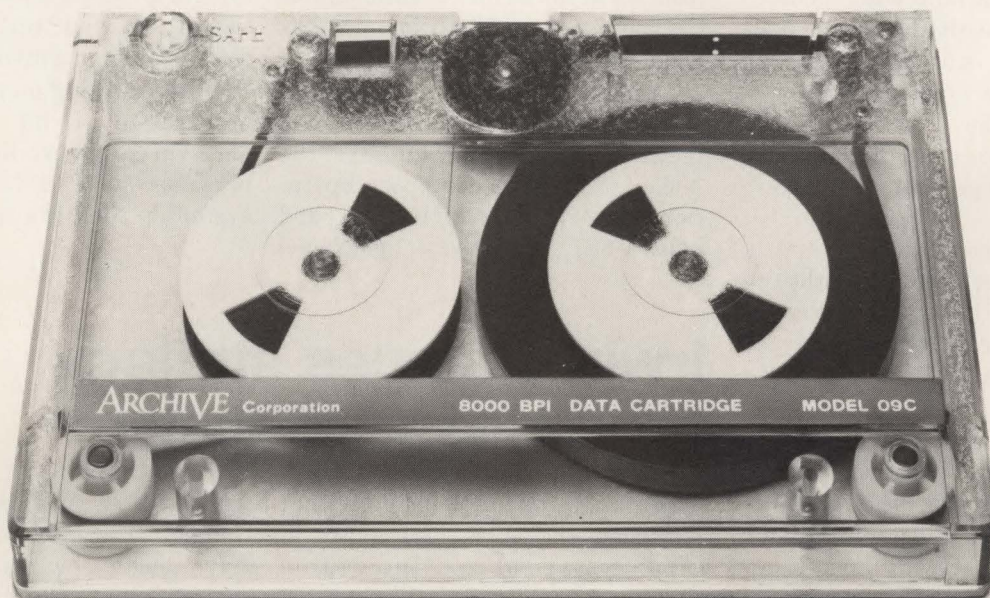
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path for GA's SPC/16 users, says computer division vice president and general manager Dick Cortese.

The 900s are said to have a 48-percent price/performance advantage over their predecessors. The entry-level model is the 910, which is rated at 1.2 times the performance of the 16/200 and is offered in a chassis-only configuration with 64K bytes of RAM (expandable to 1M byte) at a single-unit price of \$6995. The next model, the 920, has expansion and packaging options similar to the 910's, but is equipped with a faster version of the bit-slice processor said to have 1.5 times the performance of a 16/200. Prices start at \$8995.

The 930/40/50 series products are shipped with 128K or 256K bytes of main memory expandable to 2M bytes. Six models include a standard 2K-byte cache memory, which can be ordered as a \$1750 option on the remaining six. The 930s, offered in a chassis-only configuration, range from \$13,995 in a 128K-byte version without cache to \$17,950 for a 256K-byte machine with cache.

The 940s are similar to the 930s, but include a standard single-bay cabinet. Prices range from \$15,995 to \$19,950. The 950s, which offer the same hardware in dual-bay cabinetry, range from \$16,995 to \$20,950.

The systems use the GA 16 instruction set and run the GA Control operating system, which is separately priced at \$1650 to \$2750, depending on which version is ordered.

Cortese says that in addition to providing better price/performance for GA customers, the 900s are aimed at new customers in small- to medium-sized system houses and OEMs. He says GA has detected a soft spot there in the Digital Equipment Corp. and Data General Corp. marketing efforts. The 910 is positioned against PDP-11/23s, the

940 against the 11/34 and the 950 against the 11/44.

The company is also working on a 32-bit system for 1983 and has contracted with an unidentified outside vendor to adapt UNIX System III to its processors by year-end. GA will also add Pascal and C compilers to its Control operating system. The company has not decided on the design for its 32-bitter, but is considering the Motorola 68000 and the Intel 4/32, Cortese says.

At Computer Automation, the response to the recession has been a streamlining that included a recent layoff of 160 employees (about 13 percent of the work force and 15 percent of the payroll).

The layoffs came as the firm reported a third-quarter net loss of \$542,000 on sales that declined from \$18.4 million a year ago to \$16.1 million. Company president David Methvin says other cost-cutting moves might include further consolidating facilities and eliminating some field-service outlets.

Methvin says the layoffs were from all areas of CA operations, but the most severe falloff in sales has been in the Industrial Products division, in which sales of automatic test equipment "really took it in the teeth." However, Methvin says, the Naked Mini OEM computer operation "exceeded plan in the U.S.," and sales of CA's SyFa packaged

minicomputers "slowed down."

Methvin is quick to point out that this is the third major recession in the company's 15-yr. history, and each time, the company emerges "leaner and meaner," he says. One way in which the company is leaner is its reduction of long-term debt from \$10 million at the start of fiscal 1981 to \$250,000 in April. With that relatively clean balance sheet and what Methvin describes as a positive cash flow, the company is considering an acquisition. Methvin says that no targets have been identified, but that the recession could produce some bargains.

Methvin says CA is interested only in computer-oriented businesses. "We are looking for products to fit our organization or something that could be established as a new division."

In the meantime, the company is spending "heavily" on product development, although no major changes are anticipated in the short term. One project is under way to produce the equivalent of the highest powered Naked Mini 16-bit system on a board-level package the size of the Scout series. Another is development of a 32-bit Naked Mini. "We are working on a 32-bit Naked Mini quite a bit downstream," Methvin explains, but he sees no pressing need to furnish a 32-bit system in the SyFa range.

—Geoff Lewis

Irwin changes strategy for micro-Winchester

Billed as a micro Winchester that stretched the state of the art in capacity, speed and integrated backup when it was introduced almost two years ago, (MMS, November, 1980, p. 45), Irwin International's model 510 may have been overridden by industry skepti-

cism that it could be produced in volume. The Ann Arbor, Mich., drive maker now plans to separate the device, which includes a Winchester drive and an integral cartridge-tape backup device, into two units, each incorporating its own controller board. The boards

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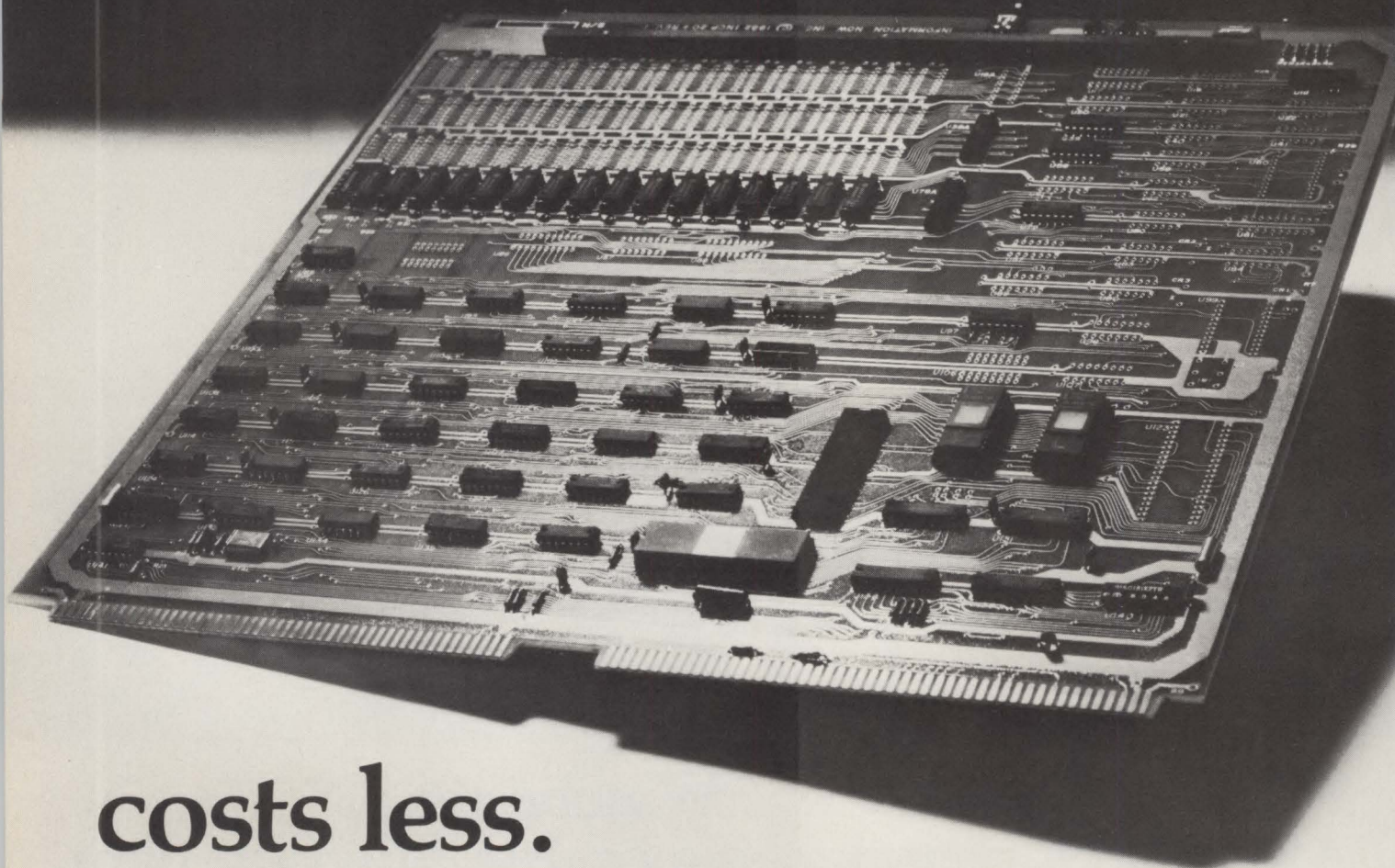
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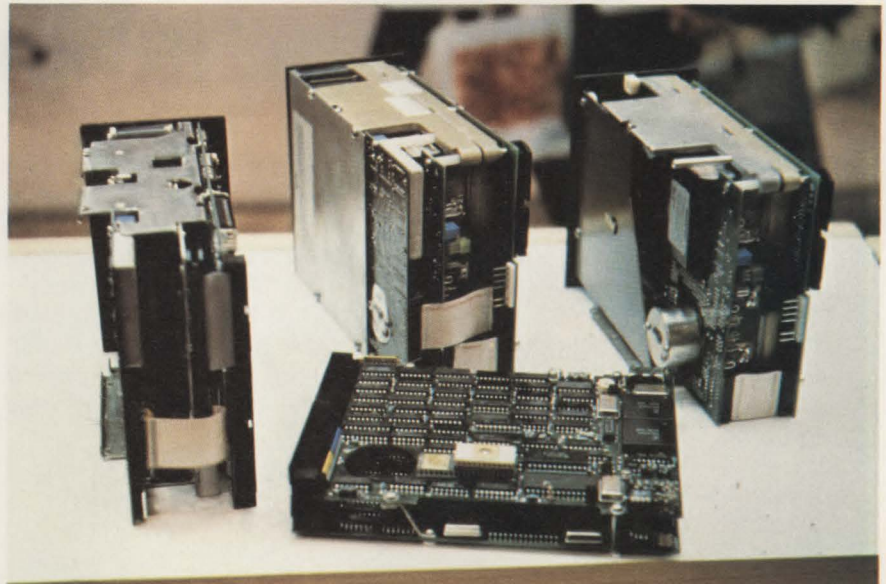
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previously had been housed in a separate unit.

The company claims to have installed 200 to 500 of the 510 drives, and will continue to market the combined version, says Roy L. Gutknecht, Irwin's senior licensing specialist. He works in conjunction with Olivetti OPE, which has licensing rights to the product. The 510, which sells for \$1800 each in quantities of 500, has 12.3M bytes of unformatted storage and a 25-msec. average access time.

By splitting the drive, Gutknecht says, a Winchester without backup can accommodate the controller in the same box. Irwin still is deciding whether to market the model 106 tape backup and controller separately, but is sure it will market the model 416 Winchester and controller box. The 416 also will be available without the controller for less than \$1000 each in quantities of 500.

Leaving out Irwin's controller opens a new market for the company—the Seagate-compatible market. "We've learned since the 510 introduction that the market



The Irwin 510 micro-Winchester, an ambitious product with advanced technologies, also will be available in a segmented version. In the center is the model 510 with integral cartridge-tape drive. The foreground shows the 1511 separate controllers for each drive. To the left is the 106 cassette without controller, which still is in question for separate release. To the right is the 416 Winchester drive without controller.

wants a Seagate-compatible disk drive," says Gutknecht. He says Irwin is working to have a Seagate 506-compatible version by year-end. Seagate claims to have shipped more than 30,000 ST-506s to date.

Gutknecht adds, "The 510 is becoming more like a regular

drive—you can or can't buy the tape."

Olivetti also hopes to sell the Winchester/controller version of the drive and the Seagate version when it becomes available.

—L. Valigra

Sord entry may improve Japanese software's reputation

Will PIPS Inns become the McDonalds of the software industry? Probably not, but the success of those software franchises in Japan may catch on in the U.S. this year when supplier Sord Computer Systems, Inc., Tokyo, Japan, brings both its Pan Information Processing System language and its μ cs stateside (see "Sord's success linked to PIPS," p. 78).

The 12-yr.-old company, with 1981 revenues of about \$25 million (estimating 200 yen = \$1), has been growing at 85 to 100 percent annually over the past five years.

Its first attempt to enter the U.S. market in 1977 failed. But, with a broader μ c line and PIPS software, the company may stand a much better chance.

Sord president and founder Takayoshi Shiina says the company will open an overseas office called PIPS Corp. this month in New York, and bring its products to the U.S. in October after it has signed some dealers.

PIPS can be loosely compared with VisiCalc and may erase much of the stigma attached to software developed in Japan. PIPS is a command-

driven, interactive spread-sheet language that processes data in pages that link a program together, instead of executing information line by line. The company claims it is much easier for a user unfamiliar with computer terminology or technology to think in terms of pages in a notebook, rather than streams of information or files.

One PIPS page consists of several columns and lines, with each column indicating an item of data, and each line indicating a record. Before data can be placed onto the program,

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This is the revolutionary new DMA Micro-Magnum 5/5. A 13.5 MBytes (10 MBytes formatted) 5¼" Winchester fixed/removable disk drive. With 6.75 MBytes on its fixed disk and 6.75 MBytes on its removable disk. It's the first of its kind, and very likely to be the best of its kind for years to come.

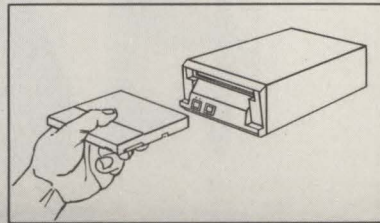
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our new 5 $\frac{1}{4}$ " Winchester is purely intentional.

Self-Sealing System for Data Integrity.

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Our high-performance Micro-Magnum design achieves incredibly fast operating speeds. Its disk-to-disk back-up time is less than 90 seconds. And its average access time is just 40 milliseconds.

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The Micro-Magnum interface is designed to be closely compatible with existing 5 $\frac{1}{4}$ " Winchester drives. Which means controllers can easily be adapted for use.

Finally, its physical size is precisely matched to standard mini-floppy front panel dimensions for easy installation.

All in all, a system designer couldn't possibly want anything else in a 5 $\frac{1}{4}$ " Winchester design. Except perhaps more information about DMA Systems. And an evaluation unit. Both of which are immediately available from DMA Systems, 601 Pine Avenue, Goleta, California 93117. (805) 683-3811, Telex 658341.

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columns first must be set up in forms that can vary in size. Prepared data then is processed through commands. Multiple page processing is possible. PIPS can be

linked to other Sord languages and software packages. Each page holds as many as 72 items in a 140-column \times 60-line table.

The most recent version of PIPS,

PIPS-III, will be available next February. The product reportedly substitutes for almost any other package written in other languages, such as BASIC, and other programs.

PIPS-III includes AUTO, INPUT and other commands similar to those used in BASIC to allow PIPS to be used for programming. Dock, or Docking BASIC, software allows programs to be input in DBASIC and processed in PIPS. PIPS database data can be output via a DBASIC program.

One potential licensee for PIPS-III believes the product was the software star of the recent Hanover Fair, but the product's packaging still must be improved before PIPS-III is officially released, he says. "PIPS-III has deficiencies in documentation, and switches in context, meaning that all program modules do not flow cohesively," says David Cole, president of Software Plus, a Culver City, Calif., software holding company. As an example, he says, the number of keystrokes for the same function in different modules may vary.

Cole is looking for a PIPS-like product that handles pages, rather than lines of information. "People don't relate to linking programs together in numerical order line by line until they reach a 'go to' statement," he maintains. He adds that 2D representations, such as pages, help users, and PIPS is one of the few products to offer this help.

PIPS-III runs on Sord's M23 μ cs, and the company's operating system. Cole would like to bring the package to the U.S. to work on any number of μ cs. Sord president Shiina, however, is focusing his efforts on dealers that will handle PIPS and Sord hardware.

The new M23 system, which will be introduced in the U.S. in October, was expected to make its debut last month at a Japan business-equipment show. It was shown at Hanover. The Z80A-based product,

PRIME, TEKTRONIX LAUNCH SOFTWARE PROGRAMS

Prime Computer, Inc., and Tektronix, Inc., have unveiled third-party software programs aimed at matching computer users with proven application packages. Prime's Solution Package involves a mutual investment between Prime and each participating firm. Pooled funds will be used to increase marketing activities, such as cooperative advertising, sales promotion and public relations. To participate, software houses must meet Prime quality and support standards and keep software optimized to Prime's hardware and systems software. Tektronix's solution-directed marketing program will focus on scientific and engineering applications for the company's computer-graphics equipment. Packages under consideration include CAD/CAM, cartography and technical data analysis.

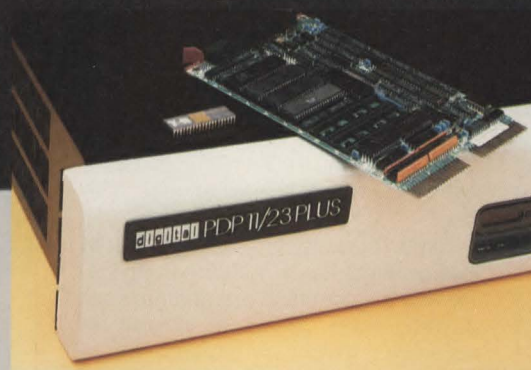
SOFTWARE FIRM PLANS INTERNATIONAL VENTURES

International Software Enterprises, a Lafayette, Ind., start-up, has been launched with the goal of capturing a "significant share" of the worldwide μ c-software market, which its founders estimate will approach \$25 billion by the end of the decade. The company is closely linked with Micro Data Base Systems, Inc., which put up about one-fourth of ISE's initial \$4 million in capital and whose MDBS III package (a database-management system for Z80 and 8080/86/88 processors, and soon to be available for Z8000, 68000 and PDP-11 systems) will be ISE's "core product." ISE has signed joint-venture agreements with major European software consultants including ADV/Orga (Germany, Austria and Switzerland), Datema (Sweden and Norway), Pactel (the U.K. and Ireland) and Cegos (France). The joint ventures will market and support "professional" packages developed by former MDBS staffers in Lafayette and other products to be acquired and qualified by ISE. Target markets will be corporate electronic data-processing managers implementing μ cs and OEMs. ISE plans to have a worldwide network in place by late 1983.

TANDEM FILES SUIT AGAINST STRATUS

After years as the almost-unchallenged leader of the redundant minicomputer market, Tandem Computers, Inc., is sitting up and taking notice of the emerging competition. The company recently filed suit in Federal District Court in San Francisco to prevent rival Stratus Computer, Inc., Natick, Mass., from continuing an advertising campaign claiming price and performance advantages over Tandem. Charging Stratus with using untrue and misleading statements in the ads, Tandem went on to say the Stratus campaign "...is predicated on denigrating the products of its competitors and in particular...Tandem Computers." Meanwhile, Dosc, Inc., Albertson, N.Y., has introduced as low-end redundant system based on parallel 8085 μ cs with 256K bytes of memory each and twin Control Data Corp. Lark 48M-byte, fixed/removable Winchester. The \$35,000 system includes two work stations and a CP/M operating system. It is the follow-on to a system with 80M-byte drives introduced last fall by Dosc, originally a system contractor that developed an 8085-based optical-character-recognition check reader for Citibank. Further down the road—and of greater significance to both Tandem and Stratus—is the expected introduction by Digital Equipment Corp. of fault-tolerant versions of PDP-11 and VAX systems.

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Mini-Micro World

which looks like a Sony Corp. portable Typecorder, has 128K of memory, an 80- or 160-column \times 8-line LCD with graphics, a keyboard, BASIC for word processing, PIPS-III software and asynchronous and bisynchronous communications. Shiina estimates the price to be about \$3000, including Sony 3½-in. dual floppy-disk drives holding 280K of formatted information each. A color monitor hookup is priced at \$400 to \$500. An optional 14-in. screen sports eight colors. Also included is the Sord disk-operating system, although CP/M may be added this month. A Brother Corp. printer is priced separately at about \$1000.

While the company already has an 8-bit μ p-based μ c line to offer



David Cole, president of Software Plus, demonstrates the PIPS software he would like to market for μ cs other than Sord's.

SORD'S SUCCESS LINKED TO PIPS

Sord's success in reentering the U.S. market may hinge on PIPS—its claim to fame in Japan. One of Sord president Takayoshi Shiina's biggest marketing coups in Japan is PIPS Inns, his chain of marketing and training outlets. A 16-hr. course is priced at about \$150. There are about 40 franchises in Japan, with one of the



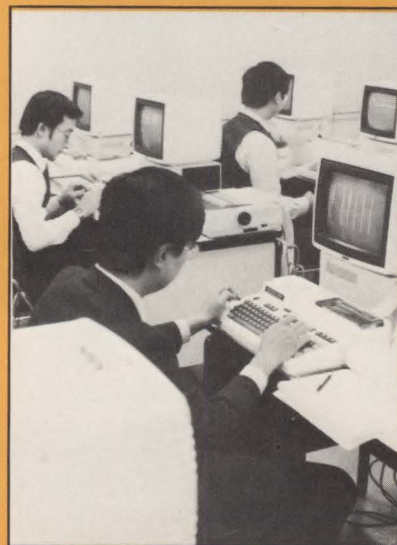
Sord Computer Systems president Takayoshi Shiina reportedly is a high-level Samurai.

newest set to be located in Tokyo's prestigious Mitsukoshi department store.

On Hokkaido, the northern island of Japan, users can learn to use PIPS by listening to the radio. Sord claims it can teach PIPS to almost anyone in 16 hrs.

Even more important than PIPS to Sord's rapid rise to stardom is Shiina. He and his company are anomalies in Japan. First, Sord is strong in software, which is unusual for a Japanese company offering such a product to the U.S. Second, Shiina is an entrepreneur in a μ c company backed by venture capital, both common phenomena in the U.S., but rare in Japan. Most electronics companies in Japan developed from domestic product efforts into computing, and are big household names such as Panasonic, Toshiba and Hitachi.

Shiina, his mother and his uncle founded the company 12 yrs. ago, and had two employees and \$3000 in assets at the end of the second year of operations. Nonetheless, Shiina decided to build hardware using chips bought from Intel. He refused to buy Japanese components until 1977, when he felt his countrymen had surpassed U.S. technology. He has built his company using leading-edge



Japanese businessmen learn to program Sord computers at a PIPS Inn, a company marketing and training outlet.

devices, some of which were unproven, such as Sony's 3½-in. floppy-disk drive. Even in the early days, Shiina envisioned a PIPS-type product, which later gave the company a big boost in the market.

Sord stands for the first two letters of soft and the last two of hard, meaning a software and hardware company. But its success may indicate a more appropriate translation: Shiina reportedly is a high-level Samurai.

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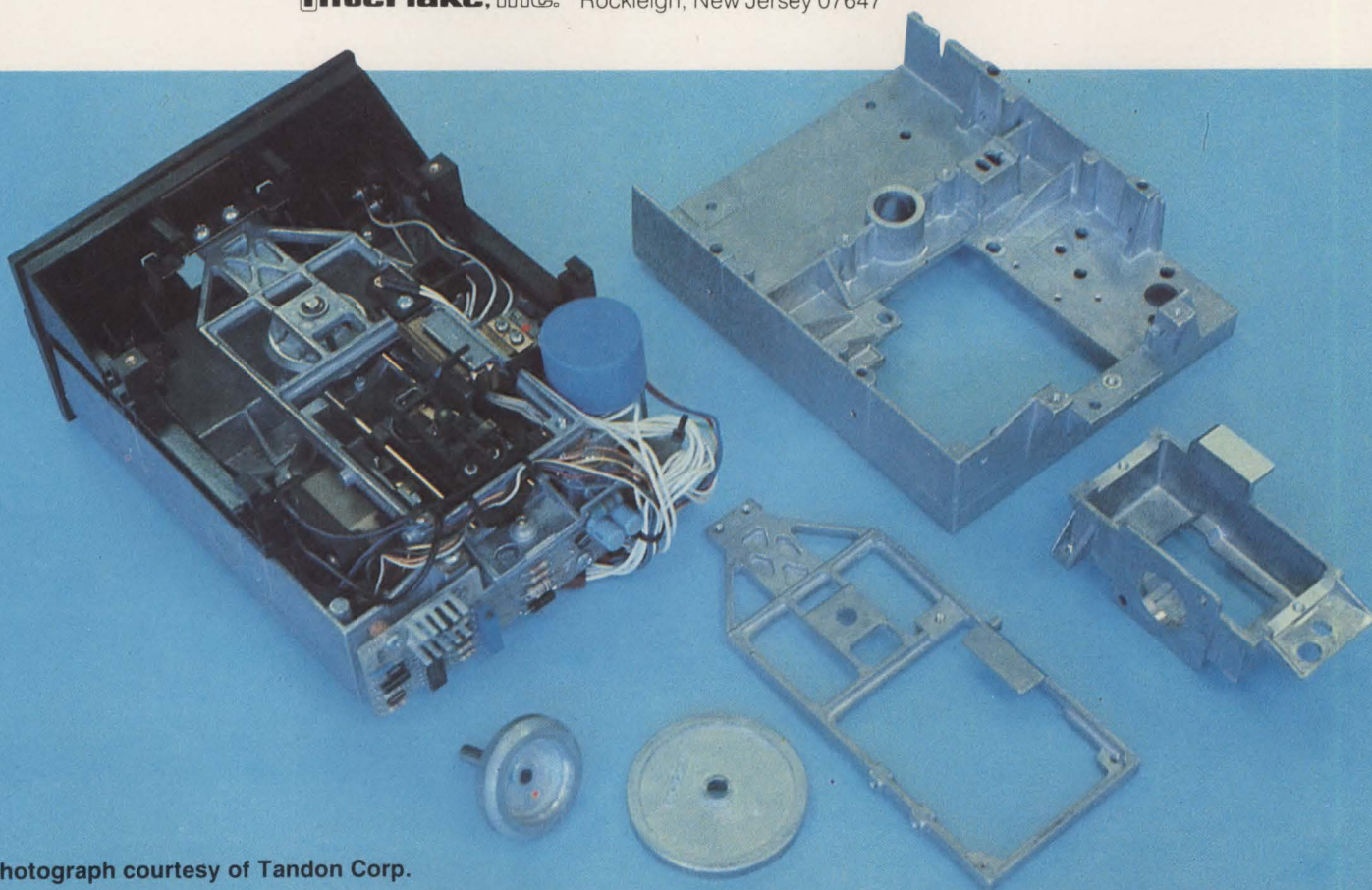
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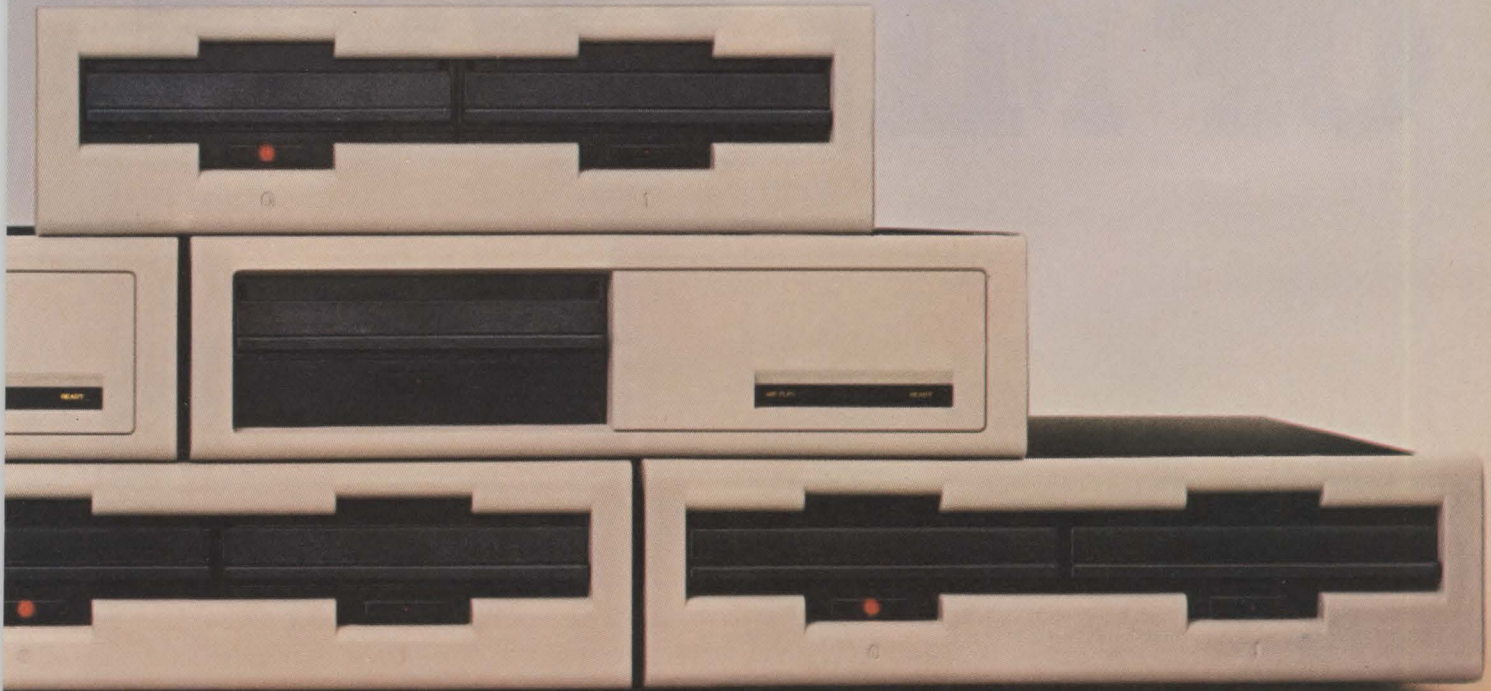
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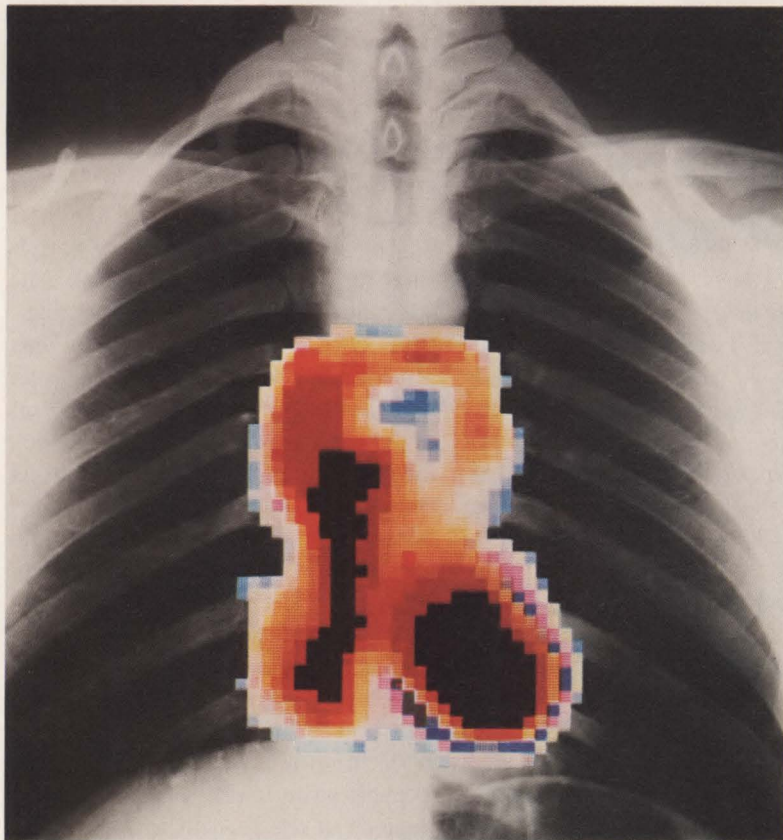
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In nuclear medicine, doctors use Shugart's SA851 drive to store and playback images of the heart (shown here superimposed over x-ray). Photo courtesy of Technicare Corporation.

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dealers, it plans to introduce the M343 16-bit system in the U.S. next year. That computer, based on Intel Corp.'s 8086, will operate on Microsoft's MDOS and Sord's RSXM real-time, multitasking operating system, both of which support PIPS. The M343 will have 256K of memory,

an Intel 8087 math co-processor, 8-in. floppy-disk drives from YE Data and a Z80 graphics controller. It will run 16-bit software. OEMs can add vertical application software, Shiina says. Future software for the M343 may include UNIX, CP/M-86, p-system and Pascal.

Future hardware includes a back-end array processor for μ c graphics and a database machine.

—L. Valigra, with contributions from MMS London correspondent Keith Jones, and Della Bradshaw, a British journalist who taught English to Japanese electronics company executives.

Burroughs launches family of μ c/work-station products

In what one company official calls "a deadly serious effort to get back into a market we abandoned" in the early 1970s, Burroughs Corp. last month launched a family of μ c/work-station products it is acquiring under an OEM contract from Convergent Technologies, Santa Clara, Calif.

The B-20 product line is also a significant part of Burroughs's plan to put its revenues back on a growth path. It is an effort that has had the personal involvement of chairman and chief executive officer W. Ralph Blumenthal, and it has spawned a special group within the Business Machines Group, a new dealer organization and Burroughs's first retail stores.

The B-20s are based on Convergent's IWS series, and basic B-21 prices range from a \$4095 B-21-1 to a high-end B-21-5 at \$14,995. All the B-20s use the Intel 8088 16-bit μ p and are available with 640K bytes of RAM. They each come with standard

RS232 and RS422 ports, a 15-in. CRT display and a detached keyboard.

A B-22 is also available and is geared toward larger clusters, supporting as many as 16 work stations instead of the four maximum on the 21 series. In addition, the B-22 has 8-in. Winchester disks of 10M or 20M bytes each and 8-in. floppy backup. Pricing ranges from \$17,000 to \$40,000.

The models differ mainly in storage capacity. Except for the B-21-1, which is designed to function as a work station with other B-20s and has no mass storage, the systems can be ordered with 5¼-in. floppy- and/or 5¼-in Winchester-disk drives in 5M- or 10M-byte capacities. The BTOS operating system—Convergent's CTOS with "subtle modifications"—is bundled into the purchase price, as is the choice of one language from among BASIC, FORTRAN, COBOL and Pascal.

More significant than the hard-

ware—which is standard Convergent fare and similar to products already marketed by NCR Corp. and Savin Corp.—is the new direction Burroughs's marketing will take. In addition to a special B-20 organization in the direct sales Business Machines group, Burroughs has launched a new dealer organization under vice president of dealer marketing Clinton Bull. Bull is responsible for developing a dealer/distributor organization to handle third-party distribution of the B-20, the OFISwriter (formerly Redac-tron) line of word processors and Series L accounting machines.

"Third-party dealer/distributors will be the bulk of the B-20 effort," Bull predicts, adding that he expects to sign between 100 and 150 dealers in the U.S. in the first year of the program. At the time of the B-20 introduction last month, the company was negotiating with two distributors representing as many as 115 dealers, he says.

A second new channel set up for the B-20s are Burroughs's retail outlets. Four such Computer Business Centers are scheduled to open in July in New York, Chicago, Houston and Atlanta. The Burroughs centers are not conceived along the lines of computer stores set up by International Business Machines Corp., Digital Equipment Corp. and Xerox Corp. Instead, they will function mainly as seminar centers where customers can see B-20 packages geared to their needs. These centers may also sell other Burroughs equipment, such as Office Systems group products, says Frank Slovenek, senior mar-

BOOLE & BABBAGE MERGES WITH ISE

Computer software firm Boole & Babbage, Inc., Sunnyvale, Calif., has merged with the Institute for Software Engineering, Menlo Park, Calif. ISE is a data-processing education and consulting-services company. Under the merger, the institute's educational, consulting, publications and conference activities will be the responsibility of an autonomous Boole & Babbage division retaining the institute's name. The Educational Services Division of Boole & Babbage will be incorporated into the institute, and ISE will continue to offer Boole & Babbage's courses, publications and services. David R. Vincent, formerly general manager of Boole & Babbage's Educational Services Division, has been named general manager.



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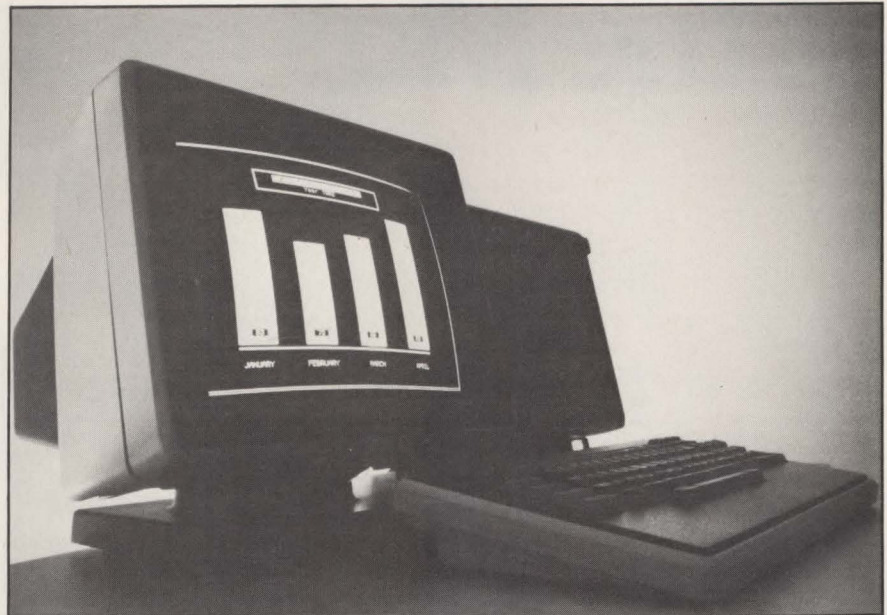
CIRCLE NO. 34 ON INQUIRY CARD

keting manager for small systems business planning.

Another new wrinkle for the B-20s is a depot maintenance plan that will be established in Burroughs's 19 domestic sales regions this summer. The depot maintenance program is expected to be about half the price of on-site service, which will also be available for the B-20s. For the high-end B-21-5, an on-site maintenance contract sells for \$1800 annually, Slovenek says.

Bull notes that the 18-mo.-old ISO program will also come into play for the B-20s "to some degree." That program is designed for ISOs offering software packages for the earlier B-90 and B-1900 small computers and involves quantity discounts and joint marketing. Some ISOs have expressed interest in the B-20, and, Slovenek says, a few are already writing programs to migrate their applications down to the B-20.

Bull adds that ISOs would have to become dealers as well to handle B-20s, but says some low-end products now handled by ISOs also may be shifted to the dealer



Burroughs Corp.'s B-20 line of work stations is based on Convergent Technologies' IWS series and is designed to get Burroughs back into a market it abandoned in the early 1970s.

network. The incentive for converting from ISO to dealer is higher margins, he says.

Application programs available from Burroughs include Convergent's word-processing package, Microsoft's Multiplan and a trio of Burroughs-developed products, including packages for wholesale distribution, a general business

accounting and a B-20 file-management system, which is written in Pascal and has English commands for end users to generate file creation and access programs. The application programs are expected to sell for about \$900 each. CP/M is not included, but Slovenek does not rule out its addition later.

—Geff Lewis

TeleVideo Systems moves aggressively into systems

Philip Hwang knows a good opportunity when he sees one. Just look at the success of his Sunnyvale, Calif., video display company, TeleVideo Systems, Inc. It already ranks among the top four companies in that business after just three years of shipping displays in volume. Hwang now has similar designs on the small-business-computer market.

The most recent part of his systems growth plan is TeleSolutions, a hardware/software package comprising TeleVideo's CP/M-based

desk-top systems and financial and word-processing software from MicroPro International, Inc. TeleSolutions is aimed at first-time business users. Company executives expect the package to help TeleVideo garner an increasing share of the business-computer market by offering more than a hardware solution to user needs.

TeleVideo's systems start with the entry-level, single-user TS801 priced at \$3295. The six-user TS806 sells for \$7195. At the top is the 16-user TS816, priced at \$16,995. All

are Z80-based machines with 64K to 128K bytes of RAM and floppy- or 5¼- or 8-in. Winchester-disk drives for mass storage. The tabletop hardware is designed to operate with the firm's intelligent displays as satellite work stations.

The systems run CP/M, which is included in the base price. The company also offers a proprietary multitasking operating system called MmmOST, which is priced separately. Applications software is prepared by TeleVideo distributors, Carter says, but CP/M-compatible packages can be obtained from many sources.

The two fully integrated Z80-based desk-top systems, the TS802 and 802H, added to the product line

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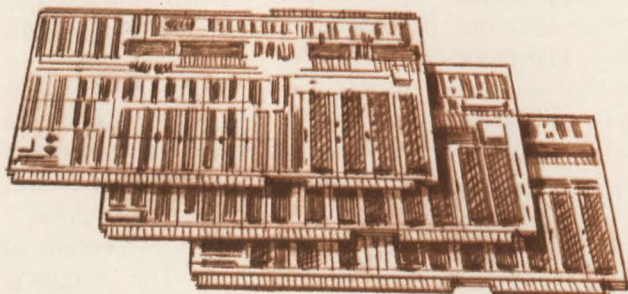
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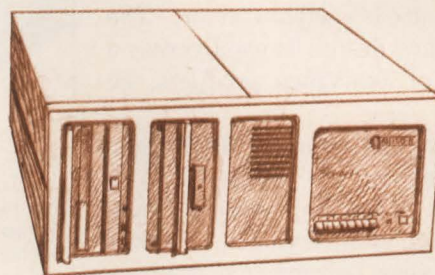
- A number of new proprietary board level products and sub-systems, based on all three major 16-bit processors, the Intel 8086; the Motorola 68000; and the Zilog Z8000. You see, we think each of these competitive items



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last November, have built-in displays and 5¼-in. floppy- or Winchester-disk drives. They are designed to operate as stand-alone systems or as satellites in a multi-user environment. The 802 is priced at \$3495, and the 802H is priced at \$6995.

TeleVideo's move into systems came after a year-and-a-half of study by Hwang, whom Carter calls a "window-of-opportunity guy." It was a logical and easy shift from building TeleVideo's intelligent terminals to building systems. "Only minor changes in ICs and the μ ps are required," says Carter. The basic board design is used across a variety of TeleVideo products, he adds.

Carter fully expects the division to have a dominant share—25 to 35 percent—of the multiterminal, multitasking small-system market within a year, barring an entry from a major competitor. "We see no major competition yet," says Carter. He claims that those already in the business—Altos Computer Systems, Cromemco, Inc., and Vector Graphic, Inc., for example—don't have a dominant share: each has less than 30 percent of the market. He thinks the market will grow 35 to 40 percent a year for at least the next five years.

"TeleVideo is coming up rapidly," says analyst Jean Yates, of research firm Gnostic Concepts, Menlo Park, Calif. "They have a powerful



The most recent part of TeleVideo's systems growth plan is TeleSolutions, a hardware/software package comprising TeleVideo's CP/M-based desk-top system and financial and word-processing software from MicroPro International.

with Altos, for instance, in the Z80-, floppy-disk-based systems market." TeleVideo's strength, she says, is in low-cost manufacturing.

Hwang built much of TeleVideo's success by keeping display-manufacturing costs low. Carter is patterning the systems division's manufacturing along the same lines. Subcontractors in Korea build covers, monitors, monitor electronics and power supplies. Processor board assembly, installation and testing are done in the U.S. Carter can't specify exactly how much

money is saved this way, but he says it's enough to enable TeleVideo to pass the savings on to the buyer. The company has maintained a 13-percent post-tax profit margin, and Carter thinks his division will keep up that standard.

TeleVideo has two operating manufacturing plants, and a 100,000-sq.-ft. facility is under construction for the computer systems division, Carter says.

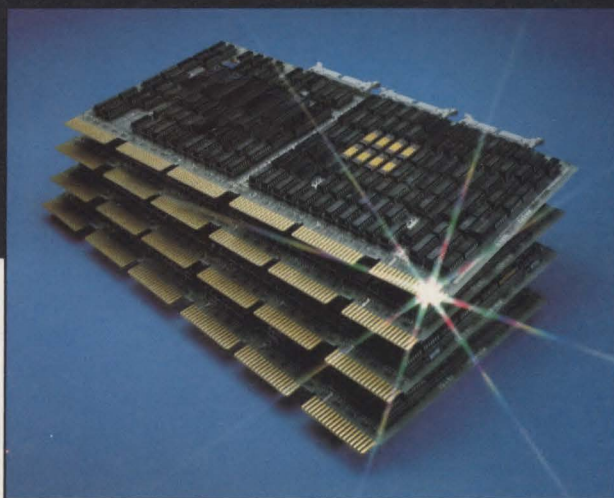
Carter, who joined the firm last December, hopes to make his division the "predominant source of sales within the company." So far, he seems to be getting close—systems account for 36 percent of TeleVideo's sales. The company ended fiscal year 1981 with \$35.4 million in revenues, up from \$11 million in 1980.

TeleVideo has been shipping TeleSolutions since January. It is a combination of an 802 or 802H and MicroPro's Calstar and Wordstar software. The TeleSolutions software is priced at \$500. "We've taken

EX-EXXON OFFICIALS FORM NEW FIRM

Three former executives of Exxon Enterprises have formed Digital Transactions, Inc., a new venture in office automation. The founders are Charles W. Murphy, former marketing director; Peter S. Buswell, former manager of product planning; and Garrett H. Weinberg, former planning director of Exxon's Communications Systems Group. In the new venture, Murphy is president and chief executive officer; Buswell is chief operating officer responsible for product planning, development and implementing; and Weinberg is chief financial officer. Digital Transaction's first product will be a telephone terminal that provides easy access to both voice and data information. A small key system, offering advanced switching, and an electronic-mail system, will follow.

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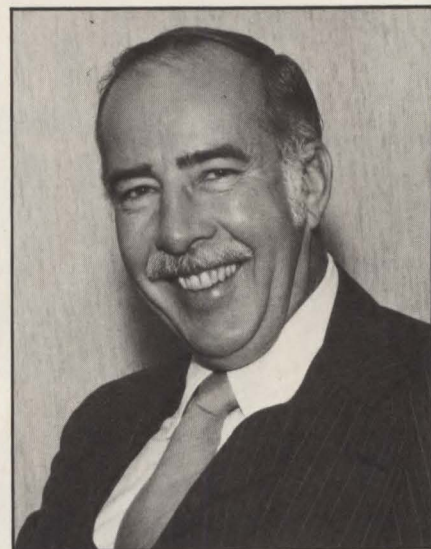
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TeleVideo's move into systems was a logical and easy shift from building intelligent terminals to building systems, says recently appointed general manager Dan Carter.

the 802 and 802H and added the software most needed by first-time users such as business professionals, doctors or managers inside operations," Carter says. He believes dealers and distributors selling to one-time, first-time users need special packages to make the sales. TeleVideo has acquired the rights to manufacture other MicroPro software, including Spellstar, Datastar, Mailmerge and Super-sort. There are no plans to bundle these packages with TeleSolutions, but they can be purchased from TeleVideo, he says.

Carter expects to use TeleVideo's large-volume buying power to continue to acquire manufacturing rights for software. Besides the MicroPro packages, he says, the company picked up the rights to Ryan-McFarland's COBOL and Minneapolis-based Open Systems, Inc.'s general accounting software.

Meanwhile, development continues in 16-bit systems, graphics and networking, all with the goal of making TeleVideo as big in systems as it is in video displays.

—Larry Lettieri

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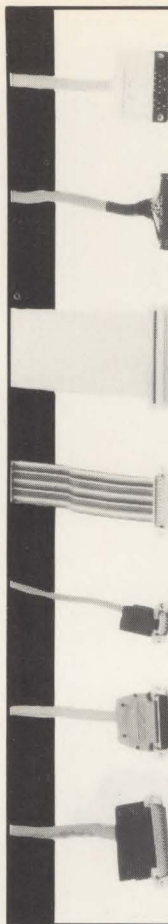
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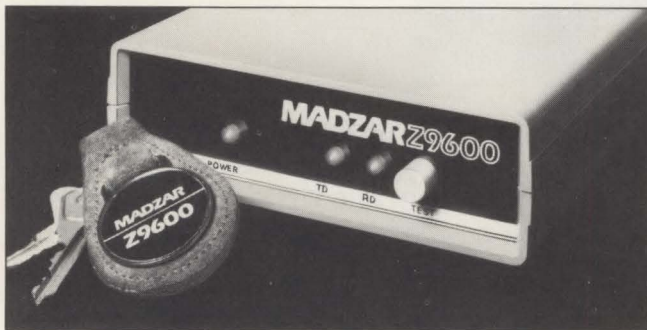
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Calendar

JUNE

- 21-25 "Personal Computers: Structure, Evaluation, Application, and Hands-on Experience" Seminar**, Cambridge, Mass., sponsored by the Massachusetts Institute of Technology. Contact: Hoo-min D. Toong, Office of the Summer Session, Room E19-356, MIT, Cambridge, Mass. 02139.
- 24-25 "Local Network Equipment: Developments and New Offerings" Conference**, Washington, D.C., sponsored by Architecture Technology Corp. Contact: Architecture Technology Corp., P.O. Box 24344, Minneapolis, Minn. 55424, (612) 935-2035.
- 28-30 Videotex '82**, New York, sponsored by Online Conferences Ltd. Contact: Videotex '82, Meeting Systems Inc., 286 Fifth Ave., New York, N.Y. 10001, (212) 563-1000.

JUNE 29- JULY 1

Spectrum of Solutions '82 Exhibition, Chicago, Ill., sponsored by Prime Computer, Inc. Contact: Marg Seay, Prime Computer, Inc., Spectrum of Solutions '82, Prime Park, MS 15-60, Natick, Mass. 01760, (617) 655-8000.

JULY

- 12-14 "Error Correcting and Detecting Codes with Applications to Computer System Design" Seminar**, Palo Alto, Calif., sponsored by Hellman Associates. Contact: Hellman Associates, Department R, 299 California Ave., Suite 300, Palo Alto, Calif. 94306, (415) 328-4091.
- 18-22 "Communications and the Future" Conference**, Washington, D.C., sponsored by the Fourth General Assembly of the World Future Society. Contact: Eric Seaborg, 1982 Assembly Committee, World Future Society, 4916 Saint Elmo Ave., Bethesda, Md. 20814-5089, (301) 656-8274.
- 19-21 1982 Summer Computer Simulation Conference**, Denver, sponsored by the ISA and scs. Contact: Marvin F. Anderson, General Director, scsc, Department of Electrical & Computer Engineering, University of Colorado, 1100 Fourteenth St., Denver, Colo. 80202, (303) 629-2685.
- 21-23 CADD Systems Seminar**, Danbury, Conn., sponsored by Orr Associates, Inc. Contact: Orr Associates, Inc., 21 Chambers Rd., Danbury, Conn. 06810, (203) 748-8044.
- 26-30 SIGGRAPH '82, Ninth Annual Conference on Computer Graphics and Interactive Techniques**, Boston, sponsored by the Association for Computing Machinery's Special Interest Group on Computer Graphics. Contact: SIGGRAPH '82, Convention Services Department, 111 E. Wacker Dr., Chicago, Ill. 60601, (312) 644-6610.

AUGUST

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

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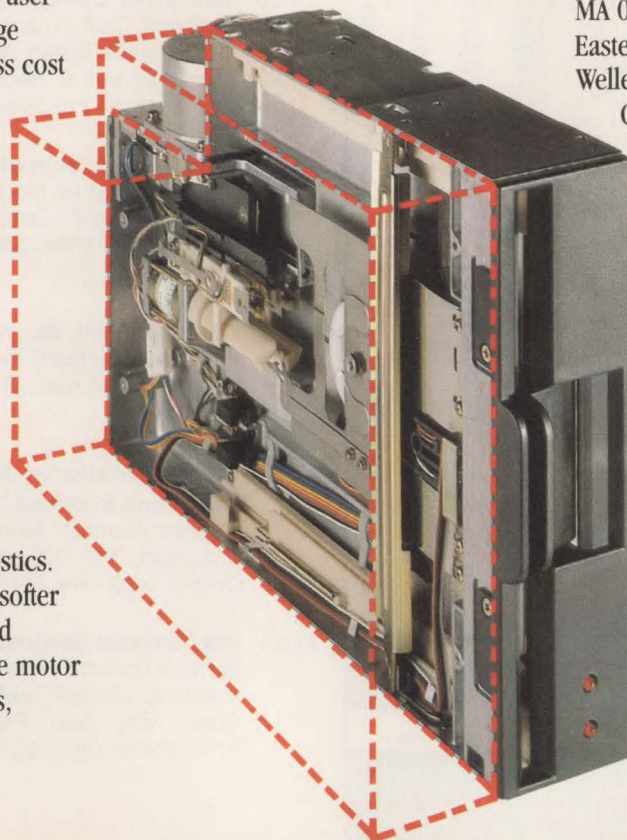
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	LA120 DECwriter III KSR	2,295	220	122	83
	LA120 DECwriter III RO	2,095	200	112	75
	LA12A Portable DECwriter	2,950	280	155	106
	VT100 CRT DECscope	1,695	162	90	61
	VT101 CRT DECscope	1,195	115	67	43
	VT125 CRT Graphics	3,295	315	185	119
	VT131 CRT DECscope	1,745	167	98	63
	VT132 CRT DECscope	1,995	190	106	72
TEXAS INSTRUMENTS	VT18XAC Personal Computer Option	2,395	230	128	86
	T1745 Portable Terminal	1,595	153	85	58
	T1765 Bubble Memory Terminal	2,595	249	138	93
	TI Insight 10 Terminal	695	67	37	25
	T1785 Portable KSR, 120 CPS	2,395	230	128	86
	T1787 Portable KSR, 120 CPS	2,845	273	152	102
	T1810 RO Printer	1,695	162	90	61
	T1820 KSR Printer	2,195	211	117	80
	ADM3A CRT Terminal	595	57	34	22
	ADM5 CRT Terminal	645	62	36	24
LEAR SIEGLER	ADM32 CRT Terminal	1,165	112	65	42
	ADM42 CRT Terminal	1,995	190	106	72
	EXCEL 12 CRT Terminal	1,695	162	90	61
DATAMEDIA	EXCEL 42 Smart Buffered CRT	995	96	54	36
	COLORSCAN 10 Color CRT	3,195	307	171	116
	925 CRT Terminal	850	82	46	31
TELEVIDEO	950 CRT Terminal	1,075	103	57	39
	Letter Quality, 7715 RO	2,895	278	154	104
	Letter Quality, 7725 KSR	3,295	316	175	119
NEC SPINWRITER	2030 KSR Printer 30 CPS	1,195	115	67	43
	2120 KSR Printer 120 CPS	2,195	211	117	80
	Executive 80/20	1,345	127	75	49
HAZELTINE	Executive 80/30	1,695	162	90	61
	MX-80 F/T Printer	745	71	42	27
	MX-100 Printer	895	86	48	32
EPSON	E0400 4 Channel Stat Mux	1,525	147	82	55
	E0800 8 Channel Stat Mux	2,050	197	110	74
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Calendar

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

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

26-27 Microprocessor/Computer Control of Hydraulic Systems Seminar, Milwaukee, Wisc., sponsored by the University of Wisconsin-Extension. Contact: John M. Leaman, Department of Engineering & Applied Science, University of Wisconsin-Extension, 929 Sixth St., Milwaukee, Wisc. 53203, (414) 224-4189.

SEPTEMBER

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

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

14-16 Mini/Micro Computer Conference and Exhibition, Anaheim, Calif., sponsored by Electronic Conventions, Inc. Contact: Eileen Algaze, Communications Coordinator, ECI, 999 N. Sepulveda Blvd., El Segundo, Calif. 90245, (213) 772-2965 or (800) 421-6816.

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

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

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

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

MORROW DESIGNS

5 1/4" DMA Hard Disk System
M5 \$2,195
M10 \$3,195

Morrow DMA Controllers Supercharge Disk Systems.

What EDN said: "The (Disk Jockey™ DMA floppy-disk controller) offers two to three times the performance of comparable controllers." And that's for either 5 1/4" or 8" floppy-disk drives operating from an S-100 (IEEE-696) bus.

How we do it? With channel drive that's almost identical to IBM 370® channel controllers. The DJ/DMA uses 24-bit addressing. The host writes commands into memory. The DJ/DMA picks up commands from the host processor via memory on the system bus, and transfers data during DMA cycles. Channel commands may be located anywhere in the 24-bit address range. Upon completion of the command, the controller returns status. It may also generate an interrupt. Chained commands allow the controller to return status, or to execute a number of commands in succession. The controller board also contains logic which allows other IEEE-696 temporary bus masters to contend for memory cycles. That's the Morrow "channel concept." Fast and Simple.

On-board Z-80A.* By managing both memory and disk transfers, the resident Z-80A allows reading or writing to almost any floppy-disk media. 8" or 5 1/4". Single or double density. Single or double-sided. And up to eight drives per controller board (no more than four of each type).

System compatible. Disk Jockey DMA sub-systems are compatible with all IEEE-696, S-100 systems (such as the Morrow Decision I™). And, with most S-100 like systems.

Faster Winchester. Hard disks put micros in the mini category. Now, Morrow's channel driven

DMA controller concept makes Winchester's lightning fast. Which Winchester? Industry standards—Seagate's 5 1/4" ST506/512, or 8" drives from Shugart/Quantum.

DMA Transfer (Burst Mode). The Morrow Direct Memory Access Hard Disk Controller (HDC/DMA) picks up commands from the host processor via memory on the system bus. Commands are accessed and data is transferred during DMA cycles. Commands and data transfers may occur anywhere in the 24-bit address range.

Interrupts. The controller can generate an interrupt at the end of each command and/or at the end of each command chain.

Imbedded μ P. An on-board 8X300 supervises data transfers between the Winchester drive(s) and main memory. Microcode in this 7 MHz bipolar microprocessor implements the command structure of the controller.

Expansion. The HDC/DMA addresses one to four drives, one to 16 drive heads and an unlimited number of tracks. These capabilities allow system upgrades to additional platters and tracks as Winchester technology advances.

S-100 sub-systems. The HDC/DMA is compatible with all IEEE-696 systems and most existing S-100 systems—providing the bus clock is 2.5 MHz or faster.

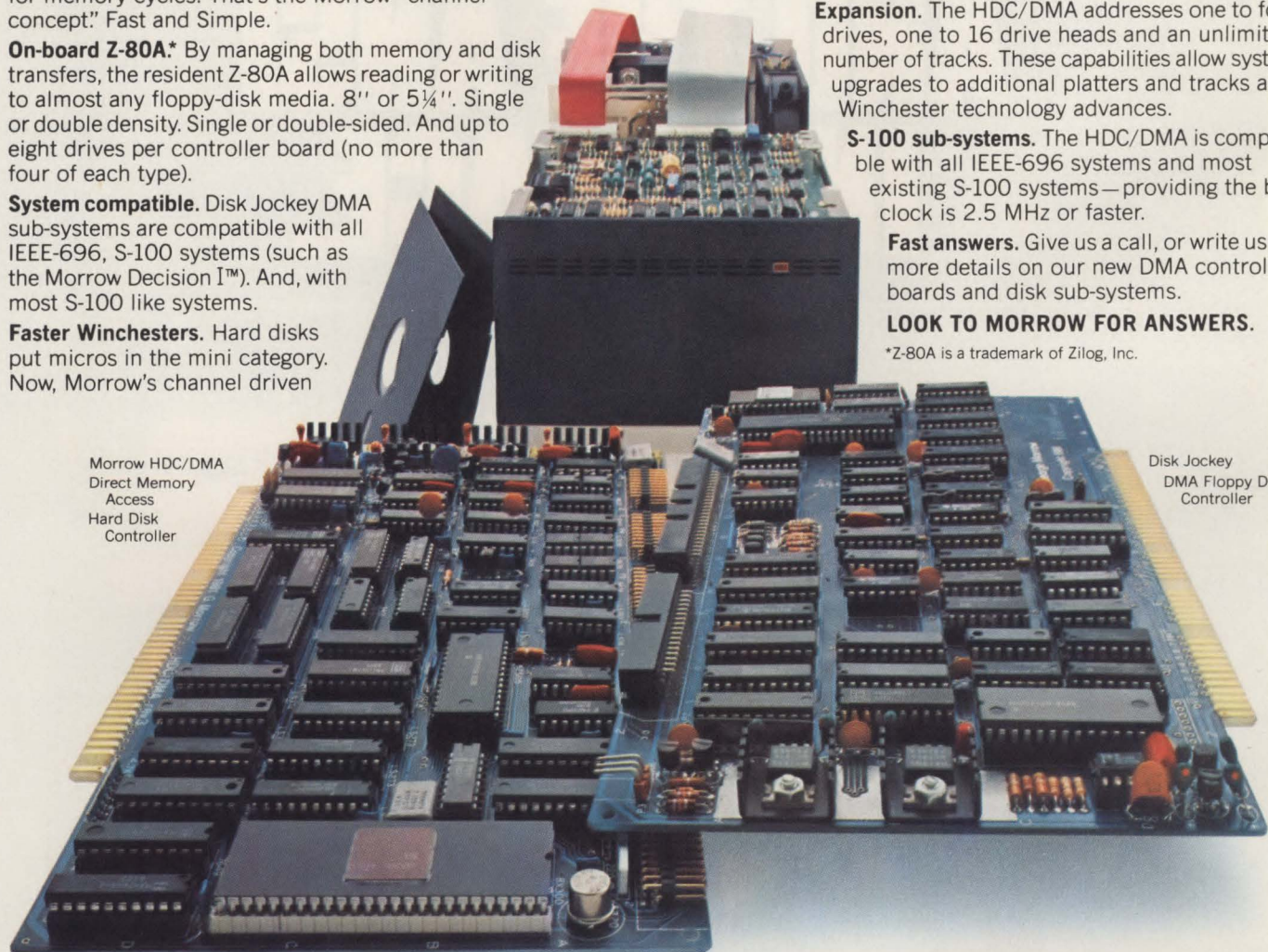
Fast answers. Give us a call, or write us for more details on our new DMA controller boards and disk sub-systems.

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INTRODUCING 3M BRAND COMPACT DISK DRIVES.

A new family of 8" Winchester drives offers you a unique combination of features—features that pay off in high-quality performance, reliability, and product migration. 3M designed and built these drives so that the features would be right for OEM applications—starting with the media itself.

1 DIFFERENT FROM EVERY OTHER WINCHESTER.

Scotch® Brand media. An industry leader for over 25 years. Its proven performance is the cornerstone of our new fixed disk drives. The medium is critical—it's *precisely* where reliable data storage should start.

One guarantee of this performance is the thoroughly proven surface lubricant called Lubyte®. Lubyte helps protect against head crashes, loss of data and computer system downtime.

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 de-

sign 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.

The third benefit the 3M Compact Disk Drive family gives you is the migration needed to keep up with user demands. Migration that won't dead-end your customers, or cost them an arm and a leg to obtain.

The 3M 8431 drive offers a total unformatted capacity of 10 Mbytes on a single disk, with 8649 BPI and an average track density of 219 TPI. The 3M 8432, with two disks, delivers 20 Mbytes, with the same bit and track density. The 3M 8533 offers 60 Mbytes 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 Mbytes.

4 THE "SUPER-CLEAN" AIR SYSTEM.

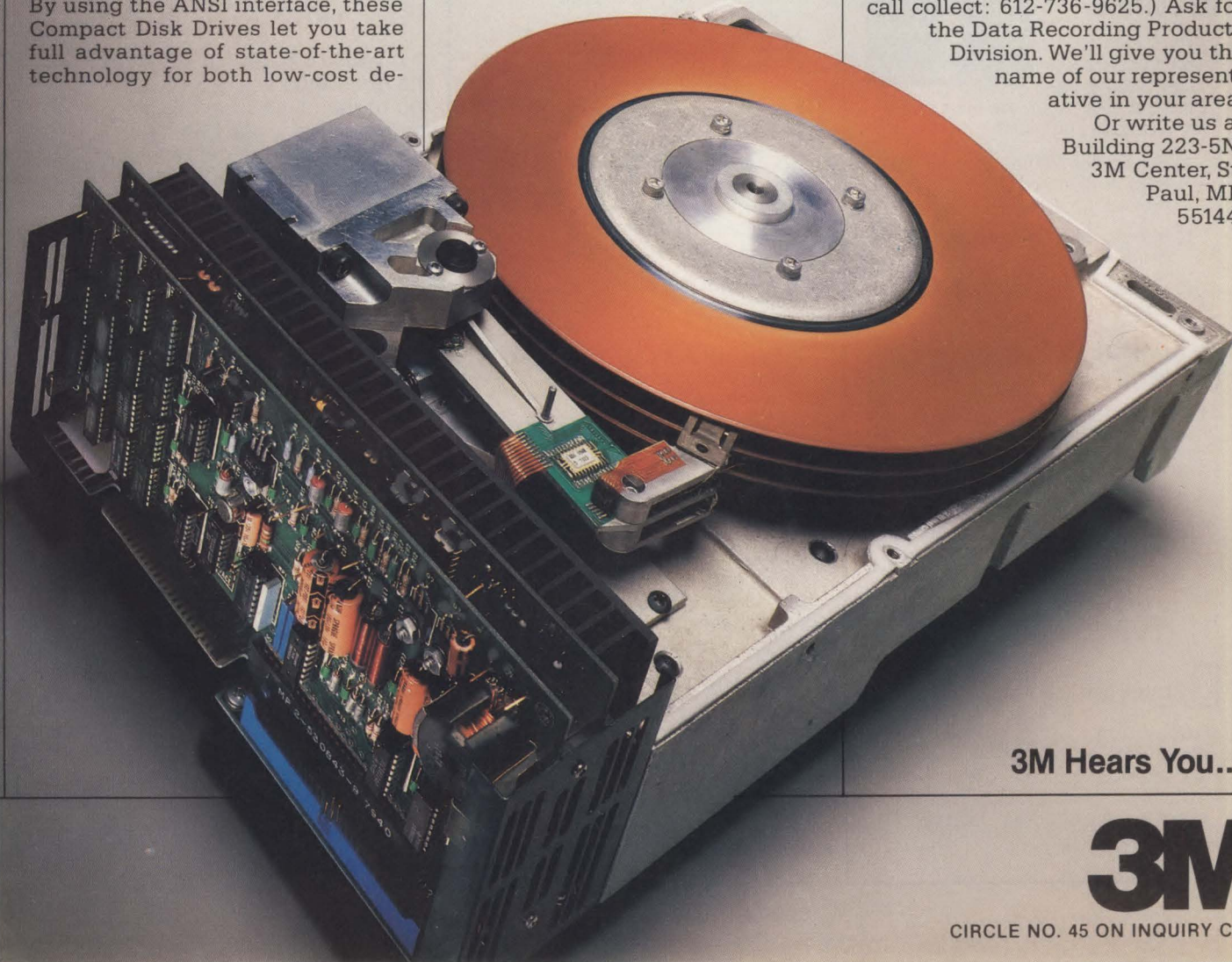
Because reliability is so critical to the operation of a sealed-environment disk drive, the drives have a specially-engineered super-clean air system (patent pending). A cast aluminum deck, for example, separates the heads and media from the motors: a feature that helps make 3M's super-clean air system 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, only 3M gives you all of these features in one 8" Winchester package. Call today for information on 3M's complete line of disk drives. (Also ask about the 3M High-Capacity Data Cartridge Drive.)

Call 800-328-1300 (In Minnesota, call collect: 612-736-9625.) Ask for the Data Recording Products Division. We'll give you the name of our representative in your area.

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CIRCLE NO. 45 ON INQUIRY CARD

Test your word processing I.Q.

DEC USERS

And discover how the advanced features of LEX-11 can increase your w-p capabilities.

THE CHALLENGE:

Almost any word processing software package will have such features as menus, editing, spelling error detection, list processing, cut and paste, automatic word wrap and automatic pagination. . .

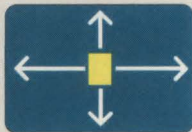
. . . But can you tell the difference between run-of-the-mill software and a system that is really special?

EEC SYSTEMS offers you this challenge! Test your word processing I.Q.

THE QUESTIONS:

1 EDITING

Which kind of editing operation is quickest to execute and easiest on the eyes of the word processing user?



- a) Full screen editing allowing for easy cursor movement around the screen?
- b) Moving the cursor around by doing a line count?
- c) Editing on the bottom line of text only?

2 DOCUMENT LAYOUT

Whatever document format you choose. . . you want to see what the finished article will look like. Should you. . .



- a) View it on the screen as it would come out of the printer?
- b) Run it through a pre-processor to see what it looks like and then if you like it, print it?

3 KEYSTROKES

Using a well designed w-p system, how many keystrokes should it take to execute the most often used w-p functions?



- a) One easy stroke with no codes?
- b) Two or more with complex w-p codes?
- c) Three or more?

4 FLEXIBILITY

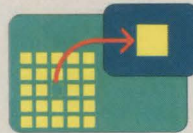
As the business manager of your company, you would like to find w-p software that you can tailor to your company's specific needs. Should you. . .



- a) Look for w-p software that allows you to change and add menus, and change function keys?
- b) Write your own custom software?

5 RETRIEVAL

If you want to retrieve information quickly from a large database, which w-p software should you choose?



- a) One that can access a particular record by going to it directly?
- b) One that searches through all the records on the database sequentially until it finds the right one?

6 COMPATABILITY

As a manager of MIS, you want a w-p system that can be integrated with any other DEC compatible application software. Should you choose w-p software with. . .



- a) ASCII formatted files?
- b) Software which requires non-printing characters in its file system?

7 MATH

Your company has a number of financial applications and is looking for a w-p package with math capabilities. Should you choose. . .



- a) On screen calculating allowing for editing, storing and recall of equations, calculations integrated with your word processing applications?
- b) Software where the math capabilities are tied to the list processing module?
- c) A separate math package?

THE ANSWERS:

If you answered "a" to all of the questions above, go to the top of the class. Chances are that you already use LEX-11 or are about to buy it. You know that LEX-11 is the ONLY word processing software that combines these advanced features. . . and more. . . in one software package.

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Hanover Fair: world showcase for personal computers, peripherals

Photos by L. Valigra

This year's Hanover Fair, held in Germany in April, was possibly the greatest show on earth for anyone interested in electronics and computers. It appears to have preempted the National Computer Conference with new-product launches. Digital Equipment Corp. made its first major announcement outside the U.S. of a new product—the VAX-11/730 low-end superminicomputer. More than 70 personal computers, including several International Business Machines Corp. spin-offs, graced the show floor along with a host of peripherals.

While DEC reportedly showed its new professional computer privately to potential customers, and crowds pressed into the Sirius booth to see that company's 16-bit system, other new small computers received equal notice. Among the new personal computers were models from Olivetti Corp., Epson, ITT and Panasonic.

Olivetti's M20 personal computer, which may be available in the U.S. this month, probably will sell for less than \$5000. That price will include a keyboard, a CRT terminal,



The Hanover Fair serves as a showcase for many products targeted at the European and U.S. markets.

a 120-cps Olivetti printer and two 5¼-in. floppy-disk drives. Based on a Z8000 16-bit μ p, the M20 has a 128K-byte main memory that is expandable in 32K-byte increments to 224K bytes (memory consists of 64K-bit RAM chips), serial and parallel interfaces, two 5¼-in. floppy-disk drives with 320K bytes of unformatted capacity, a 120-cps dot-matrix printer, graphics, Microsoft BASIC-80 and a 12-in. screen that can swivel, slide from side to side or be lifted from the main unit. The operating system is PCOS (personal computer operating system).

Epson showed two small computers it first unveiled at the Tokyo Data Show last October, and a 5¼-in. floppy-disk drive. One of the computers, the QX-20 hand-held unit that was expected to be introduced in the U.S. at NCC, contains a 6301 CMOS CPU (the CPU is upward-compatible with a 6800), 32K bytes of CMOS ROM expandable to 40K bytes, 16K bytes of CMOS RAM, an RS232 interface and a four- × 20-line LCD with 120- × 32-dot graphic resolution. Options include a floppy-disk drive and 16K bytes each of expansion RAM and ROM. Price in the U.S. has not yet been deter-



Olivetti Corp.'s M20 personal computer has a CRT terminal that lifts off, can be swiveled or shifted from side to side.



Sirius's booth, which sported a new 16-bit μ c that was released last November in the U.S., drew throngs of curious observers.



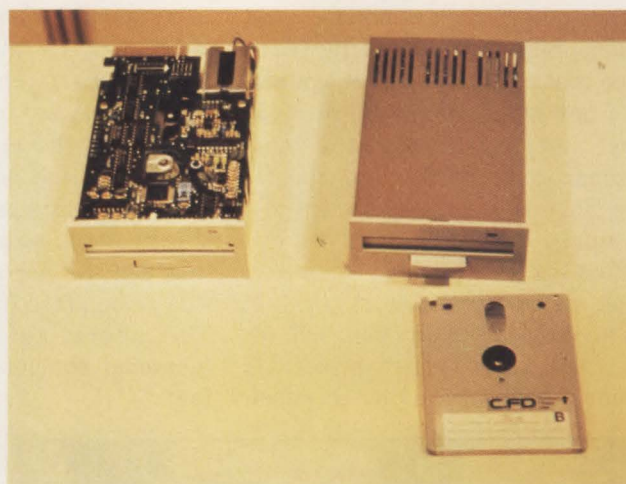
ITT introduced an IBM-like personal computer called the model 3030. It runs CP/M, MP/M and ITT's BOS operating systems.

mined for this Sony Corp. Type-corder look-alike, but in Germany, the product will be sold in September for about \$900.

ITT's model 3030, which has not yet been priced or timed for release in the U.S., will be available to OEMs and end users. The 8-bit system can run CP/M, MP/M and ITT's BOS operating systems. Languages include USCD Pascal, FORTRAN, Microsoft BASIC and a faster structured BASIC. Mass-storage options hold as much as 60M bytes. The 24 × 80 display has as many as 132 condensed characters. Application software is available, including word processing, payroll, stock control and program generation. The 3030 was one of the many IBM personal computer spin-offs at the show.

Another IBM spin-off bowed at Matsushita Electric's booth under the company's Panasonic brand name. The JB-3000 personal com-

puter will show up this year in the U.S. The 8088-based product includes 16K bytes of ROM, 96K bytes of RAM (expandable to 224K bytes), 32K bytes of RAM, a detachable keyboard, a CRT terminal with as many as eight colors and resolution as dense as 640 × 400 for graphics, a color option with composite monochrome or RGB color CRTs, a Centronics-compatible parallel interface, a Tokyo Electric Co. 120-cps dot-matrix printer, 5¼- or 8-in. diskette-drive interfaces and a loudspeaker. As many as four diskette drives of each size can be attached. Software includes MSDOS and CP/M-86 from Microsoft and Digital Research, respectively. The price for 96K bytes of memory, one 160K-byte floppy-disk drive, MDOS or CP/M, keyboard and



COMPARING THE COMPACT FLOPPY-DISK DRIVES

	Matsushita's CFD		Hitachi's HFD 305S	
	FM	MFM	FM	MFM
Recording method	FM	MFM	FM	MFM
Unformatted capacity				
One side (bytes)	125K	250K	125K	250K
Both sides (bytes)	250K	500K	250K	500K
Recording density (bpi)	4473	8946	4473	8946
Track density (tpi)	100	100	100	100
Tracks per surface	40	40	40	40
Data transfer rate (bps)	125K	250K	125K	250K
Access time (track-to-track)	20 msec.		3 msec. (15-msec. settling time)	
Media	compact floppy diskette		compact floppy diskette	
Dimensions (in.)	3.6 × 1.6 × 6		3.6 × 1.6 × 6	
Weight (lbs.)	1.4		1.49	

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More than ever, intelligent terminal users demand systems with low cost, high reliability and performance. Ontel has responded to that need and is introducing the new Series 15. We're convinced that this new series gives OEM intelligent terminal purchasers the best buy available today.

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Local programmability reduces the amount of processing and editing to be handled by the Master CPU for front end processing and editing. The 1503 can perform any heavily structured task from data processing to text processing in real time environments.

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1507 The 1507 is Ontel's newest top-of-the-line Multi-tasking DisplayComputer. It is based on proven architecture and the smallest configuration of a simple standalone system can be expanded up to a large cluster of programmable work stations running advanced business information processing routines using Ontel software.

Contact me today for information on the new Ontel Series 15 DisplayComputers.

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These incredible intelligent modems are designed around a new breed of 212A and 103 LSI modem chips. Tiny 18 and 24 pin dual in-line packages contain modulator, demodulator, transmit and receive filters, carrier detector, AGC, and answer tone generation and detection. To this nucleus of chips, we add the telephone line, user, and control interfaces. These custom modems are delivered to you with FCC certification and UL approval.

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Imagine. An intelligent 1200 bps full duplex 212A custom modem completely packaged on a 50 square inch PC board. Or a 300 bps FDX 103 modem in 10 square inches.

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So if you've been dreaming of a custom modem with all the features you want, yet small enough to fit inside your terminal or computer, stop dreaming and contact us.

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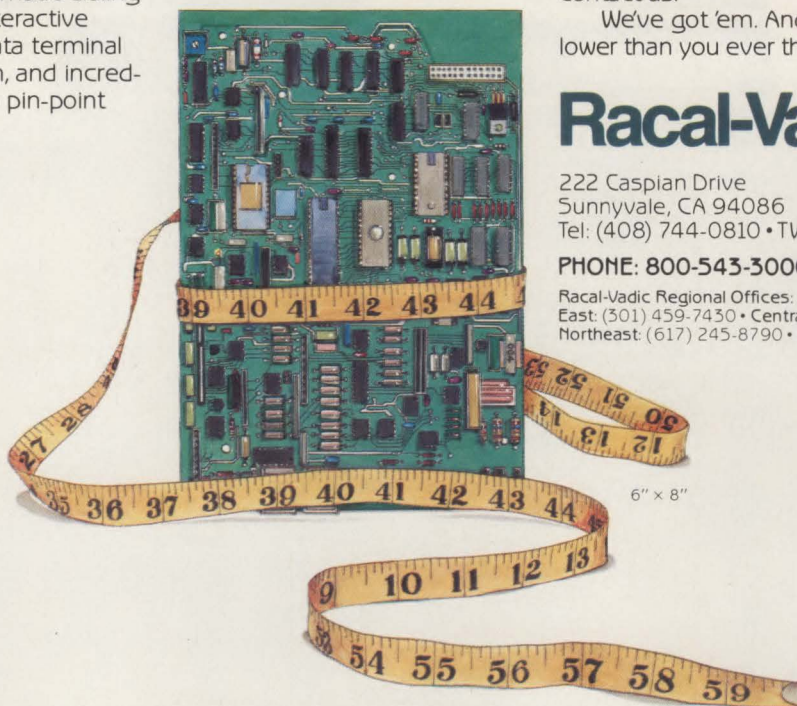
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CIRCLE NO. 48 ON INQUIRY CARD

terminal is about \$4500.

Tucked away in Matsushita's booth was something even more interesting than the JB-3000—the company's floppy-disk drive that uses 3-in. diskettes.

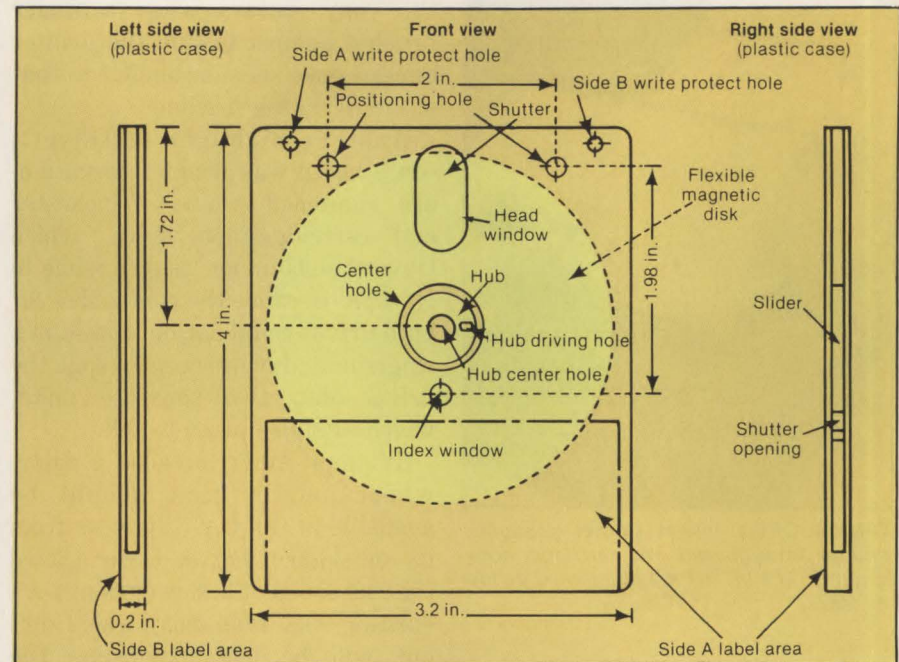
Last year, Matsushita, along with Hitachi, Ltd., and Hitachi Maxell, Ltd., announced joint support for a 3-in. floppy-diskette standard. The compact diskette is said to be compatible with and have the same recording capacity as many 5¼-in. diskettes.

The companies aimed to use the same rotation speed, data-transfer rate, recording capacity per track and other specifications as those of conventional minifloppy diskettes. The disk case measures about $3.2 \times 4 \times 0.2$ in. Diskettes are mounted in hard plastic cases, much the same as Sony's small diskette drive (MMS, April, p. 17).

Because of pending patents, Matsushita would not reveal much about its CFD compact floppy-disk drive that it showed privately. But the company did say there are four sources for the diskette. The product is expected to be shown at NCC.

The drive measures $3.6 \times 1.6 \times 6$ in. and weighs 1.4 lbs. It fits easily into the palm of a hand. Matsushita chief engineer Yasutaka Nakajima would reveal only the following details about how the company made the drive that small. The drive has a new center cramp mechanism, because the diskette has a hard plastic center hole rather than the flexible hole in conventional diskettes. A 4-bit μ c is used in the circuit controlling the drive. The disk-handling mechanism has one-touch loading and one-touch eject.

Nakajima says samples of the Matsushita unit will be available in summer; production and formal introduction will be at the end of this year. Prices for 10,000 OEM units are estimated at \$150 each. While many of the drives are



The diskette media for the Matsushita and Hitachi floppy-disk drives have been standardized from four sources. Measuring about $4 \times 3.2 \times 0.2$ in., the diskette is encased in hard plastic and has a hard plastic center. Storage capacity for an unformatted, double-sided, double-density diskette is 500K bytes.

designated for use in newly designed products, Matsushita has a separate box with two drives under development that probably will be available by the end of next year. Both OEMs and Matsushita's Panasonic subsidiary are expected to support the products.

A compact Hitachi drive, designated the AFD 305S, is expected in the fourth quarter and probably will sell for about \$200 each in OEM quantities of 500. It also was expected to be shown at NCC. Samples will be available next month, the company says, with production units scheduled in October.

Hitachi also unveiled a small diode laser printer called the SL-1000. It will be released in the U.S. next year for about \$10,000 for end users. The desk-top SL-1000 page printer produces copy at 12 pages per min. on plain, cut-sheet paper. Density is 300 dpi.

Although Hitachi was expected to show its 16-bit personal computer at the show, the unit was not on display. Company spokespersons

say the computer will be introduced in Europe at the end of this year, but it is not known when it will come to the U.S. Sources at Olivetti hinted that Hitachi may release the Olivetti M20 under its own label, in exchange for Olivetti's acquiring the selling or manufacturing rights to Hitachi's laser printer and compact diskette drive. Neither company, however, would confirm that speculation.

For its part, Olivetti OPE showed a host of products, including disk drives, diskette drives and printers. Among the printers were thermal, spark ink-jet and four-color dot-matrix models.

OPE's JP 101 spark ink-jet drew a lot of attention. Suggested retail price is about \$500, so the product will compete head-on with Epson in the low-priced computer-printer market.

The JP 101 is an 80-column, 50-line-per-min. printer in a 7×7 dot matrix. The print head uses a spark graphite principle, which is similar to writing with a pencil. Charged ink flows through a



Olivetti OPE's ink-jet printer produces sparks through the ink cartridge (foreground). The JP 101 may be priced as low as \$500.

cartridge about 2 in. long. At the end of the cartridge, a high voltage produces a spark, and the ink is directed onto the paper.

The prototype showed at Hanover, although promising in its low price and high speed, has several problems. The head heats up excessively because of high voltage,

the copy smears when a finger brushes against it, and the printer emits a gaseous odor similar to that of a duplicating machine.

Another highlight of Olivetti OPE's booth was Irwin International's combined 5¼-in. Winchester and cartridge-tape drive, which Olivetti sells under its own name in Europe. Because the controllers for both drives could not be housed in a single unit, Irwin recently split the drives into two separate units, which OPE also plans to sell.

Triumph-Adler unveiled a daisy-wheel printer that should be available in the U.S. this year from its subsidiary, Pertec Corp. Called the TRS 8008S, it is slower than T-A's existing TRS 170S daisy-wheel unit but will be less expensive, the company says. Quoted speed for the 8008S is 10 cps, compared with 16 cps on the 170S. The latter unit had been sold in the U.S. by Pertec as the Stylist 360, but was dropped this year.

Olympia moved up the performance scale rather than down with the ESW 3000 daisy-wheel printer,

which runs at 50 cps and will be sold in the U.S. by Olympia USA, Inc., Somerville, N.J. Eugene Koch, OEM sales manager at Olympia USA, notes that Olympia already sells two 15-cps daisy-wheel printers in the U.S., the ESW 103 and 102. Priced at 4150 marks in Germany (nearly \$2000), the new ESW sells for nearly 40 percent more than the two slower units.

Diablo Systems, Inc., showed for the first time its model 630 ECS daisy-wheel printer, which prints as fast as 34 cps with a dual character petal element. The printer includes a shifter so that characters on its inner ring can be printed and/or combined with the normal ASCII character set on the outer ring to produce the full set of 307 Teletex characters, the company claims. The printer is available in end-user and OEM versions. The company did not reveal OEM pricing, but the end-user price is about \$5000. Double-character wheels are priced at more than \$20 each in quantities of 50 to 100.

Brother Industries of Japan,

OLYMPIA UNVEILS PRINTER FOR CHINESE

Office automation may not get off the ground in Japan unless terminals can convert computer-processible alphanumeric codes into its Chinese-based Kanji symbols, of which there are thousands. Japan's huge neighbor, the People's Republic of China, seems to have cracked the problem with four-letter codes that can be entered at typing speed on a normal keyboard by a trained operator.

The technology to convert each code into its equivalent Chinese symbolic character and printer hard copy has been developed jointly by the Shanghai Instrument Research Institute and West Germany's Olympia Werke AG. It takes the form of an attractive ink-jet printer terminal that was demonstrated at the Hanover Fair in April.

Available to the Chinese language community in the free world as the

Olympia 1011, it is to be manufactured in the PRC under license. The Chinese intend to replace their painfully slow and clumsy conventional typewriters, which mechanically locate each symbol from an array of 2500 metal slugs. In contrast, the 1011 generates 4000 to 6000 symbols under μ p control and prints them at speeds as high as 13 symbols per sec.

The 1011 also prints 120 alphanumeric characters per sec. However, Olympia says it has no plans to enter the western alphanumeric-ink-jet printer market because sales of its daisy-wheel and other mechanical typewriters and printers might be impacted. Moreover, Olympia denies any plans to enter the potentially huge Japanese market for terminals like the 1011, even though Japan's Kanji is based largely on ancient Chinese

symbols.

Olympia is unclear about the reasons for its reluctance, but it most likely fears a swift and maybe fatal counterattack from Japan's aggressive domestic manufacturers. Moreover, Japan's Kanji symbols are far fewer than the Chinese set, and many of them have a different shape or meaning. They are also complemented by words generated with phonetic characters quite similar to western letters. Many Japanese terminals employ touch-sensitive keyboards for entering Kanji symbols.

Olympia's activities with the 1011 in the Far East are coordinated by Sinotype Systems, Ltd., Hong Kong, a firm jointly owned by Olympia, the Chinese government and the Hong Kong trading company, Sun Hung Kai (China) Ltd.

—Keith Jones

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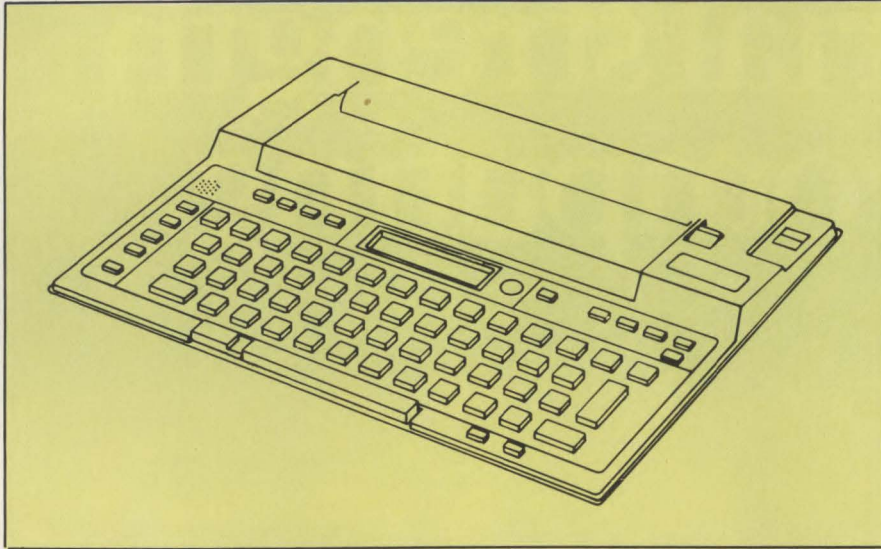
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Brother's EP-20 small electronic printer does not hook up to a computer, but is useful for travelers. The 11-cps thermal printer has a 16-digit LCD, and weighs less than 1 lb. It has 44 keys, with three functions on each.

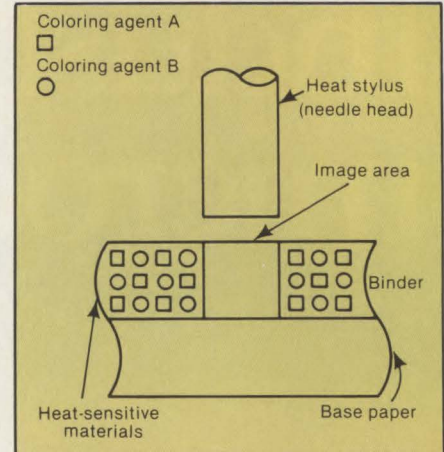
which sells mechanisms to Centronics, quietly revealed a small electronic printer. The company was secretive about the machine, but it is a thermal printer that also can use black carbon ribbons. The EP-20 is a portable, battery-powered unit that has an AC power adapter available.

The unit is designed for personal use on airplanes or in hotels. End-user price is \$200 to \$250. It

will be available in Germany in August, and possibly in January in the U.S.

Ricoh showed a number of new printers, including prototype laser and thermal printers. The LP212 tabletop laser printer produces 12 pages per min. Resolution is 300×300 dpi. The product will be sold to OEMs; pricing has not been set.

The model TP1216 thermal print-



Ricoh makes its own thermal paper for the TP1216 printer. The base color is white, and the appearance and feel of the paper are said to be almost the same as plain paper. The thermal paper consists of the base paper and the coating materials. The heat-sensitive materials are a few microns thick and include colorless dyes, binders and additives. When heat is applied, the heat-sensitive materials melt, and the resulting chemical reaction produces the image on the paper. The heat-sensitive materials in the emulsion are held by binders. Developing chemicals are not needed.

er produces about 16 lines per sec. Density is 120 dpi, and it uses thermal paper that looks very much like plain paper. Price has not been set.

—L. Valigra, with contributions from Keith Jones

Spring Comdex will teach ISOs survival skills

The first of three 1982 Comdex exhibitions, which appear to be growing as fast as the independent sales organizations they cater to, will take place from June 28 to 30 at the Atlantic City Convention Hall in Atlantic City, N.J. The Interface Group, which sponsors the show, estimates that as many as 10,000 attendees will view the 450 exhibits and pick up some tips on maneuvering an ISO through a recessionary economy—the theme of the Comdex/Spring show. The term ISO covers various kinds of third parties reselling computer equipment.

This is the second year for the

Comdex/Spring show following a successful start in New York last year.

In addition to floor exhibits, Comdex/Spring offers a 45-session conference aimed at aiding the ISOs in their business. The conference sponsors have chosen the theme of "skills for survival," which will examine and offer advice on how ISOs can cope with high interest rates and other economic matters. Some of that advice will be offered in the show's keynote address by Kenneth G. Fisher, who was president and chief executive officer of Prime Computer Inc. for six

years before resigning in 1981.

The show's conference sessions are divided into 13 groups including a computer retailing Institute for start-up ISOs, an advanced retailing institute for ISOs with some experience, the ISO college of sales knowledge, offering sales training and a session on vertical market minis offering an overview of applications software in seven market segments.

The registration fee for all three days is \$125. A one-day conference fee is \$65. An exhibit-only admission is \$10.

Some E. European firms woo Western markets

The Hanover Fair is the only show in the western world at which most eastern European manufacturers of computer equipment exhibit their goods. Most of the equipment is of little interest to potential U.S. customers, mainly because it is out of date. But some eastern Europe manufacturers have picked up contracts in the West (see "Yugoslav firm seeks U.S. agents," right).

The Hungarian import/export agency Metrimpex showed one of the few east European products with real sales potential in the West—a 3-in., single-sided floppy-disk drive with a formatted capacity of 150K bytes. Called the MCD-1, it is built by the Budapest Radio Engineering Factory, a major manufacturer of tape recorders.

The MCD-1 could be available soon in the U.S. from Pertec Corp., says Janos Otto, director of computer equipment marketing at Metrimpex headquarters in Budapest. Otto says Pertec may manufacture the MCD-1 under license and that a license may also be signed with Wabash Corp., covering the unit's medium, a 3-in. diskette enclosed in a light plastic cassette.

Features include a 250-bps transfer rate, a 235-msec. average access time and a 10-msec. track-to-track access time. The MCD-1 is already sold in western Europe. Other companies interested in handling the product in the U.S. can contact Metrimpex via the Hungarian Ministry of Foreign Trade offices in New York and Washington.

Poland's electronics export agency, Metronex, is promoting its products in the U.S. Metronex is a part owner of a distributor in Chicago, Unitronex, which started selling a bidirectional matrix print-

YUGOSLAV FIRM SEEKS U.S. AGENTS

Yugoslavia is not part of the Soviet Union-dominated Comecon economic block, so manufacturers in Yugoslavia need western markets as much as firms based in any western country. The Yugoslav organization TRS, for example, is keen to locate agents in the U.S. for a bidirectional matrix printer, the TRS 825, which employs the ballistic print-head technology developed by Lear Siegler Corp.

Zagreb-based TRS says the 192-column printer runs at 180 cps, includes serial and parallel interfaces

and carries a single-unit price of around \$1500. TRS says the printer is used widely in Yugoslavia with International Business Machines Corp. Series/1 minicomputers.

The TRS 825 is controlled by a Zilog, Inc., Z80 μ p. TRS builds complete Z80- and Motorola 6800-based μ cs for the Yugoslav domestic market.

The only impenetrable feature of the Yugoslav company is the full spelling of its name—Tvornica Racunskih Strojeva.

er last year. Called the D-200, it prints at 180 cps. Metronex says about 200 units are installed with customers in West Germany. The devices use a print technology licensed in the mid-'70s from French manufacturer Logabax.

Poland's political upheavals did not prevent Metronex from taking a booth at Hanover, and the country's production is said to be largely unaffected.

East Germany's Robotron Export-Import sees little hope of making an impression in the U.S. market, says Gunter Kruger, director of the organization's West German marketing center in Düsseldorf. But, Kruger says, Robotron is negotiating distributorship deals in western Europe for the company's K 5600-10 5¼-in. floppy-disk drive.

Agreements in the West include a contract to supply the West German arm of Commodore Business Machines with daisy-wheel printer mechanisms for a new 40-cps printer built by Commodore at Brunswick, West Germany, and

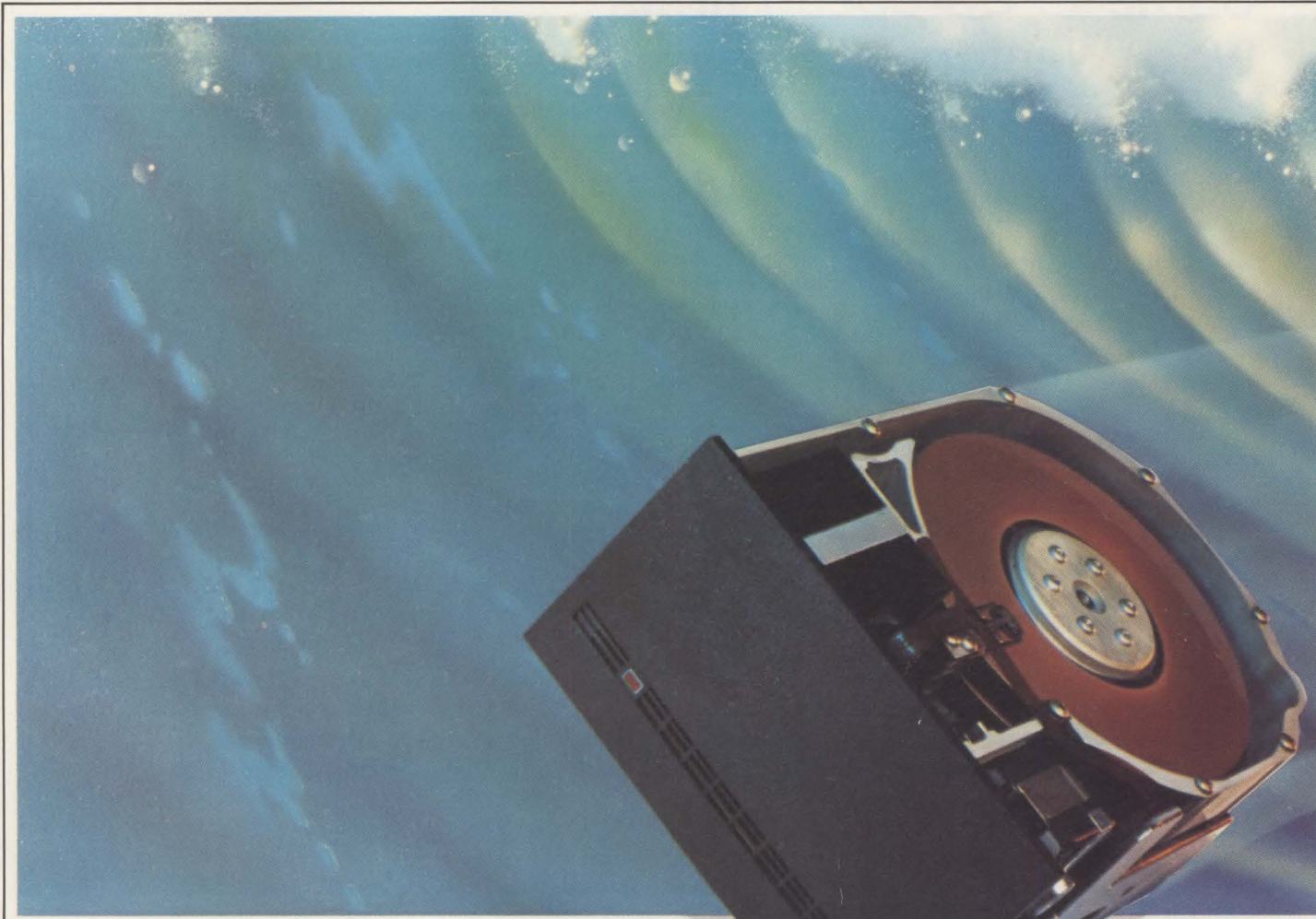
sold as the CBM 8028. Robotron also builds a 40-cps daisy-wheel printer, the 1152 model 255.

Kruger says Robotron sells mechanical typewriters in the U.S. Customers include the U.S. Army in West Germany. But he thinks Robotron faces too much fierce competition to make it worthwhile to promote its computer equipment in the U.S. Import duties of 35 percent are a major barrier.

Miroslav Kacanda of Czechoslovakian foreign trade corporation Kovo also believes it is hopeless to try to sell computer equipment in the U.S., even though other Czech products are shown in the U.S. At Hanover, Kovo showed the SM4-20 minicomputer, which can run Digital Equipment Corp.'s RSX-11 operating system. The SM4-20 made its Western Trade Fair debut at Hanover, but has been used in Comecon countries for more than two years and was demonstrated at the Leipzig Fair in East Germany this year.

—Keith Jones

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U.S. finds E. Germany a tough market to crack

Leipzig Fair, held twice a year in East Germany, is the major showcase for the East European manufacturing industry, from heavy agricultural machinery and railway rolling stock to microcircuits. It is also the main—and possibly only—entrance to the East German market for Western goods.

In March this year, 9000 exhibitors came from 60 countries. The U.S. had a block of stands with a message urging goodwill and mutually beneficial cooperation between East Germany and the U.S. Computers were noticeably absent from the U.S. booths, probably because of the U.S.-inspired Cocom agreement, under which members of the North Atlantic Treaty Organization restrict the number of computers they supply to Socialist countries and exclude the most advanced types.

Xerox Corp.'s U.K. subsidiary, Rank Xerox, concentrated on copiers, although it will consider the three-year-old Xerox 860 word processor if a test-marketing scheme in Rumania this year goes well. Rank Xerox's area manager Geoff Lincoln says that even some of the copiers are subject to the Cocom embargo if they include advanced chips. But the worst problem in selling in East Germany is the shortage of foreign currency, he says.

Many Western exhibitors agree that it takes two to five years to negotiate a company's first sales. After that, a good year—or years—is often followed by years of no orders at all. One reason is that industry planners try to avoid Eastern bloc companies competing with each other and with outside companies.

Despite these problems, the Western contingent still believes

East Germany is a worthwhile market. The competition problem can usually be solved by a company's offering something different in performance or specialized applications. Honeywell Information Systems hopes to repeat a previous success. Last year, it sold 12 Level 6 minis with 162 terminals. Leipzig was the first showing for the R32 needle-matrix printer, made by Honeywell's Italian subsidiary. The R32 has four graphics modes, in one of which a control-shifted ASCII character sets the pattern printed in a single-dot column by the nine-needle print head. The other modes are mosaic or block graphics, graphics character set and double-height characters.

CIT Alcatel, the French telecommunications company, is fairly well established in the East German market. Export manager Gilles Ferru says the company had been supplying an average of 20 million francs worth of digital lines a year to the country. Of 16 years at the



Honeywell Information Systems' Italian subsidiary showed the R32 needle-matrix printer with four graphics modes at the Leipzig Fair.

fair, Alcatel's best contract was for a computer-controlled oil distribution network selling for 100 million francs to the town of Rostock in 1978. It has also licensed Poland to manufacture to its design, and stressed technology transfer.

Siemens was there, but not to sell telecommunications. It showed two 18-month-old μ c systems for the first time. One system is for mechanical drafting, and the other is for numerical-control machine programming. Last year, the company sold more than 80-million-marks' worth of medical systems.

—Donald Kennett

E. German firm plans to export μ c system

Robotron, the East German monopoly computer manufacturer, plans to market its Micro Mind 5¼-in. Winchester-disk-based μ c in Western Europe. Robotron will start in England, where it has an office that distributes its needle-matrix and petal printers, and will move to other countries as it establishes offices.

The Micro Mind is based on the model 5120, which the company launched in its home market at the Leipzig Fair in March, but there are

differences. The 5120 has three floppy-disk drives and no Winchester drives because the company has not yet decided to make Winchester drives and does not want to import them. The Micro Mind will run CP/M, while the 5120 runs the SIOS operating system used on the low-end of the Robotron range.

COBOL and Pascal are available, and BASIC will follow in July.

Robotron plans to provide a large software library from internal and external sources for the Micro

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CIRCLE NO. 54 ON INQUIRY CARD

Mind. The company will initially concentrate on programming utilities, including a program generator, a list generator, an input generator and disk-initialization and sort routines.

Application software will include order-handling and invoicing, and users will be offered adaptations of a number of East European systems developed with clients such as banks, travel agents and conference organizers.

Robotron computers use three basic processors. The high-end EC 1055 system is compatible with the International Business Machines Corp. 370 and is based on TTL processor boards designed by Robotron. The mid-range machines are compatible with Digital Equipment Corp. PDP-11 machines and are based on U830 series bit-slice chips made by the East German semiconductor monopoly Mikroelektronik. Low-end μ cs are based on a pin-compatible Zilog, Inc., Z80 look-alike, called the U880, designed and built by Mikroelektronik.

The U880 is also used in a new multiple- μ p system in which as many as 16 processors are plugged into a high-speed bus for use in real-time monitoring and control applications.

Eastern bloc computing lags far behind the West for several reasons. One is that until about four years ago, μ ps were widely regarded as frivolous extravagances of the West, and people subscribed to a theory once advocated in the U.S.—that the nation's computing needs could be served by a relatively small number of large computers. Since then, the tide has turned, and the "five-year plans" in every industry are beginning to mention at what stage μ ps, computers or robots will be considered.

To prove that it watches what goes on in other parts of the world, Robotron demonstrated prototype voice-recognition and speech-synthesis systems. If the response

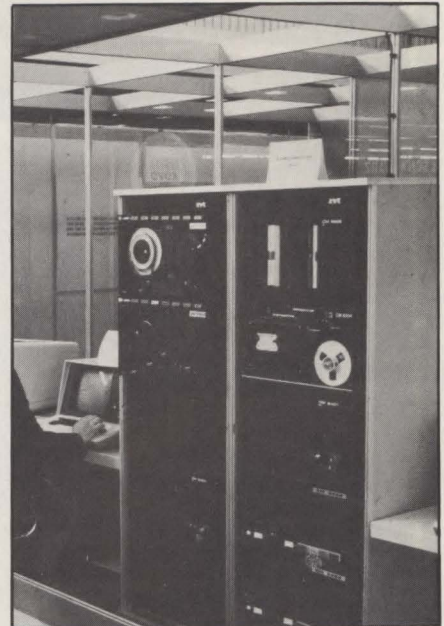
is good, they will be put into mass production.

Robotron was established in 1969 from a number of companies, the oldest of which had been making drafting equipment for 100 years and typewriters for 50. Robotron took its current shape in 1978, and last year, it merged with Zentronik, which made the small systems to complement Robotron's big ones.

Robotron exports more than 70 percent of its production, 90 percent of that to other Socialist countries, primarily Russia. It participates in the Socialist bloc ESER II unified range scheme, which is designed to avoid duplication of effort and competition by getting companies to agree on which manufacturer makes what product.

While the largest machine in the ESER II range, the 1055, is made in East Germany, the 1035 is made in Russia, the 1025 in Czechoslovakia and the 1015 and 1011 in Hungary. Cartridge-disk drives and tape transports are made in Bulgaria, paper-tape devices in Poland and floppy-disk drives in Hungary, Czechoslovakia and East Germany.

Robotron exports three times as much as it imports and says it is eager to help other countries get their production up to mass-market



The Czech-built SM4-20 minicomputer is DEC PDP-11 compatible. It is displayed at the Leipzig Fair, East Germany, at the Czechoslovakian state export bureau booth.

levels, in floppy-disk drives for example. Next year, a joint development between several countries is expected to result in a new CAD/CAM system to be launched at Leipzig Spring Fair.

—Donald Kennett

(Donald Kennett is a writer for the London-based journal *Computer-weekly*.)

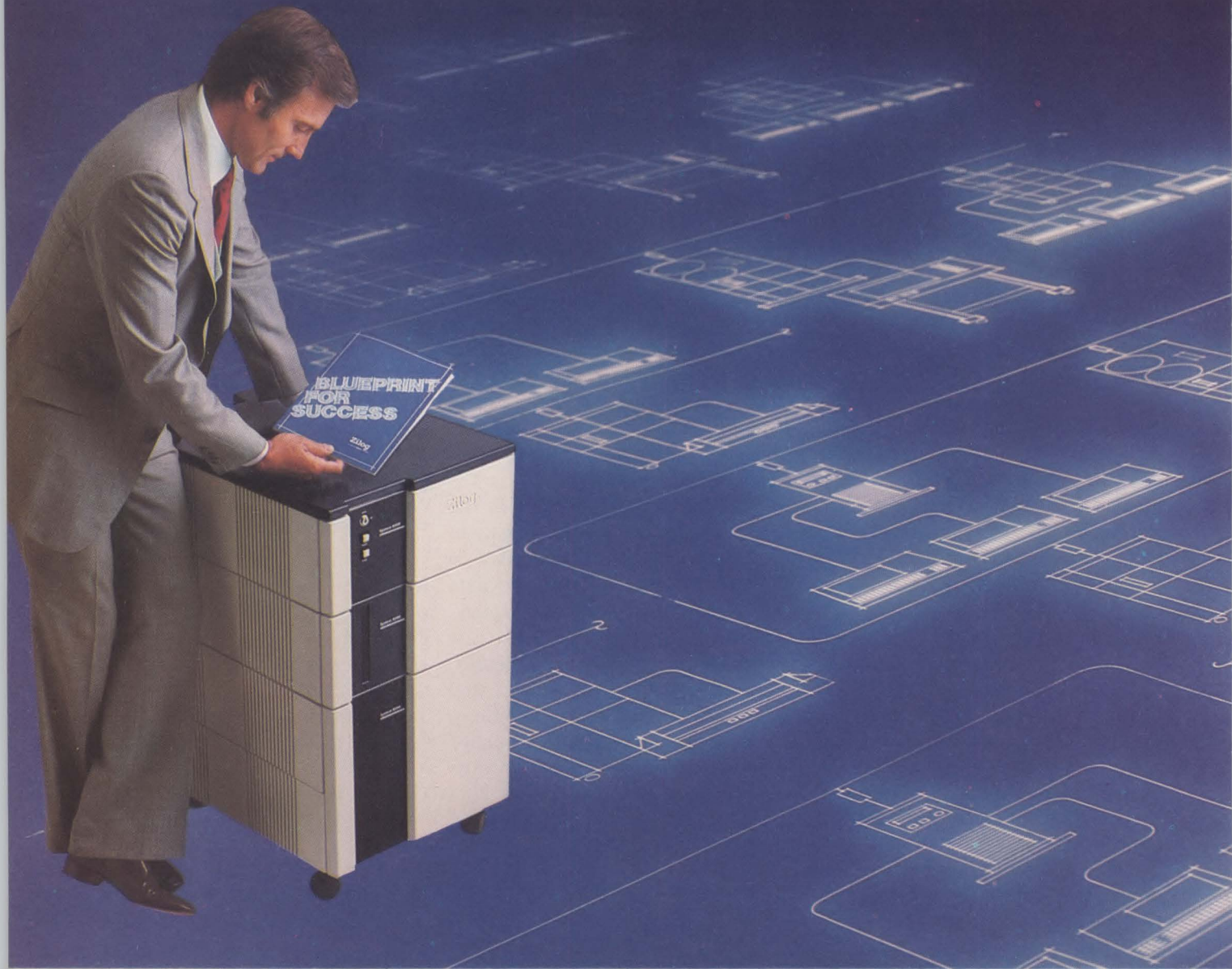
COOPERATION, NOT COMPETITION, IN THE EAST

The Eastern bloc countries' unified range scheme is designed to prevent companies in Socialist countries from competing with each other and duplicating each other's efforts. But the scheme will take time to implement, and market conditions may change too rapidly for complex cooperative arrangements or large "efficient" combines to keep pace. Just as in the West, the Eastern bloc may find that small or even new companies will market a product that competes with or even removes the market for an established company's product.

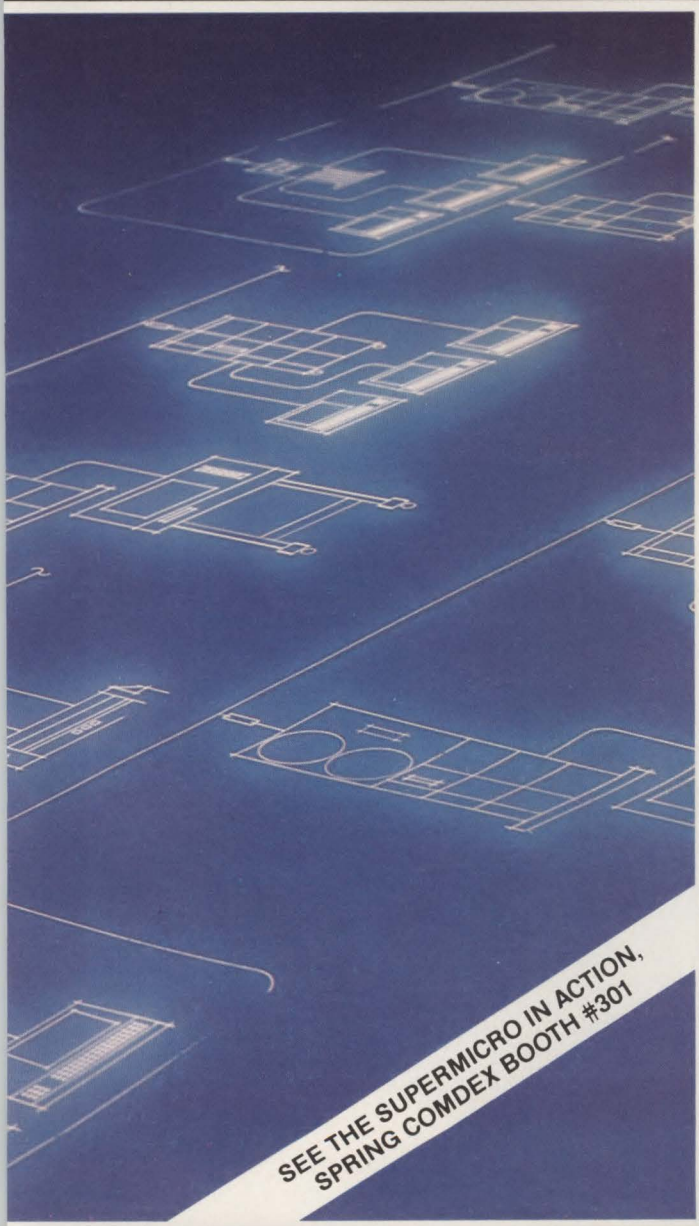
The position of the SM4-20 mini from ZVT in Czechoslovakia is not yet

clear. Like the mid-range East German Robotron machines, it is said to be compatible with the Digital Equipment Corp. PDP-11s and to run under a real-time operating system similar to RSX-11. But it has better graphics capabilities than the DEC system, the company claims, and it has 22-bit error-correcting RAM. Imports of the system to East Germany began a few months ago, less than a year after the Czech computer industry set up its own program, merging six hardware and system software-companies to put more muscle behind their export drive.

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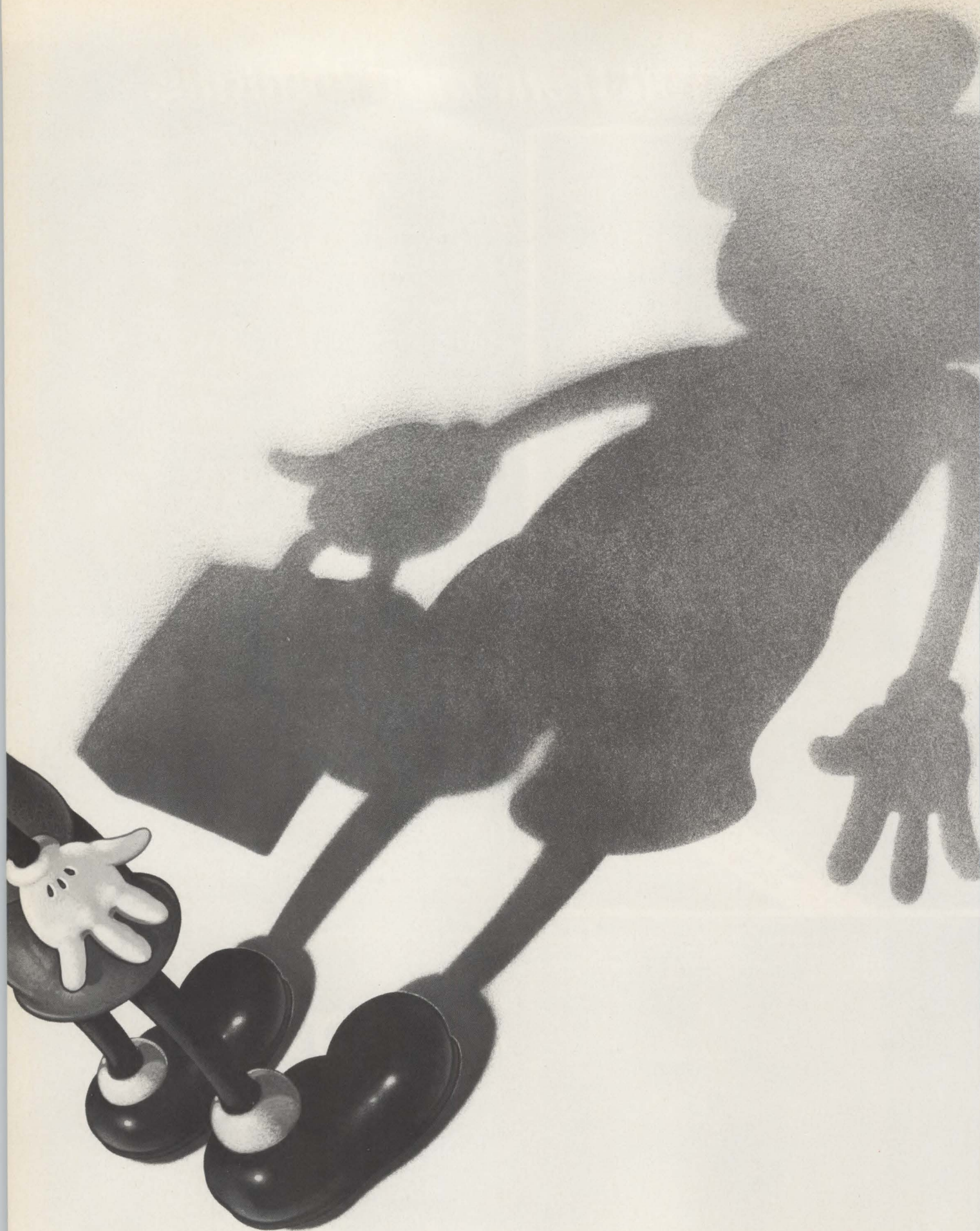
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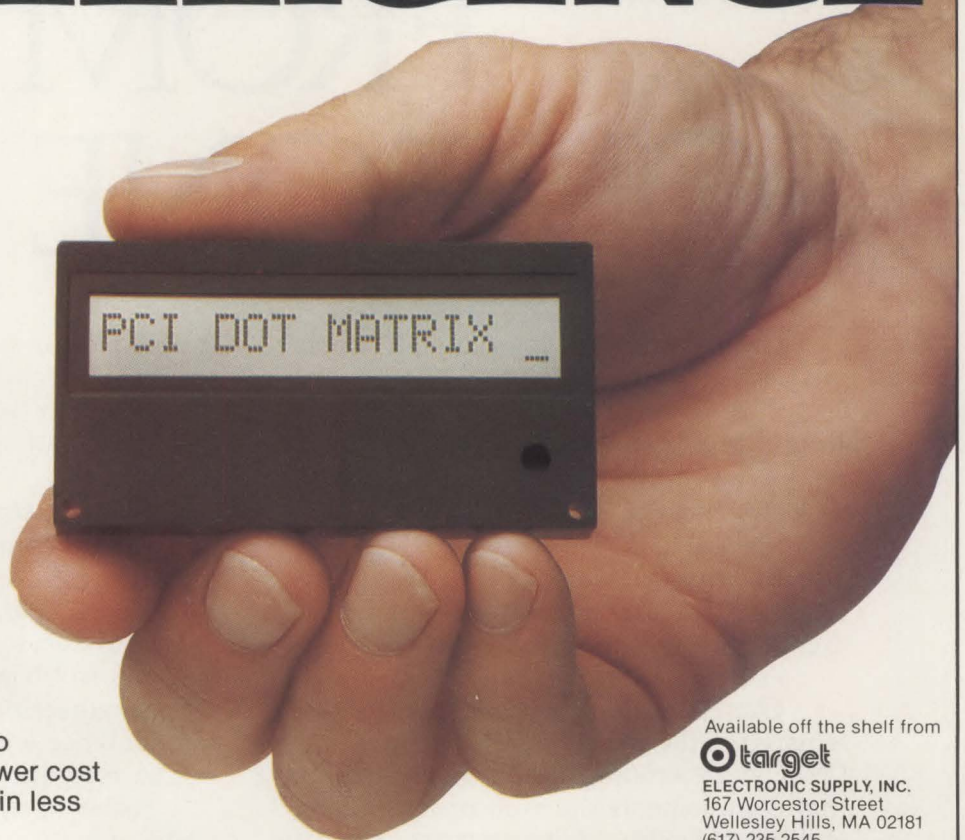
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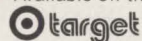
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Microsoft sues competitor, charges copyright infringement

In a move ostensibly aimed at discouraging competition with its Softcard, a plug-in board that enables Apple II computers to run software written for the CP/M operating system, Microsoft, Inc., has filed a copyright-infringement suit against competitor Advanced Logic Systems, Inc., Sunnyvale, Calif.

Microsoft filed the suit in mid-February, asking for a restraining order to prevent ALS from selling any of the allegedly pirated code. That request was denied by a San Francisco federal court. No trial date has been set, nor is it certain one will be. The suit, as they say, is pending.

By filing the suit, Microsoft, the Bellevue, Wash., μ c-software vendor, says it hopes to stem software piracy and set a precedent for such cases. Observers, however, question whether it will. Some believe several such suits in which the plaintiffs are awarded large damages will be needed to bolster what are thought to be weak software copyright laws. Others don't think the issues in this case are so clear-cut.

Microsoft's suit charges ALS with pirating software written for Microsoft's Softcard. Microsoft says ALS has used the code in its Z-Card, a product that performs a similar function to that of the Softcard, and that is part of a package from ALS called the Synergizer that includes an 80-column display card, a 16K-byte RAM board and documentation.

Specifically, Microsoft claims ALS has copied parts of the Boot and Bios programs, programs that are actually parts of CP/M and enable the operating system to work with a

particular processor—in this case a Z80. "The only substantial change to the code," says Microsoft president Bill Gates, "is the elimination of our copyright notices" from certain lines. "It [the ALS action] put us in a position of competing with our own software," he claims.

For its part, ALS is trying to downplay the suit. Marketing manager Bob Ackerman says that of the 126 pages of code filed by Microsoft with the copyright office, only four are in question. He argues, "Undoubtedly, there will be similarities because [the products] are performing similar functions on the same hardware." Ackerman adds that the Microsoft copyright registration encompasses the entire contents of the diskette, which also include code already copyrighted by Apple Computer, Inc., and Digital Research, Inc. He questions whether Microsoft can indeed copyright that material.

Microsoft's attorney, Sally Stoeurer, says that provision is made on any copyright application for listing preexisting material, such as Digital's Boot and Bios programs. "Our copyright covers the entire diskette, but we're not trying to say we own Digital Research's material," she explains. Here's where the situation gets cloudy.

Gerry Davis, Digital Research's attorney, who does not foresee Digital as a party in the case, says he and Digital Research do not condone pirating software for any reason. However, he is concerned with whether code copyrighted by one company represents such a small portion of that company's work that the company is, by copyrighting the code, preventing

others from using software that belongs to another party. "We would not like to see anyone prevented from legitimately competing with the Softcard," he says. "And they have to include Digital Research's Bios code for [such a product] to work." He adds that the Bios program is the only machine-dependent portion of CP/M. "It [Bios] would likely be the same for any given machine."

Digital Research itself was party to a copyright-infringement suit late last year. With Micropro International Inc., the company charged a Sunnyvale, Calif., company, Dataforce International, Inc., with copying and selling Digital Research and Micropro software illegally. That suit resulted in a stipulated judgment against Dataforce for \$500,000. "There was no question the software was copied," Davis says. "The defendants admitted it." Because the suit never went to trial, however, it set only a limited precedent, Davis says.

Meanwhile, ALS has stopped shipping the Z-Card containing the allegedly pirated code. A new Z-Card with new code is being delivered instead. Ackerman points out that this is not an admission of guilt, however. Microsoft will seek damages, Gates says, but an amount has yet to be determined.

Despite the Microsoft suit, sales of ALS's Synergizer are up, Ackerman says. But he's not happy about the suit. "It's interesting to see what it may mean to the software business," he says. "It's kind of a landmark case. But I'd rather leave the landmarks to somebody else."

—Larry Lettieri

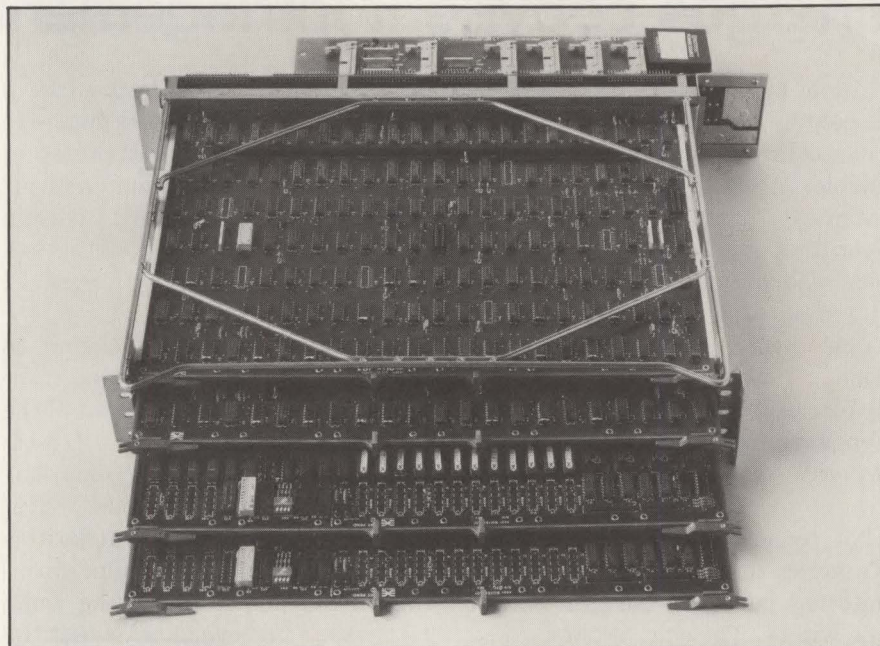
Emulex VAX controllers reflect broadened strategy

The recent decision by Emulex Corp. to establish a systems group to sell disk and tape subsystems directly to Digital Equipment Corp. computer end users is wise, say some industry observers, a sentiment with which Emulex president Fred Cox agrees. And the announcement of new Massbus-compatible disk and tape controllers for DEC's VAX, which Emulex will begin to ship in June and August, respectively, show the company is continuing to focus on the end-user market.

But Cox is puzzled by one observer's view that the strategy was necessary for the Santa Ana, Calif.-based manufacturer of DEC-compatible controllers because of a softness in orders from its established customer base of systems houses and OEMs.

"That's just not true," Cox says. "Orders are up—we're looking at 4.5 million for the current quarter." Cox says the upcoming expansion of Emulex's controller offerings for VAX superminis is part of a strategy to increase subsystem sales to DEC end users while maintaining the upward curve of Emulex controller sales.

The new products, aimed at the end-user-oriented VAX market, include the VAX-MASTER/780 disk controller for the VAX 11/780, which joins the previously announced Massbus-compatible SC-750 disk controller for the VAX 11/750. Both offer higher performance than previously available Emulex controllers that tied into the Unibus instead of to the high-speed Massbus. And due in August are the TC-750 and TC-780 Massbus-compatible tape controllers. Industry observers, including Cox, agree that these products will end up mostly in subsystems sold to end



Emulex's VAX-MASTER/780 controller ties into the VAX 11/780's high-speed synchronous backplane interface bus.

users. Cox expects that, by 1983, 25 to 33 percent of the company's business will be in end-user sales.

Marketing consultant Andrew Roman, president of Roman Associates, Newark, Calif., wonders if Emulex isn't cutting off its lifeblood by competing for end-user business with its established customer base. "It's going to hurt them in the long run," says Roman. But James N. Porter, author of *Disk/Trend Report*, disagrees. He says Emulex's entry into the end-user market is a logical move made possible by the company's public offering of shares, which provided the capital to purchase the Control Data Corp. drives Emulex is bundling into its subsystems.

Cox sees no problem with the end-user sales strategy. "We make sure we don't cut our dealers' throats by moving in on their territory," he says. "Besides, most of our dealers undersell us. We view our main market to be end users

who are willing to pay a premium for added support."

Most "added support" will come from Control Data Engineering Services, which will handle ongoing maintenance service for Emulex installations from 16 nationwide centers. Although Emulex has recently doubled its in-house staff of service engineers, their activities are restricted to subsystem installation.

Of the new Emulex products, highest hopes are held for the Emulex SC-750. Cox says the controller will give Emulex much of the plug-compatible disk-subsystem market for an installed base of VAX 11/750s he estimates will triple to 2000 during 1982. Although other controllers are available from third-party vendors for the mid-line VAX, Cox claims the Emulex SC-750 is the first to be software transparent to DEC's VMS and UNIX operating systems. He also says the Emulex SC-21, for example, does not

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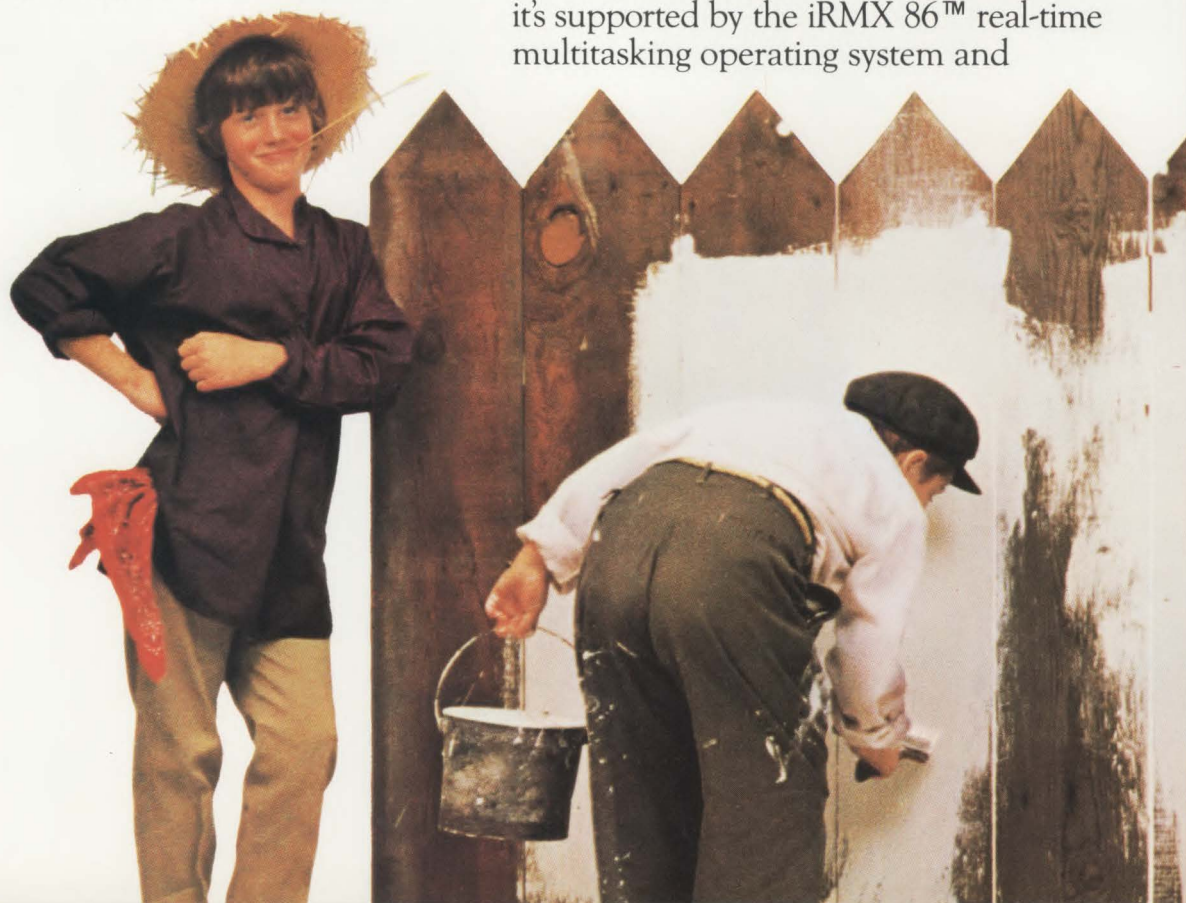
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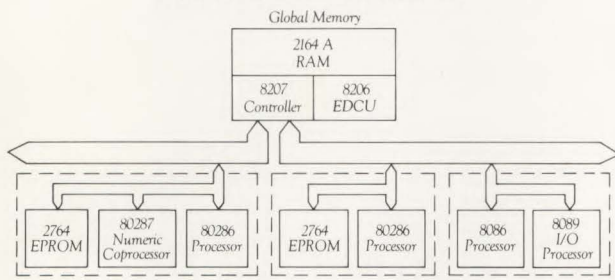
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No matter what you choose as your management base, we haven't forgotten you need a global memory to complement it. Which is where our 2164A 64K RAM, 8206 error detection and correction unit and 8207 dual-port RAM controller come in.

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Words of encouragement: Partial list of available software for iAPX 86/88 microprocessors.

<u>Operating systems</u>	<u>Languages</u>	<u>Applications</u>
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iRMX 88™	BASIC	Wordstar
UNIX	Pascal	Easywriter
CP/M	FORTRAN	Spellguard
MTOS	C	Multiplan
MS-DOS	PL/M	Peachtree General Business
MP/M	PL/1	MDBS Data Base
Oasis	JOVIAL	Selector IV Data Base
CP/NET	ADA	Pearl Program Generator
MP/NET	APL	2780/3780

But if you're really out to break response records, we have some other techniques you can use. Like coupling either processor with our 8089 I/O processor or 8087 numeric processor to magnify I/O or number crunching throughput. Or with the 80130 OS in silicon to maximize operating system performance.



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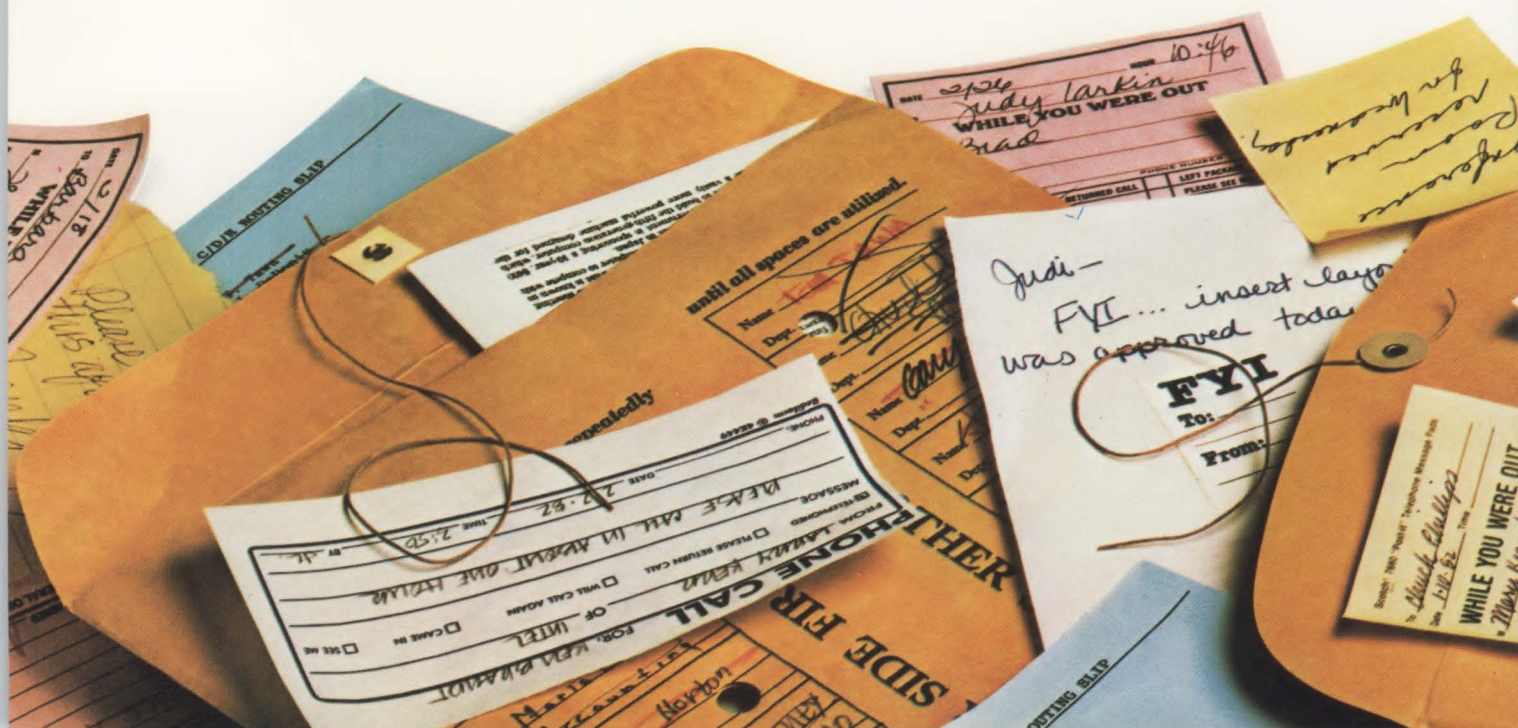
modules that tie into any Inteltec® development system can give you a jump on network software.

But the best news is this: by the time your prototype hits production, the cost of local networking won't have to preempt the rest of your system. Because you'll be able to take advantage of Intel's single-chip local area network controller to build Ethernet or any other CSMA/CD local network.

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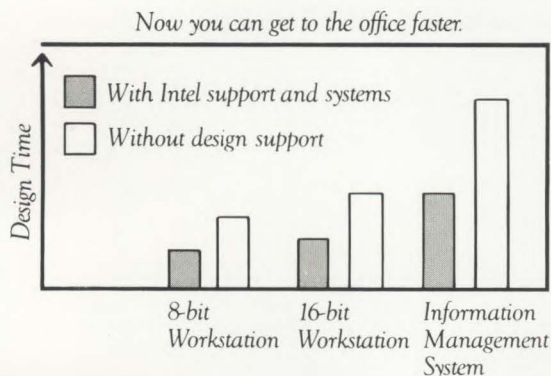
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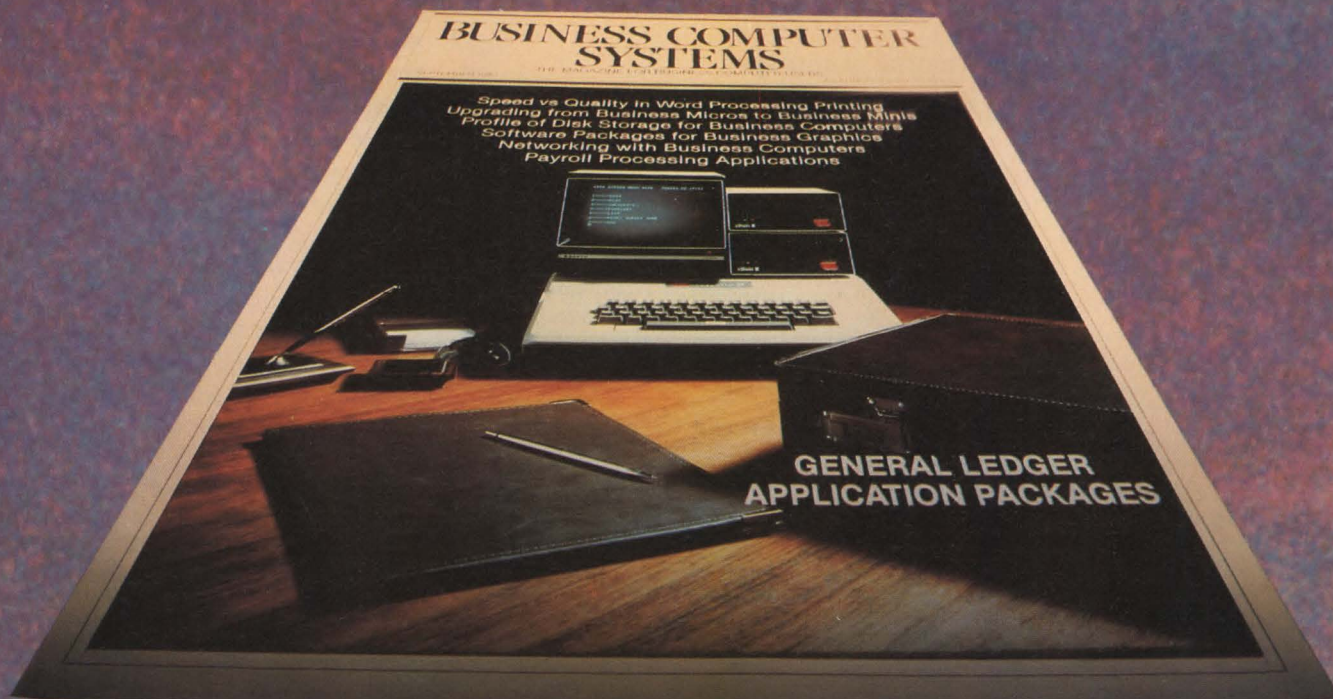
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BOX SCORE OF EARNINGS

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
Apple Computer	6 mos 3/26/82	264,572,000	27,379,000	.48
	6 mos 3/27/81	146,386,000	16,596,000	.30
AW Computer Systems	12 mos 12/31/81	1,881,657	(251,981)	(.12)
	12 mos 12/31/80	2,993,048	(18,936)	(.01)
Aydin	3 mos 3/27/82	23,532,000	1,401,000	.40
	3 mos 3/28/81	25,008,000	1,700,000	.49
Beehive International	6 mos 3/31/82	16,917,294	523,024	.17
	6 mos 3/31/81	19,327,055	2,050,777	.80
Commodore International	9 mos 3/31/82	206,336,000	28,051,000	2.73
	9 mos 3/31/81	130,477,000	17,129,000	1.66
Computer Automation	9 mos 3/31/82	50,566,000	585,000	.29
	9 mos 3/31/81	56,610,000	1,215,000	.60
Compucorp	12 mos 12/31/81	17,900,610	722,442	.22
	12 mos 12/31/80	9,366,680	50,330	.03
Computone Systems	9 mos 2/28/82	11,343,000	1,339,000	.70
	9 mos 2/28/81	7,277,000	482,000	.28
CPT	9 mos 3/31/82	103,269,000	11,206,000	.69
	9 mos 3/31/81	68,922,000	8,582,000	.58
Cray Research	12 mos 12/31/81	101,642,000	18,170,000	1.32
	12 mos 12/31/80	60,748,000	10,900,000	.85
Datum	12 mos 12/31/81	12,749,000	(238,000)	(.12)
	12 mos 12/31/80	14,919,000	258,000	.14
Digital Equipment	9 mos 3/27/82	2,804,475,000	295,407,000	5.33
	9 mos 3/28/81	2,260,067,000	226,414,000	4.50
Electronic Data Systems	9 mos 3/31/82	372,814,000	33,863,000	1.24
	9 mos 3/31/81	333,104,000	27,580,000	1.01
Emulex	9 mos 3/28/82	10,788,511	1,523,137	.66
	9 mos 3/29/81	7,242,703	902,881	.54
Gould	3 mos 3/31/82	514,500,000	20,700,000	.47
	3 mos 3/31/81	459,400,000	23,100,000	.52
International Business Machines	3 mos 3/31/82	7,066,000,000	768,000,000	1.30
	3 mos 3/31/81	6,461,000,000	730,000,000	1.25
Infotron Systems	12 mos 12/31/81	21,990,000	1,029,000	.25
	12 mos 12/31/80	19,626,000	2,510,000	.69
Mincomp	12 mos 11/30/81	641,685	(385,159)	(.062)
	12 mos 11/30/80	650,394	41,008	.018
Motorola	12 mos 12/31/81	3,335,868,000	174,990,000	5.56
	12 mos 12/31/80	3,086,439,000	186,081,000	5.96
Northern Telecom	12 mos 12/31/81	2,570,900,000	136,700,000	3.95
	12 mos 12/31/80	2,054,600,000	(185,200,000)	(5.48)
Prime Computer	3 mos 4/4/82	103,222,000	10,635,000	.35
	3 mos 3/29/81	85,043,000	8,510,000	.28
SEI	3 mos 3/31/82	9,619,000	798,000	.31
	3 mos 3/31/81	7,626,000	446,000	.24
Storage Technology	3 mos 3/31/82	262,390,000	18,015,000	.52
	3 mos 3/31/81	181,755,000	11,430,000	.39
Syntech International	3 mos 3/31/82	1,838,870	67,603	.04
	3 mos 3/31/81	1,416,951	8,537	—
System Industries	3 mos 4/4/82	16,956,000	381,000	.10
	3 mos 3/28/81	12,024,000	1,441,000	.45
Tandem Computers	6 mos 3/31/82	160,276,000	18,759,000	.48
	6 mos 3/31/81	88,026,000	11,138,000	.31
Tandon	6 mos 3/25/82	55,990,807	5,769,967	.55
	6 mos 3/27/81	21,662,091	1,804,394	—
Texas Instruments	3 mos 3/31/82	1,078,500,000	27,700,000	1.17
	3 mos 3/31/81	1,063,000,000	34,200,000	1.47

perform as well because it ties into the 16-bit DEC Unibus, while the SC-750 interfaces with the VAX 11/750's higher speed, 32-bit CPU memory interface (CMI) bus.

Cox forecasts sales of 300 SC-750s controllers by year-end. Most of those sales will be bundled with CDC drives into subsystems that emulate DEC's RM03, RM05, RP07 and RM80 subsystems. End-user prices range from \$16,200 for an 80M-byte Winchester-disk drive subsystem to \$36,550 for an RP07-equivalent with a 675M-byte Winchester. Removable-media versions are also available.

The SC-750 is available unbundled to systems houses and OEMs for a single-unit price of \$8950, which drops to \$5370 for orders of 200 or more. But Cox says the VAX-MAS-TER/780 disk controller will be sold only as part of a subsystem or to dealers that offer a high level of service because of the controller's complexity.

Emulex's VAX-MASTER/780 controller builds upon the PC board used in the SC-750, adding another board and new firmware that enables it to tie into the VAX 11/780's high-speed synchronous backplane interface (SBI) bus. The SBI interface makes the VAX-MAS-TER/780 subsystem an alternative to the System Industries 9400 disk system, which dominates the VAX 11/780 plug-compatible subsystem market. But it also creates the specter of a DEC lawsuit; DEC is suing System Industries for infringement of DEC patents on the SBI bus (MMS, January, 1981, p. 24).

Cox says he doesn't expect DEC to take legal action against Emulex because Emulex has not violated any patents, and he declines to discuss the matter further.

Cox expects Emulex's growth rate to level off from 1981's 112 percent, but he expects 1982 growth to be a more-than-respectable 55 to 60 percent.

—Kevin Strehlo

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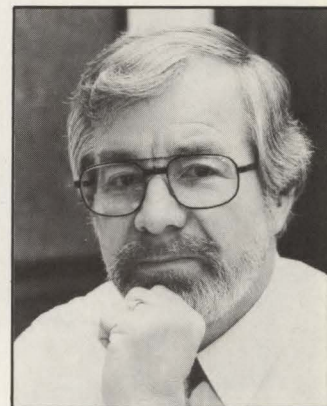
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On meeting the press

Manufacturers of computers and peripheral equipment, as well as software vendors, are vitally important to us at *Mini-Micro Systems*. It is the fruits of their labor—new products ranging from processors to disk drives to operating systems—that provide a good bit of the grist for our editorial pages each month. We need those vendors because part of our mission is to provide useful information about their products to our readers, but some of them are beginning to strain our ability to host them in Boston.



We get new product information in a variety of ways. One of our most important channels is through editors we've placed in the field to make it convenient to reach companies in those regions. We have regional editorial offices in San Jose and Los Angeles, Calif.; in New York and in London.

Other mediums of information exchange between vendors and the trade press include press conferences, news releases and press tours, each of which can be quite useful. It's the latter phenomenon—the press tour—that I discuss here because it's my view that press tours are getting out of hand in our business.

It seems that we're being asked to meet with vendors and representatives of their public relations agencies two to three times a week in our Boston headquarters. Those meetings can be productive if the companies and PR agencies have determined that they have something important enough to say to warrant the time and expense involved in getting two to six people to sit down with some of our editors. Lately, however, it has been our experience that a phone call to our regional offices, and a subsequent visit to the company by one of our regional editors, would have been just as productive in getting the story told to our readers, and it would be far less expensive for the vendor.

I'm not suggesting that we in Boston don't want to meet here to discuss new developments with their developers; that would be arrogant. What I am saying is that we have located editors outside Boston precisely to be our first point of contact about news developments—and new products are news—with companies in those regions. Phone numbers for those offices are provided on our masthead, which is usually on this page in each issue.

We benefit from the concentrated exposure to top company officials that a press tour provides, and the format is more relaxed than that of a press conference, but please give us the option of suggesting that you provide the same kind of format for our regional editors if that forum is more convenient than a press tour.

Lawrence J. Curran
Editor-in-chief

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Letters

KUDOS TO MMS

To the editor:

I saw the March issue of MMS for the first time at Interface '82 last week in Dallas. I cannot praise the magazine's staff highly enough. First, Alan Kaplan's very skillful handling of "Voiceware does it differently" (p. 183) resulted in a real improvement in structure and content, according to Centigram authors Dr. Carl Berney and Cy Harshman. And the strong treatment of the graphics definitely enhanced the impact of the article. The cover by Roger Leyonmark was stunning. Kudos are due to Vicki Blake for her art direction, and to Peter Hayhow, who coordinated the cover concept at this end. All in all, I want to compliment you on the high quality of your staff, and the professionalism with which they do

their jobs. It is a privilege to work with you.

Kathy Keenan
TFB Public Relations
Palo Alto, Calif.

ERRORS CREPT IN

To the editor:

I am pleased that our new Winchester-disk controller was mentioned in your March issue ("Companies pave way for Winchester LSI-11 market," p. 59). Unfortunately, some errors crept into the article that I would like to correct.

The WDC11 emulates the Digital Equipment Corp. RK05 (WDC11-B) or the RL01/2 (WDC11-C). Both DEC drives use 14-in. disks, while the WDC11 controls 5¼- or 8-in. disks. The DEC RK05 is not a 5¼-in. drive.

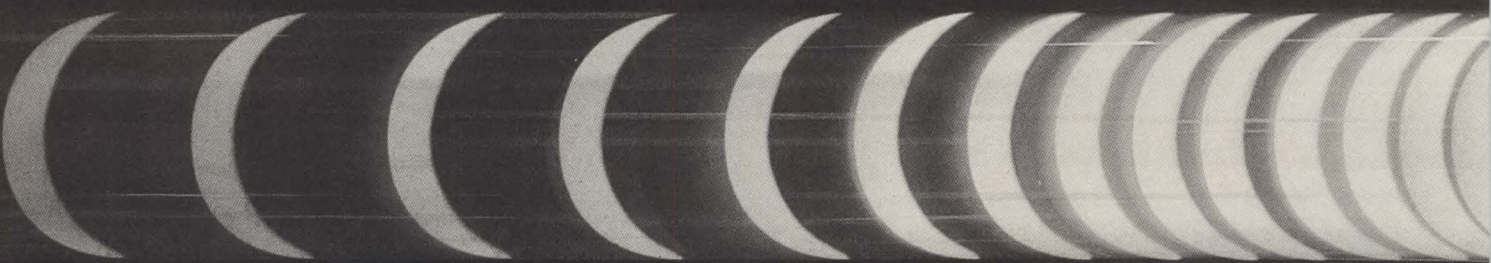
Both the WDC11-B and -C also

emulate the DEC RX02 double-density floppy-disk system. The RX02 is a 0.5M-byte-per-disk system, not 5M bytes.

The Mini-Winchester disk system (MWDS) uses the WDC11 as its controller. The MWDS-5, priced at \$4500 (not \$4050), includes a 5M-byte ST506-type drive (not a 0.5M-byte TM100-4). The MWDS-5/.5 includes both the 5M-byte Winchester drive and the 0.5M-byte floppy drive and is priced at \$5160.

I hope that these corrections will reduce the confusion caused by the errors in an otherwise informative article.

Les LaZar,
Vice President
Andromeda Systems Inc.
Canoga Park, Calif.



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A QUESTION OF RESOLUTION

To the editor:

Howard Okamoto's article "Selecting a high-performance color display" (MMS, December, 1981, p. 95) had several errors concerning raster-scan graphics systems.

I am a principal software engineer for a Fortune 100 computer manufacturer, working in an advanced-development engineering department. We are working on the display devices to be used in future products sold by the corporation.

A non-interlaced monitor does not necessarily have a lower resolution than an interlaced monitor. Interlaced versus non-interlaced has no relation whatsoever to vertical resolution. What is true is that some manufacturers of monitors "cheat," whereby the number of pieces of

vertical pixel information is reduced by one-half with each horizontal line being displayed twice, so as to require only half as much image memory. That is, 480 lines becomes 240 lines, each of which is displayed twice.

It is simply not true that increases in resolution result in increases in flicker. A screen being refreshed at 60 Hz is refreshed 60 times a sec. whether there are 240 lines or 1024 lines.

If one has the necessary money, raster-scan monitors can be made to operate at real-time rates comparable with motion-picture films (approximately 18 frames per sec.).

The group I work with has done some experiments on viewing monitors at various refresh rates under both fluorescent and incandescent lighting. We came to the

conclusion that flicker perception is not related to fluorescent lighting. It is true that flicker perception is affected by the intensity of the lighting (less light producing less apparent flicker).

All computer-graphic information does not need to be contained entirely on the CRT terminal. A more pleasing effect is present with overscan than without when the background color is other than black. No overscan results in the desired background appearing contained by a black background, which in turn is contained by the bezel surrounding the CRT. With overscan, the desired background is contained within the screen surround bezel.

Marty Halvorson
Albuquerque, N.M.

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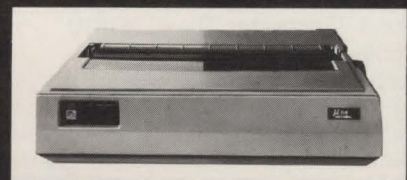
*Throughput varies with application.

gins and homes in on that spot. If you're printing labels or columns of figures, it skips over the blank spaces. That saves time plus wear and tear on the printer.

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RLX3010	31.2MB fixed Winchester (=3RL02)	10.4MB removable Winchester (=1RL02)
RLX3001	31.2MB fixed Winchester (=3RL02)	1.0MB double-sided floppy
TWO SINGLE-BOX COMPUTER SYSTEMS		
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RLX3010B	Same as RLX3010, plus built-in Q-bus backplane	
RLX3001B	Same as RLX3001, plus built-in Q-bus backplane	

- Q-bus compatibility under RSX-11M, RT-11
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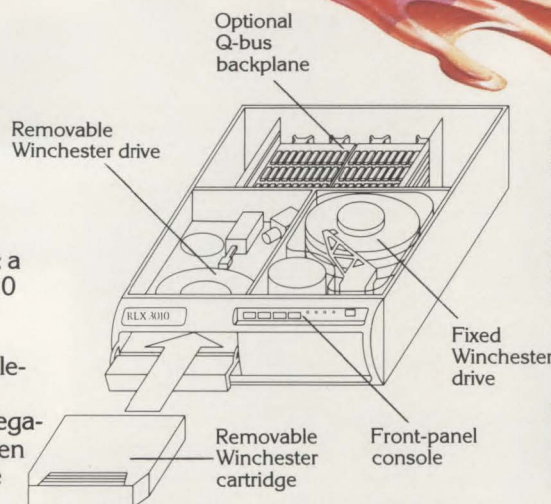
Optional Q-bus backplane and floppy backup, too

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

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

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



CHARLES RIVER DATA SYSTEMS

Can UNIX cut it in the commercial world?

By Larry Lettieri
Associate Editor

To say that a war has been declared by μ c operating-system vendors would be only a mild exaggeration. What's at stake is primacy in the market for 16-bit small-business systems, a market observers estimate will reach several billion dollars within a few years. This means there is considerable profit to be made by one company if its operating system influences how hardware is designed.

Among those operating systems most often mentioned these days is UNIX, available from Western Electric and several independent sources that are UNIX licensees. UNIX's background—it was designed to serve as a research tool within Western and Bell Laboratories—raises serious questions about its suitability to the commercial small-systems market, however. UNIX proponents are hard pressed to find fault with the operating system, but detractors are quick to point out its shortcomings in the business world.

A proponent, Robert Marsh, president and co-founder of Plexus Computers, Inc., Santa Clara, Calif., manufacturer of Z8000-based multi-user UNIX systems, says, "UNIX demand has existed within the government and in universities. But the real growth market," he continues, "is in commercial applications where people want to move their software across different hardware."

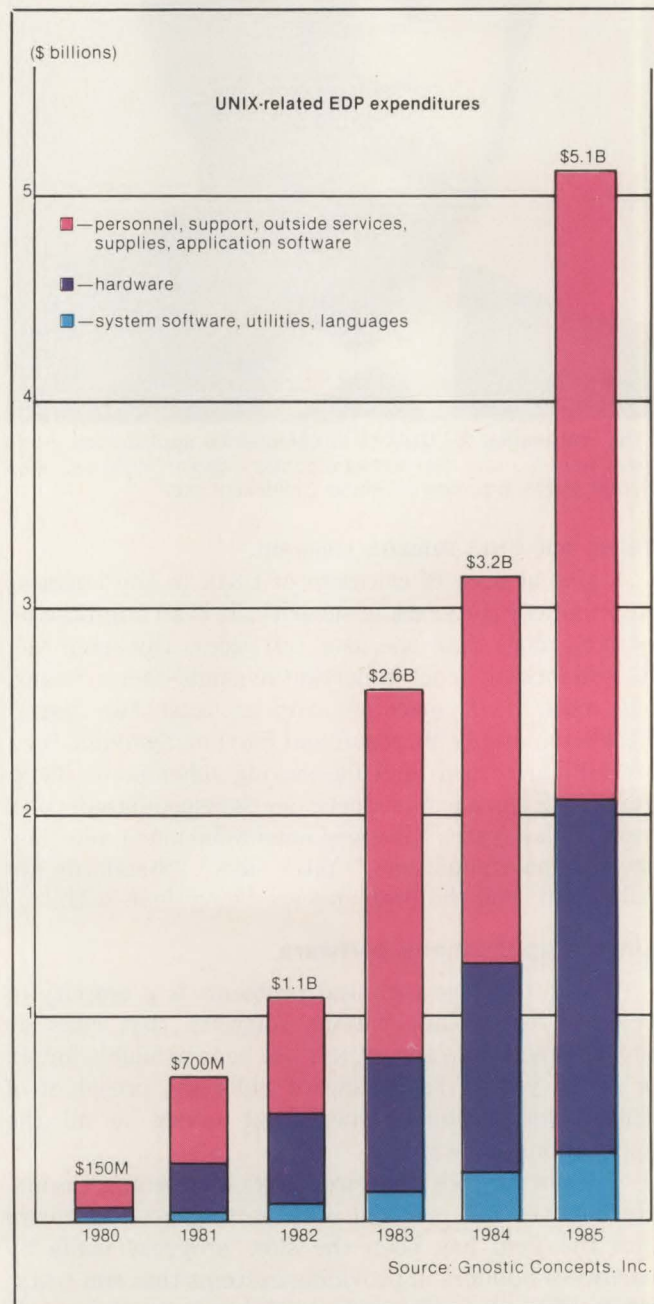
"There's no question that UNIX is suitable to the commercial environment," says Mark Ursino, product manager for XENIX, Microsoft, Inc.'s version of UNIX. "Any of the commercial vendors of UNIX have done those things that needed to be done for the business market."

Problems to overcome

Jean Yates, senior analyst at research firm Gnostic Concepts, Menlo Park, Calif., has outlined the fundamental problems with UNIX in "Making UNIX a commercial product," the first chapter in Gnostic's UNIX Information Service. Yates's study reveals that compared with what is considered essential for any easy-to-use operating system, UNIX's user interface is poor. "The casual user faces many difficulties with consistency, command syntax, the lack of prompts and helpful error messages," the report states. "The single most limiting factor to the successful commercial sale of UNIX now is the user interface."

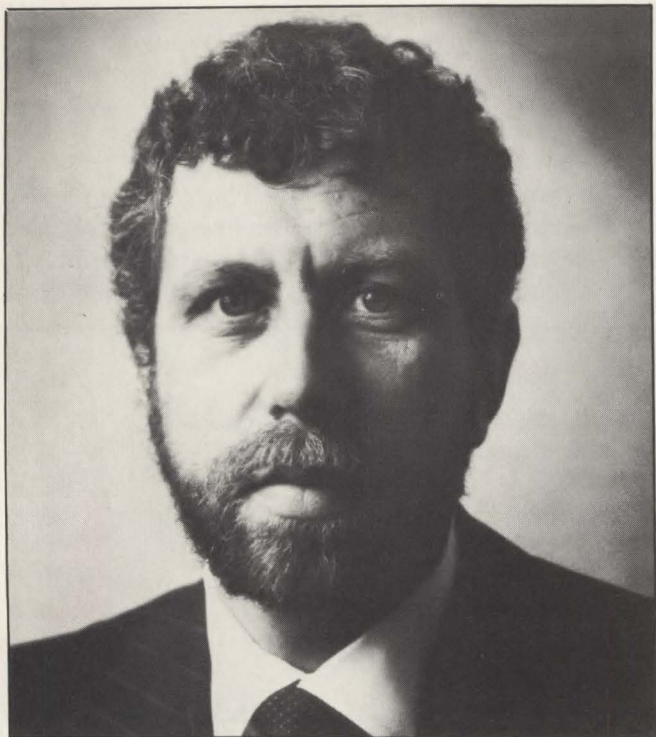
Menu screens are being added to UNIX's front end by

resellers of the operating system to provide easy access for business users. A menu screen presents a user with a display of options that points the system to a task to be performed. Each vendor's menu is unique, says



Expenditures for UNIX and UNIX-like products are expected to top \$5 billion by 1985, and may reach \$9 billion by 1986. The costs for application software, personnel and services will account for most money spent on the operating system. Source: Gnostic Concepts.

The Interpreter



"The real market for UNIX is in commercial applications where users want to move their software across different hardware," says Robert Marsh, president of Plexus Computers, Inc.

Yates, but UNIX remains constant.

A second area of criticism of UNIX in the business environment is its lack of security. It is an unprotected system; more than one user can access the same file. Record locking is not important in single-user systems, but most UNIX machines run at least two users. Resellers, notably Microsoft and Fortune Systems, Inc., are adding record- and file-locking schemes to UNIX. Fortune Systems introduced an MC68000-based UNIX machine last year. "Changes need to be made, but they are not insurmountable," Yates says. "Standards are falling out, and the problems are being dealt with."

Limited applications software

Adding to these technical problems is a scarcity of business-related applications software that runs on UNIX, some critics say. "UNIX has been available for six or seven years," says Howard Sidorsky, president of Phase One Systems, Inc., "but where is all the applications software?"

"It's not for lack of desire," says Microsoft's Ursino. He believes the problem with getting good software into the field has been the slow progress made by hardware builders in providing systems that run UNIX. "Only after the software came," he says, "did people realize what kind of hardware was needed."

Plexus Computers' Marsh, whose P/25 and P/40 systems were designed as UNIX machines, sees it

differently. "Applications software?" he asks. "All software compilers run under UNIX: for instance, all Microsoft languages and Ryan-McFarland COBOL. There's more software for UNIX than there is for CP/M," he claims. One UNIX users' group, /user/group, which Marsh founded and heads, publishes a software directory listing almost 300 packages. Gnostic's Yates says the UNIX software market is booming. "There's a lot of venture money interested in UNIX software start-ups," she says.

Software to fill the real or perceived void is expected from two sources. Ursino thinks that most high-level 8-bit μ c applications will transport easily to XENIX. He also believes that minicomputer software, which represents a substantial resource, will be transported by vendors and users who want to move their applications onto less expensive hardware such as 16-bit μ c-based machines. "By the end of this year," Ursino says, "software will no longer be in the critical path to UNIX development. It will be hardware."

Transporting UNIX to 16-bit μ ps has been a problem, says Yates. Not all the devices have the features necessary to take advantage of UNIX, which was designed for Digital Equipment Corp.'s PDP-11 minicomputers. Of the μ p transports, the Z8000 and MC68000 have been the most successful, largely because these chips have memory-management capabilities, peripheral device-handling features and, in the case of the Motorola processor, a large addressable virtual-memory space. Besides Plexus, Zilog Inc. has a multi-user Z8000-based UNIX system. Fortune Systems, Codata Systems, Inc., Sunnyvale, Calif., and CM Technologies, Inc., Palo Alto, Calif., all have UNIX running on MC68000-based hardware.

The 8086 has been more difficult than the others, primarily because it does not support memory segmentation as does the PDP-11, says Yates. Ursino says Microsoft experienced difficulties with memory management and I/O controllers. However, Ursino says that, in general, all the processors have proved challenging. "It's hard to figure out how they really do perform," he says.

Instability could hurt

Many consider the main stumbling block for UNIX's widespread acceptance in the commercial market to be Western Electric's continued control over the operating system. Researchers may not mind being faced with an evolving product, but end users and those selling to them like stability.

"By not moving to standardize UNIX, American Telephone & Telegraph Corp. is definitely hurting it," says Yates. She thinks that the operating system will lose momentum if the company does not take a firm

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"The 16-bit systems market will be determined at the operating-system level," says Jean Yates, analyst at research firm Gnostic Concepts, Menlo Park, Calif.

position within a year. She adds, however, that by calling System III, the latest UNIX release, a commercial product no longer aimed solely at research, AT&T could be heading toward support of the operating system, which would be a step in the right direction.

Plexus's Marsh is more optimistic. He thinks AT&T will not continue to influence the UNIX market. "No one company can run over such a rapidly growing market." Much of the market, he continues, will follow Western's moves, but more will go its own way. "System III was the last time Western could change the market en masse," he says.

Despite these difficulties, UNIX and UNIX-like products are expected to be successful in the small-systems market. System III and reduced license fees will help. UNIX can sell for as little as \$40 per user under the new license structure. "Now that UNIX is really cheap," says Plexus's Marsh, "you'll see it more often on small systems." UNIX may consume many resources, he adds, but the resources continue to get less expensive.

Yates believes that the real growth will start in 1983, when 100,000 licenses could be sold compared with about 10,000 estimated for 1982. Ursino believes only a

small percentage of the total demand for UNIX is met. The growth rate depends on how fast the hardware vendors get going, he says.

UNIX competitors are active

Stiff competition is expected for the small computer operating system. Digital Research, Inc., is fairly well entrenched in the 8-bit market and is moving rapidly with the MP/M-II multi-user system, the concurrent CP/M-86 single-user, multitasking version of CP/M-86 and CP/M for the MC68000. The company's chief operating officer, John Rowley, thinks his firm can dominate the 16-bit small-system market. "UNIX is best suited to software development," he says, but some successful multi-user applications of UNIX in the business market may exist. Rowley believes concurrent CP/M will take the lion's share of the single-user, 16-bit market, with MP/M grabbing a large portion of the multi-user business.

Phase One's Sidorsky says his company's 8086 OASIS-16 "is not losing ground to UNIX," even though installations of the operating system have just started. The company recently introduced its software for International Business Machine Corp.'s personal computer and plans to add OASIS for the MC68000 soon.

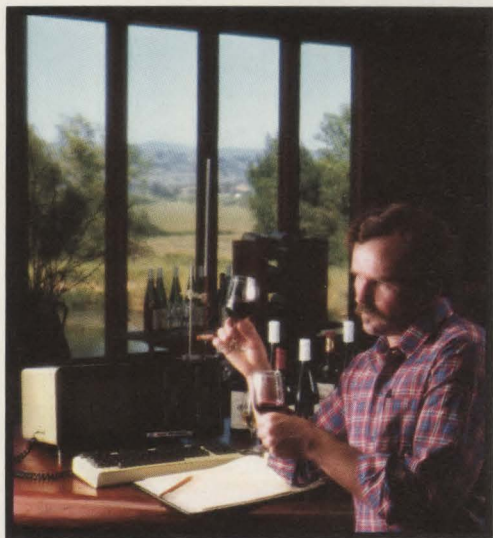
One hardware vendor is taking maximum advantage of the operating-system war. Altos Computers, Inc., San Jose, supports XENIX, MP/M and OASIS on its 8086-based multi-user systems. But director of product marketing David Witkowski says XENIX is attracting the most attention at the moment. The XENIX systems are going mostly into software-development applications, but he expects that when more XENIX application software becomes available, XENIX, MP/M and OASIS will pursue the same commercial markets. Altos then plans to let the market decide which operating system it wants. "If there's another operating system in demand," Witkowski says, "we'll support it, too."

"The company that owns the operating system for 16-bit hardware controls a huge quantity of application software," says Yates. In the short term, Digital Research and UNIX resellers will dominate the market for one- to five-user systems, she says. But the long term is a different story.

The real battle will be for networked office-automation systems, Yates explains. PABXs will be the most likely network approach, and telephone lines will link the networks together. "When you're hanging together a bunch of differently designed systems," she says, "UNIX is the choice."

"The market will be determined at the operating-system level," Yates concludes. "Hardware is a commodity. The operating system defines more parameters than the hardware." ■

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CIRCLE NO. 68 ON INQUIRY CARD

Vendors contend in network-systems market

By Dwight B. Davis
Associate Editor

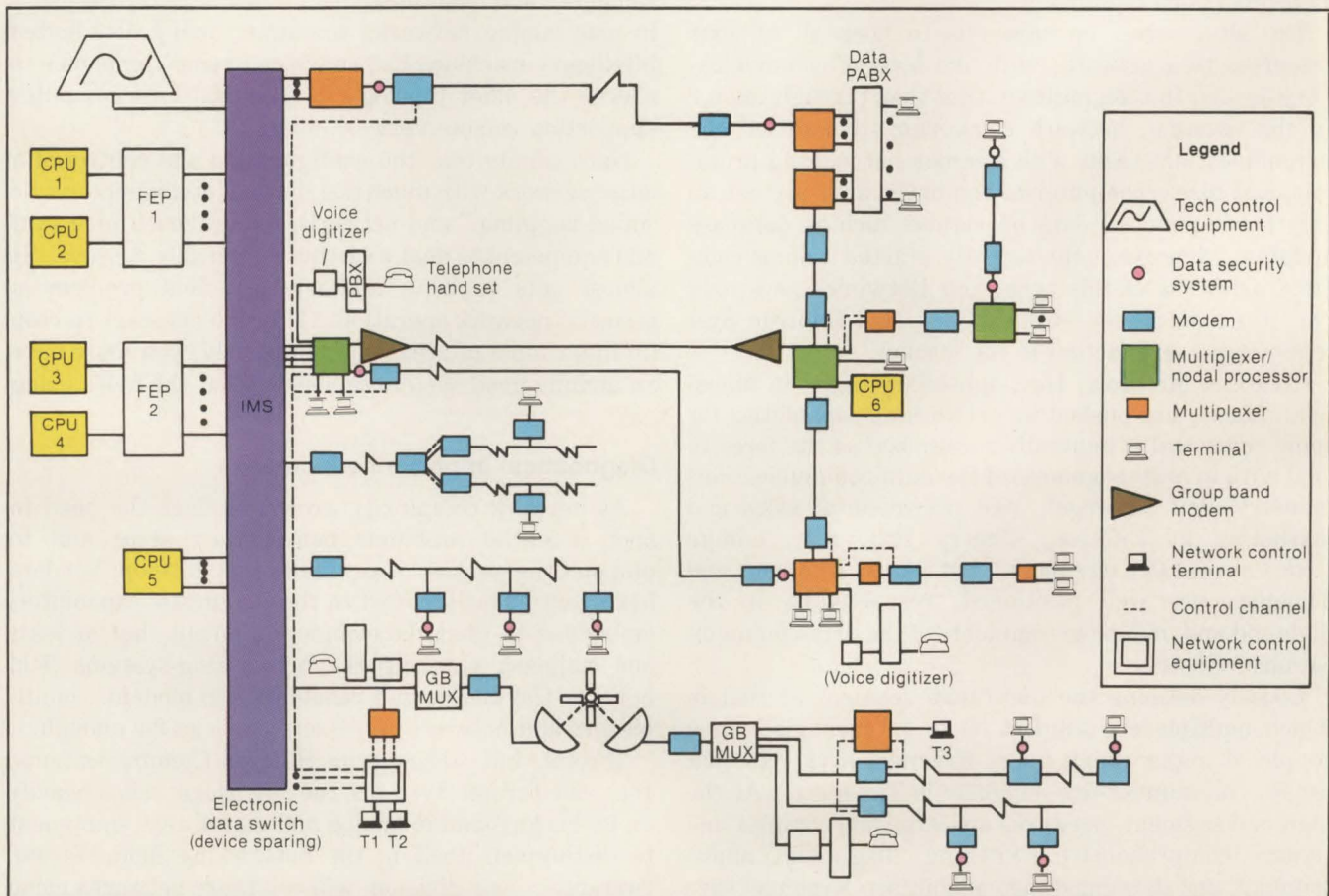
Several years ago, when options for networking data-processing equipment were limited and fairly straightforward, not many companies placed data communications high on their list of priorities. The very limitations inherent in state-of-the-art networks at that time undoubtedly contributed to the disinterest, but few companies took advantage of the benefits even these networks could provide.

Now, as firms are turning in increasing numbers to data communications to improve their information-processing and -handling operations, networking technology has reached a level of complexity that is often beyond the grasp of the available in-house engineering staffs. Several data-communications-equipment vendors that generally started out as component suppliers have moved to meet this customer need. While these vendors still market components to OEMs and sophisti-

cated end users, they also wear a second hat as suppliers of complete network systems.

The term "network" covers a lot of ground, from simple point-to-point communications links to complex configurations with hundreds of nodes and thousands of lines. Most vendors acknowledge that Micom Systems, Inc., reigns supreme in the low-end, point-to-point market (MMS, February, p. 70). Those that claim the title of network-system suppliers imply that they can build simple to very complex networks.

Ed Botwinick, president of Timeplex, Inc., Rochelle Park, N.J., draws another distinction between types of networks—those that operate through computers and those that operate around computers. In the first type, the network operates in a specific type of computer environment, often International Business Machines Corp.'s, using that computer's protocols and relying on the host computers to handle a large portion of the communications tasks. This is a poor approach, Bot-



Network complexity is increasing tremendously, as indicated in this stylized configuration from Codex Corp. Suppliers of such networks must have broad product lines to provide all the necessary functions, and must have the engineering talent to configure and maintain these systems in the most cost-effective and performance-effective manner.

The Interpreter



Ed Botwinick, president of Timeplex, Inc., maintains that product distinctions will continue to play an important role in a customer's decision on a network vendor.

winick says, "because most computer protocols are relatively inefficient users of the transmission media, and running communications through a processor to a remote processor is a very inefficient use of expensive data-processing equipment."

The alternative, he says, "is to hook all of your resources to a network, with one level of communications around the computers rather than through them." In this scheme, network components handle all the communications tasks with common networking protocols, and direct computer-to-computer links are set up only for high-speed data operations such as database updates. Timeplex only recently started selling complete networks of this type, and Botwinick says only two other companies—Codex Corp. and Infotron Systems Corp.—are factors in the market.

Codex, a Motorola, Inc., subsidiary based in Mansfield, Mass., has pushed its networking capabilities for some time, and is generally recognized as the force to deal with in most segments of the data-communications industry. Jeff Kraengel, vice president of sales and marketing at Infotron, Cherry Hill, N.J., admits Codex's overall strengths, but says Infotron and Timeplex are well positioned, respectively, in the high-end and mid-range segments of the data-communications industry.

Loosely defining the mid-range segment as that in which multiplexers support 32 to 40 channels over a couple of major trunk lines, Kraengel says, "In that range, the number-one company is Timeplex." At the high-end segment, networks are large and complex and require comprehensive switching, diagnostic, multi-trunking and data-handling capabilities. Kraengel says Infotron holds the number-one spot in that segment. The company has shipped hundreds of its 790 network

concentrators to this market, and claims a substantial lead over the main competitive product, the Codex 6050 network processor.

Product-line breadth

Kraengel's focus on products that handle the highest networking requirements is a common vendor approach. But to offer complete networks, a vendor must have a very broad product line, all the way down to low-speed modems. And even given such product-line breadth, a vendor still may not qualify as a network systems supplier. Such suppliers must also have the engineering talent to configure and install the most appropriate and cost-effective network for a customer's needs. And once the network is installed, the vendor or customer must be able to maintain its operation and service its components easily.

"The largest single consideration in setting up a network is economics," says Jim Hart, vice president of network and control products at Codex. "Not just the cost of the equipment, but the best employment of the equipment for the lowest cost. The next problem we see as a customer consideration is a combination of reliability and maintainability." Hart says the difficulty in maintaining networks containing many distributed intelligent machines has convinced some companies to choose the older topology of a central host computer supporting remote network nodes.

Hart admits that the configuration and control of a large network with much distributed intelligence can be "mind-boggling," and network vendors must have staff and equipment to deal with this complexity, he says. "It almost gets to be a military-battlefield problem in terms of network operation. "If problems start to crop up in a couple of areas simultaneously, you must have an awfully good system to decide what the hell's going on."

Diagnostics' importance increases

As network complexity grows, so does the need to spot potential problems before they occur and to pinpoint the location of any faults that develop. Vendors have continuously added to the diagnostic capabilities embedded in their datacomm equipment, but at least one company entering the networking-systems field believes the diagnostics capabilities in modems, multiplexers and network processors don't go far enough.

Torotel, Inc., through its Halcyon Communications, Inc., and Torotel Systems, Inc., divisions, relies heavily on its background in analog and digital test equipment to distinguish itself in the networking field. Torotel Systems, a new division, will configure networks using products offered through the Halcyon division and products sold by other component vendors. "One of the

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The Interpreter



Jeff Kraengel, vice president of sales and marketing at Infotron Systems Corp., *claims his company has the largest installed base of complex, high-end networks.*

strengths we have that the other vendors don't is our ability in the telecommunications-equipment test area, and the ability to develop network-control capabilities," says Max P. Beere, president of Torotel Systems.

Infotron's Kraengel disagrees with Beere's contention that networks often require diagnostic capabilities beyond those offered within standard network components. "The need for network-control systems and test equipment as separate entities will diminish," he says, "as these devices are integrated into other network products, such as the 790 concentrator." For those customers who can't effectively use the components' diagnostic features, most datacomm vendors offer or plan to offer remote diagnostic options. With these options, the vendor's technicians can remotely scan a user's network to locate trouble spots.

Just as diagnosing and controlling complex networks are difficult, so is the configuration of these networks. Getting the engineering talent to do configuring represents the most crucial aspect of a network vendor's job, says Larry R. Whitaker, who recently resigned as president of Torotel, Inc., and the Halcyon subsidiary. "As a systems company, you're selling three things: engineering knowledge, software and service," he says. "If any factor limits a vendor's growth, it will be the inability to get good technical people who really understand network design and operation."

Whitaker places less emphasis on the distinctions between vendors' network components because he believes these distinctions will blur in time. He believes economics and scarcity of engineering talent will force most network suppliers to buy many components instead of developing them in-house. Outside purchasing will cause the network vendors to incorporate the same basic units in their systems. As a result, vendor distinctions will be in areas other than products, he says.

Timeplex's Botwinick disagrees with Whitaker's

opinion that the hardware distinctions are blurring, a view generally shared by the other network vendors. "The feature spread in communications processors and multiplexers is growing, not diminishing," he says.

Infotron's Kraengel also expects product distinctions to remain, "because products are the keys each vendors uses to provide solutions to customers' problems." Hart, at Codex, says Whitaker is probably right "in that it's the software and engineering knowledge that will provide the major differentiation at the product level." But in Codex's case, Hart says, the Motorola Semiconductor connection gives his company an edge by being able to place functionality on LSI chips.

Vendors agree with Whitaker on the importance of the engineering issue, but are more optimistic about their ability to find talent. "It's been very, very tough, and we have to work extremely hard to get the people, but so far, we've been able to hire all the engineers that we need," says George B. Pressly, senior vice president of corporate development at Paradyne Corp., Largo, Fla. Paradyne is adding a general networking capability to its traditional business of supplying datacomm components and specialized equipment to link equipment in IBM environments.

Botwinick says, "Everybody in the industry is having problems getting technical support people of all types. It's a major problem, but it's not impacting our business." To help address the problem, Timeplex is starting training classes to turn recent college graduates into sales support staff.

Although the network vendors claim to have the necessary engineering talent to design complex systems independently, they all prefer to work closely with their customers when possible in configuring and implementing networks. "The need for the customers to understand their needs and problems has increased significantly," says Kraengel, "and customers have accepted the challenge. We sell on a peer-level basis. While we bring some of the finest data-communications expertise to our customers, our customers respond with very fine capabilities to apply that expertise."

Beere at Torotel Systems says his company will supply turnkey solutions when required, "but the customer needs to use the people they already have to the extent they can be used. It doesn't make any sense to go to a client and say 'Give us your problem, we'll go away and solve it for you and come back and install the solution.' What we will do is fill in the blanks to help a customer achieve the network that he needs."

Likewise, "Paradyne attacks the more complex networks in conjunction with our customers," says Pressly. "I don't believe we will be in a position to try to become turnkey vendors of networks because users want some control of the network themselves." ■

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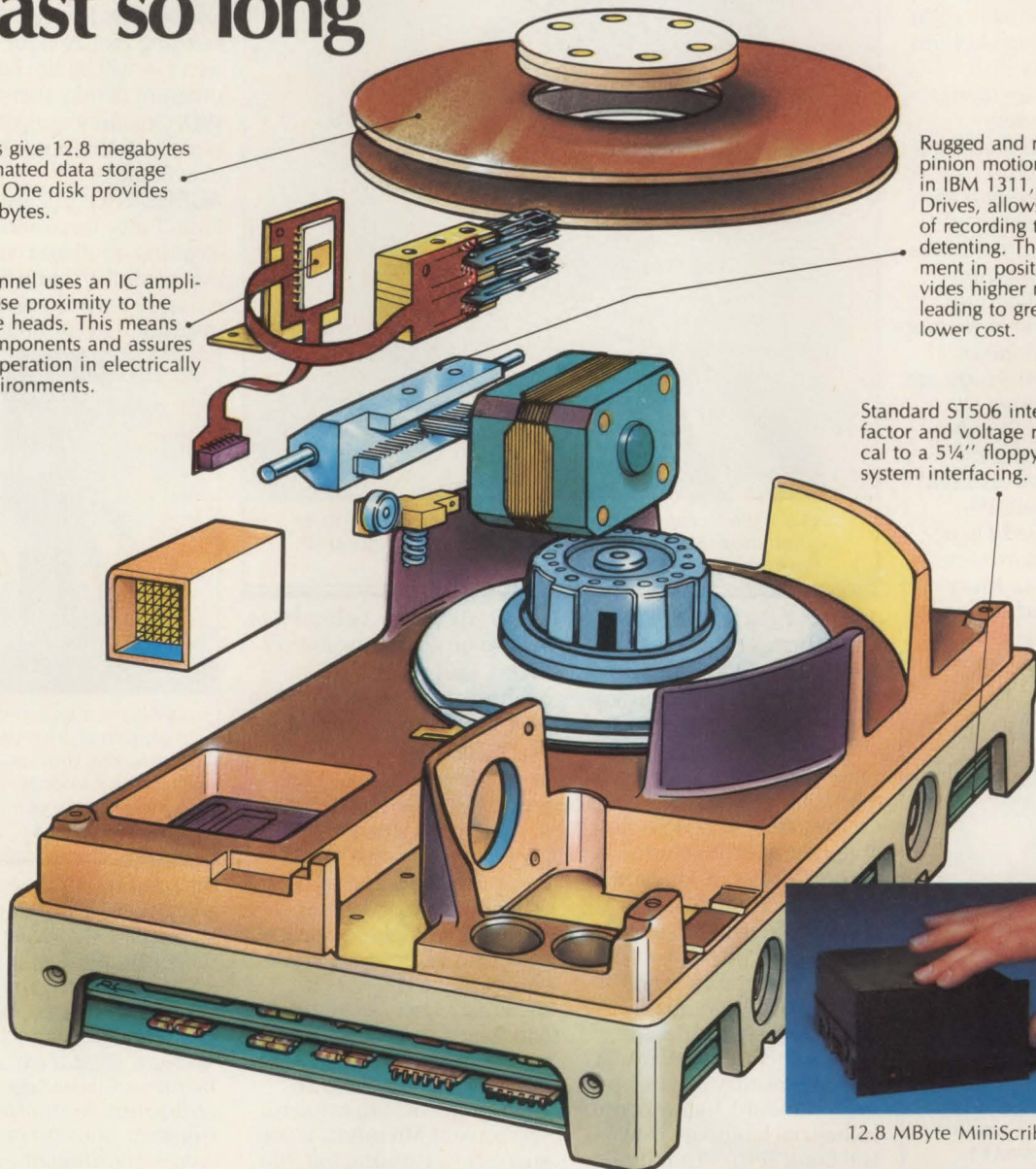
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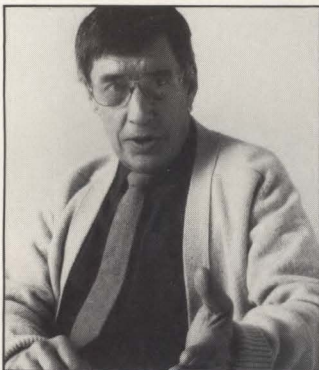
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Ada: The View From Abroad

NO. 2 IN A SERIES

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



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

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

AGERBERG: I began looking for Ada long before it existed. As a specialist in automatic control, I was searching for a modern alternative to FORTRAN. I, and my colleagues on various European committees, began to examine the options — HAL,



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

JOVIAL, CORAL 66, PEARL and others. They all had limitations. More important, though, it became apparent that national pride was the single biggest obstacle to Pan-European adoption of any existing language or development of a new language. Ada is the solution to this Gordian Knot. Although it was U.S. funded, it was a genuine international effort.

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

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

throw our weight behind it or we'll go on searching forever.

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

AGERBERG: Perhaps there is no perfect language. Yet, I ask, what's better than Ada? It is a large language, but very carefully constructed.

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

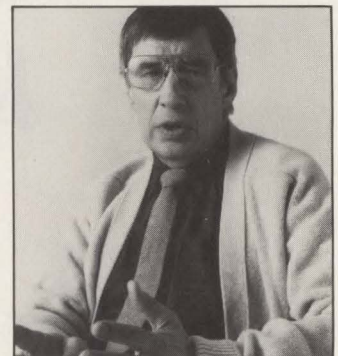
WD: Since you mentioned our SuperMicro system, we can't resist asking, how do you rate it as an Ada machine?

AGERBERG: Well, so far I've run only your MicroAda subset

on it. Still, the SuperMicro has the architecture to become an efficient, low-cost Ada learning tool. And for many users, it will be the logical program development system.

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

AGERBERG: The sky is the limit. Today the world is awaiting a full and complete Ada compiler that will run on some fairly accessible machine. Given that, Ada



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

becomes much more than a language. It becomes a new technology that will provide the foundation for a proliferation of markets and products. The future is bright — and near enough to touch.

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More vendors challenge heavyweights for electronic-mail division crown

By Sharon Frederick

Electronic mail is proving to be a market—as was the minicomputer market itself—that requires a few pioneers to blaze the trail but established vendors to legitimize it. The past year may mark the end of electronic mail's pioneering phase, as at least a half-dozen major vendors announced or initiated delivery of new electronic-mail packages.

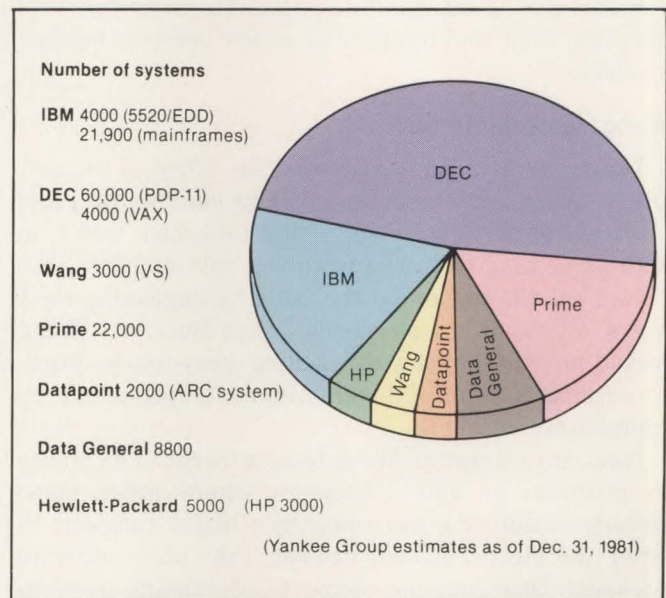
"Hardware vendors are finally jumping on the bandwagon now that they're convinced electronic mail is not only a real market, but one where there are big dollars to be made," says H. Paris Burstyn, electronic-mail specialist at The Yankee Group, a Boston-based market-research and consulting firm.

Large vendors will seize huge pieces of the market and, as in the minicomputer industry, simultaneously expand customer awareness and enlarge the potential market, predicts The Yankee Group. The result will be heightened competition and newer electronic-mail packages with greater transparency and easier database access for nontechnical users. Here's how the major vendors stack up in their attempts to provide those features based on The Yankee Group's latest research.

IBM, DEC expand to the office

Given their established installed bases, International Business Machines Corp. and Digital Equipment Corp. are critical factors in the market—particularly since each has announced it intends to pull together elements of its existing systems via electronic mail.

IBM seems particularly well positioned to gain ground in the office market, where it has faced stiff competition from Wang Laboratories, Inc. Although IBM has offered other electronic-mail packages, its new Professional Office System may be the most strategically important product the company has announced in years, according to The Yankee Group. PROFS is designed to assist managers, professionals, administrative support staffs, clerical employees and word-processing centers in creating, communicating and accessing job-related text information. PROFS takes users beyond just word processing by offering document storage, distribution, search and retrieval and time-management functions such as calendar maintenance and reminders. It gives a manager or professional composing messages the flexibility to access more complete word-processing capabilities as circumstances



Minicomputer vendors' U.S. installed equipment base. Users of DEC's VAX can choose between DEC and BBN, while IBM mainframe users can choose BBN, CCA or IBM. HP 3000 users have two electronic-mail choices, H-P's and Infomedia's. All other users have only the package offered by their system suppliers.

demand—a capability The Yankee Group judges as highly desirable and of major strategic importance.

DEC considers its DECmail the cornerstone of its office-automation offerings. DECmail runs on VAX computers under the VMS operating system and connects other software and hardware products DEC provides under the "Office Plus" moniker. For years, the company's users have asked for office software; now DEC is providing it and carefully pulling its products together to protect its installed base from competitors such as IBM and Wang. This integration will occur over time, as VAX gets word-processing functions and the PDP-11 gets electronic mail.

DECmail is based on DEC's in-house electronic-message system, which is a PDP-11-based mail system that supports more than 3000 users within the company. DEC has used the system for about three years, and its experience is reflected in a user-friendly system. While the system doesn't provide some management-support functions that a PROFS does—calendar management, tickler files, conference-room scheduling and suspense files—users find that it offers enough capabilities to warrant installing a pilot program. DECmail enables managers, professionals and secretaries to have single-terminal access to other software applica-

The Interpreter

tions running on networked computers.

While DEC software may not be as slick as some of IBM's or Wang's, it doesn't have to be, Burstyn points out. "DEC can take what packages it has to customers who've been hoping for support in the office just to demonstrate its intended direction. Its customers will purchase them and upgrade as newer versions become available."

Wang defends its turf

Until recently, Wang regarded the office as its turf. Other major minicomputer vendors such as DEC and Data General Corp. had well-established bases in data-processing and manufacturing environments, but "They left the money on the table by neglecting their users' office-automation needs," says Burstyn. "Wang picked up that money by selling easy-to-use word-processing systems into environments populated by competitors' machines."

Now, says Burstyn, Wang faces a threat to its ability to maintain or gain customers where other minis already reside. As the company's major competitors enter the electronic-mail market, they offer software packages that combine elements of existing systems and give users access to existing data files, all at a

fraction of the cost of new hardware and software systems from Wang.

Wang has countered by announcing an assortment of new office-automation and management-support products, including two electronic-mail systems tailored to specific users. The flaw in this thrust, according to The Yankee Group, is a lack of compatibility between Wang's new products and its installed base. Says Burstyn, "Despite Wang's push into local-area networks aimed at integrating office information processing, few of its recently introduced products function together harmoniously, if at all."

Wang's newest office-automation system, Alliance, is aimed at professionals and managers, and incorporates management-support functions that other vendors include in their electronic-mail packages. Alliance also has its own electronic-messaging system, which is incompatible with Wang's Mailway system. Mailway is targeted at clerical rather than managerial users, and offers full-scale word processing and a switch into electronic-mail mode. It provides no management-support functions other than messaging. Mailway is available in three versions. Level 1 does not employ a controlling unit to administer message transmissions, as do levels 2 and 3, and is not truly electronic mail. It

ELECTRONIC MAIL: WHAT'S HERE AND WHAT'S PROMISED				
Vendor	Product	Announcement; availability	Price	Special features
Burroughs	OFIS I Information System	6/81; now	\$3000	Electronic filing system
Data General	Comprehensive Electronic Office (CEO)	11/81; late 1982	\$10,000-\$15,000	Graphic transmission
Datapoint	Electronic Message System (EMS)	11/79; now	Free with hardware	Easy-to-use internal editor
Digital Equipment	DECMail	11/81; now	\$20,000 with full support; \$12,000 without support	Both command- and menu-driven
Hewlett-Packard	HPMAIL	3/82; July	\$10,000	Transmit any MPE file
IBM	Electronic Document Distribution (EDD)	11/79; now	\$339 monthly	One part of system's standard software; can communicate with any IBM computer and with any other computer emulating IBM's communication 3270, 2770 protocols
	Professional Office System (PROFS)	6/80; now	\$402 monthly software charge	Runs under VM operating system; comprehensive management package including calendar management
Prime Computer	Office Automation System	4/80; now	\$4500	Runs under Prime operating system on any Prime computer; includes foreign language dictionary
Wang	Mailway	6/79; now	Level I: \$200 license fee; Level II: \$59,000 for hardware, \$10,000 for software; Level III: \$9000	Point-to-point messaging; only marginally qualifies as electronic mail; Level II requires dedicated Mailway distribution controller; strictly document distribution system aimed at support staff
	Alliance	11/81; mid-1982	\$2000	One part of comprehensive management support package; aimed at managers
Independent suppliers				
BBN Information Management Corp.	InfoMail	1/81; now	\$35,000 to \$75,000, depending on configuration	Runs on DEC's VAX, BBN's C-70 and all major IBM operating systems; transportable
Computer Corp. of America	Comet	12/79; now	Service: \$60 per month plus minimal incidentals; Package: \$40,000 to \$60,000	Available as both software package and as service; runs on DEC PDP-11s and IBM 370-type mainframes; has forms capability
Infomedia	Jenny/3000	2/82; now	\$9800	Runs on HP 3000s
	ZAP/3000	3/82; now	\$2000	Runs on HP 3000s

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provides a cost-effective solution for organizations and departments with light document-distribution needs. For larger organizations with heavier information-handling requirements, levels 2 and 3 offer the more sophisticated store-and-forward hierarchical message-routing system, which requires a VS computer as a central mail-distribution center.

What's surprising about Mailway, says Burstyn, is that it is neither as flexible nor as easy to use as some competitive systems—just the opposite of what one might expect from Wang, a manufacturer whose office-automation products are known for those characteristics. Also surprising is Wang's overall strategy. At a time when other office- and data-processing-equipment vendors are integrating their systems—primarily through electronic-mail software—Wang seems headed in the opposite direction. Users may find that Wang meets their needs today, but other companies, such as IBM, DEC and Datapoint Corp., are aggressively entering the market with integrated, multifunctional office systems that promise adaptability. The Yankee Group sees those companies offering serious competition to Wang.

Then come the rest

Other minicomputer manufacturers that have announced electronic-mail packages, including Burroughs Corp., DG, Datapoint, Hewlett-Packard Co. and Prime Computer, Inc., "are not apt to be real factors in the market," says Burstyn. They are moving into office automation to various degrees, but to protect their own installed bases against encroachment from the three heavyweights in the field—DEC, IBM and Wang.

Of these others, Burstyn believes that Datapoint has the strongest offering. Much like its pioneering venture in local-area networks, Datapoint was one of the first vendors to offer electronic mail. Its Electronic Message System is billed as a simple-to-use turnkey package for communicating messages and documents from one user to another. The Yankee Group judges EMS easier to use than Wang's Mailway, but slightly more complex than the newer generation of electronic-mail systems typified by IBM's PROFS.

Because most of Datapoint's ARC systems are installed in data-processing environments, The Yankee Group points out, EMS's slight data-processing orientation in its command structures may be exactly what the company needs to sell the applications package. Yet it's not too complex to be marketed successfully to office-automation customers, adds Burstyn. "EMS offers enough flexibility and a broad enough range of functions to make it a successful entry."

Electronic-mail offerings from hardware vendors run only on the manufacturers' own machines. Three other

companies—Computer Corp. of American (CCA), Infomedia Corp. and Bolt, Beranek & Newman (BBN)—sell software packages to meet the needs of organizations that want to automate their offices without buying new hardware.

CCA is a pioneer in providing independent messaging and is the only vendor supplying an electronic-mail package (Comet) for DEC's PDP-11. There are 60,000 Comets installed, giving the system "a large window of opportunity until at least the end of the year, when DEC is expected to announce its own offering," says Burstyn. Infomedia markets two products designed to operate on HP 3000 minicomputers—Jenny/3000 (MMS, April, p. 60) and Zap/3000.

Last year, BBN entered the electronic-mail market via a subsidiary, BBN Information Management Corp. (IMC). Its goal is to offer information-management and communication-software products. Its first product and the foundation for a product line is InfoMail, an electronic-mail software package. InfoMail is the only package that allows different computers to communicate; any InfoMail-running computer can talk to any other InfoMail-run computer, regardless of the computers' manufacturers. The package now runs only on large systems because the program requires several hundred thousand bytes. This may limit InfoMail's short-term marketability, but the problem will diminish because minis are growing in processing power and memory size by more than 40 percent annually. InfoMail acts as an electronically organized desk, with in/out baskets and a wastepaper basket, and is aimed at management and professional users. The Yankee Group ranks it one of the most user-friendly offerings available.

In March, Hewlett-Packard introduced its promised electronic-mail system, HPMail (MMS, April, p. 60), and the Yankee Group expects NCR Corp. to announce a package for use with its "Worksaver" this year. "Look for a large increase in the number of electronic-mail installations over the next year," says Burstyn, who estimates there are now 165,000 users in the U.S. About half of those are on internal systems; the other half use Comet-like services. Burstyn expects the overall base to grow by at least 50 percent this year.

"We'll also see enhancements to a lot of systems," he concludes. "Those doing strictly messaging will gain management-support functions such as database access and time-management aids." ■

Sharon Frederick is a Boston-based writer specializing in business topics.

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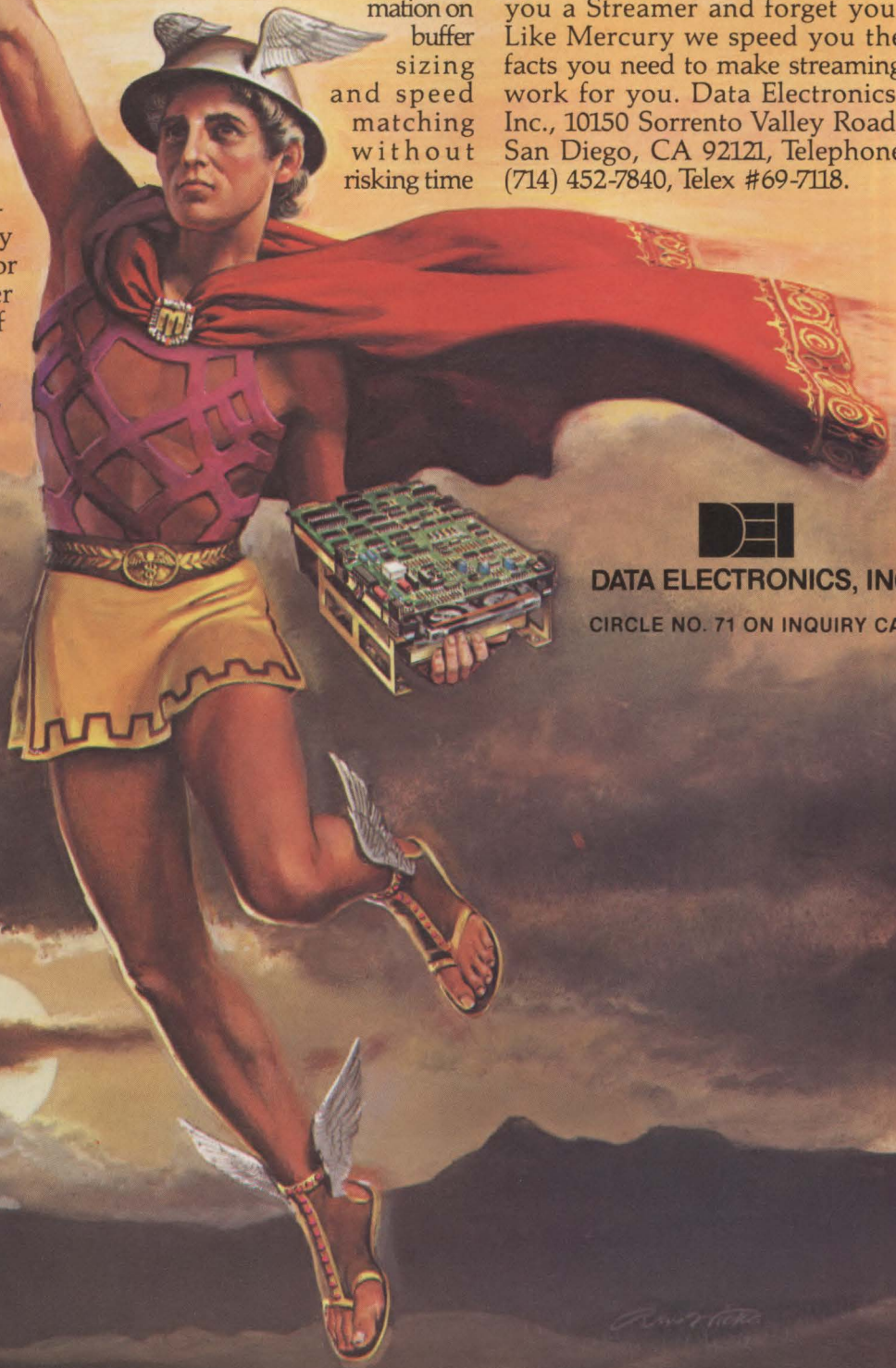
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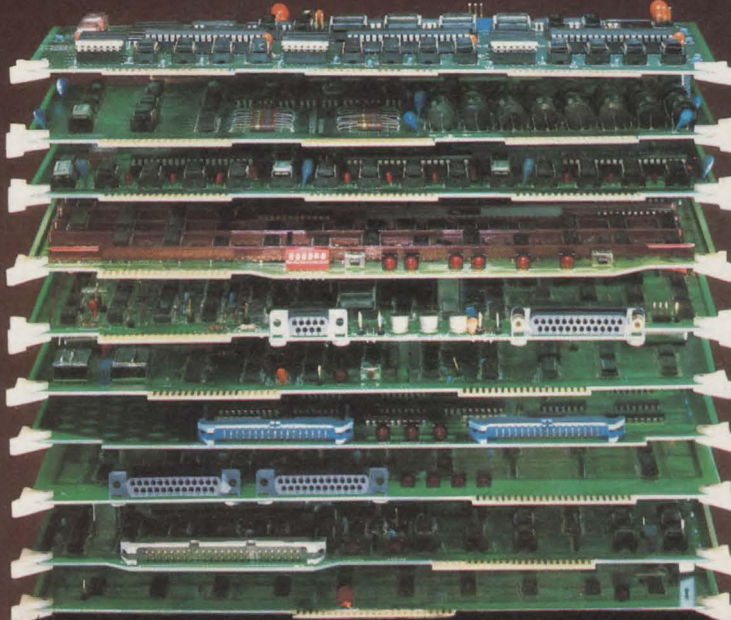
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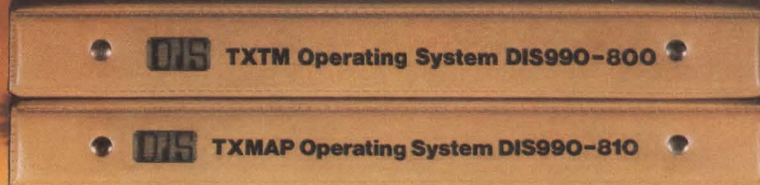
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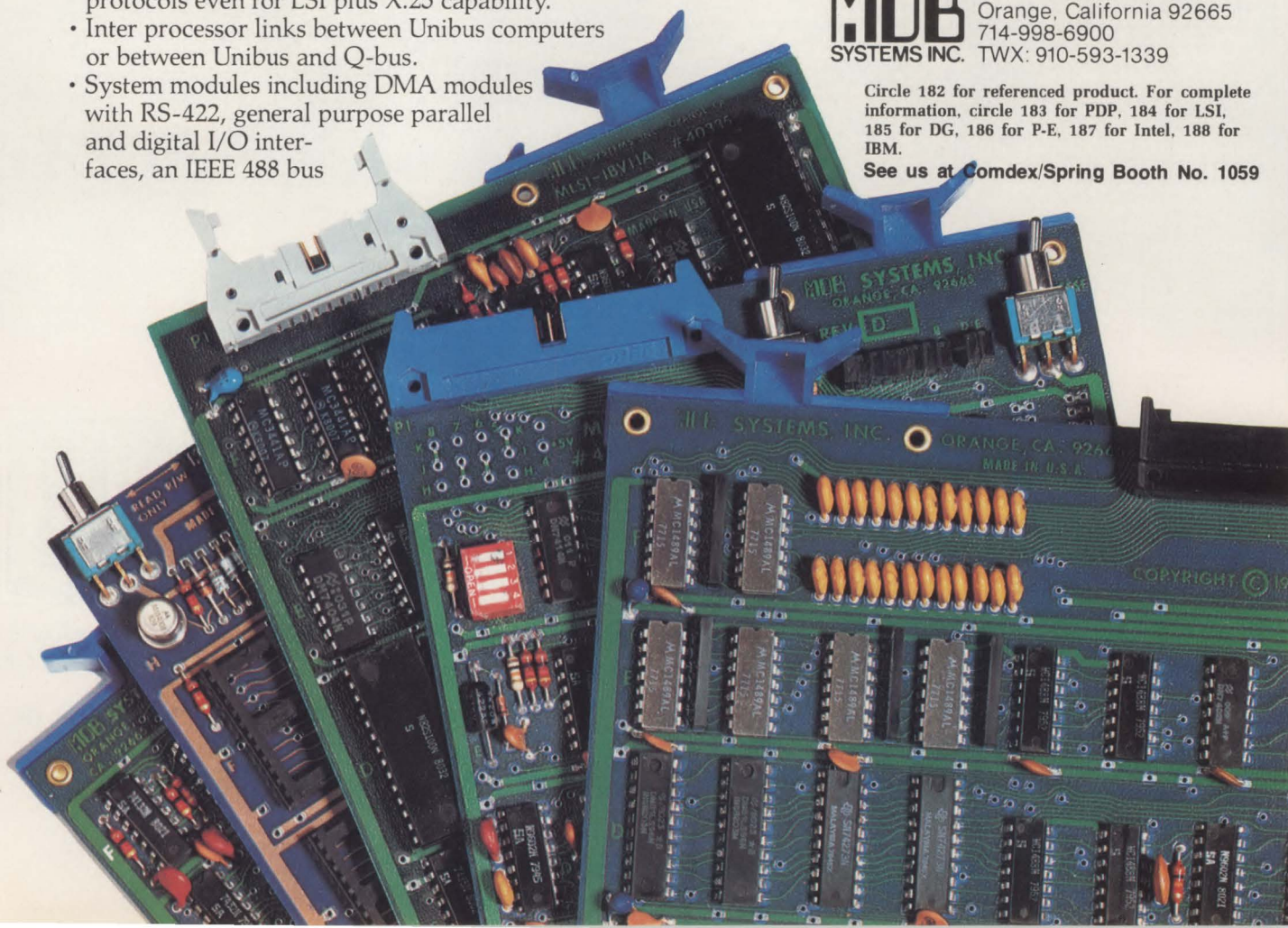
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COMMENTARY

Introducing 'Systems in Industry'

America's industry faces a dilemma: it is being told to invest in tools to improve productivity at a time when balance sheets caution fiscal conservatism. As production lines lie idle, management is pressured to approve capital outlays to boost performance or face continued market-share erosion. The problems of America's industrial base will not be easily solved, but must be faced.

Part of the solution is available within the revolution that brought computing power to medium and small businesses at a reasonable price. The minicomputers and μ cs that are restructuring the office are being hardened for entering industry. The emerging market for industrial systems promises to be huge, and *Mini-Micro Systems* intends to chronicle that growth. With this issue, we inaugurate a new section of the magazine entitled "Systems in Industry," which will report the successes and failures of companies using small systems in their plants, point out new opportunities for system builders and consider the special problems associated with industrial systems. Our first efforts include a look at a large process control system at General Motors, a small robot system at Shugart Associates, an overview of local-area networking on the factory floor and a

report on the market for the "blue-collar personal computer."

The distribution of computer intelligence to the factory floor through the use of minis and μ cs has received many characterizations, including the "factory of the future" and industrial automation. Although such terms become quickly hackneyed, they express in metaphor what many companies hope to achieve. But the obstacles to successful factory systems are formidable. There are the usual problems of interfacing, networking and software development as well as the unique problems of designing systems for hostile environments in which accuracy and continuous up-time are vital. We hope our efforts can help system builders overcome those obstacles. We invite your suggestions and comments to help us cover the computer-driven resurgence of American industry.

Eric Lundquist

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Factory networks come to the forefront

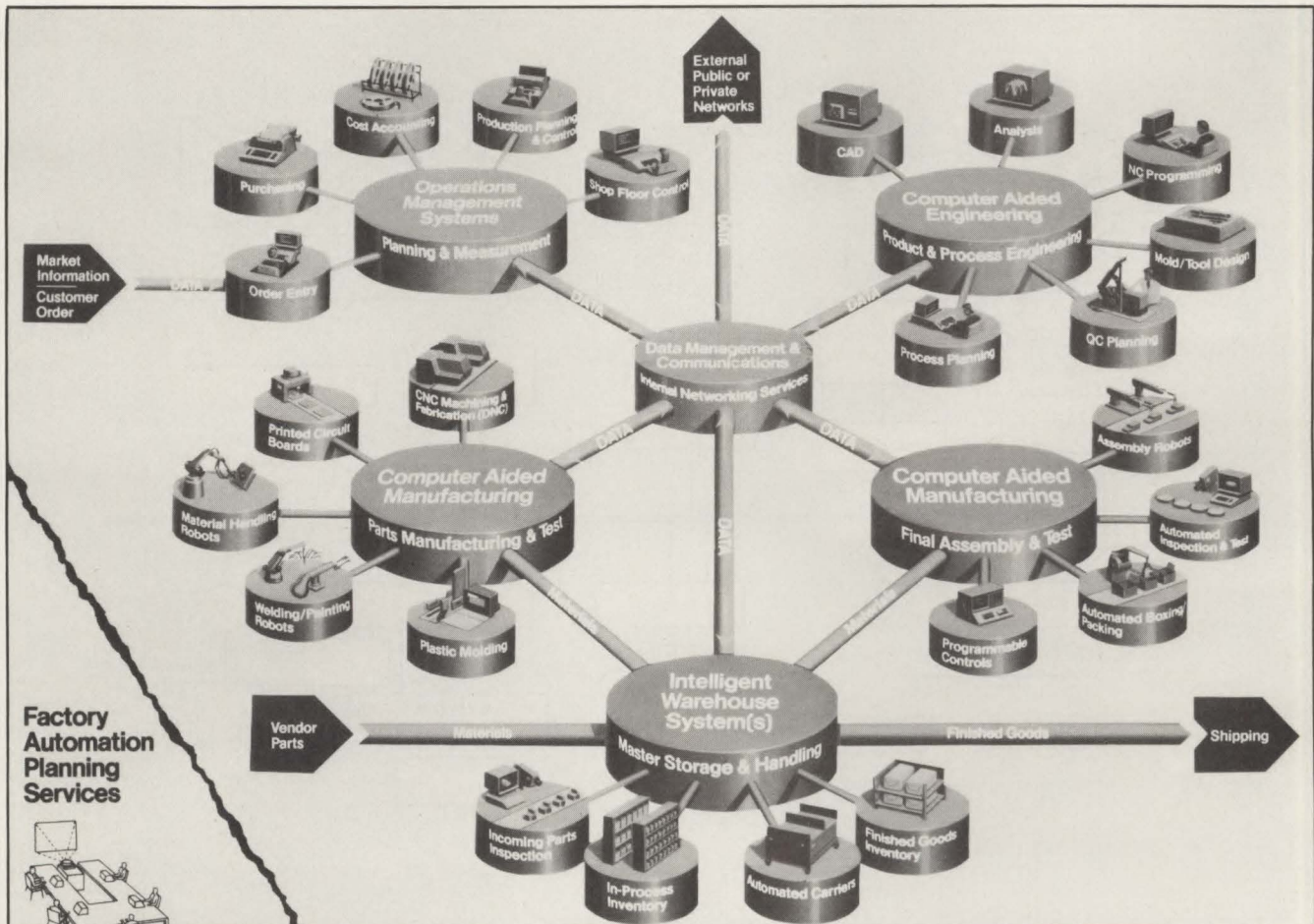
By Eric Lundquist
Associate Editor

As large manufacturing companies and system integrators wrestle with the problems of tying diverse industrial operations into a cohesive whole, vendors are coming forward with individual local-area networking solutions for the factory floor. Those solutions are similar to the bevy of LANs offered for the office, but the white-collar environment is far less hostile toward data communications than is the factory with its interference-generating electrical machinery and constant commotion. While an interrupted or improper flow of data causes discomfort in an office, it can cause disaster in a factory.

Companies as diverse as Texas Instruments Inc., General Electric Co. and the Electronic Systems Group of Gould Inc. have recently announced LANs aimed at the industrial environment. Those products, along with offerings from established vendors such as Digital Equipment Corp., Hewlett-Packard Co. and programmable-controller maker Allen-Bradley Co., are all competing in a still-embryonic market, but one that appears destined for considerable growth.

GE estimates that the factory LAN market was \$5.7 million in 1981 and has doubled for the past three years. The market will grow to \$165 million in 1985 and \$250 million in 1990, GE estimates. Of that \$250 million, the company projects, 75 percent will be from broadband and 25 percent will be from baseband networks. Further, the total LAN market in 1990 for both factory and commercial segments will be \$1 billion.

Those impressive projections imply a great change in the way factory communications will be handled.



GE's GENet LAN configuration offers 1M-to 5M-bps data rates, as many as 20 independent channels of information, compatibility with standard CATV systems and a family of interface modules. Diagram shows how the system links processes on the factory floor.

Systems in Industry

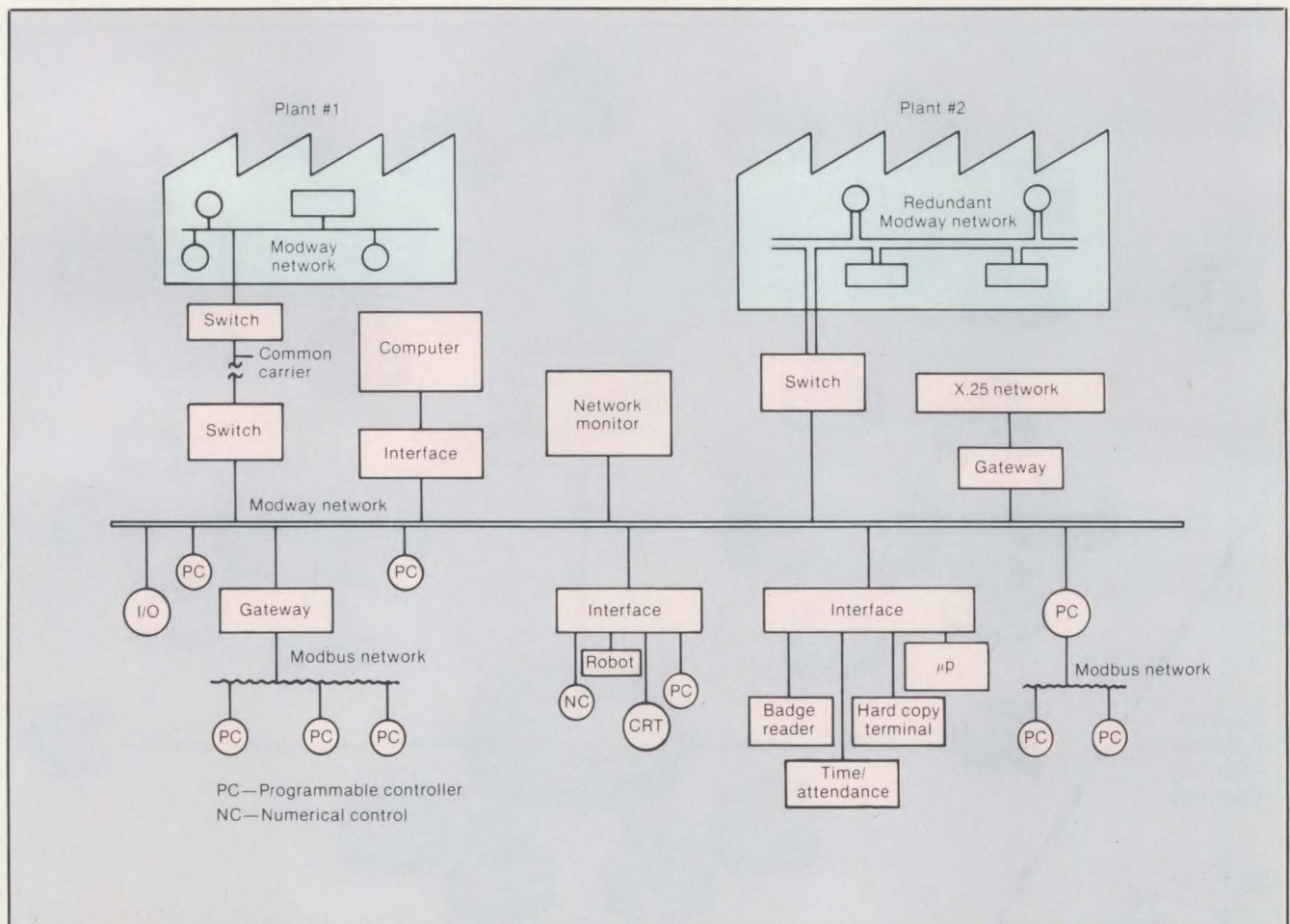
Octavio Martinez, senior vice president of GE's Intersil Systems, contends that more than 90 percent of factory-communication systems are hard-wired using a single channel, one device to another connection or using the voice-only PBX telephone switchboard as communication. Before networking can enter the factory, a host of problems must be resolved. They include developing interfaces between machinery and computers, a recessionary economy that has especially affected the industrial base and developing systems that control and monitor machinery while allowing information flow. The reward of increased productivity and profit is achieved at the risk of choosing vendors and systems when the market remains in turmoil.

"When you design a computer system, you start by designing an architecture, but I'm not sure anyone has really thought through the architecture required for a factory," says Dr. John W. Weil, senior vice president and chief technical officer at the Bendix Corp. in Southfield, Mich. Weil recently delivered the keynote address at the Information Management Conference for

Manufacturing in Chicago, where he stated that the success of linking individual factory elements will play a large part in determining the competitive success of companies and nations. Weil says the type of overall factory architecture will determine what type of technological solutions will be required and which networking schemes will emerge as leaders.

"The overall factory architecture will determine what kinds of bandwidths and data rates and two-way conversations you need. Out of that, you make a specification for a communication link or a hierarchy of such links. Disciplines in communicating around the factory might require extraordinary forms of redundancy or error correction, just to make sure that the message really gets there," Weil said.

Weil also stated that it could be a long time before standards for factory LANs evolve. He said standards usually develop in one of three ways: a de facto standard evolves when a manufacturer becomes overwhelmingly dominant, a government can impose a standard when some national interest is at issue, or a



Modicon's Modway LAN system configuration is a peer-to-peer masterless device that operates at a transmission rate of 1.54M bps for distances as long as 15,000 ft.

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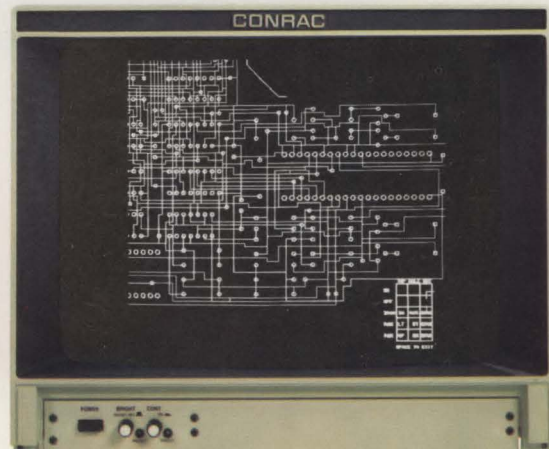
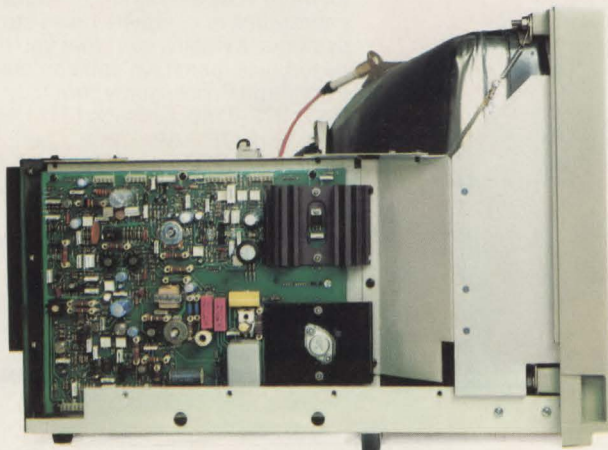
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standard evolves from a long period of useful experimentation and a gradual development of opinion across the field. Weil believes the latter method is the most likely possibility for the factory.

Several programs that may result in standards are under way. These include efforts by the IEEE and projects funded by government agencies. But the recent entrants aren't waiting and have developed proprietary systems that they say will eventually interface with other networks and conform to a standard if one is adopted. Most vendors have adopted an approach using broadband technology using a coaxial cable. Broadband uses frequency division multiplexing to allow for multiple channels (including voice and video channels) to operate on the cable.

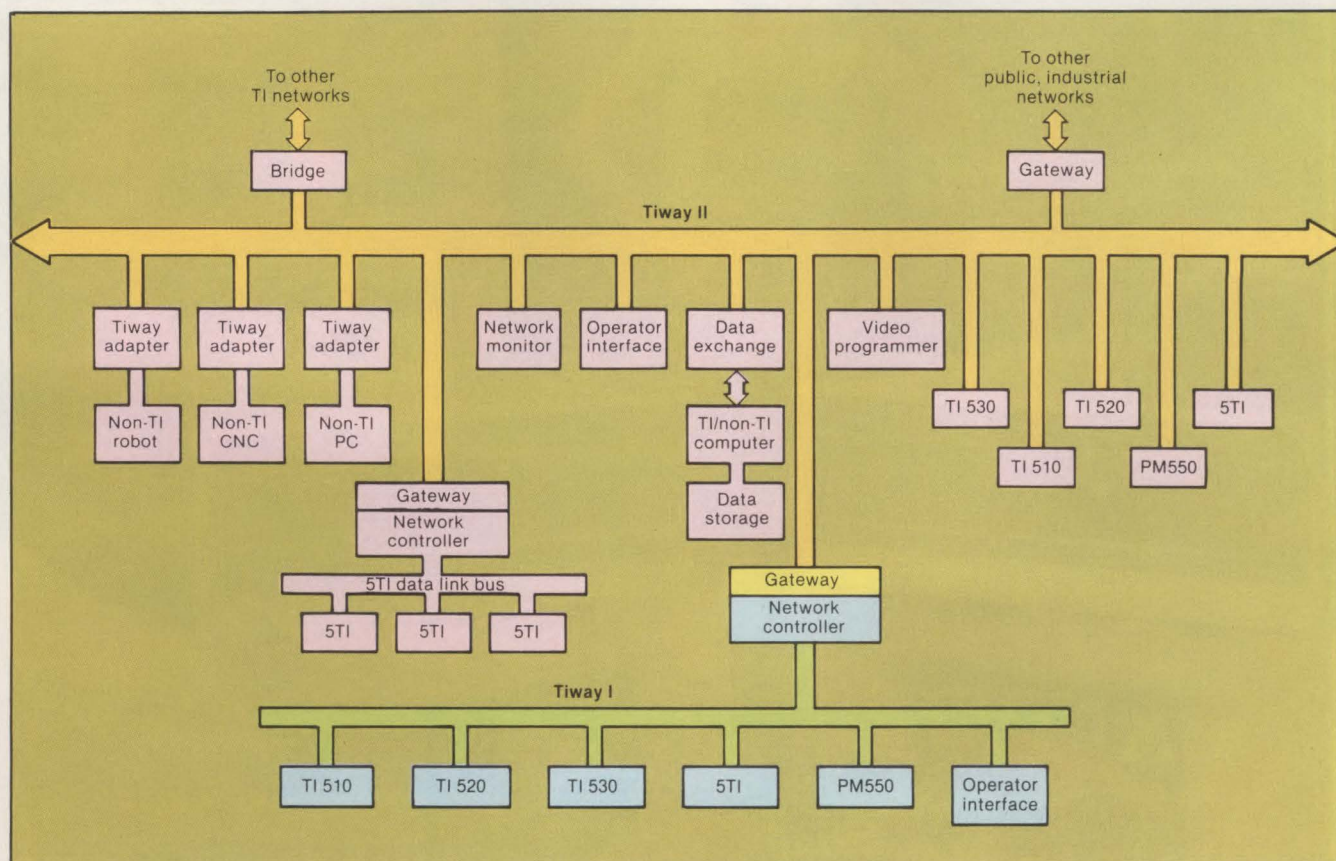
H-P, which is making substantial marketing efforts in industrial-automation applications, believes that the standardization efforts by the IEEE and the baseband Ethernet product promoted by Xerox Corp. will converge. Group engineering manager of H-P's Technical Computer Group James Bell says, "We have tried to play the role of honest broker. We believe the two Ethernet-like camps, the IEEE and Ethernet, will converge and what we will be able to offer and what those people will be able to offer will be compatible.

Until that convergence, the company is believed to be readying an LAN than will operate at a lower speed and lower cost than Ethernet.

Some analysts say attempts to tie the machinery and the information flow into one system is a mistake. "Process control for equipment and information control are two different animals, and a lot of people are trying to hang the two of them together," says C.H. "Pete" Link, a Texas-based factory-automation consultant. Whether a dual system or a single system for machinery control and information flow is used, the cable must be protected from interference. The interfaces must be built to withstand the industrial environment.

The GE LAN configuration, named GENet offers 1M- to 5M-bps data rates, as many as 20 independent channels of information, compatibility with standard CATV systems and a family of interface modules. I/O interfaces include RS232C, RS422 and 8-bit parallel and asynchronous rates as high as 56K bps. Protocols supported include the proposed IEEE 802 standard, asynchronous terminals, HDLC, DECNET and GRTS.

The system's GENet bus interface unit acts as a communications controller, allowing connected devices access to the cable. A family of μ p-driven I/O modules supports user interfaces and protocols, with each BIU



Texas Instruments' broadband strategy includes the Tiway I and II networks, both aimed at networking industrial controls into a distributed environment.

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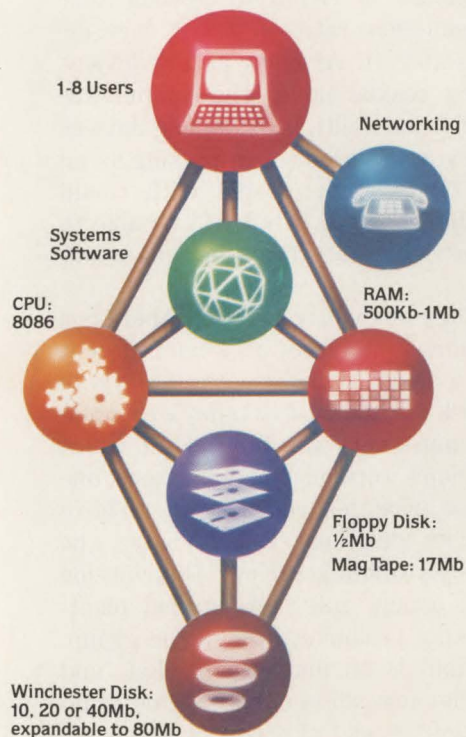


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Systems in Industry



The Intersil Systems team that developed the hardware for GE's GENet LAN for the factory and office is (left to right) Robert Gretz, senior engineer, Richard Wittlin, manager of engineering, and Dr. Kenneth Bloom, director of engineering. The broadband GE system provides a closed-circuit "data highway" that can be used to link all components of an automated factory into an advanced, "paperless" industrial system.

containing as many as four I/O modules and as many as 16 asynchronous or synchronous access devices, a CATV modem and a network-access module. The network access module is used to implement the carrier-sense multiple access with collision detection (CSMA/CD) strategy. The GENet operating system conforms to the proposed IEEE 802 LAN standard and includes and goes beyond levels 1 and 2 of the ISO reference model to provide both network and transport services. GE also provides a communication controller programmable system for protocol translation between devices. A typical network with 20 BIUS sells for about \$100,000. This year, the company plans to offer a token-passing access method and the first of several gateways for tying GENet to other networks. The company has interfaces for Digital Equipment Corp., Honeywell Inc. and Data General Corp. computers and plans H-P and International Business Machines Corp. interfaces.

GE officials claim that an internal study shows that, in a moderately automated factory, networking only a few software-based components, such as robots, security and fire systems, machine tools and master computers, would result in scrap reduction saving several million dollars, and increased productivity and maintenance. Thousands of dollars could be saved per machine tool simply by eliminating the paper tapes used to program numerical machine tools, the company says.

Texas Instruments Inc.'s broadband strategy in-

cludes the Tiway I and Tiway II networks, both aimed at networking industrial controls into a distributed environment. Tiway I is an extension of the company's programmable-controller hierarchical network, and Tiway II is a peer-to-peer network designed to use broadband CATV technology. In a statement accompanying the announcement of the two systems (Tiway I is an upgrade of a product introduced in 1980), TI's industrial control manager Mac McDonnell said, "We compared industrial-control requirements for reliability and ease of use against proposed systems and proposed standards from Technical Society Committee activities. We saw no guarantee that the proposed LANS would meet factory-automation needs or survive the industrial environment."

Tiway I uses the X.25 protocol. By year-end, the company intends to upgrade the system to a 19.2K-bps baud rate with the ability to attach 254 devices. The company also will add a network controller to provide a gateway to non-TI minis and μ cs over RS232C ports. Tiway I will be compatible with Tiway II through a gateway. Tiway II will have future compatibility with other media such as fiber optics, twisted-pair cables and phone lines. The CATV coaxial cable provides data-transfer integrity because the bandwidth is outside the industrial noise frequencies, the company claims. Data rate will exceed 1M bps.

Gould's networking plans revolve around the Modway system, a peer-to-peer, masterless (no master or bus-arbitration device is required) system that operates at a transmission rate of 1.54M bps for distances as long as 15,000 ft. As many as 250 devices can be supported over coaxial cable. The communication channel is time division multiplexed among devices needing to communicate and uses token passing as an access mechanism. The system is sold with Gould Modicon programmable controllers but will be able to connect other devices when interfaces become available.

Whichever technology or topology is used, there is a constant need for common interfaces between different vendor brands and a need to include the ability to implement the network modularly. "In today's economic environment, you must very carefully select which things you do. If you don't work on a modular basis, one in which you can revise priorities, you are going to be in trouble," says DEC vice president Roger Cady, who oversees the company's Manufacturing, Distribution and Control Product group. DEC sells unified plant-management networking products through the group.

"(Factory automation) is an immense market, and there are a lot of smaller companies out there that could use a smaller version of the sort of products we have," Cady says. ■

Do other diskette makers have this secret ingredient

$$V(Y|X) = V\left(\sum_{j=1}^K \beta_j X_j + \epsilon\right) = V\left(\sum_{j=1}^K \beta_j X_j\right) + \sigma^2$$

$$= \sum_{j=1}^K X_j^2 V''(\beta_j) + \sum_{i=1}^K \sum_{\substack{j=1 \\ i \neq j}}^K X_i X_j \text{cov}''(\beta_i, \beta_j) + \sigma^2$$

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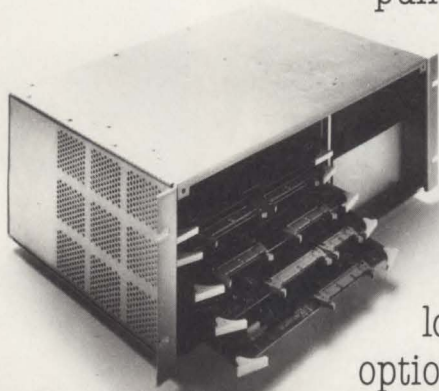


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CMS

Production monitoring in a diesel-engine plant

By Amy O'Neal Rogers, Belcan Corp.
and Fred E. Lowe, Culverin Corp.

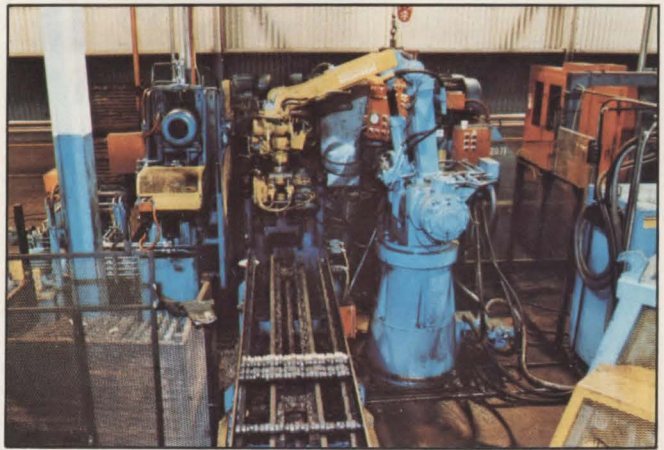
Production-monitoring systems are coming to the forefront as one of the most important components in the integrated factory. Such systems assure a smooth manufacturing process by quickly directing plant personnel to machine failures and warning when preventive maintenance, such as tool changes or quality-control checks, are required.

In April, a production monitoring system was installed at a General Motors diesel-engine assembly plant in Moraine, Ohio. Belcan Corp., Cincinnati, designed the system, and Culverin Corp., Dayton, Ohio, provided the monitoring software. The system connects a variety of minicomputers, CRT terminals and programmable controllers over a broadband coaxial-cable network. A Digital Equipment Corp. PDP 11/70 minicomputer, programmed in FORTRAN under RSX11-M, serves as a monitor, which communicates with 200 Modicon PCs, and 14 Intelligent Systems Corp. color terminals. Interactive Systems Corp. and 3M Corp. supply the communications subsystem, with a DEC PDP 11/34 front-end processor.

The system monitors more than 150 machines for fault detection and more than 3000 stations within machines for tool changes or quality-control checks. The monitoring computer automatically gathers machine-status and cycle-count data from PCs throughout the 21-acre plant. The host interprets the data from the PC and sends appropriate information to CRT terminals on the plant floor. Plant personnel use the information they receive to determine what action must be taken on what machines.

Before the system's installation, data in the plant flowed between PCs and their associated machines and from plant personnel to machines. Although the PCs contained the information to determine machine status and cycle count, the data were unobtainable. A worker had to be assigned to each machine to determine if it was working properly.

The production-monitoring system changed the man/machine relationship and allowed GM to close the information gap. With the monitoring computer and changes to the PC program, users can react to data received from the PCs via CRT terminals, rather than from the machines. Fewer workers need be assigned to monitoring duties because the system enables one worker to monitor a greater number of machines.



Robots used in engine assembly are also tied into GM's production-monitoring system.



GM's production-monitoring system monitors more than 150 machines for fault detection and more than 3000 stations within machines for scheduled tool changes and quality-control checks.

Two subsystems comprise the production-monitoring system: the data-gathering subsystem and the monitoring subsystem.

The data-gathering subsystem consists of the monitored machines and their PCs. The subsystem collects data to determine the status of machines and cycle-count data. Machine-status information tells a user whether a machine is on or off, in automatic or manual mode and loading or unloading a part. Status information tells a user whether the stations of each machine are operating. Effective status reporting must be quick, up-to-date and formatted in the PC in such a way that information can be easily obtained and interpreted by the monitoring computer. Using a bit-setting technique, the monitoring logic packs the status information into one block of registers, which can easily be accessed by the computer and decoded.

Cycle-count data are maintained so that the monitoring computer can determine when tool changes and quality-control checks are needed. For example, if a



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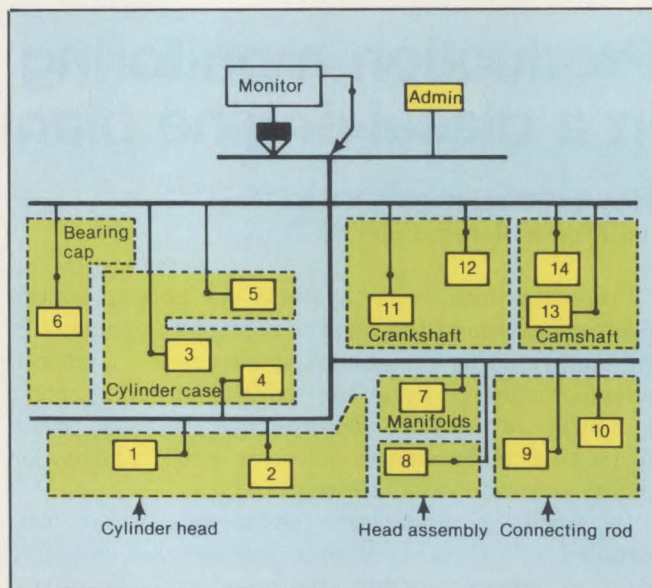
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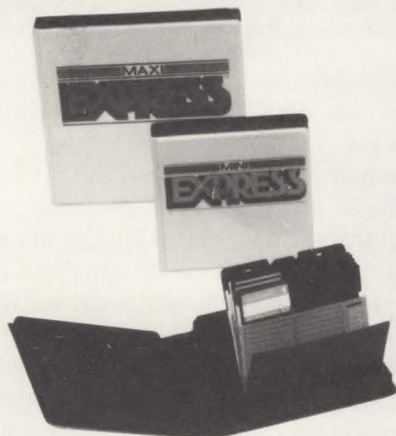
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Systems in Industry



A broadband coaxial-cable network (shown as black line) connects the production-monitoring system. The 21-acre diesel-engine assembly plant has 14 CRT displays in eight production areas (enclosed in broken lines). A 15th display is located in an administrative office. The monitoring computer gathers data from PCs attached to machines, interprets the information and transmits it to the shop floor.

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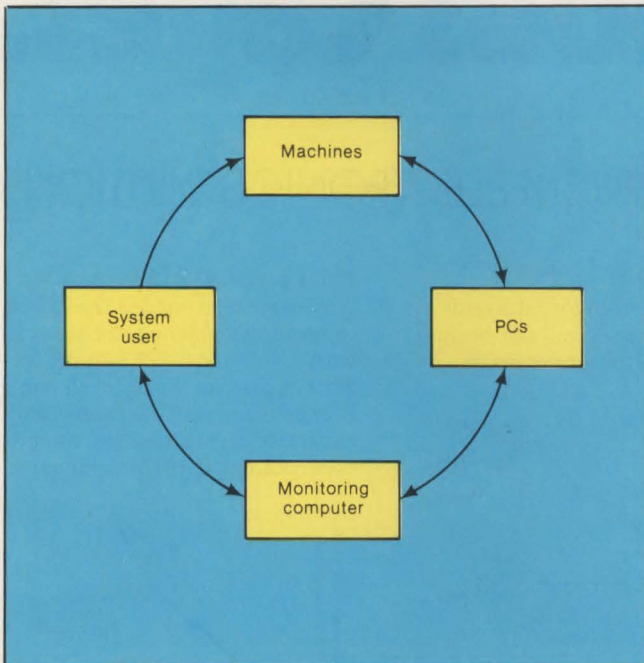
machine is down for unscheduled maintenance, and a foreman sees on the CRT screen that a tool change is due in 30 cycles, he can change the tool early to minimize down time. As with status data, machine and station-cycle count data are collected in blocks of registers. Two cascaded counters are used for each accumulator, ensuring that each PC can maintain its counts for at least 24 hr. Although the monitoring computer reads the status registers each time it polls a PC—every 5 to 10 sec.—the cycle-count data are read less frequently—every 10 to 15 min.—because those data support less critical functions.

The monitoring computer subsystem reads and interprets data from both the PCs—the “alarming” function—and from the system users—the “user-interaction” function.

The alarming function collects status information for the monitored machines and machine stations, and maintains cycle-count data for determining when tool changes and quality-control checks are required.

The user-interaction function allows plant personnel to notify the system when events such as tool changes or quality-control checks have occurred. The function also allows users to obtain more detailed information regarding a machine failure or a required action.

Access to the system is controlled by a security scheme that allows a user to perform only those functions that relate to his job. Tool setters, for example, have the authority to tell the system that a tool change has been completed, but not to shut down



Although all the data to determine the status of a machine reside in the PC, the data were unavailable to users before the installation of the production-monitoring system. The system provided a closed-loop communication channel by which users could extract relevant machine information from the PC through the monitoring computer.

the system. Users interact with the system via the CRT displays, each of which are divided into the alarm area and the user-information area.

The primary display, which a system user normally sees, is updated continually as data are received from the PCs. Through the use of color, inverse video and blinking, the display indicates any machine in the monitoring area that requires attention and the number of machine cycles until the next scheduled tool change or quality-control check. If more detailed information is required, such as when a failure occurs, a user can request a secondary display for a machine. This display provides a snapshot of the requested machine with status and cycle-count information for each station.

Before performing any function other than requesting a primary or secondary display, a user must perform a sign-in procedure, which allows the system to time- and date-stamp all transactions and to establish which functions a user can perform. After signing in, the operator can request a function or a menu showing what functions are available. A question-and-answer scheme is used if possible so that the user can respond with a yes or no. Based on authorization, users have access to verification of tool changes and quality-control checks, remapping of a CRT to monitor a different area of the plant, running a report, shutting down the system and altering of data in the system tables.

The production-monitoring system meets its designers' main objective by showing floor personnel where

MONITORING AREA - HEAD LINE - AREA 1

OPERATION ID	OPERATION DESCRIPTION	OPERATION CYCLE STATUS	LOAD STATUS	UNLOAD STATUS	NEXT TOOL CHANGE	CYCLES UNTIL
01-100	BROACH	ON	ON	ON		A0
01-101	DRILL	ON	ON	ON		A0
01-102	DRILL	ON	ON	ON		A0
01-103	DRILL	ON	ON	ON		A0
01-104	DRILL	ON	ON	ON		A0
01-105	DRILL	ON	ON	ON		A0
01-106	DRILL	ON	ON	ON		A0
01-107	DRILL	ON	ON	ON		A0
01-108	DRILL	ON	ON	ON		A0
01-109	DRILL	ON	ON	ON		A0
01-110	DRILL	ON	ON	ON		A0
01-111	DRILL	ON	ON	ON		A0
01-112	DRILL	ON	ON	ON		A0
01-113	DRILL	ON	ON	ON		A0
01-114	DRILL	ON	ON	ON		A0
01-115	DRILL	ON	ON	ON		A0
01-116	DRILL	ON	ON	ON		A0
01-117	DRILL	ON	ON	ON		A0
01-118	DRILL	ON	ON	ON		A0
01-119	DRILL	ON	ON	ON		A0
01-120	DRILL	ON	ON	ON		A0

THE FOLLOWING FUNCTIONS ARE AVAILABLE FOR SELECTION
 ADMIN - admin TCC - tool change DCC - DC check
 SIGN - sign in SFC - sign off REP - reports

The primary display presents up-to-date status reports on an assigned portion of an assembly line. Color variations, blinking and reverse video convey the importance of each status message. The upper portion of the screen displays the alarming functions, and the lower portion displays the user-interaction function.

and when a machine fault occurs. Both the data-gathering subsystem and the monitoring subsystem are easy to maintain and modify.

The data-gathering subsystem logic is consistent from PC to PC, thus simplifying system implementation and maintenance. In addition, each PC has a store of unused registers and logic lines for expansion to the monitoring system.

The modularly designed monitoring subsystem software also has several features that facilitate maintenance and modification. Its major functions, such as communications, status recognition and CRT handling, are separate so that each can be modified individually. A central dispatch function that handles user requests allows functions to be added to the system. Planned enhancements include production-scheduling and -tracking capabilities, integrated-PC support and graphics.

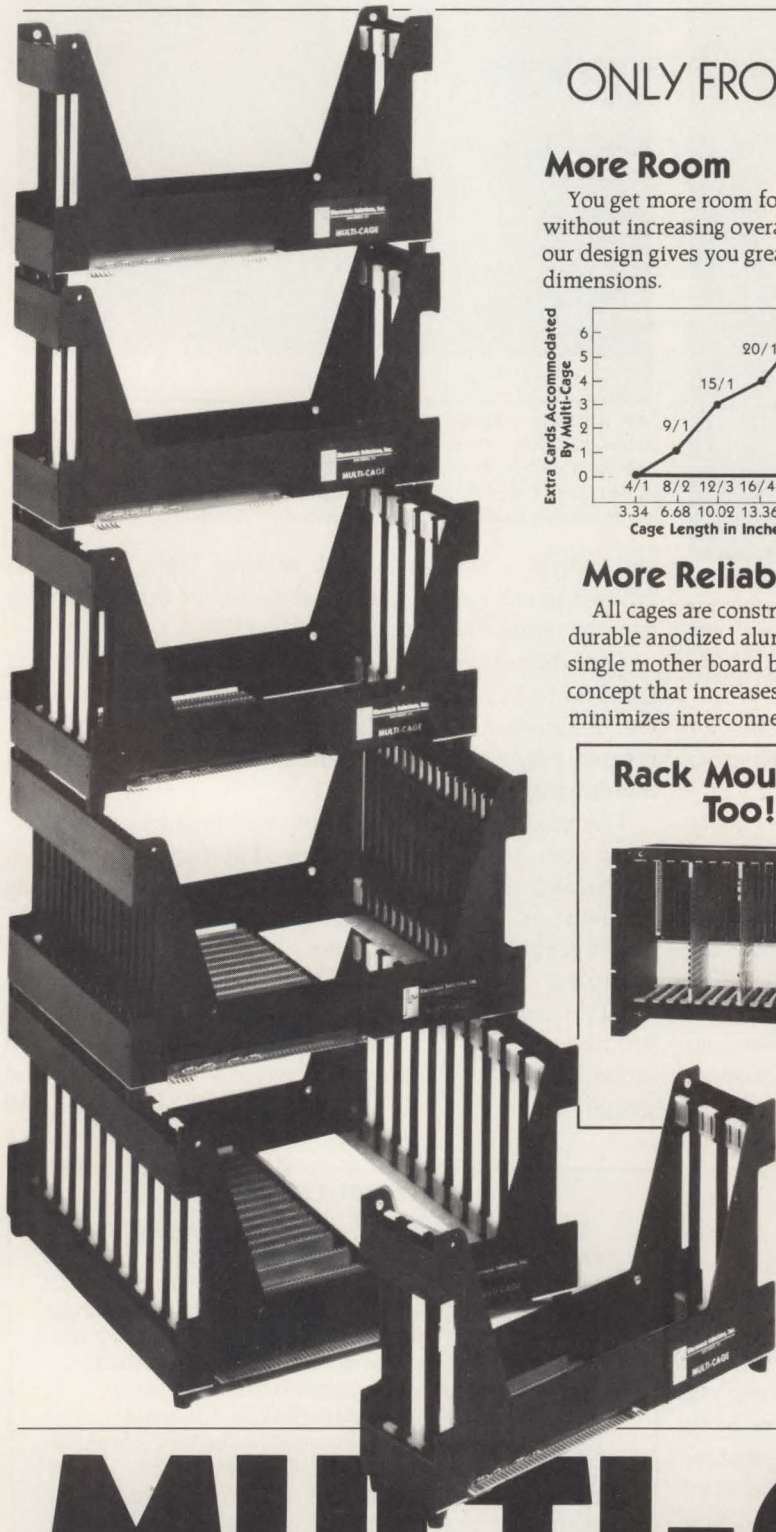
NEXT MONTH IN MMS

Watch for Mini-Micro Systems' annual special report on computer graphics in the July issue. A comprehensive survey of graphic terminals for business and science applications will lead off the feature section, which will be augmented by several other graphics-related articles, including:

- A look at turnkey graphic systems.
- A tutorial on graphic-input peripherals.
- A survey of color hardcopy devices for graphics.

Mini-Micro Systems is also planning major product survey articles in coming months, including microcomputers in August, high-level languages and development systems in September, memory systems in October and computer terminals in November.

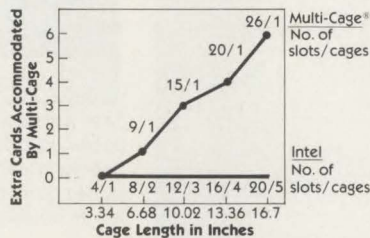
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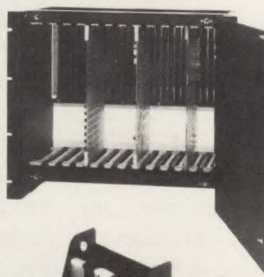
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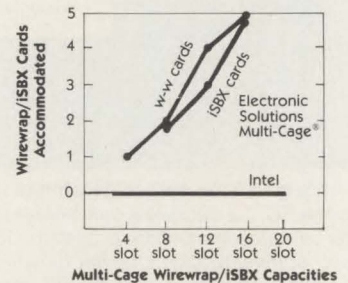
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DEC aims Professional series at industrial users

By Frank Catalano
Associate Editor

In an effort to bring white-collar solutions to blue-collar chores, Digital Equipment Corp., Maynard, Mass., will tap its installed industrial-customer base with its new line of desk-top computers. DEC is aiming the systems at supervisory applications on factory floors.

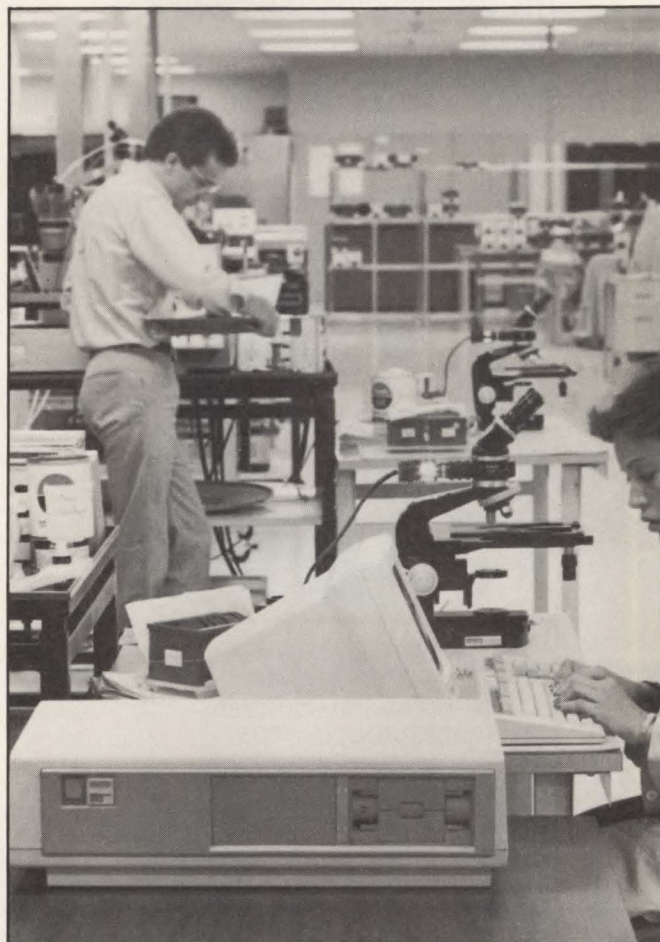
Although the four low-end systems will be marketed through DEC's Manufacturing, Distribution and Control group, the 16-bit Professional 325 and 350 computers fit into DEC's industrial architecture, says Roger Cady, executive vice president of the MDC group. Programmable in BASIC and running Aristis, a subset of DEC's RSX-11 operating system, the 325 and 350 systems are hardware and software compatible with larger VAX and PDP-11 computers and are equipped with expansion slots for interface cards. Prices for the 325 start at approximately \$3990, and prices for the 350 start at approximately \$4990.

In a factory environment, says Tony Ryanczak, market development manager for MDC, the system can be used as work stations by the first level of plant management to fill the information gap between production and business management. The planning and business functions are typically run on mainframes, and the machine process-and-control functions are run on minis, μ cs or programmable controllers, Ryanczak says.

"The plant foremen or production engineers were at the mercy of the mainframe, which extracted any supervisory data from the process-control computers and displayed the data on terminals located on the plant floor," says Ryanczak, "The Professional computers bring processing power down into the factory, where data can be directly accessed and manipulated."

Cady notes that, because the new systems are compatible with larger DEC computers, a user need not reprogram his process-control computers or mainframes to tie in with the supervisory unit on the plant floor. "The Professional computer has all the intelligence it needs to access and manipulate the data the user requires," he says. "It extends into the factory the distributed-data-processing concept that DEC pioneered in the office 15 years ago."

Cady says that the 325 and 350 can perform supervisory functions, including production planning, resource allocation, quality control, energy manage-



Digital Equipment Corp.'s manufacturing, distribution and control group is planning to sell the company's new line of desk-top computers into its installed industrial base for supervisory applications on the factory floor.

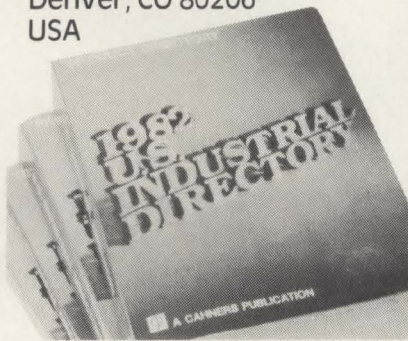
ment and preventive maintenance, and typical office applications such as electronic mail and word processing. "The same kinds of communications tools that have enhanced office productivity could also be applied on the factory floor," he says. Ryanczak notes that the 325 and 350 can be equipped "downstream" with industrial I/O capabilities, ruggedized packaging and IEEE interfaces for direct machine and process-control applications. DEC is concentrating on supervisory applications with the initial release to gain a lead in a relatively new and untapped market. "DEC already has approximately 35 percent of the direct factory-control market with our larger systems," he says. "We're working on building an

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applications strategy for plant managers. There's no one dominant in that market, and the new Professional series provides us a perfect vehicle to fill the void."

Alex Beavers, a manager of strategic planning for the Industrial Electronics Business Group at General Electric Co., considers DEC's strategy wise compared to that of other companies offering industrialized personal computers for process-control applications. He says products from Hewlett-Packard Co., Tektronix, Inc., and Fluke Manufacturing Co. lack the multi-tasking operating systems and I/O and computation speeds needed for most machine- and process-control applications, and are limited in their applications. "I see the need for the small computer in the factory as a means of distributing intelligence and providing an interface between the human and all the automation going on out on the floor," Beavers says. "The small personal computer will be an important element in collecting data from machines and displaying the data in a way that will be useful to plant management."

While the systems are not enclosed in ruggedized cabinets to withstand harsh factory environments, most applications for the systems do not require such enclosures, says Cady. "If you start talking about using them on the shop floor of Norton where you have a hell of a lot of abrasive dust floating around and grease and so forth, you may run into trouble," he says. "Such an application would require a different level of product."

DEC plans to market the Professional series under the MDC group's Unified Plant Management Strategy, which prompts customers to look at the total solution to their factory needs, Ryanczak says. "We're trying to get people to evaluate more than point applications," he says. "We want them to build their solutions around our architecture, our hardware and software compatibility and communications capability. We have the systems architecture, compatibility and communications, but we have to work on the various applications." DEC did not introduce any industrial application packages with its Professional series in May, but Cady says his group is working with third-party software houses and its internal programming team to develop such packages.

Although the MDC group caters primarily to large Fortune 500 companies and OEMs, the new systems will open markets with smaller companies as well, Cady says. "The key to the usefulness of these systems is that they're relatively inexpensive and easy to program," he says. "They'll provide new functionality to Fortune 500 companies and will bring first-time computing power to smaller companies."

The MDC group will sell to large-volume buyers directly but will depend on third-party software houses to handle smaller companies, Cady says. ■

Shugart robot system builds disk drives

By Eric Lundquist
Associate Editor

A robot system is ready to join the work force at Shugart Associates where it will assemble the basic parts of a floppy-disk drive. The system, named FAB-1, is the product of Shugart's Advanced Production Technology group. APT manager Ron Albo contends the system is one of the first to do practical assembly work.

FAB-1 is scheduled to enter the production line by mid-year at the company's Roseville, Calif., manufacturing plant. The FAB-1 process automatically completes sub-assemblies of Shugart's SA410 (single-sided) and SA460 (double-sided) 5¼-in. Minifloppy-disk drives. Plans call for the system to crank out a completed sub-assembly every 53 sec. over a 10-hr. shift. One operator will be able to oversee two of the systems and do the work that now requires six people. Albo expects the system to pay for itself in two years.

The system's success highlights the possibility of using robots for assembly and illustrates the emerging market for system builders using standard robots and controllers and incorporating them into a production system. Albo and the APT team found themselves cast into the role of system builders when an initial interest in robotic assembly received financial backing from a skeptical management. When a quick survey of the robot industry revealed a lack of system houses building the type of assembly system Albo wanted, the APT team decided to do the work themselves. FAB-1 has removed that management skepticism, and Shugart is considering extensive use of robotic assembly systems throughout the manufacturing operation, Albo says.

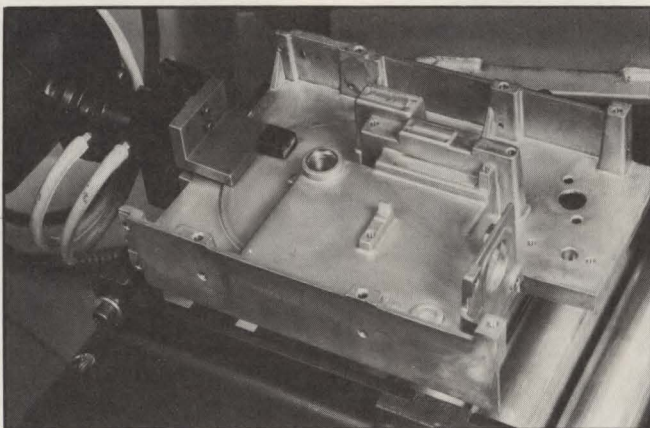


Shugart engineers Jack Brown (left) and Ron Albo, who pioneered the company's use of robotics, monitor the sub-assembly process of the SA410/460 family of 5¼-in. Minifloppy disk drives. Placement on an assembly line is scheduled for mid-1982.

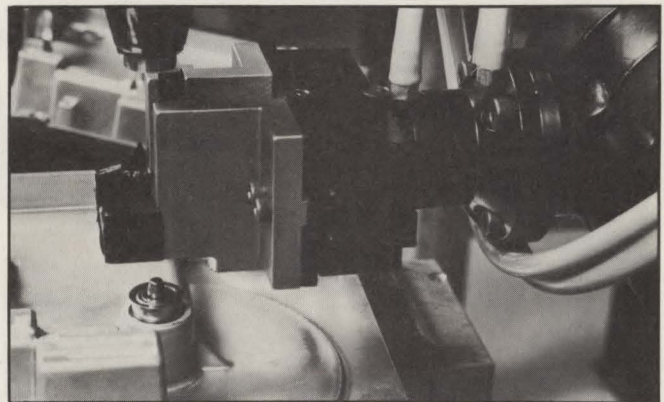
The Shugart system assembles the first eight components of the disk drives. Parts are removed from feeder mechanisms by a Unimation Corp. Unimate 500 robot. A robotic arm places the parts on a series of presses controlled by a Texas Instruments Inc. programmable controller that uses ladder-relay logic. Robot and controller movements are coordinated, but there is no electrical connection between the two.

The robot operates under VAL, a proprietary robot-oriented language developed by Unimation. Albo and Jack Brown, an outside consultant working with Shugart, were able to write the system's software despite having no knowledge of VAL. The VAL program is written in about 300 program steps.

The system essentially mimics the manual process: the robot picks an SA410/460 casting from a conveyor line and moves the casting to the first of three presses.



The sub-assembly process begins when a SA410/460 casting is picked up from a conveyor line by the robot and moved to the first of three processes.



After the casting is positioned at the first press, a flange bearing supplied by a feeder line over the press is inserted on the casting. While the sub-assembly remains there, the robot picks up a spindle and positions it at a second press.

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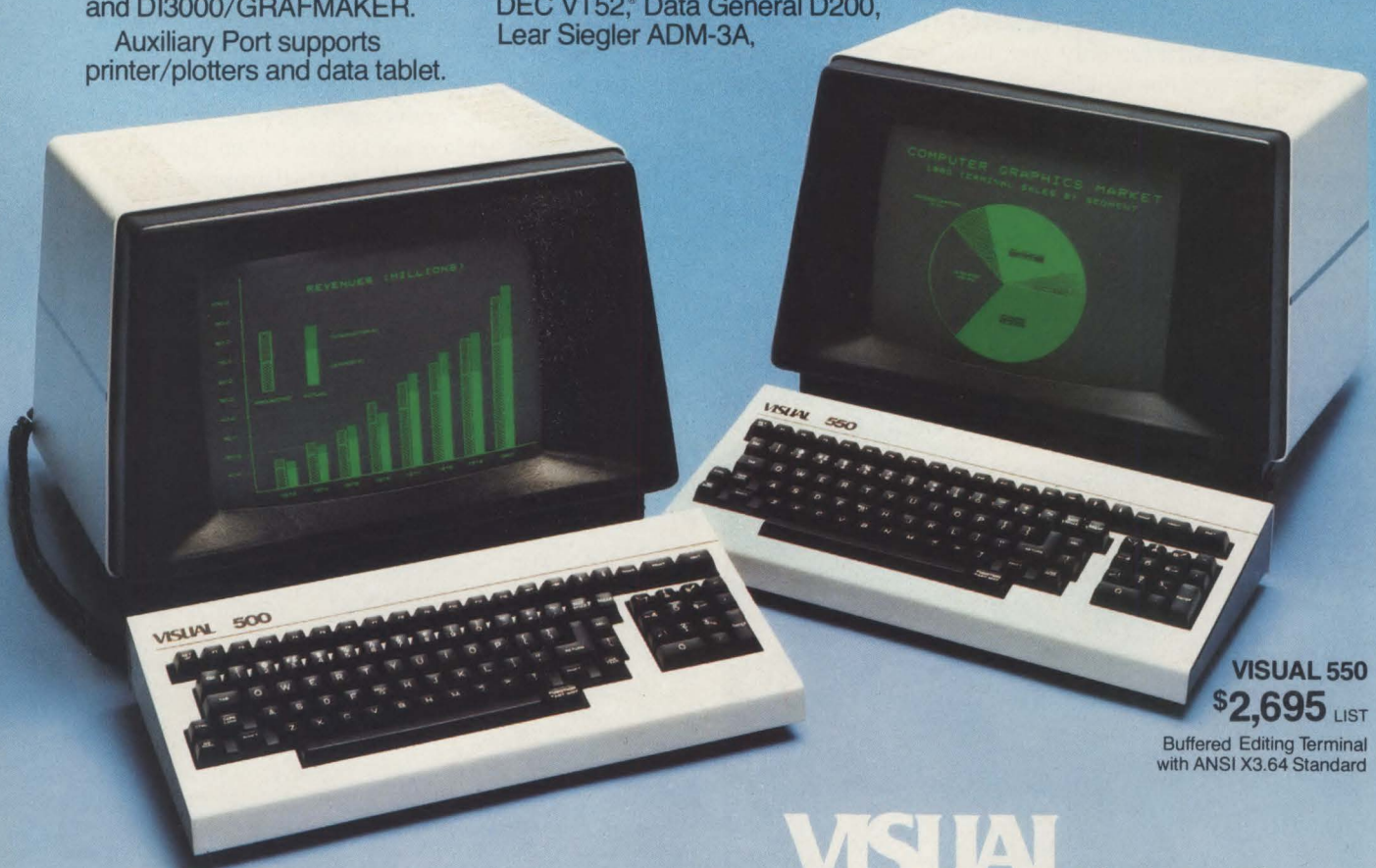
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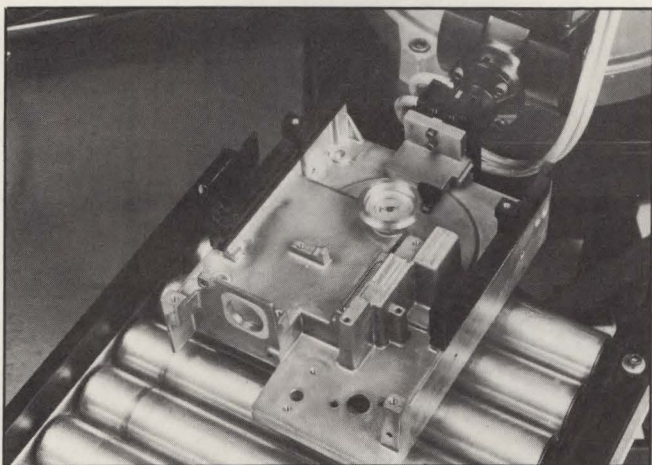
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Systems in Industry



With the sub-assembly process completed, the unit is placed on a second conveyor line. After a visual inspection, the sub-assemblies are taken to a final assembly production line for completion of the manufacturing cycle.

Another casting is automatically shifted into position on the conveyor line, replacing the one removed by the robot.

After the casting is positioned at the first press, a flange bearing supplied by a feeder line over the press is inserted on the casting. While the sub-assembly remains there, the robot picks up a spindle and positions it at a second press. Once the spindle and a spring have been inserted, a plane bearing is added, followed by a pulley.

While the casting remains at the second press, the robot picks up left and right guide rods and positions them at a third press. The rods are attached to the casting through pressure supplied by a flat press. With the sub-assembly process completed, the unit is placed on a second conveyor line. After a visual inspection, the sub-assemblies are taken to a final assembly production line for completion of the manufacturing cycle.

The parts are fed to the system using a basic gravity system, one of the areas that requires additional development. Albo says the company plans to use six-axis, rather than five-axis, robots in future systems. With a five-axis system, layout is limited to radial orientation. A six-axis robot could use a wall-mounted parts system. Installed on a factory floor, the system will be surrounded by a wire cage. An operator with a kill switch will oversee the system.

The next step for Albo will be to develop plans for tying the robot systems into larger factory data-collection systems. Shugart has invited several large companies to discuss further automation of factory operations.

"We plan to put robots where they make sense, and all robot projects have to have a pay back. One of the ground rules for vendors is the need to make a provision for data output," Albo says. ■

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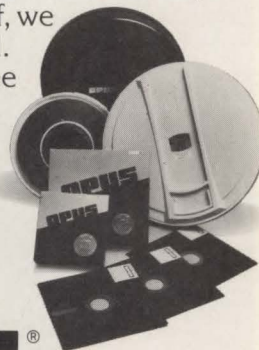
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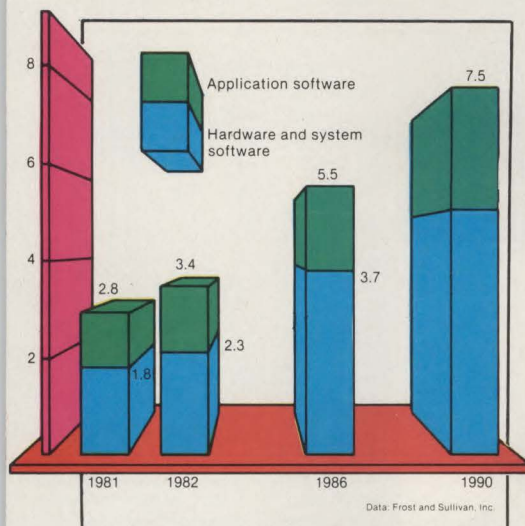


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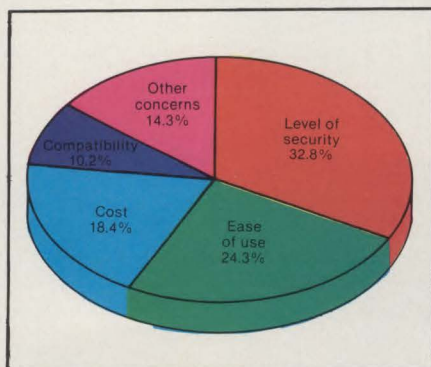
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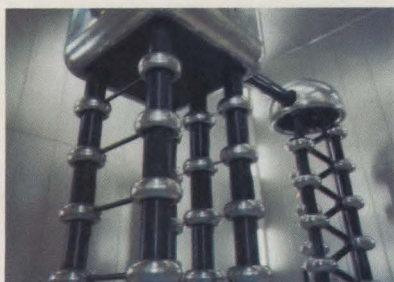
SMALL-BUSINESS COMPUTERS: Ask a group of small businessmen to describe the difference between minicomputers and microcomputers and you'll get one answer: "Who cares?" Businessmen are more interested in solutions to their corporate problems than in computer hardware. They understand the benefits of computerization but have run their businesses on paper because multi-user hardware/software business systems were too expensive. But that is rapidly changing. Small-business computers are more numerous than ever because developing and manufacturing them is easier than ever. Manufacturers face a vast array of powerful microprocessors, transportable software and inexpensive peripherals. Most make-or-buy decisions have become buy-from-whom decisions. The practical integration of mini/micro CPUs, software and peripherals into end-user and OEM systems demands familiarity with vendors and products. A comprehensive survey begins on **p. 201**.



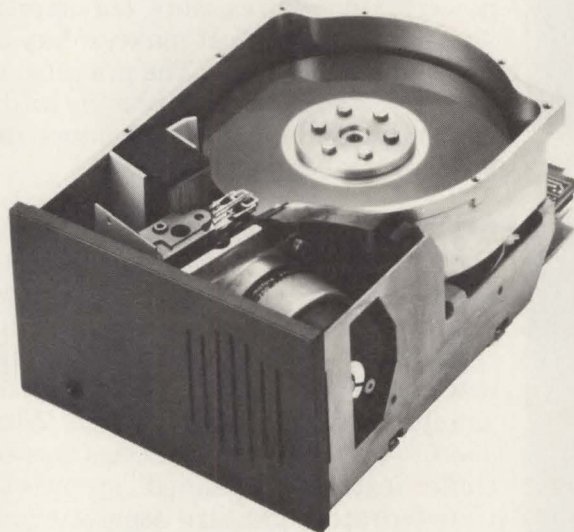
DISK DRIVES: The days when an 8-in. disk drive could be considered compact are long gone. SyQuest Technology's SQ-306 is a 3.9-in. Winchester that will be available in fixed- and removable-media versions, each with 6.38M bytes of unformatted capacity. A complete product description starts on **p. 239**. . . A new single-board controller for Multibus-based systems can simultaneously interface to 8-in. Winchester, streaming-tape and 5¼-in. floppy drives. Data Systems Design's DSD 7215 controller features "pipelined" architecture, one-way interleaved transfer rates, on-board separation and transparent disk error correction. An in-depth look at the controller begins on **p. 231**. . . The trend toward use of intelligent peripherals in computer systems has extended to disk drives. For a look at the first intelligent disk drive from Cynthia Peripherals Corp., see **p. 259**.



TECHNOLOGY: Computer crime is on the rise. System integrators and ISOs must move to provide adequate protection, not only to take advantage of a growing market for security features, but also to avoid lawsuits and comply with new federal regulations. For a look at what's going on in minicomputer/microcomputer security, see **p. 251**. . . The maturing of digital speech-compression-and-synthesis technology has prompted the evolution of many inexpensive, medium- to high-volume products that tell users anything from the time of day to the price of groceries. National Semiconductor's new speech-editing system, the Digitalker, makes synthesized speech economical for even limited-run products. A description starts on **p. 219**.



DATA COMMUNICATIONS: Local-area network developers may have placed too much emphasis on which communication medium—baseband or broadband coaxial cable—is the ultimate solution, rather than on which better supports a user's application. To understand the applications of baseband and broadband local-area networks, see the article beginning on **p. 265**. . . And for a look at two datacomm applications, check out the articles on **p. 223** and **p. 277**.



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Small-business systems solve big problems

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With a wide choice of μ ps, software and peripherals, small businessmen must select their suppliers carefully

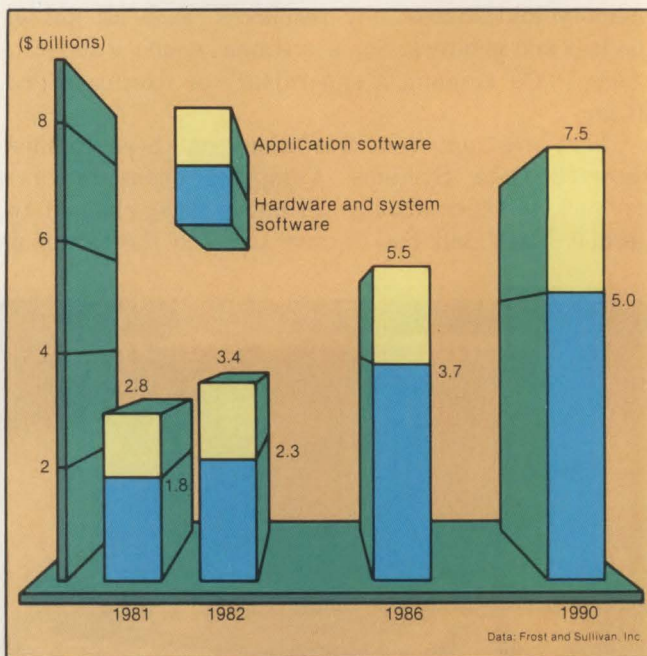
Ask 10 computer scientists to describe the difference between minicomputers and μ cs, and you'll get 10 different answers. Ask a similar group of small businessmen the same question and you'll get one answer: "who cares?"

Businessmen are more interested in solutions to their corporate problems than in computer hardware. For years, small businessmen heard about the magic that mainframes worked in Fortune 500 companies, that minis worked in medium-sized companies and that μ cs worked on financial analysts' desks. They understood the benefits of computerization but ran their businesses on paper because multi-user hardware/software business systems were too expensive.

By the mid-1970s, minicomputer vendors such as Microdata Corp., Basic Four Corp. and Four Phase Systems, Inc., had identified this market and introduced integrated small-business systems for general commercial applications. As International Business Machines Corp., Texas Instruments Inc., Hewlett-Packard Co. and others entered the market, the term "small-business system" became less and less ambiguous. GML Corp., Lexington, Mass., defines a small-business system as a multi-user system for general business applications that—in a basic configuration including CPU, disk storage, a printer and a few terminals—sells for \$25,000 or less. More than 70 companies offer products meeting this definition, and a sort across GML's on-line database of computer and minicomputer pricing information reveals few near misses price-wise.

Small-business computers are more numerous than ever because developing and manufacturing them is easier than ever. Manufacturers face a vast array of

powerful μ ps, transportable software and inexpensive peripherals, and most make-or-buy decisions have become buy-from-whom decisions. The practical integration of mini- μ c CPUs, software and peripherals into end-user and OEM systems demands familiarity with vendors and products.



The U.S. small-business computer market will be worth \$50 billion during the 1980s, according to Frost & Sullivan. Of the more than 4 million small-business computers sold during the decade, 75 percent will sell for less than \$10,000 each. Of the 2.5 million U.S. small businesses with annual revenues lower than \$10 million, 20 percent had installed computers by the end of 1981. Such penetration will increase to 25 percent this year, 44 percent by 1985 and 77 percent by 1990.

UNIX is designed for time-sharing applications and supports simultaneous program development in BASIC, C, FORTRAN, Pascal and other languages.

The new multi-user μ cs

Traditionally, μ cs have been associated with single-user personal computers and intelligent terminals. Until recently, the μ c's limited performance, memory-addressing limits and inability to share peripherals made it unsuitable for small-business applications. Early pioneers such as Datapoint Corp. and others offered μ cs in their intelligent work stations but still relied on traditional minis for their CPUs.

In 1980, Micromation, Inc., introduced M/Net, a Z80A-based, multi-user, multi- μ p small-business computer. M/Net offers 64K bytes of memory per user in as many as eight networked work stations that run programs simultaneously and have common access to mass storage and printers. The μ c revolution was under way.

The dominant approaches to multi-user technology include multitasking and multiprocessing. Multitasking uses a single CPU to handle the programs for all users. It appears to users that the computer is running only their program, although it is interleaved with other users' programs and runs each in serial pieces. Multiprocessing lets users run their programs simultaneously (in parallel) because each user has a CPU and memory and shares only resources, such as storage devices and printers. Some systems require a separate control CPU running a supervisory or executive program.

There are numerous variations on these themes. Intertec Data Systems' Compustar consists of a network of video-display terminals daisy-chained together. Each unit has its own μ p, and the terminals

share a database. As many as 255 terminals can be linked.

Seeking the combined advantages of 16- and 32-bit processing and the low cost of μ p-based systems, some companies have recently introduced 8080-, 8086-, Z8000- and MC68000-based systems with impressive capabilities. The most often-cited advantages are greater throughput, more efficient use of central storage, more directly addressable non-segmented address space, greater program-development efficiency and lower cost. Some systems support as many as 255 users, and most support at least four users. All of the μ ps address at least 64K bytes of main memory and some, such as Apollo Computer's Domain and Plexus Computer's P/25, address multiple megabytes. The Z80 is still the most widely used μ p, but in the less-than-\$25,000 range, the 16- and 32-bit μ cs are the new wave in small-business computers.

Plexus Computer's UNIX-based P/25 incorporates a multiprocessor architecture linking a job processor with as many as four 16-bit I/O processors, allowing each of these to use burst-multiplexed DMA to transfer data directly to and from main memory. The job processor performs single-bit error correction and double-bit error detection. The system runs on Bell Laboratories' new System III version of UNIX, and standard software includes C, COBOL, CBASIC-16 and MUMPS. Prices range from \$19,900 to \$47,500.

Fortune Systems' new 32:16 incorporates the 16-bit data paths and 32-bit internal architecture of the 68000. The system runs on a proprietary, enhanced version of UNIX that offers a "menu shell," sequential file-updating, a record-locking feature and automatic system reconfiguration. Fortune markets complete systems including slave terminals, and plans to target OEMs.

Wicat Systems' multi-user computers are 68000-based systems that run on the company's proprietary operating system, UNIX or CP/M. The Wicat systems support six users and 256K to 1.5M bytes of main



Desk-top small-business computers put processor, memory, off-line storage and display terminal on one work surface, often in the same enclosure. The dual processor (68000, Z80A) Radio Shack TRS-80 model 16 (left) incorporates two 8-in. diskette drives and supports two slave terminals. The Durango 900 features an integral Winchester disk and printer and supports as many as five concurrent users.

Small-business computers run efficient operating systems that support all popular programming languages used in business operations.

memory and sell for less than \$13,000 each.

Altos Computer Systems' ACS8600 family uses a multiprocessor technology incorporating Intel's 8086, and 8089 and an optional 8087 math chip. DMA capacity ranges from 500K bytes to 1M byte. Other features include error detection and correction, a Multibus expansion interface and proprietary memory management. Altos systems run CPM-86, MP/M-86, OASIS-16 or XENIX.

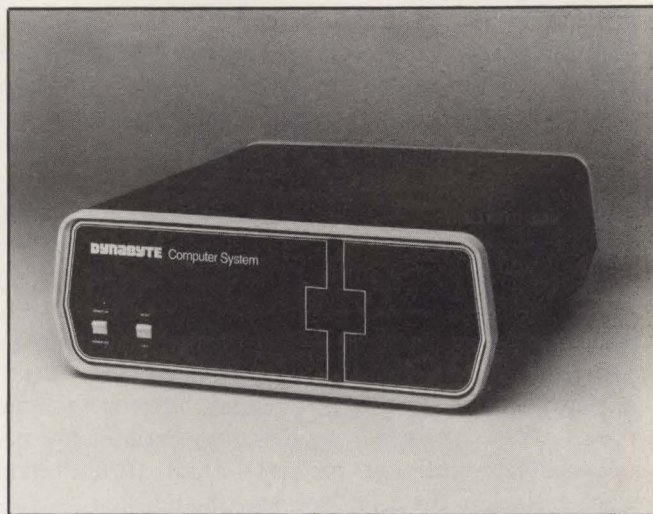
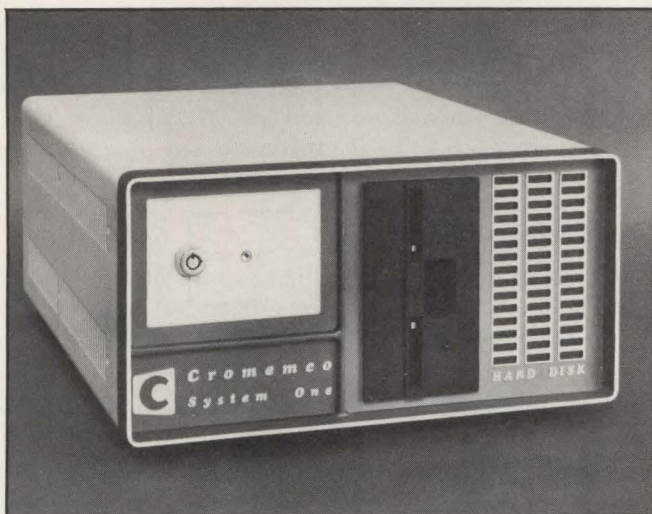
Aiming to "make a megasplash in the minipond," Charles River Data Systems' Universe 68 offers 32-bit architecture and UNOS, a UNIX-like operating system. Incorporating the 68000 and the Versabus, the system sports 24-bit addressing, giving it a directly addressable non-segmented address space of 16M bytes. Aimed at OEMs and sophisticated end users, the Universe 68 sells for less than \$20,000.

Other companies offering 16- or 32-bit μ cs include Alpha Micro Systems, Apollo, Convergent Technologies, Cromemco, Inc., Data General Corp., Digital Equipment Corp., Mercator Business Systems, Micro-five, NEC Information Systems, Inc., Onyx Systems, Inc., Pertec Computer Corp., Q1 Corp., Radio Shack, Sentinel Computer Corp., Three Rivers Computer Corp., TRW-Fujitsu and Zendex. Many others, such as Molecular Computer, have 16- or 32-bit μ cs in development.

Software keeps pace

Although software support lagged at first, small-business computers run efficient operating systems that support all popular programming languages used in business operations. The vast range of manufacturer-supplied and third-party application packages lets users configure what approximates a turnkey system for even the most specialized applications.

CP/M, developed by Microcomputer Applications Associates (the predecessor of Digital Research, Inc.) in 1974, has become a standard for single-user systems. Its popularity is attributed to the fact that it was



"Breadbox-size" units are the hearts of many multi-user small-business systems. They are usually mini-Winchester-disk-based, and offer streaming tape cartridges or diskette backup. The systems use third-party peripherals, and often third-party systems and applications software. Clockwise from top left are units from Cromemco, Dynabyte, Systems Group and Plexus Computers.

Seeking the combined advantages of 16- and 32-bit processing and the low cost of μ p-based systems, some companies have recently introduced 8080, 8086, Z8000 and MC68000-based systems with impressive capabilities.

invented at the right time, but its modular structure makes it easy to adapt to new hardware. CP/M supports ALGOL, APL, BASIC, C, COBOL, FORTRAN, LISP, Pascal and PL/1 high-level languages.

As CP/M became popular, Digital Research set out to develop a multi-user operating system. The result was MP/M (Multiprogramming Monitor for Microcomputers), which combined a resource scheduler and sophisticated terminal handling with the CP/M file system, producing a time-sharing system with multiprogramming and multiterminal features.

CP/M dominates the 8-bit market, with more than 400 companies offering CP/M systems and related applications software. Nearly one-third of the business computers in our survey run CP/M or MP/M. Of the other companies that do not use proprietary operating systems, most plan to support CP/M or MP/M—or Microsoft's increasingly popular MS-DOS or XENIX systems.

CP/M-compatible systems also abound. One example is OSM Computer Corp.'s MUSE (Multi-User System Executive). MUSE, a proprietary operating system designed for the Zeus computer, manages as many as 64 users and supports as many as three shared master printers with full spool-queue management. MUSE consists of two program modules: MUSE.COM and MUSE/U.SYS. The former resides in the master processor module, receiving requests from MUSE/U.SYS, which resides in the user processor module and handles all high-level filing handling. MUSE/U.SYS is loaded into the user module each time the user is initialized by

either a warm or cold boot.

UNIX, developed by Bell Laboratories and distributed by Western Electric, is emerging as a de facto standard operating system for 32-bit systems. It is designed for time-sharing applications and supports simultaneous program development in BASIC, C, FORTRAN, Pascal and other languages.

Written in C, UNIX offers program portability, but, says Jim Isaak, product manager for the Universe 68 at Charles River Data Systems, there is a danger in viewing UNIX as a singular, consistent operating system. Many minicomputer versions exist, and confusing things further, the super- μ c companies are introducing their own UNIX-like operating systems. On the positive side, many UNIXs in this survey represent enhancements. Fortune's 32:16, Morrow Design's Decision 1, Cromemco's CROMIX, CRDS's UNOS, Onyx's C8002, Plexus's P/25 and Q1's IDRIS are all customized, friendlier versions of UNIX.

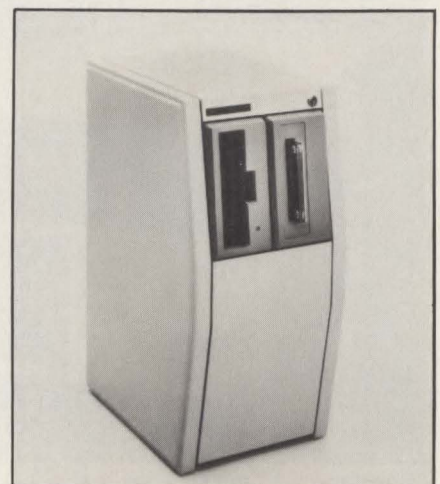
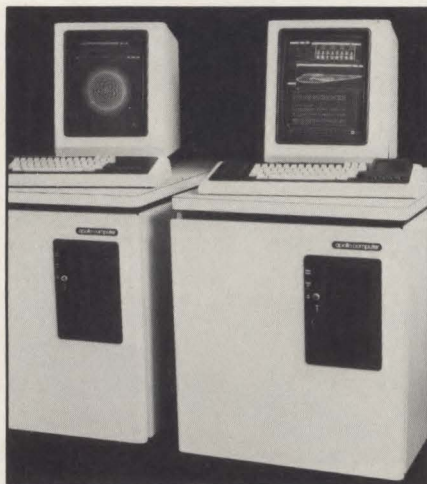
Many large, nonprofit user groups support UNIX. The formation by one users' group ("usr/group," Palo Alto, Calif.) of a standards committee to address UNIX compatibility and standardization problems indicates the concern UNIX fans have for the program.

Morrow Design's approach to these operating-system trends is to combine the virtues of CP/M and UNIX in Micronix, which simultaneously runs multiple UNIX level 6 packages or multiple CP/M packages. Its CP/M runs as a task under UNIX and accepts CP/M- and UNIX-standard media.

Peripherals: more for less

While OEMs and system integrators buy minis and μ cs, end-user businesses buy systems. Terminals, disk drives and printers are the peripherals that make CPUs with business software into systems, and all three devices are getting less expensive and more capable every day.

Terminals for business applications (MMS, August, 1981) feature large, readable screens in a variety of phosphors, and detachable keyboards with numeric and programmable function keys to speed business data



Pedestal enclosures are more compact and attractive than the high rack-style enclosures they replace in many small-business systems. From left to right, these systems from Apollo Computer, Symcro Systems and Micromation offer impressive power and look at home in an office.

THE OEM-FRIENDLY COMPUTER. BEFORE WE BUILT IT, WE LISTENED.

We asked hard questions. Of you. Of your customers. We learned that the easier a system is to use, the better it is for OEM's. Because you have better things to do than hold your customers' hands.

Your customers wanted simplicity. BMC put everything in one package: The computer, with up to 256K RAM. Full ASCII keyboard and numeric keypad. 640 X 200 pixel-addressable RGB CRT with graphics capabilities in 64 colors and hues. An on-board workprinter. Dual, double-density 5 1/4" floppies. Or a 400 Kbyte floppy and 10 Mbyte hard disk.

They wanted bundled software. So we started with the only CP/M® Operating System that fully supports color graphics. Then we added Select™ Word Processing, SuperCalc™, a mailing list manager, and the PEARL™ program generator. Plus BMC Extended Color BASIC and BASIC-80. Or, you can sell the system with your software alone.

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**SOMEONE WAS
LISTENING.**



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PEARL is a trademark of Relational Systems, Inc.
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One-supplier support. Color graphics printers, light pens, 16-bit μ p, bi-sync communications equipment, you name it. Even multi-user capabilities. All from BMC. Plus nationwide third-party field service that assures your customers of help when they need it. And, our Hotline gives you a single toll-free number for technical support.

Ready when you are. The BMC computer is manufactured by one of Japan's leading electric and electronics companies. They've been in business for 103 years. And they're planning their bicentennial. Which means we'll be here as long as you need us.

We listen. You told us what you wanted. Your customers told us what they wanted. That's how we built BMC Business Computers. Our business is to listen to your business. And respond.

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CIRCLE NO. 95 ON INQUIRY CARD



Terminals, disk drives and printers are the peripherals that make CPUs with business software into systems.

entry. Besides office-oriented ergonomics, terminals offer editing, formatting and internal diagnostics at prices small businesses can afford.

Basic alphanumeric terminals sell to end users for less than \$500, editing terminals for less than \$1200, and intelligent terminals for less than \$2000. More than 120 companies offer more than 500 terminals suitable for business systems. Price competition among Tele-Video, Inc., Applied Digital Data Systems, Lear Siegler, Inc., Hazeltine Corp., DEC, IBM and other super-volume terminal manufacturers has resulted in more than 50 terminals for less than \$1000 each.

In disk storage, the 5¼-in. Winchester disk (MMS, February) is the key product. Mini-Winchesters have made multi-megabyte databases required for accounting, inventory and payroll applications convenient (no diskette swapping), reliable and affordable. Mini-Winchesters storing 5M bytes from Tandon Corp., Seagate Technology and Shugart Associates sell for less than \$2500 in small OEM quantities. Capacities are rising as fast as prices are falling—10M bytes are as common as 5M bytes, and Ampex Corp., Computer Memories, Inc., Olivetti OPE, Rotating Memory Sys-

tems, Inc., and Seagate all offer 15M- to 20M-byte capacities.

Many drives are available with removable cartridges or streaming cartridge-tape drives for daily backup, providing the audit trails even small businesses need.

If mini-Winchesters are the most popular small-business disk drives, multi-mode serial printers are getting to be the most popular small-business printers. Traditional chain, band and drum line printers are too expensive for entry-level small-business systems, and daisy-wheel character systems offer high-quality output at very low speeds. The new multi-mode serial printers use impact matrix mechanisms to generate draft, near-letter-quality and graphics output.

General Electric Co., Centronics Data Computer Corp., Florida Data Corp., Malibu Electronics Corp. and others offer multi-mode printers that print draft-quality characters at 200 to 900 cps and near-letter-quality characters at 30 to 100 cps. Price competition has pushed end-user prices for daisy-wheel printers to less than \$3000, and these true letter-quality units are a part of most small-business systems. Multi-mode printers give first-time buyers one printer for all tasks while complementing daisy-wheel-based systems. ■

David Simpson is editor of *Computer Review*, published by GML Corp., Lexington, Mass.

SMALL BUSINESS COMPUTER SYSTEMS

Manufacturer	Model	Processor, memory (bytes)	No. of users	Storage capacity (bytes)		Software supported	Price	Notes	Circle no.
				diskette	disk				
Action Computer Enterprise	Discovery	Z80, 64K-128K	16		33M-66M	CP/M, CP/M-86 DPCOS	\$7220 base; \$15,000 with 500K-byte floppy disk, 33M-byte hard disk	multiprocessor system; 16-user system is \$24,055	390
Applied Digital Data Systems	Multivision 3	8085A-2, 64K-256K	4	700K	5M, 10M	MUON, CP/M-compatible, BASIC, COBOL, FORTRAN	\$15,000 for 4 terminals, 256K-byte CPU	without terminals; system is \$12,000	391
Alpha Micro	AM-1021, AM-1041	16-bit (AM-100/T), 128K-512K	6	1.2M	8.5M-452M	AMOS, BASIC, LISP, Pascal	\$18-\$25,000 for 8.5-32M-byte disk, four terminals	optional VCR back-up capability	392
Altos Computer Systems	ACS 8600	8086, 8087, 8089; 128K-1M	8		80M-300M	XENIX, CP/M-86, MP/M-86, OASIS-16	\$18,980 for 512K-byte CPU, 40M-byte hard disk and magnetic back-up	has as many as 3 CPUs, an 8086 master and 2 slave processors dedicated to specific tasks	393
Apollo Computer Inc.	Domain	68000, 500K-3.5M	100	1.2M	33M, 66M, 300M	AEGIS, FORTRAN, Pascal	\$25,000-\$50,000; \$30,000 for 500K-byte CPU, 1.2M-byte floppy disk, 33M-byte hard disk	series designed around coaxially connected nodes	394
Axxa Corp.	Axxa Systems 90	8085, 64K-128K	4	.25M per drive	10M	RELAX, CP/M	\$29,950 for 2 terminals, 10M-byte hard disk, letter-quality printer	terminals have 12,000 character screens (156-character column width x 77 lines/screen)	395
Basic Four Corp.	S80	8-bit, 128K-320K	4	1.2M-2.4M	5M-17M	BOSS BASIC		system has a 64K-byte file manager, 64K-byte intelligent terminals	396

Remex Times

A Leader in Peripherals since 1959

More Than 200,000 Units in the Field

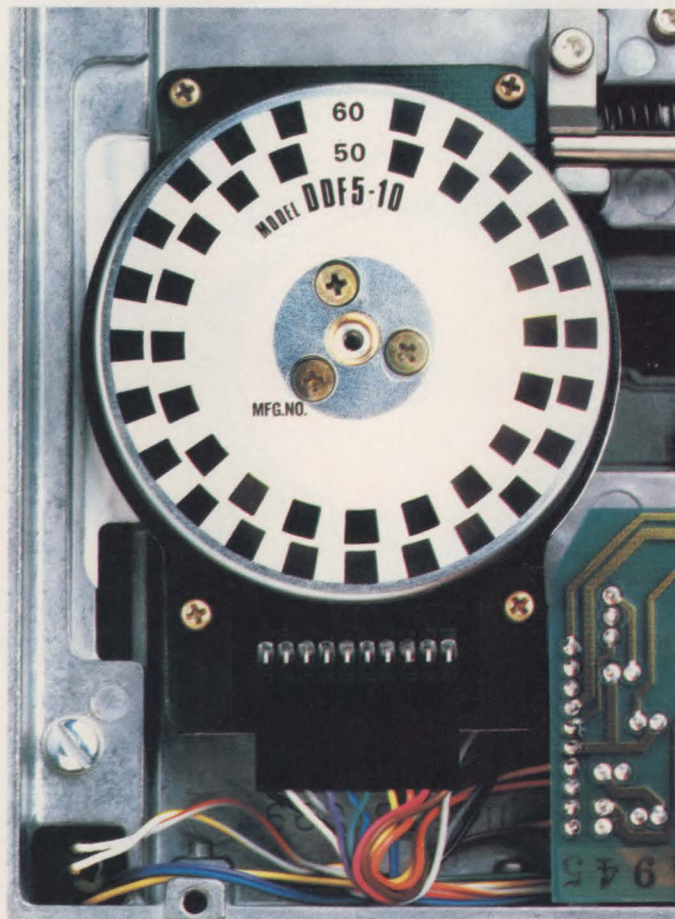
THE HIDDEN TRUTH ABOUT 5¼ INCH FLOPPYS

Belts and Brushes Murder on Life Span

The bad news for mini floppy disk drive buyers is that 5¼ inch drives are designed with belt and brush type AC motors . . . and they suffer the consequences. The good news according to high level authorities is that there is an exception. The Remex PICO™ 48/96 tpi, 5¼ inch flexible disk drive has no belts or brushes because it is the first mini-sized floppy with a direct drive DC motor. Direct drive means that improper belt seating is non-existent so variations in speed and friction-producing side loading are eliminated. Motor life is also extended. A reliable industry source indicates that the MTBF of the PICO motor is 5 years—typically ten times that of most brush type motors. The President of the United States, in his comments, stated (continued on Page 5).

Trouble Maker Eliminated

"Tap-tap wear is a thing of the past" according to design engineers evaluating the Remex PICO 5¼ inch flexible disk drive. This major cause of media damage and wear on mini floppy drives, the loading and unloading of the head on the media, has been eliminated with the Remex PICO because the PICO has no head load solenoid. This design innovation also reduces magnetic leakage which may result in data errors. Rumors that PICO will receive an award from the Association for the Preservation of the Sanity of Systems Designers were not confirmed by Remex.



Direct drive DC motor saves life of 5¼ inch floppy.

Designers Spellbound by Interchange

Reliable interchange of media between Remex PICO drives is enhanced by the precise speed control of the motor's closed loop servo. Speed is regulated to 1% on Remex PICO versus typically 2¼% on other small drives, therefore read/write errors caused by speed varia-

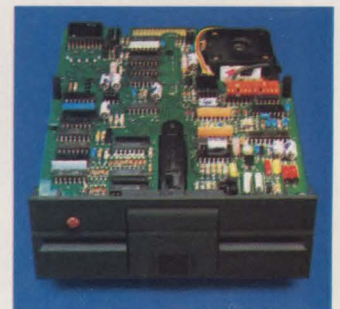
tion are not a major factor with PICO. The drive's speed control may also simplify controller design because phase lock loop requirements are less demanding. Vast crowds of cheering engineers stood outside the office of (continued on Page 11).

Drives Embezeled!

A choice of bezel sizes on the Remex PICO 48/96 tpi, 5¼ inch floppy makes this drive the appropriate choice for a wide variety of system configurations according to sources. Among the sizes available is a 2¼ inch low bezel which is ideal for space limited micro-systems. An "industry standard" bezel is optional.

Proud Parent Praises PICO

Remex is a Division of Ex-Cell-O Corporation, a Fortune 500 company with manufacturing and marketing arms in such industries as machine tool, aerospace and automotive as well as electronics. Ex-Cell-O Corporation through its Remex Division is committed to advanced technology development and quality manufacture of both 5¼ inch and 8 inch flexible disk drives.



Ex-Cell-O Corporation

REMEX DIVISION

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Namely access times up to seven times faster than standard drives with 12.65 Mbytes of storage. On just two platters. Which means it can replace the more expensive drives in your multi-task, multi-user systems. What's more it's designed so those two platters can be easily upgraded in the future.

We've bred the Griffin for reliability by building-in design features of higher performance Winchester drives. Like a heavy-duty chassis to cut vibration. A unique, ultra-clean

air filtration system that exceeds Class 100.

A calibration mode that gives disks longer life by positioning the head more accurately and a dynamic thermal compensation system that covers every track and surface to control the "tower effect." We've also made it microprogrammable so you can easily adapt it to custom applications and save money on controllers.

If you'd like to see for yourself

just what our new drive can do, evaluation units are ready and waiting because this Griffin is real.

The result of meshing Marketing with Engineering. A planned leap over the first and into the second generation of super-micro Winchesters. And it's one more plan now coming to fruition at MPI.



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SMALL BUSINESS COMPUTER SYSTEMS

Manufacturer	Model	Processor, memory (bytes)	No. of users	Storage capacity (bytes)		Software supported	Price	Notes	Circle no.
BMC Computer Group	IF800	Z80, 64K-128K	64	dual 400K	10M	CP/M, Select WP, SuperCalc, Condor DBMS, Grafit, PEARL, mail list	\$21,000 for 4 smart terminals, 10M-byte disk, 128K-byte CPU	high resolution graphics, function keys, built-in work printer standard	397
	B20 series, B90 series								398
Cado Systems Corp.	C.A.T. series I, II, III; 20/24, 20/28	8085, 32K-96K	8	1.2M	15M	CADOL, BASIC	\$23,955 for CPU, 2 CRTs, 13M-byte hard disk, P-152 matrix printer, modem	C.A.T. III priced less than \$5000 for the processor and terminal	399
California Computer Systems	2410	Z80A, 64K-256K	4			CP/M, OASIS, MP/M	\$2375 for 64K-byte CPU, 2 serial ports, diskette controller		400
	300	Z80A, 64K-512K	8			CP/M, OASIS MP/M	\$4995 for 64K-byte CPU, dual diskette drives	double-sided floppy disks are optional	
	400	Z80A, 64K-512K	8		10M, 20M	CP/M, OASIS MP/M	\$8750 for 64K-byte CPU, 10M-byte disk		
Centurion Computer Corp.	5200, 5300	8-bit, 64K-256K	20	1.2M-2.4M	24M-96M	CPL, JCL, BASIC	\$21,222 for 64K-byte CPU, CRT, 1.2M-byte floppy disk, 24M-byte hard disk	600-lpm printers available	401
	Microplus	8-bit, 64K	3	1.2M-2.5M	8M-24M	CPL, JCL, BASIC	\$15,505 for 64K-byte CPU, CRT, 1.2M-byte floppy disk, 8M-byte hard disk	options include 45-, 75- and 150-cps printers; prices begin at less than \$11,500	
Charles River Data Systems	Universe 68	68000, 256K-6M	34	1M	1M-320M	UNOS, UNIX-like C, FORTRAN, BASIC, Pascal, DBMS	\$19,200 for 256K-byte CPU, floppy disk, 16M-byte hard disk	16M-byte, directly addressable, non-segmented address space; OEM discount available	402
Columbia Data Products Inc.	DC1000	Z80A, 64K-256K	16	.6M-1.2M	10M-60M	CP/M, MP/M	\$9970 for 5-user system; \$12,465 with 1.2M-byte floppy disk	as many as 16 user stations have own dedicated satellite μ p with as much as 64K bytes of RAM	403
Compal	8200 series	Z80, 56K-208K	4	630K	5M, 15M, 30M	Extended version of CP/M	\$20,500-\$22,000 for 4 terminals, 15M-byte hard disk, letter-quality printer		404
	8500 series	8086, 128K-512K	8	1.2M	10M, 20M, 40M, 80M	MP/M-86	\$22,000 for 128K-byte CPU, 2 terminals, 10M-byte hard disk, letter-quality printer		
Computhink	Hawk-32	6800, 128K-1M	1-16	800K	5M-40M	UNIX, UNOS	\$13,400 for 2-user configuration with 256K-byte CPU, 20M-byte disk, 800K-byte diskette		405
Convergent Technologies	Workstation	8088, 8086; 128K-1M	16	1M	10M, 20M, 40M	CTOS, Assembler, BASIC, COBOL, FORTRAN, Pascal	\$3990-\$10,000	work stations are linked via local network	406
Cromemco Inc.	System One series with DPU	68000, Z80; 256K-2M	6 (with 512K)	390K-4M	5M-100M	CROMIX (UNIX-like), BASIC, C, COBOL, Pascal, FORTRAN, PL/2, APL, LISP, RPG-II	\$9495 for 512K-byte ECC CPU, 390K-byte floppy disk, 5.5M-byte hard disk	dual 68000/Z80 CPU for simultaneous use of both μ ps; on-site disk maintenance available	407
Data General Corp.	CS/10, CS/50	Micro Nova, 64K-256K	5, 8	1.2M-2.4M	12.5M-190M	RDOS, DOS, ICOS, COBOL, BASIC	\$16,200-\$25,830 for 64K-byte CPU, 2 quad diskettes, 12.5M-byte disk	CS/10, CS/50 are representative members of the CS line	408

SMALL BUSINESS COMPUTER SYSTEMS

Manufacturer	Model	Processor, memory (bytes)	No. of users	Storage capacity (bytes)		Software supported	Price	Notes	Circle no.
Datapoint Corp.	1550	Z80A, 32K-96K	4	1M	10M-40M	Datapoint DOS, CP/M	\$18,750 for 64K-byte CPU, 1M-byte diskette, 10M-byte cartridge	available software includes DATABUS, DATASHARE, BASICPLUS	409
	1800	8-bit, 64K-128K	4	1M	10M-40M	Datapoint DOS, BASIC, COBOL, RPG-II	\$24,500 for 128K-byte CPU, 1M-byte diskette, 10M-byte cartridge, 2 8200 terminals	operates as stand-alone, part of attached resource computer system, or in network configuration	
Data Terminals and Communications	Micro 210	8085, 64K	4	600K	10M, 20M	S210, M210, CP/M, MUBBS, Assembler	\$7245 for 64K-byte CPU, 1.2M-byte floppy disk, 10M-byte hard disk; \$10,240 with 1 2M-byte hard disk	applications software includes text editing, document processing, and letter writer	410
Digital Equipment Corp.	Datasystem series 315, 336, 512	16-bit, 64K-256K	4-8	1M-2M	.224M	315, 336: CTS300, DIBOL; 512: CTS 500 DIBOL, BASIC PLUS, PLUS-2, COBOL, FORTRAN, 4-PLUS, Macro, RPG-II	315: \$10,400-18,000; 316: \$21,100-35,000; 512: \$27,700-40,000	315 and 316 based on the PDP 11/23; the 512 is PDP 11/23-PLUS-based	411
Digital Microsystems	Hinet	Z80, 64K	255		10M-28M	CP/M	\$8995 for master with 10M-byte disk; \$15,375 also includes 4 64K-byte work stations	system consists of a master or controlling computer and satellite stations	412
Dual Systems Control	83	MC68000, 512K-3M	8		10M, 20M	UNIX III, COBOL, FORTRAN, Pascal	\$17,995 for 512K-byte CPU, 20M-byte disk, 4 serial ports, 1M-byte diskette, UNIX software	model 83/40 offers as much as 40M bytes of disk capacity	413
Durango Systems Inc.	900 series	8-bit, 64K	5	946K	7M, 14M	DX-85M, STARBASIC	\$13,450 for 65K-byte CPU, 400-cps printer, 1M-byte floppy disk, 14M-byte hard disk; \$21,410 for 4 terminals	introduced in March, 1982	414
Dynabyte	5000 family	Z80A, 64K-400K	8	1M-3.2M	6M-19M	CP/M, MP/M, OASIS	\$6995 for 64K-byte CPU, 5M-byte floppy disk, 6M-byte hard disk	adheres to S-100 design specifications; upgrade from single-to multi-user sells for \$1995	415
Fortune	32:16	68000, 128K-1M				UNIX, BASIC, C, COBOL, FORTRAN, Pascal		features 32-bit internal architecture, 16-bit data paths; single-user version is \$4995	416
General Automation Inc.	Series 900 (910, 920, 930, 940, 950)	16-bit (bit-slice), 64K-2M	64	1M	10M-300M	CONTROL, MTS, MIBS, BASIC, COBOL, FORTRAN, C, Pascal, UNIX (late 1982)	\$26,745 for 64K-byte CPU, 10M-byte hard disk, four CRTs	announced in April 1982; cache memory available on select models	417
Grid Systems Corp.	Navigator	8086, 8087; 256K		256K bubble memory		BASIC, Pascal, C, PL/M, FORTRAN 77; filing, planning, graphics, WP routines		terminal emulation standard; designed to tie into Grid central computer	418
Hewlett-Packard Co.	HP-250/30, HP-250/35	16-bit, 32K-128K	6	1.2M	19.6M-83M	Interpreted BASIC	\$25,100 for 32K-byte CPU, 16M-byte tape cartridge, 19.6M-byte disk	options include several international language keyboards	419
Honeywell Information Systems Inc.	DPS 6/31	16-bit, 256K-1M	16	650K	26M fixed/removable	GCOS-6, BASIC, COBOL, FORTRAN, RPG-II	\$19,500 for 256K-byte CPU, 13M-byte fixed/removable	may be used as satellite processor in Honeywell and IBM distributed networks	420



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**An entirely new 32MB memory resource
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throughput and reliability of your DEC®
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NURAM is not add-in memory. Nor is it merely a semiconductor version of a fixed head disk.

The NURAM system from National is an entirely new on-line memory resource for DEC UNIBUS systems. It's up to 32MB of auxiliary data storage. And it's all self-contained in a 12.5" high rack-mountable chassis, including the indicator panel, power supply, and cooling.

But NURAM does a lot more than just dramatically improve your system's throughput. It also gives you the utmost in field reliability and data integrity.

Better performance, higher integrity. NURAM consists of a memory controller and up to 16 two-megabyte memory boards, each containing more than 64KB of spare storage space. It's interfaced to the UNIBUS via National's powerful HEX-3000™ multi-device controller.

But as far as the operating system is concerned, NURAM looks exactly like an RS04 FHD subsystem, only faster. And in many respects, NURAM behaves much like a disk. For example, whenever a NURAM read or write operation detects a hard error, the entire data "sector" is transparently located to one of the card's spare RAMs and NURAM's map index is updated.

Finds errors and corrects them, too. But that's where the similarity ends, especially when it comes

to system reliability and integrity of the stored data.

Since all writes into NURAM include a read/compare and three automatic re-tries should the first compare fail, data integrity is greatly improved.

For added integrity, HEX-3000™ performs ECC functions on every block of data read from NURAM. So NURAM not only finds the errors, it corrects them, too.

Field maintenance problems eliminated.

Since each two-megabyte NURAM board carries more than 64KB of spare storage space, they remain fully operable several years longer than other ECC memory boards.

NURAM's front panel includes LEDs that indicate the relative status of these spare MOS "data sectors." As a result, field maintenance can be conveniently deferred to regularly scheduled visits.

Reliability designed in from the start. But NURAM's overall reliability goes far deeper than that. Only the highest grade commercial ICs are used. Then each board undergoes our standard 72-hour dynamic burn-in at 70°C.

NURAM and HEX-3000™ represent today's most significant competitive edge in UNIBUS systems. From the same company that brought solid reliability to DEC add-in memory.

NURAM — it's the next best thing to main memory.

For complete details on our NURAM system, (or for your nearest rep or broker/dealer), simply send in the coupon below or call toll-free at **(800) 538-8510**. In California **(408) 736-6994**.

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PRIAM's 158-megabyte Winchester Disc Drive

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PRIAM's 14-inch disc drive design has been proved in thousands of units shipped. It weighs only 38 pounds, and its brushless DC motor drive makes the DISKOS 15450 as mechanically simple as the turbocharger it resembles. No belts, no pulleys, no mechanical brakes. Compare the low price of the DISKOS 15450 with comparable drives. You'll agree that its cost/performance is far ahead of the pack.

All three PRIAM 14-inch drives, with capacities of 34, 68 and 158 megabytes, are

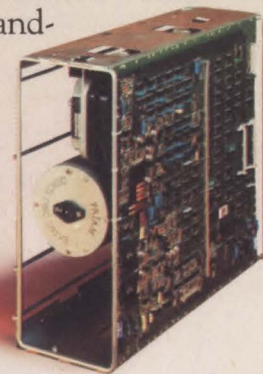
only 7" x 17" x 20" in size, including the optional power supply. They all have the same 1.04 megabyte/second data rate, and operate from the same interfaces. Standard PRIAM or optional SMD, ANSI or SMART/SMART-E Interfaces make integration of these high-performance drives into your system quick and easy.

PRIAM 8-inch drives have capacities of 11, 35, and 70 megabytes, with the same interfaces and the same grand-prix performance characteristics as PRIAM's 14-inch models.

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CIRCLE NO. 99 ON INQUIRY CARD

SMALL BUSINESS COMPUTER SYSTEMS

Manufacturer	Model	Processor, memory (bytes)	No. of users	Storage capacity (bytes)		Software supported	Price	Notes	Circle no.
				diskette	disk			disk; \$30,000 for 256K-byte CPU, 13M-byte fixed/removable disk, 3 work stations, 100-cps printer, software	
Integrated Business Computers International Business Machines Corp.	Super Cadet	Z80B, 256K	10	1M	20M, 50M	MP/M, OASIS, FAMOS	\$5595 for 64K-byte CPU		421
	Series/1								422
	System/34								
Independent Business Systems	Betasystem II	Z80, 64K-512K	16	670K-1.25M	5M-600M	IBS Pascal, CP/M FIRST, OASIS, MUDOS (TURBODOS), FORTH	less than \$10,000 for 64K-byte CPU, 10M-byte disk	based on SLAVENET processor boards which include hardware floating point option	423
Infotecs Inc.	Control Center 2	12-bit Intersil 6100, 64K-bytes per terminal	16	1M-16M	4M-800M	CC2, HIBOL	\$22,000 for one terminal, 64K-byte CPU, 15M-byte hard disk, 150-cps printer	uses multiple dedicated processing units and supports as many as 32 peripheral devices	424
Intertec Data Systems Corp.	Compustar	Z80, 64K	255		10M-96M	CP/M	\$8990 for 10M-byte disk system	systems consist of network of video-display terminals sharing disk storage	425
Logical Business Machines	Adam	8086, 192K-256K	4		20M	proprietary applications development	\$20,000 for 192K-byte CPU, 20M-byte disk, streaming tape, 1 terminal, printer	software supports development in 22 languages; printers run from disk or terminals	426
	Goliath	8086, 192K-256K, 64K per user	20	1M	20M, 40M	proprietary applications development	\$24,500 for 192K-byte CPU, 20M-byte disk, streaming tape, 64K-byte terminal with diskette; extra terminals are \$7000 each	central file manager supports 64K-byte terminals	
M/A-COM, OSI	300 series (300, 320, 350, 380)	6502, Z80, 64K	10	550K	160M, 320M	CP/M, 65U		introduced in June 1982; each user gets 2 MHz, 64K-byte board	427
Mercator Business Systems	Series 3000	8088, 64K-512K	4		10M, 20M, 40M	Business BASIC, OASIS-16, MP/M-86	\$19,900 for 4-user configuration with 64K-byte CPU, 10M-byte hard disk, 160-cps printer, display	specialty tailored vertical packages available for specific industries	428
Microfive	Series 3000	8086, 128K-1M	10	1.2M	10M-70M	STARDOS, MP/M-86, SMC BASIC	\$25,000 for 4 work stations, 250-cps printer, 1.2M-byte floppy disk, 10M-byte hard disk	software includes UPDATE, a DBMS	429
Micromation Inc.	Mariner	Z80, 64K	8	500K-2M	21M-83M	CP/M, MP/M, TURBODOS, DBOS	\$13,700 for 4 64K-byte CPUs, 500K-byte floppy disk, 21M-byte hard disk	OEM box version is \$12,500	430
Mohawk Data Sciences Corp.	Series 21	Z80, 64K-512K	8	250K-1M	2.5M-156M	OS1, OS2, COBOL, MOBOL	\$27,680 for 4 64K-byte terminals, 256K-byte diskette, 10M-byte hard disk, 45-cps letter-quality printer	operator station with 64K bytes and floppy disk is \$7900	431
Molecular Computer	Supermicro 8	Z80, 64K-576K	8		10M-30M	N-STAR, CP/M-compatible	\$11,975 for 4-user configuration with 10M-byte hard disk	formerly Infinet I; 32-user Supermicro 32 also available; processors linked via CSMA/CD bus	432

SMALL BUSINESS COMPUTER SYSTEMS

Manufacturer	Model	Processor, memory (bytes)	No. of users	Storage capacity (bytes)		Software supported	Price	Notes	Circle no.
Morrow Designs Inc.	Decision I	Z80, 65K-1M	15	400K-1.1M	5M-104M	CP/M, MP/M-2, UNIX, OASIS	\$8000 for 256K-byte CPU, O/S, 5M-byte hard disk	runs multi-user multitasks on CP/M 2.2 and/or UNIX V6 simultaneously	433
NEC Information Systems Inc.	ASTRA 230, 250, 270	16-bit, 256K-1M	16	1M-2M	25M-320M	ITOS, BASIC, COBOL, FORTRAN, Assembler, Pascal	\$24,500 for 256K-byte CPU, 3 64K-byte work stations, O/S, 1.2M-byte floppy disk, 25M-byte hard disk	character, matrix, and band printers are optional	434
NCR Corp.	I9020	16-bit, 64K-512K	24		9.8M-324M fixed/removable	IMOS, V.2, 3.5, BASIC, COBOL	\$26,000 for 128K-byte CPU, O/S, 3 CRTs, 9.8M-byte disk, 70-lpm printer	9020 is a mid-range member of the I9000 series	435
Northern Telecom Systems Inc.	400 series	8-bit, 64K-128K	8		5M, 10M, 20M				436
Onyx Systems Inc.	C8002	Z8000, 124K	8		40M-100M	UNIX, OASIS	\$25,000 for 4 work stations, O/S, 40M-byte disk	stations are linked via a local network	437
OSM Computer Corp.	Zeus 2	Z80A, 64K	64	500K-5M	34M-600M	MUSE (CP/M-compatible), FORTH	\$20,000 for 34M-byte disk, 6 Z80 work stations, 20M-byte streaming tape drive, .5M-byte floppy disk	a 64K-byte Z80A CPU in the master processor; UPS is included	438
Performance Business Machines	PBM1400	multiple Z80As; 80K host, 64K per user	4	1M	20M, 20M	CP/M-compatible	\$14,000 for 80K-byte host, hard disk, diskette	extension for a single-user CP/M system optimized for Micro Pro software	439
Perkin-Elmer Data Systems Corp.	Series Sixteen	16-bit, 64K-256K	4		10M, 67M, 300M	OS/16, BASIC, COBOL, Assembler, FORTRAN	\$11,600 for 64K-byte Mod 20; \$19,000 for 256K-byte Mod 30	model 1624 provides multiply/divide/instructions, single/double precision floating point processors and 255 vectored interrupts	440
Pertec Computer Corp.	Pertec 1000	T19900, 94K-160K	48	430K-1.2M	24M integrated	MX-BASIC, CP/M-compatible	\$13,000 for 3-user configuration with 94K-byte CPU, 2 terminals, 24M-byte hard disk		441
	PCC2000	8085, 64K-256K	5	2M	8.4M integrated, 80M add-on	CP/M, MTX, MT2	\$20,000-\$25,000 for 5-user configuration with 64K-byte CPU, 8.4M-byte hard disk	MTX provides CRT-screen formatting and report-generation commands	
Plexus Computer Inc.	P/25	Z8000, 64K-2M	16		.288M	UNIX, C, MUMPS, Assembler, BASIC, COBOL, FORTRAN, Pascal	\$24,000 for 4-user configuration with 256K-byte CPU, 22M-byte hard disk	introduced in March, 1982; P/25 prices from \$19,900 to \$47,500	442
Point 4 Data Corp.	Mark 3, Mark 8	16-bit, 64K-128K	50		.96M	IRIS, BASIC, COBOL, BLIS	\$6000-\$10,700 for box and chassis only	Mark series (models 3, 5, 8) is fully software-compatible	443
Q1 Corp.	Q1 Microlite	Z80A, 64K	16	800K	200M-400M	Q1 ROS, COBOL, PL/1	\$25,000 for 3 64K-byte work stations, 20M-byte hard disk	integrated keyboard, printer and 24x80 plasma display standard	444
	68000 System	68000, 256K-12M	16	400K-2M	5M-600M	IDRIS (UNIX-like), BASIC, C, Pascal	\$12,000 for 5-user configuration with 256K-byte CPU, 10M-byte hard disk	as many as 255 computers, terminals or I/O devices can be connected via SDLC networking	
Radio Shack	TRS-80 Model 16	68000, Z80; 128K-512K	3	1.2M-2.4M	8.4M-34M	TRS/DOS, BASIC, COBOL, FORTRAN	\$11,470 for 256K-byte CPU, 8.4M-byte hard disk, 2 DT1 terminals, cables	dual processor system compatible with TRS-80 model II	445

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With Daisywriter, you get the print style selection you need.

A 96-character enclosed print wheel cassette is easily interchangeable and self-aligning... available in 12 font styles in 15 different languages. Print pitch (10, 12, and 15) is switch selectable.

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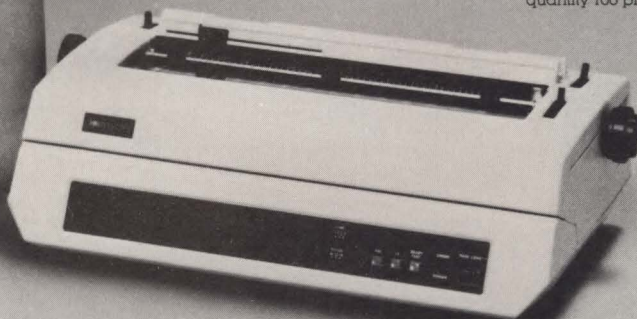
MODEL	INTERFACE	BUFFER
1500IE	IEEE 488	4 Kbyte
1500PC	Centronics, 8-bit, Parallel	4 Kbyte
1500SR	RS-232C	4 Kbyte
2000	Universal	48 Kbyte

And more.

Daisywriter emulates Diablo, Qume and NEC letter-quality printers and has enough buffer memory to type 20 pages off-line from the host computer in less than an hour.

Daisywriter can be supplied with tractor feed or sheet feeder options. There's a 99% "buffer full" warning. Panel or software selection of page length, baud rate, pitch and line spacing. Daisywriter even uses standard IBM-type cartridge ribbons. Daisywriter... your system will love it.

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CIRCLE NO. 100 ON INQUIRY CARD

SMALL BUSINESS COMPUTER SYSTEMS

Manufacturer	Model	Processor, memory (bytes)	No. of users	Storage capacity (bytes)		Software supported	Price	Notes	Circle no.
Rair Microcomputer Corp.	Black Box 3/30	8085 AH, 64K-.5M	7	.5M	6M-19.4M	CP/M, MP/M-2	\$7500 for 4-user configuration with .5M-byte floppy, 6M-byte hard disk	features integral mini-floppy and 5¼-in. Winchester; add-on as much as 100M-byte hard disk	446
	RX series (RX15, RX20, RX30)	8086, 64K-128K	4, 8		10M, 20M, 40M	RECAP, Business BASIC, IDOL DBMS	\$18,000-\$31,000	self-test firmware and battery back-up standard on RX30	447
Sentinel Computer Corp.	models 30, 40	8086, 96K-1M	17	800K	14.5M-1.2G	DBOS (DAMS), DBL, BASIC, COBOL	\$25,300 for 96K-byte CPU, 800K-byte floppy disk, 14.5M-byte hard disk, CRT, 150-cps printer, cabinet	DBOS consists of O/S, DBMS, DBOS programming language utilities	448
SDSystems	SD-700	Z80, 64K-256K	5	1M-2M	32M-96M	CP/M, MP/M-2, OASIS	\$24,195 for integral work station and 32M-byte hard disk	can be connected to SDsystems MARS/Net local network	449
Symcro Systems	SB700	Z80, 256K	200	1M-20M	20M-300M	MSL, CP/M-compatible	\$25,495 for 4-user configuration with 150-cps printer, 1M-byte floppy disk, 20M-byte hard disk, O/S	"Easy-Grow" system enables growth without replacement or modification	450
Systems Group	System 2842	Z80, 64K-512K	12	1.26M	20M-80M	CP/M, MP/M, OASIS, MP/M-2	\$15,200 for 4 terminals, 20M-byte tape drive, 20M-byte hard disk	Systems Group was formerly Measurement Systems and Controls	451
Televideo	806, 816	Z80, 64K-128K	6, 16	.5M	9.8M-23.5M	CP/M 2.2, MMMOST	\$7195-\$12,995 for 64K-byte CPU, 5M-byte floppy disk, 10M-23.5M-byte hard disk	Televideo, computers or TS800 satellites can be connected via RS422 ports	452
Texas Instruments Inc.	DS990 series (models 3, 4, 5, 7, 9, 16)	16-bit, 96K-2M	16		9.4M-127M	DX10 MICRO, DX5, DX7, DX10, DNOS COBOL, BASIC, FORTRAN, RPG-II, Pascal, TPL	\$15,500-\$52,000	models represent mid-range of DS990 series which continues with models 26, 29 and 36	453
Three Rivers Computer Corp.	PERQ	16/32-bit, 256K-1M	64	1M	12M, 24M				454
TRW-Fujitsu	Affinity 16	16-bit L16A, 124K	4	640K	5M-10M	BASIC, COBOL, Macro Assembler	\$9000 for 124K-byte CPU, 640K-byte floppy, 100-cps printer	variety of matrix, daisywheel printers available	455
Vector Graphic Inc.	5005, 5032	Z80B, 128K-256K	5	630K	5M, 32M	Extended CP/M	\$8995 for terminal, O/S and 5M-byte hard disk	model 5032, with 32M-byte hard disk and one terminal, is \$13,995	456
Wang Laboratories, Inc.	2200 series (LVP, LVPC, MVP, MVPC)	8-bit, 32K-512K	13	1M	2M-32M	BASIC-2MOS, BASIC-3/COBOL MOS	\$17,400 for 2200 LVPC with 128K-byte CPU, 1M-byte floppy disk, 16M-byte hard disk	C models run 2200 COBOL and BASIC -3 with new volume and file-management capabilities	457
Wicat	150-3, 150-6	68000, 256K-1.5M	6	1M	10M	MCS, UNIX, BASIC, COBOL, Assembler, APL, C, Pascal, FORTRAN, Ada, LISP	\$10,850-\$12,850 for 1M-byte floppy disk, 10M-byte hard disk, O/S	may be linked in a proprietary networking scheme supporting shared file access	458
Zendex Corp.	900 series	8085, 8086, 8088	8	.5M	10M	CP/M, MP/M	\$8600-\$28,230 for 4-user configuration with 1M-byte floppy disk, 10M-byte hard disk	incorporates integral floppy and Winchester disks for 10M-byte storage	459
Zilog	DCS series	Z80A, 64K per work station	4		10M, 40M	MCZ, COBOL	\$27,400 for 10M-byte disk, 2 64K-byte work stations, printer, software	central file manager supports work stations; includes Z-Net networking hardware and software	460

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Announcing the mbp COBOL Compiler for CP/M-86*... available now.



Recently, 16-bit microcomputers have been the big news. And here's more news just as big: the mbp COBOL Compiler for 16-bit systems. Not a 'sometime-in-the-future' product, it's here now—we're already delivering.

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Hardware required: 96K memory, hard disk, 8-inch floppy.

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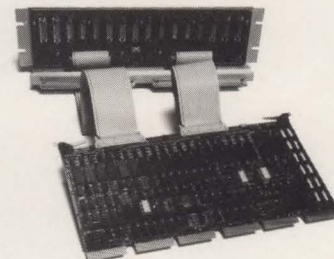
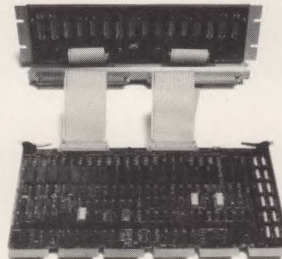
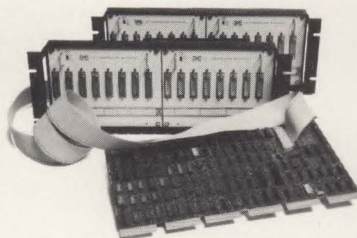
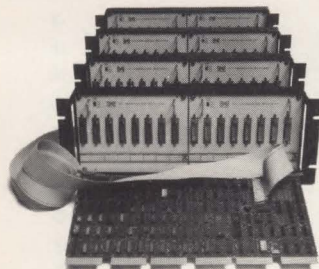
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Up to 64 DH11 channels from one board.

DH11-compatible MUX lets you mix RS-232 & current loop interfaces in 8-line groups. Built-in DM11-compatible modem control. DMA output eliminates host interrupts. Self-test capabilities. Transparent to PDP-11 software. Emulex' own software on VAX.

Higher DV11 performance, lower price.

DV11-compatible multiplexer. Mixes 8-lines synchronous & asynchronous on PDP-11s. Ideal for Bisync & DECNET. 8-32 lines per controller. DMA input & output. Software transparent under DECNET. Compact package offering higher line-handling speeds & improved throughput.

Replace DEC DZ11/E and save.

Perfect if you don't need DH11 performance. Software-transparent to all DEC operating systems. Easy PROM change enables quick upgrade to DH-11 performance. Saves one slot per 16 lines.

New economical DH11-type multiplexer.

Lowest cost, high-performance communications MUX. Priced way less than DEC's DZ11, with DMA to boot. 16 RS-232 lines per board, modem control included. Can use H317 distribution panel. Transparent to PDP-11 software; Emulex software on VAX.



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CIRCLE NO. 102 ON INQUIRY CARD

SPEECH SYNTHESIS

Bringing speech to low-volume products

FRED WICKERSHAM, GARY MULLINIX and STEVEN McGINNESS,
National Semiconductor Corp.

National Semiconductor's speech-editing products let OEMs create their own synthetic-speech vocabularies inexpensively

The maturing of digital speech-compression-and-synthesis technology has prompted the evolution of many inexpensive, medium- to high-volume products that tell users anything from the time of day to price of groceries. Until recently, adding speech to many products has been precluded by the lack of availability of the synthesized speech itself, especially custom vocabularies for low-volume users. National Semiconductor Corp.'s new speech-editing system makes synthesized speech economical for limited-run products.

ICs make speech synthesis affordable

National introduced its Digitalker preprogrammed speech-synthesis system in early 1980. The Digitalker consists of a speech-processor chip and a ROM chip. The two-chip set uses NMOS designs, sells for less than \$50 in small quantities and produces synthesized speech that sounds very much like the person from whom the speech was synthesized. The Digitalker lends itself easily to many electronic systems and applications, many of which can be controlled by 8-bit μ ps, and looks like any other peripheral on the μ p's databus. A simple 1-byte address and strobe cause a word, phrase or sentence to be spoken in a male, female or child's voice.

One disadvantage of the Digitalker was that the OEM had only a limited vocabulary from which to choose his words. Although the technology had evolved to the point at which synthesized and compressed speech could be stored in low-cost ICs, the process of synthesizing and compressing the speech was one that had to be performed by large computers and very skilled personnel at the semiconductor facility. Small-

volume customers (fewer than 500 units) with nonstandard vocabulary requirements were forced to determine the desired vocabulary for their product and wait for the synthesis software to be created, often a long and expensive process.

Editing systems make low-volume speech flexible

Today, with systems known as speech editors, low-volume users can create their own vocabularies.

National's speech-editing system is a stand-alone unit



Fig. 1. National Semiconductor's Speech Editing System includes a Z80-based μ c that supports 64K bytes of memory, two RS232 ports, dual double-density floppy-disk drives and the BLC-8281 speech processor board. Also included is the editor program and word library. Options for the MSC-6605 industrial system and Starplex development system are available.

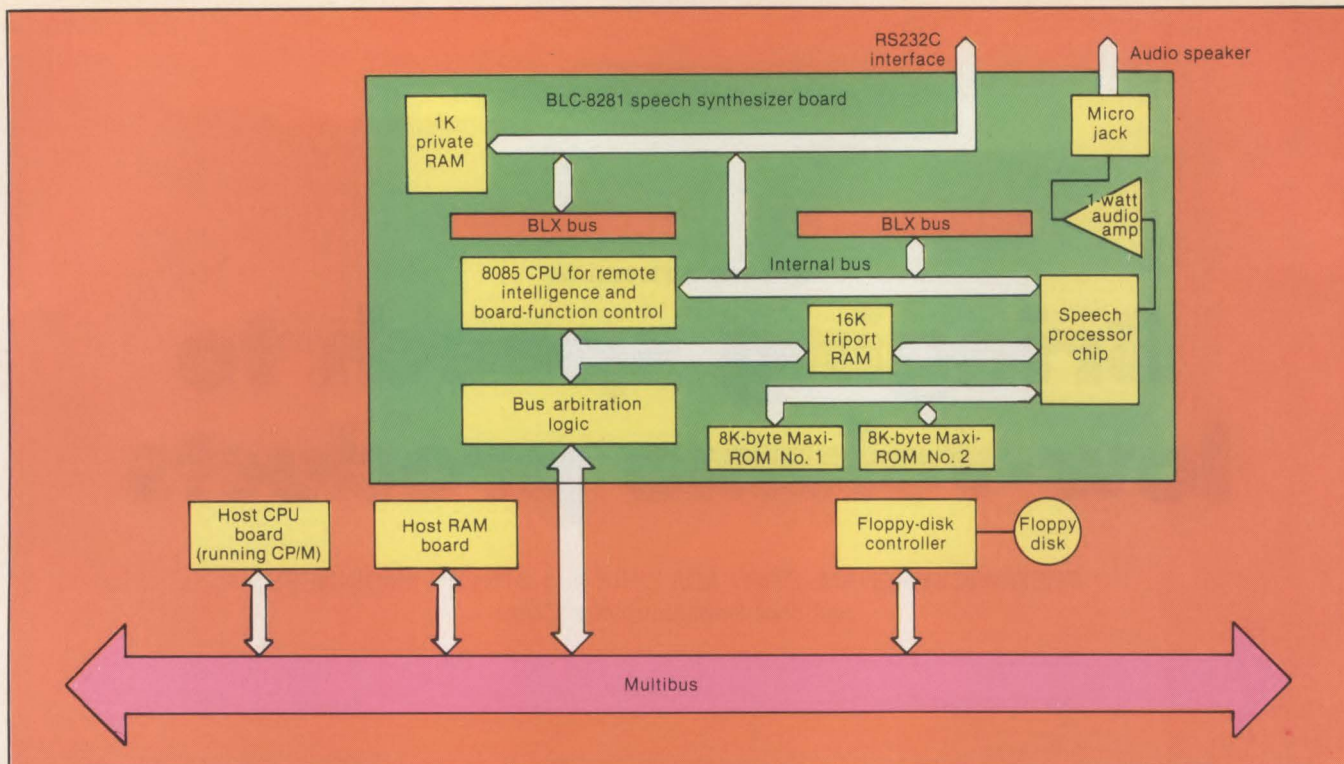


Fig. 2. Speech synthesis can be a board-level function. National's Multibus-compatible speech-processor board, the BLC-8281 can be used to convert other vendors' μ p-development systems into speech-editing systems. The board sells for about \$3000 and includes its own firmware, CP/M-compatible host software and a 1000-word library diskette. The buyer provides the development system and speaker assembly.

INSIDE THE DIGITALKER

The Digitalker speech-synthesis system is basically a two-chip circuit consisting of a speech-processor chip and speech memory, usually ROM. The speech output is mellowed by a simple filter and boosted by an inexpensive amplifier IC.

The synthesized and compressed speech data are stored in the speech ROM. The SPC controls all functions associated with addressing the speech ROM and "speaking" the desired word, phrase or sentence.

As each word, phrase or sentence

is synthesized, it is assigned a 1-byte address, which is made known to the product designer. The SPC has eight address line (SW1-SW8), allowing as many as 256 addresses for storing the desired end-product vocabulary.

For each independent vocabulary that is synthesized, a look-up table is constructed and placed in the speech ROM. This look-up table determines where the speech data are located for each 1-byte address applied to the SPC word address lines.

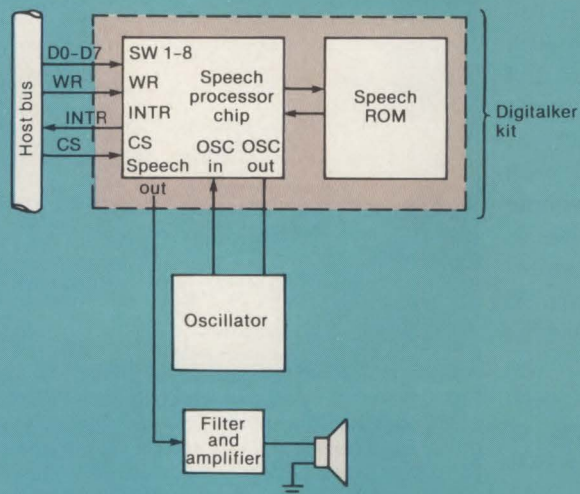
The SPC "feeds" itself from the

speech ROM, responding to various control commands and ultimately supplying its D/A converter the proper speech data. The end of each speech-data block contains control bits that cause an interrupt from the SPC to inform the CPU of the completed utterance.

For example, a typical sequence for outputting "please fasten your seat-belt" from the Digitalker would be: enable to SPC via the CS pin, apply the 1-byte address of the phrase to the SW1-SW8 word address lines of the SPC and strobe the WR input. The entire phrase would be spoken followed by an interrupt or an "un-busy" signal.

Addresses can store words as well as complete phrases, and many short sentences or phrases for a product can be assembled by stringing together (concatenating) words. The same sequence as above would be followed, but the SPC would be closely monitored so each new word can be output without delay.

Although most applications would use a CPU for system control, the SPC can operate without a CPU via mechanical switch closures. In these simple applications, a thumb-wheel switch, plus a momentary contact switch to generate the write strobe, could cause a word, phrase or sentence to be spoken from the Digitalker.



With systems known as speech editors, low-volume users can create their own vocabularies.

built around the company's speech-processor board. The unit (Fig. 1) consists of a Z80A-based μ c with 64K bytes of RAM, dual floppy-disk drives, CRT terminal and printer interfaces and a speaker assembly. It sells for around \$10,000. Vendor-supplied software includes EPROM programming routines and, more importantly, library diskettes, each containing as many as 1000 pre-synthesized words and phrases. These diskettes form the database from which a user configures a unique vocabulary.

Via a terminal, a user types in the desired words, inserting appropriate silent periods between them. The resident program extracts the appropriate words from the diskette and down-loads them into RAM residing on the speech-processor board. Upon demand, the speech-editing system "speaks back" the assembled phrases for evaluation. At this point, additions, corrections or deletions can be made to edit or otherwise perfect the vocabulary.

The speech-editing system then transfers the now RAM-based vocabulary EPROM(s) that can be used in the final product. Before making this transfer, however, the editing system puts the assembled vocabulary through a ROM optimization process that seeks ways to use the smallest amount of ROM or EPROM (approximately 1200 bits per word).

A do-it yourself board

National's newest product, the \$3000 BLC-8281, add-in speech-processor board (Fig. 2) has support software that allows OEMs to convert their μ c development stations into speech editors. Very few end-user minicomputers or μ cs offer simple speech synthesis. But now it's only a matter of time before OEMs begin integrating the boards into their products and selling speech editing to end users. ■

Fred Wickersham is marketing manager, speech products; **Gary Mullinix** is product manager, systems products; and **Steven McGinness** is product manager, board products, at National Semiconductor Corp., Santa Clara, Calif.

SPEECH COMPRESSION: THE KEY TO AFFORDABLE SPEECH SYNTHESIS

The quality and cost of digitally synthesized speech depend on the synthesis method and the amount of memory required to store the digital voice data.

Although a typical spoken word is about 500 msec. long, the digitizing process requires that each word be broken into "pitch periods," small increments about 10 msec. each in duration (a). Under analysis, these pitch periods portray small changes in the speech data and typically are identical to several preceding and following pitch periods.

National's approach is based on the fact that the human ear is insensitive to the phase of a waveform, or that waveforms of different phases can be produced that sound identical. Thus, for each pitch period of significantly changed data, the computer searches for a new waveform that sounds the same as the original but has all of its energy and is symmetrical about the center of the pitch period (b). A factor of two in compression (memory savings) can be realized with this center symmetrical waveform, as it is necessary to digitize only the first half, plus a few bits to indicate that a mirror image is to be created of the same duration.

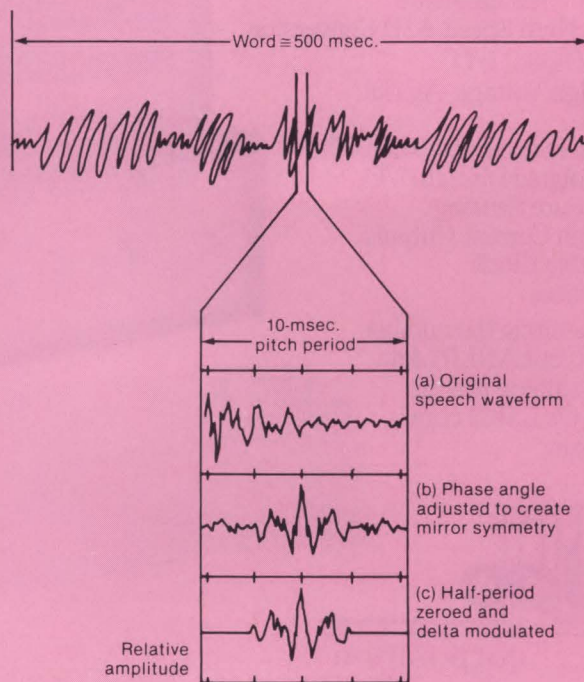
The ideally selected phase-adjusted waveform also has low-amplitude data in the first and last quarters of the pitch period. These quarters have

such low amplitude that the human ear cannot hear them, so the compression process simply reduces these first and last quarters to zero amplitude, thus allowing further reductions in digitization and memory requirements.

The resultant waveform (c) is a phase-adjusted, half-period zeroed waveform that sounds like the original

waveform (a) but requires significantly fewer bits when digitized by adaptive delta modulation.

Further compression results when waveforms of adjacent pitch periods are redundant. When this occurs, repeat bits are used to indicate redundant pitch periods. Additional reductions are realized by sorting common word sounds or phonemes.



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Particle accelerator lab targets computer access

GREG CHARTRAND, Fermi National Accelerator Laboratory

*An intelligent port-selection network
puts experimenters on-line at a unique research facility*

Experimenters at the world's largest particle accelerator depend on computers in their exploration of the basic structure of matter. After acquiring the necessary data-crunching power, the Fermi National Accelerator Laboratory found it still had a problem: providing access to users in various facilities scattered

across a 6800-acre area. Fermilab solved the problem with an intelligent port-selection system.

Selecting the appropriate network

The Fermilab particle-accelerator facility near Chicago is one of six major world centers for investigation of

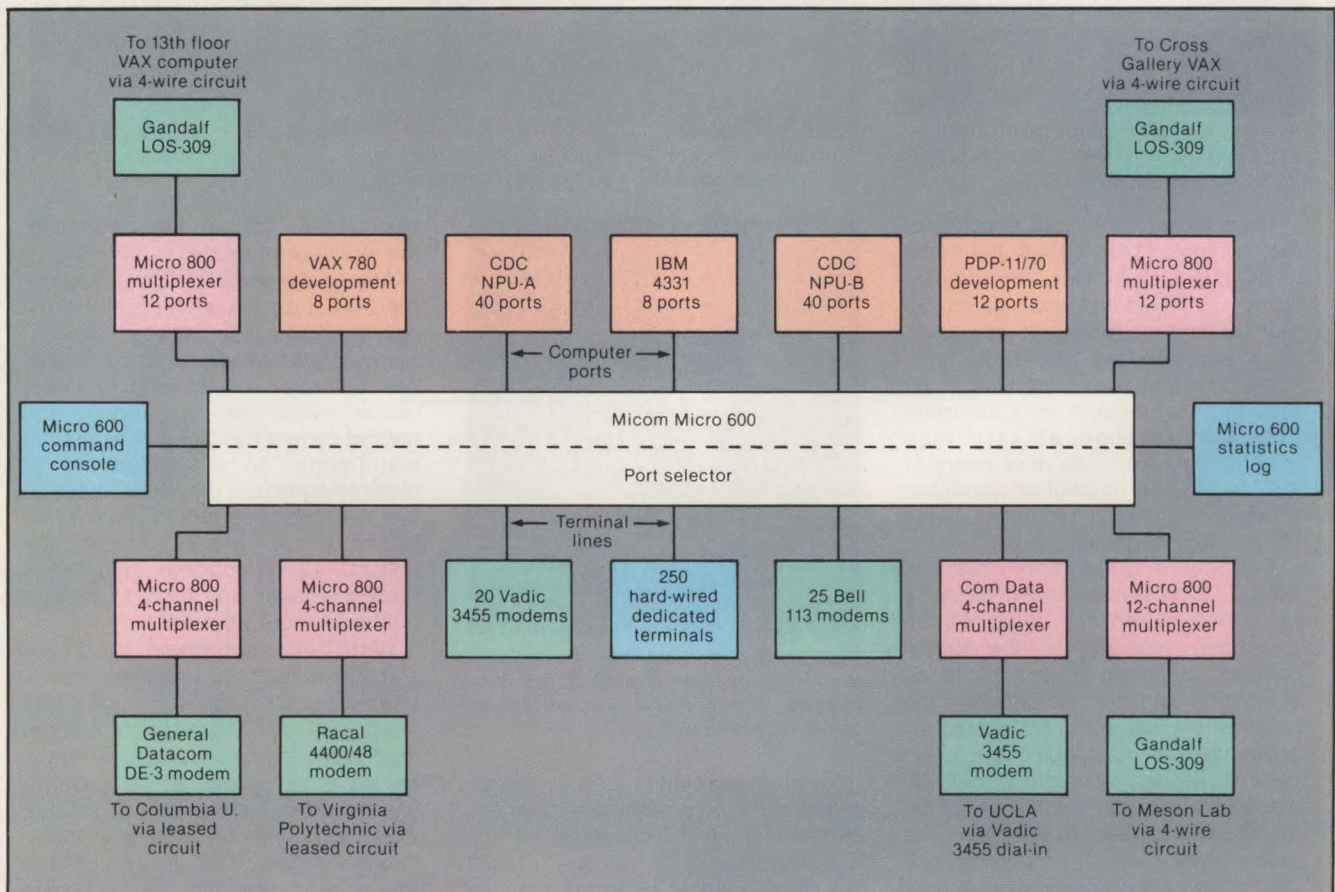


Fig. 1. Fermilab port-selection network connects users to the appropriate port on any of a number of computers, depending on demand, application and specified restrictions. The port selector interfaces with a variety of asynchronous devices, becoming transparent to a user after the connection is made.

If a connection cannot be completed because all available ports are in use, the port selector responds with a message and tells the terminal user how many others are ahead of him.

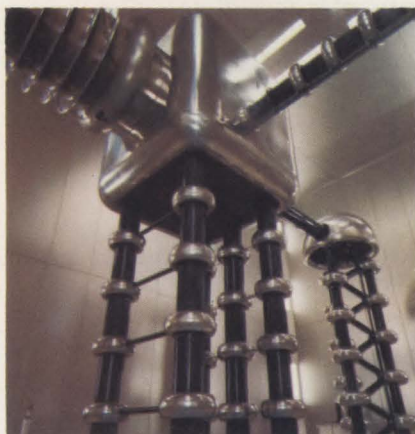
the smallest particles in the universe. Even a sizable computer installation is hard pressed to satisfy the requirements of hundreds of experimenters from across the country and around the world.

These requirements were only partially met with a batch-oriented system until 1979, when Fermilab acquired three Control Data Corp. Cyber 175 comput-

ers, each able to handle 8 million instructions per sec. These computers provided improved service via an extensive terminal network. The problem then shifted from one of providing service to one of providing access to hundreds of terminals at an affordable price.

A variety of alternatives was considered. The most straightforward solution was to connect each terminal directly to a host computer, but the cost of cabling was prohibitive. A second solution was dial-up connectors through telephone rotaries. But this would incur substantial telephone-equipment expenses, limit communications speeds and lessen data reliability. It also would have left the lab with "dumb" switching—either a connection is made, or a user receives a busy signal, with no provision for alternate routing, queueing, error

SMASHING PARTICLES FOR SCIENCE



Pre-accelerator strips protons from hydrogen gas and feeds them in a beam to the booster accelerators.

The search for the basic structure of matter has led physicists to the realm of subnuclear particles, the building blocks of such relative giants as protons and neutrons. At this level, particles can be observed only indirectly, and even then only by arranging collisions of subatomic particles traveling at very high speeds. The Fermilab accelerator is the largest of a handful of worldwide facilities capable of producing these high-energy collisions.

Fermilab's giant accelerator is housed in an underground tunnel 4 mi. in circumference. A string of 1000 21-ft.-long magnets in the tunnel confines a stream of protons to an evacuated tube locked between the poles of the magnets. By alternately powering and discharging the magnets, a stream of protons can be made to move around the 4-mi. circuit at increasing speed. At each turn, the protons are given an electrical kick that boosts their speed so that they are soon making the trip around the tunnel in 20 millionths of a second.



Aerial view of Fermilab shows a portion of the 4-mi. accelerator track (background), with various laboratories and booster accelerators (foreground).



High-energy particle collisions leave tracks in bubble chamber for later analysis. Evidence of a neutrino interaction is shown.

When the protons reach the speed required for an experiment, they are extracted from the circular orbit and directed toward a target. In the resulting violent collisions of the protons with their targets, various subatomic and subnuclear particles

are created. Through this interaction, the structure of matter is probed.

Among the particles and phenomena investigated at Fermilab are quarks and nuclear "neutral" currents. Many physicists suspect that quarks are the fundamental building blocks of matter, while the discovery of the neutral current has been compared in significance to the discovery of electromagnetism. Physicists hope to use the neutral current to link the four known forces—gravity, electromagnetism, strong nuclear and weak nuclear—under one theory, a major goal of modern physics.

Work with subatomic particles sometimes leads to promising developments in other fields. For example, many patients treated with neutron irradiation in the Cancer Therapy Facility at the accelerator have shown improvement, although the technique is still experimental. And any breakthrough in particle physics could lead to the next revolution in solid-state engineering: a lot of quarks could fit on a chip.

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Any port-contention device at the center of the system is regarded as critical and must have complete redundancy of all key elements.

traces or intelligent responses to incoming calls.

Fermilab chose to install an intelligent port selector as a front end to the Cybers and the smaller CPUs in the computer department. This option allowed for accommodating inexpensive dumb asynchronous terminals and provided the switching functions of a telephone rotary system. It also injected intelligence at the appropriate point to provide alternate routing, load balancing, contention and message broadcasting, and could be installed at a reasonable cost without changes in software.

Intelligent port-selection system

An intelligent Micom Micro600 port selector supplemented by ADC Products' connectorized telephone cables and Amphenol panels is at the hub of the Fermilab Computer Network. The system connects both terminals within the central laboratory building and those accessing the center through dial-up connections from remote locations. If a connection cannot be completed because all available ports are in use, the port selector responds with a message and tells the terminal user how many others are ahead of him. The user can elect to wait, in which case he is put in queue and connected automatically when a port becomes free, or to disconnect and try again later.

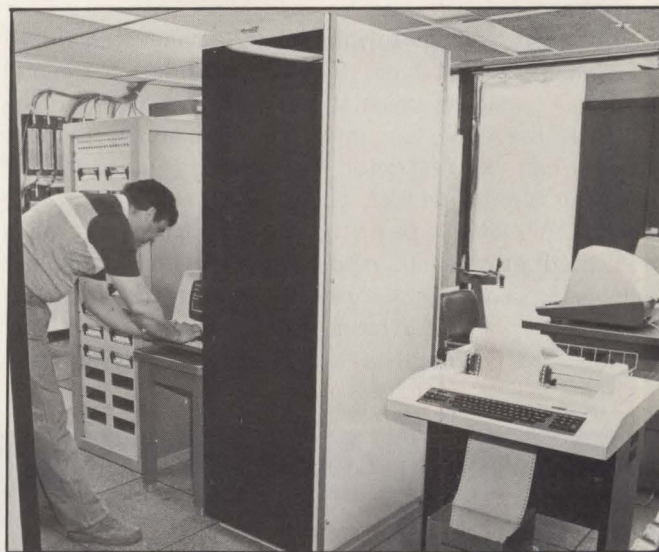
The central laboratory building has 300 terminals connected directly to the port selector through six telephone-like trunks. Each trunk consists of as many as three 25-pair connectorized telephone cables daisy-chained from floor to floor. On each floor, panels that accommodate as many as 36 two twisted-pair connections provide the terminal hookups. An additional trunk serves the "cross gallery," which is several thousand feet from the laboratory building.

Terminals are connected to the trunks with Micom Micro400 line drivers. Because these drivers are compatible with the line/port modules in the Micro600, additional line drivers are not required at the port-selector end of the cables. This feature saved the laboratory considerable money and simplified the cabling. Dial-up access to the network from outside the lab building is achieved with several types of modems, including Bell Laboratories' 103s and 212s and Vadic's 3455s. Outgoing traffic is handled through the port selector's dial-out option, allowing access to off-site computer systems. This reduces the need for external couplers or modems and increases the reliability of off-site data connections.

Access to computers

Fermilab has a number of computers that the port selector can access. The Cyber 175s are the largest, but

an International Business Machines Corp. 4331 and Digital Equipment Corp. VAX 11/780 and PDP 11/70 computers are also available. Several computer systems outside the central computing facility are linked to the port selector through Micom Micro800 data concentrators. The concentrators are also used remotely where phone lines are scarce or where the radio frequency interference from the accelerator and associated equipment would make normal line-driver and modem communications unreliable without the Micro800's error detection and correction. Fermilab expects to install several dedicated multiplexer links to universities nationwide. Links have been set up to Virginia Polytechnic Institute, the University of California at Los Angeles, the University of Colorado and Columbia University.



Micom Micro600 intelligent port selector (center) connects users at Fermilab to appropriate ports. Users and CPUs are scattered across a 6800-acre site, and communicate to the Micro600 via modems, multiplexers and trunk lines.

The Cyber 175s are connected to the port selector through two Control Data Corp. Network Processor Units, each of which contains 72 asynchronous terminal connections. The NPU connections are interleaved so that sequential port connections go to alternate NPUs providing automatic load-leveling. If one of the NPUs is down, the port selector can determine which ports are dead and place them out of service without operator intervention.

System satisfies requirements

Because of Fermilab's heavy computer-system demands, the configuration was designed for continuous operation, even with major portions down. Any port-contention device at the center of the system is regarded as critical and must have complete redundancy of all key elements. The Micro600 meets this requirement internally, and in almost three years of operation, the amount of down-time attributable to it is just minutes.

The port selector's μ c operates according to instruc-

Because the drivers are compatible with the line/port modules in the Micro600, additional line drivers are not required at the port-selector end of the cables.

tions entered through a command console that could be any of the local dumb terminals. An operator in the computer room can reassign ports from one application program or type of service to another to balance the workload. Once a connection is established, the port selector is transparent to a user. The μ c is also able to output a statistics log to the console to aid in studying usage and in tracing terminal, computer and modem problems.

Any asynchronous terminal can be connected to the Micro600, its Autobaud feature providing automatic terminal-speed detection to as much as 9600 bps. The μ c monitors each line interface, and access to port classes can be restricted for security purposes by entering commands from the console.

The Micro600 appears to the computer port as a dedicated terminal or a modem emulating the automatic answering sequence of a Bell 113 (CCITT V.21) modem. Line and port interfaces can be selected in any combination through a front-mounted thumbwheel switch.

The Micro600 handles 744 lines and ports, expandable to 992. Expansion to handle additional terminals is planned to accommodate more work at Fermilab; each discovery that the experimenters make brings new questions. As more is learned about the structure of matter, the workload at Fermilab grows, and the demands placed on the computers increase. ■

Greg Chartrand is a technical specialist at the Fermi National Accelerator Laboratory, Batavia, Ill.

NEXT MONTH IN MMS

Watch for Mini-Micro Systems' annual special report on computer graphics in the July issue. A comprehensive survey of graphic terminals for business and science applications will lead off the feature section, which will be augmented by several other graphics-related articles, including:

- A look at turnkey graphic systems.
- A tutorial on graphic-input peripherals.
- An explanation of building-block graphics.

Mini-Micro Systems is also planning major product survey articles in coming months, including microcomputers in August, high-level languages and development systems in September, memory systems in October and computer terminals in November.

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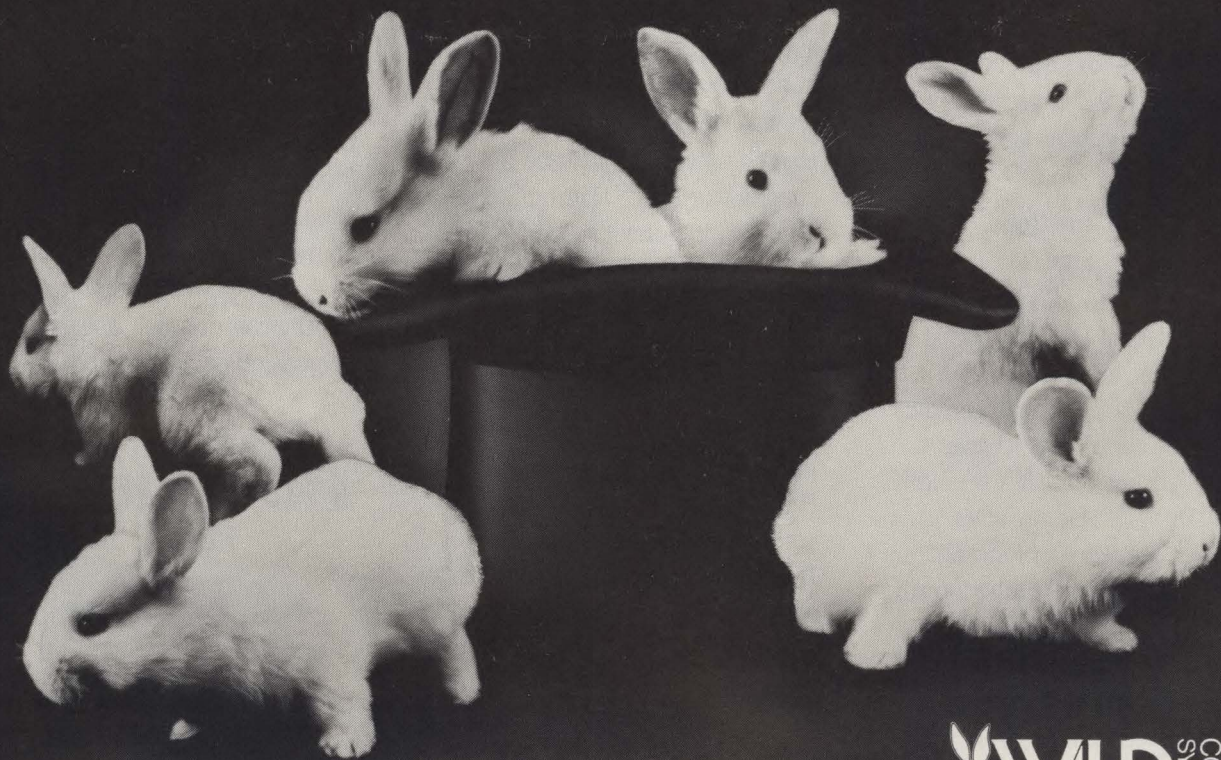
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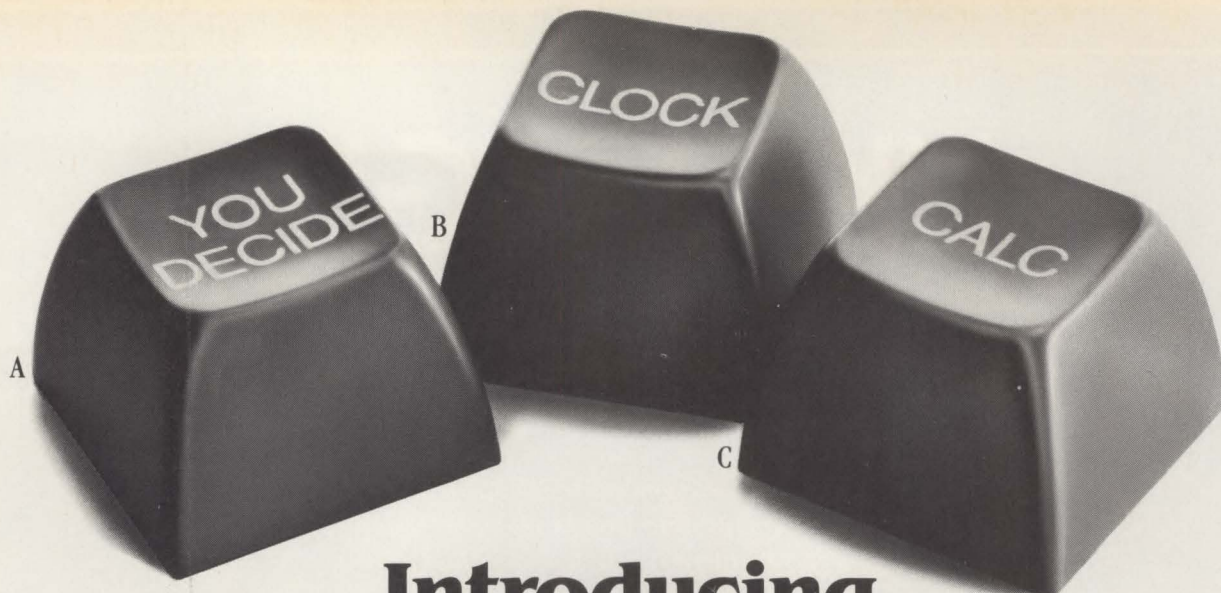


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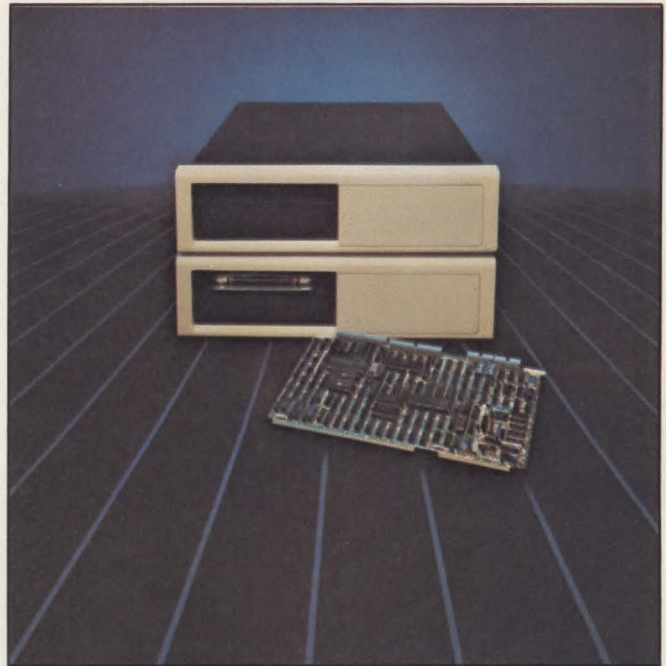
DAVID M. ARONOVITZ and RICHARD A. CLEWETT, Data Systems Design, Inc.

New single-board, multifunction controller for Multibus systems provides pipelined, non-interleaved operation

A new single-board controller for Multibus-based systems can simultaneously interface to 8-in. Winchester, streaming-tape and 5¼-in. floppy drives. Developed by Data Systems Design, Inc., for its DSD 700 series subsystems, the DSD 7215 controller emulates Intel Corp.'s ISBC 215 disk controller and ISBX 218 floppy-disk daughter board. It features "pipelined" architecture, one-way interleaved transfer rates, on-board separation and transparent disk error correction.

The DSD 7215 controller architecture (Fig. 1) consists of a high-speed internal bus, an optimized disk data path (the pipeline), internal bus masters and slave interfaces. The μ p unit and the direct-memory-access controller control the bus as masters. The Multibus interface, the streaming-tape interface and the disk-drive interface are all slaves on the bus.

The μ p unit, which provides intelligent controller functions, consists of a 5-MHz 8085 μ p, a pair of 2732, or 2764 EPROMs and a RAM/I/O-counter peripheral chip. The 256-byte RAM portion is used for a local stack and scratch area and to buffer disk commands received via the Multibus interface. The I/O ports provide control lines for the slave interfaces and the read/write controller. The μ p is used to control low-speed operations such as buffering commands from the host system, housekeeping, executing on-board confidence tests and initiating off-line backup and restore operations. The μ p also exactly emulates the ISBC 215 and ISBX 218 controller combination, resulting in compatibility with operating systems such as RMX-86 and RMX-88, as well as future operating systems and application software.



DSD 7215 disk controller board (foreground) allows flexibility in system configuration. It can be used with the DSD 736 D 40M-byte Winchester-disk drive and double-sided floppy-disk subsystem (top), and the DSD 726 T 40M-byte Winchester and 90-ips, ¼-in. streaming-tape subsystem. Both subsystems can be daisy-chained.

Disk operations are initiated by issuing a write to an I/O address—the "wake-up" I/O port—on the DSD 7215. The controller then reads the I/O parameter block, a 64-byte block of memory, to determine the command to be executed. The I/O parameter block simplifies the

The μ p exactly emulates the iSBC 215 and iSBX 218 controller combination, resulting in compatibility with operating systems such as RMX-86 and RMX-88, as well as future operating systems and application software.

creation of driver software in implementing an operating system.

The controller can queue disk-operation commands to permit overlapped seeks, implied seeks and other operations. An extension of the standard iSBC 215 codes implements tape operations.

that are too fast for the μ p. Its basic functions are to format disk tracks, recognize header fields for disk sectors and read and write data on the drive, track and sector specified by the μ p and the disk-drive slave interface. The read/write controller uses a 2910 bit-slice sequencer chip that is clocked at the disk data rate. The sequencer requires 1K word of PROM to control the dual-port buffer, error-correction-code/cyclic-redundancy-check gate-array and other circuitry. The instructions for the sequencer are decoded by a programmed-array-logic chip, one of seven on the controller to reduce chip count and power consumption. The 2910 allows the generation of data streams for direct writing in the Winchester drives via the pipeline (see "Pipelining for speed," p. 236).

The dual-port buffer consists of a buffer controller

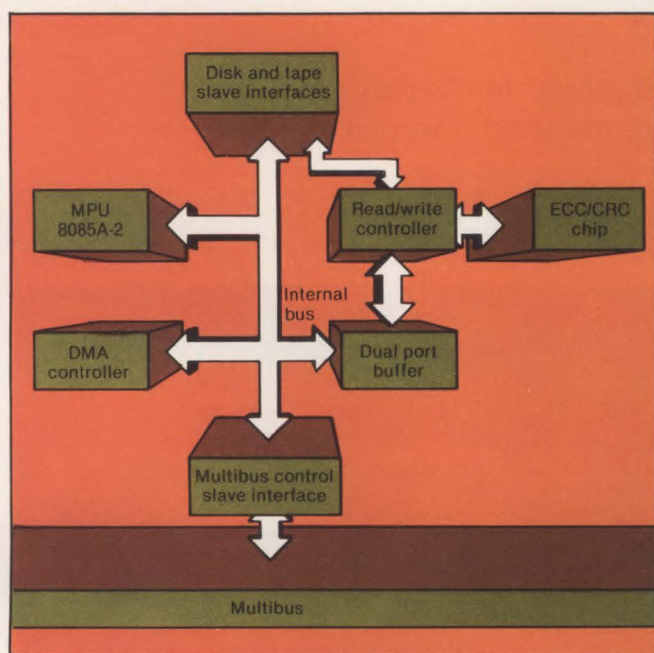


Fig. 1. DSD 7215 controller architecture consists of a high-speed internal bus connected to an 8085A μ p and a direct-memory-access controller, which act as masters. The three slave interfaces interface the controller to the drives and to outside devices via the Multibus. The read/write controller and the data separator form part of the pipeline.

The direct memory access controller, a 5-MHz 8237 chip, transfers data at high speeds between one port of the dual-port memory and two slave interfaces—the Multibus interface and the streaming-tape interface (Fig. 2). During off-line backup/restore operations, data are transferred between the disk drives and the streaming-tape interface via the dual-port buffer, leaving the host CPU and Multibus for other tasks. During disk operations, data are transferred to the Multibus interface.

The pipeline

The read/write controller performs disk operations

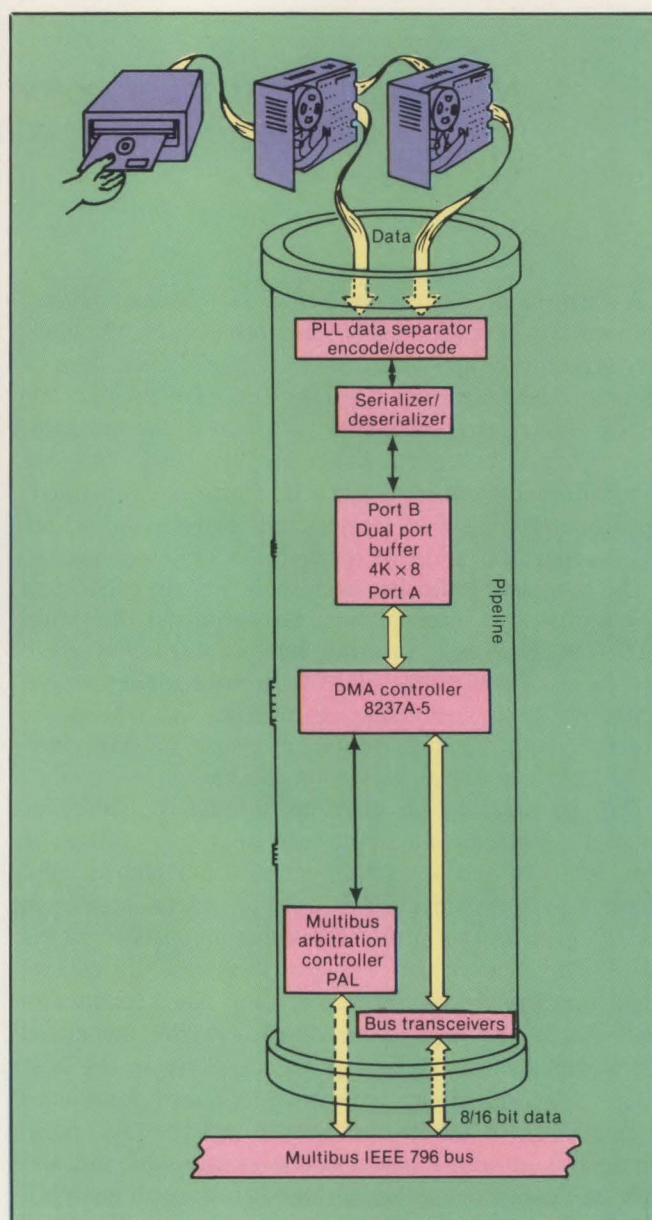


Fig. 2. Pipelined architecture of the DSD 7215 controller speeds transfer rate. Dual-port buffer allows data to be concurrently accessed from the disk and transferred to the DMA controller.

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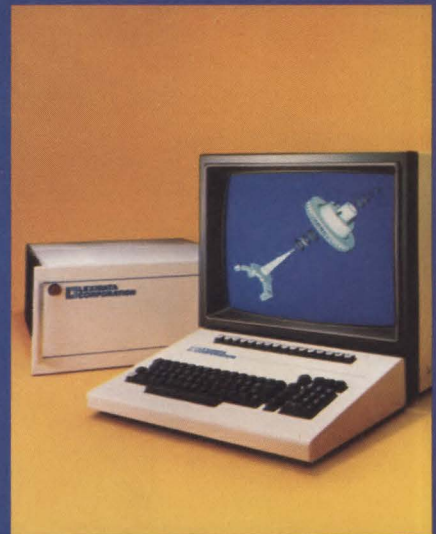
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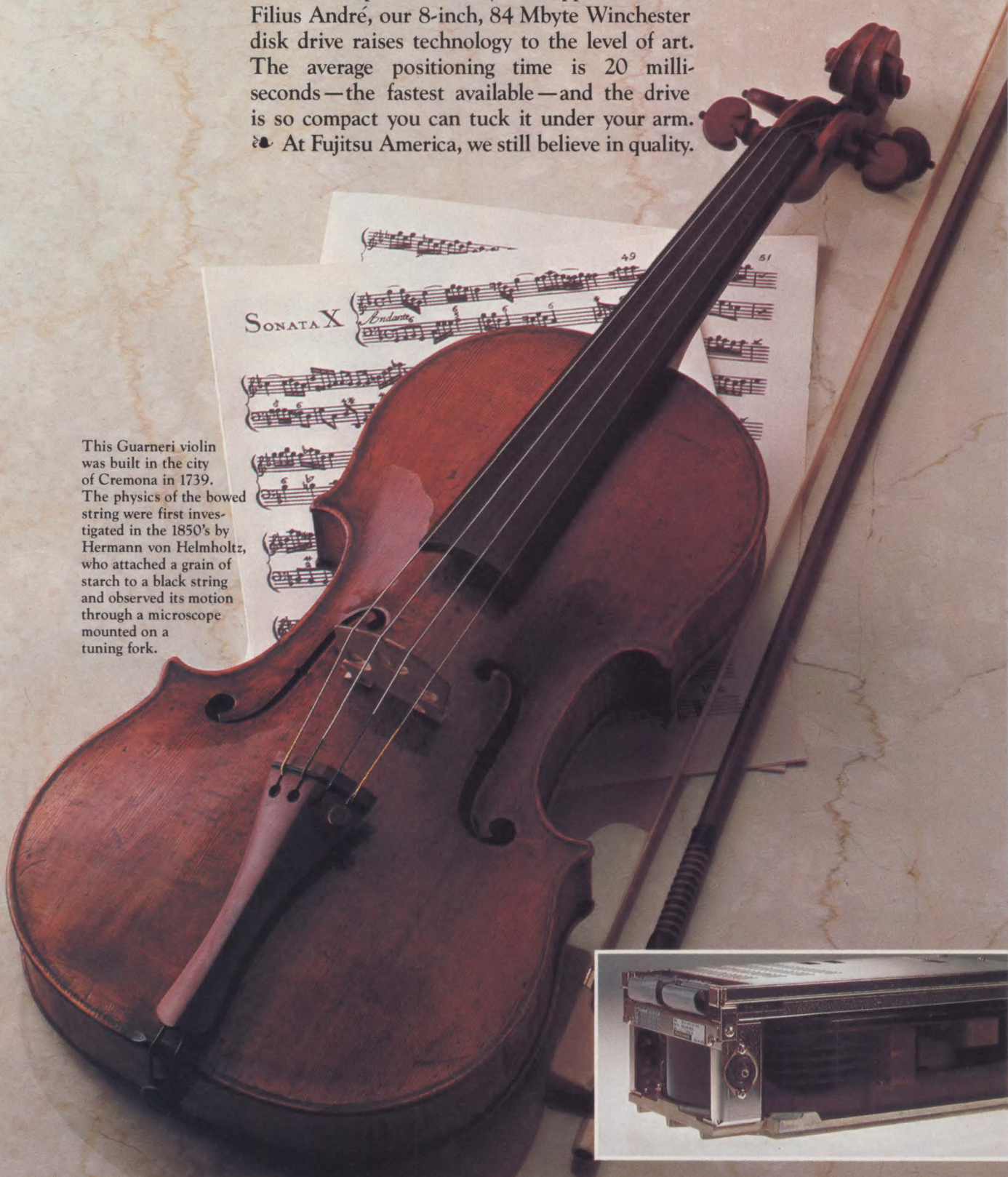
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CIRCLE NO. 110 ON INQUIRY CARD

The instructions for the sequencer are decoded by a programmed-array-logic chip, one of seven on the controller to reduce chip count and power consumption.

(two PAL chips) and 4K bytes of RAM. Both ports operate asynchronously with arbitration provided by the buffer controller. The dual-port controller anticipates successive transfers so that both the read/write controller and the internal bus master will have the next word of data available when requested.

The Multibus interface requests bus access and directs all data-transfer operations once the bus has

been acquired. Two PAL chips achieve a significant reduction in power dissipation compared to conventional arbiter chips and maintain Multibus compatibility.

The use of PALS also permits a choice of four arbitration modes. In single-transfer mode, the bus is released after each transfer. In the burst mode, the bus is released only for a higher priority device or when the transfer of a data block is completed. The controller supports the common bus request signal, which relinquishes the bus for any request or at the end of a transfer. The override mode can be used to acquire the bus and ignore higher priority requests until the end of a block transfer. The Multibus interface can transfer pipeline data as bytes or words, depending on the system environment. Word transfer results in twice the data handled per Multibus access.

TO INTERLEAVE OR NOT TO INTERLEAVE

The growing popularity of disk-intensive operating systems such as UNIX and the increasing use of large databases and complex application programs have made many users sensitive to the effects that disk-transfer rates have on overall system performance. Non-interleaved operation—the ability to read a track during a single disk revolution—should result in system performance gains when compared to making two, three or more passes over the same track to read the data.

Interleaving controls the order in which sectors of data occur on the physical disk track: it is used to increase disk-rotation time between sequential sector numbers so that data from each sector can be transferred to main memory before the next sector on the track comes under the drive head.

The "interleave factor" is the minimum number of sector intervals between the start of one sector and the start of the next sequentially numbered sector. Sector 1 is written immediately after the physical track index (Fig. 3). For non-interleaved operation, an interleave factor of 1 specifies that sectors are to be written in sequence around the track, that is, index, sector 1, sector 2, etc. Each time the interleave factor is increased by one it takes an extra disk rotation to transfer the data from one track (Fig. 4). For a hard disk, each extra rotation can account for 10 to 60 percent of the average seek time.

The operating system should be optimized to take advantage of

Interleave factor (disk rotations)	Sector numbering sequence
1	1 2 3 4 5 6 7 8
2	1 5 2 6 3 7 4 8
3	1 4 7 2 5 8 3 6
4	1 3 5 7 2 4 6 8

Fig. 3. The interleave factor indicates the number of disk rotations that must be completed to read all sectors. In one-way, or non-interleaving (interleave factor 1), the sector numbering is sequential. In this example, there are eight sectors per track, as in a single-density diskette.

non-interleaved operation. First, consider how the operating system organizes files on the disks. Sequentially organized files that use sequential sectors on the same track are in keeping with non-interleaved operation. Second, the operating system should be capable of multi-sector transfers. With the BSD 7215 controller, one command can transfer any amount of data from 1 byte to the entire disk capacity without further CPU intervention. Intel's RMX-86 and RMX-88 are examples of operating systems that can take advantage of this feature.

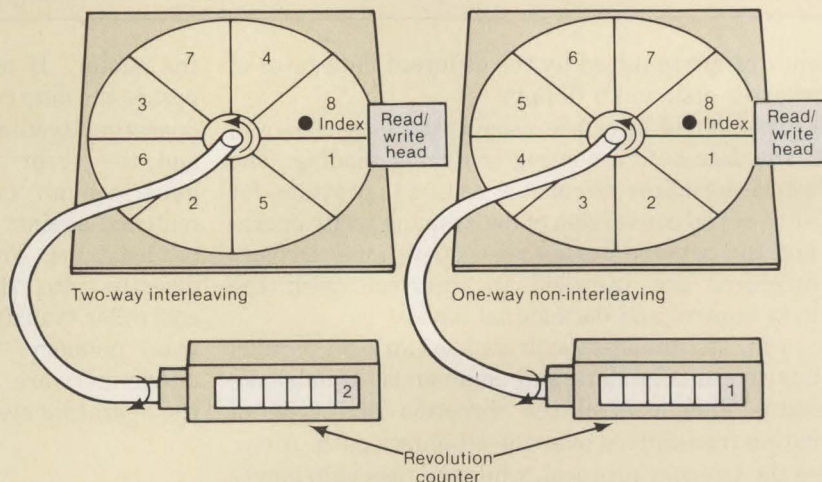


Fig. 4. Comparison of two-way interleaved and non-interleaved diskettes shows that the interleaved diskette must undergo two revolutions to bring all sectors past the read/write head. Non-interleaved diskette sectors are ordered consecutively, so that one track can be read in one revolution. Interleaved operation slows the read rate to give the controller time to transfer the data from each sector.

A conventional phase-locked loop performs data separation for the Winchester and floppy disks.

On-board data separation

A conventional phase-locked loop performs data separation for the Winchester and floppy disks. The analog loop locks the read/write controller onto the serial bit stream so that data can be correctly interpreted. The loop is optimized for the best reading margins over a wide temperature and voltage range. The data separator is flexible enough to handle the 20:1

ECC chip, which can generate both Winchester ECC codes and CRC codes for the floppy disks. This chip is a gate array with 540 gates in a 22-pin DIP using 5-micron design rules. A computer-generated polynomial is used to attain superior correction speed and accuracy compared with conventional fire codes over a variety of sector sizes. The chip generates a 32-bit code that is appended to each Winchester data sector as it is written. During read operations, the chip determines whether a detected error is correctable and prevents passing off doubtful data as good when a correction is made.

When disk data are read, the chip detects any error bursts as long as 22 bits in a sector. If an error is detected, the controller automatically tries to reread

PIPELINING FOR SPEED

Pipelining is a design technique that permits the beginning of one operation before another has been completed. Thus, a pipelined read/write controller can transfer 1 byte of data from the disk to the buffer without waiting for the DMA controller to finish its last transfer from the buffer to the memory bus.

The DSD 7215 controller uses a pipelined architecture to support non-interleaved operation at the maximum transfer rates for both floppy- and Winchester-disk drives. The phase-locked-loop data separator supports data rates in excess of current disk-drive capabilities, while the dual-port buffer logic effectively eliminates access time by pre-

fetching the next data byte in anticipation of sequential transfer. This approach avoids the data-overflow susceptibility of FIFO buffers.

Acquisition of the Multibus is accomplished by the PAL devices tailored to the architecture of the controller to provide bus arbitration without compromising overall throughput.

The time saved by pipelining could be wasted if a user improperly configures the bus priority. To prevent this, DSD 7215 offers designers several choices for bus arbitration. The best transfer rates will be achieved if the controller yields the bus only after a completed transfer. This is a good solution for database-

management-system applications, but might not be satisfactory in real-time applications. In that case, yielding to higher priority devices as determined by the backplane slot assignments might be the best compromise. The last choice is to yield the bus after each byte is transferred, providing maximum bus availability to other devices.

Giving the controller a high priority in the backplane is another way of getting the most out of the controller. Most backplanes provide a method for establishing relative priority using jumpers or slot positions in the card cage.

frequency range required by the different data rates of a Winchester disk and a floppy.

The disk-control interface uses a PAL to encode and decode the data before writing or during reading. The serializer/deserializer circuit, or SERDES, provides for parallel-to-serial conversion of data during write operations and the reverse during read operations. Drivers and receivers are installed to interface with the disk-drive control and data-signal lines.

The 1/4-in. streaming-tape drive uses an 8-bit parallel data bus to transfer data and commands. Handshake and status lines control the direction and type of information transmitted over the 8-bit data path. A PAL handles the transfer protocol, while the DMA chip moves data between the tape interface and dual-port buffer during disk backup or restore operations. The read/write controller is active during this time in handling data transfers between the disk and dual-port buffer.

Disk error correction

The DSD 7215 controller incorporates a proprietary

the sector. If a correct read ensues, the controller passes the data (via DMA) and reports a soft error to the operating system. If retries cannot correct the error and the error pattern is repeatable, the ECC chip generates an 11-bit error "syndrome" that can be matched against the original data to find the incorrect bit locations. The μ p then writes the corrected bits directly into the dual-port buffer, and the DMA controller transfers the corrected data to the Multibus main memory. Selection of automatic correction is under software control, with corrections reported to the operating system in the same way as soft errors. ■

Richard A. Clewett is Multibus and system development program manager, and **David M. Aronovitz** is Multibus-compatible mass-storage systems product line manager at Data Systems Design, Inc., San Jose, Calif.

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CIRCLE NO. 113 ON INQUIRY CARD

3.9-in. Winchester features removable media

ANDREW ROMAN, Roman Associates International

*New disk provides and backs up 6M bytes
in half the space of a minifloppy*

The days when an 8-in. disk drive could be considered compact are long gone. In recent years, manufacturers have been competing to introduce successively smaller generations of drives without sacrificing compatibility and storage capacity. That competition has brought us the minifloppy, the micro-Winchester and the half-height floppy. Now adding to the options of system integrators looking for mass storage in a small space is the 3.9-in. Winchester.

The SyQuest Technology SQ-306 will be available in fixed- and removable-media versions, each with 6.38M bytes of unformatted capacity. It has a Seagate Technology ST-506-compatible interface and data format and is designed to fit with a second 3.9-in. drive in the space of one minifloppy. The disk is scheduled for volume shipments in October at an OEM 500-quantity price of \$400.

Compatibility in a small package

The SQ-306, which measures $4.8 \times 8 \times 1.625$ in., is compatible with industry-standard $5\frac{1}{4}$ -in. Winchesters in storage capacity and track and cylinder mapping. But because the drive is half as high—1.625 in., compared to 3.25 in. for $5\frac{1}{4}$ -in. devices—one pair mounted piggyback can provide twice the storage of a $5\frac{1}{4}$ -in. drive in the same space. The SQ-306 is sector, track and data-format compatible with the 12.76M-byte Seagate ST-412 and provides the same 5M-byte-per-sec. data-transfer rate. The drive plugs into the Seagate ST-506 controller.

The removable-media version uses a 6.38M-byte (5M bytes formatted), front-loading cartridge (Fig. 1). The plastic cartridge measures $4.33 \times 4.41 \times 0.43$ in. and weighs 5 oz. Called a "Q-Pak," it was developed by SyQuest and is expected to sell for about \$30 in OEM quantities.

Cartridge insertion and removal

As the cartridge is inserted through the drive door into the drive (Fig. 2), a channel guides the cartridge



Fig. 1. The SyQuest SQ-360 3.9-in. Winchester drive uses 6.38M-byte removable cartridges, plugs into a Seagate ST-506 controller and is available in a fixed-media version. (Cutaway version shown.)

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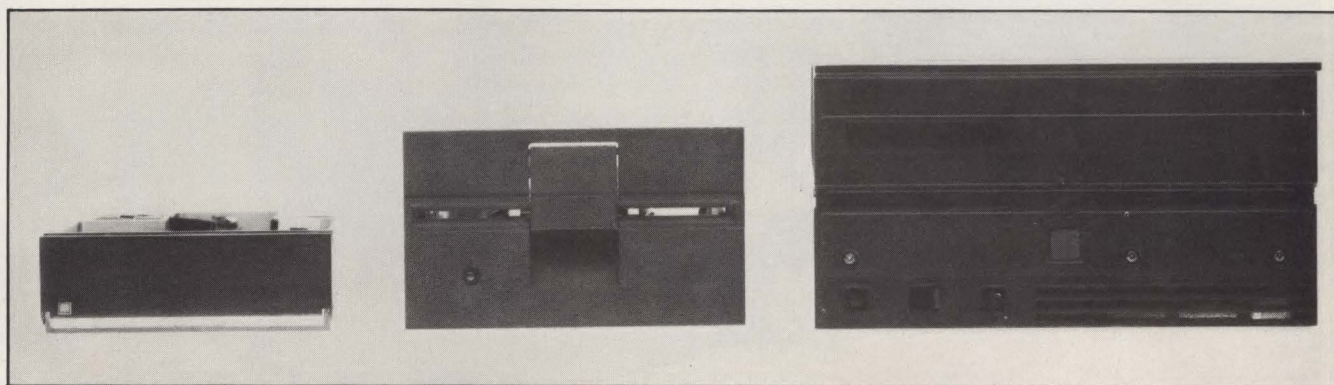
CIRCLE NO. 114 ON INQUIRY CARD

There is no dedicated zone for head takeoff/landing or shipping, saving data tracks for storage.

in, and a metal tab attached to the base casting engages the cartridge door latching mechanism, opening the cartridge doors to provide a head-access slot. The cartridge is keyed to prevent an operator from inserting it incorrectly. Another metal tab attached to the drive verifies that the door is fully open to prevent the heads from crashing into the closed door of the cartridge. This tab prevents the cartridge from being pushed further into the drive in the event the cartridge door mechanism fails to operate.

Closing the drive door after cartridge insertion seats the cartridge onto the spindle hub. Three reinforced plastic fingers attached to the cartridge secure the disk hub on the spindle shaft. The cartridge hub is also secured magnetically to the spindle flange to prevent slippage. When seated, the face of the cartridge is held firmly against an air seal to ensure a contamination-free enclosure for the flying Winchester heads. Electrical contact is also made upon door closure, and the drive spindle starts spinning the disk platter, which comes up to speed within 15 sec. An air-purge cycle to clean the head-disk assembly enclosure is not required so that the drive is ready to seek, read or write 15 sec. after closing the door.

The read/write heads are loaded onto the platter at



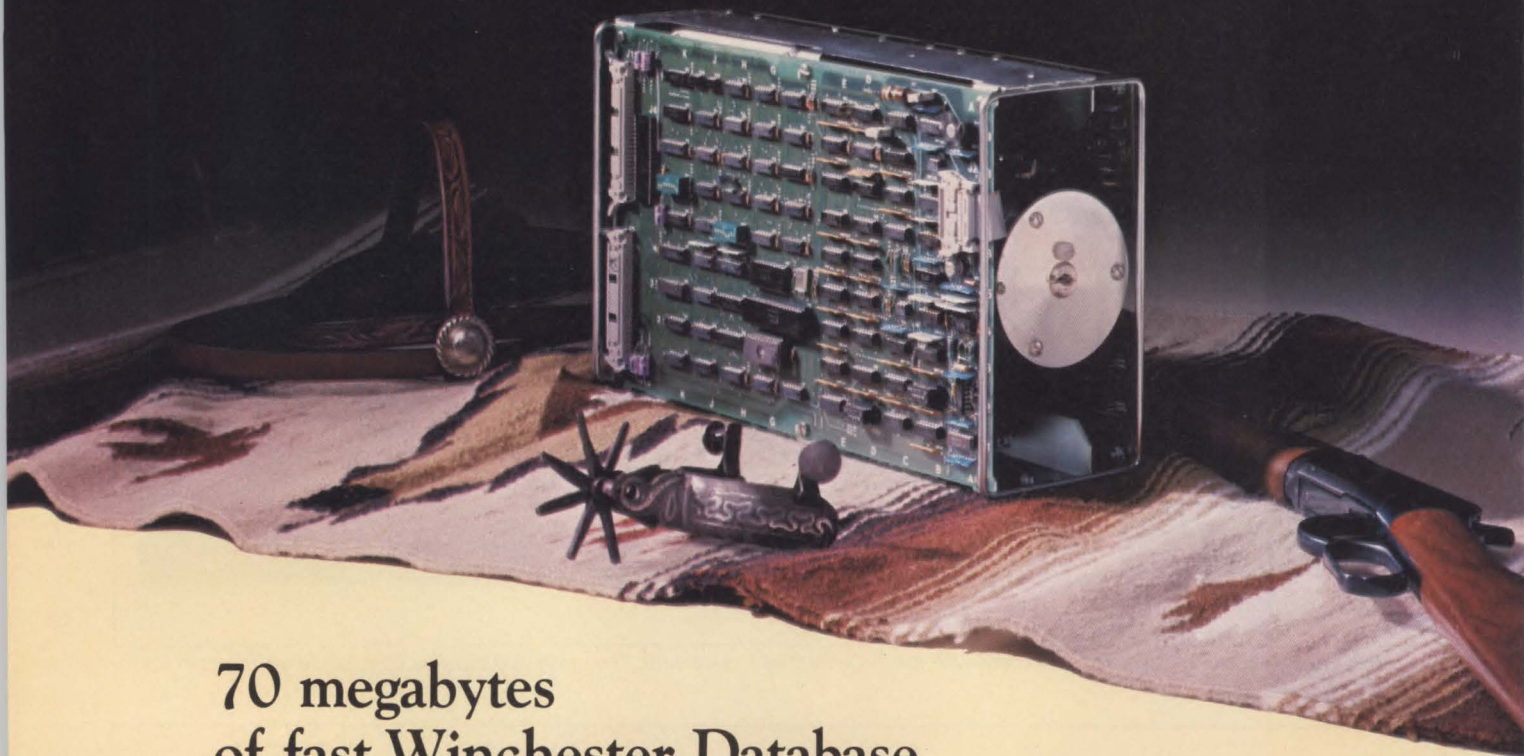
Disk drives continue the trend to compactness with the SyQuest 3.9-in. drive (left). The previous jump was from 8-in. drive (right) to 5 1/4 in.

	Syquest SQ-306	Seagate ST-412	Tandon TM602
Unformatted capacity (M bytes)	6.38	12.76	6.38
Dimensions (M x W x D, in.)	1.625 x 4.8 x 8.0	3.25 x 5.75 x 8.0	3.25 x 5.75 x 8.0
Transfer rate (bits per sec.)		5M	
Positioning time (msec.)			
Track-to-track	3	3	3
Average	70	70	138
Maximum	190	190	250
Settling time	15	15	15
Rotational speed		3600 rpm	
Recording density			
Tracks per in.	435	345	254
Bits per in.	12,000	9074	7690
Bytes per track	10,416	10,416	10,416
Tracks per surface	306	306	153
Number of platters	1	2	2
Number of data surfaces	2	4	4
Media	removable (SQ-306R) fixed (SQ-306F)	fixed	fixed
Platter size (mm.)			
Inside diameter	40	40	40
Outside diameter	100	130	130
Interface		industry standard 5 1/4-in. Winchester	
Servo technology	closed loop digital	open loop	open loop
Power requirements	12V DC, .9A 5V DC, .6A	12V DC, 1.8A 5V DC, 1.0A	12V DC, 1.5A 5V DC, 1.0A
Price (OEM quantity 5000)	\$400 fixed or removable; \$30/cartridge	\$870	\$625

Source: Roman Associates International

Comparison of specifications of SQ-306 and two micro-Winchesters shows similar head-positioning times, data format and interface. The SQ-306 uses higher density recording, is available in both fixed- and removable-media versions and is 83 percent as wide and half as high as micro-Winchesters.

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Disk-surface lubrication and head-crash protection is provided by a glass-like graphite coating deposited onto the magnetic film of the disk platter.

track 000. There is no dedicated zone for head takeoff/landing or shipping, saving data tracks for storage.

When the cartridge is to be removed, the operator activates the front-panel switch from the run mode to the load mode and opens the drive door. This activates a gear-linked mechanism that retracts the carriage, moving the heads back to track 000, and disengages the spindle drive. When the platter stops spinning, the mechanism lifts the heads from the disk surface, breaks the hold of the magnetic chuck from the spindle surface and moves the cartridge up to clear the spindle hub. Solenoids are not used in the SQ-306 because they are prone to sticking and require more power. The cartridge is now ready for removal so that another can be inserted. Total time duration for cartridge removal is 10 sec.

The drive electronics are implemented on two PC boards—the power driver board mounted in the rear and the read/write and control board mounted under the drive.

Thin-film disk media

The data-recording media used in the SQ-306 cartridge is a thin-film cobalt-phosphate-coated platter with a 3.9-in. outer diameter and a 1.575-in. inner diameter. Both surfaces of the platter are used for data storage, each containing servo positioning and index/timing data. The SQ-306 records at a density of 12,000 bpi and 435 tpi at 3600 rpm. Future enhancements may increase the density to 20,000 bpi and 1000 tpi.

Disk-surface lubrication and head-crash protection is provided by a glass-like graphite coating deposited onto the magnetic film of the disk platter.

Read/write recording heads are industry-standard 3350-type Winchester sliders made from high-permeability manganese-zinc ferrite and mounted on the stiffer 3370-type flexure assembly. The head-arm assembly has been designed so that if there is no cartridge in the drive, the heads do not touch each other whether the door is open or closed. The recording heads fly at a height of 16 μ in. An absolute air filter

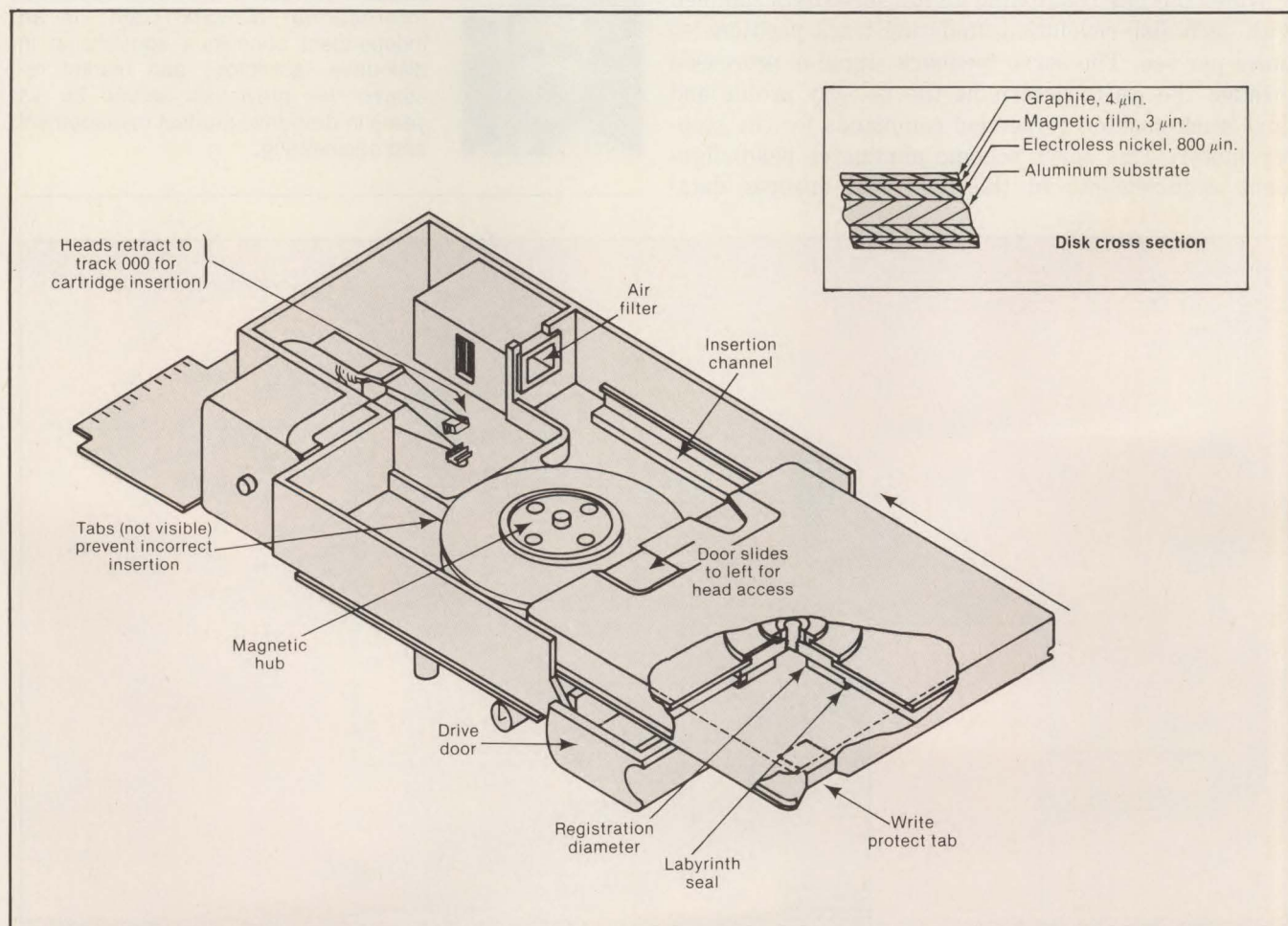


Fig. 2. As cartridge is inserted into SQ-306 drive, the cartridge door slides to the side to allow access by the heads, which are retracted to track 000. The platter is seated onto the spindle by plastic fingers on the cartridge (not visible in diagram), and is then secured by a magnetic hub. Tabs on the drive base ensure that the cartridge is inserted correctly and that cartridge door is open. The spindle starts to spin upon drive-door closure, and the drive is ready to seek or write within 15 sec. An air-purge cycle is not required.

The servo scheme eliminates head-alignment requirements in the field and ensures data-cartridge interchangeability.

that filters the air circulating in the head-disk assembly arrests nearly all particulate air contaminants 0.3 microns or higher.

Digital servo control

To enhance head-positioning accuracy and speed, the SyQuest SQ-306 implements a combination of two servo-control techniques. A "coarse" seek by the stepper motor speeds heads to the addressed track locations. Fine positioning is accomplished through a digitally sampled servo scheme that locks the read/write heads over the center line of the desired data tracks (Fig. 3). The stepper motor uses a split stainless-steel band wrapped around a capstan operating at 400 detents per revolution pulsed by control commands from a resident μ p.

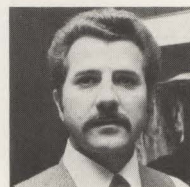
A 64-byte servo sector on each platter surface provides the fine positioning digital servo data sampled with each disk revolution, updating track positions 60 times per sec. The servo feedback signal is processed through the μ p to determine the velocity profile and final track-position correction commands for the stepper motor. This servo scheme eliminates head-alignment requirements in the field and ensures data-

cartridge interchangeability. Temperature compensation is also provided by this fine-tune servo-positioning scheme.

The explosive growth in products such as suitcase μ cs, word processors, intelligent typewriters and terminals, desk-top computers and personal computers has fueled the demand for low-cost, smaller disk drives. Market demand trends point toward the lowest cost rigid-disk drives offering the highest storage capacity in the most compact size.

SyQuest Technology was formed to develop, manufacture and market a low-cost sub-5¼-in. Winchester drive. "After listening to several large OEM customers," says SyQuest marketing vice president Larry Sarisky, "you will quickly conclude, as we did, that the higher capacity, higher priced 5¼-in. Winchester is the opposite and inappropriate direction toward which small rigid-disk-drive products should be heading."

The stakes in a tiny-disk market could be high. The worldwide OEM market for sub-5¼-in. Winchester-disk drives will account for 1 million unit shipments by 1986, valued at \$450 million. ■



Andrew Roman of Roman Associates International, Newark, Calif., is an independent consultant specializing in disk-drive technology and market research. He previously served for 15 years in disk-drive product management and engineering.

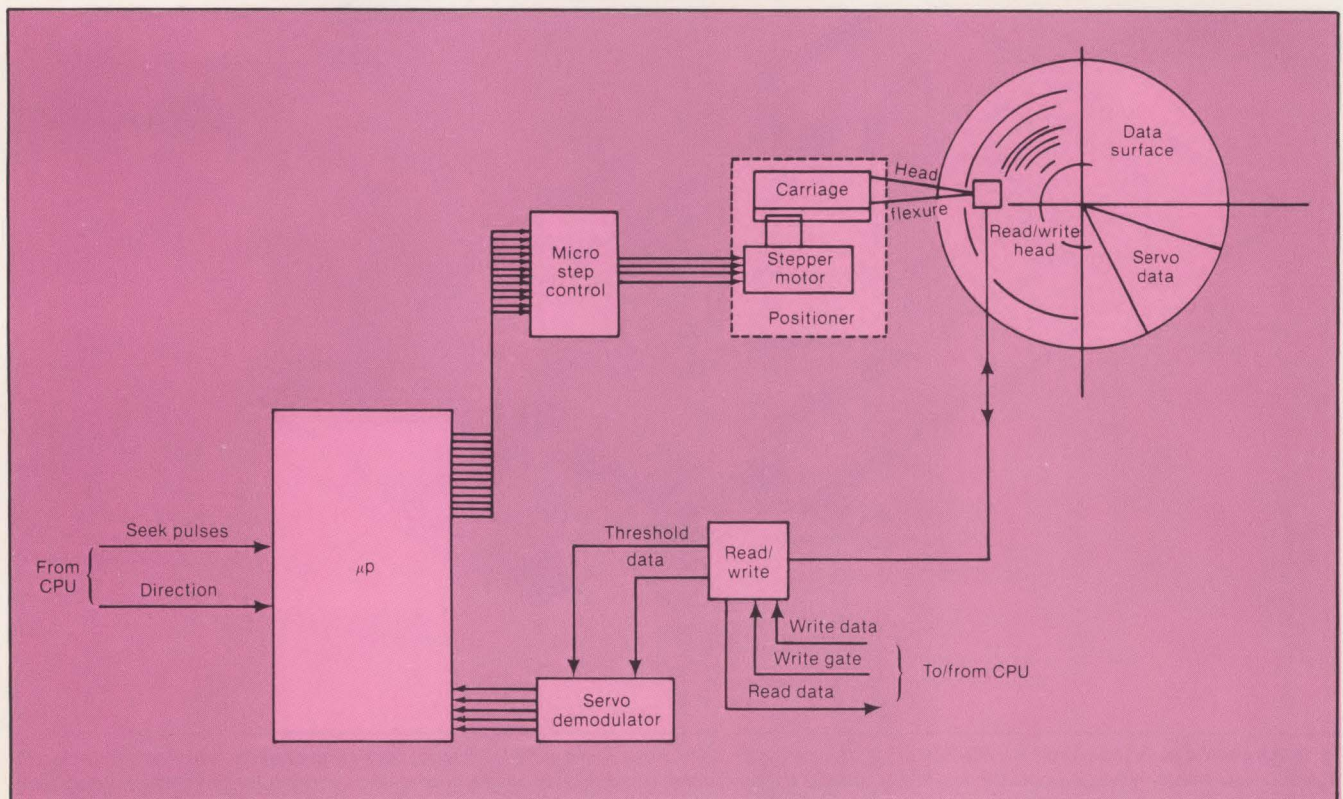
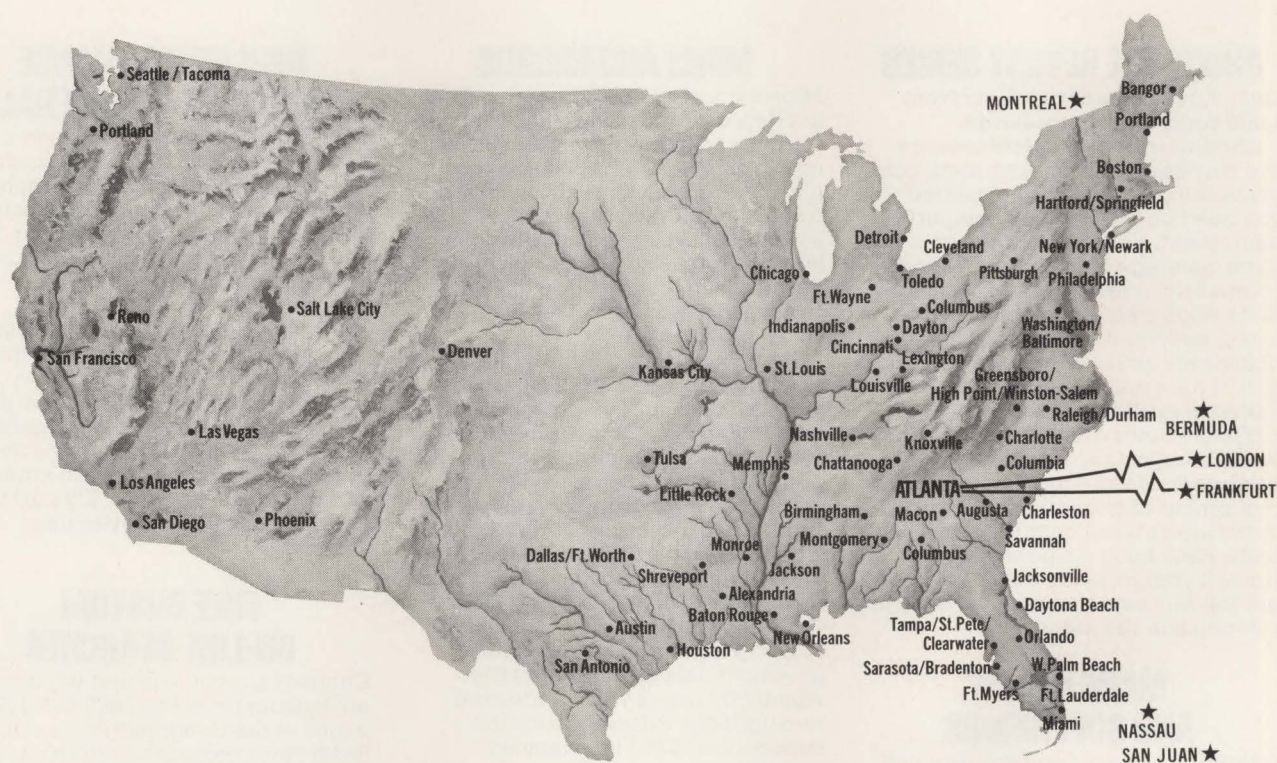


Fig. 3. Digital servo-controlled head positioning provides fine adjustment in the SQ-306. Servo data are sampled 60 times per sec. from servo sector on media, then processed through a μ p to determine correction commands for the stepper motor.

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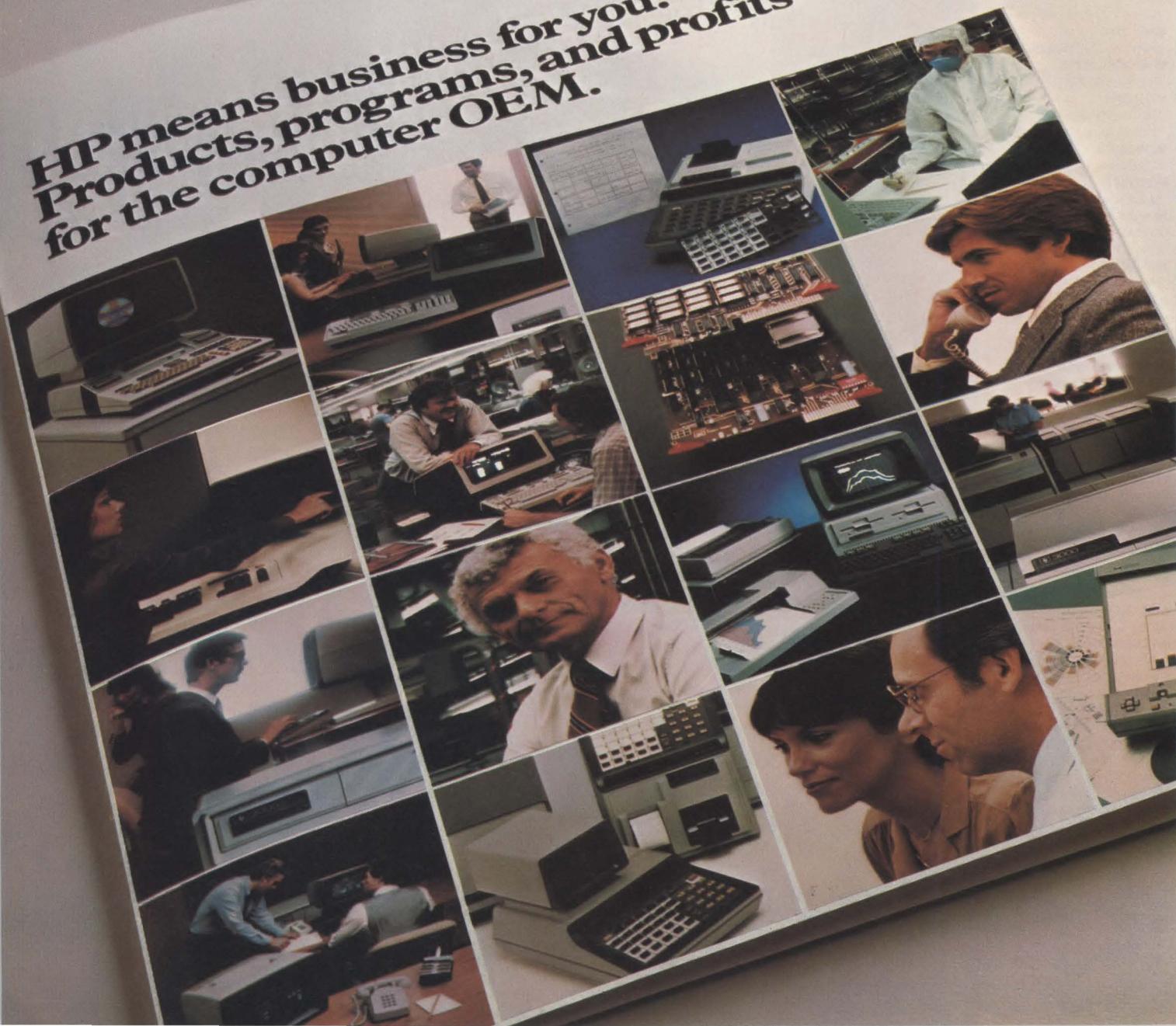
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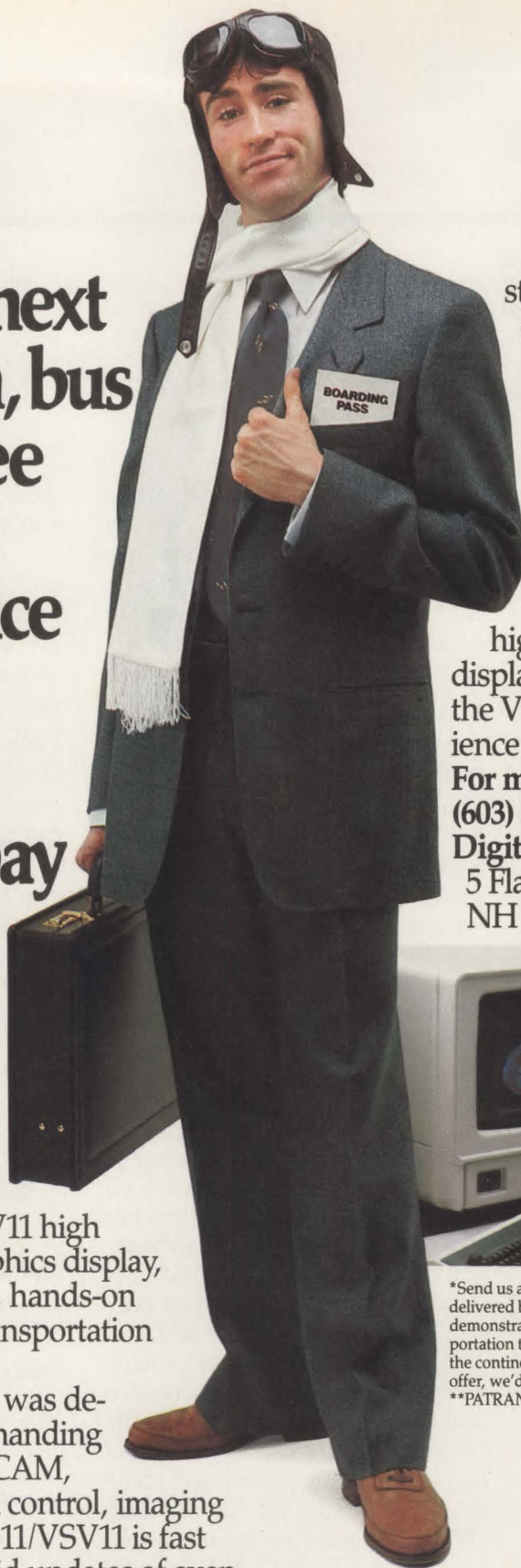
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digital

Computer security: not just for mainframes

LAWRENCE D. DIETZ, ALEC Group

System integrators and ISOs will have to think security as customers—and courts—demand safeguards against computer crime

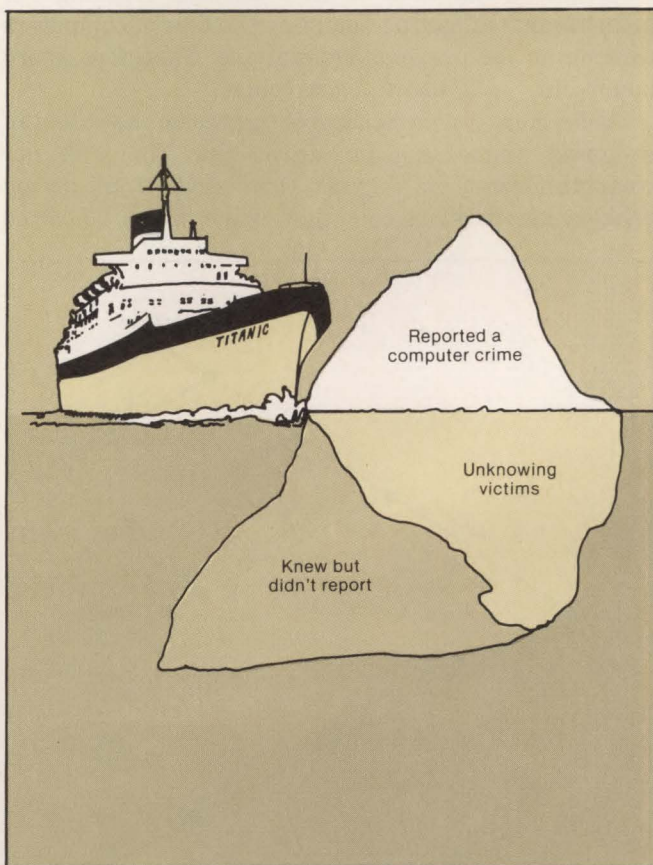
Computer crime is on the rise, and users will soon be demanding better security. System integrators and ISOs must move to provide adequate protection, not only to take advantage of a growing market for security features, but also to avoid lawsuits and comply with new federal regulations.

Litigation will spur security planning

One reason behind the push for security is the possibility that some system vendors may find themselves liable for losses incurred by their clients. If a small-business owner is defrauded by one of his employees using a computer, and it is proven that the computer was designed without "reasonable and prudent safeguards," the system vendor could be brought into any legal action taken against the employee. Product planners could also find themselves in court to justify their designs as reasonable in light of industry standards, a difficult position at best.

New government regulations will also pressure vendors to improve security. The Foreign Corrupt Practices Act, for example, forces businesses to exercise reasonable and prudent measures to safeguard their data from accidental disclosure and potential computer crime.

Safeguards on system integrity are necessary not only to preclude intentional tampering, but also to prevent accidental or unintentional harm to data. Research also indicates that the major threats to system integrity are not from sophisticated programmers, but rather from rank-and-file employees who use a system in their daily work and discover a way to gain from its unauthorized use. The need to safeguard systems is particularly acute in the small business in



Victims who report computer crime may represent only the tip of the iceberg. At least as many have probably been victimized without discovering it, and as many again may not report a crime.

which each employee wears many hats and must access much of the corporate database.

As more data, word, voice and image technology gets

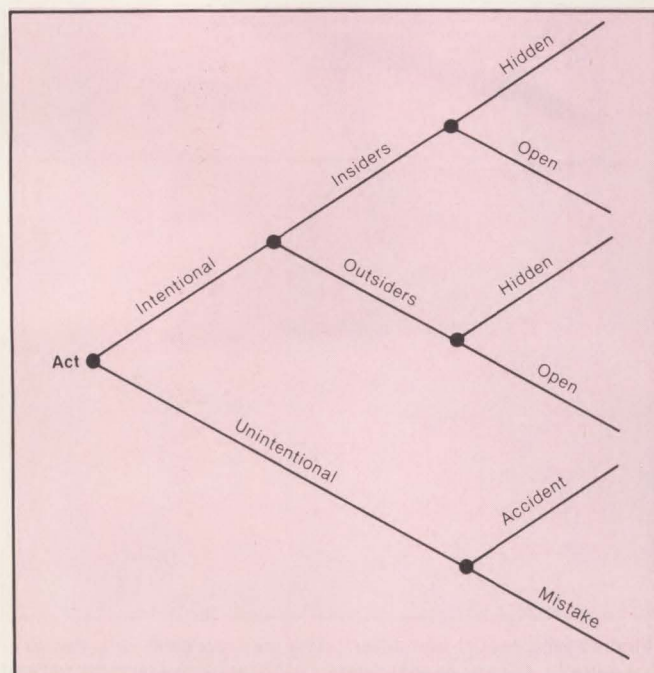
Safeguards on system integrity are necessary not only to preclude intentional tampering, but also to prevent accidental or unintentional harm to data.

dispersed through large user organizations, the need to secure the information grows. Stored information is no longer restricted to masses of data; analyses such as corporate plans and strategies are also kept in electronic format. These plans are valuable intelligence for competitors, employees and suppliers and must all be protected. Vendors in the large user community will face particularly severe tests in the years ahead.

Computer crime will increase

Computer crime will increase over the next decade. The reason is simple: more people will use more computers that in turn will store more data and other corporate resources. In both big and small companies, μ ps are pushing computer power and inquiry capabilities down to the lowest organizational levels. Furthermore, the generations of new workers entering the mainstream will not be bound by the fear of computers common in the previous generations. Therefore, more opportunity will lead to more crime.

While there are no conclusive figures on the extent of computer crime, experts agree that the gain per computer crime is higher than that from armed robbery. An average computer crime nets \$100,000 to



Perpetration decision tree helps vendors and ISOs assess the applicability of security features to a vertical market. Vendors can look at the potential dangers to the system, perform a rudimentary risk assessment and place safeguards at the points where they make the most sense from a vulnerabilities viewpoint and for cost-effective implementation.

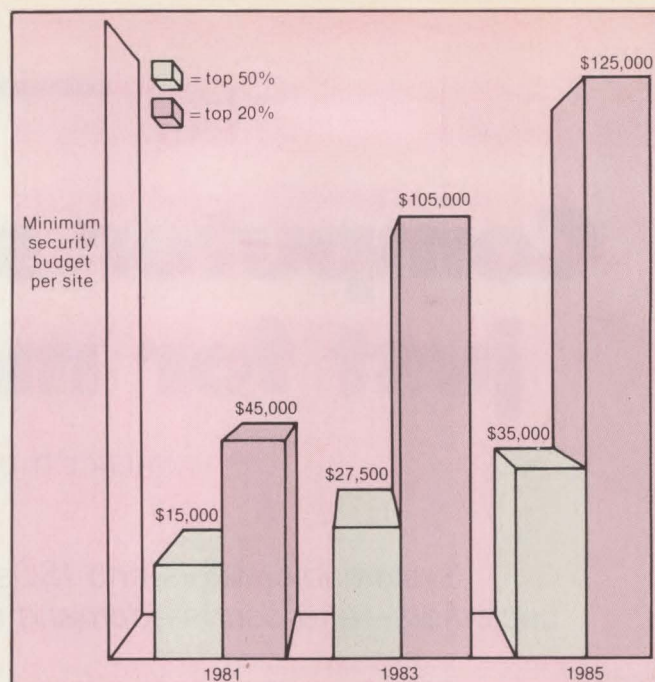


Fig. 1. Information-security budgets will grow from a median of \$15,000 in 1981 to \$35,000 in 1985. Budgets at the sites where security spending is among the top fifth will increase from \$45,000 to \$125,000 in the same time period. Source: Frost & Sullivan

\$400,000, while the average bank robber gets less than \$5000. Perpetrators of computer crime do not have to point guns, nor do they see their victims face to face. They may well feel that the chances of getting caught are small and the rewards are great. Yet only a few states have computer crime laws, and even fewer have the resources and talent to prosecute. It is no wonder then that the CRT is replacing the .45 automatic as an instrument of crime.

A recent Frost & Sullivan survey indicates that among users spending more than \$100,000 per year on data processing, 6 percent had reported a computer crime. If 6 percent knew about computer crimes within their companies and reported them, it is likely that an equal number didn't know, and yet another group knew but didn't report them.

An incident-driven market

Users often move to improve security only after they are victimized or see a competitor victimized. Along with new regulations and litigation, the expected increase in crime will inspire users to demand protection.

The Frost & Sullivan report indicates that the median annual data-processing security budget will increase from about \$5000 in 1981 to \$30,000 in 1983 (Fig. 1). These numbers might at first seem small, but these expenditures are specifically for add-on security provisions rather than for systems that provide integral security.

In listing their preferences for security products, users indicate that level of security is the most important buying criteria (Fig. 2). Ease of use is

The 9406-4

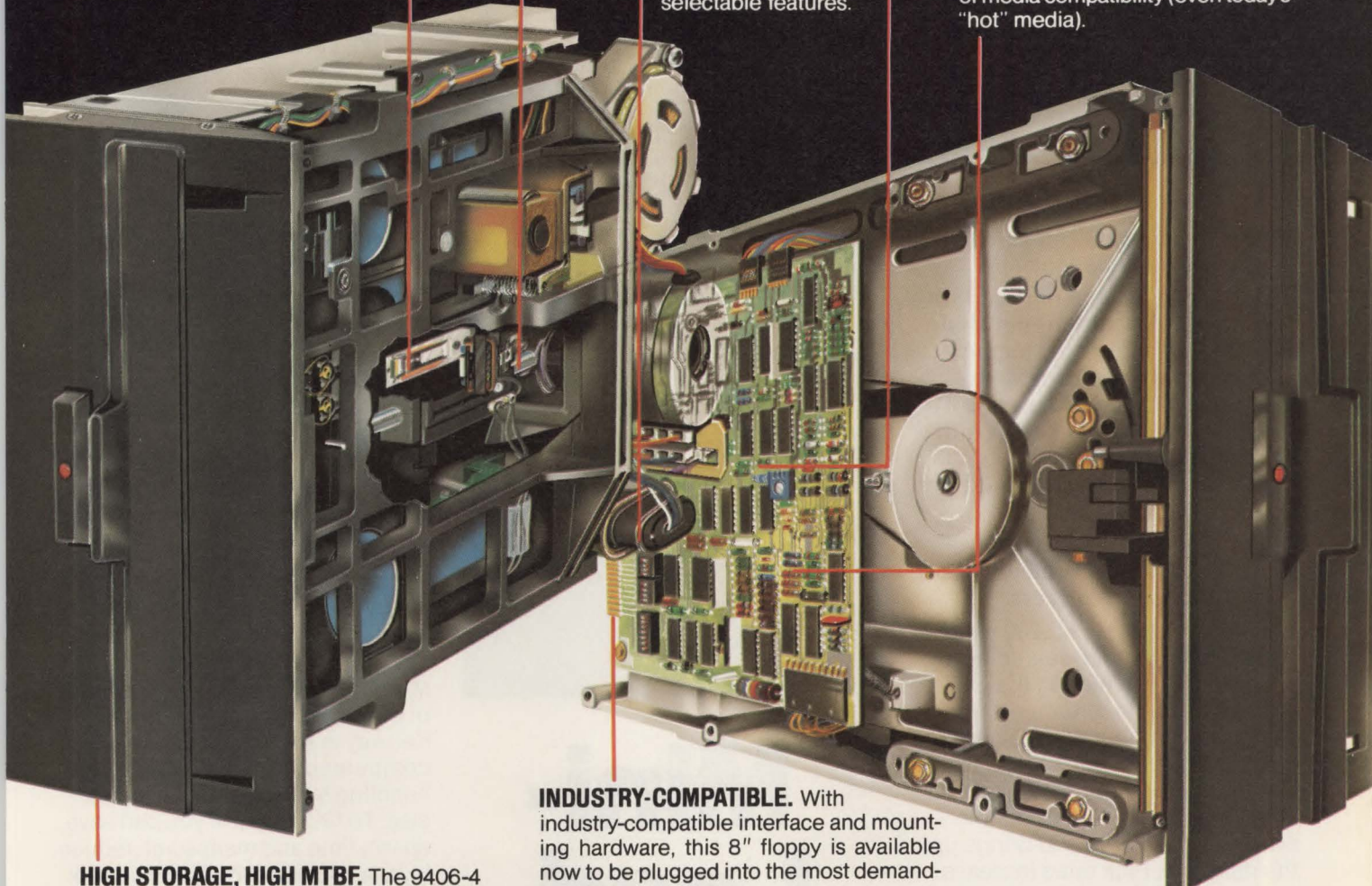
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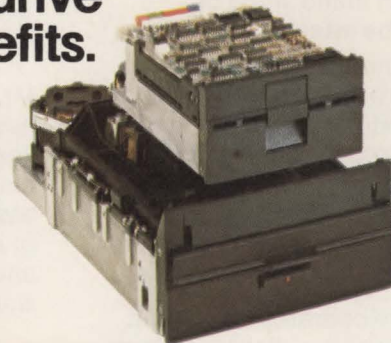


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Experts agree that the gain per computer crime is higher than that from armed robbery.

second, and cost is third. The message is that users are willing to pay for effective security.

Rarely one to miss a clear trend, International Business Machines Corp. has moved to assure customers of integral security in their systems. The National Accounts Marketing division has reinforced the issue through a series of security-related ads, and the emphasis on protection is trickling down from the large-scale systems to the System/38 and other smaller systems. Vendors seeking to compete with IBM had better be able to demonstrate comparable security features.

A five-year forecast for the information-security market shows that banking and military expenditures

NEXT MONTH IN MMS

Watch for Mini-Micro Systems' annual special report on computer graphics in the July issue. A comprehensive survey of graphic terminals for business and science applications will lead off the feature section, which will be augmented by several other graphics-related articles, including:

- A look at turnkey graphic systems.
- A tutorial on graphic-input peripherals.
- A survey of color hardcopy devices for graphics.
- An explanation of building-block graphics.

Mini-Micro Systems is also planning major product survey articles in coming months, including microcomputers in August, high-level languages and development systems in September, memory systems in October and computer terminals in November.

ATTACKS AND DEFENSES

ATTACKS: Theft and manipulation of computer information can be carried out in several ways. Many of the following approaches were adapted for Frost & Sullivan from *The Criminal Justice Resource Manual for Computer Crime* (Bureau of Justice Statistics, U.S. Department of Justice).

Browsing: Data are viewed by an unauthorized person.

Eavesdropping: A type of browsing in which the person is outside the site.

Posing or spoofing: perpetrator impersonates authorized personnel.

Scavenging: Data are intercepted while being discarded or transferred.

Data diddling: Data are altered by an unauthorized person.

Salami: Information is taken a slice at a time.

Trojan horse: Unauthorized programs are buried in the software.

Trap door: A Trojan horse program with a flag set to pop under particular circumstances.

Time bomb: A trap-door program set to pop at a particular time or date.

Superzap: Accessing the heart of the system software, overriding all safeguards.

Asynchronous: Takes advantage

of asynchronous nature of many operating systems; information is accessed before system safeguards can protect it.

Exhaustive: Attacking with all of the above.

DEFENSES: There is not yet a wide variety of software-security packages for minicomputers and μ cs. But sophisticated audit-trail and file-protection software is not the only safeguard that works: vendors can provide, and coach their customers in, more basic security techniques. Some of the following safeguards are taken from Susan Woolridge's *Security Standards for Data Processing* (Halsted Press).

Password protection: The time-honored approach. The system can shut down after a number of wrong attempts; if you aren't getting it right, you probably shouldn't be trying.

Memory write protect: If someone attempts to write over a protected area of memory, an interrupt is sent.

Memory read protect: Unauthorized users cannot access protected areas of memory.

Watch-dog timer: Corruption of the operating system by a user program interrupts a signal and

activates an alarm.

Residue protection: Files and memory are automatically wiped clean of old or scratch data.

Encryption: Any code can be broken, but you can make it too difficult to justify the effort. Information can still be accessed before or after encryption.

Site security: Get good locks with tight key control; protect windows, vents and other possible means of entry; supervise workers; lock up sensitive documentation; devise a plan for maintaining security during an emergency such as a fire.

Classifying data: A four-level approach to classification is usually sufficient, requiring users to consider the sensitivity of the data they are working with. There is no "unclassified" level—if it's worth having on the computer, it should be worth some protection:

- **Restricted:** Staff and authorized outsiders only.
- **Confidential:** Authorized staff only.
- **Secret:** Requires special protection.
- **Top secret:** Crucial information requiring maximum security.

comprise the largest portions of the market (Fig. 3). These users now have the most to lose. But the market for secured terminals and business voice security will grow at a tremendous rate over the next five years.

Security features can be designed into applications and systems software, firmware and hardware. Different markets will require different levels and types of

security, and vendors who examine the security needs of their target markets will be prepared to meet the growing demand for protection. ■

Lawrence D. Dietz, MBA, JD, is president of the ALEC Group, a San Jose, Calif., consulting firm specializing in market support of ISOs and other business-system vendors.

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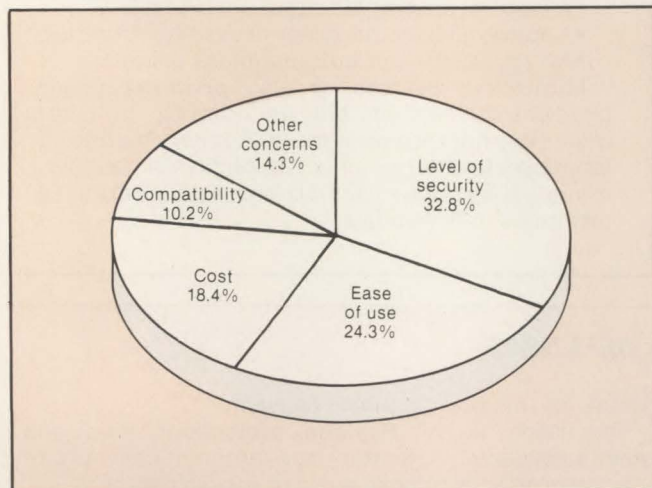


Fig. 2. Concerns of users in selecting security features are primarily effectiveness and ease of use. Less than one-fifth of users consider cost to be the major consideration. Source: Frost & Sullivan.

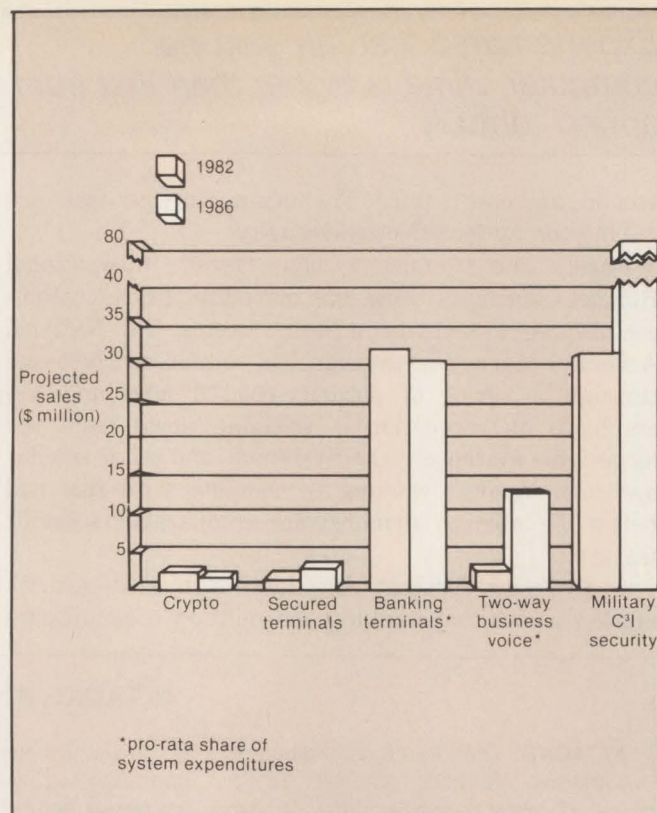


Fig. 3. Projected sales of information security show greatest growth in terminal and business voice-security markets through 1986. Crypto and banking security markets will be flat, while military C³ security will take the largest share by 1986. Source: Frost & Sullivan.

SECURITY PLANNING STEPS FOR SMALL-BUSINESS-SYSTEMS VENDORS

- Identify the vertical markets in which you are selling or in which you intend to sell.
- Look at the target businesses from the point of asset protection.
- Determine the accessibility of the assets to the computer users.
- Diagram your proposed system design.
- Review the design with knowl-

edgeable people in the target market.

- Look at the competition's security features.
- Enlist the assistance of a data processing auditor, a CPA or another business professional in the target vertical market.
- Review the target market's trade press and determine if embezzlement or similar crimes could have been

prevented if your system had been used.

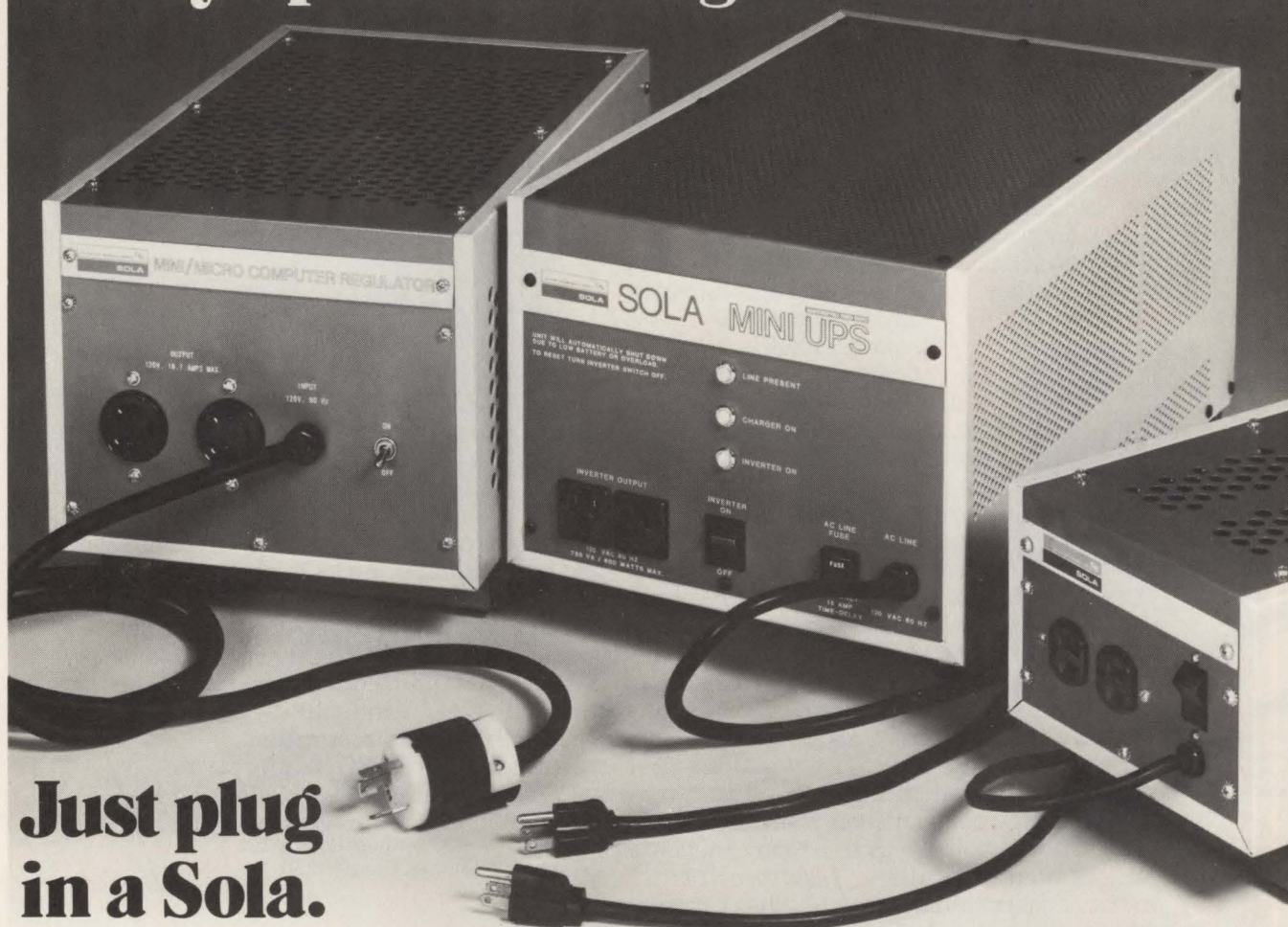
- If you have established a presence in the market, ask your customers to suggest ways your product could be misused.
- Remember that the customer will pay for something if he believes he will gain something from having it, or will lose something from not having it.

Security Do's and Don'ts

DO: Think of everything that could go wrong; it probably will, sooner or later.
Consult with users frequently.
Determine the probability of, and potential loss from, different security breaches.
Think security from the beginning.

DON'T: Assume anyone is incapable of dishonesty or mistakes.
Assume anything is secure.
Provide security features that cost more than the maximum potential loss.

Want reliable power for office electronics without costly special wiring?



Just plug in a Sola.

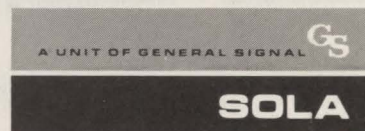
With minicomputers, terminals, word processors, disk memories and high-speed printers, you often get instructions to put in a "dedicated" power line. But, instead of breaking through walls, cutting trenches in floors, laying special conduit, pulling lots of wire and adding more breakers and switchgear to get reliable power, why not simply plug a portable Sola Power Protector into the outlet that's already there?

Dedicated lines can add anywhere from \$1200 to \$8000 or more per machine, even in new construction. For a fraction of that cost, a Sola Micro-Minicomputer Regulator not only replaces the dedicated line but does what dedicated lines can't do. It raises and lowers voltage to compensate for line fluctuations and brownouts. It blocks out electrical noise, and destructive power dips or surges. Our new Mini-UPS goes one step further. Its built-in battery maintains power when your electric utility fails. This keeps your electronics running smoothly until your generator comes on line. Both units are available in 60 Hz or 50 Hz.

Dedicated lines, at best, minimize power disturbances that are caused by other equipment in your building. Sola Power Protectors guard you against all kinds of power line disturbances regardless of where they originate. Check this chart to compare effectiveness.

	spikes and faults	dips and surges	line noise		Brownout	Blackout
			common-mode	transverse mode		
	momentary sharp voltage peaks or split-second power outages	short-term high or low voltages due to load start-up or shut-down	Unwanted voltages or frequencies due to bad grounding, switching, or radio-type interference	line-to-ground interference	Planned voltage reductions in response to high demand	Total loss of line power
Dedicated Line (with dedicated ground)	some, internal only	some, internal only	some, internal only	some, internal only	No	No
Ultra-Isolation Transformer	No	No	Yes	No	No	No
Sola Micro-Minicomputer Regulator	Yes	Yes	Yes	Yes	Yes	No
Sola Mini-UPS	Yes	Yes	Yes	Yes	Yes	Yes

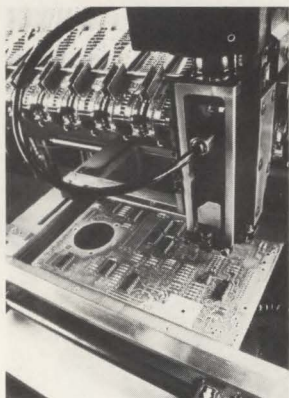
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CIRCLE NO. 121 ON INQUIRY CARD

DISK DRIVES

A SASI-compatible intelligent disk drive

GILBERT B. SHEPARD, Cynthia Peripheral Corp.

Local intelligence and SASI make this new cartridge-disk drive easy to integrate

The trend toward the use of intelligent peripherals in computer systems has extended to disk drives with the introduction of the first intelligent disk drive from Cynthia Peripheral Corp., the North American subsidiary of French computer peripheral manufacturer Cii Honeywell Bull. The D145, first in a series of intelligent drives planned by the Palo Alto, Calif., manufacturer, provides users with integrated intelligence and disk-to-disk backup in a compact package. It uses a patented embedded-servo head-positioning system to store 20M bytes formatted or 24M bytes unformatted, split evenly between a fixed disk and a 10½-in.-diameter removable disk cartridge. By combining these capabilities with a Shugart Associates Systems Interface-compatible controller and interface, the D145 makes adding high-performance storage to most minicomputers and μ cs easy and cost-effective.

Built-in backup

The D145's built-in multi-sourced backup takes the form of a front-loading, 12M-byte cartridge that

measures 11 sq. in. and is 1 in. thick. The cartridge (Fig. 1) inserts quickly and easily into the front of the drive, and its "bookcase" dimensions and sturdy construction make it easy to store.

When the cartridge is inserted into the drive and the front-access door of the drive is closed, two sequential actions occur. First, the cartridge is lowered onto the drive spindle, freeing the disk platter and positioning it on the drive spindle. Second, the read/write heads move forward through the head-access window into position over the disk platter.

As soon as the disk begins to spin, filtered air is

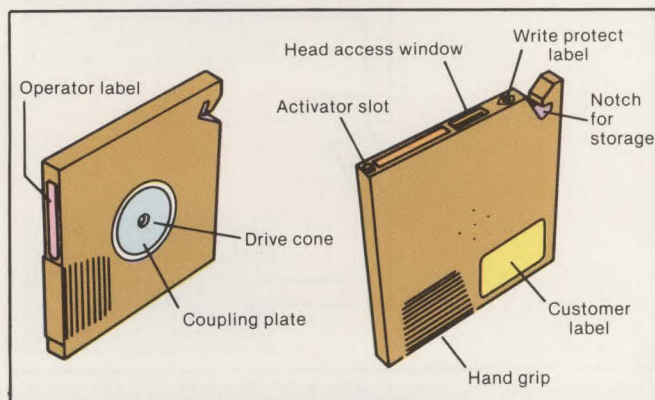


Fig. 1. The D145's removable disk cartridge is a sturdy 11- x 11- x 1½-in. unit for bookshelf or hanging storage. The unit stores 10M bytes formatted and is self-cooling and self-cleaning.

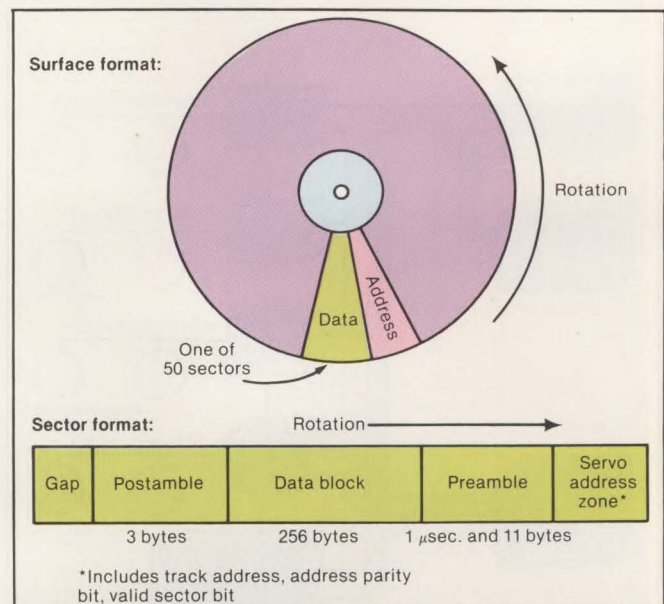


Fig. 2. Surface and sector formats show the presence of embedded servo data. Each of the D145's two surfaces contains 392 tracks formatted into 50 sectors. Each sector carries its own servo address information, and, unlike drives using dedicated servo surfaces, only 5 percent of the D145's capacity is used to store servo data.

The disk cartridge can be protected against writing or erasing a record by affixing a snap-in, write-protect label.

drawn into the cartridge and sweeps both sides of the disk before exiting through the head-access window. The air within the cartridge is entirely renewed three times per sec.

The disk cartridge can be protected against writing or erasing a record by affixing a snap-in write-protect label. With the write-protect label in place, the plunger of the intelligent drive's write-protect device cannot enter the depression in the cartridge.

An innovative servo system

Size and data capacity constraints preclude dedicating one or more disk surfaces to servo data. Cynthia's patented embedded-servo system uses less than 5 percent of the unit's data capacity for servo information. In addition to allowing track densities as high as 1000 tpi, it provides fast access time, without velocity or acceleration transducers that might affect both cost and reliability.

The cartridge disk and the fixed disk are single-sided and are formatted into tracks and sectors (Fig. 2). Each surface has 392 tracks, and each track is subdivided into 50 256-byte sectors. A servo zone at the head of each sector contains read/write-head servo information, the track address, an address parity bit and a valid sector flag. Firmware in the D145's SASI-compatible, integral controller uses the address-parity and valid-sector bits to ensure that no time is lost by addressing a defective sector.

The D145's 500-tpi track density makes the use of an external head-position transducer impractical. Servo information is read by the read/write head itself, without any other transducer, and the drive's μ c moves the head rapidly to the desired track and locks it in position with an instantaneous error of less than 3 μ m. (120 μ in.).

Head movement occurs in two steps. The coarse step quickly moves the head carriage to an approximate location with less than $\frac{1}{4}$ track pitch residual error. The fine step reduces the residual position error to less than 120 μ in.

The SASI

SASI is a developing industry and ANSI standard for connecting disk drives to a host computer. Its primary objective is to provide host computers with device independence, within a type of device. Thus, disk drives, tape drives, printers and even communication devices can be added to a host computer without modifications to generic system hardware or software. SASI host adapters are available for IEEE S-100; Digital Equipment Corp.'s LSI-11; Apple Computer, Inc.'s Apple II; Radio Shack's TRS-80 models I, II and III; Motorola's 6800 Versabus; International Business Machines Corp.'s personal computer; Intel Corp.'s/National Semiconductor Corp.'s Multibus and Mostek Corp.'s STD bus hosts.

SASI defines both hardware, including numbers of pins and connectors, and the command-structure software. It differs from most interfaces in that it is intelligent: many of the functions incorporated in separate disk controllers are now included on the drive side of the SASI interface.

SASI offers a 50-pin connector at the end port,

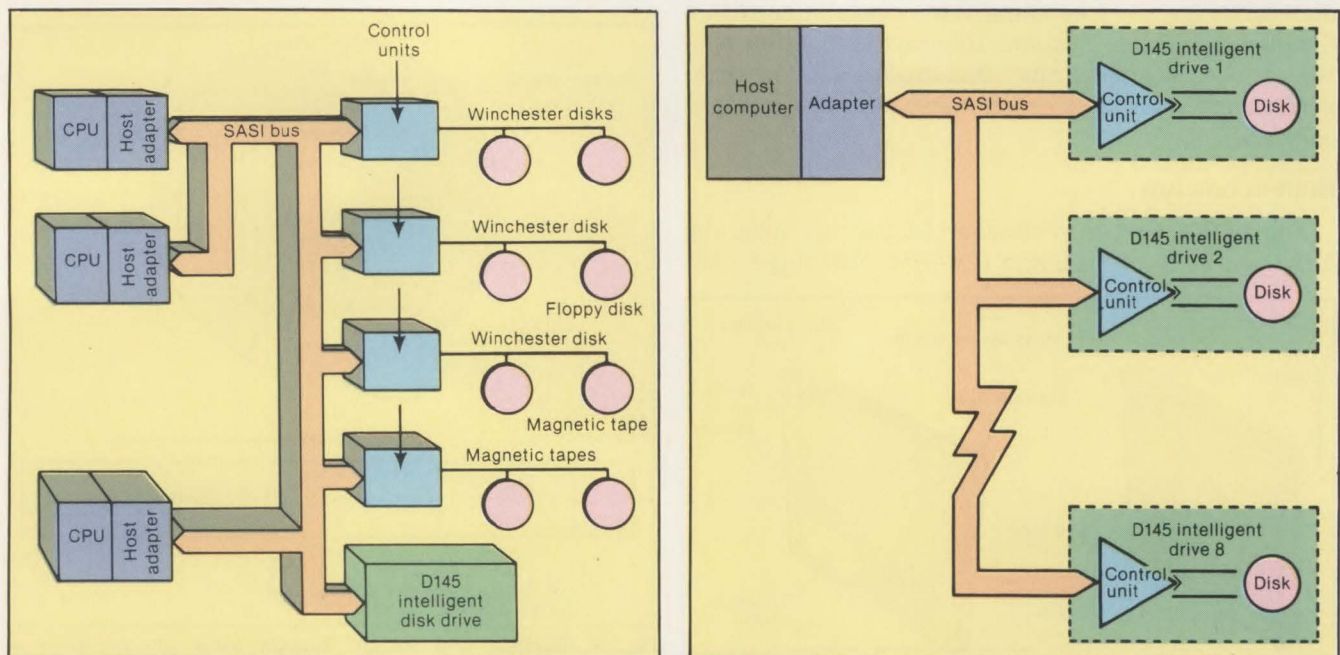
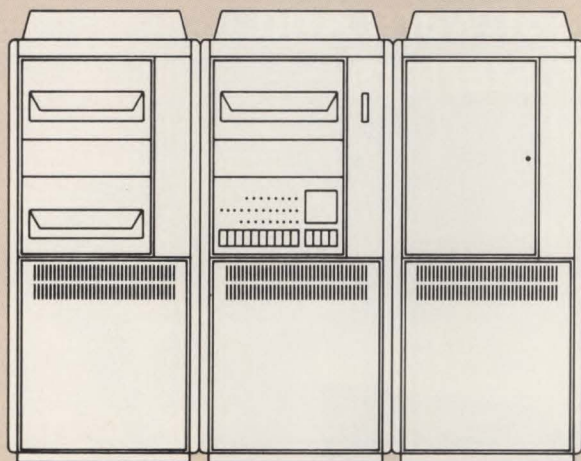
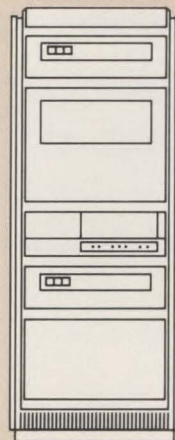


Fig. 3. Two applications of the SASI illustrate its flexibility and device independence. The configuration at left illustrates a SASI complex system in which host adapters and a SASI connect diverse peripherals to three CPUs. The configuration (right) shows that, with their integral SASI-compatible controllers, D145 intelligent disk drives connect directly to the SASI bus. As many as eight storage devices, hosts or controllers can be connected to one SASI bus.

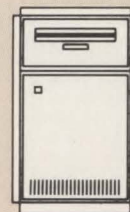
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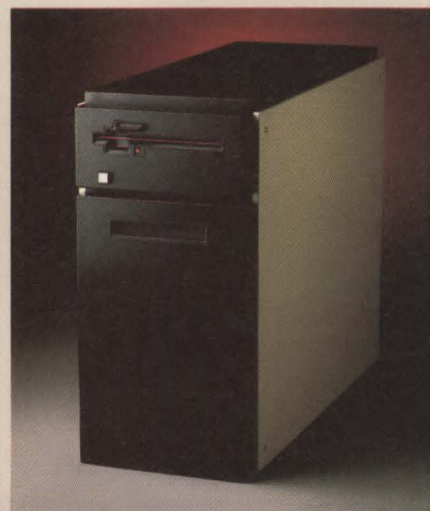
The Supermicro design provides each user with an 8-bit Application Processor, a Z80A and 64K of RAM. When another user is

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The cartridge inserts quickly and easily into the front of the drive, and its bookcase dimensions and sturdy construction make it easy to store.

as many as eight bus ports, nine data lines per port, timing of signal lines on each port, a command and message protocol, a logical interface and open-collector or differential drivers and receivers.

The SASI bus supports as many as eight SASI devices, which can be any combination of host CPUs and intelligent controllers. Fig. 3A illustrates a full, eight-device SASI complex system with five disk-control units (one inside the D145) and three computers with host adapters. Fig. 3B illustrates how a maximum of eight Cynthia D145 intelligent disk drives can be directly connected to a host computer.

Integral SASI-compatible controller

The SASI-compatible single-board intelligent controller built into D145 places all housekeeping functions, such as addressing, verifications and data recovery, in the drive instead of in a remote subsystem controller. This improves overall system execution time and frees the CPU to perform other functions such as data processing or database management instead of I/O operations.

In addition to interpreting and executing host commands, the D145's controller performs:

- **Automatic seek and verify:** A seek command is implied in every data-transfer command (read, check, etc.). If the heads are not positioned over the cylinder, a seek is initiated, and, after the seek, a track verification is performed by checking at least one sector-parity bit.

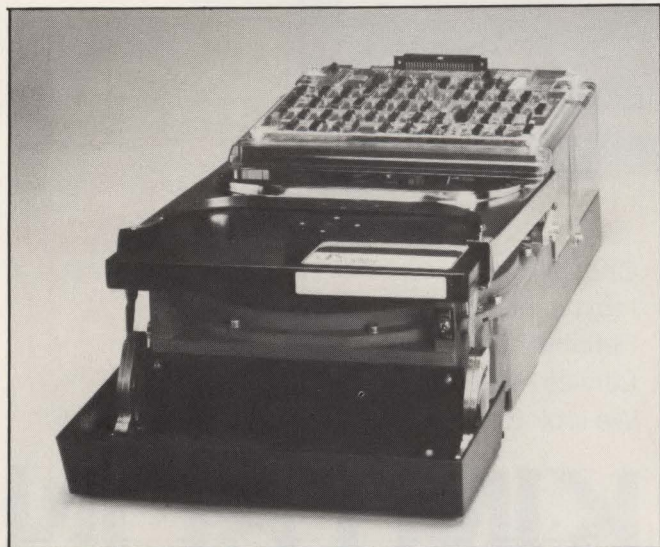


Fig. 4. Cynthia Peripheral Corp.'s D145 intelligent cartridge SASI disk drive offers 10M bytes fixed and 10M bytes removable formatted data storage. Its intelligent controller makes many drive functions transparent to its host CPU, and its interface makes it easy to connect to most systems. The D145 uses a DC motor to drive its single spindle and is easily adapted to foreign power sources.

- **Automatic track switching:** If the end of a track is reached during a multi-block data transfer, the drive automatically switches to the next track.

- **Automatic alternate-sector assignment:** As many as two bad sectors per track can be relocated. If this feature is implemented, the total number of sectors per track is reduced from 50 to 48.

- **Copy capability:** The capacity of one platter can be copied to the other (fixed to removable and removable to fixed) on-line via the computer, with automatic data verification and bad-sector flagging or off-line by simply throwing a switch.

- **Sector interleaving:** Sector interleaving is programmable, by command or selectable by switches, to a factor of 16.

- **Data error detection and correction.** If a data error is detected during a disk data transfer, the D145 automatically determines if the error is correctable. If it is correctable, the D145 intelligence corrects the information before transmitting it. If the automatic-correction feature is disabled, the data are returned to the host for data correction. When the data-error-detection and -correction intelligence encounters an uncorrectable error, it automatically tries to read and correct the data five more times. The D145 tolerates media imperfections to a 4-bit burst error on the intelligent disk drives using a 24-bit ECC polynomial.

- **Extensive fault detection:** The D145 drive provides extensive fault reporting to optimize system troubleshooting. On request, the drive supplies drive, controller and command error-code status to the host CPU for a system-fault analysis.

- **Data-transfer buffering:** Dual-sector buffers eliminate the possibility of data overruns during a data transfer. The on-board 4K sector alternates between disk and host data transfers and transfers data to the host in as little as 800 nsec. per byte, allowing a full-track read or write in one revolution of the disk.

- **Built-in microdiagnostics.** Self-diagnostic routines thoroughly test the D145 and provide a status report of its functions. They can be initiated by a set of switches or through a connector.

System integrators derive the most benefit from the D145 intelligent SASI disk drive. The D145 solves many system integrators' problems of integrating mass storage into computer systems and upgrading to higher performance storage equipment. The device independence that results from intelligence in the drive and interface lets system integrators incorporate new disk technologies into their systems without costly and time-consuming redesign.

At \$3390 in quantities of 100, the D145 offers system integrators cost advantages over disk drives that do not incorporate an intelligent controller and interface. Further cost advantages are realized with the addition of adequate backup in the D145. ■

Gilbert B. Shepard is director of product planning at Cynthia Peripheral Corp., Palo Alto, Calif.

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CIRCLE NO. 124 ON INQUIRY CARD

MINI-MICRO SYSTEMS/June 1982

Choosing between broadband and baseband local networks

GREGORY T. HOPKINS and NORMAN B. MEISNER, Ungermann-Bass, Inc.

Consider using a hierarchical design that exploits the simplicity and low cost of baseband and the bandwidth of broadband

Local-area network developers, who have traditionally focused on two communications media—baseband and broadband coaxial cable—may have placed too much emphasis on which medium is the ultimate solution rather than on which better supports a user's application. To understand the applications of baseband and broadband local-area networks, system design, performance, electrical characteristics, maintenance and installation for both media must be understood.

Baseband versus broadband

Baseband local networks typically use a bidirectional signal path on which signals are encoded onto the cable using Manchester encoding or other baseband methods. A variety of packet-mode media access techniques can be used, but the most common implementation is

Carrier Sense Multiple Access with Collision Detection (CSMA/CD), in which all subscribers share a channel. Subscribers decide to transmit after sensing that a channel is free. If collisions of data packets occur, subscribers retransmit after a randomized delay. This is an effective way to allocate capacity on a channel to "bursty," or low-duty cycle, devices, in which the channel capacity is matched to the aggregate demand of many subscribers. Xerox Corp.'s Ethernet local-area network, for example, is a baseband CSMA/CD channel that operates on 50-ohm coaxial cable at a system data rate of 10M bps.

Broadband local networks use the media technology developed by the CATV industry. Because CATV amplifiers, taps, splitters and cable can support a 300- to

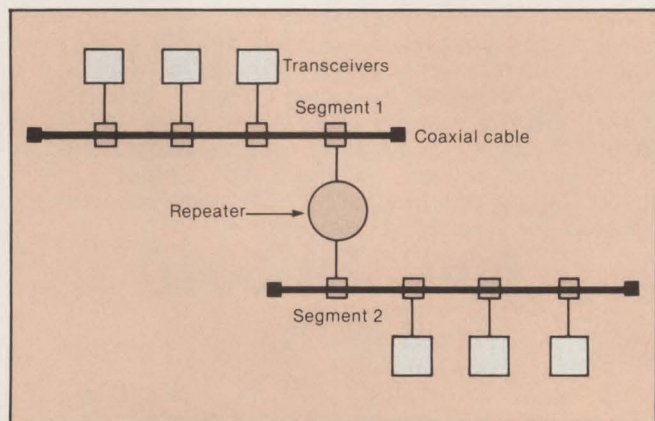


Fig. 1. Baseband network design uses bidirectional elements. An active repeater links segments of cable.

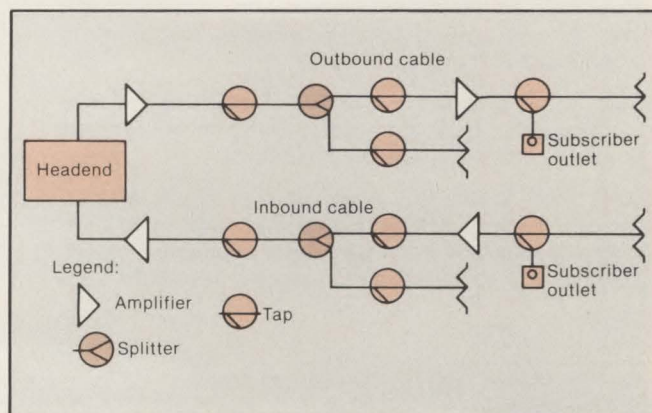
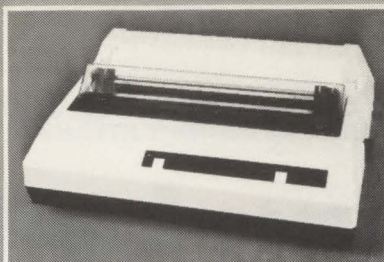


Fig. 2. Broadband network design consists of cable, splitters, amplifiers and taps. Because the components are unidirectional, inbound and outbound paths are necessary. Shown is a two-cable (four-path) configuration.

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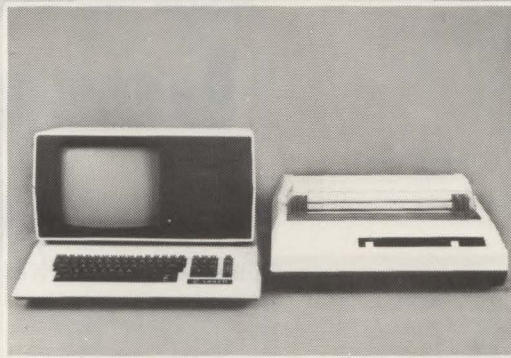
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Because CATV amplifiers, taps, splitters and cable can support a 300- to 400-MHz bandwidth, the same cable using frequency division multiplexing can support several channels.

400-MHz bandwidth, the same cable using frequency division multiplexing can support several channels. Any channel can serve as a video, data or voice system, depending on the equipment connected.

Because CATV systems are unidirectional, a transmit and a receive path must be provided. This is accomplished either by splitting the available 300-MHz bandwidth into transmit and receive channels on the same cable or by providing separate cables for signal transmission and reception. As with baseband systems, a variety of media-access techniques can be used independently of the CATV system. CSMA/CD systems are also popular for CATV-based local networks, although token passing, polling and reservation schemes have also been used as media-access techniques. Figs. 1 and 2 show baseband and broadband local-network architecture.

There are several system considerations when comparing baseband and broadband local-network imple-

mentations. One is the total geographic coverage of the network. Broadband networks have greater distance capability while retaining full bandwidth because they use active amplifiers to distribute and extend the signaling range. Baseband networks can be extended beyond their usual 3-km. range, but reduced data rate from the effects of dispersion results.

Deciding on broadband just for distance is false economy because inefficiencies are inherent in multi-channel operation, and the media-access technique is vulnerable to propagation delay. However, even with these inefficiencies, broadband delivers significant bandwidth over longer distances than baseband networks.

Another advantage of broadband is the support of multi-mode communications, including audio, video and data, on one cable pathway. This is accomplished by frequency division multiplexing or channelization in the same manner that the RF spectrum is divided. The diversity of communications available within the 300- to 400-MHz CATV spectrum is enough to satisfy the most ambitious office-of-the-future designer.

Baseband systems must be supplemented with other forms of wiring to provide non-data-communications needs. If video is required, a CATV network must coexist with the baseband network. It could be argued that all communication can be digitized and transmitted as data, but real-time digitized voice and video would overwhelm a single baseband channel. Counterbalanced against the logistical convenience of using a broadband pipeline for a company's voice, video and data-communications requirements is the potential of accidental or intentional catastrophic failure and vulnerability to professional eavesdroppers.

A single source of wideband noise at low power applied to a CATV outlet can interfere with many channels. While baseband systems are similarly susceptible, only one channel of data communications is destroyed by such noise.

Performance characteristics

The collective mythology of local-area networks greatly confuses the issue of network performance in baseband and broadband systems. Performance is more closely related to access technique than to medium. The same constraints apply to baseband and broadband systems, and performance levels differ according to differences in scale of data rate and distance.

The performance of a technique such as CSMA/CD depends on the ratio of message length to propagation delay. The higher the ratio, the better the performance because the propagation delay is the interval during which the packet is vulnerable to collision. After that interval, all users will have "heard" the transmission and deferred.

With baseband, all data must be carried on a single channel, necessitating use of a high-data-rate network such as Ethernet. For a given data-packet size in bits, this implies a short packet, which demands a short

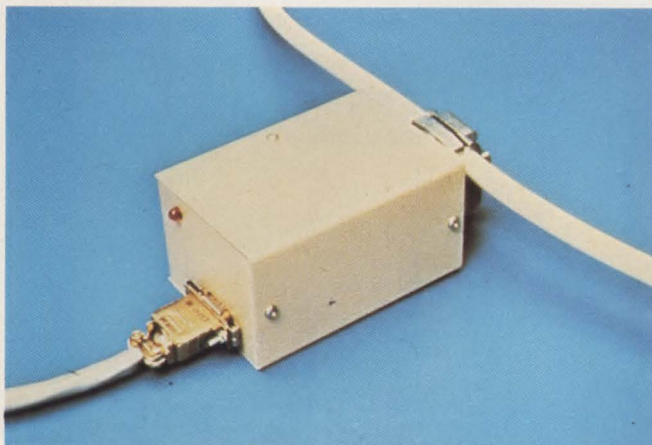
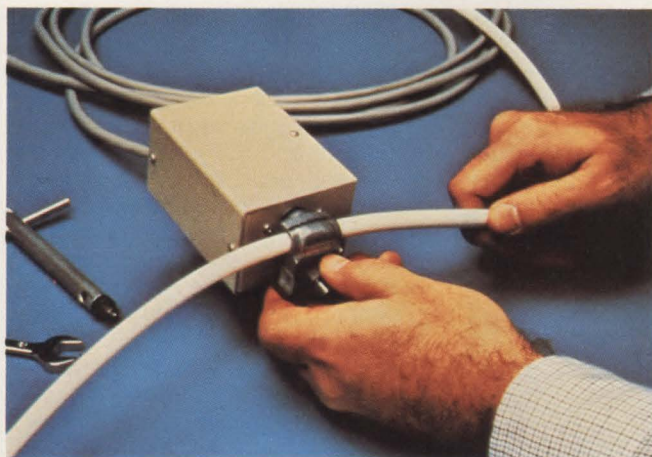


Fig. 3. Baseband interconnection technique offers relative simplicity to help keep installation and maintenance costs down, but needs better protection against stray signals.

Broadband networks have greater distance capability while retaining full bandwidth because they use active amplifiers to distribute and extend the signaling range.

propagation delay to maintain superior performance. Hence, the Ethernet specification limits total propagation delay leading to a maximum allowable distance for baseband systems of 1 to 3 km.

This distance limitation for baseband systems based on performance is alleviated by broadband techniques that can be extended to 10 km. and more. But it is impossible to extend geographic coverage without sacrificing something. In some cases, it is channel data rate. A lower data rate CSMA/CD channel, say 1M bps, would result in 10 times the packet duration than for Ethernet, and would permit 10 times the propagation delay or total layout extent. The concomitant sacrifice is the potential lack of total connectivity promised by a bus network. A 1M-bps channel provides total connectivity only with complex additions. A between-channel

COMBINING BASEBAND AND BROADBAND —THE BEST OF BOTH WORLDS

Computer users don't care what type of communications medium is used to give them networking capability; they want a simple-to-use, friendly system that is as transparent as possible.

System integrators have the same objectives. Their main concern in selecting a broadband or baseband communications medium is whether it meets their overall requirements. Ungermann-Bass's initial broadband offering for its Net/One local-area network is functionally identical to the baseband systems it is now delivering, and both hardware and software for the two systems are compatible. This means that a user can choose an optimal local-network medium without compromising on system features.

This compatibility also allows combinations of the two approaches:

using broadband where CATV cables are installed or video integration is desired, and baseband where maximum flexibility, lower cost and higher speed are required. Thus, each department in a large organization could have its own baseband network, and these networks could be interconnected with a broadband system for video services. This simplifies design and maintenance and provides greater reliability. Broadband networks can also be used where CATV cables are installed or needed for video integration.

The Ungermann-Bass Net/One is modular, so only two elements of the system (in addition to the cable) must be changed to convert a baseband system to a broadband version. A small "encoder/decoder" board in the Network Interface Unit (NIU) is

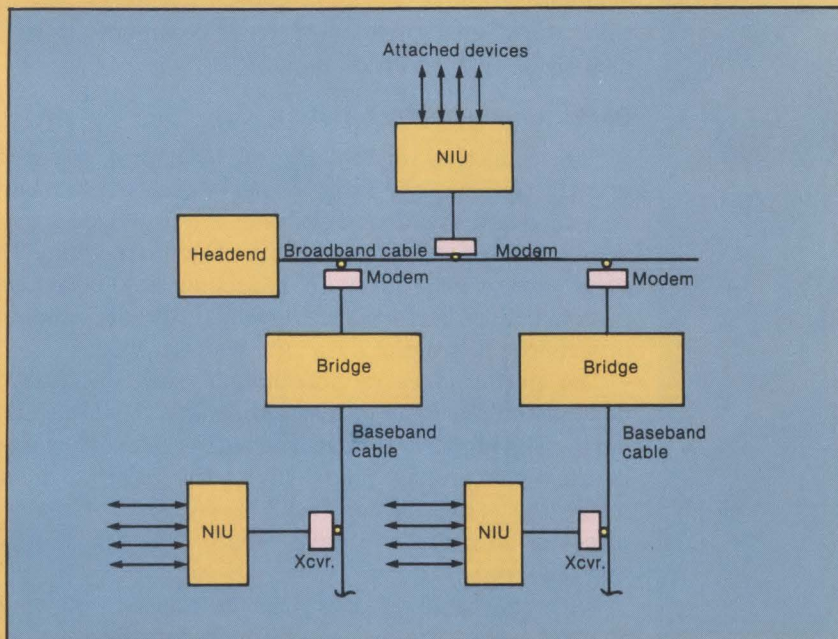
exchanged, and an RF modem replaces the baseband transceiver.

The new broadband configuration can be used with either mid-split or dual cables. In both modes, the system operates on one of five standard 6-MHz channels at a 5M-bps data rate. Frequency translation is also used in both systems.

The system employs vestigial sideband (VSB) amplitude modulation, similar to the scheme used for television transmission. All operating frequencies and parameters are compatible with EIA standards on broadband local networks.

The NIU can be equipped with both baseband and broadband network interfaces, bridging the networks. This, coupled with the strong inter-network protocols of Net/One, allows a user to address nodes miles apart as readily as if they were next door.

Ungermann-Bass offers the same selection of protocols, device interfaces and user programmability for either baseband or broadband media. Because the systems are virtually identical, costs are comparable except for the higher price of RF modems compared to baseband transceivers.



Net/One systems use baseband or broadband transmission media. Ungermann-Bass bridge products allow any number of Net/One systems to be interconnected.



The Ungermann-Bass hardware for its broadband implementation of Net/One uses standard CATV industry components. Above is a network interface unit connected to a standard CATV tap.

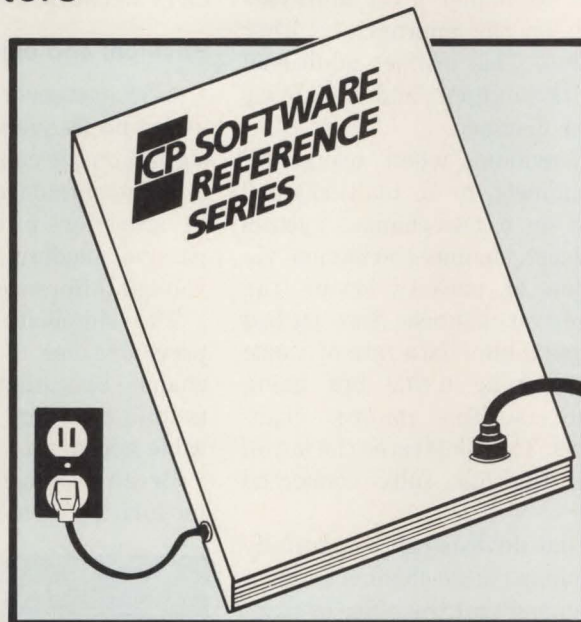
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The performance of a technique such as CSMA/CD depends on the ratio of message length to propagation delay. The higher the ratio, the better the performance.

bridge that filters packets via higher level addresses and rebroadcasts the data on the appropriate other channel is the usual solution. This invokes additional overhead, bridge delay, throughput and reliability penalties to achieve greater distance.

Increased overhead is evident when users are randomly assigned to channels in a multi-channel situation. Half the traffic on a two-channel system would have to be rebroadcast channel-to-channel via the bridge. This repetition of packets lowers the combined throughput of the two channels. Two 1M-bps channels have a combined maximum data rate of 1.33M bps of new data, the remaining 0.67M bps being bridged, rebroadcast packets. Ten 1M-bps channels can carry only 5.26M bps. This illustrates the law of diminishing returns when multiple fully connected channels are employed.

A counter-argument is that devices can be carefully allocated to channels to minimize inter-channel communication. This denies the demand that the office or plant of the future makes for full connectivity. Though yesterday's dumb terminals can be associated with specific devices, tomorrow's intelligent work stations will not flourish under such a restrictive architecture.

Another method of achieving greater distance is to use other time-division-multiplexing techniques such as TDMA with static time-slot assignments or reservations. These access mechanisms are not performance-limited by propagation delay, and can be used with baseband or broadband channels. They suffer, however, from a non-responsiveness to the bursty, low-duty cycle demand that characterizes local data communications.

One additional performance factor is the difficulty and potential uncertainty of broadband collision detection. A well designed CATV network provides equal signal strength at each outlet and presumes equal signal strength delivered from each upstream transmit-

ter. However, seasonal variations, component aging or poorly designed extensions to the original CATV system can cause variations in received signal strength at drop locations. A strong signal colliding with a weak signal may not appear as a collision to all users. Similar reception problems exist for other media-access techniques. Broadband systems typically stress higher level protocols because the communications medium for large CATV networks is less reliable than baseband.

Physical and electrical characteristics

CATV systems require power to operate the cable and use radio frequency modulation techniques to transmit signals on the cable. This power is typically supplied by a 30V AC signal from the center conductor for use by the RF amplifiers in the system. Baseband systems use a passive medium, and digital techniques based on voltage differences are used to transmit data.

The simplicity of the baseband-signaling scheme precludes use of the cable for multiple simultaneous channel operation. This is because the baseband signal is unfiltered and generates harmonics throughout the cable spectrum.

Because broadband systems impress the signal modulation on a carrier, no spectral components lower

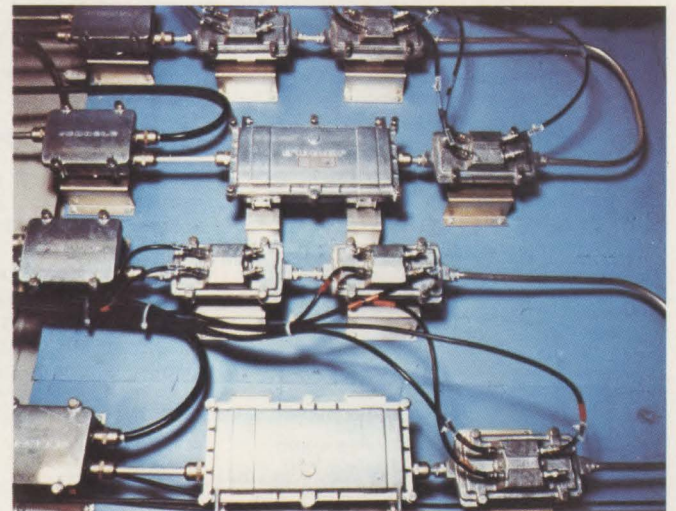


Fig. 4. Broadband connections are accomplished by linking drop cables to a four-way tap that is permanently built into the CATV trunk cable. Broadband connections provide greater stray signal protection than baseband linkages, but are also more complex. The special skills required for broadband installation and maintenance make it considerably more expensive than baseband.

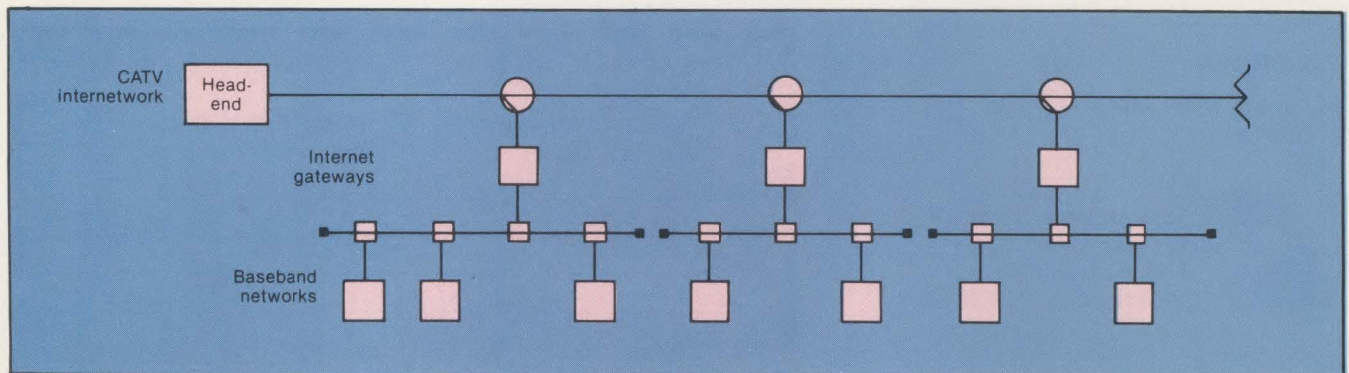
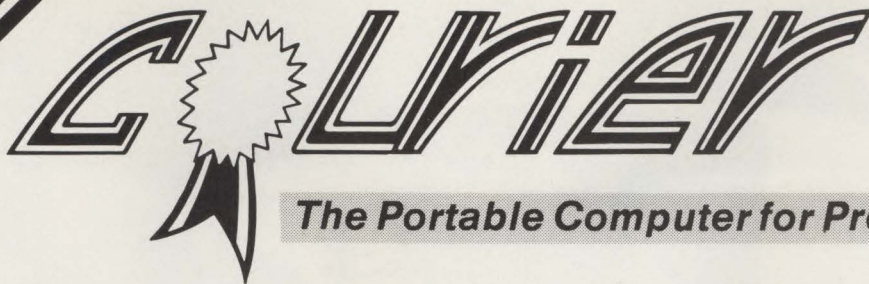
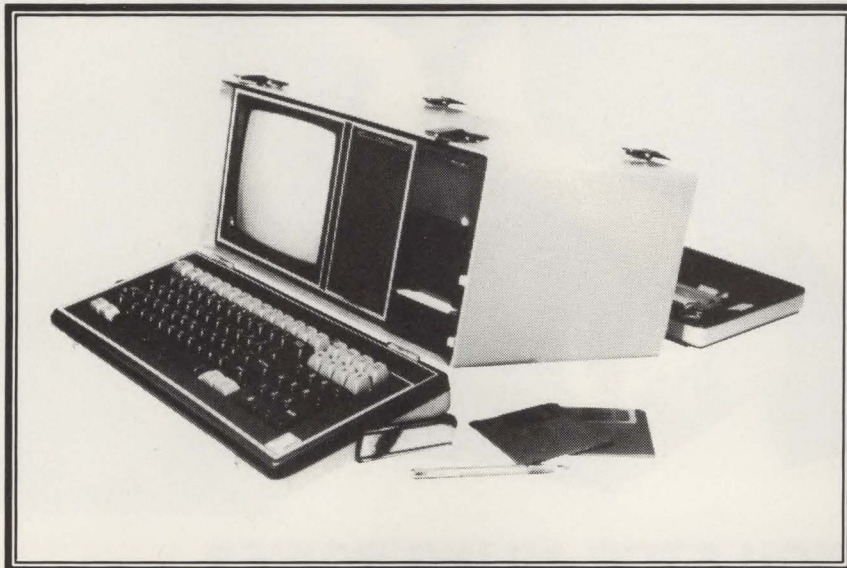


Fig. 5. Internetwork gateways route packets between networks on a channel of a corporate CATV system.



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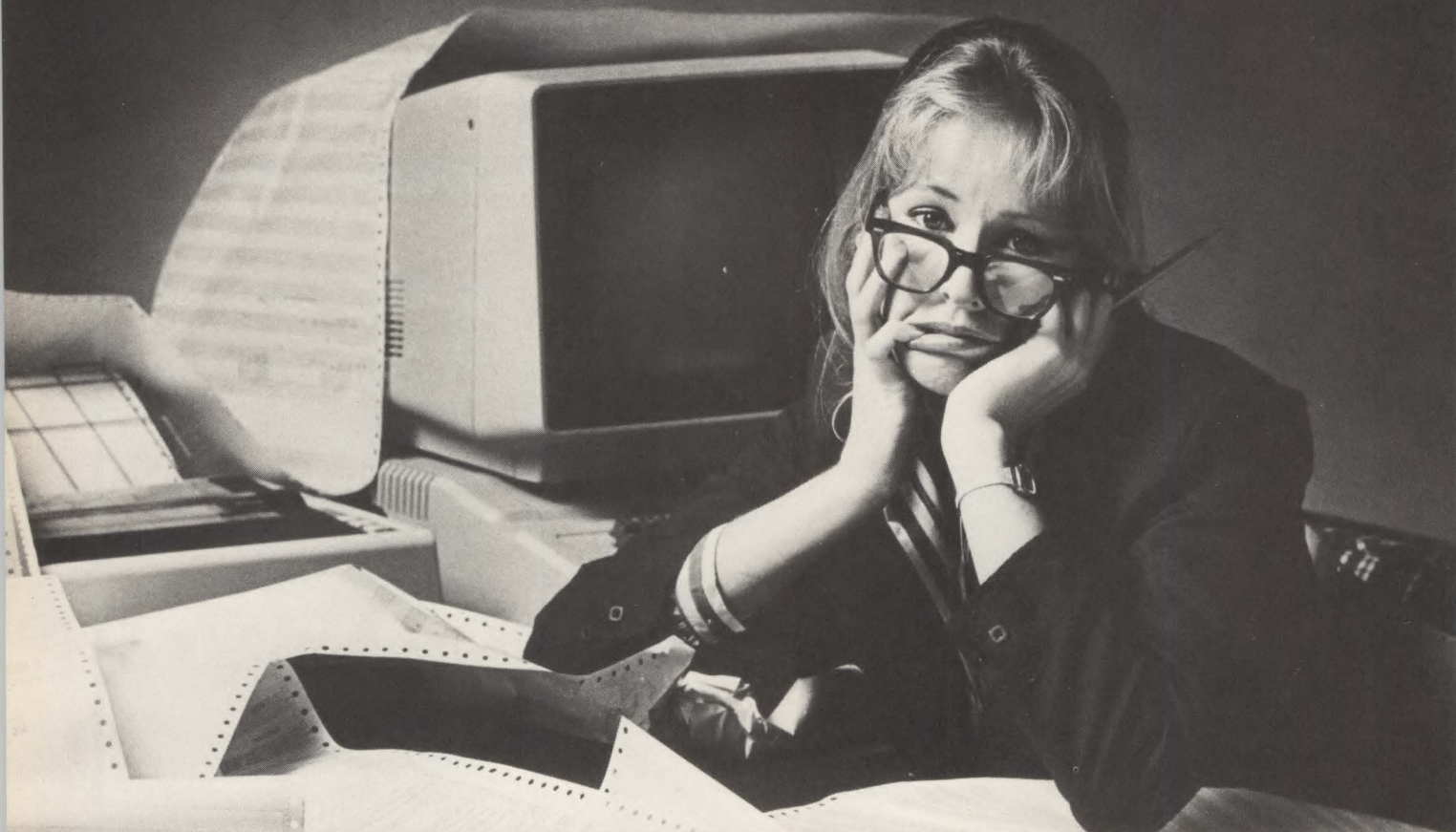
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Because of the analog nature and geographic coverage of CATV systems, companies considering broadband local networks must acquire RF technicians and test equipment for periodic alignment and maintenance.

than about 2 MHz are generated. This allows easy grounding procedures, whereas baseband cables must be grounded in only one point on the cable. Multiple-channel operation, however, is not without its problems. Care must be taken in the design and maintenance of all RF equipment to assure that noise and intermodulation (interference between channels) do not degrade system performance. Rigid specifications do not exist for RF equipment to assure that services on different channels can coexist and that keyed-off noise from a large transmitter population can be controlled. Further, interoperability of different manufacturers' equipment on a single RF channel may be difficult to achieve. For large CATV systems, cumulative noise from keyed-off transmitting equipment, packet collisions, improperly terminated taps or poorly installed components can interfere with other cable services. The baseband Ethernet system benefits in this respect, because it has been jointly and tightly specified by Digital Equipment Corp., Intel Corp. and Xerox. This specification assures interoperable equipment on the limited geography of the baseband channel.

CATV component technology has been developed with protection from stray signal ingress and egress. Metropolitan CATV operators follow strict Federal Communications Commission radiation regulations to ensure that no interference occurs with on-the-air services, especially in the Federal Aviation Administration and the navigation band areas of the signal spectrum. While the regulations do not apply to CATV systems used exclusively within a company, a local-network installer should adhere to the intent of these regulations. The CATV industry has developed connector technology that supports this signal-protection capability. Connector technology for baseband networks is still in its infancy. Figs. 3 and 4 show baseband and broadband connection techniques.

The status of CATV and baseband cables with respect to fire codes is unclear. Teflon coverings for some baseband systems are available. CATV components contain flammable dielectric material within an aluminum sheath, and their ability to pass fire codes for internal building use from state to state is unclear.

Design and installation

In evaluating local networks, relative performance and price of interface units are usually studied in great detail, but substantial cost may reside with the design and installation of the medium. This is especially true when the mobility of office and plant workers is

considered. Frequent reorganization and rounds of "musical chairs" can lead to significant wiring cost without additional local-network hardware or software expenses. Hence, broadband and baseband media must be compared not just for initial purchase price, but for probable reconfiguration costs during the life of the equipment.

A significant cost differential exists between the two media. The layout of a baseband cable plant is simple: there are five rules for trunk layout in the Ethernet specification. The rules delimit individual segment length, number of repeaters in cascade and overall cable length. Using these guidelines, a novice local-network engineer can lay out a baseband cable plant. Similar guidelines exist for other baseband implementations.

Contrasting with the fundamental simplicity of baseband is the design of a broadband cable plant. The engineering involved is similar in difficulty to designing a layout for a small town. The signal strength is equalized at all tap locations, necessitating care in the positioning of amplifiers, splitters and taps as well as calculating tap values. This is not an exercise for a novice: it requires an experienced CATV design engineer. Similarly, the care needed in selection of components forces reliance on an experienced CATV designer.

Installation parallels this difference in design complexity. A baseband cable can be installed and maintained by plant engineers and electricians. However, broadband demands RF engineering skills not usually present in a customer's work force.

Operation and maintenance

Because of the analog nature and geographic coverage of CATV systems, companies considering broadband local networks must acquire RF technicians and test equipment for periodic alignment and maintenance (amplifiers, for instance, must be adjusted for gain and slope). Attention must be given to each service placed on the cable to ensure that it does not interfere in frequency or affect the operation of other channels. Frequency management, equipment acceptance testing, configuration control and periodic maintenance are critical tasks for CATV networks. Placing all communications on a single CATV cable increases the importance of network monitoring and control. Media components and modem equipment that degrade performance must be quickly isolated and replaced.

Because of the limited distance and passive nature of baseband systems, operation and media maintenance procedures are simpler. Transceivers, the devices that transmit and receive data on the cable, are the critical element of baseband systems. If the transceiver fails in the ON state, the channel jams.

Mixing broadband and baseband

While baseband and broadband local networks meet local environment needs, there is no clear winner. Each

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Another method of achieving greater distance is to use other time-division-multiplexing techniques such as TDMA with static time-slot assignments or reservations.

has its advantages. Fig. 5 shows an architecture that uses the strengths of both. The CATV system is used as an internetwork for a number of limited-distance baseband networks. Baseband networks would be dedicated to groups within an organization for their data-communications services. When data must move between local networks, a channel of the CATV system serves as the internetwork.

In such a scheme, the CATV system serves as a trunk running between all buildings or floors in a building to teleconferencing centers, but not indiscriminately dropped to each office. This simplifies the CATV system, thus reducing design, installation, operation and maintenance costs as well as cumulative system noise. In areas in which CATV installation and design are difficult, a simpler baseband medium can be employed. Its hierarchical structure is less subject to catastrophic failure and allows individual groups to control their own networks. If significant traffic is anticipated between baseband networks (that is, terminals in building A to computers in building B), the performance of the internetwork bridge is critical.

Different baseband systems can be interconnected if they follow a fixed internetworking scheme. Thus, a variety of baseband systems incorporating coaxial cable or fiber optics and using appropriate access mechanisms can be individually selected and tailored for each group interfacing to the broadband CATV trunk. ■

Gregory T. Hopkins is eastern regional manager and **Norman B. Meisner** is manager of systems and marketing for the eastern regional office of Ungermann-Bass, Inc., Burlington, Mass.

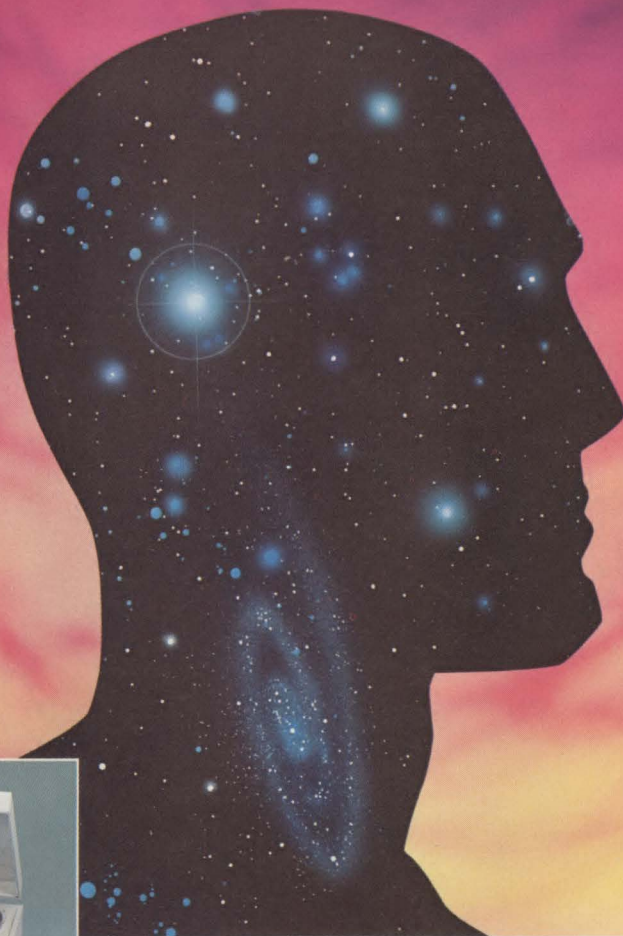
NEXT MONTH IN MMS

Watch for Mini-Micro Systems' annual special report on computer graphics in the July issue. A comprehensive survey of graphic terminals for business and science applications will lead off the feature section, which will be augmented by several other graphics-related articles, including:

- A look at turnkey graphic systems.
- A tutorial on graphic-input peripherals.
- A survey of color hardcopy devices for graphics.
- An explanation of building-block graphics.

Mini-Micro Systems is also planning major product survey articles in coming months, including microcomputers in August, high-level languages and development systems in September, memory systems in October and computer terminals in November.

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Terminals access catalogs of eight university libraries

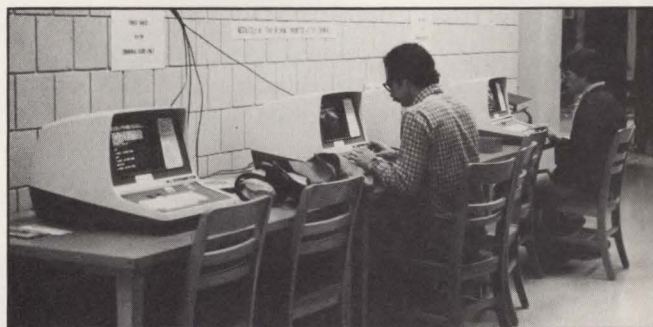
Users of eight Minnesota State University libraries now have terminal access to more than 1.25 million bibliographic records. The Minnesota State University System (MSUS) centralized library network ties 95 Applied Digital Data Systems Regent 20 terminals to a catalog information center managed by a Sperry-Univac 1100/80A computer.

Minnesota State's library communication network consists of one pair of Codex Corp. 6030 statistical multiplexers, 10 pairs of Codex 6010 statistical multiplexers and 11 pairs of 9600-bps modems to tie the main computer site to the eight remote sites. The system uses two Sperry-Univac v77-200 terminal concentrators and six 8434 disk drives.

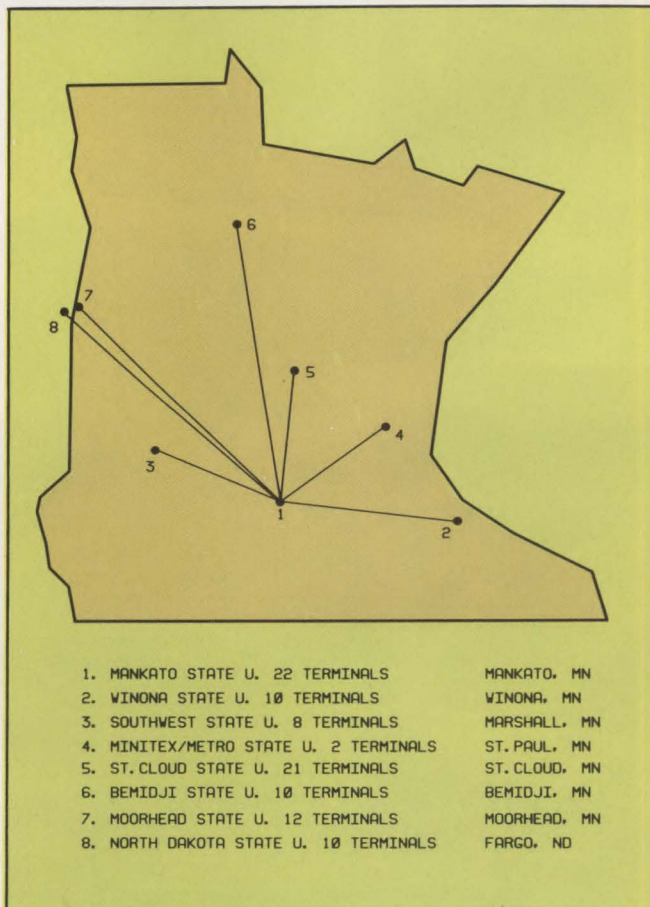
The software configuration includes the Univac 1100/36.R20 operating system; the UTC software for the Univac v77-200; the Univac 1100 data-management system, which manipulates 23 library files and related indexes; the Univac 1100 communication-management system, which interfaces the on-line terminals and the user-transaction programs; and the library-system program modules written in Univac 1100 ASCII COBOL. General transaction processing allows remote terminals to initiate execution of preregistered terminal interface modules.

The system is used for catalog access with all MSUS information resources cataloged by OCLC, an international cataloging network centered in Dublin, Ohio. Planning and development departments use circulation, acquisitions and serial control subsystems, and a statistics module records data on transaction activity, command usage, terminal and institution usage, response time and processing time. There are approximately 600,000 transactions per month at 0.25 sec. of computer time per transaction, accounting for about 15 percent of the total computer usage.

Most people can use the system after 30 min. of instruction. A handbook and library personnel are available near public-service terminals, and an on-line "help" module also offers assistance. Says Dale K. Carrison, dean of the library: "Early fears about the acceptance of the system were found to be groundless as library users of all ages and education levels operated the terminals and found that the catalog search offers retrieval power not possible through traditional methods."



Students use library network to obtain catalog information at Mankato State University in Minnesota. A total of 95 ADDS Regent 20 terminals at eight state universities access 1.25 million bibliographic records.



Remote library-network sites at Minnesota State Universities are connected to a Sperry-Univac 1100/80A computer, which processes 600,000 library transactions per month.

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CSPI array processor aimed at DEC PDP-11 OEMs

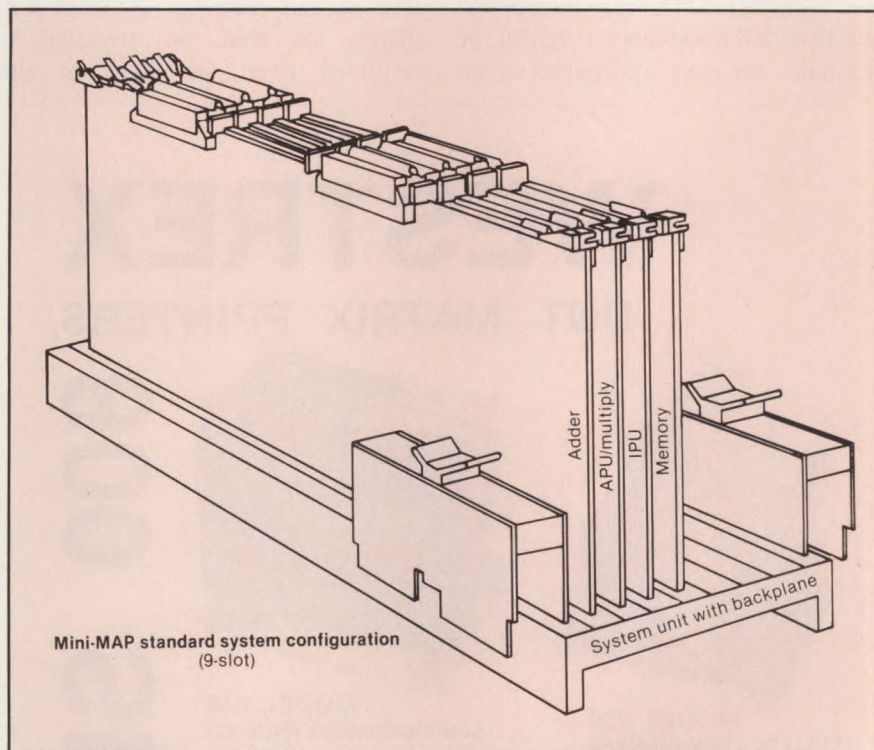
An array processor targeted at OEMs configuring Digital Equipment Corp. PDP-11 Unibus minicomputers to perform high-speed, repetitive calculations is said to complete typical scientific problems at least 100 times faster than the minicomputer alone.

"By doubling the price for a basic PDP-11 minicomputer, a user can get 100 times the performance," claims Martin Schrage, international manager for marketing at CSP, Inc., Billerica, Mass. He says a typical computerized axial tomography scan can be performed in 30 sec. on CSPI's new Mini-MAP, model MM-111 array processor, released early this month, and in 45 min. on the PDP-11.

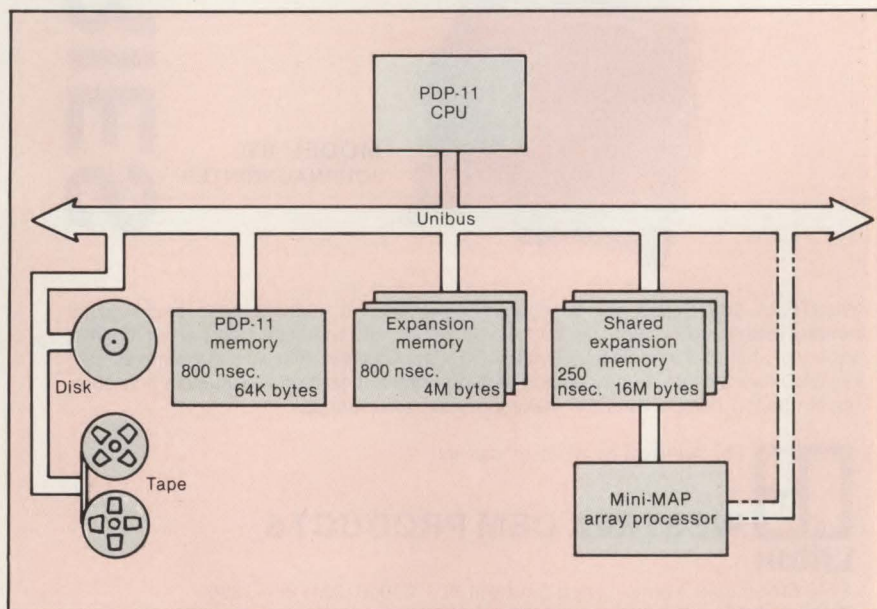
The Mini-MAP 32-bit floating-point unit will be priced at \$16,200 for a basic configuration with four boards in quantities of 50 or more. A minimum system contains four PDP-11 hex-sized boards that plug directly into a Unibus backplane.

The DEC backplanes are available from DEC and CSPI. As many as three boards can be added by OEMs, which also add peripherals that run off the DEC host. Application software for vertical markets is also the province of OEMs, although CSPI will offer some assistance. CSPI offers a library of subroutines that has been proven for five years on its other products. Mini-MAP has 50 FORTRAN-callable arithmetic routines.

Of the four boards, one is a memory board housing 64K bytes of data memory using 16K RAM chips. There also is 4K of program RAM. The separate data and program memories mean faster speeds because instruction fetching does not conflict with data, as on many minicomputers, the company says.



CSPI's Mini-MAP array processor fills four of the seven Unibus slots in the PDP-11 minicomputer. OEMs can add three boards of their choice.



With its OEM Mini-MAP product, CSPI incorporates a shared-memory concept that makes the array processor look like PDP-11 expansion memory. This means that the disk does not have to be read into PDP-11 memory first through a DMA, thus eliminating one interface board that normally would house the DMA.

As much as 16M bytes of additional data memory is available, but has not yet been priced.

One innovation over earlier products from CSPI is the way memory is handled. Mini-MAP uses a shared, or common, memory approach, which

means that a disk does not have to be read into PDP-11 memory through a DMA first. It can be read onto the Unibus and then directly into shared memory, Schrage explains, so that no transfer is required from the host to the

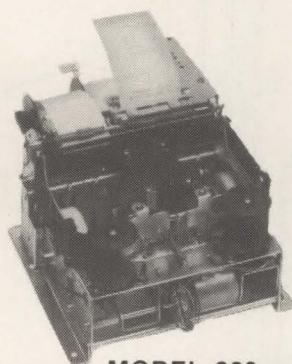
Mini-MAP. In essence, the Mini-MAP memory looks like more expansion memory for the PDP-11. By using shared memory, CSPI eliminates one interface board with a DMA that performs format conversion between the two machines.

CSPI intends to put the shared-memory concept on future products, but that is an ambitious project. With existing higher end MAP 300 and 6400 array processors, shared memory already is used with Gould S.E.L. superminicomputer models 32/77, /87 and /27.

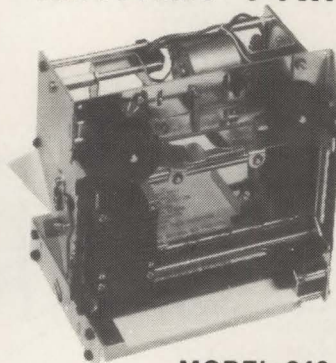
CSPI also plans to support VAX and the DEC Q-bus. The company

WESTREX DOT MATRIX PRINTERS

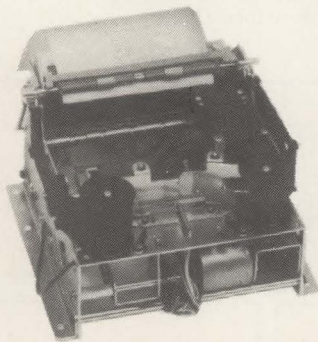
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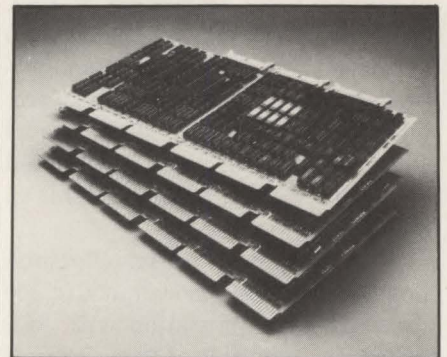
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CIRCLE NO. 132 ON INQUIRY CARD



CSPI Mini-MAP's four boards incorporate LSI to decrease the overall component count. The power consumption is 125W, compared with 800W on competitive models.

will have an assembler and loaders for the PDP-11, and FORTRAN 77 subset this year.

CSPI's MAP processors are sold mostly to end users. In performance, the Mini-MAP fits between the MAP 200 and MAP 300. In a Fast Fourier Transform, the following results for the three machines indicate times for a 1024-point complex FFT. The Mini-MAP requires 7.7 msec. to perform the task, while a MAP 200 requires 13 msec., and a MAP 300 requires 5.3 msec. The very high-end MAP 400 requires 2.7 msec.

One feature that makes Mini-MAP ideal for mobile-van applications, such as oil-field exploration, is very low—125V—power consumption. A competitive product consumes

800W, relatively high to have on a truck, explains Mini-MAP designer James Storer.

Mini-MAPS will be available in volume in October. Applications include factory floors, where, for example, an array processor can help search for cracks on soda bottles on an assembly line, and must keep up with that line and perform a test every 40 sec. Additional applications include industrial testing, such as processing a television image; robotics; oil-related activities; CAD/CAM; graphic manipulations, including 3D and color; and nuclear magnetic-resonance scanning.

—L. Valigra

CSP, Inc., 40 Linnell Circle,
Billerica, Mass. 01821.

Circle No 300

Intel system aimed at 8-bit μ ps runs CP/M

Intel Corp. has introduced what it says is the first portable μ c development system. The iPDS, a fully integrated, 27-lb. unit, is said to provide all hardware and software tools needed to develop products based on Intel's family of 8-bit μ ps. It also offers an optional CP/M operating system package that turns the iPDS into a general-purpose personal computer running any CP/M-compatible application software.

The 64K, 8085-based iPDS includes a 9-in. display screen, a detachable keyboard and a built-in 640K-byte floppy-disk drive, with as much as 256K bytes of optional bubble memory for those who do not want mechanical mass storage, the company says. Disk memory can be expanded to 2.5M bytes by adding as many as three drives.

Intel is making available several hardware/software-emulation packages for debugging processors. The iPDS accommodates as many as four

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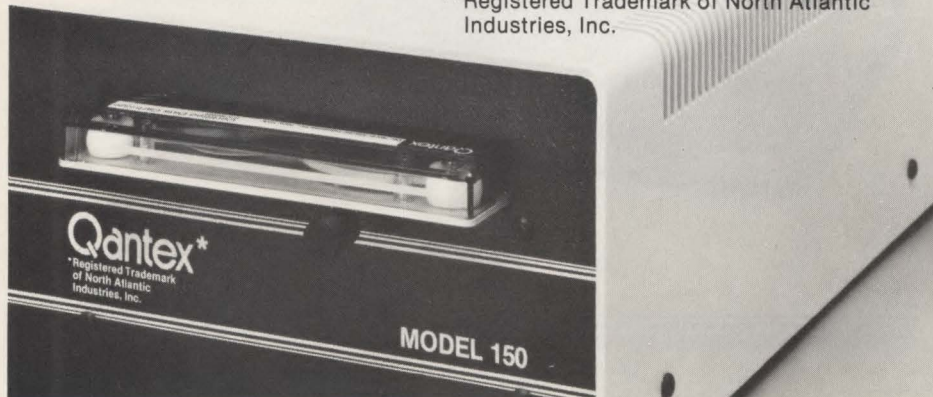
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CIRCLE NO. 135 ON INQUIRY CARD

Systems

isBX Multimodule boards to expand the system's functions with parallel or serial I/O ports or an IEEE 488 interface. The unit also accepts most Intel PROM programming personality modules for handling EPROMs or EEPROMs.

The system's ISIS-PDS operating system features a relocatable macro assembler, a screen-oriented editor, and high-level languages such as FORTRAN, BASIC, PL/1 and Pascal. ISIS-PDS will also run other Intel Inteltec development-system software.



The iPDS, a fully integrated, 27-lb. unit is said to provide all hardware and software tools needed to develop products based on Intel's family of 8-bit μ ps.

A second processor board can be added to permit two programs to run simultaneously for increased throughput, the company says. The second board, like the first, uses an 8085 processor and has 64K bytes of RAM.

An iPDS with display, keyboard, floppy-disk drive, operating system, macro assembler, text editor and documentation is priced at \$4495. A standard configuration, including emulation and PROM programming, is less than \$10,000.

—Larry Lettieri

Intel Corp., 3065 Bowers Ave.,
Santa Clara, Calif. 95051.
Circle No 301

System features 7.5M-byte Winchester

The Super Scorpio LSI-11-based minicomputer system contains a 7.5M-byte, 5¼-in. Winchester-disk drive and controller that is software

Let's compare apples



MUX25 Comparison List

FEATURE	SCITEC MUX25	MICOM M824-WF*	MICOM M824
Terminal Activated Configuration from any Terminal, On Line, Password Guarded.	✓	X	X
Any Combination of Speed, Parity, Bits, Flow Control, Field Selectable, Non Volatile Store.	✓	X	X
All Terminal/ CPU Vendor Support Standard.	✓	X	X
Per Channel Flow Control In Band/Out of Band.	✓	X	X
EIA Controls.	✓	X	✓
Terminal Activated Diagnostics from any Terminal, Password Guarded.	✓	X	X
Terminal Activated Statistics from any Terminal.	✓	X	X
Channel Priority Selectable per Channel.	✓	X	\$200
Link Speeds to 9600B.	✓	✓	✓
Remote Configuration, Diagnostics and Statistics Password Guarded.	✓	X	X
Price (based on US Domestic List).	\$1200	\$1400	\$1850

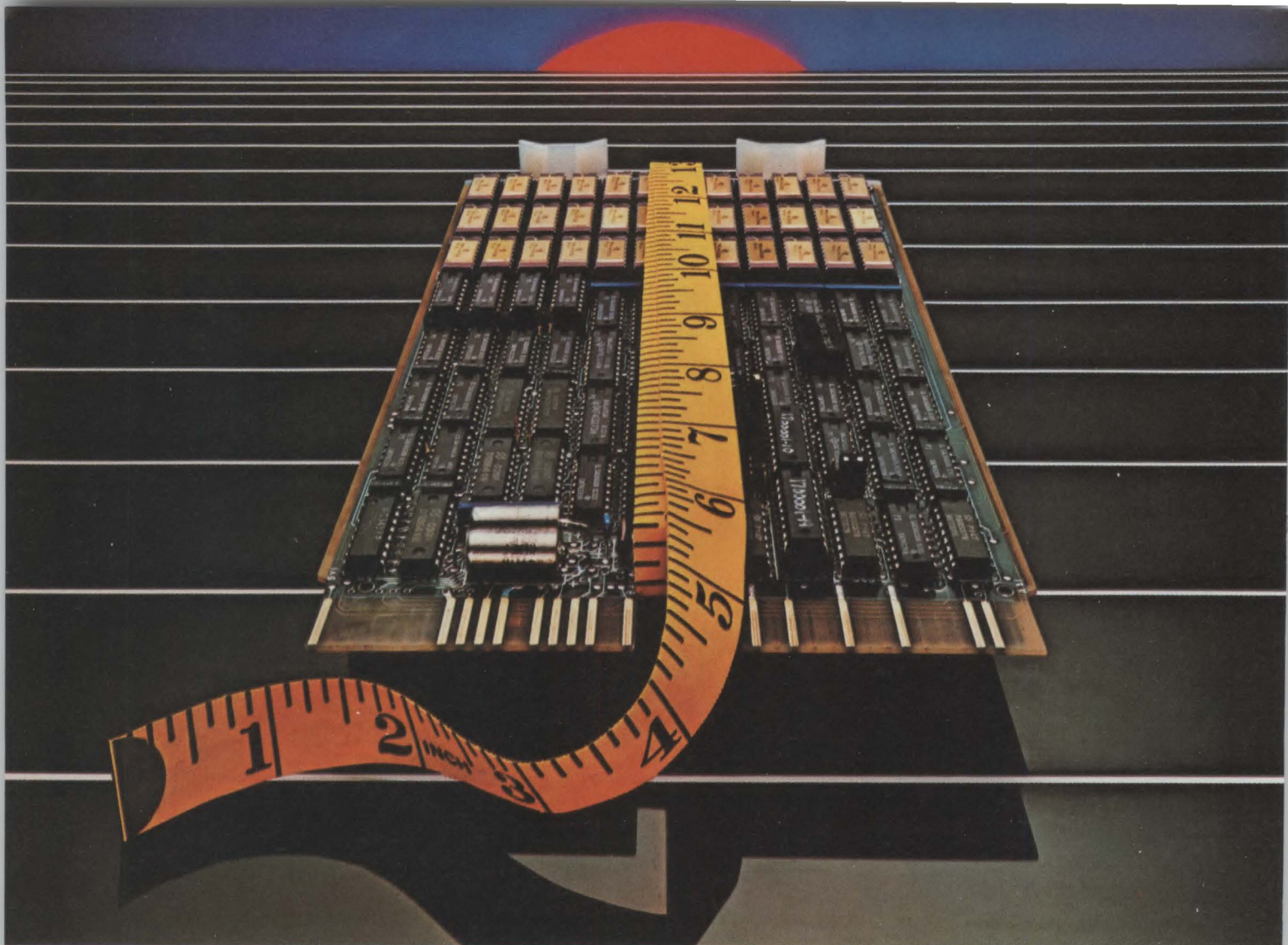
*No Frills

The Scitec MUX25 is the most versatile and cost effective 4 channel data concentrator available today. It combines low end price with high end features in a package unbeatable on today's market. Not only is it the best solution for "first time" point to point users but it is also upwards compatible to the Scitec CPX25 communications processor for use in a sophisticated network environment. Compare its features and you will see why it is the obvious pick of the crop. Write or call your nearest Scitec office for further information on the features of the MUX25 Data Concentrator. NOTE, chart comparison based on manufacturer's published information.

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Central Region: 9801 W. Higgins Road, Suite 220, Rosemont Ill. 66018. Tel: (312) 692 4930. Tlx: 253751.
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CIRCLE NO. 136 ON INQUIRY CARD



System Shrinker.

Unique on-board controller makes parity controller boards obsolete.

Greater system protection. Extra card cage space. And faster performance. TI's compact LSI-11* memory board with exclusive on-board parity controller gives you this and more.

Protects and saves

The new TMM10010 memory board performs all parity functions. Its unique on-board parity controller signals when a parity error occurs, enabling the CPU interrupt to prevent operation with incorrect data.

Besides protecting the system, the TMM10010 eliminates the need for a separate parity controller board, which frees a slot for increased memory or extra I/O.

The TMM10010 can save you even

more money. It lets you add the parity feature to a backplane that's already full.

Maximum speed

Compatible with the DEC QBUS* system, the TMM10010 runs at maximum QBUS speed, making it faster than the conventional memory board without on-board parity controller.

It also provides 22-bit addressing

capability. High-density 128 KB and 256 KB capacity on a single "dual" board. And address space DIP selectable from 256 KB to 4 MB.

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TI MEMORY BOARDS		BYTES/BOARD			
System	TI Series	64K	128K	256K	512K 1M
LSI-11*	TMM10010 ¹	X	X		
PDP-11*	TMM20000 ²		X	X	X
VAX*	TMM30000			X	X
Multibus†	TMM40010A ²	X	X	X	X

¹Parity optional

²EDAC standard

Texas Instruments invented the integrated circuit, microprocessor and microcomputer. Being first is our tradition.

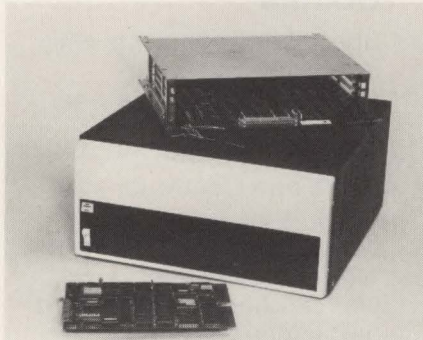
TEXAS INSTRUMENTS

INCORPORATED

CIRCLE NO. 137 ON INQUIRY CARD

*Trademark Digital Equipment Corp.
†Trademark Intel Corp.

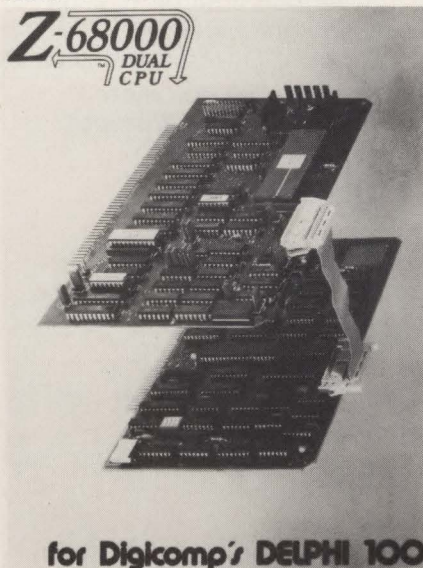
compatible with the DEC RK05. The software emulation provides three logical units, each formatted to 2.5M bytes. A 5¼-in. floppy-disk drive and controller provide 900K bytes of backup. The system can be configured with a DEC LSI-11/2 and 64K bytes of RAM or an LSI-11/23 with as much as 256K bytes of memory. A



BP44 backplane and card cage allows the system to be packaged in a 15½ × 6¾ × 15-in. desk-top enclosure, including power supplies, module and drives. Prices begin at \$6325 in large OEM quantities. Chassis and all modules are also available separately. **General Robotics Corp.**, 57 N. Main St., Hartford, Wisc. 53027. **Circle No 302**

Dual-processor system is MC68000 based

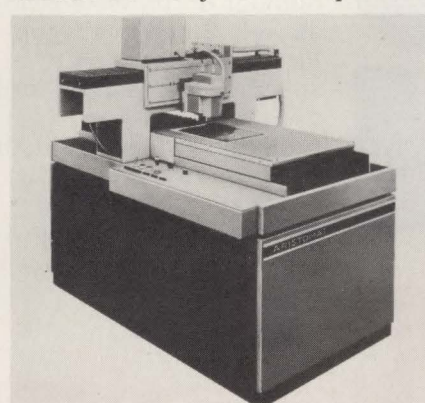
The Delphi-100 S-100 system, based on the 16-bit MC68000 CPU



and 8-bit Z80 CPU with software-controlled switching between them, runs Ada and supports a multi-tasking Pascal and all 8080 and Z80 software, including CP/M. The system includes a 256K-byte main memory, two double-sided, double-density floppy disks for a total of 2.4M bytes of storage or hard-disk systems in capacities of 40M to 160M bytes. I/O facilities include four serial ports, independently selectable for RS232C asynchronous or synchronous operation, 24 bits of parallel I/O, 16 levels of vectored interrupt and an optional real-time clock/calendar with battery backup. Other features include a 16-bit data bus, standard DMA, 16M bytes of address space and an integrated memory-mapping facility that gives the Z80 access to 1M byte without affecting the 16M-byte space of the MC68000. **Digicomp Research Corp.**, Terrace Hill, Ithaca, N.Y. 14850. **Circle No 303**

Drafting photoplotter produces PC layouts

The Aristomat 401 drafting machine with LZE 113 or 114 photo heads produces PC-board master layouts at a scale of 1:1. The plotter uses a system of aperture disks that contain as many as 100 apertures



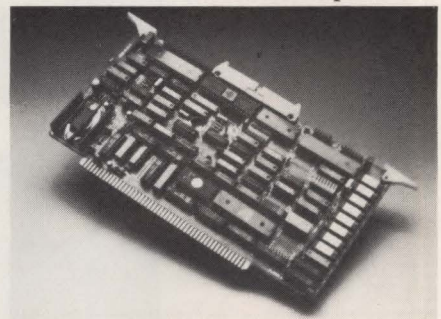
per disk. The apertures can be of points, symbols, alphanumerics or a combination. Aperture diameter size ranges from 0.002 to 0.400 in. The LZE 113/114 photo heads

operate at speeds as high as 8 ips. The system's drafting surface measures 28½ × 19½-in. and includes ball-slide movements, backlash-free ball screws and a closed-loop servo system. **Aristo Graphics Corp.**, 5 Emery Ave., Randolph, N.J. 07869.

Circle No 304

S-100 system supports DMA operation

The Super/Net S-100 single-board computer system includes 64K of bank-select dynamic RAM, a Z80A CPU, a 2716 monitor EPROM, a 5¼- and 8-in. floppy-disk controller, two serial and two parallel interface ports and a Z80A calendar timer clock for real-time interrupts. The



system supports DMA operation, meets IEEE-696 specifications and operates under CP/M and MP/M software. Price is \$1125, with volume discounts available. **Advanced Micro Digital Corp.**, 7201 Garden Grove Blvd., Suite #3, Garden Grove, Calif. 92641.

Circle No 305

Versamodule µc features MC68000

The 16-bit M68KVM02 Versamodule single-board µc, designed for the industrial and laboratory-automation markets, includes the MC68000 µp, a local bus that can be extended externally, two multiprotocol serial I/O ports, 128K bytes of dual-port RAM, and VERSADOS and RMS68K real-time system software. Other features include compatible I/O modules, including D/A and A/D

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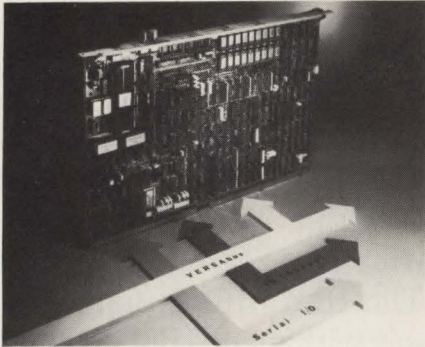
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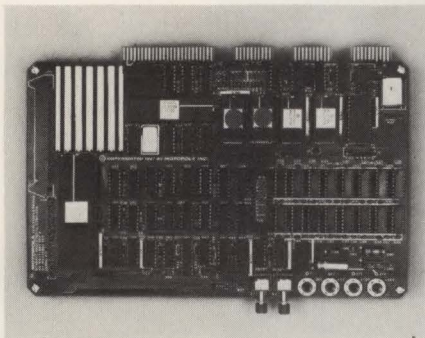
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converters, solid-state relay I/O, TTL-compatible parallel I/O and RS232C I/O boards. The module, with 128K bytes of RAM, sells for \$3900 in single-unit quantities, with OEM quantity discounts available. **Motorola Semiconductor Products Inc.**, P.O. Box 20912, Phoenix, Ariz. 85036. **Circle No 306**

Computer board is educational tool

The MC68000 educational computer board, intended as an educational tool for students and an evaluation tool for designers, is based around a 4-MHz MC68000 μ p. It also provides 32K bytes of RAM, arranged in 16-bit



words; firmware in two 8K- \times 16-bit blocks of memory; two RS232C ports; a baud-rate generator that allows selectable data rates from 110 to 9600 bps; and a Centronics parallel and an audio cassette interfaces. Firmware provides debug/monitor, program entry, assembling, disassembling and I/O functions. Price in quantities of one to five is \$495. **Motorola Semiconductor Products Inc.**, P.O. Box 20912, Phoenix, Ariz. 85036. **Circle No 307**

IAS announces color display system

The model 2100 CAD-Colographics system, for IBM CAD/CAM users, provides a black-and-white IBM calligraphic system, a 3250 graphics display system or an IAS 2100

raster-scan system. A typical configuration includes a 2120 on-line control unit that emulates the IBM 3250 and can be configured to support as many as eight local display stations or one to 16 display stations as far as 8000 ft. away and a



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The IBM 3101 is also easy to order, through our new authorized distributor network. Pick from six models with field pro-

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CIRCLE NO. 139 ON INQUIRY CARD

Systems

2140 remote graphics controller that operates as much as 8200 ft. from the 2120 via a coaxial cable and drives as many as four color-display generators with two work stations per generator. The 2160 graphics display generator offers as much as 1280 × 1024 resolution and 16 colors from a palette of 64, expandable to 4096 from more than 16 million. The system also includes a 2180 graphics display station with a display monitor, an alphanumeric keyboard, a CAD/CAM function keyboard and a light pen. Single-unit price for a basic 2100 system is \$69,950. Price per station for a configuration with eight display stations is approximately \$50,000. Volume discounts are available. **International Applied Systems**, 175 E. Dana St., Mountain View, Calif. 94041.

Circle No 308

Educational system has pretest, review modes

The CATS-80 computer-augmented teaching system for the educational and industrial-training markets includes a pretest mode that presents materials to be learned, asks questions and supplies answers. The review mode uses branching to present information based on student responses to questions. If a student answers questions correctly, the course branches to new information. If the student answers incorrectly, the course repeats information and questions or branches to a remedial mode. Three test modes—quiz, test and final—select questions randomly on previous material. The system includes the vendor's 3651 color graphics desk-top μ c with a built-in disk drive, a 32K memory, software and documentation. Price is approximately \$6000. An author incentive program allows prospective course authors to purchase a system for \$2995. **Intelligent Systems Corp.**, 225 Technology Park, Norcross, Ga. 30092.

Circle No 309

System trains, prototypes for MC68000 μ p

The Micro 68000 trainer/prototyping system for the MC68000 μ p includes a 6A switching power supply, a Versabus 68000 computer board, a hexadecimal keyboard and an LED display. It also features a 16K-byte ROM or RAM and a "Pete Bug" keyboard monitor that enables a user to enter 68000 machine-code instructions into memory and debug and run programs. A display board shows entries in hexadecimal and binary. The computer board offers two RS232 ports and 32 bits of parallel I/O. All Versabus connections are available externally for test and measurement. Price is \$985. **Computer System Associates**, 7562 Trade St., San Diego, Calif. 92121.

Circle No 310

OEM μ c system is Z80A based

The Bullet integrated Z80A-based μ c system supports CP/M and connects to any serial video terminal and a Centronics-compatible printer. The device's single board provides a 4-MHz Z80A CPU, a 128K-byte RAM that supports two users and runs under MP/M, DMA floppy-disk I/O with RAM buffering, two high-speed DMA serial ports, a DMA intelligent Winchester interface, a real-time clock and a general-purpose external DMA bus. The 368K-byte dual-minifloppy, 128K-byte RAM Bullet I, has an OEM single-unit price of \$1490, and a 50-unit price of \$1225. The Bullet II contains 736K bytes of floppy storage and has an OEM single-unit price of \$1750. The Bullet IV contains 1.47M bytes of floppy storage and has an OEM single-unit price of \$1990, and the 2.4M-byte Bullet VIII has an OEM quantity price of \$2500. **Wave Mate, Inc.**, 14009 S. Crenshaw Blvd., Hawthorne, Calif. 90250.

Circle No 311

smarter



Multiplexing at its best

Datagram sets a new standard in multiplexers by allowing error free transmission of data while at the same time providing the necessary diagnostics and statistics package required to prevent system failures.

Features

Asynchronous channel support

- Selectable per channel
 - 110 to 9600 bps
 - Autobaud up to 9600 bps
 - X-ON/X-OFF or RTS/CTS flow control
 - Echoplex
 - DTE/DCE jumper block
- 3, 5, 7 or 9 asynchronous channels support (Cost efficient 2 channel upgrade)

X.25 High speed composite link

- Error free concentration utilizing X.25 for its high speed composite link at speeds up to 19,200 bps (internal or external clock).
- Aggregate of 76,800 bps

The extra bonuses provided at no additional cost are:

- Statistics providing for each individual async channel: the total number of connections (DTR or DSR Transitions) and the amount of data transmitted and received — and the X.25 composite link: the total number of packets, reject packets and data packets transmitted and received
- Supervisory Console Port — user switch selectable
- Diagnostics to test individual system components, to on-line monitor any data channel, to accomplish individual local or remote X.25 and terminal port loopbacks



Datagram

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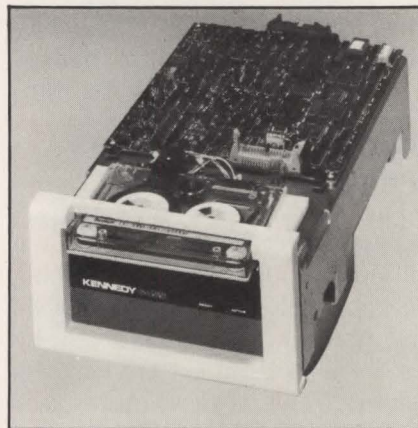
Peripherals

Kennedy cartridge streams or operates in start/stop mode

Kennedy Co. says the model 6455 cartridge transport that it introduced at the National Computer Conference is the first to operate in streaming or start-stop modes, making it useful for high-speed disk backup or normal file management.

In the streaming mode, the 6455 stores or restores 20M bytes of data in less than 20 min. In start-stop mode, the unit permits consolidation of files that reside on nonadjacent disk sectors and tracks.

At its writing and reading speed of 30 in. per sec., start-stop time is 25 msec.; 90-ips rewind speed



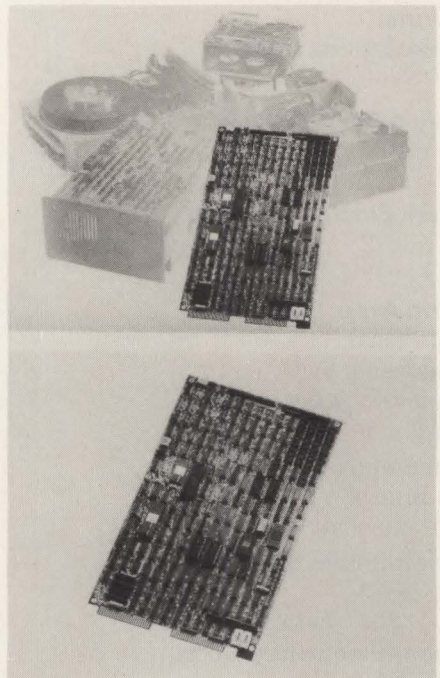
results in 75-msec. start-stop speed. The unit's servo system can stop, reverse and rewrite a 2K-byte record in 228 msec.

The four-track transport uses serpentine recording technology and 6400-bit-per-in. densities to give unformatted capacities of 11.5M, 17.3M and 21.3M bytes on 300-, 450- and 600-ft. standard cartridges, respectively.

The 6455 fits the envelope taken by an 8-in. floppy drive. Power requirements are +5V DC at 3A and 24V DC at 1.5A. The single-unit price of \$1700 drops to \$950 in OEM quantities. Deliveries are 90 days after receipt of order. **Kennedy Co.**, 1600 Shamrock Ave., Monrovia, Calif. 91016. **Circle No 347**

Controllers support Winchester, tape, floppies

The "Winifloppytape" controller supports as many as four 8-in. Winchester drives, one tape-cartridge drive and one optional floppy-disk drive. The controllers use serial tracks in forward and reverse direction to provide read or write backup data in streaming mode. Typical backup time is less than 2 min. in background mode. The controllers feature μ p intelli-



gence, single-board design and backup functions, including single command disk save/restore, automatic tape read retry on error and automatic error correction on tape during disk save. Other functions include logical-to-physical unit correlation, automatic seek and verify, automatic head and cylinder switching, alternate track assignment, odd parity checking, logical sector addressing, multiple sector buffer and interleaving, fault detection, integral data separation/encoding and programmable disk parameters. Price is \$1100 or less in quantities of 1000 units. **Data Technology Corp.**, 2775 Northwestern Parkway, Santa Clara, Calif. 95051. **Circle No 312**



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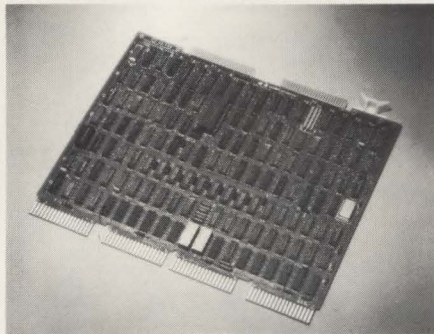
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Peripherals

Streaming-tape controller interfaces Kennedy drives

The TC-30 controller for use with DEC PDP-11 computers interfaces 1/2-in. streaming-tape drives from Cipher, Kennedy and Control Data.



The device emulates the TM11/TU10 tape system and operates the drives in the stop/start mode. It is software compatible with all DEC operating software and diagnostics. Special command bits place the system into the streaming mode and select a long-gap function for

high-speed operation. The controller can be used on drives that store 40M to 80M bytes on a 2400-ft. roll of tape. It uses 2.5A of 5V power. The quad-sized board mounts directly into the first available SPC slot and controls as many as eight streaming or formatted stop/start drives. **Western Peripherals, a division of Wespercorp, 14321 Myford Rd., Tustin, Calif. 92680.**

Circle No 348

Floppy system has two 8-in. drives

The I-47 8-in. floppy-disk system for use with Heath/Zenith computers consists of two intelligent 8-in., double-density, double-sided drives with a formatted capacity of 1.25M bytes per drive. The drives, which are in a master/slave relationship, include write/protect switches and indicators, a power-on LED and built-in power supply, fan, data

cable and documentation. As many as three slave drives can be daisy-chained to the master for a capacity of more than 5M bytes. A 6800 μ p on the master drive handles control and formatting functions,



and gives direct access to signal status. The device supports five single-density and eight dual-density disk formats. Three dual-density formats are standard IBM, including the 3740 format, and three are arranged in 26, 15 and eight

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sectors. The I-47 is priced at \$2795 and a single-drive version is priced at \$1995, with dealer discounts available. **Data Compass, Peripheral Products Division**, 2730 Regal Park Dr., Anaheim, Calif. 92806.

Circle No 313

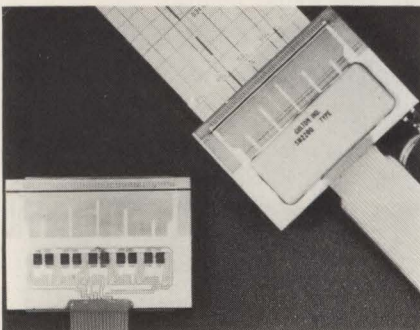
Plotters use DEC's Regis language

The DMP-4R and DMP-7R Hiplot/Regis plotters communicate with Digital Equipment Corp.'s Regis graphics language. The systems feature multi-color capabilities and manual X-Y positioning. The DMP-4R graphically reproduces an 8½ × 11-in. report in six colors and has push-button controls, 0.005-in. resolution, 2.8-ips speed and dual-port RS232C interface. The DMP-7R reproduces an 11 × 17-in. report in eight colors and features push-button controls, .005-in. resolution, 2.5-ips speed and dual-port RS232C interface. Both models can draw on paper or transparent film. DMP-4R and DMP-7R are priced at \$2380 and \$3180, respectively. **Bausch & Lomb, Instruments & Systems Division**, P.O. Box 15720, Austin, Texas 78761.

Circle No 314

Graphics print head offers 50- or 100-dpi

The SM2200 graphic thermal print head features printing rates as fast as 1 ips. The unit offers 50- or 100-dpi resolution across a 2-in. printing span. On-board BIMOS buffer memory and drive circuitry permit a cycle time as low as 10 msec. to print one dot row. The unit



enables operation as a 200- or 100-dot print head by division of the dot row into two strobe common lines. The head can be used with an integral heatsink, thermistor pre-heater and connector-terminated cable. Prices range from \$343.50 in

quantities of one to \$214.15 in quantities of 100 to 999. **Gulton Industries, Inc., Gulton Measurement & Control Systems Division, Hybrid Microcircuit Department**, 212 Durham Ave., Metuchen, N.J., 08840.

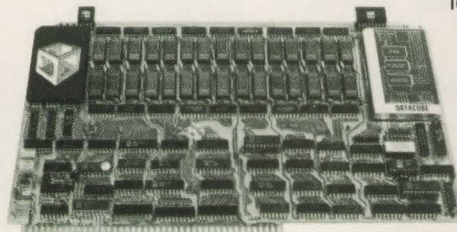
Circle No 315



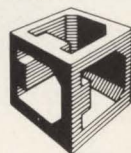
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Peripherals

Sonic digitizer meets OEM requirements

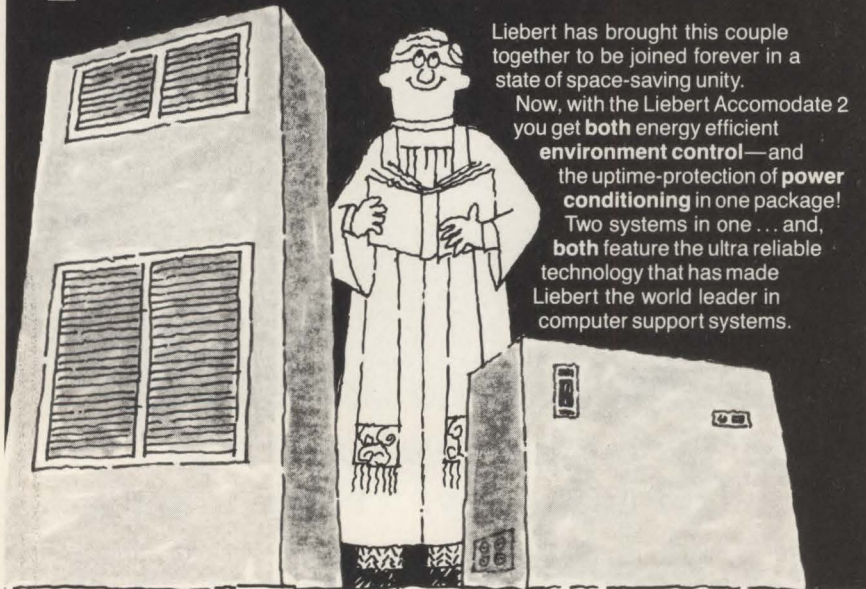
The GrafBar HP-7-OEM sonic digitizer is intended for use by OEMs in electronic data-processing and data-handling equipment requiring the digitization of 2D graphic data.

The 19- × 6- × 1¾-in. digitizer features built-in μ p conversion of slant ranges into cartesian (X-Y) coordinates. Outputs include RS232 ASCII, parallel ASCII, packed binary or BCD packed. The system includes an outside jumper on the output

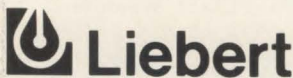
connector and an English/metric select jumper. RS232 baud rate is selectable at 150 to 19.2K bps in eight steps. The stylus- and cursor-compatible digitizer also provides a built-in 115V AC power supply, 0.01-in. output resolution and 30-count-per-sec. cartesian/100-count-per-sec. slant range digitizing rate. Other features include a built-in, five-function menu that is operational in the 2-in. margin between the GrafBar's assembly and the active area, an origin block that allows selection of any point within the active area as the 0.0 origin, a line-mode block that provides continuous succession of digitizings as long as the switch is held down and a stream mode that allows the digitizer to produce a continuous stream of coordinates without holding the contact switch closed. **Science Accessories Corp.**, 970 Kings Highway w., Southport, Conn. 06490. **Circle No 316**

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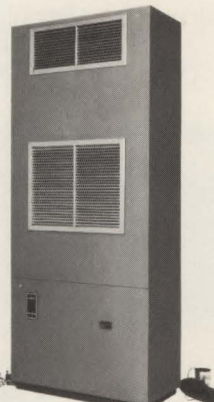
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Printer features five modes

The Z80-based model 7030 multi-mode printer offers five switch-selectable and programmable modes allowing the 9 × 9 serial dot-matrix printer to be used as an off-line print station or as a component of a data-processing system. An on-board ROM stores the system's font library, with ASCII and seven European character sets, each printable at 180, 150, 75- and 37-cps. At 37 cps, vertical resolution is 144 dpi. The unit produces draft copy at 180 cps and print quality at 150 cps. The printer contains a



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MM6



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5000 volts of static electricity produces a spark you can see, 2500 volts one you can feel; but it only takes 500 volts to cause a malfunction in some computers, word processing machines, and other sensitive electronic equipment. In other words, just because you don't feel static shocks during the humid summer months, don't assume that your static problems are over.



3M Static Control Floor Mats can create an inexpensive "island of protection" around delicate electronic office equipment,

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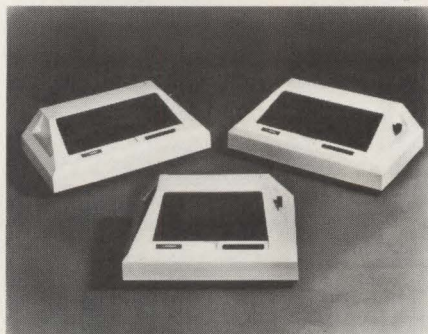
Peripherals

2.7K-byte input buffer that has graphics capability with a maximum resolution of 144×144 bit-mapped dpi at a repetition rate of 900 dpi per activated needle. The system includes Centronics parallel and RS232 interfaces including a current loop. The serial interface supports STX/ETX, X-ON/X-OFF, Busy + and Busy - with baud rate from 110 to 19.2K bps. Single-quantity price is \$1995, with quantity discounts available. **Qantex Division of North Atlantic Industries, Inc.**, 60 Plant Ave., Hauppauge, N.Y. 11788.

Circle No 317

RO printer provides . alphanumerics, graphics

The DP-9620A receive-only impact matrix printer provides alphanumeric and graphics. Alphanumeric speeds range from 200 cps at 10 cpi for a 7×9 dot matrix to 100 cps for a 13×9 dot matrix. Other character densities are 12, 15 and 16.4 cpi.



Character sets include the 96-character ASCII set with lower-case descenders. For graphics, horizontal and vertical resolutions are 72 dpi. The printer accommodates one-to six-part paper with interleaved carbon sheets as much as 15 in. wide and features adjustable-width tractors. The system includes Centronics bit-parallel and RS232C interfaces and eight serial communications protocols. A serial TTY interface is optional. Other features include horizontal and vertical tabulation and 6- or 8-lpi vertical-print resolution. The DP-9620A sells for less than \$1100 in OEM quantities of

1000 units. **Anadex, Inc.**, 9825 De Soto Ave., Chatsworth, Calif. 91311.

Circle No 318

Dot-matrix unit includes calendar clock

The SP-308 T/D dot-matrix impact printer for automatic test reports and weigh-station output prints time, day and date upon receipt of an ASCII control code. The CMOS calendar clock is backed by an



internal Ni-Cad battery that maintains time for 90 days without input power. Other features include 40-column dot-matrix impact printing at 50 cps, a 40-character buffer, 115V/230V AC, 50- or 60-Hz power input, RS232C and 20-mA interfaces and 75- to 9600-bps baud rates. Price is \$970 in single-unit quantities. **Syntest**, 169 Millham St., Marlboro, Mass. 01752.

Circle No 319

Laser system prints multiple originals

The model LPS-12 laser printing system handles multiple originals of multipage documents. The system works as an on-line output device for the vendor's OIS, Alliance and virtual storage systems. The unit operates at an average speed of 12 ppm with resolution of 300×300 dpi. The device stores multiple character sets on a system disk, and supports single and double underscore, slash overstrike, subscripts, superscripts, bold and vertical expanded print. An operator selects 10-, 12- or 15-pitch or proportionally

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Peripherals



spaced printing in portrait or landscape format. Price is \$27,995, and rental prices are \$1288 per month for a 12-month lease, \$1150 per month for 24 months and \$1064 per month for 36 months. **Wang Laboratories, Inc.**, One Industrial Ave., Lowell, Mass. 01851.

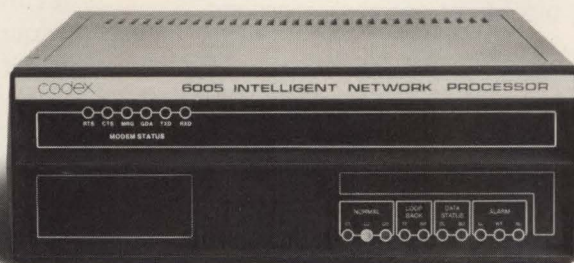
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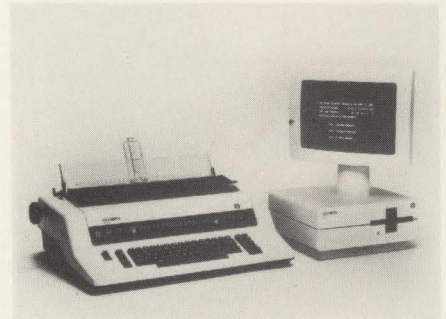
digits of RAM for program and data storage, an 8K-byte ROM that stores the terminal operating system, a two-line, 32-character LCD and CMOS or HMOS memory configurations. Other features include a sunlight-filtered bar-code scanning wand and

a programmable 28-key keyboard that includes data-recording characters, special symbols and control mode keys. HMOS versions range from \$600 to \$1700, and CMOS versions range from \$800 to \$2400, depending on configuration and

quantity. **MSI Data Corp.**, 340 Fischer Ave., Costa Mesa, Calif. 92626. **Circle No 321**

Typewriter extension does word processing

The model EX100 electronic-typewriter extension system includes an electronic typewriter, a 12-in. diagonal video display screen and a file-storage device. The system performs word-processing functions, including automatic letter writing; insertion or deletion of



letters, words, punctuation or paragraphs; error correction; and paragraph restructuring. The system also performs automatic hyphenation and word-wrap functions. The system, not including a typewriter, is priced at less than \$3500. **Olympia USA Inc.**, Box 22, Somerville, N.J. 08876. **Circle No 322**

Portable terminal has single-line LCD

The TransTerm 2 alphanumeric keyboard/display terminal for portable and remote communication consists of a single-line, 80-character LCD and a 58-key, TTY-style membrane keyboard in a 1.75- x 12.75- x 6.9-in. case. The unit communicates in full-duplex RS232 asynchronous ASCII, with 20-mA current loop or RS422 optional. Eight baud rates from 110 to 9600 bps and character parity (even/odd/mark/space) at 7 data bits per character are switch selectable. The LCD supports a 96-character

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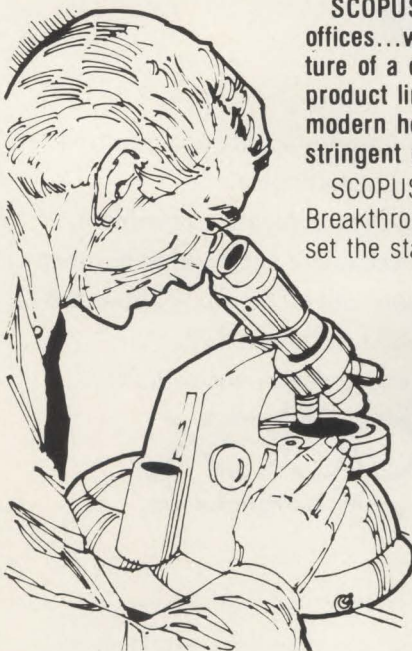
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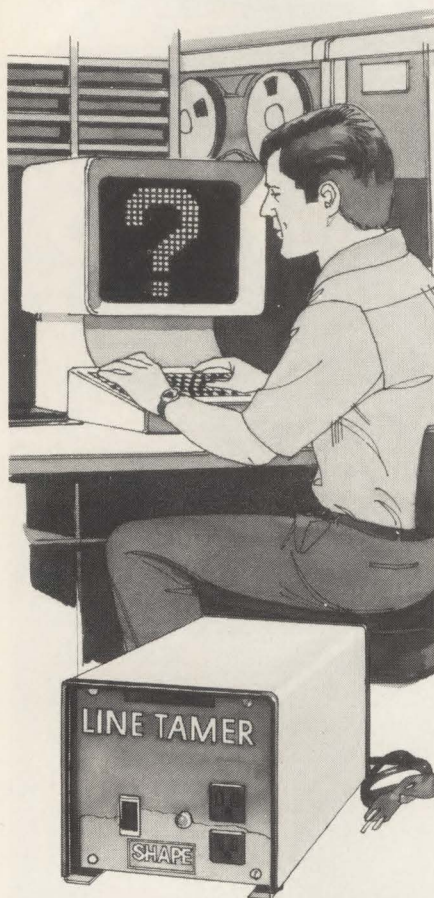


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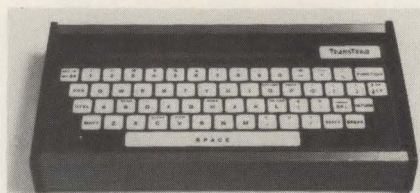
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CIRCLE NO. 152 ON INQUIRY CARD

Peripherals



upper- and lower-case ASCII set in a 5×7 dot-matrix font with an underscore cursor. Character size is 0.172×0.083 in. Memory stores 24 lines of displayed data that can be viewed locally under operator control. Three switch-selectable operating modes provide TTY compatibility, a block send mode or multidropped/polling operating with as many as 32 units. Options include expanded data memory of as much as 12K bytes, a 40-column printer and battery-powered operation. Computerwise, Inc., 4006 E. 137th Terrace, Grandview, Mo. 64030.

Circle No 323

Message system features word processing

This message-preparation system combines the vendor's Tele-Type-reader display terminal and Type-reader OCR to read, edit and format typewritten correspondence for electronic message transmission. The system supports two ports for on-line connection to multiport communications systems, message switching computers and modems



or operates with a paper-tape punch for off-line preparation of Telex and TWX messages. Word-processing features include insert/delete, automatic word wrap and reformatting. Messages originating from the scanner or the keyboard can be edited on-screen at the work station before sending or can be scanned, displayed and transmitted automatically. The work station can also receive text from its ports for editing and retransmission. Two models are available. TTR-2 which reads and processes messages prepared in Courier 10, Courier 12, Prestige Elite, Prestige Pica, Letter Gothic, Pica or Elite type styles is priced at \$18,995. Hendrix, 670 N. Commercial St., Manchester, N.H. 03101.

Circle No 324

Buffered terminal has eight function keys

The Viewpoint/60 buffered terminal includes a movable keyboard and tilt mechanism. It features eight discrete programmed function keys; fine-line business graphics; visual highlighting; editing; and local, conversational, page, message and forms operating modes. Price is approximately \$800. Applied Digital Data Systems, Hauppauge, N.Y.

Circle No 325

IBM 3104 terminal aimed at insurance

The model 3104 display terminal for insurance, manufacturing and transportation applications features a 12-in. screen that displays as many as 1920 characters in 80 columns \times 24 rows. Model B1, which has a 75-key data-entry keyboard, including 10 program function keys, sells for \$2190. Model B2, which has an 87-key typewriter keyboard with 24 program function keys, sells for \$2250. International Business Machines Corp., 900 King St., Port Chester, N.Y. 10573.

Circle No 326

New WORD SCRIBE™ Printers from Anadex: Lasting Impressions.



Letter Quality and Finished Correspondence. High Speed Drafts. EDP Reports. Charts and Graphs. Now you can have them all in one very impressive package: Word/Scribe.

Our versatile new multi-mode printer, the Word/Scribe Model WP-6000, uses our new 18-wire print head and some exceptional engineering to produce crisp characters and razor-sharp graphics. Quality-built to meet your most exacting printing needs.

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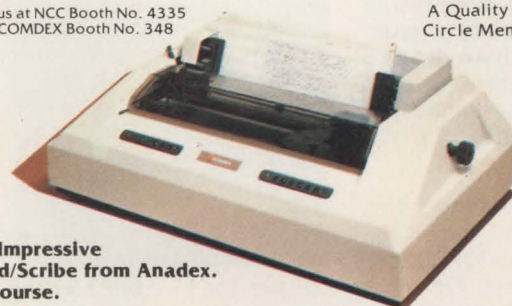
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CIRCLE NO. 155 ON INQUIRY CARD

Peripherals

Terminal system features UNIX-like operating system

The CDX-268 intelligent terminal system offers a UNIX-type operating system called OS-9 that allows users to perform data entry, on-line inquiry, time sharing and data and word processing concurrently. The system, available in single- or multi-user configurations, has disk and diskette storage systems and various printers. It also offers 3270,



2780/3780 and TTY communications protocols and industry-standard COBOL and BASIC. Other features include diagnostic control, remote monitoring and debugging, a forms-design facility for defining screen formats and ASK record management, which enables users to create, access and update office databases. Prices range from \$10,900 to \$20,000. **Codex, a subsidiary of Motorola Inc.,** 20 Cabot Blvd., Mansfield, Mass. 02048.

Circle No 327

Terminal includes auto-dial modem

The ZT-1 personal information terminal includes an auto-dial modem that can be used as an automatic dialer for voice calls. The system displays a series of menus for use with on-line information services and funds-transfer networks. Telephone numbers, computer account numbers and passwords must be entered only once, and can be used by selecting a letter from the menu that matches the phone number. Electronics are

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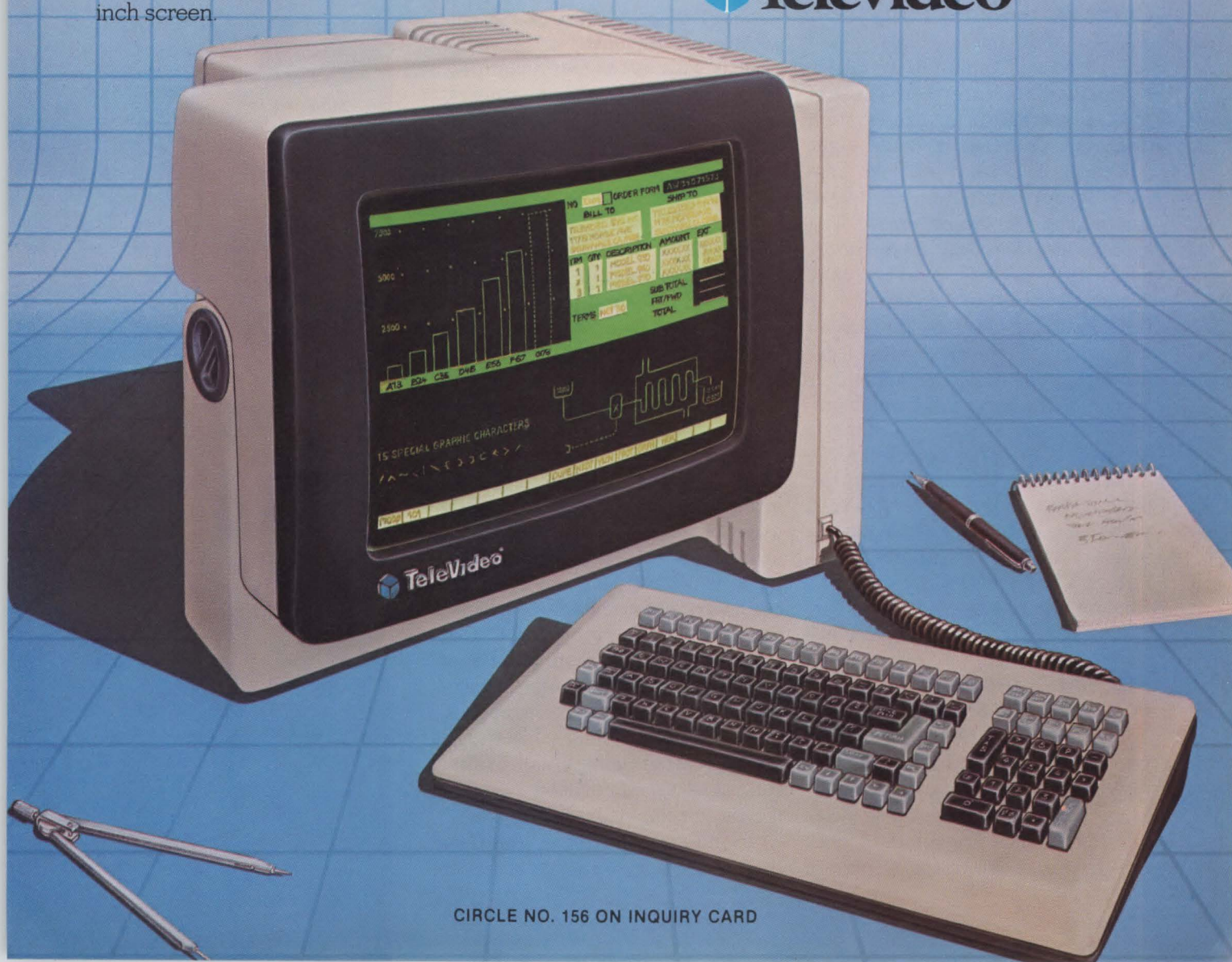
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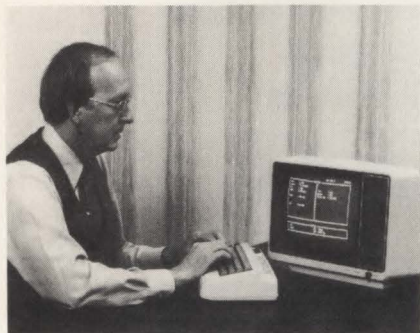
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CIRCLE NO. 156 ON INQUIRY CARD



contained in a 63-key data-entry keyboard that includes a modem circuit. Price is \$695. **Zenith Data Systems, a subsidiary of Zenith Radio Corp.**, 1000 Milwaukee Ave., Glenview, Ill. 60025.

Circle No 328

Color work station has 1024 x 768 resolution

The 60-Hz non-interlace color work station features a 19-in. 1024 x 768 raster CRT. The system displays eight colors, and eight additional colors are optional. Display features include hardware cursor and hardware erase. The system also features an operator-controlled graphic overlay that displays a symbolic menu grid over the lower one-third of the screen and an alphanumeric overlay that displays a menu in the upper left corner of the screen. The alphanumeric keyboard includes a numeric keypad and 27 programmable function keys. Voice input and the ability to recognize a 100-word vocabulary or phrases as long as 1.2 sec. are optional. **Graphics Technology Corp.**, 1777 Conestoga St., Boulder, Colo. 80301.

Circle No 329

Flat-panel display 0.26-in.-high characters

The Argus 3101-08-256N flat-panel alphanumeric DC plasma display module features 0.26-in.-high characters. The module incorporates Schmitt trigger data-input circuitry that allows the display to



operate in rugged, high-EMI environments. Data are displayed in a 5 x 7 dot matrix with a selectable cursor/underbar. The device displays as many as eight lines of 32 characters each. Data input is TTL level, six-bit parallel ASCII, at rates as high as 120 KHz. Optional character sets include English ASCII-7, general European, German, Scandinavian and Spanish ECMA fonts. Price is \$686 in 100-unit quantities.

Industrial Electronic Engineers, Inc., Industrial Products Division, 7740 Lemona Ave., Van Nuys, Calif. 91405.

Circle No 330

Interactive terminal is UNIX compatible

The 4424 general-purpose interactive terminal is compatible with UNIX and other ASCII-oriented systems. The terminal is based on the ANSI 3.64 standard and supports various host-software programs. It includes 16 user-/host-definable soft keys, enabling text editing, program commands and frequently used character sequences to be executed with one keystroke. Options, which can be down-loaded by the host or entered locally, include a terminal configuration menu that can be viewed at any time without interfering with the screen's status and keyboard-selectable transmission rate, cursor blink, tab settings, soft-key programming and printer control. Character attributes can be activated using dedicated keys with LED indicators. Other features include a 96-character ASCII set, 32



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- ☐ 2. **Physical Data Protection:** Are recovery and restart capabilities provided? Can you roll the data base back to a previous state?
- ☐ 3. **Data Security:** Does it provide separate "read" and "write" access controls? Down to the item level? Is data encryption provided?
- ☐ 4. **Data Independence:** Can the data base structure be modified without changing previous programs?
- ☐ 5. **Performance:** Can you tune performance by controlling physical storage? Can you eliminate data redundancy? Are variable length records and data compression provided? Are response times acceptable for large data bases?
- ☐ 6. **Multi-User:** Does it support concurrent multi-user access with passive and active locking at the record level?
- ☐ 7. **Ease of Use:** Can many-to-many and recursive relationships be directly defined? Can programs be written in any major programming language? Are instructions short and simple? Is quality documentation available?
- ☐ 8. **Query Report System:** Can ad hoc queries be easily made with non-procedural, English-like statements? Are sophisticated reports available from pre-defined queries? Are nested queries supported?
- ☐ 9. **Portability:** Does the DBMS run under CP/M™, MP/M, CP/M-86, MP/M-86, PC DOS™, UNIX™? On Z80™, 8086, 8088, 68000, and PDP-11™? Does it run with COBOL, Pascal, FORTRAN, PL-1, BASIC and C?
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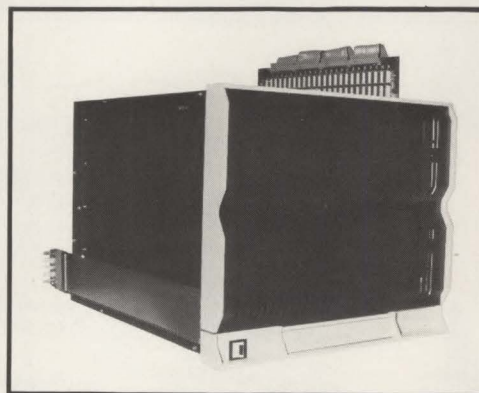
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Peripherals

line-drawing and special-symbol graphics, a split-screen capability with as many as two static regions and one scrolling region, an auxiliary page to hold data off-screen for viewing in the scrolling region and a buffered printer port that allows the screen contents to be dumped without delaying the host system. Price is \$4207. **Teletype Corp.**, 555 Touhy Ave., Skokie, Ill. 60077. **Circle No 331**

CMOS RAM retains data for 8 yrs.

The PSM 6463/100 memory board offers a 64K \times 8 CMOS Multibus RAM with a typical data-retention period of 8 yrs. The device uses standby current 16K CMOS RAM chips and Lithium battery cells with 15-yr. useful lives. Data are retained if the board is unplugged from the system. Depopulated 48K, 32K and 16K versions are available. Applications include replacement of core, EEPROMs, PROM, ROM disk and tape in systems that require firmware updates in the field. The PSM 6463/100 is priced at \$2350 in single-unit quantities, with OEM quantity discounts available. **Plessey Microsystems**, 451 Hungerford Dr., Rockville, Md. 20850. **Circle No 332**

Static RAM has 120-nsec. access time

The TMS4016NL, an upgraded version of the TMS4016 16K static RAM, offers a maximum power dissipation of 385 mW. Organized as 2K \times 8, the TMS4016NL features fully static operation and EPROM/ROM compatibility. Other features include common I/O capability, three-state outputs for OR-tie capability and a chip-select control that eliminates the need for external bus buffers. All inputs and outputs are TTL compatible, and guaranteed noise immunity is 400 mV with standard TTL loads. The TMS4016NL

is available in 120-, 150-, 200- and 250-nsec. maximum access times and minimum read/write cycle times. Fabricated using scaled MOS n-channel technology, the TMS-4016NL requires a +5V power supply and is packaged in a 24-pin

plastic package. Prices for 120-, 150-, 200- and 250-nsec. versions are \$15.90, \$13.85, \$10.75 and \$9.25 each, respectively. **Texas Instruments Inc.**, P.O. Box 202129, Dallas, Texas 75220.

Circle No 333

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Local network meets industrial requirements

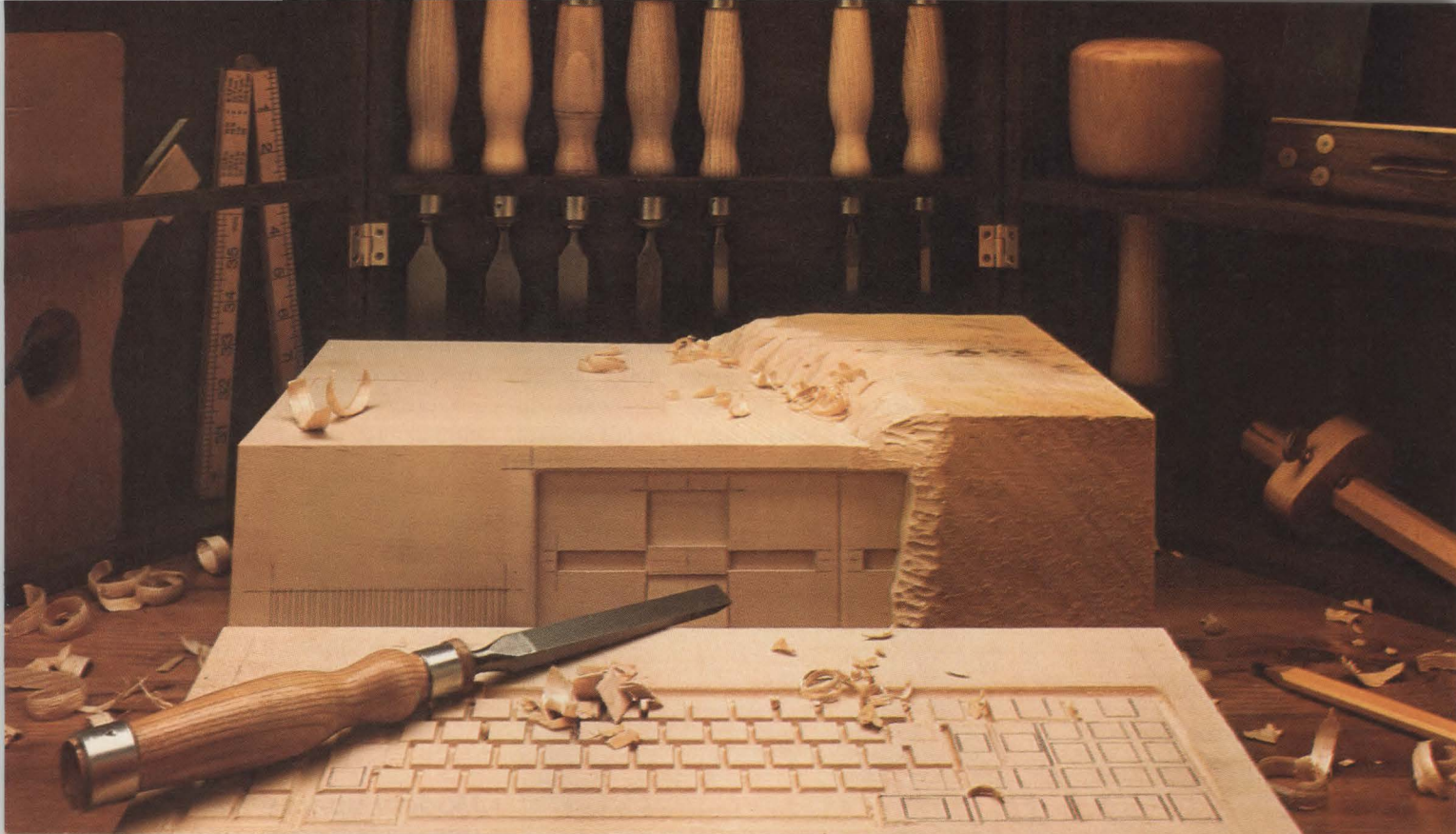
Not satisfied with the electrical characteristics of Xerox Corp.'s Ethernet local-area network, Cromemco, Inc., has designed its own LAN, which features a physical link rugged enough to operate reliably in factories as well as in offices. Called C-NET, the Mountain View, Calif., firm's product operates over twin-axial cable at speeds as high as 880K bits per sec. and, like Ethernet, uses a carrier sense multiple access with collision detection (CSMA/CD) technique.

ISO-ANSI reference model	C-NET standard
Application layer	Host computer software
Presentation layer	
Session layer	
Transport layer	Software service for C-NET interface
Network layer	Input-output processor Z80
Data-link layer	Serial input-output controller Z80S10
Physical layer	Differential transceiver and twin-ax cable

Cromemco's C-NET communications controller and associated software address the first four layers of ISO's/ANSI's model for open-system interconnection.

Using a bus-type topology, C-NET can link all of Cromemco's μ c products, including its 8-bit systems, its new 68000/Z80A dual-processor unit and its as-yet-unannounced personal computer. By using shielded twisted-pair cable with differential drivers, C-NET provides isolation between the cable and the interface hardware, which prevents a node failure from affecting the entire network and also isolates node electronics from electrical faults in the network cable. Cromemco claims that Ethernet's unbalanced coaxial cable scheme is more susceptible to external interference than is C-NET's design.

A C-NET interface controller sells for approximately \$1000, but by



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CIRCLE NO. 161 ON INQUIRY CARD

hooking multiple stations through a single node, the cost-per-station connection is in the \$500 range, says David Mandelkern, director of strategic planning at Cromemco. He says the interface design requires no overhead from the attached

processors. Cromemco will publish C-NET's specifications for use by interested parties.

A C-NET cable span as long as 2000m. supports as many as 255 stations. Interface hardware includes a Z80A μ p for system control,

a Z80 serial I/O chip for SDLC bit protocol selection and data transfer and 16K bytes of RAM and 32K bytes of ROM for networking software and message buffering.

C-NET's packet header protocol is similar to Ethernet's, so higher level software for one network can be adapted for use on the other, Cromemco says. The company plans to develop gateways to link C-NET with other LANs and with various long-haul networks. C-NET availability is scheduled for this summer. **Cromemco Inc.**, 280 Bernardo Ave., Mountain View, Calif. 94043.

Circle No 349



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CIRCLE NO. 162 ON INQUIRY CARD

Modem boards use STD-bus

The SB8601 and SB8602 coaxial-cable-driven modem boards, for multiple-node data-acquisition networks in factory-automation, automatic-test and process-monitoring applications, use the STD-bus. The SB8601 contains an asynchronous/synchronous serial interface port to drive its on-board modem and operates at rates as high as 19.2K bps. The SB8602 contains only the modem board and coaxial-cable interface. When driven by the vendor's synchronous data-link controller, the SB8602 operates at 1M bps and transfers a 2K-byte data block in 17 msec. Both boards use FSK modulation and provide typical error rates of less than 10^{-12} for installations with a 20-dB signal-to-noise ratio. Standard RG-59 coaxial cable can be used for links of nearly 1 mi., and other cable types can extend the range to 5 mi. A 30-dB dynamic range allows modems to be attached to the cable at any point without gain adjustment or adjacent modem overload. In quantities of 25, the SB8601 is priced at \$470, and the SB8602 is priced at \$440. **Micro/sys**, 1367 Foothill Blvd., La Canada, Calif. 91011.

Circle No 350

SIEMENS

The disks are flexible, our standards are not. Inflexible Standard No. 1...Design Excellence

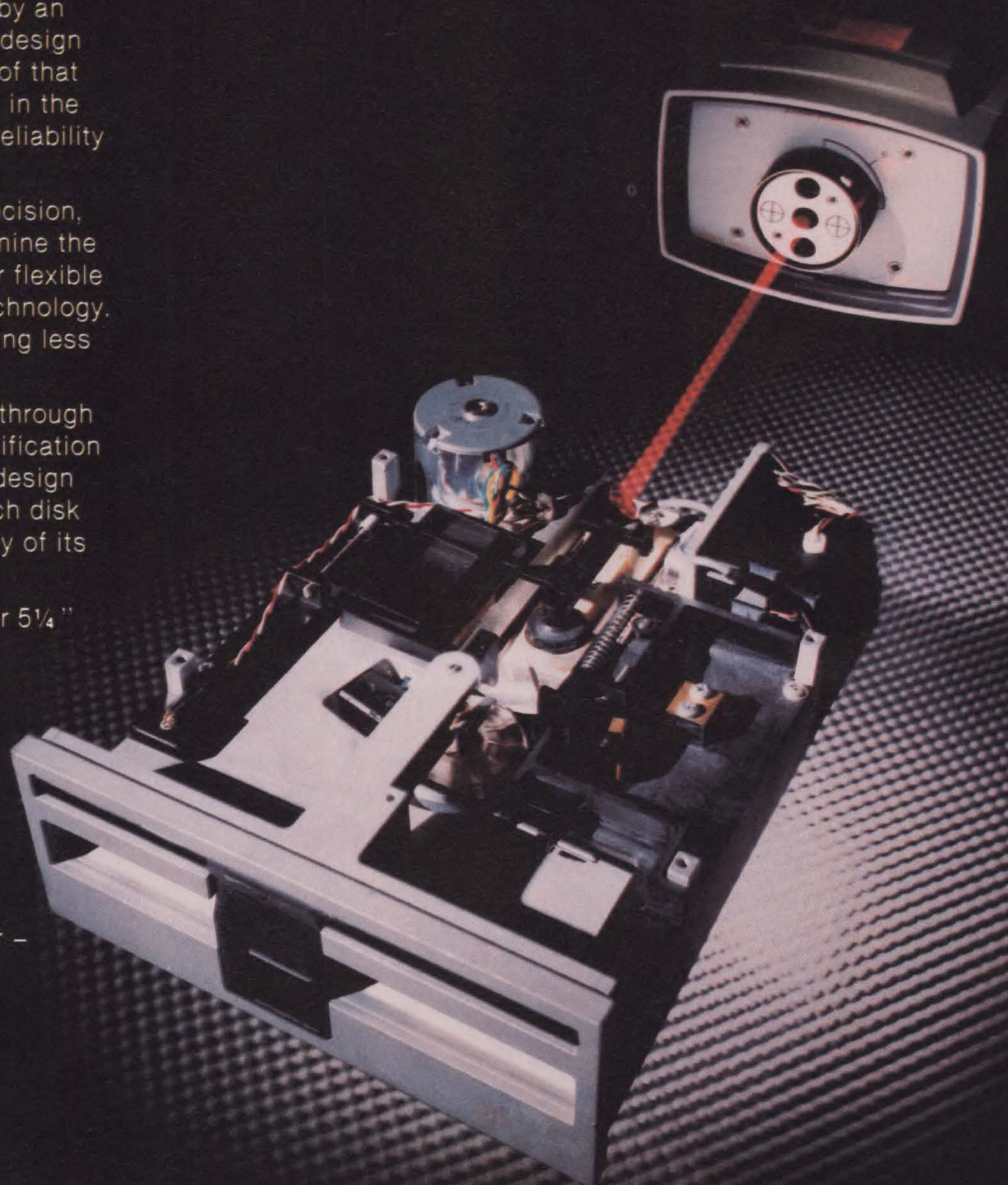
At Siemens, we're driven by an inflexible commitment to design excellence. The intensity of that commitment is evidenced in the proven performance and reliability of our disk drives.

With uncompromising precision, Siemens engineers determine the positional accuracy of our flexible disk drives using laser technology. Design excellence. Anything less would not be Siemens.

From design conception, through product certification, qualification and implementation, our design standards ensure that each disk drive we produce is worthy of its Siemens nameplate.

Further information on our 5¼" or 8" Flexible Disk Drives is available from Siemens Corporation, OEM Data Products Division, 240 E. Palais Road, Anaheim, CA 92805 (714) 991-9700 Telex 685695

Or contact our Distributor - Diplomat Electronics, 490 S. Riverview Drive, Totowa, NJ 07512 (201) 785-1830



Siemens... Engineering Reliable Drives

CIRCLE NO. 163 ON INQUIRY CARD

CC-8000-003 510 944

Software

Operating system manages task scheduling

MTOS-68K, a real-time, ROM-able, multitasking, multiprocessor operating system coded in assembly language, manages task coordination, memory pools, I/O, priority scheduling, interrupt processing and multiple processors. One copy of the system can run on 16 processors sharing a memory. All processors are equivalent; there are no masters or slaves. Application software can be written in Assembly or in a higher level language, such as Pascal or C. A one-time source code license fee is \$9500. **Industrial Programming Inc.**, 100 Jericho Quadrangle, Jericho, N.Y. 11753.

Circle No 334

DBMS runs on DG computers

The DNA database-management

system has automatic database restoration to protect against unintentional "wipeout." DNA runs on Data General micro-Nova, Nova and Eclipse computers under the AOS, AOS/VS, DOS, RDOS and MP/OS operating systems. File definitions are stored in the database, providing a data dictionary. Data retrieval uses random or sequential keys and supports multiple logical files with relational fields. **Exact Systems and Programming Corp.**, P.O. Box 115, Thornwood, N.Y. 10594.

Circle No 335

Productivity aid runs on IBM System/34

Toolkit/34, running on IBM Corp. System/34 minicomputers, is intended to speed information retrieval and to simplify testing and debugging during application-program development. Functions

include resizing user files or libraries, copying file segments, displaying files on a work station or a printer, displaying and modifying contents of the local data area and switch settings, modifying a saved job during testing and debugging, changing the session library and displaying file catalogs at a work station. Price is \$400. **Real World Software**, 10636 Main St., Bellevue, Wash. 98004. Circle No 336

FORTRAN package runs on DEC computers

MPMath, for Digital Equipment Corp. PDP-11 and LSI-11 computers running the RT-11, RSX-11M, TSX-Plus or STAR-eleven operating systems, is a library of FORTRAN-callable, reentrant macro subroutines to manipulate 16-, 32- and 48-bit fixed-point numbers. Subrou-

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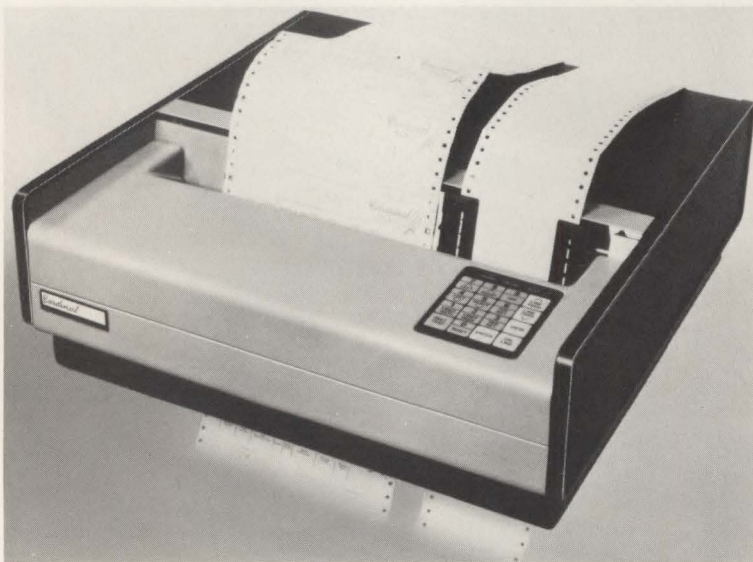
The Compiler Company

HEADQUARTERS: RYAN-MCFARLAND CORPORATION, 609 DEEP VALLEY DRIVE, ROLLING HILLS ESTATES, CA 90274, (213) 541-4828

tines, which handle mixed-mode (combinations of single-, double- or triple-precision numbers) arguments, can be included in a shared resident library. MPMath functions include multiple-precision compare, addition, subtraction, multiplication and division operations, as well as binary to/from ASCII conversions. Price is \$250, including media and documentation. **ConTel Information Systems**, 4330 East-West Highway, Bethesda, Md. 20814. **Circle No 337**

Cardinal® 2170

High Speed Dot Matrix Data Printer



○ Five paper drive combinations including top or bottom tractor drive and individual forms handler.
○ 200 cps.

○ 9-pin ballistic print head, 650 million character life.

○ Near letter-quality print at 100 cps.
○ Heavy-duty industrial design.
○ Five-input interfaces available.

Cardinal's new 2170 is a rugged performer, tough enough to take anything a factory environment can dish out... yet sophisticated to the point of engineering genius.

Unlike many of today's data printers, the 2170 is available with bottom tractor

feed. This enables an operator to remove a form immediately after the last line is printed.

Self diagnostic and signature analysis are built right into the 2170 too. This makes troubleshooting as simple as flipping a switch.

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Phone: (417) 673-4631

File librarian provides two security levels

The MicroLIB CP/M and MP/M disk-file librarian enables users to store many disk files in one larger file, or library, where data are managed, updated and retrieved. Two levels of security are provided: password protection and password plus data encryption. A 50-character description, kept with each file, is displayed by library directory commands and printed on reports. Users can establish relationships between groups of files and then process an entire group with one command. Entries can be date-stamped when they are added to a library and each time they are processed. Single-copy price is \$295. **Advanced Micro Techniques**, 1291 E. Hillsdale Blvd., Foster City, Calif. 94404. **Circle No 338**

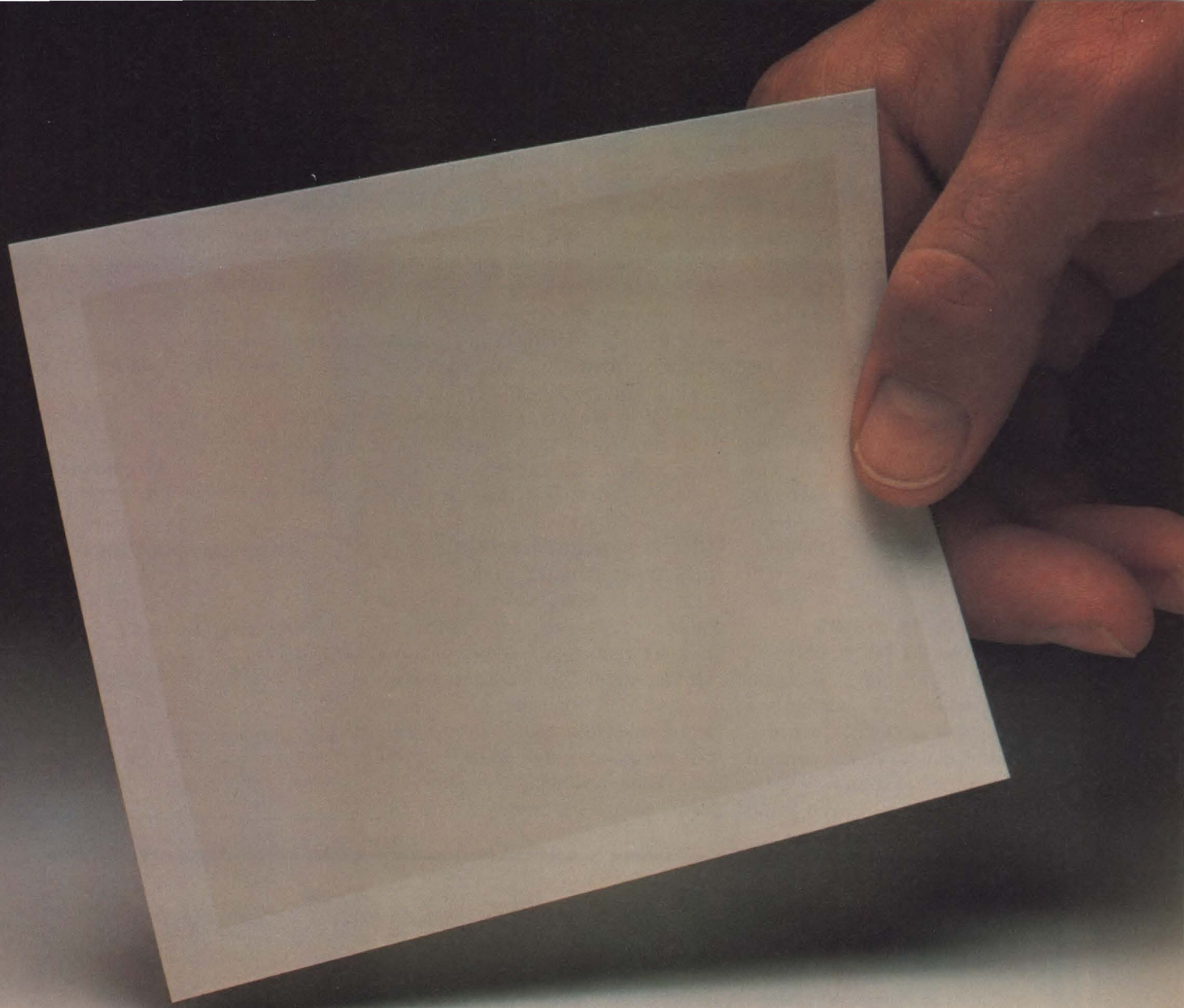
Development package runs on 70-Series μ ps

System-70, a cross assembler for National Semiconductor 70-Series μ ps, runs on CP/M-based μ cs. The package features a macro assembler, an interactive editor/assembler, a text editor and off-loading facilities. The macro assembler includes macro and conditional assembly functions and the ability to chain source files during a single assembly. Programs developed under this system must be off-loaded to the target processor for test. The off-loading mechanism is a direct transfer from memory, via a byte stream over a CPU port, or via .COM or .HEX disk files. Price is \$150. **Allen Ashley**, 395 Sierra Madre Villa, Pasadena, Calif. 91107.

Circle No 339

Utility defines function keys on TRS-80

Available on disk for the TRS-80 model III, the Superkeys utility allows single-key entry of BASIC

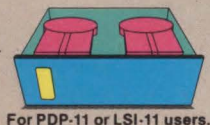


Here is a picture of a WINCTM08 controller as seen from your DEC computer.

Our WINC08 controller is completely software transparent to DEC's RL02, so your PDP-11 or LSI-11 computer won't even see it!

And while this Q-Bus[®]/UNIBUS[®] compatible controller will be totally invisible to your computer, the advantages of using it will be *immediately visible* to you.

For instance, when teamed with our dual 8-inch Winchester disk drives, WINC08 offers up to 41.6 megabytes of storage capacity in a DEC "look-alike" enclosure just 5¼ inches high. The result? With WINC08, you get



For PDP-11 or LSI-11 users.



For LSI-11 users.

four times the storage capacity of DEC's RL02 in one-eighth the space!

For LSI-11 users who want the flexibility of an 8-inch Winchester combined with an 8-inch dual-headed floppy disk, there's the WINC08/F controller. It provides emulation of both the RL02 and RX02 in a single 5¼-inch high enclosure!

Both the WINC08 and WINC08/F controllers offer the highest throughput available. Maximum data reliability. Unique on-board self-test capability. And the best price-to-performance ratio in the industry!

Now you can add storage capacity and increase the efficiency of your DEC system in the bargain. And we'll deliver your choice of a dual

Winchester, or Winchester/floppy combination in just thirty days. Either way, you'll see a big difference, even if your computer doesn't see a thing!

To order—or for additional information—call or write us today. Advanced Electronics Design, Inc., 440 Potrero Avenue, Sunnyvale, CA 94086. Phone 408-733-3555 TELEX 357-498.

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DESIGN, INC.**

keywords. The program includes a keyboard definition set, or a user can create his own. As many as 255 characters can be assigned to each key. Functions such as RUN, LIST and EDIT can be assigned to one key. Graphic strings can also be recalled and saved with one key. On-screen single-line editing and renumbering are done with the line-renumber/screen-editor features. Superkeys is priced at \$49.95. **Advanced Operating Systems**, 450 St. John Rd., Michigan City, Ind. 46360. **Circle No 340**

C function calls create indexed files of records

C-ISAM, a library of C function calls to create and manipulate indexed files of records, provides record-level concurrency control automatically or manually at a programmer's option. There is no

limit to the number of indexes that can be built for a file. Each index can have as many as eight parts, each with a unique data type. Duplicate values can be allowed for each index on an individual basis. C-ISAM is priced at \$900 on 16-bit μ cs, slightly higher on larger machines. **Relational Database Systems, Inc.**, 1208 Apollo Way, Sunnyvale, Calif. 94086.

Circle No 341

DIBOL system transfers files over phone lines

ITU-11 is a utility designed to transfer disk files over telephone lines between two DIBOL programs running under the CTS-300, CTS-500 or VAX/VMS operating systems. Retransmission occurs automatically if errors are detected in received data. The block being transferred is displayed to the user. A log file

records the transfer progress. The user can abort the transfer at any time without destroying previously transferred files. ITU-11 can use directory listing files to transfer multiple files without user intervention. Transfer speed is 5 to 7 sec. per block at 1200 bps. Price is \$1000. **Compu-Share, Inc.**, 3824 50th, Lubbock, Texas 79413.

Circle No 342

NEXT MONTH IN MMS

- A look at turnkey graphic systems.
- A tutorial on graphic-input peripherals.
- A survey of color hardcopy devices for graphics.
- An explanation of building-block graphics.

The Matchmakers

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6400 bpi
start-stop
cartridge



Whatever micro you have, there's a good chance we have a controller that matches your system with a high performance cartridge tape drive, IBM compatible 9-track, LSI-11 streamer or disk drive.

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9-track



We've designed interfaces to link these drives with a number of micro capabilities, including S-100, SS-50, TRS-80, Z-80, Multibus and RS232C.

Whether you need backup, archival or working storage, talk to us. For more information on Alloy magnetic media



8000 bpi
streaming
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capabilities, contact Marketing Department, Alloy Engineering Co., Inc., 12 Mercer Rd., Natick, MA 01760. (617) 655-3900. TWX: 710-346-0394.

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Facing today's 5¼ inch Winchester alternatives can be a distressing experience. At ATASI we have been listening to the needs of the OEM user and we have responded.

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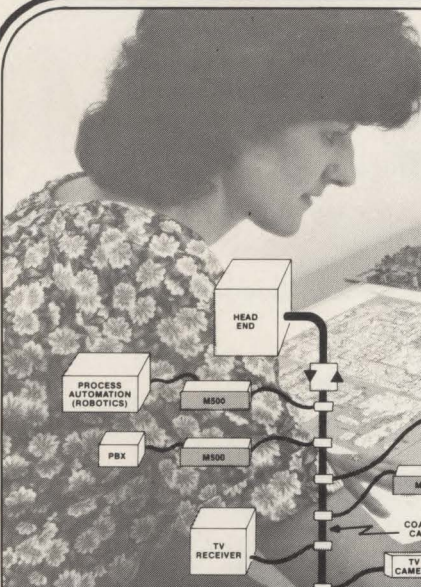
CIRCLE NO. 169 ON INQUIRY CARD

Stepping-motor controller is STD-bus compatible

The model STD-2680 intelligent stepping-motor control card provides an interface between a stepping-motor translator and an STD-bus μ c. The device uses a Z80

μ p to control start-stop rate, ramping, slew rate and position of a stepping motor. The start-stop rate and slew rate are programmable from $\frac{1}{2}$ to 32,768 steps per sec. in $\frac{1}{2}$ -step-per-sec. increments, and position is programmable from

-16,777,215 to +16,777,215 steps. A position accumulator available to the host CPU keeps track of the accumulated motor position from -2,147,483,648 to +2,147,483,647 steps. Any parameter which does not change must be defined only once. The stepping-motor translator outputs are optically isolated and can be configured for step CW and step CCW pulse trains or a pulse train and direction level. Other outputs include a status flag that



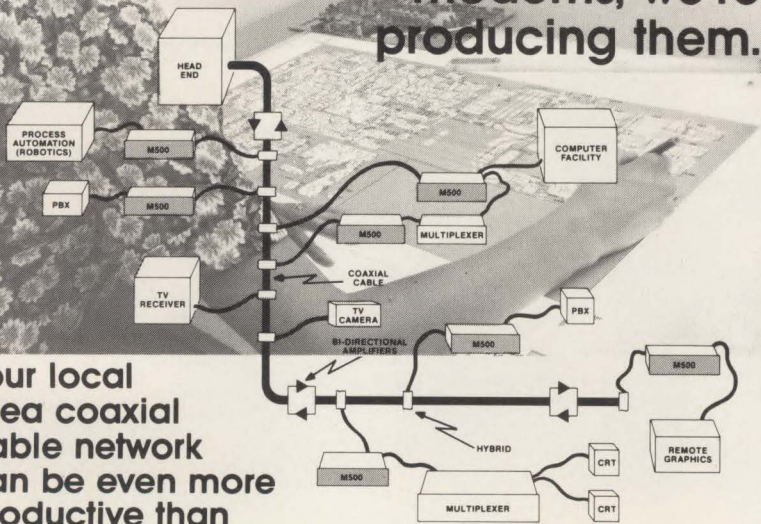
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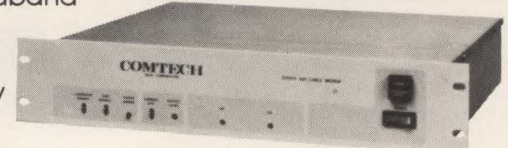


COMTECH Data Corporation

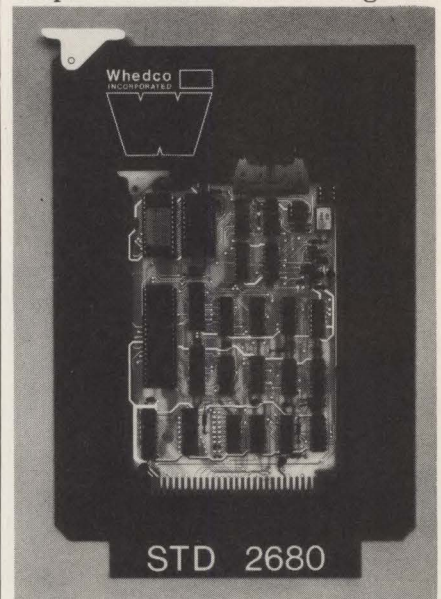
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CIRCLE NO. 170 ON INQUIRY CARD



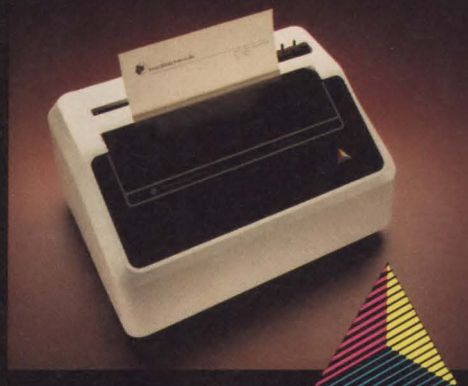
can be used to interrupt the host CPU once a positioning task is completed. Price is \$250 each in 100-unit quantities. **Whedco, Inc.**, 6107 Jackson Rd., Ann Arbor, Mich.

Circle No 343

Push-button switches provide mounting

The 583 and 587 series momentary, push-button switches have terminations for right-angle mounting and support brackets, respectively. The 583 series, for mounting on a PC board that is perpendicular to a front panel, has two epoxy-sealed PC-terminal types: vertical mount bent at 90 degrees and horizontal mount bent at 90 degrees. The 587 series permits mounting when PC board and front

ALL MATTER IS MODULAR. YOUR PRINTER SHOULD BE, TOO.



Introducing the Prism Printer™ from Integral Data Systems, the first truly modular, field-upgradeable dot matrix printer for the OEM. The Prism Printer is the OEM's key to solutions for their system because no other printer offers you as much (or as little) as you need.

Start with the basic printer which features text-quality printing; then add the performance modules you need — when you need them. Add the semi-automatic single sheet feeder for word processing. Install the Sprint Mode™ for high-speed data output. Add the Dot Plot™ option for graphics. And nothing is better for communicating effectively than the Prism Color™ option for high-quality, multi-color output (and at less than one-third the cost of any other color output device in this performance range!) Additional Prism option modules will be available soon. Special OEM configurations are also available. OEM products are backed by nationwide service, as well as training and parts support for in-house service.

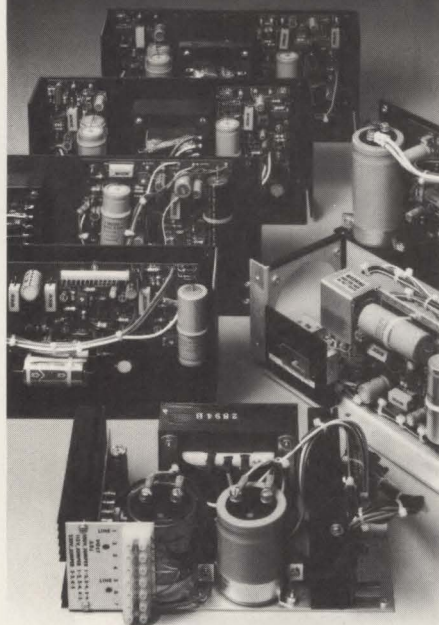
Modular flexibility means you'll never pay too much or get too little again. At last, the chemistry is right between you and your printer.

For the name of the distributor nearest you call toll free (800) 258-1386. In New Hampshire, Alaska and Hawaii, call (603) 673-9100. For more information, call (603) 673-9100.



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DISK DRIVE POWER BY XENTEK



Here are some of Xentek's 43 varieties of Disk Drive Power Supplies

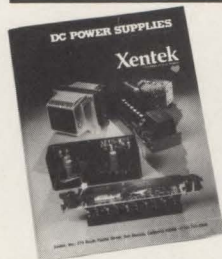
Whether you use floppy or hard disks, or a combination—or disks with tape drive backup—chances are we've already designed and built the supply that matches your requirements. There are off-the-shelf models for many popular single and multiple 5¼" and 8" floppies, and OEM supplies for 5¼", 8" and 14" Winchester.

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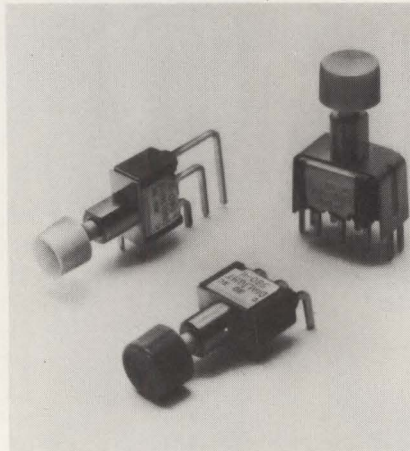
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CIRCLE NO. 172 ON INQUIRY CARD

Components

panel are parallel. Its terminals are also epoxy-sealed, with a thickness of 0.030 in. All switches are available in SPDT or DPDT. Both switches offer a choice of contact ratings to accommodate high and low current levels. For lower current levels, contacts are gold plated. A second version, combining standard with low-level, has gold-over-silver contacts, the latter

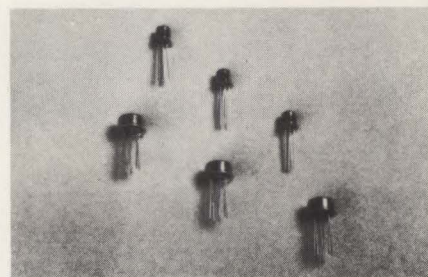


handling higher currents. The 583 series switches are priced at \$1.55 in quantities of 1000, and the 587 series is priced at \$1.49 in quantities of 1000. **Dialight, a North American Philips Co.**, 203 Harrison Place, Brooklyn, N.Y. 11237.

Circle No 344

TI announces six optocouplers

These six optocouplers, for coupling low-output MOS and CMOS ICs to power devices and other systems in motor-speed control, meter and numerical-control-system applications, feature 500-percent typical current-transfer ratio and a 1000 electrical-isolation rating. Three devices are available in JAN, JANTX and JANTXV versions. Each optocoupler consists of a gallium-arsenide-diode infrared source that is optically coupled to a high-gain phototransistor. The models 4N47, 4N48 and 4N49 are packaged in TO-78 metal-can packages and can withstand a collector-base voltage

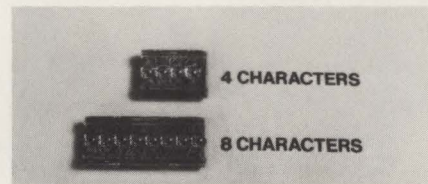


of 45V and a collector-emitter voltage of 40V. Maximum continuous-collector current is 50 mA, and maximum continuous power dissipation at 25°C is 300 mW. The 3N261, 3N262 and 3N263 are provided in TO-72 metal-can packages, allowing the devices to dissipate a maximum of 190 mW continuously. Prices range from \$4.50 to \$10.63 in 100-unit quantities. **Texas Instruments Inc.**, P.O. Box 202129, Dallas, Texas 75220.

Circle No 345

TI announces two LED displays

The four- and eight-character HDSP6504 and HDSP6508 red LED alpha-numeric displays are second-sources to Hewlett-Packard parts. Both have a 16-segment font, allowing them to display the 64-character ASCII set and special characters. Character height is 3.81



mm. Under typical operating conditions, each segment has an average forward current of 0.8 mA. Maximum reverse voltage for each segment at 25°C is 5V, and peak forward current under the same conditions is 200 mA. Average power dissipation per character is 138 mW. In 100-unit quantities, prices for the HDSP6504 and HDSP6508 are \$12.30 and \$23.58, respectively. **Texas Instruments Inc.**, P.O. Box 202129, Dallas, Texas 75220.

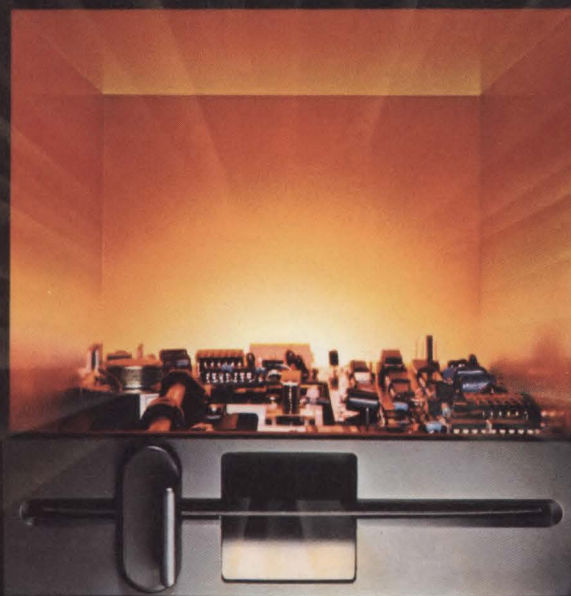
Circle No 346

QUME

QUMETRAK 142

Our new Qumetrak 142 floppy disk drive sets new quality and capacity standards for half height drives. It's not only the first 5¼" half height drive with ½ MB capacity, it's designed to be produced in the large quantities you need. Qumetrak 142 costs less than standard 5¼" drives,

and provides the same high level of reliability that you've come to expect from Qume. For more information about this 48 TPI double-sided, double-density beauty, call your local sales office or distributor, or contact Qume. (408) 942-4000. 2350 Qume Drive, San Jose, California 95131.



We shrank the drive
and the price, but not the
quality or capacity.

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CIRCLE NO. 173 ON INQUIRY CARD

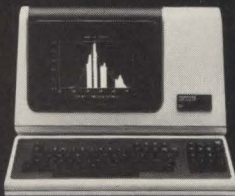
Brochure features optical reader system

The development of forms for optical reader systems is featured in a six-page brochure. The brochure describes how forms should be produced to achieve reading-

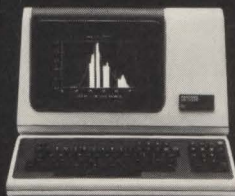
equipment efficiency in documents read per min., minimum rejection rate, eliminated keystrokes and eliminated keying errors. It discusses matching specifications of the reading equipment, carbon paper, ink and mechanical and

printing tolerances and illustrates samples of various form uses, such as charge-card system forms, optically read identification numbers on forms, dual optically read systems (typewritten entries and bar codes on subsequent copies) and multi-use forms with optically read consecutive numbers. **The Standard Register Co.**, P.O. Box 1167, Dayton, Ohio 45401. **Circle No 351**

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VT100 With 640 x 240 Resolution



VT101 With 640 x 480 Resolution



VT131 With 640 x 240 Resolution

Digital Engineering is now offering new GEN.II™ Retro-Graphics terminal enhancements for DEC's™ VT100™, VT101™, VT102™, VT131™, and VT132™.

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OEM catalog details Power PAC products

A line of off-the-shelf power supplies for OEMs is described in a 12-page brochure. The brochure includes general-purpose, single- and multiple-output power supplies; disk drive and μ p supplies; modular supplies for industrial, OEM and system applications; power supplies on plug-in PCs; and custom power supplies for medical-electronic, switching system, broadcast-CRT, computer-peripheral and graphic-editing terminals. The text contains specifications, photos, dimensional drawings, ordering information and terms, including price, delivery and a five-year warranty on all products. **Power PAC Inc.**, P.O. Box 777, 32 Meadow St., South Norwalk, Conn. 06854. **Circle No 352**

Folder details tape drives

The STC 3000 series high-performance magnetic-tape subsystems is featured in a six-page folder. The brochure describes the series' high-density recording, high-speed data transfer, automatic loading, SPAR (subsystem program for analysis and repair) diagnostics, rewind and switching. Technical data on the 3800-III and 3800-IV controllers, and 3430 through 3670 tape drives are included. **Storage Technology Corp.**, 1601 23rd St., Denver, Colo. 80216. **Circle No 353**

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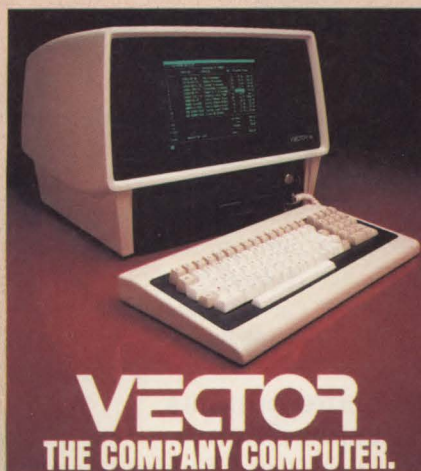
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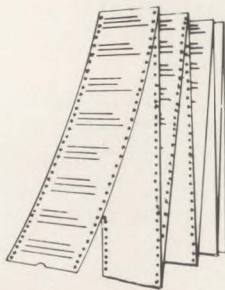
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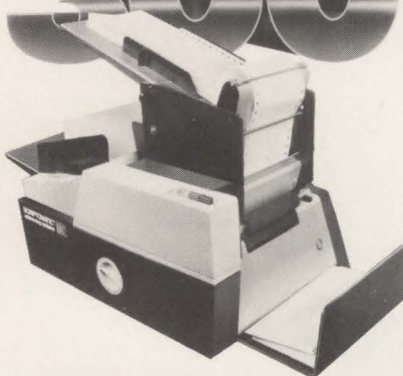
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Literature

Catalog features data- conversion components

A line of monolithic, hybrid and modular data converters are described in a catalog. The publication lists A/D and D/A converters, analog multiplexers, sample-holds, voltage references and precision resistor networks. **Hybrid Systems Corp.**, 22 Linnell Circle, Suburban Industrial Park, Billerica, Mass. 01821.

Circle No 354

Brochure outlines PC capabilities

Design, fabrication and assembly of PC boards and other electronic and electromechanical services for the industrial, military and commercial electronics markets are detailed in an illustrated brochure. The brochure describes the vendor's capabilities in PC-board design, fabrication and assembly; electromechanical assembly and packaging; CAD and computer-aided photo-plotting; and electronic/electro-

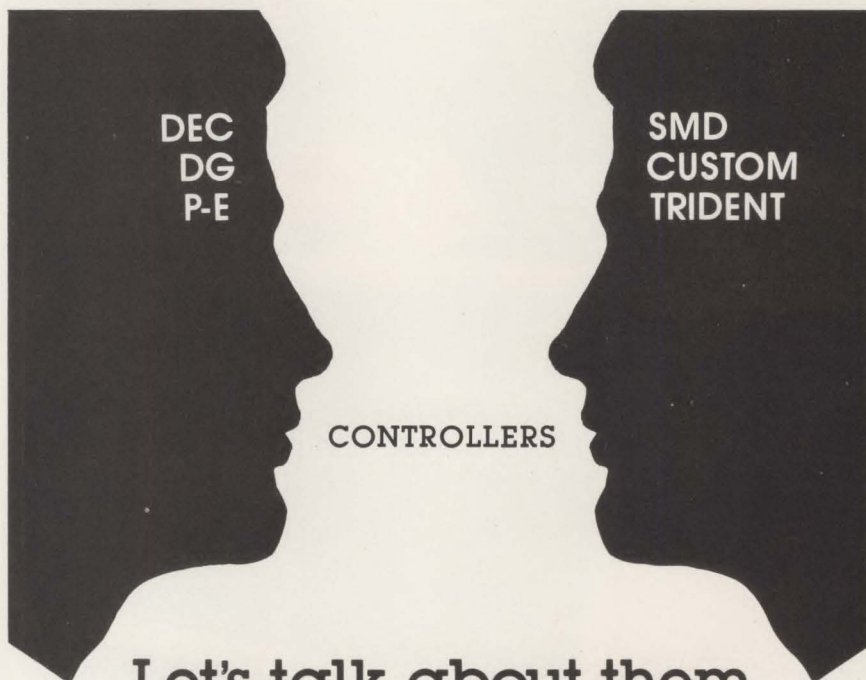
mechanical services. The booklet covers μ p, TTL, CMOS, Schottky, ECL, MECL, analog and RF boards. It also covers design and manufacture of backplanes, flexible circuitry and other interconnection components and systems. **4th Generation Technical Services, Inc.**, 315 Old Rogers Rd., Bristol, Pa. 19007.

Circle No 355

Catalog details TI semiconductor products

Semiconductor products are featured in a 128-page catalog. The catalog provides specifications for the vendor's line of μ cs, memories, logic arrays, voice synthesis, digital logic, linear circuits, telecommunications, optoelectronics, discrete devices and military products. The catalog also includes an appendix on IC part-number coding and package-outline drawings. **Texas Instruments Inc.**, P.O. Box 202129, Dallas, Texas 75220.

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Wet Ink Department: **Spectra Logic Corp.**, Sunnyvale, Calif., has garnered more than \$1 million in contracts from three Perkin-Elmer Corp. OEMs for Spectra 14 controllers. A total of \$2 million in Spectra 10 disk and Spectra 20 disk/tape controllers will be integrated into Data General Corp. minicomputers from DG OEMs LTX Corp., Newton, Mass., and STS Systems Ltd., Quebec....**The U.S. Naval Surface Weapons Center** at Dahlgren, Va., as part of its computer expansion program, has contracted for more than \$1 million in System 20 Local Net broadband networking systems from Sytek, Inc., Sunnyvale....**The Atlanta-based Transit Operations Directorate of Computer Sciences Corp.'s Systems Division** has signed a three-year \$10-million contract with the Niagara Frontier Transportation Authority to supply communications systems for the NFTA 6.4-mi. rail line connecting downtown Buffalo with the State University of New York's South Campus.

Ground-Breakings: **Honeywell Information Systems**, which recently christened its \$9.5-million software center/manufacturing plant in Phoenix, broke ground on a 105,000-sq.-ft. office and laboratory wing addition

to its two-building Solid State Electronics Division in Minneapolis....**Hillsboro, Ore.**, is the site of Irvine, Calif.-based **Wyle Distribution Group's** ninth full-service facility....**The Consulting and Technical Services Division of Contel Information Systems**, Great Neck, N.Y., has opened an office to house West Coast operations in La Canada Flintridge, Calif.

Money Talk: Nashua, N.H.-based **Sanders Associates** has received \$3 million in initial funding from Lockheed California for the engineering development phase of a program to update the OL-82/AYS Airborne acoustic processors used aboard the U.S. Navy's S-3A Viking antisubmarine warfare aircraft....**Harris Corp.**, Melbourne, Fla., received \$3.4 million in initial funding from the Naval Electronic System Command for a military satellite communication project, which will cost \$30 million over the next three years....An undisclosed amount of funding has been given to **M/A-COM DCC**, Germantown, Md., by the International Maritime Satellite Organization, London, to study hardware design and performance specifications for a new generation of shipboard satellite communication terminals.

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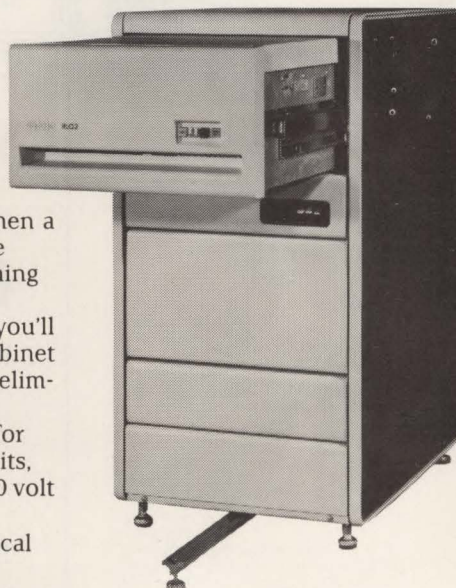
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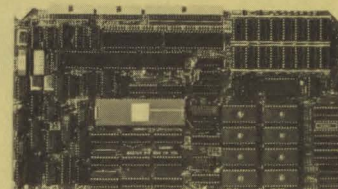
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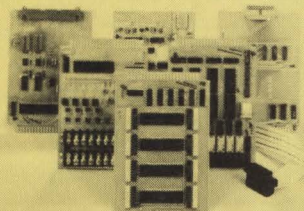
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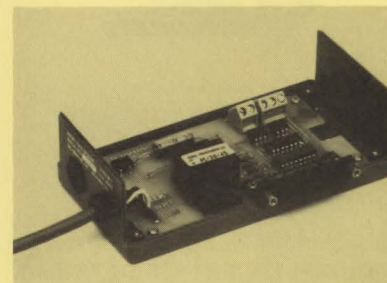
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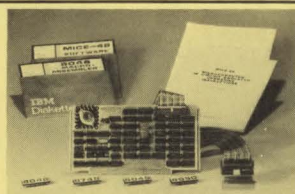
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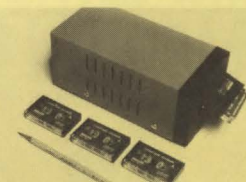
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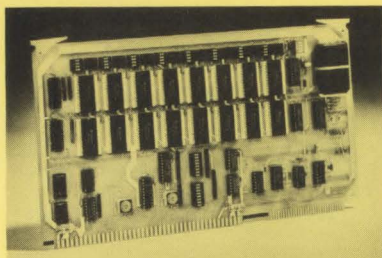
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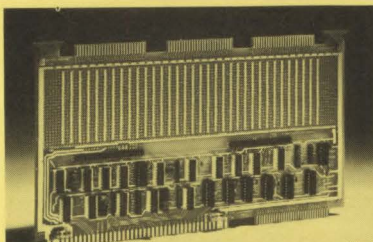
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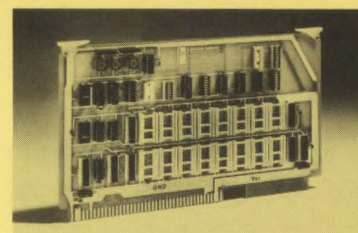
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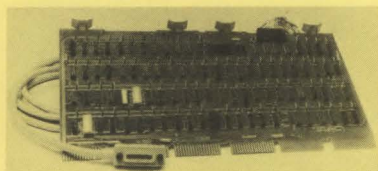
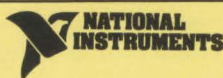
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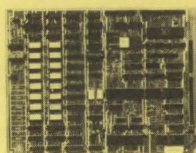
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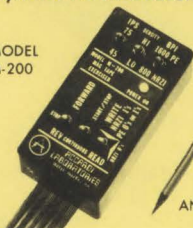
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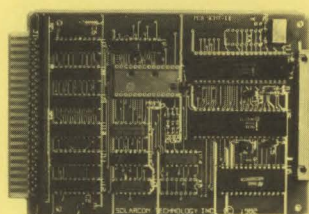
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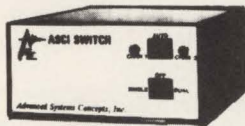
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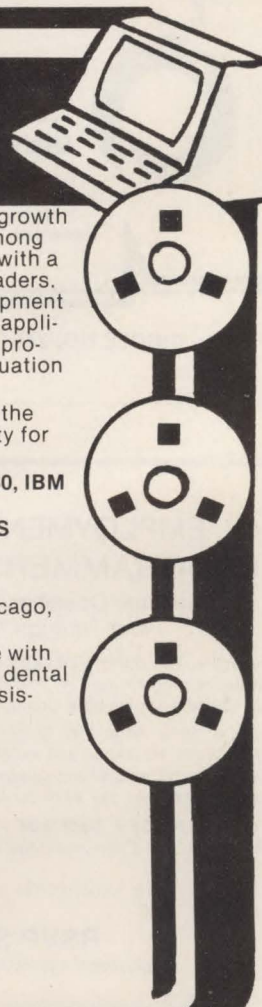
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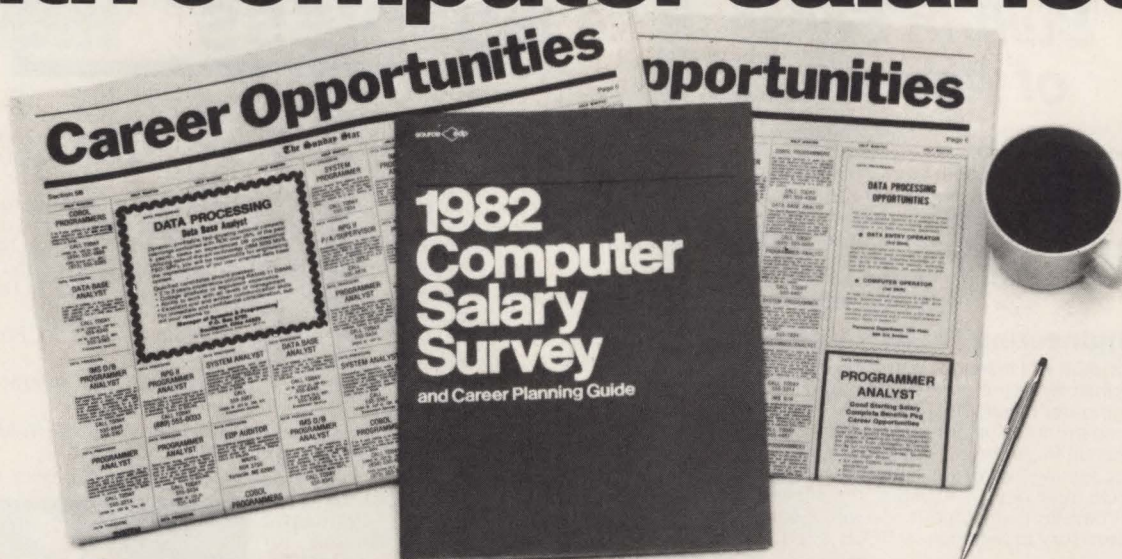
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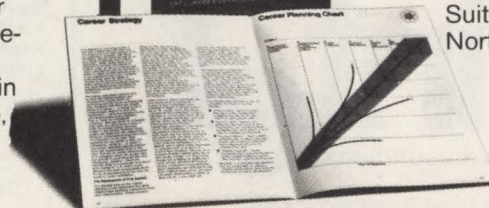
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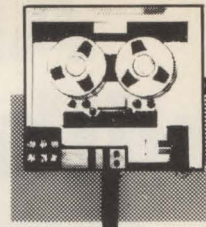
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