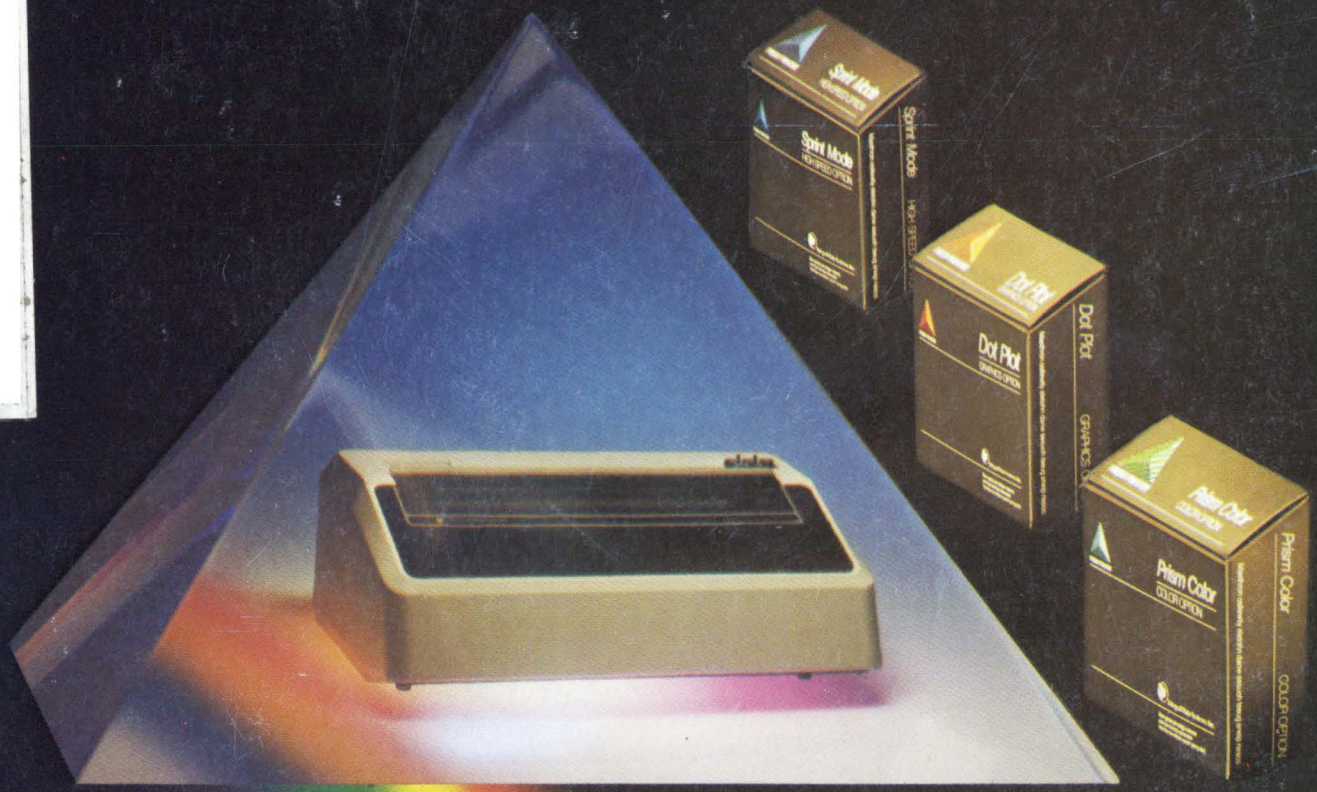
Mini-Micro Systems

A CAHNERS PUBLICATION

JANUARY 1982



The IDS Prism—upgrading by modules

Sixth annual survey on PRINTERS:

- **serial printer profile**
- **line printer roundup**
- **report from Japan**

We'll back up our disks— and anyone else's.

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

All of these products were conceived and designed to meet the need for reliable, low cost backup — for our systems or for any other system.

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Plus backup. Responsive service is a natural part of our offer. It gives you the support of factory-trained representatives in our nationwide service network. They're strategically located near all major metropolitan areas and make certain that your OMNI 800 printers are up and running all the time.

For more information on our Model 810, our Models 840 RO and KSR, plus our new lower prices, contact your nearest TI sales office, or write: Texas Instruments Incorporated, P.O. Box 202145, Dallas, Texas 75220. Better yet, call us now:

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TI invented the first integrated circuit, microprocessor and microcomputer.

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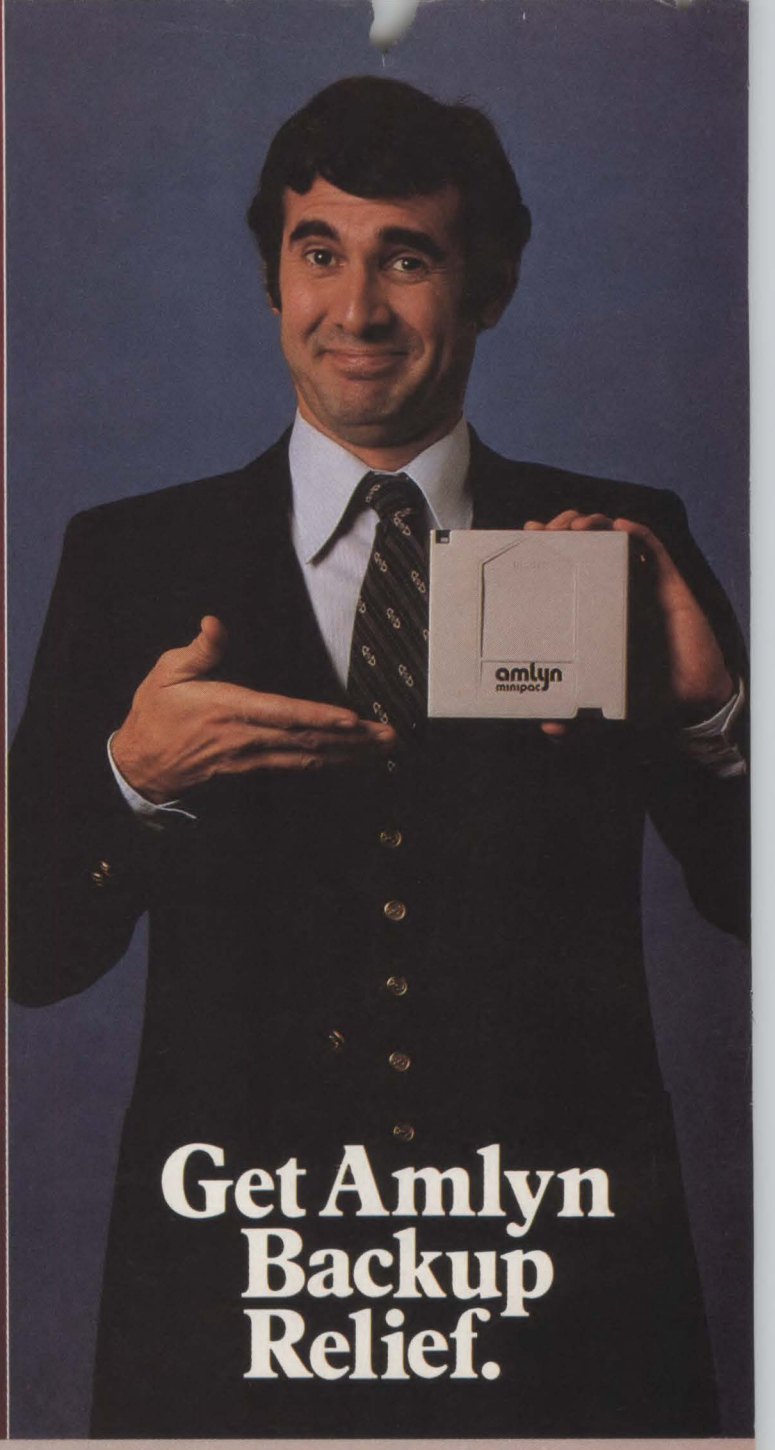
CIRCLE NO. 2 ON INQUIRY CARD

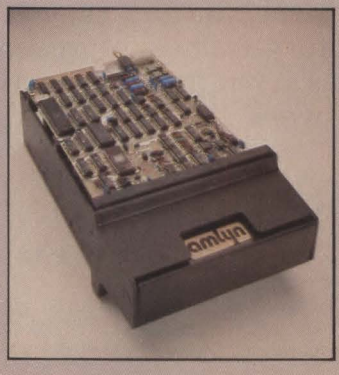
Got the Backup Frazzles?



Get Amlyn Backup Relief.

Frazzled by the hunt for Winchester backup that's easy to use, trouble-free, economical, compact, plug compatible, which also has 100 + % capacity of 5¼ ″ Winchester disk drives?

Hunt no more. You just found the solution to your problem. It's the new Amlyn MiniPac Drives, offering all you've searched for, *plus dynamic on-line operation.*



Amlyn's Model A506 and 5850 minifloppy disk drives deliver 8 MBytes of dynamic data storage in a five-diskette, removable MiniPac cartridge. And diskettes can also be removed and replaced even with the drive's power on.

Plug compatible with 5¼ ″ Winchester or 8 ″ floppy disk drives, the Amlyn MiniPac Drives not only back up dynamically...they also can assume primary storage responsibility!

Should your Winchester drive fail, the Amlyn A506 or 5850 will still keep your business in business. They will perform all system functions. Perfectly. Not only that, the Amlyn MiniPac drives do it with versatility and reliability unmatched by other minifloppy drives.

So, if you want relief, give us a call. Or write. All you have to lose are The Frazzles.

amlyn

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San Jose, CA 95112
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FOR IMMEDIATE INTEREST ONLY CIRCLE #3
FOR INFORMATION ONLY CIRCLE #4

Integral Data System's Prism dot-matrix printer reduces the expense of upgrading by permitting users to add modules for color, graphics, greater resolution, faster print speeds and character sets (see p. 207). Cover design by Chris Crosson, Design Resource Group, courtesy of Integral Data Systems.

Page 35 . . . . . ISOs call the shots

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BPA ABP

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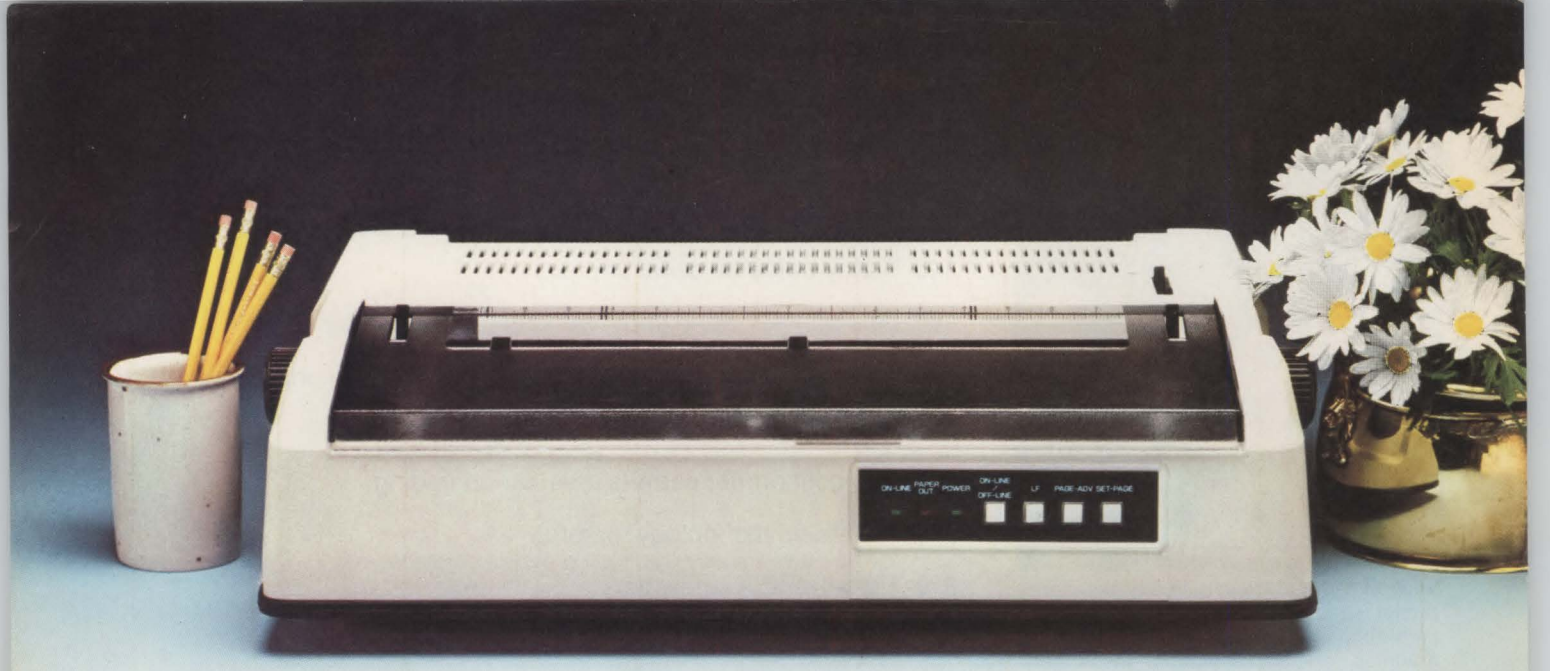

C. Itoh's new *F-10 Printmaster* Daisywheel printer is the compact beauty you can easily get attached to. Just look at what you get:

1. Small footprint, low-profile design (only 6" high) fits easily into your system.
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Printmaster is fully backed by C. Itoh's warranty and complete support organization. Contact C. Itoh Electronics, Inc. 5301 Beethoven St., Los Angeles, CA 90066 (213) 306-6700.

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HOW DO I LOVE YOU? LET ME COUNT THE WAYS.

CIRCLE NO. 5 ON INQUIRY CARD

APPLE III MAY UPSTAGE APPLE IV

The efforts by Apple Computer, Inc., to remedy the problem of disillusioned dealers and to concentrate on the enhanced Apple III may delay the company's introduction of the Apple IV personal computer. The Apple IV project is under tight wraps, but there is speculation that its introduction has been delayed at least until June. "They need time to gain dealer acceptance for the Apple III," says Peter A. Wright, an analyst with the Gartner Group, Inc., Stamford, Conn. The Apple IV is expected to be aimed at office applications and to include graphics and networking functions. It is believed to be a 16-bit Motorola 68000-based system using the UNIX operating system. The machine includes a hard disk and 128K bytes of memory. Some dealers speculate that Apple will have difficulty pulling together resources to introduce the new product. Other competitors with similar products will already have a lead time when the Apple IV is introduced. Those companies include Fortune Systems, Inc., which will not have production units of a competing 68000 μ-based system until at least March. The company plans to incorporate a hard disk into its system soon. However, Wright points out that Apple has a strong name and customer base on its side, and dealers can trade in earlier Apple models for the new system.

PERKIN-ELMER READIES CAD/CAM WORK STATIONS, HIGH-END PROCESSORS

Late this month, Perkin-Elmer Corp. plans to offer work stations that support the CADAM CAD/CAM package that P-E licensed from Lockheed Corp. two months ago. Essentially equivalent to work stations already installed at Lockheed, the systems consist of a Vector General display tube, a 550 system console and a 32-bit processor from Perkin-Elmer, a disk drive and an L-shaped desk. A company source says two CADAM work stations will be available, including a single-user model selling for approximately $150,000 and a dual-user work station priced at about $220,000. These versions function as distributed work stations connected to a mainframe computer. The source indicates, however, that Perkin-Elmer will offer a stand-alone turnkey CADAM system this year. Licensing fees for the Lockheed software will be about $3000 per month.

Also in the works at Perkin-Elmer are new 32-bit processors that will reportedly fit at the high end of the firm's five-model family and that might be introduced by May.

HEWLETT-PACKARD ANNOUNCES DESK-TOP GRAPHICS SYSTEM

The latest addition to Hewlett-Packard Co.'s line of desk-top computer systems will be unveiled this month. Called the 9836A, the machine is aimed at the computer-aided engineering (CAE) market. Like all of H-P's recent desk-top systems, the 9836A used a Motorola 68000 processor. It includes a 12-in. display and two 5¼-in. floppy-disk drives. Besides H-P's standard Pascal package, the 9836A is available with VisiCalc, graphics and statistics software and a project-management package. Company officials say other applications packages will be added through H-P's third-party software program, HP-Plus. An optional color-graphics interface card and a 256K-byte RAM board are also available. A basic 9836A system sells for $11,950.

The Palo Alto, Calif., company is also introducing a single-user interactive graphics system, the HP1360. The system consists of an HP9826A or an HP9836A desk-top computer with a graphics interpreter, a graphics tablet and a 13- or 19-in. display. A graphics utility package, called InteGral/60, performs device handling, graphics and database functions. With an HP9826A CPU, the system sells for less than $31,000; with an HP9836A CPU, it sells for about $34,000.

SEVERAL PRINTER ANNOUNCEMENTS SLATED FOR SPRING

Florida Data Corp. plans to announce a version of its OSP 120/130 office printers with a facsimile capability at this spring's National Computer Conference. The new printer will output information, and input capability will be added later. The printer includes added electronics and an OCR-like lens. Software is under development. OSP printers can be retrofitted with the additional electronics.

In a recent development in the non-impact printer arena, Xerox and Siemens are battling each other to gain major contracts with such companies as NCR. NCR recently signed up for the forthcoming Siemens ND-3 laser printer, which may sell for $200,000 in end-user versions. Sources close to the Siemens and NCR say that NCR may market the printer in the spring, even before Siemens's formal introduction. The loser in the contract, which is estimated to be worth as much as

$20 million, is Xerox's unannounced 8700 printer, a lower speed version of the company's 9700.

Both Wang Laboratories, Inc., and Digital Equipment Corp. are reportedly eyeing Xerox's 8044-print server. A Wang spokesman, however, says that the 8044 is not being used in the Wang image printer.

Mannesman-Tally is expected to announce the MT-120 matrix line printer this spring at Germany's Hanover Fair. The printer, previewed at November's Comdex show, will compete with Printronix's 600-lpm P600 printer. The less-than-$1000 MT-120, targeted at personal-computer use, is slated to be introduced early this year.

Delphax Systems, Mississauga, Toronto, Canada, reportedly has shipped the first evaluation version of its ion-deposition printer (MMS, June, 1981, p. 179) to Dataproducts' recently established Austin, Texas, non-impact printer operation.

Microtek, Inc., plans to introduce its 80-cps Tekwriter 2 dot-matrix printer by the end of this month. The printer was shown as a prototype at November's Comdex, but was not demonstrated. The 8085 μp-based nine-wire printer has a standard 1K-byte buffer that is expandable to 25K bytes. List price is $695, including a tractor assembly. The printer produces graphics when linked with a TRS-80 μc and incorporates a print head and mechanism manufactured by Two Day.

AMD TO EXPAND REGISTERED PROM FAMILY

Advanced Micro Devices, Santa Clara, Calif., will add to its line of registered PROMs this year. Joining the 512 x 8-bit devices are the 8K (1024 x 8) AM27S35 and the 16K (2048 x 8) AM27S45. Both are built with AMD's IMOX-II oxide-isolation process, which improves chip densities, and feature eight registers in master/slave configurations. The parts will be available in 24-pin slimline packages. Prices have not been established.

NATIONAL ADOPTS EUROCARD WITH CMOS μC BOARD FAMILY

National Semiconductor Corp. is adopting the single-width Eurocard format—rather than using the Multibus for its new line of board-level products, which will be introduced this month. The products, based on the Santa Clara, Calif. company's CMOS NSC800 μc chip set are aimed at RCA 1802 users. Production is slated for the second quarter of this year.

OLIVETTI OPE PUSHES FURTHER INTO U.S. DISK-DRIVE MARKET

Olivetti OPE, Tarrytown, N.Y., intensifies its year-old push into the U.S. peripherals market this month with revamped versions of its HD 561 5¼-in. Winchester-disk drive. Three versions of the HD 562, which have increased storage capacities and improved track-to-track access times, are scheduled for volume production. The HD 562/1, 2 and 3, have one, two and three platters, respectively, and incorporate ferrite heads. The HD562/1 replaces the earlier HD 561. The three-platter HD 562/3 has 11.25M bytes (unformatted) and 9.12M bytes (formatted) storage capacity. The HD 562/2 has 7.5M bytes (unformatted) and 6.08M bytes (formatted) capacity, while the HD 562/1 has 3.75M bytes (unformatted) and 3.04M bytes (formatted). Track-to-track access time has been decreased from 2 msec. for the HD 561/2 to 1.1 msec. for the new drives. Average access time for the trio has been cut in half to 66 msec. The two-platter version is priced at $1300 in single-unit quantities, and $720 in 1000-unit quantities.

UNIT LETS PHONE SERVE AS ALPHANUMERIC TERMINAL

Ten pre-production units of Comput-a-talk, a low-cost system that incorporates a speech-synthesis chip for data-entry verification, will be shipped this month by the system's vendor, Telephone Computer Co., Arlington, Va. The product permits touch-tone and rotary telephones to interface with various computers and to function as data-entry and -retrieval terminals. Peter J. Tsakanikas, company president, says his firm will deliver 100 more units in March, and will then begin volume deliveries expected to total 17,000 units during the year beginning May 1. Measuring 10 in. wide x 11 in. deep x 2 in. high, the Comput-a-talk units are essentially single-board computers with modems and various translator programs that permit users to enter numerals and letters from phone keypads and dials into computers. The units incorporate National Semiconductor Corp.'s Digi-Talker speech synthesizer, which can support vocabularies of more than 1000 words. Prices for the units

PLESSEY ADDS WINCHESTER STORAGE WITH EFFICIENT BACKUP

FOR LSI-11/23* MICRO SYSTEMS

28 MBYTE WINCHESTER

Plessey's SYST-23VTJ adds real mass storage to the LSI-11/23 for a complete microcomputer system. 28 Mbytes of reliable Winchester storage in a compact table-top package.

More storage than any LSI-11 configuration DEC* offers.

1/4-INCH CARTRIDGE BACKUP

Backup the contents of your Winchester onto tape cartridges. System backup takes only 2.5 minutes per 14 Mbytes with Plessey's fast quarter-inch tape streamer.

Cut media costs too. Tape cartridges reduce your costs and store easily.

**Trademark of Digital Equipment Corporation.*

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GREATER FLEXIBILITY

Plessey Peripheral Systems offers more configurations, systems options, and software enhancements than you thought possible. All to give you the most powerful microcomputer system available.

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At the lowest price possible. More performance doesn't have to cost more money . . . if your next DEC computer is a Plessey system.

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Call Plessey Peripheral Systems for rapid delivery of your SYST-23VTJ. Or any other DEC-processor-based system. Put the improvements to work for you.

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CIRCLE NO. 6 ON INQUIRY CARD

"We help companies get down to business in 14 languages. Our Scotch® Brand Disk Cartridges make sure nothing gets lost in the translation."

Mike Kirk, President
ITA International, Inc.
Kansas City, Missouri

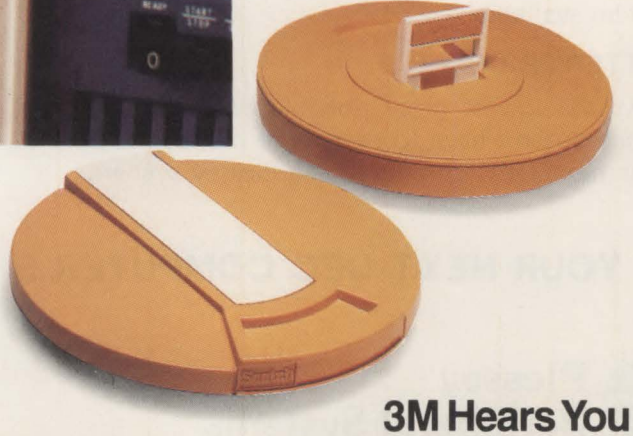
ITA doubled productivity with its unique brand of computer-aided translation and printing. So today, they prepare overseas sales materials for Fortune 500 companies in 14 different languages: up to 25 *thousand* pages per year. To avoid formatting problems and guarantee reliable storage, they use 16-megabyte Scotch 940 Disk Cartridges on their Phoenix drives.

That reliability is critical. The servo side of each 940 disk is precisely written under stringent 3M controls. Like all front and top-loading cartridges, the 940 disk is 100% tested and certified before it leaves the factory.

Plus, all Scotch disk cartridges are protected by 3M's exclusive CRASHGUARD® disk coating. It greatly reduces the risk of a head-crash, and minimizes the damage if one does occur.

You can get Scotch disk cartridges for use on most cartridge drives. To find out where, call toll-free: 800-328-1300. (In Minnesota, call collect: 612-736-9625.) Ask for the Data Recording Products Division. In Canada, write 3M Canada, Inc., Ontario.

If it's worth remembering, it's worth Scotch Data Recording Products.



3M Hears You...

CIRCLE NO. 7 ON INQUIRY CARD

3M

will range from $995 to $1495, depending upon the computers with which the Comput-a-talk must interface. Tsakanikas says order-entry applications will constitute a major market for the product, as will applications in health services and manufacturing. Tsakanikas also expects to serve the off-track betting market and foresees consumer applications, such as linking home users to on-line databases, with the phone serving as an entry terminal and a television serving as the display unit. The consumer version of the Comput-a-talk will sell for about $595, he says. Telephone Computer Co. will use 28 manufacturer representatives to market the product nationwide.

PRO SOFTWARE CONVERTED FOR DEC, IBM SYSTEMS

Two companies plan to convert the Pro application program development software developed by Data Technical Analysts in Hawaii (see "Big Japanese firms back CIE's small-business entry," p. 28) for use on International Business Machines Corp. mainframes and Digital Equipment Corp. PDP-11s. Pro Computer Sciences, Inc., Newport Beach, Calif., plans to sign a joint R & D agreement with a Fortune 500 company to convert Pro to its 370 series mainframes nationwide. In exchange, the Fortune 500 company will receive a minority share of PCS. PCS will then market the converted Pro to other large end users of IBM equipment.

Another start-up, Pro-IV, Inc., also in Newport Beach, expects to complete conversion of Pro to run on DEC PDP-11s by the NCC this spring. Pro-IV plans to sell the software to DEC Systems houses unless high-level discussions held recently with DEC lead to DEC's direct marketing of Pro.

ESP TRIES AGAIN WITH REVISED DATA-MANAGEMENT PACKAGE

ESP Computer Resources, Inc., has just begun shipping a revised version of its dataKEYper, an interactive data-management system designed to run on Apple II computers. DataKEYper was central to the Hollis, N.H., firm's thrust last spring to add applications software packages and turnkey μc systems to its traditional business of data-processing consulting and facilities management. The initial version of dataKEYper suffered from architectural problems, says company president Robert J. Elliott, and was pulled off the market for reworking. He says that after experience with some local customers' installations, the company will attempt to market the product nationally through a dealer network. Priced at $250, dataKEYper will probably be enhanced and raised in price to about $500, Elliott says. The package will serve as the foundation for a turnkey business system ESP plans to offer by the end of this quarter. The bookKEYper I system will consist of an Apple II and, typically, Corvus Winchester-disk drives, and will probably sell for less than $5000. Versions with floppy-disk drives will also be available. A planned higher level system, bookKEYper II, will not incorporate the dataKEYper package, and will be targeted at larger, more sophisticated business, Elliott says. The firm may spin off a scaled-down version of bookKEYper I that will address the consumer market and will perform such applications as home finances.

PERKIN-ELMER-BASED OCR SYSTEM TO BE SHIPPED THIS QUARTER

This quarter, the Optical Business Machines subsidiary of Florida Data Corp. will begin shipping a data-entry system incorporating optical character recognition (OCR) and key-to-disk input linked to Perkin-Elmer minicomputers. Two versions are available: one is based on P-E's 16-bit model 1620 minicomputer, and the other is based on the 32-bit model 3210. The systems, which will be configured and supported by Optical, include a 10M-byte P-E M46-710 Vanguard cartridge disk system, a P-E model 550 keyboard and terminal, a 1600-bpi magnetic-tape unit and Optical's new Laser-Two data-processing system OCR machine. Optical provides application software at an additional charge. Applications include general accounting, inventory control, piecework reporting in factories and data entry for employee attendance in large companies. The system can be used to access mainframe databases in remote locations. More than 24 terminals can be linked on the system. Prices for the 16 and 32-bit systems are $149,000, and $179,000, respectively, both including tape drive.

RANDOM DISK FILES

Memorex Corp. plans to enter the 5¼-in. Winchester-disk-drive market this quarter with a line of 6M- and 10M-byte drives called the 506 and the 510. Details of Memorex's new hardware are sketchy,

but the company will initially license the drive design from a vendor and then shift to in-house production. Whose drive will be used is not known, although reports are circulating that the Santa Clara, Calif., drive and media vendor was showing hardware built by Nippon Peripherals, Ltd., at its suite at the recent Comdex show.

Rumors flying around the recent Comdex show to the effect that PerSci, Inc., has shut down are unfounded, says Bob Harlan, president of the West Los Angeles, Calif., floppy-disk drive maker. Harlan concedes, however, that PerSci is having some rocky times and that sales have dropped by nearly 50 percent to the $300,000-per-month level. He also says that there have been layoffs at the company, and that he is actively seeking a merger partner.

The first 3½-in. Winchester-disk drives from a U.S. vendor may appear in evaluation quantities this year from an as-yet-unnamed Orange County, Calif., firm. Specs for the 3.3M-byte drive include the use of plated media, bit densities around 13,000 bpi and track densities around 200 tpi. Price is expected to be $450 per drive in OEM quantities. A 6.6M-byte spin-off is planned for mid-1983.

Orange County, Calif., media start-up Charlton Associates, Inc., will move into a pilot production facility in Irvine, Calif., this month, and will have evaluation disks on the market during the third quarter of this year. First product will be oxide-coated media for high-capacity 5¼-in. Winchesters.

Follow-on hardware from Minneapolis-based Computer Products Corp. reportedly will include an SMD-compatible controller and a Multibus-compatible controller for 5¼-in. Winchesters that is expected to include an integral data separator. Both products may appear during the third quarter. Also available from Computer Products next quarter is a line of controllers for the Archive/Cipher ¼-in. streaming-tape cartridge drives.

The first product from San Jose, Calif., FCI Magnetics may appear at this spring's NCC in the form of 5¼- and 8-in. thin-film Winchester media. The media can be integrated into drives without any modification of the read channel. The disks offer higher read resolutions for any flux density. By year-end, the firm plans to mass-produce these disks using a totally dry sputtering technique, says one source close to the company. The company is also considering media that will support bit densities in the 16,000-bpi range.

Atasi Corp., Sunnyvale, Calif., will unveil two high-capacity 5¼-in. Winchester-disk drives during the second quarter. The hardware reportedly will be in the 20M-byte and higher range, using either two or three platters, voice-coil actuators and Seagate ST-506 interfacing. Prices have not been set.

An upgraded 8-in. Winchester-disk drive will be announced by 3M Co. around mid-year. Code-named Alpine, the drive reportedly will offer twice the capacity of the firm's high-end 8533 60M-byte drive announced last spring (MMS, June, 1981, p. 16). Also rumored for the second quarter is 3M's first ¼-in. streaming tape-cartridge drive. The hardware is designed for backup in systems using the 8533 Winchester and carries the code name Pecos. Prices have not been set for either drive.

Planning shipments of evaluation hardware this year is Sunnyvale, Calif., Data Peripherals. The product will be a 5¼-in. removable-only Winchester that will use Dysan Corp.'s 5M-byte disk cartridge. The drive is used in Seagate's thin-film ST-706 removable-only device and DMA Systems, Inc.'s Micro-Magnum 5/5.

Data Master, Inc., Camarillo, Calif., will announce a two-platter 5¼-in floppy-disk drive at NCC '82. The company originally announced its hardware at the 1980 NCC, but has reengineered the device to handle 2M bytes of storage using Dysan's spin-coated media and a micro-stepper actuator. Subsequent iterations of the drive could offer capacities in the 4M-byte range.

Longmont, Colo., start-up Amcodyne, Inc., may have its first hardware—an 8-in. Winchester combining a fixed platter with a removable disk cartridge—ready for announcement by second quarter. The drive is being defined and could come to market at a lower price than competing fixed/removable hardware from Control Data Corp. and Perkin-Elmer.

UNGERMANN-BASS TO DELIVER BROADBAND NETWORK BY MID-YEAR

Ungermann-Bass, Inc., Santa Clara, Calif., will introduce a broadband network—data, voice and video—early this year. The single-cable system will run with U-B's existing Ethernet baseband hardware and software after slight modifications by the user, says a company source. The system consists of the cable and controller hardware, and the user must add RF modems. The company plans to begin deliveries by mid-year. Specifications are still being determined. The company will continue to supply Ethernet and new broadband products.

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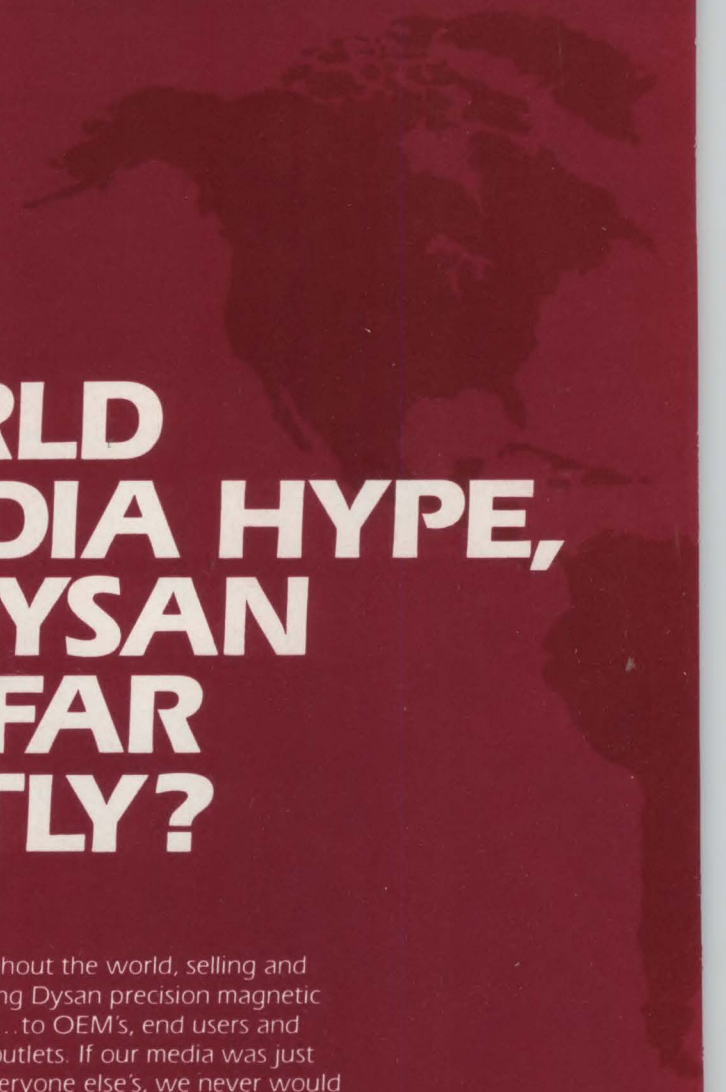

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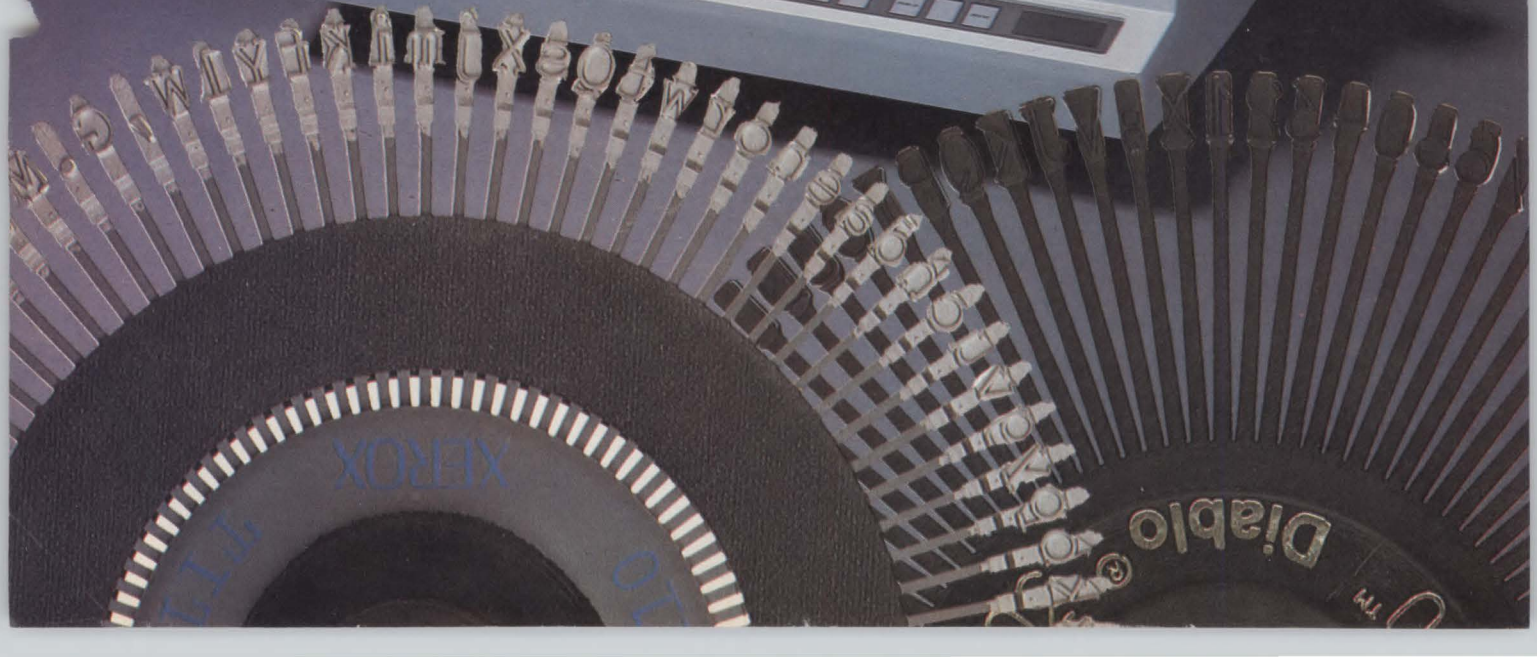


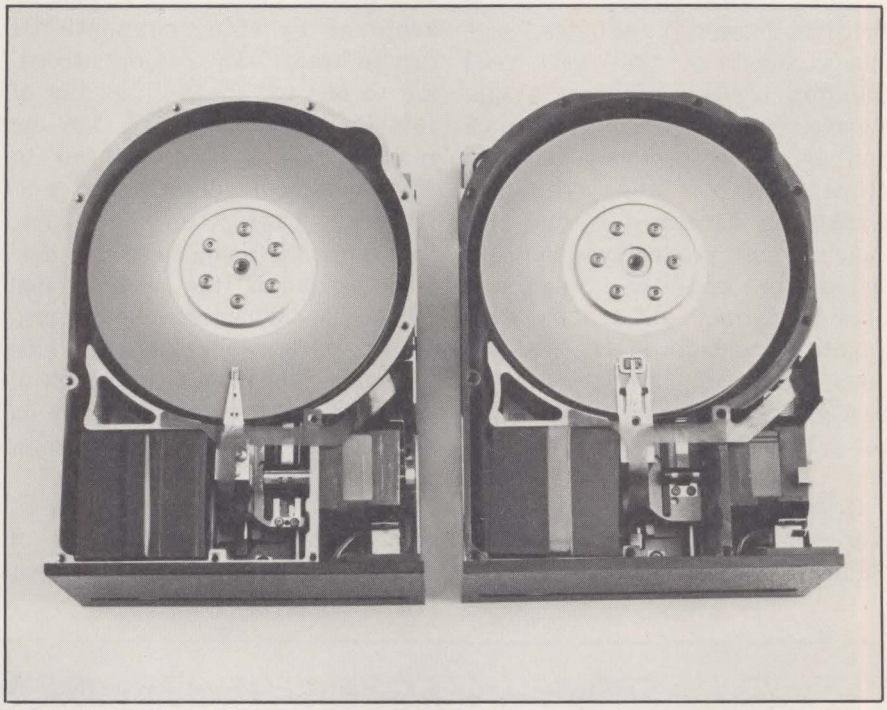
CIRCLE NO. 12 ON INQUIRY CARD

Seagate defers thin-film drives, unveils conventional Winchester

Seagate Technology, the dominant supplier of 5¼-in. Winchester 155 disk drives, plans to ship production quantities this quarter of its ST-412, a two-platter, 12M-byte device equipped with manganese-zinc ferrite heads. At the same time, the company announced that it planned to defer—perhaps indefinitely—its ST-512, a two-platter, 5¼-in. Winchester that was the first of its kind to offer similar capacities through the use of thin-film read/write heads, and that has already begun to ship in evaluation quantities (MMS, April, 1981, p. 135).

The decision to upgrade storage capacities of Seagate hardware from the 6M-byte level of the ST-506—the first 5¼-in. Winchester to be introduced (MMS, April, 1980, p. 79)—to the current 12M-byte level using ferrite head technology rather than the thin-film components originally proposed, is the result of an unanticipated demand for small Winchesters in the 12M-byte range, says Finis Conner, executive vice president and co-founder of the Scotts Valley, Calif., peripherals house. "Higher capacity drives continue to be announced in large numbers," he says. "This has created both a real and a perceived demand for this hardware that is growing faster than we had anticipated." The ST-412, he says, is Seagate's response to this demand.

The new drive operates at 345 tracks per in. (compared to 255 tpi for the ST-506 and 270 tpi for the thin-film ST-512), and incorporates the same number of cylinders (306) as the ST-512. Both drives operate at 10,417 bytes per track. The ST-412 operates at 9074 bits per in. compared to 7690 bpi for the ST-506 and more than 10,000 bpi for the ST-512. Transfer rates are set at 5M bytes per sec.—the same as previously announced Seagate hardware.



Production of Seagate Technology's 12M-byte ST-512, *the first 5¼-in. Winchester to be equipped with thin-film read/write heads (r.) has been deferred in favor of the ST-412, a 12M-byte device incorporating manganese-zinc ferrite heads, like the ST-512 and the company's 6M-byte ST-506 (l.), the new drive stores data on two platters. The new drive is scheduled to go into production this quarter.*

Conner reports that his firm already has orders for the new drive. "We've had this device in the back room for some time," he says. "We don't feel that there will be any problems with it and that we can ramp up production to the 12M-byte level very quickly." One reason for this, he explains, is commonality of parts. "Aside from the heads themselves," he says, "the only difference between the ST-412 and the ST506 is the stepper motor and the band actuator. We've changed these in order to accommodate the increased number of cylinders on the new drive."

Conner stresses that Seagate's decision to offer higher capacity drives using conventional heads and to defer production of thin-film Winchesters is market driven and is not the result of any technology problems associated with thin-film components. Many feel, however, that the decision to go with ferrite heads may have been forced on Seagate by production problems at Dastek Corp.—the company's sole source for these heads (see "Technology exchange seen pushing thin-film heads", p. 18).

Production issues aside, many feel that the application of thin-film read/write head technology to small Winchesters may have been premature anyway. Texas Instruments Inc., which holds a manufacturing

license for both the ST-506 and the thin-film ST-512, introduced a two-platter, 12M-byte, thin-film media drive using conventional ferrite read/write heads at the recent Comdex show. "Thin-film media is the right answer to 12M bytes," says one TI engineer. "We don't need thin-film heads." TI's new 5¼-in. Winchester will operate at 9200 bpi and 400 tpi, respectively, and will store data on 306 cylinders. Evaluation hardware is due this quarter, with production quantities slated for mid-year. Single-unit pricing is set at $1575, with quantity discounts at the 500-unit level reportedly available at 38 percent off. Pricing for the ST-412 is set at $1500 in single-unit quantities and $950 in 500-lot orders.

Others also feel that thin-film read/write heads are not called for. "Multiple-sourced heads of this type won't be available in quantity until 1983 at the earliest," says Menlo Park, Calif., consultant James McCoy. "Even then, this technology may offer little to the small Winchester market that cannot be achieved by using conventional ferrite heads." The reason: according to McCoy, the full benefits of thin-film technology will not be realized unless it is coupled to advanced media designs and controllers. "Until then," he says, "conventional manganese-zinc ferrite heads in the conventional monolithic Winchester configuration, or newer ceramic/ferrite designs will be more than capable of supporting 12M bytes of storage on two-platter, 5¼-in. Winchesters, much less three-platter devices."

Jim Porter, Mountain View, Calif., consultant and publisher of *Disk/Trend Report*, also feels that 1982 is not the year of the thin-film 5¼-in. Winchester. "The majority of the 5¼-in. drives shipped this year will be in the 6M-byte range," he says. "The market for these drives is still very price sensitive, and is still in the floppy-disk-upgrade mode. Six megabytes is more than enough to meet this requirement." Nonetheless, Porter says that 12M-byte drives will be shipping in some quantity this year, and that more importantly, systems integrators will begin designing them into new offerings.

Santa Barbara, Calif., industry analyst Raymond Freeman Jr., anticipates that 12M-byte, 5¼-in. Winchesters may be more popular in 1982, however. "Business computers will develop an appetite for more mass storage," he says, "especially as multi-work-station systems become more common-

TECHNOLOGY EXCHANGE SEEN PUSHING THIN-FILM HEADS

The exchange last November of thin-film read/write head technologies between Dastek Corp. and Information Magnetics Corp. (InfoMag) may signal the first of a series of inter-company agreements aimed at ensuring a second-sourced supply of criticial components to vendors of small Winchester-disk drives.

The move by the two firms involves passing design and development information from Dastek, a Los Gatos, Calif., subsidiary of Dysan Corp. to InfoMag, a wholly owned subsidiary of Santa Barbara-based Computer and Communications Technology Inc. (CCT). InfoMag, in turn, will pass on to Dastek its back-end expertise in grinding and lapping heads and in system assembly and production. The exchange calls for each company to develop compatible, interchangeable products. No money is involved in the transfer.

"The independent thin-film-head business is groping a bit, and the Dastek/InfoMag exchange is an interesting approach toward resolving some of the problems these vendors are facing," says Santa Barbara-based industry analyst Raymond Freeman Jr. One such problem is lack of customers, despite the fact that the large-volume market for 5¼-in. Winchesters may be moving to higher capacity levels faster than originally anticipated. There is also some question about whether Dastek's production facilities will be up to the challenge. In a move seen by many as a partial response to the production problems, Dysan has already taken complete control over Dastek.

Finis Conner, executive vice president and co-founder of Seagate Technology is concerned, however, that production problems at Dastek, combined with a demand for higher capacity hardware, could be the first skipped beats in Seagate's otherwise smooth entry into the rotating-memory business and its early dominance of the 5¼-in. Winchester market. As a result, Seagate plans to ship production quantities of a 12M-byte drive equipped with manganese-zinc ferrite heads later this quarter.

"There is potentially a huge market for thin-film read/write heads, and Dastek won't be able to cash in on it if it has to supply components only to Seagate," says industry analyst Andrew Roman, "Dastek made a wise decision when it lined up with InfoMag."

Dastek will also be able to take advantage of InfoMag's extensive in-place sales and marketing staffs, both of which Dastek lacks, Roman says. "InfoMag, on the other hand, gets the technology it needs to counter the thin-film-head efforts of Goleta, Calif. neighbor, Applied Magnetics Corp."

InfoMag itself does not see thin-film technology creating any significant impact on the small-Winchester market until 1983 at the earliest, however, and will not ship any product developed under the agreement with Dastek to any other drive vendor until a restriction clause limiting sales exclusively to Seagate expires in April of this year.

place." In this light, he sees Seagate's decision to use ferrite read/write heads as a prudent one. "It reduces the risk for the buyer," he explains. "Their decision should be viewed in a positive vein."

For his part, Conner still believes that 5¼-in. Winchesters equipped with thin-film read/write heads may not be too far off. Evaluation versions of a three-platter thin-film spin-off of the 12M-byte, ST-412 could be announced this fall, he says. Also due around the same time are evaluation versions of the thin-film ST-706, a 6M-byte, removable-only, 5¼-in. Winchester using the disk-cartridge media developed by Dysan Corp. in conjunction with Seagate and DMA Systems, Inc., Santa Barbara, Calif. (MMS, November, 1981, p. 46). "We believe that the industry must go to thin-film heads," Conner says. "This has been part of our business plan since we founded the company over two years ago." —*John Trifari*

Apple tries again with enhanced Apple III

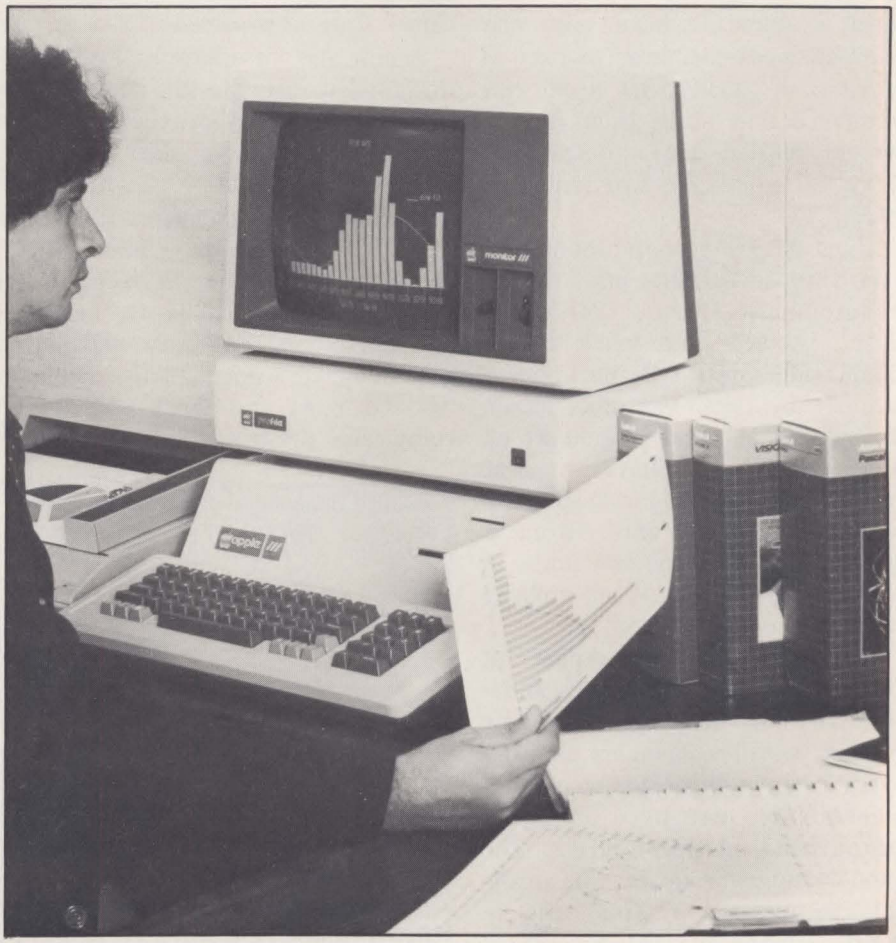
More than a year after releasing the Apple III computer, which officials at Apple Computers, Inc., admit was unreliable and "software-starved," the company is rereleasing the machine. This time, the number-two-ranked personal- and small-business-computer supplier claims the unit to be problem-free and better suited to the small-business market.

Prices for the revamped Apple III, including a new operating system, seven new software packages, as much as 256K bytes of memory and a Winchester-disk drive, start at about $3500, $500 less than its predecessor.

Peter Lieu, an analyst with Arholdt & S. Bleichroeder and an Apple II user, says that Apple's move to rerelease the Apple III is a response to International Business Machine Corp.'s recently introduced personal computer (MMS, October, 1981, p. 63). "They (Apple) want to give their dealers an indication that something is being done to respond to the IBM challenge," says Lieu. "So they match IBM in memory size and software and they provide a hard-disk drive, which IBM doesn't have." Lieu adds, however, that the Apple III has a bad reputation among dealers and users and that, despite the $500 price cut, the bare-bones machine is still more expensive than IBM's personal computer, which starts at $1595.

Introduced at the 1980 National Computer Conference, the original Apple III was first criticized by dealers whose demonstration models were failing long before off-the-shelf quantities were available. Typical problems associated with the machine included loose chip sockets and faulty connectors between the PC board and the computer.

Barry Yarkoni, Apple's manager



The rereleased Apple III *includes the Business Graphics III software package, which enables users to create graphics displays and hard copy.*

for strategic planning for the Computer Systems Division, says that improved quality-control audits have eliminated most of those problems. "What they should have done was introduce the Apple III when it was ready and not a year ahead of time," says Lieu.

While Apple sources concede that the Apple III was late hitting the market, they rebuff criticism that the enhanced version was designed as a response to the challenge posed by IBM in the low-end market. "For a long time, we've expected the likes of IBM and Xerox to enter the market," notes Yarkoni. "But our response to new competition is something that has been planned for the last two years—not since August."

William Hood, vice president and general manager of Apple's Computer Systems Division, says the small-business-computer market is growing so quickly that Apple can persevere and strengthen its 25-percent market share, despite an entry "as seemingly threatening as IBM's."

About 327,000 low-end computers were shipped in 1980, but Venture Development Corp., Wellesley, Mass., projects that more than 2 billion such units will be shipped annually by 1985. Venture's Karen Hurowitz adds that shipments of small-business computers priced at less than $20,000 are increasing at a 33-percent annual rate, from a projected total of 60,000 units in 1981 to more than 142,000 units in 1984.

While the original Apple III included 128K bytes of non-expandable internal memory, the new system provides as much as 256K bytes using an expansion board that incorporates 64K-byte chips acquired from multiple sources. The memory-upgrade board was available to owners of Apple IIIs in mid-December and will be offered as a system option early this year.

To put added capability into the hands of small-business users, Apple provides the optional 5¼-in. ProFile Winchester-disk drive. Providing 5M bytes of storage, 35 times that of Apple's conventional 143K-byte floppy-disk drive, ProFile accesses data 10 times faster than the floppy unit. Yarkoni says that ProFile is best suited for applications such as accounting, which require large databases.

The hard-disk drive includes a head-disk assembly built by Seagate Technology Corp. and an Apple-built intelligent controller, power supply and interface card. The only backup for ProFile is another hard-disk unit. "For the market we're dealing with," says Apple's Hood, "if the data is so valuable as to require backup, then the cost of another ProFile would be insignificant." ProFile is priced at $3495.

A new SOS 1.1 operating system, designed to use the full 256K-byte memory and to support the 5M-byte ProFile, was also unveiled for the Apple III, along with seven software packages. Those packages include Business Graphics III, VisiCalc III, Access III, Apple Writer III, Business BASIC, Apple III Pascal and Script III. Software delivery schedules were not announced, but Yarkoni says additional SOS 1.1-compatible programs will be available through the company's Special Delivery Software Program (see "Hardware vendors scramble for software," p. 115) next year.

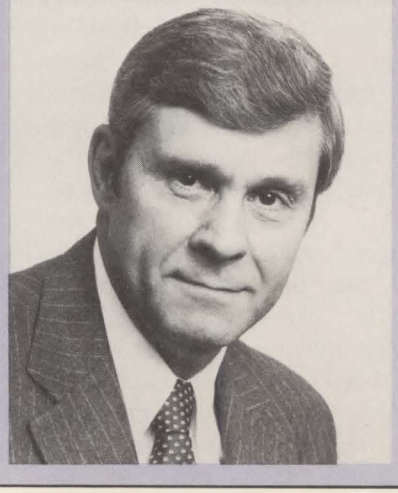
In the meantime, Apple III users may have to use Apple II software, which can be run on the larger system using a new emulation mode diskette. Further, CP/M programs might be able to run on the Apple III by early next year. An Apple source says that the CP/M system will be provided by Microsoft, Inc., Kirkland, Wash.

Yarkoni contends that programs written for SOS 1.1 are superior to those written for CP/M, but that Apple cannot ignore the existing CP/M library. He admits, however, that Apple is using CP/M as an expedient until additional SOS 1.1 programs are available. He adds that IBM is using the same strategy for its personal computer.

Customers who purchased the original problem-plagued Apple III will receive the SOS 1.1 operating system, upgrades to existing software offerings and a diagnostic disk to identify hardware bugs, free.

If major problems arise with the old machines, Yarkoni says, users can return their systems to an Apple service center for repair or replacement. "We've weeded out most of the flaky machines in the field," he says. —*Frank Catalano*

Prime Computer has dipped into the IBM Corp. management ranks for a new president and chief operating officer. *Joe M. Henson, 48, comes to the Natick, Mass.-based Prime following a 27-year career with IBM, where he most recently served as vice president of management services for the company's General Products Division. Henson replaces John K. Buckner, Prime's vice president of finance, who had been interim president for nearly five months following the abrupt departure of Kenneth G. Fisher last summer. Buckner has resumed his finance position. Fisher remains tight-lipped about his future plans and his reasons for resigning. In addition to the president and chief operating officer posts, Henson was also named a director of the company.*



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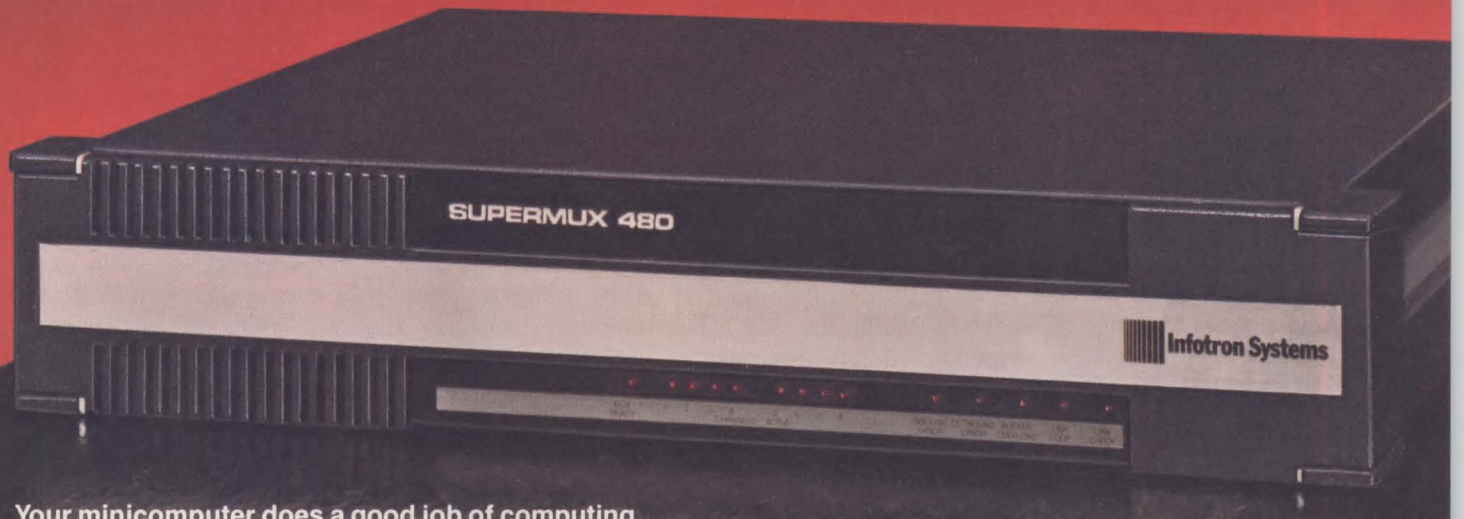

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Half-high 8-in. floppy race heats up with Shugart entry

Shugart Associates will begin deliveries of a "slimline" 8-in. floppy-disk drive this month. The Sunnyvale, Calif., company's SA810 and SA860 join the offerings of three other vendors in the first major redesign of 8-in. hardware in several years. The change may bolster the 8-in. hardware's sales, which have been sagging under growing shipments of 5¼-in. drives.

"Last year was the turning point," says industry analyst Andrew Roman, Newark, Calif. "Shipments of 5¼-in. drives exceeded those of 8-in. drives." He says to help shift the balance and maintain volume shipments, the 8-in. market needs slimline hardware.

Key to the new hardware's anticipated success are its physical size and its compatibility with current 8-in. products. As the moniker implies, the drives are half the height of standard 8-in. devices. Therefore, it's possible to double a system's storage capacity without repackaging or increasing the space by stacking two slimline drives on top of each other.

Additionally, drive makers have reduced the lengths of the hardware by at least 2 in. Although the change of depth allows for some innovative system design, it is just a bonus of the overall repackaging of the hardware. "The depth of the drive isn't important," says Roman. "The height is."

The immediate effect of the slimline hardware will be that system OEMs now using standard 8-in. drives can double their systems' storage capacities without repackaging.

Shugart's product manager for the SA810/860, Ray Heckman, says, "Those OEMs who need to go to a desk-top system can, and still protect their investment in SA850 interfaces and driver software." Analyst Roman expects slimlines to impact new designs in the market for single-board computers, systems with CPU and I/O on one board the size of a floppy-disk drive.

Genesis of the slimline design is credited to Micro Peripherals, Inc. The Chatsworth, Calif., company introduced the first slimline in the spring of 1980, but deliveries of evaluation units did not start until November of that year. Company officials say the hardware was delayed because customers wanted a shorter, as well as thinner, package. The MPI hardware is, in fact, less than half height.

With about 1000 evaluation units delivered, Tandon Corp., also of Chatsworth, is the only volume shipper. The company's single-sided slimline was unveiled at last year's National Computer Conference. A double-sided version has since been introduced.

Siemens Corp., Anaheim, Calif., has a slimline drive under development and hopes to have prototypes of double-sided hardware ready by this year's National Computer Conference.

In the half-height derby, MPI claims its series 40 to be the winner. The models 41 and 42 measure 2 in. high, 11¼ in. deep. Shugart's SA810 and SA860 are 2.3 in. high and 12 in. deep, and Tandon's 848-1 and 848-2 Magnum drives measure 2.3 × 13.35 in. Siemens is less definite about its drives' dimensions, but is certain they will be half-height. All companies' drives are 8.55 in. wide.

Jim Porter, Mountain View, Calif., analyst and publisher of *Disk/Trend Report*, says that slimlines will keep some manufacturers in the 8-in. fold, but he doesn't anticipate a significant effect on 5¼-in. drive shipments. He estimates that total 1982 8-in. hardware shipments will be 1.9 million, and that 5¼-in. shipments will approach 3 million.

J. Barrie Clark, product manager for rotating memories at Siemens, agrees with Porter on the impact of slimlines on 5¼-in. drives. "The effect will be minimal," he says, explaining that the important benefit of the smaller drive is size. It seems users are interested in 5¼-in.

JAPANESE SLIMLINES EXPECTED BY SPRING

Domestic suppliers of half-high 8-in. floppy-disk drives don't plan to have the U.S. market to themselves for very long. Most observers expect Japanese manufacturers to enter the U.S. by this spring with slimline hardware. "I expect at least six Japanese competitors by NCC," says Shugart's Ray Heckman.

At least one Japanese vendor has already shown a half-high drive. YE Data, which designed Qume Corp.'s first floppy-disk drives, displayed hardware at the Sicob show in Paris last fall. It's rumored that YE's arrangement with Qume might be broadened to include the Japanese firm's YD180, a 12.6-in.-deep, half-high drive available in Japan.

NEC is thought to be readying its half-high FD1165 hardware for a second-quarter U.S. introduction. The device measures 13.1 in. deep. The company has reportedly delivered several thousand FD1165s in Japan.

Most Japanese drive vendors are expected to enter the half-high market. Many are already delivering drives to Japanese small-systems vendors. The list of likely vendors of high-high floppy-disk drives reads like a who's who of the Japanese electronics industry. Besides, NEC and YE Data, observers anticipate products from Hitachi, Toshiba and Mitsubishi.

Most small system users think all micro-computers are created equal. And they're right. If you want performance, convenience, styling, high technology and reliability (and who doesn't?) your micro usually has a price tag that looks more like a mini. It seems big performance always means big bucks. But not so with the SuperBrain!

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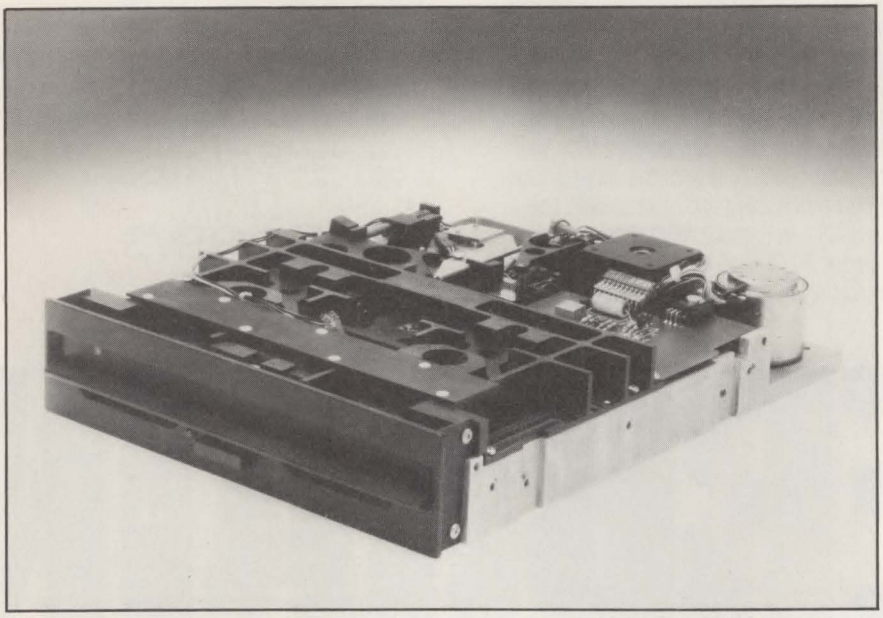

Micro Peripherals, Inc., claims its model 40 to be the winner in the half-high race. *Its model 40 measures 2 in. high, 11¼ in. deep.*

hardware regardless of the initial investment in interfaces and software.

The slimline hardware will have no immediate effect on existing 8-in. hardware. "New systems will incorporate the thin drives," says Porter. "But that will not happen instantaneously." Heckman at Shugart doesn't expect the SA810 or SA860 to begin affecting Shugart's standard-height, double-sided, double-density SA850 design-ins until next year, and even then he expects the effect to be minimal.

MPI chairman, Ralph Gabai, expects a slow deterioration of the standard 8-in. market. He says, however, "Some of the market will never change." Analyst Roman adds, "I don't expect a phase-out of standard 8-in. hardware. Once a drive has been designed into a system, it's there for 10 years."

Roman maintains the the overall effect of slimlines will be positive. New systems will incorporate the slimline hardware, he says, but the total effect will be to sustain 8-in. products in general. "Standard 8-in. hardware has matured," he says. "Shipments of older products will slow down, but they will never stop." One result of this slowdown, he contends, will be a drop in the prices of standard 8-in. hardware.

Roman says the availability of half-high drives will force manufacturers of standard-height 8-in. hardware to reduce prices, although he doesn't expect the cuts to be drastic. A Shugart SA850, for instance, sells for about $400 in quantities of 5000 units. Roman says a 5-percent drop should put the hardware into the same price category as the new drives.

In contrast, a Shugart spokesman says, his company sees no impact on the prices of standard 8-in. hardware for at least a year. "It's simply a matter of availability," he points out. Until manufacturers can ramp up their production of half-high drives, he says, prices of standard hardware will remain steady.

In the long term, however, Shugart expects the prices of traditional 8-in. devices to rise in response to inflation. The drives are mature and are no longer driven by technology.

Prices for slimline drives will be lower than those of standard drives because manufacturers are further along the learning curve. "They've worked out the problems encountered in building standard floppies, and are tooled up for manufacturing," Roman points out. And as drive makers move down the new curve, the Shugart spokesman says, prices will drop further.

Tandon Corp. vice president, Don Taylor, says his company, for instance, has reduced the costs to build its slimline drives by almost 40 percent, resulting in a 10 to 20 percent reduction in the price of a drive to a volume buyer. Although his firm has not set prices for its drives, Siemens's Clark also believes that half-high hardware will sell for 10 to 20 percent less than standard drives at first. Prices will drop further within two or three years, he adds. "On a price-per-pound basis only," he says, "the new drives have to cost less."

Shugart's SA810 single-sided, half-high drive will be priced at less than $400 in quantities of 500, says the company. The SA860, in similar quantities, will sell for about $450. MPI's model 41 sells for $300, and model 42 sells for $400, both in OEM quantities. Tandon's TD 848-1 single-sided drive sells for $350, and the double-sided TD 848-2 sells for $405 in 500-unit quantities.

Estimates vary for the number of slimline drives to be shipped this year. Analyst Porter estimates that by year-end, less than 5 percent of the total 8-in. drive market will be slimline hardware. That number could grow to about 30 percent in a few years, he adds. Analyst Roman expects an industry total of 65,000 for 1982. In contrast, Tandon's Taylor says his company will be shipping 5000 drives a month by the end of the first quarter of this year and plans to be delivering nearly 12,000 a month by year-end. Heckman says Shugart will produce about 50,000 devices this year. MPI's Gabai estimates a similar number—20,000 to 50,000—for his firm. He says the market "could become explosive, though." *—Larry Lettieri*

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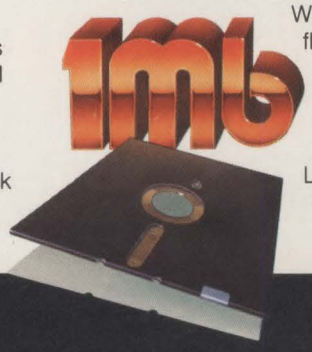

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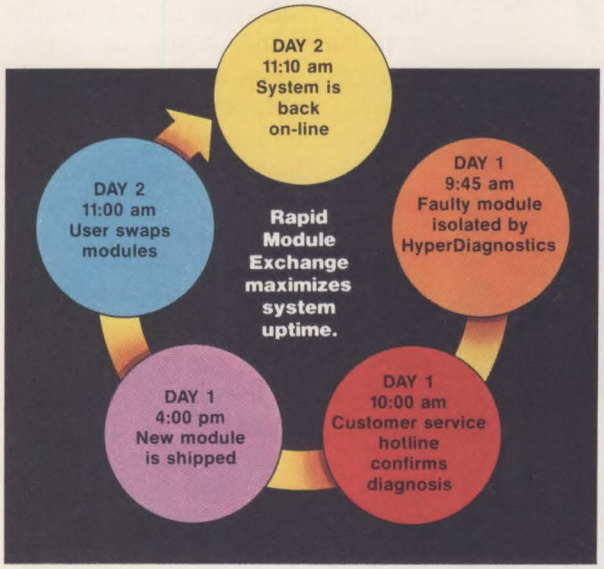

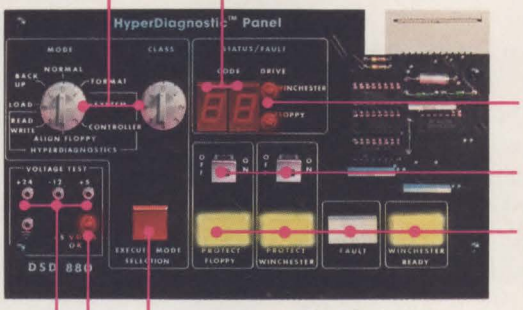

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Data Systems

Big Japanese firms back CIE's small-business entry

Japan has already invaded the low end of the U.S. OEM small-business computer market, so why should another entry have industry observers raising their eyebrows? First, CIE Systems, Inc., the company planning to announce the Japanese computer this month is backed by C. Itoh & Co., Ltd., Tokyo, Japan, a company with revenues three times those of International Business Machines Corp. CIE is also backed by Hitachi Ltd.'s Consumer Products Division, with its massive manufacturing capacity. The two companies represent combined revenues of $60 billion a year. Second, CIE's initial offering will feature a software program called Pro, which the Irvine, Calif., start-up says will avoid the oft-discussed programming bottleneck by eliminating the coding and debugging steps involved in application-program development.

The new hardware, dubbed the CIE 68-20 in its basic configuration, is a desk-top system built around the CIT 101, C. Itoh's VT-100-emulating terminal, and a 16-bit 68000 μp from Hitachi with 128K bytes of main memory and a communication controller for four RS232 devices. Mass storage is provided by the first U.S. appearance of Nippon Peripheral Corp.'s 10M-byte, 5¼-in. Winchester-disk drive. Backup will be handled by YE Data's double-sided, double-density 5¼-in., 96-track-per-in. floppy-disk drive, announced for the first time in the U.S. at the November, 1981, Comdex by Qume as the Fastrack 532. Single-quantity price is expected to be $10,000, plus a licensing fee of $1500 to $2000 for the Pro software. CIE also offers C. Itoh's letter-quality F10 printer in quantity for less than $1000.

Sushil Garg, Pro's chief developer *(seated), fine tunes the software for Hitachi's 68000-based computer as CIE executive vice president Jay Kear (l.) and a visitor look on.*

With several million dollars of C. Itoh's R & D behind it, CIE Systems is buying and moving into a $5-million building in Irvine, Calif., says Jay Kear, the company's executive vice president and general manager. Once settled, CIE will immediately use its cash operating fund of $5.6 million and its ample credit for its plans to sell tens of thousands Hitachi computers to OEMs.

C. Itoh had decided to market Pro software before hardware was even considered, says Kear. The third implementation of an application-level operating system developed by Sushil Garg, at Data Technical Analysts, Honolulu, Pro is already licensed and marketed in other versions by General Automation and Microdata under the names NoCode and All, respectively. Pro is claimed to reduce application-development time by a factor of four to 20, depending on the application. In one benchmark test performed by Garg, an order-entry application that took 320 hours and 30 min. to implement on a Microdata Reality system with a full complement of software tools, was up and running in 18 hours and 42 min. using Pro. Microdata cites more conservative figures, which nevertheless show a 6.5 reduction in development time.

CIE is the only Pro licensee to take an OEM approach. As such, Kear says, the company is not competing with either Microdata, GA, or Capro, another licensee expected to have a Pro system in March or April. But at the end-user level, the high quality and volume production that have given the Japanese an edge in other markets will be an important CIE advantage, Kear says.

"Hitachi's Consumer Product Division makes a number of electronic goods—TVs under its own name and for RCA, for example—which routinely sit in somebody's house for five years without failing," Kear says. "It's a company geared to high volume and low cost with fantastic quality and reliability. We went with them rather than with the Hitachi computer group that makes mainframes because the Consumer Product Division has an almost unlimited manufacturing capability, second to nobody, including IBM."

But while not too many people question the hardware offering from CIE, the market success of Pro remains to be seen. "Pro and All may have their greatest impact in lower end systems," says Warren Blossom, Microdata's vice president of marketing. He says interest in Microdata's high-end Sequel system with All has been strong, however, especially among large companies. "Turnaround time of three years for new applications requested of swamped data-processing departments is not uncommon, and the Sequel system with All promises some relief. Yet we are being very cautious. We want to make sure the product is debugged before we

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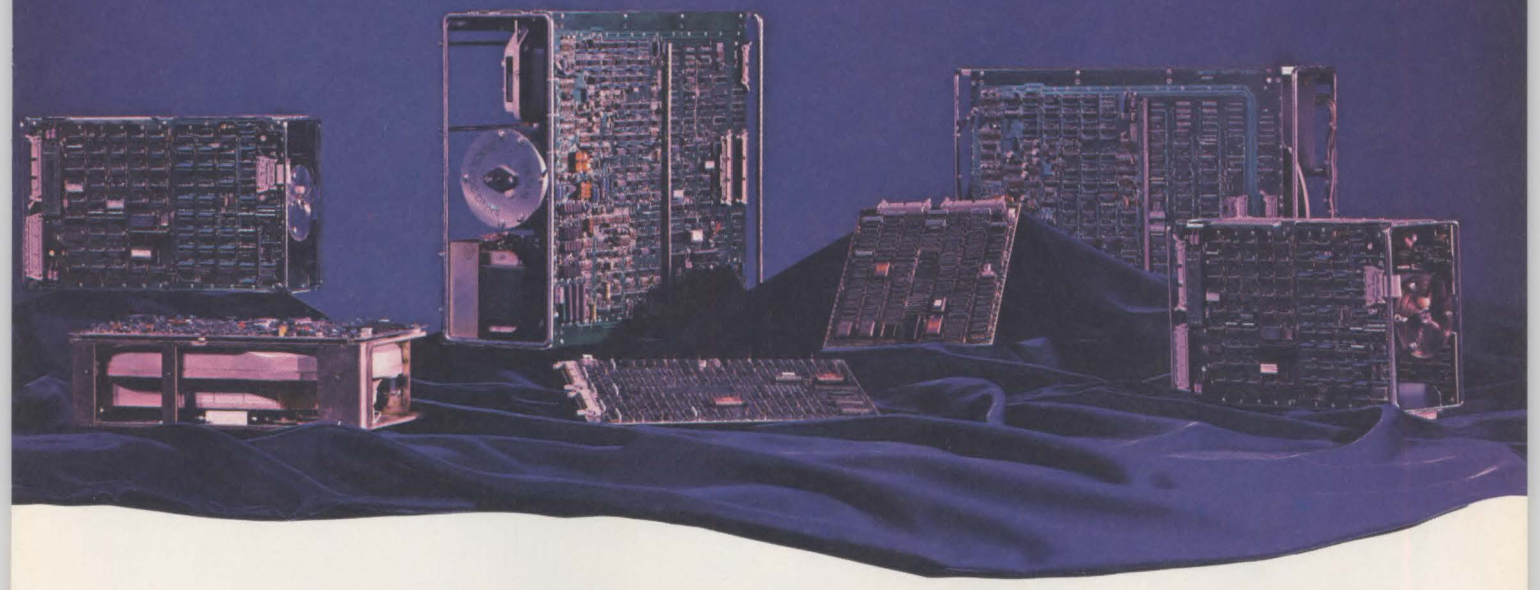

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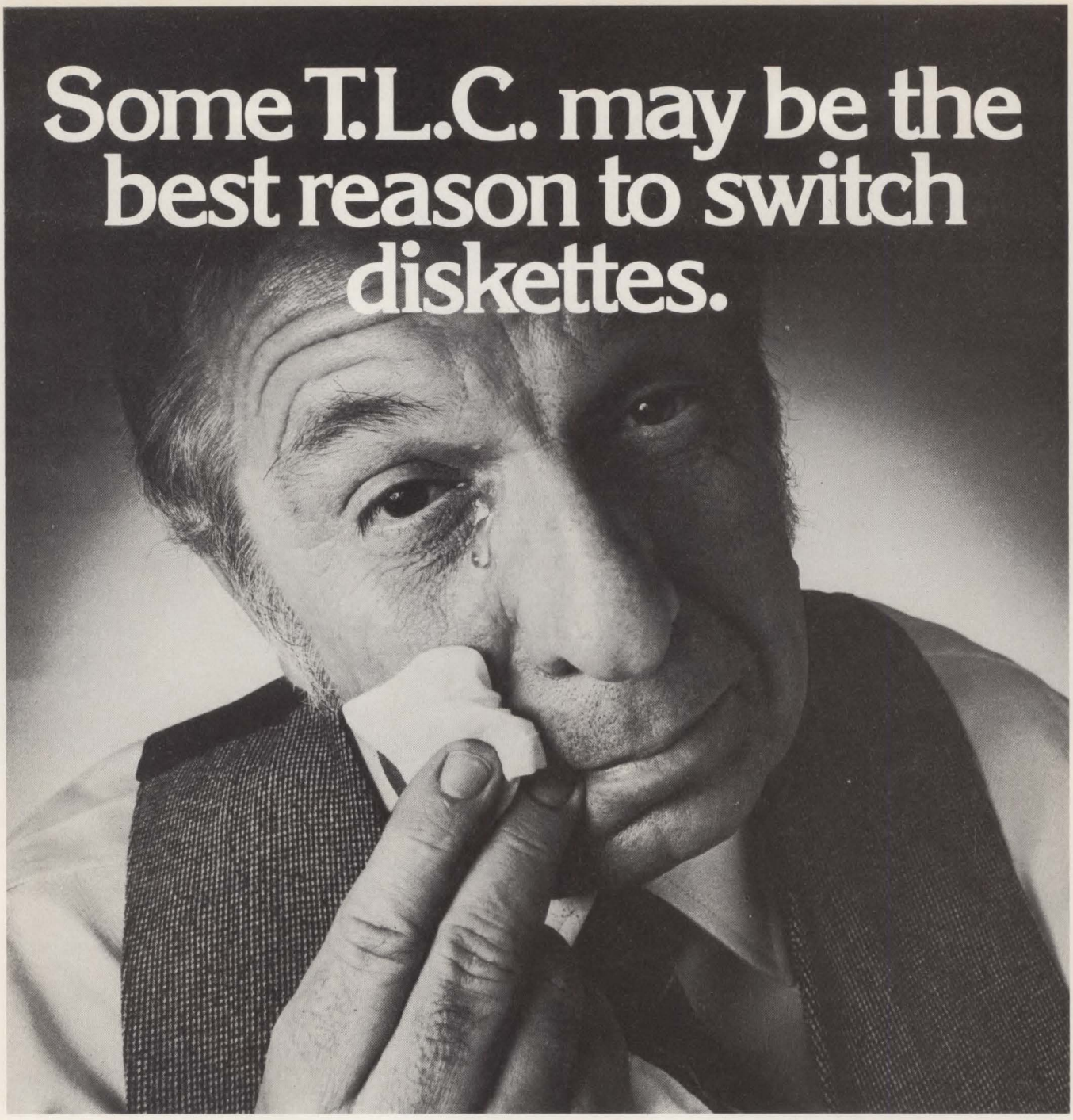

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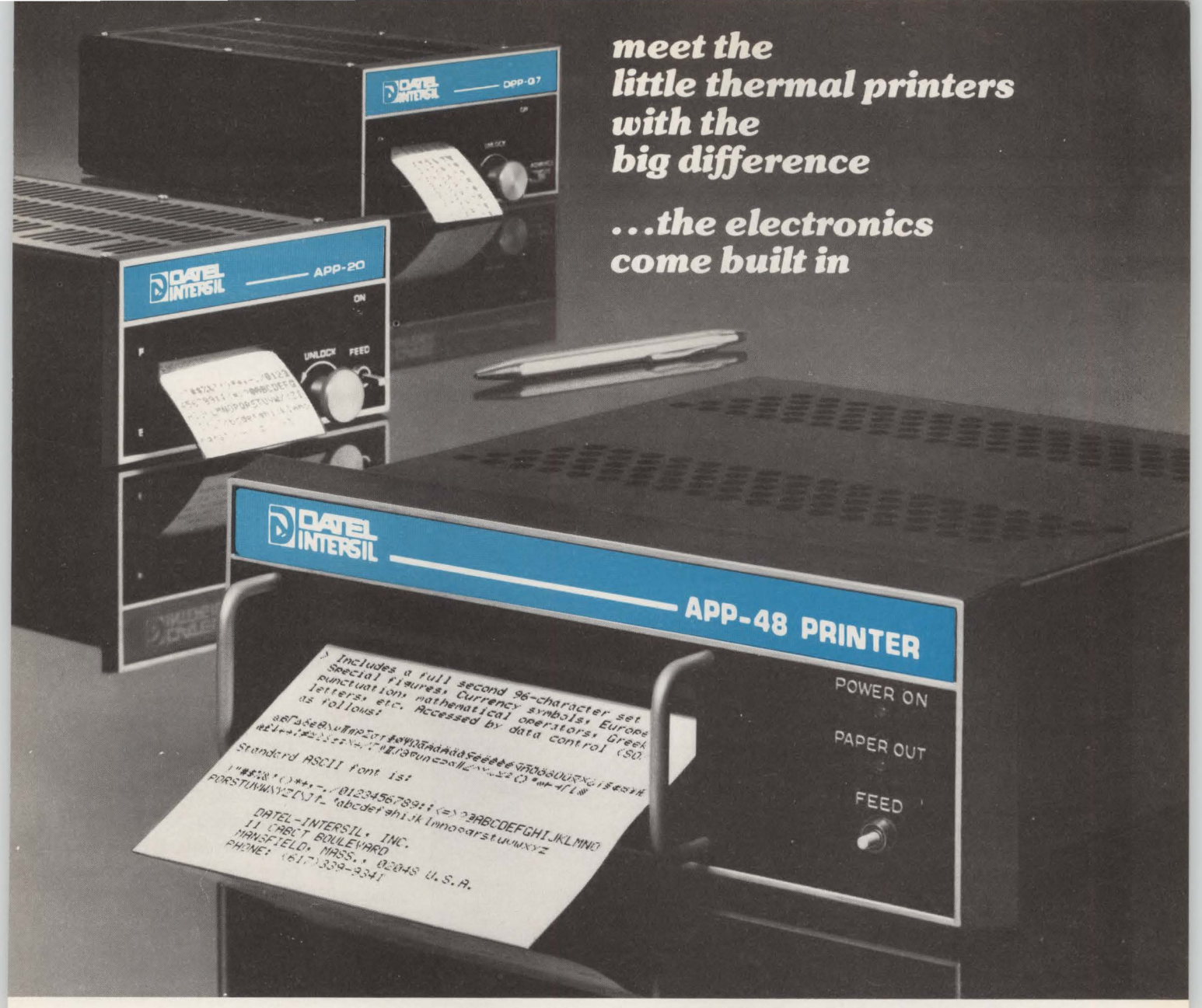

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move it in any quantity, so we aren't shipping until May or June," Blossom says.

GA, the only company with installations of the software, offers a basic system configured around the GA 220 computer for an end-user price of around $20,000, including the NoCode licensing fee. Gordon Nylen, product-line manager for NoCode, says that there are only a few successful NoCode installations after a year of availability, but that the product is gaining momentum. "One of the biggest problems has been credibility," says Nylen. "You tell somebody that Pro or NoCode improves software productivity by a factor of 10, and they say, 'sure it can!' But we have the benchmarks to prove it."

Despite NoCode's slow start and the slow introduction of similar software from Microdata and CIE, Nylen remains enthusiastic about his company's product. He says GA hopes to become an OEM distributor for the CIE system to fill out GA's low-end NoCode product line.

Others are openly skeptical. Lawrence Finch, for example, chief executive officer of Shasta General Systems, a Sunnyvale, Calif., systems OEM, has discussed buying a bare-bones configuration of the new Pro machine from CIE, and has seen the NoCode software run. He remains unconvinced, however. "I'm not sold on the 'open sesame' approach," Finch says. "I've been waiting 27 years for the software answer, and I'm not sure it's here yet."

Egil Juliussen, an analyst with Future Computing, Inc., a Richardson, Texas, consulting firm, predicts a tough time for CIE if it ventures into the small-business-systems OEM market armed only with Pro. "Although they have the Japanese reputation for quality going for them, I don't see that or this applications generator giving CIE an edge," Juliussen says. "Most OEMs would rather go with CP/M or UCSD P-code systems than with Pro, just because there are proven application packages available. CIE might have an advantage with a businessman who would like a tailored accounting system so he can run his business more effectively."

CIE expected both resistance to its unusual software and a desire among third-party vendors for application software. To alleviate those problems, CIE plans to add Pascal and other high-level languages to its new offering, which uses a Versados operating system modified to accommodate the Multibus standard. But because software packages for Versados have just begun to appear, CIE is also talking with Digital Research and Microsoft to explore the possibility of adding

MINIBITS

PERSONAL COMPUTER MARKET BOOMS DURING 1981

An influx of Japanese products during 1981, combined with a rapid growth of new developments, will challenge users and dealers of personal computers who will have trouble deciding what to buy, according to a study by Strategic, Inc., San Jose, Calif. New developments impacting the market include the entry of such companies as International Business Machines Corp., Xerox and Hewlett-Packard Co. with low-end systems, the growth of voice-input and local-area-network technologies, the acceptance of CP/M as a standard personal-computer operating system and the move toward 16-bit hardware for low-end systems. The report also notes that more on-site service contracts will be offered during the coming years, as well as support literature for software products. Factors accelerating the personal-computer market include a growth in venture capital funds, public stock offerings and company acquisitions.

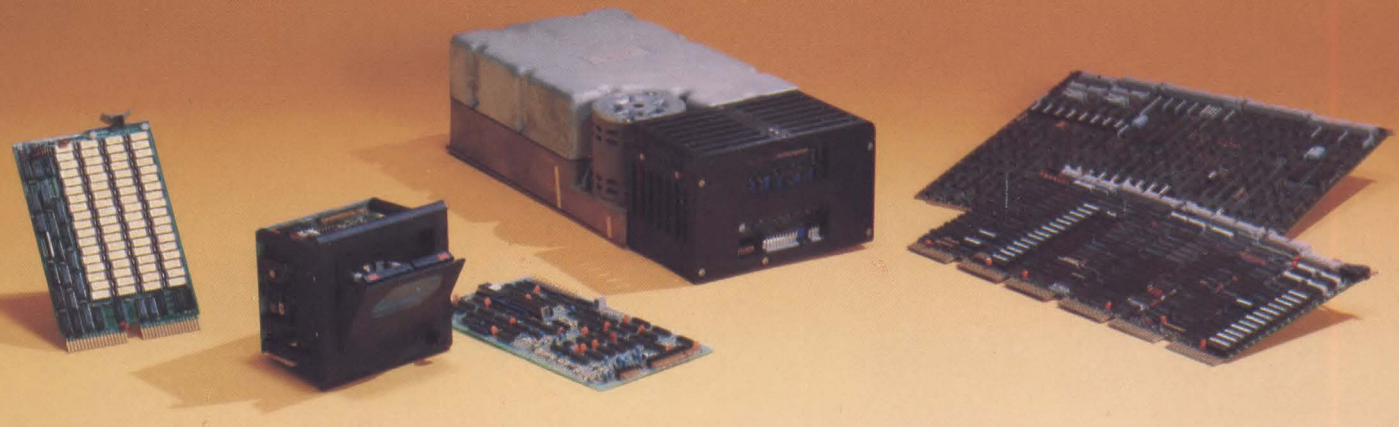
TAPE DRIVES TO BE USED IN TOLL SYSTEMS

Innovative Data Technology, San Diego, Calif., will supply 200 ½-in. tape-cartridge drives over the next year to two companies building systems for California's Department of Transportation. The systems will be used to collect toll data, including time, date, toll-collector identification, vehicle class and charge-account information. Tetra-Tech Services, San Diego, will receive half of those tape drives, which will be used in charge-billing systems to be set up in California toll booths. Sierra Information Systems will incorporate the drives they receive into a toll-collection and -audit system.

COMDEX MAY DOUBLE IN SIZE NEXT YEAR

Before exhibitors at last November's Comdex Show in Las Vegas had a chance to disassemble their booths, they were already reserving space for next year's show. Sheldon Adelson, president of the Interface Group, Framingham, Mass., the exhibition firm that sponsors Comdex, says that 94 percent of the 648 exhibitors at the '81 show signed for next year, in addition to an estimated total of 50 new companies. Adelson says that about 700 companies have placed orders for 2351 booths and that there is a waiting list for 350 slots. The Interface Group is working to reserve the entire 750,000-sq.-ft. Las Vegas Convention Center for the '82 show, rather than the 335,000-sq.-ft. East Hall where Comdex '81 was held. If they succeed, Adelson says, next year's show could include as many as 3500 booths—more than double the size of the last show, which included 1630 booths. He adds that the final head count of attendees at the '81 Comdex exceeded 23,500.

digital sales associates



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New, the MicroSTOR-1123 delivers one-half megabytes of memory in a single Q-bus slot. It features 22-bit addressing, parity, and it is easily configured for battery backup mode.

Features and Benefits

- **64K dynamic RAM**
- **Up to 4 megabytes expansion**
- **Requires only 5 volts**
- **Attractive unit and volume prices**

Cambex offers many other dynamic memory products for PDP-11, LSI-11 and VAX 11/780 computers. Complete information will be sent to you —including information on our semiconductor RK05 disk replacement.

CIRCLE NO. 173

RAYMOND ENGINEERING, INC.

Microprocessor-Based Cassette Tape Drive

The Model 6440 Raycorder II represents a cost effective, "state-of-the-art" design, that combines a simplified mechanical configuration with the sophistication of microprocessor-based control electronics. At the heart of the Raycorder II is a processor-based control system which continuously monitors and regulates tape speed and tension while assuring uniform start/stop profiles.

Features and Benefits

- **Simplified mechanical design, only two moving parts**
- **Performance equal or better than capstan drive machines**
- **Sophisticated control electronics provide gentle tape handling**
- **Precise head alignment for cassette interchangeability**
- **Reinforced molded plastic structural parts for strength and stability**
- **Easy cassette load and removal**

Raymond manufactures a full line of mini-cassette, Philips cassette and ¼ inch cartridge drives available with standard serial or optional 8-bit parallel, RS-232 or IEEE-488 interfaces.

CIRCLE NO. 174

SLI INDUSTRIES

"SLI Cheyenne Disc Subsystem" Winchester Technology

The Cheyenne 8-inch Winchester-type disk drive offers capacity from 7.4 to 83 MBytes. Also featured are SMD, ANSI and "Floppy" interfaces. Microprocessor based electronics are used to control servo functions, self-diagnostics and interfacing.

All aluminum construction is used for maximum heat conduction; heat producing components are physically separated for maximum convection heat transfer and high power dissipation devices are mounted to large surface area convectors.

Features and Benefits

- **PROM control for write compensation, servo functions, executive program and interface control**
- **Modular electronics design, bolted directly to rear of unit for easy access—or separable for remote operation**
- **Power and interface connections at rear of unit, positioned to allow easy access**
- **Non-recoverable error rate less than 1 in 10^{12}**

CIRCLE NO. 175

SPECTRA LOGIC CORPORATION

Single and Multifunction Disk/Tape Controllers for DEC, D.G. and Perkin-Elmer Computers

AN INDUSTRY FIRST, multifunction controllers, SPECTRA 21 and SPECTRA 20, replace separate disk and tape controllers in DEC and D.G. computers. You can attach up to four SMD compatible disk drives and up to eight formatted tape drives, including the new streaming drives. Full multifunction emulation of standard DEC and D.G. subsystems is provided. And, if you do not use tape, ask about our single function DEC, D.G. and Perkin-Elmer emulating disk controllers.

A SPECTRUM of Benefits

- **Substantial savings—eliminates most of the cost of a separate tape controller**
- **Dual microprocessor design for simultaneous control of both disk and tape subsystems**
- **Full hardware error detection and correction**
- **SPECTRA STREAM software allows tape streaming at full 100 IPS speed under standard operating systems software**

CIRCLE NO. 176

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The SOURCE for Your Computer Peripherals

HMW ENTERPRISES, INC.

Full Graphics Desk Top Terminal

The Model HMW 9001 desk top graphics terminal is a completely stand-alone device used for color display of text, forms, graphs, plots and diagrams. This terminal requires only 110v power and an RS-232 or 20MA current loop communications interface to be placed on-line. Communication with both full and semi-graphics is programmable from 110 to 9.6 kilobuad, half or full duplex asynchronous block transfer mode. The HMW 9001 is organized as a semi-graphics character oriented terminal with an optional full graphics point addressable overlay. The 13″ high resolution in-line gun CRT displays 80 ASCII characters per line by 48 lines per page. Large characters are written at 80 characters per line by 24 lines per page. Up to 64 user defined special characters are provided for forms and diagram generation. The optional 8-color full graphics overlay has a resolution of 512 x 256 and features an 8K byte program buffer. The on board 2D graphics package features vector, circle and polygon generation, polygon translation, color mixing and color prioritization. The interactive keyboard features long life hall effect solid state switches and is functionally organized by color and layout. On board firmware supports an extensive line of peripherals including light pen, joystick, track ball, floppy disk and printer.

CIRCLE NO. 170

ADAPTIVE SCIENCE CORPORATION

ModulasOne Microcomputer Modules

The ModulasOne line of microcomputer modules provides cost-effective performance to OEM and end-users alike. The large selection of modules has been proven worldwide—on oil drilling rigs, in television stations, with nuclear test apparatus and in many other applications.

The set of thirty modules includes microprocessor modules (6802, 6809, 6502), memory, digital and analog interfaces, packaging, backplanes and a substantial selection of special-purpose boards. ModulasOne emphasizes modularity with its fully buffered low-noise bus, slot-position independence and high-packing density. Flexibility is achieved by using 4.5″ by 6.5″ modules which focus on specific functions—users are not required to purchase excess unused functions as can be the case with larger modules.

Features and Benefits

■ One-Bus, the efficient bus for the 6800 family ■ Selection of 25 modules for ModulasOne-Bus ■ Additional support modules including one-card computers ■ Software, firmware and system support ■ Development system sets available ■ Support for 6502, 6802 and 6809 microprocessors

CIRCLE NO. 171

SERIAL LAB PRODUCTS, INC.

SL-800/800M Series Intelligent Serial I/O Modules and Systems

The SL-800 Series is a unique new line of computer peripherals for low-cost data acquisition and control—without the need for bus interfacing. It is powerful, flexible, economical and easy to use: with the SL-800 you can install Analog and Digital I/O where it is needed using existing RS-232C/RS-423 lines. Multiple units may be daisy-chained on the same line for even more cost savings! You can share the same line with existing terminals or other RS-232C based peripherals. User systems and OEM modules available.

Features and Benefits

■ Enhance signal intensity by eliminating long runs of low level signals ■ Simple ASCII-based command protocol may be used with hi-level languages ■ Transparent to host when not executing commands ■ Reduce wiring and installation costs ■ Locate up to 4000′ from host computer with RS-423 ports ■ OEM module available for hi-volume applications

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HOW CIE'S PRO ATTACKS PROGRAMMING BOTTLENECK

Sushil Garg hatched the idea for Pro after his frustration at having continually to recode the elements common to the business applications he wrote for Data Technical Analysts, a Honolulu-based service bureau. He wrote a subroutine for each element, and then developed a linking algorithm that generates an application based on specifications input by a user. Development of these specifications requires a system analyst, who fills in blanks on a series of questionnaires to define the file contents, system structure, screen masks and report formats desired. This information is then input to Pro via a menu-driven series of CRT-terminal displays.

Pro then takes typically fewer than 20 sec. to pick and link the precoded subroutines necessary to create the desired application software. Thus, without writing a single line of code, a user has customized a menu-driven, prompt-aided package that can encompass database management, report generation and file updating. If a change is desired, the user goes back to the filled-out questionnaires, determines what specifications need changing and revises only those via the main menu.

Developers and licensees of Pro stress that it is not a program generator. The machine language subroutines that implement the common business application elements always reside in main memory and are shared by on-line users. Microdata's All and CIE's Pro occupy about 20K bytes, while General Automation's NoCode, which was partially written in FORTRAN, has a mainline program of about 48K bytes. User-dynamic partitions containing the run-time specifications, which vary in size according to the application, are typically 6K to 8K bytes.

Most industry observers, used to the high overhead of typical software productivity-enhancement tools, are often surprised that Pro, All and NoCode run more efficiently than applications developed using ordinary programming techniques. Benchmarks run by Microdata pitting All against Databasic versions of the same application show All running 1.5 to 8.5 times faster, depending on the application and system configuration.

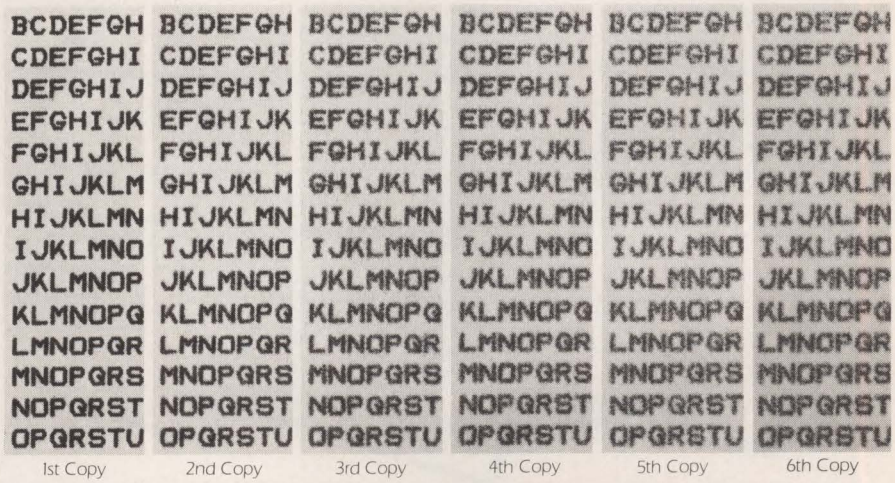
GA's NoCode, the earliest commercial implementation of the software and the product of Garg's development work on a GA computer, is slightly inferior to All and Pro, says CIE's Jay Kear, executive vice president and general manager. He reports that GA is considering updating NoCode to the more user-friendly interface of the other two licensees, which would make the three functionally identical. That would please Garg, who hopes for sufficient standardization of his brainchild to allow applications to be transferable among the manufacturers' machines.

CP/M and UNIX to its new machine.

CIE also plans to prove how well Pro performs, and has set up a beta test site at a large racquetball club. "The application will have to handle a large number of things," Kear says, "including court scheduling, billing for court time, no-shows and laundry; pro shop and restaurant purchases; and even opening the door or denying admission when a member's ID card is put into the slot, based on whether the account is current." Kear says the owner of the club will have to hire a systems analyst to define the problem, but after the system specifications are worked out, the application will take an employee with no programming experience only two days to implement.

The first installations of the CIE Pro system will be implemented by C. Itoh America. A basic configuration of the system will be installed in each dealership of American Isuzu Motors, Inc., and in all Mazda dealers east of the Mississippi River.

—Kevin Strehlo



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CIRCLE NO. 18 ON INQUIRY CARD

ISOs are 'calling the shots' in small-computer distribution

Independent sales organizations (ISOs) are calling the shots in the small-computer distribution market. Because of the glut of small-business systems priced between $5000 and $20,000, the growing number of applications and the expanding base of potential users, the limited number of financially solid ISOs can afford to be more choosy in selecting equipment and vendor partnerships.

ISOs—distributors, dealers, commercial OEMs, office-product dealers, systems houses and computer retailers—are becoming more demanding in terms of help they expect from manufacturers. And they're getting it—technical support, creative financing programs for users, floor-plan assistance, cooperative advertising, software support, service, training and quick deliveries. These incentives mean more attractive margins for dealers because manufacturers usually shoulder the costs.

At the same time, however, manufacturers are being careful to affiliate only with ISOs that are financially stable and professionally competent.

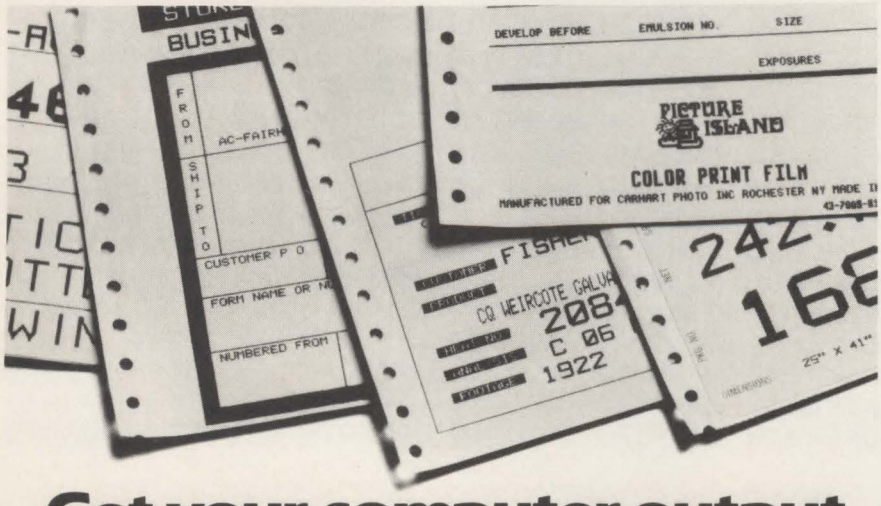
North Star Computers, Inc., San Leandro, Calif., is one manufacturer that openly expresses a willingness to cater to dealers' demands. "We'll do anything we can to make it easier for our dealers to sell our products," says Elliot Wasserman, vice president of marketing. "We need them badly."

Robert Ashley, president of Ashley Office Equipment, Texarkana, Texas, chose Data General Corp., both for its support package and for its service organization. "I wanted a company that had a complete package to offer, including sales, service, software and software support. I'm not a programmer, nor do I want to be," he says. DG also offers video training for users and dealers, floor-plan assistance and financing for end users.

For Allen L. Watts, president of InterACT Distributing Co., Asheville, N.C., an authorized DG distributor, vendor selection was influenced by cash concerns. He says 70 percent of his customers will get some type of financing when buying a small computer. "Banks have been hesitant because many small businesses are new," he explains. That's when Watts is glad he chose DG as a vendor, because it offers end-user financing through Hertz Corp.

Watts would also like to see better purchase terms for distributors, such as those initially offered to him to carry his other small computer, the Xerox Corp. 820. Xerox let him order 200 820 systems and not pay for 90 days. That gave him a more positive cash flow as he resold the equipment to dealers. He says Xerox will stop the program soon, but "it did get the product on the shelf."

The ability of retailers is being strained as more vendors try to grab a share of this fast-growing market. Bruce Burdick, an owner of four Cumberland outlets in the Midwest, says the average retail computer store can stock only about three product lines in 2000 to 3000 sq. ft. of floor space. Such a limitation is forcing retailers to become choosy as to which products they will stock and is allowing them



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CIRCLE NO. 18 ON INQUIRY CARD

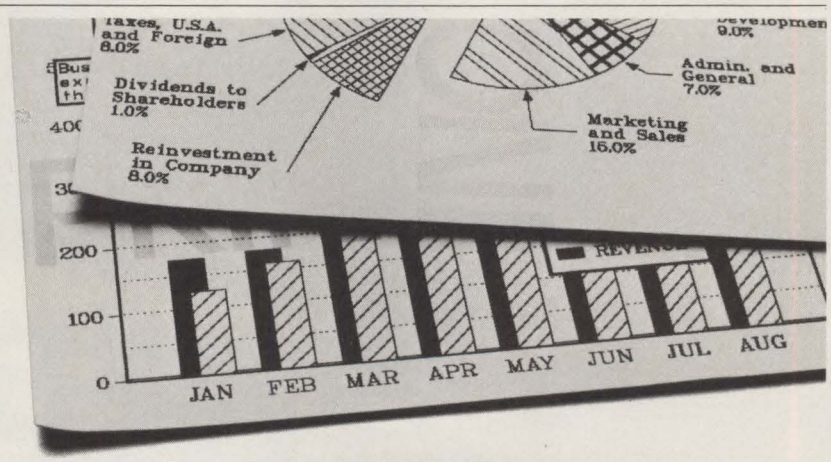
Illustration by Jon McIntosh

to make demands of the vendors they deal with.

Some retailers receive help to get their stocked products out the door. Leading Edge Products, Inc., Canton, Mass., is cutting the initial purchase commitment for retailers, so products move quickly from the manufacturer, through Leading Edge and to retailers on an as-needed basis. "Leading Edge has built its business by allowing retail stores to buy when they need a product. And we deliver," says assistant to the president Tom Shane. Some hardware vendors are also cutting their own margins and offering increasingly larger discounts to lure ISOs.

"The discount range has increased about five percentage points in the past 24 months," says North Star's Wasserman. He says hardware discounts range from 30 to 40 percent, while software discounts are higher because of lower production costs.

Recently, Digital Equipment



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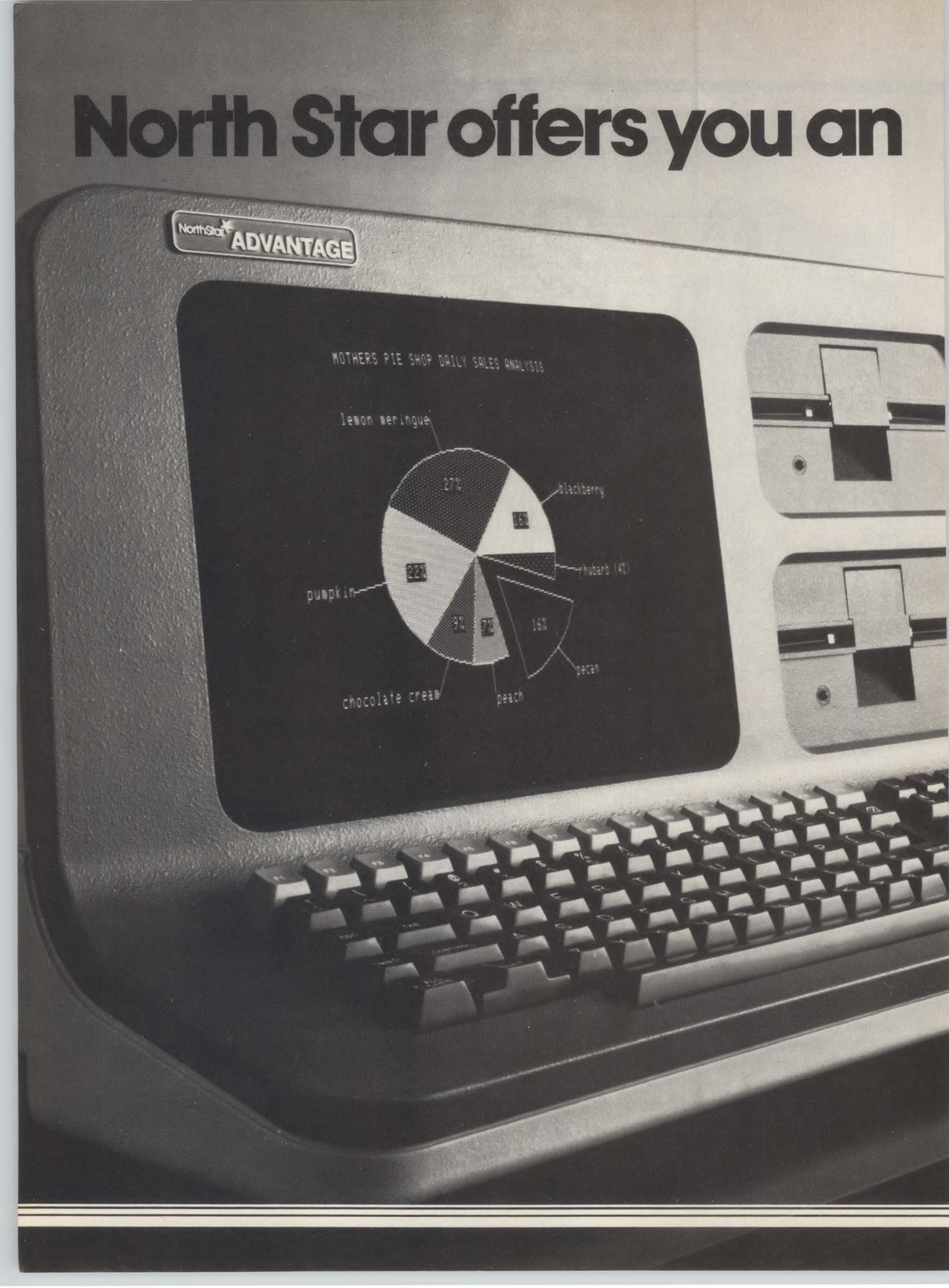

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The ADVANTAGE is fully CP/M® compatible. Neither IBM nor Apple provides this ability to run the broadest range of industry-standard applications. In addition, only North Star offers 10 application packages for word processing, financial analysis, accounting and data base management.

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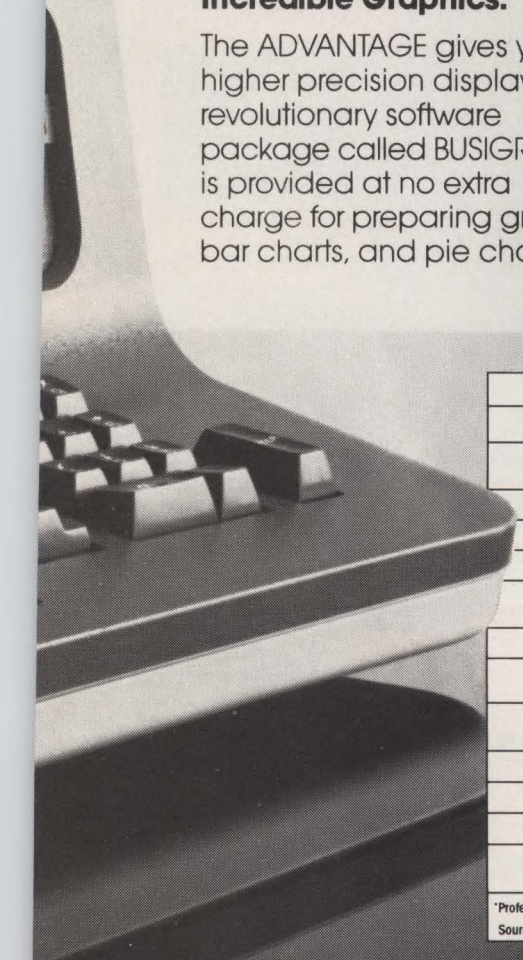

THE INCREDIBLE ADVANTAGE COMPUTER COMPARISON CHART*

	NORTH STAR ADVANTAGE	IBM PERSONAL COMPUTER	APPLE III
MICROPROCESSOR(S)	Z-80A Central processor 8035 Auxiliary processor	8088 processor	6502A processor
GRAPHICS DISPLAY RESOLUTION	640 x 240 pixels	640 x 200 pixels	560 x 192 pixels
DUAL FLOPPY DISC CAPACITY	720K bytes	320K bytes	280K bytes
CONVENIENT DESKTOP PACKAGE*	Yes, all in one enclosure	No, 3 enclosures	No, 3 enclosures
BUSINESS GRAPHICS SOFTWARE INCLUDED?	Yes	No	No
CP/M COMPATIBLE?	Yes	Partial	No
LANGUAGES SUPPLIED BY MANUFACTURER	Graphics BASIC, PASCAL, COBOL, FORTRAN, C	BASIC, PASCAL	BASIC, PASCAL
APPLICATIONS S/W PACKAGES SUPPLIED BY MANUFACTURER	10 packages	5 packages	5 packages
SELF-TEST DIAGNOSTIC	Yes	Yes	No
NATIONAL ON SITE SERVICE	Yes	No	No
MANUFACTURER SUPPLIED PRINTERS	Letter quality/matrix (136 columns)	Matrix (80 columns)	Letter quality/matrix (80 columns)
RETAIL PRICE PER KILO-BYTE OF DISK STORAGE	$5.55	$11.17	$15.57

*Professional configuration: Dual Floppy Disks, Monochrome Display, Keyboard, CPU, 64K bytes (or minimum) RAM Memory, and Printer Interface.

Source: Dataquest and Manufacturer's Literature, November 1981.

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RAISE YOUR GRAPHICS STANDARD!

Price/performance you couldn't get before in a high resolution raster terminal no matter how far up you climbed—it's yours in the Genisco G-1000.

The G-1000 high resolution (1024 x 792) desk top terminal offers extraordinary brilliance and contrast with full raster erasability, *plus* the intelligence of a Z-8001 microprocessor and 16K each of RAM and PROM. The price is less than $9,000 in OEM quantities.

What you get for your money is the industry's only true raster replacement for the Tektronix 4014-1 terminal (plug to plug and software compatible) and a no-end-in-sight expandable, fully programmable tool for CAD/CAM, plot previewing, mapping and many other present and future applications.

Expand your G-1000 capability with an optional alphanumeric overlay and memory to 512K bytes RAM and 32K PROM for distributed processing applications. Attach a graph tablet and/or one of several hard copy devices.

No matter how you look at it, it comes out on top. Raise your graphics standard. Call or write for a G-1000 brochure to Genisco Computers Corporation, 3545 Cadillac Avenue, Costa Mesa, CA 92626, (714) 556-4916.

Genisco

GENISCO COMPUTERS CORPORATION

CIRCLE NO. 20 ON INQUIRY CARD

Corp. unveiled a plan that allows authorized distributors and other commercial OEMs to receive a 40-percent discount if they agree to purchase at least 12 DEC Datasystem 336 or 512 packages per year. The 40-percent figure is broken down into a 36-percent price discount and a 4-percent cooperative advertising allowance per system purchased.

But while many manufacturers are willing to meet dealers' demands, they are also expressing concern about the availability of financially solid ISOs. The possibility of a shortage of qualified dealers may impact the industry's ability to grow, says one West Coast executive.

"The market for this hardware is growing 40 percent a year," says Lore Harp, president and cofounder of Vector Graphic, Inc., Westlake Village, Calif. "We must grow at a rate of 100 percent a year or get out of the business." Harp is concerned that a shortage of good, strong dealers may crimp the marketability of systems such as her company's $4000 Vector 1600 and its new multi-user Vector 5005 ($8995). "Everyone is battling to establish the distribution networks they need," she says.

Harp says the main problem in qualifying dealers to handle systems in Vector's price range is financial. "It's difficult for dealers to get credit, and banks aren't interested in taking computers as collateral for loans," she says. "Besides, even if they did get a loan, dealers can't pay 18 percent interest and still make a profit." The result is something of a distribution anomaly. Harp says several Vector dealers have folded as a result of the credit crunch, and overall there has been a slowdown in payments. Despite this, sales continue at a brisk pace. "There has been no corresponding slowdown in orders," she reports. Nonetheless, Vector is taking strong steps to enforce its credit policies and has not shied away from eliminating dealers that aren't performing.

"We don't want a dealer's business if they can't make it," says Microdata ISO director Clarence Sullivan. "So we look for sales ability, as shown by a track record of five years in computer sales. We also require a business plan...and we have a minimum financial resources policy in major markets."

Finding good distributors is a challenge, says Peter Zinsli, vice president of marketing for Rexon Business Machines. "The real problem is it's not hard to find

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- Selectable Jump or Smooth Scroll
- Split Screen
- Selectable International Character Sets

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- International Character Sets Available
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ADM 32 OEM EXPANDABLE SMART TERMINAL

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- Optional Polling
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- Full Editing/Visual Attributes/Business Graphics
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- Jump or Smooth Scroll

Until now there's been quite a war going on over prices and features in the terminal industry. Until now, that is—the competition just lost, hands down.

For years, Lear Siegler has set the standards of the industry. Dumb and smart. And the competition has worked hard to imitate them.

But these new prices and performance features are the toughest standards anywhere. Bar none. So it's back to the drawing boards for everyone else in the industry.

Meanwhile, Lear Siegler is featuring a complete family of low priced, high performance terminals with attached or detachable selectric keyboards, white or green screens, Dumb or smart.

The detachables offer extra memory and accept an extra board for speech, graphics, modems, controllers or additional memory. Options include 15" screens and a convenient tilt mechanism.

So if you've been holding out, waiting for the right prices and features, give in.

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INCREDIBLE PERFORMANCE, INCREDIBLE PRICES.

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DATA PRODUCTS DIVISION

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CIRCLE NO. 22 ON INQUIRY CARD

distributors; it's hard to find good ones." High interest rates make selling computers more difficult, Zinsli adds. "It puts stress on distributors who, if they don't get financing or if they have one bad month, will definitely be hurting."

But financial stability isn't the only strength vendors seek in an ISO. For many suppliers of small-business systems, the most important attribute of any ISO is the organization's ability to add value to the system. William Chalmers, who recently assumed the presidency at M/A-COM Office Systems, Inc. (formerly Ohio Scientific), Aurora, Ohio, says about 90 percent of M/A-COM's revenues come from medium-to-high added-value resellers. These are systems houses and OEMs that serve vertical markets.

Chalmers characterizes high added value as the ability of an ISO to write application software, sometimes design custom interface boards and provide local customer service and support. "We've had most of our success with these kinds of resellers because they provide more customer satisfaction than others; they're not interested solely in their dollar turnover."

Paul R. Tucker, vice president for marketing in distribution sales at Honeywell Information Systems, Inc., Newton, Mass., says the entire line of DPS-6 and Level 6 minicomputer-based line of systems is offered through distribution, but mainly through systems houses, not retailers, "because these are 16-bit minicomputers, not μcs," which retailers can sell more easily than a mini, Tucker says. He's definitely looking for Honeywell's systems houses to add value, "to augment our end-user business, especially in vertical markets where we're not strong," he notes.

About 40 percent of the units (not dollars) that Honeywell ships goes through resellers, six of which Tucker says are system-house-like distributors. Typical of them is the Ultimate Corp., Clark, N.J., which sells Honeywell systems under the Ultimate name. Ultimate is also a good example of the support commitment that Honeywell will make to selected ISOs that have solid track records. "Ultimate didn't exist three years ago," Tucker says, "but they're selling our systems at a rate of about 500 a year now, and had 66 dealers signed by the end of 1981."

Honeywell established a branch-level organization consisting of eight people who work exclusively with Ultimate to help develop Ultimate's dealer program through documentation, training and seminars to acquaint the dealer with the hardware.

Tucker says Honeywell's distribution sales were outstanding in 1981, reflecting a twofold increase over 1980 and the largest year-end backlog in four years. "We don't see any evidence of a recession," he says.

—Reported by Lawrence J. Curran, John Trifari, L. Valigra, Eric Lundquist, Kevin Strehlo, Frank Catalano and Nancy Love; compiled by Peter Hayhow

Datapoint adds graphics, laser printer to ARC network

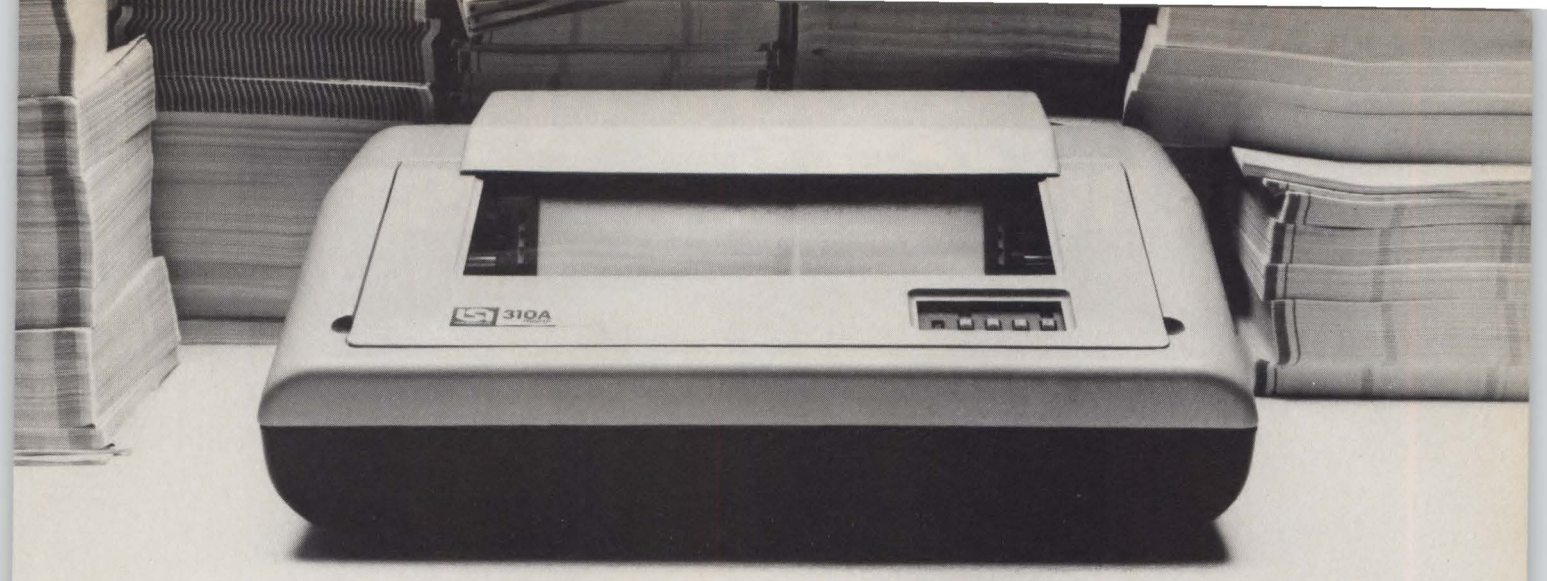
With the November additions of a color business-graphics system, an intelligent laser printer and a versatile facsimile interface to its Attached Resource Computer (ARC) network, Datapoint Corp. believes it can keep its more than 2000 ARC customers happy, and also silence critics who say that one supplier can't adequately meet all its customers' office-automation requirements. System universality is especially important to vendors such as Datapoint and Wang Laboratories, Inc., which keep access to their office networks proprietary, thus preventing outside suppliers from selling compatible components.

In addition to the three new functions, ARC systems also support data and word processing, an electronic-message service and voice and data communications.

In the realm of office automation, the new ARC products "further entrench and advance Datapoint's leadership, and they already have a pretty big lead in this area," says Stephen T. McClellan, an analyst with Solomon Brothers, New York. "Wang has made the most dramatic move with its Alliance system to be competitive with Datapoint," he says. "But Datapoint is still in the lead, and not waiting for anybody."

Of the three recent ARC enhancements, the 9498 facsimile communications interface may be the most innovative. The interface attaches through an RS232C port to any Datapoint processor running the firm's resource-management system (RMS). When necessary, the interface serves as a protocol-conversion unit for direct communications between CCITT Groups I, II and, optionally, III facsimile devices. The 9498 also transmits facsimile images to and from disk-based storage associated with a single Datapoint processor or within an ARC network.

"As far as I know, this is the first facsimile device capable of inputting standard fax information into computer storage," says H. Paris Burstyn, an analyst with The Yankee Group, Boston, Mass. "It's a very significant announcement. There are almost 300,000 installed facsimile machines in the U.S., and



Hummm Economics.

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

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

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

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

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

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

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

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

FEW OPTIONS. A LOT OF STANDARDS.

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

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

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

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

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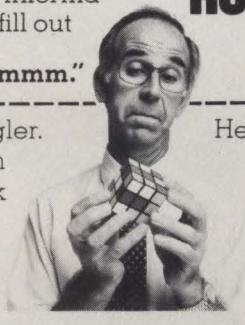
THE 310A HUMMM TERMINAL.

LEAR SIEGLER, INC.
DATA PRODUCTS DIVISION

"Hummmm."



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

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

Name_____

Distributor _____

Distributor Sales Rep_____

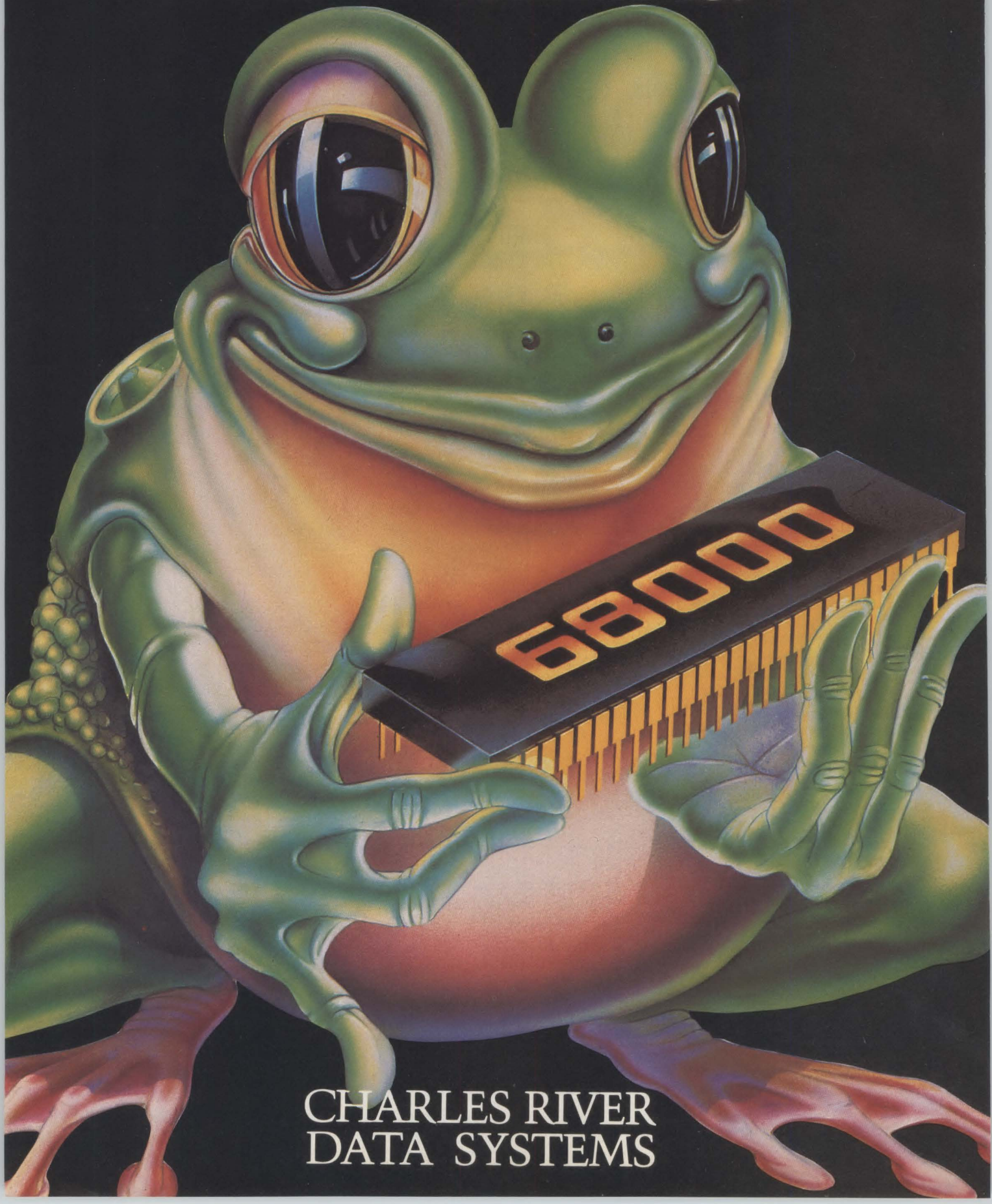
Distributor Location_____

Distributor Telephone_____

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

CIRCLE NO. 23 ON INQUIRY CARD

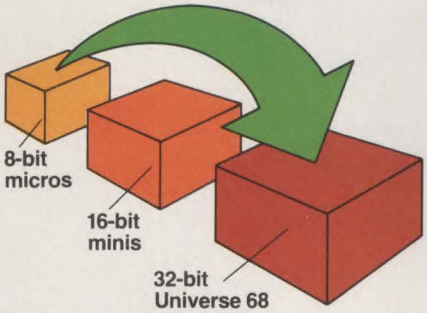
Universe 68 leapfrogs the 16-bit minis.



CHARLES RIVER
DATA SYSTEMS

Introducing the first 32-bit supermicro for OEMs

Our new Universe 68 computer system offers powerful 32-bit architecture, a microcomputer price, the programming efficiency and portability of a UNIX-like operating system, and the refreshing experience of working with a computer supplier whose business practices are actually designed to make life easier for OEMs.



Jumping over outmoded 16-bit architecture

Built around the Motorola 68000 microprocessor, the Universe 68 system is a 32-bit supermicro that leapfrogs conventional 16-bit minicomputer technology. It has directly addressable, non-segmented address space of 16 million bytes, compared to the 64-kbyte limitation imposed by 16-bit architectures.

That means greater functionality per dollar, increased program development efficiency, and power to tackle demanding new applications.

The Universe 68/10 computer system

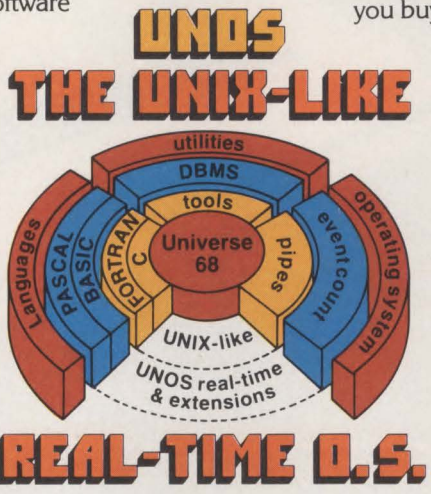
Outhopping supermini prices

The Universe 68 gives you 32-bit performance at micro prices – –while the big frogs in the minicomputer pond are still offering 32-bit technology only in expensive "superminis." A Universe 68/10 with 32-bit processor, 256 kbytes of memory, floppy disk, and Winchester disk sells for under $20,000. Order ten, and the unit price drops to $16,860, including system software.

Springing past conventional system software

UNOS, our UNIX-like operating system, is part of the new generation of more flexible, easier to use software written in the high-level systems programming language C. To help OEMs develop products faster and less expensively, it incorporates UNIX features (such as "pipes," I/O redirection, and hierarchical files), plus portability that conventional systems software can't match.

To its UNIX-like base, which supports FORTRAN and C languages, UNOS adds PASCAL and BASIC, an expanded data base management system (DBMS), and an array of run-time oriented, real-time transaction processing capabilities, including a highly sophisticated "Eventcount" process synchronization mechanism. These extensions can be the key to implementing real-time and information systems applications.



Croaking obsolete business practices

OEMs often find computer suppliers tough to deal with. Bundled hardware and software limit flexibility in configuring systems, while proprietary busses and assembly-language software can lock you in to one vendor.

We're out to change all that by offering OEMs a choice. You can buy complete systems from us, and just add application software. Or buy some components from us, and go elsewhere for others. You can even buy UNOS from us and run it on someone else's hardware. And by building the Universe 68 computer around standard, non-proprietary technology like VERSAbus, SASI bus, and the 68000, we've made second-sourcing easy.

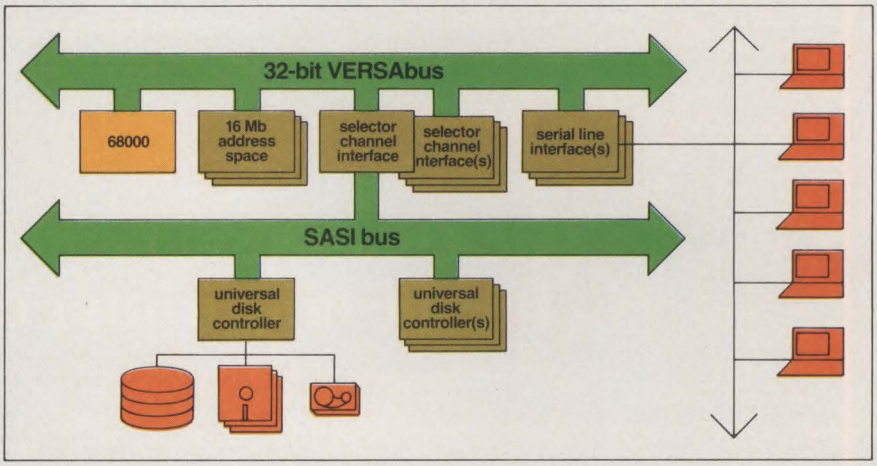
We've also introduced a more sensible approach to discounts. We give you discount credit for everything you buy. Our software discounts are based on how many licenses you buy, not in one year, but over *twenty* years. And they cut deep – all the way to 98%. We think this honestly reflects our costs: software development costs are almost entirely loaded at the front end, and support costs fall quickly once an OEM has gained experience.

Swallowing up the competition

If you need 32-bit power at a micro price and you can't wait for the minicomputer giants, you should know more about the Universe 68 computer and UNOS. For full information, call or write Charles River Data Systems, 4 Tech Circle, Natick, MA 01760, (617) 655-1800.

With the price/performance story we have to tell, we're ready to make a megasplash in the minipond.

The Universe 68 system takes advantage of standard building blocks, such as the 68000 microprocessor, 20-megabyte-bandwidth VERSAbus, and SASI bus.



UNIX is a trademark of Bell Laboratories. VERSAbus is a trademark of Motorola.
SASI bus is a trademark of Shugart Associates. UNOS is a trademark of Charles River Data Systems.

CIRCLE NO. 24 ON INQUIRY CARD

The One Printer Solution for the Two Printer Problem.

HIGH SPEED DATA PROCESSING

The new Dual-Mode 200 brings speed and uncompromising print quality to business and professional applications.

Financial statements, inventory reports, labels and more are printed at data processing speeds from 165 cps to 250 cps.

Fully adjustable tractors and a friction feed platen provide precise forms handling for pinfeed and single sheet paper.

Complete "Dot Control" graphics is standard with resolution to 120 x 144 dots per inch.

Interfacing is easy with both E.I.A. RS-232C serial and an ASCII parallel port.

LETTER QUALITY WORD PROCESSING

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

The standard Titan 10 pitch font is complemented by an array of optional fonts including Elite 12 pitch, italics, proportionally spaced, OCR-A, scientific and foreign character sets.

Up to 12 font selections may be stored in the printer and interchanged while printing.

The Dual-Mode 200 accepts standard daisywheel print commands for word processing system compatibility.

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The Dual-Mode 200 Printer for the one printer office.

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CIRCLE NO. 25 ON INQUIRY CARD

DOTS DO IT BETTER™

everyone of those devices is now a potential input and output device to an ARC system."

Because the 9498 interface permits disk storage of facsimile data, the product allows such information to be handled in a store-and-forward mode. Users can store multiple fax pages on disk for automatic transmission to remote locations during low phone-rate hours. The 9498 also permits unattended reception of facsimile transmissions, storing the pages on disk for later hard-copy output.

Within an ARC network, facsimile pages can be output on other facsimile machines or on Datapoint's new laser printer. The stored fax data can also be called up for viewing on the company's new graphics display. David A. Monroe, vice president, office graphics systems, says users of the Electronic Message Systems (EMS) can add facsimile data to their standard text messages. EMS users can also compose messages on their work stations and transmit them directly to a fax machine, without first creating a hard-copy version of the message.

Datapoint does not offer its own facsimile transceiver, Monroe says, but the company will soon market one. Scheduled for availability next summer, a basic version of the 9498 facsimile interface, which is compatible with Groups I and II analog devices, sells for $4950. With the Group III digital option, the interface sells for $7450.

Simultaneously displaying as many as 16 colors on its 512 × 482 raster screen, Datapoint's 9680 color business-graphics system also includes an input tablet and a system controller in its basic configuration. Operating with the company's 6000 processor, each graphics controller supports only one display terminal. This one-to-one configuration creates centralized graphics stations within the ARC networks, rather than distributing graphics to user terminals throughout the system.

Frank Gens, also an analyst at The Yankee Group, believes the lack of multi-user capabilities on the graphics system and its orientation toward a central graphics-production environment represent system drawbacks. "The level of resolution that the system offers is not suitable for presentation-type graphics," Gens says.

However, he is impressed with the graphics software Datapoint has developed for the system. "The graphics software is probably the best offered by any integrated systems vendor," he says. "The draw capability that lets you do freestyle drawings is terrific." The system also operates in five other modes—Chart, which presents data from ARC files in various chart configurations; Script, which lets users assemble a series of images for successive presentation; Playback, which provides for the running of scripts or single images for presentations; Library, which handles image storage and retrieval on disks; and Output, which provides for various types of hard-copy production of images.

Datapoint offers several output devices as options to its basic $30,000 graphics system, which is available now. A matrix color printer sells for $15,000, a 35-mm. camera system for slides sells for $10,000, and a $20,000 device produces slides, transparencies and 8- × 10-in. prints. Graphics images can also be output in black and white on facsimile units or on the laser printer, model 9660.

The 9660 incorporates a laser-based, electrophotographic printing module manufactured to Datapoint specifications by a supplier. Delivering 480 (horizontal) × 240 (vertical) resolution, the intelligent 9660 produces correspondence-quality output at 20 surfaces per min.

Two of Datapoint's new ARC products *are the 9660 laser printer and the 9680 color business graphics system (background). In addition to the standard input tablet, display terminal and graphics controller, the system includes an optional color matrix printer and a slide, print and transparency output device.*

The printer will initially be available with five typefaces, each having different character sets, such as italic, bold, domestic and international. As many as 32 different character sets can be printed on a page.

The laser printer has five input paper drawers, permitting different types of paper to be readily available for automatic feeding. As many as eight output modules, each containing 10 bins, can be connected to the printer. Lock boxes are available for bins having confidential material.

Users throughout an ARC system can access and instruct the printer from their own terminals, specifying such variables as typeface, type of paper and output bin routing. Available this summer, the 9660 laser printer with one 10-slot output module and a supply cabinet is priced at $65,000. *—Dwight B. Davis*

Triple-encryption devices operate at 6.5M-bps rates

30783J315Q330DS62312M347L4RAJ 40911T3032FN24532E128B3TG32N21 X69234H. The preceding won't make much sense to an unaided reader, but this string of jumbled letters and numbers does contain a hidden message. And although the message is difficult for a person to decipher without the proper key, the decoding procedure would be child's play for many of today's powerful computers.

To ensure that government agencies use more complex coding methods than used in the sample above, the National Bureau of Standards (NBS) several years ago adopted the Data Encryption Standard (DES) developed by IBM Corp. Although some critics claim weaknesses exist in the DES, the standard, now available on LSI chips, is gaining support from commercial as well as government users. Manufacturers of data-encryption/decryption devices are, therefore, finding it advantageous to incorporate the DES into their products.

One such manufacturer, Linkabit Corp., San Diego, Calif., has introduced a family of DES-based products. Linkabit, a M/A-COM company, says its LC76 data-encryption/decryption family offers at least one major advantage over other DES products on the market—faster data rates. Edward Zbik, program manager for the four LC76 devices, says most DES encryption units operate at maximum rates of 19.2K or 56K bps. One of the Linkabit units, the LC76-G, encrypts digital data streams moving as fast as 6.5M bps.

A general-purpose unit, the LC76-G operates independently of data format and can be set by a user to function at various data rates. Linkabit's other three units are designed to operate transparently within systems complying with Bell North American Standards DS-1, DS-1C or DS-2. The LC76-DS1 device functions at 1.544M bps, the LC76-DS1C at 3.15M bps and the DS2 at 6.3M bps.

To protect information beyond the level provided by basic DES encryption, Linkabit uses a triple-encryption scheme. Each unit stores two "master" keys that are two randomly generated 56-bit numbers (plus 8 bits for parity). These two master keys (A and B) generate "working" keys, first using master key A, then using master key B, then using master key A again. The triply encrypted working keys are distributed to all network users and are automatically changed every 24 hours.

Although the electronic distribution of the working keys across a network could result in an eavesdropper obtaining these keys, the intruder would be hard pressed to decipher the system's master keys. J. Michael Nye, president of Marketing Consultants International, Inc., Hagerstown, Md., is a recognized authority in the data-encryption field (MMS, June, p. 139). "Unless your perceived threat is the (U.S.S.R.'s) KGB or GRU, or our NSA (National Security Agency), it really doesn't matter if someone intercepts your encoded working key," Nye says. "The work/break cost to determine the master keys is very prohibitive."

Also stressing the difficulty of determining the LC76's master keys, Zbik points out that, with two 56-bit keys, the possible key combinations total 2^{112}. The company says, "If a dedicated computer could search through 1 trillion keys per sec., 1 billion of these computers would take 165,000 years to try all master-key possibilities."

Other features of the LC76 units, which start at $9900 in small quantities, include a redundancy option, a dual-channel option, battery backup and self-test capabilities. The units are designed to comply with Federal Standard 1027, which, consultant Nye says, relates primarily to the proper implementation and the secure maintenance of the DES keys. To meet parts of 1027, the LC76 units have mechanically secure enclosures, alarms for tampering and hardware failures, locks to prevent removal of the units and protection against electromagnetic emissions that might provide key information.

Zbik admits the LC76 family focuses only on specific network applications, and he says Linkabit may eventually offer lower end, protocol-independent encryption devices. "But we see more and more of a need for high-speed aggregated data. Because of the expense of terminal-to-terminal communications, companies will aggregate to a high data rate and use T-1 leased lines, microwave and maybe satellite communications. That's the market we're going to go after."

—Dwight B. Davis

[The cipher for this article's first sentence is developed by arranging the alphabet with vowels first, "x" and "z" deleted, and ordering the remaining letters in the usual order. Successive base-5 numerals are assigned to this 24-letter alphabet, with leading zeros (used in codes for "A, E, I, O") replaced by a digit higher than 4, followed by any other character (digit or letter). Consonants can be inserted between these developed letter code groups for confusion, and vowels other than "o" can be used between letter code groups to separate words. Thanks to Alan Kaplan for developing this code.]

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ergo 3000

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THE KEYBOARD
This detached, low-profile keyboard with integrated palmrest is truly state-of-the-art. Layout design and priorities are based on operator comfort and familiarity. Seven LED indicators are built-in to highlight current terminal status.

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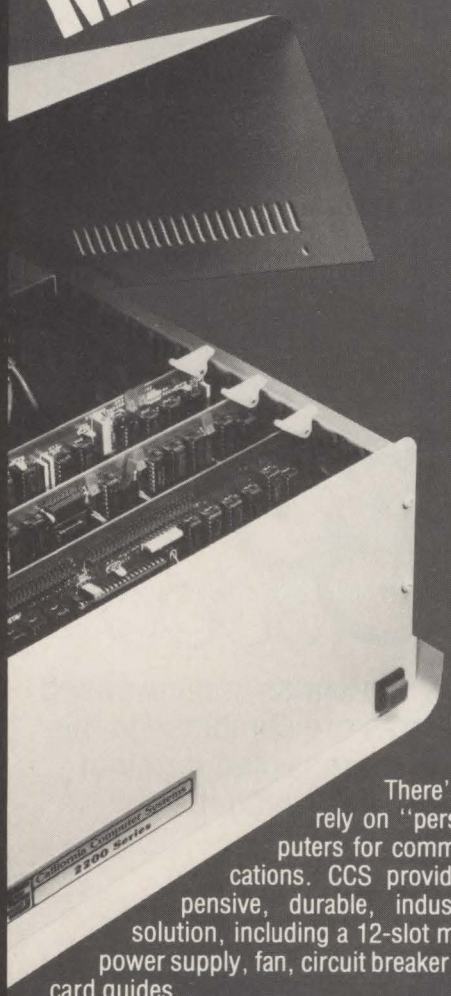
CIRCLE NO. 26 ON INQUIRY CARD

S-100 INDUSTRIAL MAINFRAME.



There's no need to rely on "personal" computers for commercial applications. CCS provides an inexpensive, durable, industrial quality solution, including a 12-slot motherboard, power supply, fan, circuit breaker, and locking card guides.

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Telex 171959 CCS SUVL

CIRCLE NO. 27 ON INQUIRY CARD

Calendar

SHOWS & CONFERENCES

JANUARY

21-26 The Southern Tier Personal/Small Business Computer Show, Binghampton, N.Y. Contact: Dallas DeFee, 48 Crary Ave., Binghampton, N.Y. 13905, (607) 729-5558.

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

26-28 ASEE '82, Advanced Semiconductor Equipment Exposition, San Jose, Calif., managed by Cartlidge & Associates, Inc. Contact: Cartlidge & Associates, Inc., 491 Macara Ave., Sunnyvale, Calif. 94086, (408) 245-6870.

FEBRUARY

10-12 1982 IEEE International Solid-State Circuits Conference, San Francisco, sponsored by the IEEE Solid-State Circuits Council, the IEEE San Francisco Section and Bay Area Council and the University of Pennsylvania. Contact: Lewis Winner, 301 Almeria, Box 343788, Coral Gables, Fla. 33134, (305) 446-8193.

16-18 International Exhibition and Conference of Semiconductor Production Equipment, Wiesbaden, West Germany, sponsored by Cartlidge & Associates, Inc., and Network, Ltd. Contact: Charles Yourd, Exposition Manager, Cartlidge & Associates, Inc., 491 Macara Ave., Suite 1014, Sunnyvale, Calif. 94086, (408) 245-6870.

21-23 Non-Impact Printing Technologies DataBase Access Meeting, San Francisco, sponsored by Advanced Technology Resources Corp. Contact: Linda M. Tempero, ATR Corp., 6256 Pleasant Valley Rd., El Dorado, Calif. 95623, (916) 626-4140.

22-24 Federal DP Expo, Washington, presented by The Interface Group. Contact: The Interface Group, 160 Speen St., Framingham, Mass. 01701, (800) 225-4620 or (617) 879-4502.

23-24 OEM Conference on International Export & Sales, Paradise Island, the Bahamas, sponsored by the Caribbean Association of Industry and Commerce. Contact: Van Ferguson, Executive Producer, Ormand Vee Co., 8852 Leslie Ln., Des Plaines, Ill. 60016.

23-25 Computers & Automated Systems Exhibit, Paradise Island, the Bahamas, sponsored by the Caribbean Association of Industry and Commerce. Contact: Van Ferguson, Executive Producer, Ormand Vee Co., 8852 Leslie Ln., Des Plaines, Ill. 60016.

26-28 Computer Expo '82, Orlando, Fla. Contact: Tom E. Blayney, Executive Director, Adventure International, P.O. Box 1185, 377 E. Highway 434, Longwood, Fla. 32750, (305) 339-1731.

MARCH

3-7 Third Annual Microcomputer Week Conference, Jersey City, N.J., sponsored by Catalyst. Contact: Mitchell E. Batoff, Jersey City State College, Jersey City, N.J., (201) 434-2154 or 547-3094 or 3098.

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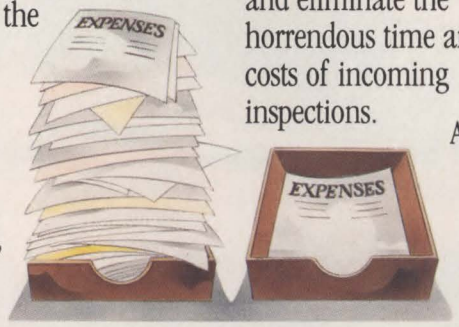
They're less expensive going in, and that's only the beginning.

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

NEC printers have up to 50% fewer parts than competitive printers, so you stock fewer spares.

Built-in quality bolsters profits.

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



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

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

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

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

Spinwriter and Trimliner™ models galore

We've got 14 different Spinwriter models, at speeds up to 55 cps with Qume, Diablo, Centronics, or RS-232C interfaces. All use functional, easy-to-service single-board electronics, a one-piece universal power supply, and digital controls that eliminate many moving parts. Plus 10 forms handlers designed and built by NEC.

Our Trimliner line printers print up to 600 LPM. They have a 30-minute MTTR, the industry's best. A 50% better MTBF than competitive models. And a variety of quietized packages.

Because our Spinwriter printers have an MTTR as low as 20 minutes, one-third as long as others, your servicemen can average three times as many repairs per hour.

Take the first step to improving your profits.

Send for information on NEC printers, or call your nearest NECIS sales office.

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Our significantly better DOA rate lets you dock merge with confidence and save hundreds of dollars per unit.

NEC DOA rate: less than 1%.

Other printers' DOA rate: more than 5%.

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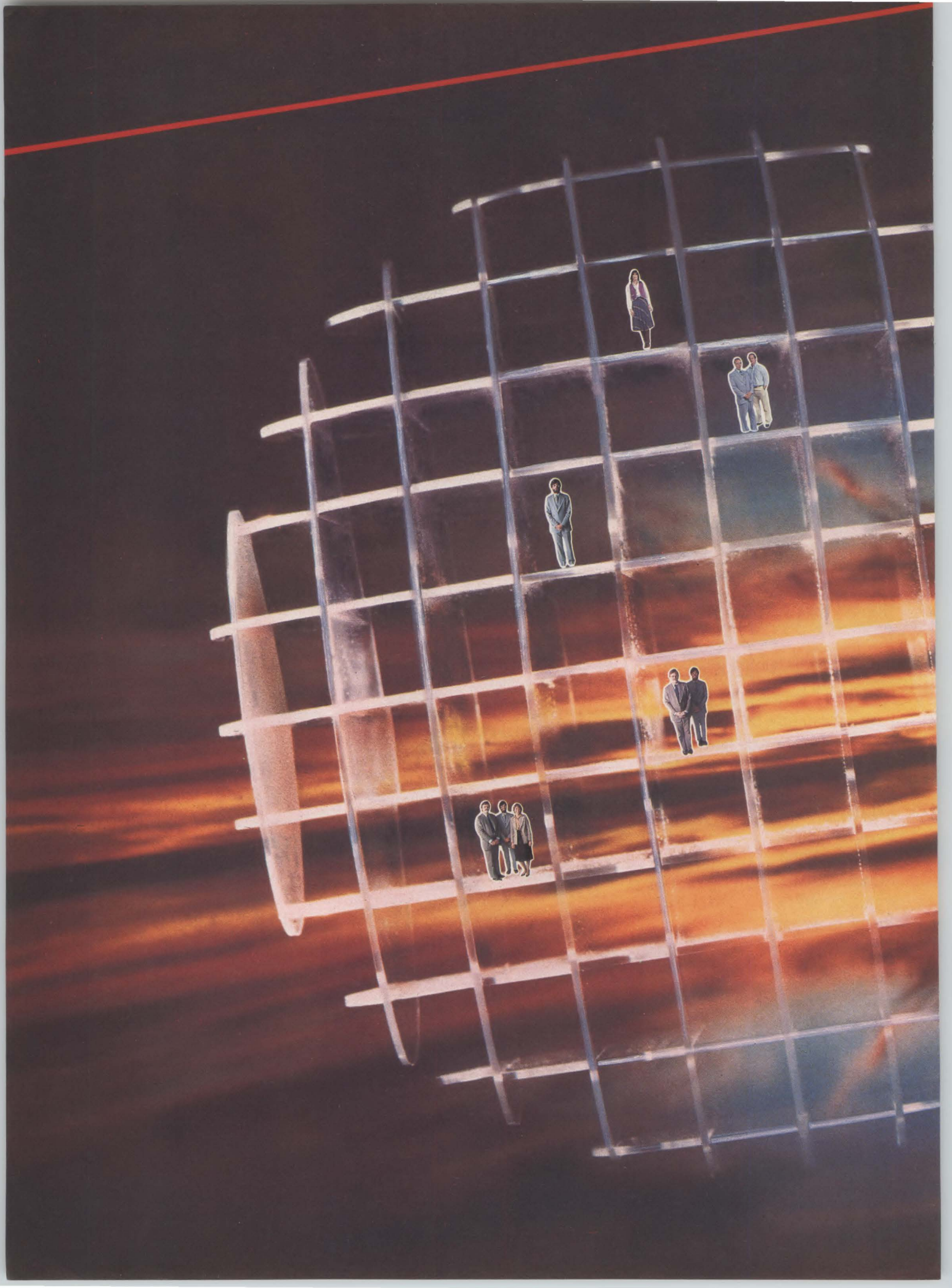

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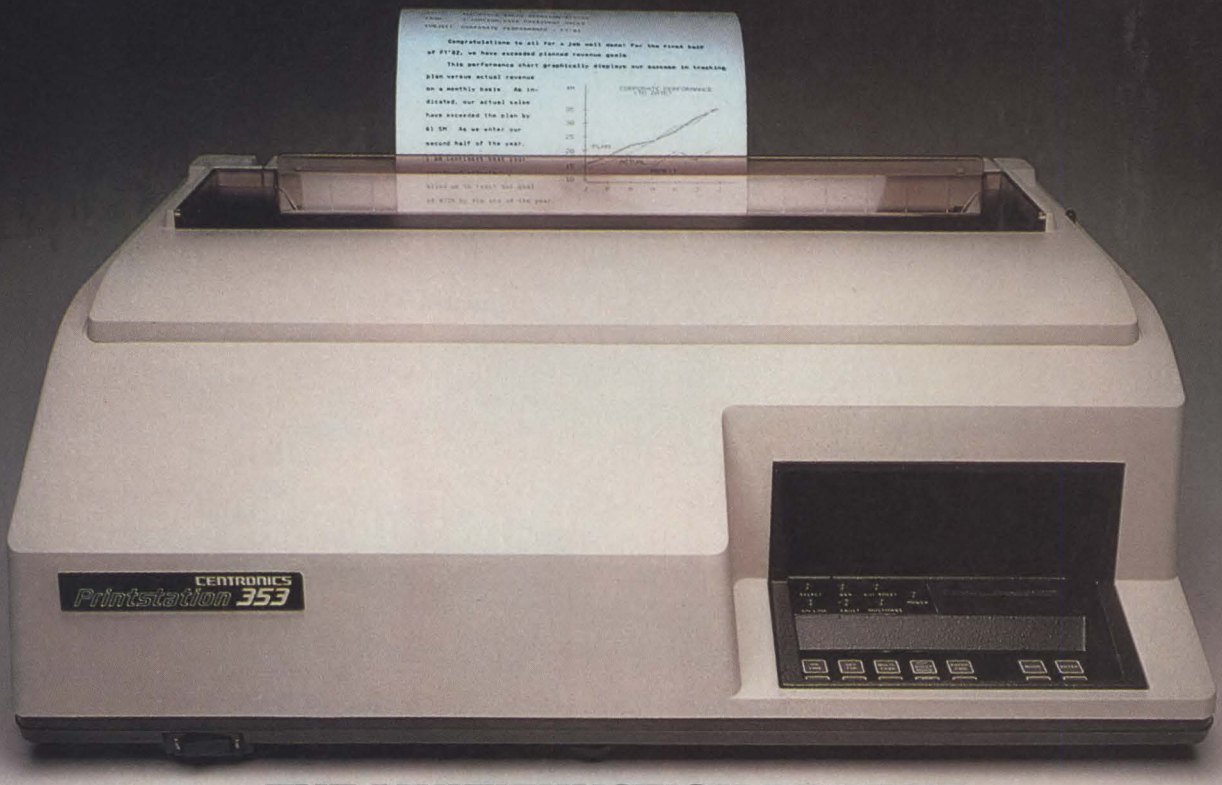
THE PRINTSTATION 350. ITS BEAUTY IS MORE THAN SKIN DEEP.



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Calendar

7-10 **TI-MIX (Texas Instruments Minicomputer-Information Exchange Conference),** Las Vegas, Nev., sponsored by Texas Instruments Users Group. Contact: TI-MIX, M/S 2200, P.O. Box 2909, Austin, Texas 78769, (512) 250-7151.

8-12 **DIDACTA '82, World Fair for School, Education and Training,** Hanover, West Germany, sponsored by Hanover Fairs. Contact: Hanover Fairs Information Center, P.O. Box 338, Whitehouse, N.J. 08888, (201) 534-9044.

9-11 **Federal Office Systems Exposition,** Washington, D.C., sponsored by National Trade Productions, Inc. Contact: Joseph P. Rubel,. National Trade Productions, Inc., 9418 Annapolis Rd., Suite 206, Lanham, Md. 20706,(301) 459-1815.

10-12 **Fourth International Conference on Thermoelectric Energy Conversion,** Arlington, Texas, sponsored by the Graduate School and the Electrical Engineering Department of the University of Texas at Arlington and the Fort Worth Section and Region of the IEEE. Contact: K.R. Rao, Professor of Electrical Engineering, P.O. Box 19016, University of Texas at Arlington, Arlington, Texas 76019,(817) 273-2671.

22-24 **Information Systems Education Conference,** Chicago, sponsored by Data Processing Management Association Education Foundation. Contact: Dr. Stephen B. Weiner, Program Coordinator, 12611 Davan Dr., Silver Spring, Md. 20904, (301) 622-0066.

22-25 **The Second Middle East Business Equipment Show,** Manama, Bahrain, organized by Arabian Exhibition Management WLL. Contact: Rosemary Phillips, Arabian Exhibition Management WLL, Windsor House, 4950 Calthorpe Rd., Edgbaston, Birmingham B15 1TH U.K., (021) 454-4461 or Stefan Kemball, Arabian Exhibition Management WLL, P.O. Box 20200, Manama, Bahrain, (Telephone) 250033.

22-25 **Interface '82,** Dallas, co-sponsored by *BusinessWeek* and *Data Communications* magazines. Contact: Peter B. Young, The Interface Group P.O. Box 927, 160 Speen St., Framingham, Mass. 01701, (800) 225-4620.

22-26 **WCGA '82 "Computer Graphics for Design and Construction Productivity" Conference,** Washington, sponsored by World Computer Graphics Association Inc., The Building Research Advisory Board of the National Academy of Sciences in cooperation with the International Planning Committee and others. Contact: Exhibit Coordinator, WCGA, 2033 M St., N.W., Suite 250, Washington, D.C. 20036, (202) 775-9556.

23-25 **SOUTHCON '82,** Orlando, Fla. sponsored by the IEEE Region Three; the Atlanta Section of the IEEE; the Florida Council of the IEEE; and the Dixie, Sunshine and Piedmont Chapters of the ERA. Contact: Dale Litherland, Director of Education, SOUTHCON '82 Professional Program Committee, Suite 410, 999 N. Sepulveda Blvd., El Segundo, Calif. 90245, (213) 722-2965.

25 **ANSI 1982 Public Conference,** New York, sponsored by the American National Standards Institute, Inc., and the Association Francaise de Normalisation, Contact: Priscilla F. Trias, ANSI, Inc., 1430 Broadway, New York, N.Y. 10018, (212) 354-3315.

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	LA34 DECwriter IV Forms Ctrl.	1,095	105	58	40
	LA120 DECwriter III KSR	2,295	220	122	83
	LA120 DECwriter III RO	2,095	200	112	75
	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
	VT18XAC Personal Computer Option	2,395	230	128	86
TEXAS INSTRUMENTS	TI745 Portable Terminal	1,595	153	85	58
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	TI Insight 10 Terminal	695	67	37	25
	TI785 Portable KSR, 120 CPS	2,395	230	128	86
	TI787 Portable KSR, 120 CPS	2,845	273	152	102
	TI810 RO Printer	1,695	162	90	61
	TI820 KSR Printer	2,195	211	117	80
LEAR SIEGLER	ADM3A CRT Terminal	595	57	34	22
	ADM5 CRT Terminal	645	62	36	24
	ADM32 CRT Terminal	1,165	112	65	42
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	DT80/3 CRT Terminal	1,295	125	70	48
	DT80/5L APL 15" CRT	2,295	220	122	83
TELEVIDEO	920 CRT Terminal	895	86	48	32
	950 CRT Terminal	1,075	103	57	39
NEC SPINWRITER	Letter Quality, 7715 RO	2,895	278	154	104
	Letter Quality, 7725 KSR	3,295	316	175	119
GENERAL ELECTRIC	2030 KSR Printer 30 CPS	1,195	115	67	43
	2120 KSR Printer 120 CPS	2,195	211	117	80
HAZELTINE	Executive 80/20	1,345	127	75	49
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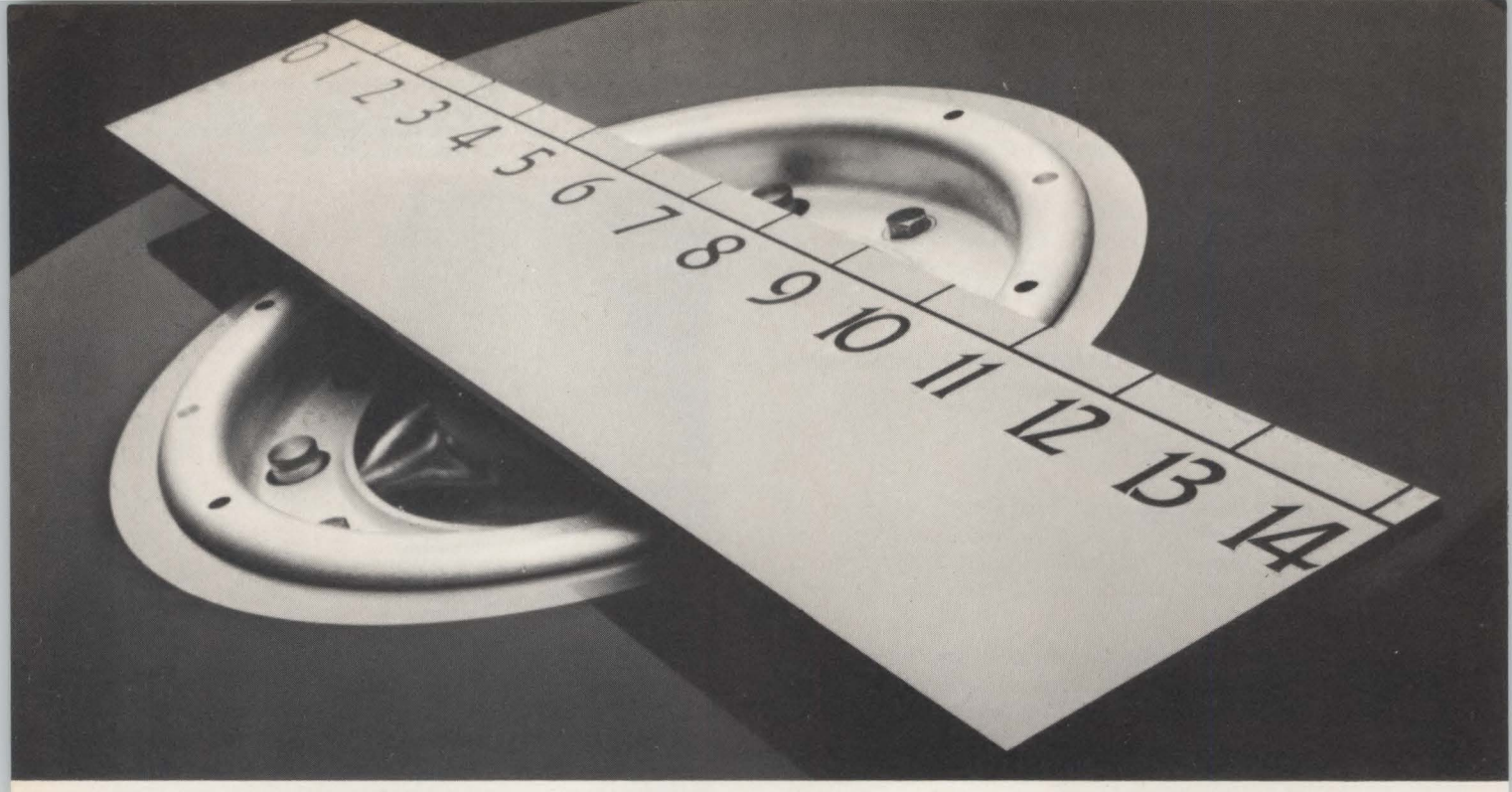

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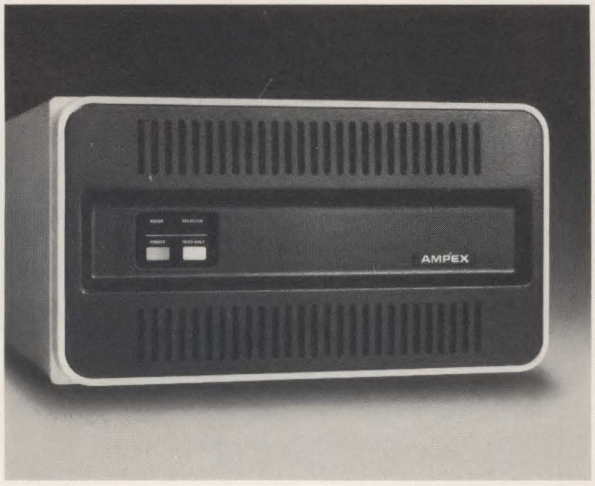

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CIRCLE NO. 33 ON INQUIRY CARD

General Electric broadens 'factory-of-future' thrust

A joint venture in computer-aided engineering (CAE) between General Electric Co. and an Ohio consulting and software company isn't big news in itself, but its significance can be more clearly discerned against the background of other recent moves by GE toward implementing the factory of the future.

Those other steps include the company's acquisition in recent months of a CAD/CAM graphics system and software company and its establishment of a new organization devoted to developing and selling computer-controlled robots for factory applications.

The considerable attention that computer manufacturers have recently devoted to office automation has partially obscured the business potential that GE planners are seeking through their multifaceted factory-automation endeavor. They estimate that the North American market for robot systems alone is valued at $100 million, and will reach $800 million by 1985. Those robots are controlled by μcs, such as the Digital Equipment Corp. LSI-11 and the Intel Corp. 8080.

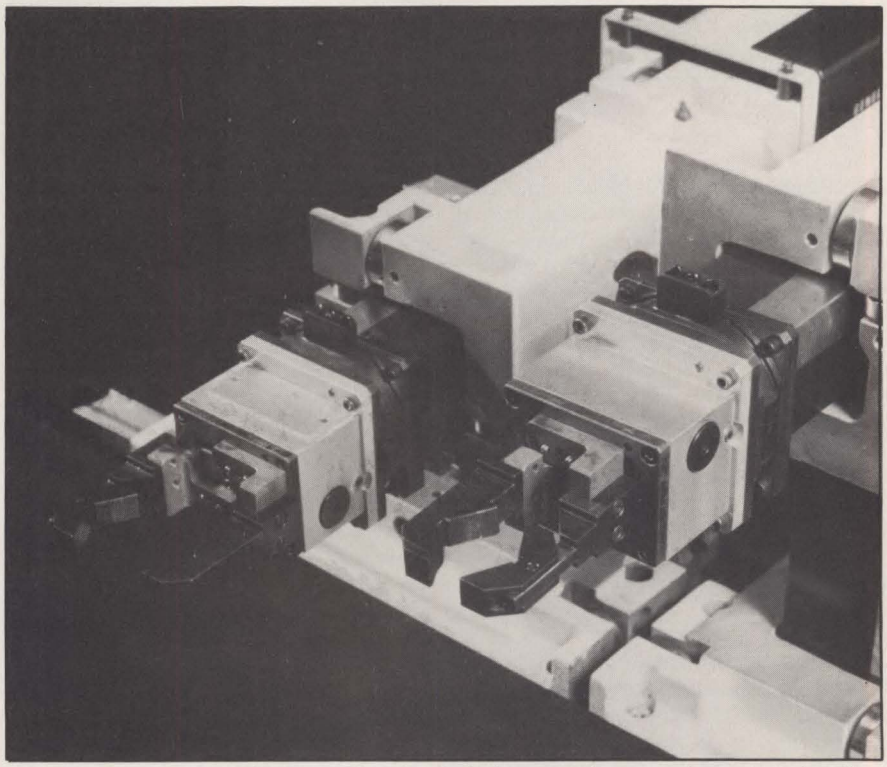
There's also a beckoning market in factory automation for suppliers of minicomputers, graphics terminals and the kind of software embodied in the GE joint venture, which resulted in the formation of a new company effective Jan. 1. The joint venture involves the acquisition by GE of 48 percent of Structural Dynamics Research Corp., Cincinnati, plus 51 percent of the newly formed joint venture—General Electric CAE International, Inc. The joint venture company will encompass but go beyond CAD/CAM to automate the entire product-development process from conceptual design to manufacturing for products ranging from aircraft to kitchen blenders.

The joint venture with SDRC was announced during the Autofact III CAD/CAM and factory-automation conference in Detroit in early November. In outlining the joint venture, James A. Baker, executive vice president and sector executive for GE's technical systems sector, said it was the latest move in a series of steps representing a major commitment by GE to become "a supplier of electronic equipment for the automated factory of the future." The technical systems sector, Fairfield, Conn., encompasses the company's electronic and industrial-automation operations.

Baker also listed some of GE's earlier moves in the factory-automation thrust. When added to the $20.1-million outlay for the SDRC venture, they amount to almost $700 million. The previous steps include:

- acquisition of Intersil, Inc., a Cupertino, Calif., manufacturer of ICs for $235 million;
- acquisition of Calma Co., a Santa Clara, Calif., CAD/CAM equipment and software supplier, for $170 million;
- formation of a new business—the Automation Systems Operation, Bridgeport, Conn.—within the technical systems sector to produce and sell industrial robots, five of which were demonstrated at Autofact III for the first time (see "The Automation Systems lineup," p. 58);
- plans to spend $250 million for R & D focused squarely on electronics in industrial applications.

All that activity indicates that GE is committed to CAD/CAM and CAE in a big way. The company and affiliates will deliver minicomputer- and μc-based CAE software and



The Allegro programmable assembly robot *includes one to four arms that operate together or independently. It can be used for automotive and electronic products and mechanical devices weighing less than 7 lbs.*

services through a variety of channels. The channels include GE CAE International productivity centers, the GE Information Services Co.'s (GEISCO) international computer and software network and independent suppliers of systems, including International Business Machines Corp. and Digital Equipment Corp.

Jason R. Lemon, chairman and chief executive officer at SDRC, said in Detroit that the multilevel distribution scheme will help potential users grow with CAE. The productivity centers will enable customers to experiment with CAD/CAM and to investigate and use the CAE software in an entry-level approach to automated design and manufacture. The centers will also have personnel to help customers develop their own application software.

There will eventually be several such centers, with seven locations identified: three in the U.S. (Cincinnati, Detroit and San Diego, Calif.) and four elsewhere (London, England; Paris, France; Tokyo, Japan; and Wiesbaden, West Germany). The centers will provide Calma interactive graphics systems, DEC VAX computers and even numerically controlled machining centers that customers can use to design and machine parts that they need. Personnel at the centers will also be able to produce N/C tapes for customers.

The complete SDRC CAE software library will also be sold by Calma, and selected software will be available from other CAD/CAM system suppliers, including Gen-Rad, Inc., and Applicon, Inc. DEC already sells the SDRC CAE software with its VAX supermini systems, and SDRC recently signed an agreement that allows IBM to sell some of the software with its 4300 series systems.

Finally, Lemon said that manufacturers who have progressed beyond the scope of the productivity centers can tap into distributed CAE software databases through the worldwide GEISCO network, which supports the X.25 telecommunications protocol. He pointed out that the network can be used as a single site to maintain and enhance numerous software packages, "and to download them automatically to machines of various types, with different operating systems and in different locations in a company."

Baker doesn't believe that GE will be without competition in its computer-based factory-of-the-future strategy. He said, though, that there is room in this country for four or five corporate efforts of the magnitude of GE's "to give U.S. productivity a shot in the arm." He expects similar major thrusts by companies such as Westinghouse Electric Corp.

Lemon elaborated on the productivity theme when he observed that SDRC CAE programs have reduced costs by as much as 30 percent and design cycles by 25 percent in a variety of products from automobiles to electric irons. He added that such savings can't be ignored in a nation where industrial productivity has been essentially flat for several years. —*L.J. Curran*

THE AUTOMATION SYSTEM LINEUP

At November's Autofact III CAD/CAM and factory-automation conference in Detroit, General Electric demonstrated five new robots, each aimed at factory-automation applications. Except for the Allegro assembly robot, all other units are based on Intel μps. The Allegro device is based on a Digital Equipment Corp. LSI-11/02 μp and an Intel 8080 μp. The robots include:

- Allegro, a programmable assembly robot with one to four arms that operate together or independently. The unit can be used for multicomponent automotive and electronic products and mechanical devices weighing as much as 7 lbs. The device's control unit includes a multiprocessor with distributed functions. The CPU controls a μp and I/O options, including digital control signals, analog input signals, a keyboard printer and a portable "teach box," which assists the programmer by guiding the robot through its operation while recording the steps in computer memory.
- P5, a programmable, five-axis process robot that performs welding, deburring, polishing, grinding, sealing and assembling applications in manufacturing environments. The unit features a computer teach box.
- AW7, an arc-welding robot that features dual non-contact sensors that are effective with a variety of metals, including stainless steel, aluminum and ferrous and nonferrous metals. The robot's control system is based on point-to-point control for sensing, tracking, checking, linear interpolation computation, wrist-motion compensation and shifting. The AW7's μp-based brain provides continuous-path and point-to-point control.
- SH6 (horizontal) and SV6 (vertical) spraying robots, which apply paints, lubricants, anti-corrosive oil and sealing chemicals. The units include a teach box, a long, straight spray line that can be programmed with two teach points and instant display of any programming error.
- OSO optoelectronics systems operation, which provides non-contact on-line inspection of randomly oriented products at rates as high as 900 parts per min. The unit is aimed at discrete-parts fabrication, assembly and packaging in the automotive, appliance, instrumentation, pharmaceutical, electrical and electronics industries. The unit includes a PN2304 decision processor and a TN2500 charge-injection-device camera.

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

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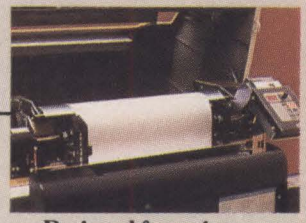
Our compressed-pitch feature lets you print a full 132 characters on standard 8½-inch paper. Or 198 characters on 14-inch form.



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- *2, 5¼" floppy disk drives (1.92 MB or 320KB)*

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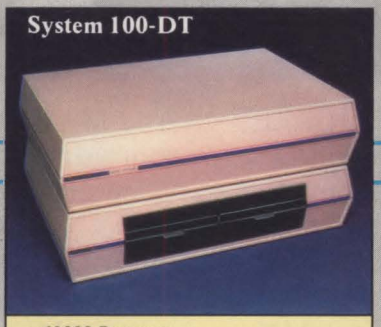

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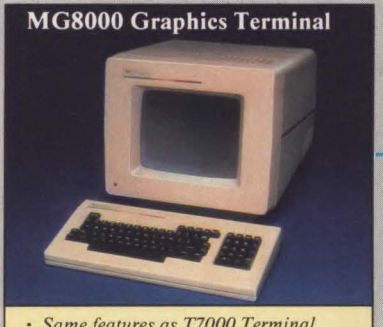

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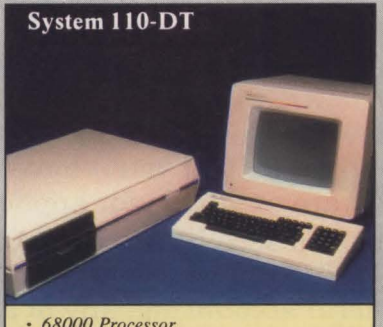
- *Optional touch panel*

System 110-DT



- *68000 Processor*
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- *Ideal single-user workstation for video-disc and simulation*

CIRCLE NO. 35 ON INQUIRY CARD

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The background to the MARINER system is a photograph of the Lagoon Nebula, which can be seen with the aid of binoculars in the constellation Sagittarius.
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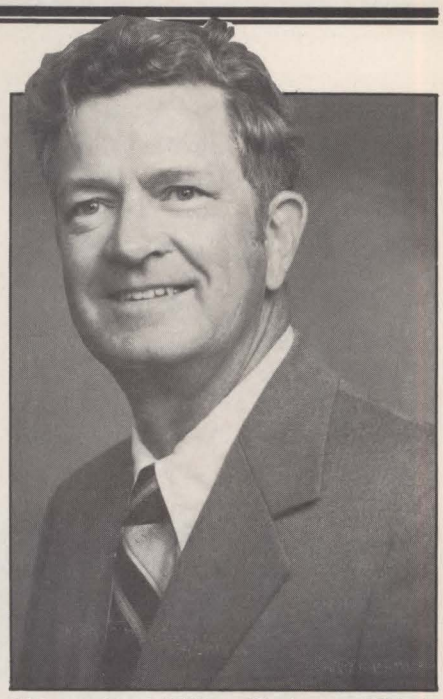
MICROMATION

CIRCLE NO. 36 ON INQUIRY CARD

OSI transforms under new president



OSI president William Chalmers: *"This is not an Ohio or a scientific company any more."*

When acquisition - minded M/A-COM, Inc., Burlington, Mass., acquired Ohio Scientific, Inc., in November, 1980, there was much talk about what telecommunications conglomerate M/A-COM would do with the Aurora, Ohio, company. Much speculation centered around a forthcoming family of intelligent data-communications terminals that will serve as an office link in M/A-COM's satellite business-communications systems.

Now, William Chalmers, OSI's second president since the acquisition, is bolstering the company's small-systems stance by consolidating 110 hardware and software products, turning to outside vendors for vertical software packages, changing the company's name and image, hiring a new management team and channeling more money into R & D (see "OSI consolidates product lines," below).

The not-so-smooth acquisition of OSI has, within a year, virtually transformed the company, through M/A-COM resources, from a shoestring, technical-product operation offering little documentation and support, into a $500-million company focusing on full solutions for users. To emphasize the commitment, Chalmers, formerly head of Centronics Data Computer Corp.'s Quietwriter printer project, has changed OSI's name to M/A-COM Office Systems, Inc., because, says Chalmers, "This is not an Ohio or a scientific company any more."

A little more than a year ago, OSI was headed by Michael and Charity Cheiky, company founders. Charity Cheiky, company president, was succeeded by Harvey White, who has since returned to M/A-COM's Linkabit Corp. subsidiary, which develops advanced digital signal-processing equipment. Michael Cheiky, formerly OSI's chairman, now heads a nine-person advanced R & D group in Santa Barbara, Calif., and Charity has retired.

Under the Cheikys, OSI grew from $25,000 in seed money in 1975, to $18 million in revenues in 1980. The acquisition by M/A-COM was unusual in that it was for an undisclosed amount of cash, rather than by a stock transaction, and in that M/A-COM supplied a new OSI president as part of the package.

The company is expanding physically as well. Although headquarters and main manufacturing facilities will remain in Aurora, a near-term development team will be based in Boston, with a support engineering group in Aurora. Charles Bickoff, a Centronics veteran and now OSI's vice president of engineering, will be based in Boston and head both groups.

Chalmers hopes OSI will reach $50 million in revenues in two years. To do so, the company will focus on vertical product mass marketing, using software packages from independent vendors. "OSI hasn't been supporting users. About 80 to 90 percent of the users are, thus, OEMs," he says. He plans to qualify vertical packages and help market them, a strategy that will lead to reference sales. What package will be offered first is not yet known.

He also hopes to leverage

OSI CONSOLIDATES PRODUCT LINES

In November, Ohio Scientific trimmed its 110 hardware and software products into three basic lines, which include the high end of the personal computer market, single-user small systems and a multi-user system with hard disks and networking capabilities. All machines have transportable software, enabling users to upgrade their systems.

The C100 personal computer includes an 8-bit processor, graphics, an integral keyboard, and I/O ports. Retail price is less than $3400.

A family of three small-business systems, the C200 is designed to expand from a single-user floppy-disk-based system to multi-user or hard-disk configurations. The desktop system typically supports as many as four users, but rack-mounted versions support as many as six users. Single-user versions sell for $4000 to $8000.

The high-end C300 μc business system is available in 10M-, 40M- and 80M-byte hard-disk versions. The systems can expand to six-user time-shared systems or to full networked configurations. Prices are $10,000 to $20,000. OSI president William Chalmers claims these seven systems, with hardware and software upgrade potential, position OSI with a family of computers to service the μc market in much the same way that Digital Equipment Corp. services the minicomputer market and that International Business Machines Corp. services the mainframe market.

resources at M/A-COM—such as Sigma Data's software, Alanthus Data Communications' terminals and 65 U.S. service locations—to compete with North Star Computers, Inc., Dynabyte, Vector Graphic and Altos Computer Systems.

Chalmers says the company has redone the remaining products' documentation, and corrected some hardware and software problems. "You can call it stopgap," he says. "We're trying to get production runs on fewer models and increase the learning curve in the factory. The result will be better quality and better deliveries." The next generation of products, he says, will be 8088 μp-based and will possibly use CP/M, thus carrying OSI into the 16-bit world.

—*L. Valigra*

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
Advanced Micro Devices	6 mos	9/27/81	135,972,000	2,629,000	.16
	6 mos	9/28/80	147,621,000	13,865,000	.88
Analysts International	3 mos.	9/30/81	6,643,000	263,000	.22
	3 mos.	9/30/80	5,558,000	142,000	.16
A. W. Computer Systems	9 mos.	9/30/81	1,506,678	(100,365)	(.05)
	9 mos.	9/30/80	2,300,471	58,891	.03
Beckman Instruments	3 mos	9/30/81	159,421,000	8,431,000	.40
	3 mos	9/30/80	138,557,000	8,405,000	.40
Burroughs	9 mos.	9/30/81	2,387,915,000	85,983,000	2.07
	9 mos.	9/30/80	2,108,135,000	150,713,000	3.65
C-3	6 mos	9/30/81	21,917,000	3,757,000	.44
	6 mos	9/30/80	14,045,000	2,181,000	.31
Computer Sciences	26 weeks	10/2/81	297,632,000	6,912,000	.51
	26 weeks	9/26/80	278,503,000	13,060,000	.96
Datum	9 mos.	9/30/81	9,546,000	(149,000)	(.08)
	9 mos.	9/30/80	11,830,000	290,000	.16
Genisco Technology	year	9/30/81	23,280,373	1,236,266	.63
	year	9/30/80	17,516,283	1,203,341	.63
GenRad	9 mos	10/3/81	117,748,000	(1,925,000)	(.25)
	9 mos.	9/27/80	108,624,000	7,755,000	1.06
Icot	3 mos.	10/31/81	5,580,000	117,000	.01
	3 mos.	11/2/80	6,365,000	17,000	—
Int'l Business Machines	9 mos	9/30/81	20,077,000,000	2,227,000,000	3.80
	9 mos.	9/30/80	18,408,000,000	2,329,000,000	3.99
Nuclear Data	6 mos.	9/31/81	22,798,000	528,000	.31
	6 mos.	8/31/80	19,758,000	725,000	.43
Reynolds and Reynolds	12 mos.	9/30/81	212,236,135	7,118,248	1.51
	12 mos.	9/30/80	210,251,745	10,966,670	2.33
Robinson Nugent	year	6/30/81	30,722,509	2,480,052	.95
	year	6/30/80	28,845,462	3,020,448	1.16
System Industries	9 mos.	9/27/81	42,859,000	4,542,000	1.38
	9 mos.	9/28/80	27,043,000	1,108,000	.78
Ultimate	6 mos.	10/31/81	14,914,097	1,198,607	.21
	6 mos.	10/31/80	6,623,829	344,343	.07
Vector Graphic	3 mos.	9/29/81	8,963,000	881,000	.17
	3 mos.	9/29/80	4,249,000	423,000	.08
Wang	year	6/30/81	856,376,000	78,073,000	1.36
	year	6/30/80	543,272,000	52,113,000	1.00
Zenith	9 mos.	10/3/81	922,700,000	14,100,000	.74
	9 mos.	9/30/80	853,700,000	20,000,000	1.06

IBM, TI initiate authorized-distributor programs

International Business Machines Corp., which has become much more aggressive in third-party marketing efforts, and Texas Instruments Inc. have joined the ranks of vendors endorsing authorized-dealer programs.

Within weeks of IBM's announcement that it would sell the 64M-byte Piccolo 8-in. Winchester-disk drive to OEMs, IBM's Marketing Channels Department made a second move into the third-party arena by naming the company's first seven authorized distributors. During October, as IBM unveiled its authorized-distributor program in New York, TI invited its OEMs to a meeting in Texas, where the company detailed its version of authorized-dealer distribution.

IBM's authorized-dealer program is overseen by the company's White Plains, N.Y., Marketing Channels Department headed by Gabe Fusco and is part of the recently formed Information Systems Group. The first two products under the dealer program are the company's 3101 CRT terminal and the new 3232 model 51 non-impact 450-cps electromatrix printer.

"The IBM announcement revolutionizes the distributor business," claims Sonny Monosson, chairman of the Boston-based American Computer Group and one of the authorized IBM dealers. "By far, IBM has the most advanced agreement that I have seen in terms of understanding the traditional problems a distributor has in carrying inventory and handling products and servicing customers. In the short time that I have been an IBM distributor, the company has given me fantastic support," Monosson says.

Monosson, whose company also distributes Digital Equipment Corp. products, says he doesn't see

— For more information on HI-G dot matrix printer, Circle No 37. or call (203) 623-3363

any conflict in handling both DEC and IBM products. "My job is to move hardware, and I don't feel there is a conflict of interest as long as I do my job," Monosson says.

In addition to Monosson, the IBM-authorized dealers include two other computer-product dealers—David Jamison Carlyle Corp. and Pacific Mountain States Corp.—and four industrial distributors—Arrow Electronics Inc., Hall-Mark Electronics Corp., Schweber Electronics Corp. and the Wyle Distribution Group.

When asked why the company is moving into third-party marketing, an IBM spokesman says, "The intent (of the program) is to use distributors to increase our sales coverage to customers not normally served by IBM sales organizations."

In characteristic IBM manner, the spokesman will not comment on how fast the authorized-dealer program might expand, how the dealers are selected, what discounts are offered or what products might be in the program's future offerings.

An official in the Marketing Channels Department says the dealer program will be expanded gradually and other IBM products that conform to the ASCII (American national standard code for information interchange) standards are the most likely candidates to be included in the IBM dealer lineup. Discount schedules vary but are believed to average about 30 percent.

IBM is discovering that it can be represented by outside people at the quality level the company requires," says Tom White, a vice president with Pacific Mountain States Corp. White acknowledges that his relationship with IBM is still in the honeymoon stage, but is impressed with IBM's approach to dealers. "It's phenomenal to me to look at the minutest detail to which IBM goes in support of its products," he says. "They make sure that all the backup documentation, contracts, paperwork, brochures and support literature are there," White says.

The TI-authorized dealer program was detailed to the company's OEMs in October. It is expected to provide the main marketing channel for the company's recently introduced Business System 200, the first in a line of small-business systems. The system is built around TI's TMS9900 16-bit μp and includes 64K bytes of memory implemented using 64K DRAM chips.

The Business System 200 is available in four versions that differ only in disk-storage capacity. The models range from the 220, which uses two 5¼-in. floppy disks for combined storage of 1.2M bytes to the 251, which uses two 5¼-in. Winchester disk and an 8-in. floppy-disk backup for a combined storage of 11.2M bytes. System 200 prices start at $6200, with shipments scheduled to begin in the first half of 1982.

The TI-authorized-dealer program allows qualified dealers to use the TI name and logo and includes several changes in existing TI/OEM relations. Under the authorized program, TI will provide cooperative advertising funds, and dealers will offer a 90-day warranty on new packaged systems and a 30-day warranty on CPU bought separately and existing packaged systems.

Discounts range from 31 to 36 percent, an increase from 27 to 38 percent previously offered, and there will be no back-billing lower thasn 31 percent at a contract's end. In the past, a distributor could be back-billed to a single-quantity price.

—Eric Lundquist

AT & T MOVES TO FORM SUBSIDIARY, OFFER ACS

The American Telephone and Telegraph Co. filed a plan with the Federal Communications Commission last month, outlining the route Bell proposes to follow in forming a fully separate, unregulated subsidiary. Although AT & T's competitors are involved in a U.S. Court of Appeals case that bears directly on the formation and operation of such "Baby Bell" subsidiaries, the communications giant has asked the FCC to rule on the new proposal quickly, relying upon the guidelines set forth in the controversial Computer Inquiry II Final Decision (see "The deregulation puzzle—putting the pieces together," p. 129). AT & T hopes to form the subsidiary by June 1 at the latest, and says the offshoot's first product will be the long-overdue Advanced Communication Service (ACS).

Designed for business customers, ACS will reportedly allow various computers and terminals to communicate, even if the products run different codes, protocols, data formats or transmission rates. Under the Computer Inquiry II's rules, the subsidiary could provide services such as ACS and sell customer premises equipment (CPE). However, the firm would not be permitted to own transmission facilities and would have to obtain such services under tariff from common carriers.

To finance the subsidiary, AT & T plans to supply a $3-million cash advance and $56-million worth of physical assets. In turn, the subsidiary would issue shares of its common stock to AT & T. Overall, the Bell Operating Telephone Companies and AT & T Long Lines would provide approximately $134 million to form the subsidiary and to launch ACS, for which they would be reimbursed. AT & T estimates the total cost to finance ACS operations will reach $434 million.

—Dwight Davis

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We're bursting with new ideas when it comes to small business computers and peripherals designed to give you much more value for your money. That's why we've zoomed to our No. 1 position among independent suppliers of CRT terminals. We make it our business to get new ideas to market first. So, meet our latest new idea. The Model TS 802.

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CIRCLE NO. 38 ON INQUIRY CARD

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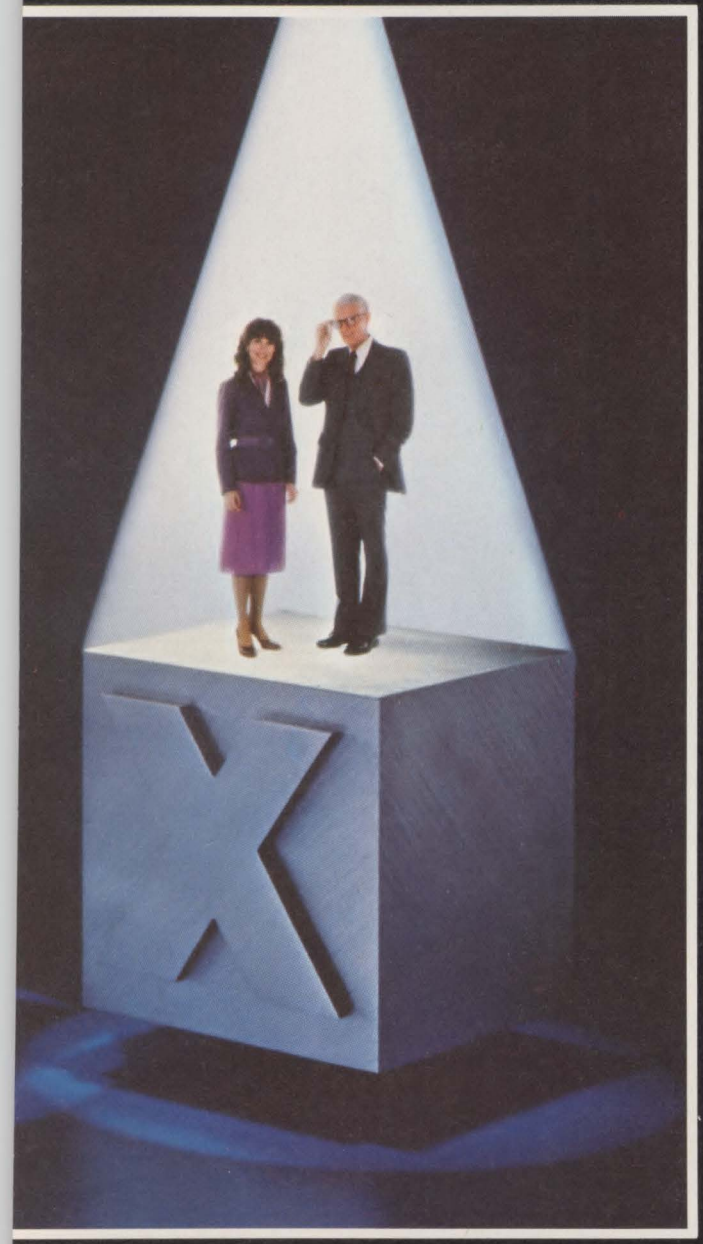
8000 with UNIX* means business.



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The dramatic growth and availability of UNIX-based application software packages is a clear indication that more than ever UNIX means business. So, if you mean business, call or write Zilog for the full Supermicro story. You'll find no other manufacturer offers better technical support and field service than Zilog.

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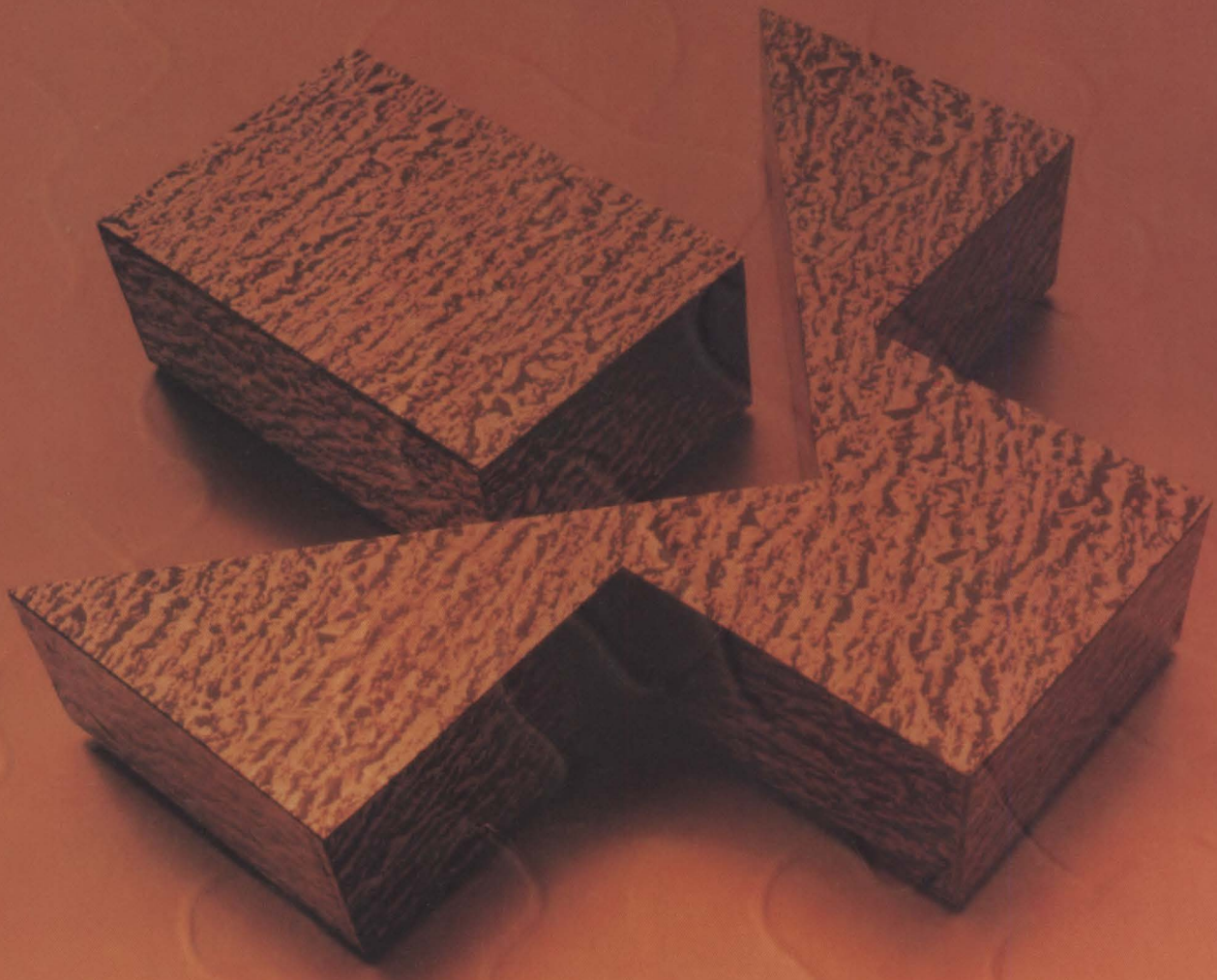
All the pieces are in place.



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CIRCLE NO. 40 ON INQUIRY CARD

Altos 16-bit system runs XENIX, CP/M, OASIS

This month, Altos Computer Systems will begin delivering an 8086-based μc system said to run a variety of operating systems, including Digital Research's CP/M-86 and Phase One Systems' OASIS-16. The San Jose, Calif., company's ACS8600 also supports XENIX, Microsoft's implementation of UNIX. Officials at Altos say it is the first application of XENIX on the 8086.

The eight-user system includes error - detection - and - correction (ECC) capabilities, and an Altos/Microsoft-designed memory-management (MMU) scheme. Memory management is a prerequisite for UNIX compatibility.

These features, plus the 16-bit architecture and operating systems, says vice president of marketing Ron Conway, put the 8600 in the class of Digital Equipment Corp.'s PDP-11/70 or IBM Corp.'s Series/1 minicomputers.

A basic system includes 0.5M bytes of main memory (64K-bit RAMs) and 10M bytes of hard disk via an 8-in. Winchester drive manufactured by Quantum Corp., Milpitas, Calif. With 1M byte of floppy-disk backup, that system sells for $12,990. Six hard-disk configurations are available, the company says, with prices ranging as high as $18,980 for an 8600 with a 40M-byte Winchester and a 17M-byte Data Electronics Inc. ½-in. cartridge-tape drive. Memory can be expanded to 1M byte.

Main memory is organized on 16-bit words, with 6 extra bits for ECC functions. The ECC circuitry uses Hamming codes to generate the check bit for each word.

Memory management, which allocates arbitrary amounts of memory to each user, is accomplished by a 256- × 21-bit RAM. The device maps memory to its contents and prevents illegal access or overwriting.

Supporting the 8086 CPU are Intel's 8089 and 8087 co-processors. The former handles direct-memory-access functions and I/O processing, while the latter supports floating-point arithmetic. The 8087 is optional.

Altos has been shipping Z80-based systems since 1977. The company claims to have 15,000 systems installed. Altos says it is shipping 1000 machines a month.

The 8-bit software—written under CP/M, MP/M and OASIS—will remain compatible with the 8600, says Conway. Software drivers that are being written by the operating-systems suppliers will re-compile the Z80 code. Microsoft's versions of BASIC, COBOL, Pascal and FORTRAN, as well as Ryan-McFarland COBOL, Pascal/M-86 and C-BASIC-86 will provide language support.

A Multibus interface, which allows the 8600 to be used in applications other than standard business, will be also available. Multibus access raises the question of networking, specifically of Ethernet compatibility.

The company says that the 8600 will "probably" be Ethernet compatible, although the Multibus interface enables the system to connect with any standard architecture.

Altos will market the new hardware to OEMs, its traditional sales vehicle. Conway indicates that the firm is working with dealers, as well, and expects to have about 500 lined up by the time shipments begin in January. —*Larry Lettieri*

GRAPHICS WILL BECOME MAJOR OFFICE COMPONENT

The next major component of office automation will be graphics, says Meldon K. Gafner, vice president of marketing at Integrated Software Systems Corp., San Diego, Calif. Computer graphics already is widely used in 28 of the 35 most profitable companies in the U.S., Gafner adds, and the number of graphics users is growing approximately 60 percent a year. Statistics indicate that there will be 40,000 new users this year.

"Certain hardware and software developments over the past several years are responsible for making computer graphics affordable and effective for office automation," says Gafner. For example, a color plotter that sold for $40,000 15 years ago now sells for $4000, and the same plotter that produced two to four charts per hour now produces 10 to 20. In addition, today's graphics software is higher quality, easier to use and much more flexible. As a result, says Gafner, the office of the future will enable users to preview, alter and send graphics information without leaving a work station or using data-processing personnel. This will give executives easy access to graphics for briefings, presentations and other purposes.

Graphics can be implemented into office-automation systems now. For example, graphics capabilities can be added to μc software supporting word-processing applications, while office-automation packages can be implemented on larger computers that already have graphics capabilities.

"As administrative staffs in other organizations find out that the tools they need are already in place," Gafner says, "the full demand for computer graphics will be unleashed."

14-in. Winchester line may handle 1G byte

The high-capacity 14-in. Marksman disk drives unveiled at the recent Comdex show by Century Data Systems are the first in a new series of higher performance Winchesters that the company says will ultimately offer storage capacities as high as 1G byte.

The new hardware family, called the Advanced Marksman Series (AMS), will incorporate the first linear voice-coil actuators on a Century Winchester and, at an average access time of 25 msec., will be the fastest device of its type to hit the OEM market so far, says Rick Brechtlein, newly appointed marketing vice president at the Anaheim, Calif., Xerox subsidiary. Evaluation versions of the first of these drives, a four-platter, 190M-byte AMS-190, are scheduled to be shipped this quarter.

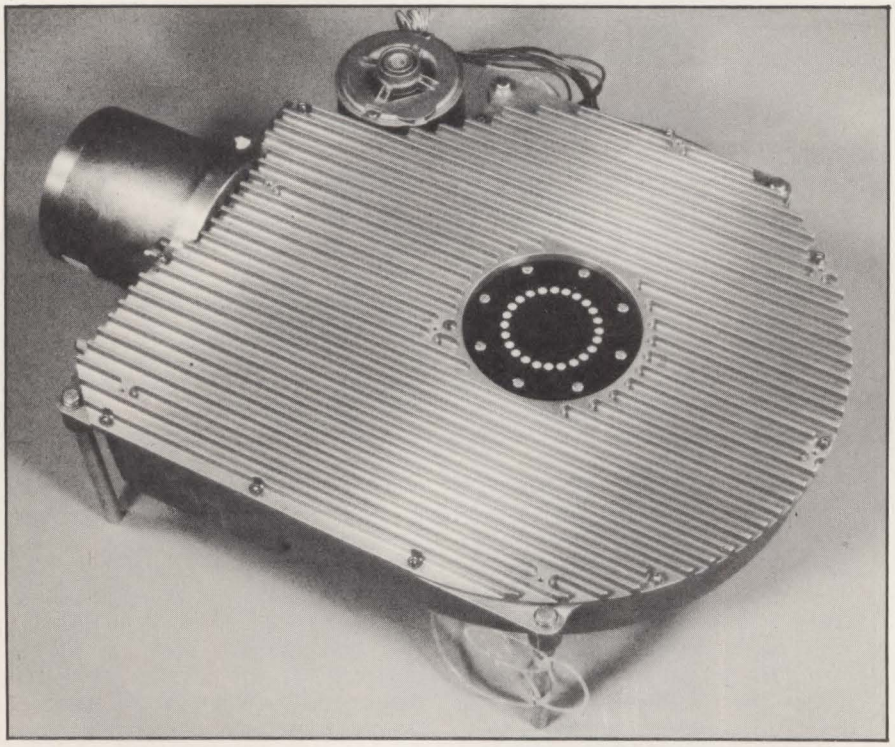
Due late this year from Century will be a second four-platter, 25-msec. version that will use significantly higher bit and track densities to pack 380M bytes of data into a package the same size as the AMS-190. Both drives will incorporate storage module drive (SMD) interfaces, and will use proprietary ferrite read/write heads—a move Brechtlein says will obviate the need for Century to turn to thin-film technology for the foreseeable future at least. "We don't want to be pioneers in this area," he says. "There's no risk in using ferrite heads."

Century's head design leaves a lot of room for data storage increases, Brechtlein goes on. The new heads will handle bit densities of 12,000 flux changes per in., he says, compared to 7545 fcpi on the AMS 190 and 10,000 fcpi on the AMS 380. The heads will also tolerate track densities in the 1000-tpi range, he goes on. The AMS 190 operates at 480 tpi; the AMS 370 at 712 tpi.

Also contributing to higher track densities in the new Century hardware is what Brechtlein terms a ventilated spindle. According to the Century executive, this spindle design spreads heat build-up more evenly throughout the sealed head-disk assembly so that each platter expands at the same rate. Heat expansion in the HDA can be a problem in multi-platter drives, using dedicated surfaces for tracking data, he maintains. The reason: correct head positioning is maintained by reading track location data from the servo surface. If platters have expanded or contracted unevenly due to temperature differentials, however, a track location calculated on the servo surface may not correspond to the same location on a data surface. The result will be a positioning, or off-track, error. "There is less than 0.5°F temperature change between disks," Brechtlein says. "We have no problems with track densities."

Century plans to bring its new AMS series drives up to the 600M-byte and higher range around the end of the year, with the 1.2G-byte device to follow. Century has little to say about these higher capacity drives, other than to note that the move into the gigabyte range may very well entail thin-film read/write heads tied to multiple actuators. Also under investigation, Brechtlein says, are increased data capacities through vertical recording. Xerox has such a project under way at its Palo Alto, Calif., research labs, he says.

Also announced at Comdex by Century was a joint agreement with Adaptive Data and Energy Systems (ADES), under which the Pomona, Calif., hardware house will develop combination disk/tape formatters for Century's 20M- to 160M-byte



Century's AMS 190: *Now being shipped in evaluation quantities, this 190M-byte 14-in. Winchester will be followed soon by a 380M-byte version. Ultimately, Century plans to bring the drive up to 1G byte using thin-film read/write heads. Note linear voice-coil actuator (l.).*

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Marksman drives equipped with either stepper- or torque-motor actuators. Priced at $875 in 100-lot orders, these formatters will permit either one or two of these Marksman drives to be interfaced to either Archive or Data Electronics ¼-in. streaming tape-cartridge drives. The formatter will handle off-line backup at a streaming rate of 5M-bits per sec., selective file backup and restore functions. Century has no corresponding formatter program in the works for its higher performance drives, although Brechtlein says that his company is now working on a specification. "It could be an intelligent device," he says. Pricing for the AMS 190 is $5900 in 100-lot orders; pricing for the AMS 380 has not been set. —*John Trifari*

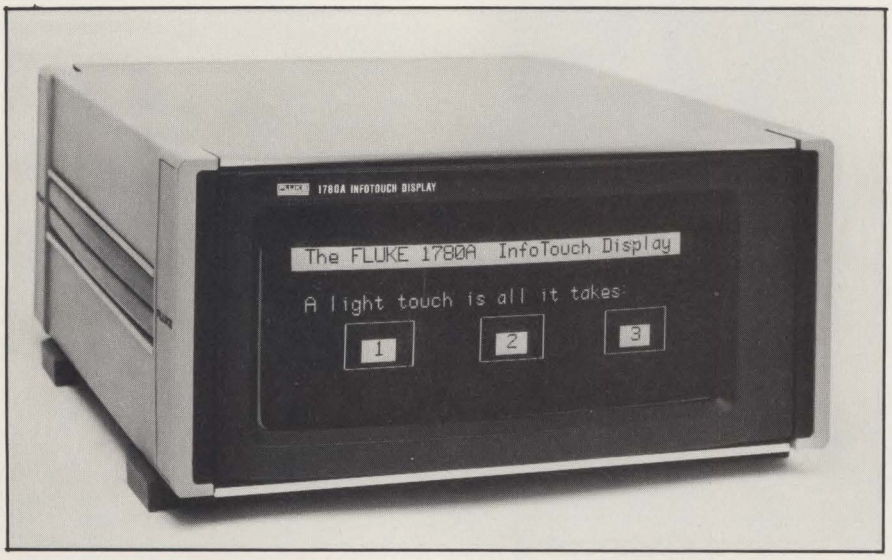
8-IN. HARDWARE TO COME

Century Data Systems plans to compete aggressively in the market for high-capacity, high-performance 8-in. Winchester hardware. To come this quarter is a fixed/removable drive based on the Dysan 200-mm. disk cartridge and a choice of an SMD, ANSI or the SASI interface recently announced by Shugart Associates. Due this year is an 80M-byte, 8-in. pack drive that will compete directly against the 9-in. RMD drive planned by Control Data Corp. (MMS, September, 1981, p. 10). According to Brechtlein, this device will have the same footprint as an 8-in. floppy-disk drive, permitting two devices to fit side-by-side in a 19-in. rack. It will be twice as high as a floppy-disk drive, however. Right now, Century is working with a number of suppliers, including sister subsidiary Xerox Magnetics, to develop media standards for the new disk pack. No pricing information is available on either of these two drives.

The company also intends to be a factor next year in the market for conventional disk-pack drives. Now shipping in evaluation quantities is the company's T306, a 300M-byte, 10-disk, 14-in. drive that Brechtlein says is plug- and pack-compatible with the 3330-technology SMD hardware supplied by CDC and Ampex. The T306 sells for $10,810. Century will continue to support its earlier pack entry, the Trident drive, Brechtlein says.

Instrument maker enters OEM market with touch terminal

Developed for use in automatic test equipment, the 1780A touch-input device is viewed by executives at John Fluke Manufacturing Co., Inc., Everett, Wash., as that company's ticket to expand beyond its traditional test-and-measurement business and into the world of OEM computer hardware.



John Fluke Manufacturing Co.'s model 1780A touch-input terminal *is designed for factory-floor and process-control applications, and is the company's first venture away from its traditional end-user instrumentation sales.*

"This is our first 'iron' product," says Chris Kenworthy, marketing manager at Fluke's Control Products Business unit, "and we're looking to move it in large volumes." Kenworthy says the new hardware uses an RS232 interface, and is designed principally for factory-floor and process-control applications in which operator experience with computer terminals may be limited. "The 1780A is not what could be called a conventional CRT with touch control added on," he says. "The people we see using this device won't hesitate to touch a screen, but may hesitate if they have to push buttons on a keyboard."

Touch input on the device is handled by a proprietary system comprising two scribed Mylar sheets that overlay the face of the terminal screen. These overlays provide 60 sense areas arranged in six rows of 10 on a screen measuring 3 × 7½ in. Each block on the screen is the size of three double-sized characters.

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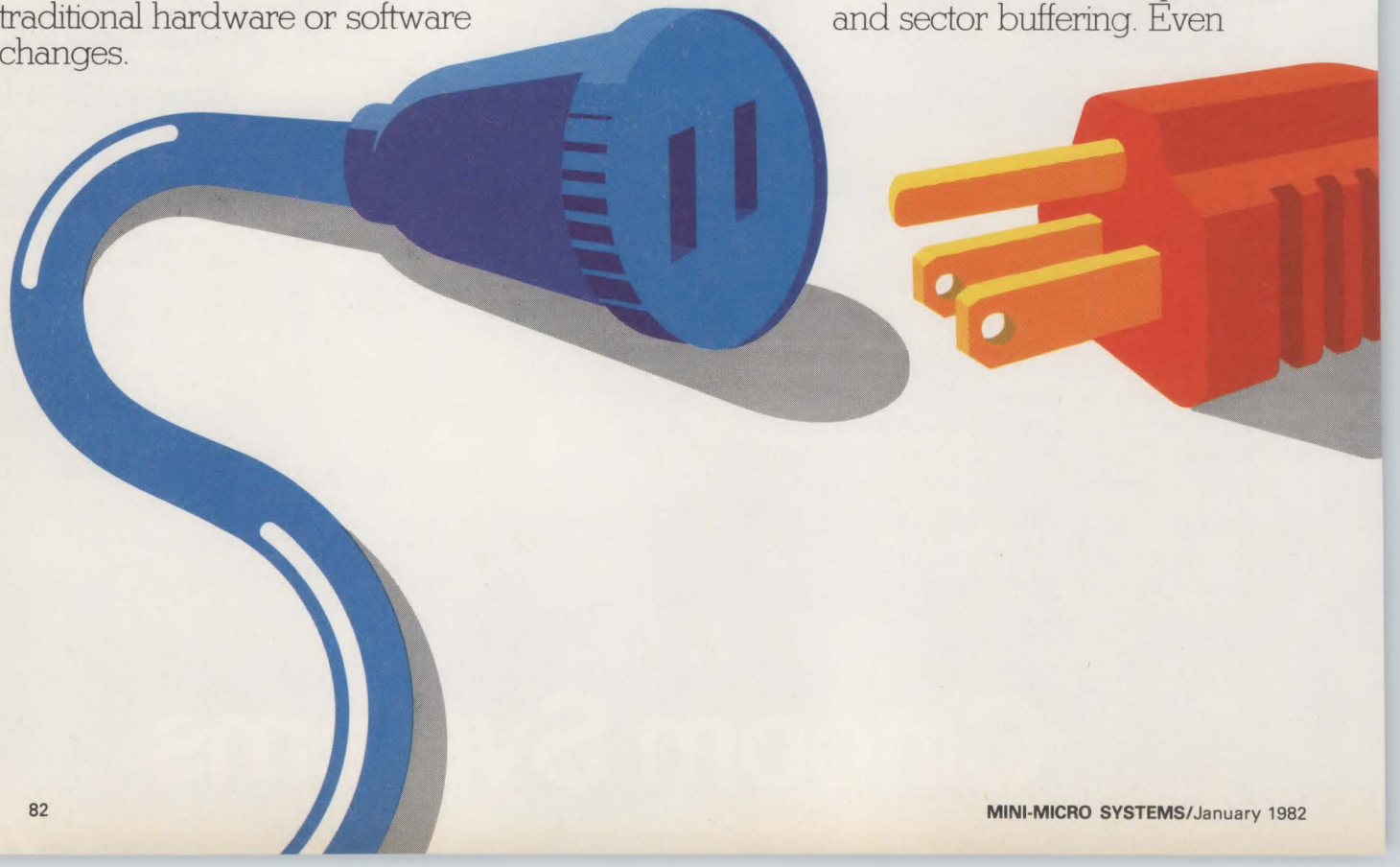

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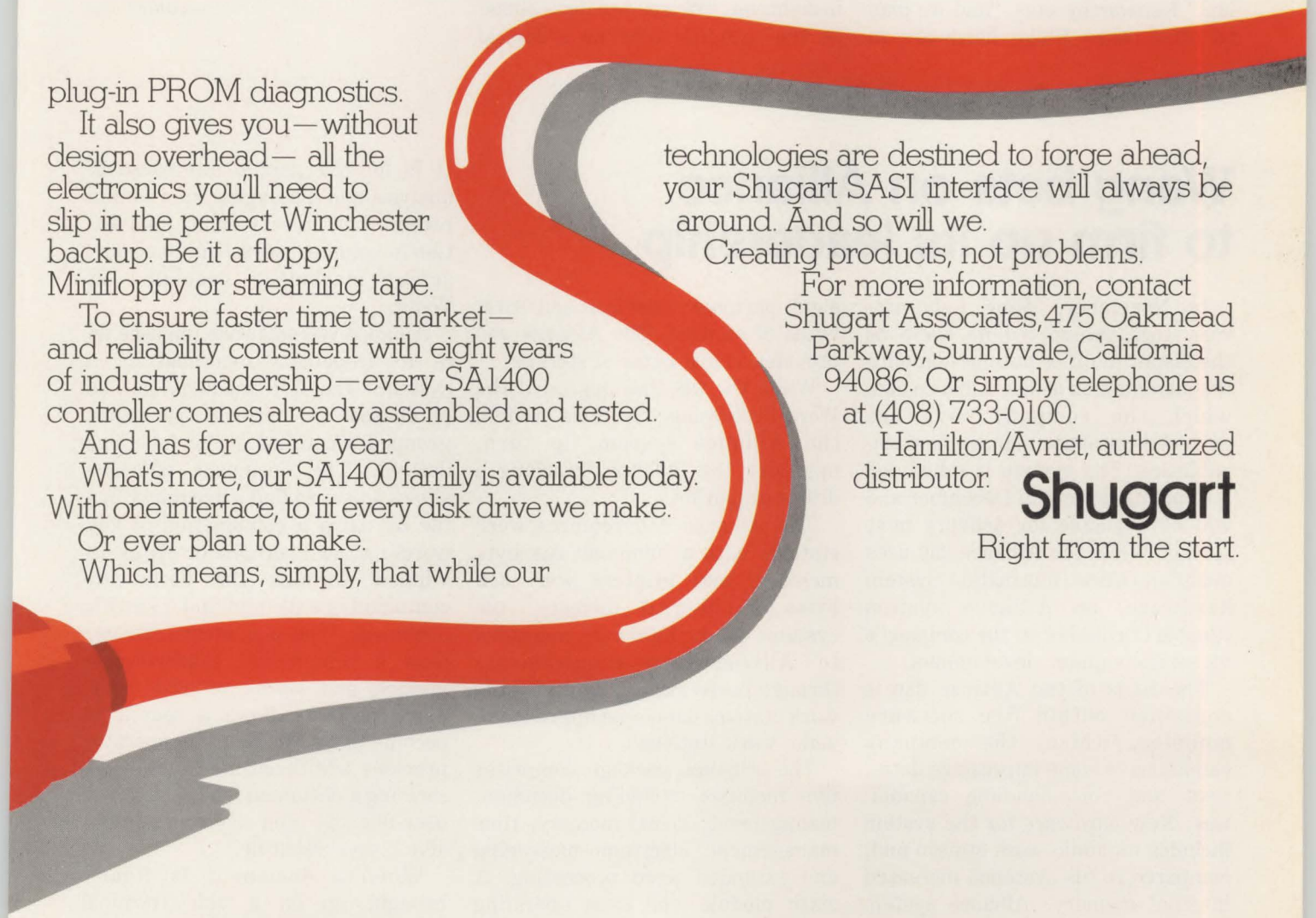

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Output on the display is based on a 96-character ASCII set, and includes software-generated video, blinking, underscoring and highlighting as standard. Options include a full keyboard and a numeric keypad.

The 1780A is a spin-off of the company's two-year-old 1720 GPIB touch-input instrumentation controller. "This device fell into our lap," Kenworthy says, "and we plan to offer other Fluke hardware in high volumes when it can be done easily." Fifty 1780A terminals have already been shipped, he goes on, and the company plans to have 1000 in the field by the third quarter of next year. The Fluke factory-repair group will handle service.

Kenworthy concedes that his company is exploring uncharted waters, even though, he says, there isn't much competition for the 1780A in sight yet. "We see products aimed at the systems OEM as a logical growth path for the company," he says, "but whether we pursue that market will depend on how we do with the 1780A. We'll know something next year."

The company is shipping limited quantities of the 1780A, and plans to be in full production by mid-1982. Single-unit price, including power supply, is $1995; in 250-lot orders, price is $1396 each.

—John Trifari

Wang bets on Alliance to firm up its leadership

In November, Wang Laboratories, Inc., reasserted its claim as the leader in office automation with the introduction of The Alliance 250, which the company says has powerful database-management capabilities. The system is scheduled for outside testing in December and will be available for delivery next spring. While the Alliance 250 uses modified Office Information System hardware, an Alliance system capable of running on the company's VS series is under development.

The basis of the Alliance 250 is contained within five software modules, which, the company claims, have some impressive data-, text- and voice-handling capabilities. New hardware for the system includes an audio work station and, compared to OIS systems, increased internal memory. Alliance system modules run on a distinct Alliance operating system. Although an OIS system can be upgraded, software would require varying degrees of rewriting.

The OIS line was introduced in 1979 and consists of six models, starting with the OIS 105 and ending with the OIS 145. The 145 can include as many as 24 work stations, eight peripheral devices and 835M bytes of storage. The Alliance 250 provides 1120M bytes of storage.

While the OIS line upgraded the Word-Processing Systems (WPS), the Alliance system, in turn, upgrades the OIS line, reaching a different market.

The Alliance 250 requires work stations with a minimum 64K-byte memory, and printers with 64K bytes of internal memory. OIS systems can be hardware-upgraded to Alliance 250 requirements through board swaps. However, OIS work stations cannot be upgraded to audio work stations.

The Alliance package comprises five modules, including document management, visual memory, time management, electronic messaging and extended word processing. A sixth module, the CP/M operating system, which allows a user to employ applications running under CP/M, is also available. The modules are priced as follows: visual memory: $6000, CP/M: $1000, basic package: $3000, notebook: $1000, time management: $2000 and voice documents: $2000.

"The Alliance 250 is five times more powerful than our 100 series. It is for the person interested in analysis and massaging information rather than in retrieving information in volume," says John Shoucair, senior marketing specialist at Wang.

Alliance 250 software imposes an 8- to 15-percent overhead on a system. The five modules can be purchased in optional packages, grouped according to the functions desired. The document manager allows a user to find a document in a file by using a combination of key words, titles, authors or dates to winnow through the documents contained in a file and find a specific document. The document manager uses a compressed binary-access method and works on the "and" principle that allows a search to become more precise as an operator provides additional information describing a document. "The system is user-friendly and not code-intensive," says Shoucair.

When a document is finally brought up on a video-terminal screen, word-processing functions can be performed.

The visual-memory module allows users to create files tailored to a user's specific needs. Visual-memory capabilities are restricted to information contained in 275M bytes of memory. With the visual-memory module, a user can build files based on a set of user-defined parameters

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and can add to the field or to records. There are no limitations to the lengths of a field, and fields are created by adding key terms. Access to fields is limited by a firm's security supervisor, who defines what information can be accessed by which individual.

The time-management module has extended calendar and scheduling capabilities. It is also the first module that makes use of the Alliance 250's audio work station. Under time management, a user can set up a calendar with a reminder file and can perform other scheduling functions, such as setting up a meeting by inquiring when other users of the Alliance system have an open time on their schedules. Also under time management, a user can perform simple electronic messaging.

Under the audio portion of the electronic-messaging module, the system can perform four functions. When tied into the phone lines, the system automatically dials on dual-tone multifrequency (touch-tone) systems, sends voice dictation and allows editing of dictation and messages.

The audio portion is based on voice digitization, and, although digitized messages do not appear in written form on the video display screen, cue marks that allow for editing appear at regular intervals.

The expanded word-processing module includes glossary-by-example and spelling verification of as many as 80,000 words. It also allows typewriter functions to be mimicked on the screen.

The Alliance system will be sold with three optional packages. A basic package includes the document-management and the expanded word-processing modules and can be expanded to include visual memory. A second option includes the basic package, option one and the electronic-messaging and calendar modules. A third option includes voice-messaging and transcription.

The system works with daisy-wheel and dot-matrix printers but not with Wang's image or line printers.

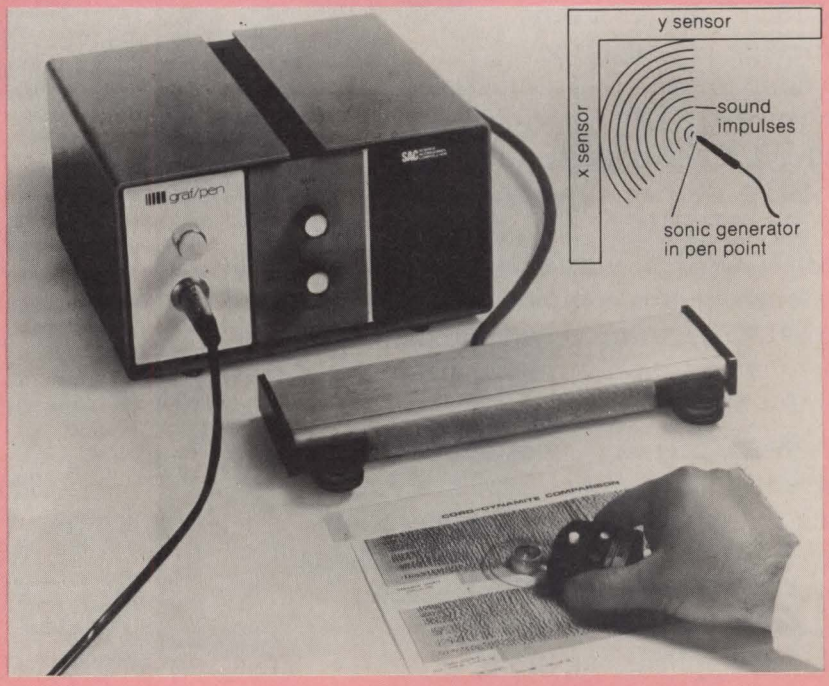
—Eric Lundquist

DIGITIZING ON SOUND PRINCIPLES

While plotters convert computer-processed data into hard copy, digitizers convert hard copy into data for computer processing. This is usually done by embedding a pressure- or capacitive-sensing device in a tablet on which is placed the material to be digitized. The location of the input stylus or cursor used to draw or trace lines is then determined by physical or capacitive contact with the tablet.

The Graf/Pen system from Science Accessories Corp., Southport, Conn., does not require a tablet. A sonic digitizer, it uses hypersonic impulses generated at the input device as its "yardstick." The times required for the sound wave to reach two microphone sensors, which measure X and Y distances, respectively, are converted into X and Y coordinates. Because sound waves move freely through air, there is no need to be in contact or in close proximity to a defined tablet. The sensors can be mounted on any display surface (a table, a drawing board, a blackboard or a projection screen), on which graphics data are most conveniently handled.

Another advantage of using sound as a ranging device is that digitization need not be confined to a plane. Because sound waves travel in all directions, 3D units that can digitize shapes in space are both feasible and available. In such systems, three sensors are used to generate X, Y and Z coordinate sets.



A typical sonic digitizing system *consists of an electronic control unit, sensor assembly and hand-held stylus or cursor as the input device. In operation (inset), the control unit initiates energy impulses that are converted to sonic waves by the input device, measures the time required for the sonic energy to reach each of the sensors and converts the time into digital distance measurements. Interfaces connect the digitizer directly to a variety of computers.*

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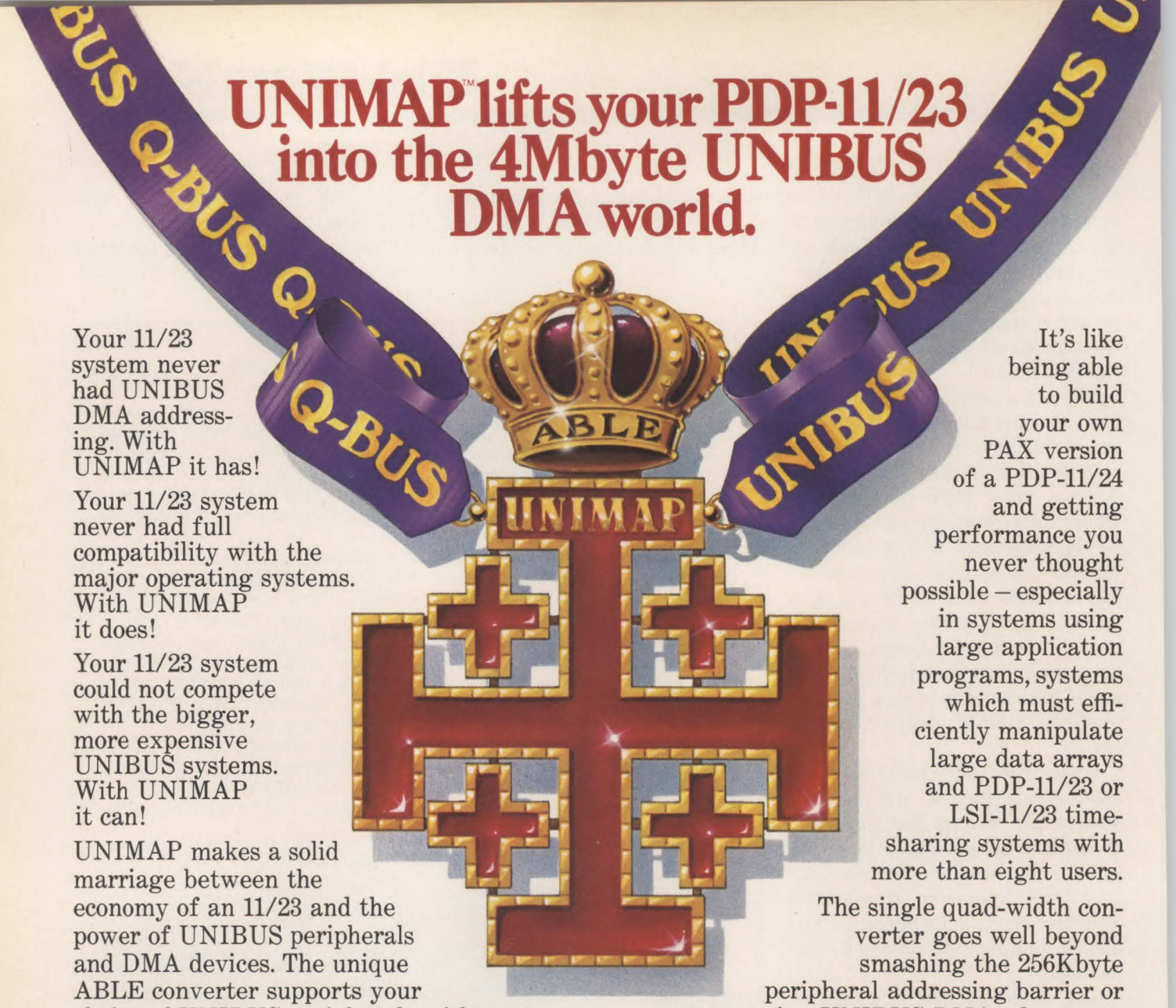

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CIRCLE NO. 46 ON INQUIRY CARD

Japan challenges at Systems '81

Japanese printer manufacturers were present in force at the huge Systems '81 computer exhibition in Munich last October, an indication of their determination to dominate the European market.

The Epson division of Shinshu Seiki Co. Ltd. exhibited its low-cost matrix printer products, including the 80-column MX-80 family, which is competing fiercely with the Centronics 730 series. Gunther Bretthauer, sales manager for Epson Deutschland GmbH, said the Japanese company had an appearance at Systems '79 "to test the water" and is now the market leader in Europe for 80-column printers. "Epson has already secured huge contracts with NV Philips and International Telephone and Telegraph for 80-column units to be used with the Philips P2000 and ITT 2020 personal computers," Bretthauer said. "On a worldwide basis, we have contracts with International Business Machines Corp. and Hewlett-Packard Co. In Europe, we are building up a dealer network from our headquarters at Düsseldorf, West Germany."

The Epson exhibits included the miniature model 150 dot-matrix printer, a 16-column unit that measures 3 × 1.7 × 0.5 in. (73 × 43 × 13 mm.) and operates at 1 lps.

C. Itoh & Co. Ltd., is also running its European printer marketing operation out of Düsseldorf. The company is selling three new impact printers built in Japan by the Tokyo Electric Co. Those printers include the F-10 daisy-wheel unit introduced in September, 1981, with two models running at 40 and 55 cps, the 80-column, 100-cps model 8500 matrix printer introduced in July and the 136-column, 120-cps model 1550, which sells for $1200 in the U.S. Osamu Ikeda, head of C. Itoh's printer marketing operation said, "C. Itoh has been selling OEM printers in Europe for the last five or six years, and we are now beating Centronics. Our main competitors in the matrix-printer business are Japanese. The only serious European-based competitor is Mannesmann Tally. The French manufacturer, Logabax, and Data Recording Instruments of Britain are not big enough to be a serious challenge. C. Itoh has distributors all over Europe."

Another giant Japanese company, Marubeni Corp., also exhibited a wide range of peripherals, including a 40-column thermal matrix printer built by Shinwa Ltd., which manufactures the Olivetti-designed mechanism, and CTI Corp., which developed the software and firmware. John Chambers, Marubeni's European marketing manager for electronic equipment, said that the thermal unit was being offered to the German state-owned common carrier, Deutsche Bundespost, for use as a hard-copy printer with terminals linked to its public videotex service, Bildschirmtext. Marubeni, which sells in the U.S. as Martec Corp., also exhibited the ASP 3500, a 180-cps, 136-column impact-matrix printer built by Alps Electric Co. Ltd., Yokohama, Japan. John Chambers said that Marubeni is seeking distributors for the ASP 3500 throughout Germany.

Mitsui & Co. Ltd. also exhibited the ASP 3500. The company's Düsseldorf office is also seeking German distributors.

Tokyo-based Toshiba Corp., which made its debut at Systems, demonstrated the TH-2100H, a new 136-column, 100-cps impact matrix printer. It uses a head with 24 less-than-0.2-mm.-diameter wires. The head enables printing of Kanji Chinese characters used in Japanese writing. A Toshiba spokesman explained, "We are seeking big OEMs for the TH-2100H first, and we plan to appoint distributors all over Europe."

Ricoh, best known in Europe as a copier manufacturer, demonstrated the 65-cps RP1600 daisy-wheel

WESTERN EUROPEAN PRINTER SHIPMENTS
(Origin of vendor by technology — 1980)

	North American vendors (000)	Market share	Western European vendors (000)	Market share	Japanese vendors (000)	Market share	Total (000)
Serial character	41.8	58.4%	19.8	27.7%	10.0	13.9%	71.6
Serial dot matrix	197.3	52.2%	136.4	36.1%	44.0	11.6%	377.7
Serial non-impact	14.4	54.5%	12.0	45.5%	0.0	0.0%	26.4
Line printer	45.6	80.6%	7.0	12.3%	4.0	7.1%	56.6
Total	299.1	56.2%	175.2	32.9%	58.0	10.9%	532.3

Source: IDC Europa

unit, which it began selling in Europe from its Amsterdam, the Netherlands, headquarters more than two years ago. Ricoh says more than 10 West German word-processor manufacturers use its printers.

Two other Japanese companies, Mitsubishi and Sanyo, plan to start selling printers. Mitsubishi will market its own equipment, while Sanyo will begin selling printers from another manufacturer this year.

Opposition to the Japanese onslaught in the 80-column market was presented by Mannesmann Tally in the form of the MT 100 family of 80-column matrix impact units introduced in 1981. The company also showed its MT 400 line of 132-column units. Mannesmann Tally spokesman Hermann Vogt said, "We are competitive with the Japanese in price and quality and enjoy the advantage of manufacturing in Europe. We are concentrating all our matrix printer manufacturing at our plants at Elchingen, Germany, and Vienna, Austria." The company plans to have the Tally operation, Kent, Wash., manufacture the comb printers it developed before its merger with Mannesmann. "We are talking to μc builders Apple Computer, Inc., and Commodore Business Machines Corp. about our matrix printers," said Vogt. "There are about 30 systems suppliers at Systems '81 using our printers as part of their configuration."

Centronics did not exhibit at Systems '81 because of the imminent introduction of the 350 series of 132-column matrix printers. "The 350 launch was very near, but we could not show the new units so we decided not to appear at all," says Centronics's European vice president Terry Harris. He claims that Centronic's nonappearance has nothing to do with the company's financial problems. Concerning Centronics's position in the European market, Harris says, "About 40 percent of our worldwide shipments are to customers in Europe; we still have at least 50 percent of the market for 132-column printers. C. Itoh is not ahead of us, but Epson may be shipping more 80-column printers than us." In addition to the company's U.S.-built 730 series of 100-cps unidirectional printers, is a 150-cps, bidirectional, 80-column unit built in Japan as part of its 150 series introduced in 1981, says Harris. "We manufacture our 700 series of 132-column printers in Ireland for European customers, and the main advantage is having a strong engineering base close at hand. It does not, however, provide any significant cost savings over the Japanese," he says.

John Gripton, European marketing director of Dataproducts Corp., said his company was staying out of the 80-column business "at least for the time being. Our policy is the top-down approach. Our top priority is our D50 line of 50- and 55-cps daisy-wheel printers and our 132-column M100 matrix printers, which we plan to assemble at our plant in Ireland for European customers. In Europe, the D50 printers compete mainly with Japanese suppliers, while the main competitors for the M100 are Centronics and Mannesmann. We want to retain our high-quality line-printer image in the serial-printer market and do not want a head-on image with the Japanese." —*Keith Jones*

JAPAN TO CHALLENGE U.S. MATRIX MANUFACTURERS

By 1980, Japanese printer vendors commanded almost 14 percent of the Western European daisy-wheel printer business and 12 percent of the market for serial dot-matrix units. In the daisy-wheel market, Japanese manufacturers are likely to encounter stiff competition from European electronic typewriter manufacturers, such as Olivetti and Triumph-Adler. But Japanese vendors of matrix units will soon be challenging the market leaders—U.S.-based Centronics and European-owned Mannesmann-Tally—in the non-captive market.

These are some of the findings made in a study on the Japanese push into Europe prepared by IDC Europa, Ltd., and by International Data Corp., Boston. The study, called "The Threats and Opportunities of Japanese Vendors in Western Europe," underlines the fact that printers are one of the first types of computer hardware to be actively promoted by the Japanese. The study names Epson and Oki Electric as the two leading threats to Western manufacturers in the dot-matrix printer market, while C. Itoh, Ricoh and Nippon Electric Co. are the leading Japanese daisy-wheel suppliers in Europe.

The IDC survey predicts that the Japanese will move into the ink-jet printer market in Europe in the next two or three years. This will satisfy Europe's increasing demand for graphics and color printing.

The report also claims that the Japanese have a long way to go before they achieve a strong position in the line-printer market. IDC points out that U.S. manufacturers commanded 80 percent of the European line-printer business in 1980. IBM Corp. and Dataproducts Corp. together accounted for 50 percent. But IDC sees Japanese manufacturers of dot-matrix printers enjoying a fast rate of sales growth. In Europe, the Japanese are represented by Oki Electric, which accounted for 7 percent of total line-printer shipments in 1980.

NEXT MONTH IN MMS

- A detailed look at the floppy-disk market, with complete listings of manufacturers.
- A comprehensive survey of the Winchester disk market, also with complete listings of manufacturers.

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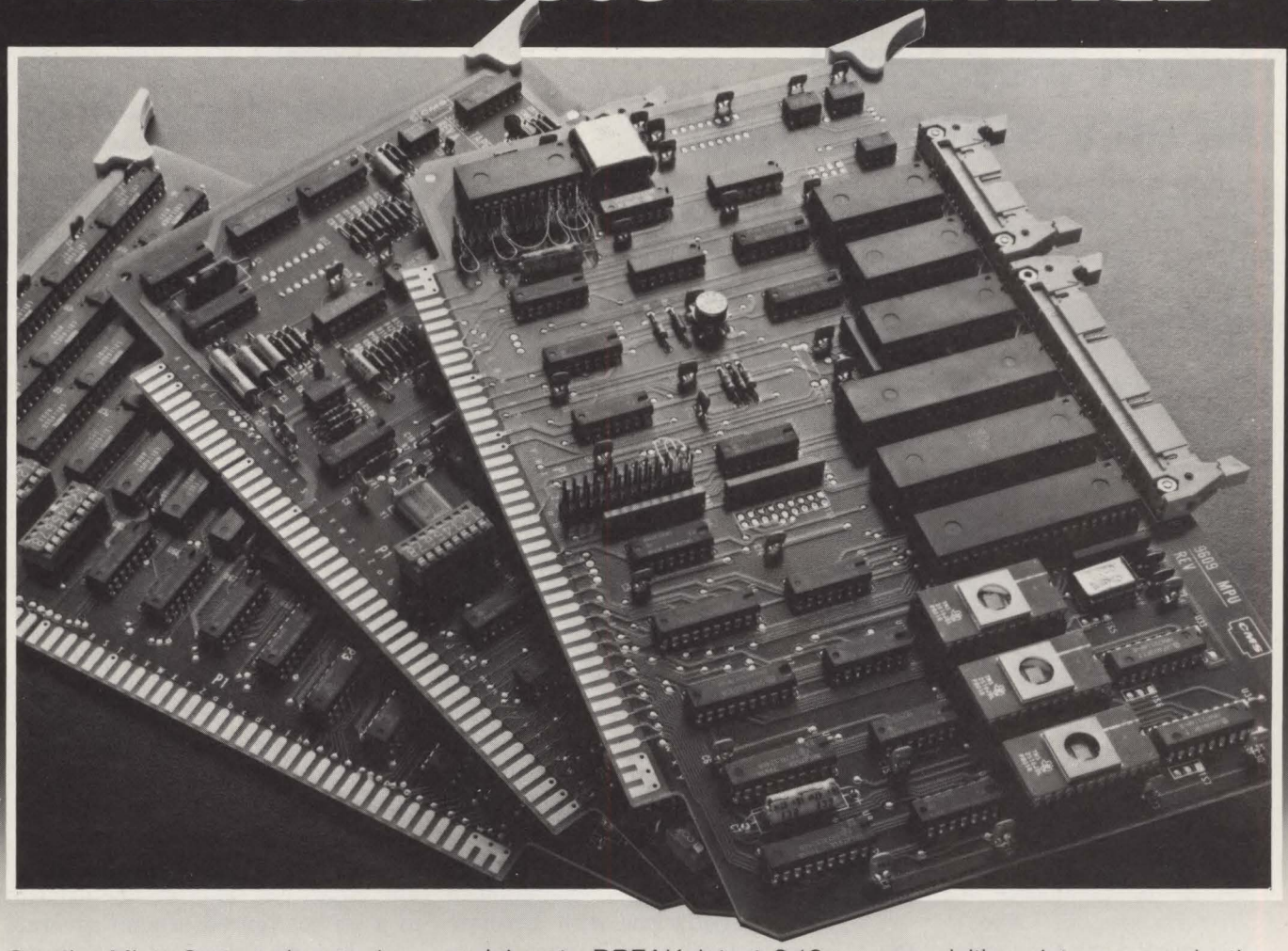

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CIRCLE NO. 47 ON INQUIRY CARD

Britain tries to fill Japan's software gap

If Japan hopes to repeat with computers the export victories they have won with cars and consumer electronics, they must supply one vital missing ingredient—software.

Some British software houses hoping to supply that ingredient to the Japanese staged the Information Technology Exhibition in Tokyo last November. At the show, 14 exhibitors offered products and services to the software-hungry Japanese industry.

Backed by the British Overseas Board, a government agency established to promote exports, the show was the idea of the Computing Services Association, an independent group representing the interests of many of Britain's leading service bureaus, systems integrators and software houses. The event was organized by the London Chamber of Commerce with the British Embassy in Tokyo.

Exhibitor Safe Computing, Birmingham, England, used the show to gain a back-door entrance to the U.S. market. Safe found a Japanese small-systems manufacturer interested in Safes, an interactive production-control package. Company chairman Philip Rule explains, "There are about 500 Safes installations worldwide. But there are only six sites in the U.S. running the package. We hope to form an agreement with a Japanese small-systems supplier that is active in the U.S. market. Under that agreement, we will develop a version of Safes for the Japanese machine, and they will sell it in the U.S. and Japan. We have already talked about Safes to U.S. subsidiaries of several Japanese systems suppliers, and we used the Tokyo exhibition to contact their parent companies. There is a serious shortage of small-machine packages in Japan, and I am convinced we can do business there."

Safe Computing's plans in the U.S. market go beyond a deal with a Japanese systems supplier. The company will launch a portable μc version of Safes this year. The system runs machines that support Micro Products Software Ltd.'s MicroCOBOL, a family of portable commercial applications packages. MPSL's U.S. marketing operations is Palo Alto, Calif.-based subsidiary, Microcobol Protocols, Inc. The MicroCOBOL packages are enhanced with Safes that run under MPSL's BOS operating system. Safe Computing hopes to sell a μc version of Safes through some of MPSL's network of U.S. agents, but is also interested in new U.S. agencies.

Software Ireland, Belfast, Ireland, appeared at the exhibition to initiate negotiations with Japanese μc manufacturers interested in having accounting applications software developed for European customers. Software Ireland's managing director Gordon Bell pointed out, "Our background is in developing applications software for Digital Equipment Corp. machines, but we are now acquiring experience with μcs running under CP/M, MP/M and UNIX. The Japanese manufacturers we are talking to have machines that support these operating systems. There is a dearth of software products in Japan for μcs."

Another exhibitor at Tokyo, Compact Accounting Ltd., talked with floppy-disk-drive manufacturer YE Data, the Japanese distributor for Compact's systems generator, Nucleus. Nucleus runs under any machine supporting the CP/M or CP/M 86 operating system. YE Data also handles CIS COBOL for MicroFocus. Compact's accounting managing director Peter Bronson says that Nucleus is designed for generating relatively simple labor-intensive programs, such as selective report production. Bronson expects YE Data to sell Nucleus to Japanese μc manufacturers aiming at the Western market. The product is already available in the U.S. on Applied Digital Data Systems μcs, and a U.S. marketing company, Compact Systems International, has just set up shop at Syosett, Long Island, N.Y. to promote the product. It is also selling Compact's accounting packages that run under CP/M and UNIX.

Pactel, the computer and telecommunications side of London consultancy PA International, demonstrated the Microsim cross compiler for μps. Pactel officials say the Tokyo show represented a toe in the water for Microsim, which enables fully relocatable object code to be generated on a wide range of mainframes and minicomputers. The object can be down-line loaded to a μc configured around several μps, including Intel Corp.'s 8085 and 8048, Motorola's 6800, Zilog's Z80 and RCA's 1802. With Microsim, a user writes his program in the assembler code of the target μc.

Pactel also demonstrated Paragon, a vehicle-scheduling package that runs on any machine with a FORTRAN compiler, including DEC's LSI-11 and PDP-11 minicomputers. Microsim and Paragon are available in the U.S. from the Pactel offices at Princeton, N.J. Pactel's managing director Derek McLaren foresees a more promising market in the near future for Pactel's software products than for its consultancy services. "The Japanese perceive a need for software products, but the market for consulting is better developed at the moment in Europe and the U.S."

—Keith Jones

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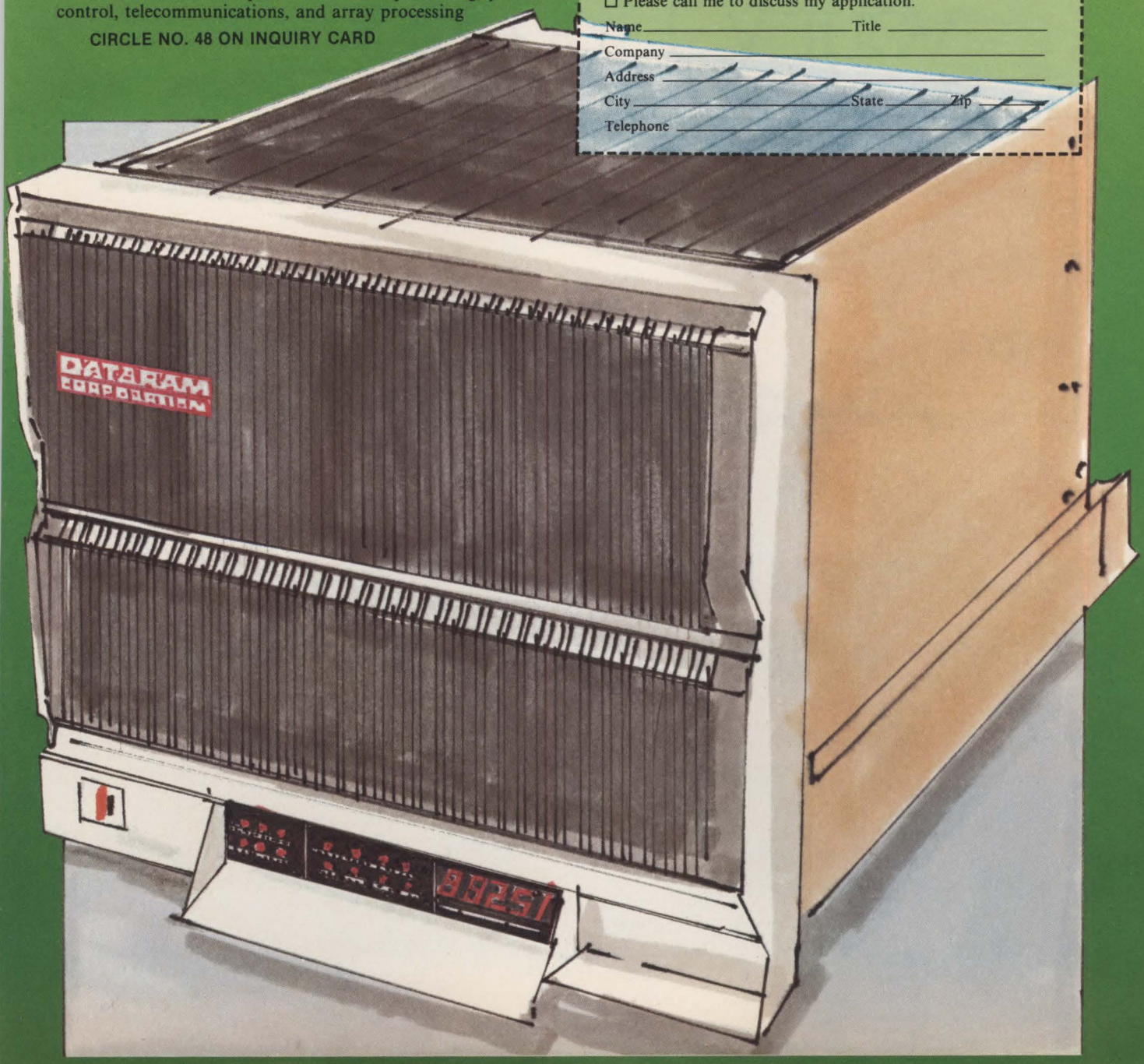
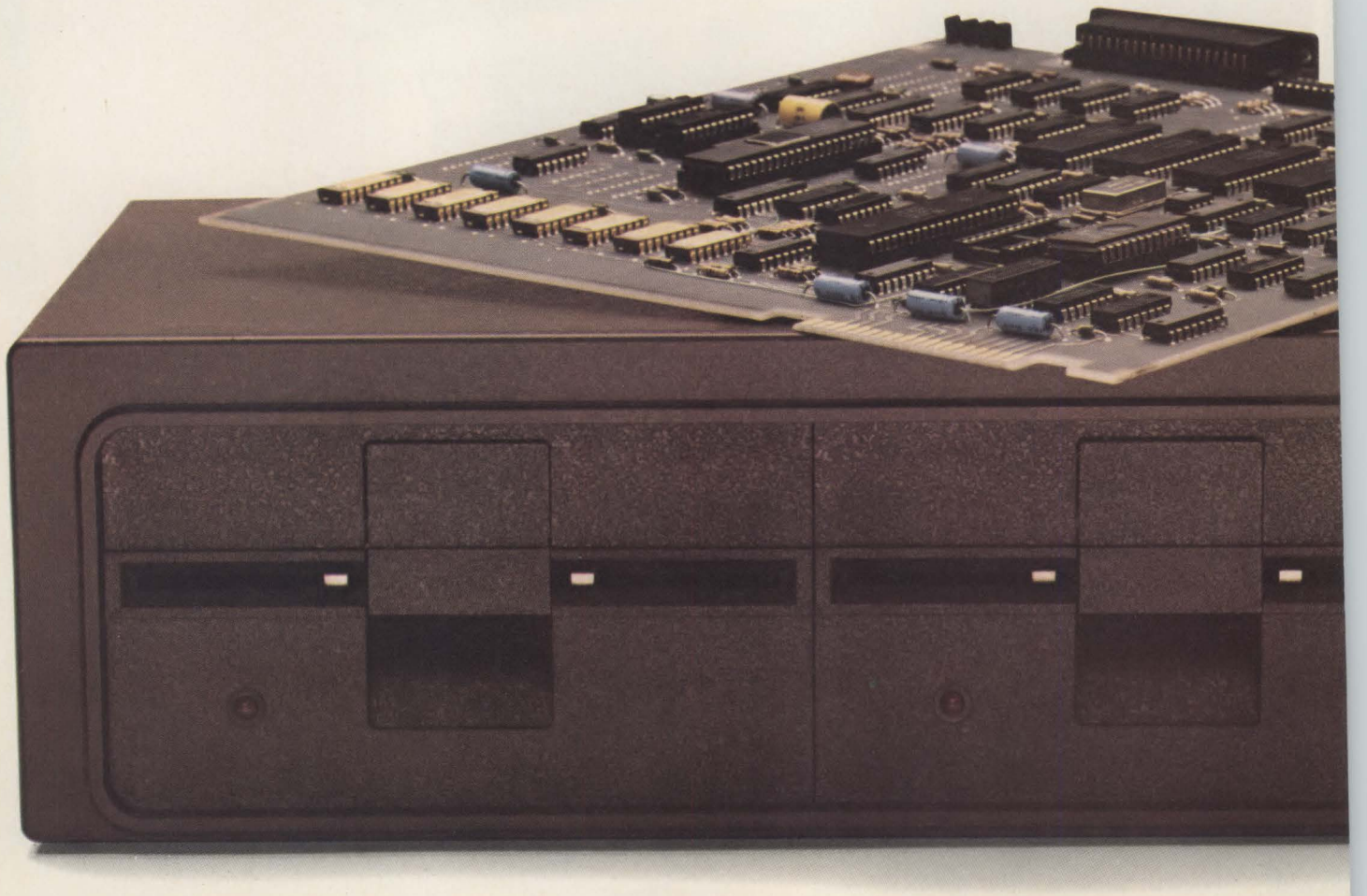


Here's everything you need to make your VT100 a CP/M personal computer.



DIGITAL ANNOUNCES THE VT100 PERSONAL OFFICE COMPUTING OPTION.

If you've made up your mind to add personal computing capability to your office, Digital has good news: the VT100 personal office computing option.

Now you can turn one of the world's most widely used ASCII video terminals into your own personal office computer to run one of today's most popular operating systems: CP/M.®

What's more, your Digital service representative or terminals distributor can have your option installed and running in just 15 minutes.

CP/M: THE DECADE'S FASTEST GROWING FAMILY OF SOFTWARE.

Today, VT100 option owners can choose from a library of compatible software encompassing high-level languages and a wide variety of popular applications: financial modeling, word processing, mail list, statistical package, and data base communications (to external data base sources).

The library is rapidly expanding with new offerings. And many of the more than 2,000 programs already available for CP/M are being specially edited for this option.

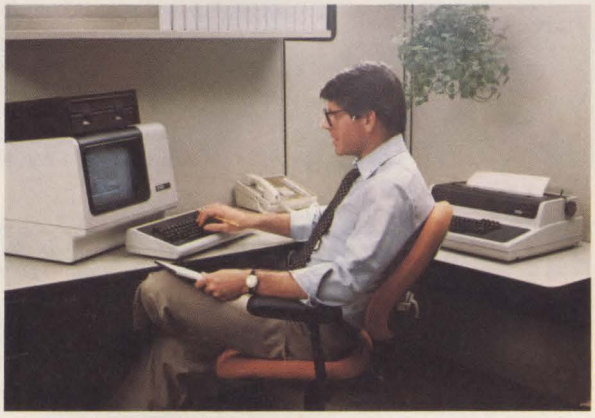
Of course, the idea of personal computing isn't new to us. In fact, Digital pioneered the concept in the early 1960s when we developed interactive computing. And it's the basic principle behind every product we've ever produced.

That's why we originally designed the VT100 with enough power and space so you'd be able to turn it into a personal computer today. Like all the computers we've designed, it lets you get the information you want, in the form you want, when you want it.

And like all our computers, it's backed by one of the world's largest service forces dedicated to small computers.

Digital has more than 16,000 service professionals worldwide. And 350 fully equipped vans coast-to-coast totally dedicated to terminals and small systems.

Digital's VT100 video terminal. It's half of the personal office computer you've been looking for.



Digital's personal office computing option comes with a Z80-based CPU, dual mini floppy drive standard (second dual floppy drive optional), diagnostic disk, user documentation and guide, and installation hardware.

To get the rest, contact your local Digital terminals distributor or your Digital sales office. For the name of your nearest distributor, call 1-800-258-1577. In New Hampshire, call 603-884-7492. In Canada, call 1-800-267-5250.

Digital Equipment Corporation, Terminals Product Group, MR2-2/M67, One Iron Way, Marlboro, MA 01752. In Europe: 12 Av. des Morgines, CH-1213 Petit-Lancy/Geneva, Tel. 011-41-22-93-33-11. In Canada: Digital Equipment of Canada, Ltd.

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Multiplan™: tools that will sell a lot of computers.

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Tools for decision makers. Multiplan is a second generation electronic spreadsheet simulator. It is highly interactive, user-friendly, and easy to learn. It provides all the tools users need for answering the toughest question in business: "What if...?" And, it's specifically designed for non-computer people.

A better marketing tool. When you build Multiplan into your system, you add the sales appeal of an endlessly useful numeric worksheet. A single tool with dozens of uses: Financial Analysis. Capital management. Accounting. Numeric modeling. Market analysis. To name just a few. You can build Multiplan into a vertical system, bundle it on a menu or use it as a turnkey system.

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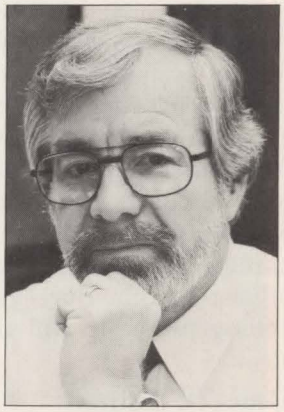
A tale of two trade shows



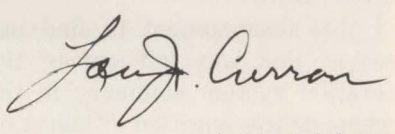
The success of the most recent Comdex show prompts me to contrast that show with the National Computer Conference. I'm not suggesting that NCC isn't successful, but its sheer size has made it increasingly difficult to manage well. The two shows shouldn't be directly compared because their audiences are substantially different, but the view in this corner is that NCC's sponsors can make that forum even more successful by more closely selecting their audience, as the Comdex sponsors have.

The Comdex show has clearly become what its sponsors planned that it would—a forum for information exchange between manufacturers of small systems and peripheral devices on one side, and independent sales organizations on the other.

Comdex sponsors went too far last November in Las Vegas in pointing with pride to the number of exhibitors they attracted, claiming it was the biggest computer exhibit ever. They didn't point out in their publicity, however, that the average exhibit size in Las Vegas is substantially smaller than NCC's average booth size, which is one of the Comdex strong points. The other chief strength is that the exhibits and program sessions are carefully tailored to the ISO audience, so that there aren't hordes of students and literature gatherers clogging the aisles—a situation that seriously hampers NCC's effectivenss. The last NCC reported more than 80,000 registered to see the show; the Comdex gathering in November had some 23,500.

There was no grumbling from exhibitors about non-qualified shoppers or generalized crowding. In fact, exhibitors signed up in droves to go back again this year; the booth count this fall could double the 1630 total of November, but the important point is that there's twice the space available in the Las Vegas Convention Center compared to the area covered last time.

We hope the success of Comdex convinces its sponsors that they need to scrupulously guard its vendor-ISO format. We also hope that there may be some lessons that AFIPS can learn about restructuring NCC to make it more manageable. One way to do it may be to go back to a variation of the old Spring and Fall Joint Computer Conference format, but with a twist. The spring gathering might be devoted to superminicomputers, mainframes and their related software and peripheral equipment, while the fall show could be for systems, software and peripherals associated with 16-bit applications.



Lawrence J. Curran
Editor-in-chief

Letters

NETWORK AVAILABLE NOW

To the editor:

Your article on the broadband network from Mitre (MMS, October, 1981, p. 34) may have some readers wondering why such a system is not readily available commercially. For those wondering, such capability is available as an off-the-shelf product from International Computing Co. ICC's products for local-area networks include software for transparent, TTY, X.25, X.25 PAD and other protocols. Burroughs and IBM polling protocols will be available soon.

James O. Mulford
Director, Denver Operations
International Computing Co.
Fairborn, Ohio

KUDOS FOR MMS

To the editor:

Mini-Micro Systems is an invaluable aid to me as a systems analyst. With the fast pace of the ever-changing data-processing field, I find it difficult to keep abreast of developments without the information provided by magazines such as yours. Being a small data-processing organization supporting many applications, time is tight, but because of the content of MMS, I am able to stay informed of developments in the computer field. Thank you for producing a magazine of such high quality.

Robert A. Premovich
EDP Systems Analyst
Arizona Health Sciences Center
Tucson, Ariz.

OS ADDITION

To the editor:

I was disappointed to find our product line was left out of the operation system summary in the recent article entitled "Operating systems cost more—but also do more." (MMS, October, 1981, p. 113). National Semiconductor Corp.'s μc systems division has been shipping the BLMX-80 operating system since February, 1981. We offer this product in recognition of the fact, that even in simple applications, the major cost in time and funds is the software. A second advantage of a software offering from a hardware vendor is guaranteed compatibility between the software and the supported hardware, even if the vendor must make hardware revisions.

BLMX-80 was specifically designed for real-time, or process-control, applications. If the disk file system is linked with the operating system, it will also serve as a general-purpose operating system. The nucleus was written in assembly language, versus an intermediate or high-level language, thus providing a "true" 2K-byte OS in ROM/PROM. This, together with the fact that BLMX-80 features direct-interrupt processing versus task-level interrupt handling, provides for real-time responses to asynchronous events as much as 10 times faster than with conventional multitasking architectures. Unlimited internal copies and no royalties on distribution of derivative code are included in the $2400 price tag.

Steven McGinness
Product Marketing Manager
Board Level Products
National Semiconductor Corp.
Santa Clara, Calif.

PRICE CORRECTION

To the editor

I very much appreciated your article "Which DBMS is right for you?" (MMS, October, 1981, p. 157).

My company's product, FACTMATCHER, was listed by Harvey Weiss. However, the price quoted includes both hardware and software.

Depending on the size of the total system, FACTMATCHER software ranges from $12,000 to $50,000.

David N. Beer
Product Manager
Mini-Computer Systems, Inc.
Elmsford, N.Y.

LOW-COST SBCs

To the editor:

Although your article "Single-board computers offer greater choice and power" (MMS, September, p. 121) was for the most part quite accurate, a few comments are in order.

As to the statement that 8-bit single-board computers are available for less than $300, indeed! Our M-80 kit sells for $69 in single-unit quantities and can be supported with either Monitor or BASIC software.

The days when 8-bit μcs were limited to 64K address space were passed long ago. The MCPU-800 sports an on-board complement of 96K bytes of RAM and ROM, with extension to more than 2M bytes easily accomplished. Our application programs routinely use more than 64K bytes of memory.

The discussion in the article on power requirements is also somewhat misleading. Many second-generation single-board μcs require +5V only. The MCPU-80 with a 4-MHz Z80A, 64K bytes of RAM, 32K bytes of ROM, 32 I/O bits and an RS232 serial port needs only +5V at 1.5A (7.5W). Single-board computers that require 20W to 30W are the exception and not the rule.

Eric M. Miller
President
Miller Technology
Los Gatos, Calif.

GRAPHICS ON LOW BUDGET

To the editor:

I found the article "Tektronix graphics on a low budget" (MMS, September, p. 78) to be very

interesting. Unfortunately, a couple of errors crept into the text. The resolution of the Digital Engineering RG512 is 512 × 250, not 640 × 480 as stated in the article. The 640 × 480 figure is for the DE VT-640, which adds graphics to the Digital Equipment Corp. VT-100 terminal. The resolution value for the Selanar VT-100 retrofit card is 1225 × 240, not 240 × 24.

It would have been useful to note the difference in implementation philosophy between the VT-100 graphic-retrofit cards offered by Digital Engineering and Selanar. The Selanar unit is user-installable, and uses only the display capability present in the standard DT-100 (non-interlaced, high horizontal resolution), resulting in the 1225- × 240-dot resolution. The Digital Engineering card uses the VT-100 interlaced display option, requiring the terminal distributor to replace the standard CRT terminal in the VT-100 with one that has a long persistence phosphor. This allows the DE unit to double the vertical resolution, giving a 640- × 480-dot display. This format is probably more useful than the format provided by the Selanar unit.

Another approach to low-cost Tektronix graphics compatibility is the VDC11 card introduced by Andromeda Systems, Inc., last spring. The VDC11 card provides all the logic circuitry for a standard video terminal, Tektronix 4010 graphics capability (resolution is 512 × 256) and the graphic enhancements found in the RG512 (selective erase, graphics screen readback), plus an independent serial interface. The VDC11 is intended to plug into a DEC LSI-11/Q-bus backplane and is dedicated to that system. The user need add only a video monitor and a keyboard to have a fully functional alphanumeric and graphic terminal. The VDC11 card is available in two versions. The VDC11-A emulates the ADM-3A+ terminal while in alphanumeric mode; it sells for $1200. The VDC11-B emulates the DEC VT-52 in alpha mode; it is priced at $1400. The serial interface on the VDC11 card will allow the introduction of a stand-alone (non-Q-bus-dependent) version in the near future. Complete terminal subsystems, including the VDC11 card, video monitor, serial keyboard and cables, are priced at $1700 (ADM-3A+ emulation) and $1900 (VT-52), less than half the price of a Tektronix 4010. Prices for the stand-alone versions will be comparable.

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

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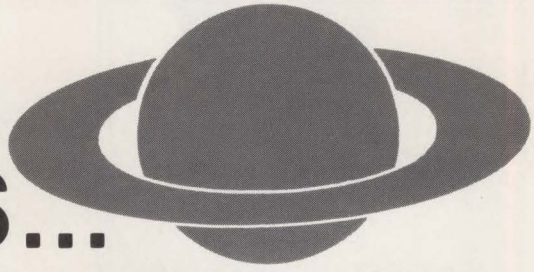

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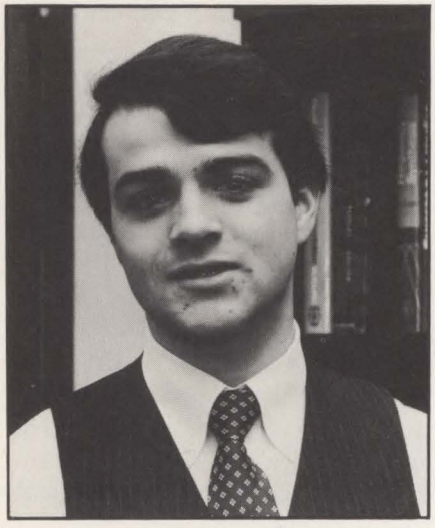
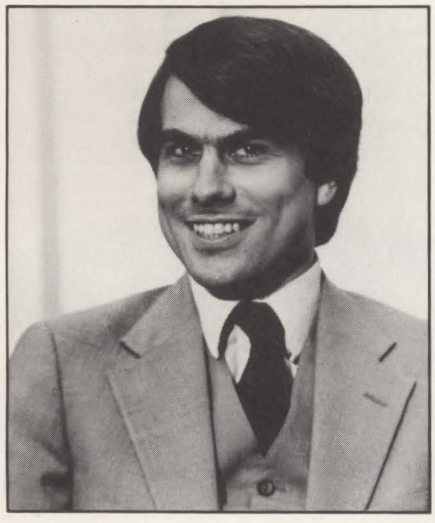
New directions in a new year





The first issue of a new year is an appropriate one to introduce new people and new directions. In that spirit, this issue contains the initial efforts of two new staff members, the introduction of a new section and a first-hand report on the deepening impact of Japanese companies as they compete for worldwide printer markets.

Lori Valigra became news editor in October, and departed almost immediately on a two-week assignment to Japan to do the reporting for her comprehensive article (see "A report from Japan," p. 187).

There are two additions to our editorial staff: Patrick Kenealy in Boston and Kevin Strehlo in Los Angeles. Both are associate editors, but their assignments differ substantially. Pat reports to executive editor Alan Kaplan, and is primarily responsible for producing the major product survey articles that have been a mainstay of our feature article section for years. We call them product profiles, and Pat's first one appears on p. 157.

Pat's credentials for his new assignment are most appropriate. He came to us from GML Corp., a computer-based quantitative research organization in Lexington, Mass., which continues to assist the editorial staff in its research. As senior technical editor, Pat managed GML's editorial staff, edited GML's *Computer Terminal Review* and *Computer Display Review* reference handbooks and was responsible for the technical content of all GML's extensive printed and on-line reference products.

Pat received a B.A. in economics, with a concentration in industrial organization, from Harvard University. His studies included considerable analysis of the data-processing industry, and led to an honors thesis on the organization of the display terminals segment.

Kevin Strehlo is the fourth editor we've located in California. Along with Larry Lettieri and Nancy Love, Kevin will assist John Trifari, our West Coast bureau manager. John has moved from Los Angeles to our San Jose office, and Kevin is working out of the Los Angeles office, covering developments in the Southwest.

He has worked as a public relations writer on high-technology accounts for an Orange County agency, and has been a free-lance contributor to *Popular Computer* and *Computer* magazines. Kevin began his journalism career with *Off Duty*, a leisure-time publication that concentrates on audio, video and photography topics. He served in the Hong Kong home office as managing editor for a year. Kevin studied computer science and English at the University of California.

Finally, the new department we're introducing with this issue is the Mini-Micro Interpreter. The section is directed and edited by associate editor Eric Lundquist, and answers a need we've recognized for a vehicle to present more in-depth analysis of issues and trends affecting the computer industry than we can in the shorter stories typical of the Mini-Micro World section.

S. Henry Sacks

S. Henry Sacks
Vice President and Publisher

A sojourn in Japan

The first visit to a country and culture that differs greatly from one's own can be traumatic, pleasant or something in between. I had read enough about the Japanese people, their culture and business practices before going to Japan to make me very curious and eager to visit their country. Nonetheless, I was apprehensive about how my expectations would match with reality.

For one, as a journalist, I went at a time when Japanese printer companies, especially, might have felt they were under attack by the American press for their aggressiveness in the U.S. market. I was surprised, however, to find how open most companies I visited were about their activities and market figures, even though much of this "secret" information is in the public domain in Japan. Secondly, I was a bit concerned, after being prepared that it would be an issue, about the reaction of a male business society to a female, especially a young female. To a large extent, age connotes experience in Japanese businesses. I was received as a curiosity by most, and actually welcomed on the basis of gender at one company that had never had a female journalist visitor.

The most overwhelming impression, however, is of the attention to detail in the Japanese culture and business. The Japanese people are very conscious of appearance. For example, in restaurants, plastic models of the food on the menu are on display. The models look almost good enough to eat, with everything arranged appetizingly.

In business, as well, the Japanese are very conscious of color, shape and size, especially when manufacturing products for sale in other cultures. For example, Japanese cars shipped to the U.S. have the steering wheel placed on the left side. (Like the British, the Japanese drive on the left side of the road, with the steering wheel on the right.) Yet one complaint I heard from some Japanese was directed at the fact that U.S. auto makers don't show the same sensitivity by modifying autos for export sale to Japan.

The Japanese, though, seem enamored of American-made items. Many of the men wear Western string ties. But as willing as the Japanese are to adopt American items, there is a large and growing U.S. trade imbalance with Japan. In December, U.S. Commerce Undersecretary Lionel Olmer said the U.S.-Japan economic relationship is in serious trouble because the U.S. cannot continue to absorb trade deficits such as the $20-billion imbalance with Japan forecast for this year. Europeans also are concerned. In October, about 20 Japanese executives touring Europe to promote understanding of trade policies found that their talk fell on deaf ears. The Europeans are upset that Japan is closed to their products.

Japanese-U.S. competition in computers can only intensify, and the need for U.S. vendors to offer high-quality products at competitive prices and respond to customers' requests cannot be overemphasized. Although it would be difficult to transplant Japanese methods to U.S. businesses, manufacturers should use their experience with Japanese competitors, and take advantage of any time lead that product innovation still assures them in their home market.

Lori Valigra
News Editor

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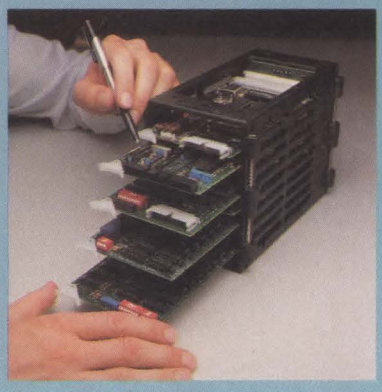

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Accessories	Card Cages (4-, 8-, 16-slot); Single Card Adapter; Adapter/Buffer Module; Cable Driver Adapter/Buffer; Design Prototyping Module; Extender Module

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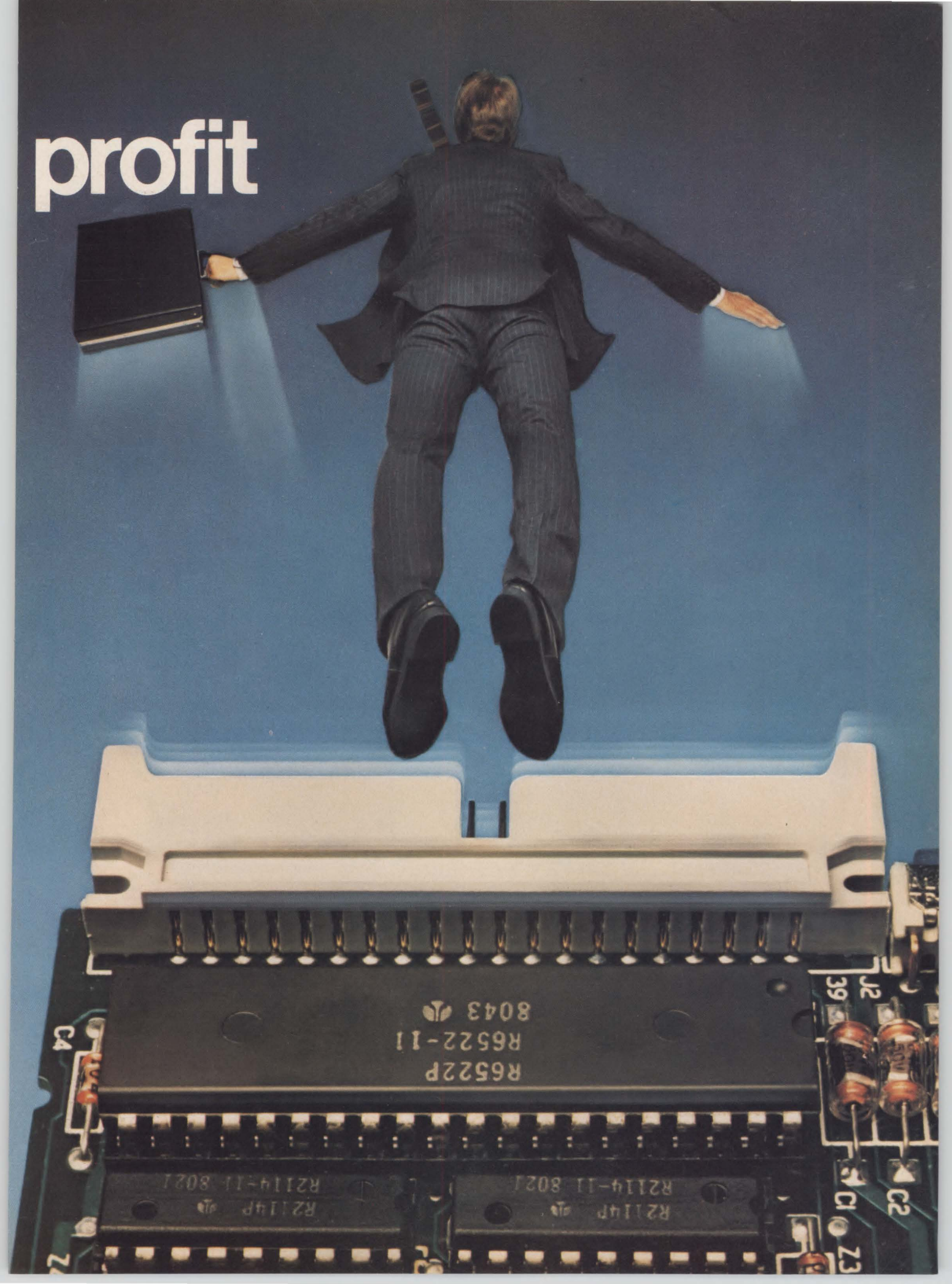
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CIRCLE NO. 53 ON INQUIRY CARD

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

Voice store and forward— is the message getting through?

By Dwight B. Davis
Associate Editor

For a market consisting of about 30 installed systems and a few service bureaus, and representing only about $10 million in sales for 1981, the voice-store-and-forward sector has generated a lot of noise lately. A year ago, just one company, ECS Telecommunications, Inc., Dallas, was actively marketing a digitized voice-messaging system to the general business community. Today, participants in this market include International Business Machines Corp., Wang Laboratories, Inc., Delphi Communications Corp. (an Exxon Communications Systems company) and a host of others. The Yankee Group, Boston, predicts the infant market will approach $500 million in annual sales by 1985.

While impressive, the growth potential of the voice-store-and-forward-market is believable, considering the target customer base—everyone who uses a telephone. The market size, coupled with voice messaging's likely impact on a typical office worker's routine, is encouraging the market entry of computer vendors that already sell equipment to automate the office. Datapoint Corp., for example, will probably introduce a voice-store-and-forward system this year that will operate under the umbrella of its Attached Resource Computer (ARC) network. Because it already markets a private branch exchange (PBX) telephone system compatible with ARC, Datapoint has a jump on such office-automation vendors as Digital Equipment Corp. and Data General Corp., which have yet to offer any voice-oriented equipment.

Business users will initially constitute the bulk of the market, but residential customers will soon join the fold, with likely coaxing from AT & T. The outlook for this emerging technology, in short, seems great. However, limited vendor experience coupled with the sudden emergence of several competitive offerings is resulting in system capacity discrepancies and lists of features that often confuse, rather than attract, customers.

Voice taken for granted

Mounting vendor activity in the voice-messaging market follows by several years similar activity surrounding text-based, electronic-mail systems. In their attempt to visualize and shape the office of the future, computer companies initially focused on text communications simply because their equipment was not voice oriented. This text bias occurred despite the fact that people communicate most often, and most efficiently, by voice.

At the Midcon/81 show in Chicago, Anne L. Doren of Sudbury Systems, Inc., Sudbury, Mass., described studies that indicated voice communication is twice as

HOW VOICE STORE AND FORWARD WORKS

All the voice-store-and-forward systems now making their market debuts operate using essentially the same technology. Words spoken into a telephone handset or an audio work station are converted from their analog form into a digital format by an IC codec (coder/decoder) device. Most companies use a CVSD (Continuously Variable Slope Delta) modulation technique to code the voice at rates in the 20K- to 30K-bps range. At such rates, the digitized voice retains many of the audio characteristics of a speaker's normal voice.

Once digitized and stored on disk, voice messages can be manipulated in the same manner as computer-based, electronic-mail text messages. Users are assigned a personal "voice mailbox," into which other system users can deposit voice messages. To retrieve messages stored in a voice mailbox, each user has a code that gives him access to the box.

Digitized-voice message systems provide users with capabilities far beyond those available from automatic tape answering machines. The digitized messages are instantly available from the random-access disks, and a single message can be broadcast simultaneously to many listeners. Received messages can be expanded and forwarded to new mailboxes if necessary, and most store-and-forward voice systems let users code messages for sending when telephone rates are low or when people in other time zones are available.

efficient as text communication for interactive problem solving. In 1974, Sudbury Systems introduced a voice-messaging system for radiology departments in hospitals. "We intend to offer a system for general-office use very shortly," Doren says, claiming the company's Rapid Telephone-Access System (RTAS) can be modified through software changes to move from the "closed" radiology application to an "open" business configuration.

"Voice being more efficient than text is one of those truisms that people just don't think about because it's so obvious," she says. This relative efficiency, coupled with its familiarity, makes voice an attractive messaging tool, despite the large amounts of disk storage digitized-voice messages require. Most existing voice systems digitize spoken words with compression rates of 20K to 30K bits per sec., Doren says. At Midcon/81, she pointed out that the phrase "Now is the time for all good men..." takes 3 to 5 sec. to speak and, depending on the compression technique, requires from 30K to 300K bits of memory space when digitized. Stored as text, the phrase occupies less than 500 bits of memory.

Given digitized voice's mammoth memory requirements, the plunging cost of bulk storage probably represents the key technological factor prompting companies to enter the voice-store-and-forward field, says Howard I. Cohen, a member of the technical staff at GTE Laboratories, Waltham, Mass. But market needs have also driven the technology's introduction. Voice communications may be efficient, but first the connection between speakers must be made. Studies show that only one in four telephone calls reaches the intended recipient, and the term "telephone-tag" is rapidly entering the vocabularies of people who make multiple calls back and forth before finally reaching each other.

Same technology, different approaches

The expense and frustration caused by interactive telephone shortcomings is being attacked in two ways by voice-store-and-forward vendors. Most offer complete turnkey systems for rental or sale to customers. Another approach is to offer a voice-messaging service bureau, as does Voicemail International, Inc., Santa Clara, Calif. Subscribers to Voicemail's service pay a $10 set-up charge for two voice mailboxes, plus a $25 monthly service charge. The monthly charge includes 50 30-sec. message units, after which subscribers pay 50¢ message unit.

Service bureaus are an attractive alternative for companies that can't afford $90,000 to $525,000 to buy one of the turnkey systems. The bureaus also give customers a chance to use and evaluate the new technology before committing to a heavy capital investment. ECS Telecommunications Operates two of its 64-port Voice Message Exchange (VMX/64) systems as service bureaus, one in Dallas and one in New York, primarily for customer evaluations. At least two other vendors, Delphi Communications and Voice & Data Systems, Inc., Chicago, also offer both turnkey systems and service bureaus.

One company, Commterm, Inc., Burlington, Mass.,

	ECS	VOICE & DATA	WANG	IBM	DELPHI
System name	Voice Messaging Exchange-VMX	Outvoice	Digital Voice Exchange-DVX	Audio distribution system	Delphi Voice Messaging System-D-VMS
System location	Customer premise or service bureau	Customer premise or service bureau	Customer premise	Customer premise	Customer premise or service bureau
Who can use?	Subscriber	Subscriber	Subscriber	Subscriber	Subscriber or PSN
Cost/user of largest systems	$175 (3000 users)	$110 (3100 users)	$400 (800 users)	$235 (1000 users)	$250 (100 users)
Type of phone required	Touch-tone	Touch-tone or rotary	Touch-tone	Touch-tone	Touch-tone or rotary
Type of message delivery	Mailbox	Mailbox	Mailbox or forced	Mailbox	Mailbox
I.D. required for delivery?	Yes	Yes	Yes	Yes	Yes
Maximum message length	10 min.	User-specifiable	90 sec.	6 min.	User-specifiable

All the systems listed have the following features: *system prompts, user-override prompts, broadcast capability and archival storage and retrieval. All except the Commterm and Voicemail International systems can respond to a message without dialing a code, and all except the Voicemail system can forward received messages. Note: PSN = Public Switched Network; Forced delivery = a sent message causes the recipient's phone to ring. This chart is based on one developed by the Yankee Group, but some entries have been updated by* Mini-Micro Systems.

used its background in radio paging systems to get its foot in the digitized-voice-messaging door. The firm's Voice Message Retrieval System (VMRS) was first offered as an enhancement to Commterm's radio common-carrier products. A spokesman says the company has installed 16 VMRS systems, including several in telephone answering-service environments and one interfacing directly with a company's PBX (private branch exchange).

Most turnkey voice-messaging systems are designed to interface to the customers' various PBX phone systems. One system, the Voice Storage System (VSS) from Solid State Systems Inc., Marietta, Ga., can operate as such a general stand-alone unit or as an integral part of the company's "Smart Telephone System" PBX. Jason Schloss, director of marketing, explains that the VSS, which is sold only through distributors, realizes its full potential when functioning within SSSI's PBX.

"In the studies we have done, it appears that the single biggest problem with a voice-storage system is getting users to use it," he says. "As an integral part of a smart switch (PBX), you can program your extensions to forward calls automatically into the Voice Storage System after a certain number of rings. This function, called automatic ring-through, forces the use of the VSS."

While integration within a PBX switch can enhance a voice-messaging system's operation, store-and-forward integration in a total office environment could be a more worthy goal, says John W. Sawyer, director of voice communications at Wang in Lowell, Mass. He talks of the "hyper-documents" that could be created by combining voice, text and image automation. Wang markets two voice-messaging systems—the Digital Voice Exchange (DVX), a phone-based stand-alone system and an audio work station-messaging option that operates in the firm's coaxial-cable-based Alliance office system.

Although the two systems cannot yet communicate, Sawyer says they will probably have that capability within six months. He expects hyper-document capability to become available from Wang within 12 to 18 months. The modular DVX is available in 12 configurations to support 200 to 800 telephone customers. The work-station-oriented Alliance voice option, connects as many as 96 users on four 24-terminal Alliance units.

VOICE MAIL COMMTERM	INTERNATIONAL	SYSTEMS
Voice Message Retrieval System	Voice mail	Voice Storage System-VSS
Customer premise	Service bureau	Customer premise or service bureau
Subscriber	Subscriber or PSN	Subscriber
$78 (1536 users)	Set-up $10/user + $25./user/mo. + 50¢/ 30 sec.	$2 (64,000 users)
Touch-tone	Touch-tone or rotary	Touch-tone or rotary
Forced	Mailbox	Mailbox or forced
Yes	Yes	Yes
User-specifiable	Yes 30 sic. increments (no limit)	Yes User-specifiable

Configuration discrepancies

The number of users each stand-alone store-and-forward system can support is an area of controversy. Two key system components help determine how many users a system can effectively handle—the number of trunk-line ports available and the amount of disk storage for the digitized messages. But a comparison of several systems shows wide discrepancies between the resources allocated and the number of users said to be supported.

To support its maximum of 800 users, for instance, the Wang DVX provides 16 ports and 1100M bytes of disk storage. ECS's new VMX/16 is claimed to support 1000 users with 16 ports and 400M bytes of storage. IBM says its 10-port, 500M-byte Audio Distribution System also supports 1000 users. And Voice and Data Systems' mid-range Out-Voice system supports its 1000 users with 32 ports and 600M bytes.

Three 64-port systems exist, and the variation in claims continues at the high end too. The VMX/64 from ECS provides 800M bytes of storage for as many as 3000 users. Supporting 3100 users, Voice & Data Systems' 64-port Out-Voice has 1200M bytes of disks. Finally, Solid State Systems says its VSS can hold the codes for 64,000 users, but this 64-port system provides just 264M bytes of storage. Given these differences, few would question Sawyer's assessment that "As an industry, we have not yet learned what kind of parameters we're dealing with."

On the other hand, Gordon Matthews, chairman of ECS Telecommunications, argues that his company knows exactly what it's dealing with. He says three key voice-messaging variables—the number of ports, the grade of service (probability of encountering a busy signal) and the number of users—are expressed mathematically in the "Erlang B" formula. "There's a very well-understood relationship between the three variables," Matthews says, "and I think this aspect of

traffic engineering is one of our strong points."

As an example of the Erlang B formula, Matthews describes the 16-port VMX/16, which theoretically supports 1000 users who send or receive about three 1.25-min. messages per day. "With our system, the grade of service for that much traffic is P.03. So three times out of every 100 times that you call, you'll encounter all the lines being busy." Matthews cautions that even a small decrease in the number of ports can dramatically affect the grade of service. If the system described in his example had 10 ports rather than 16, he says, the grade of service would be P.024, meaning a busy signal 24 percent of the time.

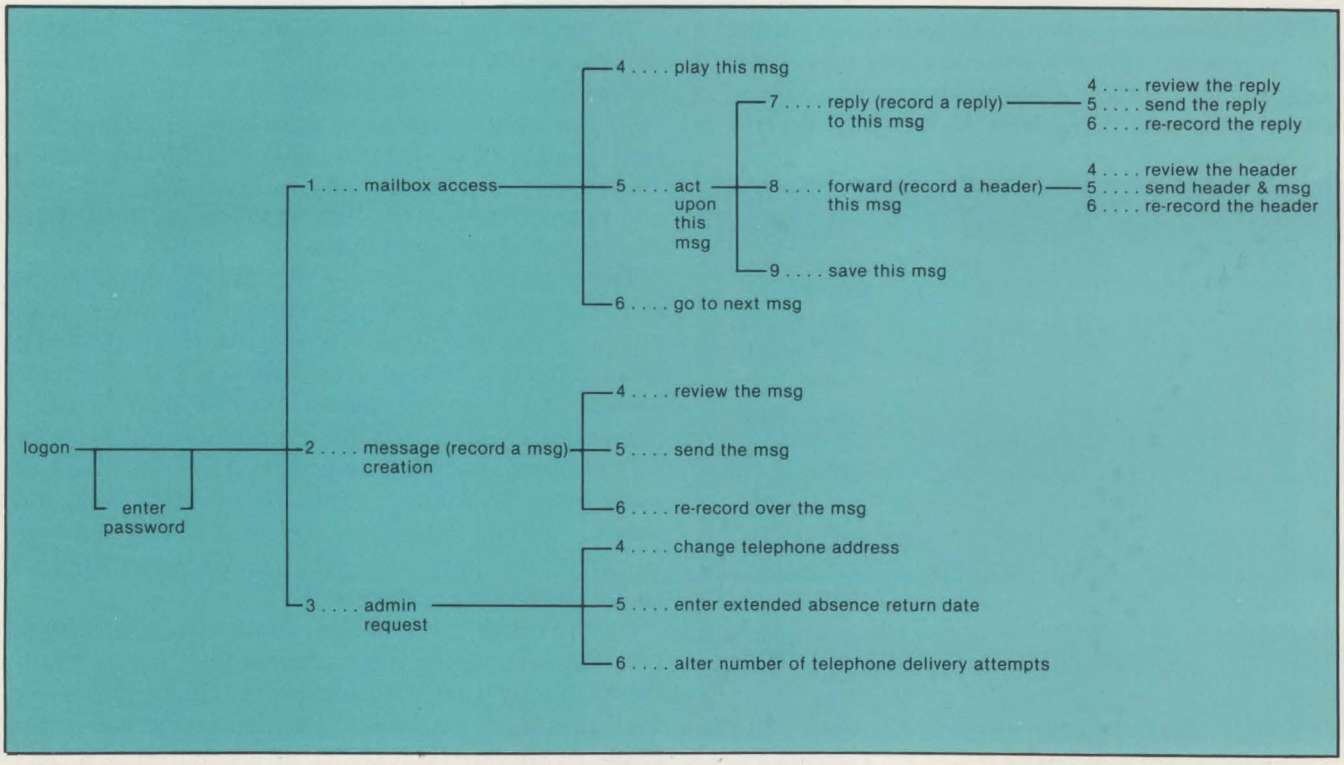
Feature wars

Matthews says ECS concentrates on system basics rather than relying heavily on a list of features to sell systems. He cites electronic PBXs as a technology in which competitors tried to out-feature each other, and worries voice-store-and-forward vendors may follow the same route. "The problem is," he says, "none of the features are used."

But given the same underlying technology, albeit implemented in a wide variety of configurations, features represent the battleground where the vendors try to give each system its own special character and allure. IBM's ADS uses the letters on touch-tone keypads along with the numbers; Voice and Data Systems' Out-Voice provides a "Message Announcer" phone attachment that lets users know messages are in their mailboxes; and all the systems provide combinations of such features as programmable message lengths, mass calling across stored distribution lists, secure forms of access and nonsubscriber access to the system, coding messages for future transmission, dictation capabilities that permit message editing, archival storage off-line, pause compression and others.

Different features appeal to various users, and each vendor hopes that the feature mix it offers will be a winning combination. But everybody's new at this game, and Sawyer at Wang cautions users to look at the system and the company behind the features for one important reason. "Most of the features are configurable in software," he explains. "If your system whistles three times before turning green, mine will too, if the market says that's clearly valuable."

To a degree, the features represent philosophical differences between vendors. For example, Wang limits the message length in its DVX to 90 sec., while others offer virtually unlimited message time. Sawyer argues



System prompts and user response options for Wang's Distributed Voice Exchange *(DVX) are illustrated in this flowchart. While specific to the DVX, the chart demonstrates the general way that most voice-store-and-forward systems let users gain access and reach the desired system function. Unlike the above approach, which uses the numerals on a telephone keypad to initiate operations, IBM's Audio Distribution System (ADS) uses the letters also displayed on the keys.*

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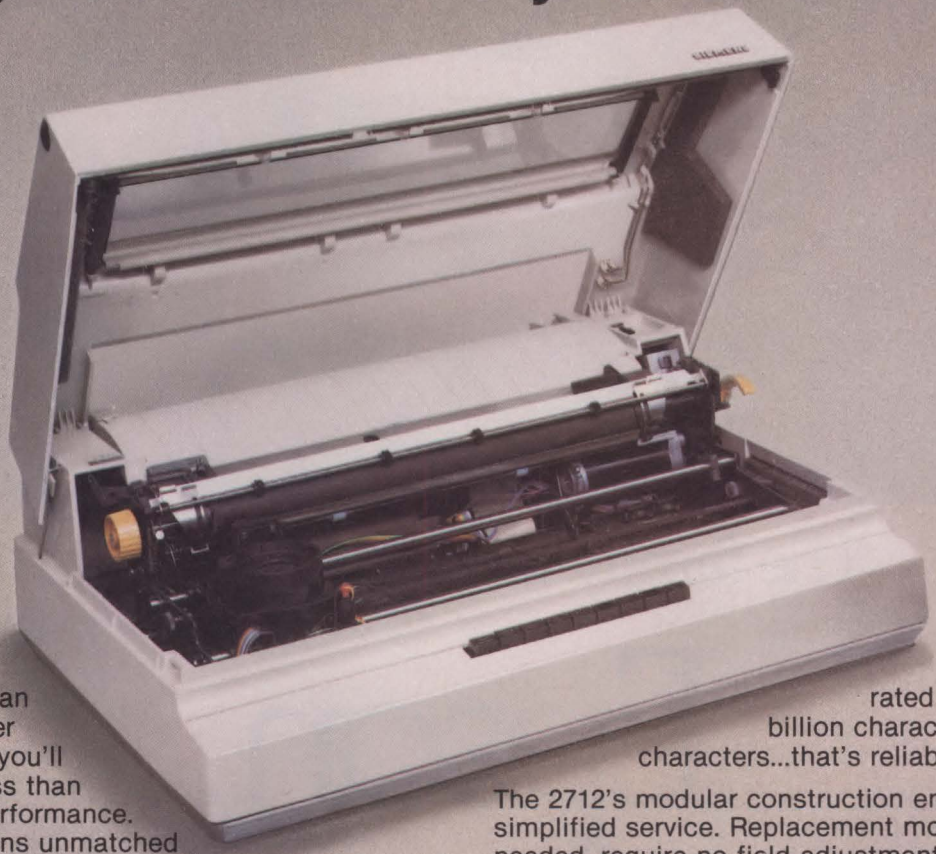

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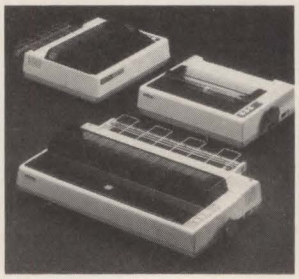
But the best reason to buy our printers is our printers. They're a family that was designed, engineered and built to stay together. For a long time.



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CIRCLE NO. 163 ON INQUIRY CARD

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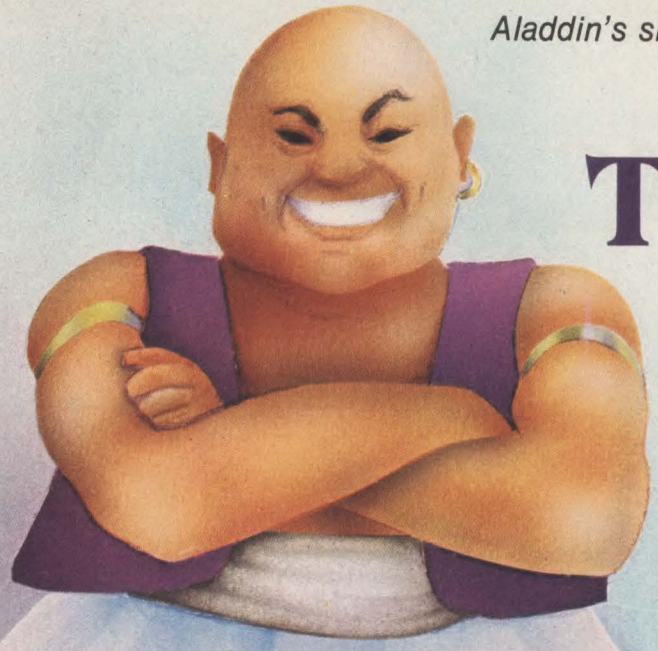

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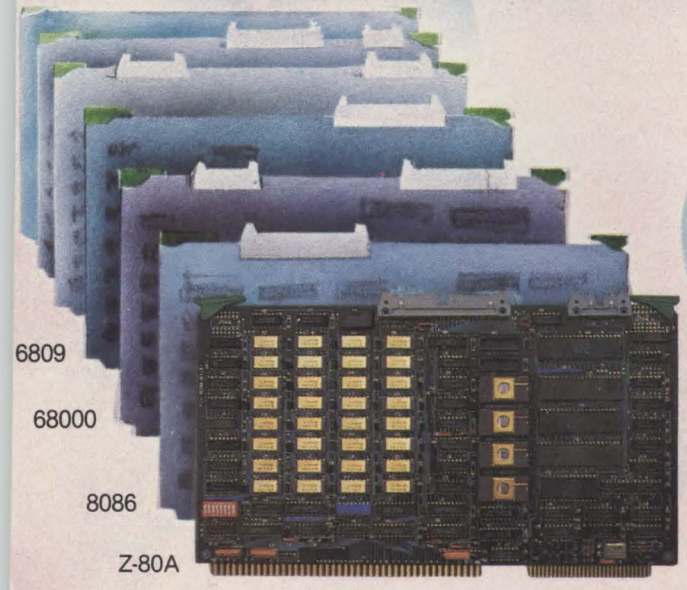

The Perfect Slave, controlled by the Multibus Master, can . . . be disabled from the Bus (overcoming the 1 Meg Multibus limitation) . . . function as 4 independent computers . . . double as 256K memory . . . operate as a peripheral I/O controller . . . and serve over 96 independent users when used in combination.

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Non Glare Screen	STD	STD
Smooth Scroll, Slow Scroll and Jump Scroll	STD	NO
Audible Key Click	STD	STD
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Split Screen	STD	STD
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N-Key Rollover	STD	NO
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CIRCLE NO. 55 ON INQUIRY CARD

the 90-sec. limit serves one of the purposes of voice-messaging systems—keeping the communication brief and to the point. The limit prevents abuse of the system, he says.

Voice and Data Systems, among others, chose to make message length user programmable. The company's chairman, Donald W. Young, admits the average message in store-and-forward systems is 49 sec. long, but, he says, "That is almost like saying I have one foot in the oven and one on an ice cube, and on the average I'm cool." Because of the variation in requirements, "We think the ability to mold the system to the company's needs is very important, which is why more than 30 of our features can be tailored to the company's own parameters."

Most of the vendors, including Wang with its 12 modular DVX configurations, attempt to provide some degree of tailoring for customer needs. And while the vendors all believe their perceptions of system functionality are correct, no one will stubbornly maintain restrictions that could jeopardize sales. Sawyer at Wang, for instance, says, "I think you will find in subsequent releases that the message length will be a system parameter that allows the system to be configured as the user wants."

User-friendly operation

Regardless of the features a system offers, the ease with which users can access and understand the features represents a key system concept. Even here, however, there can be philosophical differences, says Cohen at GTE Labs. "There's an academic argument about how much the users should have to change their habits," he says. "One school believes the equipment should be totally user friendly, totally sympathetic. The other school says, 'Baloney, you've got a big capital investment. If you've got to get people to change their usage a bit, so what,'"

All the store-and-forward vendors know that potential problems exist at the user/machine interface. "The whole purpose of interactive messaging is to keep messages short and to cut down the time people spend using the phone," Doren of Sudbury Systems says. "If the phone now represents a game of dungeons and dragons, I don't think you will get effective work done."

Pete Poltrack, senior program administrator for IBM's Audio Distribution System believes a friendly user interface is the first thing customers will look for. Representing IBM's first voice-oriented product, the ADS is also the company's first system designed for management users along with the support staff. "Executive users may not want to sit down in a class to learn the system," Poltrack says, "so how quickly they can pick up the operation is very important. A vendor who has an easy-to-learn, logical interface will be the winner."

Ironically, despite Poltrack's high rating of system friendliness, several of his competitors claim the ADS has so many features it's very difficult to use. Wang's Sawyer compares the ADS to "a cockpit that looks like a DC-10," and Matthews at ECS says, "The IBM system presents all its features to all the users everytime they use it. With our system, I can tailor my voice mailbox a single time to make it do what I want it to do. IBM users can't turn features on or off."

An IBM spokesman contends, however, that "You don't have to play around with all the features; they're strictly optional." And Poltrack says the charge of system complexity "is absolutely an unfair assessment. If you can remember the word GLRT, it's very simple to use the system." Pushing the "*" key followed by the "G" or 4 key, for instance, places the ADS user in the GET mode for message selection. Likewise, *L accesses the LISTEN mode, *R reaches RECEIVE, and *T lets the user TRANSMIT. ADS also uses the "#" key to access a HELP mode that gives users assistance.

Once all the system configurations and features are compared, customers must also face the question of who will provide maintenance and how much it will cost. Typical cost is not trivial. ECS, for example, charges $30,000 for the yearly maintenance of its VMX/64 system. The vendor's service resources must also be examined, putting some of the smaller companies in competition with the IBMs and Wangs, which have established their support credentials.

Some small vendors may choose to enlist the aid of a larger organization for maintenance. Voice and Data Systems is following this route through a first-of-a-kind agreement with Intel Corp. Chairman Young says, "We will be installing through Intel Corp., which will also service our systems. We are the first company with whom Intel has made an arrangement for such a third-party relationship."

Despite the confusing facts and figures customers must face when evaluating the new voice-store-and-forward systems, the vendors are probably on target in their optimistic projections of market growth. The entry of Wang and, especially, IBM into the fray is serving to legitimize the once-esoteric voice-messaging sector. And the technology will fit naturally into the evolving automated-office environment.

Customers' initial confusion about competitive offerings and claims may, in fact, improve their perceptions of the much-sought-after user-friendly interface. After all, once the customers get through the mind-boggling job of evaluating the store-and-forward systems, the operation of even the most complex system will probably seem easy in comparison. ■

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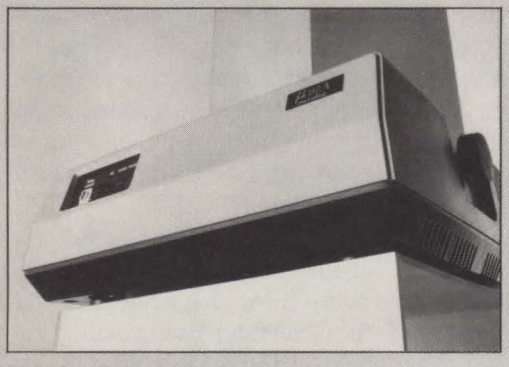

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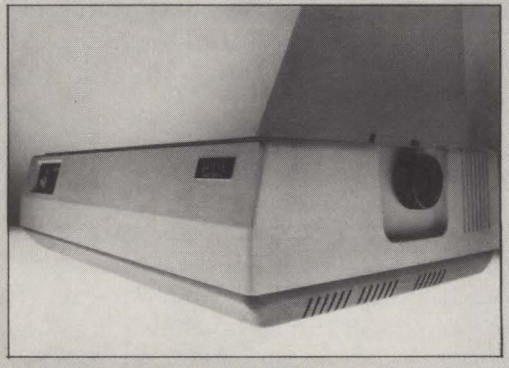

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CIRCLE NO. 56 ON INQUIRY CARD

Hardware vendors scramble for software

By the *Mini-Micro Systems* Staff

The software search is on, with hardware vendors scrambling to attract independently developed software packages for what is becoming an applications-oriented systems market. Hardware vendors' lures include vastly increased market exposure through the vendors' sales force, but independents remain wary of becoming too closely associated with any company.

Vendor programs range from directory listings to substantial marketing ties. Vendors recognize that the key to selling a system resides as much in software as in the CPU. Software is often even more important than hardware. While the hardware vendors' programs offer potentially larger market exposure, they also raise the specter of increased competition for system integrators, who may find themselves competing against their suppliers.

The software-acquisition programs touted in the minicomputer and μc industries come from both fledgling and established vendors, whose engineers have traditionally blanched at the thought of approving an outsider's program to run on their companies' computers.

International Business Machines Corp., Digital Equipment Corp., Data General Corp., Hewlett-Packard Co., Intel Corp., Apple Computer, Inc., and Texas Instruments Inc. are a few of the companies that have introduced software-acquisition programs.

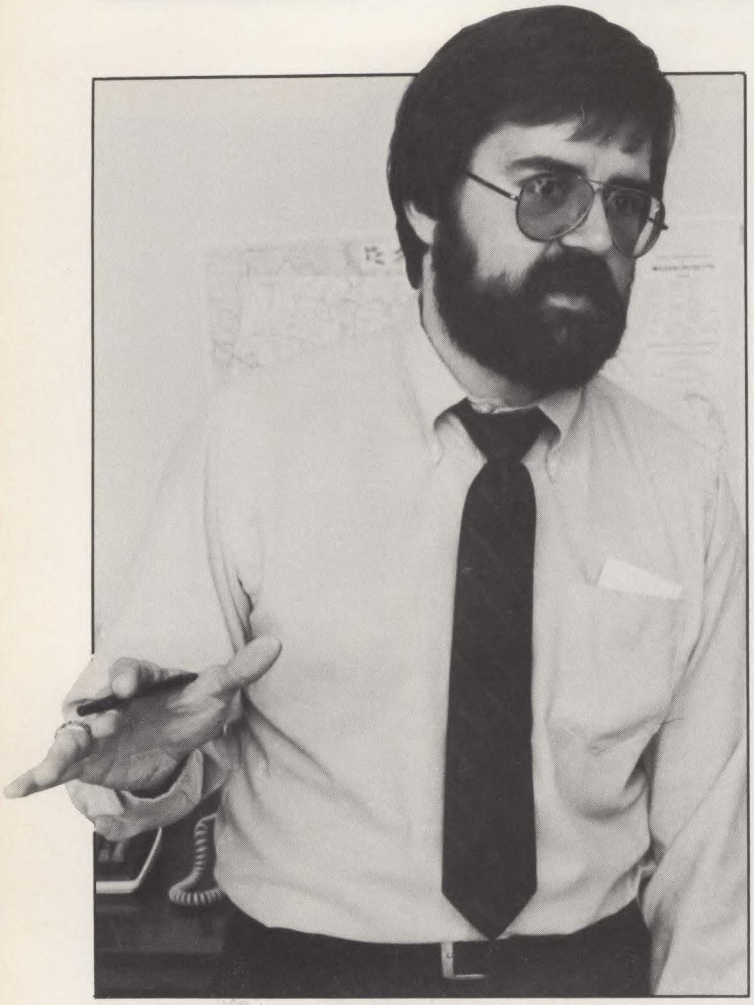
"Hardware vendors recognize that the data-processing market is not going to be a machine market in the next 20 years. The way the price/performance curve is headed, they won't be able to keep having high revenues simply by selling machines. They have to shift their revenue base. One area to shift to is software," says Christopher Gray, vice president at Manufacturing Software Systems, Williston, Vt. The software-evaluation and consulting firm concentrates on manufacturing resource-planning software, one area of interest in many software-acquisition programs.

A major reason for the increased number of vendor software programs, Gray says, is high software-development costs and a limited number of software developers. "Despite the labor-productivity tools developed over the last 10 years, developing software is still labor intensive," Gray says. He believes the manufacturing-applications segment is particularly attractive to hardware vendors because of its enormous market potential. Gray estimates that 40,000 manufacturing companies having 500 or fewer employees could use manufacturing-resource-planning systems. Out of that 40,000, only 5000 are now using such systems.

Intel Corp.'s Software Distribution Operation is headed by Judy Ross, *who oversees a staff of 18 dedicated solely to third-party software.*

"You can see the trend," says George Hall, applications-software manager for DEC. "Even DEC says it does not have all the programmers necessary to develop everything from scratch." Hall oversees DEC's comprehensive-application program (CAP), which is aimed at putting independent-software products into the DEC application lineup.

"Large consumers cannot afford to write everything their way and are considering buying packages," says Hall. "We too look at the bottom line, and if a product is reliable and supportable, it is a good decision to bring it in even if we must adjust our support strategy."



John Hime, manager of independent packaged software marketing for Data General's Information Systems Division, *says Data General is considering closer relations with independent software developers.*

DEC's CAP program has four levels of software acceptance, including referrals, recommendations, an external applications software library and direct sales and support by the company. The levels roughly coincide with progressively closer affiliations. At the fourth level, DEC handles service and updates. Also at that level, total sales revenues flow to DEC rather than being split with an independent software company.

"We are just beginning to recruit applications specialists in the field and come up with career paths for them," Hall says. "Today, the applications specialist will help with training on the product, tomorrow, he may assist the customer on the buy decision, and, in the future, he may run a field-applications support center," Hall says.

In light of field-service limitations, DEC is cautious about embracing a wide variety of packages that would quickly strain support and sales capabilities.

Within DEC's Manufacturing, Distribution and Control Product Group are two software products developed outside the company but now being sold with the DEC name and warranty. They include the VAX manufacturing control system (VMCS) and the process monitoring and control system (PMCS). VMCS was developed by Interactive Information Systems Inc., Cincinnati, Ohio. It is a VAX-computer version of the interactive manufacturing control system (IMCS) sold by Interactive Systems. PMCS was developed by Biles Associates, Houston.

"We are exclusively a software products manufacturing company dealing in manufacturing applications," says Lloyd Baldwin, director of operations at Interactive. "DEC has a right to take the IMCS software and build its own product from it, but we are not exclusively tied to DEC in any way." Baldwin is pleased with the DEC agreement, but determined to maintain an arm's length from DEC. "Our agreement does not give them any right to control our product in any way, shape or form. It conveys no rights to our product to them except to market to their own marketplace," he says.

"One of the reasons we terminated an OEM agreement with DEC was to make sure that we didn't have any conflict of interest with DEC. When you are a hardware OEM, you don't control the show because you are captive to a dealer or manufacturer, and you've got to dance to his tune. As a software developer, we are in control, and the vendor is kind of an OEM to us," says Baldwin.

The desire to remain hardware independent is also important to Setpoint Inc., a privately held company worth $6 million in sales. Setpoint derives its revenues mainly from service, consulting and engineering in the petrochemical and process-control market. DEC endorses two Setpoint products under the Recommended Marketing Program: an automated batch-control program, called Abcon, and a process-control and monitoring software package, called Setcon.

"DEC does not license our product; they recommend our product," says Norman Hanson, vice president of products for Setpoint. "They use us as a tool for helping to sell their computer. We license the product to the end user. DEC has no responsibility for the maintenance of the Setpoint packages. We are hardware independent, and we want to stay hardware independent."

DEC competitor DG has also introduced a marketing program aimed at signing on independent software firms to develop and market software for the company's Eclipse systems. The program is overseen by the company's Information Systems Division and will be handled by that division's Independent Packaged Software marketing group.

"Even though we have good OEMs, we have a need for end-user sales to Fortune 2000-type companies that want to buy directly from us. To do that, we need a lot

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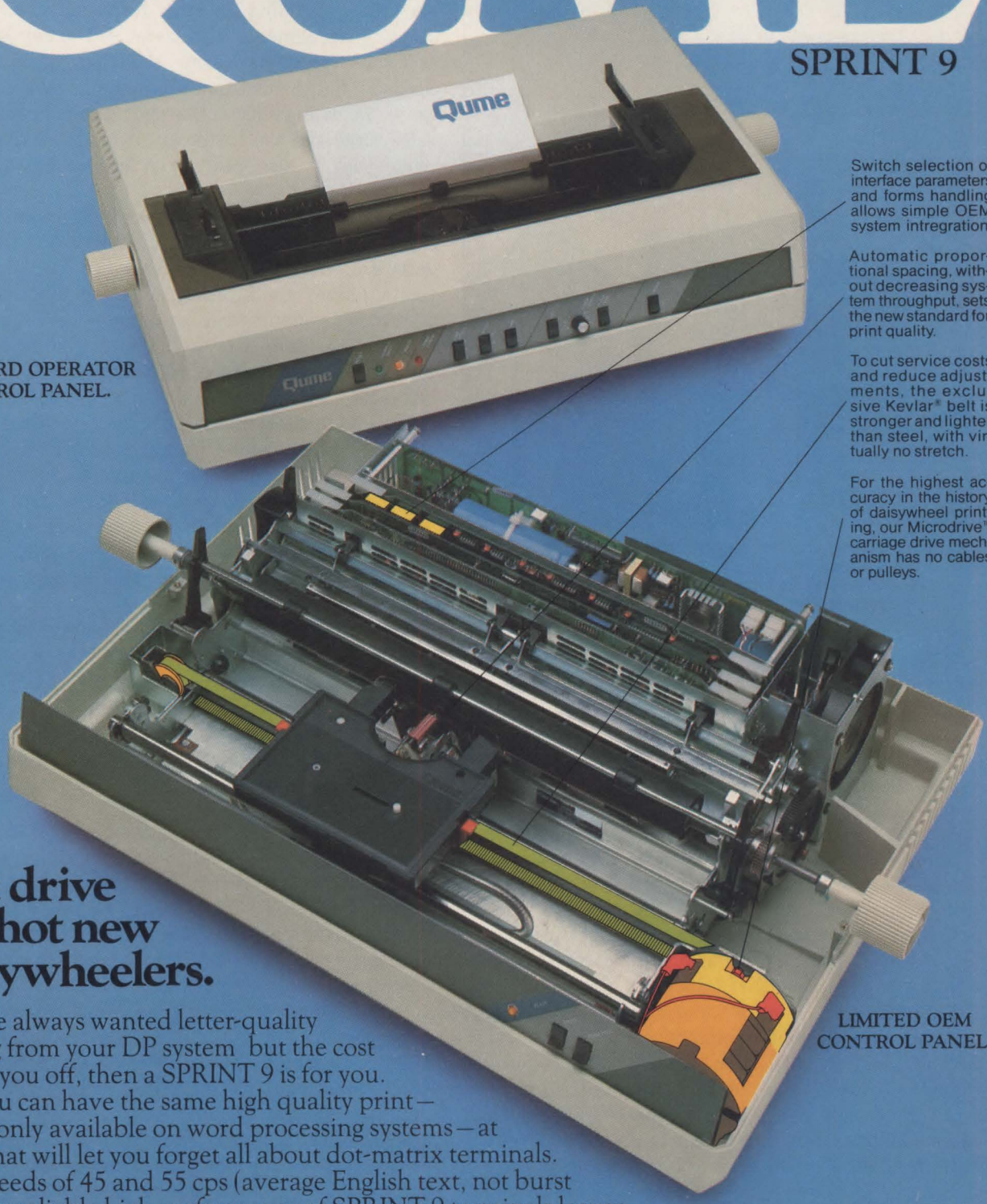

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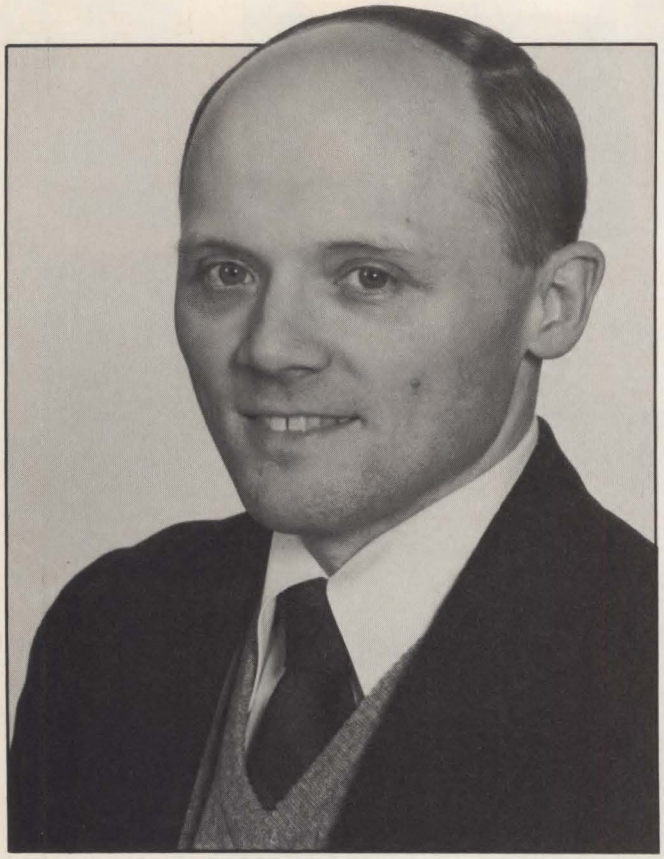

George A. Hall, *applications software manager for Digital Equipment Corp.'s manufacturing, distribution and control product group, says even DEC is admitting it does not have all the programmers necessary to develop everything from scratch.*

of high-quality applications software," says John Hime, manager of independent software marketing at DG.

Under the as-yet-unannounced marketing arrangements, DG will maintain hardware and operating system software, and independent third parties will handle their application software. Further, software houses will get a bonus percentage of the hardware sales price whenever the software is the deciding factor in a sale. DG is also considering closer ties with independent software firms, possibly including exclusive rights and maintenance. He says DG has no programs to announce because it must first weigh maintenance, and service and sales costs related to selling into very specialized markets.

Meanwhile, IBM gave approval to independent-software acquisition in September when the company's General Systems Division said it would consider software submitted by non-IBM sources. The nonexclusive marketing arrangement applies to industry-applications software for GSD products for which IBM does not offer a similar program.

Frank O'Donnell, IBM's manager of services and special application development at GSD, says the program extends one the company has had for two years. "It is evolutionary—something we felt was good and would like to do more of," O'Donnell says. GSD has about 585 applications and development programs, approximately 100 of which are from external sources, he says. The independent software firms or IBM provide service, depending on the terms of the contract. Royalty agreements also vary, O'Donnell says. The software products carry the IBM name and are licensed, but the fact that it is supplied by a vendor will be in the availability notice that IBM publishes for the sales force and the customer. It bears an IBM product name, but it also bears a reference to the source, O'Donnell says.

In the μp market, Intel Corp.'s Software Distribution Operation is dedicated solely to third-party software. Judy Ross, who heads the operation for the Santa Clara, Calif., company, says SDO distributes operating systems and programming languages for about six vendors. Her staff of 18, including marketing and engineering personnel, establishes the selection criteria.

For SDO to distribute an operating system, Ross says, the package "must be widely accepted; it must be a standard." Programming languages must meet an established standard, such as ANSI or ISO, she adds. Intel handles Digital Research Corp.'s CP/M, for instance, as well as the Pacific Grove, Calif., company's CP/M-86 and MP/M-86, the single- and multi-user packages for Intel's 8086.

Ross says SDO, in some cases, buys the exclusive rights to a package—as is the case with a Jovial compiler for PSS, Inc.—or distributes the software. Ross says SDO compiles a catalog of software for Intel hardware. Ross thinks the relationship has worked well so far. "A customer can buy from SDO or from the vendor," she says. This option reduces potential conflict.

Steve Ballmer of Microsoft, Kirkland, Wash., also expects his firm's arrangement with SDO to work well. The firms closed a deal about two months ago. SDO distributes Microsoft's MSDOS, an operating system written for IBM's 8088-based personal computer; several languages; and Multiplan, a new modeling and electronic-worksheet package.

A spokesman for Digital Research, sensitive to his firm's agreements with its distributors, points out that Digital Research views Intel's SDO strictly as an OEM—not as a distributor. The company will not reveal details of its contract with SDO.

Microsoft's Ballmer says that the terms of his contract vary, depending on whether the software is distributed or if Intel sells it as an OEM. There is a minimum up-front royalty fee paid for the software," he says.

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Hewlett-Packard Co. began its third-party software program, HP-Plus, last July. Each H-P computer has its own HP-Plus operation, and each has the same methods and goals. Martha Linenburger, manager of third-party software marketing for H-P's business computer group, says that HP-Plus puts the software into three categories. The first group includes packages—now only tools and utilities—distributed by H-P. The company actively markets these packages and splits the revenues with the third-party vendors, who provide support. The second group, referenced packages, includes applications programs. H-P promotes them, but the vendor makes the sales. The third group includes packages that the company lists in a quarterly directory. H-P does no further marketing of these packages. The listings are aimed primarily at new software vendors and include almost every company selling H-P-compatible products, says Linenburger.

H-P sometimes acquires complete rights to a package and, in one case, acquired an entire company, IMAX, Inc., Linenburger says. The first of the three companies whose products are being distributed by H-P is Computing Capabilities Corp., Mountain View, Calif. The firm's Insight package, a utility aimed at developing on-line transaction-processing systems, has suffered from "the usual start-up pains, but is smoothing

INDEPENDENT SALES ORGANIZATIONS PUSH TOTAL SOLUTIONS

Memphis, Tenn.-based Data Communications Corp. is considering entering the cable TV-applications market as a Data General Corp. OEM, says Skip Sawyer, director of product development at DCC. This is a natural move for DCC, Saywer says, because the company already configures systems with custom software for the broadcasting industry.

Meanwhile, Digital Equipment Corp. and International Business Machines are looking at the same market, Sawyer says, and, like many other systems houses, DCC doesn't like seeing the "big boys" in its domain. "DEC showed up at the National Cable Television Association exhibition. They even paid for a booth occupied by two software companies that were exhibiting DEC-based packages," Sawyer says. "I asked one of the software guys why DEC was there, and he said, 'DEC's just giving us a hand because we sell their hardware.' When I asked him if he'd heard DEC was getting into cable TV software, he said, 'I guess they might.'"

"IBM has gotten into that market too," Sawyer says. They just purchased a company with a cable-TV billing system and could throw a huge sales force at it. But the TV market is only $30 million to $50 million. It wouldn't be worth it for IBM unless they got the whole thing."

"DCC's Mini Division in the U.S. was doing wonderful business as a DG OEM, adding value with an operating system and third-party software, slugging it out with Wang Laboratories, Inc., Datapoint Corp. and NCR Corp.," Sawyer says. "Then DG started selling their own software packages, and soon our salesmen were rubbing shoulders with their salesmen, bottlenecking at the end-user's door. It turned into a love/hate relationship; my company was both DG's customer and competitor.

"We took to hiding from DG's salesmen, and we started hiding our customers from them. Otherwise, there were conflicts—big conflicts, that boiled up into angry conferences in the really big offices, over who had rights and who should back off. We have the advantage, and hardware vendors have the problem. When you move into a vertical market, you must have specialized knowledge. We've got it. We're not going to lose," Sawyer says.

Sandra Kurtzig doesn't think her company will lose either. But as president of Cupertino Calif.-based ASK Computer Systems, Inc., the largest supplier of turnkey manufacturing management systems in the U.S. and Hewlett-Packard Co.'s largest purchaser of HP 3000s, she has a lot to protect against incursion by H-P or DEC, ASK's other hardware supplier. "I prefer to compete with a hardware vendor," Kurtzig says. "At least you know what you're dealing with. So many software companies think cutting prices, or selling something they don't really have, is the way to get business. It's like competing with a cloud."

"Hardware companies don't know how to sell software," she says. "They're still selling bits and bytes. The customer doesn't care what black box the solution comes in, as long as the problem gets solved. We understand their problems, and that's where the hardware vendors have some catching up to do."

Hardware vendors' rush into applications software would have made Kurtzig nervous three years ago, she says. But $13 million a year in sales has allowed ASK to stockpile a large supply of the key ingredient for success in its market: good people with experience in manufacturing. "The hardware vendors do not pay salespeople as well as independent companies can," Kurtzig claims. "So we attract the best people, the ones who really understand the application, who can communicate to the manufacturer on his level."

IBIS, Tustin, Calif., has focused on software applications. Now, the company is moving into hardware, challenging the vendors in their own arena. "It all belongs together," says company head John Hall. "Vendors who have overlooked that are very shortsighted."

Lawrence Finch, chief executive officer of Shasta General Systems, a Sunnyvale, Calif., Xerox OEM, echoes the theme. "I've never separated hardware from software," Finch says. "All I can tell the pure hardware company with no software is this: Jump on in; the water's fine."

—Kevin Strehlo

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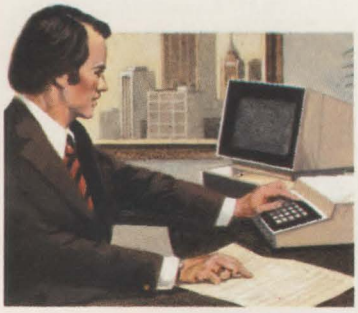

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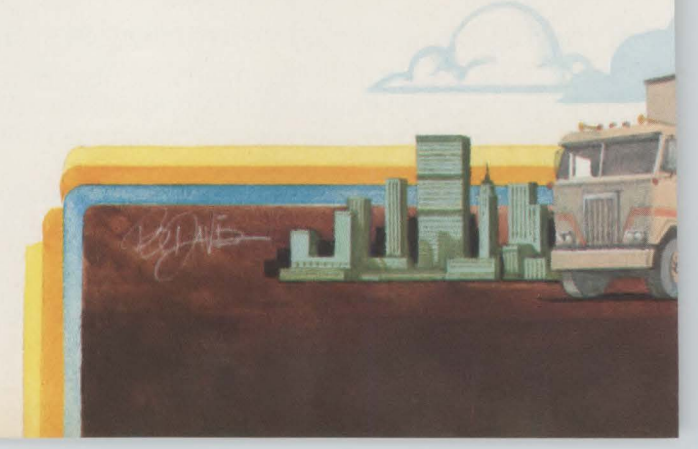

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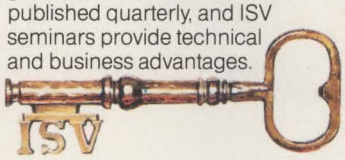

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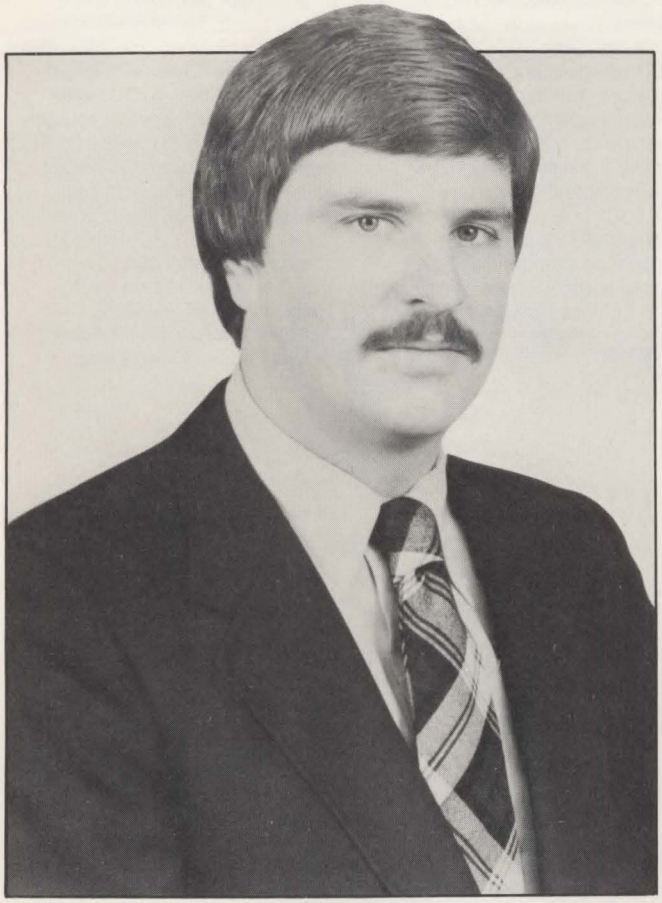

Chris Gray *of Manufacturing Software System, Inc., says hardware vendors will have to increase their software offerings to protect their revenue base in the future.*

out," says CCC president, Don Lee. Part of the problem was making the H-P sales staff aware of the program. "These were products available from H-P, but they were not H-P products," says Lee. H-P he says, has given sales forecasts for his product for the year, but no commitment has been made. Lee believes that HP-Plus can potentially boost sales of his three-year-old company.

TI has two third-party software programs under way. Its Industry Applications Specialist program distributes only applications software. Customers are typically Fortune 1000-type companies, a spokesman says. The IAS arrangement with the software vendor is not exclusive: TI sells the hardware, and the software vendor sells the software. Occasionally, TI and the software house jointly propose a solution to a customer, the spokesman adds. IAS offers only one industry-specific application program—an insurance company package developed by Lycor Corp.

TI's other third-party program, Software Solutions, includes three groups aimed at producing software for TI's Business System 200 computers. The Brandname Applications software program handles packages from TI's OEMs. The Referenced program is a compilation of all software available for the System 200.

The third part of Software Solutions, introduced in November, 1981, at Comdex, is the Application Distribution Center. This center acts as both publisher and distributor of software; TI distributes and publishes software from qualified vendors. Payment to the vendor is on a royalty basis, the spokesman says.

Apple Computer, Inc., has been relying heavily on third-party software vendors for the past three years and has accumulated more than 100 programs from outside authors.

"Application software typically takes on the form of added value rather than being directly related to the primary reason a customer buys one of our machines," notes Michael Kane, former head of Apple's Software Special Business Unit before leaving the company in November. The Special Business Unit is headed by William Hood, vice president and general manager of the Computer Systems division. It solicits software from outside vendors, evaluates packages and draws up contracts with authors.

"The time and effort a company such as Apple must devote to developing and testing its own application software often doubles or triples the investment the company has in the system that the software will be used on," says Kane, adding that such software often has only short-term application in the market. Kane says that Apple would rather devote R & D money to developing system software, which, he says, has long-term marketability.

Of all the third-party software the company receives, only three percent is approved for distribution. An initial screening determines if a submitted packages fall into one of Apple's target markets—small-business, personal, professional and educational users. A final screen tests the technical characteristics of the software and evaluates whether it is reliable and maintainable.

For authors whose packages make it through the evaluation process, a contractual agreement is drawn up specifying that the authors must service and maintain their products as well as provide documentation and owners manuals. Kane says authors typically receive 20 percent of sales revenues from their programs, measured by dealers' receipts. Payment higher than that depends on whether Apple plans to release a package under the Apple label, a Special Delivery Software label or the author's label. Apple licenses all the rights to programs released under its own label—about half of its software offerings. ■

Mini-Micro editors contributing to this article include Eric Lundquist, Larry Lettieri and Frank Catalano

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The deregulation puzzle: putting the pieces together

By Arthur Hill
Washington Correspondent

Prospects for an early solution to the communications-deregulation puzzle as well as how it will affect the computer world appear to be dimming fast. Concerted opposition to the deregulation of Bell by computer industry representatives and major telecommunications users have temporarily derailed legislative and regulatory efforts designed to allow AT & T to enter the enhanced communications markets.

On Capitol Hill, key members of the House Telecommunications Subcommittee are supporting a massive staff study that proclaims the data-processing market could be hurt by Bell's entry on a deregulated basis. If this conclusion becomes part of a telecommunications-regulation reform bill now being drafted by the subcommittee, the legislation will be in sharp contrast to a Communications Act reform measure approved by wide margins in the Senate.

Meanwhile, computer-industry spokesmen continued pressing the Federal Communications Commission to reconsider its decision to allow Bell into unregulated communications markets through a subsidiary corporation. Last November, the Computer and Communications Industry Association (CCIA) attacked the "Computer II" decision on two fronts by asking the FCC to postpone implementation of the decision and at the same time asking the courts to expedite its appeal.

In its report, the House Telecommunications Subcommittee said that approximately 2150 "highly competitive" data processors act as a "service submarket" in the enhanced-communications sector. The report concludes that the object of deregulation is to allow AT & T to gain a foothold in this market without diminishing the competitive forces now in place. "Vigorous competition depends upon the availability of high-quality transmission facilities for lease at reasonable rates," the report says.

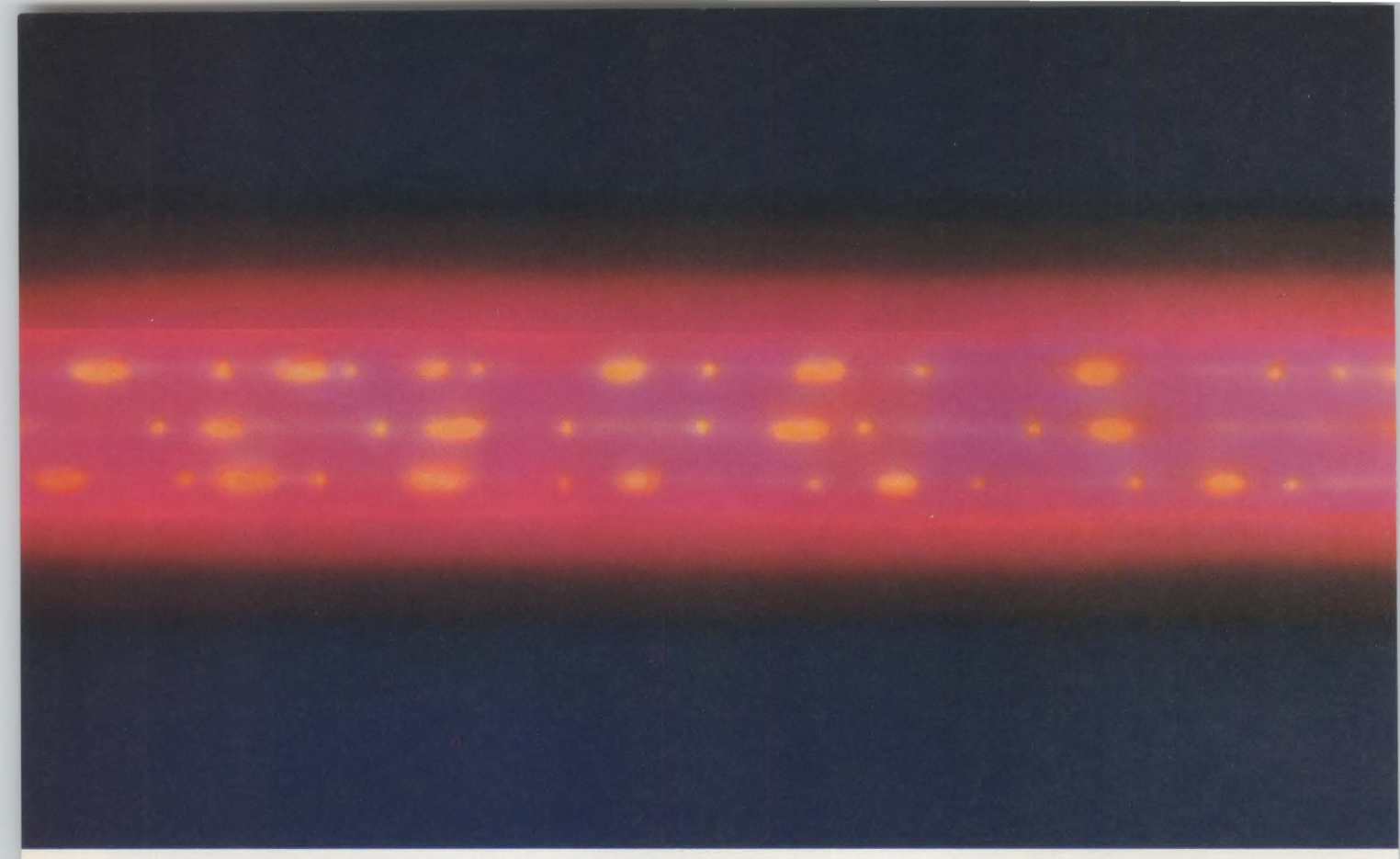
One problem remains, however: Regulatory forces simply lack the capacity to determine whether AT & T was using its vast revenue sources to subsidize its unregulated communications services, "thereby unfairly burdening monopoly rate payers and simultaneously creating a barrier to competition in the services market."

To reinforce its concern, the report points to a recent study of the FCC by the General Accounting Office, the investigative arm of Congress. In its report, the GAO concluded that the commission is "not equipped" to regulate the kind of business activities that Bell or any of its subsidiaries could undertake under a deregulation scheme. "The FCC has never required the kinds of accounting procedures and accounting records (necessary to monitor) cost-allocation between AT & T and its affiliate," said the GAO report.

Representative Tim Wirth (D.-Colo.), *energetic chairman of the House Telecommunications Subcommittee, who wants an early solution to the communications deregulation puzzle: "I'm 'hearinged' out."*

Legislation approved by the Senate allows Bell to compete through a separate subsidiary with businesses providing computer services. Critics of the Bell deregulatory effort believe that sponsors of the legislation failed to take into account the conclusions reached by the GAO and the House report. These same critics also charge that the FCC itself has failed to recognize its impotence in the face of the Bell juggernaut.

In its petition for a stay in the computer II decision, the CCIA stated that a subsequent decision revising the



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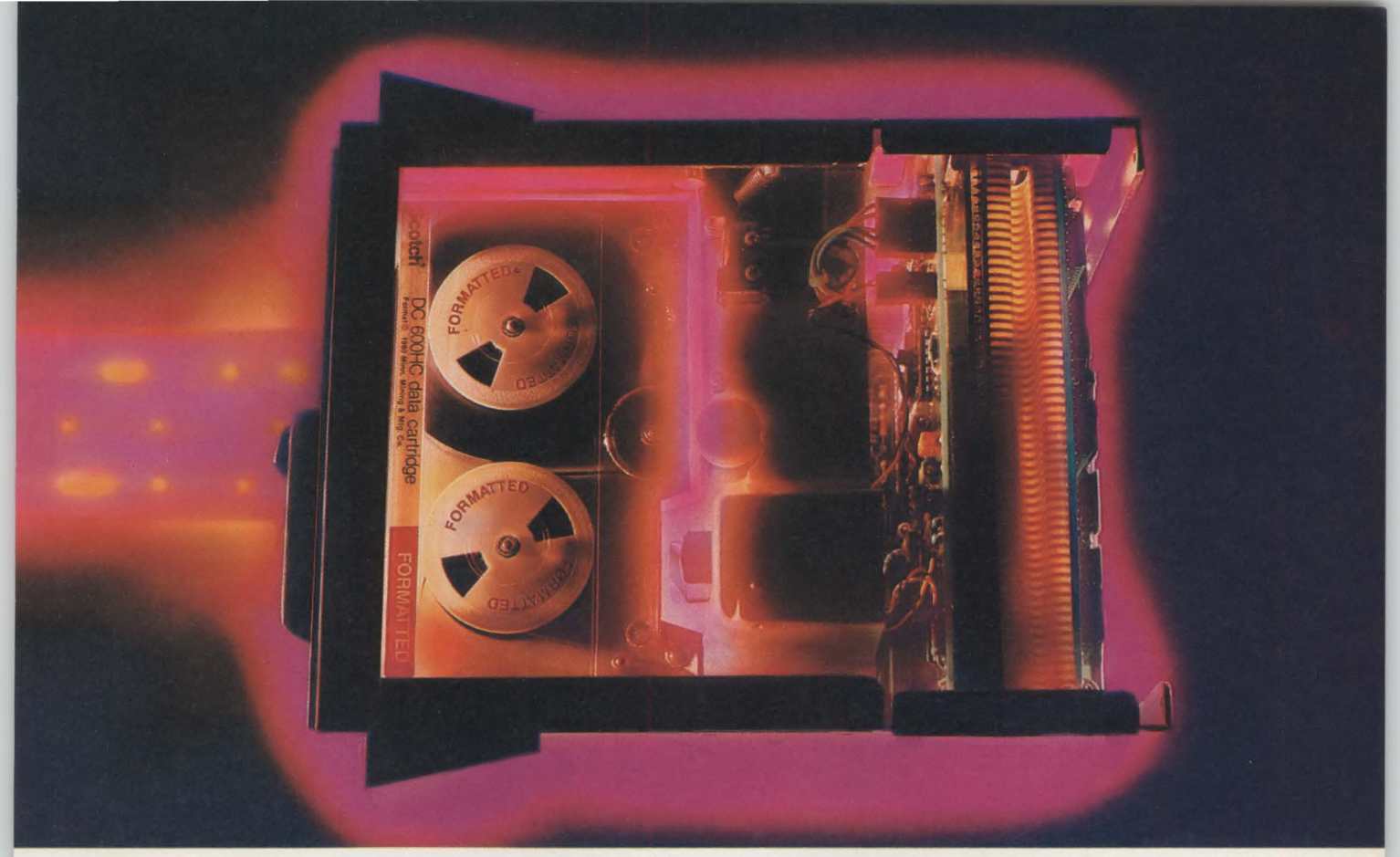

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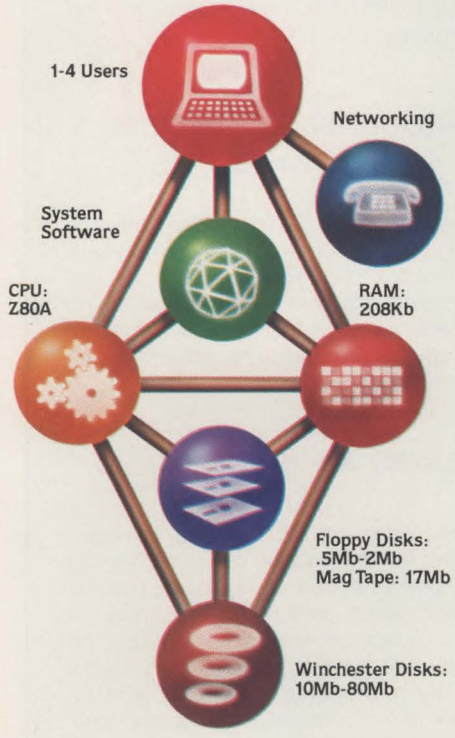

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date that Bell can enter unregulated markets is "confusing and a further demonstration of the ineffectiveness of the FCC's proposed regulatory framework." The commission originally stated that the decision would go into effect on Jan. 1, 1983. But last October, the deadline was modified when the FCC said the 1983 date is now "the outer limit for compliance."

But the fact that the date has been modified was not the principal concern for the CCIA. For the new order also appears to allow AT & T to market computer equipment through Western Electric as well as though the separate subsidiary, a modification which CCIA says places its members in "severe jeopardy and subject to irreparable harm." The association states the commission should not implement its decision until after the courts have had the opportunity to review Computer II.

If CCIA's petition for a stay is granted, and if, as expected, the legislation in the House differs substantially from the Senate version on the scope of AT & T's activities in the computer market, it could be several months, perhaps years, before computer manufacturers, their customers and the rest of the telecommunications sector grasps what the regulatory order means to them. Only one fact appears certain at this point. Representative Tim Wirth (D.-Colo.), the energetic chairman of the House Telecommunications Subcommittee, wants to get the show on the road. "I'm 'hearinged' out," he says. ■

WASHINGTON BRIEFS

ENGINEER SHORTAGE PREDICTED

The nation faces a serious shortfall of electrical and computer science engineers. That's the contention of Dr. F. Karl Willenbrock of Southern Methodist University testifying before the Joint Economic Committee of Congress. Willenbrock said the engineering personnel shortage threatens both the nation's defense and the ability of the U.S. to compete for domestic and world markets. Appearing in behalf of the American Electronics Association, Willenbrock reported on an AEA survey that concluded that over the next five years, 113,000 technical professionals and more than 140,000 paraprofessionals will be needed. But, he said, "The shortfall between supply and demand of BS/EE and CS engineers projects to 129,000, or 25,000 annually." But, he added, some encouraging trends include an increase in the number and quality of students now enrolled in engineering schools and an 18-fold jump in the number of women and minorities in undergraduate programs.

GSA FAILS TO ACHIEVE AUTONOMY

An effort by GSA to avoid some of the red tape involved in limited computer acquisitions has reportedly failed. GSA had contacted several federal agencies offering procurement autonomy if GSA could audit purchases after the fact. But few agencies agreed to the proposal, leading GSA to scrap the plan.

OFFICE AUTOMATION EMPHASIZED

Office automation is "the driving force behind productivity," said Richard S. Beal, special assistant to the President and director of the Office of Planning and Evaluation, speaking at the second annual Federal Office Automation Conference. Speaking before 1000 attendees, Beal said he was concerned that few Americans, not only in government, but in the private sector as well, see falling productivity as a major issue. The U.S. is changing from a society of goods and services to an "information society," Beal contended, and he called for a "better, more potent and critical understanding of productivity in the context of the information age we are entering." Beal urged federal office managers to appoint an executive to push office automation. Without such emphasis, he said, organizations will fail to move hard and fast enough in the direction of office automation.

XEROX RAPS PROCUREMENT OFFICIALS

At the same conference, Xerox president David Kearns criticized government procurement officials for failing to recognize that "we're in the systems business now." He said that some agencies are still trying to determine whether a word processor is a typewriter or a computer, adding, "If we work together, we can bring efficiency and flexibility into government management."

GSA HEAD CREATES ADVISORY BOARD

Gerald P. Carmen, head of the General Services Administration, has created an advisory board composed of executives from business, industry and labor to provide counsel on the government's procurement policies. In addressing CBEMA's annual procurement conference, the GSA administrator vowed to run his agency "like a business," in part by developing a closer working relationship with government vendors. At the same time, he says, he faces the future "with optimism," and has no interest in the scandals that plagued GSA during the Ford and Carter Administrations.

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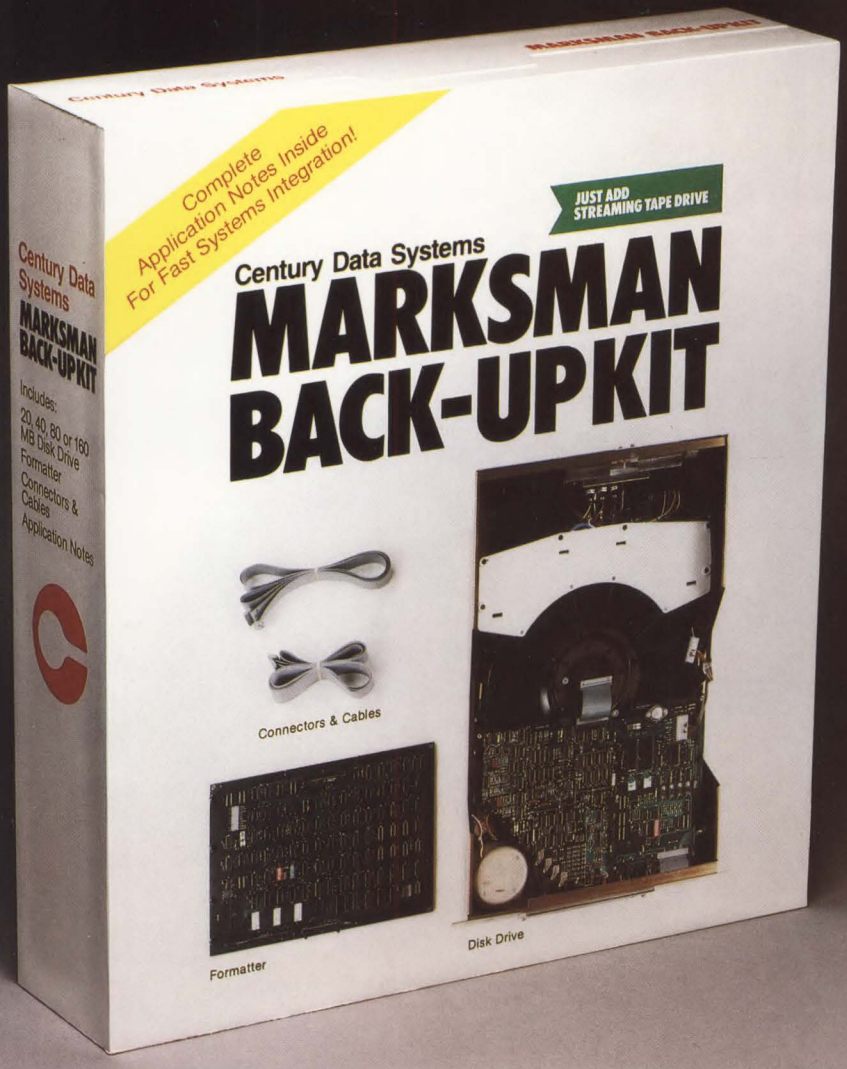
Finally, an off-the-shelf answer to Winchester back-up.



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

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

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

Continued on next page

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

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

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

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

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

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

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

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

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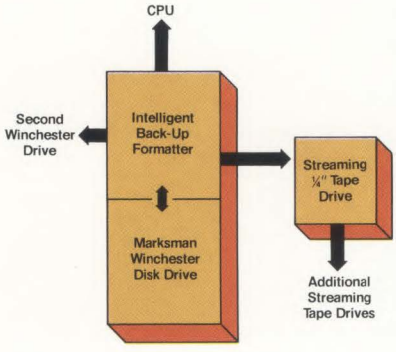
back-up. *Continued from first page*

A storage system independent of the CPU.

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



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

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

The advantages of streaming tape.

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

Available now.

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

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

Sidewinder is a trademark of Archive Corp.; Quarterback is a trademark of Cipher Data Products; Streamer is a trademark of Data Electronics Inc.; CP/M and MP/M are registered trademarks of Digital Research, Inc.; Unix is a trademark of Bell Laboratories; and Multibus is a trademark of Intel.

Century Winchesters don't crash, they land.

You've heard of crashed disks before. But you've probably never heard of one in a Winchester.

That's because Winchesters rarely crash. And at Century Data, we take special pains to make sure of it.

In addition to the standard protection of disk lubrication and feather-light heads, we've designed a unique braking system and special head landing zones where no data is stored.

During a power failure or reduction, the brakes automatically slow the disk in seconds rather than minutes. And the head is programmed to seek out it's special data-free landing zones.

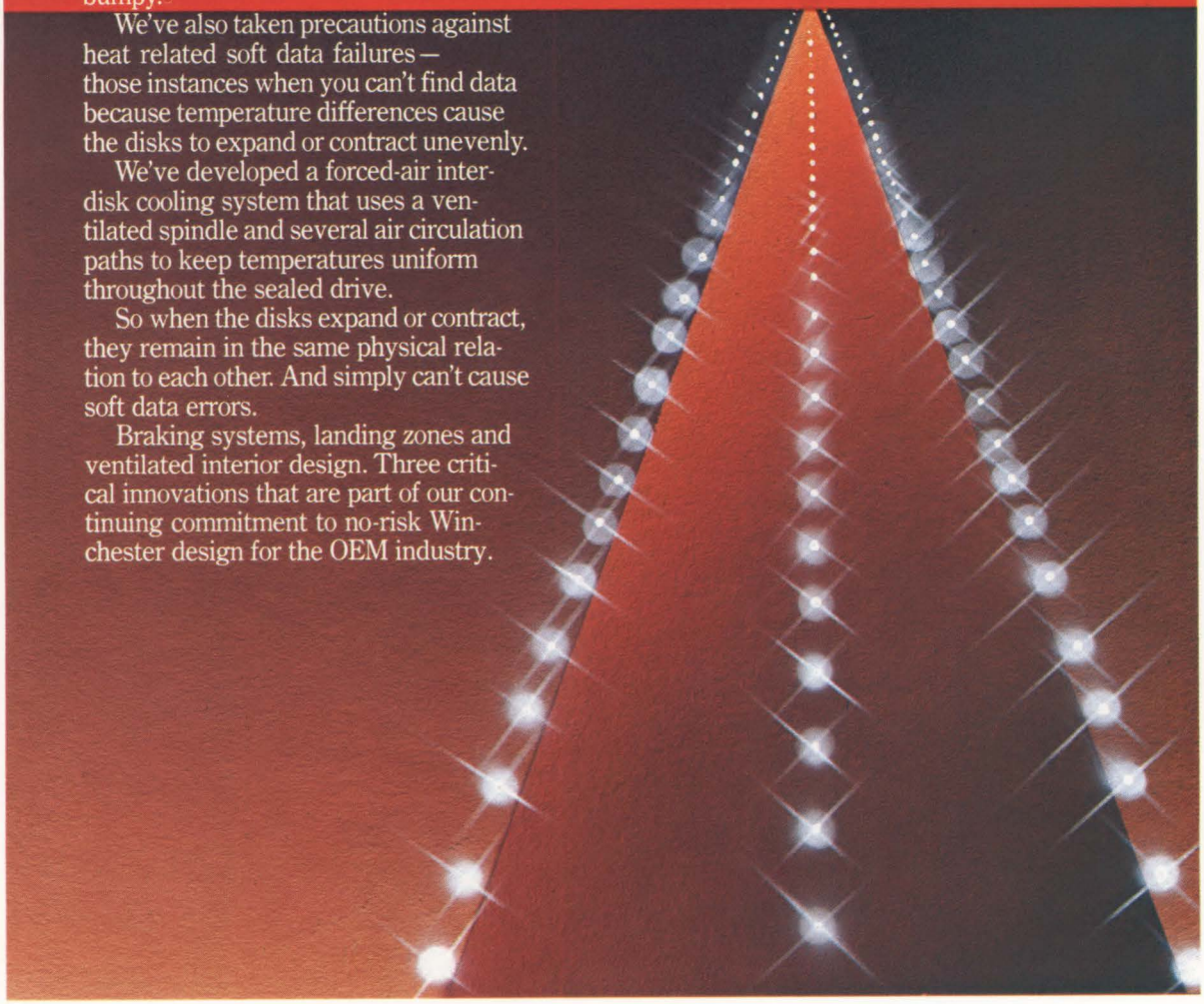
The combination not only prevents crashes, it virtually insures the data's integrity even if the landing is a little bumpy.

We've also taken precautions against heat related soft data failures—those instances when you can't find data because temperature differences cause the disks to expand or contract unevenly.

We've developed a forced-air inter-disk cooling system that uses a ventilated spindle and several air circulation paths to keep temperatures uniform throughout the sealed drive.

So when the disks expand or contract, they remain in the same physical relation to each other. And simply can't cause soft data errors.

Braking systems, landing zones and ventilated interior design. Three critical innovations that are part of our continuing commitment to no-risk Winchester design for the OEM industry.



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

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

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

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

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

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

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

Q: How are these drives being used in Japan?

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

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

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

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

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

Now media compatible.

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

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

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

- ☐ Intelligent Marksman Backup Package
- ☐ Marksman Winchester Disk Drives
- ☐ Trident Removable-Pack Disk Drives
- ☐ I would like an evaluation unit of the above.

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- determine projected changes in market shares
- identify emerging industry growth areas
- identify the major criteria used by purchasers to evaluate suppliers
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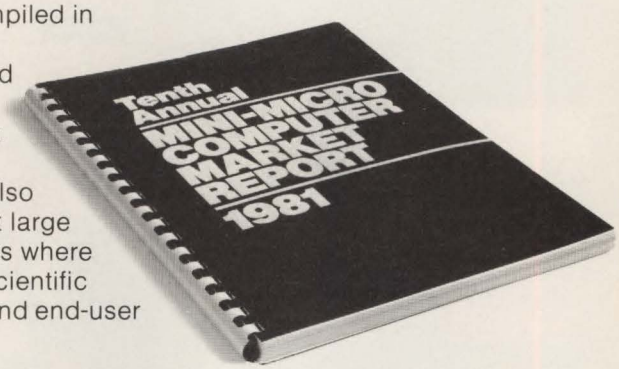
Most comprehensive industry survey

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



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

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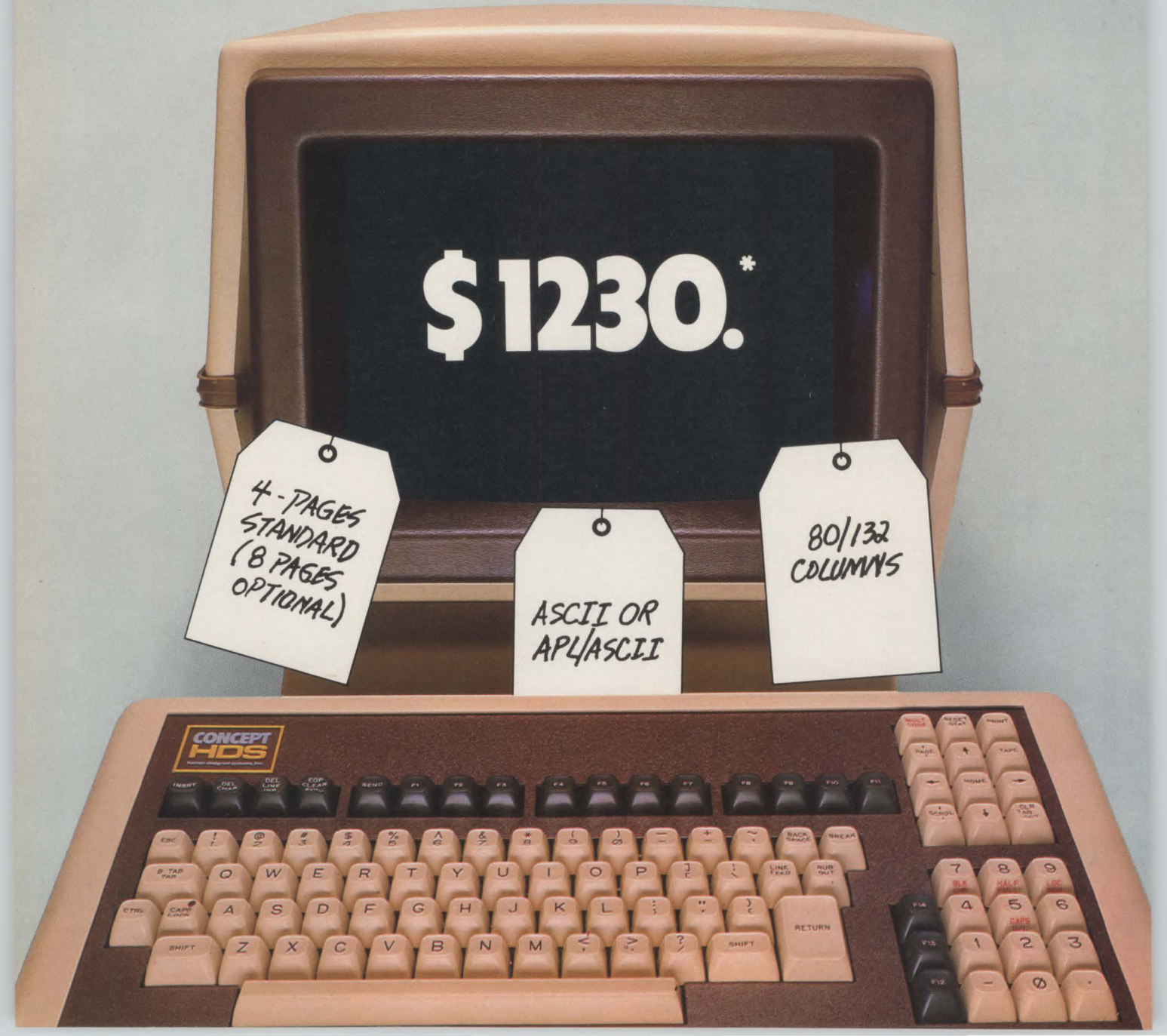
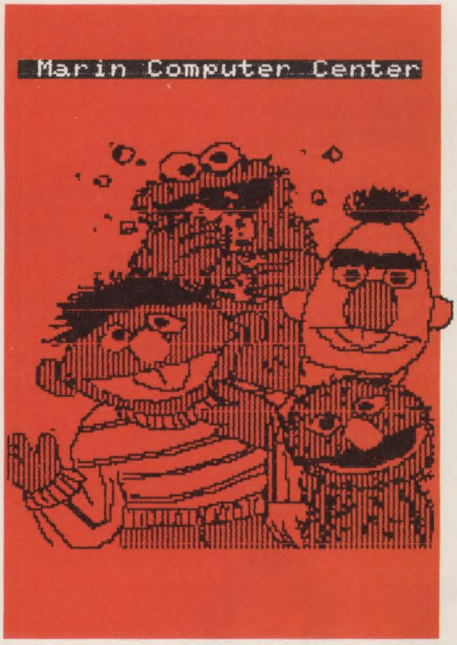
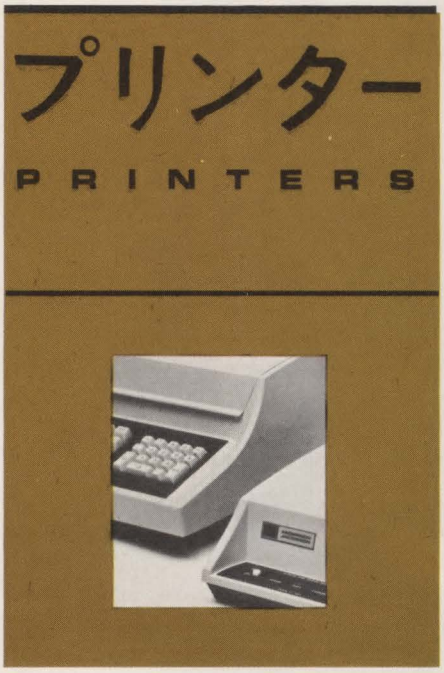


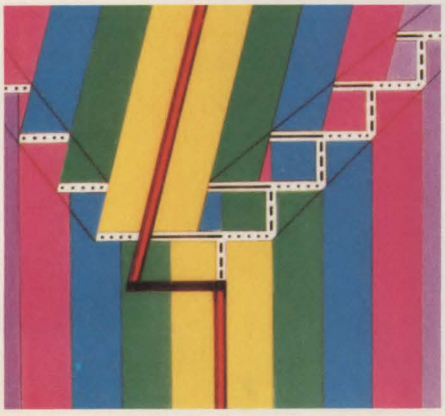
FEATURE HIGHLIGHTS



145 Growing at 20 percent a year, the $600-million U.S. serial-printer market is served by more than 120 international vendors that offer more than 500 models to end users and systems integrators. Fierce competition from Japan has kept domestic manufacturers active, and serial-printer innovations occur not in intermittent flurries but as a sustained blizzard that leaves a heavy accumulation of new models. Because of this, prices are falling toward the $500 level; matrix-print quality is improving; printer speeds are rising; better design and construction are improving reliability; and μps and memory are boosting local capability with graphics, multi-font and other features. For a comprehensive profile and survey of products, see p. 145 . . . Meanwhile, the line-printer industry has not been the beneficiary of startling innovations in the past several years, as band and matrix technologies continue to hold the fort. The talk among manufacturers concerns low-cost, high-reliability laser and other non-impact printers, but a potential revolution is at least a few years away. For a detailed look at the line-printer industry and its price/performance improvements, see p. 156.



173 For years, the teleprinter industry has lived in the shadow of the more exciting CRT-terminal industry. Teleprinter market research is less plentiful and exact than CRT research, but GML Corp., a Lexington, Mass., research firm, has information pointing to a serious shakeout in the teleprinter industry. For details, see the article beginning on p. 173 . . . U.S. peripheral manufacturers, particularly those that sell low-end printers, have felt the Japanese muscle flex over the past year. Some Japanese marketing figures may seem exaggerated, but Japanese manufacturers know they are doing extremely well in the U.S. market, and they aren't modest about it. News editor Lori Valigra presents her first-hand look at the Japanese printer industry, starting on p. 187 . . . Today's typical μc user buys a system to do a specific job, but later embarks on a search for new applications—a development that has spawned a tremendous "after-market" for software, hardware add-ons and accessories. A dot-matrix printer from Integral Data Systems reduces the expense of upgrading by permitting users to add modules for color, graphics, greater resolution and higher print speeds, often by adding little more than a ROM to the system. An examination of the "Prism" printer begins on p. 207.



225 Sometimes the only barrier between a scientific theory and its acceptance in the scientific community is a theorist's inability to communicate the idea effectively. For Dr. Richard Hey, a geologist for Scripps Institution of Oceanography, computer graphics provided the bridge between his elegant theory and a skeptical crowd of fellow researchers. For an interesting look at an interesting application, see p. 225 . . . Databases that create indexes by joining tables are called relational. INGRES, however, enjoys a position almost unique among DBMSs: it is truly relational. It creates new tables from existing ones; data storage and retrieval are based on a knowledge of how those tables are constructed. On p. 231, consultant Harvey Weiss continues his DBMS series.

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CIRCLE NO. 67 ON INQUIRY CARD

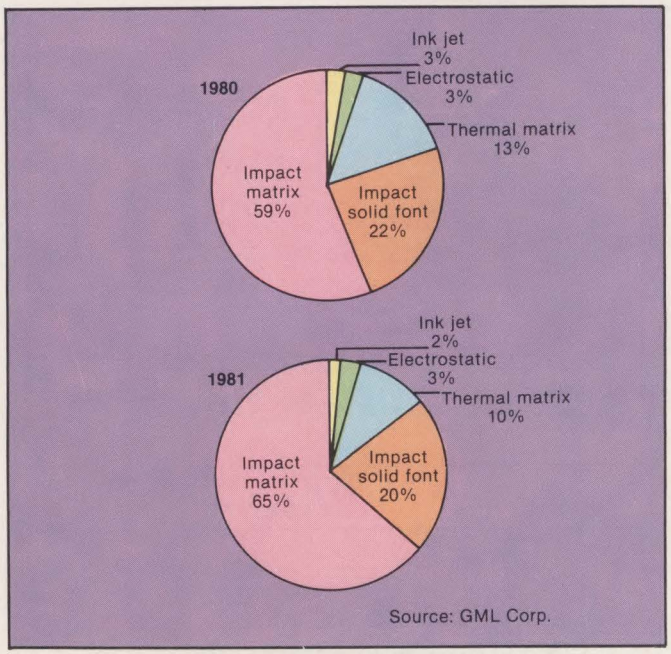
Sunny times for serial printers

PATRICK KENEALY, Associate Editor

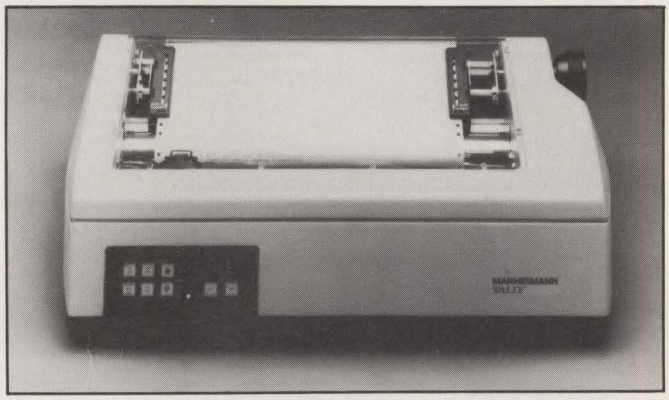
Prices are falling, while print quality and speed, formerly a trade-off, are beginning to converge

Growing at 20 percent a year, the $600-million U.S. serial-printer market is served by more than 120 international vendors that offer more than 500 models to end users and systems integrators. Fierce competition from Japan (see "A look at the Japanese printer industry," p. 187) has kept domestic manufacturers active, and serial-printer innovations occur not in intermittent flurries but as a sustained blizzard that leaves a heavy accumulation of new models. Five general trends transcend the diversity of products and firms that form the serial printer market:

- prices are falling toward the $500 level in response to Japanese price leadership;
- matrix-print quality is improving as matrix-printer manufacturers try to crack the burgeoning word-processing market;
- printer speeds are rising, as always;
- better design and construction are improving reliability and making printers more at home in the office;
- μps and memory are boosting local capability with graphics, multi-font and other features.



Serial-printer technology trends are toward matrix methods and away from solid fonts. *Fully formed character printers generate letter-quality output but print at 75 cps or less. Matrix printers reach 900 cps and generate near-letter-quality output at 50 to 150 cps. Thermal printing is losing popularity in serial printers but gaining interest in teleprinters. Electrostatic methods still suffer from low quality and high paper costs. Ink-jet printing is available in only a few expensive units but holds promise for the future.*



Multimode serial printers such as this Mannesmann Tally 440 have enjoyed instant popularity. *The unit prints 7 × 9 characters at 400 cps and 40 × 18 dot near-letter-quality characters at 100 cps. The device prints bar codes, OCR characters and six font sizes. Options provide graphics, plotting mode and two- and four-color printing.*

Progress in pricing and print heads

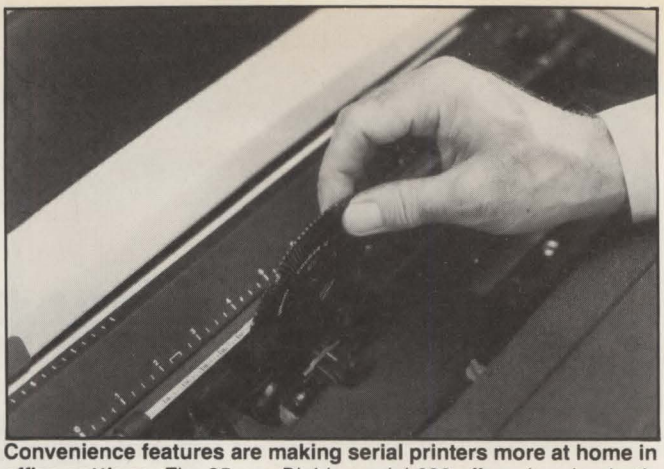
Serial-printer pricing trends are more difficult to discern than those in other computer markets. Price changes issued by large manufacturers such as Diablo

In this electronic age, the speed and output quality of most serial printers is controlled by an electromechanical device: the print head.

Systems, Inc., Integral Data Systems, Inc., and Centronics Data Computer Corp. are often adjusted by distributors, dealers and independent representatives before they are fixed for small-volume systems, integrators and end users. Buyers and vendors still report falling prices, and numerous units carry end-user prices lower than $1000.

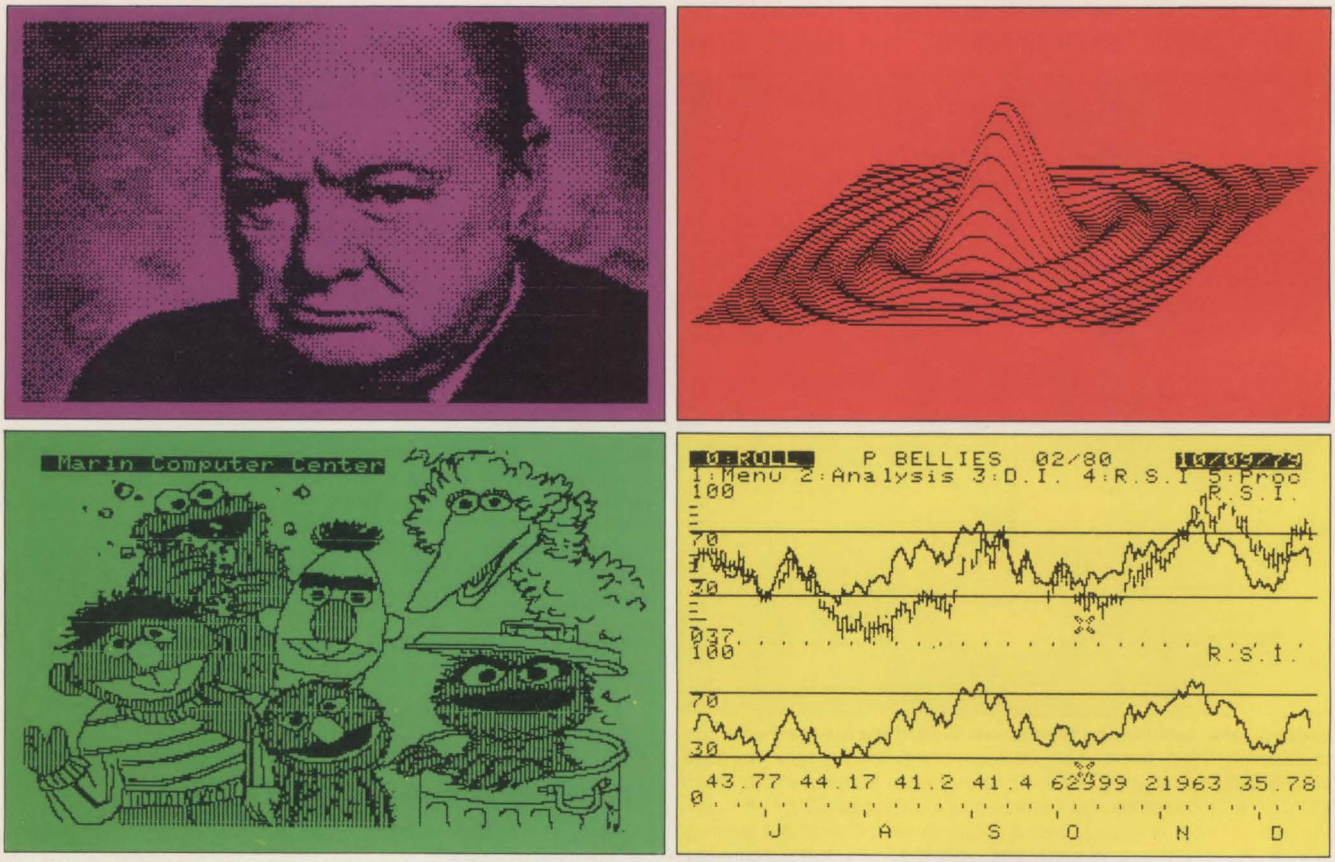
In this electronic age, the speed and output quality of most serial printers is controlled by an electromechanical device: the print head. Two types of print heads dominate the serial-printer market: solid-font impact print heads, which are used in 21 percent of the models on the market, and impact-matrix print heads, employed in 57 percent. Thermal-matrix print heads are used in 12 percent of teleprinters, and ink-jet and electrostatic print heads account for the remaining 10 percent.

Popular types of solid-font impact print heads include the daisy wheel popularized by Diablo and Qume Corp., the print thimble made by NEC Information Systems Inc., Olivetti Peripheral Equipment's print cup and IBM Corp.'s golf-ball print mechanism. Printers that use these print heads are called font or fully formed character printers. All produce multi-copy letter-quality output at 40 to 60 cps, and Qume has a dual print-head model that prints 75 cps. Many units print low- and medium-resolution graphics using everyday letters and punctuation marks, and many print bidirectionally for increased throughput. All offer operator-interchangeable print elements, and most offer a variety of elements that give users stylistic and character-set flexibility.



Convenience features are making serial printers more at home in office settings. *The 25-cps Diablo model 620 offers drop-in plastic daisy wheels with automatic ribbon and print-wheel positioning. An electronic encoding system senses the wheel position after it has been inserted into an envelope-like enclosure and locks it in place.*

Impact-matrix print heads are the hottest item in serial printers today. Early impact-matrix printers used seven-wire print heads to produce 5 × 7 dot characters at more than 100 cps. In the late 1970s, speeds reached 200 cps, and nine-wire print heads were

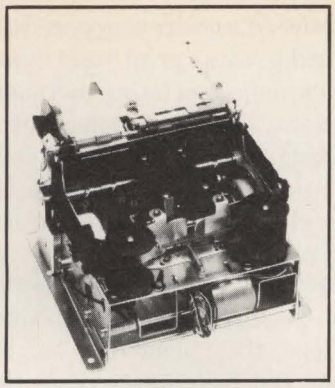


Graphics packages are the most popular serial-printer option and are becoming standard features. *Printed by an Okidata Microline printer with a resolution of 60 × 66 dpi, the images above are typical of the dot-addressable graphics available on matrix printers.*

WESTREX

DOT MATRIX PRINTERS

800 SERIES



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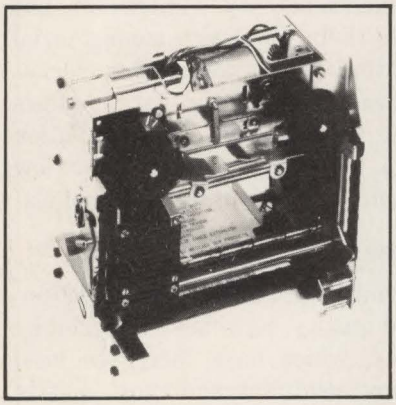
Basic models illustrated on this page are obtainable with various options to suit your application needs. Data sheets with technical specifications for each of these products are available upon request.



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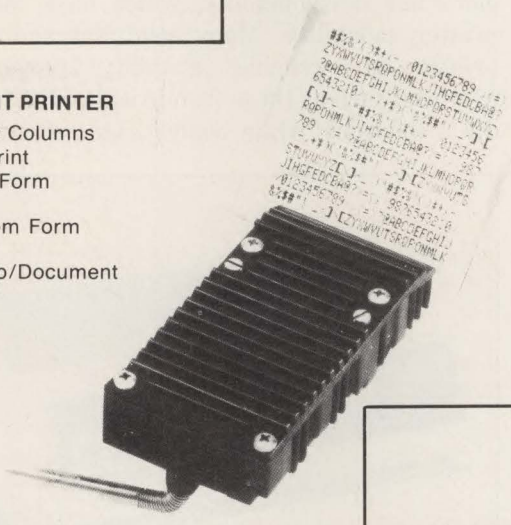
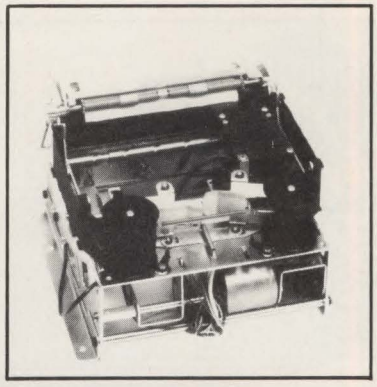
- Top and Bottom Form Sensors
- Adjustable Slip/Document Stop

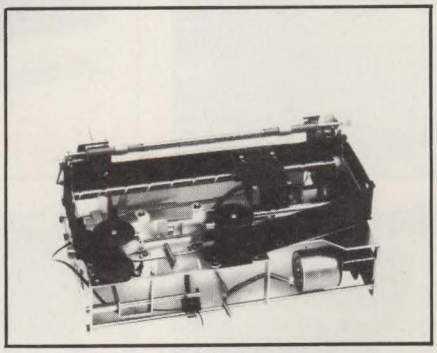




AT THE HEAD, THEY'RE CLASS!

MODEL 801
LOW PROFILE, LOW WEIGHT, PRINT HEAD:

- 7 Needle Vertical Array
- Low Power Consumption
- 100% Duty Cycle
- 100 Million Character Life



MODEL 880
JOURNAL PRINTER

- Up to 96 Characters Per Line @ 12 CPI
- Bi-Directional Printing
- Standard & Graphic Feed
- 576 Print Dots Per Line

MODEL 850
JOURNAL PRINTER

- 51 Print Columns
- Integral Paper Supply Holder
- Easy Top Paper Insertion
- Document Validation Capability

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CIRCLE NO. 68 ON INQUIRY CARD

The combination of print head and electronic progress has given birth to a multimode serial printer that produces very fast impact-matrix output and a slower near-letter-quality output.

introduced to ease the legibility problems that limited impact-matrix printer sales. Two dozen serial printers now print faster than 200 cps, and while speed has not been forgotten, recent impact-matrix research and development has focused on print quality.

Anxious to capitalize on the word-processing market's demand for high-quality output, many impact-matrix printer makers have developed units that provide near-letter-quality output at faster than daisy-wheel speeds. Two impact-matrix methods produce near-letter-quality output. The first method—multipass printing—is used by Florida Data Corp., Malibu, Digital Equipment Corp. and others. Multipass printers make two or more passes to print one line, cutting speed but achieving high resolution, 19 × 18 dot characters. The second near-letter-quality matrix-printing method uses high-density (many wires) print heads to print high-resolution characters. The Integral Data Systems 460 uses a nine-wire staggered-array print head to print 24 × 9 dot characters in one 160-cps pass. Epson America and Fujitsu America Inc. have announced 24-wire staggered-array heads as the trend toward greater print-head density continues.

Non-impact printing methods are also used in serial printers. The two popular methods are thermal-matrix printing, which uses heat to form matrix characters on heat-sensitive paper, and electrostatic printing, which uses electricity to burn characters onto silver-colored electrosensitive paper. Both are more reliable than impact methods because they are less mechanical and don't require ribbons. Although they print faster than 120 cps, they print only single copies, use expensive paper and have lower resolutions than impact-matrix printers. Thermal and electrostatic printing are popular in teleprinters in which reliability is important, but poor print quality limits their popularity among serial printers. Ink-jet printing is a non-impact serial-printing method that has not caught on yet. It offers the promise of silent, high-speed, high-resolution matrix printing but is expensive, suffers from low reliability and is available only in half a dozen models.

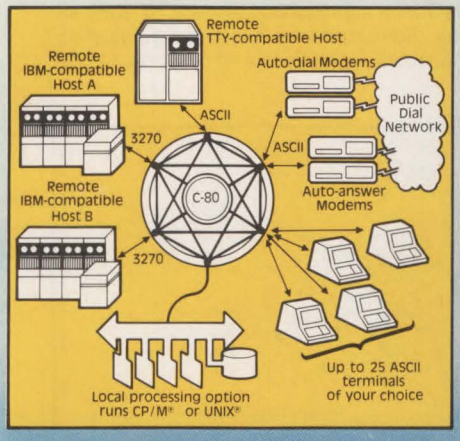
Functionality flourishes

Electromechanical print-head innovations, which increase output speed and quality, have been matched by electronic developments, which have increased local printer capability. Many solid-font and most matrix printers have graphics capability. Inexpensive matrix printers, such as those from Anadex Inc., have 75 × 75 dpi resolutions, while sophisticated matrix units, such

Modern serial printers offer low-noise level, flexible forms handling and easy ribbon replacement. *Clockwise from top left, these printers from Hewlett Packard, Okidata, NEC Information Systems and Diablo approximate the size and weight of an office typewriter. Engineering efforts have improved reliability and appearance.*

How to use up to 25 ASCII terminals as full-screen editing 3270 workstations.

Yes, the Alanthus C-80 performs ASCII to 3270 protocol conversion, enabling you to substitute virtually *any* inexpensive ASCII terminal for 3270s. It also gives you dial-up access to 3270 applications, with full-screen editing, from almost anywhere.



Dual IBM host interface ports allow simultaneous access to two totally separate host mainframes or networks. And, you're not limited to dialing in to the host; you can dial out to the public DDD network or you can dial out to the timesharing and electronic mail service of your choice.

The C-80 costs surprisingly little to rent or buy. Add your line and terminal savings, and you'll agree the C-80 is a deal you can't afford to miss.

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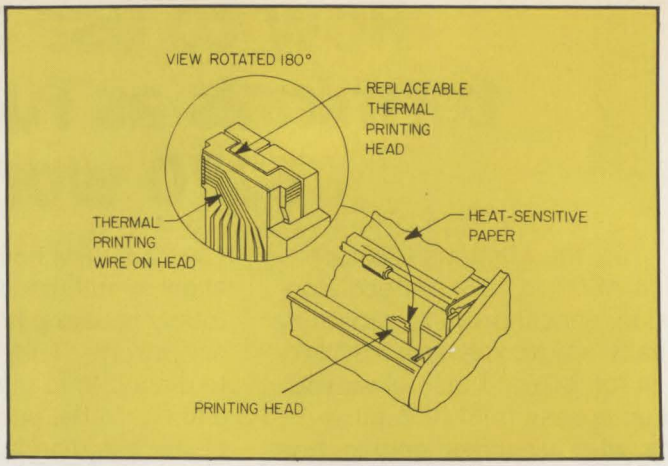
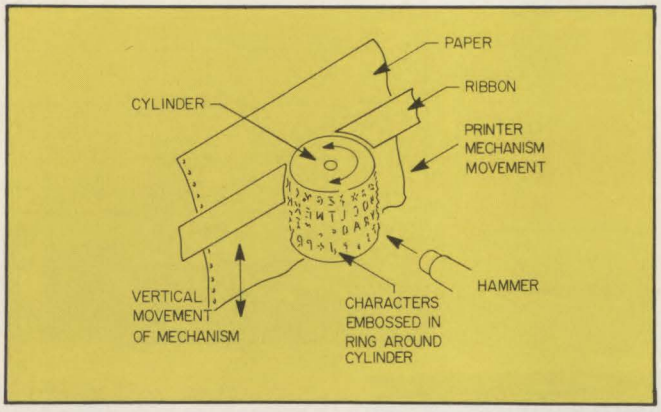
® UNIX: Bell Telephone Laboratories

Thermal and electrostatic printing are popular in teleprinters, in which reliability is important, but poor print quality limits their popularity among serial printers.

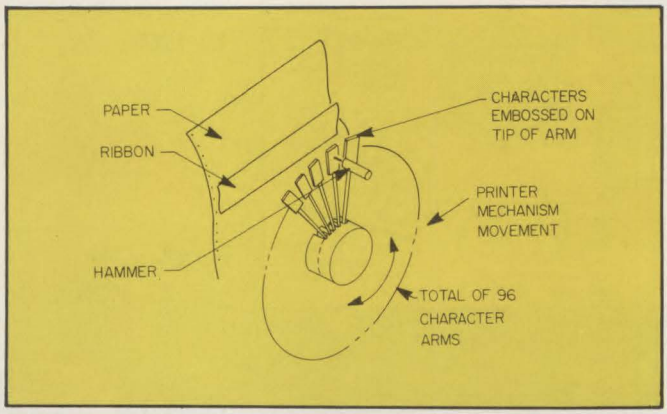
as those from Malibu Electronics, have resolutions of 120 × 144 dpi. Daisy-wheel printers, such as the Diablo 620, have 120 × 48 dpi graphics resolutions. Matrix printers often offer compressed- and expanded-font printing. Because their heads traverse the paper at a constant rate, these units print 16½ cpi faster than they print 10 cpi. The same memories that permit compressed and expanded characters also permit foreign-language, OCR and bar-code character sets. Many serial printers offer multiple sets as standard, with more sets available as plug-in ROM options.



Thermal printers are non-impact printers that form characters by pulsing elements of the dot matrix on a special heat-sensitive paper. *The heads are made from a high-resistance material, such as tin oxide or a semiconductor. Semiconductor heads are sometimes ICs that include decode and drive electronics in addition to the dot-matrix mechanism.*



Cylinder printers have an embossed character set arranged in a series of rings around the cylindrical printing mechanism. *The cylinder is rotated and shifted up or down to move the character into position and then a hammer strikes the cylinder.*

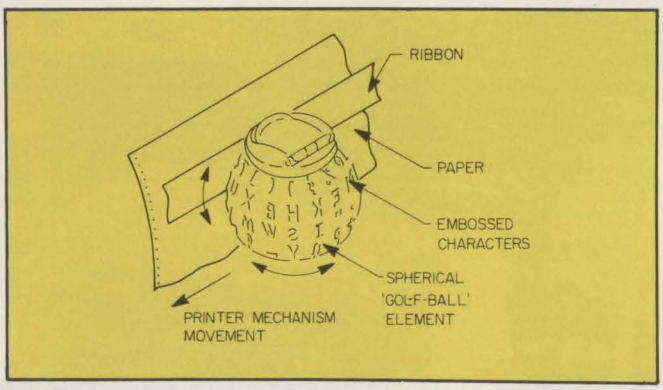


Daisy-wheel printers have a series of "petals" radiating from the hub of a wheel. *Each petal has an embossed character, which is struck by a hammer after it has been rotated into position.*

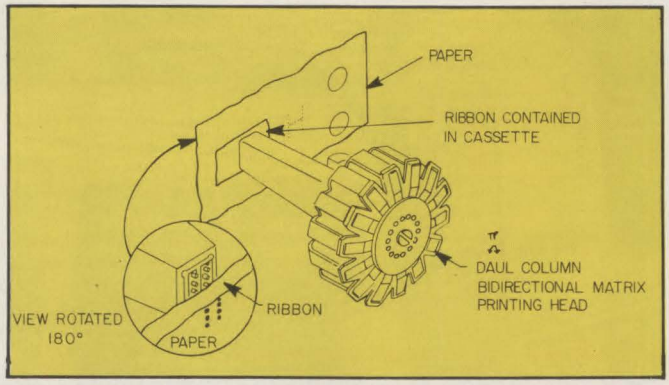
The combination of print-head and electronic progress has given birth to a multimode printer that produces very fast impact-matrix output and slower near-letter-quality output. DEC's new Letterprinter 100 ($2590 per single unit) features three operating modes: 240 cps, 7 × 9 character output for high-speed data-processing printing; 80-cps, 33 × 9 character output for moderate speed, memo-quality output; and two-pass 30-cps, 33 × 18 character output for near-letter-quality printing. Other multimode serial printers are made by Centronics, Florida Data (top speed 900 cps), Malibu Electronics, Integral Data Systems and others.

Engineering excellence is evident

While most design and development efforts have



Golf-ball printers are similar to cylinder printers but use a spherical print mechanism. *When the character has been rotated into position, the sphere strikes the paper.*



Impact-matrix printers have symbols that are composed of a series of dots. *A set of needles in the print head strikes the printer ribbon to form the character.*

One of the great masters?

Although the Datasouth DS180 matrix printer may not exactly rate as a work of art, our customers have a *very* high opinion of its value. Over the past year, we have shipped thousands of DS180 printers to customers throughout the world. Many of our sales now come in the form of repeat business—a strong testimonial to the acceptance of a product.

The success of the DS180 in a very competitive market did not happen by accident; rather through our sensitivity to the needs of the industry. This sensitivity we carry through research and development, production and quality control and finally, to after sales support and service.

Recently we introduced new enhancements to make the DS180 printer even more versatile. Dot addressable raster scan graphics produces output of computer generated charts, maps and graphs at a resolution of 75 x 72 dots per inch. Variable horizontal pitch selection allows printing at 10, 12 or 16.5 characters per inch plus double wide printing at 5, 6 or 8.25 characters per inch. The expanded 2K FIFO print buffer handles a full CRT screen dump at up to 9600 baud without delaying the host system. We also offer transparent mode for isolating communications problems, and for APL users, the dual ASCII/APL character set option.

Check our list of features and we think you will agree that the DS180 offers the most complete performance package in matrix printers.

DS180 PRINTER STANDARD FEATURES
- Microprocessor Control
- 180 CPS Print Speed
- Bidirectional Logic Seeking
- 1000 Character Buffer (Expandable)
- 9x7 Dot Matrix
- Expanded Characters
- Adjustable Printhead 1-6 Copies
- 96 ASCII Character Set
- Cartridge Ribbon
- 132 Column Print Width
- Tractor Feed (Front or Bottom)
- Non-Volatile Format Retention
- Top of Form
- Horizontal Tabs
- Vertical Tabs
- Perforation Skip-Over
- Auto Line Feed
- 6/8 LPI
- Auto End of Line Carriage Return
- 5 IPS Paper Slew
- Parallel and Serial Interfaces
- 110-9600 Baud Communications
- Terminal Status Indicators
- Audio Alarm
- Self-Test
- X-on, X-off
- Paper Out Detection

OPTIONAL FEATURES
- Compressed Print – 10, 12, 16.5 cpi
- High Resolution Dot – Addressable Graphics
- 2k Expanded Print Buffer
- APL/ASCII Character Set

The DS180 is available nationwide through our network of sales/service distributors.

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CIRCLE NO. 70 ON INQUIRY CARD

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Serial printer sales show no signs of slowing, and unit dollar volume sales are growing at more than 20 percent annually.

been directed toward higher speed and better print quality, much has been done to increase serial-printer reliability and operator convenience. New serial printers are sleeker and smaller than their predecessors and are more often tabletop units than pedestal-mounted ones. They weigh less (typically less than 50 lbs.), use less power, make less noise (less than 55 dBA is the industry goal) and are comfortable in an office environment.

Easy-to-use, flexible-forms hardware enables most units to use variable-width punched or plain fan-fold paper, and sheet feeders for printing numerous single-sheet forms are popular in word-processing applications. Many units allow rear and bottom paper feeding, and all units keep paper paths simple for easy loading. Plastic cartridges for cloth and Mylar ribbons make ribbon changing less messy, and high-yield cartridges make changes less frequent. Print-head life averages more than 100 million characters, and a few 200 million- to 500 million-character print heads are being advertised.

Users agree that serial-printer reliability has improved, but manufacturers' reliability figures are often inconsistent. Design modularity in electronics and print mechanisms has improved mean time to repair figures, and most manufacturers quote MTTRs between 30 and 60 min. Some manufacturers encourage users to perform routine maintenance and parts replacement. Epson offers its units with a $30 disposable print head, which users replace every 50 to 100 million characters.

Future developments

Serial-printer developments show no signs of slowing, and unit and dollar volume sales are growing at more than 20 percent annually. Distributed processing will spur serial-printer sales because it must increase local hard-copy capability as it increases local memory and processing power. While high-speed matrix printers are well suited for distributed data-processing applications, they are less suited to the faster growing word-processing applications dominated by daisy-wheel and other solid-font impact printers.

Solid-font impact technology has had little success breaking the 60-cps barrier, but matrix-printer technology has progressed from 5 × 7 dot printing to near-letter-quality standards in less than a decade. Multimode printer manufacturers bill their products as the "single-printer solutions to data- and word-processing printing needs," and, judging by orders for these unproven units, users believe those claims.

Under the leadership of the multimode manufacturers, impact-matrix printers should win an even larger share of the serial-printer market at the expense of solid-font models. Electrostatic and thermal-matrix printers will remain popular for high-reliability applications, but their sales will be restricted by special-paper, single-copy and low-resolution limitations. Ink-jet printers produce silent near-letter-quality output at 200 cps. If manufacturers can reduce prices and raise reliability of these units, they could silently infiltrate offices everywhere. ■

SERIAL PRINTERS

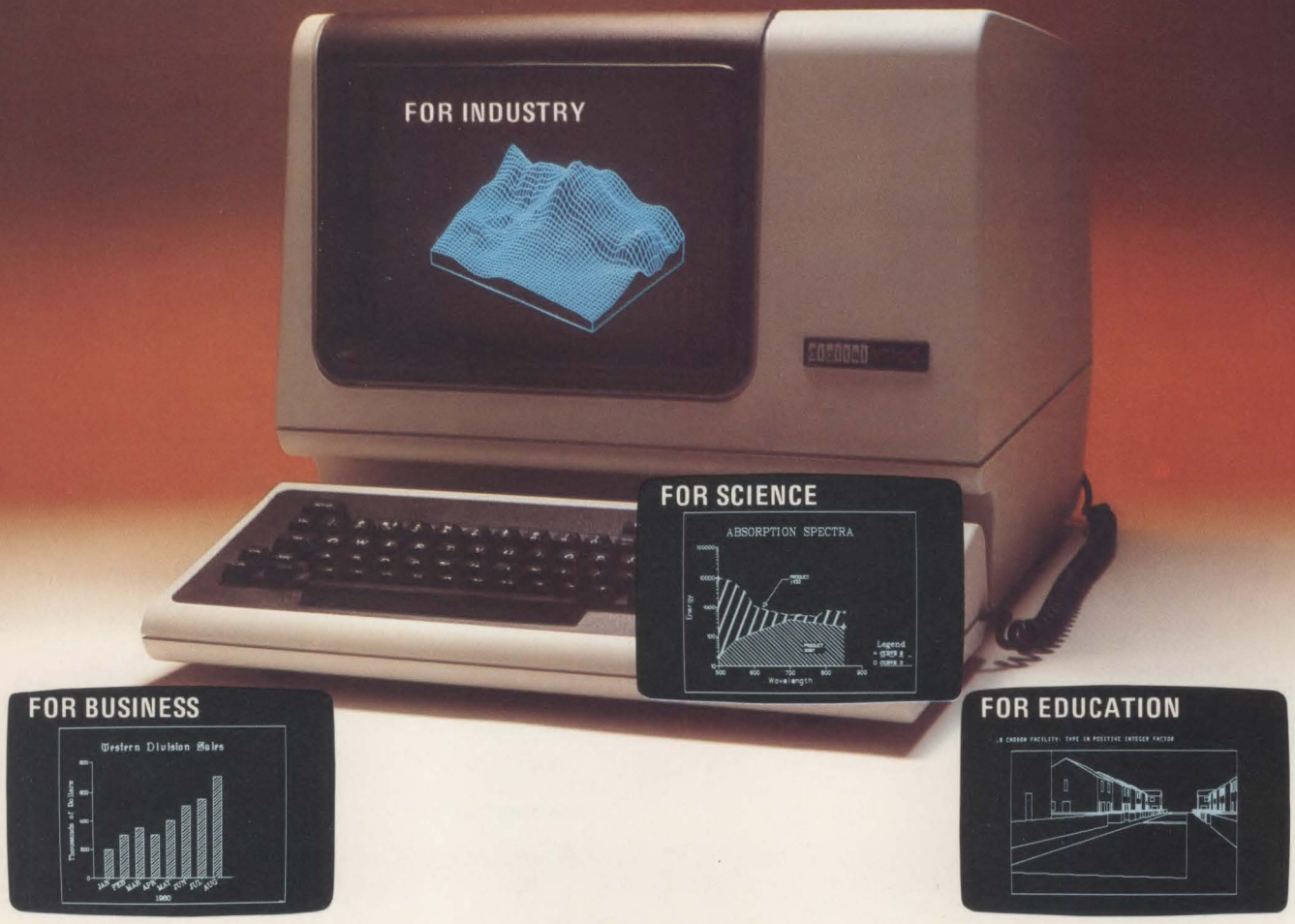
The following table lists current serial printer manufacturers and their products. The table was prepared by *Mini-Micro Systems* with the help of the GML Computer Product Database. Dealers, distributors and resellers have been excluded from the table, leaving those who manufacture, add significant value to or single-source serial printers in this country.

Manufacturer	Model(s)	Printing Method	Speed (cps)	Price
Addmaster San Gabriel, Calif.	50 and 60 Series	solid front impact	48-66	$110-$120
Alanthus Rockville, Md.	T-300, T-302	impact matrix	30	$1300-$1530
Alphacom San Jose, Calif.	Sprinter 20, 40, 80	thermal matrix	40-160	$175-$595
Amperex Hicksville, N.Y.	DX 486, GP-300	impact matrix	40, 80-300	$450, $3165
Anacom General Fullerton, Calif.	150, 160, 150Z, 160Z	impact dot matrix	150	$1450-$1695
Anadex Chatsworth, Calif.	DP-500, DP-650, DP-750, DP-1000, DP-8000, DP-9000 Series	impact matrix, impact solid font	25-2000	$570-$1650
Anderson Jacobson San Jose, Calif.	AJ-800 Series, AJ-650, Quietype	impact matrix, impact solid font, inkjet	30-210	$1295-$3500
Apple Computer Cupertino, Calif.	Silentype	thermal matrix	40	$395
Atari Sunnyvale, Calif.	800 Series	impact matrix, thermal matrix	37-50	$300-$1000
Axion Glendale, Calif.	EX-800, GP-80M, IMP Series	impact matrix	30	$399-$749
B-G Instruments Alta Loma, Calif.	PP-101, PP-201	thermal matrix	22, 28	$595

Manufacturer	Model(s)	Printing Method	Speed (cps)	Price
Beehive International Salt Lake City, Utah	P1600, 3287	impact matrix	160	$2395, $4790
Binder Datentechnik, GmBH, Germany	Series 1000, 2000	impact matrix	150, 200	$3000, $3400
Burroughs Detroit, Mich.	AP 100, AP 300, SP110, TP300 Series, B80 Series, B91	impact matrix	90	$900-$2490
C. Itoh Electronics Los Angeles, Calif.	Comet, Comet II, Starwriter, Starwriter II, 800 Series, 8300	impact matrix, impact solid font	25, 45, 125, 150	$995-$2795
Canon Lake Success, N.Y.	P2010, P2020	impact matrix	74	
Capitol Circuits Allston, Mass.	40, 100, 200, 400 Series	impact matrix	58-120	$545-$800
Centronics Hudson, N.H.	microprinter 700 Series	impact matrix, one electrostatic	60-180	$349-$2965
Clary San Gabriel, Calif.	AN16, SP20	impact solid font	25	
Commodore Santa Clara, Calif.	4022	impact matrix	65	$795
Comprint (Computer Printers) Mountain View, Calif.	912 Series	electrosensitive matrix	225	$660-$1195
Computer Devices Burlington, Mass.	Q3, 1200 Series	thermal matrix	45-65	$425-$1585
Computer Optics Bethel, Conn.	CO:7787-1	impact matrix	88	$5290
Computer Transceiver Systems, (CTSI) Paramus, N.J.	400, Execuport Series	impact matrix, thermal matrix	30	
Control Data Minneapolis, Minn.	Certainty 420, 9300 Series	impact matrix	180	$4950-$5380
Coosol Costa Mesa, Calif.	101 Series	impact matrix	55, 65	$325-$545
CPT Hopkins, Minn.	Rotary V	daisywheel	40	$4000
Custom Terminals Hauppauge, N.Y.	1002	impact matrix	180	$1650
Data General Westboro, Mass.	6000 Series	impact matrix	30-180	$2200-$5300
Data Machines Bath, Ohio	DMI-40	impact matrix	80	$250
Data Recording England	6000 Series	impact matrix	140, 150	$2100-$3180
Data Terminals and Communications Campbell, Calif.	DTC-382	daisywheel	45	$4350
Datacq Monterey, Calif.	MDC 300 Series, Print Swiss	solid font impact	59, 63	$645, $895
Datagraphix San Diego, Calif.	132-81	impact matrix	120	$3200-$4585
Datapoint San Antonio, Texas	9200, 9600 Series	daisywheel, impact matrix	3-160	$1750-$5150
Dataproducts Woodland Hills, Calif.	D-150, M-100, M-120, T-80, M200	daisywheel, impact matrix, thermal matrix	47-340	$1471-$2250
Dataroyal Nashua, N.H.	5000, 7000 Series	impact matrix	120-165	$1160-$3080
Datasouth Charlotte, N.C.	DS-180	impact matrix	180	$1395
Datel-Intersil Mansfield, Mass.	AIP-40, APP Series, DPP-Q7	impact matrix, thermal matrix	21-58	$445-$1095
Decision Data Horsham, Pa.	6540 Series	impact matrix	120-1250	$2395-$4895
DI/AN Controls Boston, Mass.	60	impact matrix	180	$1400
Diablo Systems Hayward, Calif.	Hytype I, Hytype II, 2300, 1600, 600 Series	daisywheel, impact matrix	25, 40, 45, 200	
Digi-Data Jessup, Md.	2511 RO	impact matrix	150	$1550
Digital Equipment Corp. Maynard, Mass.	DECwriter Series	impact matrix	30, 180	$2090-$2700
DIP Boston, Mass.	80 Series, 132	impact matrix	100, 110	$499-$995
Eaton Watertown, Wis.	7000+	impact matrix	50	$389
Electronic Products San Diego, Calif.	EPAC 6880, IMP-1, IMP-1M, MP44	impact matrix, electrostatic matrix	50-88	$257-$875
Epson America Torrance, Calif.	MX Series, TX-80	impact matrix	80-125	$450-$995
Extel	AH	impact matrix	30	$1760

Manufacturer	Model(s)	Printing Method	Speed (cps)	Price
Northbrook, Ill.				
Facit Data Products Greenwich, Conn.	4500 Series	impact matrix	100-250	$898-$4275
Florida Data West Melbourne, Fla.	OSP120, OSP130, PB600, BNY	impact matrix	150, 600, 900	$3900-$4100
Fujitsu America Japan	SP830, DPS200B	daisywheel, impact solid	80, 200	$2650, n/a
General Electric Waynesboro, Va.	Terminet Series	impact solid, impact matrix	30-200	$1175-$5375
Gulton Industries East Greenwich, R.I.	ANP-9, AP-200, Microplot, NP7	thermal matrix	24-88	$495-$2000
Heath St. Joseph, Mich.	WH-14	impact matrix	50	$895
Hewlett-Packard Palo Alto, Calif.	2600 Series, 82905	impact matrix, thermal matrix	120, 180	$945-$5500
Hi-G Windsor Locks, Conn.	9/80, 9/132	impact matrix	150	$995, $1100
Hokushin Japan	LLT 16, LLT 17	impact solid font, impact matrix	40, 165	$6600-$10,000
Honeywell Minneapolis, Minn.	PRU Series, PRT1004	impact matrix, impact solid font	30-160	$2260-$4000
Howard Industries Anaheim, Calif.	Typriter 221	impact matrix		$2750
IBM Armonk, N.Y.	2222, 3200, 3710, 4970, 5103, 5200, 6640 Series	impact solid font, impact matrix, inkjet	30-182	$2000-$27,130
Impact Data Anaheim, Calif.	801, 961	impact matrix	132	$849
Infoscribe Santa Ana, Calif.	500, 1000	impact matrix	150, 180	$1595, $1000
Integral Data Systems Milford, N.H.	445, 460, 560	impact matrix	50-180	$795-$1695
Interface Systems Ann Arbor, Mich.	ISI387, 736	impact solid font, impact matrix	50, 180	$4250
International Microtronics Tucson, Ariz.	NP-7	thermal matrix	28	$520
International Technology New York, N.Y.	MP-2000	impact matrix		$175
Kontron San Mateo, Calif.	DDP 5080	electrostatic matrix	32	$645
Leanord France	Picoprint 24	electrostatic matrix	24	$770
Lear Siegler Anaheim, Calif.	310, 310A	impact matrix	180	$2000, $2045
Litton Westrex West Caldwell, N.J.	M-1824, MR-1824, MS-4000, 800 Series	impact matrix	60, 80, 150	$180-$290
Malibu Electronics Westlake Village, Calif.	200, DM-200, 165	impact matrix	165, 250	$2995, $2295
Mannesmann Tally Kent, Wash.	MT-1800, M, T Series	impact matrix	160, 200	$1500+
Matchless Systems Gardena, Calif.	Starwriter, MS-1400	daisywheel, impact matrix	25/45, 125	$1795, $1195
Memorex Santa Clara, Calif.	1300, 2056, 2087, 3056	impact matrix	100, 180, 200	$1400-$6675
Mepcom International Dallas, Texas	EZ print 21	impact matrix	43	$395
Micro Peripherals Salt Lake City, Utah	MP-40, TP-40, 80 Series, 99G	impact matrix, thermal matrix	50-100	$435-$849
Microdata Irvine, Calif.	5126, 5166, 5556	impact matrix	165	$4600-$5200
Microtek San Diego, Calif.	Bytewriter-1, MT-80	impact matrix	80, 125	$299, $795
Miltope Plainview, N.J.	LP3036, TP2000, TP2001, TP4080	impact matrix, thermal matrix	160, 180	$4250-$6000
Mohawk Data Sciences Parsippany, N.J.	1310, 2141	impact matrix, impact solid font	100, 5	$6000, $4293
Motorola Phoenix, Ariz.	700 Series	impact matrix	60, 120, 180	$2095-$3125
National Data Products Middleton, N.J.	T1602	impact matrix	160	$4000
NCR Dayton, Ohio	1226, 6600 Series	impact matrix, thermal matrix	30-173	
NEC Information Systems Lexington, Mass.	Spinwriter 3500, 5500 and 7700 Series	print thimble, solid font impact	30, 55	$1254-$3055
Novell Data Orem, Utah	Image 800	impact matrix	150	$1695
Okidata Moorestown, N.J.	CP210, Microline 80 Series	impact matrix	80, 110, 120	$545-$1315
Olivetti	DP2000, DY, Praxis, Sprinter Series	daisywheel, impact matrix	10-160	$175-$2020

Manufacturer	Model(s)	Printing Method	Speed (cps)	Price
Tarrytown, N.Y.				
Panasonic Secaucus, N.J.	EUY Series	electrostatic matrix, thermal matrix	23-160	$28-$196
Perkin-Elmer Randolph, N.J.	CP 310, 650 Series	impact matrix, impact solid font, thermal matrix	45-180	$1327-$5500
Pertec Chatsworth, Calif.	P250, P80, Stylist 360	impact solid, impact matrix	17-250	$930-$2550
Plessey Peripherals Irvine, Calif.	CP-4282 PM Series	impact matrix	150-200	$1450-$3500
Practical Automation Shelton, Conn.	DMTP Series, PK 970	impact matrix	100, 110, 120	$259-$712
Printacolor Norcross, Ga.	158001, GP1024	inkjet matrix	40	$5695, $7695
Printek Benton Harbor, Mich.	900 Series	impact matrix	170, 340	
Printer Systems Gaithersburg, Md.	PSC Series	daisywheel, impact matrix	41, 180	$4450, $6410
Printer Terminal Ramona, Calif.	877, 879	impact matrix	120	$1145, $1299
Qantex Plainview, N.Y.	6000, 6001	impact matrix	150	$1375, $1385
Qume Hayward, Calif.	Micro 3, Widertrack, Twintrack, Sprint Series	daisywheel, impact matrix	35, 45, 55	$1550-$4330
Qwint Systems Northbrook, Ill.	RO-743	impact matrix	50	$795
Racal Milgo Miami, Fla.	4287	impact matrix	160	$4250
Ramtek Santa Clara, Calif.	4100 four-color printer plotter	5x7 dot impact matrix	132	$12,000
Radio Shack Fort Worth, Texas	QP Series	impact matrix, electrostatic matrix	30-200	$219-$1960
Russel Instruments England	RD140, RD240	impact matrix	82	$1000, $1200
Sanders Technology Amherst, N.H.	Media 127	impact matrix	216	$3900
SCI Systems Huntsville, Ala.	1100, 1110	electrostatic matrix	2200	$304-$735
SCM-Kleinschmidts Deerfield, Ill.	7301, 7311, RO	impact solid font	40	$10,445
Series 1 Plus Wharton, N.J.	S-340		340	$5750
Siemens Germany	PT 80	inkjet matrix	90	$3919
Southwest Technical Products San Antonio, Texas	PR-80, 6450	impact matrix	80, 120	$949, $2395
Sperry Univac Blue Bell, Pa.	0780, 0790 Series	impact solid font, impact matrix	30-200	$11,600
Star Micronics New York, N.Y.	DP-822, DP-824, DP-8480, DP-822G, DP-824G	7x9 dot impact matrix	53, 80	$70-$495
Sweda International Pine Brook, N.J.	MR-1824	impact matrix	50	
Syntest Marlboro, Mass.	SP-300 Series	impact matrix	50, 80	$362-$695
TEI Houston, Texas	3431, 3432	impact matrix	150	$1695, $1995
Teletype Skokie, Ill.	30, 40 Series	impact matrix	10, 30	$1612
Telex Raleigh, N.C.	TC200 Series, 281, 311	daisywheel, impact matrix	30, 45, 180	$1200-$9200
Telpar Addison, Texas	PL-20, 80, 48 Series	thermal matrix	24-150	$315-$825
Texas Instruments Dallas, Texas	800 Series	thermal matrix, impact matrix	30, 75, 120, 150	$995-$1995
Triformation Stuart, Fla.	1SE-1, LED-120	Braille	10, 120	$3200, $14,500
Trilog Irvine, Calif.	150	impact matrix		$2600
Trivex Costa Mesa, Calif.	0862	impact matrix	165	$6450
United Systems (Digitec) Dayton, Ohio	6100, 6300, 6400, 6500 Series	electrostatic matrix, thermal matrix	42-64	$395-$725
Victor Chicago, Ill.	80, 130, 5000 Series	impact matrix	100, 110	$420-$1075
Wang Laboratories Lowell, Mass.	2200, 5500 Series	daisywheel, impact matrix	15-200	
Xymec Irvine, Calif.	HY-Q 1000	impact solid font	30	$2850



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CIRCLE NO. 71 ON INQUIRY CARD

Line printers: band and matrix technologies hold the fort

DAVID FREEDMAN and DAVID SIMPSON, GML Corp.

A revolution in non-impact line printers may be in the wings, but a familiar crop of impact printers is still on top

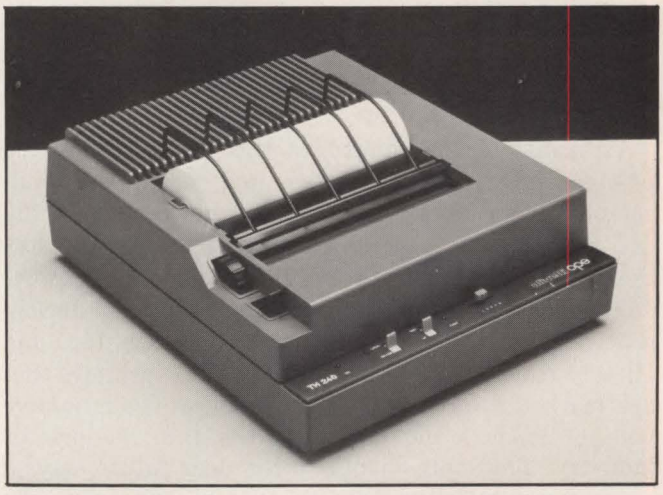
Unlike the terminal and disk industries, the line-printer industry has not been the beneficiary of startling innovations in the past several years. The terminal and disk industries have been swept by low-cost editing terminals and Winchester drives, respectively, but the direction that line printers will take is not clear. The talk among manufacturers concerns low-cost, high-reliability laser and other non-impact printers, but a potential revolution is at least a few years away. For now, band and impact matrix printers remain popular among the technologies, while all line printers show some improvements in price/performance.

Slow-moving industry

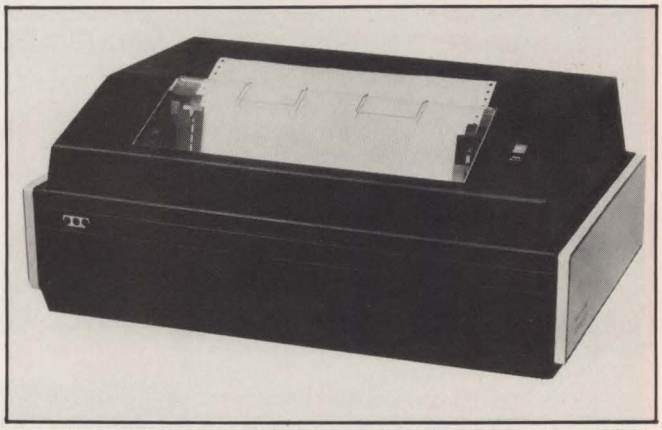
The slow movement of the line-printer industry is probably partially a result of the relatively small number of manufacturers. Of the more than 300 vendors that offer a line printer under their own names, fewer than 30 manufacture a device, including a mechanism. Even some of the largest, most well-integrated vendors have stayed out of the line-printer business, including Honeywell Information Systems, Digital Equipment Corp. and Wang Laboratories, Inc.

Why do so many vendors depend on so few printer manufacturers? "The manufacturing of a line printer is

The accompanying survey offers information on line printers actively marketed in the U.S. Only those vendors manufacturing a line printer in its entirety are included. When applicable, speeds are given for 64-character type sets. Prices do not include interfaces except when noted, and generally do include controllers. IBM printers are listed on page 160.



Olivetti TH 240 *provides 24-lpm thermal printing for $800.*



Ubiquitous Teletype model 40 uses belt technology and is available in a mechanism-only version for OEMs.

Thermal printers are typically used in applications needing slow to moderate speeds, but recent developments have concentrated on increasing speeds and developing new print fonts.

a very difficult process," explains Bob Olson, peripherals product manager for Paradyne Corp., which sells its printers through OEMs. "The cost would be tremendous, and the returns wouldn't be that good." Because most users expect their line printers to be workhorses, vendors look to the reputation of manufacturers. Such manufacturers are also often able to provide a line of printers, easing problems in service and upgrading. Thus, many vendors who usually avoid mentioning the origins of OEM components are glad to credit the manufacture of their line printers to Dataproducts Corp., Teletype Corp., Printronix, Inc., and others.

Peripheral vendors, like system vendors, also typically stay away from manufacturing line printers. But because most system vendors depend on the same line-printer manufacturers, line-printer OEMs are in a good position to compete for end-user dollars. OEMs can offer similar printers at lower prices, usually with added interfaces or features. Many borrow only print mechanisms, adding all other hardware themselves. Value-added printer vendors include BDS Computer Corp., Digital Associates Corp., Southern Systems, Inc., and IEI.

Virtually all the companies that manufacture line printers have familiar names, and most have well-established product lines. The few newcomers to the list—Canon U.S.A., Inc., AM International and Delphax Systems, Inc.—offer printers using relatively unproven technologies: laser, magnetographic and ion deposition, respectively. Although Fujitsu America, Inc., and Hitachi America, Ltd., manufacture line printers that are marketed in the U.S., the Japanese vendors have not yet made a big push into the U.S. line-printer industry. That may change in the near future, says a marketing specialist close to Hitachi, who says the company may attempt to capture a larger share of the market a year from now.

A wide selection of printers

Although there are fewer than 75 families of line printers available, the selection spans a wide spectrum of speeds, prices and technologies.

The advent of laser printers has increased print speed, but few users require the 20,000-lpm throughput that this technology provides. Most line printers are in the 500- to 1000-lpm range, which is adequate for most minicomputer users. Abut a third of all line printers offer print speeds higher than 1000 lpm. Most of these are in the 1200- to 1500-lpm range, with a few printing at more than 2000 lpm, and 20 percent printing slower than 500 lpm.

Line-printer prices start at about $3000, and more than one-fifth are priced at less than $5000. (Single-unit prices are used when possible in this survey.) Most of the rest are priced at $5000 to $15,000, tapering off with increasing price. The median price of a line printer is $8000. A correlation between speed and price exists (Fig. 1), but it is not exact, because speed/price ratios vary for different technologies. Regardless of technology, however, users are getting greater throughput per dollar than ever.

Print technology is crucial in the printer industry, taking precedence over speed and price for many applications. Each technology offers distinct advantages and disadvantages, although various refinements have made many line printers more versatile. Familiar technologies are represented by available line printers, and a few new technologies are also provided.

Impact printers: still on top

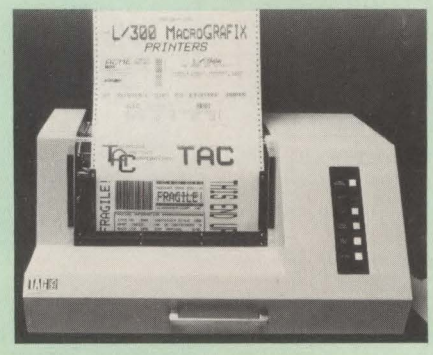
While the rest of the computer industry's technology seems to change almost weekly, impact line-printing technologies have remained fundamentally unchanged over the past several years. Popular for crisp, multicopy printing, impact line printers' recent refinements have increased reliability and flexibility.

Belt and band: Typically operating at 300- to 1200-lpm speeds, with prices ranging from $4000 to

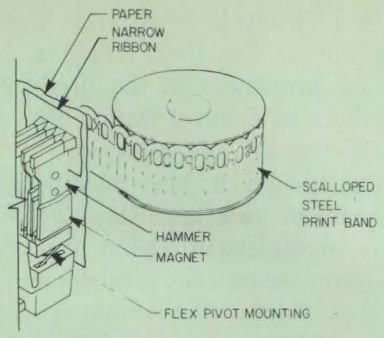
VALUE-ADDED VENDORS

The OEM line-printer industry is thriving, with more vendors repackaging line printers than making them. The degree of repackaging varies. Some vendors merely swap logos, while others, such as Digital Associates, BDS and Southern Systems, take printer mechanisms from manufacturers such as Printronix and Dataproducts, and add interfaces, controllers and cabinets.

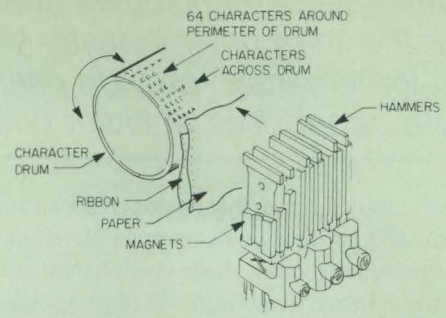
By adding the appropriate electronics, some vendors can direct printers



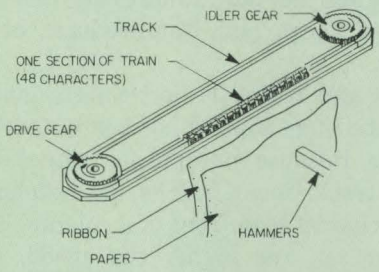
at markets different from those for which the printers were designed. Technical Analysis Corp., Atlanta, provides Printronix line matrix printers with extensive graphics capabilities—including vertical, extended-size and bar-code printing—for labeling applications. Taking a new approach to an old product, Spur Products, Los Angeles, Calif., has developed a controller for the IBM 1403, allowing it to run with minicomputers, including the IBM Series/1.



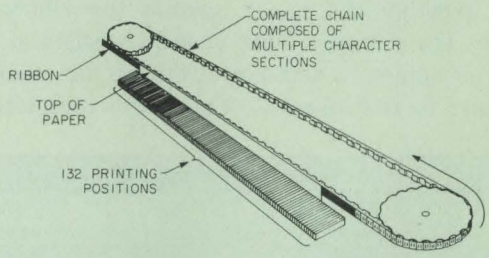
Belt and band printers *employ either of two horizontally rotating devices: a belt with character slugs or a steel or plastic band with embossed characters. As the character to be printed moves into position, a print hammer is actuated, impacting the paper against the ribbon and the character.*



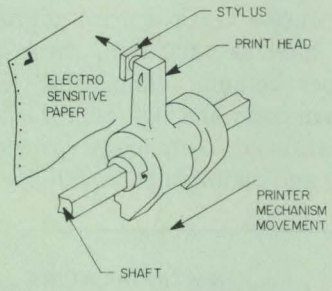
Drum printers *have a complete character set for each column in a line embossed on a cylindrical steel drum. The surfaces are rotated vertically, using bearings at each end. Images are transferred to the paper when hammers strike both the paper and the inked ribbon, which are sandwiched between the drum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

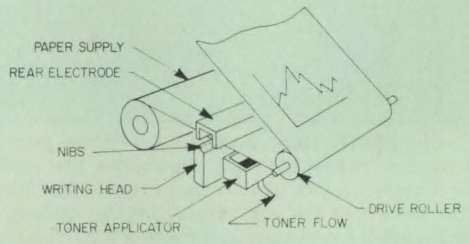


Train printers *have character slugs with embossed character images that are pushed along a horizontal track by a pair of gear drivers past hammers that strike the paper and inked ribbon. Multiple sets of characters are typically in the track; therefore, only a fraction of a revolution is required to set a character in front of a column. The smaller the character set, the faster the printer speed.*

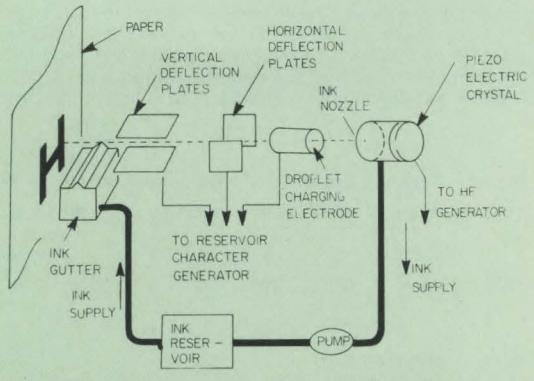


Chain printers *operate on a principle similar to that of train printers, with the following differences: slugs on a chain printer are linked together, do not slide in a track and are driven by a sprocket wheel rather than a drive gear. Chain and train technologies are often combined, producing a more precise vertical character alignment.*

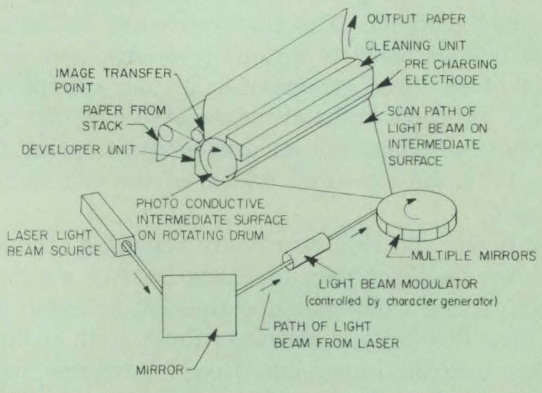




Electrostatic and electrographic printers *are high-speed, non-impact devices using a moving row or rows of styli to charge spots selectively on dielectric paper. Toner is attracted to the charged area and then fused to the paper to create a permanent image.*



Ink-jet printers *use electrostatic deflection plates to control a spray of electrically charged ink on ordinary paper. As many as 500 dots make up the ink-jet matrix, resulting in a close resemblance to solid character copy. A variety of fonts can be stored in additional ROM and switched in when desired.*



Photoelectrographic printers *are high-speed, non-impact devices using light from a photographic drum or belt, or laser beam, to create a latent image of charged dots. The image then captures a dry toner that is transferred to plain or specially coated paper.*

New non-impact technologies promise to do for the line-printer industry what μps did for terminals: provide users with more capabilities at lower cost.

$20,000, belt and band printers continue to enjoy the lion's share of the line-printer market. Unless non-impact devices overcome their drawbacks and make major advances into the medium- to high-speed market, belt and band printers are expected to continue this dominance over the next five years.

Belt and band printers use a horizontally rotating embossed steel band or plastic belt. As the character to be printed moves across the page, a print hammer is actuated at each place in the line where that character appears, striking the paper against the ribbon and character. The hammer bank usually consists of a full line of print hammers, but slower models use a half-line of hammers to reduce costs. Printing a complete line

COMPARING TECHNOLOGIES

	Impact character	Impact matrix	Non-impact (excluding laser)
Average price	$11,000	$6000	$6000
Average speed	750 lpm	300 lpm	900 lpm
1pm/$000	68	50	150
Advantages	• Crisp, fully formed characters • Multipart forms	• Inexpensive • Font flexibility • Graphics • Multipart forms • Easily maintained	• Fast • Inexpensive (electro/thermal) • Quiet • Font flexibility • Graphics
Disadvantages	• Noisy • Requires more maintenance • Little font flexibility	• Noisy • Relatively slow • Characters not fully formed	• Requires special paper • No multipart forms • Characters not fully formed

Trade-offs in line-printer technologies. *Non-impact printers offer fast printing for the money but have drawbacks that make them unacceptable for some applications. Laser printers (not included in this chart) are extremely fast but very expensive. Among impact devices, matrix printers are slower, with lower quality characters, but they provide font and graphics flexibility.*

occurs while a full group of print characters passes by each print hammer. The characters can be arranged on the belt or band in various positions, such as two groups of 96, three groups of 64 or four groups of 48. Because the belt or band moves at a constant speed regardless of character-set arrangement, print speed varies with the size (font width) of the character set employed.

Belt/bands and ribbons require replacing, and reliability can be a problem for these mostly mechanical devices. Aside from changing the belt or band, users have little flexibility in character fonts, with all but the simplest graphics impossible. Recent advances, however, have improved ease of operation and reliability. Quietized cabinets have become standard, minimizing relatively higher decibel levels that characterize impact printers, new ribbons have a life of 2 million lines, and mechanical parts have been minimized to enhance reliability. Belt and band printers provide low-cost, high-quality output at relatively high speeds with multipart forms. For these reasons, belt and band printers are prominent in the product lines of such major vendors as Control Data Corp., Dataproducts, General Electric Co. and Teletype.

Drum: Although a few manufacturers are still producing drum printers, this technology appears headed for obsolescence. Drum printers have a complete character set for each print column embossed on a cylindrical steel drum that is rotated vertically before a line of rear-striking hammers. Although drum printers can print at speeds as high as 1250 lpm (in the case of Dataproducts' 2470), precision is necessary to maintain high-quality print. The hammers require frequent adjustment, and drums may need replacement. Old technologies die hard, however, and Decision Data Computer Corp. and Dataproducts both offer drum printers.

Chain and train: Train printers push unconnected characters slugs along a horizontal track past a row of hammers. Because multiple characters sets are typically in the track, only a fraction of a revolution is required to set a character in front of a column. The smaller the character set, the higher the speed. Chain printers differ from train printers in that the slugs are linked together, do not slide in a track and are driven by a sprocket wheel rather than a drive gear.

Some manufacturers offer variations on the basic technology. Data Printer Corp.'s ChainTrain uses 8 eight-character links pulled around a monorail providing more precise vertical print alignment. With print speeds as high as 1200 lpm, these printers use one hammer per column, eliminating hammer-shuttling. Fusing chain/train and belt/band techniques, Dataproducts' Charaband technology provides high speeds (1500 lpm) and claims high reliability. The Charaband

IBM LINE PRINTERS

IBM sells line printers only to end users with IBM or IBM plug-compatible systems. Like IBM's other products, their line printers are generally highly rated in performance and reliability, but prices are steep. The company's line printers span the range of impact technologies from chain printers (the 1403) to matrix printers (the 5225). The 3800 laser printer has reportedly overcome many down-time problems, but carries a price tag restricting it to extremely short-demand, high-volume applications.

Model	Type	Speed	Columns	Max. Forms Width	Price
1403	chain	340 to 600	120/132	15 in.	$ 18,760 to $ 38,140
3203	train	600 to 1200	132	20 in.	$ 27,360 to $ 38,320
3211	train	2000	132		$ 50,900
3262	belt	650	132	16 in.	$ 14,000
3289	belt	400	132	15 in.	$ 8,900
3800	laser	20,000	132/204	14.8 in.	$358,800
5225	matrix	195 to 560	132/198	14.8 in.	$ 16,350

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Data Printer Corp.'s ChainTrain uses eight eight-character links pulled around a monorail, providing more precise vertical print alignment.

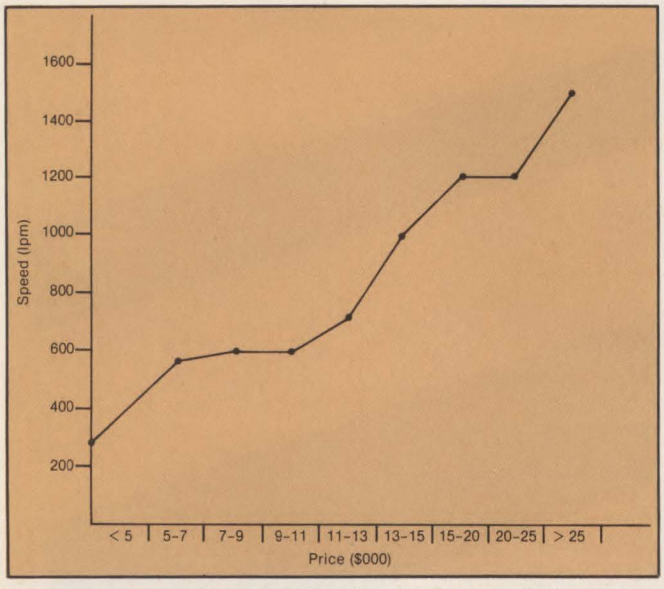
print drive features character slugs individually attached to a reinforced polyurethane band that rides on a roller-bearing roadbed.

CDC's 9372-3, International Business Machine Corp.'s 3211 and Telex Computer Products, Inc.'s model 7211 train printers achieve 2000-lpm speeds and are competitively priced. Overall reliability is good, although hammer adjustment and track wear can be problems.

Matrix: For applications requiring medium-speed, and heavy-duty printers that can accommodate numerous character sets and quality graphics, line-matrix printers offer an alternative to band/belt, drum and chain/train printers. Impact matrix line printers print a line of dots at a time. In Printronix printers, 44 hammers shuttle across three character-positions to form a 9 × 7 overlapping dot matrix, while the paper is moved up one vertical dot-row. Tally Corp.'s T-3000 series line printers use a single-piece oscillating print comb with 132 hammers, while Hewlett-Packard Co.'s 2608A uses 11 12-toothed comb segments. A voice coil rather than more common stepper motors controls paper-advance in the 2608A.

Impact matrix line-printer speeds range from 125 lpm (Tally's T-2000) to 560 lpm (IBM's 5225), and from $3620 (Okidata Corp.'s Slimline) to $10,400 (H-P's 2608). Applications with modest speed requirements can often find better price/performance with matrix serial printers. Their relatively low cost results from eliminating character-carrying devices such as drums and trains. Thus simplified and more electronically based, matrix printers not only cost less, but maintain greater reliability. Matrix printers can also provide graphs, pictures, bar codes and expanded character sets with special or larger fonts. Other claims include the elimination of smeared letters, misalignment resulting from font movement during hammer impact and quieter operation.

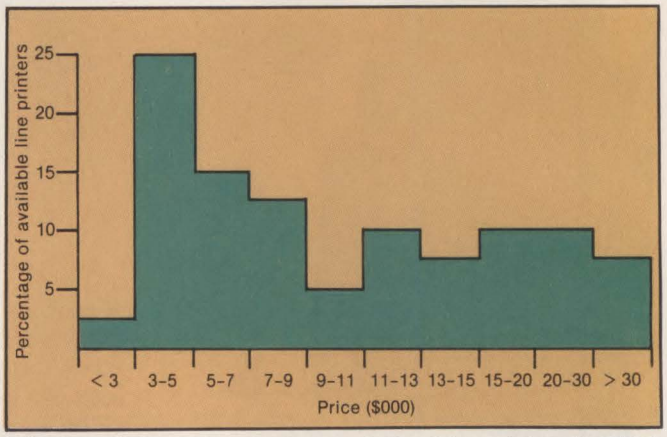
As the need for printers serving business and special applications increases, and the cost of integrated electronics decreases, impact matrix line printers will probably increase in popularity.



Speed increases directly with price for impact character line printers. *Speed/price characteristics for matrix printers (not included in the graph) vary widely with technologies and vendors.*

Non-impact printers: the new technologies

With the demand for business applications involving multipart forms, the major drawback to non-impact devices is their inability to produce these forms. Manufacturers of non-impact printers counter this argument by pointing out that their printers can duplicate a print page as often as needed from memory, and that the last copy will be as good as the first. However, with heavy work loads, a user may not be able to monopolize the CPU's time for this task.



Price/population chart shows popularity of line printers in $5000 range. *Less popular is the $10,000 range, separating many 500-lpm printers from 1000+-lpm printers. Few line printers sell for less than $4000, while the more-than-$30,000 range is the territory of high-speed laser printers. Figures do not include IBM printers, which are sold directly to end users.*

Non-impact printers are quiet and can print as fast as 45,000 lpm. The fastest non-impact line printers are expensive, however, and may require special paper.

Electrostatic and thermal: Electrostatic printers are high-speed devices that use moving rows of styluses to charge spots selectively on dielectric paper. Toner is attracted to the charged areas and fused to the paper to create a permanent image. Houston Instruments' 8200 series of printers uses a double row of styluses to form a 7 × 9 dot matrix.

Thermal printers form characters by selectively pulsing elements of the dot matrix on heat-sensitive paper. The print heads are made from either high-resistance material, such as tin oxide, or a semiconductor. As the thermal print head moves across the specially coated paper, wires in the head are selectively heated, producing the dot matrix. The Olivetti Corp. TH 240 thermal printer, at $800, prints at 240 lpm with

The important plus in matrix printers:

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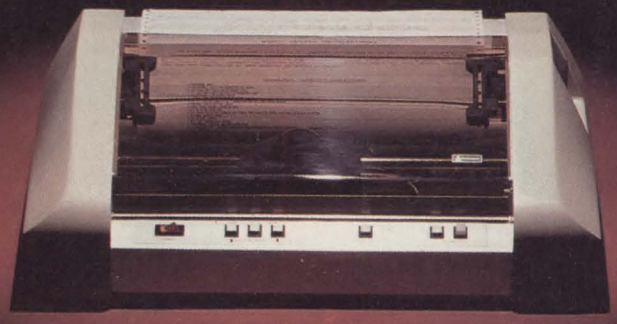

Since their introduction in mid-1980, the Anadex high-resolution DP-9500 Series matrix printers have set new standards for printer quality and performance. All models feature the rugged Anadex 9-wire print head that combines long life with resolutions of 72 dots/inch vertical and up to 75 dots/inch horizontal. With this kind of resolution, fineline graphics (under data source control) and razor sharp characters are pluses built into every printer.

Performance Plus

The full standard ASCII 96 character set, with descenders and underlining of all upper and lower case letters, is printed bi-directionally, with up to 5 crisp copies, at speeds up to 200 CPS. Models DP-9500 and DP-9501 offer 132/158/176 and 132/165/198/220 columns respectively. Print densities are switch- or data-source selectable from 10 to 16.7 characters/inch. All characters can be printed double-width under communications command.

Interface Plus

Standard in all models are the three ASCII compatible interfaces (Parallel, RS-232-C, and Current Loop). Also standard is a sophisticated communications interface to control Vertical Spacing, Form Length and Width, Skip-Over Perforation, Auto Line Feed, X-On/Off, and full point-to-point communications.

Features Plus

As standard, each model features forms width adjustment from 1.75 to 15.6 inches, shortest-distance sensing, full self-test, 700 character FIFO buffer (with an additional 2048 characters, optional), and a quick-change, 6 million character life ribbon.

Quality Plus

Beyond the built-in performance of the grafixPLUS series printers, the engineered-in quality and support are equally important. The result? Approval of both UL and FCC, Class A; operating noise levels under 65dbA; and a nationwide service organization second to none.

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CIRCLE NO. 74 ON INQUIRY CARD

Even if reliability improves, the more-than-$100,000 price of major laser printers will continue to limit acceptance.

80-character columns. H-P's 9876 thermal graphics printer plots and produces copy at 400 lpm with an 80-character column.

Thermal printers are typically used in applications needing slow to moderate speeds, but recent developments have concentrated on increasing speeds and developing new print fonts. As speeds increase and smaller dot sizes allow better print quality, thermal printers will be suitable for a wider variety of applications.

The advantages of both electrostatic and thermal printers are quiet operation, low purchase and maintenance prices and the absence of moving parts and messy ribbons.

Ink jet: These printers use electrostatic deflection plates to control a spray of electrically charged ink on regular paper. As many as 500 dots comprise the ink-jet matrix, resulting in a close resemblance to solid-character copy. Mead Digital Systems' Dijit printer sprays ink onto a moving web of paper. A variety of fonts can be stored in additional ROM and switched in, and a user can change type size or line spacing with a line of text. The Dijit prints at extremely high speed—800 ft. per min.

In addition to speed, ink-jet printers offer high resolution, multiple fonts and graphics. They are, however, relatively expensive.

Ion deposition: Introduced in May, Delphax's 2460 image output module is an innovation in line-printing technology. The 2460, a print engine selling for $8000 in OEM quantities of 500, is intended as the base component of a system. The base unit includes the print mechanism, the ion-dot control electronics, an 8-bit (plus parity) parallel-data interface and a power supply. The company claims that a printer using the 2460 mechanism can sell for one-half the price of competitive models. At 60 pages per min., the 2460 competes with printers using laser-xerography techniques and, because of the higher electronics content of the 2460, can

Line Printers

Manufacturer	Model	Type	Speed (lpm)	Columns	Maximum forms width (in.)	Price	Comments
AM International	PXL-6	magneto-graphic	300	132	8.5	OEM quantity 1000: $5000	Serial or parallel interfaces. End-user prices $12,000 to $15,000
Burroughs Corp.	B9247-15	train	1500	132	17.8	44,000	Includes controller, interface, powered forms stacker
	B9246-3 B9246-6	band	300, 600	132	17.8	$11,000, $14,000	Includes controller and interface
Canon USA	LBP-10	laser	600	132	10.3	$11,000	OEM quantity 100: $7500. Self-diagnostics. 10 letter-size pages per min.
Centronics Data Computer Corp.	6080, 6081	band	600	132 (136 opt.)	17	$8525	LP series compatible with PDP-11, LSI-11, DG Nova or Eclipse, IBM Series 1
Control Data Corp.	9372-3	train	2000	132 (136, 184 opt.)	16.8	$38,000	IBM 3211 plug-compatible. Includes controller and interface
	9383, 9386, 9389	band	300, 600, 900	132 (136, 184 opt.)	16.8	$5665, $7625, $11,415	Centronics and RS232 interfaces. Optional 48, 96, 128 character bands are operator-changeable
	9380-12	band	1200	132 (136, 184 opt.)	16.8	$13,640	Optional 48, 96 and 128 character bands are operator-changeable
Data General Corp.	4215, 4216	drum	600 (with 64-character set) 436 (with 96-character set)	136	16.75	$20,000, $22,000	Includes controller and interface
	4244, 4245	drum	900 (with 64-character set) 660 (with 96-character set)	136	16.75	$28,560, $30,240	Includes controller and interface
	432X Series	band	300	132	16.0	$10,450 to $12,430	64 or 96 (opt.) character sets. Programmed I/O controller (opt.); date channel controller (opt.)

Delphax's 2460 replaces the laser, scan mirror and laser modulator used in xerographic systems with a digitally controlled ion-projection device that lays charged image dots directly onto the surface of a dielectric-coated drum.

claim higher reliability and greater cost-effectiveness.

The 2460 replaces the laser, scan mirror and laser modulator used in xerographic systems with a digitally controlled ion-projection device that lays charged image dots directly onto the surface of a dielectric-coated drum. The ion-projection device is an XY intersection of crossed conductors separated by mica insulators. When a burst of high-frequency AC is applied to one of these intersections, the mica dielectric breaks down and ionizes the air at that point. Once the intersection, or "ion pool," is energized, the ions are stripped from the pool, focused and projected through holes in a plate backing the XY intersection onto the dielectric surface of the drum. Toner is attracted to the negatively charged ion dots and is transferred to the paper by a pressure roller at a resolution of 240 × 240 dpi. Heat is not required.

Delphax claims that in addition to halving the initial cost, the 2460 allows users to operate the system at one-fourth the cost of competitive systems. Cost of ownership is rated at 1.5¢ per page based on monthly print volumes of 100,000 pages or more.

Systems integrators have shown much interest in the new print mechanism, the major reservations being those that greets any newcomer: incorporating many new and untested aspects and the viability of the mechanism from a manufacturing standpoint.

Magnetographic: The only line printer on the market using magnetographic or magnetic imaging, technology is AM International's PXL-6, introduced in September by the company's Printer Systems Division. Both General Electric and Honeywell are also said to be planning high-speed printers using this technique, with completion expected in 1982.

The PXL-6 prints 6 ppm, or roughly 300 lpm. AMI plans to market the printer only to OEMs per page

Line Printers

Manufacturer	Model	Type	Speed (lpm)	Columns	Maximum forms width (in.)	Price	Comments
Data General Corp.	435X Series	impact matrix	300	132	16	$6300 to $7000	With serial, programmed or date channel controllers. For DG Nova and Eclipse systems
Data Printer Corp.	1260-64, 1200-64	chain-train	600, 1200	132 (136 opt.)	19.5	$11,485, $22,515	$7635 in quantity 100. Price with controller and interface is $12,680
	3121, 3600	band	600, 1200	132 (136 opt.)	17.5	$7050, $14,975	$4750 in quantity 100. Price with controller and interface is $8250
Dataproducts Corp.	BP1500, BP1800	band	1500, 1800	132 (136 opt.)	18.75	$17,500 $18,700 (OEM single-unit quantities)	Print density control, paper puller, adjustable forms thickness. Includes DP parallel interface
	B300, B600, B900	band	300, 600, 900	132 (136 opt.)	16	$5000, $6650, $9800	Operator-changeable print band. Optional RS232 and Centronics interfaces
	2260, 2290	drum	600, 900	136	16.7	$9980, $13,000	Acoustic dampening hood. Interfaces with entire line of DP printers
	2470	drum	1250	132 (136 opt.)	19	$23,670	Modular design allows OEM to select only those parts needed
	Charaband 2550	band	1500 (with 48-character set)	132 (136 opt.)	18.7	$26,760	Charaband is operator-changeable
Decision Data Computer Corp.	6665, 6680, 6610	drum	650, 800, 1000	132	16.4	from $16,000, $18,500, $22,800	Includes controllers and interface. Compatible with IBM Series/1: Sys /34,/38; 4300; 3030; 3; 360/370. Also DEC, DG and H-P systems
Delphax Systems	2460	ion deposition	2400	132	N.A.	$8000 (OEM quantities)	Print mechanism with parallel interface and power supply.
Fujitsu America Inc.	M3030, M3021	band	370, 670	136	17	$4800, $5800 (OEM quantities)	Includes DP interface, off-line self-test diagnostics and fault indicators
General Electric Co.	Terminal 310, 340	belt	425	132	15	$3895, $3860	Multi-interface capabilities. Optional front load, low-paper sensor and forms basket

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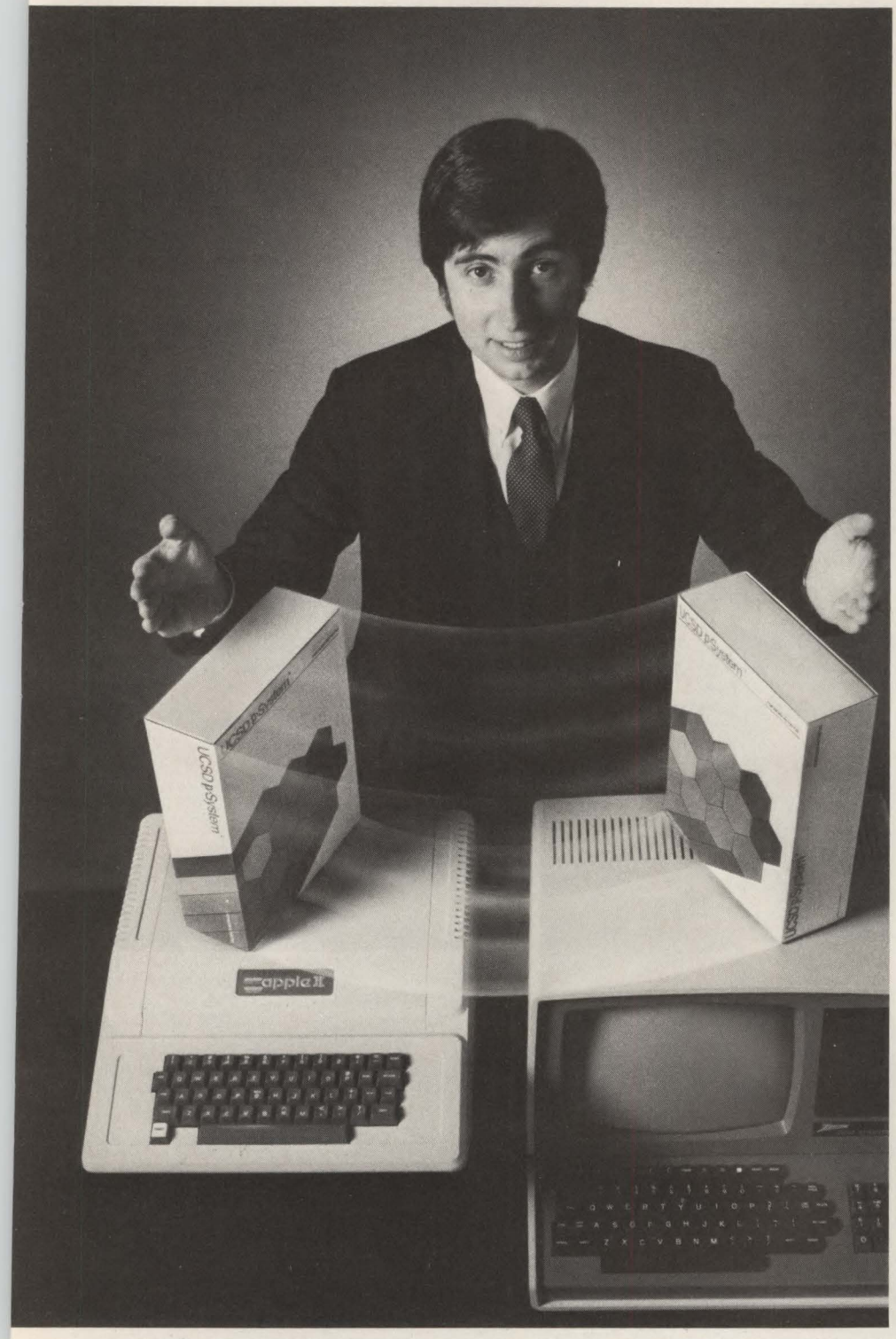

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CIRCLE NO. 75 ON INQUIRY CARD

Applications with modest speed requirements can often find better price/performance with matrix serial printers.

maintenance and supply costs are estimated at 2¢ or 3¢.

The magnetic-imaging system, based on a technology licensed from Cubic Western Data, uses a continuous magnetic tape to transfer two lines of print to paper at a time. Transfer is effected by copier-toning techniques. The PXL-6 has as many as four cartridge ROM-loaded fonts on-line simultaneously, and will be available with approximately 50 type styles. The printer produces graphics, including logos and letterhead. It is aimed at builders of shared-resource and processing systems and multifunction word- and data-processing systems.

Laser: Laser printers use a beam of light to create latent dot images on the surface of a photographic drum or belt. These images are then transferred to plain or specially coated paper by means of a dry toner.

Despite the attention that laser printing has received in the past few years, only a small number of laser printers are available, and most of these have limited applications.

"The major deterrent to laser printers has been reliability," says H-P's Bob McCaleb, adding that this problem has set the laser-printing industry back several years. IBM's 3800 and Xerox's 9700 laser printers have been haunted with reports of long and frequent down times, but many problems seem to be solved. "It's a brand new technology," points out Keith Davidson, manager of advertising and customer relations at Xerox Corp. "We all had to learn to use it, including customers."

H-P and Siemens Corp. offer "second-generation" laser printers, which are less expensive, more compact and, say manufacturers, more reliable than IBM and Xerox printers were when they were introduced. H-P claims a 100,000-page MTBF, while DatagraphiX, Inc., which offers a printer based on Siemens's ND-2 laser device, says up-time for laser printers has increased markedly.

Line Printers

Manufacturer	Model	Type	Speed (lpm)	Columns	Maximum forms width (in.)	Price	Comments
Hewlett-Packard Co.	2680	laser	3000	132 (136 opt.)	12.7	$121,000	User-defined character sets. 180-dpi resolution. Self-diagnostics
	2608	input matrix	400	132	16.1	$10,400	Parallel interface, comb hammerbank, full graphics capability
	9876A	thermal	480	80	8.5	$4725	77-dpi resolution, graphics capability, HPIB standard interface, optional RS232
Hitachi	FP1250	band	1250	132	17	$12,000	Manufactured by Hitachi Koki, marketed in U.S. by Nessei Sangyo America
Houston Instrument	8200 Series	electro-static	1000-2400	80/132	8.5-14.7	$2950 to $3750	192-character font. Katakana and Cyrillic optional
Mannesmann Tally	T-3300	matrix	300	132	15.8	$5495	RS232 interface available
Mead Digital Systems	2700 Dijit	ink jet	800 ft. per min.	variable	18	$550,000	400 font styles. Dual tape drive optional
NEC	Trimliner	band	300/600	132	18	$4800, $6920	Quick-change print band. RS232 interface optional
Okidata	Slimline Series	matrix	125-300	132	16	$3620 to $5380	12 program-selectable fonts. Graphics optional
Olivetti	H 240	thermal	240	80	8.75	$800	Printer/plotter version available
Potter Instrument	LP6351	matrix	500	132	16.7	$9000	Includes controller and interface
Printronix	P-150/300/600	matrix	150/ 300/600	132	16	$5480 to $8680	DG, DEC controllers and RS232 interface optional
Storage Technology Corp.	1200, 1800	band	1200, 1800	132	18.8	$32,900, $68,200	Acoustical hood holds noise level to 74 dbs
	2250, 2600, 3000	band	2250, 2600, 3000	132 (150 opt.)	18.8	$80,350, $87,130, $94,700	Includes controller and interface
	4303/15	band	1500	132	18.75	$38,320	Fully automated power stacker, off-line diagnostics, interchangeable 432-character print band
Teletype	Model 40	belt	300	80/132	15	$2317	Available in forms tractor and friction feed models, with or without cabinet
Xerox	9700	laser	18000	variable	8.5	$380,000 (typical)	300 x 300 dot/in. resolution. Stores 12 128-character fonts

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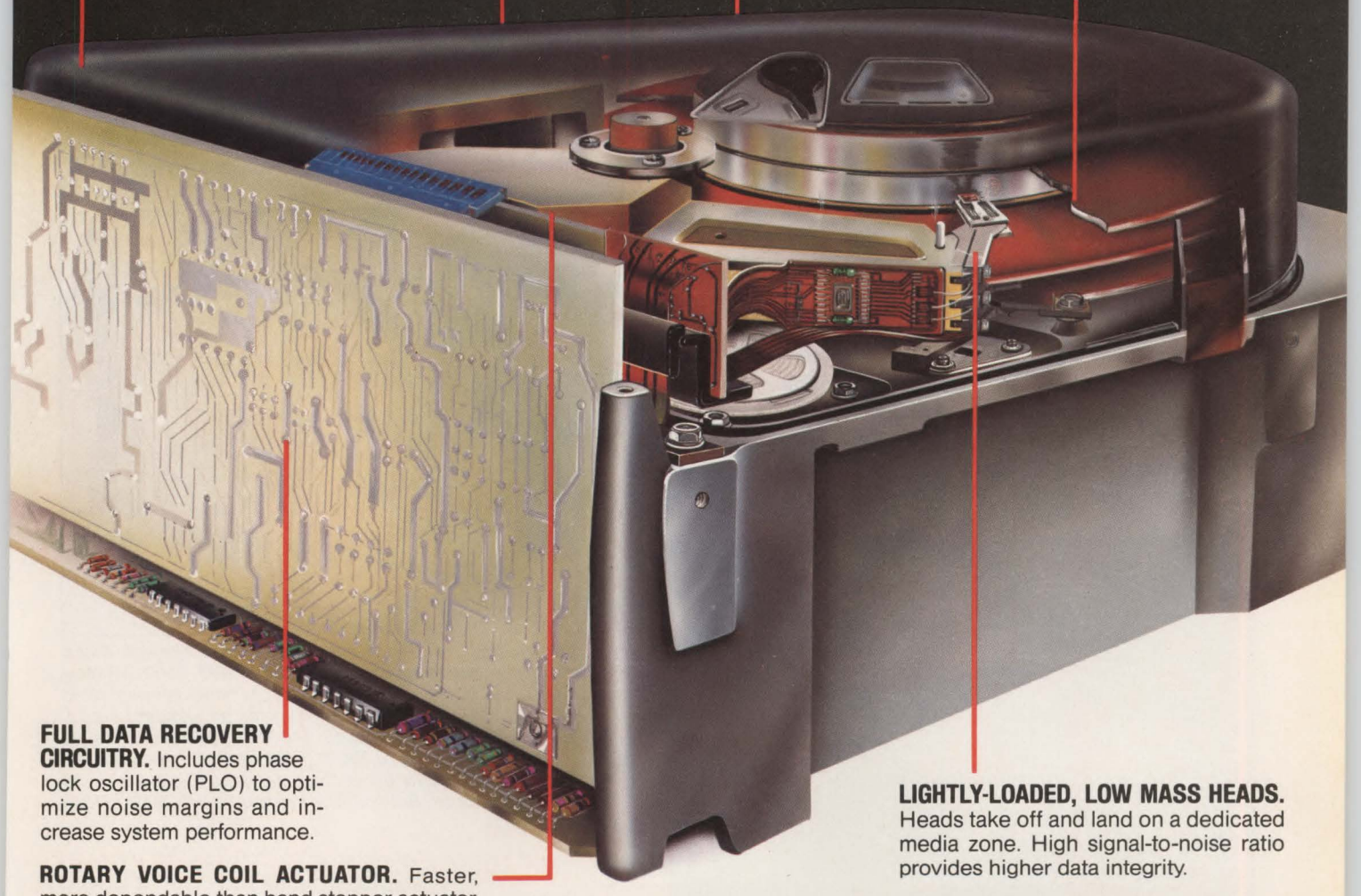

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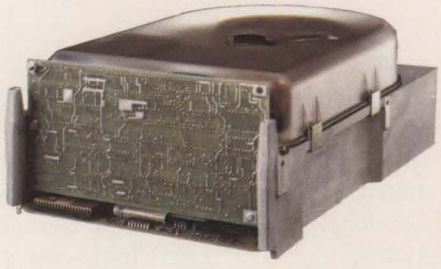

CONTROL DATA

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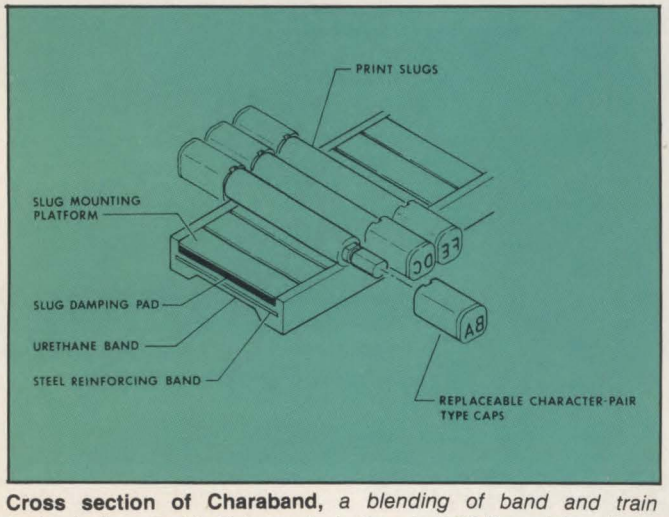
CIRCLE NO. 180 ON INQUIRY CARD

Although there are fewer than 75 families of line printers available, the selection spans a wide spectrum of speeds, prices and technologies.

Even if reliability improves, the more-than-$100,000 price of major laser printers will continue to limit acceptance. Lower price, even at a sacrifice of speed, may be the goal of the next generation of laser printers. Canon U.S.A. offers a 600-lpm, $11,000 laser printer, but many users find its price/performance unacceptable.

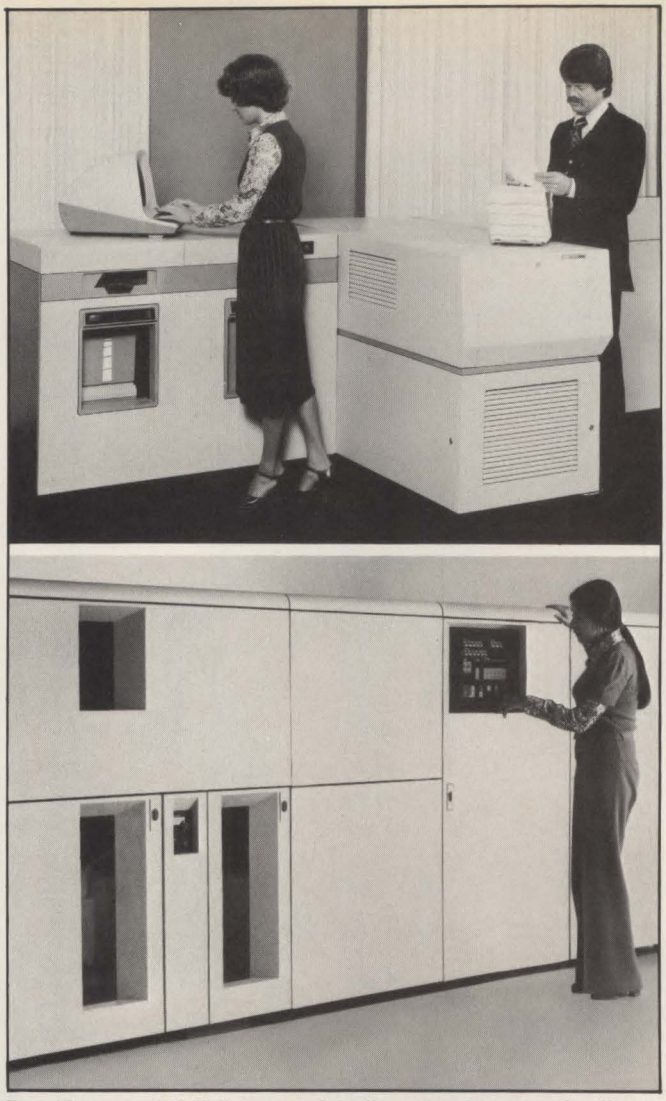
The future

New non-impact technologies promise to do for the line-printer industry what μps did for terminals: provide users with more capabilities at lower cost. Laser, ion and magnetographic printers are potentially more reliable than impact printers, because the former use fewer mechanical parts and offer high-speed printing at lower costs. How long before someone announces a high-speed, highly reliable laser printer selling for less than $10,000? Almost every major vendor in the computer industry claims to have such a printer under development, but few predict its shipment before the mid- to late-1980s.



Cross section of Charaband, *a blending of band and train technologies, used in Data products Corp.'s 2550 line printer, shows ease with which type caps can be replaced for special fonts or maintenance.*

Sooner or later, a manufacturer will introduce a revolutionary printer and make it look easy. Then, other companies will be tempted to try their hands at the line-printer industry, offering refinements and reduced prices. Traditional line printers might become obsolete, very inexpensive or very specialized, such as those requiring multipart forms or fully formed character printing. But NEC OEM marketing director Bruce Thatcher cautions against disregarding any technology,



Two "heavyweight" "super printer" contenders are the Xerox 9700 "electronic printshop" (top) and the IBM 3800 printing subsystem. *The 9700 simultaneously produces computer-generated text, business forms and a variety of graphics on standard 8½- × 11-in. plain paper at 2 pages per sec. The 3800 operates as fast as 13,360 lpm to produce about 10,000 11-in. sheets of printed paper an hour. It accommodates a variety of character sizes and styles on 50 sizes of continuous forms. Both printers use low-power lasers to form character images.*

even if low-cost laser printing becomes a reality. "This is a cyclical business," he explains. "When everyone thought the magnetic-tape market would die, along came Winchester backup."

For now, the industry can live comfortably with the selection of line printers. Improved reliability and price/performance have enabled the printers, especially band- and line-matrix printers to meet the needs of most users. The non-impact revolution is approaching, but this crop of line printers is unlikely to become obsolete in the near future. ■

David Freedman is editor of *The Computer Review,* published by GML Corp., Lexington, Mass., and technical director of GML's on-line database of computer hardware information. David Simpson is editor of GML's *Computer Peripherals Review.*

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CIRCLE NO. 78 ON INQUIRY CARD

Teleprinter industry consolidation goes virtually unnoticed

PATRICK KENEALY, Associate Editor

Consistent sales and glamorous entries mask ominous industry rumblings

For years, the teleprinter industry has lived in the shadow of the more exciting CRT-terminal industry. While 1981 display-terminal sales reached $1.5 billion, the year's teleprinter sales totaled only $200 million to $300 million. More than 1.5 million teleprinters are installed worldwide, while the much newer display terminals have an installed base of roughly 3 million units. Teleprinter market research is correspondingly less plentiful and exact than CRT research, but GML Corp., a Lexington, Mass., research firm, has information pointing to a serious shakeout in the teleprinter industry.

GML's data on the products and firms that define the teleprinter industry are as instructive as the more usual data on the buyers and the cash flows that define the teleprinter market. Industry developments follow user preferences but dictate buyer choices, so a shakeout is of immediate concern to current and future buyers alike. To explain this very real shakeout, one must examine historical teleprinter prices and the technologies that make those prices possible.

A formerly stable past

The teleprinter industry has been a stable one. The number of models offered to end users and system integrators grew steadily from 1970 to 1977 at an average annual rate of 35 percent (Fig. 1). As competition between manufacturers intensified, teleprinter prices fell from an average of more than $4800 in 1971 to more than $4000 in 1977. This seemingly gradual price decline proved too difficult for many manufacturers to sustain, and in 1978, six fewer teleprinters were available than in the previous year. Encouraged by better economic times in 1979 and 1980, manufacturers introduced more models than they discontinued and brought the total number of teleprinters on the market to nearly 300 by December, 1980.

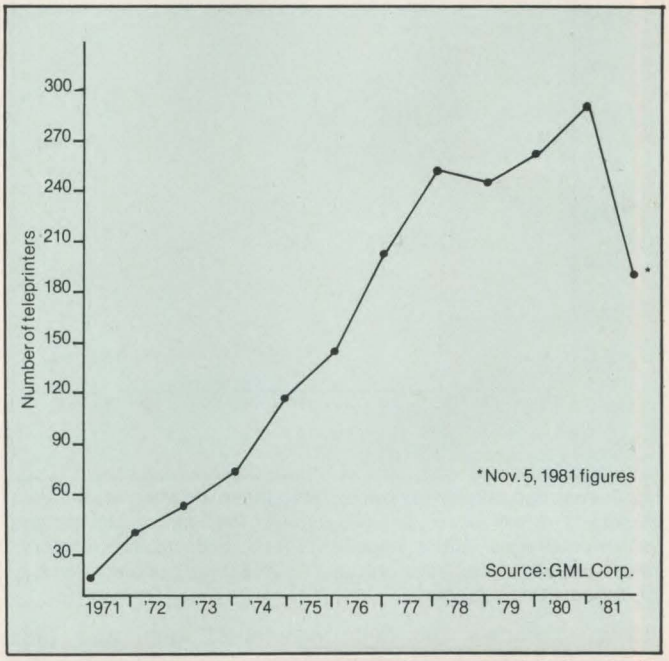


Fig. 1. The number of teleprinters on the market fell drastically during 1981. *Sales in the $250-million-per-year market remained stable, but user choices were severely restricted as dozens of manufacturers cleaned house.*

In 1981, more than a dozen new models were introduced, but manufacturers discontinued more than 100 models, and the number of models on the market fell 37 percent—from 292 to 185 by November. Industry analysts report low but stable sales for 1981, but user choices are severely curtailed.

Prices stay homogeneous

Increased competition and new technology, especially in keyboards, casings and matrix print heads have steadily lowered average teleprinter prices over the past decade. Cost-cutting innovations have been less dramatic in the past few years, and prices have fallen

The number of teleprinter models offered for sale to end users and systems integrators grew steadily from 1970 to 1977 at an average annual rate of 35 percent.

more than 1 percent per year compared to an average annual drop of 3 percent from 1971 to 1977 (Fig. 2). This year's average teleprinter price of $3881 was only slightly lower than last year's average of $3908, but the difference between past and current price distributions gives a better picture of teleprinter pricing trends.

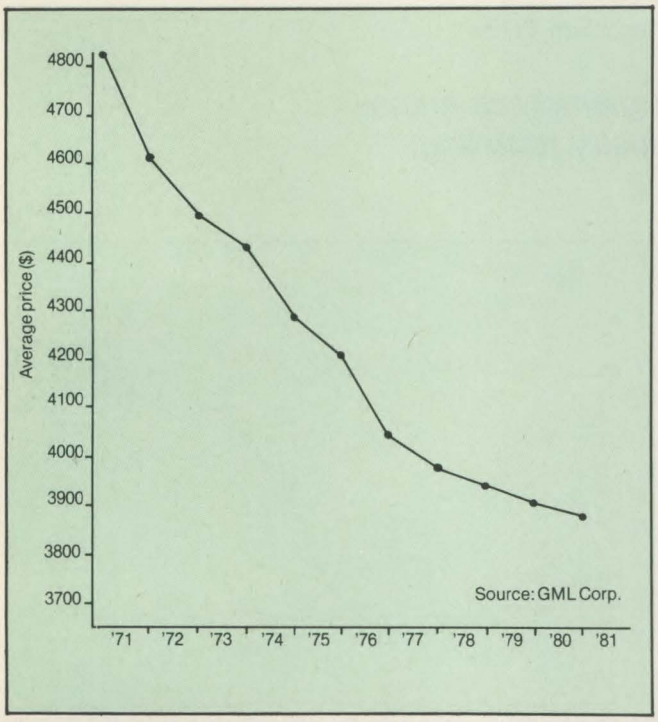
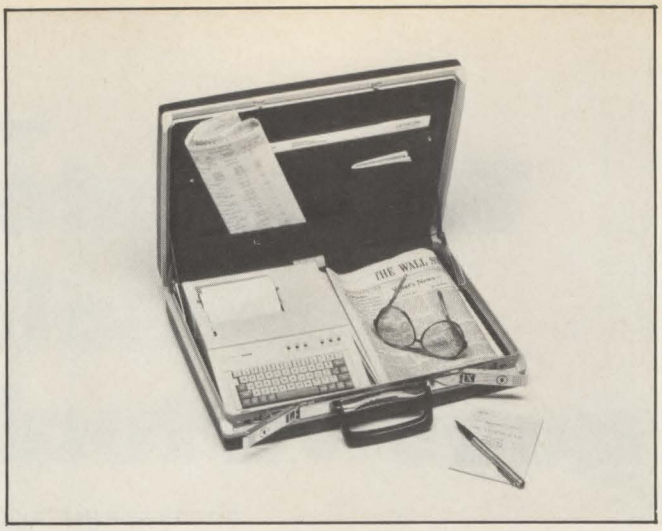


Fig. 2. Average teleprinter prices have fallen slowly over the past decade *to reflect less expensive circuits, keyboards, casings and print mechanisms. Major innovations have been scarce in recent years, and unit prices have dropped by less than 1 percent annually for the past three years.*

Fig. 3 shows the distributions of 1980 and 1981 teleprinter prices. The two spreads are similar, but the 1981 distribution is skewed to the left, lower than the 1980 distribution, reflecting the emphasis manufacturers place on low-end models. Last year marked the first time that more than half of the teleprinters on the market sold for less than $3000 each. Teleprinter prices remain higher than similarly intelligent CRT terminals and lower than CRT/serial-printer combinations, and cost cutting innovations have been scarce in recent years. As in the CRT industry, though, manufacturers add features and sell price/performance when they can no longer sell price alone. While recent technology has done little to cut unit prices, it has done much to enhance local capability.

Technologies diverge

Teleprinters are distinguished technologically by



Portable teleprinters have given way to very portable teleprinters *such as the Lexicon LEX-21 and the Quint Systems KSR-743. The Lexicon unit includes a telephone hookup and prints 40 columns while occupying the same desk space as a sheet of notebook paper. The Quint Systems unit prints full 80-character lines but doesn't fit in a briefcase.*

printing method, speed, size and local intelligence (Fig. 4). They are still fairly evenly divided between matrix and solid-font mechanisms, but the trend is toward matrix methods. Matrix printers offer high speed-to-price ratios, while solid-font printers produce high-quality copy at relatively low speeds.

The cost and size of high-speed, solid-font print mechanisms, like those made for low-end line printers, make them impractical for incorporation into teleprinters, and virtually all solid font-teleprinters use daisy-wheel mechanisms and operate at 65 cps or slower.

Progress in matrix-printer design, on the other hand, has been rapid. Multi-pass and high-density print heads have improved the legibility of matrix-printer output at the expense of speed-to-price ratios. Eighty percent of all teleprinters use impact-print mechanisms, popular for legibility and for their multi-copy and plain-paper capabilities.

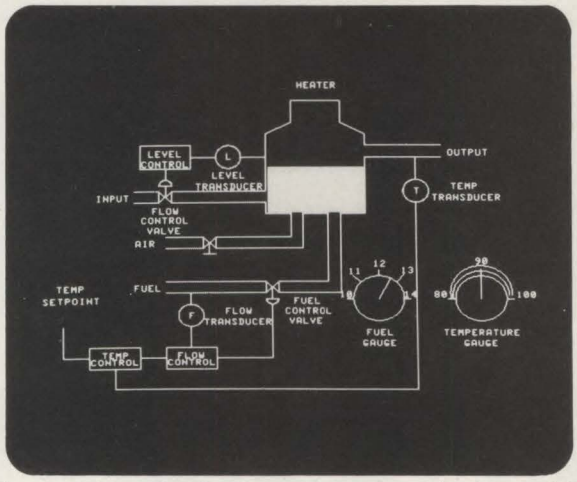
All solid-font teleprinters and 69 percent of all matrix teleprinters are impact devices. Non-impact thermal, electrostatic and ink-jet teleprinters all use matrix

There's already $50 million in software behind the HP 1000 L-Series microsystem.

What we just added makes it look even better.

Low-cost, high-performance graphics.

At only $10,800, Hewlett-Packard's Model 5 microsystem now includes an integrated HP 2623 graphics terminal (with built-in graphics printer) and our powerful Graphics/1000-II software. So you can picture your more demanding applications without the expense of add-on graphics.



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Graphics/1000-II uses straightforward, high-level graphics commands that let you concentrate on getting to the solution—without writing time-consuming subroutines. And, the device-independent software allows you to develop your applications without worrying about which peripherals will be used. This reduces development time *and* maintenance costs.

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To get the complete picture on this new graphics microsystem, contact your local HP sales office listed in the White Pages. We'll be glad to arrange a hands-on demonstration. Or, write for more information to Hewlett-Packard, Attn: Joe Schoendorf, Dept. 08117, 11000 Wolfe Rd., Cupertino, CA 95014.

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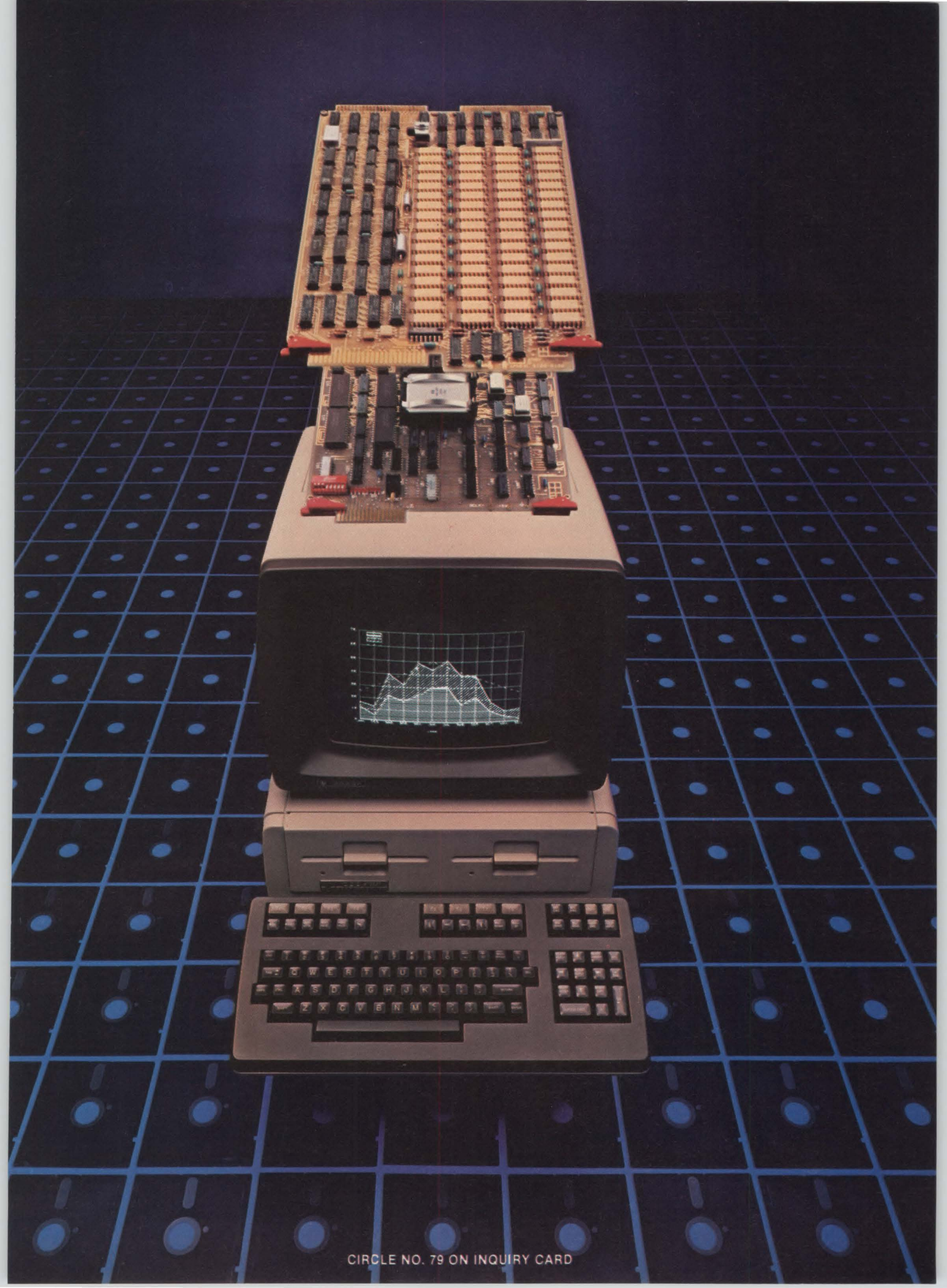

CIRCLE NO. 79 ON INQUIRY CARD

Teleprinter speed is closely related to printer technology and, after price and printing method, is the most important distinguishing teleprinter characteristic.

mechanisms to offer quiet, medium-speed printing at moderate prices. Thermal and electrostatic printers require no ribbons and are less mechanical than impact matrix printers (hence more reliable) but suffer from single-copy and special-paper limitations. Thermal printing is the most popular non-impact printing technology and is used in 18 percent of all teleprinters. Ink-jet print mechanisms offer fast, absolutely silent, near letter-quality printing but are expensive and need ink cartridges just as impact printers need ribbons. Although half a dozen serial printer vendors offer ink-jet printers, the 270-cps Siemens PT80I is the only widely used ink-jet teleprinter.

Speeds slacken

Teleprinter speed is related closely to printer technology and, after price and printing method, is the most important distinguishing teleprinter characteristic. Teleprinter speeds range from less than 10 cps to more than 300 cps for the fastest matrix printers, but 98 percent or more operate at 10 to 20 cps. Fig. 5 shows the distribution of current and last year's speeds. Most of the units with speeds lower than 60 cps are solid-font impact printers. A few fast daisy-wheel and slow, high-resolution matrix printers have speeds of 70 to 100 cps. A full 15 percent of teleprinters run at 120 cps, and many thermal and electrostatic models are in this group. To a large extent, 120 cps is the industry standard for fast medium-priced matrix devices. Teleprinters faster than 120 cps are generally more expensive matrix devices, although some devices selling for less than $3000 operate at 180 cps.

The 180- to 200-cps range is the realm of today's fastest popular teleprinters. The popularity of 1200-bps communications lines and modems has made 120-cps models popular for remote and local use. Widespread demand for faster teleprinters will materialize only with improvements in teleprinter error checking and general-purpose, especially telephone, communications equipment. In 1981, teleprinter speeds remained in recognized historical ranges, but the distribution of speeds changed. The average speed of all commercially available units fell 30 percent from 59 cps in 1980 to 40 cps in 1981.

Technology has reduced teleprinter prices more slowly than the market desired but has increased speeds faster than the market required. Price competition has made margins on conventional units dangerously narrow. New technology has been used to differentiate teleprinters by intended application rather than by strict price/performance. Current models incorporate cassette and diskette storage drives; compressed, wide and foreign print fonts; and single- or

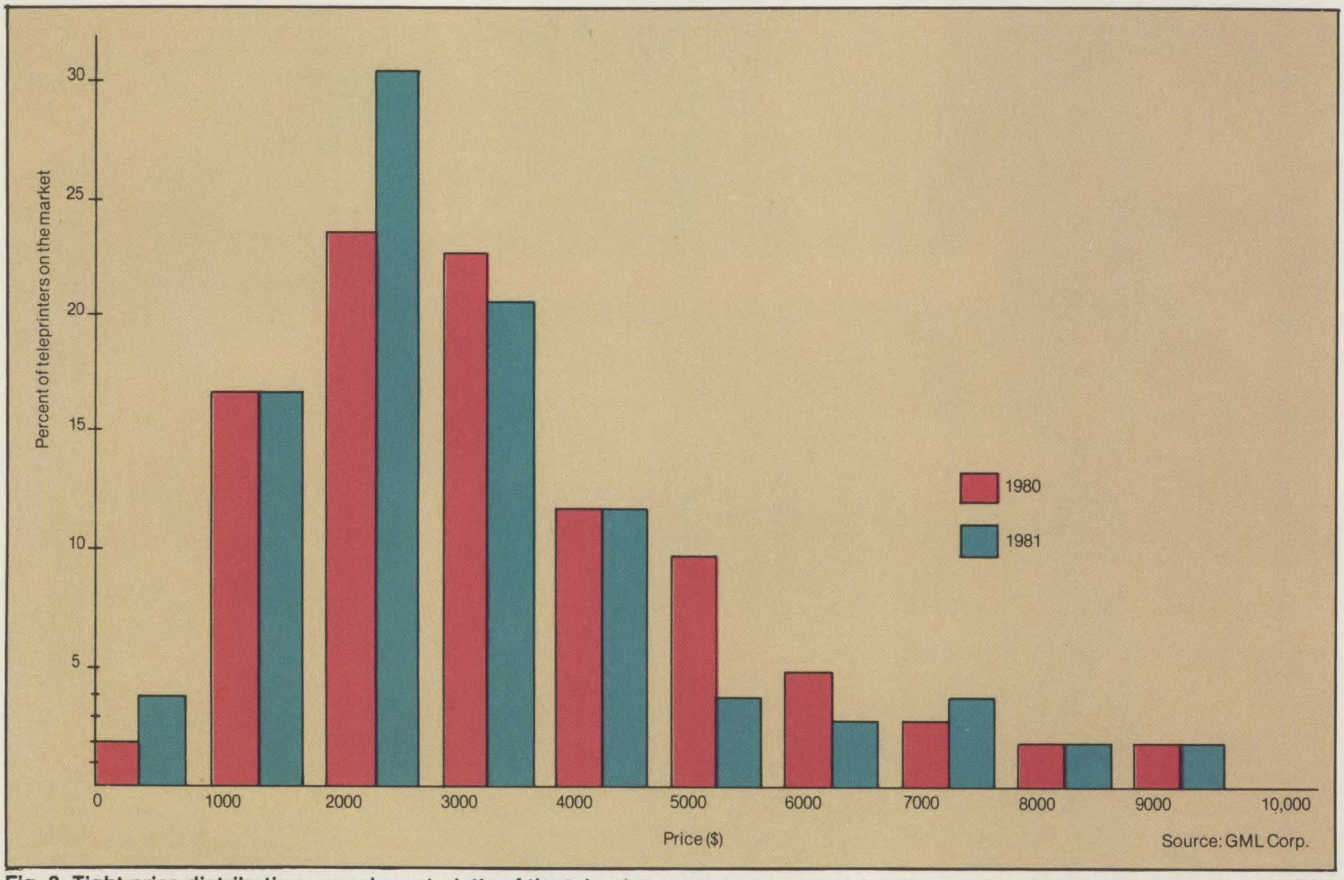

Fig. 3. Tight price distributions are characteristic of the teleprinter industry, *but 1981's distribution has shifted slightly lower than 1980's. Last year (1981) marked the first year that more than half the teleprinters on the market sold for less than $3000 each.*

...Over one megabyte of user available RAM for your HP9845! *

Yes, you read it right! Over 1 megabyte of user available RAM for your 9845! The Infotek AM 45B memory consists of two circuit boards, each containing 524K bytes of memory. The boards are form, fit and function interchangeable with the 131K byte boards designed for your machine. The installation can be made in minutes and does not involve any modification of your HP 9845.

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CIRCLE NO. 80 ON INQUIRY CARD

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That's because our new VGR-4000 graphics recorder for DVST's utilizes a high resolution format with 2000 x 2000 sample points, independent of display size. And delivers a sharp looking record on dry silver paper in only 14 seconds.

You can choose from two sizes of picture formats that are switch-selectable with no board changes or complex adjustments. You can also select black-on-white or white-on-black pictures, simply by flipping a front-panel switch.

With the multiplex option, you can even mix 11-inch and 19-inch display sizes without adjustments. An optional built-in test pattern generator aids troubleshooting and verifies proper unit operation.

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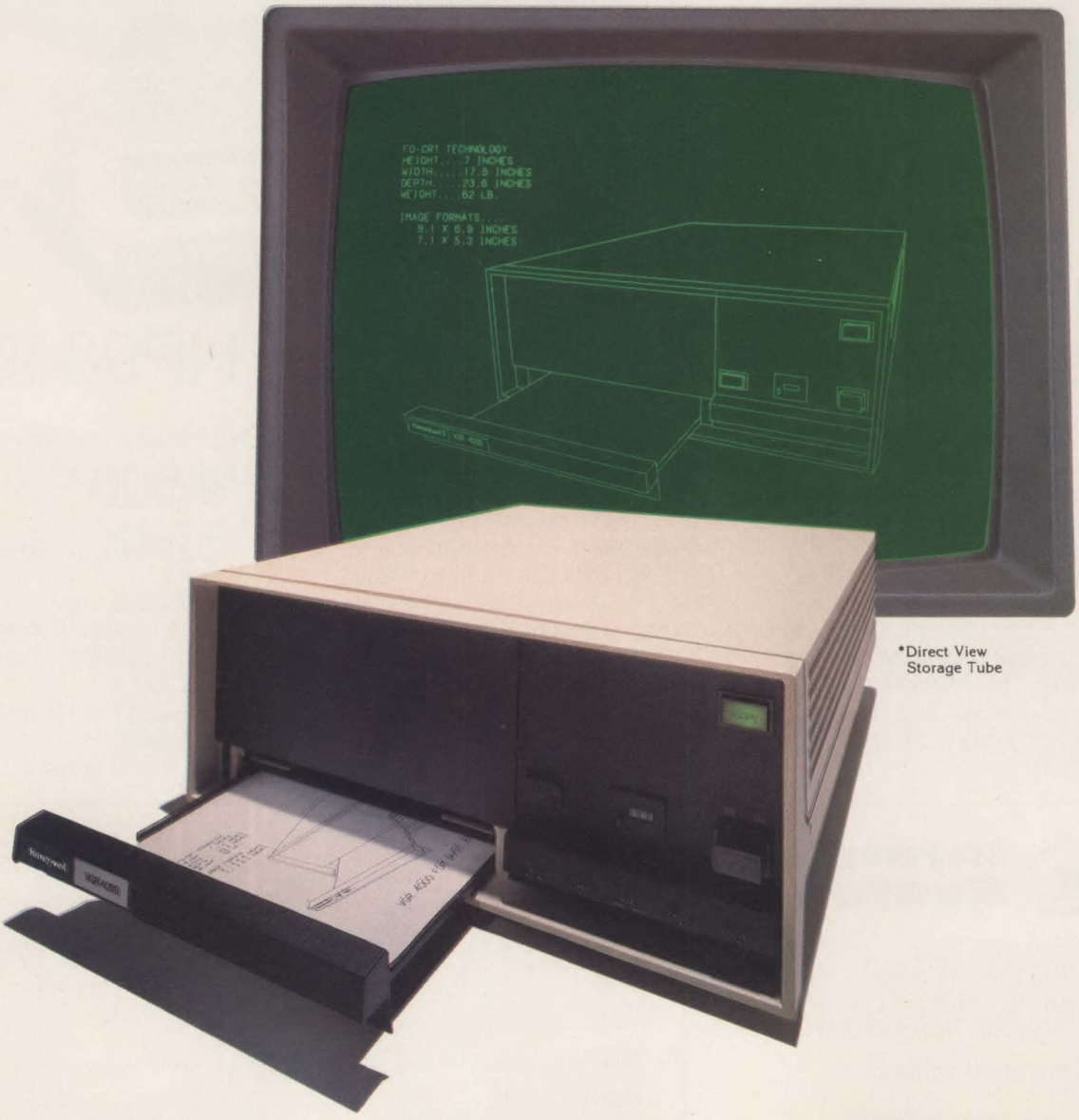

*Direct View Storage Tube

Honeywell

CIRCLE NO. 81 ON INQUIRY CARD

Faced with a shrinking share of the general-purpose terminal market as a result of slow price cutting, teleprinter vendors are packing their products with new features.

multi-line displays. Special-application devices include point-of-sale, graphics, communications (Telex, TWX and DDD) foreign-language, data-encryption and word-processing teleprinters.

Portable models are the most popular special-purpose teleprinters. Of the 29 portable units on the market, most are briefcase sized and feature integral modems

Pedestal-mounted teleprinters such as this General Electric unit *are the most common physical teleprinter type. As brand identity gets harder to establish and office space gets more expensive, manufacturers will introduce more streamlined desk-top teleprinters.*

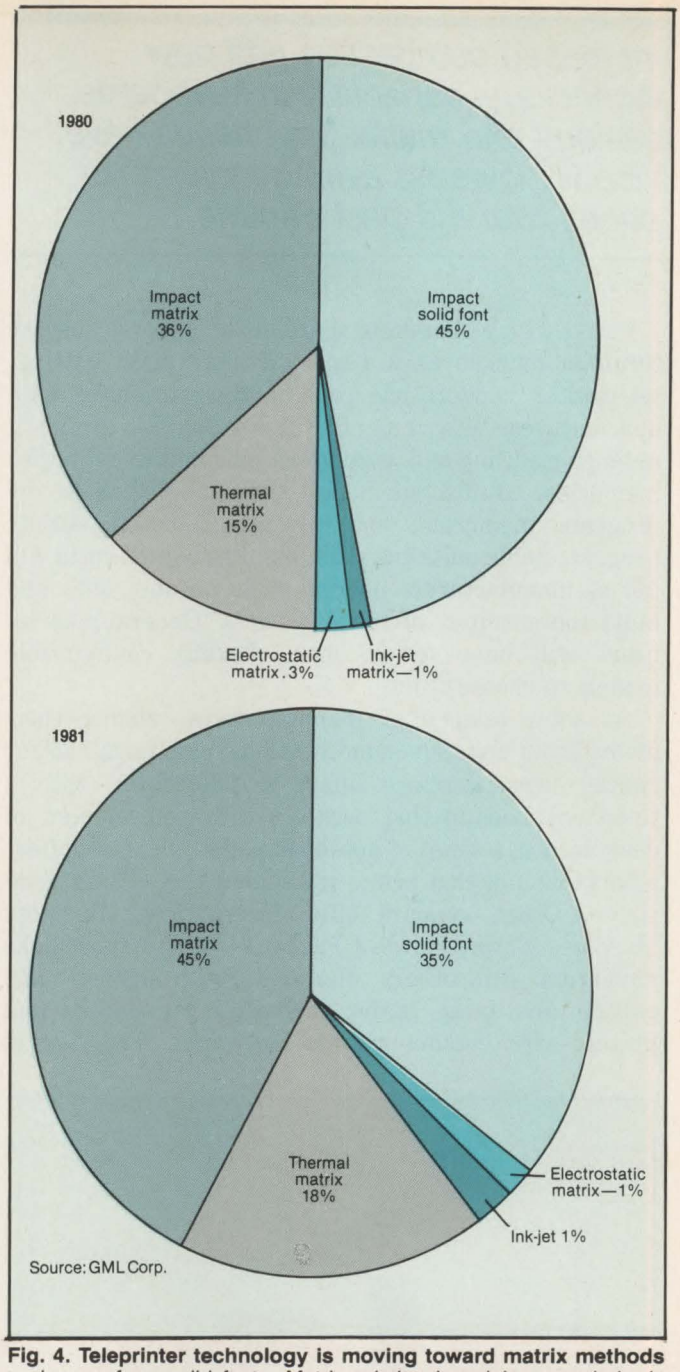

Fig. 4. Teleprinter technology is moving toward matrix methods *and away from solid fonts. Matrix printing is gaining popularity in impact and non-impact applications because it produces high speed-to-price ratios. Solid font printers produce better quality output at slower speeds, but matrix printer resolution is improving daily.*

and acoustic couplers. Allen G. Jacobson, president of Computer Transceiver Systems Inc., exemplifies the bullish attitudes of portable teleprinter manufacturers: "We believe that the growth rate of portable, typewriter-sized terminals will continue at approximately 25 percent per year. But, he says, "Growth will peak within the next five years," and spectacular new growth will come only with the penetration of the new home market.

A foggy future

The industry consolidation of 1981 has further obscured the already-murky future of the teleprinter. By definition, teleprinters provide users with interactive data communications and constant hard copy. The teleprinter's self-sufficiency is at once its raison d'etre and its curse. Users valuing hard copy or portability more than price or speed buy teleprinters, but most multiterminal users follow distributed processing trends and buy display terminals with one shared serial printer for every four or five displays. Word processing seemed promising as a growth area for teleprinters as more and more word processors were tied into data-processing systems, but the trend to clustered, CRT-based word-processing systems bodes ill for the teleprinter.

Increased competition and new technology, especially in keyboards, casings and matrix print heads have steadily lowered average teleprinter prices over the past decade.

Faced with a shrinking share of the general-purpose terminal market as a result of slow price cutting, teleprinter vendors are packing their products with new features. New units offer high-resolution graphics, extensive editing and word processing and larger buffer memories. Buffer memories are supplemented by program memories, and several μp-based, locally programmable units are available. Production costs will fall as manufacturers narrow their product lines and build more copies of fewer models. General-purpose users will have fewer, more flexibly configurable models to choose from.

As some teleprinter manufacturers enhance their mainstream units, even more will develop terminals for special uses. Lexicon offers a teleprinter with a telephone hookup that occupies the same amount of desk area as a sheet of notebook paper, and CTSI offers a portable unit that prints 136 columns on 14⅞-in.-long paper. Other vendors offer International Business Machines Corp., Hewlett-Packard Co. and Burroughs emulators. Still others offer units with answer-back, editing and large buffer memories for public- and private-wire communications networks. The largest manufacturers are developing special products for the banking, airline, retailing and securities industries, and a few companies manufacture or adapt teleprinters for military use.

The teleprinter industry did not crumble or even crack in 1981; it just cleaned house for the 1980s a year too late. The spread of word and distributed processing have ambiguous implications for the teleprinter industry. The home-μc market may represent a teleprinter growth area if buyers can be convinced to substitute teleprinters and TV sets for display/serial-printer or

Desk-top teleprinters such as this Anderson Jacobson 860 are gaining popularity *for office applications. With an accompanying modem the 860 communicates at 1200 bps and attains burst printing speeds of 140 cps.*

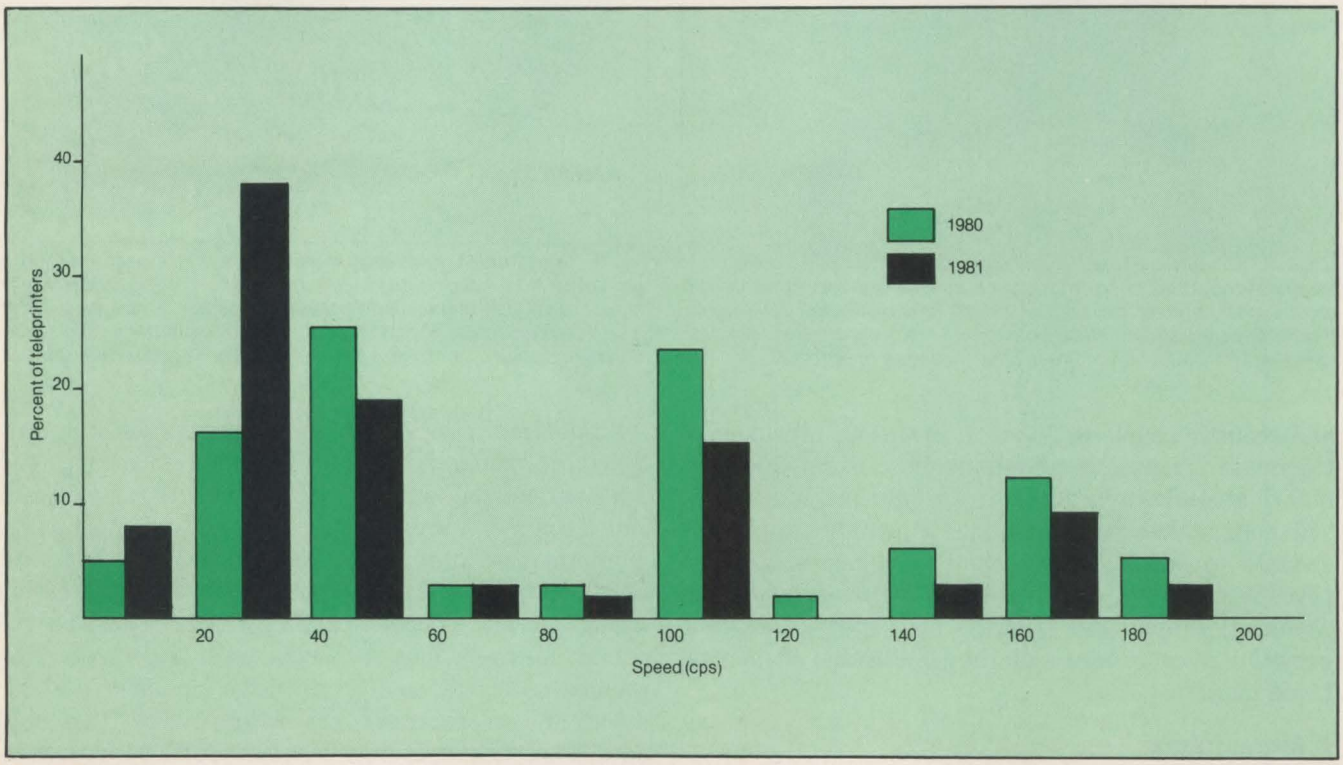

Fig. 5. Teleprinter speeds have dropped overall compared to 1980 figures. *The average speed of all teleprinters offered during 1981 was 40 cps, down 30 percent from the previous year. Manufacturers have narrowed their product lines and are concentrating sales and development efforts on popular 30- and 120-cps models.*

The best reason to buy our new 620 printer is our 630 printer.

Introducing the new Diablo 620 printer. The first low-cost, low-speed printer good enough to be part of the Diablo family. The 620 prints up to 25 CPS and features automatic print wheel recognition. Like our 630 printer, the 620 is built with the kind of quality and reliability Diablo printers are famous for.

Each long-life plastic daisy wheel can be dropped in without removing the ribbon and will last for more than 15 million characters. Wheels are currently available in four pitch styles and a variety of fonts.

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If you'd like more information on the growing family of Diablo printers, write to Diablo Systems, Inc., P.O. Box 5003, Hayward, California 94545, or contact the Diablo Systems sales office nearest you.

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CIRCLE NO. 82 ON INQUIRY CARD

Teleprinters should keep their 15- to 20-percent dollar volume of the terminal market by virtue of their integral hard-copy capabilities, compact size and growing functionality.

television set/keyboard/serial-printer combinations in their systems. Most teleprinter manufacturers are primarily serial-printer manufacturers, so sales revenues in the conjectural case above would end up in the same pockets. Because prices and margins are higher for teleprinters than for RO serial printers, manufacturers will continue to push teleprinters in the face of stable if not skyrocketing demand. A case in point is Centronics, which sells a wide range of serial printers. The company offers only one teleprinter, the veteran model 761, but says it has plans in the teleprinter market.

Teleprinters should keep their 15- to 20-percent dollar volume of the terminal market by virtue of their integral hard-copy capabilities, compact size and growing functionality. As more electronic, less mechanical printer technologies reach the market in the form of less expensive high-resolution print mechanisms, teleprinter prices should fall. Teleprinter manufacturers that put the same effort into print mechanisms as display terminal manufacturers put into refining and mass producing CRTs will reap CRT-sized sales revenues.

Teleprinter manufacturers will have no single industry-wide goal such as speed in the line-printer industry or price in the dumb-CRT-terminal industry. Instead, they will follow the divergent goals of speed, price, print quality, portability, intelligence, customization and emulation. The teleprinter industry shows the signs of intense competition common to any mature market, but shows no signs of the technical obsolescence that slowed the paper-tape and card-reader markets. The need for self-sufficient remote terminals will keep the teleprinter industry alive, and the innovative serial printer technology will keep it healthy. ■

TELEPRINTER SUPPLIERS

The following is a guide to teleprinter terminal vendors. An extensive model-by-model teleprinter survey will appear in our March data communications issue.

For more information, Circle No.

Anderson Jacobson, San Jose, Calif. 427
800 series of solid font units and a new impact matrix unit

Applied Computer Systems, Sunnyvale, Calif. 428
SA300 μp-based daisy-wheel unit

Centronics, Hudson, N.H. 429
761 impact matrix unit

Computer Devices, Burlington, Mass. 430
A wide variety of portable, thermal and matrix units sold under the Miniterm name

Computer Transceiver Systems, Inc. (CTSI), Paramus, N.J. 431
Execuport line of full-function portable units

Data General Corp., Westboro, Mass. 432
180-cps impact matrix unit in its Dasher series; DTC-300 and 380 series of daisy-wheel units

Dataproducts, Woodland Hills, Calif. 433
50-cps solid font and 340-cps impact matrix units; 120-cps impact matrix unit, the 6540 fast and slow impact matrix units, the 1640 daisy-wheel unit

Diablo, Hayward, Calif. 434
630KSR daisy-wheel unit

Digital Equipment Corp. Maynard, Mass. 435
30- and 120-cps teleprinters in the DECwriter series

Digitronics Division of Comtex Information Systems, Cumberland, R.I. 436
400 AlphaVerter with standard off-line storage and optional display

DMC, Santa Clara, Calif. 437
Special-purpose financial terminals

E-Systems, ECI Division, St. Petersburg, Fla. 438
UCG-136, a 120-cps impact matrix unit

Extel Corp., Northbrook, Ill. 439
Specialized units for Telex and private wire communications

General Electric Co., Waynesboro, Va. 440
Terminet series of impact solid font and matrix printers with speeds from 30 to 200 cps

Hewlett Packard Co., Palo Alto, Calif. 441
Thermal and impact matrix units in its 2600 series

Honeywell Information Systems, Minneapolis, Minn. 442

IBM Corp., Armonk, N.Y. 443
Portable electrostatic matrix units with integral storage and displays

Lear Siegler, Anaheim, Calif. 444
Two 180-cps impact matrix units.

Lexicon of Miami, Miami, Fla. 445
LEX-21 portable teleprinter

Logabax, Arcuell, France 446
Buffered 180-cps matrix units for communications applications

Microdata Corp., Irvine, Calif. 447
A few high-speed matrix units for use with proprietary computer system

NEC Information Systems, Lexington, Mass. 448
Print-thimble-based Spinwriter series of 55-cps units

Olivetti Corp., New York, N.Y. 449
A few 30-cps models with optional storage

Qume Corp., Hayward, Calif. 450
Sprint series of daisy-wheel units, low-speed solid font units

Qwint Systems, Northbrook, Ill. 451
KSR-743 portable unit

Siemens, Munich, Germany 452
Impact matrix and ink-jet units

Systematics General, Falls Church, Va. 453
Ruggedized units for military use and a fast impact matrix unit

Teletype, Skokie, Ill. 454
Several impact solid font and impact matrix units

Telex Terminal Communications, Raleigh, N.C. 455
A variety of IBM-compatible units

Texas Instruments, Dallas, Texas 456
Silent 700 series of portable thermal matrix terminals and Omni-800 series of impact matrix models

Trans-Lux, Norwalk, Conn. 457
Impact matrix units for Telex and TWX applications

Trendata Corp., Sunnyvale, Calif. 458
Solid font and fast matrix units

Trendcom Corp., Sunnyvale, Calif. 459
Low-cost thermal matrix units

Xerox Corp., Dallas, Texas 460
Daisy-wheel units and a 200-cps impact matrix model

Minicomputer users:

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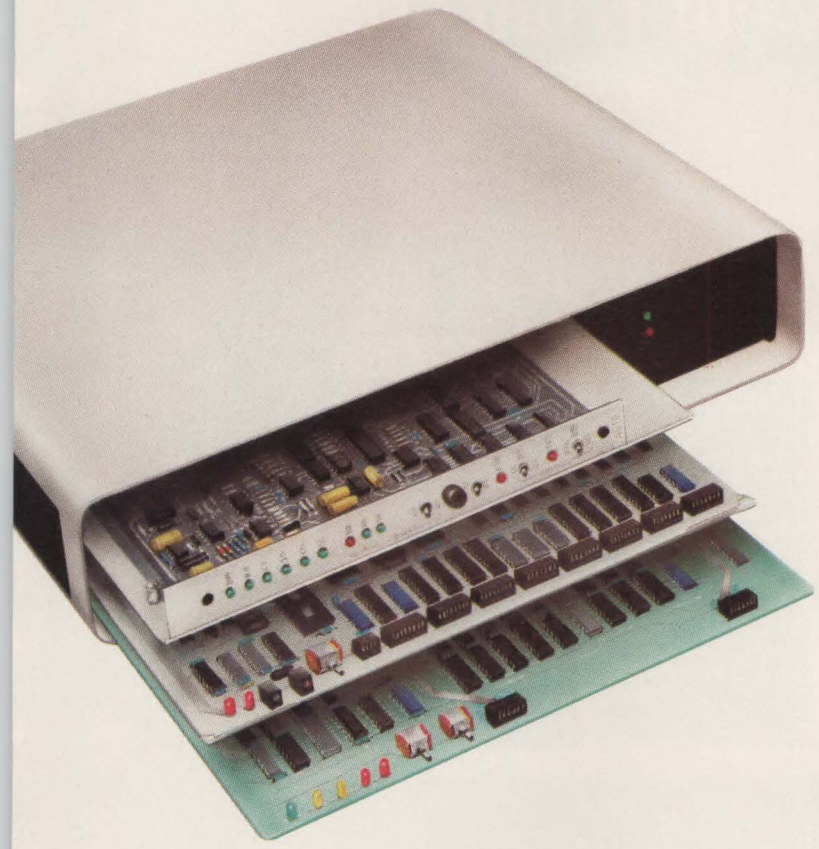
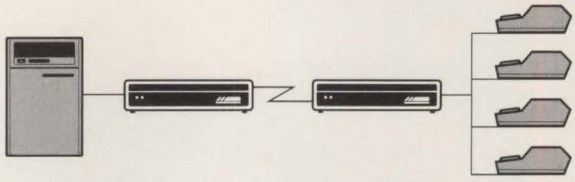


Asynchronous statistical multiplexer

Synchronous statistical multiplexer

High speed modem



The Timeplex E/SERIES is a complete data concentrator system designed to economically link clusters of remote terminals to your minicomputer.

E/SERIES: Cuts communications costs. Suddenly, saving communications costs by linking several terminals to one shared telephone line becomes easy.

Unlike the competition, the Timeplex E/SERIES simplifies the challenge of point-to-point communications by incorporating three functions in a single compact unit. One system offers you a statistical multiplexer supporting 4 to 16 asynchronous channels, *plus* an optional statistical multiplexer for an additional synchronous channel, *plus* an optional integral high speed modem.

E/SERIES: Puts it all together. Putting three functionally distinct modules in one enclosure eliminates external communications units and bulky, expensive cables. And, a minicomputer interface option further reduces costs. The result: System planning and installation is extremely simple. Reliability is enhanced. Costs are dramatically reduced.

Free step-by-step Guide. This easy-to-understand booklet contains all the facts on how to remote your terminals, simply *and* economically. Just write or call Timeplex for your free copy.

For the name of the E/SERIES stocking distributor nearest you, call 201-368-0736.

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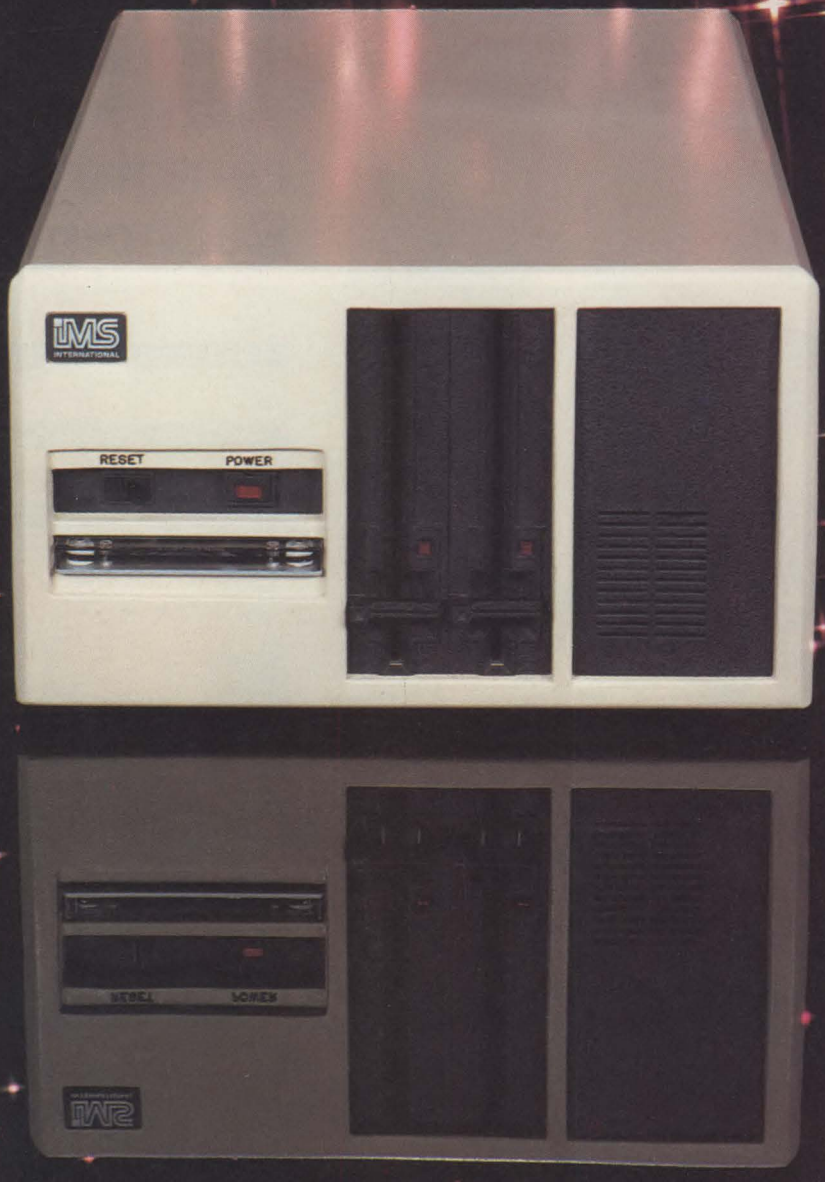

Configuration shown includes two slimline double sided, double density drives, 40 M byte Winchester subsystem with tape back-up.

The New 8000 SX Micro Computer System With Winchester And Floppy And Tape

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CIRCLE NO. 84 ON INQUIRY CARD

PRINTERS

A look at the Japanese printer industry

LORI VALIGRA, News Editor

Here's a first-hand observation of some of the main companies that have made the Japanese so successful in the printer market

The approach to Japan by air takes one over barren shores and mountains and almost desolate farm regions. At first sight, it is difficult to fathom how the people of this tiny country could have pulled together their resources to become a major supplier of products whose quality has received worldwide acclaim. But, when exposed to members of this quiet, patient, delicate society, steeped in history and protocol, it is apparent that the diligent Japanese, with their insatiable desire to learn, have applied their cultural strengths in business.

U.S. peripheral manufacturers, particularly those that sell low-end printers, have felt the Japanese muscle flex over the past year. Combined figures from Oki Electric Industry Co., Tokyo Electric Co., Ltd. (TEC), and Shinshu Seiki Co. (Epson) show that more than 500,000 small dot-matrix printers were shipped worldwide last year, and almost half of those were exported to the U.S. Numbers compiled by Dataquest, Inc., a Cupertino, Calif., market-research firm, are more conservative. Dataquest shipment estimates for less-than-$1000 printers by those three companies are 120,000 in 1981, which could grow to 250,000 to 275,000 this year. This means that last year, the three held a 30 percent market share, and this year are expected to hold as much as 50 to 60 percent. Part of this growth, Dataquest says, is a result of large orders

of small printers from International Business Machines Corp. and Hewlett-Packard Co.

Centronics Data Computer Corp., whose name was once equated with leadership in dot-matrix printers, was bumped from its top market berth. Others, such as Anadex, Inc., retreated from the intense low-end competition (MMS, May, 1981, p. 27).

"They (Japanese manufacturers) have consistently waited, until now, for markets and standards to emerge. They built products to meet the standards and

プリンター
PRINTERS

have done very well," says O. Ralph Finley, vice president and director of the Electronic Printer Industry Survey at Dataquest.

The onslaught of Japanese printers shows every indication of continuing. This article intends to give a perspective from first-hand observation of some of the main companies behind the success (see "Japan challenges at System '81," p. 89). Although the potpourri of less-than-$2000 low-end printers can be classified in many ways, major product lines of companies are grouped here into general technologies, such as dot matrix and fully formed, so that each company's approach to its market segment can be compared and contrasted. Also included is a look at future technologies that may fall into the low end.

The Japanese view of success

Although the following figures may seem exaggerated, Japanese manufacturers know they are doing extremely well in the U.S. market, and they aren't modest about it. An article published in Japan's *Nikkei Sangyo Shimbun (Nikkei Industry Newspaper)* last October that was translated into English for MMS, says the export of small Japanese printers is growing so rapidly that Japan is expected to lead the world market soon. About 70 to 80 percent of the U.S. market for those printers already is held by the Japanese, the article claims.

Printer shipments by Shinshu Seiki, Oki and TEC have doubled over the last year, "and they can hardly meet orders at the moment. Since small-sized computers, including personal computers, have become very popular recently, the demand for Japanese-made, small-sized printers connected to those computers has been showing a remarkable growth because of their excellent quality," the article states. Figures supplied by the Japan Electronic Industry Development Association (JEIDA) to the Ministry of International Trade and Industry (MITI) show that 653,000 serial printers, with a value estimated at $700 million (assuming 200 yen = $1), will be shipped by Japanese companies in the year ending March, 1982. During the same period, an estimated 30,000 line printers valued at $630 million will be shipped. The figures, representing both domestic and import numbers, indicate a 30- to 40-percent growth over 1980, says Shigehiro Okamura, a staff member at MITI. He adds that in 1980, the ratio of serial printers shipped to OEMs as opposed to end users (printer shipped as part of a system) was 2:1.

Production of the NEC 3500 Spinwriter at the company's Niigata plant *on the Sea of Japan will more than double by April.*

Epson has two manufacturing facilities for printers in the Shiojiri-City area northwest of Tokyo. *This assembly line is in the main Epson plant. Demand for Epson's MX series printers is so great that the company is air-shipping 4000 printers to the U.S. each week.*

Despite those huge sales figures, Okamura says the revenue contribution of Japan's printer industry to the country's total electronics industry is a mere 2 percent. In turn, the electronics industry as a whole contributes at least 10 percent to Japan's gross national product.

MITI's involvement with printer companies to date has been minimal because MITI has focused on guiding large computer suppliers competing with IBM and other giants. The label "Japan, Inc.," for printer companies seems a misnomer. Japanese printer companies compete fiercely with one another in several world markets. One example of inter-company competition—

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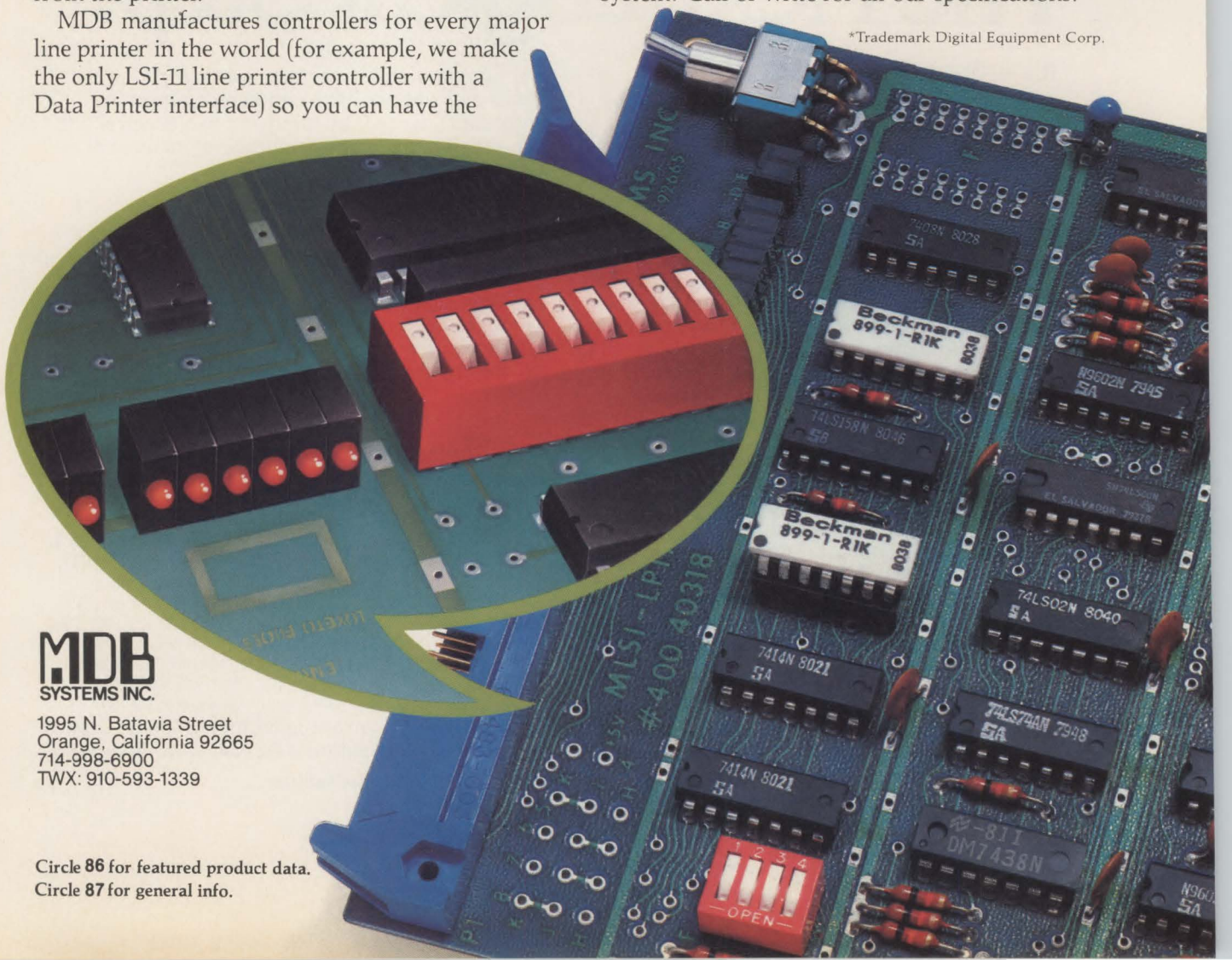

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Shinshu Seiki and Seikosha, both members of the Seiko group—will become more obvious as the two companies stake out new markets. Shinshu Seiki supplies a printer under the brand name Epson for the IBM personal computer, and Seikosha sells low-end printers to Tandy Corp.'s Radio Shack division. Seiko exemplified such internal competition in the watch business until it gained a dominant market share. Now the two competing watch groups cooperate.

While many U.S. printer companies are just that—printer companies—many Japanese printer manufacturers supply systems, integrated circuits, other components and peripherals. Their degree of vertical integration extends into entire system packages. Nippon Electric Co., Ltd. (NEC), for example, sells many of its matrix printers as part of its systems for Japanese users. In that way, it not only has a captive printer supply, but also can expand into other markets. Many companies freely serve as OEMs for others when incorporating some printers into their own systems. Thus, Sharp Corp. buys daisy printers from Ricoh Co., Ltd., and matrix printers from NEC, NEC buys from TEC, and so on.

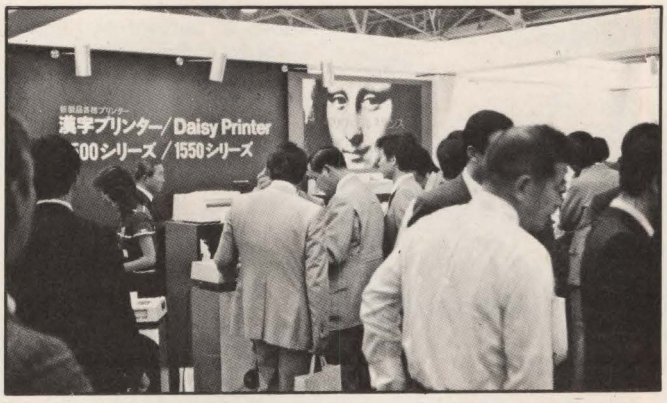
A wide range of technologies

Many Japanese companies offer a range of printer technology products from the low to the high end. For the next few years, Japanese companies will try to reduce noise and add graphics and other features to impact dot-matrix printers. Fully formed character printers will continue primarily as exports targeted at office-automation applications, and efforts to reduce price by reducing mechanical parts are in full swing. Much development of 24-wire matrix print-head printers will remain geared toward Chinese Kanji character printing for Japanese office-automation systems. Many manufacturers believe this expensive technology is not required in the U.S. for high-quality printing.

The most promising low-cost, low-end printer technology on the horizon is thermal. Most major manufacturers are looking into it to incorporate high-quality printing on plain paper. At the high end, most manufacturers agree that laser printers are too costly and still too complex to filter down to the low end. Additionally, although many firms are eyeing ink-jet printers as a quiet and high-quality technology, the cost is still too high for low-end users to expect a product in the next five years. Most agree, however, that ink jet is the way to go for multicolor printing.

Dot matrix: the big success

The most obvious success story is that of Shinshu Seiki with its Epson printers. Located in Shiojiri-City, Shinshu Seiki is pegged by some as the only competitor in the low-end dot-matrix arena. Also known in Japan as Epson, the company is part of the Suwa Seikosha group, which manufacturers watches and electric shavers. The Seiko group is made up of Suwa Seikosha, Daini Seikosha and Seikosha. Distribution of all Seiko products is handled through a trading company, K. Hattori, which is the Seiko Group parent company. Epson also has a U.S. operation, Epson America, Inc., Torrance, Calif. With $300 million in revenues in 1981, Epson has five divisions, the largest of which produces 6 million miniprinter mechanisms annually for electronic cash registers.



Popularity of low-end printers is growing in the Japanese market, *as evidenced by the crowded C. Itoh booth at last October's Data Show in Tokyo.*

Epson's involvement in 80-column matrix printers came as a response to its small-business computer operation, which began four years ago. Growth of that printer business can be described as overwhelming. In 1980, Epson shipped 80,000 MX-80 and MX-100 personal-computer printers worldwide; the number grew to 300,000 in 1981. Last January, 10,000 80-column printers were produced. By October, that number had increased to 40,000 units, half of which were shipped to the U.S., says Susumu Aizawa, managing director of Shinshu Seiki.

"In October, 1980, when we introduced the MX - 80, I didn't expect today's success. But, by the price, quality and design features, I thought that we'd be one of the best," he says. "I thought the primary part would be quality. If the quality is good, dealers can sell the product easily, and even beginners can use it." He explains that Epson printers are used in both the hobbyist and business markets. Epson has about 1000 dealers in the U.S. The MX-80 is its hottest seller. The MX Series represents 20 percent of Epson's printer business.

Aizawa says Epson is quickly approaching 50 percent of the worldwide market for its 80-column printers. He sets Epson's Japanese market share at 70 percent, and

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its European share at 60 percent, primarily in West Germany and England. Market share estimates in the U.S. vary greatly, although most market participants concede at least a 35-percent share to Epson. Aizawa says that half—or 100,000—of all MX-80s shipped have gone to the U.S. About 70 percent of Epson's printers are sold through distributors, and Aizawa hopes to increase that to 80 percent this year, relying less on large OEMs. "OEMs must be a minor portion (of sales). We want to be famous in the world, so we must be directly combined with customers," he says.

Epson is increasing production of products to shorten delivery times. For the past three months, Aizawa explains, the company has chartered weekly flights to Los Angeles to ship 4000 printers per flight. "We lose money sending printers by air freight, which is more than double the cost of sending printers this way," he says.

Part of Epson's success is a result of quality control. "In the U.S., there are excellent companies in printers and computers. When the pricing competition is strong, American companies move manufacturing outside of the U.S., and quality control decreases. It is a poor strategy to move manufacturing offshore. You can lose the reputation for quality control," he says.

About 80 percent of Nippon Electric's Spinwriter fully formed character printers are earmarked for U.S. export, *says NEC's Setsuo Hasegawa (center). On the left is Tsuneo Nishi, and on the right is M. Takaki.*

Close on Epson's heels...

Quality is also an important concern for TEC and one of its major customers, Radio Shack. TEC is a manufacturing company that builds printers according to specifications supplied by large customers such as Radio Shack and C. Itoh & Co., Ltd. Tandy chairman Phil R. North credits his company with helping to impose strong quality-control standards on its suppli-

HISTORY OF NEC SERIAL PRINTERS

	SP-40	5500 Series (SP-55)	7700 Series (SP-55 SBP)	3500 Series LCLS (low cost, low speed)	VLCLS Series (very low cost, low speed)
First delivery of production model	June, 1975	Dec., 1977	July, 1980	Dec., 1980	
Size (MM)	600 × 605 × 225	600 × 415 × 210	600 × 415 × 210	570 × 395 × 208	570 × 360 × 155
Weight	45kg.	24 kg.	23 kg.	17 kg.	12 kg.
MTBF (hours) Actual	1500	2000	2500	3000	3500
estimate	2000	3000	3500	4000	4500
Control system	Analog servo	Analog servo	Digital servo	Stepper motor	Stepper
PC board	6	3	1.5	1	1 with power supply
Electronic parts (pieces)	—	780	430	340	250
Electrical adjustment	Required	Not required	Not required	Not required	Not required
Mechanical parts (pieces)	350	300	300	150	120
Screws	350	180	180	50	40
Cover	Sheet metal	Aluminum die-cast	Aluminum die-cast	Plastic mold (structural foam)	Plastic mold
Dot matrix printer (counterpart machine)	SP-180	SP-120	SP-200	SP-100	VLCLS Dot

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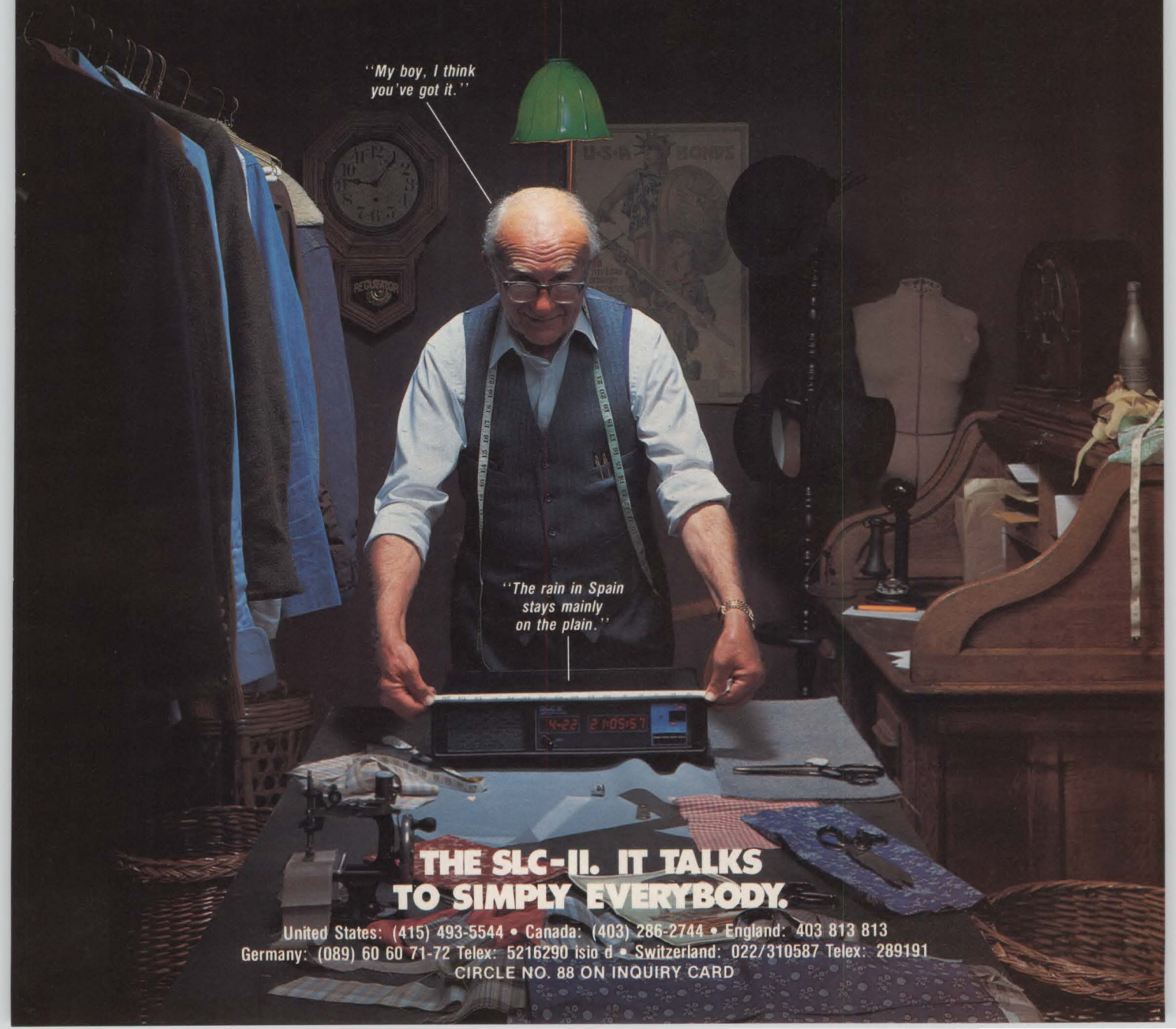

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ers. Through its trading organization, A & A, Tandy sends inspectors to TEC factories to open and inspect 10 sealed boxes before each shipment is made to Fort Worth, Texas. There, another inspection takes place at a TEC facility, according to Koichi Yagame, manager at TEC's bureau-machinery department, Tokyo. "The printers are built with reliability in mind because they are shipped all over the world," he says.

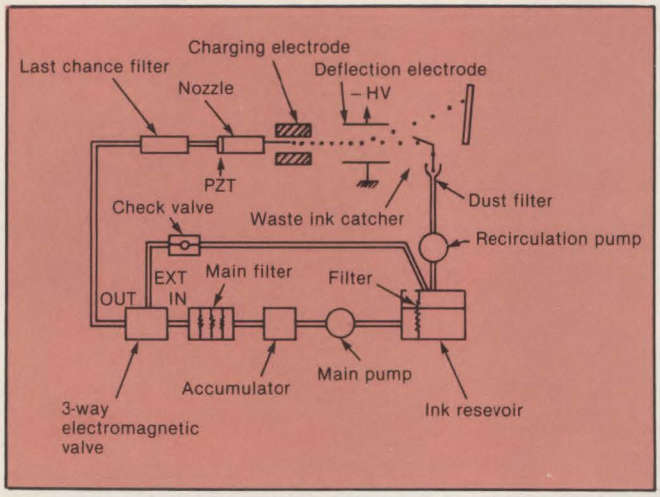

Fig. 1. A look inside Sharp's ink-jet printer. *Both the model 300 and 500 ink-jet printers from Sharp are based on the same principle of continuous ink-stream printing. Each droplet is formed from a continuous stream of ink. Electric pressure in the print-head creates a low frequency that is applied to part of the print nozzle. Under the control of a Z80 μp, the sound shakes the ink into drops, which are released through one hole in the nozzle. The characters are deflected onto the paper.*

Toshiba Corp. owns 52 percent of TEC, which was founded in 1916. The 1981 net sales were about $400 million. About 40 percent of its business is dedicated to custom Toshiba products, such as lighting fixtures, vacuum cleaners and small electric appliances. The remaining 60 percent goes to printers, office-automation equipment and small-business computers. Printers account for more than 20 percent of TEC's business.

Tandy and C. Itoh are TEC's major printer clients, each of which accounts for 40 percent of printer sales. The remaining 20 percent is for OEM customers. TEC is trying to increase the ratio of OEM customers. TEC chooses not to compete with its buyers by selling its printers under its own label.

The arrangement with Tandy, which began about three years ago, has worked out well for both parties. "We prefer the products we sell to be as exclusive as possible. We have our own codes and interface standards. We like TEC for this reason," says Jon Shirley, vice president of merchandising for computer products. Tandy is such a large customer that it can afford to call the shots on specifications and low prices. "The vendor can offer a lower price knowing the production line is long term," says North.

TEC is also pleased because orders are received from Tandy one year in advance. "This is very secure, and we can make our production schedule in advance," says TEC's Yagame. Three Tandy dot-matrix printers are manufactured at TEC's Mishima plant.

The company's Ohhito plant is the production site for C. Itoh printers, including two daisy-wheel and five dot-matrix models. The maximum manufacturing capacity for all TEC printers is 50,000 monthly, Yagame says. He adds that 50 percent of TEC's printers are shipped to the U.S., while 20 percent go to Japan and Europe each, and 10 percent go elsewhere.

Fortunately for TEC, much of the development, R & D and tooling costs for the C. Itoh printers are paid by C. Itoh. "This means a good and long-term relationship," says Kazuo Kikuchi, manager of the electronic-equipment department of C. Itoh Data Systems Co., Ltd., Tokyo. " To keep up the relationship nicely, we have close ties with TEC on all management levels. Everyone thinks of the other parties involved."

C. Itoh, a 120-year-old trading company with $37 billion in transactions in 1980, has two means of selling products in the U.S., Kikuchi explains. First, a manufacturer can sell its products through C. Itoh. Second, customers can acquire worldwide marketing information, and C. Itoh can set up the specifications and farm the work out to a manufacturer on contract. That manufacturer is TEC. U.S. sales are handled by C. Itoh Electronics, Inc., Los Angeles. C. Itoh has 167 offices in 75 countries.

A number of printers are sold by C. Itoh, including dot matrix, daisy wheel and ink jet (supplied by Sharp). In the U.S., C. Itoh sells the Comet I and II dot-matrix printers and the Starwriter I and II daisy-wheel printers. These units are being replaced with the models 8500, 1550, F-10-40 and F-10-55, respectively, which have speed and design improvements over the earlier models.

Although C. Itoh views the U.S. as the main market for low-cost printers, its basic strategies are set in Japan. "We like to spend most of our time and money in Japan to debug the unfavorable parts of the product before export," Kikuchi says. That focus helps eliminate some of the problems encountered when a product fails in the field.

Deliveries are also criticial, Kikuchi says. Part of the reason Japanese companies can meet schedules, he says, is that employees cooperate when overtime is required. Unlike workers in the U.S., Japanese employees typically remain at a company during their entire career. "If deliveries are not on time, the company loses

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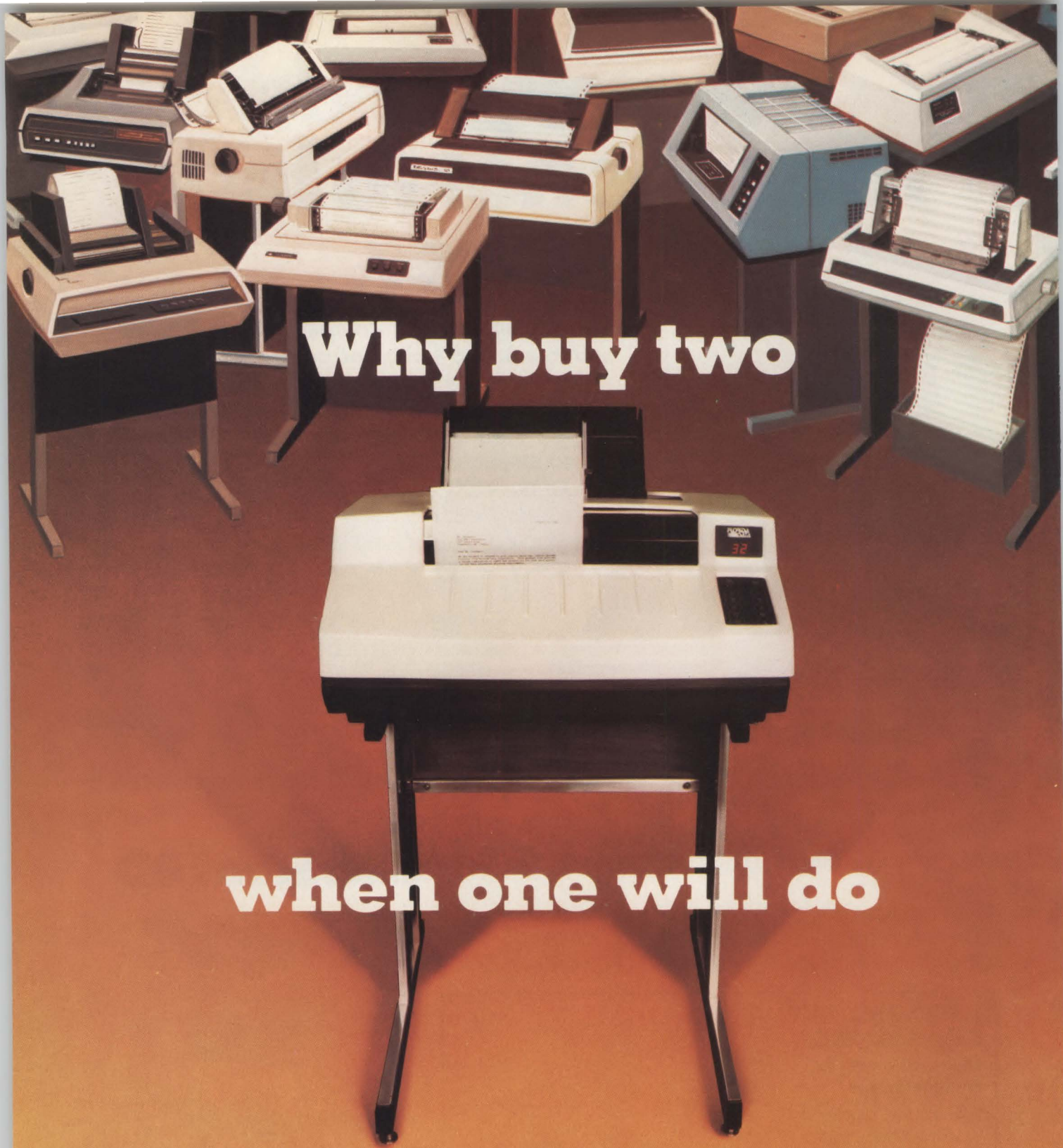

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business, company profits decline, and the employee's salary is not increased as much, nor are the bonuses as high," he says.

About 70 percent of C. Itoh's low-cost printers (by quantity) are exported in a 3:1 ratio of U.S. to Europe. Kikuchi says Americans seem to emphasize the price and design of a printer and decreasing the amount of static electricity. Static electricity passing from a person to the printer can cause malfunctions or ruined components. Europeans are more conscious of noise, reliability and function. He says low-cost printers are gaining in popularity in Japan.

Another top supplier of low-end matrix printers in both the Japanese and U.S. markets is Oki. With net sales exceeding $883 million last year, Oki has a broad range of printers on the market or in the wings. It also sells minicomputers, μcs telecommunications equipment, intelligent terminals and Japanese word processors. Its printer technology lineup includes impact dot matrix, 24-wire-head matrix, laser, daisy, thermal, ink jet, ink mist, electrophotographic imaging and multipass.

Although Oki is ranked among the top three Japanese suppliers of low-end printers in most countries, it has had difficulty expanding its customer base in the U.S. because of the relatively high price of its products. While the export ratio for Oki's printers has been equally divided between the U.S. and other countries, the U.S. portion is expected to grow soon to about 66 percent, says Hiroshi Kojima, principal staff, data products business unit, of Oki's Information Processing Group. In the low-end printer lines, about 70 to 80 percent of the Microline products are flagged for export. The Microline series is sold through distribution and through Oki's U.S. arm, Okidata, Mount. Laurel, N.J. Last year, combined export totals for the models 80, 82A and 83A were 100,000 units, Kojima says. The company, which makes all of its own printers, has a 10,000-per-month production capacity on assembly lines for the three products, and that capacity is being tripled. It is readying eight autohand robots, which it made, and 13 pick-and-place automotive handlers to increase output by 20,000 units a month. "I never heard of robotics used in the assembly of printers (because of the high number of mechanical parts)," Kojima says. However, such robots are common in Japanese automobile factories and have received much publicity.

In tripling production, Kojima expects the cost of manufacturing to drop, enabling Oki to absorb lower selling prices. He questions lowering prices much more, because there have already been "fallout" companies from that market, and because he feel the low-end market has stabilized.

Oki has become one of the first Japanese printer manufacturers to use robots on its assembly lines. *Oki's Hiroshi Kojima says that with robots, 20,000 more units can be produced monthly, enabling the company to absorb lower selling prices.*

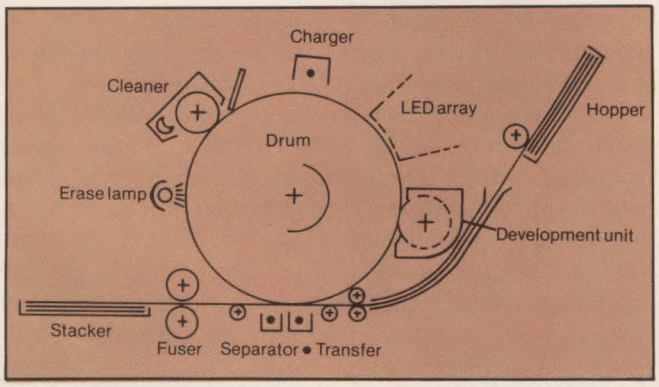

Fig. 2. Oki is excited about its small electrophotographic printer, which uses in-line LEDs instead of lasers. *The company claims the technology is unique and plans to begin showing it in the U.S. this year. The LEDs are embedded in one row of 240 dots in an LED head. Each LED is turned on and off, depending on the character to be printed. The latent character image is transferred onto a photoconductive drum and then onto plain paper, where it attracts monocomponent dry toner, which is pressure-fused to the paper. Although the patented print-head is difficult to make, Oki expects to begin shipping this printer to Japanese users in the next two to three months. The high-end printer, which runs at about 20 pages per min., incorporates a 16-bit 8086 μp and will be priced at $5000 to $10,000, depending on configuration.*

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Kojima is not overly concerned about the fact that Epson has a stronger presence than Oki, because Oki has a broader range of products, he says. "Across the board, we will continue on all printer levels. Low-end printers do not occupy a large percent of Oki's business."

"To keep up *the relationship nicely, we have close ties with TEC on all management levels. Everyone thinks of the other parties involved," says C. Itoh's Kazuo Kikuchi.*

Fully formed printers: a price decline

Even though prices for fully formed character printers are declining, the price decreases probably will not be so dramatic as those of dot-matrix products. A low-cost printer can be realized to some extent, but the number of mechanical components limits the price reduction.

Nippon, which claims it has dominated the Japanese market for fully formed character printers since 1975 and which recently competed strongly with Diablo Systems, Inc., and Qume Corp. in the U.S., is expected to ship a very low-cost printer to the U.S. by mid-year.

Established in 1899 in a joint venture with Western Electric Co., NEC traditionally is a communications company that for the past 20 years has also sold computers. The company produces a wide range of products, from semiconductors and personal computers to mainframe computers and peripherals, including disk drives and printers. Printer products include fully formed, dot matrix, laser, line and band units. The $395-billion company has more than 60,000 employees and exports products to 140 countries. The primary printer exported is the Spinwriter, a fully formed character printer, although Trimliner band printers also are sold in the U.S. The company's U.S. arm, NEC Information Systems, Inc., Lexington, Mass., sold about $80 million in products in 1981, says Setsuo Hasegawa, general manager, international EDP marketing division, Tokyo. About 400 model 3500 Spinwriter printers were shipped to the U.S. last year, in addition to other Spinwriter family members. Hasegawa says that about 80 percent of Spinwriter production is earmarked for export to the U.S., while 10 percent is for Japan and Europe.

A relative newcomer to OEM sales six years ago, NEC previously bought printers, explains M. Takaki, vice president at NEC's Fuchu City plant, which manufactures some printers. The company sells many of its own printers with its computer systems, although it uses a TEC printer for its PC8000 personal computer. Last September, NEC officials divided the terminal and printer operations and formed a separate printer division.

The company's main printer-manufacturing plant is in Niigata, on the Sea of Japan. NEC plans to more than double the plant's production capacity for the low-end, 33-cps Spinwriter 3500 from about 3000 to 7000 units a month, Takaki says.

An even lower end model than the 3500 is expected this year, and is tentatively called the 2003 (MM, December, 1981, p. 5). Operating at 20 to 25 cps, the 2003 incorporates about about one-third fewer electronic parts, weighs less and has a better mean time between failure than the 3500. Target price, in 2000-unit quantities, is $600 to $700, says Tsuneo Nishi, sales promotion supervisor, NEC printer division.

NEC strives for technological commonality among different printer series (see "History of NEC serial printers," p.192). For example, the company's serial printers all have dot-matrix counterparts. This also will be true of the model 2003. However, Takaki adds that NEC has not yet decided to become a matrix-printer supplier to OEMs because of increasing competition. The company will continue to focus on both the word-processing printer and data-processing matrix printer markets.

NEC has differentiated itself from other fully formed character printer manufacturers by using a thimble rather than a daisy-wheel element to print. The thimble resembles a modified badminton birdie. Takaki explains that the thimble approach, which originated 10 years ago, stemmed from the need to have 128 characters for the Japanese market. Most daisy printers have 96 characters, one on each "petal." A 128-petal daisy, Takaki says, would have too large an angular moment

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of inertia and would require a lot of power from servo or stepper motors to rotate the element. NEC's 64-finger element, with 2 characters per finger, has a 2-in. diameter.

Ricoh faced a similar problem in developing a fully formed printer for Japan. At first, Ricoh pursued a thimble-cup technology similar to that of NEC. It sold that technology to Interdata (now Perkin-Elmer), but Interdata's Carousel 300 printer, which was on the market in 1976, was discontinued. Ricoh then chose

"In October, 1980, when we introduced the MX-80, I didn't expect today's success. *But I thought by the price, quality and design features that we'd be one of the best," says Epson's Susumu Aizawa, here with one Epson's other successes—miniprinter mechanisms for electronic cash registers.*

daisy technology, placing two characters on each petal for a total of 128, explains Tetsuo Kitamura, assistant general manager, Ricoh Electronics Technology Division.

Kitamura says most customers think the company came into the printer business very recently, but Ricoh claims a long history of funding printer development. Founded in 1936 to market sensitized paper, Ricoh expanded to sell cameras, copiers and watches. In addition to printers, the company sells office computers, word processors and facsimile machines. The company has $1.4 billion in net sales and 29 consolidated subsidiaries. OEM printer sales are a very small part of its overall business.

Sales of Ricoh's RP1600 45-cps daisy-wheel printer did not take off until 1980 because the price of the predecessor model had to be reduced and because of a subsequent signing of a major customer: Radio Shack.

More than 90 percent of Ricoh's daisy printers are exported, mostly to the U.S. "Daisies are out of the question for Japanese business transactions," Kitamura says, "because there is a need for more than 2000 characters for Kanji printing. Dot matrix is the answer for word processing in Japan."

Kitamura does not expect substantial changes in daisy technology over the next five years, but he does anticipate price decreases by lowering the number of parts and changing the way of manufacturing and of making electronic components. Ricoh soon will introduce a low-cost daisy printer to track the decreasing prices of personal computers.

Brother Industries reportedly is also shipping a low-cost daisy printer to Computers International, Inc., Los Angeles. That printer, called the Daisywheel 1000, was introduced last November at a suggested retail price of $1495. ITS Japan Co., Ltd., sells the printer for Brother.

Improving dot-matrix quality

The argument that two printers are needed for a computer system—one for higher-speed dot-matrix output and one for letter-quality business printing—takes a different angle in Japan. Printer manufacturers selling into both the U.S. and Japanese markets claim that either multi-wire print-heads or multiple passes of the print-head on dot-matrix printers represent a reasonable compromise. But for the Japanese, 24-wire heads are necessary to get good quality in printing complex Chinese Kanji characters. These printers, however, are too expensive for use in the U.S. Many Japanese users have had to settle for alphanumeric printing and output of some characters in the other two Japanese alphabets. But with the recent emphasis on office-automation products in Japan, the need for high-quality Kanji printing as well is generating market interest for printer manufacturers.

"It is difficult because you need 24 wires working simultaneously to produce the characters. In the process, much heat is created in the printhead," says Hashi Y. Hashimoto, engineering department manager, Peripherals, Terminals and Computers Division of Alps Electric Co., Ltd., Yokohama. Alps, which has yet to market its two nine-wire dot-matrix printers in the U.S., is developing a 24-wire dot-matrix printer that is scheduled for release this spring in Japan. Alps also is revising one of its printers in a version that has two rows of staggered pins, one with five and one with four pins.

Toshiba Corp., Tokyo, which claims to be one of the first companies to invent a 24-wire printer, just began shipping a 24-wire-head printer in the U.S., the TH-2100H. Introduced at last year's National Computer Conference, the dual-mode printer operates at 100 cps

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for word-processing and 160 cps for data-processing quality, respectively. Under software control, either all or 16 of the 24 wires can be used to improve throughput. That model cannot print Kanji characters, but fonts can be down-loaded into it.

"There may be arguments as to how many wires are needed. There is no answer yet," says Hiromi Kamimura, manager of international marketing in Toshiba's computer division. "For people who want to stay with high-speed printers and who are willing to compromise some print quality, 16 wires may be satisfactory. The reason for 24 wires is that we want a good product for the Japanese market, especially word processing," adds Kazuo Ishiguro, manager of the electronic-appliances department of Toshiba's international operations, electronics products segment. Price of the printer—as much as $2500—is still relatively high.

Tetsuo Kitamura says more than 90 percent of Ricoh's daisy printers are exported. *"Daisies are out of the question for Japanese business transactions, because there is a need for more than 2000 characters for Kanji printing. Dot-matrix is the answer for word processing in Japan."*

Toshiba plans to release a new Kanji printer this quarter in Japan. Based on the TH-2100H mechanism and priced comparably in Japan, the 3100 series is more compact.

One of Toshiba's strongest competitors in Japan is Oki, which expects to ship 30,000 such high-resolution printers in Japan this year. The company has two 24-wire-head models: the 8300 and the 8530.

In the U.S. market, Oki expects to solve high-resolution printing by using multi-pass technology, such as that used by Integral Data Systems, Inc., Milford, N.H. An Oki Microline 84, for example, operating at two passes, would run at one-fourth the speed of a regular model 84. In the first pass, the dot density is doubled and the speed is decreased 50 percent, resulting in 100 cps. This is also true of the second pass, so the usual 200-cps speed is cut one-fourth, or 50 cps. Oki's Kojima points out that "the 24-wire or the two-pass operate at the same speed, but the 24-wire costs 20 percent more."

IBM recently placed an order for the 8530 24-wire-head machine to use in the IBM 3283-53, Kojima says. Even though Oki does not intend to sell its 24-wire printer in the U.S., Kojima says, the company will not sell the head separately to low-end printer competitors.

Others interested in multi-wire print-heads include Epson, TEC, C. Itoh and NEC. Epson has developed a 24-wire-head printer that will be sold as part of a Japanese office system.

NEC also has 18- and 24-wire printers. TEC has an 18-wire Kanji printer that incorporates two rows of nine staggered wires. A 24-wire-head printer is under development.

C. Itoh also introduced the TEC 18-wire-head printer as the model 8600. Retail price is about $1200. The printer is for the Japanese market only, although C. Itoh's Kikuchi says that the product may be brought to the U.S. this year under a different name and at a different price. Speed in printing alphanumerics is 180 cps; Kanji character speed is slower.

Kikuchi says the heat generated in printing complicated Kanji symbols is absorbed by a heat sink. In printing Kanji, all 18 wires operate simultaneously in a 16 × 15 dot matrix. In comparison, alphanumerics is printed in 7 × 9 dots. He adds that 18 wires are enough to print some Kanji characters but 24 wires are required to produce the full set of characters.

C. Itoh has sold a 24-wire model, the 2200, in Japan for two years. The heavy-duty printer is priced two-and-one-half times higher than the 8600. Kikuchi says 18-wire printers are sufficient for the U.S. market, but 24-wire printers may be the answer in competing with daisy-wheel quality. The price choice, he says, is up to the customer.

Technologies to watch

Hope has been placed in ink-jet technology for the next generation of dot-matrix printers, primarily because of the ink jet's high-quality print and quietness. Many printer manufacturers are carefully watching market acceptance of ink-jet products, but that acceptance is creating a Catch-22 situation. While reliability has been one objection to ink-jet printers, price has been equally objectionable in the low-end market. Without demand and subsequent high-volume

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manufacturing, it is difficult to reduce price significantly. The most viable low-cost, near-term alternative may be thermal printing on plain paper.

Epson's Aizawa says ink-jet output is excellent and the printers are simple and fast, but he questions their reliability. Referring to ink-jet technology, he paraphrases an old proverb: "A beautiful woman does not necessarily make a good wife." Nonetheless, Epson is watching the ink-jet market.

Sharp Corp. has proven to be one of the model companies to watch in ink-jet technology (Fig. 1). In 1969, development began on an ink-jet printer based on an A.B. Dick patent, which is also the source for IBM's ink-jet printer. The model 500 was shown for the first time in the U.S. at last year's NCC. Another model, the 300, has been used in time-sharing systems in Japan for the past five years. Sharp is not sure when the model 500 will be offered in the U.S., although it may be this summer. C. Itoh recently began shipping that model in Japan.

Hiromasa Sasaki, deputy general manager of the systems equipment division of Sharp's industrial instruments group, believes that ink jet will remain a high-grade printer technology. "If we increased production 10 times in five years, assuming that the number of customers increases, production costs should decrease. But other low-end impact-printer production costs also will decrease." He says that in five years, production costs for ink-jet printers will still be 30 to 40 percent higher than those of impact printers. Those costs now are 60 to 100 percent higher.

Although Sharp's printer uses continuous-stream technology, the company intends to show a prototype printer at this year's NCC that uses drop-on-demand technology, similar to that of Siemens Corp. Sharp's Sasaki says drop on demand is better for four-color printing on the new machine.

Oki has several types of ink technology printers in development, including ink jet and ink mist (Fig. 2). Oki's Kojima does not see a strong demand for its 200-cps ink-jet printer yet, primarily because of high price. But as soon as the market opens, Oki plans to jump in. "Instead of decreasing the price of the ink-jet printer, we may go for a thermal ink-transfer system on plain paper. But for color graphics, we need ink jet," he says.

Oki expects to offer a high-speed thermal printer in two to three years, Kojima says. "We're looking at thermal ink transfer onto plain paper," explains Kojima, rather than using specially coated thermal paper. "But there are some problems in doing this with a low-end printer. First is the stability and wearability of ink. Second, the ink is expensive." Many companies are working on thermal technology, he says, adding that as long as special paper is required, thermal printers won't gain a big market share.

He adds, though, that thermal technology is the easiest way to reduce printer cost. Thermal printers typically contain few mechanical parts and are very quiet. Kojima believes that a 60- to 80-cps thermal printer could be priced at $200 in two to three years, if the printer contains an in-line thermal head such as that offered by Olivetti. The Olivetti printer is manufactured by Shinwa.

Others interested in thermal printing include Toshiba and Epson. Epson has patents on plain-paper thermal printing using a thermal head and thermal ribbon. "One of the most difficult parts of non-impact printing is that you can't make multiple copies. All business machines require copies," says Epson's Aizawa. C. Itoh remains skeptical of thermal printers because they still require specially coated paper. C. Itoh's Kikuchi believes dot-matrix printers will remain strong, mainly because of price. ■

PRINTER MANUFACTURERS IN JAPAN

	Serial	Line	Non-Impact
Alps Electric	X		
Ando Electric			X
Brother Industries	X		
Canon			X
Casio	X		X
Chuo Electronic	X		
Citizen	X	X	
Data General Japan	X		
Epson/Shinshu Seiki	X	X	
Fuji Xerox			X
Fujitsu	X	X	X
Hitachi	X	X	
Hokushin	X		
IBM Japan	X	X	
Konishiroku			X
Kusuda Office Equipment Co.			X
Marubeni Electronics	X		
Marubun	X		
NEC	X	X	
Nikkyo Electric	X		
Oki Electric	X	X	
Oki Univac	X	X	
Olivetti Japan	X		
PanaFacom	X		
Ricoh	X		
Sankyo International	X		
Seikosha	X		
Sharp			X
Shinko Electric			X
Siemens	X		X
Tanimura	X		
TEC	X		
TI Asia Ltd.	X		X
Tokyo Heavy Industry	X	X	
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Source: Japan Electronic Industry Association, Peripherals and Terminals Guidebook, 1981

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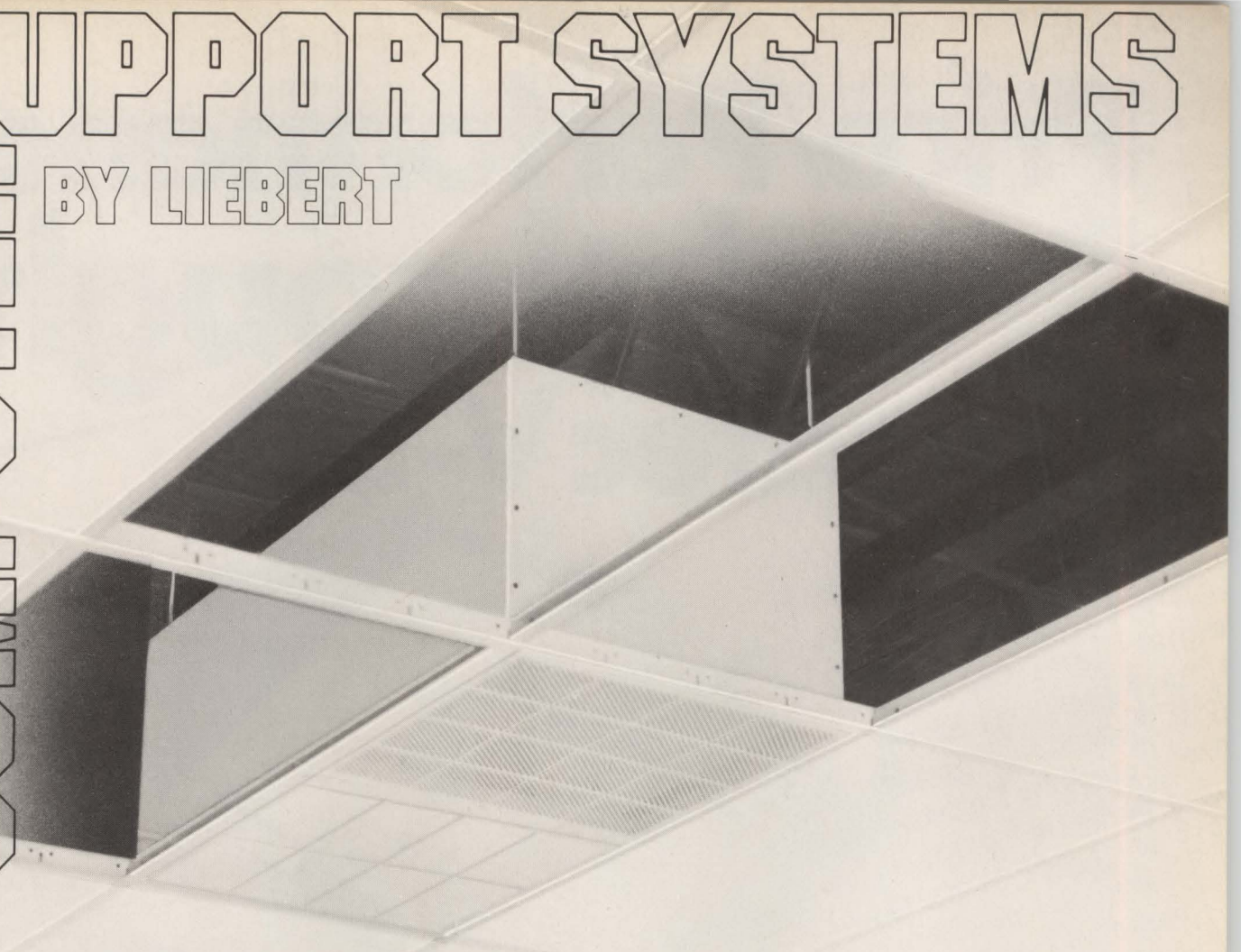

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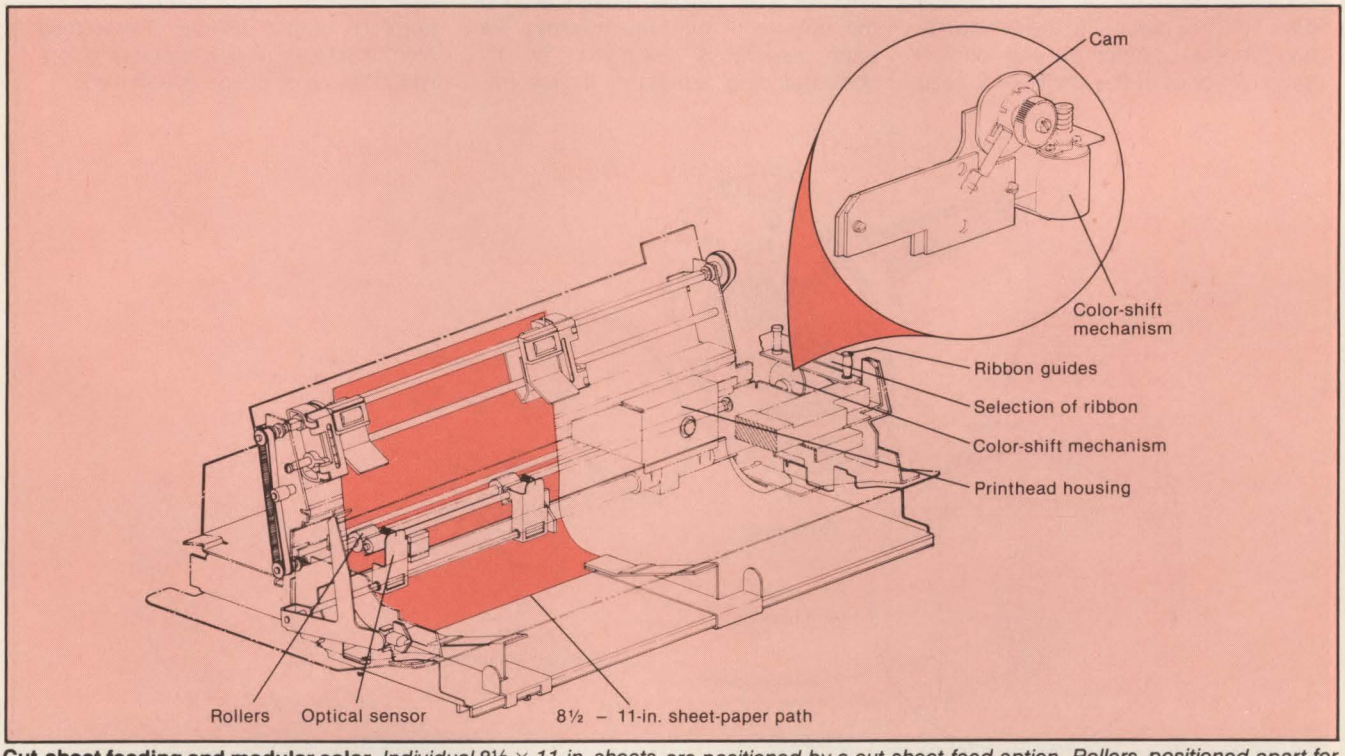
Integral Data System's Prism allows users to add new capabilities, including higher speed and graphics, simply by adding a ROM

Today's typical μc user buys a system to do a specific job or set of jobs, such as word processing, statistical analysis, financial modeling, general ledger or accounting. But before long, the user often embarks on a search for new applications—a development that has spawned a tremendous "aftermarket" for software, hardware add-ons and accessories. This search usually runs into a major financial roadblock: how to upgrade



Cut-sheet feeding and modular color. *Individual 8½ × 11-in. sheets are positioned by a cut-sheet-feed option. Rollers, positioned apart for EDP paper feed, are pinched when the feed switch is engaged. As each cut sheet is fed into the printer, a reflective optical sensor is tripped. Rollers engage 1 sec. later, advancing paper to first possible print line. Also shown is the placement of color-shift mechanism beneath the ribbon cartridge. A four-sided optically encoded cam shifts the ribbon to one of four color bands within 100 msec.*

Prism's design tackles three long-standing mechanical problems: poor dot matrix character resolution, expensive techniques for positioning the print head and paper and time-consuming manual positioning of cut sheets.

the system printer for the enhanced capabilities that new applications require.

A dot-matrix printer from Integral Data Systems, called the Prism, reduces the expense of upgrading by permitting users to add modules for color, graphics, greater resolution, higher print speeds and character sets, often by adding little more than a ROM to the system. Speeds of the basic Prism range from 110 cps (mono-spaced mode) to 150 cps (proportional spacing, 24 × 9 matrix density), and an optional module increases the speed to more than 200 cps in an open-matrix font. An 80-column version of the basic Prism sells for $899; a 132-column model is $1299.

A Motorola 6803 μp and a real-time multitasking operating system control the Prism's functions. One board contains the unit's control electronics, including 2K of RAM and 8K of ROM. ROM can be expanded to 24K for OEM requirements. The system provides both RS 232C and Centronics-compatible parallel interfaces. For greater flexibility, the printer interface resides on a separate card that plugs into the controller board, enabling an OEM to substitute an interface to meet specific needs.

The Prism operating-system and foreign-character sets reside in 6K of ROM, with the remaining ROM available to the user or OEM for special character sets or enhancements. Plug-in ROM chips enable many performance modules to be implemented with simple ROM chip changes on the controller board.

The Prism prints correspondence-quality print bidirectionally in a 24 × 9 overlapping dot matrix at 110 to 150 cps. Character densities are 10, 12 or 16.8 cpi, and double-width characters are also available.

The basic package

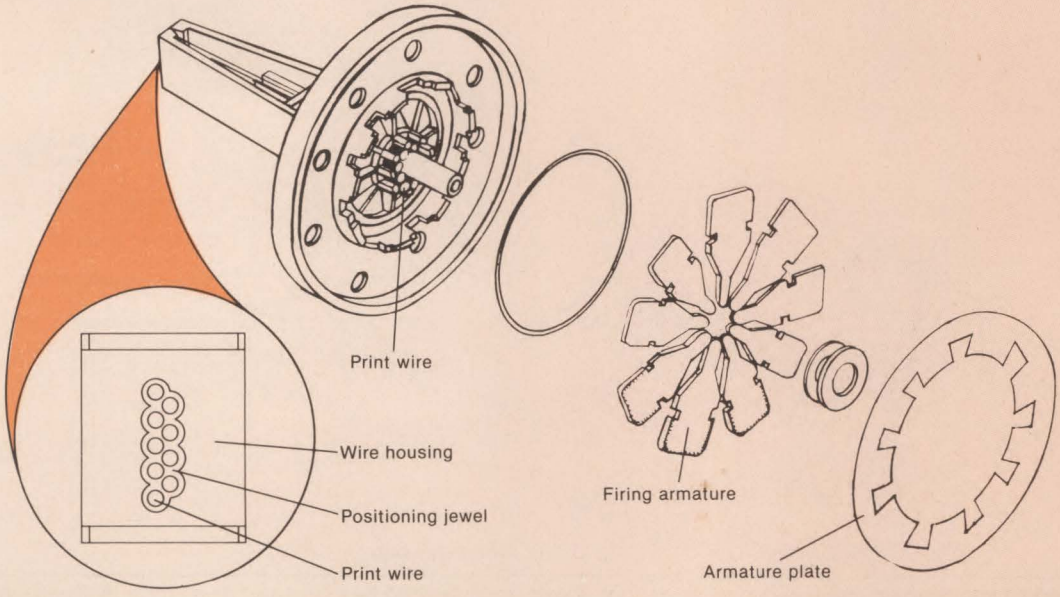
The basic Prism features logic-seeking print-head movement; a 7.5-ips paper-slew rate; two levels of diagnostics: automatic power-on systems-check and a built-in operator-initiated self-test providing a repeat-

OVERLAPPING FOR HIGHER RESOLUTION

The IDS Prism uses a nine-wire ballistic print head having a staggered two-row configuration. One row has five 14-mil-diameter needles, and the other has four. The firing algorithm is such that each dot overlaps adjacent dots 10 to 20 percent in the horizontal and vertical planes on the printed page. A jewel in the print-head nose guides each needle as it strikes the paper. The jewel is primarily responsible for Prism's vertical overlap and enhanced print quality.

Print needles are fired by solenoids, one per wire, placed radially around the outside of the wire housing. As each needle is "slapped" by its corresponding armature, it flies forward to strike the ribbon.

An important benefit of the overlapping dot matrix in the graphics mode is an 84- × 84-dpi presentation with a square-aspect ratio and unusually high resolution for a low-cost raster-graphics output device. Overlapping also facilitates mixing process colors when the color option is installed.



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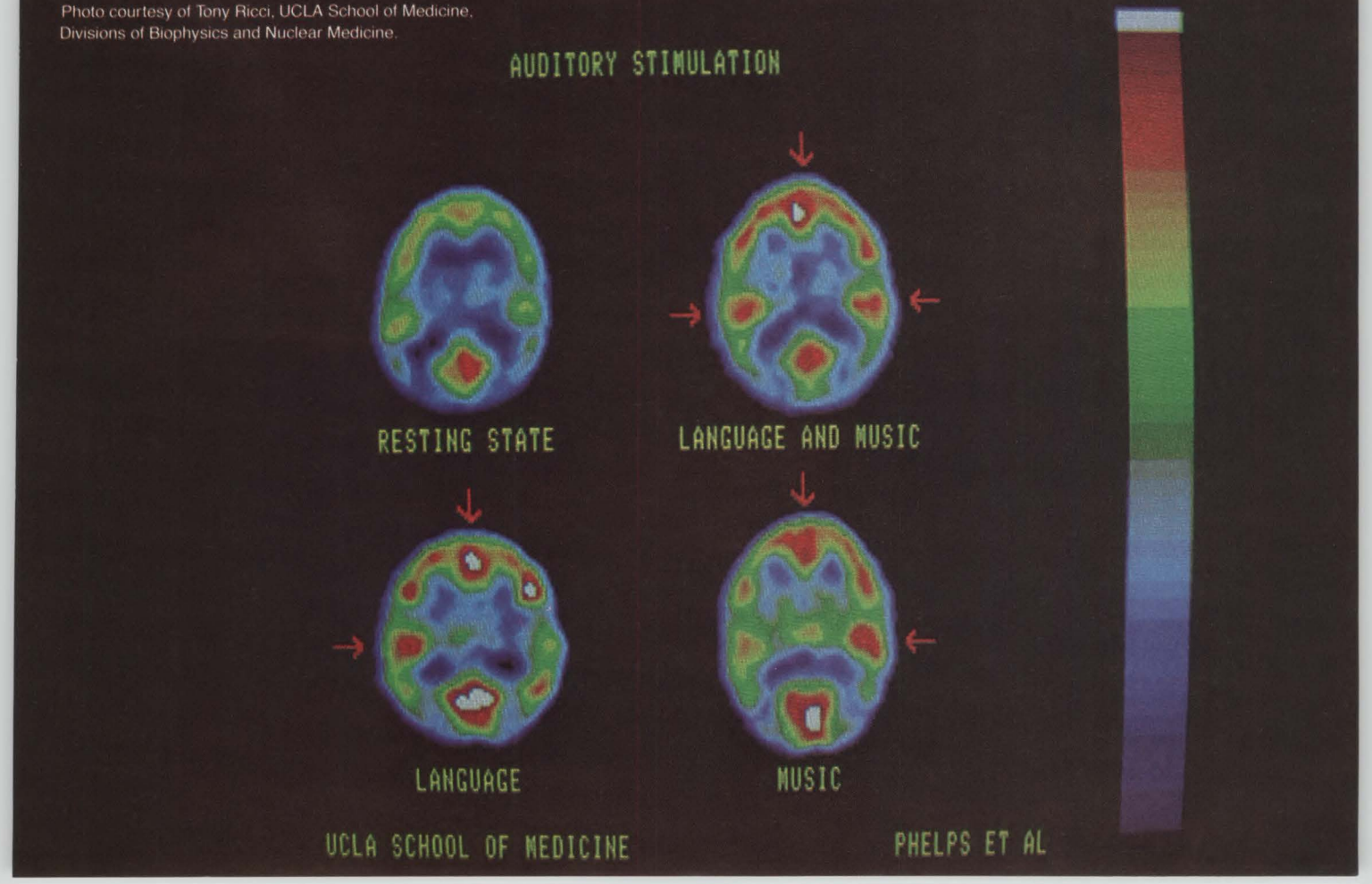
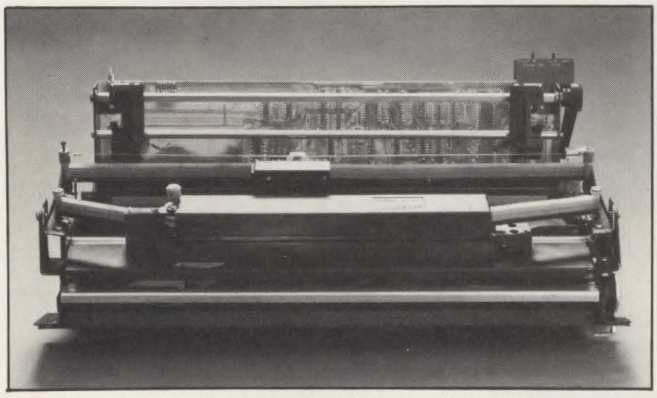


A Motorola 6803 μp and a real-time multitasking operating system control the Prism's functions.

ing alphanumeric pattern; switch- or software-selectable paper lengths and line densities (6 or 8 lpi or programmable in 1/96-in. increments); selectable baud rates of 300, 1200, 2400 or 9600 bps; proportional character spacing with automatic text justification, perforation skip and line feed with carriage return; and tractor feed of forms with as many as six parts. Ergonomic features include the printer's low profile and relatively quiet (less than 63-dBa) operation.

In addition to answering low cost and modularity problems, Prism's design tackles three long-standing mechanical problems: poor dot-matrix character resolution, expensive techniques for positioning the print head and paper and time-consuming manual positioning of cut sheets.



The Prism dot-matrix printer from Integral Data Systems *can be upgraded with add-on modules. An 80-column version of the basic unit sells for $899, and a 132-column model is $1299.*

To improve character resolution, Prism uses a nine-wire print head arrayed in two staggered rows of needles, providing an overlapping dot pattern that imparts solid lines and curves to each character (see "Overlapping for higher resolution," p.208).

Proper positioning of print head and paper requires costly optical encoding of motors or closed-loop feedback. Prism relies instead on greater control over its two stepper motors that drive the print head and paper-feed mechanism. The high-torque, conservatively rated motors improve reliability; vertical forms are handled in 1/96-in. increments, and the print head is positioned in 1/120-in. increments.

Modules make the difference

The printer's performance and versatility are enhanced by adding optional modules, some available now and others expected soon. These options include:

- **Cut-sheet feed,** which semiautomatically positions each newly inserted sheet to exactly the same spot as the ones before it. The paper is then advanced to the first possible print line, which can be programmed by a user at the printer or through the system. Software then moves the paper to any print position.
- **Prism color,** a ROM-controlled module, provides a choice of three four-zone ribbons—one with black and three process colors (cyan, magenta and yellow) for color mixing; another with black and three primary colors (red, blue and green); and a third with black only, for automatic ribbon shift, and cycles to extend the life of the ribbon in non-color applications. Estimated ribbon life for each band is 2.5 million characters. The color modules can be installed in 20 to 30 min.
- **Dotplot graphics,** which provides 84- × 84-dpi raster graphics in a single pass, and 168- × 168-dpi with four passes. Dotplot is installed by plugging ROM into a socket on the controller card.
- **Sprint mode,** a ROM firmware substitution that transforms the Prism into a dual-speed printer able to print more than 200 cps in a standard open matrix.
- **Special character sets,** which can be incorporated via a firmware ROM upgrade, include a wide variety of special character sets, including Helvetica, foreign characters, APL and scientific notation.
- **Cassette sheet feed,** which attaches to the printer and automatically feeds as many as 200 sheets.

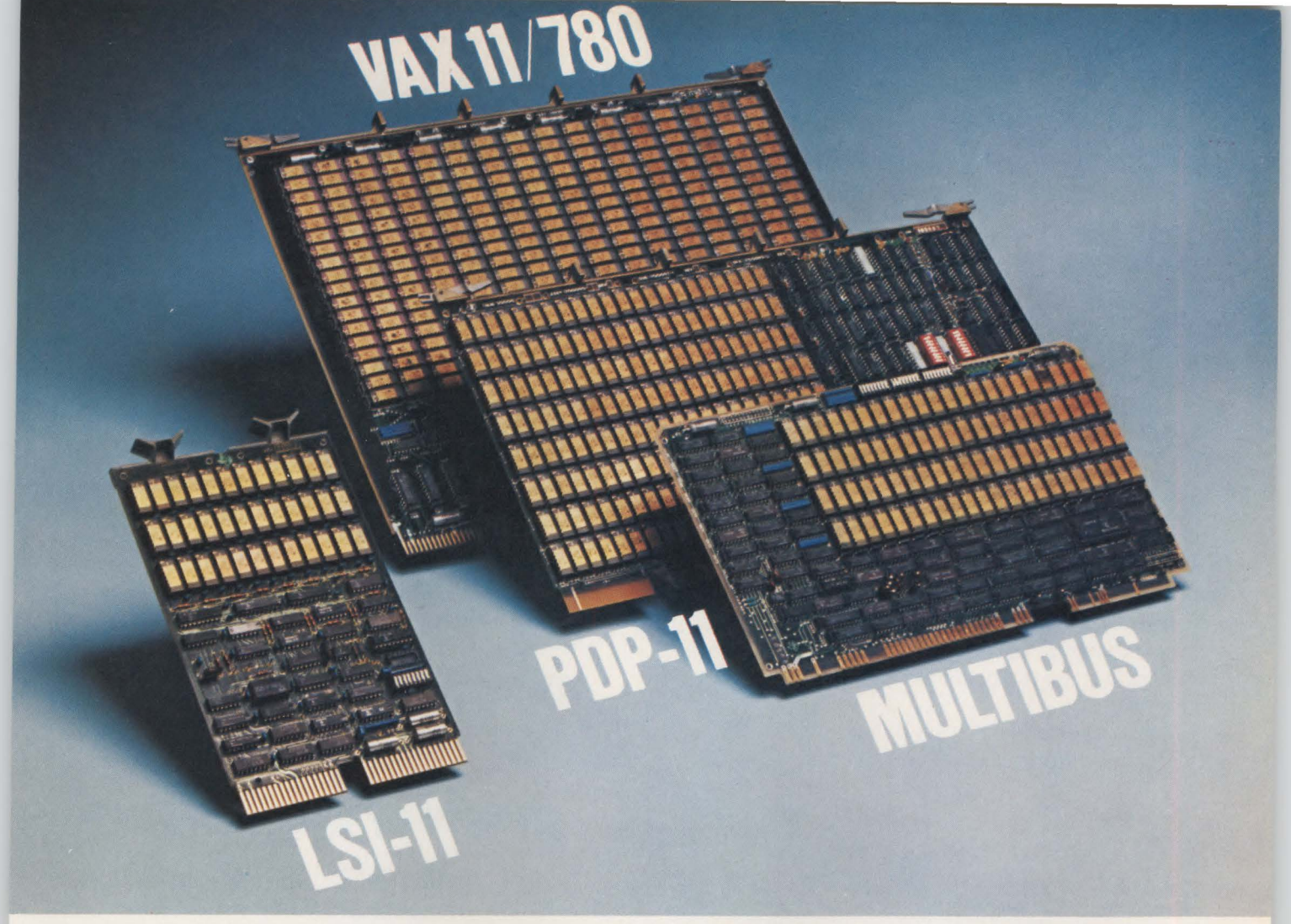
Marketing the Prism

IDS markets Prism to key systems manufacturers through its 1300 dealers, including Computerland, The Computer Store and Team Electronics, and 50 worldwide distributors, including High Technology, CCM Inc. and Teleprinter, Ltd. More than 200 independent IDS-trained and approved service centers provide field service, and on-site third-party service is also available.

As a result of its experience in the retail-store market—selling 50,000 units during its first three years—IDS believes that success of the Prism concept in the retail market centers on dealers. The fact that only one basic printer need be kept in stock to meet a multitude of application requirements should help consolidate inventory. Second, modular printer upgrades will bring customers back (just as software often does) when customers add applications and upgrade hardware. Third, IDS maintains a mailing list compiled from returned warranty cards to inform customers about new upgrade products.

In the OEM market, IDS offers the Series 2000 version of the Prism. This product will also be available in 80- and 132-column models, but will have customized software and interfacing to meet OEM requirements. Prices will depend on modifications and quantity. ■

John E. Leaird is a consultant at Leaird Associates, Arlington, Mass.



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VAX†	TMM30000					X	X	X
Multibus‡	TMM40010[2]	X	X		X	X		

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PRINTERS

Print-band technology matures

RICHARD IRELAND, Documation, Inc.

Less expensive and longer lasting bands are just two reasons for the growing popularity of band printers

Print bands have revolutionized the impact line-printing industry since the first band printer was introduced in 1970. Lower cost, printing flexibility and reliability, so important to anyone buying a printer, have motivated nearly all manufacturers of train, drum or chain printers to add band printers to their product lines. Forecasts estimate that 55 percent of all line printers shipped in North America in 1982 will use bands (Fig. 1).

Building better bands

All band printers sold today are "back printers." Print hammers behind the paper push the paper against a ribbon that has a continuous steel band behind it. The steel band, etched with alphanumeric characters, moves horizontally. Hammer strokes—as brief as 17 μsec. in some cases—imprint characters on the page. Logic circuits in the printer synchronize the firing of the hammers with the moving characters on the print band by using magnetic pickups to sense character timing marks also etched on the band.

Print bands are etched to make a font by using a process similar to that used in PC-board manufacturing. Etching reduces the cost of both volume production of standard font bands and customized character sets.

The extreme accuracy required to manufacture print bands is solely a product of precision artwork. Photo reduction of plotting techniques produces thousands of nearly identical bands. The procedure includes:

- Generating the artwork,
- Determining the sequence of characters,
- Reducing the artwork photographically (usually a 3:1 reduction),
- Cleaning the steel sheets and coating them with photoresist, a photosensitive semisolid that solidifies on exposure to ultraviolet light,
- Imposing the art on the steel with ultraviolet light, converting the characters to a plastic hard enough to withstand acid,

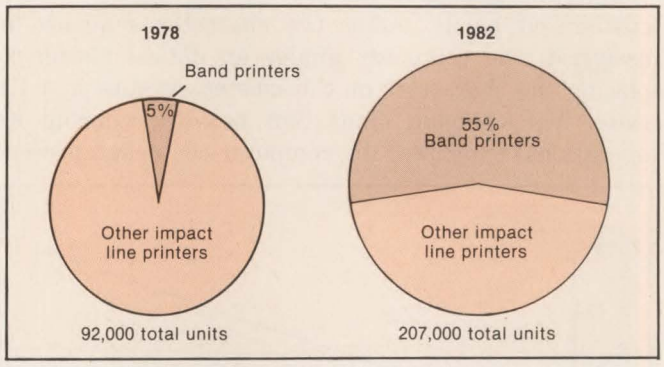


Fig. 1. Band-printer shipments will grow *from 5 percent of the North American impact line-printer market in 1978 to an estimated 55-percent share of the total 207,000 impact line printers sold in 1982. (Source: Dataquest)*

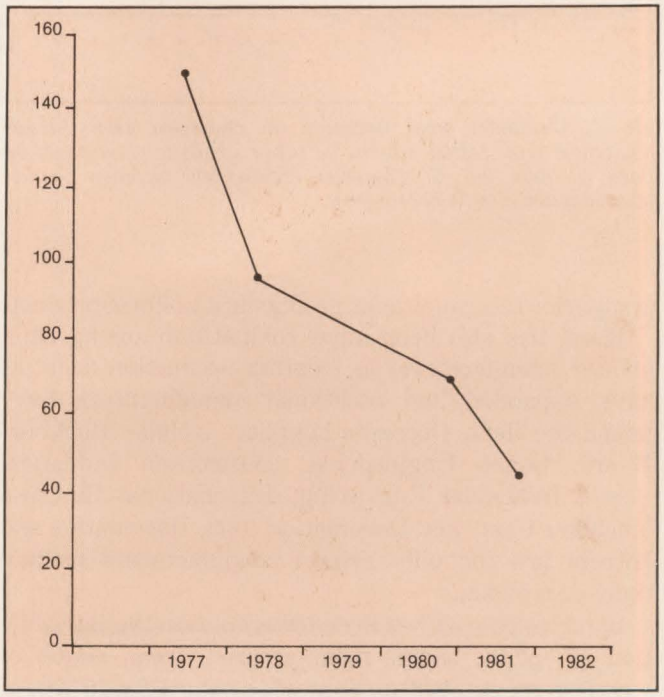


Fig. 2. Print-band prices have dropped steadily *as a result of increasingly better technology and more competition among manufacturers.*

Failure is usually the result of wear and is influenced by character area and shape, hammer contact time, ribbon material, band steel and even printer application.

- Etching away the background with acids, leaving the characters raised to the correct height,
- Slicing the steel sheet into bands, which are then laser-welded and polished to minimize ribbon wear.

Prices are dropping

During the past five years, print band prices have decreased dramatically as a result of increased competition and innovative technology (Fig. 2). One manufacturer, Documation, Inc., a subsidiary of Storage Technology Corp., Melbourne, Fla., has used CAM techniques to reduce the cost of making low-volume customized bands. After the character sequence is assigned, the computer guides an optical plotter in placing the characters on the master artwork in a 1:1 ratio. The company finds that besides reducing its operational expenses, the computer-controlled process is superior to a camera for producing a uniform product.

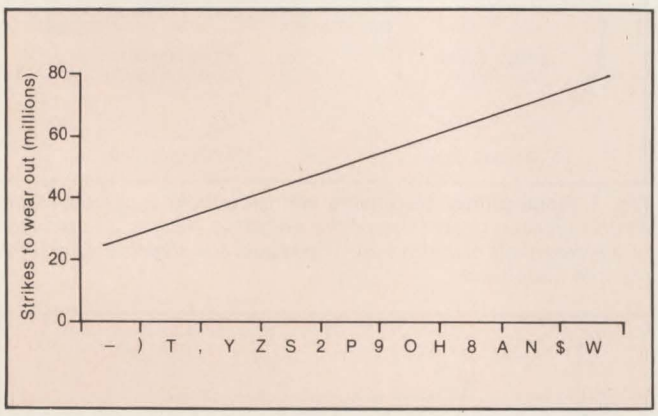
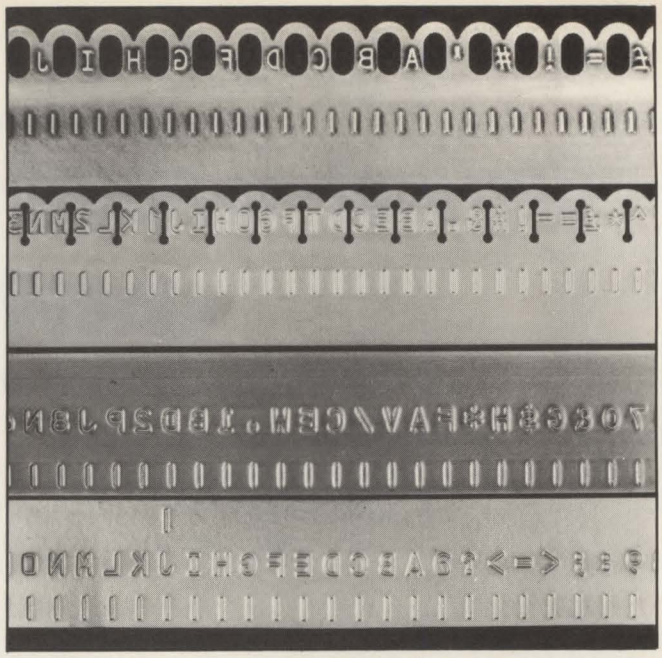


Fig. 3. Character wear depends on character area. *Smaller characters wear faster. It takes far fewer strikes to wear down the dash (l.) than the W. Character impressions typically become unacceptable after 0.002-in. wear.*

There has also been more competition among band printer manufacturers as existing production facilities have expanded and additional manufacturers have joined the field. Domestic suppliers include: Buckbee-Mears, Grace Engineering, Hutchinson Industrial Corp., Industrial Engraving, International Business Machines Corp. and Documation. IBM, Documation and Hitachi are the only printer manufacturers making their own bands.

Band usage cost has been lowered with the introduction of print bands manufactured from alloys of stainless steel, such as Sandvik or the Hitachi GIN-6. These steels are harder than the traditional 410 stainless types and extend character life two to three times that of characters made with 410 steel for the same cost. The harder alloys also are slightly more resistant to damage because of their higher tensile strength.



Various print bands are manufactured in America today: *From top: Dataproducts' B300 and B600, STC/Documation's/3000 and Control Data Corp.'s 9380 family. The vertical bars beneath characters are timing makers. The thickness of Documation's band varies from 4/1000 to 6/1000 in. Characters are raised 10/1000 to 12/1000 in.*

Prospective band printer users should investigate the type of steel used to make the band. All band printers will not operate satisfactorily with these new steels because the steels' magnetic properties differ.

Band printers offer variety

The major operational benefit of band printing is flexibility. Print bands are the line-printer version of interchangeable elements for typewriters. Users can easily change character-set type styles or lengths in 1 or 2 min., eliminating the need for service calls that are often required with other printer technologies.

Other example of the flexibility offered by print bands include:

- Optimized character sets such as a core-dump band with a high percentage of zeros and ones.
- Nonstandard character-set lengths. One company offers a 67-character set containing 64 ASCII characters and three special characters.
- Bands tailored to foreign-language alphanumeric applications, including Japanese and Korean.
- Extended character sets such as ALA or APL.
- Unique applications, such as plotting, bar-code oversized-character and user-designed-character bands.

Wear is inevitable

A print band, like a typewriter ribbon, is a consumable. Failure is usually the result of wear and is

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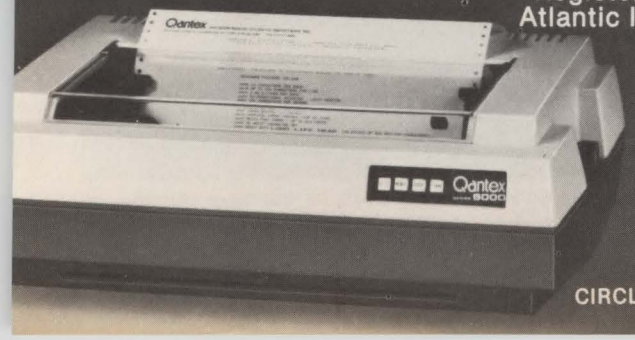

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During the past five years, print band prices have decreased dramatically as a result of increased competition and innovative technology.

influenced by character area and shape, hammer contact time, ribbon material, band steel and even printer application.

Character area is fundamental to character design (Fig. 3), so adding additional characters of the same small-area, high-use letter or number will extend band life and maintain or increase throughput. Some ribbons are abrasive and can shorten band life. If additional characters cannot be added and the abrasion problem cannot be overcome, the alternative is to use bands made of harder steel alloys.

The applications in which a print band is used also determine its longevity. If a printer is used only to print core dumps, a user will usually tolerate considerable degradation in print quality. If, however, the printer is used for general data processing, degradation is less acceptable, and the print band must be replaced more often. If the printer is used to produce letters for mass mailings, and both upper- and lower-case characters are used, very little degradation is tolerable. High-use characters such as lower-case "e" and "t" wear fastest and soon tend to print wider than others, thus degrading band life.

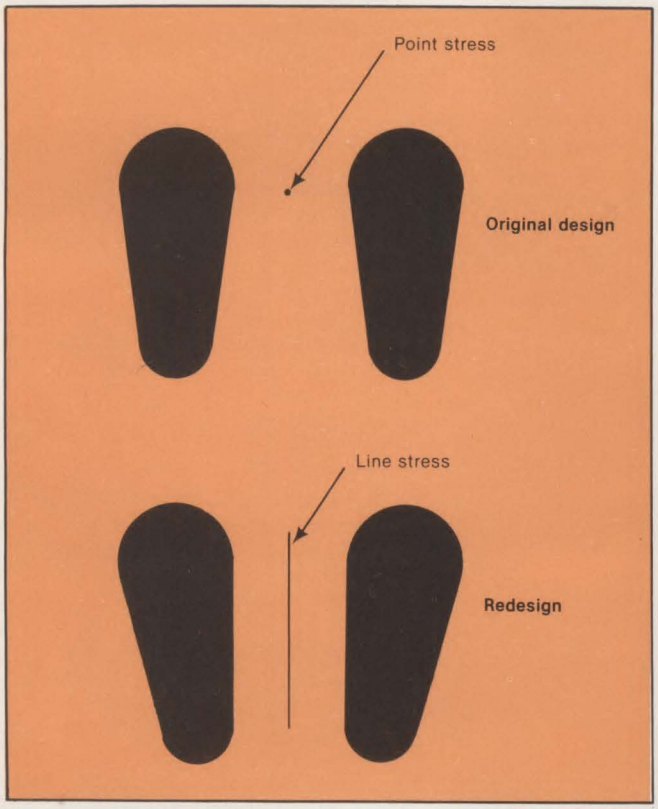
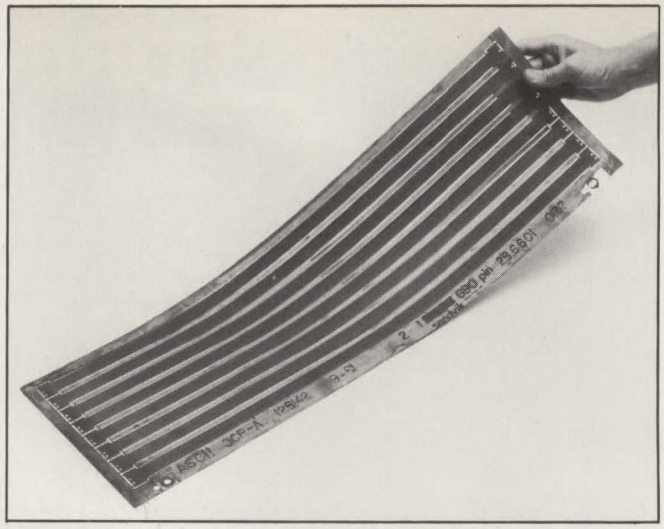


Fig. 4. Character restyling can increase longevity. *A simple redesign of this quotation mark lengthened a point stress to a line stress, extending character life.*



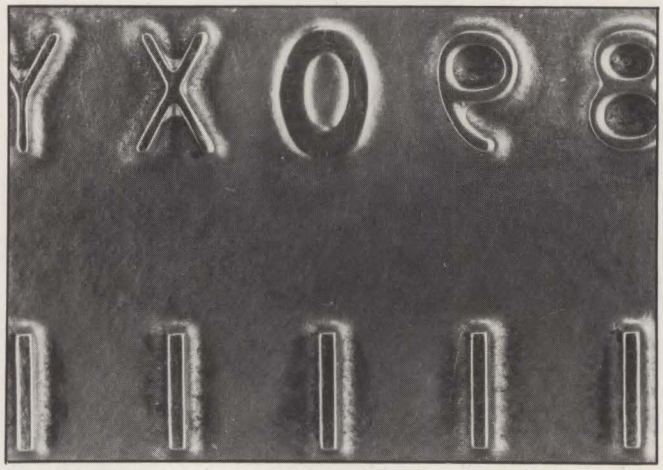
Print bands are etched from large sheets of stainless steel, *separated, butt-welded and polished. Documation's bands are typically 58 in. long and contain 432 characters.*

A print band weighs only a few ounces and can be rotated at very high speeds without the periodic lubrication required on other types of line printers. High-speed band printing is controlled by the response time of the hammer bank and paper-drive systems, not the band itself.

Character density on horizontal font printers, in which characters are narrower than they are high, is typically greater than that on a drum printer. Higher density characters result in more characters moving past the hammer bank per unit of time, yielding higher speed printing when all other factors are equal. As the band velocity is reduced, printer throughput decreases, but the sharpness of printed characters improves. Speed and character sharpness must be weighed against the applications.

Reducing failures

Slight deviations in print-hammer timing causes a horizontal misregistration of characters that is only slightly noticeable. The same characteristic is true with



Heavily used characters can be worn by abrasive ribbons, *as evidenced by the "spreading" of the numeral zero.*

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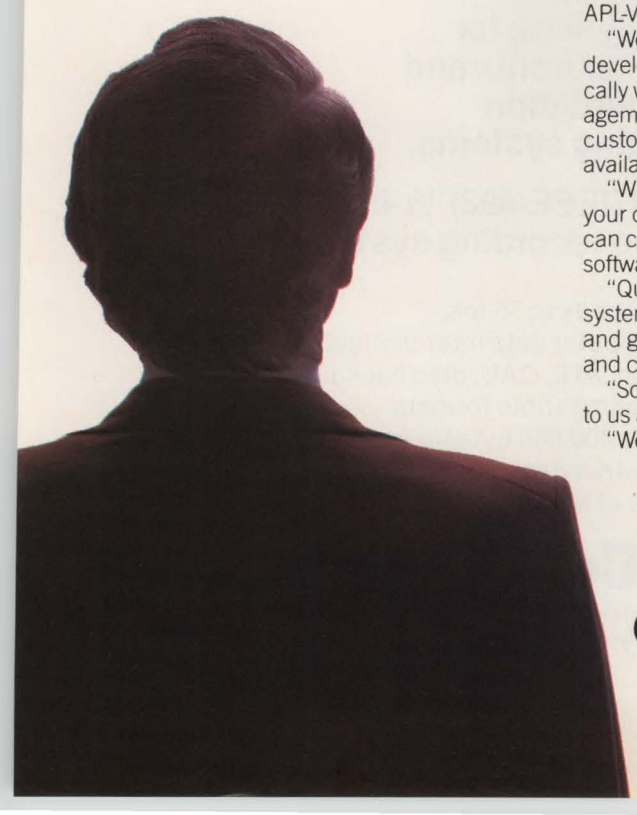

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Users can easily change character set type styles in 1 or 2 min., eliminating the need for service calls that are often required with other printer technologies.

other horizontal-font printers. With drum printers, however, any timing inaccuracies cause a very noticeable wavy print line.

Printer manufacturers have learned how to optimize character placement for minimum breakage. A properly installed and high-quality print band is a very reliable component. Some print bands have recorded in excess of 100 million lines on more than 3000 miles of paper. This is quite a feat for a paper-thin ribbon of stainless steel. Premature catastrophic failures occur, however, because of operator abuse of poor character placement and design.

Other failures have been traced to inter-character stress (Fig. 4). One example is a "greater-than" symbol facing a "less-than" symbol (><). In this case, stress can be lessened by blunting the pointed ends of the adjacent characters. In other cases, some bands with extremely wide characters, such as Text or Courier type styles, must be laid out carefully to minimize stress.

Band printing has captured a major portion of the high-speed printing market by offering greater printing performance at lower cost than other high-speed impact technologies. The latest band printers offer even greater cost savings by incorporating longer wearing print-band materials, LSI circuitry for increased reliability and improved self-diagnostic features for better operator maintenance. ■

Richard Ireland is senior engineer at STC/Documation, Palm Bay, Fla., where he has set up artwork-generation, character-design, band-layout and finishing and quality-control methods.

NEXT MONTH IN MMS

Disk drives get the feature spotlight in the February issue of Mini-Micro Systems. There will be major product surveys, including:

- A detailed look at the floppy-disk market, also with complete listings of manufacturers.
- A comprehensive survey of the Winchester disk market, also with complete listings of manufacturers.

Other articles will cover:

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CIRCLE NO. 166 ON INQUIRY CARD

The advent of a new daisy

KENNETH C. FREUND, Dataproducts Corp.

Dataproducts DP-55 features modular approach that enhances both its user flexibility and servicing

The combination of acquired daisy-wheel technology and a "keep-it-simple" design approach has spawned the DP-55, the latest daisy-wheel printer from Dataproducts Corp. Two other innovative features in the 55-cps printer are a new hammer design that has fewer moving parts and creates less noise than conventional hammers, and the use of PROM modules that offer custom function selection for end users or OEMs.

Dataproducts entered the daisy-wheel business in 1979 with the purchase of that technology from Plessey Corp. The Plessey technology was refined for 18 months and offered in the Dataproducts D-50 daisy-wheel printer, which served until a development group designed a third-generation daisy wheel "from the ground up." The DP-55 is the embodiment of that group's efforts.

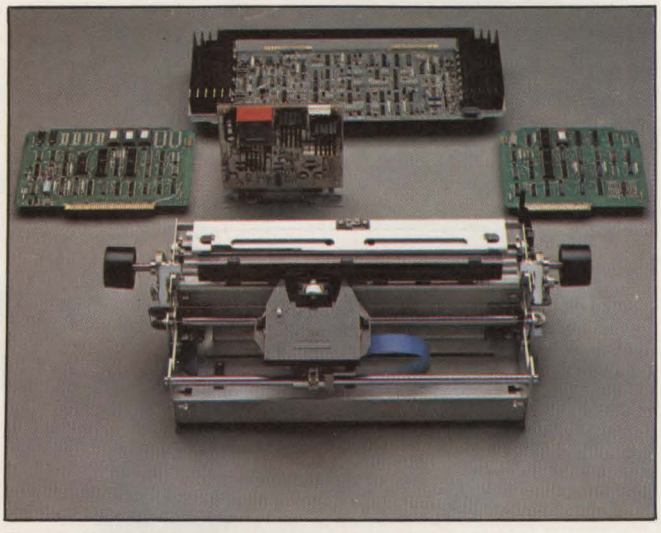

Fig. 1. Exploded view of printer *shows hinged board cage in background, into which circuit boards are folded. The fold-in, fold-out approach simplifies servicing the printer, and the separate boards for analog and digital electronics provides more efficient heat dissipation than does combining those functions on one board.*

Back to the design basics

The DP-55 design philosophy gets back to basics: mechanical and electrical simplicity for maximum product reliability, high-quality print and optimal up-time. Mean time between failures is conservatively estimated to be 3000 hours at a 25-percent duty cycle; mean time to repair any failure is less than 15 min. The DP-55 is believed to be far less complex, have fewer moving parts and require fewer adjustments than any other available daisy-wheel printer. A single-action print hammer, compatibility with virtually any existing system and modular design should enhance the printer's appeal.

The DP-55's modularity is embodied in multiple snap-in, snap-out PC-board assemblies that are housed in an easy-access, hinged board cage that folds out flat or locks in place at an angle for fast service or board replacement (Fig. 1). The modular design also accounts for the DP-55's ability to accommodate so many OEM and end-user requirements—most importantly, superior-quality print, relatively quiet operation (listed at 62 dBA), a variety of industry-standard printer-interface compatibilities and convenient printer/operator interface features. The OEM flexibility built into the DP-55 includes universal power-source capabilities, a wide range of printer-emulation interfaces, expandable programmable memory, custom function select PROM modules and built-in serviceability in both the electrical and mechanical design of the machine.

Easy on the operator

Operator ease is provided by a control panel equipped with LED displays that identify 16 printer conditions, including paper out, buffer overflow, modem off, ribbon out, carriage check and other status information. This display facilitates maintenance and keeps the operator aware of details that may require attention.

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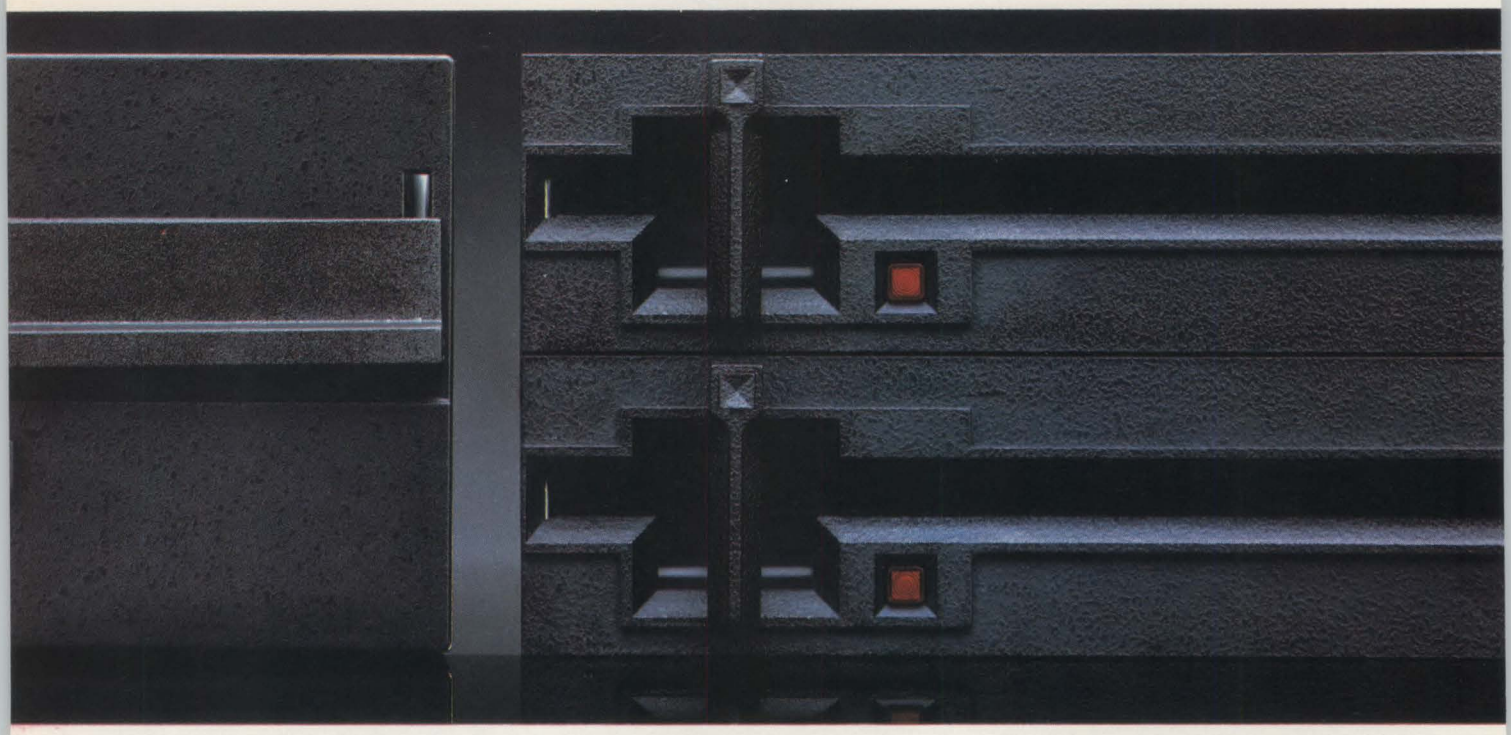

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Operator ease is provided by a control panel equipped with LED displays that identify 16 printer conditions, including paper out, buffer overflow, modem off and other status information.

In addition to the external control panel, the printer includes a functional setup select panel under the front cover. An operator can manually set more than 20 parameters for printer operation, such as use of plastic or metal print wheels, normal or hard hammer energy control of the innovative single-action hammer, 6- or 8-lpi spacing, auto line feed and others. Most of these functions can also be selected by a host computer by down-line loading instructions to the printer via the interface. There is also a manual printer and platen adjustment to accommodate forms with as many as six copies.

High-reliability electronics

Electronically, the DP-55 incorporates several common-sense design approaches. Its circuit-board assemblies, for example, are separated into analog, digital and interface modules. Each board has its own slot in the fold-out card-cage chassis and quickly snaps in and out of its slot to mate with a single edge connection.

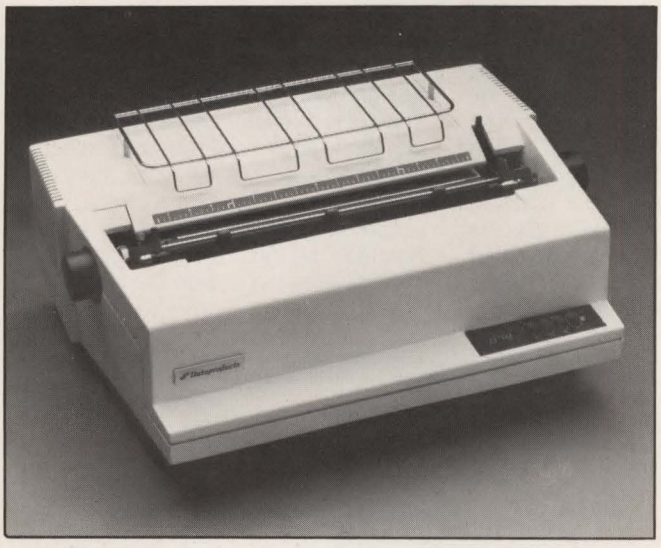


Fig. 2. The DPS-55 operates at 55 cps *with a plastic print wheel, and, at 62 dB, is one of the quietest daisy wheels available.*

Rather than crowd all analog and digital components onto a single card that is expensive to manufacture, test, repair and replace, the separate-card approach prevents many common printer failures. Because analog circuitry runs at higher temperatures and speeds and has more line-transmission inconsistencies than digital circuitry, most analog failures tend to be catastrophic, shutting the printer down. By expanding the board space available for analog components on a single dedicated board, the devices can be spread out to reduce heat buildup, line transients and analog noise—all of which means cleaner, more efficient operation and dependability.

The modular approach extends even to the motors used to drive the printer's various assemblies. Both stepper motors and DC servos are used: the former for driving ribbon and paper feeds, which require exact motor speeds from an open-loop motor; the latter to drive carriage and print wheel, which require constant current.

The printer uses a hybrid power supply with both common 60-cycle linear current and switching technology for controlled current. Power-supply design conserves energy and lightens line loads. The combination also provides cooler operation and less wear on devices requiring switched power, such as the printer's fast-acting internal motors. For manufacturing, it is less expensive to combine switched and non-switched power-supply control than to design and add a fully switched power supply. The unit also accommodates universal 100V, 120V, 220V and 240V operation with selection controlled by positioning a switch card in the terminal's fuse housing. The DP-55 has 6K bytes of PROM, which is expandable to 12K bytes, enabling the printer to be programmed in firmware to a user's application. An input buffer of 1K to 3K bytes of RAM holds data down-loaded from a host or serves as a screen dump, enabling an operator to load a page from the operator terminal as it is edited for printing. The operator can then move on to other tasks.

Hammer, noise and speed

Mechanically, the DP-55 features Dataproducts' proprietary single-action print hammer, incorporating a design that improves hammer-strike consistency for improved print quality and longer hammer life. The hammer differs from most daisy-wheel print hammers in that it doesn't employ a mechanically driven trigger that is activated electronically to slam the hammer into the print wheel. Instead, the single-action hammer uses a solenoid coil that electronically fires the hammer (see "How the hammer works," p. 222).

A bidirectional carriage assembly contains all carriage electronics on a built-in interconnect board to facilitate fast and easy replacement or maintenance of the hammer, ribbon motor, end-of-ribbon sensor, motor-transducer sensor and tilt solenoid. By mounting the interconnect board on the carriage, all carriage devices can be removed without disconnecting wires in the rear of the printer near their power source and then pulling the wires to the front of the machine.

At 62 dB in its standard cabinet, the DP-55 is one of the quietest daisy wheels available. A quietized cabinet rated at 55 dBA will be available as an option for even quieter operation. The DP-55's solid construction fosters rigidity, which results in low vibration and stable printing characteristics.

Using standard plastic print wheels, the printer operates at 55 cps when printing the 3A test pattern

Circuit-board assemblies are separated into analog, digital and interface modules.

(AAA-AAA-etc.) and 50 cps when printing "Shannon" text. End users can select from a variety of industry-standard mono-plastic, dual-plastic and metal printwheels in 88-, 92- and 96-character sets. Use of metal wheels results in a slight degradation in print speeds to about 48 cps because of the wheel's higher mass and longer settling times, which are required to achieve optimal print quality.

Options, features and interfaces

Print logic includes automatic bidirectional printing, automatic slew over consecutive spaces and line feeds, plus relative and absolute horizontal vertical tabulation. These features combine to improve printer throughput. Slew rate is more than 50 ips when tracking horizontally and 4½ ips vertically.

On-board diagnostics provide functional testing at the host computer's or the operator's command. Diagnostics include an overall printer operational and function test or a step-through test.

Dataproducts offers the DP-55 with Qume-, Diablo- and Centronics-compatible interfaces. OEMs can select the appropriate Dataproducts' daisy-wheel printer without any modifications for system interface. In addition, Dataproducts or an OEM can readily develop custom interfaces because of a modular interface board design.

HOW THE HAMMER WORKS

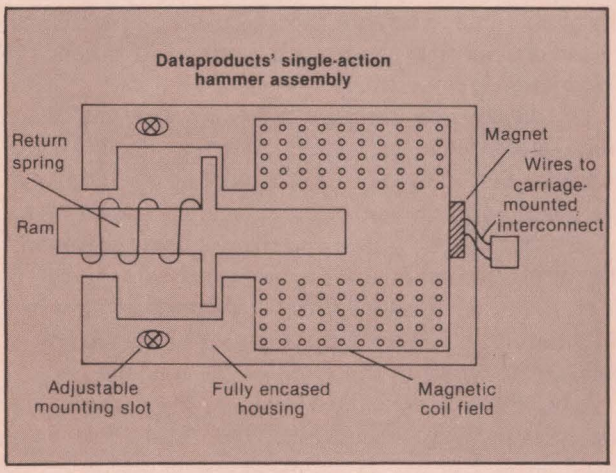
The patented single-action hammer assembly of the DP-55 (Fig. 3) is quieter, has fewer moving parts and produces sharper print quality than the conventional double-action ballistic-type daisy-wheel hammer (Fig. 4). Design simplicity is achieved through the use of a magnetic coil wrapped around the spring-loaded hammer ram. Electrical impulses to the coil fire the ram into the print wheel electronically so that impact is always uniform.

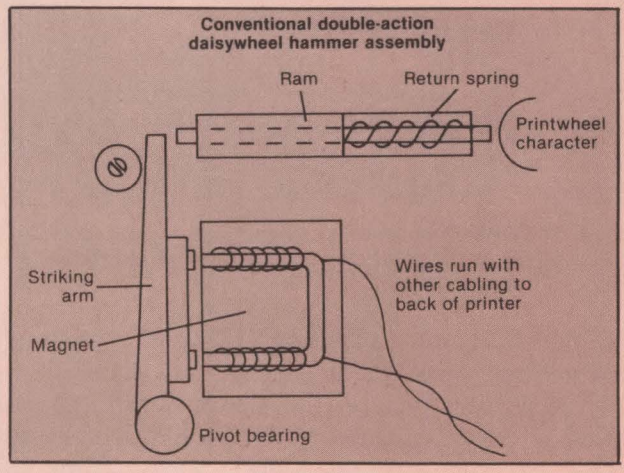
The spring and rear-mounted stabilizing magnet assure minimum recoil and rebound of the hammer ram. The only noise heard is that of the hammer striking the wheel. In a conventional assembly, which is much more complex because it has more moving parts, a double-action "click-clack" occurs because the magnetic pulse pulls the striking arm into the ram, which in turn fires the ram into the print wheel. More and higher frequency noise is emitted from printers using this type of hammer mechanism because two slaps occur.

Dataproducts design engineers claim the single-action hammer requires less maintenance because it has fewer moving parts and is housed in a single mounting assembly. If failures occur, the entire assembly can be easily removed from the carriage. Two screws hold the hammer in position, and its wiring runs to the interconnect board located in the carriage mounting. A conventional hammer assembly typically has wires that are included in a cable that runs to the power source in the back of the printer. If failures occur in a conventional hammer, the technician has more parts to remove and must disconnect the cable and remove the hammer wires from the cable. The technician must then re-mount more spare parts and rethread the cable, which requires more work, and is a much more expensive servicing procedure because there are more parts.

Print quality is said to be more consistent with the Dataproducts single-action hammer because its design eliminates rebound and its firing mechanism sends a smooth, constant stroke to the print wheel. There is also less flutter at the print wheel.

Life expectancy of the single-action hammer is said to be more than several hundred million strokes.





Figs. 3 and 4. Single is simpler. *The single-action hammer assembly (l.) in the DP-55 is simpler and quieter than a conventional assembly (r.). In the DP-55 assembly, electrical impulses to the coil fire the ram into the print wheel electronically, with no intermediate striking action. The spring and magnet assure minimum recoil of the ram. In the conventional hammer design (r.), there are two distinct firing movements: magnetic pulse pulls the striking arm into the ram, which, in turn, fires the ram into the print wheel, and produces the noisy "click-clack" sound typical of this design.*

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The friction platen is easy to remove for cleaning and to free any paper caught in the platen mechanism. Available accessories include tractors with unidirectional or bidirectional motors for continuous-form paper handling, bottom paper chute or automatic sheet feeders with single or dual paper bins.

Available interfaces include 8-bit μp bus, Qume or Diablo personality modules, Centronics parallel interface and standard RS232C, 20-mA current loop. Dataproducts also offers a word-processing package using add-on PROM modules.

The DP-55 is the first of a third-generation daisy-wheel line, with slower and faster models planned. Single-unit OEM price for the DP-55 is $1790, and delivery is 90 days ARO; first shipments are scheduled for this month. ■

Kenneth C. Freund is director of product management at the word-processing division of Dataproducts Corp., Irvine, Calif.

NEXT MONTH IN MMS

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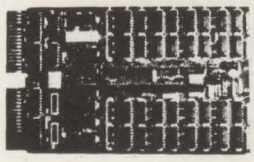

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COMPUTER GRAPHICS

A neglected theory gets a boost from graphics

DAVID FREEDMAN, GML Corp.

Computer animation closes a communications gap in one geologist's theory

Sometimes the only barrier between a scientific theory and its acceptance in the scientific community is a theorist's inability to communicate the idea effectively. For Dr. Richard Hey, a geologist at Scripps Institution of Oceanography in California, computer graphics provided the bridge between his elegant theory and a skeptical crowd of fellow researchers.

A theory ignored

Hey's "Propagating Rift" theory, presented in 1975, intended to provide a straightforward solution to a phenomenon that had been baffling geologists for years: a pattern of apparent fractures across sections of ocean floor. Other scientists proposed the existence of "micro-plates," plates of crust on the ocean floor, to explain the formations, but Hey's theory suggested that only two plates of crust created the patterns. Despite the simplicity of his theory, Hey's work was ignored. "There always seems to be a lot of resistance to simple ideas," he explains.

After struggling unsuccessfully for four years to gain acceptance for his work, Hey decided that the problem was not with his theory, but with the fact that no one understood it. People could not visualize the motion of the plates through time and space. As a result, Hey planned a sequence of pictures to illustrate the rifts. Computer graphics seemed the ideal medium for this animation.

Pictures help

Working first with a Tektronix 4010, and later with a Tektronix 4027 graphics display and a Prime 750 host computer, Hey and his colleagues developed an algorithm that simulated the plate motion. He then needed to develop a program that achieved a pattern matching those that had been observed. Because of the difficulty in obtaining data for events that occur miles below the

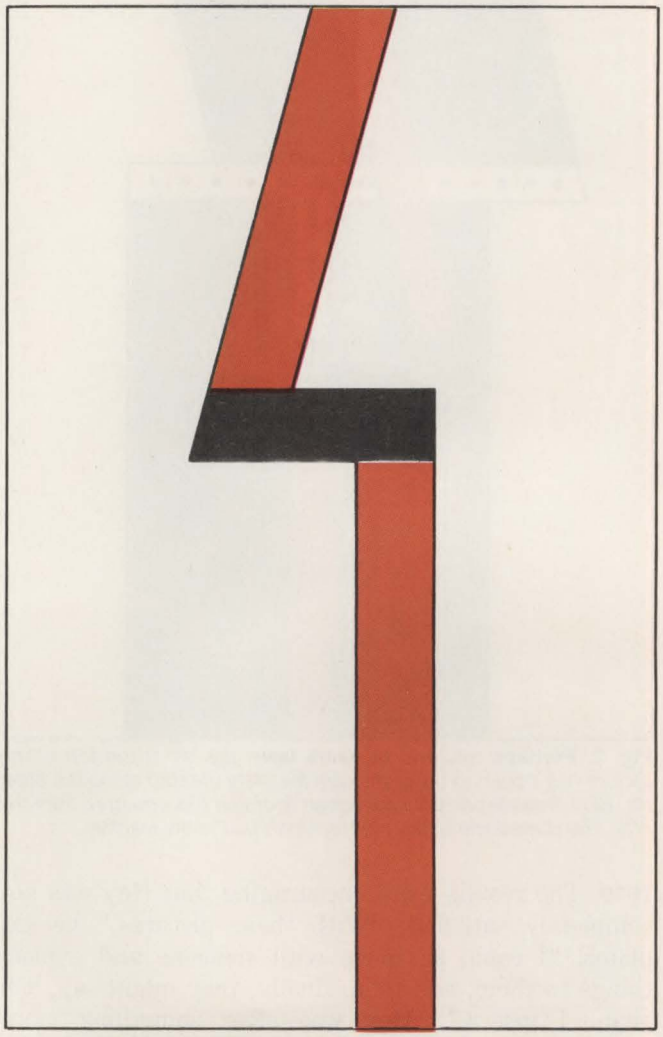

Fig. 1. Propagating Rift theory *is demonstrated by stills from computer-generated animated film. The pictures represent a view from above of a section of ocean floor. The brown lines are spreading centers, or rifts, from which new ocean floor moves perpendicularly. The heavy black line is a transform fault, marking the boundary between moving plates.*

Working first with a Tektronix 4010, and later with a Tektronix 4027 graphics display and a Prime 750 host computer, Hey and his colleagues developed an algorithm that simulated the plate motion.

ocean's surface over millions of years, Hey used "forward modeling." With forward modeling, Hey guessed at reasonable values for the variables, and compared the resulting picture to the actual patterns. He then continued to adjust the variables until the pictures matched.

Hey showed the pictures to fellow researchers in

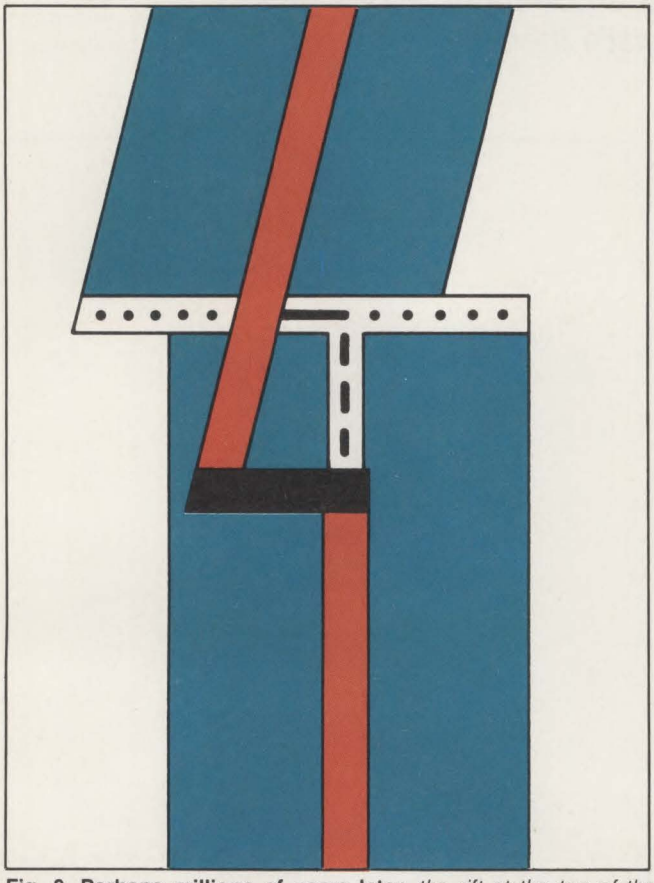

Fig. 2. Perhaps millions of years later, *the rift at the top of the picture has begun to break through the plate created along the other rift. Blue areas represent new ocean floor that has emerged from the rifts. The dotted line is the old transform fault, now inactive.*

1979. The results were encouraging, but Hey was not completely satisfied. "With these pictures," he explains, "I could sit down with someone and explain things to them, and then, finally, they might say, 'Oh yeah, I get it.'" Hey was after something more striking.

Film brings acceptance

With the help of Stanford geologist Doug Wilson, Hey began work on an animated film. They constructed an animation platform for a Bolex 16-mm. camera, aimed the camera at the display screen, and produced the movie frame by frame. Although it took eight hours to make a 3-min. film, Hey believes it was worth the effort. "The first time I showed the movie to colleagues, the people with competing theories were sitting in the front row. After the film, they each agreed that my theory explained things that theirs didn't."

Others confirm the impact of the film. Dr. Eli Silver, with the University of California at Santa Cruz, had a rival theory, but the film helped change his mind. "Another area of consciousness is awakened by a visual presentation," says Silver. "Certain things really struck me." Dr. Richard Carlson of Texas A & M University, agrees: "The film is very convincing."

Since the film was shown, support for Hey's theory has increased. Several phenomena that have puzzled geologists and oceanographers might now be solved as a result of Hey's model. Researchers hope to use Hey's model to predict the existence of valuable deposits of ores near the edges of plates. Hey plans to spend time next year near the Galapagos Islands, investigating rift propagation with high-resolution geophysical techniques before exploring rifts in the Alvin diving vessel two miles under the ocean's surface.

More graphics to come

Much of this work is still speculative, but one thing is clear: Hey's use of computer animations probably increased the acceptance of his theory. This success has not been lost on his fellow scientists. "A lot of people are talking about making movies now," he points out. The University of California's Silver believes that computer animation will have "a significant impact on science communications in future years."

Some, however, see a danger in relying on animation techniques to push a theory. Carlson questions the

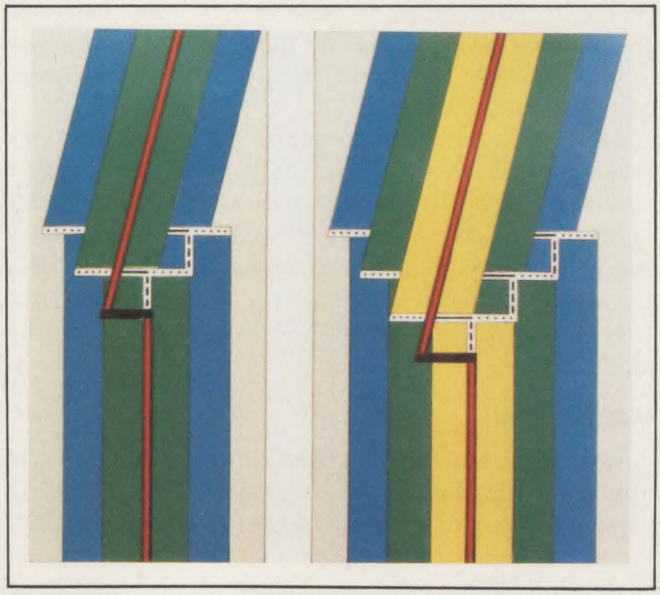

Fig. 3. and 4. The rift continues to propagate, *leaving behind a jagged pattern of inactive transform faults (dotted lines) and offset pieces of crust of different ages (colored strips).*

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CIRCLE NO. 199 ON INQUIRY CARD

Scientists should carefully compare a model to the actual data before accepting a theory, regardless of how good the model looks on film.

benefit of films such as Hey's for those who are unfamiliar with the details of the work. "People tend to get wrapped up in the dramatic effect of the film," he warns. "It's easy to be misled." Carlson feels that scientists should carefully compare a model to the actual data before accepting a theory, regardless of how

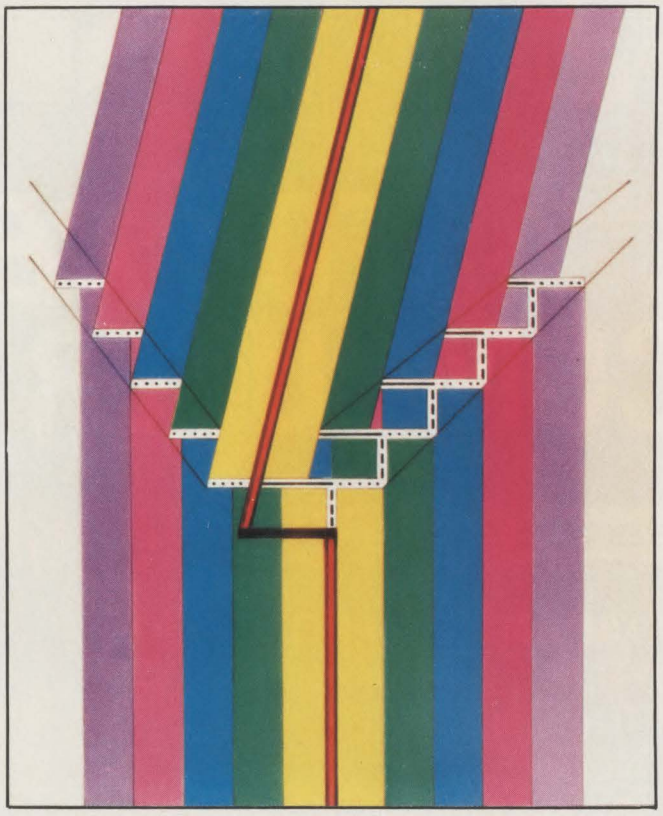

Fig. 5. The resulting pattern is similar to those observed today on the ocean floor. *Its complexity baffled geologists; some attributed the jagged line to "micro-plates," each with its own transform fault. The Propagating Rift theory is simpler, but was not accepted until demonstrated on film.*

good the model looks on film. But, having closely examined Hey's model, Carlson admits, "It's probably right."

Despite such misgivings, it is likely that more scientists will work with computer-graphics techniques in the future. As hardware prices drop, software improves and competition for research dollars intensifies, graphics becomes an increasingly indispensable tool in the laboratory. ■

David Freedman is an editor at GML Corp., Lexington, Mass.

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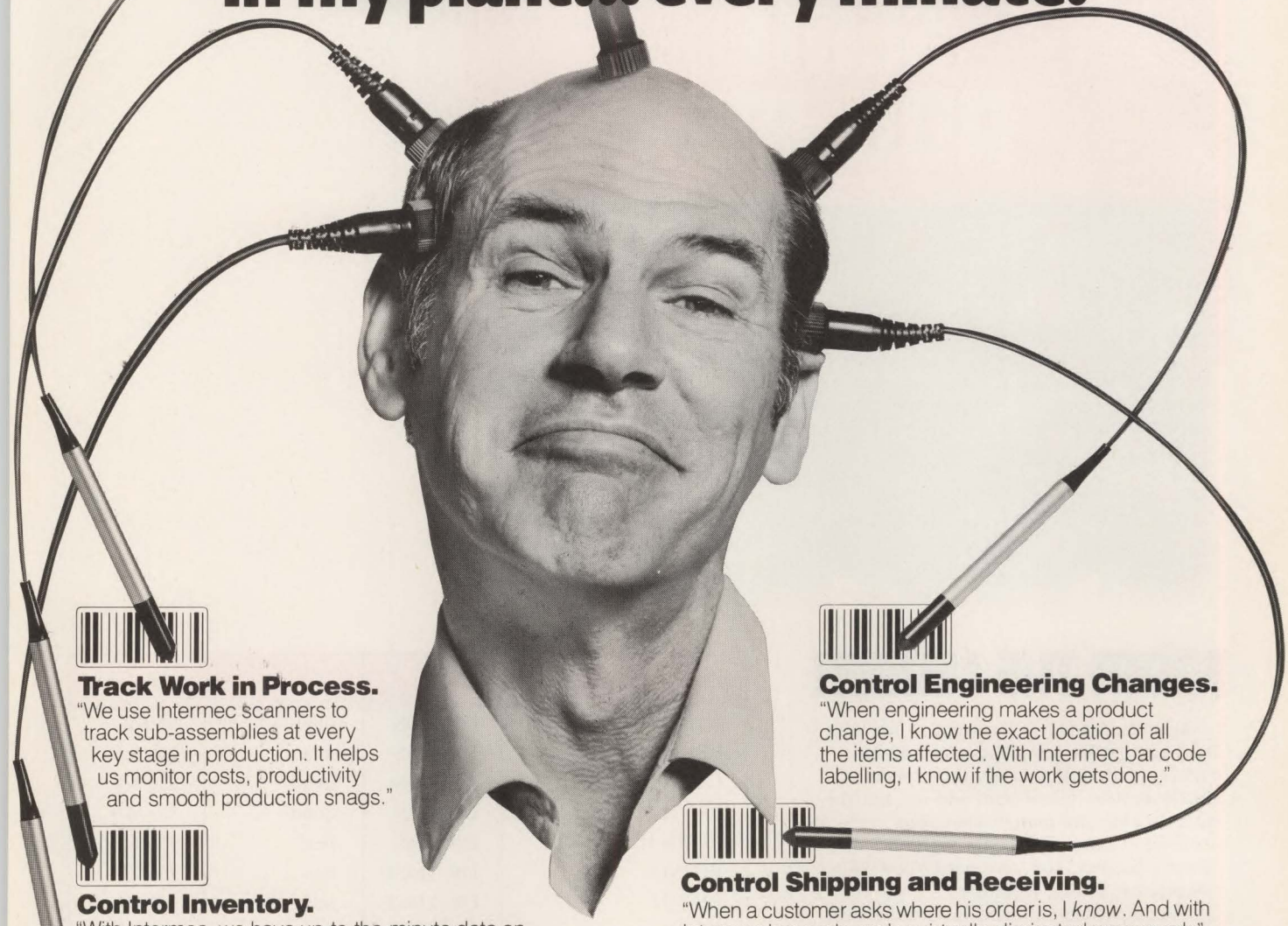

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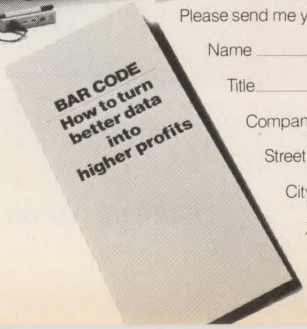

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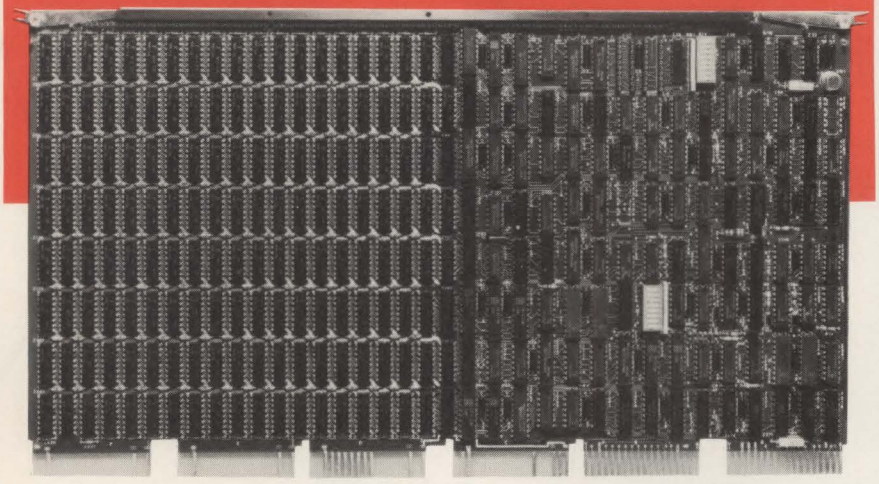

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CIRCLE NO. 112 ON INQUIRY CARD

SOFTWARE

INGRES: a data-management system for minis

HARVEY M. WEISS, Weiss & Associates

Creating new tables from old, this DBMS reduces processing time while providing security controls others don't have

Seventh in a Series

Databases that create indexes by joining tables are called relational. INGRES, however, enjoys a position almost unique among DBMSs: it is truly relational. It creates new tables from existing ones; data storage and retrieval are based on a knowledge of how those tables are constructed. This method requires fewer indexes, shorter processing time and less storage. In addition, INGRES allows data to be stored and retrieved without having to develop programs first, and provides some privacy controls not available in many other DBMSs.

Starting at college

INGRES (interactive graphic retrieval systems) is based on ideas proposed by Dr. E.F. Codd of International Business Machines Corp., and was developed as a research prototype at the University of California, Berkeley. The DBMS has been available since 1976, and the "university version" is claimed to be used at more than 125 UNIX sites. Designers of the prototype have helped develop an enhanced version, which Relational Technology, Inc., has marketed for the minicomputer market.

INGRES, available only on the Digital Equipment Corp. VAX-11/780 and 11/750, runs under the VMS

This is the seventh in a series of evaluation reports on database-management systems for minicomputers. The first, on the ORACLE system, appeared in the August, 1980, issue, and the second, which ran in October, reviewed SEED. Other articles reviewed QDMS in February, 1981, TAGS in March, MDBS in April and DRS in August. These reports are intended to provide sufficient information about a DBMS to enable potential users to determine if they should install the system. Each article surveys the features of a single DBMS and evaluates it against a standard set of critera. If there is a system you would like to see reviewed, please send its name and supplier to: Editor, Mini-Micro Systems, 221 Columbus Ave., Boston, Mass. 02116. For more information on systems that have been reviewed or on how to evaluate other systems, Weiss & Associates is in business to help.

Example of report writer format

```
/*      ACCOUNT - example of billing type report        */
.NAME   arep
.QUERY  range of t is transact
        range of a is account
        range of c is customer
        retrieve (c.name, c.address, c.city, c.state, c.zip,
        charge = t.amount*t.type,
        payment = t.amount*(1-t.type),
        amt = ( - t.amount*t.type) + (t.amount*(10t.type))
              where     a.acctnum = t.acctnum
              and       c.name = a.name
.SORT   name, acctnum, date
.FORMAT acctnum(" nn/ - nnnnnn/ - n"), date (c8),
        transnum ("nnnn")
.FORMAT payment,charge,amt,balance("     $$$,$$$,$$$.zz")
.POSITION balance(78)
.HEAD   name
        .NEWPAGE    .NL 3
        .PR name  .NL
        .PR address .NL
        .PR city (c0), " ", state(c0), " ",zip("NNNNN") .NL4
.FOOT   name
        .NL3 .PR "End of accounts for: ",name, NL
.HEAD   acctnum
        .NL3
        .P  "Account: ",acctnum, .RT balance .P "Opening
            balance": balance, NL2
        .UL  .CE acctnum .P "Account" .CE date .P "Date"
             .CE transum .P "Transaction" .RT payment
             .P "Payment" .RT charge .P "Charge" .RT balance
             .P "Balance" .NL
        .NOU
        .TFORMAT acctnum(" nn/ - nnnnnn/ - n ")
.FOOT   acctnum
        .NL 2
        .PR  "Account", acctnum, "totals." .T + 8, .P transnum,
             payment,
        .NL 2 .RT balance .P "Closing balances:",
                          sum(amt,,balance) .NL
.HEAD   page
        .NL2
        .PR "Customer: ",name .CE .P "Date: ", current, date,
        .RT .PR :Page ",page, number .NL4
.FOOT   page
        .NL 3
```

The most important feature of a relational DBMS is its ability to retain information about the location of data elements so that new tables can be created from existing ones.

operating system. The DBMS runs in the batch and on-line modes simultaneously, and relies on the resident operating system for its communication support. Security and privacy mechanisms operate at the database, record-type, field, field-value and key levels. In addition, security can be implemented by operation type, terminal number that issued the operation or by the time of day and day of the week. Restart/recovery options include automatic or manual roll-forward or roll-backward facilities.

INGRES supports the relational DBMS concept in which "tables" of data are stored. Information about each table, such as its name, data elements, number of lines (records) it contains and manipulation information, is stored in the data dictionary. During data-processing operations, these tables can be created, deleted or altered.

The most important feature of a relational DBMS is its ability to retain information about the location of data elements so that now tables can be created from existing ones. INGRES implements this capability—the "join"—through its RETRIEVE command.

Example of report writer output

Customer: Big Daddy — Date: 10-JUL-1981 — Page 1

Big Daddy
1 Bestview Lane
Topofthehill NJ 05436

Account: 74-902543-6 Opening balance: $234,657.00

Account	Date	Transaction	Payment	Charge	Balance
74-902543-6	81/07/01	0101	$100,000.00		$334,657.00
		0102		$50,500.00	$284,157.00
		0103		$24.56	$284,132.44
		0104		$10,100.00	$274,032.44
	81/07/15	0105	$50,000.00		$324,032.44
	81/07/17	0106		$10,143.54	$313,888.90
		0107		$243.56	$313,645.34
	81/07/22	0108		$100.00	$313,545.34
	81/07/23	0109		$25,000.00	$288,545.34
		0110	$100,000.00		$388,545.34

Account: 74-902543-6 Closing balance: $388,545.34

End of Account for: Big Daddy

EXPLAINING THE EVALUATION MATRIX

The tool that is used in the evaluation process is the Evaluation Matrix. In a competitive evaluation, the matrix lists the criteria used, the vendors being considered and the ratings each receives. (Not all criteria can be used each time.) The first step is to establish an importance weight factor for each criterion. This factor establishes the relative importance of a feature or capability of the DBMS in meeting system requirements. A scale of 1 to 10 is used. The vendor's software is then rated, again on a scale of 1 to 10, according to its ability to meet that criterion, establishing the vendor's requirement score. Multiplying the importance weight factor by the vendor's requirement score produces an effective score.

For example, if one of the selection criterion, a database loader (software), is extremely important, it could be assigned a weight of 10. If vendor 1 does not provide such an offering, its ability to meet this criterion would be 0. The resulting effective score for this criterion for this vendor is 0 ($0 \times 10 = 0$). However, vendor 2 might provide such a product, receiving a rating of 10. That vendor's effective score would be 100.

Evaluation scores should be established as follows: 10 means the feature fulfills all requirements; 8 indicates it is state of the art; 6—the feature leaves something to be desired; 4—the feature is limited but there is a satisfactory alternative; 2—significant drawbacks were found with no satisfactory alternative; and 0—the feature is not needed and/or the capability does not exist.

Once all criteria used in the selection process have been weighted, and all vendors' responses have been rated, their effective scores can be calculated, totaled, and the top vendor can be identified.

The criteria listed in the matrix could become standard to define system requirements for a database. The evaluation matrix is used only to establish a rating for a DBMS and how it meets all the criteria as if each had an importance weight of 10.

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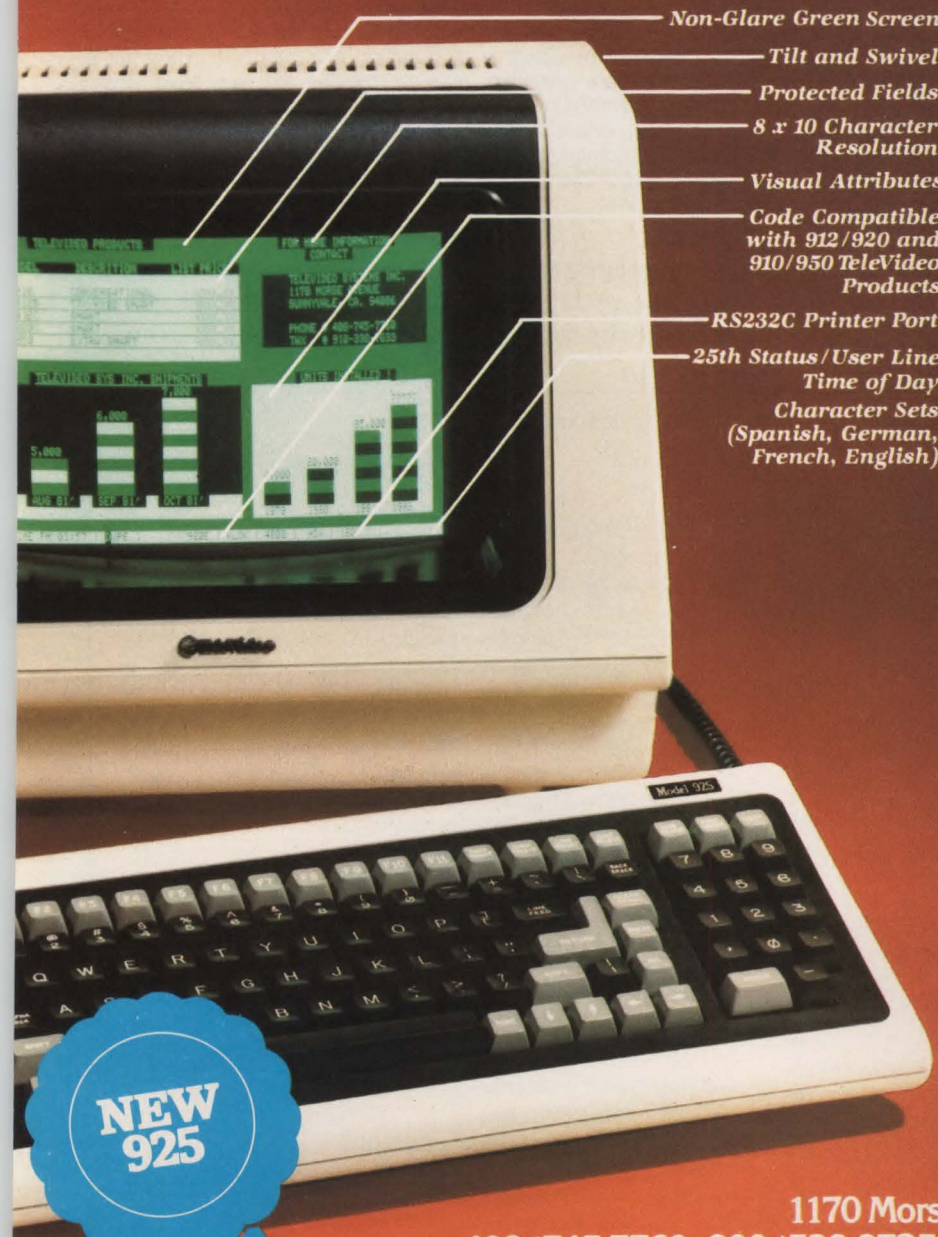

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CIRCLE NO. 113 ON INQUIRY CARD

The integrated data dictionary consists of a series of relations or tables in which data are kept about the database, its users and processing mechanisms.

INGRES components

INGRES has three major components: the data language "QUEL," an integrated data dictionary and the kernel.

QUEL is a high-level, English-like but nonprocedural language that queries, manipulates, defines and controls the database. Its statements, which tell what's to be done with data (rather than how it's to be done) can be executed individually or used within computer programs written in any of several host languages. This capability is provided through the extended version of QUEL called EQUEL. These host languages are C, FORTRAN and Pascal. Implementation is planned for BASIC and COBOL.

```
Example 1:
    range of p is parts
    range of s is supply
    retrieve into newsupply(
                    number = s.snum,
                    p.pname,
                    s.shipdate)
    where s.pnum = p.pnum

Example 2:
    create newsupply(
            number = i2,
            pname - c20
            shipdate = c8
```

INGRES creates tables (relations) in two ways: *by entering the data itself, or by using existing tables. In example 1, where table dimensions are unknown, INGRES creates the new table "Newsupply" by entering the data itself, as do all relational-type DBMSs. In example 2, where table dimensions are known, INGRES uses its RETRIEVE command to form "Newsupply" from preexisting "Parts" and "Supply." The fact that this process is dynamic makes INGRES truly relational.*

The **integrated data dictionary** consists of a series of relations or tables in which data are kept about the database, its users and processing mechanisms. During

EVALUATION MATRIX VENDOR RATING: INGRES

SELECTION CRITERIA	VENDOR SCORE
1. DBMS Manipulation Process:	
1.1 Data/Record Generation	10
1.2 Database Update Process	10
1.3 Database Deletion Process	10
1.4 Security Techniques	10
1.5 Privacy Control Techniques	10
1.6 Data Integrity Controls	10
1.7 Data Format Translation	10
1.8 Error Processing Techniques	6
1.9 Data Redundancy Controls	4
1.10 Data Compaction Process	8
1.11 Data/File Convertibility	10
1.12 Program/Data Independence	10
1.13 Data Manipulation Language	10
Possible: 130	118
2. DBMS Physical Structure:	
2.1 Record Structure (Logical/Physical) Supported	10
2.2 Record Creation Process	10
2.3 Record Modification Process	8
2.4 Physical Storage Processes	10
2.5 Record Indexing Mechanisms	10
2.6 Data Space Management	8
2.7 DBMS Structure	10
2.8 File Growth	8
Possible: 80	74
3. DBMS Tools:	
3.1 Data Query Facility	
3.11 Availability of Tool	10
3.12 Ease of Use	10
3.13 Capabilities	10
3.2 Report Writer Facility	
3.21 Availability of Tool	10
3.22 East of Use	8
3.23 Capabilities	10
3.3 Data Dictionary Facility	
3.31 Type	10
3.32 Ease of Use	10
3.33 Program/Operation Interface	10
3.34 Reports Capability	0
3.4 Data Communications Facility	
3.41 Protocols Supported	4
3.42 Ease of Use	4
3.5 System Development Tools	
3.51 System Design Tools	2
3.52 Program Development Tools	2
3.53 Data Base Design Tools	2
3.54 Screen Design Tools	10
Possible: 160	112
4. System Implementation:	
4.1 Hardware Requirements	6
4.2 Data Base Loading Facility	8
4.3 Data Definition Language	10
4.4 Vendor Support	8
Possible: 40	32
5. Secondary Features	
5.1 DBMS Utilities	
5.11 Performance Statistics	0
5.12 Simulation Facility	0
5.2 Vendor Response to Hardware/Software Changes	6
5.3 Ease of Installation	8
5.4 DBMS Maintenance Policies	6
5.5 Customer Experience	6
5.6 Documentation	10
5.7 Training Availability	6
5.8 System Performance	8
Possible: 90	50
Total Possible: 500	INGRES: 386

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CIRCLE NO. 115 ON INQUIRY CARD

A user can provide the dictionary with data relative to securing the relation, the storage access method to be used and the life of the relation.

execution, the dictionary furnishes database-manipulation information, such as edit criteria, validation procedures, integrity controls and security locks. The dictionary forms the interface between the data-manipulation language and the kernel, which invokes the dictionary.

Using INGRES

A user logs on INGRES as does any other VAX-VMS user. Having invoked the DBMS, the user creates and/or manipulates databases using QUEL or the report writer. There are two ways to create databases (relations) in INGRES: the CREATE command can be used to define a new relation with no records (tuples), or RETRIEVE INTO can be used to create a new relation using one or more previously defined relations as the data source.

In addition to the data-referencing domain characteristics, a user can provide the dictionary with data relative to securing the relation, the storage access method to be used and the life of the relation. There are seven access methods: ISAM (index sequential method), CISAM (compressed ISAM), HASH (a random hashing storage feature), CHASH (compressed HASH), HEAP (a sequential file mechanism), HEAPSORT (a sorted HEAP system without duplicates) and CHEAPSORT (compressed HEAPSORT).

Users can create, expand and delete information from the dictionary about tables, indexes, secondary indexes, views of the database and access to the database.

Rows or columns can be dynamically added to the tables or can be changed or deleted through various QUEL commands. Once a database has been created, QUEL or any host language can be used to query it or process its data. Accidental destruction of a database is prevented by INGRES's updating mechanisms.

RELATIONAL TECHNOLOGY: A COMPANY OVERVIEW

Relational Technology, Inc., Berkeley, Calif., has been in business for a year. The company announced INGRES in December, 1980, and delivered it in March, 1981. Approximately 20 companies are using the DBMS, in addition to some 150 to 200 users at the University of California, Berkeley, where it was developed.

The **kernel** provides the interface between the VAX-VMS operating system and the internal workings of INGRES. It manages all INGRES processing and enables INGRES to support the concurrent batch and on-line operations. Each user has a virtual copy of INGRES.

The INGRES report writer enables users to create formatted listings of data from an INGRES database. INGRES creates the code to produce the report from commands that describe the document and data to be printed. The report writer produces camera-ready output for inclusion into other documents, regular listings of data for management and production needs and ad hoc reports that can be stored and varied through the use of parameters when the report is run.

A query-by-forms feature, intended for release this month, enables users to design business forms on a screen. Using the tutorial approach developed under INGRES, a user can manipulate data in a user-friendly environment. As a system-development tool, INGRES offers a tremendous advantage for the non-data-processing-oriented user. Data can be stored or retrieved quickly using the report writer or query language without first developing the program.

Evaluation of INGRES

Relational Technology presented Weiss & Associates with a list of 10 users of its commercial version of INGRES. Several were using it as the heart of applications they were building for customers. The comments received were all positive relative to the product's stability, ease and economy of use, its capabilities and efficiency and the support provided by Relational Technology. ■

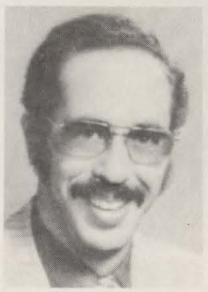
NEXT MONTH IN MMS

Disk drives get the feature spotlight in the February issue of Mini-Micro Systems. There will be major product surveys, including:

- A detailed look at the floppy-disk market, also with complete listings of manufacturers.
- A comprehensive survey of the Winchester disk market, also with complete listings of manufacturers.

Other articles will cover:

- The reliability of head/disk interface design.
- Designs for media-interchange ability.



Harvey M. Weiss, principal consultant at Weiss & Associates, Aurora, Colo., has more than 20 years of experience in data processing. He is known internationally as a speaker and author of articles on database, security and data-processing planning. Weiss & Associates serves clients in industry, education and government with DBMS development, designs and evaluation/selection.

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CIRCLE NO. 116 ON INQUIRY CARD

COMPUTER GRAPHICS

Adding local intelligence to graphics terminals

MICHAEL DOLAN, Megatek Corp.

Front-end processors provide more local control, freeing the host computer for other tasks

The use of μps is becoming more common in many complex computer peripherals, such as disk controllers, communications interfaces and graphics displays. The μps significantly off-load the host of the detailed handholding that might be required for the peripheral. Overall functionality remains the same, but it is distributed from the host and into the peripherals. Nowhere is the concept of distributed processing more valuable than in computer graphics, which would otherwise cut deeply into a host's ability to handle other tasks because of the considerable computing power required to operate highly interactive graphics work stations.

Evolution of distributed processing

Traditionally, "dumb" graphics work stations were interfaced directly to a mainframe, which was responsible not only for all its application-oriented computing, such as a finite-element modeling system or a seismic data-collection system, but also for the matrix calculations required for graphics manipulations. The work stations displayed only the screen image. And the dumber the work station, the bigger the mainframe required to handle multiple stations.

More recently, distributed processing was achieved with the use of minicomputers as intermediaries between mainframes and the work stations. This allowed much local programmability as well as higher level functionality. The mainframe could communicate short high-level commands that the minicomputer could expand into many calculations and operations with the graphics display. The problem with this approach was that a dedicated minicomputer might be needed for each graphics work station, thus increasing cost.

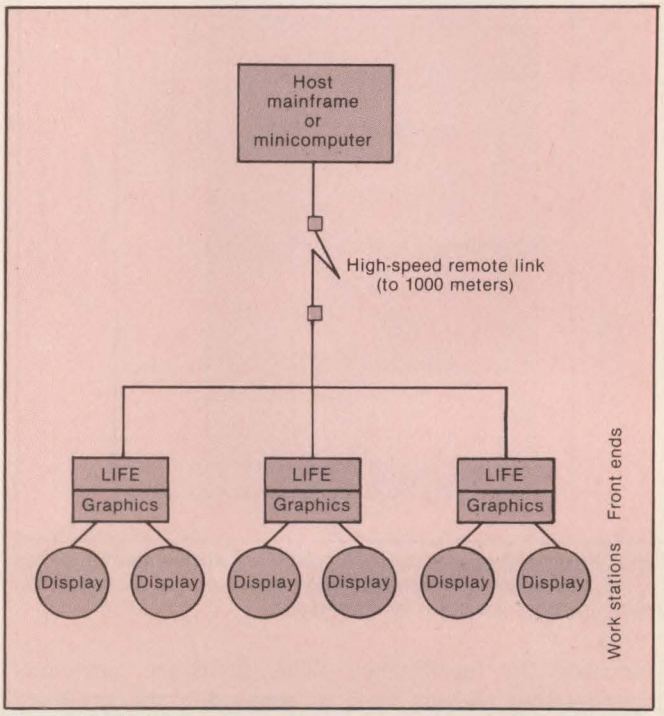


Fig. 1. Each front-end processor supports two work stations. *Communications with the host are reduced because "housekeeping" and graphics-specific processing are performed at the work-station end.*

To solve the cost problem while providing greater distributed processing, graphics manufacturers now provide local intelligent front-end (LIFE) products that place high-level intelligence within graphics work stations. An example is the LIFE product recently introduced by Megatek Corp. for use with its Whizzard 7200 family of high-performance graphics work stations.

Combining local transformation and picking, users might write a program that ties an input device to a display object for direct, on-screen control of an object's orientation.

What LIFE is about

The intelligent front-end LIFE processor includes three PC boards: an Intel 8086-based μc, a memory board with as much as 512K bytes of memory and an interface board offering RS232 or high-speed parallel interfacing to the minicomputer or mainframe. All boards are part of the graphics hardware. In contrast to a standard host interface, another level of command interpretation is built in.

On power-up, the 8086 is loaded by an IPL cassette that contains a real-time, multitasking operating system as well as firmware that gives the front-end

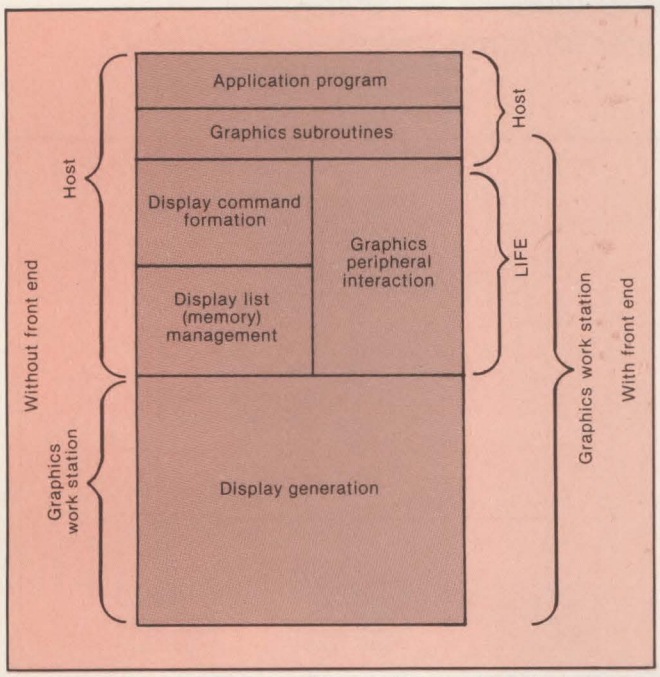
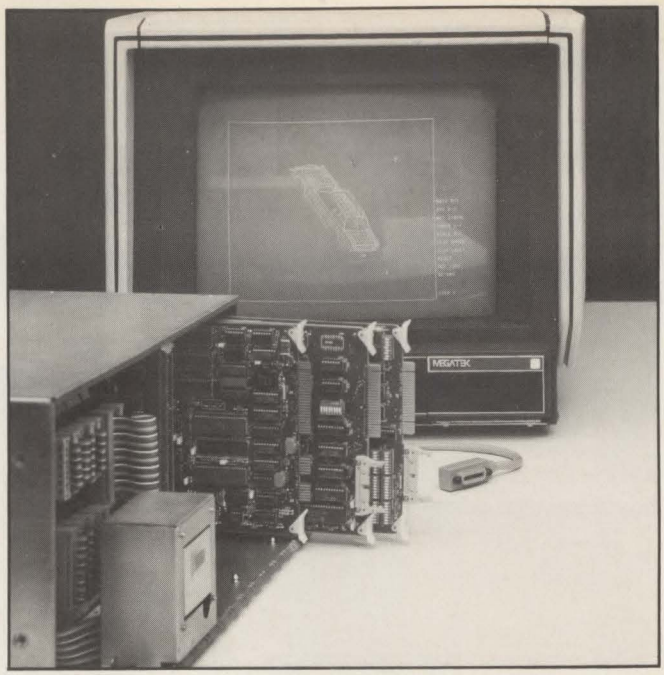


Fig. 2. Front-end processor at the graphics work station *assumes control of display command function and memory management, freeing the host computer for other tasks.*

processor its intelligence. The firmware performs housekeeping chores, such as managing the graphics display list, supervising all peripheral interaction and managing event queues. Because the LIFE operating system is multitasking, both the standard firmware intelligence and user-developed applications programs can be executed simultaneously. These programs use standard Intel file-link format, and cross-assemblers are available to generate files on the host-computer.

Two work stations can be connected to each front-end processor using RS232 lines at 19.2K bps or a high-speed parallel interface that runs in a DMA mode at 250K bytes per sec. at distances as far as 1000M. from the host. Because this parallel interface uses the bus-structured



Megatek's local intelligent front-end (LIFE) processor, *showing CPU, memory and interface boards.*

IEEE-488 standard, multiple graphics work stations can be connected to a 1000M. parallel communications line (Fig. 1). This enables remote graphics laboratories to be connected easily and inexpensively to the host with transfer rates as high as 250K bytes per sec. The IEEE-488 interface connects the front-end processor to virtually any computer system. A second, optional IEEE-488 interface can be used to connect the front-end processor to instrumentation that can be programmed for viewing as they are collected or to a disk drive to call up file data directly.

The benefits of the graphics work station's intelligence and flexibility include:

- The host computer is relieved of housekeeping and graphics-specific tasks,
- A high level of programmability is provided to define additional graphics functions specific to an application,
- Communications traffic is greatly reduced between the work station and the host computer, freeing the host for other application-oriented or real-time tasks.

Getting more from LIFE

The firmware provided in the front-end processor is intended to bring many normal graphics systems functions from the host to the work-station level (Fig. 2). As an example, consider the management of display list memory. As users build pictorial images on a graphics-display screen, vector information is entered in the display list memory and then read by a graphics processor in the work station to create the picture on the display. As drawings are created, memory is filled. But as a user modifies the picture, deleting vectors and adding new ones, information is removed from the display list. Memory-management schemes must be

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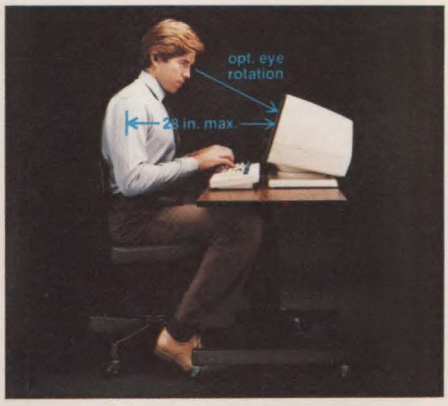

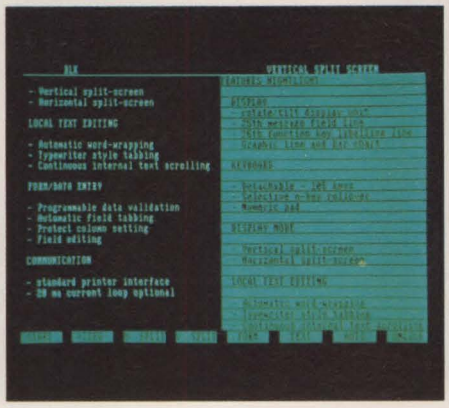

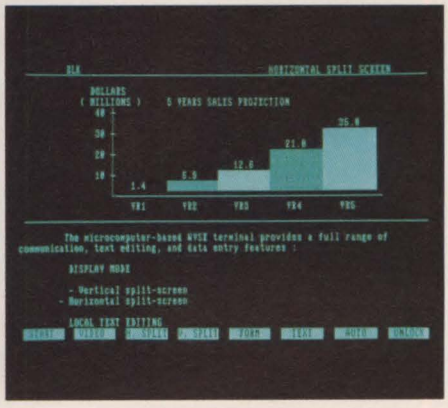

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Menus can be nested in the front-end CPU, enabling a user to pick through a series to specify an action in fine detail.

used to delete and reclaim used portions of memory for reuse so the user will not run out of memory. This management of graphics resources is accomplished easily in a front-end processor and relieves the host of having to do this for the peripheral.

Another example of the normal graphics functions that now can be handled at the work station is the mathematical computation required for graphics. If a user wants to rotate or orient an object, much complex matrix arithmetic is involved. While graphics hardware can transform the vectors during display generation, it does not create the transformation matrixes required.

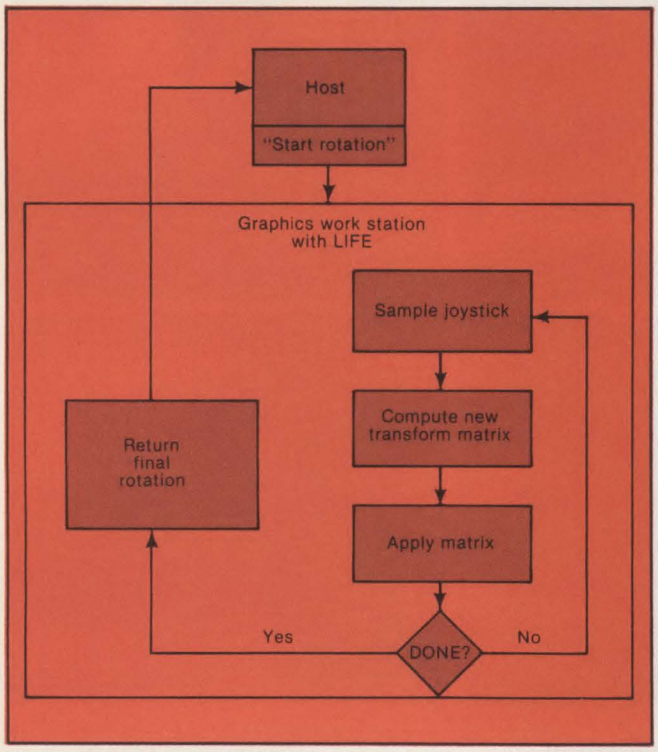

Fig. 3. Graphics manipulation of an object on the screen *by joystick is performed at the work-station level.*

To rotate an object 30 degrees on the screen, for example, a host had to compute a 4 × 4 matrix and transmit it to the work station for transformation of the vectors to accomplish the rotation.

Using new local front-end devices, the host now simply commands the work station to rotate the object. The front-end CPU performs the calculations required to produce the matrix and interfaces directly with the transformation hardware and an input peripheral. When very high speed is desired, an optional Intel 8087 floating-point processor can be added to the front-end processor for even faster computational speed.

A graphics front-end processor also enables "picking," in which a user chooses from a set of pixels on the screen. Previously, considerable communications traffic between terminal and host often occurred during this process. With front-end intelligence, the loop is local. Menus can be nested in the front-end CPU enabling a user to pick through a series to specify an action in fine detail. Only the final results of his selection process must be transmitted to the host computer. The front-end CPU simply works through a user-programmed table of menus at the local level.

Combining local transformation and picking, users might also write a program that ties an input device to a display object for direct on-screen control of an object's orientation. (Fig. 3). Once an object has been defined on the screen, it can have a transformation associated with it, and an interactive device such as a function knob or a joystick can locally modify the transformation. One command could be brought down from the host to attach the joystick so that when a user pushes the joystick forward, the object might rotate clockwise and when he pulls back, it would rotate counterclockwise.

Controlling transformations locally with a peripheral device involves much computation. Every time a user moves the joystick, the host must input the joystick position, perform a computation and send a matrix to the graphics processor to rotate the object. Once the attachment command is sent to the front-end processor, a local loop is created that relives the host of the entire task. The front-end processor then does all the sampling and calculation for local control of the object rotation, and performs those tasks quickly because there is no communication delay.

Drawings evolve from primitives

Another application that can be developed by users for front-end functionality is creating higher level graphics primitivies—the geometric shapes used as building blocks for drawings. There are three basic primitives: points, lines and polygons. Points define a coordinate location, lines connect points, and polygons are collections of more than two lines. Most graphics displays support only the lines, going from point to point to create a drawing. With today's sophisticated graphics systems, users prefer to define lines in terms of a few control points. Rather than specify a detailed list of points to be connected for a curve, for example, users specify only the control points and have the system generate curves connecting them. This is important in finite-element modeling.

Users have always been able to increase graphics functionality by using their host computers, but at the expense of an additional load on the host. Placing more of the graphics application functionality at the local level increases operational flexibility and speed and frees the host computer for other application tasks. ■

Michael Dolan is product manager, Megatek Corp., San Diego, Calif.

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Plexus Z8000 UNIX system has PDP-11/45 performance

Year-old Plexus Computers, Inc., will begin delivering its first product—a multiple Z8000-based, multi-user UNIX-system—by year-end. Officials at the Santa Clara, Calif., company say the P/40, the first in a proposed family of systems, is as powerful as Digital Equipment Corp.'s PDP-11/45.

Plexus co-founder and CEO Bob Marsh claims the system has been designed explicitly for UNIX. In the case of the P/40, he says, "we have transported a machine to an operating system." The P/40's buses, memory management, I/O processes and terminal-handling capabilities have been optimized for UNIX, he says.

Further, Marsh says, the P/40 has been designed to use industry-standard buses and peripheral interfaces. "Customers want standard products," he says, adding that Plexus has adopted de facto standards when appropriate, rather than opting for standards of what he calls the "academic variety," such as Ada, which have been discussed but not implemented.

The P/40 uses the IEEE's version of Intel's Multibus. The Multibus was selected, says Frank Madren, vice president of marketing, because of its high data-transfer rates. Additionally, the storage module device (SMD) interface is used for disk drives. A 14-in. SMD Winchester drive from Fujitsu is built into the system and is available in two capacities, 72M or 145M bytes. A ½-in. streaming-tape drive from Cipher Data Products is included in the cabinet. Main memory is available in 256K-byte increments to 1M byte. Madren says that memory will be expanded to 4M bytes with 64K-bit RAMs in the future.

As many as eight Z8000s are used in the P/40, Madren says. One serves as the system's job processor, while one handles each of the system's peripheral groups. The job processor has full access to main memory; the peripheral processors access memory for data transfers. A typical configuration includes 5 to 15 terminals linked to the P/40 via RS232C lines. Plans call for incorporating P/40 into a local network as well, Madren says, though it is too soon to say which protocol Plexus will adopt.

Madren says Plexus will not develop applications software, nor does the company plan to distribute any. The P/40 will initially be shipped with a UNIX C-compiler and a Z8000 assembler. Within six months, Madren expects to have COBOL, Pascal, FORTRAN and BASIC ready for the system. UNIX is not known as a commercial-environment operating system, he says, but he expects that COBOL will help commercial-applications development. Micro Focus, Inc., Santa Clara, Calif., and Ryan-McFarland Corp., Aptos, Calif., are reportedly developing a UNIX-based COBOL.

Madren says Plexus will build its own direct sales force to cover the dozen top metropolitan areas in the U.S. He says that a European office will probably be opened later. Sales also will be made through dealers and distributors, Madren says. He expects to establish a service organization some time after the sales force is in place.

The Plexus small-business system *incorporates a 16-bit Zilog Z8000 μp.*

A typical 8-user P/40 with CPU, 0.5M bytes of memory, 72M bytes of hard-disk storage, an eight-channel intelligent communications interface and a magnetic-tape unit sells for $49,500. A UNIX license from Plexus is $5000. *—Larry Lettieri*

Circle No 426

NEC adds system, peripherals to Astra line

NEC Information Systems, Inc., Lexington, Mass., has added a high-end system to its Astra business-computer-systems line. The Astra 270 supports as many as 16 work stations, stores as much as 1024K bytes of main memory and sells for $46,000, fully configured. Deliveries are scheduled to start in early 1982.

With the 270's introduction, NEC also announced a new release of the Astra operating system, reduced the price of main memory and disk storage throughout the five-model Astra family and added several peripherals.

The model 270 increases the amount of main memory on the Astra line from 384K bytes to 1M byte. The 270 also supports 256M bytes of disk storage. It uses bipolar

semiconductor circuitry to achieve a 600-nsec. memory-cycle time.

The new release of the Astra operating system (release 4.2) is fully compatible with the previous release (3.59) and features added support for the Astra's 1M-bps channel between work stations and CPU, enhanced automatic spooling and added data-management capabilities.

The use of 256K-byte memory boards, storing twice the capacity of previous boards, enables the increased main memory. The 256K-byte boards are priced at $2700 each. The price of disk storage was also reduced, with 31M bytes going from $8900 to $6500.

The new peripherals include an 8-in. Winchester-disk drive, a letter-quality Spinwriter printer, a dot-matrix printer, a magnetic-tape unit and a color work station.

—Eric Lundquist

The Astra 270 *is the new high end member of NEC Information Systems Inc.'s business computer line. The 270 can support as many as 16 work stations and support up to 256M bytes of disk storage.*

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Circle No 425

Itek unveils multiple-application typesetters

Basing its products on a concept called Multiple Application Phototypesetting Systems (MAPS), Itek Graphics Systems, Lexington, Mass., has introduced two integrated office systems—the Quadritek 1400 and 1600. Compatible with the company's earlier 1200 line, the systems offer a CP/M operating system, MicroSoft BASIC prgrams and the WordStar word-processing package integrated with the two Itek phototypesetters.

MicroSoft BASIC, under license from MicroSoft, Inc., enables the Quadritek 1400 and 1600 systems to perform cost estimating, inventory control, accounts receivable and payable, general-ledger accounting and payroll analysis. WordStar, licensed by MicroPro International Corp., gives system users com-

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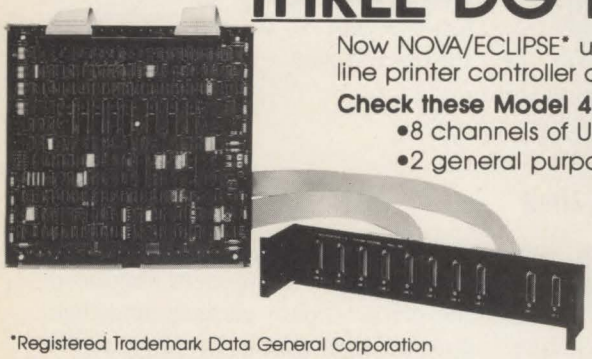

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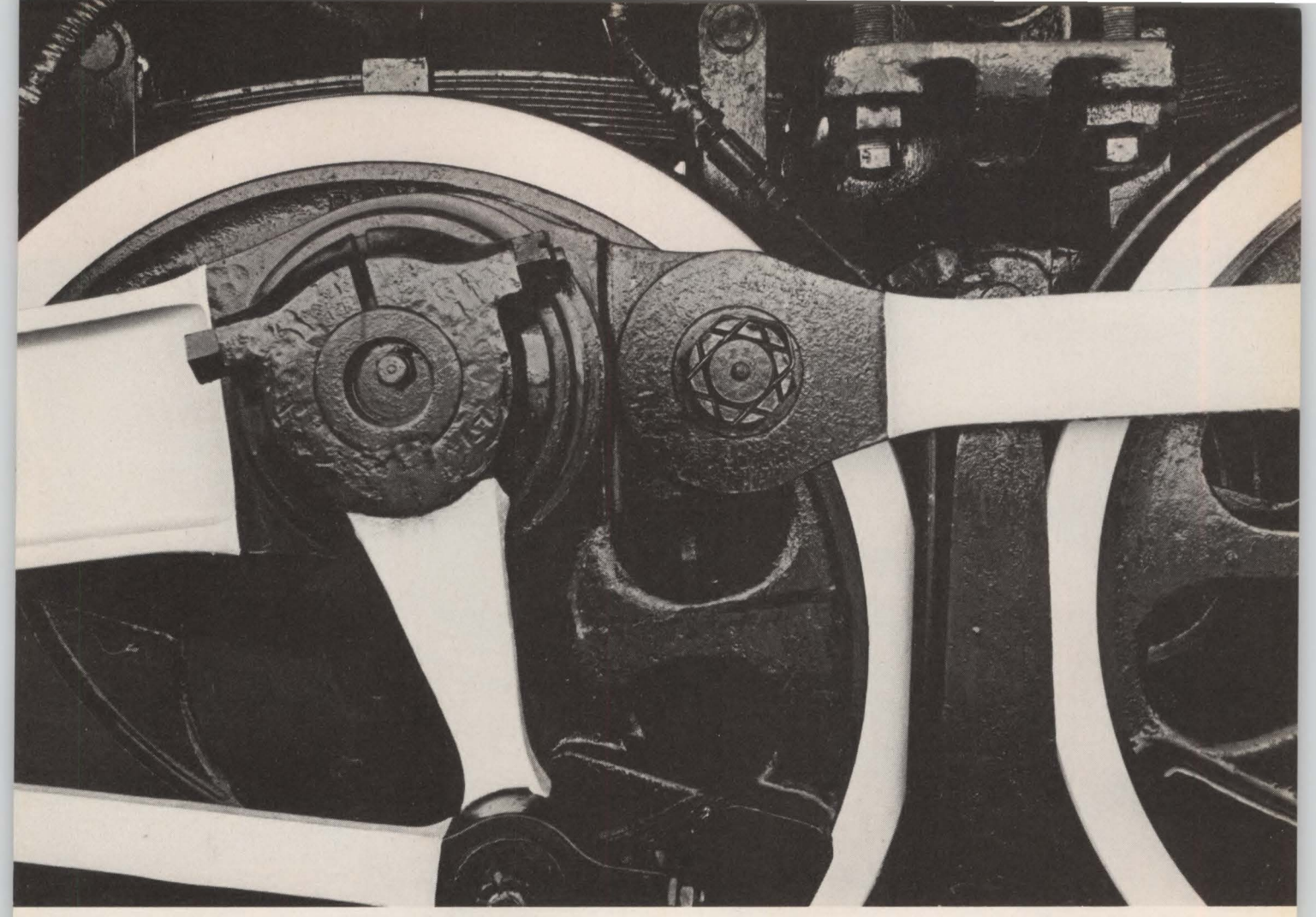

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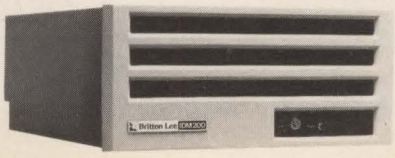

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DYNABYTE Business Computers

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mands for text transcription, manipulation and formatting, and drives Itek's QuadPrint impact printer for hard-copy output.

The Quadritek 1400 and 1600 consist of three basic modules, each with a dedicated μp; a VDT and keyboard; a floppy-disk drive that stores as much as 984K characters; and the typesetter. Using its own μp, each module operates separately from and simultaneously with the other modules. A foreground/background program enables operators to keyboard or edit copy while other jobs are being typeset in the background.

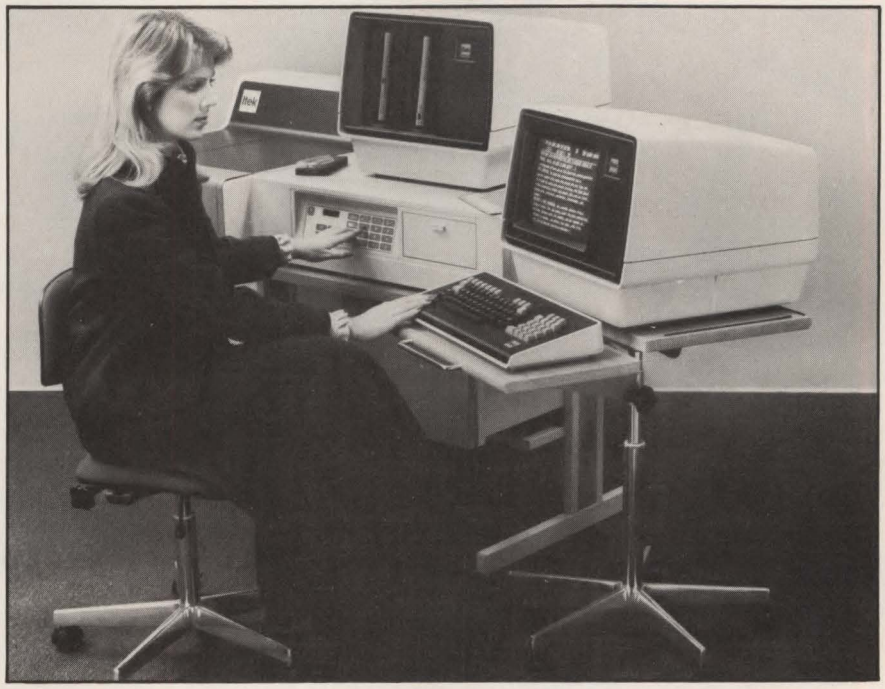
Itek's Quad Quick software is also available on the systems. It provides pre-programmed formats for business cards, letterheads/envelopes, newsletters, invitations/announcements, postcards/tickets, text, forms and brochures.

An optional data-communications interface lets the 1400 and 1600 exchange data directly or via a telephone modem link with other computers, word processors, terminals, OCR devices or printers. Transfer of data from other processors through this interface eliminates the need to rekeyboard or reedit the information.

Although many other companies sell business and word-processing systems, Itek's expertise in phototypesetting is being touted as the distinguishing feature of the 1400 and 1600. The machines' high-quality, flexible output can be used for printing catalogs, advertising and sales literature, government reports and copy for graphics displays. Operating at 25 or 50 lines per min., the typesetters hold four fonts on-line.

Available now, the 1400 and 1600 sell for $16,000 to $20,000. A four-terminal system with a QuadPrint printer sells for less than $40,000. **Itek Corp., Graphic Systems Division,** 811 Jefferson Rd., Rochester, N.Y. 14692.

Circle No 424



Itek's Quadritek 1400 and 1600 *can queue nine phototypesetting jobs in memory for automatic printing. The screen indicates when a new job begins and informs the operator of required font changes.*

HOW TO SAVE $5000 ON A LINE PRINTER FOR YOUR DEC COMPUTER

Simple. Buy your printer directly from a Dataproducts or Printronix distributor.

THE CATCH:

You have to buy a Datasystems line printer controller.

Because Datasystems is the only line printer controller installed and maintained by the same nationwide on-site customer service organizations that support your Dataproducts or Printronix printer.

Comparable savings and on-site service exists for Data General and IBM Series/1 systems. Call us at (714) 566-5500 for the name of your nearest distributor for these line printers and our Datasystems Controllers.

DATASYSTEMS CORPORATION

We make the difference.

10072 Willow Creek Road, San Diego, CA 92131

CIRCLE NO. 123 ON INQUIRY CARD

DEC* COMPUTER SYSTEMS COME IN SMALL PACKAGES

UP TO 40M BYTES!!

The SMS Disk System 11X is a powerful tabletop DEC microcomputer system. Using Winchester disk storage, DEC's RT-11, RSX-11M software and DEC application software run without the expense, inconvenience and space requirements of disk cartridge peripherals. Weighing only 80 pounds and requiring only 10½" of table top or rack space, it also offers the following benefits:

MAXIMUM PERFORMANCE AND CAPACITY

- 8.9Mb, 17.8Mb, 26.7Mb or 35.6Mb of formatted Winchester disk storage plus 1.2Mb of useable floppy disk storage.
- Fast data transfer of 427K bytes/sec increases performance of field proven DEC software.

INDUSTRY COMPATIBILITY

- Automatic recognition of DEC RX01, RX02 and IBM diskette formats.
- Uses industry's leading 16 bit microcomputer—LSI-11/2 and LSI-11/23.
- Supports up to 256K bytes memory—future expansion to *4M bytes!*
- Expandable industry standard RS-232C serial ports.

CONVENIENT "MINUTE-PER-MEGABYTE" BACKUP

- Only *40 seconds* required for Winchester backup onto 1.2M byte floppy diskette.
- Standard RT-11, RSX-11M, and SMS utility software supports partial or selective file backup and load operations.

RELIABLE AND MAINTAINABLE

- Modular construction and minimal parts count ensure long *MTBF* and short *MTTR.*
- Automatic bootstrap tests CPU, memory and Q-bus operation before software loading.
- Off-line and on-line systems and drive tests verify correct disk and controller operation.
- Automatic error retry, ECC (Error Correction Code) and Winchester disk flaw management insure exceptional data integrity.

FIELD PROVEN SOFTWARE

- User-friendly *real time* RT-11 and CTS-300 operating systems requires minimum overhead.
- *Multi-task, multi-user* RSX-11M operating system supports hierarchical file structure.
- FORTRAN IV, FORTRAN IV-PLUS, BASIC language support.
- Wide range of available DEC application software including DYNIX* (based on UNIX V7.0), RTFILE* data base management, WP SATURN* word processing, CAP-CPP MicroCobo

AVAILABLE WITHOUT CPU AND MEMORY FOR VOLUME REQUIREMENTS!!

Scientific Micro Systems
777 East Middlefield Road
Mountain View, CA 94043
(415) 964-5700 TWX: 910-379-6577
Western Regional Office (602) 978-6621
Midwest District Office (312) 966-2711
Eastern Regional Office (617) 246-2540

* DEC Trademark of Digital Equipment Corporation
* DYNIX Trademark of Re Santa Cruz Operation
*RTFILE Trademark of International Computing Company
*WP SATURN Trademark of Saturn System Inc.
*CAP-CPP MicroCobol Trademark of Portable Software In

CIRCLE NO. 124 ON INQUIRY CARD

Four Phase announces office-management system

The COMS/IV corporate office-management system for electronic mail, document management, document processing and executive services contains the vendor's Series IV system and the System 311 and 312 node controllers. Each controller supports as many as eight of the vendor's series IV minicomputers, each of which supports as many as 32 multifunction work stations. Every node in the network

can communicate with every other node. The 311 and 312 processors execute standard IBM 360/370 software without modification. The 311 includes 1M byte of memory, 600M bytes of disk storage, one line printer and a tape drive. Each System IV/95 includes 672K bytes of memory, 32 terminals, 80M bytes of disk storage, and 11 character printers. A configuration consisting of one System 311 and three IV/95 systems can be leased for less than $300 per month per CRT terminal on a 42-month lease. **Four-Phase Systems,** 10700 N. DeAnza Blvd., Cupertino, Calif. 95014.

Circle No 423

Symcro announces business computer

The model SB700 Easy-Grow business-computer system makes one or more CP/M μcs available to each user, while serving as many as 200 independent simultaneous users. The system uses as many as six 20M-byte, 8-in. Winchester-disk drives providing a maximum of 120M bytes of disk storage. The unit incorporates as many as 256 Z80-based processor modules, each containing 65.5K bytes of RAM. The system also includes as many as 256 work stations, 256 printers, four disk controllers and 600M bytes of storage. A minimum system, including four processor modules, a 20M-byte Winchester-disk drive and a 1M-byte floppy-disk drive, sells for $15,115. A two-user system, including two keyboard/display work stations and a 150-cps printer, sells for $19,210, and an eight-user system with peripheral equipment sells for $37,020. **Symcro Systems, Inc.,** 7300 Crescent Blvd., Pennsauken, N.J. 08110. **Circle No 422**

PK Systems announces law-office system

The Business Manager attorney's time and billing system for the Zenith Z89 μc performs timekeeping, billing, and accounts receivable functions in law offices. Two systems are available. The A system, with a Z87 dual 5¼-in. floppy-disk drive handles as many as 375 cases, 1500 work-in-process

HOW TO SAVE $5000 ON A LINE PRINTER FOR YOUR DATA GENERAL COMPUTER

Simple. Buy your printer directly from a Dataproducts or Printronix distributor.

THE CATCH:

You have to buy a Datasystems line printer controller.

Because Datasystems is the only line printer controller installed and maintained by the same nationwide on-site customer service organizations that support your Dataproducts or Printronix printer.

Comparable savings and on-site service exists for DEC and IBM Series/1 systems. Call us at (714) 566-5500 for the name of your nearest distributor for these line printers and our Datasystems Controllers.

DATASYSTEMS CORPORATION

We make the difference.

10072 Willow Creek Road, San Diego, CA 92131

CIRCLE NO. 125 ON INQUIRY CARD

$4,895*

LIMITED TIME OFFER

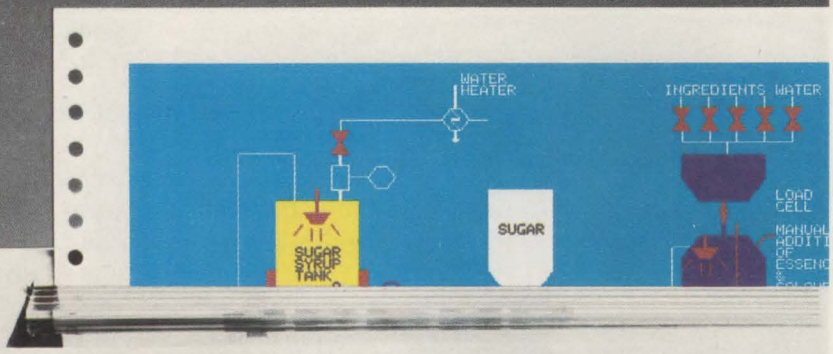
IS-8001 Ink Jet Color Printer

All the high quality of ink jet printing without the high cost. Dot-matrix overlay system produces eight-color hard copy graphs and charts. Unattended operation. On-board microprocessor. Can be driven as an intelligent terminal! Compatible with Intelligent Systems' character graphic computers. Typewriter-size unit uses ordinary fanfold paper. Fast, very quiet and cost efficient. Only 10¢ per copy!

Hurry! Offer expires January 31, 1982. Compare this incredible price. Compare the per-copy cost. Call or write *today* for the name of your nearest representative. And hurry! Time is running out.

PrintaColor

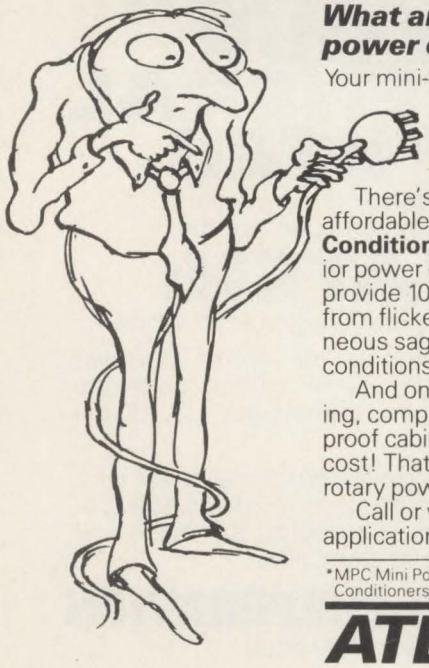
*U.S. domestic price only



PrintaColor Corporation, P.O. Box 52, Norcross, Georgia 30091 404/448-2675

CIRCLE NO. 126 ON INQUIRY CARD

USERS OF DG MV8000, DEC 11/70, PDP-11 VAX, PRIME 750, HP3000



What are you going to do about power conditioning?

Your mini-computer needs power conditioning–but what solution are you going to buy? A costly and finicky UPS or an expensive (and often ineffective) transformer/regulator?

There's a better choice–the effective and affordable **ATLAS MPC Mini Power Conditioner.*** The ATLAS MPC uses the superior power conditioning of a motorgenerator to provide 100% clean computer grade power free from flickers, transients, brownouts, instantaneous sags and surges, under and over voltage conditions.

And only the ATLAS MPC offers compact sizing, computer grade ground, a handsome soundproof cabinet, fastest delivery, *and* the lowest cost! That's why ATLAS is the industry leader in rotary power systems.

Call or write for ATLAS MPC literature and application information.

*MPC Mini Power Conditioner available 10 to 18KVA. Larger Power Conditioners available to 500KVA.

ATLAS ENERGY SYSTEMS 9457 Rush Street El Monte, CA 91733 (213) 575-0755

CIRCLE NO. 127 ON INQUIRY CARD

New Systems

records, 999 billing codes and 850 accounts-receivable records. The B system uses a Z47 8-in. dual

floppy-disk drive. The A and B versions sell for $7090 and $9090, respectively, including a matrix printer and software. Software is also available separately for $950 for a single-CPU license with dealer, OEM and distributror discounts available. **PK Systems, Inc.,** 113 N. Center, Bloomington, Ill. 61701.

Circle No 421

MTU unveils desk-top computer

The MTU-130 desk-top computer features a 256K-byte address space, a 480 × 256 graphics display, as much as 4M bytes of floppy-disk storage, and anti-piracy hardware. The system includes a 96-key keyboard, including full numeric keypad, cursor keys and 10 programmable function keys, plus a fiber-optic light pen. It also provides a card cage for four expansion boards, a power supply, a fan, a 1W audio amplifier, a 5- × 3-in. speaker, an RS232 port, two parallel I/O ports and switched AC outlets. Software includes CODOS, an advanced disk-operating system with UNIX-style files and device-independent I/O, Microsoft BASIC, graphics commands and operating system interface commands. A screen editor that edits files of any size and a four-voice music package are also included. **Micro Technology Unlimited,** P.O. Box 12106, 2806 Hillsborough St., Raleigh, N.C. 27605.

Circle No 365

LEADER OF THE PACK

You'll see a lot of confusing claims for disk packs and storage modules, but here are a few tips that can help you make the right choice when you're specifying your next pack:

BASF products represent BASF technology and quality, because, unlike many suppliers, we make them ourselves.

We polish our uncoated metal disks to a mirror finish for optimum headflight characteristics and virtually no possibility of media-induced headcrash.

We coat, polish, and burnish each disk by our own process, assuring you of long-lasting, trouble-free operation.

We magnetically orient all oxide particles in the disk coating for greater packing density.

We drive-test each pack before it leaves the factory, for top performance with no surprises.

BASF has your configuration and format*...at a competitive price, ready for immediate delivery.

For the name of your nearest supplier, write BASF Systems Corporation, Crosby Drive, Bedford, MA 01730, or call 800-343-4600.

*For Burroughs: Front-load single disk cartridges, 80 MB Tridents.
For CDC: 80 and 300 MB storage modules, Phoenix single disk cartridges.
For Data General: 50, 100, 200, and 300 MB disk packs, top-load single disk cartridges.
For DEC: 100 and 200 MB 12-high packs, front-load single disk cartridges, 80 and 300 MB storage modules.
For Honeywell: Phoenix single disk cartridges, 80 and 300 MB storage modules, 100 MB packs.
For IBM: 100 and 200 MB 12-high packs, top and front-load single disk cartridges.
For Wang: Phoenix single disk cartridges, 80 and 300 MB storage modules, top-load single disk cartridges.

BASF

BASF Systems Corporation
Attn.: Marketing Services, Computer Division
Crosby Drive, Bedford, MA 01730

Please send me information on BASF disk packs.

Name/Title _____

Company _____

Address _____

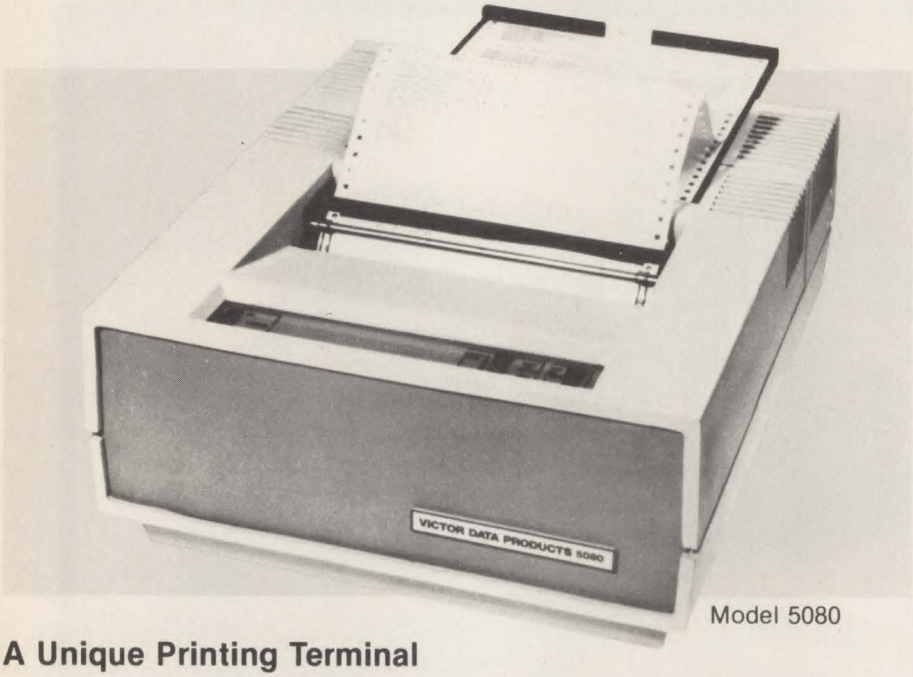
City _____ State _____ Zip _____

Telephone _____

MMS-1

CIRCLE NO. 128 ON INQUIRY CARD

VICTOR... Number 1 in Impact Matrix Printing!



Model 5080

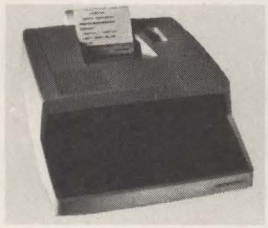
A Unique Printing Terminal

- 80 column, bi-directional printing
- Upper & lower case font
- Full graphics — 480 columns per line
- Top of form & horizontal tabs
- True 100 cps throughput
- Bi-directional friction and sprocket paper feed
- Large 360 character buffer
- Four interfaces — standard parallel & RS232 & TTY & IEEE-488
- Baud rate switch selectable
- Self-test
- UL/CSA approved
- Intelligent shortest path head return

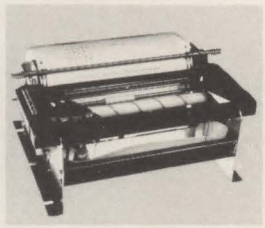
The Model 5080, shown above, is a heavy-duty printing terminal offered for sale at most competitive prices. Only $995 in single quantity! This printer has been designed to conform to the most stringent computer specifications, including software on/off control, status feedback signals and a busy signal should you fill our extra large buffer. Don't delay, order now to insure early delivery!

Victor has delivered more than 700,000 industrial, quality matrix printers. These are terminals, mechanisms, and heads designed to solve your problems. Products that are backed by a strong application engineering staff, worldwide service and 50 years of Victor pride in product.

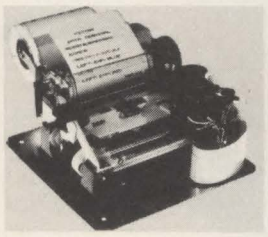
A Complete Line of Impact Matrix Printers



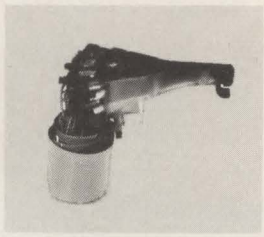
Model 5010



Model 80



Model 130



Model 129

VICTOR DATA PRODUCTS

Subsidiary of Walter Kidde & Company, Inc.

KIDDE

3900 North Rockwell Street, Chicago, Illinois 60618

Telephone: 312-539-8200

CIRCLE NO. 129 ON INQUIRY CARD

New Products

accessories and supplies

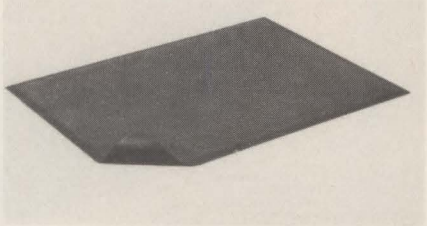
Shugart offers head-cleaning kit

This floppy-disk-drive head-cleaning kit in 5¼- and 8-in. sizes contains two lint-free, nonabrasive polyester diskettes in vinyl jackets, a 4-oz. bottle of cleaning solvent and

a dispenser cap. The kit, which provides 13 cleanings per diskette, cleans single- or double-sided drives with a wet/dry application. The kits sell for $28 for the 8-in. size and $26 for the 5¼-in. size, in OEM quantities. **Shugart Associates,** 475 Oakmead Parkway, Sunnyvale, Calif. 94086. **Circle No 401**

CRP offers abrasive mats

These abrasive mats are precleaners for use with sticky or tacky mats at clean-room entrances. The fibrillated polypropylene pile mats



are mounted on vinyl backing, and can be cleaned by vacuum or hose. They are available in 27- × 36-in., 36- × 60-in. and 48- × 72-in. sizes. **Clean Room Products,** 56

When You Need . . .

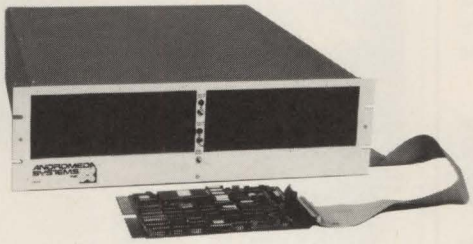
WINCHESTER DISK SYSTEMS

FOR THE Q-BUS

ADD-ON SUBSYSTEMS

MWDS

WDS

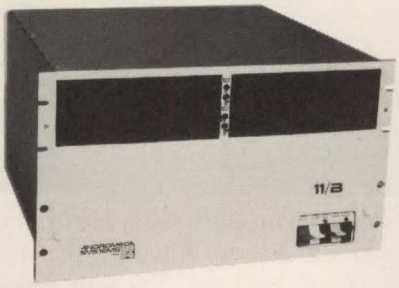


RPX60

5-1/4″ DISKS

11/M-W

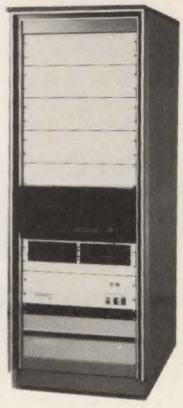
8″ DISKS



11/B-W

14″ DISKS

11/B-WTS



FULL TURNKEY COMPUTER SYSTEMS

. . . think of Andromeda

Andromeda Systems, Inc. offers the Q-Bus user a wide selection of Winchester disk based mass storage systems. Both add-on subsystems and full turnkey computer systems are available. Current storage capacities range from 2.5mb to 160mb. The Winchester disk controllers emulate DEC RK-05, RL-01/02, and RP-02/03 devices for compatibility with existing operating systems. Winchester disks in 5¼″, 8″ and 14″ formats are used to obtain the best possible performance in a variety of package sizes.

Back-up is to floppy disk or streaming magnetic tape. The 5¼″ and 8″ systems may be specified with an intregral floppy disk drive; these systems use the Andromeda WDC11 controller that includes an RX-02 emulating floppy disk controller on the same dual-width card. Also available for backup is a separate, high performance, non-emulating floppy disk controller, the DFDC11/DMDC11. This proprietary controller offers 25 to 61 percent more storage along with a data transfer rate 2.25 times faster than the RX-02.

We offer a complete line of Q-Bus based systems and other LSI-11 related products. For details, contact:

ANDROMEDA SYSTEMS INC.
9000 Eton Ave.
Canoga Park, Calif. 91304
Phone: 213/709-7600
TWX: (910) 494-1248

DEC, LSI-11, RK-05, RX-02, RL01, RP02 are trademarks of the Digital Equipment Corp.

CIRCLE NO. 130 ON INQUIRY CARD

4 Low Cost RS232 INTERFACE PROBLEM SOLVERS

PPB-41 ($395)

HIGH SPEED CRT DUMP!

Stop waiting for your fast CRT to dump its screen to your slow printer. The WTI Printer Port Buffer (PPB-4) easily connects between your CRT's RS232 Printer Port and Printer to receive up to 4K of data (2 screens) at 9600 Baud and release the data at the printer speed. Baud rates are switch selectable and the unit features Printer Busy and Buffer Full signals.

TM-41 ($295)

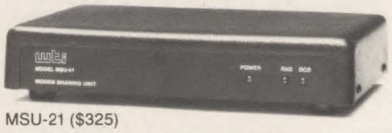
PUSH BUTTON TERMINAL SWITCHING!

Fed up with the hassle of plugging and unplugging data cables? The TM-41 switching device is capable of switching common RS232 signals between 4 input ports and one output port. Each port may be selected by a special switch module that is connected to the data cable and contains an activity LED and select switch.

CAS-41 ($395)

CODE ACTIVATED SWITCHING!

Your computer may select one or any combination of up to 4 RS232 ports by a simple 2 character user selectable ASCII control code sequence. The CAS-41 features switch selectable baud rates, ACK/NAK answerback, data loopback functions and activity indicators.



MSU-21 ($325)

TWO TERMINALS SIMULTANEOUSLY SHARE ONE MODEM!

The MSU-21 allows 2 ASCII terminals to simultaneously share one modem or data line. Individual baud rates can be selected for each port allowing two terminals, for example, to operate at 600 baud over a 1200 baud modem.

Call toll free or write for more information.

western telematic, inc.

2435 s. anne st., santa ana, ca 92704
call toll free (800) 854-7226
in california (714) 979-0363

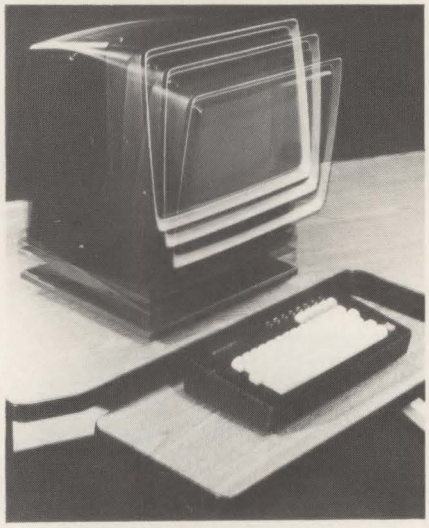
CIRCLE NO. 131 ON INQUIRY CARD

New Products

Penataquit Ave., Bay Shore, N.Y. 11706. **Circle No 402**

Structural offers adjustable CRT platform

This portable, tilting, swiveling, sliding CRT-terminal platform for desks or tables requires no mounting hardware. The platform tilts 20



degrees up or down from horizontal position and swivels 360 degrees for shared or angle use. The unit slides as far as 8 in. front to back and is available in various sizes. **Structural Concepts Corp.,** 17237, Van Wagoner Rd., Spring Lake, Mich. 49456. **Circle No 403**

Epoxy coating provides laser marking

This DK18-05 Gold epoxy coating powder for laser marking on axial or radial-lead devices produces a high-contrast, dark-brown image for character definition on monolithic or multilayer ceramic or tantalum capacitors, resistors, hybrid circuits and resistor networks. The powder is applied by electrostatic or conventional fluid-bed processes, has 85°C fusing and is non-burning. The powder is priced at $6.30 per lb. in minimum packages of 40 lbs., with quantity discounts available. **The Dexter Corp., Hysol Division,** 15051 E. Don Julian Rd., Industry, Calif. 91749. **Circle No 404**

GACC
GRAND AMERICAN COMPUTER CORP.

LSI-11 — PDP-11 — VAX

DEC* & COMPATIBLES

•DISC SYSTEMS

GRK06/7	32MB w/wo CTLR
GRK06/7	64MB w/wo CTLR
GRK06/7	96MB w/wo CTLR
GRM02/3	80MB w/wo CTLR
GRM04/5	300MB w/wo CTLR
GRM80	160MB w/wo CTLR

•MAG TAPE SYSTEMS

GTU-45	45 IPS tape & CTLR
GTU-75	75 IPS tape & CTLR
GTU-125	125 IPS tape & CTLR

•COMMUNICATIONS

DH11-AD	16 LINE MUX
DH11	8-64 LINE MUX
DZ11-A	8 LINE MUX
DZ11-B	8 LINE add/on MUX
DZ11-E	16 LINE MUX

•MEMORY

GMS11	MOS/PARITY FOR Q-BUS
GMS11	MOS/PARITY FOR UNIBUS
GMK11	MOS/ECC FOR 11-70
GMS780	MOS/ECC FOR VAX780

•PRINTERS

•CRT TERMINALS

•ACCESORIES (CABINETS, POWER SUPPLIES, BACKPLANES)

•USED DEC EQUIPMENT

RP06 — DH11
RP04 — MEMORY
RM02/3 — CPU's
RK06/7 — TAPES

•MANUFACTURERS

DEC
CDC
EMULEX
PLESSEY
FUJITSU
KENNEDY
NATIONAL SEMICONDUCTOR

•BEFORE YOU BUY CHECK WITH US WE CAN BEAT ALL PRICES!

•GET WHAT YOU WANT: SAVINGS, SERVICE, & SUPPORT

GRAND AMERICAN COMPUTER CORPORATION
15471 RED HILL AVE SUITE #A
TUSTIN, CALIF 92680
TELEX - 670497 GRAND AMFDGLDA
(714) 731-1519

*TRADEMARK OF DIGITAL EQUIPMENT CORP.

CIRCLE NO. 133 ON INQUIRY CARD

New Products

data acquisition

Datel-Intersil unveils V/F converters

The models VFQ-2 and VFQ-3 monolithic voltage-to-frequency converters use CMOS and bipolar technology in a charge-balanced IC. Two external capacitors enable setting the output pulse rate at 10 to 100 KHz. Pulse and square-wave outputs are available. The VFQ-2's maximum linearity at 10 KHz is 0.01 percent, and the VFQ-3 has a maximum of 0.25 percent. For a 100-KHz output, the maximum linearity of the VFQ-2 is 0.08 percent, and the maximum for the VFQ-3 is 0.5 percent. Internal circuitry includes an operational integrator; a comparator; a digital-delay circuit; single-pole, a double-throw electronic switch; a start circuit; a divide-by-two circuit; and two output-drive circuits. In quantities of one to 24, the VFQ-2C sells for $12.50, and the VFQ-3C sells for $4.95. **Datel-Intersil,** 11 Cabot Blvd., Mansfield, Mass. 02048.

Circle No 399

TI announces PCM CODECs

The models TCM2910A, TCM4910 and TCM4110 pulse-coded-modulation encoder/decoders are second-source replacements for Intel Corp.'s 2910A, 4910 and 4110, respectively. The TCM4910 and TCM4110 incorporate an A/D/D/A signaling interface, u-law commanding and time-slot decode logic for a voice-band PCM communications channel. The three parts incorporate NMOS technology. Typical operating power consumption is 230 mW, with a power-down mode that typically requires 33 mW. In 24-pin ceramic packages, the TCM2910A, TCM4910 and TCM4110 are priced at $11.62, $13.55 and $15.26, respectively, in 100-unit quantities. **Texas Instruments Inc.,** P.O. Box 202129, Dallas, Texas 75220.

Circle No 400

So many analyzers for rent . . .

It defies logic!

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CIRCLE NO. 134 ON INQUIRY CARD

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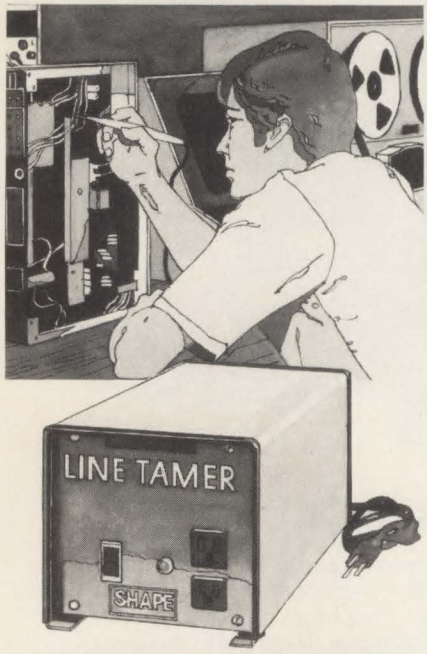

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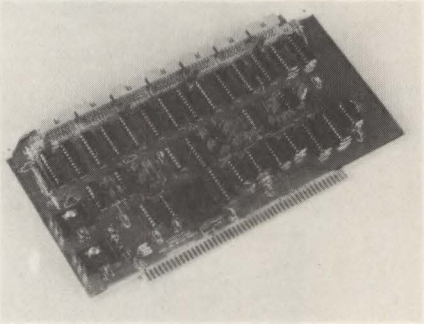
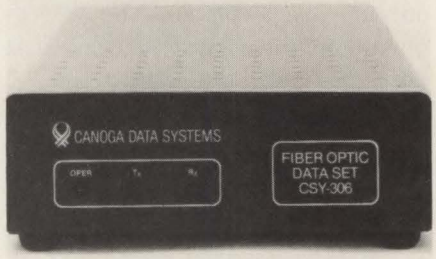
New Products

datacomm

Canoga Data introduces fiber-optic data set

The CSY-306 fiber-optic data set for computer-to-computer data transfer or for extension of satellite data links taps undetected into data-transmission lines to transmit sensitive or proprietary data as far as 1 km. Features include CCITT V.35 OR EIA RS449/423 interfaces, selectable data rates from 56K to 2.69M bps, handshaking-signal options, including RTS, CTS, DTR, DCD and DSR, and a manually selectable remote loopback. Other features include a bit-error rate of less than 1 bit in 10^{-9} and a clock signal that is transmitted with the data. Price is $1800 in small quantities with quantity discounts available. **Canoga Data Systems,** 21218 Vanowen St., Canoga Park, Calif. 91303. **Circle No 395**





DCC announces LTR trunking system

The LTR lightwave-thin-route trunking system uses fiber optics to transmit multiple T1 lines over distances as far as 35 KM. without repeaters. The system accepts one to nine standard DS-1 signals from independent sources, multiplexes them into a 10 × T1 data stream, adds housekeeping and overhead bits and transmits the information over a fiber-optic cable at 16 M bps. Features include standard interfaces at the T1 level and three plug-in T1 equalizers to cross-connect equipment as far as 655 ft. from the system and to provide a DSX-1-compatible interface. **Digital Communications Corp., Lightwave Communications Division,** 11717 Exploration Ln., Germantown, Md. 20767. **Circle No 396**

Rockwell introduces 9600-bps integral modem

The single-board V96 modem subsystem operates at 9600-, 7200-, 4800- or 2400-bps data rates and in half-duplex, two-wire or full-duplex, four-wire modem. The subsystem is compatible with CCITT V.29, V.27 ter, V.27 bis or 300 bps per CCITT.30. It features automatic adaptive equalization that enables data to be transmitted over long-distance, voice-grade switched networks. The unit consumes 3.5W of power and can be used with dedicated lines or on a general switched network. **Rockwell International, Electronic Devices Division,** 3310 Miraloma Dr., Anaheim, Calif. 92803. **Circle No 397**

Datec introduces Bell-compatible modem

The Datec 33, a 300-bps Bell-compatible originate/answer modem, includes a front-panel voice/-data button, long-space disconnect, five diagnostic tests and built-in A control. The unit operates via telephone over dial networks or over two-wire leased lines and uses an RS232C interface to connect terminals to computers. A stand-alone unit sells for $399, and a card sells for $325. **Datec, Inc.,** 300 E. Main St., Carrboro, N.C. 27510. **Circle No 398**

Our story begins in the middle.

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

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

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

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

BBN Computer offers incomparable customer service, a full range product line, and the rare advantage of nationwide single vendor sales and support. If you want to finish first, begin in the middle.

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*UNIX is a trademark of Bell Laboratories.

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LSI-11* Q-BUS* ARRAY PROCESSOR
Full Floating Point, Under $6K

Do you do...FFTs, digital filtering, vector math, matrix manipulations or other signal processing algorithms?
We do too!
Do you do them *FAST* on an 11/03, 11/2, or an 11/23?
We do!...and so can you.

In fact, the SKYMNK Micro Number Kruncher is already designed into:

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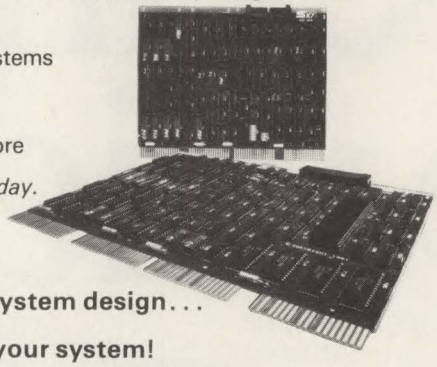

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MULTI-CAGE®

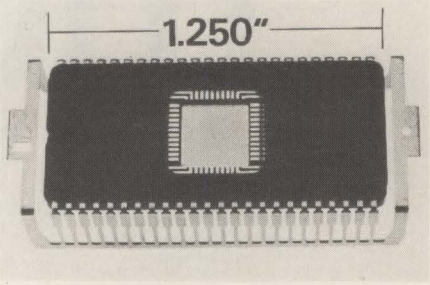
CIRCLE NO. 138 ON INQUIRY CARD

New Products

design aids

Ceramic package has 48 leads

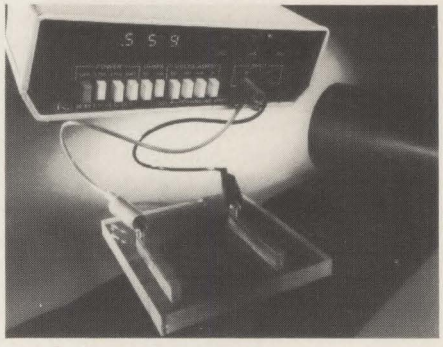
The 48-lead high-density Diapak uses external leads on 50-mil centers, with 600-mil row spacing. The package can be re-flow soldered directly to a circuit board, or it can be inserted into a DIP socket that



has a 100-mil pin pattern for soldering to a circuit board. Features include hermiticity to 1×10^{-8}, low-temperature frit-seal lid and aluminum wire-bond fingers. Planarity of bond fingers meets or exceeds requirements for automatic wire bonders. DIP configuration permits use of existing assembly and transport equipment. The package is also available in 64- and 40-lead models. **Diacon, Inc.,** 12810 Hillcrest Rd., #209, Dallas Texas 75230. **Circle No 390**

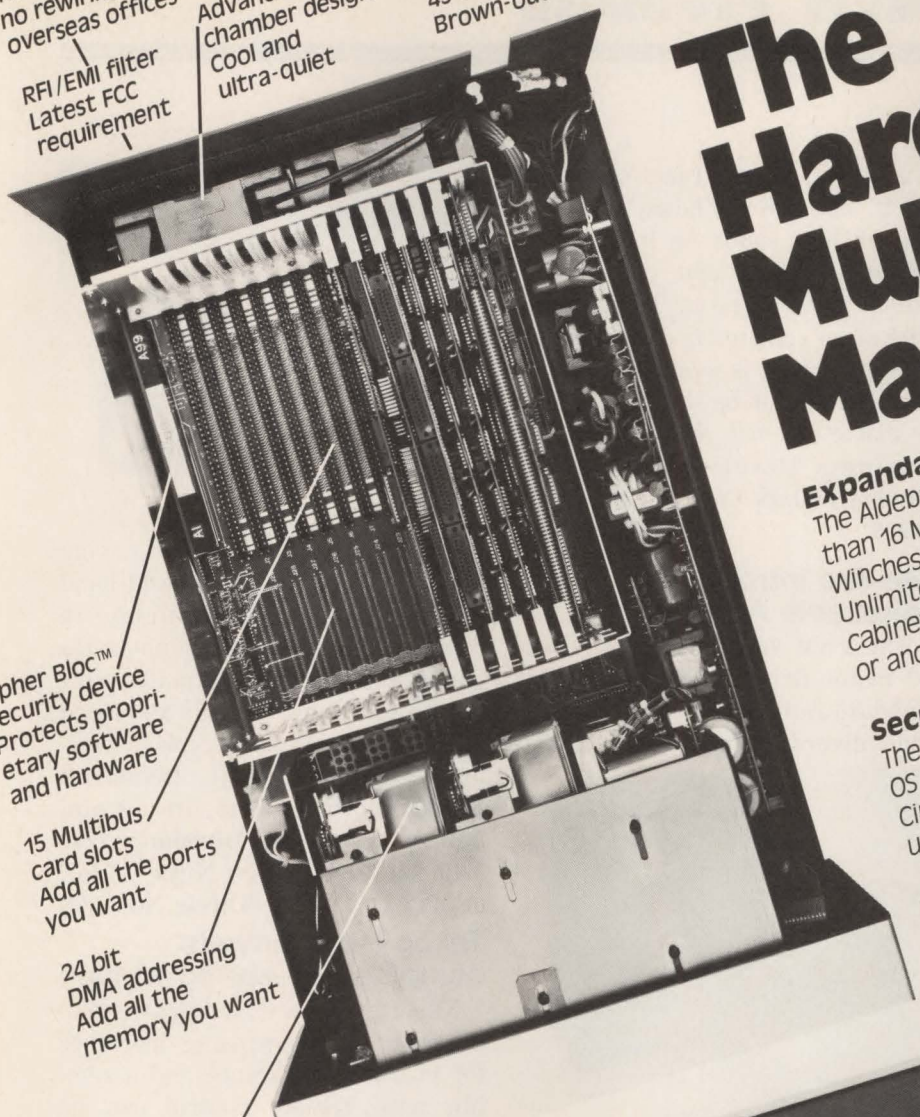
Conductive film is nonmetallized

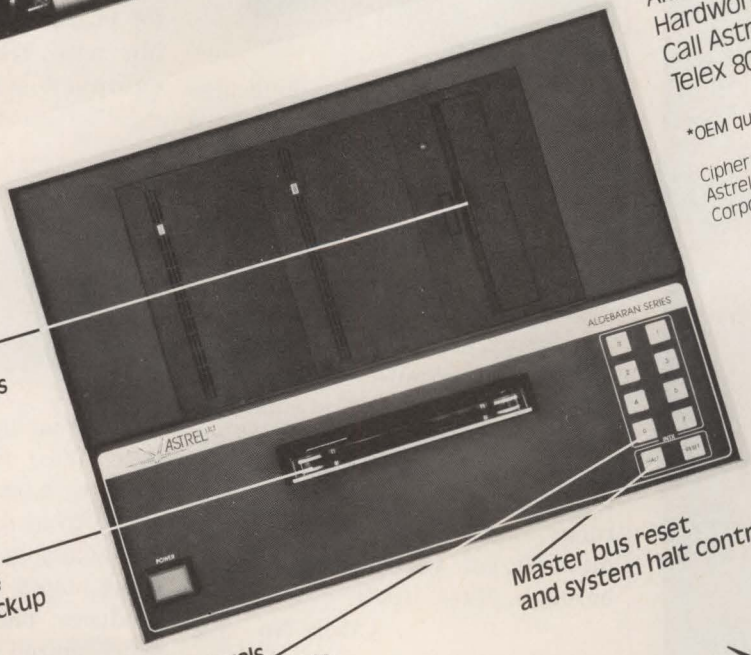
Kimflow conductive film is perme-



ated throughout with carbon black, rendering it electrically conductive without metallization. The film conducts electricity with a volume resistivity as low as 0.36 ohm × cm. The moisture-proof film is stable

The Hardworking Multibus™ Machine





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The Aldebaran™ System Series supports greater than 16 Mbyte of main memory, multiple Winchesters and floppy disk drives (>40MB). Unlimited configurations, all in the original cabinet! No need for additional power supplies or another chassis.

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New Products

over a temperature range as high as 130°C. The film can be metallized on one or both sides or in bands of different widths and patterns. It can be used alone or in laminates with other conductive or nonconductive materials, is available as wide as 48 in. and can be smooth-surfaced or matte-finished. **Schweitzer Co., Business Development Group, Kimberly-Clark Corp.,** Lee, Mass. 01238. **Circle No 391**

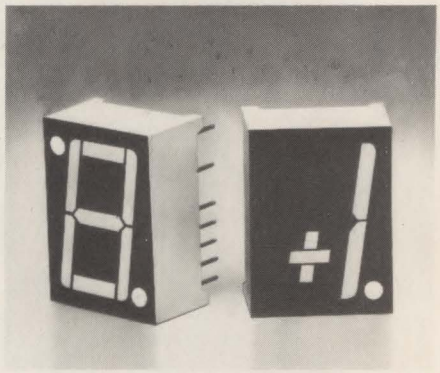
Vee-Arc introduces adjustable AC drive

The PWM 7000 adjustable speed AC motor drive is available in six standard ratings from 1 HP to 15 HP and delivers a pulse-width-modulated waveform that nearly duplicates a true sine wave. The unit operates from standard 230V, three-phase, 60-Hz current and delivers from 0V to 230V, 3- to 60-Hz constant torque, with extended frequency ranges as high as 180 Hz available. Features include LED status indicators, AC line fusing, output motor contactor and grounded-power heat sinks. Options include adjustable jog, forward/reverse, dynamic braking, DC braking, extended acceleration/deceleration, extended frequency range, input contactor and speed meter signal. **Vee-Arc Corp.,** Westborough, Mass. 01581.

Circle No 392

IEEE announces 0.8-in. red displays

The LR8900R series 0.8-in., red, seven-segment LED displays is designed for applications in which displays must be read over long distances. The units use right-hand decimals and are available in common-anode and common-cathode configurations. The units incorporate red segments on a red-faced background and have typical viewing distances of 33 ft. **Industrial Electronic Engineers, Inc., Component Products Division,** 7740 Lemona Ave., Van Nuys, Calif. 91405. **Circle No 393**



Tekno-Parts unveils compression-spring winder

These pneumatic, automatic-compression, spring-winding machines for in-line manufacture and assembly with remote control can be equipped with a heat-treating device that does not increase cycle time. Wire dimensions range from 0.004 to 0.025 in., and cycle times range from 0.7 to 2 sec. The units are available in two models. One, when used in assembly lines, produces one spring at a time synchronized to line requirements. The other produces six to 12 springs per cycle and assembles them simultaneously. **Tekno-Parts Inc.,** Suite 418, 303 E. Wacker Dr., Chicago, Ill. 60601. **Circle No 394**

DISTRIBUTED MICROPROCESSING LOCAL AREA NETWORK

The era of the local computer network has arrived. What was once a quiet experiment has become today's computer phenomenon, and Digital Microsystems is proud to be among the few who recognized the network's potential long ago.

Over 300 HiNet™ installations are already up and running in 16 countries. More are being added every month. Why? Because HiNet delivers the power, flexibility and other features that network users demand.

Compare HiNet to Minicomputers and Microcomputers

DMS gives network users the best of both worlds: HiNet combines the low cost of microcomputers with the high-performance benefits of minicomputers. HiNet also offers the modular configurations, distributed processing, and shared peripherals that neither of the other systems are able to provide.

You see, unlike other computer systems, HiNet gives a low-cost, high-performance computer to each user—there's no central processor to overload!

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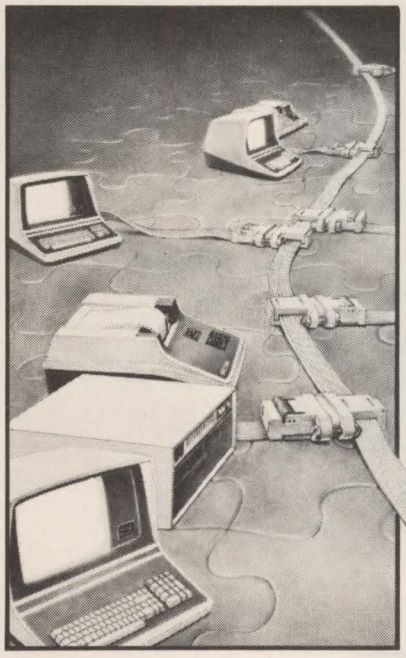

HiNet
Local Computer Network

HiNet is the Alternative

SYSTEM HIGHLIGHTS: Multi-tasking, multi-user local network designed to address up to 255 stations · Wide range of networking configurations · Shared or local disk storage and printers · Intelligent hard disk controller · Streamer tape or proprietary fast floppy back-up · Redundant master station for real-time system back-up · All I/O and networking ports provided · Reliable single board design.

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SYSTEMS SOFTWARE ADVANTAGES: Total CP/M™ compatibility in a multi-user, network environment · Record locking and security password protection of all network data · User assignment/reassignment to any station anywhere on the network · Flexible disk partitioning · Background print spooling and master station disk access, freeing the master station for its own user's processing · Extensive user-friendly diagnostics for improved efficiency and system uptime!

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HiNet has the cost effective power, performance and flexibility you want in a local computer network—the first of its kind to be delivered. Just what you'd expect from Digital Microsystems—the first company to deliver microcomputer business systems, double density floppies, and Winchester hard disk systems. So, before your competition becomes a HiNet dealer, compare. Compare quality, reliability, design, and performance. Contact the DMS Corporate office today: (415) 532-3686, TWX: 910-366-7310...or the DMS International office in London: 01-353-1081, TELEX: 23721.

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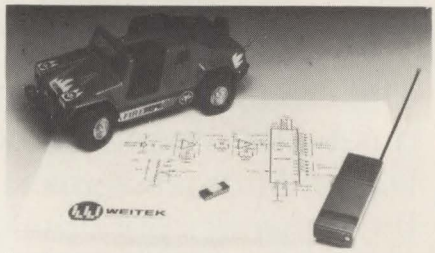
CIRCLE NO. 141 ON INQUIRY CARD

components

Weitek introduces voice-recognition chip

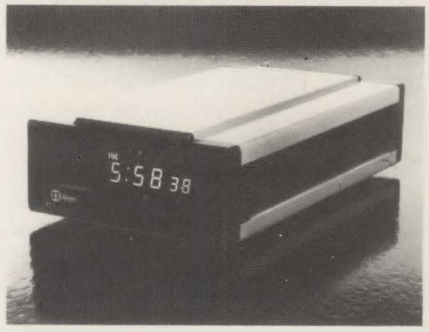
The WTV008 single-chip voice recognition system recognizes words or phrases in two pages of as many as eight words each. The unit consists of a single-chip digital processor with an analog speech-input preconditioning circuit that receives speech from a microphone. Recognized utterances activate one of eight bit-line outputs and a four-line BCD number output; an output strobe indicates recognition status. Price, including a custom-



ized vocabulary set, is less than $10 each in quantities of 100,000 or more. **Weitek Corp.,** 3255 Scott Blvd., Building 2B, Santa Clara, Calif. 95050. **Circle No 388**

Burr Brown introduces 16-bit A/D converter

The model ADC76 16-bit hybrid A/D converter features a 67 KHz throughput rate for 14-bit resolution and 59 KHz for 16-bit resolution. Specifications include 15-μsec. conversion time for 14-bit resolution and ±0.003-percent-FSR maximum



linearity error. Gain drift is ±15 ppm/°C, and offset drift is ±10 ppm of FSR/°C (bipolar). Selectable analog input ranges are ±2.5V, ±10V, 0V to +5V, 0V to +10V, and 0V to +20V. The IC incorporates a comparator, a clock, a reference and laser-trimmed thin-film components in a 32-pin, bottom-brazed ceramic package. Performance operating range spans 0 to 70°C, and power requirements are ±15V DC and +5V DC. The device is available in two models, the 13-bit linear ADC76JG and the 14-bit linear AD676KG, which sell for $165 and $191, respectively, in 100-unit quantities. **Burr-Brown, Data Conversion Products,** Box 11400, Tucson, Ariz. 85734. **Circle No 389**

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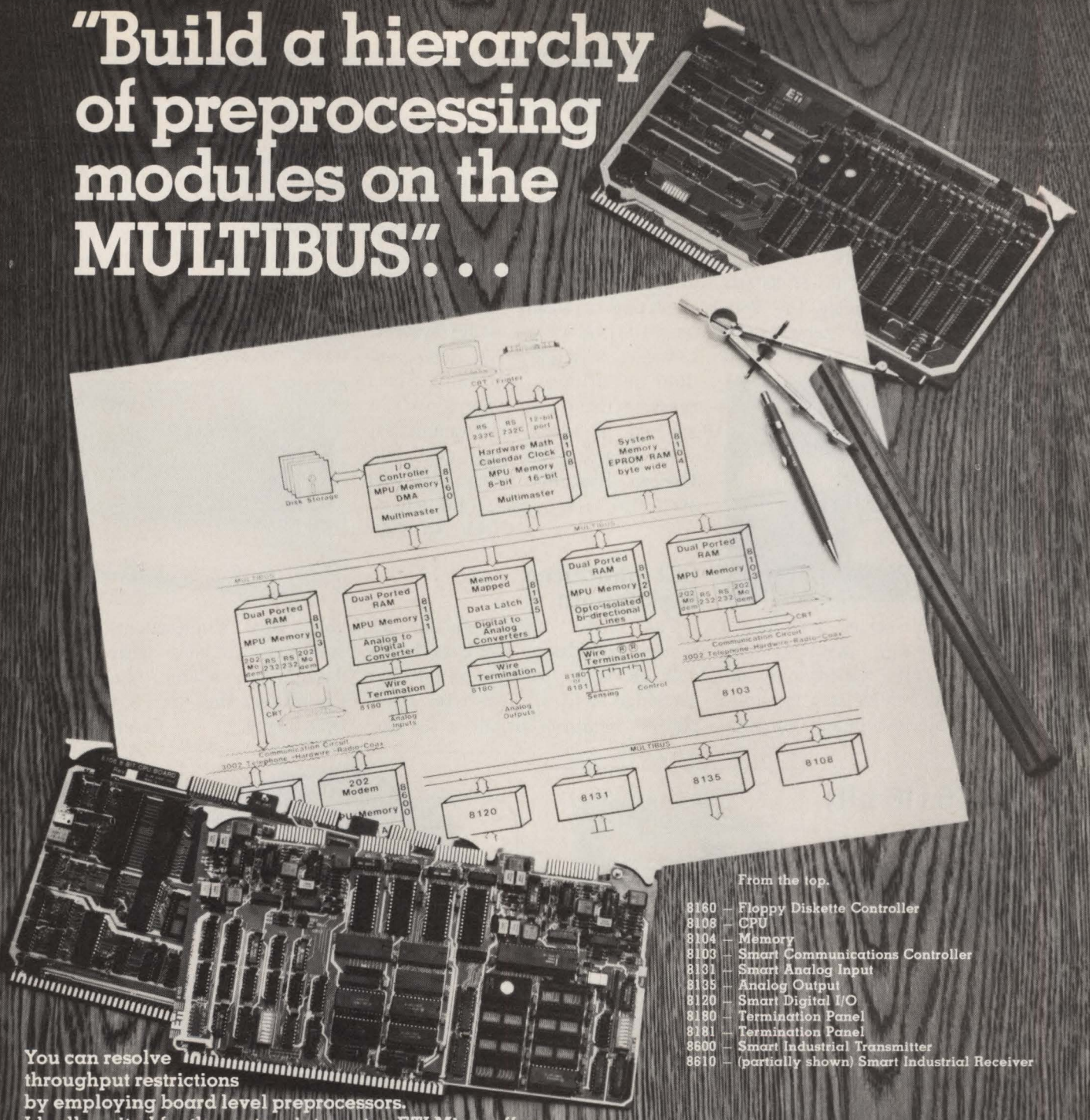
CIRCLE NO. 142 ON INQUIRY CARD

"Build a hierarchy of preprocessing modules on the MULTIBUS"...



From the top.

8160 – Floppy Diskette Controller
8108 – CPU
8104 – Memory
8103 – Smart Communications Controller
8131 – Smart Analog Input
8135 – Analog Output
8120 – Smart Digital I/O
8180 – Termination Panel
8181 – Termination Panel
8600 – Smart Industrial Transmitter
8610 – (partially shown) Smart Industrial Receiver

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The Combination That Works.

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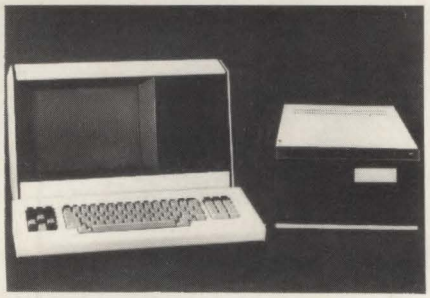
CIRCLE NO. 143 ON INQUIRY CARD

micros

Codata offers Multibus μcs

The CTW series of Multibus-compatible μcs includes the Z80-based CTW-100, the Z8000-based CTW-200 and the 68000-based

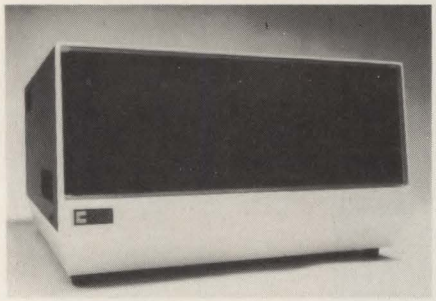


CTW-300. The series includes a selection of 5¼-in., 10M-byte Winchester-disk drive, a 380K-byte dual minifloppy-disk drive or a 17M-byte tape-cassette drive in any combination. The μcs store 64K bytes to 1M byte of RAM. The CTW-300 processes FORTRAN and Pascal software, including the ANSI-standard FORTRAN-77. The languages operate under the MERLIN, a UNIX-like operating system. The CTW-200 uses the XENIX operating system. CTW-300, with one 5¼-in. drive, one dual minifloppy and one tape-cassette drive, sells for less than $20,000 in single-unit quantities, with quantity discounts available. **Codata Systems Corp.,** 285 N. Wolfe Rd., Sunnyvale, Calif. 94086.

Circle No 386

CCI introduces desk-top μc

The model XP/4 desk-top μc system includes a 20M-byte hard-disk drive, a 10M-byte removable cartridge and a 10M-byte fixed platter. Features include a Z80 μp, 64K of RAM, an anti-glare 24-line × 80-character CRT display, a serial communications channel and a Centronics-compatible parallel printer interface. Options include a selection of dot-matrix and daisy-wheel printers. The system is supported by CP/M, with Microsoft BASIC, FORTRAN and COBOL avail-



able. OEM single-quantity prices start at $15,250, with quantity discounts available. **Commercial Computer, Inc.,** Box 39355, Solon, Ohio 44139. **Circle No 387**

DCS/86 (16 bit) Multibus® Microcomputer System $6500

MINICOMPUTER PERFORMANCE The DCS/86 is an industrial quality rack-mountable Multibus* compatible microcomputer system with the performance of a mini. The DCS/86 utilizes the Intel 8086 16-bit microprocessor and has memory expansion to 1 megabyte with automatic error correction. A 64K byte system with CPM/86** software is $6500.00.

HIGH RELIABILITY The DCS/86 is a compatible upgrade to the field proven DCS/80 which has been used for over two years in hundreds of demanding industrial applications. All electronics are subject to industrial "burn-in" at 55°C in insure long term reliability.

SOFTWARE The DCS/86 has the most extensive array of software available for 16-bit microprocessors. CPM/86** is a direct descendent of CPM/80** utilized by the DCS/80 and over 200,000 micro-computers world wide. Optional software include MS-DOS*** (DOS used on IBM personal computer) and MPM/86** (multi-user, multi-tasking.) High level languages include Fortran-77, Pascal, Basic, Cobol, PL/I (Subset G) and "C".

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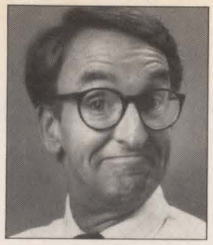
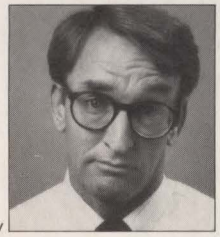


Barney Stevenson just spent two years programming and de-bugging a process control system in assembly code.

Now Barney thinks he deserves some congratulations for his efforts.

Sorry Barney,

NO CIGAR.



Barney Stevenson thought he deserved a pat on the back. As project manager at Smart Widgets, Inc., he had taken on the biggest real-time process control headache of his life. And after 24 months he'd finally succeeded in programming and de-bugging Smart's newest product.

We think Barney missed the boat.

Barney figured the choice was simple. High level languages like Pascal and Fortran could program quickly, but would run too slowly and take up too much memory. Assembly code would take longer to program and de-bug, but was the only answer for real-time applications.

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CIRCLE NO. 76 ON INQUIRY CARD

minis

Minicomputer is Nova compatible

The MiniMate Nova-compatible minicomputer features a 100-nsec. arithmetic - instruction - execution time, a 200-nsec. load-and-store time, a 55-nsec. memory-access time and a 128K-byte capacity. DMA transfer time is 800 nsec. Other features include execution/DMA overlap, a modular power supply, a control module that can be removed from the front and plugged into the backplane and software compatibility with IRIS, RDOS BLIS/COBOL and VMOS. Board-only versions, including 64K or 128K bytes of memory, sell for $5025 and $7125, respectively. Versions including the CPU, memory, power supply, an enclosure and 64K or 128K bytes of memory sell for $7875 and $9975, respectively. Quantity discounts are available. **Integrated Digital Products,** 3156 E. La Palma Ave., Unit A, Anaheim, Calif. 92806.

Circle No 380

Zehntel announces dual-processor computer

The Gemini dual-processor computer for the vendor's Troubleshooter 800 in-circuit test system consists of two 16-bit, single-board CPUs with UNIX-based software. A Z8001-based minicomputer handles all user and interface tasks, including operating the tester's automatic program generator and performing data analysis. An 8086-based CPU controls the analog and digital testing hardware. System software creates a multitasking, multi-user environment, enabling several users to access the system while it is performing production testing. The system also includes 256K bytes of main memory, and mass storage includes a 34M-byte Winchester-disk drive with a 17.5M-byte tape-cartridge backup. **Plantronics Zehntel, Inc.,** 2625 Shadelands Dr., Walnut Creek, Calif. 94598. **Circle No 381**

Microtech introduces Winchester-based systems

This family of Dart-based minicomputers, available in seven configurations, includes a 16-bit system and 64K bytes of RAM. The systems support Winchester-disk drives storing 10M bytes on one spindle to as much as 732M bytes on four spindles. The devices use streaming-tape backup. The systems run the IRIS operating system and various applications packages. Prices range from $14,950 to $36,000. **Microtech Business Systems,** 3180 Pullman St., Costa Mesa, Calif. 92626. **Circle No 382**

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CIRCLE NO. 147 ON INQUIRY CARD

power supplies

Nova announces 1-KVA UPS

The 1-KVA Min-Taur produces a sine-wave output with less than 5 percent harmonic distortion, and with an optional built-in solid-state transfer switch, provides as much as 50 percent overload for as much as 1 min. The system accommodates an input of 120V AC ±10 percent, 60 Hz, ±5 percent, one-phase; output voltage regulation is 120V AC ±1 percent, 60 Hz, ±0.5 percent. The instrument has built-in rechargeable batteries with 15 min. of reserve

power. The internal battery charger has an automatic float-equalize circuit for charging after a utility failure and consequential battery discharge. Price is $3125. **Nova Electric Manufacturing Co.,** 263 Hillside Ave., Nutley, N.J. 07110.

Circle No 383

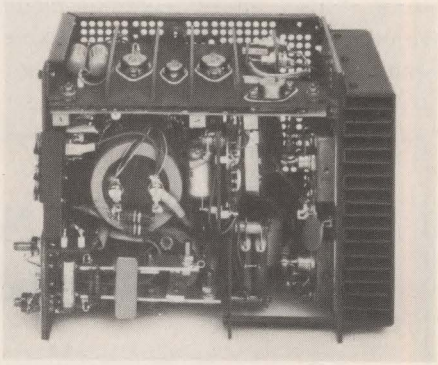
AC voltage monitors have detachable detectors

These AC voltage monitors, consist of a Modutector detector module and a detachable μp-based printer/controller module. The system enables threshold limits, calendar and clock settings and monitor identification number to be entered with push-button keys. The unit can be removed from its briefcase and left at a site. The monitor distinguishes and identifies the following AC line perturbations exceeding operator set thresholds: low and high voltage levels based on a moving 16-cycle time period; sags and surges of ½ to 511 cycle length, including dropouts; impulses with a rise time of less than 50 μsec. and as high as 1000V; common -mode noise between line and ground exceeding a 5V factory-set threshold; and power outages exceeding a six-cycle duration. The system's memory stores 28,675 events for several months under backup battery power. Price is $4500, including one Modutector module; extra Modutectors sell for $1200 each. **The Superior Electric Co.,** 383 Middle St., Bristol, Conn. 06010.

Circle No 384

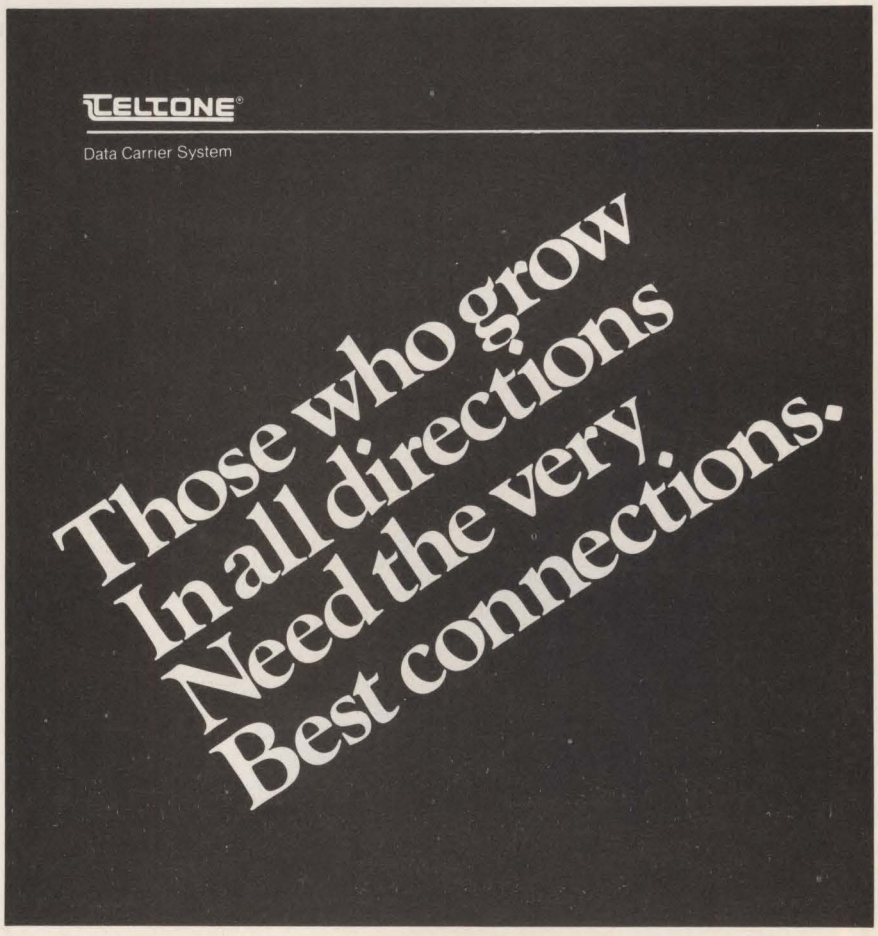
Power supplies are convection cooled

The LYS-D convection-cooled, open-frame power supplies have outputs of as much as 28V and currents as high as 120A. The series includes 42 single-output, four dual-output and eight triple-output models. All models have overvoltage protection. Line regulation is 0.1 percent. Load regulation is 0.1 percent for all single-output models and the 5V output of triple-output models and 100 mV from 0 to full



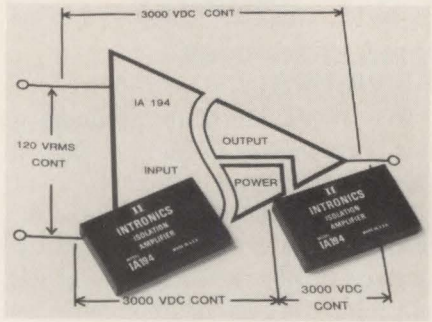
load of dual-output models and for dual output of triple-output models. Prices are $630 in single-unit quantities and $473 in 1000-unit quantities. **Lambda Electronics,** 515 Broad Hollow Rd., Melville, N.Y. 11747.

Circle No 385



Intronics announces isolation amplifier

The model IA194 isolation amplifier offers a 30-KHz bandwidth, 3000V I/O power isolation, 100-μsec. settling time, 90-dB common-mode rejection, externally programmable gain, a floating internal supply for powering an external transducer and external synchronization of the internal oscillator used in obtaining the input isolation. Its 0.1-percent linearity enables compatibility with 10-bit data-acquisition systems, and input voltage noise is held to 3 μV, 10 HZ to 1 KHz, with 40 pA maximum current noise for the same range. Relative accuracy, including all

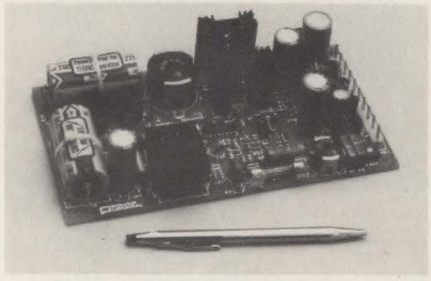


effects of offset, temperature and linearity is ±0.5 percent over the full range of 0°C to 80°C. Price is $119 in quantities of one to nine. **Intronics,** 57 Chapel Hill St., Newton, Mass. 02158.

Circle No 378

Power General offers 50W power supply

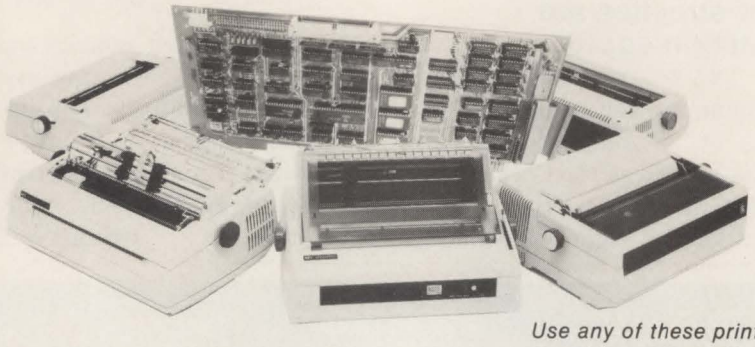
The series 4050 power supplies, for operating μp-based systems, are



true off-the-line switchers with as many as four output voltages on one PC board. Full rated output is provided over an ambient temperature range of 0°C to 50°C with a 2-percent/°C derating to 71°C. The series includes four models, including 4050-1 (+5V at 6A, −5V at 1A, +12V at 1A, −12V at 1A), 4050-2 (+5V at 6A, −5V at 1A, +15V at 1A, −15V at 1A), 4050-3 (+5V at 6A, +12V at 1.5A, −12V at 1A) and 4050-4 (+5V at 6A, +15V at 1.5A, −15V at 1A). The devices' input offers pin-strappable voltage ranges of 85 to 130V AC or 170 to 260V AC at 47 Hz to 470 Hz. The units also include an RFI input line filter. Prices range from $149 to $159. **Power General,** 152 Will Dr., Canton, Mass. 02021.

Circle No 379

Intelligent Solution MAKES Dumb Printers *SMART.*



Use any of these printers with your computer.

THE INTEGRATOR ELIMINATES CHANGE.

THE INTEGRATOR—A Z80-based interface board—connects these printers to any computer with an RS-232 or Centronics parallel I/O port.

- **Diablo M-630 with Qume or Diablo interface.**
- **NEC 3500 Q/D, 5500 Q/D, 7700 Q/D.**
- **Qume Sprint 3 & Qume Sprint 7 with 13-bit interface.**
- **Fujitsu SP830. HyType II.**
- **Ricoh RP 1600.**

And gives you these bonus features:

- Optional 16K or 48K RAM.
- 16 baud from 50-19, 200—hardware/software selectable.
- RS-232, Centronics Parallel, IEEE ports, Current Loop.
- Switch selectable protocols: NEC 7710, Diablo 630, Qume Sprint 5.
- 24 switch selectable functions.
- Auto bi-directional printing with optimized thruput.
- Sheetfeeder and graphics modes.
- Auto proportional spacing and tab setting.
- Sheetfeeder and graphics modes.
- Auto proportional spacing and tab setting.
- Upgradable to latest software.
- Complete word processing features, standard.
- Supports optional front panel.

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Intersell added THE INTEGRATOR to the NEC Spinwriter. Since then, this successful, value-added printer has enabled the sale of the SELLUM I "with satisfaction guaranteed", to dealers and systems integrators.

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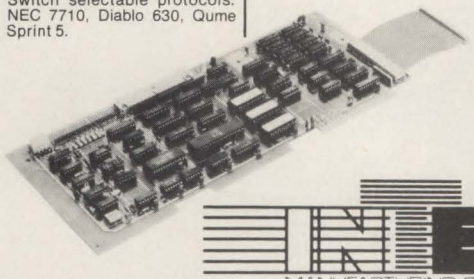

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CIRCLE NO. 148 ON INQUIRY CARD

printers

NEC introduces dot-matrix printer

The bidirectional PC-8023A dot-matrix printer produces dot graphic screens on paper at 100 cps. The

printer uses cartridge or ribbon spools and pin- or friction-feed delivery. It handles as many as three copies of fan-fold, roll or cut-sheet paper and originals. Matrix options include 7 × 9 English, 8 × 8 graphic and 8 × 8 dot graphic. Font sizes range from 40 cpl, 4 cpi, to 136 cpl, 17 cpi. Fonts feature fixed- or proportional-spacing format options at 6 or 8 lpi plus 1/144-in. incremental line feed. Price is $795. **NEC Home Electronics U.S.A., Personal Computer Division,** 1401 Estes Ave., Elk Grove Village, Ill. 60007.
Circle No 358

GE announces forms-access printer

The TermiNet 200 forms-access line printer produces one to nine copies at 200 cps, with a paper-slew rate of 20 ips. The unit includes a nonvolatile memory that stores as many as eight vertical formats, an adjustable tear bar, servo-driven tractors that enable operators to make forward and reverse manual alignments to all forms, 7 × 9 dot-matrix format and an optional print head with a 9 × 9 matrix that permits underlining and lower-case descenders. Other features include switch or code-controllable print compression at 10, 13, 15 and 16½ cpi and switch-selectable vertical spacing at 6 or 8 lpi. Price is $3010 in single-unit quantities. **General Electric Co., Data Communication Products Department,** Waynesboro, Va. 22980.
Circle No 359

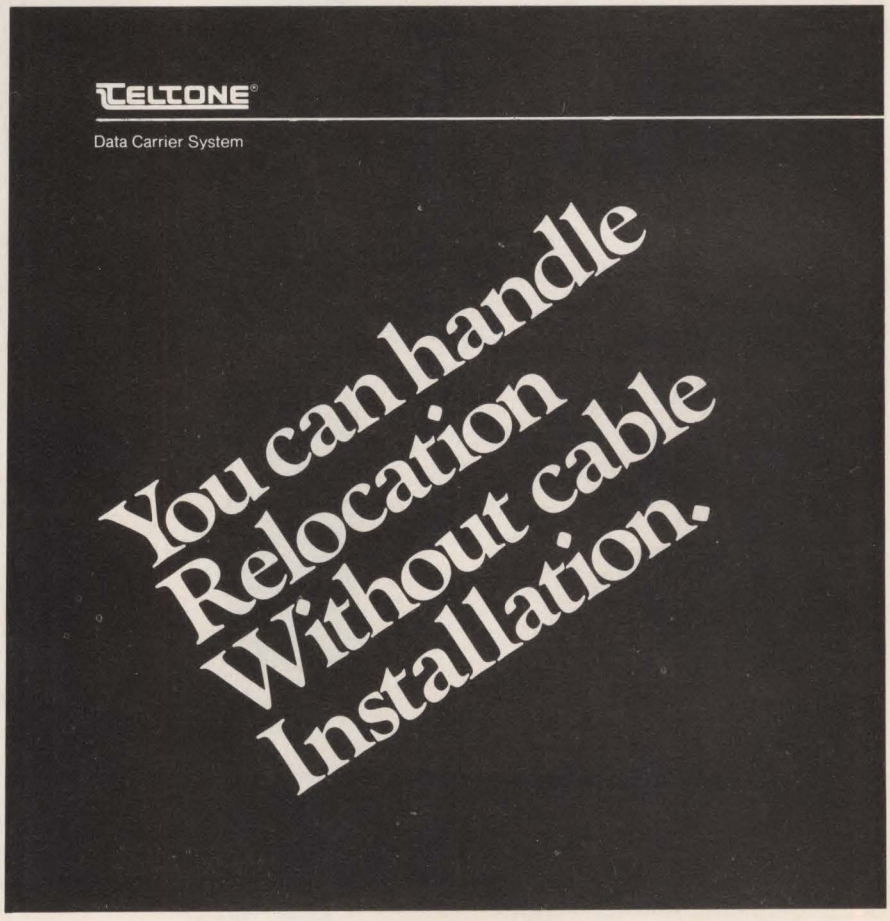
Zenith offers 150-cps printer

The Z-25 dot-matrix line printer prints at more than 150 cps at speeds as high as 300 lpm. The device interfaces with μcs using RS232C or 20-mA current loop at baud rates as high as 9600 bps. Features include a 9 × 9 dot matrix, a 95-character ASCII set, upper- and lower-case characters and 33 graphics characters. Character pitch is 10, 12, 13.2 or 16.5 cpi. The unit includes LED control-panel indica-

tors and automatic test-printing and status lights. Price is $1595. **Zenith Data Systems,** 1000 Milwaukee Ave., Glenview, Ill. 60025.
Circle No 360

Demand label printer produces bar codes

The Moduprint dot-matrix demand label printer prints bar codes, OCR, alphanumeric characters and graphics using adhesive labels, multiple-part forms and card-stock tickets and tags. The unit interfaces to labeling machines; butcher,



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At these one day, regional conferences guests will have a close-up view of every type of computer and peripheral-mini/micros, disk drives, tape drives, printers, interfaces, controllers, graphic display terminals—and will be welcome to attend a program of technical seminars covering the latest state-of-the-art technology. Some of the companies associated with the series include Arsycom BV, Century Data Systems, CII Honeywell-Bull, Cipher Data Products, Control Data, Dataram, Genisco Computers, International Memories, MDB Systems, Priam, Printronix, Remex, National Semiconductor, Kennedy and Trilog.

Technical product seminars will be presented on streaming tape drives, graphic display systems, winchester disks, matrix line printers, color printer/plotters and add-in memories.

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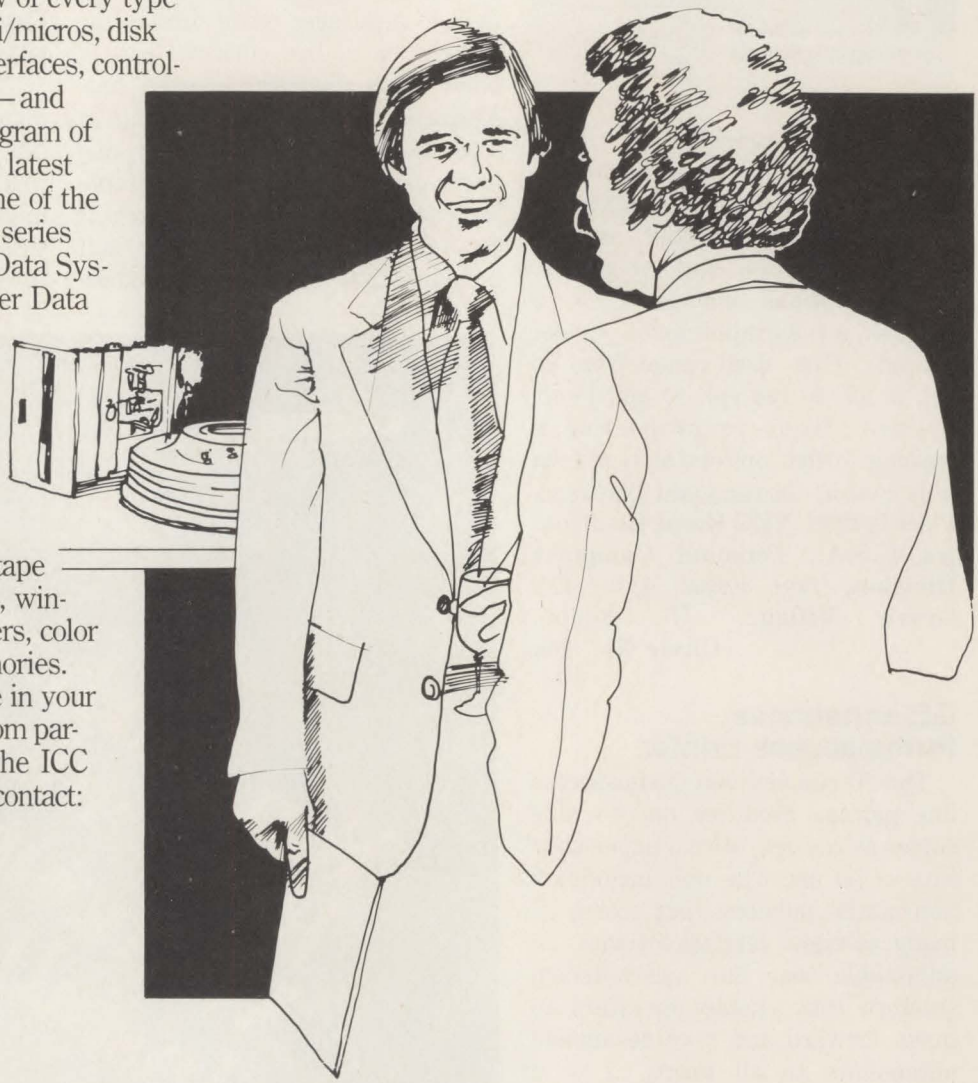
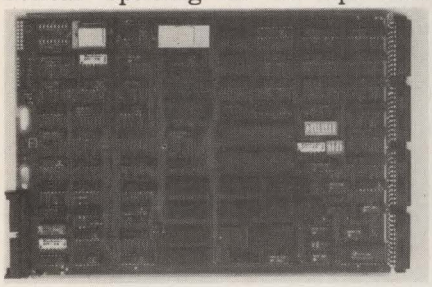


Invitational Computer Conferences

grocer and shipping-department scales; and warehouse/stockroom-product or material-identification systems. Dot-placement variation averages 0.001-in. from target point, allowing the unit to print optically scannable codes. The printer produces alphanumeric characters at speeds as high as 250 cps using pressure rollers for supply advance. **Data Specialties, Inc.,** 3455 Commercial Ave., Northbrook, Ill. 60062. **Circle No 361**

BDS offers print system for Series/1 minis

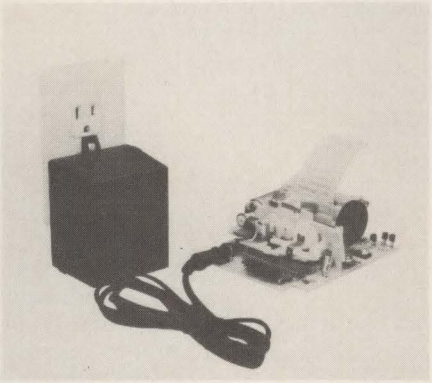
The model IPL07 printing system for IBM Series/1 minicomputers includes a controller and a band or a matrix printer. Print speeds range from 100 to 1800 lpm. The controller is software-compatible with IBM RPS and EDX operating systems. On-card 2901 bit-slice μps convert EBCDIC from the Series/1 bus to printer-control signals. The printer features 132-column format, horizontal spacing at 10 cpi and



switch-selectable line spacing at 6 or 8 lpi. Other features include a 64-character set, self-test, a diagnostic display, a paper puller and a UPS. A 96-character set and foreign-language bands are optional. Prices range from $4800 to $28,000, depending upon printer speed, in single-unit quantities. **BDS Corp.,** 115 Independence Dr., Menlo Park, Calif. 94025. **Circle No 362**

Hycom introduces 12-cpl printer subsystem

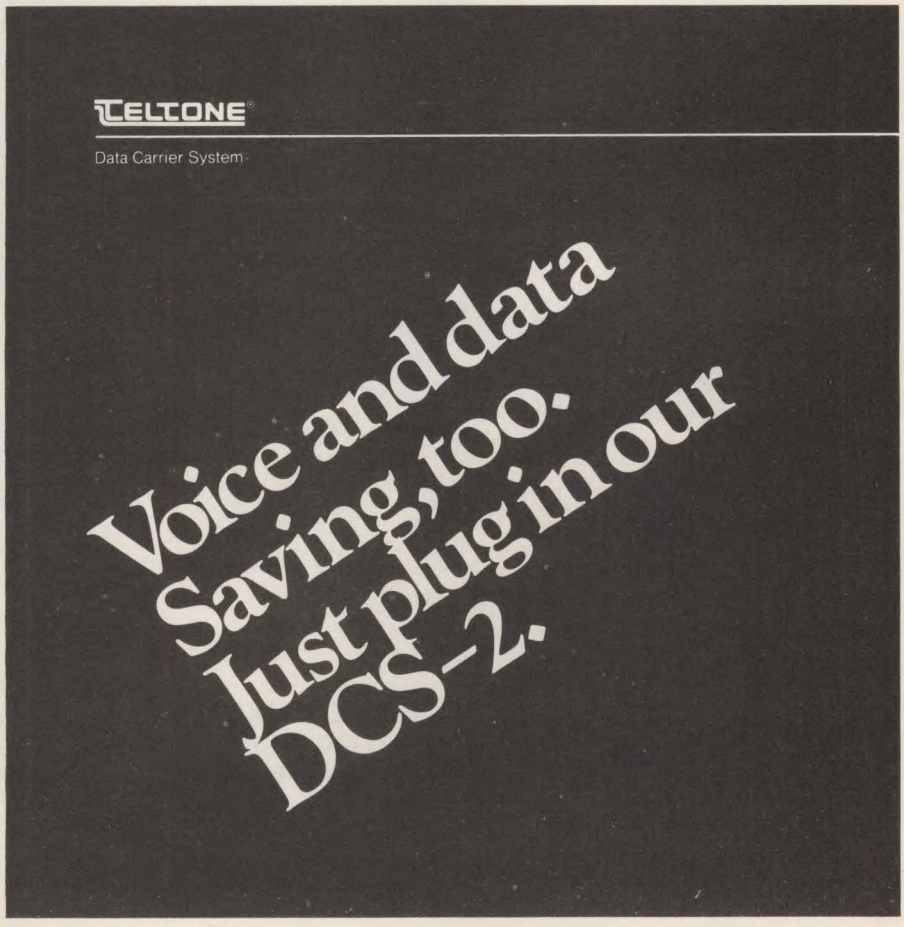
The SS-12 printer subsystem prints 12 cpl. It requires 6V, 800 mA power and accepts parallel, BCD or RS232 data at speeds from 110 to 9600 bps. The unit prints in



electrosensitive dot-matrix format, in a 64-character set at 5 lps. Features include a tear bar, a paper advance, a one-line buffer and expanded-print and self-testing modes. Price is $150, including power supply, in 100-unit quantities. **Hycom,** 16841 Armstrong Ave., Irvine, Calif. 92714. **Circle No 363**

Four-Phase announces 450-lpm printer

The model 8155 solid-font impact band printer prints 450 lpm using a 64-character band or 375 lpm with an optional 96-character band. The model is compatible with the vendor's series IV processors and can be changed from upper-case print to upper- and lower-case print with no software adjustments. The 132-column printer has a 10-cpi print format with switch-selectable vertical line spacing of 6 or 8 lpi. The printer also includes a 12-channel vertical forms unit. Price is $19,500. **Four-Phase Systems,** 10700 N. DeAnza Blvd., Cupertino, Calif. 95014. **Circle No 364**



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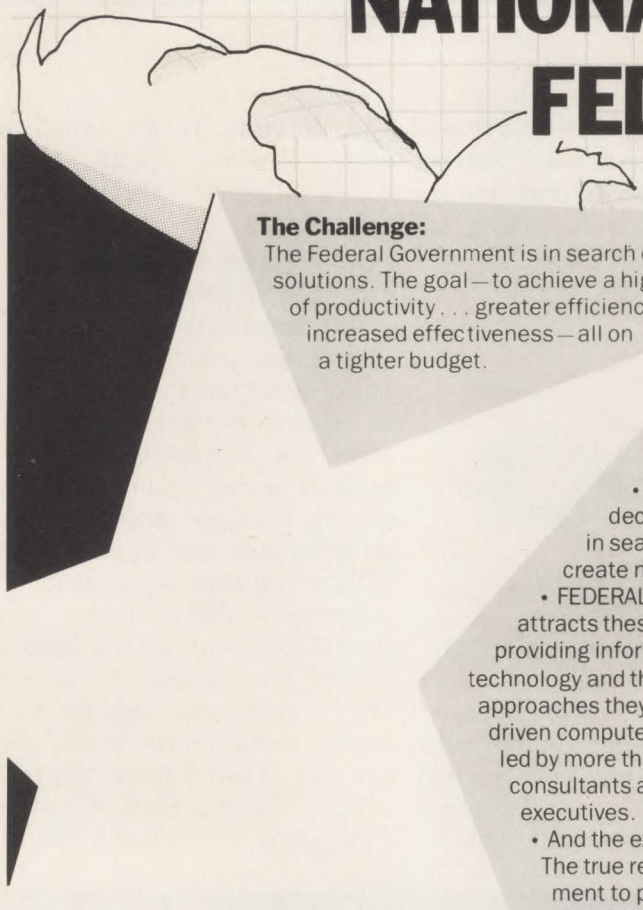

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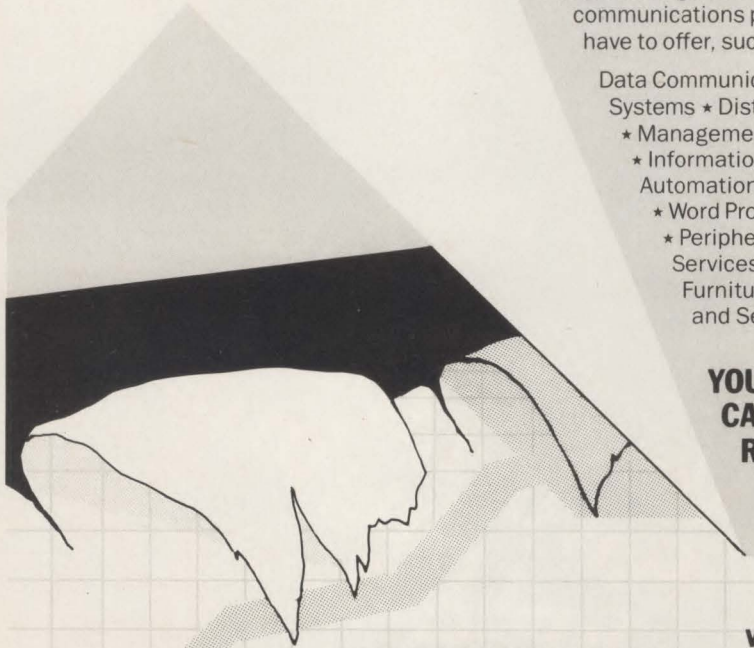

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terminals

H-P introduces office display terminal

The HP2382A office display terminal operates in block, line or character modes with full-duplex, asynchronous data communications via an RS232C interface. The unit is software compatible with the vendor's 2622A and 2640B terminals and incorporates a 9-in., etched, glare-reducing screen that displays 80 columns × 24 lines, eight screen-labeled soft keys and a typewriter-style detached keyboard. Features include inverse video, underlining, blinking and half-bright, the ability to store as many as two pages of 80-character lines, cursor-control keys and screen scrolling. A 64-character line-drawing set and keyboards and characters sets in Swedish/Finnish, Norwegian/Danish, French, German, U.K. and

Spanish are optional. The terminal sells for $1700. Language keyboards are $80 each, and a line-drawing character set sells for $80, with OEM and volume discounts available. **Hewlett-Packard Co.,** 1501 Page Mill Rd., Palo Alto, Calif. 94304. **Circle No 368**

Teleray announces model 100 enhancements

Ten features have been added to the vendor's 132-column model 100 CRT terminal. The features include the ability to make the unit a VT-132 or a VT-100 emulator. Other added features include block mode, full editing, half-duplex communications, forms transmit protect mode and the ability to execute or transmit user-programmable functions on-line. Price remains at $1745. **Teleray, Division of Research, Inc.,** Box 24064, Minneapolis, Minn. 55424. **Circle No 369**

Micro Display offers display terminal

The Apple-compatible Genius CRT display terminal for the vendor's μcs feature a 15-in. screen that displays 57 lines × 80 characters, with 66 lines × 80 characters optional. The system displays black-on-white characters and is compatible with CP/M-based programs. It displays large sections of code at one time and includes a high-resolution display with 87-MHz bandwidth and 6K bytes of buffer memory. The system, including an Apple interface card, sells for about $1795 in single-unit quantities, with dealer and quantity discounts available. **Micro Display Systems, Inc.,** 514 Vermillion St., Hastings, Minn. 55033. **Circle No 370**

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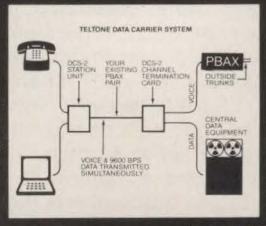

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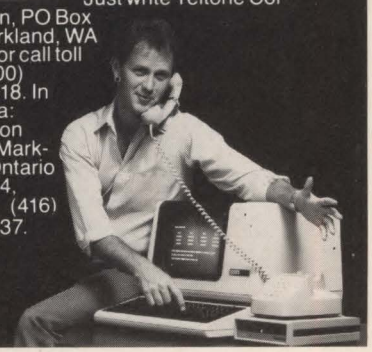

FCC part 68 registered. For users of DEC, H-P, Data General, Prime, Tandem, IBM Series/1 and other asynchronous computers.

CIRCLE NO. 149 ON INQUIRY CARD

test equipment

MST system tests 8-, 5¼-in. floppy disks

The System 810 single- or multi-station system tests and certifies almost 40,000 single-sided 8-in. floppy disks and 63,000 single-sided 5¼-in. floppy disks per month. The system comprises one to four certification stations, a system console, an operator terminal and a system software diskette. Three certification stations are available. Model 811 tests 8-in., 48-tpi disks, model 812 tests 5¼-in., 48-tpi disks, and model 813 tests 5¼-in., 96-tpi disks. Each model processes single- and double-sided disks. The system supports any combination of models 811, 812 and 813, with a maximum of four certification stations per system. Each 811/812/813 station contains a

floppy-disk drive, a media sorter, a pre-amp driver, an analog certifier controller and a proprietary FDIC controller. The stations are controlled by software via the FDIC and the analog certifier. Price for a system with four certification stations is less than $100,000. Stations are also available separately. **Media Systems Technology, Inc.,** 17991 Fitch Ave., Irvine, Calif. 92714. **Circle No 366**

Three Phoenix offers digital logic tester

The 3PX560 digital logic functional circuit-board tester enables programs to be generated off-line, thus not disrupting production. The device uses a fault dictionary-isolation procedure. It also includes a DEC TU-58 format minimagnetic-tape cassette for program loading and storage. It stores as many as 100 programs. **Three Phoenix Co.,** 21639 N. 14th Ave., Phoenix, Ariz. 85029. **Circle No 367**

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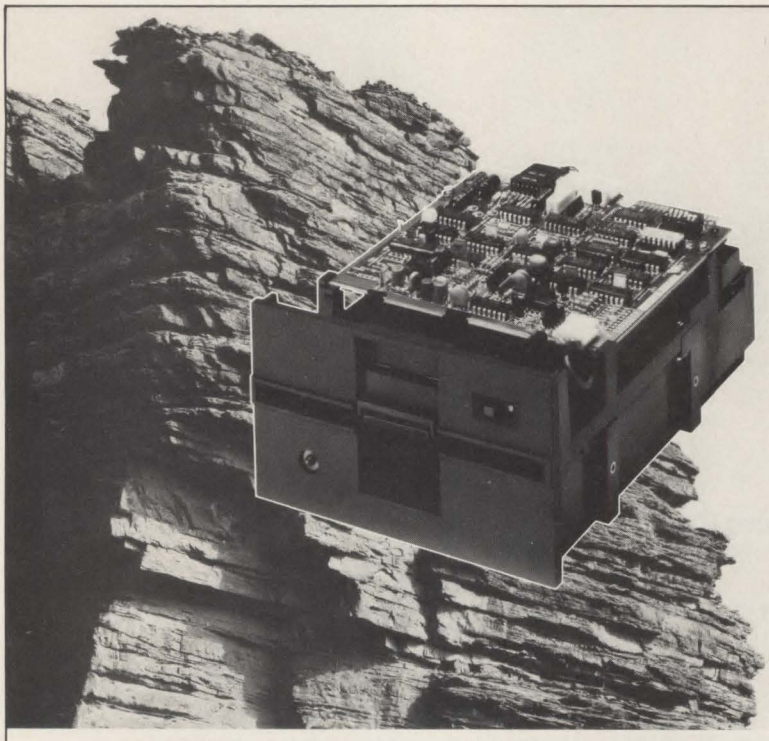
Virtual storage manager runs on minis

The VSM reentrant, sharable virtual storage manager provides as much as 4000M bytes of data storage per user and is intended for applications requiring large data arrays and databases. The package uses a least recently used technique that keeps the most frequently used data segments in memory and supports global and local virtual-data arrays. Each user can have as many as 128 active virtual arrays, each of which can have a maximum of 127 dimensions. VSM is available for CDC 6000/7000/CYBER, IBM 360/370/303X, DEC PDP-11/VAX, and Data General Nova/Eclipse series computers. **Applied Modeling, Inc.**, 7033 Canoga Ave., Suite 15, Canoga Park, Calif. 91303.

Circle No 405



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BPS unveils listing generator

The BPSXREF listing and cross-reference generator for Microsoft's BASIC-80 5.X language produces formatted program listings and alphabetized lists of program variables and functions cross-referenced to the line numbers where the listings are used. The listing includes page titles, page numbers and skipped lines. Options allow the user to select simple listings, detailed cross-references or a combination of the two. The system operates on ASCII-formatted CP/M files produced by MBASIC's SAVE command with the A option, or by text editors such as ED, Wordmaster and Mince. Price is $124. **BPS,** 82 Woods End Rd., Fairfield, Conn. 06430. **Circle No 406**

Elliam announces utilities-software disk

The DMM-1 utility-software disk for CP/M features an XDIR command that displays disk-directory file names in alphabetical order, shows the file size for each file name and provides a disk-usage summary. Other features include an Extract program that lists a portion of a file between two label names, a strip routine that removes hex code from a PRN file and makes it into an ASM file, a Sort program, which creates a symbol table from an ASM assembly, and a Convert routine that changes all uncommented lower-case characters to upper case. Price is $35. **Elliam Associates,** 24000 Bessemer St., Woodland Hills, Calif. 91367. **Circle No 407**

CIRCLE NO. 152 ON INQUIRY CARD

System provides management for UNIX

The LOGIX relational database-management system runs under UNIX and UNIX-like operating systems. The system enables users to define relations, enter and edit data, create new relations and select items from a relation according to complex conditions. LOGIX generates reports, print forms and update relations using interpreted or compiled queries; provides mechanisms to protect the integrity of data stored in a relation; and reports items that violate user-specified integrity constraints. Each database is a UNIX directory, with various files containing data, queries and auxiliary information; a sub-directory holds the relations and indexes. Price is $5000. **Logical Software, Inc.,** 1218 Massachusetts Ave., Cambridge, Mass. 02138.

Circle No 412

Operating system offers record and file locking

This operating system for multi-user μc systems designated MP/M II, features record and file locking and optional password protection for data security. The system requires an 8080, 8085 or Z80 processor, a 48K RAM, a clock timer interrupt, one disk subsystem and a console. It can support as many as 16 consoles, 16 printers and 16 disk drives with as much as 512M bytes of storage each, for a total of 8G bytes of on-line storage. MP/M can manage as many as 400K bytes of RAM. Utilities include a relocatable macroassembler, a linker with overlay facilities and a program library manager. Price is $450. **Digital Research,** P.O. Box 579, Pacific Grove, Calif. 93950. **Circle No 413**

Operating system is written in C

This C-language-based real-time operating system kernel, called OS/RT, for use on 8-, 16-, and 32-bit processors, is portable and machine independent and requires a 250 to 500-byte machine-dependent interface. The system supports memory, processes, events, interprocess communication and interrupts, with dynamic creation and destruction of resources. The interrupt structure permits time-outs if a system clock is available, and user programs refer to user-defined resource IDs or resource names. An unlimited binary license sells for $8000. **The Destek Group,** 1923 Landings Dr., Mountain View, Calif. 94043.

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Syscon unveils relocatable assemblers

The Macro-68 and Macro-18 relocatable assemblers run on the Motorola 6800 and the RCA 1802, respectively. The assemblers include macro and conditional assembly syntax, a relocatable linking loader and a library manager. Both generate a Microsoft-compatible relocatable object file that allows relocation of 8-bit expressions. The assemblers on 8-in. soft-sectored diskettes sell for $250. **Syscon Corp., Product Development Group,** 4015 Hancock St., San Diego, Calif. 92110. **Circle No 408**

Timin announces FORTH application modules

This FORTH source-code application-modules diskette contains data structures, software-development aids, string manipulators, an expanded 32-bit vocabulary, a screen calculator, a typing-practice program and a menu generation/selection program. The diskette also provides example of recursion, BUILDS...DOES usage, output number formatting, assembler definitions and conversational programs. Other features include 100 screens of software and 100 screens of instructional documentation. Price for an 8-in. diskette is $75. Larger disks sell for $90. **Timin Engineering Co.,** 9575 Genesee Ave., Suite E-2, San Diego, Calif. 92121. **Circle No 409**

Package provides job-cost accounting

The DPCOST job-cost accounting system for IBM System/34 computers, captures CPU and print time by work station, user ID, job name, application code and user/work station on a daily basis. It also maintains year-to-date and month-to-date totals by work station, user ID, job name and application code. The $375 price includes installation, documentation and a 30-day money-back guarantee. **Jessup, Mallette & McBroom Inc.,** 1810 116th Ave. N.E., Bellevue, Wash. 98005. **Circle No 410**

DTI provides word processing for CP/M μcs

The CP/M-based Spellbinder word-processing package includes a hierarchy of MACRO commands for such tasks as Que and Zip sorting, mail merge, forms generation and line numbering. The package uses single-key commands that operate in command and edit modes. In the edit mode, a user selects word, character, sentence and paragraph editing. **Data Technology Industries,** 700 Whitney St., San Leandro, Calif. 94577. **Circle No 411**

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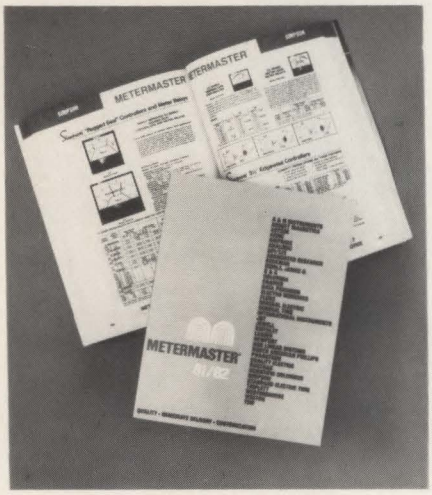
New Literature

Catalog outlines test-and-measurement products

Design and performance specifications for meters, oscilloscopes and other test-and-measurement products are described in a catalog. The 432-page directory is organized alphabetically and uses photographics, tables and charts. **Metermaster,** 5646 Jillson St., Los Angeles, Calif. 90040. **Circle No 415**

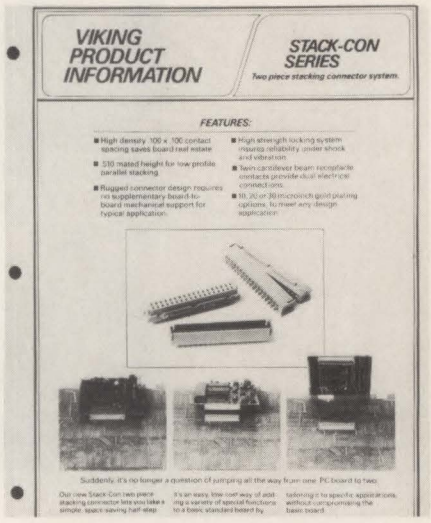


Newsletter features CAD/CAM guide

CAD/CAM software, systems and information sources are detailed in a newsletter. The guide describes source materials and names of suppliers, including addresses, contact persons and phone numbers. Sources outside the U.S. are also included. **CAD/CAM Guide, c/o The Harvard Newsletter on Computer Graphics,** Service Department, P.O. Box 89, Sudbury, Mass. 01776. **Circle No 416**

Bulletin outlines connector applications

A two-piece stacking connector system for high-density PC- board packaging, is described in a four-page, color bulletin. The bulletin gives applications information, as well as features, specifications and ordering information. **Viking Connectors, Inc.,** 21001 Nordhoff St., Chatsworth, Calif. 91311. **Circle No 417**



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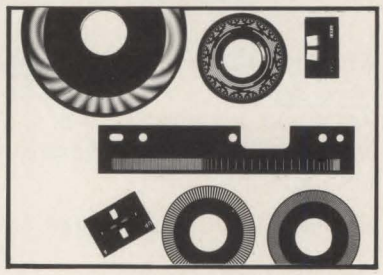

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ALONE COMPANY, LTD.
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Los Angeles, CA 90012
213-621-2360

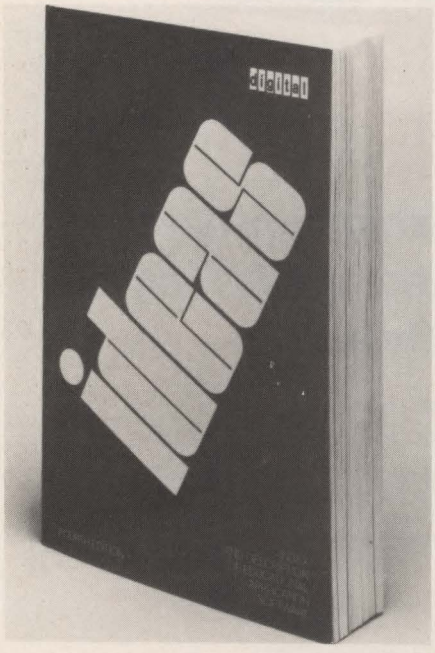
CIRCLE NO. 157 ON INQUIRY CARD

Databook features memory, logic circuits

Bipolar memory and logic circuits are described in a 362-page databook. The book includes chapters on the HAL and HMSI logic families, PROM, ROM, character generators, PAL, FIFO, arithmetic elements and logic, multipliers/dividers and octal interface. **Monolithic Memories,** 505 Hamilton Ave., Palo Alto, Calif. 94301. **Circle No 418**

Handbook lists applications packages

More than 300 application packages for the vendor's computer systems using the VAX/VMS and RSTS/E operating software are listed



in the fourth edition of an educational application software handbook. The 367-page publication lists packages alphabetically by application and under VAX/VMS and RSTS/E sections. The book also details general-purpose simulation system, scientific-information retrieval and TOTAL data-management packages. **Digital Equipment Corp., Education Computer Systems Group,** PK3-2/M94, 129 Parker St., Maynard, Mass. 01754.

Circle No 419

Hybrid catalog describes components

Components for data-conversion and signal-processing applications are described in a catalog. The publication features physical, electrical and electronic specifications of products. Also covered are DA/AD converters, analog multipliers/dividers, multiplexers, sample and high-speed/hold amplifiers, DC-to-DC converters and line-operated suppliers. **Hybrid Systems,** 22 Linnell Circle, Surburban Industrial Park, Billerica, Mass. 01821.

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Type of machine(s)

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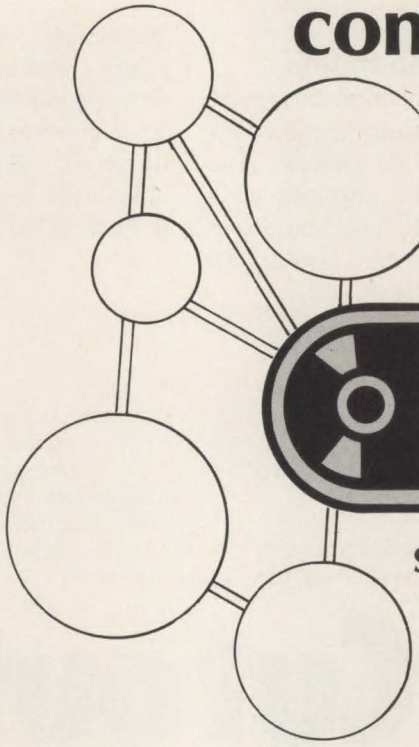

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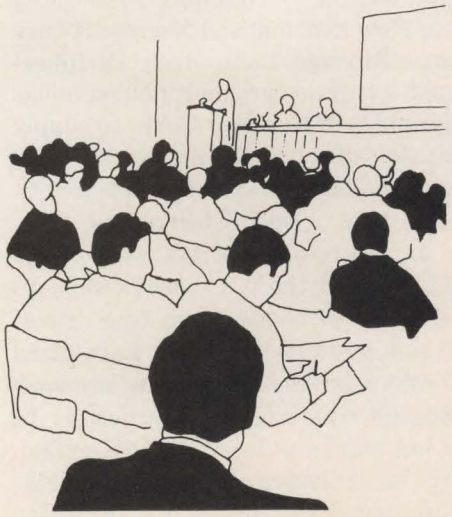

Endpoints

Wet Ink Department: **Intel Corp.** and **Advanced Micro Devices** have entered into a 10-year cross-licensing/technology-exchange agreement that will make AMD a second-source supplier of Intel's 16-bit 8086 μp. **Fujitsu Ltd., Matra-Harris Semiconductor, Harris Corp.** and **Siemens** also manufacture the 8086 under an agreement with Intel, and **Mitsubishi** and **Nippon Electronics Corp.** plan to produce designs independently....Intel's **Magnetics Division** has entered into a cross-licensing/second-sourcing agreement with Canada's **Mitel Semiconductors** for the 1M-bit 7110 magnetic bubble-memory device. The Kanata, Ontario-based firm will use the bubble chips in its SX-2000 digital switching system, now under development, and also sell the devices to OEMs. Intel is said to be looking for additional second sources for its bubble chips, both here and abroad....**Lexor Corp.** has signed a three-year, $26-million contract with **Tozer Kemsley Millborne Ltd.,** London, for more than 3000 Lexoriter model 9 word processors....Two three-year agreements will net an estimated $10 million for Woodland Hills, Calif.-based **Dataproducts Corp. Tektronix** signed a $6-million contract to purchase Dataproducts' M-200 matrix printers for use with the Tektronix line of μp development systems, and **Modular Computer Systems,** Fort. Lauderdale, Fla., signed a $3-million contract for Dataproducts' B-300, -600 and -900 band printers and 2470 drum printers. Modcomp plans to incorporate the B-series printers into its "Classic" line of minis, and the drum printers into systems for the National Aeronautics and Space Administration Space-Shuttle program....**Performance Business Machines,** the μc systems division of **MicroPro International,** has signed $6-million worth of contracts with six overseas firms to distribute its first product, the Z80-based single-board PBM-1000 μc. The system will be marketed by **Terodec Ltd.** in the U.K.; **Locasyst, S.A.** in France; **Amsterdam Computer Connection** in the Netherlands, Belgium and Luxembourg; **Kneisner Elektronik** in West Germany; **Benman Processing Ltd.** in Australia and New Zealand; and **Microsoftware Associates** in Japan....**Storage Technology Peripherals Corp.** has signed a three-year, multimillion-dollar contract with **National Cash Register Corp.** to supply NCR with tape subsystems for its 8000-series CPUs. STC has been providing NCR's Micrographics Division with tape subsystems since 1978....**Data Electronics, Inc.,** has entered into an overseas contract with **S E Laboratories, Ltd.,** to supply the U.K.-based company, Europe's largest supplier of tension-arm tape transports, with 1000 streaming-tape drives. S E Labs plans to incorporate the backup drives into its Data Streamer 9700, a system using an 8-in. Fujitsu Winchester. In another move, DEI has signed a one-year, $2.5-million contract to supply its "Funnel" 17.3M-byte, high-density, digital tape-cartridge drives to **Televideo Systems.** Televideo will use the ¼-in. Winchester-backup devices for its Systems III computers....**Falco Data Products,** Sunnyvale, Calif. has authorized **Hall-Mark Electronics** to distribute Falco's TS-1 smart terminal in 22 outlets throughout the country. **Galaxy Computers,** Sunnyvale, Calif., has signed an OEM agreement with **Control Data Corp.** for CDC Lark Winchester drives for the model 700 small-business computer system....Production is rolling at the new 40,000-sq.-ft. **Micro Peripherals, Inc.,** facility in Singapore. Initial products are the models 51 and 52—48-tpi, single- and double-sided floppy-disk drives. First shipments of 10,000 drives have been delivered, and the company says production will soon reach 5000 a month.

Ground-Breakings: **Informatics** sold its general-accounting application-software business to Raleigh, N.C.-based **Global Software,** whose president, Ronald Kupferman, was a founder of Informatics' Application Products Division. Informatics recently acquired **Management Control Systems,** Atlanta, for cash and stock. MCS revenues for 1981 are said to exceed $4 million....**Genisco Technology** has changed the name of its Components Division to **Genisco Electronics Division....Able Computer** has opened a 24,000-sq.-ft. facility in Irvine for corporate and general adminstration and for engineering, accounting and marketing departments. The move boosts Able's total floor space to 60,000 sq. ft., and company sources say another move is planned within the next six months....Floppy-disk-drive vendor **Micro Peripherals** has opened its first European sales and support office in Reading, England. The operation, code-named MPI-Europe, will support MPI's network of 14 European distributors and will be headed by sales manager Chris Scotford....**Applied Data Communications** has announced the opening of an eastern regional office in McLean, Va....**Triumph-Adler** subsidiary **Pertec Computer Corp.** has established a field-service organization to support a line of tape transports offered by its Peripherals Division. The organization will support primarily OEMs, with end-user support on a limited basis....**Advanced Micro Devices** has shut down its **Advanced Micro Computers** division. AMD executives say the company will continue supporting its Z8000 family with circuits and development systems that are available or under development, but that no new products will be added...**BDS Corp.** has opened a 20,000-sq.-ft. facility in Menlo Park, Calif....**Cipher Data Products,** headquartered in San Diego has purchased a 15-acre site in Colorado Springs, Colo., which company sources say could provide more than 300 jobs within three years. Construction of a 50,000-sq.-ft., $3.5-million building on the new site is slated for completion in June.

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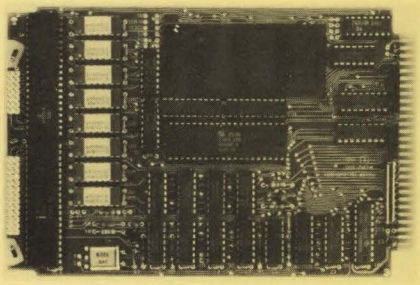

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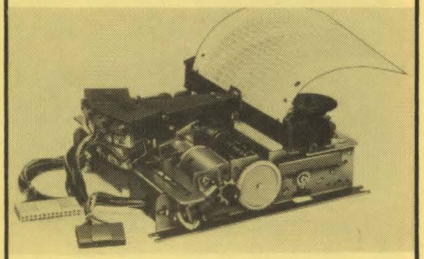

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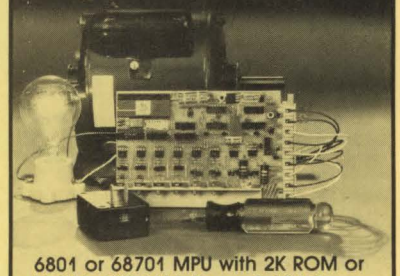

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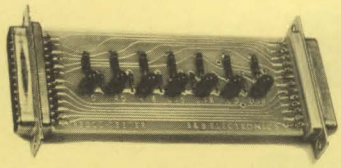

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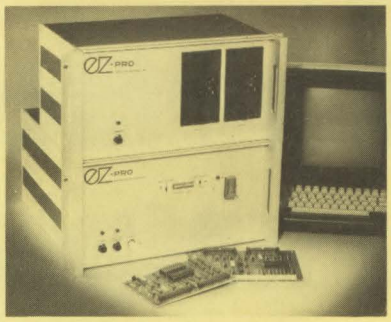

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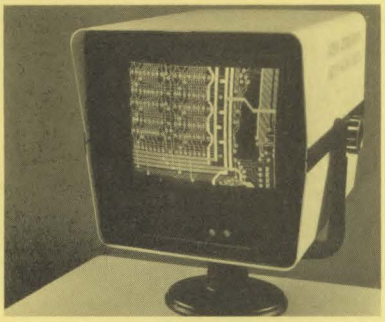

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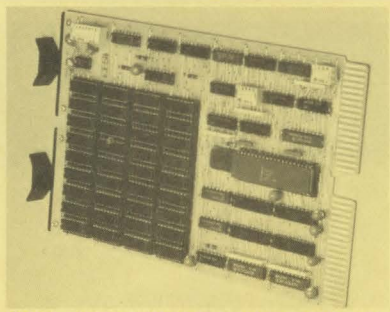

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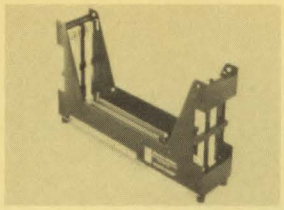

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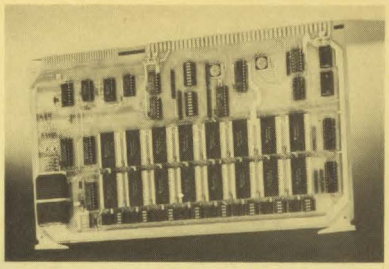

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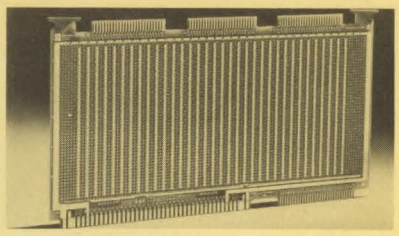

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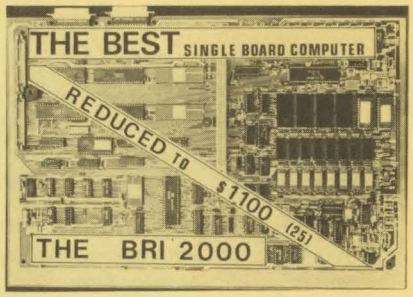

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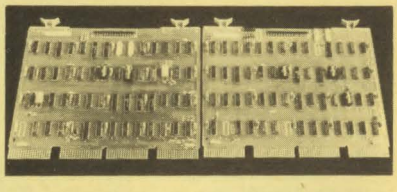

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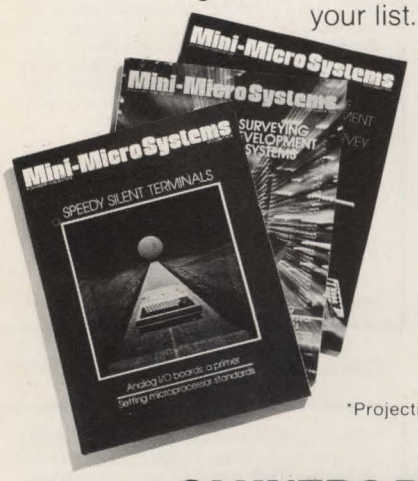

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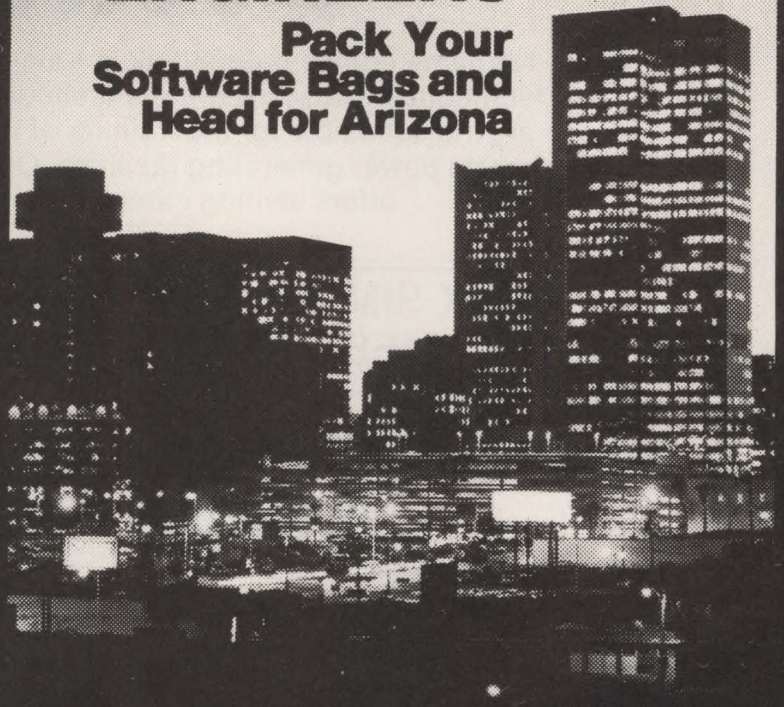

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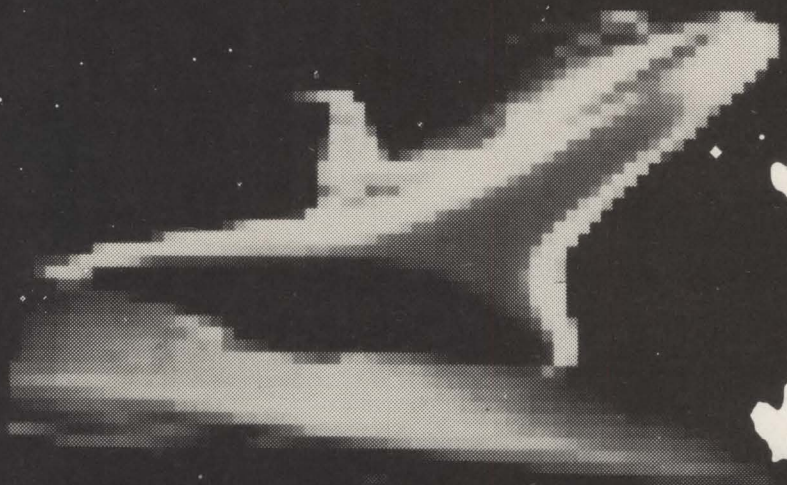

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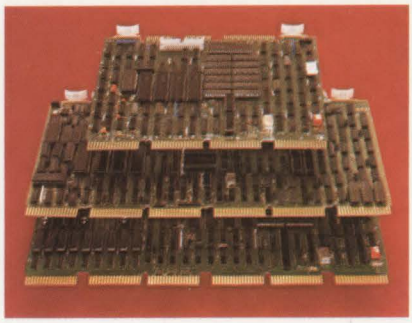

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If you've looked into building your own, you'll find that the OrangeBox™ is just the kind of package your own designers would want to put together, given the time—and money—to "do it right." MICOM did it right—we *had* to—since the hardware was to become the base for many of our best known products, including the new Micro800/2 Data Concentrator. As a result, the OrangeBox™ is as esthetically pleasing and as simple to operate as it is functionally efficient. And thanks to MICOM's very large production volume, it comes *at a price that may surprise you.*

Neatly integrated into its injection-molded case are an up-to-date set of very efficient components, including a fast Z80A, RAM, EPROM, SIO chips, programmable DIP switches, LED's, up to 18 I/O interfaces, and even matched integral modems. Since its programming characteristics will be immediately familiar to most communications designers, your application can be implemented in very little time, using the OrangeBox™ either as an intermediate step toward an in-house design or as a base for continuing product development.

Protocol conversion? Node processing? Terminal cluster control? Front-end processing? Packet Assembly/Disassembly? Network security monitoring? The OrangeBox™ is the right hardware for all of them. Call or send today for a set of brochures describing the OrangeBox™ and MICOM's other OEM products.

What could you do with an "empty" OrangeBox™?

MICOM® *MicroComputers for DataCommunications™*

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